AAPT-ONTARIO NEWSLETTER

VOLUME 1, NO. 1
OCTOBER, 1979

What is THIS?

This newsletter is the first in an infinite series of newsletters produced by the executive of AAPT-Ontario with the purpose of providing items of interest to Physics teachers in Ontario. Newsletters will be distributed every three months or so, or whenever the executive has culled sufficient material.

You can help us. Let us know if you have attended an exciting conference, read a good book, seen an interesting film. Write a short note about the conference etc., and it will be included in the next newsletter.

Grade 11 Prize Exam

At the business meeting of our June conference, it was suggested that AAPT-Ontario sponsor a Physics Contest for grade 11 students. Plans have already been started in this regard. The hope is that the contest will stimulate interest in Physics in students at that level, act as a primer for grade 13 contests, provide reward for achievement, and, from our point of view, publicize AAPT-Ontario throughout the province.

The exam will consist of approximately 20 questions which will be based on the curriculum suggested by the Ministry of Education. It will be available to students who are currently enrolled in grade 11 or who just finished in the previous semester. The exam will take place in late or middle May. We hope to be able to provide at least a certificate to the winner and runner-up in each school, and larger awards for province-wide winners. If we can receive financial backing, say from industry, our visions of more prestigious awards for each school (e.g., plaques, calculators) may be realized.

For this first year (Spring, 1980) we are going to have a trial run of the test, in order to get the "bugs" out of the logistics. If you are a secondary school teacher and are interested in having your students participate in the trial run and/or subsequent contests, please reply to the questionnaire included with this newsletter. If you are willing to participate in the creation of the test, or willing to be part of the administrative organization, just write Doug Fox a note (see questionnaire for address).

Membership Blitz

There are now 200-odd members in AAPT-Ontario. If we may judge from the response at our June meeting, our Section is serving a useful and vital need. Let's tell our colleagues. We need a membership blitz!

Phase one of the attack was completed months ago when letters describing AAPT-Ontario were sent to all Secondary Schools, Colleges, and Universities in Ontario. It is now time for phase two: a one-on-one attack by each of our members. Surely you know a colleague who would enjoy membership in AAPT-Ontario. A blank membership application is included with this newsletter; fill it out in your colleague's name, and the next time you see him/her, ask for a dollar and mail both (the dollar and the application, not the dollar and colleague) to Doug Cunningham (address on application.)

We hope to double our membership by June, 1980. It can be done if you will help to spread the word.

By the way, your membership is good until June, 1980.

Your Executive

If you did not attend our inaugural meeting in June, you will be unaware of the results of the election of the executive. If you have ideas regarding directions in which AAPT-Ontario might go, please let any of the executive know.

President	Ernie McFarland Department of Physics University of Guelph Guelph, Ontario N1G 2W1
Vice-President	Douglas R. Fox Belle River D.H.S. 333 South Street Belle River, Ontario N0R 1A0
Secretary-Treasurer	Douglas Cunningham Bruce Peninsula D.S. P.O. Box 178 Lion's Head, Ontario N0H 1W0
Section Representative (to the Nat'l. AAPT)	T. Dean Gaily Department of Physics University of Western Ontario London, Ontario. N6A 3K7
Member-at-Large	Jim Stevens Assistant Vice-President, Academic University of Guelph Guelph, Ontario N1G 2W1

Annual Meeting - June, 1980

Plans are now being made for our second annual conference. We hope to hold it at Trent University in Peterborough on either June 13-14 or June 20-21. Both of these are a Friday-Saturday combination, which seemed to work well this year. Which of the two pairs of dates is better for you? Fill out the attached questionnaire and return it (as soon as possible so that arrangements at Trent can be finalized) to Doug Fox, who, as Vice-President of our Section, is Conference Chairman.

"Forgotten Fundamentals of the Energy Crisis"

Remember Al Barlett's superb presentation at the banquet at our June conference? It is available on colour videotape (55 minutes) from Mr. D. Space, Educational Media Center, Stadium 310, Box 379, University of Colorado, Boulder, Colorado 80309, U.S.A. The tape may be purchased for $52.00 (U.S.) for 3/4" U-Matic Cassette, $40.00 (U.S.) for ½" Beta-Max Cassette or ½" VHS Cassette, or $46.00 (U.S.) for ½" Reel to Reel.

Alternatively, you may borrow the University of Guelph's copy (3/4" U-Matic Cassette) by contacting Ernie McFarland, Dept. of Physics, University of Guelph. If you require ½" reel to reel, you may borrow a copy from Ray Jones, Quinte Secondary School, 45 College Street West, Belleville.

The paper on which the tape is based (or is it the other way around?) was published in the American Journal of Physics, 46 (9), Sept. 1978, 876-888.

Review of the Annual Meeting

(a condensation of the Ontario Section News in the "AAPT Announcer", by Dean Gaily)

The first meeting of the Ontario section was held June 15 and 16, at the University of Guelph. Attended by more than 80 members of the section, the meeting was highlighted by the after-banquet speech by Al Bartlett, University of Colorado, Boulder, "Forgotten Fundamentals of the Energy Crisis". The meeting began with a panel discussion of "Grade 13 Physics Curriculum". The panel members developed an active dialogue on the physics curriculum in Grade 13 and the influence of the STAO document on the physics core curriculum for Ontario Secondary Schools. Two sessions of contributed papers followed covering topics on high school course descriptions, PSI in University courses, astronomical observations, home lab projects,cartoons in the classroom, the TAO of physics, computers in the lab and simple demonstrations in physics.

In celebration of the centenary of the birth of Einstein, Warren W. Johnson of the University of Rochester spoke on "Gravitational Waves and Their Detection". This invited talk reviewed the history of gravitational wave ideas beginning with the General Theory of Relativity and summarized the work to date on the detection of such waves. The current work at Rochester was outlined and the audience was left with a feeling of excitement for this very current area of research.

At the business meeting of the section the newly elected officers were introduced and the important contributions to the founding of the Ontario Section by George Kelly and Ernie McFarland were applauded by those present. A discussion of the aims and goals of the section followed with numerous ideas being aired and noted by the new executive.

Saturday's session began with the invited paper "A Survival Kit of Demonstrations for Physics Teachers" by George Vanderkuur, Ontario Science Centre, Toronto. No one present will forget the hair raising experience of George's vortex generator gun and all were thrilled by his "bubble inside a bubble inside a bubble". A session of contributed papers followed covering mini projects in high school courses, PSI tutors, solar energy, test items, eclipse photographs and the Physics Challenge Competition.

"Optics in the Sky" by Jim Hunt, University of Guelph, encouraged all in attendance to seek sun dogs and solar halos among other phenomena associated with sunlight refracted or reflected from atmospheric ice crystals. Jim's talk included spectacular lecture room demonstrations and was widely enjoyed. The meeting ended on a participatory note as five or six people contributed a short presentation of their favorite demonstrations.

(continued in next column)

"Review" (continued)

The success of this first meeting was widely acknowledged and the efforts of the conference organizers were deeply appreciated by all attendees.

Upcoming

AAPT-APS Joint Winter Conference, Chicago, Jan. 21-24, 1980.

* AAPT-Ontario Conference*, June 13-14 or June 20-21, Trent University, Peterborough.

CAP Conference, June 16-19, McMaster University, Hamilton.

AAPT Summer Conference, June 25-27, Troy, New York.

Outstanding High School Student Certificates

(this information was gleaned from the "AAPT Announcer", May, 1979)

The national AAPT provides, upon request, a high-quality certificate for outstanding high school students in physics. This certificate is suitable for presentation at graduation ceremonies; it comes with a sample news release for use in local media and a brief questionnaire in which the name of the student, the university he/she has selected, and the major he/she has selected is asked. Ontario teachers who have requested these certificates have been very pleased with them.

To receive one (limit: one per school), write to: High School Certificates,
A.A.P.T.,
Graduate Physics Building,
SUNY at Stony Brook,
Stony Brook, N.Y.
11794, U.S.A.

Include teacher's name, school name, and school address. As well, in order to collect data on the physics programs in schools in which these Awards are being given, A.A.P.T. asks that you please answer the following questions:

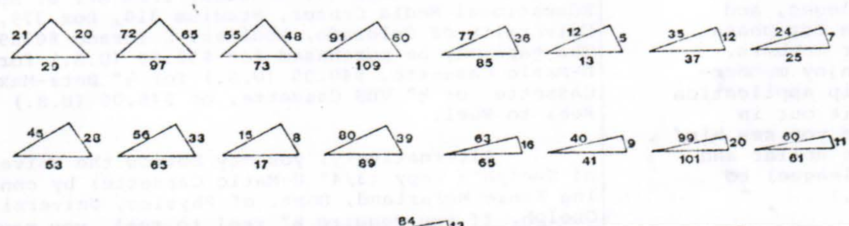
No. of introductory physics classes: Text:
No. of advanced physics classes: Text:
No. of physics teachers:
Average number of students per physics class:
No. of graduating students:
Are you a member of AAPT? *

*not a requirement for requesting award certificates.

Open letter to the readers:

Tired of the same old 3-4-5? Put some variety back into your exam and homework problems! Here are the seventeen other dissimilar right triangles having integer sides with legs < 100:

Donald F. Kirwan and Jack Willis
University of Rhode Island



* This is reprinted, with permission, from "The Physics Teacher", December, 1976.

// AAPT-ONTARIO NEWSLETTER
VOLUME 1, NO. 2
JANUARY, 1980

AAPT-ONTARIO NEWSLETTER

DATES SET FOR 2ND CONFERENCE

June 13 and 14 (Friday-Saturday) have been chosen as the dates for our 2nd annual conference, to be held at Trent University this year. Make a note on your calendar today.

CALL FOR PAPERS

This is a call for papers for our June conference. Papers are invited on any topic pertaining to the teaching of Physics: innovations in teaching methods, new ways to teach old material, interesting tangential topics, etc., etc.

Papers will be 10 minutes in duration, with 5 minutes afterwards for questions. 15 minutes (instead of 10) may be requested by the contributor, to be allotted at the discretion of the Program Chairman. We hope to have at least one poster session; if you are interested in this mode of presentation, please indicate this with your abstract. (In a poster session, each contributor makes a display on his/her topic and the displays are arranged in a room; people who are interested in a particular presentation can then interact personally with the contributor.)

An abstract of about 150 words should be submitted by March 31 to:

Mr. Douglas Fox
Belle River D.H.S.
333 South St.
Belle River, Ontario
NOR 1A0

Please indicate any requirements for audio-visual equipment.

A useful article "How to present a paper at an AAPT meeting" appeared in the November 1978 issue of "The Physics Teacher". If you do not have access to this article and would like a copy, simply request one when you submit your abstract.

GRADE 11 PHYSICS CONTEST

Many thanks go to those who volunteered to participate in the trial run of a Grade 11 Physics contest. The size of the response was gratifying. Those who indicated a willingness to participate in the trial run will be contacted individually in March. If all goes well we hope to hold the contest concurrently with one of the Grade 13 contests to minimize the supervision necessary. In 1981 the contest should be ready for use in all schools in Ontario. Watch for that announcement in this newsletter.

REPORT ON PHYSICS WORKSHOP, SUDBURY

A Physics Workshop was held at Laurentian University on Nov. 26, 1979 from 4 to 9 p.m. Sponsored jointly by the Laurentian University Physics Dept. and AAPT-Ontario, it consisted of two sessions, one on "Forces and Effects in Rotational Frames of Reference" and the other on "Physics in Everday Situations". Each session comprised presentations by participants and films.

AAPT-Ontario is happy to co-sponsor such meetings of Secondary School and University teachers and is willing to assist in whatever way possible. In the future, we hope that various AAPT-Ontario members will be able to offer workshops developed by the National AAPT on topics such as Piaget's Theory of Learning, Introduction to Microcomputers, Building Student Confidence in Physics, etc.

LOGO FOR AAPT-ONTARIO

If you are very observant, you will have noted that the logo at the top left of this newsletter is not the same as that on our first newsletter. The logo on the first newsletter was that of the National AAPT; the one on this newsletter is the National AAPT one surrounded by a circle which represents an "O" for Ontario. Thanks for the idea goes to Erich Barth, Art Director of the Dept. of Information of the University of Guelph.

CONSTITUTION CHANGES

In order to improve the operation of our AAPT Section, the Executive Committee is recommending two changes to the Constitution of AAPT-Ontario. One is the creation of a nominating committee to handle the nomination and election of members of the Executive Committee each year, the other is an increase in the term of office of both the Section Representative (to the National AAPT) and the Secretary-Treasurer from one to three years.

The main functions of the nominating committee will be to solicit nominations from the general membership, and to make nominations itself, especially in the case of insufficient nominations from the membership. The nominating committee will also conduct the election. The committee will consist of the President (chairman of the committee), Past President, and one person from the general membership appointed by the President and Past President. No member of the nominating committee may be nominated for an office. In the case of the office of President or Past President being vacant for whatever reason, the Section Representative will fill the vacant committee position.

The increase in term of office of the Section Representative and the Secretary-Treasurer was sparked by a recent publication by the National AAPT which suggested to Sections that continuity in these offices is important. This change is to be made retroactively, i.e., the terms of our present Section Representative, Dean Gaily, and our present Secretary-Treasurer, Doug Cunningham, will be increased from one to three years. Both Dean and Doug kindly have agreed to donate their time and talents for this additional two years. As a result of this change, the annual election of officers will normally consist of an election of a Member-at-Large and a Vice-President (who will become President after a year, and then Past President). Every third year, a new Section Representative and Secretary-Treasurer will be elected.

According to terms of our Constitution, "Amendments ... shall be made by a two-thirds majority of those voting in a mail ballot conducted by the Executive Committee". The detailed changes to the Constitution are given on a separate sheet. Please indicate your approval or disapproval of the changes in the spaces provided and return by Jan. 25 to Ernie McFarland. Thank you for your participation.

NAME AND ADDRESS CORRECT?

Are your name and address correct (including postal code) on the mailing label which brought this newsletter to you? If not, please inform Doug Cunningham, Secretary-Treasurer, AAPT-Ontario, Bruce Peninsula District School, P.O. Box 178, Lion's Head, Ontario N0H 1W0.

MEMBERSHIP & FINANCIAL STATUS

As of January 1, 1980, membership in AAPT-Ontario stands at 250. This number consists of 153 Secondary School teachers, 90 University teachers, 6 at Community Colleges, and 1 miscellaneous. There has been a 25% increase in membership since September, 1979 - not bad, but there are still a lot of teachers hiding in the woodwork.

We have $320.10 in our bank account (Jan. 1, 1980). With 250 memberships at $1.00 each, it is obvious that we actually turned a profit at our June conference, even with our low registration fees.

A CINESCOPE OF PHYSICS

"A Cinescope of Physics" is an extremely useful publication by AAPT which gives information on over 1300 Physics films. The book begins with a list of over 100 films under the heading "Films Every Physics Library Should Have", and then lists all 1300 films under subject headings. Finally, there is an alphabetical listing of all the films with a short description for each one: a two-sentence synopsis of the film, plus duration, price, where available, when and where reviewed, etc.

This book is available from the Publications Department, AAPT, Graduate Physics Building, SUNY at Stony Brook, Stony Brook, N.Y. 11794, U.S.A. The price is $10.00 (U.S.) for members of the National AAPT, $12.50 (U.S.) for non-members.

CALL FOR PAPERS FOR STAO 80

The biennial conference of STAO (Science Teachers Association of Ontario) will be held Nov. 6-8 at the Skyline Hotel in Toronto. STAO is calling for short papers (10 to 15 minutes, or longer) on teaching innovations, interesting demonstrations, useful techniques or ideas for teaching science, etc.

Subject areas are wide open.....Biology, Environmental Science, Chemistry, Computers, Energy, Earth Sciences, Physics, General Science, etc.

As are levels........Elementary, Intermediate, Senior

And languages........French or English

Please contact Bob Loree at;

Oakville-Trafalgar High School,
291 Reynolds Street,
Oakville, Ontario.
L6J 3L6

Please provide name, work address, telephone number, occupation, subject area, level, language, paper length, outline of content and audio visual equipment needed.

Deadline for papers: February 15, 1980

SOME AIP BOOKLETS

The American Institute of Physics (AIP) has many interesting publications. Three booklets of particular interest to teachers are listed below:

"Physics: A Career for You" - 12 pages with colour photos containing career information for high school students and University undergraduates. Single copies free, multiple copies 40¢ each. Publication #R-279 (1977).

"Planning for Graduate Work in Physics" - 9 pages with suggestions for the student considering advanced study in physics, astronomy, and related fields. Single copies free, multiple copies 25¢ each. Publication #R-278 (1977).

(continued in next column)

AIP booklets (continued)

"You Can Help Make a Better World through the Wise Use of Science" - a leaflet to encourage students to take science courses in high school. Publication #R-234 (1970). No price given in AIP Catalogue, therefore assumed free.

To order any of the above, or to obtain an AIP "Current Book and Pamphlet List", write to: American Institute of Physics, 335 East 45th St., New York, N.Y. 10017, U.S.A.

UPCOMING

AAPT-APS Joint Winter Conference, Chicago, Jan. 21-24.

* AAPT-Ontario Conference*, June 13-14, Trent University, Peterborough.

CAP Conference, June 16-19, McMaster University, Hamilton.

AAPT Summer Conference, June 25-27, Troy, New York.

STAO 80 Conference, Nov. 6-8, Skyline Hotel, Toronto.

APPARATUS

The December 1974 issue of "The Physics Teacher" was a special issue devoted to apparatus. Reproduced here (with permission) is a sampling of the myriad short notes.

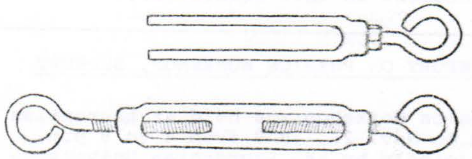
BROWNIAN MOVEMENT

Obtain from the Biology Department half a teaspoon of the red powder known as ""Carmine (Alum Lake)". This dye, which can also be ordered from chemical supply companies, is used for staining slides in histology and cytology. With a dry toothpick or wooden splint, add a very small amount of the powder to a drop of water on a microscope slide. Brownian movement of the pretty red particles can be easily observed with an ordinary microscope with a 10x occular and a 43x objective.

Sister Martha Ryder
Clarke College
Dubuque, Iowa
52001

INEXPENSIVE TUNING FORKS

Turnbuckles that are readily available in hardware stores ($.30 and up, depending on size) can be cut to make tuning forks. One eye from the turnbuckle is cut short to become the handle, threaded back in and held tightly with a nut.



The body of the turnbuckle that becomes the vibrating prongs is a hard aluminum alloy with a nice finish, easy to cut and file, and attractive when completed.

These forks are as loud or louder than the regular steel tuning forks, but do not sound for as long after being struck. With so little money invested in them, one feels free to change their frequencies, shortening the prongs to raise, filing at the base to lower the frequency.

Robert H. Johns
The Academy of the New Church
Bryn Athyn, Pennsylvania
19009

AAPT-ONTARIO NEWSLETTER

VOLUME 1, NO. 4

MAY, 1980

Election of Officers

Enclosed with this newsletter is a ballot for the election of officers. We have two candidates for the office of Vice-President and one for Member-at-Large. All of these nominations were made by the nominating committee, since there were no nominations from the general membership. (This was a bit of a surprise; last year there were some nominations from the members.)

The candidates for Vice-President are Gord McKye and Jim McTavish; both are very strong candidates, as you will see from the biographical descriptions which are enclosed. Please mark your ballot and mail it in the enclosed envelope by May 30.

The new Member-at-Large (by acclamation) is John Earnshaw, Chairman of the Physics Dept. at Trent University. John has been very active in Physics education, and has presented papers at conferences held by AAPT, STAO, and CAP. He is a member of the committee working on the STAO Physics Assessment Instrument Pool which is a test bank of physics questions for use in the secondary schools. His experience and expertise will be of great use in the AAPT-Ontario Executive.

There was much discussion within the nominating committee, and with other members of AAPT-Ontario, regarding the number of candidates to be nominated for each office. It was decided, for this year at least, to nominate two poeple for the office of Vice-President (a most important office) and to nominate only one person for Member-at-large. If you have an opinion (positive or negative) concerning this decision, please let it be known to the nominating committee (Ernie McFarland, Dean Gaily, and George Kelly).

Conference Approaching Quickly

There is now less than a month until the AAPT-Ontario conference. We have now (May 18) between 50 and 60 preregistrants, and the number is increasing daily.

Although the preregistration deadline was May 15, a kind eye will be turned to preregistration forms arriving before the end of May. So if you haven't preregistered, do it now!

Registration fees "at the door" will be $1 more per day than the preregistration fees.

Membership Renewal

If you haven't renewed your AAPT-Ontario membership for 1980-81, now is the time to do so. Use the top portion (membership renewal) of the conference preregistration form sent with the previous newsletter, or just send your name with a dollar to Doug Cunningham, Bruce Peninsula DHS, P.O. Box 178, Lion's Head, Ont. N0H 1W0.

Have You Seen ... ?

1. PS News

"PS (Problem Solving) News" is a sharing of ideas about problem solving. It is printed bi-monthly by the Department of Chemical Engineering, McMaster University, Hamilton, L8S 4L7. The most recent issue (#7, March-April 1980) has some interesting information from the Doctoral thesis of Herb Lin of the Physics Dept. at MIT concerning the problem solving difficulties encountered by freshman students in physics.

To get on the mailing list for "PS News" contact D.R. Woods at McMaster (address above). It's free.

2. Current

"Current" is a component in Ontario Hydro's Energy Education Program; it is published six times per year. The first issue came out quite recently (March, 1980).

From the editorial: "Energy is now perceived by educators as a topic that is an important area for study in the classroom. The question is how to include it? We hope that 'Current' will be a helpful contribution toward alleviating the serious shortage of resource materials and toward providing background information as the basis for lesson planning or to support classroom projects. We will...feature interviews with people concerned about energy, explanations of complex technology and new perspectives on the future of our energy problems."

The first issue featured (among other things) an interview with Tuzo Wilson, a column by Jay Ingram ("Quirks and Quarks"), and a display of postage stamps (related to energy) from the collection of Jim Hunt of the Physics Dept. of the University of Guelph.

To receive a free subscription to "Current" contact P. J. Spratt & Associates, 212 King St. W., Suite 214, Toronto, M5H 1K5

Copying of this newsletter has been provided courtesy of the Physics Department of the University of Guelph.

SUMMER'S CELESTIAL HIGHLIGHTS

by Doug Cunningham

The warm summer evenings coupled with vacations away from city lights bring many people closer to the stars than at any time of the year - and what a time to be aware! The beautiful star clouds of the Milky Way, riding high overhead through the constellation of Cygnus, and continuing on through Aquila and down into Sagittarius, are impressive in themselves, yet seen through 7 x 35 binoculars they present the viewer with a sight that is just stunning. The annual Perseid meteor shower peaks on the night of August 11th-12th at which time 50 bright meteors per hour can be sighted. The occurrence of this faithful shower so close to new moon makes this event a viewing must. At the beginning of June the 5 naked eye planets will be visible just after sunset - beginning with Saturn near the meridian and continuing westward through Mars, Jupiter, Venus and Mercury - certainly a striking sight. Mentally connect these planets with an invisible line - you have now traced the ecliptic on the sky and are looking out through the plane of our solar system - neat! All through the summer months the moon, in various phases, will make close approaches to these planets and will, in some instances, actually cover-up the planet - an event known as an occultation. As an aid for those unfamiliar with the summer skies I've enclosed a diagram of the constellations as seen from Southern Ontario during mid July at 10:00 pm.

Celestial Events For June

June	1	Mercury 0.3°N of Venus
June	5	Last Quarter Moon
June	11	Aldebaran 0.7°S of the Moon
June	12	New Moon
June	14	Mercury Greatest Elongation E
June	18	Jupiter 0.01° South of the Moon
June	19	Mars 2° South of the Moon
		Saturn 0.3° South of the Moon
June	20	First Quarter Moon
June	21	Summer Begins
June	25	Mars 1.7° S of Saturn
June	28	Full Moon

Celestial Events For July

July	5	Last Quarter Moon
July	9	Venus 0.2° S of the Moon
July	12	New Moon
July	15	Jupiter 0.6° S of the Moon
July	17	Saturn 0.7° S of the Moon
July	20	First Quarter Moon
July	21	Venus Greatest Brilliancy
July	27	Full Moon
July	28	Meteor Shower - δ Aquarids 10/hr.
July	31	Mercury Greatest Elongation W.

Celestial Events For August

Aug.	3	Last Quarter Moon
Aug.	6	Venus 0.3° S of the Moon
Aug.	9	Mercury 2° N of the Moon
Aug.	10	New Moon
Aug.	11	Perseid Meteors - 50 per hour
Aug.	12	Jupiter 1° S of Moon
Aug.	13	Saturn 1° S of Moom
Aug.	18	First Quarter Moon
Aug.	24	Venus Greatest Elongation - W 46°
Aug.	25	Full Moon

Lost Member!

Our last mailing (conference programme, etc.) addressed to one of our members was returned by the postal authorities, claiming that there is no such person at the address that we used.

The member is Duncan Edwards; the address that we used is R. R. #3, Stouffville.

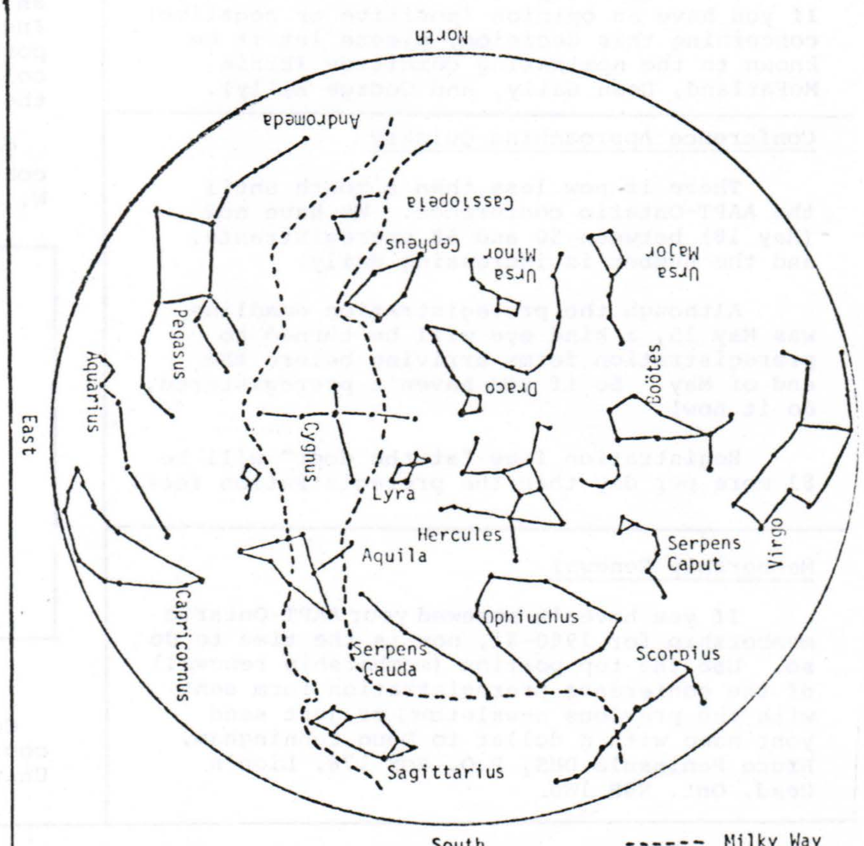
If you know Duncan Edwards and can give us his address (or can ask him to send us his address), please help us out. Thank you. The correct address should be sent to Doug Cunningham, Bruce Peninsula, D.S., P.O. Box 178, Lion's Head, Ont. N0H 1W0

Coming Up

June 13-14	AAPT-Ontario Conference, Trent University, Peterborough
June 16-19	CAP Conference, McMaster University, Hamilton
June 25-27	AAPT Summer Conference, Troy, N.Y.
Nov. 6-8	STAO 80, Skyline Hotel, Toronto

The Summer Skies - mid-July - 10:00 p.m.

Orientation: Turn the chart until the direction you are facing is at the bottom.



Volume II, Number 1

AAPT-ONTARIO NEWSLETTER

Doug Fox, Editor

GRADE 11 CONTEST RESULTS

The 1980 trial run of the AAPT - Ontario Grade 11 Contest was a hugh success. Here are some of the results.

In order the top ten students were from

1. Eastwood Collegiate, Kitchener
2. Grenville Christian College, Brockville
3. Bluevale CI, Waterloo
4. Clarkson SS, Mississauga
5. Wexford CI, Scarborough
6. Clarkson CI, Mississauga
7. Sir Wilfred Laurier, Scarborough
8. Martingrove CI, Mississauga
9. Belle River DHS, Belle River
10. Bruce Peninsula DS, Lion's Head

The top schools were

1. Clarkson SS, Mississauga
2. Wexford CI, Scarborough
3. Martingrove CI, Islinton
4. Bruce Peninsula DS, Lion's Head

Our thanks to all the students and teachers who participated to help make this run a success.

We will be province wide with the contest on May, 1981. Watch for us then and tell your friends. Details will be mailed to all schools in the province.

NEW CURRICULUM

The Ontario Ministry of Education is hard at work developing a new senior science curriculum. One document will cover physics, chemistry, biology and a new senior general science course.

In the area of physics the structure will include activities, content and skills which overlap like the primary colours to produce a relevance. It is expected that the grade 11 course will consist of core plus optional units and that the grade 13 course will not undergo any drastic changes.

Applied science is a new course to be offered at the grade 11 or 12 general level with equal portions of physics, chemistry and biology. Topics such as food, transportation, shelter, energy, recreation and waste will be addressed from the various subject viewpoints.

We might expect the final version to be in the schools in the fall of 1982. AAPT - Ontario is looking forward to the introduction of this new curriculum and will keep you posted on its progress.

NEW OFFICERS

During the June meeting at Trent this year a new slate of executive officers was announced. They are listed below. AAPT - Ontario would like to thank Jim Stevens of the University of Guelph for his contribution as member-at-large. We welcome John Earnshaw of Trent to this position and Gordon McKye as our new Vice-President.

Past President	Ernie McFarland, Physics Department, University of Guelph Guelph, Ontario, N1G 2W1
President	Doug Fox, Belle River D.H.S., Belle River, Ontario, N0R 1A0
Vice-President	Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario M9C 2B3
Secretary-Treasurer	Doug Cunningham, Bruce Peninsula DS, P.O. Box 178, Lion's Head, Ontario N0H 1W0
Member-at-large	John Earnshaw, Physics Department, Trent University, Peterborough, Ontario, K9J 7B8
Section Representative	T. Dean Gaily, Physics Department, University of Western Ontario, London, Ontario, N6A 3K7.

ONTARIO SECTION - SECOND ANNUAL CONFERENCE - 1980

The Ontario Section held its Second Annual Conference June 13-14, 1980, at picturesque Trent University, located by the Otonabee River in Peterborough, Ontario.

Meeting Festivities began Thursday evening with a social hour for early arrivals at Lady Eaton College, and continued right through until the close of the meeting Saturday afternoon. Over one hundred of the Section's nearly four hundred members attended the conference.

Friday's program began with a spirited panel discussion, "Physics Education in Ontario: Past, Present and Future". The invited panel consisted of: Jim Stevens, University of Guelph; Jack Wright, The University of Western Ontario; Elgin Wolfe, University of Toronto, and Bill Konrad, Tecumseh Secondary School, Chatham.

Two sessions of contributed papers followed the discussion. At the business meeting, Ernie McFarland co-founder of the Ontario section, was presented with an AAPT pin. After the business meeting, Tim C. Ingoldsby, AAPT Staff Physicist, presented an invited paper "Microcomputers in the Laboratory".

Friday evening's events began with a cash bar on the bank of the Otonabee River, and an outdoor barbeque-banquet. Following the barbeque, participants toured the physics and physical chemistry facilities of Trent University. The building proved easy to locate - it was the only structure on campus with an "Eggbeater" windmill on the roof!

Saturday program events included two more contributed paper sessions, a highly entertaining demonstration free-for-all featuring short demonstrations contributed by section members, and an invited paper, "Quarks, Leptons, Gluons, and All That", by Dr. Nathan Isgur of the University of Toronto.

A listing of contributed papers follows:

"Physics Principles used in the Resource and Environment Fields", John Earnshaw, Trent University;
"Mosquitoes and Muscles", Ivars Peterson, Trinity College School, Port Hope;
"Some Demonstrations re: Center of Mass and Stability", Ernie Mc Farland, University of Guelph;
"Re-inventing a Wheel: An Experience with a Lab Project", Ronald Kelly, St. Charles College, Sudbury and Syed Ziauddin, Laurentian University, Sudbury;

"The Surprising Occurrence of First Digits", Dick Barton, Carleton University, Ottawa;
"Viscous Damping and Restitution Coefficients for a Glider on an Inclined Linear Air Track", N. Gauthier, Royal Military College of Canada, Kingston;
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"Physics in Everyday Situations", Syed Ziauddin, Laurentian University, Sudbury;
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"A Test Tube for Physicists", Raymond E. March, Department of Chemistry, Trent University, Peterborough;
"The Freshman Physics Lab at Western", Tom Stewart, The University of Western Ontario, London;
"A Flexible Approach for Developing Curriculum Resource Materials for General Level Grade 11 Physics Students", Ed James, Cameron Heights C.I., Kitchener;
"Experiments in Special Relativity Using Compton Scattering of Gamma Rays", Peter A. Egelstaff, Jenny A. Jackman, Peter J. Schultz, Bernie G. Nickel, and Innes K. MacKenzie, University of Guelph;
"Astrophotography for Physics Teachers and Students", John Lynialuk, Wiarton District High School.

T. Dean Gaily

UPCOMING EVENTS

Science Teachers' Association of Ontario
November 6, 7, 8, 1980
Skyline Hotel, Toronto Contact: 4046 Bartlett Ct.,
Burlinton, Ont.,
L7L 1Z9

AAPT - Michigan Section

We will be province wide with the contest on May, 1981. Watch for us then and tell your friends. Details will be mailed to all schools in the province.

NEW CURRICULUM

The Ontario Ministry of Education is hard at work developing a new senior science curriculum. One document will cover physics, chemistry, biology and a new senior general science course.

In the area of physics the structure will include activities, content and skills which overlap like the primary colours to produce a relevance. It is expected that the grade 11 course will consist of core plus optional units and that the grade 13 course will not undergo any drastic changes.

Applied science is a new course to be offered at the grade 11 or 12 general level with equal portions of physics, chemistry and biology. Topics such as food, transportation, shelter, energy, recreation and waste will be addressed from the various subject viewpoints.

We might expect the final version to be in the schools in the fall of 1982. AAPT - Ontario is looking forward to the introduction of this new curriculum and will keep you posted on its progress.

NEW OFFICERS

During the June meeting at Trent this year a new slate of executive officers was announced. They are listed below. AAPT - Ontario would like to thank Jim Stevens of the University of Guelph for his contribution as member-at-large. We welcome John Earnshaw of Trent to this position and Gordon McKye as our new Vice-President.

Past President	Ernie McFarland, Physics Department, University of Guelph Guelph, Ontario, N1G 2W1
President	Doug Fox, Belle River D.H.S., Belle River, Ontario, NOR 1A0
Vice-President	Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario M9C 2B3
Secretary-Treasurer	Doug Cunningham, Bruce Peninsula DS, P.O. Box 178, Lion's Head, Ontario NOH 1W0
Member-at-large	John Earnshaw, Physics Department, Trent University, Peterborough, Ontario, K9J 7B8
Section Representative	T. Dean Gaily, Physics Department, University of Western Ontario, London, Ontario, N6A 3K7.

A A P T - 1980 SUMMER MEETING - Troy, N.Y.

With official attendance of 475 physics teachers, the Summer AAPT meeting in Troy, N.Y. was the largest meeting ever held by AAPT in the summer. Canadian representation numbered 27 including two members of the executive committee. The four days of meetings began on Tuesday, 24th of June with workshops on microcomputers, student confidence in physics, medical physics and solar energy. At an idea exchange meeting of section officers the poster display from our section created much interest and many favorable comments were received on our obvious success at getting a new section off to a flying start. Three days of invited and contributed papers followed with a wide and sometimes bewildering array of topics covered. Popular sessions on apparatus and teaching demonstrations, physics and sport and computers in teaching were well attended. At such a large meeting as this there is always plenty for everyone and it continues to be my own feeling that the many personal contacts and friendships that arise are the most valuable feature.

The next meeting of the association will be in January 1981 in New York City, followed in June 1981 with the Summer meeting at Stevens Point, Wisconsin.

T. Dean Gaily

ference.

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Science Teachers' Association of Ontario
November 6, 7, 8, 1980
Skyline Hotel, Toronto — Contact: 4046 Bartlett Ct., Burlinton, Ont., L7L 1Z9

AAPT - Michigan Section
November 8, 1980
Wayne State University, Detroit, Michigan
Contact: Dr. Wm. Beres, Wayne State University, Detroit, Michigan, 313-577-2769

American Association of Physics Teachers - National Winter Conference
January 26-29, 1981
New York City — Contact: AAPT Executive Office, Graduate Physics Bldg., SUNY at Stony Brook, Stony Brook, NY 11794

Grade 11 Prize Contest - AAPT - Ontario
May, 1981 (Details will be sent to all schools)
Contact: Doug Fox, Belle River DHS, Belle River, Ontario

AAPT - Ontario, Third Annual Conference,
June 12, 13, 1981,
University of Toronto, Toronto
Contact: Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3

American Association of Physics Teachers - National Summer Conference
June 17 - 19, 1981,
Steven's Point, Wisconsin — Contact: As for the Winter meeting

FALL'S CELESTIAL EVENTS - bu Doug Cunningham

'Autumn! The cool crisp nights with their lengthened periods of darkness coupled to the end of daylight saving time provide an almost ideal climate for astronomy. In the west, as nightfall approaches and the star clouds of Sagittarius and Scutum become lost in the twilight the prominent Fall Constellations of Aquarius, Cetus, Pisces, Pegasus, Andromeda. Aries, Trianpulum Perseus and Cassiopeia approach the meridian while the summer skies provide splendid views of the Milky Way star clouds and nebulae those of late fall provide dazzling views of the "open or galactic clusters". These comparatively loose clusters of relatively young stars, containing up to a few thousand members, are located in the spiral arms of our Galaxy. Certainly the Pleiodes, and the Hyades, both naked eye galactic clusters in the Constellation Towus, are impressive enough to the unaided eye but just wait for your first views of them through wide angle binoculars! .... and the double galactic cluster in Perseus when seen in a rich field telescope - wow! In addition to these regular astronomical sights the fall skies will produce 5 meteor showers, a number of occultations including a spectacular graze of Regulus on November 1st near North Bay, numerous conjunctions of the planets with the moon in the Eastern morning sky and a fine planetory grouping involving Mercury, Venus, Saturn, Jupiter with Accturus and Spica on the morning of November 19. I've exclosed a map showing the Fall Constellations as seen from mid Ontario at 10:00 p.m. on November 1st. Clear skies and good observing!

Celestial Events for October

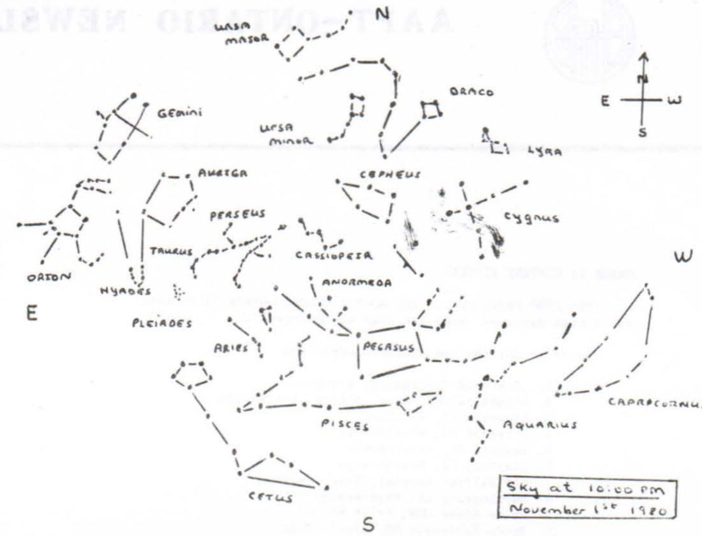
Oct. 2	Mars 1.0°s of Uranus
Oct. 5	Venus 0.8°s of the Moon
Oct. 7	Jupiter 2.0°s of the Moon
Oct. 8	New Moon
Oct. 10	Mercury at Greatest Elongation $\overset{E}{}$ (25°)
Oct. 16	First Quarter Moon
Oct. 21	Orionid Melcols (25 per hour) (best viewed after 3:00 a.m. on the 21st)
Oct. 23	Full Moon - (Hunters' Moon)
Oct. 30	Last Quarter Moon Venus 0.5 $N^\circ$of Jupiter

Celestial Events for November

Nov. 1	Spectacular Graze of Regulus near North Bay
Nov. 3	S. Taurid Meteols (15 per hour) (moonlight interfaces) Venus 0.6°S of Saturn Jupiter 3°S of the Moon
Nov. 4	Saturn 2°S of the Moon Venus 2°S of the Moon
Nov. 7	New Moon
Nov. 15	First Quarter Moon
Nov. 16	Leonid Meteors (15 per hour) (best viewed in the morning of November 17)
Nov. 19	Beautiful Planetory Configuaration prior to sunrise Mercury at Greatest Elongation W(20°)
Nov. 22	Full Moon
Nov. 29	Last Quarter Moon

Celestial Events for December

Dec. 1	Jupiter 3°S of the Moon Saturn 2°S of the Moon
Dec. 4	Venus 4°S of the Moon
Dec. 7	New Moon
Dec. 9	Mars 4°S of the Moon
Dec. 13	Geminid Metcols (50 per hour) (Best viewed after midnight Dec. 13-14)
Dec. 14	First Quarter Moon
Dec. 15	Venus 1°N of Uranus
Dec. 21	Solstice (11^h56^mAM EST)
Dec. 21	Full Moon
Dec. 22	Ursid Meteols (15 per hour) (moonlight interfaces)
Dec. 29	Last Quarter Moon Jupiter 3°S of the Moon Saturn 2°S of the Moon



MEMBERSHIP

Membership figures are constantly growing. If you did not renew either in June as a part of registration for the conference or otherwise, then this might be our last contact with you. After this newsletter non-renewals will be chopped from the mailing list. Send one dollar (with that of a collegue if you would) and your name and address to Doug Cunningham, Bruce Peninsula DS, Box 178, Lion's Head, Ontario, NOH I WO. Do it today.

Currently we are the second largest section in North America. Only Texas stands in the way of a Canadian coup and we are not that far away.

ADVERTISING

The AAPT - Ontario Newsletter accepts advertising from scientific supply firms, publishers and others. The rate is six dollars per insertion. Camera ready copy at twice business card size must be supplied. Our printing process this year has changed which made this size change necessary. The size of the final ad will be about business card size.

The Newsletter is mailed directly to over 300 teachers of physics in Ontario. We offer the best coverage for your advertising dollar.

GIFTED STUDENTS

Do you know of any special programs/contacts/resources/activities for the gifted physics student? Why not share your knowledge with others. Drop a short note to Doug Fox, Belle River D.H.S., Belle River, Ontario, NOR 1A0.

Interference experiments with TV sets

Robert H. Johns
The Academy of the New Church, Bryn Athyn, Pennsylvania 19009

This can be a take-home experiment. All the apparatus needed is two television sets having UHF coverage and a window screen or aluminum foil reflector. The electromagnetic waves used for television transmission are conveniently man sized so that setting up interference effects and measuring wavelengths are easy to do.

One of the TV sets is used as a transmitter. Its local oscillator radiates enough energy to be seen and heard on another set several meters away. It will blank out the white noise on the receiver screen and quiet the between-channel hiss from the speaker. The transmitter's frequency will be about 12 channels lower than what its UHF dial indicates, however. To operate as a transmitter–receiver combination, place the sets a meter or two apart and turn down the sound and picture of the transmitter to avoid getting confusing information from it. With the receiver on UHF and tuned near channel 70 but not receiving any commercial broadcast, tune the transmitter around channel 80 and its signal will be seen and heard. Amazing! Even this much experimenting will be very rewarding and should lead to some messing around by any student or physicist.

A metallic reflector near the receiver will produce cancellation (reappearance of noise and hiss) and reinforcement. If the reflector is behind the receiving set, the distance between adjacent cancellation positions is half a wavelength. If the

Fig. 1. The dark set is receiving electromagnetic waves from the white transmitting set directly and also by reflection from the window screen.

sources. With a regular station tuned in, the reflector can be used to find the direction to the transmitting station if there aren't too many other reflectors nearby.

This has been a lot of fun, and leads to a great many questions. Some basic electronics books and *The Physics of Television* by Fink and Lutyens (Doubleday, New York, Celestial Events for November

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We are looking for science teachers capable of writing resource materials for classroom use (filmstrips, cassette tapes, 16 mm films . . .) for grades 7-13. Please send brief resume including any writing experience you may have, to:

D. Peirce
P. J. Spratt & Associates
212 King Street West
Toronto, (Ontario)
M5H 1K5

Telephone: 416-598-1082

SUPPLIERS AT CONFERENCE

AAPT - Ontario would like to thank the following suppliers for their support at our recent conference.

Merlan Scientific Ltd.
Sargent-Welch Scientific of Canada Ltd.
J.M. LeBel Enterprises Ltd.
Peterborough Computers
Surtronics
D.C. Heath Canada Limited
John Wiley and Sons Canada Limited
Holt, Rinehart and Winston of Canada, Limited
McGraw-Hill Ryerson Limited

with you. After this newsletter non-renewals will be chopped from the mailing list. Send one dollar (with that of a collegue if you would) and your name and address to Doug Cunningham, Bruce Peninsula DS, Box 178, Lion's Head, Ontario, NOH I WO. Do it today.

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Fig. 1. *The dark set is receiving electromagnetic waves from the white transmitting set directly and also by reflection from the window screen.*

This has been a lot of fun, and leads to a great many questions. Some basic electronics books and *The Physics of Television* by Fink and Lutyens (Doubleday, New York, 1960) should be on hand to absorb some of the interest generated.

TPT, January 1974, pg. 38

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AAPT–ONTARIO NEWSLETTER

Doug Fox, Editor,

Volume II, No 2

January 1981

AAPT - ONTARIO GRADE ELEVEN PRIZE CONTEST

On May 12, 1981 AAPT - Ontario will sponsor the first Grade Eleven Prize Contest. Students currently enrolled in Grade 11 physics are eligible to write (or were enrolled in the immediately previous term in semestered schools)

The Contest will consist of about 30 multiple choice questions based on the grade 11 curriculum guidelines plus some questions on general physics knowledge, history and current events. Certificates will be sent to the top two students in each school by AAPT - Ontario. Each school will reward its top student through the purchase of a book or magazine subscription as prize. AAPT - Ontario will provide prizes for the top ten entries in the province with appropriate certificates. A levy of $ .50 per student entry will help to defray the costs involved

Further details will be sent to every school in Ontario as the contest date approaches.

AAPT - ONTARIO ACTIVE

Four executive members of AAPT - Ontario will be travelling to New York for the AAPT National Winter Conference, January 25-29, 1981. They will be representing the Ontario Section as well as giving papers, chairing sessions and being active with various committees. Further details will appear in the next issue.

Five hundred and fifty copies of our last newsletter were distributed. Many found their way to the STAO Conference. This issue goes to press in the amount of 1000 copies, many of which will be distributed in New York. They were a popular item at the Summer Meeting in Troy, New York.

Doug Cunningham represented AAPT - Ontario by presenting a session on science clubs at a PA Day for the science teachers of Kent County in November.

Ernie McFarland has been elected Chairman of the Apparatus Committee of the National AAPT.

CONFERENCE

Arrangements have been made for Jearl Walker to be at the AAPT - Ontario Conference on June 12 and 13, 1981 at the University of Toronto. He will be taping some of his 'spots' for the Quirks and Quarks radio show.

A special guest will unveil the first details of the new curriculum guidelines for senior division physics for Ontario.

AAPT · ONTARIO

CONFERENCE

UNIVERSITY OF TORONTO

JUNE 12/13 1981

JEARLE WALKER

AAPT · ONTARIO

GRADE ELEVEN PRIZE CONTEST

MAY 12, 1981

COMING EVENTS

January 25-29, 1981 AAPT National Winter Meeting
New York City (*)

February 6, 1981 McMaster University Physics Contest
for details Physics Department
McMaster University
1280 Main Street West
Hamilton, Ontario
L8S 4M1

May 7, 1981 Sir Isaac Newton Physics Contest
for details Phil Eastman
Physics Department
University of Waterloo
Waterloo, Ontario
N2L 3G1

May 12, 1981 AAPT - Ontario Grade Eleven Prize Contest

May 10-17, 1981 Canada Wide Science Fair
Waterloo, Ontario

June 12, 13, 1981 AAPT Conference
University of Toronto
for details contact
Gordon McKye,
Etobicoke Board of Education,
1 Civic Centre Court,
Etobicoke, Ontario.
M9C 2B3

June 17-19, 1981 AAPT National Summer Meeting (*)
University of Wisconsin,
Steven's Point, Wisconsin

January 25-28, 1982 AAPT National Winter Meeting
San Francisco (*)

June 1982 AAPT National Summer Meeting
Ashland, Oregon (*)

January 24-27, 1983 AAPT National Meeting
New York City (*)

(*) for details contact AAPT Executive Offices
Graduate Physics Building
SUNY at Stony Brook
Stony Brook, NY, 11794

LOST

In our last mailing we seem to have lost one of our comrades.

Ron Conrad
Tagwi SS
Cornwall, Ontario

The envelope was returned "unknown". If you know where we can reach Ron please contact AAPT - Ontario

... IN THE NEXT ISSUE

Call for Nominations: AAPT - Ontario will be calling for nominations for the offices of Vice-President (who then progresses through the offices of President and Past-President) and Member-at-Large. If you are interested or if you know of someone who is suitable and willing to serve then resumes should be prepared.

Call for Papers: If you are interested in sharing some of your experiences or ideas or a favourite demonstration you will be asked to submit abstracts. Details in the next issue.

OVERDUE

Did you pay your fees for 80/81? If you did not then there is an enclosure with this newsletter. Please mail this enclosure with your $ 1.00 to

Doug Cunningham,
Secretary-Treasurer,
AAPT - Ontario
Lion's Head, Ontario
NOH 1WO

Speakers' Corner

AAPT-Ontario is starting to compile a list of good speakers who are willing to speak about topics in physics (or the teaching of physics) to professional development day groups or to classes of physics students. John Earnshaw, our Executive Member-at-large, is coordinating the compilation of the list. Once completed, the list will be available to anyone interested in receiving it.

If you or a colleague are willing to speak, please send the speaker's name, address, and telephone number along with a brief (2 or 3 sentences) description of the topic to John Earnshaw, Chairman, Dept. of Physics, Trent University, Peterborough, Ontario, K9J 7B8.

PHYSICS NEWS IN 1980

The American Institute of Physics is the sponsor of this little booklet. It becomes available at the end of each year. The editor's copy for 1980 had not arrived and so this review is about the 1979 issue.

The booklet's 90 pages cover topics from acoustics to vacuum physics. Articles average two-thirds of a page and include references. They are written at a level easy enough for a high school teacher but broad enough for a PhD candidate briefing for her comprehensives. It even includes an article on the Nobel Prize winners and a description of their work. The booklet is indexed but not illustrated.

All the topics found to be interesting cannot be listed here but a few of them are:
Progress in Concert Hall Acoustics
A Binary Pulsar and Gravitational Waves
The Shrinking Sun
Newton and Bohr: Back in the Running
QCD and Gluons
Magnetic Fields and the Brain
Magnetic Fusion: Tokamak Program

Permission is granted to journalists to use the material in the booklet without referencing the source. All of this and the cost is only $ 1.00 (US and payable in advance). It is a bargain second only to membership in AAPT - Ontario. Order this valuable aid from

Public Information Division
American Institute of Physics
335 East 45 Street
New York, NY, 10017

January Highlights

Sat. Jan. 3 Quadrantid Meteor Shower (best viewed in the early morning hours.... 40 meteors per hour)
Sun. Jan. 4 Venus 3 deg. south of the moon in the morning sky
Mon. Jan. 5 Venus 0.6 deg. south of Neptune
Tues. Jan. 6 New Moon
Wed. Jan. 7 Mars 1.6 deg. south of the cresent moon in the west at sunset.
Tues. Jan. 13 First Quarter Moon
Wed. Jan. 14 Conjunction of Jupiter with Saturn and Gamma Virgo at 3:00 am EST.
Fri. Jan. 16 Aldebaran 0.9 deg. south of the Moon
Tues. Jan. 20 Full Moon
Penumbral eclipse of the moon beginning at 12:35 EST and max eclipse at 2:40 am EST
Fri. Jan. 23 Mercury 0.3 deg south of Mars- low in the south west after sunset
Sun. Jan. 25 Close approach of Jupiter, Saturn and the Moon in the constellation Virgo
Tues. Jan. 27 Last Quarter Moon

February Highlights

Sun. Feb. 1 Mercury at Greatest Eastern elongation
Tues. Feb. 3 Venus I.6 deg south of the Moon just before sunrise
Wed. Feb. 4 New Moon
Thur. Feb. 5 Mars 0.6 deg. south of the Moon in the west at sunset
Wed. Feb. 11 First Quarter Moon
Thur. Feb. 12 Aldebaran 0.9 deg. south of the Moon... Grazing Occulation
Wed. Feb. 18 Full Moon
Thur. Feb. 19 Conjunction of Jupiter with Saturn and Gamma Virgo 2:00 am EST
Sat. Feb. 21 Close approach of Jupiter, Saturn, and the Moon
Thur. Feb. 26 Last Quarter Moon
Minor Meteor Shower .. Delta Leonids

March Highlights

Wed. Mar. 4 Mercury 2 deg. north of the waning cresent Moon
Fri. Mar. 6 New Moon
Wed. Mar. 11 Aldebaran I.0 deg. south of the Moon
Thur. Mar. 12 First Quarter Moon
Sun. Mar. 15 Mercury at Greatest Western elongation
Fri. Mar. 20 Full Moon
Vernal Equinox 12:03 pm EST Spring begins
Close approach of Jupiter, Saturn, and the Moon
Sat. Mar. 28 Last Quarter Moon

REVIEWERS WANTED

In issues of this newsletter to follow we wish to publish reviews of publications of the National AAPT. If you are selected we will send you a sample copy of the publication. Return it with your review and we will see that you receive your personal copy of the publication. Choose your title and write to

Doug Fox, President,
AAPT - Ontario
Belle River District High School
Belle River, Ontario
NOR 1AO

Include a brief sketch of your background that would make it appropriate for you to be selected to do that review. The list follows and will be extended in subsequent newsletters.

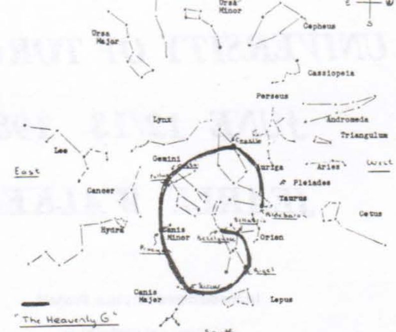
Musical Acoustics: Selected Reprints
Teaching Physics Safely
Energy and Solar Heating
Microcomputers in the Classroom
Teaching Introductory Physics

Star Gazing In Winter!

by Doug Cunningham

The crunch of the crystalline snow breaks the stillness of the January night. As I pass the snow laden cedars at the back of our yard my gaze turns skyward, past the chimney plumes that rise like sentinels from the surrounding homes, and meets the brilliant, sparkling stars of the "Heavenly G". This "Heavenly G" is an asterism, not one of the 88 designated constellations, but a distinctive pattern (G) formed by mentally connecting 9 bright stars from 6 adjacent constellations. These Ist magnitude luminaries are: (listing from the top of the G) Aldebaran (in Taurus), Capella (in Auriga), Castor and Pollux (both in Gemini), Procyon (in Canis Minor), Sirius (in Canis Major), followed by Rigel, Bellatrix and Betelguese (all in Orion). Once you have identified the "Heavenly G" (see the following star chart) concentrate on the colour differences of the stars. A real treat is to view these stars through binoculars..... from the dazzling blue white of Sirius and Rigel through the yellow of Capella to the orange of Aldebaran and the red of Betelguese.... fine contrasts. No longer do stars continue to be anonymous, dull lights in the sky. The "Heavenly G" is not the only asterism visible ....in fact, of the 27 asterisms listed in Menzel's Field Guide to the Stars no fewer than 18 of them can be viewed in the early winter evenings. Probably the most recognized asterism is the "Big Dipper" but others, such as the "Pleiades", the "Great Square of Pegasus" and the "Belt of Orion" are close seconds. The next night you are out snowmobiling, or snowshoeing, or X-country skiing take a few minutes to enjoy the stars of winter.....you won't be disappointed.

During the next three months the celestial sphere will provide, in addition to the usual winter constellations and lunar phases, two meteor showers (one major shower on the morning of Jan. 3 and one minor shower on the morning of Feb. 26), a penumbral eclipse of the moon on the night of Jan. 19-20, and a number of conjunctions of Jupiter with Saturn. On the morning of Jan. 14 at 3:00 EST Jupiter will pass south of Saturn which in turn will be just south of the pretty double star, Gamma Virgo. A rich field telescope will be able to frame both planets and the double star in the same field of view.... a beautiful sight. If bad weather prevents viewing this conjunction then a repeat performance is predicted for Feb. 19 at 2:00 am EST as Jupiter again passes Saturn in retrograde motion. For those interested in the relatively new field of Amateur Astronomy called Grazing Occultations there will be a daylight occultation of Aldebaran on Thur. Feb. 12 at 5:00 pm EST and expeditions are being organized to observe the graze of this occultation just south of Buffalo N.Y. Details of these and other events are given in the table below.



THE NIGHT SKY....EARLY FEBRUARY AT 9:00 pm EST

Doug Fox, Editor
Volume II, No. 3
March 1981

AAPT—ONTARIO NEWSLETTER

CONFERENCE

CALL FOR PAPERS

CONTEST

NOMINATIONS

CALL FOR PAPERS

This is a call for papers for our June conference. Papers are invited on any topic pertaining to the teaching of Physics: innovations in teaching methods, new ways to teach old material, interesting tangential topics, etc., etc.

Papers will be 10 minutes in duration, with 5 minutes afterwards for questions. 15 minutes (instead of 10) may be requested by the contributor, to be allotted at the discretion of the Program Chairman. We hope to have at least one poster session; if you are interested in this mode of presentation, please indicate this with your abstract. (In a poster session, each contributor makes a display on his/her topic and the displays are arranged in a room; people who are interested in a particular presentation can then interact personally with the contributor.)

An abstract of about 150 words should be submitted by April 23, 1981

to Gordon McKye
Etobicoke Board of Education,
1 Civic Centre Court,
Etobicoke, Ontario,
M9C 2B3

Please indicate any requirements for audio-visual equipment.

A useful article "How to present a paper at an AAPT meeting" appeared in the November 1978 issue of The Physics Teacher. If you do not have access to this article and would like a copy, simply request one when you submit your abstract.

CALL FOR NOMINATIONS

In addition to our nominating committee we also receive nominations from the membership.

With the lengthening of the terms of office of the Section Representative and Secretary Treasurer to three years, there are only two offices open for nomination this year: Vice-President and Member-at-Large.

The Vice-President must be willing to undertake a three-year commitment, the first year as Vice-President (conference programme chairman) the second as President, and the third as Past-President. In these first few years of our organization we clearly need someone with initiative who will open new areas of activity for AAPT - Ontario.

The Member-at-Large will sit on the Executive Committee for one year offering advice and support in many ways and doing special tasks as assigned.

Do you know a member who can make a useful contribution to our Section? Send in a nomination. Are you eager to help out in the administration of the Section? Great! Have a fellow member nominate you.

Send nominations to

Ernie McFarland,
Department of Physics,
University of Guelph,
Guelph, Ontario.
N1G 2W1

Include the following information:

1. Position (Vice-President or Member-at-Large)
2. Name of Nominee
3. Nominated by
4. Brief biographical sketch of about 100 words

Election Timetable

Nominations received by	April 24, 1981
Ballots mailed week of	May 6, 1981
Ballots returned by	May 29, 1981

GRADE ELEVEN PRIZE PHYSICS CONTEST

Plans are in high gear for this event Tuesday, May 12, 1981. Posters, letters and order forms are in the mail now addressed to the Physics Teacher in each high school in Ontario. If you did not receive a copy by the middle of April contact:

Doug Fox,
Belle River DHS,
Belle River, Ontario.
NOR 1AO

AAPT NATIONAL WINTER MEETING - 1981

An unseasonably mild week in late January in New York City greeted attendees at the 1981 winter meeting of AAPT. Four section officers (President Fox, Vice-President McKye, Past President McFarland and Section Rep. Gaily) were among those present at the four day meeting. This meeting featured the expected number of diverse workshops, always filled to capacity long before the start of the meeting and there were interesting and well-attended daily sessions. A special 50th anniversary session featured several outstanding talks on past and future directions of AAPT and these together with other join-with-APS sessions were the high points of the meeting.

Hands-on applications sessions involving computers in Physics education, specifically in the laboratory environment; how to set up a micro computer facility; the biannual apparatus competition and a session on training graduate student teaching assistants were all well attended features of this meeting. Besides all the contributed and invited presentations this meeting is always associated with various organizational committee meetings. In the Section Representatives meeting a new chairman was elected, Howard Voss of Arizona. Bob Bauman, the past president has become the national V.P. of AAPT. We all congratulate Ernie McFarland on his election to a post on the Apparatus Committee and hope to see lots of nuts & bolts from him.

Overall, an interesting and lively meeting as usual, highlighted by the personal contacts made, old friends revisited and the thrill of Broadway.

T. Dean Gaily.

CONFERENCE

Gordon McKye is busy planning this year's conference to be held at the University of Toronto, June 12 and 13, 1981. We will again offer our popular pre-conference mixer on Thursday evening, June 11, 1981. Dr. Donald Ivey of the University of Toronto will give the keynote address at the banquet Friday evening at the Faculty Club. Also on Friday, Doug Bannister of the Ministry of Education will speak about the new senior guidelines. A special lunch will also highlight Friday.

On Saturday both Jay Ingram of CBC and Jearl Walker will speak. They will also tape segments of Quirks and Quarks live. Our popular demonstration session will also occur so get your latest invention polished and perfected. Gravity paint?

MEMBERSHIP

Membership in AAPT - Ontario continues to grow. We are now well over three hundred in number. This is full evidence of the value of the services we provide: conference, newsletter, contest and more.

If you are not now a member but have received a copy of this newsletter then send your one dollar membership fee to

Doug Cunningham,
Bruce Peninsula District School,
Lion's Head, Ontario,
N0H 1W0

This fee will enroll you until June 1982. You will save more than this in reduced membership registration rates at the conference as well as receiving four editions of the newsletter during the 1981/82 year.

COMING EVENTS

April 25, 1981 Waterloo Saturday Seminar in Science details: Dr. G.E. Toogood
Department of Chemistry
University of Waterloo
Waterloo, Ontario,
N2L 3G1
(519-885-1211 ext. 3774)

May 7, 1981 Sir Isaac Newton Physics Contest for details Phil Eastman
Physics Department
University of Waterloo
Waterloo, Ontario
N2L 3G1

May 12, 1981 AAPT - Ontario Grade Eleven Prize Contest

May 10-17, 1981 Canada Wide Science Fair
Waterloo, Ontario

June 12, 13, 1981 AAPT Conference
University of Toronto
for details contact
Gordon McKye,
Etobicoke Board of Education,
1 Civic Centre Court,
Etobicoke, Ontario.
M9C 2B3

June 17-19, 1981 AAPT National Summer Meeting (*)
University of Wisconsin,
Steven's Point, Wisconsin

October or November York University Science Olympics

January 25-28, 1982 AAPT National Winter Meeting
San Francisco (*)

June 1982 AAPT National Summer Meeting
Ashland, Oregon (*)

January 24-27, 1983 AAPT National Meeting
New York City (*)

(*) for details contact AAPT Executive Offices
Graduate Physics Building
SUNY at Stony Brook
Stony Brook, NY, 11794

PHYSICS BUMPER STICKERS

From the Society of Physics Students,
American Institute of Physics,
335 East 45th Street,
New York, NY, USA.
10017

40¢ each (US funds) plus 50¢ handling on orders of less than 10

Physics Makes The World Go 'Round
Join the Physics Generation
May the NET FORCE be with you
Physicsits Do It With Charm
Beware of Quantum Ducks Quark! Quark!
Support Your Local Physics Department
Physics is Good for You
Legalize Physics

STAR GAZING IN SPRING

- by Doug Cunningham

One of my students has just received a 13" Dobsonian reflecting telescope and during a night of observing, turned the large cyclops toward the Realm of Galaxies on the border between the spring constellations of Virgo and Coma Berenices. He excitedly described to me his elation at capturing fourteen galaxies in a single field of view. As I felt his enthusiasm I could not help remembering Robert Burnham's remark that the appeal of astronomy is both intellectual and aesthetic - one sees with both the eye and the mind. These faint patches of light, although not particularily impressive in small telescopes, become fascinating objects when one contemplates their actual nature. Here on the border between Virgo and Coma are literally hundreds of vastly remote stellar cities each composed of suns and shining across millions of light years of space and time. This Virgo cluster as it is called, measures at least 40 million light years in diameter and may contain 10 000 individual galaxies. It now appears that our own Milky Way Galaxy is gravitationally associated with this Cluster. Take a trip in space and time this spring. All you need is a 6 inch telescope, clear dark skies and adapted eyes.

In addition to the splendid views of these island universes the spring skies offer many other attractions. The giant planets Jupiter and Saturn, both in Virgo, will be visible for most of the night and during selected times will make close approaches to the waxing gibbous moon. Two meteor showers are due: the Lyrids on April 22 and the Eta Aquarids on May 4. The occurance of the full moon close to the Lyrids will hamper observation but the Eta Aquarids are favourably placed near the new moon. For those with access to moderate sperature telescopes two observations of occultations by asteroids will be visible. In both cases the light drop due to the occultation will be greater than three magnitudes. Interested observers may obtain up-to-date information on occultations from Dr. David Cunham, IOTA, P.O. Box 596, Tinley Park, Illinois, 60477, USA. In light of the current debate concerning the existance of satellites of asteroids, observations of these occultations may provide important

Suppliers and Publishers are welcome advertisers in this Newsletter. It is mailed directly to over three hundred teachers of Physics in Ontario. There is no better advertising value. Camera ready copy must be supplied. Ads are reduced to 70% of the submitted size. The cost of an ad such as the one in this newsletter is $ 6.00. Send the ad and a cheque payable to AAPT - Ontario to

Doug Fox,
Belle River District High School,
Belle River, Ontario.
NOR 1AO

SPRING'S CELESTIAL EVENTS

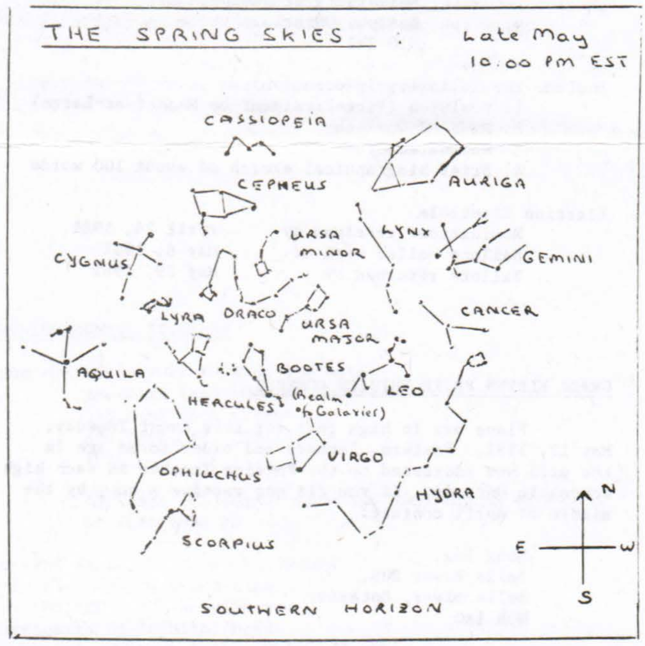
APRIL

Th	Apr 3	- Mercury 1.1° north of the Moon
Sa	Apr 4	- Occultation of SAO 158864 (8.8^{m} star) by the asteroid Aegina. Visible in southern Ontario
		- New Moon
Sa	Apr 11	- First quarter Moon
Th	Apr 16	- Jupiter 3° south of the Moon
Fr	Apr 17	- Saturn 1.7° south of the Moon
Su	Apr 19	- Full Moon
We	Apr 22	- Lyrid Meteors, 15 per hour, max at 3:00 am EST
Mo	Apr 27	- Last quarter Moon

MAY

Su	May 3	- New Moon
Mo	May 4	- Eta Aquarid Meteors, 20 per hour max, best viewed early Monday morning before sunrise.
Su	May 10	- First quarter Moon
We	May 13	- Mercury 8° north of Aldebaran
		- Jupiter 3° south of the Moon
Th	May 14	- Saturn 1.8° south of Moon
Mo	May 19	- Full Moon
We	May 20	- Venus 6° north of Aldebaran
Tu	May 26	- Last quarter Moon
		- Mercury at greatest eastern elongation

Clear skies and good observing!



American Association of Physics Teachers
ONTARIO SECTION

ORDER FORM: AAPT - ONTARIO GRADE ELEVEN PRIZE CONTEST

Name of Teacher: ______________________________

Name of School: ______________________________

Address of School: ______________________________

Postal Code: ______________________________

Please send _______ papers at 50¢ each = $__________

*Please include _______ memberships at $1.00 each = $__________

Cheque payable to AAPT - Ontario in the amount of $__________

*(As a convenience you can join AAPT - Ontario at the same time as you)
(order papers. If more than the teacher listed above wish to join)
(list the names on the other side of this form and include one dollar)
(for each.)

Mail this form and your cheque immediately to:

Doug Fox,
Belle River DHS,
Belle River, Ontario,
N0R 1A0

American Association of Physics Teachers
ONTARIO SECTION

GRADE ELEVEN PRIZE PHYSICS CONTEST

TUESDAY 1981 05 12

The purpose of the Contest is to generate interest in Physics and to give scholar level students an opportunity to measure themselves against others in the provincial.

The contest will be made up of about twenty-five multiple choice questions. The questions will be based on the grade 11 curriculum, current events, general knowledge, history and novel physics trivia.

Prizes and certificates will be offered at the school level and for the top students in the province.

You must be enrolled in grade 11 physics to be eligible to write the contest. (In semestered schools you may write if you were enrolled in the fall semester.)

Contact your Physics Teacher for more information

______________________ ________

Teacher Room

American Association of Physics Teachers
ONTARIO SECTION

Belle River DHS,
Belle River, Ontario,
N0R 1A0

1981 03 31

Dear Collegue:

On May 12, 1981, the Ontario Section of the American Association of Physics Teachers will sponsor its first Grade Eleven Prize Physics Contest. The purpose of the Contest is to generate interest in physics and to give scholar level students an opportunity to measure themselves against others in the province.

The Contest will consist of about 25 multiple choice questions. Most of the questions are based on the content of the current government guideline. In addition there are a few questions concerning physics history, current events and general knowledge. The Contest will be written in a two hour period under local school supervision on Tuesday, May 12, 1981.

Prizes and certificates will be awarded at both the school level and the provincial level. Each school will purchase a prize for its own top student. AAPT - Ontario will supply certificates for first and second place winners in each school. Special certificates and special prizes will be awarded by AAPT - Ontario for the top ten students at the provincial level.

Here are the steps to follow:

1. Fill out the enclosed entry form. Coordinate your school so that only one entry comes from each school. Include a cheque payable to AAPT - Ontario at the rate of 50¢ for each student entry. Mail entry forms immediately. They must be received by April 16, 1981. Students who write the Contest must be currently enrolled in grade eleven physics or were in the term immediately preceding in semester schools.

2. Order your school prize now! We suggest a copy of Jearl Walker's Flying Circus of Physics with Answers. Write to the Order Department, John Wiley & Sons, 22 Worcester Road, Rexdale, Ontario, M9W 1L1. If you order by school purchase order or on school letterhead the cost is only $13.56. Postage costs will be added to the invoice which will be shipped with the book. No need to include money at the time of ordering.

3. Reserve an appropriate room and arrange for the supervision of the exam Contest on May 12, preferably in the morning. Then stand back and watch the stampede of enthusiasm!

Yours sincerely,

Doug Fox

Doug Fox.

DF:jd

Doug Fox, Editor

AAPT-ONTARIO NEWSLETTER

Volume II, No. 4

May 1981

CONFERENCE PROGRAMME

CURRICULUM EXPERTS

NEW EXECUTIVE

AAPT - ONTARIO GROWS AND GROWS AND ....

Membership in AAPT-Ontario continues to grow at an extremely rapid rate. Our membership now stands at 430 and grows with each passing day. The most recent spurt in growth is attributable to responses from the Grade Eleven Prize Contest. This added about 120 members to our ranks.

Welcome to these new members. We are a service organization. Let us know how we can serve your needs. The benefits of membership are many. They include four issues of this newsletter and a healthy reduction in registration fees at our June Conference.

If you are not now a member but wish to be, then simply send one dollar to -

Doug Cunningham,
Bruce Peninsula District School,
Box 178,
Lion's Head, Ontario,
N0H 1W0

Your membership will be good until June, 1982. Please indicate your professional affiliation: university, CAAT, high school, other.

CONFERENCE

With this newsletter you have likely received a copy of the programme for our June Conference at the University of Toronto, June 11, 12, 13, 1981. This year's programme highlights include Doug Bannister with new physics information from the Ministry of Education, Don Whitewood with Microcomputers in the Physics Classroom, a banquet address entitled "Sientific Litteracy" by Dr. Don Ivey of U of T, tours of the facilities at U of T, Jay Ingram and Jearl Walker plus a taping of Quirks and Quarks segments and George Vanderkuur with Programmes in Physics for Gifted Students.

There will be twenty or more tables of suppliers and publishers with their wares, sixteen contributed papers on various teaching topics of interest, the latest in Physics films for viewing and plenty of opportunity for conversation with collegues new and old from all over the province and beyond.

We hope to repeat the very popular Thursday evening social again this year. We hope that those who stay in residence will plan to come early for this and that those who do not commute from too great a distance will consider this worthwhile evening as a part of the Conference not to be missed. Report to New College as stated in the programme and see the poster there for directions to the social.

Another Conference event with high appeal is "My Favourite Demonstration". If you want to share a secret of yours then tick the box on the Conference pre-registration form. During this hour physics teacher after physics teacher quickly dash to the front of the room with a bag of goodies tucked underneath their arm. They might have a device or a tale of some sort. Don't miss this one as you are sure to find lots of things of use. The time fills up rapidly so be sure to send in early.

In the centre of the programme is your form for pre-registration. Be sure to use it and to use it right away to avoid bitter disappointment.

GRADE ELEVEN PRIZE CONTEST

At the time of this writing the Contest is still a week away. There are some preliminary things about the Contest that you might want to know. We sent out about 2852 papers to 178 schools and that averages about 16 per school. A few late responses are bolstering these numbers.

If you have not yet arranged for the prize for the first placed student in your school then may we suggest a copy of The Flying Circus of Physics With Answers by Jearl Walker. Contact the Order Department at John Wiley & Sons, 22 Worcester Road, Rexdale, Ontario, M9W 1L1. Order on school letterhead or on a purchase order to receive a reduced rate for the book.

Overall results and provincial winners will be announced at the June Conference at the University of Toronto and will also be published in the Newsletter scheduled for late September.

AAPT - Ontario will award calculators to the top twelve students in the province. This is through the generous support of the following institutions: the University of Guelph, the University of Waterloo, the University of Western Ontario, the University of Windsor, Laurentian University, the University of Ottawa, the University of Toronto and Trent University. This support is very much appreciated. In addition Guelph has supplied computer time and the University of Waterloo mailing labels. Questions and other such help came from the University of Guelph, the University of Western Ontario and the University of Windsor.

CURRICULUM EXPERTS

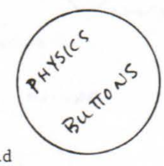
AAPT - Ontario has need of quite a number of people with curriculum expertise to work on various projects in the coming year. If you are interested in such a task then drop a line to

Doug Fox,
Belle River DHS,
Belle River, Ontario,
N0R 1A0.

Include your name, home and school addresses, the number of years experience teaching senior division physics and any other information that you feel pertinent. We need a fairly large number of people so do not feel shy about proclaiming your interest.

BUTTONS

Youth Science Foundation,
151 Slater Street, Suite 302,
Ottawa, Ontario. K1P 5N3



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A PRELIMINARY REVIEW:

PHYSICS: A PRACTICAL APPROACH Alan J. Hirsch

John Wiley and Sons Canada Limited, 1981
467 pages & appendices $_____

Alan Hirsch and John Wiley & Sons are to be commended on their production of a level four physics text. They are the first to fill the void which has existed and has been ignored for years.

The book consists of eight units entitled Preparing for Physics; Fluids; Motion Mechanical Energy and Machines; Heat Energy; Waves Sound and Music; Electricity and Electromagnetism; Light and Colour; and Atomic Physics. Six appendices complete the book.

Sample problems are often illustrated with sketches. Each chapter (23 in all) begins with a list of goals for that study section. Sample problems are scattered throughout the text and at the end of the sections are practice problems. At the end of each cahpter there are review problems. The problems which are more difficult are identified with a circle as being such. The last entry in each chapter is a set of answers to selected problems. Almost 60 experiments are also with the chapter in the sections that they pertain to. Questions at the end of each experiment try to focus attention on important points.

The type is large and well spaced. Print occupies only two thirds of the page leaving a wide margin at the right. Occasionaly this space is used for figure or notes. Conscious attempts at short sentences and easy wording is evident. Varying shades of green and grey aid the diagrams and the sketches in the book. These colours are used in the headings, titles and marginal notes as well. Photographs are plentiful (23 in a tested 100 pages) as are diagrams (63 in the same 100 pages). Many of the figures are combinations of 5 or more separate sketches to illustrate a point.

It is very difficult to criticize a text without actually having used it in the classroom. This is the final test and the only basis for a decision regarding a text. To work toward this I had five randomly selected students in grade eleven-four review the text in some detail. They rated the book an overall 9.4 out of 10 and found little fault. Two found that the language was occassionally a problem - too scientific.

Star Gazing in Summer
by Doug Cunningham

This summer, on a clear, dark, moonless night away from the light pollution of our urban areas ....

Just wander off by yourself
And look up from time to time
In perfect silence
At the stars.

Walt Whitman

One region of particular note, and certainly worthy of inspection by binoculars, is the Great Sagittarius Star Cloud. This splendid central section of our Milky Way can be viewed against the southern horizon in the late evenings of July and August. Not withstanding E.E. Barnard's comment in 1913 that "one necessarily fails in an attempt to describe this wonderful region of star masses" the imagery of some poets' verbal paint brushes gives one a reasonable preview. Consider Tennyson's imagery

...regions of lucid matter taking form
Brushes of fire, hazy gleams,
Clusters and beds of worlds, and bee like swarms
of suns and starry streams

or Robert Burnham's composition

...look now upon the River of Heaven
Sky road of the Immortals,
White with the Star-frost of a billion years.

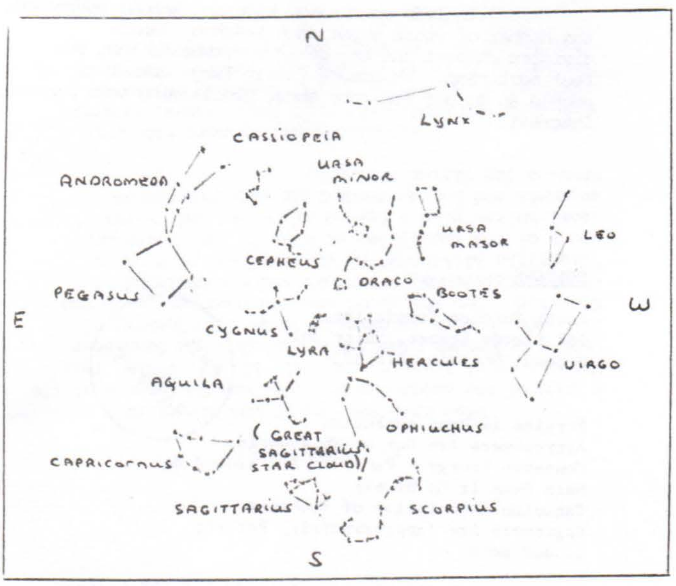
In addition to the outstanding views of our Milky Way and the summer constellations the summer skies will present a lunar eclipse on the evening of July 16th, a solar eclipse on July 30th, two occultations of stars by asteroids (June 4th and August 26th), two meteor showers, and numerous close approaches of the planets with one another and the moon. Clear skies and good observing!

June

Why a topic such as polarization and its application is continually missing from texts is something that I'll never understand. It is high in interest has many easy experiments and demonstrations, is a part of the students everyday life, shows the basic nature of light and the difference in behaviour between transvers light waves and longitudinal sound waves. This is a small point however and Hirsch has covered much ground in this text already which is of an non-traditional nature.

Can one really judge a text when it is the only one in its field? Probably not. My personal summation might be given this way - I order sets this morning for my classes next year.

The Summer Constellations



Late July : 10:00 PM

Wed. June 3	Venus 4° North of the Moon
	Mercury 3° North of the Moon
Thurs. June 4	Occultation of 7.1^m SAO 142674 by the Asteroid Antigone (10:16 EST)
Tues. June 9	Mercury 1.7°S of Venus
	First Quarter Moon
Wed. June 10	Close Approach of the Moon to Jupiter and Saturn
Wed. June 17	Full Moon
Sun. June 21	At 6:45 EST - Summer Begins
Wed. June 24	Lost Quarter Moon
Tues. June 30	Mars 4° North of the Moon

July

Wed. July 1	New Moon
Fri. July 3	Venus 1.3° North of the Moon
Tues. July 3	Close Approach of the Moon to Jupiter and Saturn
Wed. July 3	First Quarter Moon
Thurs. July 16	Full Moon
	Lunar Eclipse
	Moon Enters Penumbra 21^h 5^m EST July 16
	Moon Enters Umbra 22^h 25^m EST July 16
	Middle of Eclipse 23^h 47^m EST July 16
	Moon Leaves Umbra 1^h 8^m EST July 17
	Moon Leaves Penumbra 2^h 28^m EST July 17
Thurs. July 23	Venus 1.2°N of Regulus
Fri. July 24	Lost Quarter Moon
Tues. July 28	Delta Aquorid Meteors - Best Viewed on the morning of July 28 (20 per Hour)
	Mars 3° North of the Moon
Thurs. July 30	Jupiter 1.2° South of Saturn
	New Moon
	Solar Eclipse - The path of totality extends from the Black Sea, across the Soviet Union and eastward across the North Pacific

August

Sun. Aug. 2	Venus 2° South of the Moon
Tues. Aug. 4	Close Approach of the Moon to Jupiter and Saturn
Fri. Aug. 7	First Quarter Moon
Wed. Aug. 12	Perseid Meteor Shower (50 per Hour) Best Viewed Early Morning Aug. 12 After Moon Set.
Sat. Aug. 15	Full Moon
Sat. Aug. 22	Lost Quarter Moon
Tues. Aug. 25	Close Approach of Venus to Saturn
Wed. Aug. 26	Mars 1.4° North of the Moon
	Occultation of 8.7^m SAO 126198 by the Asteroid Artemis at 10:40 EST
Thurs. Aug. 27	Venus 0.9° South of Jupiter
Sat. Aug. 29	New Moon

NEW CURRICULA FOR HIGH SCHOOL PHYSICS

The Ministry of Education for Ontario is currently revising the Senior Division Physics outlines. The official document will not be released for about a year but usually reliable sources have informed us that it might look something like the following:

General Level - might consist of four core units of electricity, light, mechanics, and a smaller unit of nuclear. This would constitute about half the total course. The optional units might be the other half of the programme and might include astronomy, electronics, fluids, heat, machines, magnetism and electromagnetism, sound, sources of energy, or vibrations and sound waves of which about five would be chosen.

Advanced Level - might consist of three core topics of electricity mechanics and nuclear each of about equal weight and constituting a little less than half of the course. Optional topics make up the remainder of the time with some choice being offered among fluids, heat, machines, sources of energy and conservation, electronics, electromagnetism, astronomy, light and colour, models of light, sound and vibrations and waves. There might be a choice of about five from this group in a "choose one from column A..." style.

Grade thirteen - physics will, it is thought, consist of more core than the other grades. It might consist of 75% core and 25% optional topics. Core might include kinematics, dynamics, bodies in equilibrium momentum and energy, electric charge and field theory, relativity and early quantum theory. Optional topics might be circular and rotational motion, electromagnetic waves, elementary particles, quantum theory, vibrations and waves and light from which three or four might be chosen.

There is still a long road ahead in the development of these courses and their final form might not even resemble this preliminary view.

TEE-SHIRTS

If you are interested in very neat tee-shirts with physics, math and computer sayings and slogans, these are available at reasonable prices from:

Soft-Wear Unlimited International,
Star Route Box 38,
Winthrop, WA, U.S.A.,
98862

Some of the more interesting sayings are:

Neutrinos have no solidarity
The Dopplev Effect (red & blue)
There is hopeful symbolism that flags do not wave in a vacuum
Mom and Dad went to Alpha Centauri and all I got was this dumb T-shirt
Friction is a drag
Entropy isn't what it used to be
Friction is a drag
Last year I kouldn't spel Ph.D. Now I are one!
Reality is for those who can't face Science Fiction.
May the GLUON be with you
The meek shall inherit the Earth (The rest of us will escape to the stars)
Time is God's way of keeping everything from happening at once.

Send for their catalogue of more than 115 designs, each of which is illustrated.

LOST MEMBERS

Each time we mail a newsletter we find that we have lost a few members. The newsletter is returned to us as undeliverable. If you know the members listed below tell us where they are or let them know that they are lost and have them contact us. When you change your address be sure to let us know.

One nomination has been made for each of the two vacant positions on the 1981-82 Executive of AAPT-Ontario, and therefore these positions will be filled by acclamation.

George Kelly will be our new Vice-President (then President '82-'83, and Past President '83-'84). George was co-founder of AAPT-Ontario in 1979 and was heavily involved in the administrative work that was required to create the Section (preparing a constitution, planning the first conference, etc.). He has been a teacher for 27 years and a member of AAPT since 1969. At present he is the physics head at Lester B. Pearson C.I. in Scarborough. He has been active in arranging workshops for Scarborough P.D. days, and has been very involved in using P.S.E. (Personalized Student Instruction, i.e. modified Keller plan, mastery approach) in the P.S.S.C. Physics course for grade 13.

One new Member-at-Large will be Syed Ziauddin (better known to many AAPT-Ontario members as "Zee"), who is chairman of the physics department at Laurentian University. "Zee" has been very active in promoting dialogue between secondary school teachers and university faculty in the Sudbury area and in increasing AAPT-Ontario membership there. His research area is physics of the upper atmosphere and he is very interested in physics education at all levels. He worked for two summers as Director of Summer Institutes to introduce P.S.S.C. programs in schools and colleges.

AAPT-Ontario is looking forward to the leadership of George Kelly and Syed Ziauddin in strengthening and expanding the activities of the organization.

Allan N. Brown,	Mr. David Rimmer,
P.O. Box 967,	101 Oakwood Avenue,
Campbellford, Ontario,	Toronto, Ontario,
K0L 1L0	M6H 2V9
Ms. Judy Conn,	D.S. Ainslie,
14 Oakmeadow Blvd.,	93 Upper Canada Drive,
Scarborough, Ontario,	Willowdale, Ontario,
M1E 4G1	M2P 1S6

SUPPLIERS AND PUBLISHERS

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Doug Fox,
Belle River District High School,
Belle River, Ontario.
N0R 1A0

Demonstrating interference

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H. L. Armstrong
Department of Physics, Queen's University, Kingston, Ontario, Canada

Here is a way to show what happens when light from two coherent sources, e.g., two Young's slits, interferes. The rays of light from the two sources to the place in question (it is convenient often to think in terms of rays) may be represented by two cords. The heavy white cords often used for clotheslines are convenient. Alternate sections, of suitable length, are colored black and left white. The white sections may represent crests of the waves, the black, troughs.

Each cord may be fastened at one end to places a little apart. The cords are held by the other ends, stretched out, and let cross somewhere. The place at which they cross represents the place in question, at which the interference is being considered.

If there should be a white section of each cord at the place where they cross, that means, in terms of the waves, that crests from each source will meet there at a certain time. A little later, troughs from both sources will meet there, and so on. So the waves from the both sources will add in their effects; there will be what is called constructive interference. Likewise if the cords should cross where they are both black.

If, however, a white part of one cord should meet a black on the other, that would correspond to a crest from one source meeting a trough from the other. The one would counteract the other; there would be destructive interference.

It is easy, then, by moving both cords about, to have them cross at different places, and to see where there would be constructive, where destructive, interference. The former, in terms of light, would, of course, correspond to bright fringes, the latter to dark.

NOBEL PRIZE Reproduced with permission

The 1980 Nobel Prize for Physics was awarded to Val Fitch of Princeton University and James Cronin of the University of Chicago for their work on the violation of CP invariance. Their findings, first announced in 1964, have had implications for particle physics and for theories of cosmology.

Symmetry is important in physics. Not necessarily the geometrical symmetry we associate with a snowflake, but the more general symmetry, or invariance, of equations under the action of a mathematical operation. In the quantum mechanical language used in formulating particle interactions these equations have as their variables the wave functions which describe individual particles. These wave functions in turn are characterized by spatial coordinates (x,y,z), momentum coordinates, (P_x, P_y, P_z), and other attributes such as spin, charge, baryon number, etc.

The invariance of equations is important since it is linked to the conservation of those physical quantities which characterize systems of particles undergoing interactions. The conservation of momentum, for example, is related to the invariance of the Hamiltonian (the function which expresses the total energy of an isolated system of particles) under the mathematical operation consisting of a simple spatial translation; in other words, the physics does not change when you shift all x coordinates three feet to the left.

The conservation of energy and momentum are implicit in classical (pre-quantum mechanical) equations of motion. Other conservation laws, asserted only in recent times, have less physical foundation; examples of these are the conservation of parity and charge conjugation number. Parity is both a quantum number, an attribute which particles may have (even parity or odd), and a mathematical operation. To say that parity, the quantum number, is conserved in a reaction is to say that the parity of the system of particles before the interaction, whether two particles about to collide or a particle about to decay, equals the total parity of the system after the interaction. In this regard, the conservation of parity is a notion associated with the invariance of the reaction as a whole, and not with individual particles. Parity is assigned to particles on the basis of the behavior of their wave functions under the parity operation, which consists of inverting all spatial coordinates. This operation is similar to but not identical with reflection in an ordinary mirror: the parity operation reflects sets of coordinates through the origin (trades [x,y,z] for [-x,-y,-z]), while reflection in a glass mirror changes only one coordinate ([x,y,z] becomes [-x,y,z]). In particle physics, an interaction (or decay) conserves parity if it remains invariant when the wave functions of all the particles undergo the parity transformation. Until 1956 it was observed that the strong interaction (responsible for the nuclear force) conserved parity.

String and sticky tape experiments

THE PHYSICS TEACHER FEBRUARY 1978 105

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Section Editor: R.D. Edge, Physics Department, University of South Carolina, Columbia, South Carolina 29208

It is truly amazing how many qualitative and quantitative physics experiments can be done with very simple equipment if you put your mind to it. There are many curious and paradoxical problems which can be solved using Bernoulli's principle. One is to get a dime off a table into a cup on the table without touching the coin. The cup must be shallow, or tilted so that the lip is about 2 cm off the top of the table, and about 2-3 cm behind the dime, which is placed 1-2 cm from the edge of the table, as shown. It looks impossible for the dime to get into the cup, but if you blow hard and suddenly, parallel to the table top, the dime hops in. As the air is blown rapidly over the top of the dime, Bernoulli's principle tells us that the pressure is lowered there, and the pressure differential between the top and bottom of the dime raises it off the table, and allows it to be blown into the cup. So much for the qualitative explanation, which will satisfy most people, but suppose we apply a little mathematics. Bernoulli's principle states that the pressure differential, p, between the top and bottom of the dime is given by

$$p = \frac{1}{2}\rho V^2$$

where ρ is the density of air (1 Kg/m^3) and V is the velocity of the air blown over the dime. Now, the area of the dime A (2.5×10^{-4} m^2) multiplied by this pressure differential must equal the gravitational attraction on the dime, mg, if it is to rise off the table. Since the mass of the dime is 2.24 gm, the gravitational force is about 0.0224N.

So

$$mg = A\frac{1}{2}\rho\, V^2 \text{ and, putting in numbers,}$$

$$0.0224 = 2.5 \times 10^{-4} \times \frac{1}{2} \times 1 \times V^2$$

This gives V = 13.4 m/sec which is 48 km/hr or 30 mph. If we perform the same trick with a quarter, we require 16 m/sec or 37 mph, and for a nickel it is 17 m/sec or 38 mph. In fact, it must be much more than this to get the coin into the cup. Our little calculation tells us a surprising fact—we can blow at least 30 to 40 mph—something you can tell any blowhards you know!

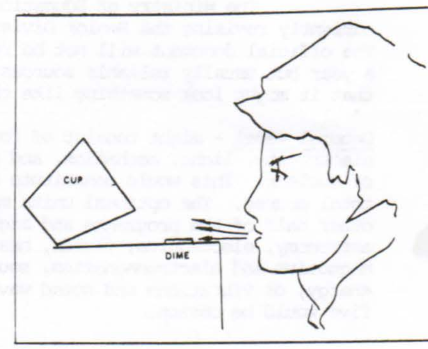


Fig. 1. Blowing the dime into the cup.

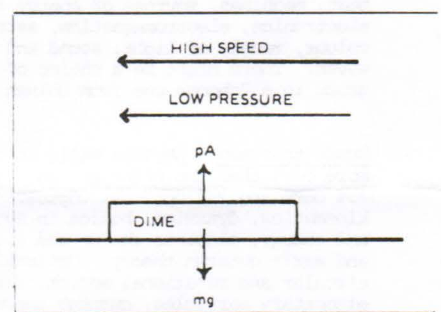


Fig. 2. To lift the dime, the differential pressure must be at least large enough so that $pA = mg$.

Center of gravity of a student

particle physics; it replaces all negative charges with positive charges and vice versa, but leaves spatial coordinates alone. This operation, in effect, exchanges particles for their antiparticles. Like parity (P), the charge conjugation operation has associated with it a quantum number (C).

Charge conjugation and parity invariance were upheld in various scattering experiments up to that time; C and P had therefore been deemed to be "conserved quantities." And then an experiment conducted in 1956 showed that parity was not conserved after all. In fact both C and P operations are violated by the "weak interaction" (responsible for radioactive decay, among other things). It was then felt that the interaction of particles would remain invariant under the combined action of parity and charge conjugation. Even CP invariance, though, was found to be violated in the K meson experiments of Fitch, Cronin, and their collaborators, James Christenson, and Rene Turlay.

This experiment, conducted at the Brookhaven AGS accelerator in 1964, observed the decays of neutral K_2 mesons. CP invariance specifies that the K_2 may decay into three pi mesons (pions) but not two. They observed, however, that one out of every 600 decays produced only two pions. This evidence for CP non-invariance was later supported by other experiments at Brookhaven and at Stanford involving other K_2 decay schemes in which the decay products included electrons or muons.

Apparently the violation of CP invariance implies the violation of T invariance. The T (time) invariance operation inverts the time variable (substitutes -t for t) in all wave functions. T invariance must be violated whenever CP is violated in order that an even more important symmetry, the triple operation of CPT, remain intact. The overthrow of CPT invariance would cause grave problems for current theories of particle interactions since it is founded upon Einstein's special theory of relativity.

The invariance or noninvariance of physical laws under the C, P, and T operations addresses the question of how symmetric the universe may be: T invariance implies that nature does not distinguish between backward and forward running reactions; P invariance implies that nature does not distunguish between left and right; C invariance implies that nature does not prefer matter to antimatter. The failure of these symmetries actually helps to promote, and not confound, the prevailing model of cosmology and elementary particles.

This theory, called the "grand unified theory," postulates, among other things, that during the early moments of the universe, shortly after the big bang, there existed many super-heavy particles, with a mass more than 10^{15} times that of the proton. These particles, known as X and $\bar{X}$ bosons, are thought to decay into quarks and leptons; the quarks then organized into baryons and antibaryons. These X bosons are therefore instrumental in creating baryons and, at a subsequent time, in destroying them. (See the article on proton decay in the particle physics chapter in this book.)

Two of the striking features of the universe are the relative scarcity of antimatter and the ratio of photons to baryons, about 10^9 (a billion to one). It is at this point that the CP noninvariance becomes important. At a very short time after the singularity of the big bang (10^{-35} sec), under conditions of high temperature (10^{28}K) and high energy (10^{15}GeV), the forces responsible for CP noninvariance are comparable to other forces. As the universe cooled production of baryons and antibaryons proceeded, but at slightly different rates, a result of the CP asymmetry. As the universe cooled further, many of the baryons and antibaryons annihilated each other in matching pairs creating in their place two photons. If the initial CP imbalance were as small as one part in a billion, the universe would eventually develop a preponderance of matter over antimatter: when, for example, one-billion-plus-one baryons interact with one billion antibaryons, what remains is one baryon, no antibaryons, and a billion photons. This scenario explains both the photon-to-baryon ratio and the scarcity of antimatter.

G. Stroink
Department of Physics, Dalhousie University, Halifax, N.S., Canada B3H 3J5

Several textbooks[1] written for students in the life sciences show, in one of their problems, how the center of gravity of a person can be determined by weighing the person on a board supported by wedges on two scales, one at each end of the board. This problem is the keystone of one of our lab experiments dealing with forces, torques, and the center of gravity. The preparation time to start this lab is relatively short, particularly when workshop facilities are available to cut wood. The students enjoy it, possibly because it requires them to participate actively, and it starts them thinking about the forces and torques acting on them in daily life. Two students require the following equipment:

- one board of 2 x 6 ft plywood, 3/4 in. thick
- one bathroom scale, flat on top (no handle)
- one meter stick
- two wooden wedges, each 2 ft in length, but of different heights.

To determine the location of the center of gravity the wedges are placed near to and parallel with the ends of the board. One rests directly on the floor, the other on the bathroom scale. The wedges differ in height by the height of the bathroom scale. This ensures that the board is horizontal when laid on top of the wedges. The student of predetermined weight lies down on the board and his or her center of gravity can be determined by calculating the sum of the torques around the point where one of the wedges supports the student (Fig. 1). In this approach the weight of the board is ignored. It is our experience that some students gain sufficient insight into the problem to include the location of the center of gravity of the board and its weight – as determined by the bathroom scale – to obtain a more accurate location of the center of gravity of the student.

One can simplify the lab by allowing the students to use two bathroom scales. In that case, one can compensate for the weight of the board by adjusting the scales to read zero with the board alone resting on the scales.

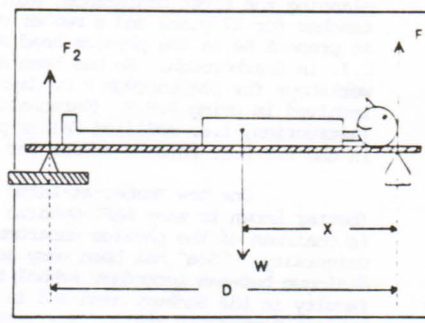


Fig. 1. The center of gravity of the student can be found from the equation $F_2 \cdot D = W \cdot X$. F_2 is read from the scale. W is the weight of the student, determined previously.

The experiment described above is a part of a more extensive lab dealing with forces.

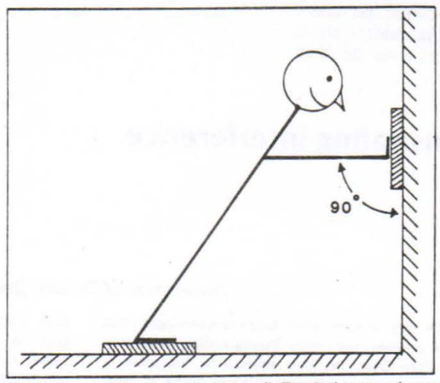


Fig. 2. A student leaning against the wall. Two bathroom scales are needed to determine all the forces that act on him in this position.

In this experiment students study the forces while standing on one scale and pushing down on a second scale located on the bench, they check their measured center of gravity by balancing on a single wedge, and locate the center of gravity of a person lying on the board with his legs straight up.

In another part of the experiment, the student leans against a wall as far as possible, as indicated in Fig. 2. Two scales are used to determine the magnitudes of the forces.

In analyzing this situation we assume that the vertical component of the force at the wall is negligible.

If "momentum and impulse" have been treated already in the course then the following experiment can be added: Ask the student to stand very quietly on the scale and let him look carefully at the scale indicator. The periodic movement that can be observed on the scale corresponding with his heart beat is a nice demonstration of how a change in momentum (of the blood) can produce a force. This principle is applied in the Ballisto cardiograph.[2]

References

1. A. H. Cromer, *Physics for the Life Sciences* (McGraw-Hill, New York), 2nd ed., p. 63.
   J. Kane and M. Sternheim, *Life Sciences Physics* (John Wiley, New York), p. 78.
2. S. MacDonald and D. Burns, *Physics for the Life and Health Sciences* (Addison-Wesley, Reading, Mass.), p. 85.

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

From the Editor

The Ontario Section of the American Association of Physics Teachers is one of the largest and most active sections. We are proud of that fact and hope that in the coming year we can build on what we have already achieved and continue to offer services and resources that are of value to the Physics teachers of Ontario and beyond. Membership continues to be strong. If you have not renewed your membership or if you wish to become a member, please send $1.00 to our Secretary/Treasurer, Mr. Doug Cunningham, Bruce Penninsula District School, Box 178, Lion's Head , Ontario, N0H 1W0. Your mailing label should include Jun 81 or Jun 82 indicating the date to which membership is paid. Please indicate your professional affiliation: university, CAAT, high school. Your membership will be good until June 1982 and you will continue to receive our newsletter and notice of conference and services.

If you have any comments or suggestions either about the activities of AAPT-Ontario or this newsletter, please write to the editor:

Gordon McKye,
Etobicoke Board of Education,
1 Civic Centre Court
Etobicoke, Ontario, M9C 2B3

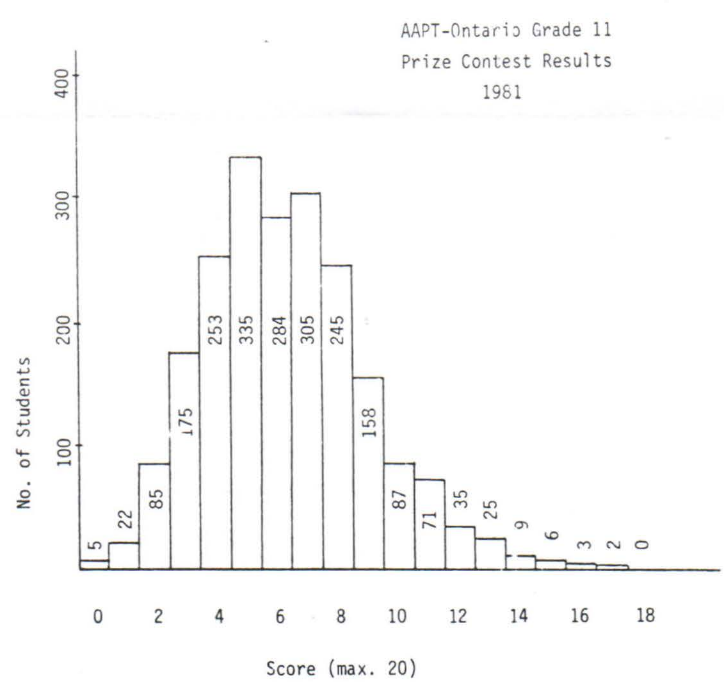
A LIST OF THE PROVINCIAL WINNERS FOR 1981

SCORE	STUDENT	SCHOOL	TEACHER
17	N.E. Hunt	MacKenzie HS, Deep River	Doug Moon
17	R.J. Kirkness	Woburn CI, Scarborough	L. Rice
16	R.M. Boeckner	Woburn CI, Ottawa	
16	M. Li	Nepean HS, Ottawa	Doug Ramsden
16	M.G. McKendry	Orangeville DSS, Orangeville	Don Bosomworth
15	P.T. Shannon	Almonte DHS, Almonte	James Blair
15	G.K Morton	MacKenzie HS, Deep River	
15	I.J. Miller	MacKenzie HS, Deep River	
15	G.C. Celetti	Laura Secord SS, St. Catharines	El Umbrico
15	M. Luscher	Eastdale CVI, Oshawa	E.G. Milne
15	M. Allen	Kingston CVI, Kingston	D.J. Knapp

Grade 11 Physics Contest

AAPT - Ontario's Grade Eleven Prize Physics Contest was held on Tuesday, May 12, 1981. Over 2800 papers were ordered for use in 184 schools. First and second place certificates were sent to schools to give to their winning students. Eleven provincial winners received TI-35 calculators and special gold certificates. Funds for the provincial winners were provided by various physics departments in Ontario Universities: the University of Guelph, the University of Waterloo, the University of Windsor, the University of Western Ontario, Trent University, Laurentian University, Carleton University, and the University of Toronto. (Please note that Carleton's name was mistakenly left out of this list published in a previous Newsletter. We regret this oversight on our part.) A list of the provincial winners and their schools is given below. Congratulations to all those who participated.

This year the Contest will be held on Tuesday, May 4, 1982. If your school has not received Contest information by April Fools' Day, contact Doug Fox, Belle River District H.S., Belle River, Ontario, N0R 1A0.



Reporting to you

ONTARIO SECTION - THIRD ANNUAL CONFERENCE - 1981
by Dean Gaily

The third annual conference of the Ontario Section, hosted by the University of Toronto's Department of Physics, was held on June 11-13, 1981. Attended by over 100 members, the meeting began with the usual Thursday evening rap session and gettogether at New College and continued at an interesting and enthusiastic pace through Saturday afternoon.

David Harrison, U. of T. local host and Gordon McKye, Etobicoke Board of Ed. program chairman together provided a stimulating and enjoyable meeting. Program highlights from the contributed papers on Friday were:

"Spring Wars and Mystery Boxes", Bill Konrad, Tecumseh S.S., Chatham;
"Induction Transducer for Recording Glider Velocity on an Air Track", P; Rochon and N; Gauthier, R.M.C., Kingston;
"Errors Anyone", N; Pereira, Agincourt C.I., Scarborough.
"Computer-aided Testing in Freshman Physics Laboratories", D.R. Hay, U.W.O., London;
"The Importance of Newton's First and Third Laws", G.S. Rose, U.W.O., London;
"Streaming and What to Teach in Grade 13 Physics", Bill Prior, Malvern C.I., Toronto;
"The Use of an Analog Computer in Physics Demonstrations", G.R. Heyland, Northern College, Kirkland Lake;
"The Great Physics Poster Contest", Doug Fox, Belle River D.H.S., Belle River;
"A Personalized Student Instruction (P.S.I.) Approach to Grade 13", George Kelly, Pearson C.I., Scarborough;
"A Simple Demonstration of Spherical Aberration", A.R. Lachaine and P. Rochon, R.M.C. Kingston;
"'Eureka!' TVOntario Physics Programs", Ernie McFarland, University of Guelph, Guelph;
"Give a Lift to Your Science Program - TryModel Rocketry", Doug Cunningham, Bruce Peninsula D.H.S., Lions Head.

Two invited presentations on Friday, "Current Ministry (of Education) Activities" by Doug Bannister and "Micro-computers in the Physics Classroom" by Don Whitewood of Toronto were well received and led to the Banquet in the U. of T. faculty club and the talk on "Scientific Literacy" (sic) by Donald Ivey of Toronto. Tours of the physics and astronomy department facilities followed.

Saturday's program started with two invited papers, "Putting Science on the Air" by Jay Ingram and "Amateur Science for Physics Education" by Jearl Walker. This combined presentation, featuring Sauce Bearnaise and lemon meringue pie by Jearl, for radio audiences only, was undoubtedly the hit of the conference.

Contributed papers were:

"Physics of Home Heating and Energy Conservation - Theory and Practice", S; Ziauddin, Laurentian U;, Sudbury;
"Studying Wave Motion on a Microcomputer", Malcolm Coutts,Riverdale C.I., Toronto;
"Studies on Why Some Students 'Just Don't Get It'",David Harrison and A.W. Key, U. of Toronto;
"Individualized Physics-Minicourse and Micro computers",Gordon McKye, Etobicoke Board, Etobicoke;
"Teaching Archaeometry: An Interdisciplinary Link Between Physical Science and Anthropology", R.M. Farquhar, U. of Toronto.

The meeting ended with two features on demonstration, first our usual "My Favourite Demonstration" with several stimulating examples followed by "Science for the Gifted (Process or Content)" by George Vanderkuur of the Ontario Science Centre.

AAPT 1981 SUMMER MEETING - STEVENS POINT, WISCONSIN
by Ernie McFarland

The popularity of the AAPT Summer Meeting continues to grow. The 1981 meeting at Stevens Point, Wisconsin, set a new attendance record (506), breaking the mark set only a year earlier. Workshops were not only filled, but extra sessions of many were added to the schedule on the spot.

Highlights included:
- the Millikan Award to Al Bartlett and his Millikan lecture (to be published in the December, 1981, issue of the "American Journal of Physics" — look for it; it is expected to be one of the most popular articles ever to appear in AJP);
- a fascinating banquet talk by Robert Greenler about light in the sky and colour in the clouds, including a demonstration of the "green flash";
- a two-part evening demonstration show, followed by an outdoor courtyard reception (free beer, cheese, popcorn);
- three sessions on light, vision, and colour.

AAPT-Ontario was well represented: Don Bosomworth (Orangeville DSS), John Huschilt (U. of Windsor), Eustace Mendis (Ontario Science Centre), Dave Whiting (Merlan Scientific), Doug Fox (Belle River DHS), and Ernie McFarland (U. of Guelph). Four new members were added to AAPT-Ontario at the meeting: from Rhode Island,Texas, Newfoundland, and Alberta. In view of AAPT-Ontario's rapid growth, John Layman (President-Elect of the AAPT) confided a mock fear that the AAPT would eventually become only a subsidiary of AAPT-Ontario.

With the costs of the big-city Winter Meeting becoming even larger, it is expected that the Summer Meeting will increase even more in popularity. Future locations are Ashland, Oregon (June, 1982) and Memphis, Tennessee (June, 1983).

Physics Olympics

ATTENTION, PHYSICS OLYMPIANS!

Have you set a date and a place for a Physics Olympics in your region in the coming school year? Please send us the information as soon as possible along with the name, address, and telephone number of the right person to get in touch with should anyone have further questions. We will publish a list of all the scheduled Olympics we know about in the next national AAPT Announcer, in a winter Physics Teacher, or both.

We have received an interesting request for records that have been set in previous competitions. For instance, what is the highest ratio achieved in your region for weight supported to mass of bridge? The highest successful paper tower (in metres per sheet)? The slowest average forward speed for a slow bicycle race (metres/minute)? The fastest average speed for a vehicle powered by candle, mousetrap, or rubber band? Records for distance and duration of paper airplane flights? Other competitive events for which record keeping is appropriate?

If you haven't been keeping records, consider doing so this year, and send them to the committee for publication. And don't forget to include your rules for any newly-invented or revised event, if it proves successful. Incidentally, has anyone had any luck with the laser shoot? If so, provide details!

Send your information (or your questions or requests for material) to the Physics Olympics Subcommittee, c/o Jean Brattin, 3146 Warrington Rd., Shaker Heights, OH 44120.

SERP Report

SECONDARY EDUCATION REVIEW PROJECT

Your executive felt that it was important that some voice of physics teachers of the province of Ontario be heard by the Secondary Education Review Project. For that reason, at our spring meeting a response was finalized and subsequently sent to SERP. That response is reprinted here for your infomation.

The American Association of Physics Teachers has a strong and independent Ontario Section. We are grateful for the opportunity to have input into the redesigning of the secondary school.

1. AAPT - Ontario supports more compulsory hours of science education.
With the ever increasing presence of science in the students' lives and the forecast of even more in the future more science emphasis in education is warranted. We must prepare students for a technological society by improving their scientific literacy and developing their skills in critical thinking.

2. AAPT - Ontario supports a maximum science class size to promote safe conduct of laboratory work.
Research shows that laboratory accidents increase with more students in the class. We recommend a maximum of 24 students in advanced and general level science classes and 16 in basic and modified science classes.

3. AAPT - Ontario supports the equality of board resources with respect to science consultants, coordinators and non-teaching lab assistants.
Science teachers must cope with rapidly changing information and heavy loads of extra duties related to their science subject. Every science teacher should have available support from a local consultant or coordinator. As well boards should hire full, part time or itinerant lab assistants for equipment maintenance, control, ordering and preparation freeing the teacher to better perform the educative functions.

4. AAPT - Ontario wishes to have input into the formulation, implementation and evaluation of physics curricula.
We speak for more than 500 physics educators in Ontario high schools, colleges and universities and can provide valuable input into physics education.

5. AAPT - Ontario supports the need for increased amounts of professional development for science teachers within their discipline.
It is important for science teachers to keep up with new developments in science and pedagogy. The increasing average age of secondary school teachers and subject discipline switches due to declining enrollment necessitate professional development on a scale far larger than the present. A reasonable percentage of instruction costs should be spent on the professional development of teachers across the province.

6. AAPT - Ontario is concerned about the standards of education under the proposed compression of the secondary education system.
Great care must be taken to ensure that standards do not decline as a result of the proposed compression. The insurance should be in place and operating before the compression is begun.

7. AAPT - Ontario is concerned about the possible effects on the student caused by the compression of the secondary education system.
The general level student might find the pace of the compressed secondary school more than he is able to cope with.
Difficulties might be incurred by students who have not attained the proper piagetian levels necessary for certain subjects.
Timetabling flexibility now in the system will be reduced.

Coming events

National Winter Meeting
JANUARY 25-28, 1982, San Francisco
Abstract deadline: October 20, 1981

Ontario Section Meeting
JUNE 17-19, 1982, U of WO, London, Ontario
Abstract deadline: April 15, 1982

National Summer Meeting
JUNE 23-25, 1982, Ashland, Oregon
(Joint Meeting with Pacific Northwest Association of College Physics)
Abstract deadline: March 30, 1982

National Winter Meeting
JANUARY 24-27, 1983, New York City
Abstract deadline: October 20, 1982

National Summer Meeting
JUNE, 1983, Memphis, Tennessee
Abstract deadline: March 30, 1983

Financial Statement

AAPT - Ontario Section is in a solid financial position. We have $10.56 in our Current Account and a total of $965.00 in a Daily Interest Savings Account - plus accrued daily interest; There are no major outstanding bills. Our successful June Conference incurred a number of expenses - all of which have been met from the registration proceeds. These expenses were:

Program Printing, Mailing Costs and Support Materials	$168.85
Thursday Night Social	22.26
Guest Speaker Expenses	295.29
U of Toronto - Banquet Expense	775.99
Accommodation	768.50
Conference Meals	772.95
Total Conference Exp.	$2803.84

Regarding our association membership - we have now passed the 500 mark! - Unfortunately not all members have paid up their membership dues for the current 81-82 period - in particular 205 members still have to remit their $1.00 membership fee. This renewal may be sent to Doug Cunningham, c/o Bruce Peninsula District School, Lion's Head, Ontario N0W1W0.

Suppliers take note

This newsletter goes to perhaps the best 500 physics teachers in Ontario. For a cost of only $10.00 we will include a small calling card size advertisement in our newsletter. We appreciate your interest in physics teaching and want to maintain a good working relationship with you.

Star Gazing

STAR GAZING IN AUTUMN by D. Cunningham

In all fields of human endeavour achievement arises as the result of a conscious journey of the human spirit. For amateur astronomers this adventure of the spirit can crystallize in many ways --from the methodical sweeps of the dedicated comet hunter, through the journeys of the peripatetic astronomers as they chase grazes, eclipses, and asteroid occulations, to the systematic observing of variable stars and the careful observation and description of splendid deep sky objects. For one of our own AAPT-ONT members, Steve Dodson, this journey of the spirit involved the design and construction of one of the largest amateur reflecting telescopes in Canada. Phoenix II, as it is called, uses a 22 inch f/7.4 primary mirror purchased from Gerard Pardeilhan of the San Francisco Sidewalk Astronomers. Steve's achievement results from his ingenious combination of a scaled up Poncet Platform with a large Dobsonian reflector and a trailer to produce a large mobile telescope with equatorial tracking capability. First sight of this 1500 lb. orange and blue cyclops leaves most amateur astronomers with their mouths agape and an incredible expression on their faces. When the telescope is directed toward the zenith and observers climb up the special giraffe chair to the eyepiece they are 16 feet above the ground. And what of the views provided by this huge light bucket which collects 6000 times more light than the dark adapted human eye?...well, Vega, the brightest star in the constellation Lyra, appears as brilliant as a welder's torch, spiral structure is observed in the famous Whirlpool Galaxy(M51), the huge globular cluster in Hercules (M13) is resolved to the core, and the Trifid Nebula (M20) in the constellation Sagittarius, revealed, besides a bulbous nebulous patch trisectd with dark rifts of obscuring matter, colour contrasts and dark lanes in the reddish section. Steve's plans for the future involve refining and motorizing the tracking to develop full photographic capability. If you find yourself in North Bay, I'm sure Steve would enjoy showing you the result of his own spiritual journey...Phoenix II.

In spite of the unstable weather conditions usually associated with the months of November and December, the Fall period presents the amateur astronomer and casual star gazer with the reasonably good observing conditions associated with long, cool, crisp nights. Against the background of the Fall constellations (see attached map) the planets will make close approaches to one another and to the waning crescent moon. As most of the planetary action will occur in the morning sky, only those hardy souls willing to leave the warmth and comfort of their bed will enjoy these celestial sights. As if to provide an added incentive for early morning activity, there will be 5 meteor showers. The best displays are usually provided by the Orionid Shower on October 21 and the Geminid Shower on December 13...in both cases, however, the moon will interfere by making it difficult to see the fainter meteors. In any event, if the skies are clear where you live, all the showers are worth an attempt. Clear skies and good observing!

September

Tues., Sept. 1	:	Jupiter 4°S of Moon
	:	Venus 5°S of Moon
Sun., Sept. 6	:	First Quarter Moon
	:	Venus 2°N of Spica
Thur., Sept. 10	:	Mercury 4°S of Saturn
Sun., Sept. 13	:	Full Moon (called the Harvest Moon)
	:	Mercury 3°S of Jupiter
Sun., Sept. 20	:	Last Quarter Moon
Tues., Sept. 22	:	Autumnal Equinox...Fall Begins
Wed., Sept. 23	:	Mercury at greatest Eastern Elongation
Sun., Sept. 27	:	New Moon
Tues., Sept. 29	:	Mercury 9°S of Moon

October

Thur., Oct. 1	:	Venus 7°S of Moon
Tues., Oct. 6	:	First Quarter Moon
Tues., Oct. 13	:	Full Moon (called the Hunters Moon)
Sat., Oct 17	:	Venus 1.9°N of Antares
Mon., Oct. 19	:	Mars 1° N of Regulus
	:	Last Quarter Moon
Wed., Oct. 21	:	Orionid Meteors...25 meteors per hour - best observed after mid night and before the last quarter moon rises. Observe on the night of Oct: 20-21.
Thur., Oct. 21	:	Mars 1.4°S of the Moon
Sun., Oct. 25	:	Saturn 3°S of the Moon
Tues., Oct. 27	:	New Moon
Sat., Oct. 31	:	Venus 6°S of the Moon

November

Mon., Nov. 2	:	Taurid Meteors...15 meteors per hour - best observed in the morning of Nov. 2 between 3:00 AM and 6:00 AM
	:	Mercury at Greatest Western Elongation.
Wed., Nov. 4	:	First Quarter Moon
Thur., Nov. 5	:	Mercury 1.2°N of Jupiter
Tues., Nov. 10	:	Venus at Greatest Eastern Elongation
Wed., Nov. 11	:	Full Moon (called the Frosty Moon)
Tues., Nov. 17	:	Leonid Meteors...15 meteors per hour - best observed around 1:00 AM on the night of Nov. 16-17.
Wed., Nov. 18	:	Last Quarter Moon
Thur., Nov. 19	:	Mars 2°S of the Moon
Mon., Nov. 23	:	Jupiter 4°S of the Moon
Thur., Nov. 26	:	New Moon
Mon., Nov. 30	:	Venus 3°S of the Moon

December

Fri., Dec. 4	:	First Quarter Moon
Fri., Dec. 11	:	Full Moon (called theLong Night Moon)
Sun., Dec. 13	:	Geminid Meteors...50 meteors per hour - best observed before moon rise on the night of Dec. 12-13.
Wed., Dec. 16	:	Venus at Greatest Brilliancy
Fri., Dec. 18	:	Last Quarter Moon
	:	Mars 3°S of the Moon
Sat., Dec. 19	:	Saturn 3°S of the Moon
Mon., Dec. 21	:	Jupiter 4°S of the Moon
	:	Winter Solstice...Winter Begins
Tues., Dec. 22	:	Ursid Meteors...15 meteors per hour - best observed in the early morning hours of Dec. 22
Sat., Dec. 26	:	New Moon
Tues.,Dec. 29	:	Venus 2°N of the moon

AAPT Apparatus

AAPT APPARATUS COMPETITION

The Apparatus Committee of the AAPT sponsors a biennial Apparatus Competition. In 1982 it will be held at the AAPT summer meeting in Ashland, Oregon during the month of June.

If you have designed a novel piece of apparatus, or have made unique modifications to existing apparatus, why not enter. The prizes are substantial — $300.00 first prize, $200.00 second and $100.00 third in each of the two categories, Pre-College and College. You do not have to travel to Oregon; just send your apparatus and an explanatory exhibit.

Further details will appear in later newsletters.

American Association of Physics Teachers

AAPT Ontario Section

FOURTH ANNUAL CONFERENCE

at UNIVERSITY OF WESTERN ONTARIO LONDON, ONTARIO

JUNE 18 & 19, 1982

Program at a glance

Conference Features

PROGRAM HIGHLIGHTS

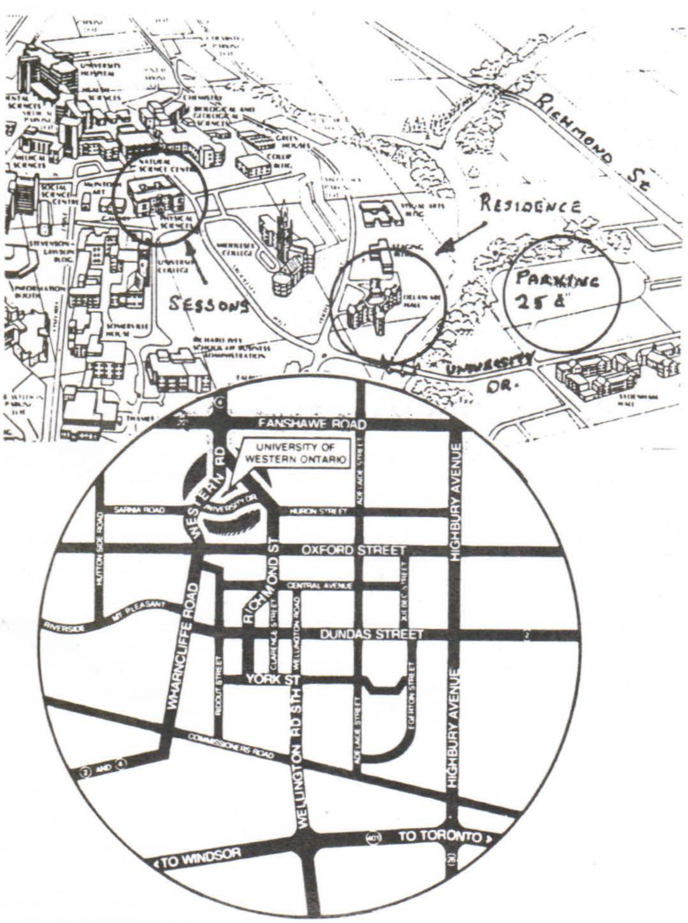
Pre-Conference Workshop

Physics Olympics Panel
Creativity in Classroom - Dr. Don Woods
McMaster University

Banquet Speaker - Dr. Eric Rogers, Princeton University

Computer Program Exchange

Invited Speakers:
Dr. John Vanderkooy - Waterloo
Dr. Brian Kaye - Laurentian
Dr. Don Woods - McMaster



THURSDAY, JUNE 17th

PRE-CONFERENCE WORKSHOP - Dr. Don Woods
Physics & Astronomy Building, Room 123

9:00 - 5:00	All-day workshop on "Creativity in the Classroom" Meals available in U.W.O. cafeteria.

CONFERENCE PROGRAM BEGINS

7:00 - 11:00	Registration, Reception, and Cash Bar in Delaware Hall Residence. All Conference registrants are welcome! DON'T miss this popular event!

FRIDAY PROGRAM JUNE 18th

8:30 - 9:15	Register in Physics & Astronomy Building Room 123 and visit displays
9:15 - 9:30	Welcoming remarks in Physics & Astronomy Building - Room 137
9:30 - 10:30	Panel on Physics Olympics: Dean Gaily, Ed Gregotsky, Murray Kucherawy, student guest
10:30 - 11:00	Coffee and Physics Displays
11:00 - 12:30	Contributed papers A1-A6
12:30 - 1:30	Lunch and Displays
1:30 - 2:30	Invited paper: Prof. Don Wood of MacMaster University Topic: "Building CREATIVITY in our students"
2:30 - 3:00	Business Meeting - Gord McKye Presiding
3:00 - 3:30	Coffee and Physics Displays
3:30 - 4:30	Contributed papers B1-B4
4:30 - 5:15	Computer program exchange session
5:30 - 6:30	Cash Bar at Delaware Hall
6:30 - 9:00	Banquet-Barbecue in Delaware Hall
8:00 - 9:00	Keynote speaker: Dr. Eric Rogers of Princeton University Topic: "Examinations...a powerful influence for good or harm in developing new teaching!"
9:00 - 11:00	Tour of Physics facilities

SATURDAY PROGRAM JUNE 19th

8:30 - 9:00	Register in Physics & Astronomy Bldg - Room 123
9:00 - 10:00	Invited paper: Dr. Brian Kaye of Laurentian Univ. Topic: "Delightful Discoveries of Physics in Unexpected Places"
10:00 - 10:30	Coffee and Physics Displays
10:30 - 11:30	Contributed papers C1-C4
11:30 - 12:30	Seminar: Dr. Eric Rogers of Princeton University Topic: "Why not explain by demons?"
12:30 - 1:30	Lunch
1:30 - 2:30	Invited paper: Prof John Vanderkooy of University of Waterloo Topic: "Using computers in the measurement and design of loud-speaker systems"
2:30 - 3:15	My Favourite Demonstration Dr. Tom Stewart of U.W.O. presiding
3:15 - 4:15	Computer program exchange session

General Information

GENERAL CONFERENCE INFORMATION: The Fourth Annual Conference of the American Association of Physics Teachers (Ontario Section) will be held from Thursday evening, June 17th to Saturday afternoon, June 19, 1982, at the University of Western Ontario, London, Ontario

REGISTRATION: Registration for residence and the Conference will occur at Delaware Hall residence on Thursday evening from 7:00 p.m. to 10:00 p.m. and on Friday and Saturday in the Physics Office in the Astronomy and Physics building (room 123). Conference parking is provided in the (Medway) parking lot across the river from Delaware Hall (25¢). Those who have pre-registered can pick up their package of materials from the registration desk. Note the cost of the conference is less if you pre-register. Whether you are staying at the college or not, plan to join us on the Thursday evening from 7:00 p.m. to 11:00 p.m. for our popular informal get-together in Delaware Hall. This is a great time to make new friends and renew old friendships. Confirmations will be sent to all registrants.

PLEASE NOTE: Pre-registrations must be received by June 4th!!

CONFERENCE MEALS: Both accommodation and meals will be provided at Delaware Hall. Book your meals in advance and pay for them together. Meal tickets are available without overnight stay but buy them in advance to avoid confusion.

PRE-CONFERENCE WORKSHOP: Dr. Don Woods' workshop on creativity will commence in the Physics and Astronomy building at 9:00 a.m. on Thursday, June 17th for those who are registered. Meals on Thursday are available in U.W.O. cafeterias.

BARBEQUE: The Barbeque (weather permitting) will be held on the lawn outside Delaware Hall on the banks of the Thames River. The keynote address will be given by Dr. Eric Rogers in Delaware Hall following the Barbeque. You are invited to bring your spouse if you so wish.

NEW!!! COMPUTER PROGRAM EXCHANGE

Bring your best program on a protected disk (or tape) and a blank disk as there will be an opportunity for you to display and exchange (mine for yours) programs on Pets and Apples (microcomputers). A room and a time has been allocated for this from 4:30 to 5:15 Friday; and 3:15 to 4:15 Saturday. This will be an informal exchange session.

PROGRAM CONVENOR - George F. Kelly
Lester B. Pearson C.I.
150 Tapscott Road
Agincourt, M1B 2L2

"A" Session Abstracts

A-1 How Olympic Records Depend on Location

Ernie McFarland, Dept. of Physics, Univ. of Guelph, Guelph

The Olympic records of many athletic events show anomalies in the results for the 1968 Mexico City Olympics. These anomalies can be explained by taking into account the low value of "g" and the low air density at Mexico City. The explanations provide an extremely interesting example for use in introductory mechanics courses.

A-2 A Simplified Method of Teaching A.C. Suitable for High School Courses

Donald S. Ainslie, 25 Hawthorn Ave., Toronto

The study of Physics should emphasize the experimental aspects of the study rather than the mathematical concepts and made relevant to everyday life. The outline in my paper is a simplified approach to the study of A.C. circuits which does not require a knowledge of calculus. In place of the usual textbook introduction, start with a C.R.O. to show that the ordinary 60 Hz power supply is sinusiodal. For an A.C. current $i_m \sin\theta$ flowing in a resistance R the power in watts W is $W = i_m^2$ (Ave. of $\sin^2\theta$)R. Now for N pairs of values of $\sin\theta$ and $\cos\theta$ the value of each pair $\sin^2\theta + \cos^2\theta$. The sum for each series = N. But the $\sin^2\theta$ sum = the $\cos^2\theta$ sum = N/2. Hence the average = 1/2 and the energy output per second W is $W = i_m^2/2$ R or $W = i^2R$ where $i = i_m/\sqrt{2}$ represents the rms value of the current and is the value ordinarily used in AC work. For voltage measurements V = Vm/V2. If the full wave is rectified, AC output is measured by means of a DC meter, the indicated value equals to arithmetic average ia of the current. Now $i_a = i_m$ (Ave. of $\sin\theta$). In appendix to a paper (Crucible 1980) on the simple pendulum, I derived a proof showing that the average of $\sin\theta = 2/\pi$ and hence $i_a = i_m\, 2/\pi$. These ideas have been used to drive noncalculus proofs for the standard equations pertaining to AC circuits. This should be of special interest to a group of students who about this time in their life start experimenting with radio and T.V. circuits.

A-3 The Use of Calculus in Grade 13 Physics

Bill Prior, Malvern C.I., 55 Malvern Ave., Toronto

Most grade 13 Physics text books avoid the use of Calculus since the students for whom these books were written do not study it. This is not true in Ontario. There are many places in the grade 13 Physics course where the techniques of Calculus can provide valuable enrichment. Several examples of this will be discussed in this presentation.

A-4 Photography As A Motivator

Bob Orrett, Cawthra Park Secondary School, Mississauga, Ontario

General level physics teachers are always looking for ways to motivate their students through practical applications of the laws of physics. Photography provides endless examples of the uses of the rules of optics and gives most students a "want to learn" attitude which is so pleasant to teach to.

The author will describe with slides how his classroom is transformed into a photography studio four weeks out of each year. A proven technique for teaching the unit will be described along with suggestions for resource material.

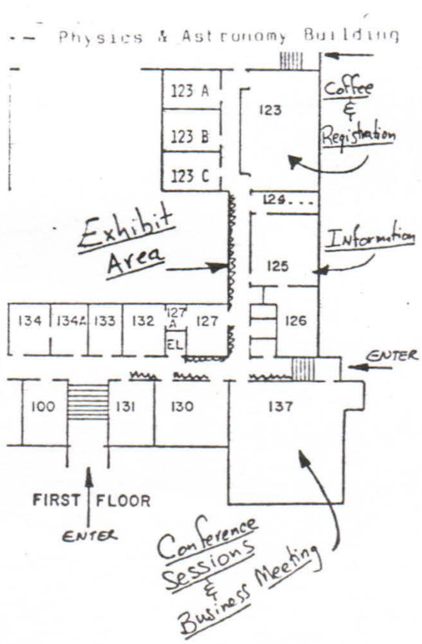
A-5 & A-6 Have Telescope, Will Travel

Steve Dodson, Ecole Secondaire Algonquin, North Bay

The largest mobile telescope in Canada unites in its design two recent and previously separate breakthroughs, making it practical for a single individual to transport and set up at remote sites a very stable and powerful instrument with equatorial tracking.

Considerations of centre of gravity and stability which lead to the new design will be discussed and highlights of the post-completion telescope treks (both cosmic and highway-type) will be presented.

When the 1st report was made at last June's conference, construction was only half completed. A month and a half later the finished scope merited 2nd prize for mechanical design at the "Stellafane" telescope maker's conference in Vermont. In the 3 months following completion hundreds of people at widely-scattered sites have viewed deep-sky wonders through this 22-inch reflector.



"B" Session Abstracts

B-1 A Lab Tutor called "Superbrain"

J. Law, F.R. Hallett, and S. Bird, Physics Department, University of Guelph, Guelph, Ontario

Superbrain Microcomputers have been integrated into our Biophysics I and II courses as adjuncts to laboratory tutors. Students perform their laboratory exercises as usual and then have a choice of either getting their data and calculations checked by a lab instructor or by the Superbrain Micro. A software package written in Microsoft V5.0 Basic contains all the labs that are performed in both courses. Students choosing to have their lab checked by the Superbrain, if successful, get a printed slip which they can attach to their lab book.

The software/hardware will be described. Some results of student reactions will be presented. A demonstration of the system on a Superbrain will be given.

B-2 Using Computers in the Physics Lab

Alan Hirsch, Woodlands School Mississauga

Using simple computer programs to analyse experimental data has great advantages for certain physics experiments.

The students have instant feedback and they learn from interacting with each other as the computer tells them whether or not their results are within an acceptable range.

Another advantage, probably the most important one, will be discussed during the presentation.

B-3 Method for Collecting and Analyzing Data in Study of Normal Modes

P. Rochon & N. Gauthier of Royal Military College

When a single glider attached to 2 springs on a horizontal linear air track is put in motion, there results an oscillation characterized by a single frequency. However, when 2 identical gliders are coupled to each other by a third spring, the resulting motion is characterized by 2 frequencies.

We have used the induction technique described by us elsewhere[1] to analyze the motion of the gliders and to study the phenomenon of energy transfer from 1 glider to the other.

Our method uses the voltage output of the induction transducer, transforms it into a digital signal, and feeds it directly into a computer. Results will be presented and discussed.

1. P. Rochon & N. Gauthier - Am Journal of Physics, January 1982; also, P. Rochon, N. Gauthier, & J.R. Gosselin, Physics 13 News, January 1982.

B-4 Computer-Aided Testing in Freshman Physics Laboratories at U.W.O.-the Second Year

Donald R. Hay, Physics Dept., U.W.O., London, Ont.

Conventional grading of laboratory reports on each experiment was replaced by oral interviews several years ago, and by computer testing for half of the students two years ago. At the beginning of the current year, the computer tests were replaced by tutorial dialogs on computers. The latter reviewed numerical calculations, the use of units, and the interpretations of parameters in formulas, without assigning a grade.

Each student's performance was assessed in a short interview by the T.A., following the computer dialogue.

Student reaction to this method of grading generally was favourable. Adverse comments were directed mainly at the time spent in waiting for computer terminals and oral interviews, and the tendency for some T.A.'s to extend the short interview into a longer tutorial. From the viewpoint of the laboratory supervisor, the computer dialogues gave all students a painless introduction to computers, provided a uniform screening of those aspects of analysis that are most difficult for T.A.'s to review, and quickly indicated shortcomings in the preparation of the T.A.'s, the students, and the laboratory manual. These results suggest the need for more extensive use of the computers in a tutorial role as part of the laboratory, and for better training of the T.A.'s for in-laboratory assessment of the student's work.

"C" Session Abstracts

C-1 Poetic Imagery In Astronomy

Doug Cunningham, Science Head,
Bruce Peninsula District School

Perhaps no other branch of physics has the power to overwhelm and captivate the imagination of young people quite like astronomy. Direct experience of the heavens usually evokes both an emotional and intellectual response--seeing with both their minds and their eyes as they experience at first hand incredibly wondrous and beautiful celestial sights. Certain writers, such as Tennyson, Whitman, and Serviss have a unique ability to capture this emotional essence by producing a crisp train of intellectual associations. As educators, we can capitalize on these poetic flights of imagery and thus bring astronomy alive for our students. Perhaps in this area is a lesson for all science teachers.

C-2 Physics and Society, A Unit

Dr. Eknath V. Marathé, 25 King's Grant Rd., St. Catharines, Ontrario

Last few years, at Grantham High School, a General Science course is being taught at Grade 13 level. This is an experimental course and a number of units for the course have been developed. The course is basically designed for the students who have very little background in Science but have basic mathematics skills. The general goal of this course is to expose the students, who will not necessarily pursue study of Science in their future life, to the processes of Science. The so called "Scientific Process" is not a monopoly of Science. It is hoped that the students will learn to approach any problem in a logical manner after having some basic facts in hand. One of the Units, Dynamics, Kinematics, and Economics of Automobile is presented.

C-3 A Statics Unit for Grade 13

Robert H Squires, B.A.Sc. M.A. Brantford C.I. & V.S.

Statics became an orphan when dropped from the math courses in the mid 1960's.

At Brantford C.I. & V.S. we adopted it as part of the Grade 13 Physics course in 1978. Despite a lack of S.I. metric problems we struggled through the first year and now have a large bank of student material.

Topics covered are: forces, components, concurrent forces, equilibrium, friction, non-concurrent forces, moments, rotational and translational equilibrium and couples. The unit requires 3 weeks of non-semestered time.

C-4 Milli & microsecond lab timing with a microcomputer

Peter Spencer, Leacock C.I., Scarborough

It is possible to use a microcomputer and a few photo transistors in the introductory lab as either a very versatile timer with pulse, gated, one shot, data-logging, on time of flight modes, or as a frquency meter with one shot, averaging, or data-logging modes.

Conference Exhibitors

Publishers
Book Society of Canada
D.C. Heath
Holt, Rinehart & Winston
McGraw-Hill, Ryerson Ltd.

Scientific Equipment
Sargent Welch Scientific
Merlan Scientific
Lyons Logic (Computers)

PRE-CONFERENCE WORKSHOP

Workshop Leader: Donald R. Woods, McMaster University

Don is a Professor and Chairman of the Department of Chemical Engineering and has for a long time been interested in improving teaching and learning and especially improving the student's abilities to solve problems. To gather information on what the problem is in teaching problem solving, he became a freshman student and followed the same group of undergraduate students through their four-year undergraduate program. Some of these students volunteered to attend extra sessions to display how they solved or did not solve their homework assignments.

Based on this research, the major challenges of teaching problem solving were identified and a set of teaching and learning objectives identified. Teaching materials are being prepared and revisions are being made to the curriculum. Since 1974 Don has presented over 200 seminars and over a dozen workshops on developing problem solving.

He received the OCUFA Award and the McMaster Student Union Award for outstanding teaching. He is the author of half a dozen texts and over 100 papers. He edits a bimonthly newsletter on teaching problem solving "PS News", and is on the editorial board of the newsletter "Problem Solving".

WORKSHOP PROGRAM - Thursday, June 17th

In Physics & Astronomy Building - Room 123

9:00 a.m. to 10:00 a.m. - Overview (Unit 1)

10:00 a.m. to 10:15 a.m. - Break

10:15 a.m. to 12:00 noon - Developing Awareness (Unit 2)

12:00 noon to 1:30 p.m. - Lunch - U.W.O. Cafeterias

1:30 p.m. to 3:00 p.m. - Creativity (Unit 4)

3:00 p.m. to 3:15 p.m. - Break

3:15 p.m. to 5:00 p.m. - Creativity (Unit 4)

AAPT (ONTARIO) ANNUAL MEETING - JUNE 17-19/82

REGISTRATION FORM

NAME:..

HOME: ....

BUSINESS ADDRESS:..

HOME PHONE:.. BUSINESS PHONE:..

MEMBERSHIP RENEWAL

Membership in A.A.P.T.(Ontario Section) costs $3.00 per year.(still a Bargain!!)

( )I wish to renew my membership for the 1982-1983 year, ( )I wish to become a member for the first time!

PRE-CONFERENCE WORKSHOP

( )I wish to register for the Workshop on The Teaching of CREATIVITY in the classroom $10.00

CONFERENCE PREREGISTRATION

Note that the rates at the Conference will be higher than the rates quoted below. If you are using the low preregistration rates, please mail so this form will be received by June 4th.

( )1 Day, AAPT-Ont member $10.00 ( )1 day, non member $13.00

( )2 Days,AAPT-Ont member $17.00 ( )2 days, non member $20.00

( )I plan to contribute a demonstration in the session 'My Favourite Demonstration'.

Title of My Demonstration ....

ACCOMMODATION AND MEAL RESERVATION

Accommodation and meals will be at Delaware Hall, University of Western Ontario.
Please prepay both accommodation and meals. Meal tickets will be provided when you arrive on campus.
Meal tickets are available without overnight stay!!

Arrival at residence: date: June ....time:............ Departure: date: June .... time:...............

ACCOMMODATION : Single room..$18.19 (7% Ont tax inc)/night for..... nights => $ ....

Twin room..$12.84 (7% Ont.tax inc)night/person for ..... nights => $ ....

If you have requested twin accommodation, please give room-mate's name:...

Meals requested:

	breakfast ($4.00)	lunch ($5.00)	Banquet-Barbecue $15.45
Friday June 18	....	....	(10% Ont.tax inc) => $.........
Saturday June 19	....	....	

TOTAL Accommodation and meals -> --> $...............

TOTAL REGISTRATION FEES

Membership (1982-1983)	$.	3.00
Pre-Conference Workshop-->	$.	.
Conference preregistration	$.	.
Accommodation and meals	$.	.
TOTAL	$.	.

NOTE:

DEADLINE FOR
PREREGISTRATION IS
JUNE 1ST!

Please send a cheque or money order, payable to AAPT-ONTARIO, for the above total along with this registration form to: Prof. Dean Gaily, Department of Physics, Unversity of Western Ontario, London, Ontario, N6A 3K7.

PRE-CONFERENCE WORKSHOP

Workshop Leader: Donald R. Woods, McMaster University

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3:00 p.m. to 3:15 p.m.	-	Break
3:15 p.m. to 5:00 p.m.	-	Creativity (Unit 4)

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol III No 2 Feb 1982
Editor: Gordon G. McKye

Gr 11 Physics Prize Test

This year's Contest will be written on Tuesday, May 4, 1982. Mailings addressed to the Physics Teacher will be sent out to the high schools in mid-February. The philosophy of the Contest remains the same: to give the best students a chance to measure themselves provincially and to generate some interest in physics in all students. Certificates are given to the top two students in each school. Each school provides a prize for its top student. Provincially, the top eleven (or so) are given special certificates and prizes. Costs for the Contest have increased substantially and we must charge one dollar per entry requested. The time period for the Contest has been set for one-and-a-half-hours.

If you have not received your mailing by April Fool's day, then call Doug Fox at 519-728-1212.

Eric Rogers to speak

We are pleased to announce that Professor Eric Rogers (Coulomb's law film) has agreed to attend and give an address at this year's AAPT (Ontario) meeting. Plan now to attend this fine conference. For many people, it is the highlight of the conference year.

AAPT ONTARIO '82 CONFERENCE JUNE 17, 18, 19, AT WESTERN UNIVERSITY IN LONDON

Call for Papers!!!

Now is the time to prepare your presentation for our annual June conference at Western University. Program plans are underway which include a 'super' workshop on the topic 'PROBLEM SOLVING' by Prof. Don Woods of McMaster University, a panel on PHYSICS OLYMPICS, special invited papers, contributed sessions, and of course the popular "MY FAVOURITE DEMONSTRATION"!!

Organize your abstract for that particular topic or idea you do so well and share it with your colleagues as a presentation in the contributed paper section. If you have not given a paper and are uncertain about it, there is an article elsewhere in this newsletter entitled "Why Publish". If you indicate you are interested when you send in your abstract, we will also send you a copy of an article from the Physics Teacher on "How to present a paper!!".

Send your abstract to: Dr. Neves Periera, 2621 Midland Ave., Agincourt, Ont ario M1S 1R6

It is essential you respond soon as the program must be prepared for early distribution. Thus the DEADLINE IS APRIL 4th for submission of abstracts.

Convenor George Kelly

AAPT Ontario Executive

President: Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3, 416-626-4360.

Past-President: Doug Fox, Belle River High School, Belle River, Ontario, N0R 1A0, 519-728-1212.

Vice-President: George Kelly, Pearson Collegiate Institute, Scarborough Board of Education, Scarborough, Ontario.

Secretary-Treasurer: Doug Cunningham, Bruce Peninsula District High School, Lion's Head, Ontario, N0H 1W0, 519-793-3211.

Section Rep to National AAPT: Dean Galey, Physics Department, University of Western Ontario, London, Ontario, 519-679-2568.

Member-at-Large: Syed Ziauddin, Physics Department, Laurentian University, Sudbury, Ontario, P3E 2C6.

Ontario Nominations

Nominations are requested for the following positions on the AAPT (Ontario) executive: Vice-president, Secretary-treasurer, Section representative (to National AAPT), Member-at-large. Any member of AAPT (Ontario) can make a nomination. Please send all nominations, by February 28, to Gordon McKye, Etobicoke Board of Eduction, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3.

Congratulations

Congratulations to Ernie McFarland (U of Guelph and past president of AAPT(Ontario)) for his appointment as Chairman of the AAPT (National) Physics Apparatus Committee. This is the first time that a Canadian has been chosen to chair a major committee in the National AAPT. Congratulations, Ernie.

Congratulations to two other AAPT members who have received honours. Jack Wright, who retired from Althouse College last year, and Gordon McKye, who is AAPT president this year, have received the STAO Award of Merit for Excellence in the Teaching of Science. Elgin Wolfe (FUET) was the first winner of the new award last year. We are pleased to have two physics teachers chosen to receive this award in 1981. It is evident that they represent many fine teachers of physics across the province. Congratulations, Jack and Gordon.

Scarborough Science Awards

SCARBOROUGH SCIENCE AWARDS COMPETITION.

This competition has been in operation for about 10 years and is still going strong. Every year in June, Science students from Scarborough Collegiates voluntarily compete for about $1500 cash prizes in biology, chemistry and physics. A 1.5 hour examination in each subject (multiple choice) is given to grade 13 students, and computer marked with prizes awarded at the fall commencement exercises in each collegiate. The operation of this competition is shared by rotation among the 19 collegiates and more directly under the supervision of Mr. Don Garratt, the Science Co-ordinator for the Scarborough Board.

The financing comes from continuing solicitations by science heads from the many manufacturing firms in the area, the Scarborough Board itself, and two or three major contributors. Recognition is given to these firms who send their representatives to make the presentations at commencement exercises.

The exams, compiled by various high school vice-principals and professors from Scarborough College, are based on the Grade 13 programs and take about an hour and a half to complete. Students may take one or more of these multiple choice tests.

The object of the awards is to reward excellence of Scarborough science students and to offer challenge to high-calibre students who are often exempted from final examinations. The exams last year were written in the borough's municipal building, but in the past they have been held in the individual schools and the exams sent on to have the results tabulated.

Competition is keen among about 250 students who participate to win one of the five awards in each subject yearly. A first place award of $150 will help when that student faces the cost of university in the fall. Although only one award can be won by a particular student, there are many who place high in all three subjects. Scarborough Award Certificates are presented to the top 20 in each subject.

For further information, contact Don Garratt at the Scarborough Board of Education, 140 Borough Drive, Scarborough, Ontario, M1P 4N6.

George Kelly

AAPT Apparatus Competition

APPARATUS COMPETITION - 1982

The thirteenth biennial Apparatus Competition is scheduled for the AAPT 1982 Summer Meeting in Ashland, Oregon. The informal atmosphere of the summer meeting will allow entrants to utilize some of the support facilities of the host institution and will encourage substantial communiciation (and hands-on experience) in regard to the apparatus entered.

Apparatus entered in the competition should be
1. Either new in design or a modification of existing apparatus;
2. Not commercially available;
3. Not described in a previous written publication.

The apparatus may be set up by the participant (or an attending colleague) or may be shipped to Ashland and assembled by members of the Apparatus Committee.

Judges chosen for the competition will make awards in both entry divisions: (1) Pre-college (open to pre-college teachers only), and (2) College (pre-college teachers excluded). Award winners who are able to be present will be recognized at the evening demonstration program of the summer meeting. The following prizes will accompany awards given by the judges in each of the two divisions:

First prize - $300.00
Second prize - $200.00
Third prize - $100.00

At the discretion of the judges, all three awards are not necessarily given in each Division.

A short manuscript must be submitted when entering. The manuscript should include a brief account of the use of the apparatus and a description of the apparatus complete enough to enable others to duplicate the apparatus. It should be written with publication in mind and be preceded by a 100-200 word abstract. All manuscripts describing apparatus accepted for the competition will be published in an AAPT occasional publication and abstracts of the winning apparatus will be published in the AJP.

The deadline for entering the competition is April 1, 1982. Send application, complete with manuscript to the Competition Director: R.W. Peterson, Department of Physics, Bethel College, 3900 Bethel Drive, St. Paul, MN 55112. For further information, contact Ernie McFarland, Chairman, AAPT Apparatus Committee, Dept of Physics, University of Guelph, Guelph, N1G 2W1 (519-824-4120-ext 2261)

Star Gazing

STAR GAZING IN WINTER by Doug Cunningham

By mid-February at 9:00 PM one of the most striking and splendid constellations approaches the meridian. Orion, known variously as the Hunter, Giant, and Warrior, lies partly within the Milky Way and extends on both sides of the celestial equator thus affording visibility to all continents. It is not surprising then that many cultures have contributed to the mythology of Orion. Most renditions of this mythological figure's astirism picture him bravely facing the charge of Taurus the Bull, with a lion skin shield held high on one arm and a threatening, raised club in the other hand. Attached to his narrow waist belt is the nebulous gleam of his sword, while behind him, dutifully following, are his two dogs - represented by the additional Constellations of Canis Major and Canis Minor. The sword blade centres around the multiple star system, Theta Orionis, which, if you have access to a telescope of any aperture, will treat you to a celestial vista of such splendor that words sometimes fail to express the grandeur. The region around Theta Orionis is home to the Great Orion Nebula. This grand stellar nursery is some 1900 light years away, extends 30 light years in diameter and contains enough "star stuff" to produce 10,000 stars like our sun. This nebula of interstellar gas and dust shines by the green light of OIII fluorescence initiated by the UV radiation emanating from Theta and has delighted and inspired many astronomers. Consider the description of G.P. Serviss:

"...stars apparently completed, shining like gems just dropped from the hand of the polisher, and around them are masses, and eddies, and currents, and swirls of nebulous matter yet to be condensed, compacted, and constructed into suns."

In large amateur telescopes, the central regions of the nebula reveal a wealth of detail - Theta Orionis is resolved into 4 sparkling components (called the Trapezium) and the surrounding regions contain delicate streams, slender filaments, dynamic swirls and dark globules. In some instances, a slight hint of pink colour in addition to green is sensed. No wonder that Mary Proctor in her book "Evenings with the Stars" describes this nebula as

"Isles of light and silvery streams, and gloomy gulfs of mystic shade."

During these winter months, observers of the superior planets, Mars, Jupiter and Saturn will have to wait until late evening or early morning for their views of these planets. Mars will be found in the Constellation Virgo near 1 magnitude Spica; Jupiter will be found in the Constellation Libra, and Saturn will be found in Virgo, near Mars and Spica. The waning gibbous moon in its easterly journey about the earth will make close approaches to these planets resulting in a number of fine apparitions for those budding astrophotographers. There will be two major meteor showers of note - the best of these is the Quadrantid shower with 40 meteors per hour and they are best observed during the early morning hours of Sunday, January 3. The Lyrid shower lacks the strength of the Quadrantid, but the 15 meteors per hour are best observed after midnight on Thursday, April 22. Clear Skies and Good Observing!

JANUARY

Sun. Jan. 3	:	First quarter moon Quadrantid meteors (40 per hour, best observed during the early morning hours of Sunday)
Sat. Jan. 9	:	Mercury 5° S of Venus Full Moon (The Old Man)
Fri. Jan. 15	:	Mars 3°S of the moon
Sat. Jan. 16	:	Mercury at greatest eastern elongation Saturn 3°S of the moon Last quarter moon
Sun. Jan. 17	:	Jupiter 4°S of the moon
Mon. Jan. 25	:	New moon Partial eclipse of the sun visible from New Zealand

FEBRUARY

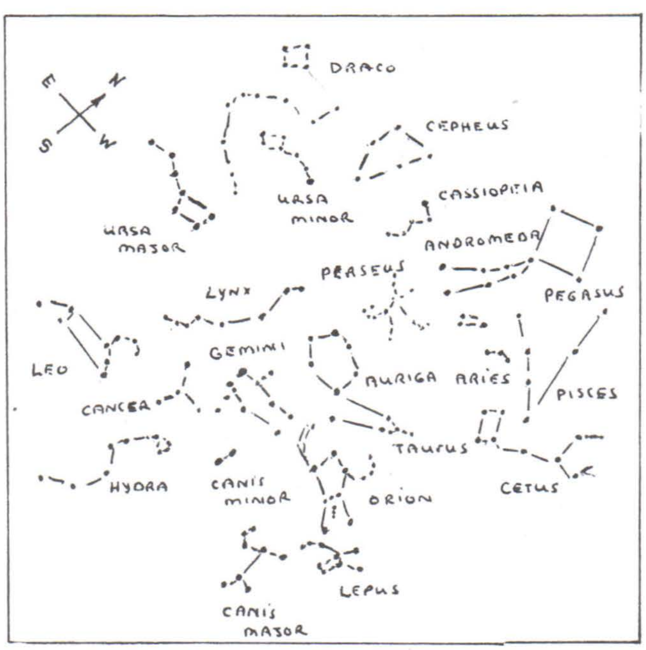
Mon. Feb. 1	:	First quarter moon
Mon. Feb. 8	:	Full moon (The Wolf Moon)
Fri. Feb. 12	:	Mars 2°S of the moon Saturn 3°S of the moon
Sun. Feb. 13	:	Jupiter 4°S of the moon
Mon. Feb. 15	:	Last quarter moon
Sat. Feb. 20	:	Venus 7°N of the moon
Sun. Feb. 21	:	Mercury 2°N of the moon
Tues. Feb. 23	:	New moon
Thur. Feb. 25	:	Venus at greatest brilliancy (-4.3°)
Fri. Feb. 26	:	Mercury at greatest western elongation

MARCH

Tues. Mar. 2	:	First quarter moon
Tues. Mar. 9	:	Full moon (The Sap Moon)
Thur. Mar. 11	:	Mars 2°S of the moon
Fri. Mar. 12	:	Saturn 3°S of the moon
Sat. Mar. 13	:	Jupiter 4°S of the moon
Wed. Mar. 17	:	Last quarter moon
Sat. Mar. 20	:	At 22^h 56^m U.T. spring begins - Vernal Equinox
Sun. Mar. 21	:	Venus 5°N of the moon
Wed. Mar. 24	:	Mercury 2°N of the moon
Thur. Mar. 25	:	New moon

APRIL

Thur. Apr. 1	:	First quarter moon Venus at greatest western elongation
Mon. Apr. 5	:	Mars at -1.0° makes its closest approach
Wed. Apr. 7	:	Mars 2°S of the moon
Thur. Apr. 8	:	Full moon (The Egg Moon) Saturn 2°S of the moon
Fri. Apr. 9	:	Jupiter 3°S of the moon
Fri. Apr. 16	:	Last quarter moon
Tues. Apr. 20	:	Venus 4°N of the moon
Thur. Apr. 22	:	Lyrid meteors (15 meteors per hour - best observed in the early morning hours of Thursday)
Fri. Apr. 23	:	New moon
Fri. Apr. 30	:	First quarter



The Constellations - Early February 9PM

Coming events

Eastern Ontario Science Council and STAO sponser a seminar on MICROCOMPUTERS IN SCIENCE EDUCATION
April 2 & 3, 1982. Cost is $25.00 including lunch and banquet.
Contact Peter Aci, Smith Falls District C.I., 2 Gould Street, Smith Falls, Ontario, L7A 2S5. Phone 613-283-0288.

University of Waterloo - Saturday Seminar
April 17, 10 AM to 4 PM at U of W.

TEACHING GENERAL LEVEL STUDENTS IN GRADES 11 & 12
A "how I do it" sharing session for biology, chemistry and physics. If you are willing to contribute, contact Reg Friesen at U of W, 416-885-1212, ext 2505. Registration inquiries should also be directed to Reg. Cost will be less than $10.00 including lunch.

Sir Issac Newton (SIN) Test
Thursday, May 6, 1982
Contact P.C. Eastman, Dept of Physics, University of Waterloo, Waterloo, Ontario, N2Z 3G1 or phone 519-885-1212,Ext 2237.

Ontario Section Meeting
JUNE 17-19, 1982, U of WO, London, Ontario
Abstract deadline: April 15, 1982

National Summer Meeting
JUNE 23-25, 1982, Ashland, Oregon
(Joint Meeting with Pacific Northwest Association of College Physics)
Abstract deadline: March 30, 1982

National Winter Meeting
JANUARY 24-27, 1983, New York City
Abstract deadline: October 20, 1982

National Summer Meeting
JUNE, 1983, Memphis, Tennessee
Abstract deadline: March 30, 1983

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Do not underestimate the eductional value of decorating a classroom with posters. High school teachers, and especially university teachers, think that this is for elementary schools only and that students will not learn unless the teacher teaches him. This is not so. Idle moments before, during and at the end of class can be of more value if the teacher has provided something of educational value to look at.

J. Weston Walsh has published many fine series of posters for physics teachers. The latest, GREAT PHYSICISTS, is the best of them all. The twelve posters illustrate physicists from Aristotle to Oppenheimer in caricature. Two colours are used on heavy, glossy white paper 28 cm x 35.6 cm. Five clues on each poster try to lead the student to the identity of the physicist. A large introduction suggests four different ways to use the poster series. There is an annotated list of referencs and an extensive answer key. Five supplementary questions are provided for use with each poster. All of these together make the poster set a complete and invaluable learning aid.

And now Professor X, you have exactly what you need to dress up that hallway display case.

Why Publish?

Educational journals are the life blood of the true professional. Here he finds the new directions that education is moving. Ideas are presented which he might adopt or they can generate a critical self-examination of his own teaching practice. The information shared in journals can reduce the duplication of effort that plagues our profession.

The educators who write for these journals are often classroom teachers just like you. They feel comfortable about sharing what they do in their classrooms with the rest of their profession. Their work reflects well on their board, their school, their profession and themselves. There is no doubt that publishing contributes much to a personal resume too.

For the physics teacher there are several journals in which to publish: The Crucible, The Physics Teacher, and Phys 13 News. Obtain a copy of the journal and then write for their "information for contributors". Tell them what your idea is and they will tell you if their journal is appropriate. What they send you will tell you how to prepare your submission in the correct format. It is usually quite an easy thing to do. Be sure to have your paper read by a colleague or two before you send it away.

If you have ever given a paper at an AAPT Conference or a STAO Conference, this might be the subject for your first publication. When you have done it once, it becomes quite easy. You could start by doing a review of a new text or other learning aid (which you often get to keep). Other ideas include equipment notes, favourite demonstrations, evaluation techniques, locally designed units, field trips, worksheets, puzzles, instructional designs, student projects and worksheets, motivators, interest grabbers, science club activities and so on.

Your product does not have to be perfect. Gauss did not publish many of his discoveries because he always wanted to polish them just a little more before showing them to his colleagues. He was only credited with a few discoveries as his own.

Your product does not need to be extensive. Short notes and descriptions are valuable.

Your product does not need a research background. It is not necessary to do deep researches of the literature for all possible past references. It only has to be something that works.

So stay an extra hour after school some day to write down something you do that might be of value to others. Share your professionalism with your colleagues.

OSC Science School

Ontario Science Centre Science School

This new school will offer enrichment science programs for grade 13 students. Enrollment will be limited to 25 students. In one semester, students will study chemisty, physics, biology and algebra. The Science Centre will be the classroom. All resources will be available. For information and application, contact Charles Cohen, OSC; phone 416-429-4100, ext 161.

Physics News in 82

This is a 120 page booklet edited by Phillip Schewe and distributed by AIP, 335 East 45th Street, NY, NY 10014. US $2.00 prepaid. This publication contains 63 articles on 11 major topics in physics.

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol III,No 3, May 1982
Editor: Gordon G. McKye

Ontario Section Annual Conference June 17–19, 1982

University of Western Ontario Campus, London, Ont

The 1982 Annual Conference of the AAPT Ontario Section is fast approaching. The conference this year will be from June 17-19 at the University of Western Ontario Campus in London, Ontario. Professor Dean Gaily of the Physics Department of U of W (also 1982-83 AAPT Ontario Vice-President) is handling the registration and arrangements on site. Current Vice-President (and 1982-83 AAPT Ontario President) George Kelly is the conference organizer. The conference will continue the very successful pattern of short consecutive papers with a mixture of invited guests and participants contributing. We are very pleased to have Professor Eric Rogers (of PSSC film fame - Coulomb's Law) with us to both bring the banquet address and present an additional paper. Professor Rogers is coming for the duration of the conference so you will have plenty of time to chat with him. In addition there will be other invited papers by Don Wood, John Vanderkooy and Brian Kaye. The complete program of the conference will be included in the regular mailing of this newsletter; however, if you do not get one, please write or phone George Kelly, Lester B. Pearson Collegiate Institute, 150 Tapscott Road, Agincourt, Ontario, M1B 2L2, 416-292-0101.

You will find background information on the invited guest speakers contained in this newsletter. We are counting on you to continue to support this annual meeting and make it the success it has been in the past.

Make plans today. Register by June 4, 1982

US Test Question Pool

Recently the national AAPT did a feasibility study concerned with the establishment of a national test question pool. The decision that resulted was positive. The pilot phase of this pool is in the area of introductory calculus based physics. If deemed successful, the project will expand into other areas.

A coordinator was recently appointed for this part of the project and, together with an advisory board, will conduct this first phase over a two-year period.

AAPT-Ontario is pleased and proud that one of our members, Doug Fox, participated in the original study and has further been appointed to the three-member advisory board overseeing the project.

AAPT Ontario Executive 81–82

President: Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3, 416-626-4360.

Past-President: Doug Fox, Belle River High School, Belle River, Ontario, N0R 1A0, 519-728-1212.

Vice-President: George Kelly, Lester B. Pearson Collegiate Institute, 150 Tapscott Road, Agincourt, Ontario, M1B 2L2, 416-292-0101.

Secretary-Treasurer: Doug Cunningham, Bruce Peninsula District High School, Lion's Head, Ontario, N0H 1W0, 519-793-3211.

Section Rep to National AAPT: Dean Gaily, Physics Department, University of Western Ontario, London, Ontario, N6A 3K7, 519-679-2568.

Member-at-Large: Syed Ziauddin, Physics Department, Laurentian University, Sudbury, Ontario, P3E 2C6.

Background information on conference speakers

Prof. Eric M. Rogers

Eric M. Rogers is Professor of Physics at Princeton University. He earned his degree in Physics and Mathematics at Cambridge University, where he worked under Lord Rutherford in the Cavendish Laboratory. Dr. Rogers has developed and taught Physics courses at Princeton for the last thirty plus years. For some years he was on the contributing staff of the Physical Science Study Committee, and more recently has been organizer for the Nuffield Foundation's O-Level Physics Teaching Project. In 1969 he was awarded the Oerstead Medal of the American Association of Physics Teachers, generally considered the highest award in the United States for contributions to the teaching of Physics. His enthusiasm for Physics is well demonstrated by his splendid work in the Coulomb's law and other films used in the Grade 13 P.S.S.C. Course. We feel we are greeting an old and valued friend when we welcome Dr.Rogers to our Conference. Dr. Rogers will speak at the banquet-barbecue on the topic "Examinations -- An Influence for Good or Evil in Our Physics Courses??".

Prof. Don Woods

In 1974 McMaster engineering school undertook a major task that would reveal the keys to how to teach creativity in problem solving. In 1974 Don Woods of the Department of Chemical Engineering became a student again. He enrolled as a freshman engineering student and attended all required lectures along with his classmates. He heard what they heard; he got together for two hours each week with about a dozen of his classmates who volunteered to show how they tried to solve their assignments. Don moved with this same group through the next three years doing the same thing each year. Since he and the others graduated, Don has presented workshops on his discoveries in Europe and the United States and has written widely on the subject. He now publishes a problem solving newsletter which has attained a circulation of over 600. He is one of the world's leading experts on this topic. We look forward to the presentation of his pre-conference, all-day workshop on CREATIVITY on June 17th at University of Western Ontario. Don will also present a paper during the conference itself.

Dr. Brian H. Kaye

Dr. Brian H. Kaye was educated in Great Britain at the University of London, obtaining his Ph.D. in Physics in 1962. He has worked on a wide range of industrial aspects of physics. In the period 1955-1959, he worked on the atomic bomb and travelled to Australia to take part in atomic bomb trials. From 1959 to 1962, he taught physics at Nottingham and District Technical College. During this period he worked closely with the drug industry to look at problems involving the physics of tablet making and the delivery of drugs to the body. He also worked on problems of coal mining and health physics. From 1963 to 1966, he worked at the IIT Research Institute at Chicago where his investigations in fineparticle science ranged, literally, from what makes dirt stick to a carpet to the problems of designing special paints for spacecraft.

He came to Laurentian in 1968 as a Professor of Physics and enjoys teaching optics, thermo dynamics and other branches of physics. He has been actively engaged in developing liberal science options for students with such courses as cybernetics communcations, industrial science and courses on his specialty - fineparticle science. He pioneered the use of television teaching and has published over one hundred research papers.

The topic of his conference presentation will be "Delightful Discoveries of Physics in Unexpected Places".

Prof. John Vanderkooy

John was brought up in Hamilton, Ontario, the family being involved in the market garden and greenhouse business. He graduated from McMaster University in 1962 with a BSc in Engineering Physics. He went on to complete both his MSc and his PhD at McMaster. John moved to Waterloo in 1970 joining the faculty of the University of Waterloo. His research was initially in basic solid state physics but has moved in recent years to electronics and audio systems. John has many publications in this field to his credit. Professor Vanderkooy currently is active in the use of modern computer assisted techniques to analyse and improve information and sound systems.

Reporting to you...

Winter meeting — 1982 San Francisco

Although dates are set far enough in advance to rule out the possibility that the coincidence was deliberate, AAPT and the American Physical Society certainly picked a wild time to have a meeting in San Francisco. Not only was the celebration of the Chinese New Year (the Year of the Dog) in full swing, but the San Francisco 49'ers won Super Bowl XVI on the Sunday preceding the meeting, setting off a crazy celebration that lasted most of the week! Although no event in the San Francisco Hilton produced hysteria approaching that which was present in the streets, participants agreed that the 1982 Winter Meeting program presented ample opportunities for professional growth and stimulation.

In looking back on the meeting to determine highlights, my first impression that remains vivid is the heightened cooperation of the AAPT and the APS. This judgment is confirmed by an examination of which sessions were most popular; almost without exception, they were jointly sponsored sessions. Three presentations by Nobel Laureates were particularly popular. Luis Alvarez' lecture on "Asteroids and Dinosaurs" and Arthur Schawlow's Address of the Retiring APS President were examples of great teaching as well as solid physics. Schawlow's "live" demonstrations of incoherent light and the Doppler shift were certainly memorable. I.I. Rabi's Response upon receiving the Oersted Medal provided a marvelous insight about events during the "golden age" of the development of modern physics, as well as a sobering assessment of the current state of scientific research.

Several AAPT sessions were well attended. These included:

- an invited session on research in physics education;
- a session on new developments in astronomy (jointly sponsored by the Astronomical Society of the Pacific);
- a session on research in physics education;
- a session on word processing for physics teachers.

As usual, a full spectrum of pre-meeting workshops were presented. Interest in the AAPT Microcomputer Workshop remained high, and several other workshops were equally well received. One other special event deserves mention: many registrants attended an evening open house at Frank Oppenheimer's extraordinary participatory science museum, The Exploratorium.

No description of a meeting in San Francisco would be complete without some mention of the cultural and culinary experiences provided. Every evening, groups of physicists could be seen organizing dining and theatre outings. Every subsequent morning groups could be found singing the praises of this Chinese restaurant or that French restaurant. The New York delegation even managed to find a nearby delicatessen every bit as good as those in the Big Apple!

Tim Ingoldsby

AAPT Ontario Executive 82—83

In response to the call for nominations issued in the last newsletter, only one person has been nominated for each position. As a result, the positions are filled by acclamation and the executive for 1982-83 will be as follows:

President: George Kelly, Lester B. Pearson Collegiate Institute, 150 Tapscott Road, Agincourt, Ontario, M1B 2L2, 416-292-0101.

Past-President: Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3, 416-626-4360.

Vice-President: Dean Gaily, Physics Department, University of Western Ontario, London, Ontario, N6A 3K7, 519-679-2568.

Secretary-Treasurer: John Hlynialuk, Wiarton District High School, Box 580, Wiarton, Ontario, N0H 2T0, 519-534-1900.

Section Rep to National AAPT: Neves Periera, Agincourt Collegiate Institute, 2621 Midland Avenue, Agincourt, Ontario, M1S 1R6, 416-293-4137

Member-at-Large: to be announced.

Change in section fees

As most of you know very well, the AAPT (Ontario) fee structure for the past three years has been nominal. The $1.00 fee has been token and the newsletter has been supported mainly by a small profit from the annual conference. With the dramatic increase in mailing costs, that nominal fee is unsatisfactory. There are other arguments for raising the fees as well. The matter has been considered by the executive. The proposal is to raise the fees to $3.00 for 1982-83 and to $5.00 for 1983-84. According to our constitution, this decision needs the support of the membership and I will therefore ask you to respond by mail to this recommendation. One word of explanation. You will notice on the enclosed conference registration, that the fee is already set at $3.00. We have also announced the $3.00 fee in the Grade 11 test information. This has been necessary because of timing and in order to remain solvent for 1982. If, for some reason, the fee increase is turned down, it will be the task of the general meeting (at the conference) to decide how to handle the situation. One way to look at the $3.00 charge is to consider it a $1.00 membership with a $2.00 levy for mailing costs. (Blame the government!!)

Will you please return this ballot (or a copy if you want to keep Doug's facinating Star Gazing column on the back of this page). Ballots should be mailed to arrive by June 1. Mail to Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3.

The AAPT (Ontario Section) fees should be raised to $3.00 for 1982-83 and to $5.00 for 1983-84.

○ Agree ○ Disagree

Star Gazing

STAR GAZING by Doug Cunningham

The time was 5:30 on a cold March 14th Sunday morning as I climbed over the fence separating our backyard from our neighbour's pasture. The whole world seemed asleep -- no car lights to define the distant county roads, even our neighbour's fox hounds were silent -- only a slight breeze coupled to the crunch of the ice crystals underfoot penetrated the still morning. F-om the middle of the pasture, I carefully scanned the eastern sky now bathed in the first light of dawn -- yes! -- there it was! -- tiny Mercury, almost lost in the morning twilight. As my gaze swept westward, the grand planetary alignment of 1982 unfolded -- brilliant Venus just west of Mercury, then the waning gibbous moon, Jupiter, Saturn and ruddy Mars formed a fine apparition in the southwest. With all the advance publicity generated by this planetary alignment, I wondered how many people would leave the warm comfort of their beds to make their own observations -- not many I expect.

The media interest in this alignment of the planets can be traced to a 1974 book, "The Jupiter Effect", written by John Gribben and Dr. Stephen Plagemann. On March 10th, 1982, all 9 planets plus 4 bright asteroids were contained within a heliocentric sector of 95° in extent. The authors suggested that the increased tidal distortion produced by this lining up of the planets in the same sector would raise solar tides and increase solar activity. The increased solar wind resulting from the increased solar activity would interact with the earth's magnetic field and affect the rate of the earth's rotation, triggering earthquakes and upsetting traditional weather patterns. However, in a worst case scenerio, L.C. Thompson in a September, 1981, article in Sky and Telescope magazine, calculated that the tidal forces resulting from the planetary alignment are insignificant and thus effectively debunked the Jupiter Effect Hypothesis.

Although March 10 has come and gone, and the predicted dire consequences have failed to materialize, the current planetary alignment is still a splendid celestial event and well worth more than a casual glance. Tiny M-rcury was the first planet to break the alignment as its swift orbital motion about the sun has carried it past the sun and into prominence in the western sky at sunset. However, during these spring months, Mars, Saturn and Jupiter will be prominent objects high in the southern sky at midnight and throughout the early morning hours. In addition, the moon, in its easterly journey about the earth, will make close approaches to these planets resulting in a number of fine apparitions. Those readers who have access to a telescope will enjoy splendid views of these planets -- from the ice caps of Mars, through the moons and surface features of Jupiter to the impressive rings of Saturn. Clear skies and good observing!

MAY

Tues.,	May 4	:	Mars 3°S of the moon Eta-Aquarid meteors (20 per hour, but moonlight will interfere)
Wed.,	May 5	:	Saturn 3°S of the moon
Thur.,	May 6	:	Jupiter 4°S of the moon
Sat.,	May 9	:	Mercury greatest eastern elongation
Tues.,	May 11	:	Neptune 0.3°S of the moon
Sun.,	May 16	:	Last quarter moon
Thur.,	May 20	:	Venus 3°N of the moon
Sun.,	May 23	:	New moon
Sat.,	May 29	:	First quarter moon
Mon.,	May 31	:	Mars 5°S of the moon

JUNE

Tues.,	Jne 1	:	Saturn 3°S of the moon
Wed.,	Jne 2	:	Jupiter 4°S of the moon
Sun.,	Jne 6	:	Full moon
Mon.,	Jne 14	:	Last quarter moon
Fri.,	Jne 18	:	Venus 2°N of the moon
Sun.,	Jne 20	:	Mercury 1°S of the moon (occultation visible from north of North America)
Mon.,	Jne 21	:	New moon Summer Solstice (summer begins at 17h 23m)
Sat.,	Jne 26	:	Mercury at greatest western elongation
Mon.,	Jne 28	:	First quarter moon Mars 6°S of the moon Saturn 3°S of the moon
Wed.,	Jne 30	:	Jupiter 4°S of the moon

JULY

Tues.,	Jly 6	:	Full moon (The Hay Moon) Lunar Eclipse - Visible in North America

NOTE:

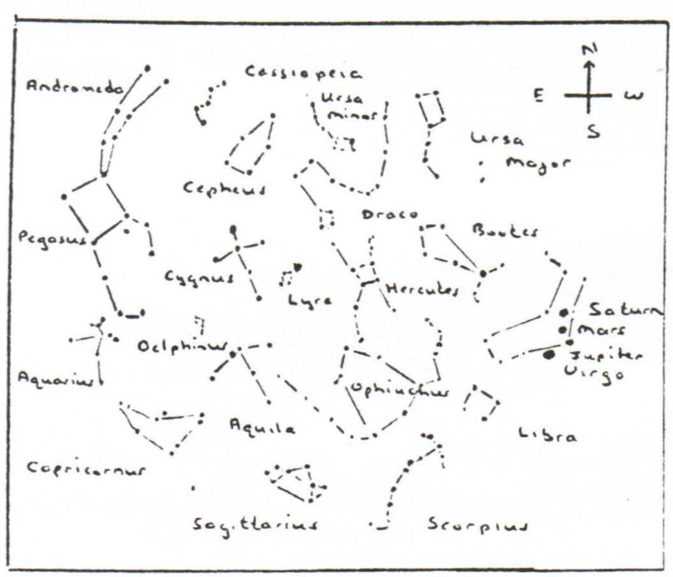
Moon enters penumbra	4h 22m UT
Moon enters umbra	5h 33m UT
Total eclipse begins	6h 38m UT
Middle of eclipse	7h 31m UT
Total eclipse ends	8h 24m UT
Moon leaves umbra	9h 29m UT
Moon leaves penumbra	10h 39m UT

Sat.,	Jly 10	:	Mars 3°S of Saturn
Wed.,	Jly 14	:	Last quarter moon
Sun.,	Jly 18	:	Venus 0.6°N of the moon
Tues.,	Jly 20	:	New moon
Mon.,	Jly 26	:	Saturn 3°S of the moon Mars 6°S of the moon
Tues.,	Jly 27	:	Jupiter 4°S of the moon First quarter moon
Wed.,	Jly 28	:	S. Aquarid meteors (20 per hour)

AUGUST

Wed.,	Aug 4	:	Full moon (Green Corn Moon)
Tues.,	Aug 10	:	Mars 2°S of Jupiter
Thurs.,	Aug 12	:	Last quarter moon Perseid Meteors (best observed before moonrise at midnight -- 50 per hour)
Tues.,	Aug 17	:	Venus 1.4°S of the moon
Thurs.,	Aug 19	:	New moon
Fri.,	Aug 20	:	Mercury 5°S of the moon
Sun.,	Aug 22	:	Saturn 3°S of the moon
Tues.,	Aug 24	:	Jupiter 4°S of the moon Mars 6°S of the moon
Thurs.,	Aug 26	:	First quarter moon

THE CONSTELLATIONS IN EARLY JULY



John from Herb

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

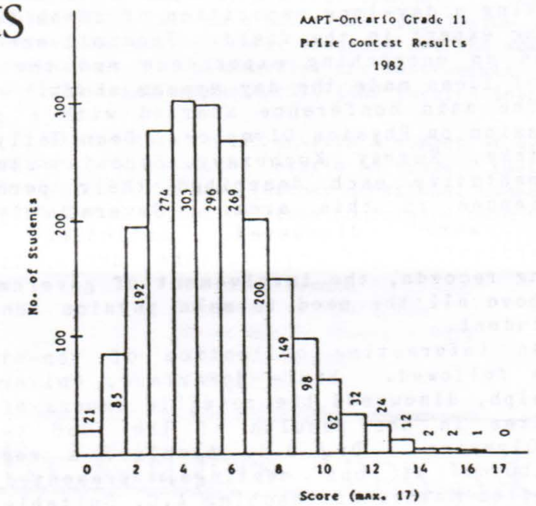
Vol IV No 1 Nov 1982

Editor: George F. Kelly

Grade 11 Physics Test Results

This year's Contest was written on May 4, 1982 by 2024 students in 184 schools. This is down a little from last year, probably due to the very necessary price increase. The same number of school participated as last year and the number of students scored was much closer to the number of papers ordered.

The average score was 5.3 out of 17. A histogram of the results is shown below. Processing was done in three almost equal batches. On the result sheets the rank is within the batch but the percent is almost constant from batch to batch with the same score.



A list of provincial winners is shown below. Our congratulations to them and to their teachers. Each student receives a TI-35 calculator and a special gold certificate. Funds for these are provided through the generosity of the physics departments of the following Ontario Universities:

University of Guelph
University of Waterloo
University of Windsor
University of W. Ontario
University of Ottawa
McMaster University
Trent University
Laurentian University
Carleton University
University of Toronto
Laurier University
Brock University

Their support of our endeavours is much appreciated. Please read this list of supporters to your classes.

The idea of the Contest was taken up and a very similar one was run in the Philadelphia area schools on May 18, 1982. The format was very similar to the Ontario Contest and used our bank of questions from the 1981 Contest. It was a successful venture according to James H. Nelson of Harriton High School, Rosemont, P.A. 19010, who ran the contest.

News of the Contest is spreading and we even had students write in Manitoba and British Columbia. We do not restrict ourselves to Ontario and welcome all students at this level to participate.

Next year's Contest will be written on Tuesday, May 3, 1983. We'll be back with changes. The Contest will have more questions, about twenty-five. The Computer Program has already been modified to reduce run time. Results should be in the schools by the end of May at least. Efforts are being made to eliminate the "batch effect" in the printed results.

Doug Fox.

Provincial Winners

Score	Student	School	Teacher
16	M.J. Gold	Malvern CI Toronto	W. Prior
15	T.D. Metzger	Elmira DSS Elmira	D. Ratz
	J.A. Coleman	Upper Canada College Toronto	R. Kuzniak
14	R.R. Ramlochan	Harrow HS Harrow	M. Klinck
	K. Rajagopal	Earl Haig SS Willowdale	G Bourchier
13	M. Baghai	Upper Canada College, Tor.	
	J. Carter	Malvern CI Toronto	
	R. Keates	Rideau DHS Elgin	R. Chahal
	J.A. Summers	Applewoood Heights SS Mississauga	F. Brown
	B.P. Kalicharan	Northern SS Toronto	B. Robb
	J.B. Vankay	Northern SS Toronto	
	B.P. Dickson	Frontenac SS Kingston	J. Young
	B. Brown	Lawrence Pk. CI Toronto	R. Saylor
	O.H. Hall	West Hill CI West Hill	D. Bosy
	J.F. Baumgartner	Woburn CI Scarb.	D. Bell
	G. Bell	Streetsville SS Mississauga	P. Swan
	I.D. Williamson	Colonel By SS Ottawa	W. Hall

1982 Conference Report

The Ontario Section held its Fourth Annual Conference at the University of Western Ontario in London, Ontario, on June 17, 18, and 19, 1982.

Professor Don Woods, chairman of the Department of Chemical Engineering, McMaster University, set the tone for the three-day conference in his pre-conference workshop on "Creativity and Problem Solving in the Classroom." About thirty-five registrants at this workshop turned from skeptics to converts following a day-long exposition of ideas from a leading expert in the field. From all accounts it was an encriching experience and the fast flow of ideas made the day appear short.

The main conference started with a panel discussion on Physics Olympics. Dean Gaily, Ed Gregotsky, Murray Kucherawy, and a student representative each described their personal experiences in this area. Several Olympic items were discussed including the standardization of rules, the necessity of keeping records, the involvement of government, and above all the need to make physics fun for the student.

An interesting collection of ten-minute papers followed. Ernie McFarland, University of Guelph, discussed the possible causes of the anomalies in the results of the 1968 Mexico City Olympics. Dr. D.S. Ainslie, a regular contributor at our meetings, presented "A Simplified Method of Teaching A.C. Suitable for High School Courses." Bill Prior addressed the problem of "The Use of Calculus in Grade 13 Physics"; besides providing enrichment, the author was convinced that this was the best way to teach calculus. By transforming his classroom into a photography studio four weeks out of a year. Rob Orrett showed how he uses "Photography as a Motivator" to teach a unit on optics to his general level students.

"Have Telescope, Will Travel" - with this innocent title, Steve Dodson practically stole the show. With his 22" reflector on a trailer behind his car he travelled 350 miles from North Bay to make this presentation and to set up his telescope for viewing the night before. Many got their first magnificent look at Jupiter and Saturn. Steve described his trials and joys in the construction of this telescope. "The motivation to build the instrument came from the AAPT Ontario Section meetings," he said, paying generous tribute to those present. Dr. Don Wood expanded on his pre-conference workshop in his invited paper on "Building Creativity in Our Students."

Short papers followed:
"A Lab Tutor called Superbrain," J. Law, F.R. Hallet and S. Bird, University of Guelph;
"Using computers in the Physics Lab," Alan Hirsch; "Method for Collecting and Analysing Data in Study of Normal Modes," P. Rochon and N. Gauthier of Royal Military College; and "Computer-Aided Testing in Freshman Physics Laboratories at U.W.O. - the Second Year," by Donald R. Hay.

The day ended with a banquet-barbecue at which Dr. Eric Rogers of Princeton University was the keynote speaker. About 83 attended the banquet and were well rewarded by Dr. Rogers' lively, humorous, and educational talk on "Examinations...A Powerful Influence for Good or Harm in Developing New Teaching." Dr. Rogers' enthusiasm and bounce were admired by all. He had enough energy after the banquet speech to conduct what he called a "shredder," a method, overtly at least, of producing good examination questions.

On the second day of the Conference we heard the amusing Dr. Brian Kaye of Laurentian University in his "Delightful Discoveries of Physics in Unexpected Places." Short papers that followed were: "Poetic Imagery in Astronomy," by Doug Cunningham; "Physics and Society," a unit by Dr. Eknath V. Marathe; "A Statics Unit for Grade 13," by Robert H. Squires; and "Milli-Microsecond Lab Timing with a Microcomputer," by Peter Spencer.

120 or so registrants went home after a most successful Conference. There were many memorable occasions and rarely a dull moment. It was also a time for renewing old friendships and for making new ones.

Our next meeting will be held on June 16, 17 and 18, 1983 at the University of Waterloo, Waterloo, Ontario, Canada.

F.N. Pereira, Section Representative.

Permanent Editor for Newsletter

The Newsletter needs a permanent editor!

Ever since Ernie McFarland sent out the first newsletter there have been different people edit this copy, one each year. While it is not onerous in itself (as long as the members generate articles for printing) there is a "breaking in" period each year for the new editor. He must learn to do many things which are completely new to him (her). I feel it is time to consolidate this operation under the direction of an interested (talented) member of our section. Look around in your area for someone you think might do this job, or maybe consider this yourself, as something that you would like to do! It has fallen to the President of the Section to make up, print, and send out this Newsletter hence there has not been a chance to develop much continuity (Doug Cunningham's Star Gazing column excepted) or even to present some editorial comment as each has had to learn his (her) job. I would be interested to hear from you about this proposal one way or the other so it can be presented to the annual meeting at our Conference in June at University of Waterloo. Send any correspondence to G. Kelly, Lester B. Pearson C.I., 150 Tapscott Road, Agincourt, Ontario, M1B 2L2.

Members only ? — Your executive has decided that we cannot continue to send Newsletters to non-members because of the increased cost for printing and postage!! Send your $3.00 membership fee to John Hylnialuk, Wiarton District High School, Box 580, Wiarton, Ont. N0H 2T0.

Ontario Assessment Instrument Pool. Physics

by Elgin Wolfe

It is about a year since the English version of the first package of the Ontario Assessment Instrument Pool: Physics containing 446 multiple choice instruments was distributed to schools and physics teachers throughout the Province of Ontario. The French translation is presently being distributed. Teachers have found the instruments challenging for students, valid to the curriculum and easy to use both for teaching and testing. However the Physics Pool is far from complete. Additional instruments are needed to assist teachers in evaluating the progress of students in different levels of programs toward the attainment of the numerous goals and objectives of physics. The Pool as it develops should include a variety of instruments: objective instruments, including short answer, true-false, matching, and multiple choice; subjective instruments, including numerical problems; situation incidents, including lab exercises; and ways of making the teacher's observations more objective, including checklists and rating scales.

With this in mind, the effort during the 1981-1982 year was devoted to preparing for screening in May of 1982 objective instruments suitable for use in evaluation at the grade 11 general and advanced levels. A total of 1240 multiple choice and true-false instruments were selected, edited, and organized into sixty-two different test booklets. Each booklet was screened by students in both general and advanced level programs with the intent that the resulting data would help the Subject Advisory Group judge the validity of each instrument for both target populations. The student data was processed using a computer in early June of 1982. The results from the computer, and the feedback instruments completed by teachers were used by a measurement and a subject specialist during the revision of the instruments. Recommendations were prepared for consideration by the Subject Advisory Group in the fall of 1982. The Subject Advisory Group considered 1296 instruments; 56 instruments were spinoffs from the original 1240 instruments. 1157 instruments survived for publication. During the period 1978-1980 the project also generated a sample of instruments other than multiple choice and alternate response. Matching exercises, completions, short answers, essay questions and problems have been edited and detailed marking schemes have been prepared. The Subject Advisory Group will validate these instruments at its next meeting. Plans are to send out to teachers early in 1983 a package containing well over 1300 subjective and objective instruments.

Several activities are planned for the 1982-1983 year. 540 multiple choice instruments suitable for grade 13 have been edited and organized into 18 test booklets for screening in January of 1983. Field trials of the published instruments will take place in May of 1983. Whereas the purpose of screening trials is to identify defective instruments before publication, the purpose of a field trial is to obtain statistics on a representative sample of published instruments so that teachers can be provided with performance values. These performance values will assist teachers to select instruments appropriate to a particular population and to make comparisons between their students and the sample of students used to standardize the instruments. Plans are to field trial approximately 1500 physics instruments.

I hope this report answers a number of questions that you may have about the Ontario Assessment Instrument Pool: Physics. If you have further questions, comments or suggestions, do not hesitate to forward them to

OAIP: Physics Project
Research Branch
Ministry of Education
Mowat Block, Queen's Park
Toronto, Ontario
M7A 1L2

Fee Changes Approved

In the May Newsletter was a ballot to be completed and returned to Gord Mckye regarding the proposed change to the Constitution pertaining to the yearly fee. In the business meeting at the June Conference Gord announced that the poll approved the fee change for the years 1982-83 (fee $3.00) and 1983-84 (fee $5.00). This change has been helpful in meeting our increased mailing and printing costs for the Newsletter and the Conference program. It is rewarding to see that our members are aware of extra costs and are doing something about them. G. Kelly.

AAPT Ontario Executive

President: George Kelly, Lester B. Pearson Collegiate Institute, 150 Tapscott Road, Agincourt, Ontario M1B 2L2, 416-292-0101.

Past President: Gordon McKye, Etobicoke Board of Education, 1 Civic Centre Court, Etobicoke, Ontario, M9C 2B3, 416-626-4360.

Vice President: Dean Gaily, Physics Department, University of Western Ontario, London, Ontario, N6A 3K7, 519-679-2568.

Secretary-Treasurer: John Hlynialuk, Wiarton, District High School, Box 580, Wiarton, Ontario, NOH 2TO, 519-534-1900.

Section Rep to National AAPT: Neves Periera, Agincourt Collegiate Institute, 2621 Midland Avenue, Agincourt, Ontario M1S 1R6 416-293-4137

Member-at-Large: Ken Woolner, Physics Department, University of Waterloo, Waterloo, Ontario, N2L 3G1

1983 Conference at Waterloo

EXECUTIVE CONFIRMS WATERLOO CONFERENCE DATES
JUNE 15, 16 and 17, 1983.

Last week-end your Executive confirmed the dates for the FIFTH ANNUAL CONFERENCE of the Ontario section of the AAPT. This Conference will be held in the 'exam weeks' of June 16th, 17th and 18th. The Conference will keep its traditional Friday-Saturday format with the possibility of a Workshop arranged for Thursday, June 15th. We are pleased that the University of Waterloo has agreed to host our Conference. Our Vice President, Dean Gaily, will be our Conference convenor for 1983. He can be contacted at the Physics Department, University of Western Ontario, London, Ontario N6A 3K7. - G. Kelly

Star Gazing by Doug Cunningham

The aroma of the bar-b-que mingled with the background chatter of our guests, while overhead, in the clear skies for which the Bruce Peninsula is famous, the full moon moved eastward toward an encounter with the earth's shadow. It was Monday night, July 5, 1982 and the drama of this lunar eclipse had been eagerly anticipated by amateur astronomers for some time. A combination of circumstances suggested that this eclipse would be unusual. Firstly, the fact that the path of the moon would take it through the central part of the umbra promised a dark eclipse; secondly, the recent March eruption of El Chichon in Southern Mexico had ejected considerable dust and ash high into the stratosphere and this promised not only a darker, redder eclipse, but the possibility of an asymmetric shading at totality; and finally, the opportunity to view a totally eclipsed moon against the grandeur of the Sagittarius star clouds of our Milky Way was an opportunity not to be missed. It was with these promises in mind that a number of friends and students gathered at our home for an eclipse party. We hadn't long to wait for the drama to unfold.

Although the first portion of the earth's shadow, the penumbra, produced little, if any, detectable shading of the moon, the notch produced by contact with the umbra at 5:32 UT was quite obvious - even without optical aids. As the eclipse progressed numerous Northern horizon stars made their appearance, defining constellation details and revealing some Messier objects. By mid-totality, at 7:31 UT, the eclipsed moon was splendidly framed against the star clouds of Sagittarius and the Milky Way was visible as a bright band connecting the Northern and Southern horizons. And what of the asymmetric shading -? We certainly were not disappointed. The moon's Northern hemisphere was coloured a dark grey with little detail visible in even the largest telescopes, and the Southern portion of the moon appeared a deep coppery red colour. The dust of El Chichon had made its impact by affecting the sunlight refracted by our atmosphere into the Northern half of the earth's shadow.

Through the telescope the eclipsed moon acquired a 3-D quality due to the many background stars sprinkled around the lunar limb. Physics teacher, John Hlynialuk of Shallow Lake, observing with his homemade 12 1/2" reflector, remarked on the "dynamic" quality of this eclipse. As the leading edge of the eastward moving eclipsed moon passed in front of the numerous background stars the sudden and dramatic stellar disappearances produced a show to rival the eclipse itself. Finally, at 8:24 UT, the moon, now low in the West, left the umbra with an event which paralleled the famous diamond ring effect of solar eclipses. Although the brightening of the eastern lunar limb lacked the brilliance and suddenness of the solar eclipse diamond ring, the phenomenon was impressive none the less. For this writer, and many other amateur astronomers, the lunar eclipse of July 6, 1982 was the best yet!

For those interested, hardy souls there will be another lunar eclipse in 1982 - one which can be observed in the cold early morning hours of December 30. This eclipse cannot be observed in its entirety from Ontario; however, the eclipse events leading up to the end of totality can be observed until approximately 7:30 am when moonset will occur. The details of this eclipse, are given along with other key celestial events, are given in the monthly summaries which follow. Clear skies and good observing!

<u>November</u>

Mon. Nov. 1	Mercury 0.7° S of Saturn Full Moon - "The Hunter's Moon"
Mon. Nov. 8	Last Quarter Moon
Sat. Nov. 13	Saturn 3° S of the Moon
Mon. Nov. 15	New Moon
Wed. Nov. 17	Leonid Meteors (15 Meteors per hour - best observed during the early morning hours of Nov. 17)
Fri. Nov. 19	Mars 0.5° S of the Moon
Tues. Nov. 23	First Quarter Moon

<u>Note</u>: Among the naked eye planets only Mercury, Saturn and Mars can be seen this month, but only with difficulty due to their proximity to the sun.

<u>December</u>

Wed. Dec. 1	Full Moon - "The Long Night Moon"
Tues. Dec. 7	Last Quarter Moon
Sat. Dec. 11	Saturn 3°S of the Moon
Mon. Dec. 13	Jupiter 2° S of the Moon
Tues. Dec. 14	Geminid Meteors (50 meteors per hour - best observed during the morning hours of Dec. 14)
Wed. Dec. 15	New Moon
Sun. Dec. 19	Mars 1.6° N of the Moon
Wed. Dec. 22	Winter solstice - winter begins 39 UT) (meteors per hour best observed in the morning hours of Dec. 22)
Thurs. Dec. 23	First Quarter Moon
Thurs. Dec. 30	Full Moon - Lunar Eclipse

<u>Lunar Eclipse Details</u>

Moon Enters Penumbra	8h 52m UT
" " Umbra	9h 50m UT
Total Eclipse Begins	10h 58m UT
Middle of Eclipse	11h 29m UT
Total Eclipse Ends	11h 59m UT
Moon Leaves Umbra	13h 07m UT
Moon Leaves Penumbra	14h 06m UT

Note: Moon Set 7:30 EST

Thurs. Dec. 30 Mercury at Greatest East Elongation

<u>Note</u>: Of the naked eye planets Saturn, Mars and Mercury can be seen easily - Mercury and Mars in the S.W. at sunset and Saturn in the east before sunrise. Toward the end of December, Jupiter can be glimpsed low in the south-east at sunrise.

American Association of Physics Teachers
ONTARIO SECTION

YOU ARE MISSING AND ARE MISSED!!

You are missing from our list of renewing members of the Ontario AAPT Section for 1982-83.

We are missing the very basis of our association- the concern and striving for excellence in teaching of Physics that characterize our membership... your membership.

We prize your support and concern for Physics education and miss it when it is withdrawn.

I can't believe you no longer hold to this concern. I rather believe you just need a reminder!!

Please pay membership fees of $3.00 for 1982-83!

FEE FOR 1982-83 IS ONLY $3.00!!!

Yes! That's right! Only $3.00 for so much!
For an association with Physics teachers who are striving for excellence in teaching Physics.
Which is providing a forum for interaction between Physics teachers in the Secondary, Community Colleges and University panel.
Which has presented the concerns of Physics teachers to provincial authorities.
Which arranges and runs the Grade 11 Physics Contest each year..
Which prints a Newsletter several times a year.
Which holds an annual Conference in June each year.

REJOIN the over 500 Physics teachers in this province associated with our Section, its Conference, its Grade 11 Physics Contest, and its Newsletter by sending in your membership fee ($3.00).

NEWSLETTER TO CEASE!!
We REGRET that we cannot continue to send out newsletters to non members since costs are too great. PLEASE attend to this at once.

FILL OUT the chart at the bottom of this page and send it to
Mr John Hylnialuk
Wiarton District High School,
Box 580, Wiarton, Ontario.
N0H 2T0

G Kelly - President 1982-83

Dear John:

I wish to rejoin the Ontario section of AAPT by sending you the yearly fee of $3.00.

yours truly

....
Your name and school

....
address please!

American Association of Physics Teachers
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G Kelly - President 1982-83

American Association of Physics Teachers

Ontario Section
FIFTH ANNUAL CONFERENCE

University of Waterloo

June 17 & 18, 1983

Program at a glance

Thursday, 16 June

8:00-12:00 Early registration and pre-conference Reception - Village 2 (cash bar).

Friday, 17 June

8;45-9:00 Registration in the Foyer of the Physics Building, University of Waterloo.

9;00-9;15 Opening remarks and welcome. Rm. 145 - Physics Building.

9:15-10:15 Roger H. Stuewer, School of Physics & Astronomy, Univ. of Minnesota "The Discovery of the Compton Effect".

10:15-11:00 Coffee, discussion & physics exhibits.

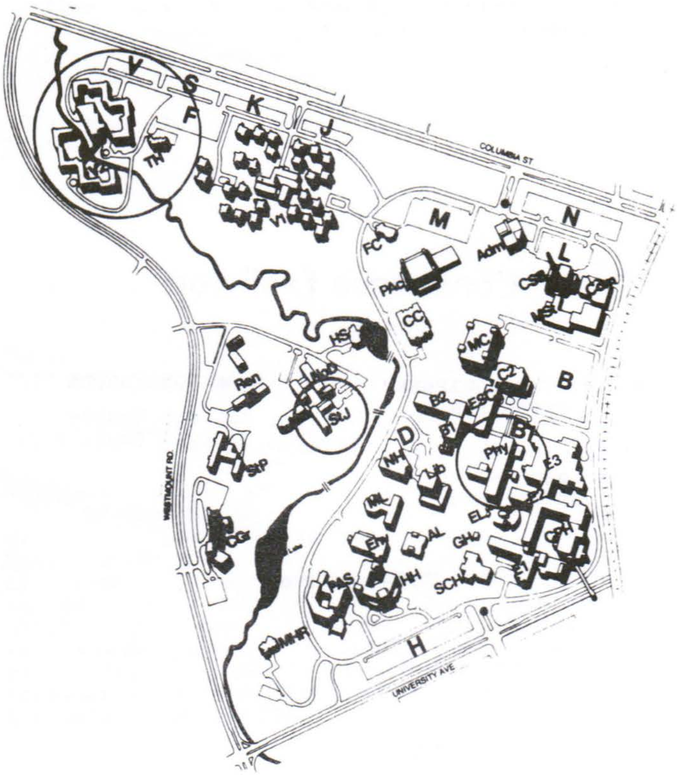
11:00-12:15 Contributed papers A1-A4.

12:15-2:00 Lunch in Village 2.

2:00-3:00 George Brenciaglia, Ontario Hydro, "Ontario Hydro's Nuclear Power Generation Program".

3:00-3:30 "New Developments in Physics Teaching at the Provincial, National and International Levels" - George Kelly.

3:30-4:15 Coffee, discussion & exhibits.



4:15-5:15 My Favourite Demonstration/Reviewing Physics Software for the Microcomputer, Neves Periera, George Kelly, Doug Abe.

5:30-6:30 Pre-Banquet Reception & Mixer (cash bar) St. Jerome's College.

6:30-8:00 Annual Conference Banquet

8:00-9:00 Conference Keynote Speaker, Mr. John J. McDermott, Dept. of Education, Commonwealth of Pennsylvania, "The Events at Three Mile Island and Their Effects Upon the American Public".

9:00-11:00 Informal Discussions & Reflections.

Saturday 18 June

9:00-10:15 Contributed Papers B1-B4.

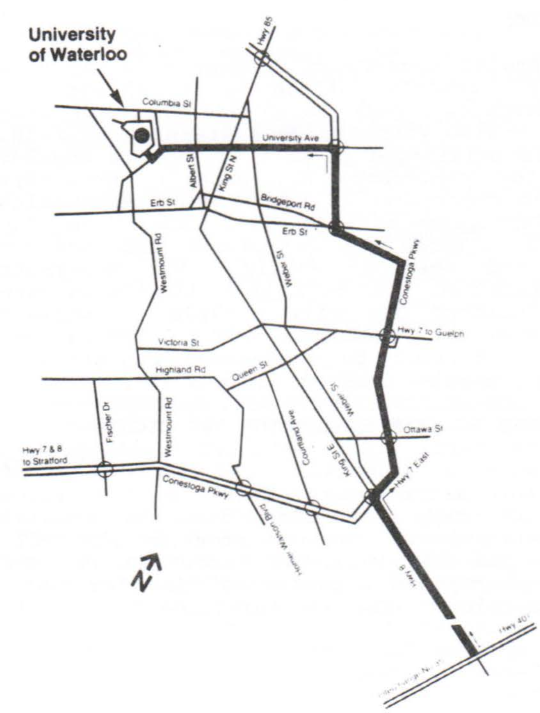
10:15-11:00 Coffee & discussion.

11:00-12:00 "A Decade and a Half of SIN", P. C. Eastman, Dept. of Physics, University of Waterloo. "Jobs for Physics Grads", J. Earnshaw, V.P. Admin. & Finance, Trent University.

12:00-1:45 Lunch

1:45-3:00 Contributed Papers C1-C4.

3:00-3:15 Conference Wrap-Up.



General Information

The Fifth Annual Conference of the Ontario Section of AAPT will be held on June 17 & 18, 1983, at the Department of Physics, University of Waterloo, Waterloo, Ontario.

EARLY REGISTRATION & PRE-CONFERENCE RECEPTION:

Registration for residence and the Conference will begin at 8:00 p.m. Thursday 16 June in Village 2 residence at the University of Waterloo. The annual pre-conference reception and good-time get-together will also take place in Village 2, commencing at 8:00 p.m. Registration facilities will close at 9:30 p.m., but the reception will proceed until midnight. Plan to check in on Thursday evening, meet your friends and get caught up on the latest news!

REGISTRATION

Conference registration for those not in residence (or those checking in on Friday) will take place in the foyer of the Physics Building at Waterloo beginning at 8:45 a.m. on Friday 17 June. Conference parking for residents is available in lots near Village 2. Commuter parking for non-residents is available for 50¢ per day. Confirmation will be sent to all registrants.

Please send your registration to Ken Woolner, Dept. of Physics, University of Waterloo, by June 1, 1983.

CONFERENCE MEALS

The package of accommodation plus meals is outlined on the registration form. For those commuting to the conference, meals are available. Meal tickets will be provided at registration.

BANQUET

The Annual Conference Banquet will be held at St. Jerome's College on Friday evening. A reception (cash bar) will be held from 5:30 - 6:30 with the meal starting at 6:30. We are privileged to have as keynote speaker for the conference Mr. John J. McDermott of the Department of Education, Commonwealth of Pennsylvania, who will speak on The Events at Three Mile Island and their Effects upon the American Public. Mr. McDermott was part of the team sent to investigate the incident and will provide a complete review of this monumental event. The banquet is not limited to conference registrants. Bring a guest! Banquet tickets $20.

COMPUTER PROGRAM EVALUATION AND EXCHANGE

Following a discussion and evaluation of available microcomputer software, facilities will be made available for the perusal and exchange of physics programs for PET, Apple and IBM microcomputers. Bring your best program on a protected disk (or tape) and a blank disk to participate in this activity.

Conference Features

-Pre-Conference **Reception**-Thursday evening.

-**Banquet Speaker**
John J. McDermott tells all about Three Mile Island & its Aftermath.

-Bring your **favourite demonstration** & microcomputer program and exchange with others.

-**Invited speakers**
Professor Phil Eastman-Waterloo-on "SIN"
Professor John Earnshaw-Trent-on Jobs for Physics Grads.
Professor Roger Stuewer-Minnesota-on the History of the Compton Effect.
Mr. George Brenciaglia-Ont.Hydro-on Nuclear Power Generation in Ontario.

Keynote Speaker

THE EVENTS AT THREE MILE ISLAND AND THEIR EFFECTS UPON THE AMERICAN PUBLIC

John J. McDermott, Dept. of Education, Commonwealth of Pennsylvania, 333 Market Street, Harrisburg, Pa. 17109

This is an hour-by-hour account of the worst nuclear accident to date. Mr. McDermott helped man the Pennsylvania Emergency Management Agency Command Post in Harrisburg during the accident. The accident is described in detail, and comparisons are made of the risks of generating electricity via nuclear power and other energy sources. Events since the accident will be discussed, and a videotape of the damaged core will be shown.

Conference Exhibitors

SCIENTIFIC EQUIPMENT SUPPLIERS

Merlan Scientific
Sargent-Welch Scientific

BOOK PUBLISHERS

Addison-Wesley
John Wiley & Sons, Inc.

"MORE TO COME"

Invited Speakers

THE DISCOVERY OF THE COMPTON EFFECT

Roger H. Stuewer, School of Physics and Astronomy, University of Minnesota, Minneapolis, Minnesota

The discovery of the Compton Effect by Arthur Holly Compton in late 1922 provided the first conclusive experimental proof for Einstein's light quantum hypothesis of 1905, and it was a key experiment leading to the creation of modern quantum mechanics in 1925-26. This lecture will first describe pertinent historical developments in physics between 1905-1916, before Compton received his Ph.D. degree, and will then trace in some detail the long and difficult route traveled by Compton between 1916 and 1922 which led him to his famous discovery.

ONTARIO HYDRO'S NUCLEAR POWER GENERATION PROGRAM

John Brenciaglia _ Mgr., Fuels & Physics Dept., Ontario Nuclear Services, Ontario Hydro.

A DECADE AND A HALF OF SIN

P. C. Eastman, Dept. of Physics, University of Waterloo

A short history of the Sir Isaac Newton Physics Test for the past fifteen years will be presented. Sample questions from selected SIN tests will be presented (some good, some bad and some undefined - including the seven deadly SINS!) Winners for 1983 will be announced, with discussion to follow.

JOBS FOR PHYSICS GRADUATES

John Earnshaw, Vice President, Administration & Finance, Trent University.

Many high school students have little knowledge of the career paths followed by Physics graduates. Data accumulated over fifteen years shows that there is a wide variety of careers in which a physics background is of use. Examples will be presented which challenges the myth that physics is useless compared to other fields. Evidence exists showing that there will be increasing demand for physicists during the balance of the '80s.

Session A

"FLUIDIZED BED" HEAT EXCHANGER PHENOMENON -A WINTER DRIVING HAZARD

Syed Ziauddin, Laurentian University, Sudbury, Ontario, P3E 2C6

Fluidized bed as a heat exchanger has greatly increased the efficiency of the extraction of energy from incinerators, for useful purposes. Winter driving conditions could suddenly produce a situation similar to a fluidized bed, which, with the same rapidity, fog up the windshield of a moving vehicle completely, thus creating a serious hazard.

SCIENCE TOURING THROUGH BRITAIN

Don Stephen, Barrie Central Collegiate, Barrie, Ontario

Places of scientific interest hold secrets about the scientists' personalities that are fascinating to both students and teachers alike. Some of these secrets are revealed in this slide-accompanied presentation about Newton's home at Woolsthorpe, Darwin's home at Downe and the Universities of Cambridge, Oxford and Manchester. Also, solutions to problems encountered in touring sites of scientific interest in Britain are discussed. Finally, the audience will be invited to exchange their favourite stories about science personalities or places of scientific interest throughout the world.

A SIMPLE SPEED OF LIGHT EXPERIMENT

Mats Selen, Innes K. MacKenzie, Dept. of Physics, University of Guelph, Guelph, Ontario, N1G 2W1

An intuitively simple experiment has been developed which measures the speed of 2.42 picometre photons (annihilation gamma rays), by timing their flight over a known distance. The experiment simultaneously tests Einstein's second postulate: that the speed of light is independent of the speed of the source. The data for determining "c" to within five percent of the accepted value can be acquired in less than one hour. This, together with the fact that data analysis is very straightforward, makes the experiment ideal for an undergraduate second year laboratory.

THE SEPTEMBER 1984 SCIENCE GUIDELINES

Brenda Molloy, Bayridge S.S., Kingston, Ontario

The Ministry of Education is rewriting the Science Guidelines from grade seven to grade thirteen (OAC). A nine-member Project Planning Team, under the direction of Jack Bell and Don Garratt, have been in session since November 1982. The process being used and some of the draft materials produced will be presented and discussed, with emphasis being placed on the Physics sections.

Session B

MEASURING THE SPEED OF ELECTRONS IN SOLIDS WITH MICROCURIE SOURCES -- A NEW UNDERGRADUATE EXPERIMENT

John Root and Innes K. MacKenzie, Dept. of Physics, University of Guelph, Guelph, Ontario, N1G 2W1

The systems normally used for measuring Compton profiles require the use of hazardous source strengths and long counting periods which are incompatible with undergraduate experiments. A new configuration permits the measurement of profiles of good statistical precision and high resolution with counting times of about 10 minutes while using gamma ray sources - 100 μ Ci. Examples will be chosen from metals (where the Fermi energies are usually obvious), commercial polymers and semiconductors. Sensitivity to crystal orientation will also be demonstrated.

THE USE OF "MX" NOTATION TO SIMPLIFY AND SOLVE PROBLEMS INVOLVING MANY VARIABLES

George Kelly, L. B. Pearson C. I., Scarborough, Ont.

The process of solving problems involving a variation can be greatly simplified by the recognition of the "mx" property of each variable. Using this "mx" utility, algebraic variations are simplified and generalizations are easily demonstrated. A special solution format that utilizes this property will be discussed with examples shown. By getting the student to think along "mx" lines we can effectively enhance their abilities for "formal thinking". This "utility" can become an effective part of a student's solution techniques with many applications across the field of Physics.

INTRODUCING THE PRINCIPLES OF PHYSICS TO ELEMENTARY STUDENTS

Doug Cunningham, Bruce Peninsula D.H.S., Lions Head, Ontario.

A program designed by senior science students which uses the idea of a Science Circus to present Physics principles to Elementary School students has been developed at Bruce Peninsula D.H.S. Results and overall impressions from the first version of this exciting idea for science teaching will be presented.

Session C

A REVIEW OF THE AAPT-ONTARIO GRADE 11 PRIZE EXAM

Doug Fox, Belle River D.H.S., Belle River, Ontario, N0R 1A0

The results of the 1983 AAPT-Ontario Grade 11 prize exam in physics will be presented. Some background on this increasingly popular physics exam will be covered and the future prospects and implications for the Ontario Section will be discussed.

EVALUATING PHYSICS SOFTWARE

Paul McHoull, Chairman, STAO MSC, 3149 Windwood Dr., Mississauga, Ontario, L5N 2K4

The criteria developed by the STAO Microcomputer Studies Committee for the evaluation of physics software will be described. Some experiences gained in evaluating public domain software for the Toronto Board of Education will also be related. Some examples of the best (and some of the worst!) programs will be displayed during the presentation. Several disks of physics programs for the PET microcomputer will be available for copying (all are public domain material). Evaluation forms for those persons willing to review computer programs for STAO will be available.

A LITTLE PUNK ROCK FOR YOUR GENERAL LEVELS

Bob Orrett, Cawthra Park S.S., 1305 Cawthra Road, Mississauga, Ontario, L5G 4L1

The teaching of sound, electricity and magnetism is often very abstract for general level students. It must be applied in some meaningful way. The study of stereo sound equipment not only works well as an application of physics, but seems to be a topic that teenagers are particularly keen to learn. The author will describe how he has used this idea to enhance a general level grade eleven physics program.

HALLEY'S COMET, LIGHT PRESSURE, AND THE LORENTZ FORCE

N. Gauthier and P. Rochon, Dept. of Physics, Royal Military College of Canada, Kingston, Ontario

Halley's comet will visit Earth again in 1986. This momentous occurrence fascinates people so much that every visit since the year 240 B.C. has been recorded in one form or another, the only exception being in 163 B.C. We must prepare our students for this unique scientific experience. The present paper discusses the effect of light pressure on the comet's tail. Kepler had originally conjectured, more than 364 years ago, in 1619, that sunlight causes comets' tails to generally point away from the sun. Maxwell's theory of light gives us a quantitative understanding of how this occurs. However, traditional presentations, being based on Maxwell's stress tensor, are too advanced for a late secondary or early undergraduate level. In this paper, we present an elementary proof that light exerts pressure in its direction of propagation. Newton's second law for an ion in an electric and a magnetic field is solved simply. The solution indicates that the ion drifts in the direction of propagation of the incident light and so explains why comets' tails point away from the sun.

AAPT (ONTARIO) ANNUAL MEETING - June 16-18/83

REGISTRATION FORM

Name: ______________________________

Home Address: ______________________________

Business Address: ______________________________

Home Phone: ______________ Business Phone: ______________

MEMBERSHIP RENEWAL

Membership in A.A.P.T. (Ontario Section) costs $5.00 per year (Still a Bargain!)

( ) I wish to renew my membership for the 1983-84 year

( ) I wish to become a member for the first time!

( ) I have already paid my $5.00 membership for 1983-84

CONFERENCE REGISTRATION

( ) 1 Day, AAPT-Ont. member $ 15.00 ( ) 1 Day, non member $20.00

( ) 2 Days, AAPT-Ont. member $ 20.00 ( ) 2 Days, non member $25.00

( ) I plan to contribute a demonstration in the session 'My Favourite Demonstration'

Title of my Demonstration ______________________________

ACCOMMODATION AND MEAL RESERVATION

Accommodation and meals will be at Village 2, University of Waterloo. Please prepay both accommodation and meals. Meal tickets will be provided when you arrive on campus.

Arrival at residence: Date: June ____ time: ____

Departure: Date: June ____ time: ____

ACCOMMODATION AND MEALS
(Breakfast and Lunch) Single room: $27.20 (for ____ nights = $____
Twin room: $23.00 (for ____ nights = $____

If you have requested twin accommodation, please give room-mates' name ______________

COMMUTER MEALS: (No overnight accommodation)

	Breakfast ($4.00)	Lunch ($5.00)	Banquet ($20.00)
Friday, June 17	______	______	______
Saturday, June 18	______	______	

TOTAL REGISTRATION FEES

Membership (1983-84)	$ 5.00
Conference registration	$
Accommodation and meals	$
TOTAL	$

NOTE:

DEADLINE FOR REGISTRATION IS

JUNE 1ST !

Please send a check or money order, payable to AAPT-ONTARIO, for the above total along with this registration form to: Prof. Ken Woolner, Department of Physics, University of Waterloo, Waterloo, Ontario. N2L 3G1

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol IV No 2 Jan 1983

Editor: George F. Kelly

AAPT-ONTARIO members on National Committees

Several members of AAPT Ontario have responsibilities in the national AAPT parent organization and at my request have taken the time to write of these activities. We commend them in their tasks and reaffirm our support of them and other National AAPT activities.

AAPT Apparatus Committee

Ernie McFarland

I've been on the AAPT Apparatus Comittee since Jan. 1981, and have been chairman of it since Jan. 1982 (my term as committee member and chairman both will run out in Jan. 1984).

The major goals of this committee are to encourage the development of apparatus which will aid the teaching of physics and to expedite the dissemination of information about such apparatus.

To achieve these goals, three main methods are used:
(a) biennial apparatus competition-- this competition, held in conjunction with an AAPT summer or winter meeting, offers substantial cash prizes to teachers who develop new apparatus, or who use existing apparatus in a new way.

(b) events sponsored at meetings-- the committee sponsors talks, etc., at AAPT meetings; for example, at the 1983 winter meeting in New York, the committee is sponsoring a three-hour demonstration extravaganza in which John Johnson (a committee member) and Bob Neff, two high school teachers, will present a "zillion" demonstrations useful in teaching physics.

(c) publications-- the committee offers support to the editor of the sections "Apparatus Notes" in the American Journal of Physics, and has a long involvement with the sections "Apparatus for Teaching Physics" and "String and Sticky-tape Experiments" in "The Physics Teacher". As well, the committee encourages people to publish articles or books related to apparatus.

As Chairman of the Apparatus Committee, I am automatically a member of the Programs Committee, which assists the Vice-President (Program Chairman) in setting up programs for the AAPT winter and summer meetings.

AAPT ONTARIO PHYSICS TEACHERS SADDENED BY DEATH OF PROF. DONALD S. AINSLIE, Ph.D.

Physics education in Ontario lost one of its formost supporters and entrepreneurs in the passing on December 14 of Dr. Donald S. AINSLIE in his 90th year. AAPT Ontario will feel the loss deeply as Prof. AINSLIE had been a regular contributor to its Conference sessions. His presentations were always well presented, well received and challenging. His thorough knowledge of the field of Physics, primarily electrostatics, was apparent to all who viewed his "home brew" apparatus that demonstrated electrostatic and other principles clearly and effectively. It is hoped to have a more descriptive resume of the work of Dr. Ainslie in a future newsletter.

AAPT Nominating Committee

Dean Gaily

Since June 1982 I have been serving on the nominating committee for national offices of AAPT. This important committee (5 members) has the responsiblity of bringing forward to the general membership nominees for vacant positions in the AAPT Executive.

In New York at the Winter meeting in January, 1983 nominations will be made for the office of Vice President, Treasurer and Member of the Executive board representing High School teachers. In addition, the committee will put forward one name for each of the 12 area committees of AAPT.

By being a part of the nominating process I am trying to include members of our section as potential nominees at all levels of the national organization.

This opportunity to let the rest of North America see how effective we are at the administration of our organization and its relation to all of physics teaching is a unique one and we should all consider participation.

If you or any of your colleagues are interested in serving in the administration of AAPT at any level, please contact me.(address elsewhere in this newsletter)
(Note: You must be a member of the national AAPT to be an officer - not just a member of AAPT Ontario.)

Here are the area committees: Apparatus; Physics in Two-Year Colleges; Computers in Physics Education; Professional Concerns; Instructional Media; Research in Physics Education; International Education; Science Education for the Public; Physics in the High Schools; Women in Physics; Physics in Minority Education; Physics in Higher Education.

AAPT Committee on International Education

Twice a year at the national meeting this area committee of AAPT meets and considers matters relating to Physics Education on an international level.

Because of budget limitations, visits by physics educators from abroad to national AAPT meetings are no longer funded through this committee but an emphasis on communication between physics educators in foriegn countries is now the main goal of the committee.
One of the most visible committee activities is the publication in the AAPT Announcer of details regarding forthcoming international meetings devoted to physics or science education.

The committee also supervises the distribution of the American Journal of Physics and The Physics Teacher to certain individuals and institutions in the underdeveloped third world countries. The committee is in the process of developing a limited directory of contact people who are active in physics education throughout the world.

This is one of twelve active area committees of the national AAPT organization, if you are interested in serving on such a committee or have a contribution to make to such an activity, please contact me.

T. Dean Gaily
Department of Physics
The University of Western Ontario
London, Ontario
N6A 3K7 (519-679-2568)

MICROS IN PHYSICS
by Nevis Pereira

As the availability of micro-computers becomes more and more widespread, the need to share ideas on the use of micros becomes more urgent.

Anyone who has had any experience with micros soon realizes that there is so much to learn. One of the better ways of doing this is to share your ideas with others.

This column is intended to serve such a purpose. If you discover or come across an idea, no matter how simple, that may be of use to a Physics teacher, please drop me a line and we will have it published in our newsletter. Please include your name, address and phone number.

To start the ball rolling here are two ideas from me.

IDEA 1

I have used the 'MECC' (Minnesota Educational Computing Consortium) program called 'nucsim' (Apple) in my Grade 12 Physics class as a lab experiment. It effectively demonstrates a practical method of finding the half-life of a radioactive isotope. The MECC program 'RADIOACTIVE' is a good simulation of the decay process and was effective as a demonstration program. - Neves Pereira Agincourt C.I. 2621 Midland Ave, Agincourt, Ont. 293-4137

IDEA 2

We have copied and improved upon a data reducing program we call 'Curve-fit' (Apple). We use this program in conjunction with all Grade 13 Labs. It will take an ordered set of data and fit them to a straight line using the least square method. The program then gives you the slope of the line and the sum of the squares of the deviations. Besides fitting Y vs X it will also handle Y vs $1/X$; Y vs X^2; Y vs $1/X^2$ and will graph the straight line. N Pereira and F Picard of Agincourt C.I. (see address above)

If you have been succesful in using the computer in your classroon, then Dr.Phil Eastman of the University of Waterloo is looking for you. One of the topics to be discussed at the Waterloo Saturday Science Seminar (April 23) is "Computers in the Classroom". Share your success with other teachers! Contact Phil at 519-885-1211-Ext-2237 or write to him care of the University of Waterloo Physics Department. (See coming events for address!)

CALL FOR PAPERS...

Now is the time to prepare your presentation for our annual June conference at University of Waterloo on Friday-Saturday June 17-18, 1983. The program consists of invited papers, contributed papers, and of course the popular "My Favourite Demonstration"!!

Organize your abstract for that particular topic or idea you do so well and share it with your colleagues as a presentation in the contributed paper section. If you have not given a paper and are uncertain about it, just indicate this when you send in your abstract and we will sent you a copy of an article from the Physics Teacher on "How to present a paper!!".

Send your abstract to:

Dr Dean Gaily,
Physics Department,
University of Western Ontario,
London, Ontario N6A 5K7

It is essential that you respond soon as the program must be prepared for early distribution. Thus the DEADLINE IS APRIL 8th for the submission of abstracts.

1982 CONFERENCE TREASURER'S REPORT
by John Hylnialuk

The financial status of AAPT-Ontario appears very solid now that the bills have been paid from last June's conference. A profit (including fees paid at the Conference) of $1582.09 was realized even though expenses which included accommodation, meals, printing, speakers, etc. reached a total of $6325.31. Last year's conference cost about half this amount-inflation strikes again.

There were 125 registrants at the conference with participants from Sudbury to Connecticut and Montreal to Alberta! All of the feedback we have received so far indicates that we are doing things right. If you missed this conference, you missed a good one!

Our present bank balance stands at $1679.03 with no outstanding bills exclusive of the Grade 11 Physics Contest which is self-supporting.

AAPT Ontario is developing ongoing projects consistent with the goals of our organization (see goals elswhere in the newsletter).

One of these involves setting up an archives of documents, photos, etc. relating to the history of AAPT Ontario. Doug Cunningham, who has been with the organization since its start, has agreed to handle this and is looking for suitable materials-especially photos from the past conferences to add to our collection. Hopefully some of these interesting items will be on display at our next conference at Waterloo, June 17-18.

If you can contribute any material for copying, please send it to

Doug Cunningham
P.O. Box 35
Lion's Head, Ontario
N0H 1W0

The aims of A.A.P.T. Ontario

To work to improve Physics education at all levels in Ontario.

To be the focal point for the sharing of information.

To bring together people with common interests.

To act as an agent for interface dialogue (high school/university, educators/public, educators/Ministry, etc.)

To promote the national resources that are available through AAPT: TPT, workshops, conferences, resource booklets, high school certificates, etc.

To aid the teacher in keeping abreast of current knowledge.

To expand the breadth of the teachers' knowledge in applications of physics to music, medicine, engineering, etc.

To work hard to remove the myth that physics is an impossible subject but instead show how it is related to everyday life.

To encourage our colleagues to publish their ideas, worksheets, projects, approaches, equiment, evaluation tools, etc. in appropriate journals.

AAPT ONTARIO NOMINATIONS

Nominations are requested for the following executive postions on the AAPT Ontario executive: Vice-President, Member-at-large presently held by Dean Gaily and Ken Woolner respectively. Any member of AAPT Ontario can make a nomination. Please send all nominations, by March 11th, to:

George Kelly
Lester B Pearson C.I.
150 Tapscott Rd.
Agincourt, Ontario M1B 2L2

NEW SCIENCE GUIDELINES

by George Kelly

Jack Bell and Don Garratt of the Ministry of Education have actively generated discussions and feedback on certain suggested changes to the existing Secondary Science program in the schools of Ontario (grades 7-13). The discussion papers which were distributed to small groups of Science teachers, have been circulated and responses (in writing) have been submitted.

While nothing is firm on this matter, Jack Bell outlined the expectations of the review committee for the future.

As a result of this first wave of responses, a framework for the Guideline will be proposed by about mid-February followed by further validation exercises across the province.

There will, of course, be continued sampling of opinion. Written submissions with input will be accepted throughout the remainder of the year. These well may alter the nature of the final presentation.

AAPT Ontario will be part of this ongoing analysis as it expects to participate in this evaluation process!

Here are some of the questions being posed related to the Grade 13 Program. As you will see these are important questions.

"It is proposed that revised courses in Biology,Chemistry and Physics be developed for Grade 13. Certain characteristics of such courses should be determined clearly in advance of their development."

a) While these are advanced-level courses, should they be more rigorous than present courses?

b) should there be greater specificity in stating what is taught?

c) Should the courses be more practical, that is, relate more to technology, engineering, medicine, etc., and contain references to more practical applications?

d) Must such courses be closely keyed to a "story-line"? Or can we create courses whose topics can be inter-related by "big ideas" or some other means to demonstrate coherency?

e) How should high technology influence Grade 13 courses? - - - Should some units(s) relate closely to computer usage?

f) Can we obtain the right kind of help from the universities to form "lists of enabling knowledge" to prepare students for University? This has been done in Chemistry. Should we do this?

g) What proportions should be core and optional?

h) Should the courses attempt to cater both to the University bound student and to the University-non-science-bound student? If so, how? Perhaps, by means of options?

i) How should preparation for entry into the CAATs influence the development of Grade 13 courses?

j) How should industry and business influence the development of senior science courses?

Your responses to the above question will interest Messers Bell and Garratt on the 17th floor of the Mowat Block,Queen's Park, Toronto, M7A 1L2.

Should you wish to respond through AAPT Ontario, please feel free to write to Geo Kelly, 150 Tapscott Road, Agincourt, Ontario, M1B 2L2

GRADE 11 PHYSICS PRIZE TEST

The Grade 11 Prize Test will be written on Tuesday, May 3rd, 1983. The procedure will be much the same as last year's contest. Mailings will be sent out to the High Schools by mid-February . Again Certificates will be given to the top two competitors in each school. Usually each school provides a prize for its top student. Last year the top 17 students were awarded a TI-35 calculator and a special gold certificate. We are grateful for the support of the Universities of Ontario who provide some of the funds. It is expected that the cost per entry will remain at one dollar. The only change is that the time period has been reduce to ONE HOUR.

If your school has not received your mailing by APRIL 1, then contact Doug Fox in Belle River at 519-728-1212 or write to him. (see coming events for address)

Free booklet available

George Kelly

From time to time complaints are heard that scientists are unable to communicate information about science in a way that is understandable by a lay person. Helping to dispel such complaints are the authors of a publication to be had by writing to Ernie McFarland at the University of Guelph.

The authors, Jim Hunt, a physicist, and Nigel Bunce, a chemist have been writing a weekly science column "The Science Corner", in the newspaper "The Guelph Daily Mercury", since 1977. The articles in this book are selections from their column.

This book contains articles which relate physics and chemistry to astronomy and earth sciences. The topics are varied, from the exotic ("Black Holes") to the mundane ("Structure of Coal"), and all provide an interesting look at science today.
The article about Haley's Comet is particularly interesting as it updates our understanding in preparation for the spectacle soon to grace our night sky.

The articles have proven to be immensely popular among interested elementary and secondary teachers and students, as well as among interested laypersons. This book is just the thing to stimulate projects and experiments at your school.

This book is free for the asking!

Send your request to:

E.L. McFarland
Coordinator of Student Relations
Department of Physics
University of Guelph
Ontario, Canada, N1G 2W1

Editorial Error Corrected

In the process of preparing the report from the Conference '82, I omitted a paragraph describing the sessions on the Saturday and especially describing the presentation by Dr. John Vanderkooy. I extend my apology to Dr. Vanderkooy and to Dr. Tom Stewart who chaired the "My Favourite Demonstration" session. Please find the "omitted" paragraph below!!

(continuing the description of day 2 of the conference)

Up and about again was Dr. Eric Rogers, who laced his seminar on "Why Not Explain by Demons" with personal anecdotes about Einstein, Rutherford, and Chadwick. Professor John Vanderkooy of University of Waterloo followed with "Using Computers in the Measurement and Design of Loud Speaker Systems." The Conference ended with the ever-popular "My Favourite Demonstration." We could have used double the time that was allotted to this item. Maybe next year. - (end) - G Kelly

STAR GAZING

by Doug Cunningham

The aperture revolution! Amateur astronomers have never had it so good. A glance through the many advertisements in Sky and Telescope magazine will reveal a variety of telescope designs and apertures that were unthinkable just 10 years ago. In the mid 1960's the standard size amateur telescope was the 6" Newtonian reflector.... rarely would one find an aperture of 8" and certainly a 12.5" aperture was something only dreamed about. Now one can purchase a 16" Newtonian reflector from Crown Optics for only $1185 U.S., and Coulter Optical offers a 29" Dobsonian style Nertonian reflector for about $3500 U.S. Why such an emphasis on telescope aperture? Quite simply, the telescope is a "light bucket".. the light gathering performance and resolving capability are determined by the aperture.

I remember a conversation with Roy Bishop, now editor of the RASC's Observer's Handbook, just after Coulter Optical had offered a 17.5" mirror for sale to the public. What would he do as an astronomer with such an aperture?... his reply.. to observe and sketch the faint detail in galaxies...detail that is often lost when photographers overexpose the central parts in order to reveal the detail in outer regions.

On August 3, 1764 Charles Messier described a nebula located near the belt of the constellation Andromeda under the unimposing title of M31.."..a spindle..it has a resemblance to two cones of light facing each other at their bases..". I experienced the thrill of working with a large aperture telescope a year ago when I observed that same nebula, now known as the Andromeda galaxy, through a 14" Celestron Schmidt-Cassegrain telescope. The galaxy was positioned near the meridian and the seeing conditions were excellent. The view was splendid..much brighter and crisper than that obtained with the 6" reflector...the detail visible included the bright nucleus, the companion galaxy M32 and M110, the spiral arms with two distinct dust lanes and the open cluster NGC 206 embedded in the south west part of the spiral arms. Encouraged by the detail visible and, with the aid of a finder chart published in the Nov. 1979 issue of Sky & Telescope, I continued my search for additional detail and was rewarded by the identification of a globular cluster in a galaxy that was 2.2 million light years distant. In my mind's eye I superimposed on this sight the view of the great globular cluster M13 in Hercules which is a mere 21 000 light years distant and took one more step towards appreciating the scale of the universe. It's too bad that Messier couldn't have seen this detail in his spindle shaped nebula that amateur astronomers now regularly observe with their large aperture telescopes.

A brief summary of the main celestial events occurring during the first four months of 1983 is given below. Of particular interest are the close approaches of the moon to the planets culminating in a daylight occulation of Jupiter on April 2.

Clear skies and good observing!

JANUARY - Sat. 22nd: First quarter moon.
Fri. 28th: Full moon.

FEBRUARY- Thu. 3rd: Saturn 2 degrees South of the moon.
Fri. 4th: Last quarter moon.
Sun. 6th: Jupiter 1.5 deg. South of the moon.
Tues. 8th: Mercury at greatest West Elongation.
Thu. 10th: Mercury 2 deg North of the moon.
Sun. 13th: New Moon.
Tue. 15th: Venus 4 deg,Mars 5 deg North of the Moon.
Thu. 17th: Jupiter 0.8 deg North of Uranus.
Fri. 18th: Venus 0.5 deg South of Mars.
Sun. 20th: First quarter Moon.
Sun. 27th: Full Moon.

MARCH - Thu. 3rd: Saturn 1.7 deg South of the Moon.
Sun. 6th: Jupiter 1 deg South of the last quarter moon.
Mon. 14th: New moon.
Wed. 16th: Mars 5 deg North of the Moon.
Thu. 17th: Venus 5 deg North of the Moon.
Mon. 14th: Vernal Equinox..Spring begins.
Tue. 22nd: First Quarter Moon.
Mon. 28th: Full Moon.
Wed. 30th: Saturn 1.5 deg South of the Moon.

APRIL - Sat. 2nd: Occultation of Jupiter by the moon, visible from North America at 8:00 Universal Time.
Tue. 5th: Last Quarter Moon.
Sat. 9th: Mercury 1.4 deg North of Mars.
Wed. 13th: New Moon.
Wed. 20th: First quarter moon.
Thu. 21st: Mercury at Greatest Eastern Elongation.
Fri. 23rd: Lyrid Meteor Shower (15 meteors per hour best observed during the early morning hours of the 23rd).
Tue. 26th: Saturn 1.6 deg South of the moon.
Wed. 27th: Full Moon.
Fri. 29th: Jupiter 0.6 deg South of the moon.

IMPORTANT DATES COMING UP!

Univ.Guelph open Science Seminar
Tuesday Feb 15that 4.0 p.m.
"Canada in Space"by Brian Fuller of
Spar Aerospace (canadarm fame!)
Physics Science Bldg. Rm 113
University of Guelph

Waterloo Saturday Seminar
April 23, 1983 both a.m. and p.m.
Topics: Glass blowing;mineral foundations;
DNA ; Computers in Classes
for more info contact Phil Eastman or
Jerry Toogood at Waterloo

Grade 11 Prize Contest
Tuesday May 3rd, 1983
For info contact Doug Fox, Belle River District High School,
Belle River, Ontario N0R 1A0.

Sir Isaac Newton (SIN) Test
Thurday May 5th, 1983
For info contact P.C.Eastman, Dept. of Physics,
Univ. of Waterloo, Waterloo, Ontario N2Z 3G1.

National AAPT SUMMER MEETING
June 15-17, 1983.
Memphis Tennessee
Abstract deadline: March 20, 1983.

AAPT ONTARIO Section meeting
June 17-18, 1983, at Univ. of Waterloo,Waterloo, Ontario N2Z 3G1.
Abstract Deadline: April 8th
Send to Dean Gaily, Physics Dept. Univ. of Western Ontario,
London, Ont. N6A 3K7.

PHYSICS for TEACHERS
June 27th to July 8th
Short course on Physics Demonstrrations and outdoor activities.
at the Royal Military College in Kingston, Ontario
for info contact Geo. Vanderkuur at
The Ontario Science Centre 770 Don Mills,
Ontario M3C 1T3

S.T.A.O.Region 7 & 8 (Toronto and Area)
Computer Conference
November 5, 1983
At Upper Canada College.

Event of the decade!!

National AAPT WINTER CONFERENCE
JANUARY 1985 AT
ROYAL YORK HOTEL, TORONTO!

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol IV No 3 April 1983

Editor: George F. Kelly

F.O.S.T.E.R. ONTARIO

(Friends of Science, Technology, Engineering and Research)

by Mrs. Gerald DesRoches of F.O.S.T.E.R. ONTARIO

Science's link with the Public

Foster Ontario is a non-profit society dedicated to the advancement of science. It was begun at the urging of Canadian scientists, engineers, doctors and businessmen just two years ago. Dr. J. Tuzo Wilson, Director General of the Ontario Science Centre, began to plan such a society.

To date there are twenty branches throughout Ontario with interest spreading throughout Canada. The Toronto branch is closely affiliated with the Science Centre and enjoys the benefits of being able to use the facilities of the Centre. The outlying branches have had volunteer staff members bring programs to them on request. An Ontario program committee has been formed to assist the branches with their functions.

Some of the programs so far have included popular talks, film series (in particular, the series from British Columbia called "Connections" on the development of technology), "Physics is Fun" demonstrations, "Astronomy in Your Own Back Yard" (by Doug Cunningham of Ontario A.A.P.T. - ed.), a Vegetarian film and feast, a study of claims to the paranormal called "Extra-Sensory Deception", Plate Tectonics and Continental Drift, and preparations for Saturday morning classes for young children.

All the members of the Ontario Board and all the area Convenors are volunteers. Membership is restricted to individuals and costs to members are low (Adult membership is \$10.00 and student membership is \$5.00). Members receive a monthly copy of Newscience--the Ontario Science Centre's publication--and a F.O.S.T.E.R. newsletter edited by Marg Maher, a staff member of the Centre. The newsletter contains:
- a regular feature by Dr. Wilson called "Canadian Innovators"
- news from the branches
- news from schools, universities, engineering, medical, technical and scientific societies in and around Ontario
- notices of lecture, open houses, courses and any happenings related to science, tchnology, engineering and research

Many programs are free or are of special cost to F.O.S.T.E.R. members.

Applications for membership:

Cheques should be made payable to F.O.S.T.E.R. ONTARIO and mailed to

Dr. J. Tuzo Wilson,
Director General,
Ontario Science Centre,
770 Don Mills Road,
Don Mills, Ontario,
M3C 1T3

Include your name, address, telephone number and postal code (Students should give the name of their school, college of university).

In MEMORIUM

Prof. Donald S. Ainslie, PH.D.

Donald Ainslie was in his 90th year when he died. He was born near Windsor in a small town called Comber. After finishing high school in Leamington, he attended University of Toronto, graduating in about 1915.

He put his Physics knowledge to work almost immediately, travelling to Great Britain to help in the installation of underwater harbour defenses at ports around England and Scotland during World War I. While working at Dunure Scotland he met his future wife, Dorothy, whom he would marry about ten years later in 1927.

After the war he worked on his doctorate at the University of Saskatchewan. His teaching then took him to the University of Western Ontario from about 1927 to 1929, and then to the University of Toronto until the Second World War.

In World War II he travelled to Halifax where again he helped with naval defense and underwater mine detection.

After the War it was back to the University of Toronto until retirement at 65. Toronto's mandatory retirement could not stop a man of his energies and he worked for five more years at the expanding University of Windsor.

For the next twenty years of his life he remained active, continuing with experiments in the lab at his home, helping with Science clubs in public school, prolifically writing articles for science and Physics digests, and of course, looking forward to his annual pilgrimage to the A.A.P.T. Ontario Conference.

We of the Ontario A.A.P.T. will miss Donald Ainslie. We are consoled by the certainty that his love for Physics and his scholarship has been passed on to the many Physics students who were privileged to have been taught by him.

We thank David Ainslie, a Physics teacher at St Mary's District Collegiate and a nephew of Dr. Ainslie for the above information.

Mrs. Jackie Shaw, Head of Physics at Branksome Hall in Toronto writes to tell us that Dr. Ainslie has willed all of his Physics experiments and papers to the Physics department at Branksome Hall. His daughter, Mrs. Margaret Tuer, is a mathematics teacher there.

F.O.S.T.E.R. Ontario branches are located in Burk's Falls, Deep River- Pembroke, Guelph, Kapuskasing, Kingston, London, Niagara-St. Catherines, North Burlington, Ottawa, Peterborough,Sarnia, Sault St. Marie, Sudbury, Thunder Bay, Toronto, Waterloo-Cambridge and Windsor. If you wish to contact any of the convenors in your area, address your request to:

Mrs. Gerald Desroches.
288 Indian Valley Trail,
Mississauga, Ontario,
L5G 2K8.

Ed note: We commend to our membership this worthy organization whose aims are consistent with those of the A.A.P.T.

Analysis of an Experiment by G Kelly

This P.S.S.C. Experiment is usually the first experiment that the new grade 13 students in Physics undertake. The pre-experiment demonstration of the graphical techniques used in this experiment tend to "give away" the relationships between the height, the time and the diameter of the hole emptying the cylinder.

I now use other data in my "demo" that will do the same thing without giving away the relationships mentioned above.

A sonometer (wire stretched over a sounding box) will generate sound frequencies (f) that are dependent on
(i) the length of the string (l)
(ii) the tension (force) of the string (F)

Keeping all other variable constant (material, cross-sectional area, density,etc.) I have used the following data to demonstrate to my students the power of the graphical techniques to determine variable relationships. By using a program that I have generated on my Apple II, I have been able to demonstrate quickly the graphs (curved) of this data and manipulate this same data to give straight line graphs.

TABLE OF FREQUENCY OF THE GENERATED SOUND

		TENSION IN WIRE in Newtons			
	Force	50	64	80	100
Length					
	100 I	181	205	229	256
in	80 I	226	256	286	320
cm	60 I	301	380	380	425
	40 I	453	512	572	640
	20 I	905	1024	1145	1280

AAPT Ontario Section

MEMBERSHIP RENEWALS AND NEW MEMBERSHIPS 1983-84

There are three ways to renew your membership in A.A.P.T.Ontario for 1983-84.

(i) You may have already renewed when you ordered your Grade 11 Physics Contest papers'

(ii)You may wish to renew when you register for the Annual June Conference (see program)

(iii) Or you renew by completing the form below and send it along with the membership fee of $5.00 (cheques payable to A.A.P.T.Ontario) to
John Hlynialuk, Wiarton District High School,
Wiarton Ontario, N0H 2T0

Name ....

School (University)..

Address..

City.....................................Prov........................

Postal Code.................................. Renewal O New member O

A.A.P.T.Ontario meets with MINISTRY

by George Kelly

On Saturday morning, April 16th at Lester B Pearson C.I. in Scarborough, eleven A.A.P.T. Ontario members met with Jack Bell and Jim McTavish of the Ministry of Education to provide some input to the on going curriculum review.

Discussions were lively and frank dealing with issues crucial to Physics Education in Ontario. It was generally agreed that the meeting was a worthwhile venture, a beginning for A.A.P.T.Ontario-Ministry dialog.

When NOT to use a Micro in Physics

by P. T. Spencer,Stephen Leacock C.I.
2450 Birchmount Road,
Agincourt, Ontario M1T 2M5

Although we do not use the P.S.S.C. text in our Grade 13 Physics classes here at Leacock, we still use the P.S.S.C. Lab Guide (fifth Edition).

We start the course with Appendices 1 and 2 from the Lab Guide. Appendix 2 introduces the student to graphic techniques of obtaining equations from data, including a brief mention of the utility of using log-log plots to find power laws.

"But how do you know which is the best straight line?" we are asked many times. At this point we suggest they do a least squares linear fit (linear regression). This does not present much of a problem as many of our students have calculators that will do this automatically, and some others have taken the Grade 12 Computer Science course in which linear regression is taught.

Now, what about non-linear relations, such as, inverse and inverse square? How do they do those on as calculator? Don't they need a microcomputer now? No!!! Any power law can be handled on a calculator with linear regression. All you have to do is to take the logarithm of both co-ordinates of each point and enter that into the linear regression. The slope is then the power, whether positive, negative (inverse), and/or fractional, and the antilog of the intercept is the multiplicative constant. This simple technique can be used by any student with a multi function calculator, and can be used during tests and quizzes too! (Something you can't do with your micro!)

The P.S.S.C.Lab Guide continually askes questions such as "How closely do they agree?". We discourage, via marks, vague answers as we expect our students to provide quantitative answers such as percentage difference, percentage error, and so on.

What then do we do about Experiment #6, Centripetal Force, where in the fifth edition the students are told: "You can calculate the value of FT^2 from your table and see how close they are to their mean value". In this case we tell our students to calculate some measure of central tendency, such as standard deviation. Standard deviation functions are very common on calculators nowdays. We elicit from students that a good measure of how close data is to their mean is something like the classical deviation, namely

$$\frac{\sum_{i=1}^{n} |x_i - \bar{x}|}{n}$$

, and then tell them that the standard deviation that the calculators have is the same thing, only slightly camoflaged, namely

$$\sigma_n = \sqrt{\frac{\sum_{i=1}^{n} |x_i - \bar{x}|^2}{n}}$$

If they enter two numbers, say 10 and 20, their calculators give $\bar{x}$ = 15, and σ_n = 5, both in accordance with their intuitive notions of "average", and "average difference from the average".(Note that the σ_{n-1} button gives a result not in accordance with the intuitive notion of what standard deviation should be.)

In short then, if you are using a microcomputer to help your students do graphing, curve fitting, or data reduction, please reconsider - your students may already be better equipped to do these things than you thought.

BOOK REVIEW: : by Doug Cunningham

Why Experiments ?
Why Statistics ?

by W Hines, H. Lachmansingh, D. Miller
available from
U of Guelph Bookstore cost $4.50

Perhaps the best vehicle for realizing the aims of any science program is the "science project". Students are encouraged to work on a problem in an area of science that interests them... problems usually requiring both library and laboratory research. In my own experience the essential ingredient for a successful project is the interest and enthusiasm of the student. Another ingredient of importance is the interested attention of the teacher... to provide encouragement when the difficulties seem overwhelming and, equally important, to serve as a sounding board as the student plans his (her) research. Typical problems encountered during the planning and execution of the experimental work involve knowing what to measure and how to measure it, distinguishing between comtrols and controlled variables, coping with differences in ages or environmental conditions, and learning from experiments that fail. In this area of experimental design good resource material has been hard to find....that is, until this book "Why Experiments? Why Statistics?" was written by Hines, Lachmansingh, and Miller. Although the purpose of the book is to serve as a guide for students embarking on the adventure of a science project, many educators will also find the information helpful.

In spite of the title the authors have chosen to emphasize good experimental design and sound experimental practises and deliberately refrained from an advanced treatment of statistics. Their concerns center around experimental variability, the importance of planning in experiments, the need for controls, and the role of the blind experiment.

It is not surprising then to find the main body of the book organized into chapters with headings which reflect the experimental process....ie designing experiments, performing experiments, summarizing observations, writing reports, and reaching a conclusion. Each of these chapters follows a question and answer format that is effective in conveying the main ideas. In the section on summarizing observations, the authors have used 5 examples from the life sciences to illustrate the basic organizing of data, the tabulating and graphing of experimental results, and the descriptive statistical summary. They indicate that other statistical summaries are possible but beyond the scope of their book.

The authors have added three appendices -: appendix A is a summary of steps to be followed in experiments; appendix B contains a list of 26 biological topics for science fair experiments; and most important, appendix C contains reports of two experiments along with valuable criticisms. These comments and criticisms are quite instructive.

In summary this softcover book is very readable, well organized, amply supplied with examples and would be a valuable addition to the science library of any school.. I would recommend this book as required reading for any students and their teachers involved in science project work.

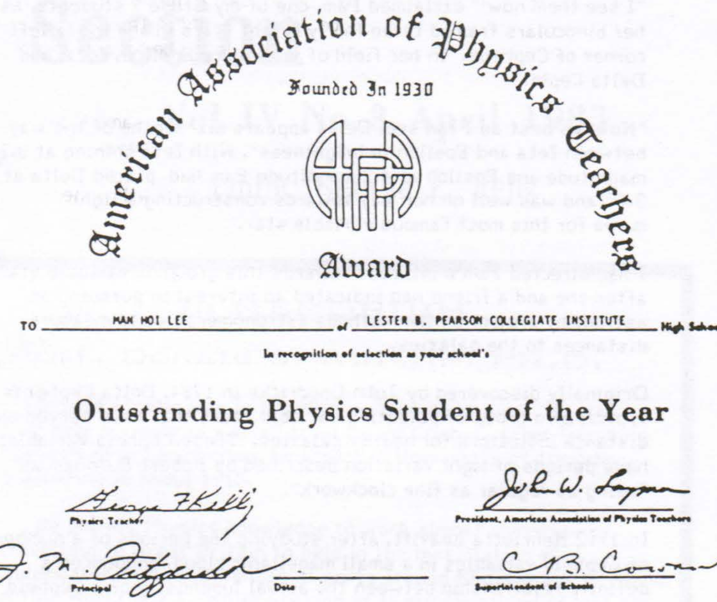
AAPT Ontario members author Articles for "PHYSICS TEACHER"

by George Kelly

The April edition of "The Physics Teacher" contains articles by three members of AAPT Ontario. Congratulations are extended to Doug Cunningham and John Hlynialuk for their lead article on "Grazing Occultations". It is really a great article. I'm glad that the fine talent we have in AAPT Ontario can be shared with other Physics teachers.

Doug Fox also has a good article (page 251) on "Teacher's Pets: Programmed experiences in classical mechanics". We again commend these members on this recognition.

AAPT AWARD CERTIFICATES free!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The following questions are asked to help the Committee collect data on the physics programs in the schools giving these awards. We will be pleased to send you the certificate upon receipt of this completed form.

Number of General Grade 11 Physics classes....................

Number of Advanced Grade 11 Physics classes ....

Number of Physics teachers. ....

Av. No. students per class ....

Number of grade 13 Physics graduates ....

Are you a member of (national) AAPT?(Y/N).................
(NOT NECESSARY for requesting certificates.)

Send your request to:

HIGH SCHOOL CERTIFICATES,
American Association of Physics Teachers,
Graduate Physics Building,
SUNY at Stony Brook,
NY 11794, U.S.A.

STAR GAZING
by Doug Cunningham

"I see them now!" exclaimed Pam, one of my Grade 9 students, as her binoculars framed three fairly bright stars in the lower left corner of Cepheus. In her field of view were Epsilon, Zeta, and Delta Cephi.

"Now, as best as I can see, Delta appears six-tenths of the way between Zeta and Epsilon in brightness". With Zeta shining at 3.3 magnitude and Epsilon at 4.2 magnitude Pam had placed Delta at 3.8^m and was well on her way towards constructing a light curve for this most famous variable star.

I had directed Pam's interest towards this group of variable stars after she and a friend had indicated an interest in pursuing an astronomy project on the methods astronomers use to measure distances to the galaxies.

Originally discovered by John Goodricke in 1784, Delta Cephei is typical of a group of pulsating variable stars that have served as distance indicators for nearby galaxies. These Cepheid variables have periods of light variation described by Robert Burnham as "being as regular as fine clockwork".

In 1912 Henrietta Leavitt, after studying the periods of a number of Cepheid variables in a small magellanic cloud, announced a definite relationship between the actual luminosity of a Cepheid and its period of light variation. In particular, the longer the period, the larger the time-average luminosity. After Harlow Shapley stated, in 1917, the relationship in terms of a useful law, a relatively simple distance determination method was made available to astronomers.

In actual fact, two period luminosity laws were discovered because the Cepheids could be members of the arms of spiral galaxies, called Population I types, or they could be the Population II types, 1.5 magnitudes fainter, found in galactic halos, global star clusters, and elliptical galaxies.

The mechanism responsible for the pulsations is not completely understood but apparently the outer envelopes of the Cepheid stars are involved wherein the opacity of the Hydrogen and Helium ionization zones acts as a reverse valve to orchestrate the pulsations.

The use of Cepheid variables as "standard candles" to determine distances opened the door for Edwin Hubble's discovery of the expanding Universe. This use of the Cepheids was elegant- wherever a Cepheid was found, its period indicated the absolute luminosity and then its apparent faintness was a measure of the distance.

The observation of variable stars, of which the Cepheid forms only a small class, is a productive and valuable enterprise for the amateur astronomer. Anyone interested in this branch of amateur astronomy should contact

American Association of Variable Star Observers,
187 Concord Avenue,
Cambridge, Massachusetts
02138 U.S.A.

CELESTIAL EVENTS CALENDAR

MAY

Sun May 1 Neptune 1.5^0 N of moon
Thurs May 5 Eta Aquarid Meteor Shower (20 high speed meteors per hour)
- best observed during the early morning hours on May 5th
Thur May 12 New moon
Mon May 16 Venus 1.5^0 N of the moon
Jupiter 0.8^0 N of Uranus
Thur May 19 First Quarter moon
Mon May 23 Saturn 1.8^0 S of the moon
Thur May 26 Full moon

IMPORTANT DATES COMING UP!

Grade 11 Prize Contest
Tuesday May 3rd, 1983
For info contact Doug Fox, Belle River District High School, Belle River, Ontario NOR 1A0.

F.O.S.T.E.R. Guelph Chapter
Wednesday May 4th, at 7.30 p.m.
Room 113 Physical Science Bldg.
University of Guelph, Guelph, Ont.
Topic: "Astronomy in your own back yard"
Doug Cunningham, Science Head at Bruce Peninsula D.H.S.

Sir Isaac Newton (SIN) Test
Thursday May 5th, 1983
For info contact P.C.Eastman, Dept. of Physics, Univ. of Waterloo, Waterloo, Ontario N2Z 3G1.

National AAPT SUMMER MEETING
June 15-17, 1983,
Memphis Tennessee
Abstract deadline: March 20, 1983.

AAPT ONTARIO Section meeting
June 17-18, 1983, at Univ. of Waterloo, Waterloo, Ontario N2Z 3G1.
Convenor : Dean Gaily, Physics Dept. Univ. of Western Ontario, London, Ont. N6A 3K7.

COMPUTERS IN EDUCATION
Conference & Summer Institute
June 20-July15th
Rutgers the State Univ. of New Jersey
Contact Dr. Michell E Batoff
245 Nassau St. Suite D
Princeton, New Jersey 08450

PHYSICS for TEACHERS
June 27th to July 8th
Short course on Physics Demonstrations and outdoor activities. at the Royal Military College in Kingston, Ontario
for info contact Geo. Vanderkuur at
The Ontario Science Centre 770 Don Mills Rd.,
Don Mills, Ontario M3C 1T3

S.T.A.O.Region 7 & 8 (Toronto and Area)
Computer Conference
November 5, 1983
At Upper Canada College.

Event of the decade!!

National AAPT WINTER CONFERENCE
JANUARY 1985 AT
ROYAL YORK HOTEL, TORONTO!

CONGRATULATIONS

A.A.P.T.Ontario takes pride in congratulating Doug Fox, a former President of A.A.P.T. Ontario and Newsletter editor, on his appointment to the Editorial Board of the National A.A.P.T. Publication "THE PHYSICS TEACHER". No doubt the experience gained as editor of this newsletter will make him a valuable member of that organization. - Geo Kelly

JUNE

Fri June 3 Last Quarter moon
Wed June 8 Mercury greatest western elongation
Thur June 9 Mercury 0.8^0 S of the moon
Sat June 11 New moon
Solar Eclipse visible from New Guinea
Tues June 14 Venus 1.5^0 S of moon
Thur June 16 Venus greatest Eastern elongation
Fri June 17 First Quarter moon
Mon June 20 Saturn 2^0 S of the moon
Tues June 21 Summer Solstice
Wed June 22 Jupiter 1.2^0 S of the moon
Sat June 25 Full moon
Partial Lunar Eclipse- moon enters umbra 3:14 DLS

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume V, Number 1 September 1983

Editor: Dean Gaily

COMING ATTRACTION!!

PLAN NOW!! **MARK THIS ONE DOWN!**

Sixth Annual AAPT-Ontario Conference

14-15-16 June, 1984 (Thurs. thru Sat.)

Royal Military College, Kingston, Ontario

MEMBERSHIP RENEWALS

AND

NEW MEMBERSHIPS

1983-84

On the mailing label for this Newsletter is the date of your membership expiration. To renew your membership or to become a member for the first time, complete the form below and send it along with the membership fee of $5.00 (cheques payable to AAPT-Ontario) to:

John Hlynialuk
Wiarton District High School
Box 580
Wiarton, Ontario N0H 2T0

NAME.......................................

SCHOOL (UNIVERSITY).........................

ADDRESS....................................

CITY.....................PROV.............

POSTAL CODE.........RENEWAL.....NEW MEMBER.....

AAPT-ONTARIO EXECUTIVE ('83-'84)

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Archivist:
Doug Cunningham, Bruce Penn. D.H.S., Lions Hd.

Grade 11 Prize Editor:
Doug Fox, Belle River D.H.S.

From the Editor:

In assuming the reins of this publication from the able hands of George Kelly, (who is now enjoying life in Neuchatel, Switz. for a year) I am able to inflict a few of my own thoughts on you. The recent decision and hoopla from the Ministry regarding the deployment of microcomputers into every classroom and in fact at every student's desk in the near future causes me to stop and reflect a bit. In the April issue of "The Physics Teacher", Cliff Swartz also had cause to reflect on a similar but slightly different problem, although his suggestions are similar to my own thoughts. I quote:

"First, we have the crisis. Our students are not doing as well in science and math tests as students in other countries. Furthermore, they are not doing as well as they used to do here. The teachers of science and math are leaving the profession, and no new ones are being trained. In response to the crisis there are alarms and excursions. Now there are stirrings in the land. Out of Washington come rumors of crash programs and cash programs. Oh boy, oh boy, oh boy. Here we go again."

"Would you like to know how I would spend the money? I'm so glad you asked. As a guiding rule I would stay far away from high technology. Twenty years ago I claimed that tlelvision in schools was a waste of money and probably harmful. Today I feel the same way about computers. If you want kids to have computer literacy, do it on somebody else's nickel - not the science budget. Actually I don't even know what computer literacy means, and I suspect no one else does either. Perhaps it's something like typewriter literacy."

In a similar vein, Rod Grant, who just completed a 6 year term as Secretary of AAPT (Nat'l.), gave a paper at the recent Memphis meeting on "Finding Proper Roles for Computers in Physics Education". Here's his abstract:

"I have begun asking myself whether we have been forced to leave the 'Age of Reason' in order to enter the 'Age of Computers'. As acess to computer hardware has become commonplace rather than elitist, the game-in-town has become euphemistically known as 'Computer Literacy'. What is meant by this term? Examples of thoughtful, clever, and even pedagogically useful applications of the computer are known. Nevertheless, the computer is often an add-on from the student's viewpoint; few examples of the successful integration of the computer into the physics curriculum are known. Likewise, evaluation which might suggest what has been gained or lost in the meantime is scarce. At this adolescent period in the development of uses of the computer in physics education, it seems appropriate to assess where we are, to outline the questions that remain before us, and to open for possible discussion examples of both proper and questionable uses of the computer."

Both of these highly respected physics educators are telling us the same thing - Let's go a little slowly into this 'Computer on every desk' scenario. Certainly computers are here to stay. I use one in my own research lab, and in my classroom teaching, wouldn't be without it, but I own it, not vice-versa. Today, too many of our students are enraptured by the keyboard and are oblivious to the physics. My suggestion: keep the physics content high, use the computer as a tool; we'll have stronger students as a result.

Dean Gaily

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Ottawa, Canada K1A 9Z9

FIFTH ANNUAL AAPT ONTARIO CONFERENCE

Hosted by the Physics Dept. at Waterloo, with details admirably handled by Ken Woolner, the fifth annual conference of AAPT-Ontario was held June 17 and 18, 1983. Starting off with the now famous reception and mixer on Thursday evening, the conference got under way Friday morning with the invited talk "The Discovery of the Compton Effect" by Roger Stuewer of the Univ. of Minnesota. This lively and extremely interesting presentation set the tone for a very stimulating and productive conference. Four contributed papers followed; Fluidized Bed Heat Exchanger Phenomenon - A Winter Driving Hazard by S. Ziauddin, Science Touring Through Britain by Don Stephen, Simple Speed of Light Experiment by Mats Selen and Innes MacKenzie and The September 1984 Science Guidelines by Brenda Molloy. A second invited talk, "Ontario Hydro's Nuclear Power Generation Program" by George Brenciaglia was next and then George Kelly, retiring president of the section, surprised everyone with "New Developments in Physics Teaching at the Provincial, National and International Level" which turned out to be a spirited and fast moving business meeting of the section. The announcement of the new members of the executive; Brenda Molloy, Vice-President and Eknath Marathé, Member-at-Large, shared the spotlight with the news of Ernie McFarland's nomination for the office of Vice-President of the National AAPT organization. The first day of the conference closed with the traditional "My Favourite Demonstration" and a review of selected physics software for microcomputers.

Our annual banquet was held in St. Jerome's College at Waterloo. An excellent meal was folowed by an intensely detailed account of "The Events at Three Mile Island and Their Effects Upon the American People" by Les Ramsey of the Atomic International Forum, Washington D.C. Saturday morning four more contributed papers were heard; Measuring the Speed of Electrons in Solids with Microcurie Sources - A New Undergraduate Experiment by John Root and Innes MacKenzie, The Use of MX Notation to Simplify and Solve Problems Involving Many Variables by George Kelly, Introducing the Principles of Physics to Elementary Students by Doug Cunningham and Overview of Perspectives on Energy Program (AECL) by Danny Peirce. Next came Phil Eastman with "A Decade and a Half of SIN" and John Earnshaw "Jobs for Physics Grads", both invited talks. The conference ended with contributed papers Evaluating Physics Software by Paul McHoull, A Little Punk Rock for your General Levels by Bob Orrett and A Review of the AAPT-Ontario Grade 11 Prize Exam by Doug Fox.

THE ACCELERATION DUE TO GRAVITY FOR $1.39

One of the basic aims of education is to try to have the student do the experiments instead of seeing a demonstration. If you try to measure the acceleration due to gravity then you are talking big bucks for a classroom set of equipment. This article outlines how you can have your students do the experiment for about $1.39 per lab station.

The equipment needed consists of a metre stick (the major expense), two small screw eyes, two nails, a ball bearing, talcumed marking tape[1] or carbon paper, masking tape, string and matches. Instead of a metre stick you could cut wood of the same length but it is a good opportunity to get rid of the old sticks with inches on one side.

Pairs of nails (about 30 cm apart) for each lab station are driven into the wood moulding above the chalkboard all around the room. The metre stick is the clock and the ball bearing is the falling object that we drop. To calibrate the clock the students are directed to let the stick swing freely with small amplitude and determine the period as the average time for ten swings. Another trial at larger amplitude shows the student that there is no difference in the period caused by the change in the amplitude. Now the equipment is arranged as in the diagram. One end of the string is taped to the ball. The string runs over the same nail that the stick is hung on and then over the second nail and down to the screw eye near the end of the stick. String can be saved if an extra half metre of string is at this end and then fed through the apparatus as string is used up in the various trials of the experiment. The metre stick has the talcumed tape or carbon paper on the side that faces the ball.

Now the experiment is performed. The centre of the ball is marked on the chalkboard. The string is burned at the point marked by the arrow. This causes the ball to fall and the metre stick to begin to swing at exactly the same time. The latter can be thought of as starting the clock. After one quarter of a swing the stick strikes the ball and the ball leaves a mark on the tape. The ball has fallen a vertical distance equal to the distance between the initial chalk mark on the board and the mark on the tape on the ruler when it is in the rest position. The fall occurs in a time equal to one quarter of the period of the pendulum. The formula $g = 2d/t^2$ yields a decent value for g.

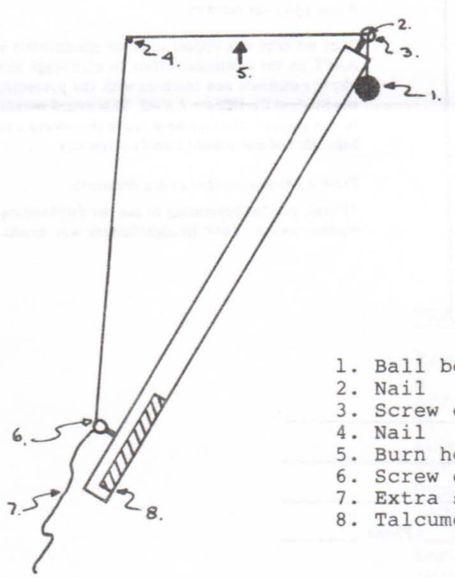
For a second and third trial the string is fed through the system and retaped to the ball. An average of three results can give g to within 5-10%. The best result comes from the case where the period is very well determined. This is done by accurate counting of fractions of a swing and letting the pendulum swing for a longer period of time.

An added bonus to this experiment can be achieved by using ball bearings of different mass. When the value determined for g is plotted against the ball bearing mass it becomes evident that there is no efect caused by the mass.

Doug Fox
Belle River D.H.S.

[1] Available from most scientific suppliers. The tape is red but is covered by a layer of talcum on one side to make it white. When something hits or rubs on this side of the tape the talcum is removed and a red mark is left.

DIAGRAM



1. Ball bearing
2. Nail
3. Screw eye
4. Nail
5. Burn here
6. Screw eye
7. Extra string
8. Talcumed tape

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume V, Number 2 December 1983

Editor: Dean Gaily

AAPT-ONTARIO ANNUAL CONFERENCE
JUNE 14-16, 1984 (THURSDAY THROUGH SATURDAY)
ROYAL MILITARY COLLEGE, KINGSTON

Features
All-day workshop on Thursday
Contributed papers
Invited speakers
"My Favourite Demonstration"
Good food, inexpensive accommodation and an excellent chance to renew old friendships and make new ones!

Plan now to attend--Get release time--Request travel support--Arrange coverage for your classes/exams--Make travel arrangements

DO IT NOW!!!

GRADE ELEVEN PRIZE PHYSICS CONTEST

The 1983 edition of the Contest was dedicated to Dr. Donald Ainslie who passed away in January of 1983. Dr. Ainslie was well known to anyone who has attended AAPT-Ontario Conferences. Somehow Dr. Ainslie's enthusiasm for physics might have generated the huge interest in this year's Contest. Three thousand three hundred copies of the Contest were ordered. Most went to Ontario shcools but interest from outside the province is increasing. Any school is welcome to participate in the Contest.

A great deal of credit must go to the University Physics Departments for their support. Particular mention must be made of the University of Guelph and the University of Waterloo. As well, the Universities listed below showed their interest in physics education by sponsoring provincial certificates and provincial prizes.

University of Guelph	Brock University
University of Ottawa	Carleton University
Queen's University	Laurentian University
University of Toronto	McMaster University
University of Waterloo	Trent University
University of Windsor	Wilfred Laurier University
University of Western Ontario	

This year ten students showed their expertise beyond two and a half thousand others who were graded and achieved recognition as provincial winners. For this they received gold certificates and TI-35 calculators. Congratulation to them and to their teachers.

PROVINCIAL WINNERS

1983

SCORE (OUT OF 25)	STUDENT	SCHOOL	TEACHER
21	V. Mak	Malvern C.I.	W.R.C. Prior
20	M. Lee	Woburn C.I. Scarborough	D.H Bell
	P. Kupchak	Nickel Dist. S.S. Sudbury	V. Bene
18	E. M. Brenner	Hill Park S.S. Hamilton	C.F. Reid
	A. P. Clarke	Nepean H.S. Ottawa	D. Ramsden
	D. J. Deforge	Westlane S.S. Niagara Falls	C.D. Malkiewich
	C. E. Harper	Notre Dame Coll. Welland	S. V. Speranzini
	J. K. Marshall	Loyalist CI & VS Kingston	R. Phillips
	P. R. C. Nelson	North Park CI & VS Brantford	M. Oates
	A. J. Pak	Woburn CI Scarborough	

In addition, the top two students in each of the 217 participating schools received certificates from AAPT-Ontario. The top student in each school received a prize from the school, usually a book.

The 1984 edition of the Contest will take place on Tuesday, May 1.

Doug Fox
Essex County Board of Ed.

From the Editor..

It's "Go to Meetin'" time again. The Annual Joint meeting of AAPT and the American Physical Society will be held in San Antonio, Texas from 30 January to 2 February, 1984. Highlights of the program include:

The Ceremonial Session, featuring the presentation of the Oersted Medal to Frank Oppenheimer (the Exploratorium-San Francisco) and the Richtmeyer Lecture, "On the Matter of the Universe" by David N. Schramm of the U. of Chicago.

Symposia featuring Steven Weinberg, Sheldon Glashow and John Wheeler.

A symposium on the next generation of accelerators that will present some aspects of the plans for the Superconducting Supercollider.

A session sponsored by the AAPM on "Medical Imaging" as well as two refresher courses: "Thermoluminescent Dosimetry and Its Applications in Cancer Therapy" and "Computers in Medical Physics".

Symposia on: The Crisis in Science Education; Advanced Undergraduate Laboratories with Computers; Innovations in Physics Education; Women in Research; Computers in Physics Education; Minorities in Research; History of Physics; etc., etc.

An evening Demonstration Show.

Workshops on Microcomputers, Advanced Interfacing, Apple Interfacing, Introduction to BASIC, Physics of Toys and Building Student Confidence in Physics plus numerous Commercially Sponsored workshops.

Open Houses sponsored by several AAPT Area Committees.

Apparatus and Textbook Show

And much, much more...

All of this will take place in the January climate of the deep south...need I say more? For anyone who attends one of these meetings, the opportunity to charge your Physics Teaching batteries is beyond question. Meeting new friends, including some of those "big names" in the field, exchanging ideas and techniques with them and finding out that your ideas and problems are in many instances shared with others can be one of the most rewarding experiences in a career. I know that it is difficult and sometimes seemingly impossible to get away or to find the $ support needed to attend these far away meetings, but as anyone like Doug Fox, George Kelly, Neves Pereira or Ernie McFarland can tell you, the return is well worth the effort.

This leads me to a reminder to you that in January, 1985, this Annual Meeting will be held close to home in Toronto, so by all means, begin to plan now to attend this "Once in a lifetime opportunity". And.."See you in San Antonio".

Dean Gaily

MEMBERSHIP RENEWALS

AND

NEW MEMBERSHIPS

1984-85

On the mailing label for this Newsletter is the date of your membership expiration. To renew your membership or to become a member for the first time, complete the form below and send it along with the membership fee of $5.00 (cheques payable to AAPT-Ontario) to:

John Hlynialuk
Wiarton District High School
Box 580
Wiarton, Ontario NOH 2TO

NAME...

SCHOOL (UNIVERSITY).......................................

ADDRESS...

CITY..

POSTAL CODE..............RENEWAL........NEW MEMBER ?...........

SCIENCE INFORMATION #7

(An Informal Newsletter on Intermediate/Senior Science Curriculum Renewal

(Ed. Note: The following is excerpted from the above Ministry publication.)

Additional Writers Needed

We were most pleased with the writing that took place this summer towards the new science curriculum guideline. However, there are still some courses for which no writing has been done, and creative writers are needed to work on these courses before and/or during next summer. The following list of courses indicates the areas where writers are needed.

A. General Level Courses

1. Applied Physics - Grade 12
This course should approach the study of Physics from the perspective of applications of physical laws and principles to everyday life. It will include some mathematical applications but with a minimum of abstract problem solving.

2. Applied Physics/Chemistry - Grade 12
This course is renamed from the Technical Science suggested in SCINFO 4, but the intent is similar. It would be recommended for students at the general level who have taken Applied Chemistry and/or Applied Physics and who may be considering courses at Community Colleges. It would likely include some topics not found in traditional Chemistry and Physics courses. It could be taken concurrently with the Grade 12 Applied Physics course.

3. Applied Biology - Grade 11

4. Applied Chemistry - Grade 11

B. Advanced Level Courses

1. Technological Science - Grade 12
This course is perceived as a course for those advanced-level students who are considering taking one or more of the new Technological OACs and possibly heading for courses at University or Community College. It would contain some topics which are not in Advanced-level Chemistry or Physics.

2. Geology - Grade 12
This course will be developed jointly under the Science and Geography guidelines. Two or three science teachers with background and experience in Geology are needed to serve on this writing team. The level of difficulty has not yet been determined but it will probably be offered at the advanced and general levels.

C. OAC

1. Integrated Science
To date, this course is just an idea. It is intended primarily for students going on to University in fields other than science, but may be interested in a science course that is more issue-oriented than the traditional courses at this level. It would allow a mix of all the disciplines in science as they are needed to deal with social issues that can best be understood with a knowledge of some basic scientific principles.

Teachers who are interested in writing for any of the above courses are invited to write to:

Don Garratt
Science Project Leader
Senior and Continuing Education Branch
Ministry of Education
17th Floor, Mowat Block
Queen's Park
Toronto, Ontario M7A 1L2

Please inlude the following information in your application:

- Name, address, telephone number
- School (name, address)
- The courses and levels you are interested in writing for
- Background - academic and teaching (courses taught)
- Writing experience (texts, board writing teams, articles)

Please note that you are not eligible to write for the Ministry if you are currently under contract to write or revise materials for a publisher.

October, 1983

KEPLER'S THIRD LAW

by Eknath V. Marathé,
St. Catharines, Ont.

For the week of Nov. 15 to Nov. 22, 1983, I gave to my Grade 13 Physics class the following assignment, as one of my weekly assignments to them. I am very happy to state that the students completed the task successfully to my and their satisfaction.

ASSIGNMENT

1.(a) Calculate the Kepler constants for the following Central Force Systems by calculating R^3/T^2 values for each of their satellites; (1) Earth, (2) Mars, (3) Jupiter, (4) Saturn, (5) Uranus, (6) Neptune, (7) Pluto.

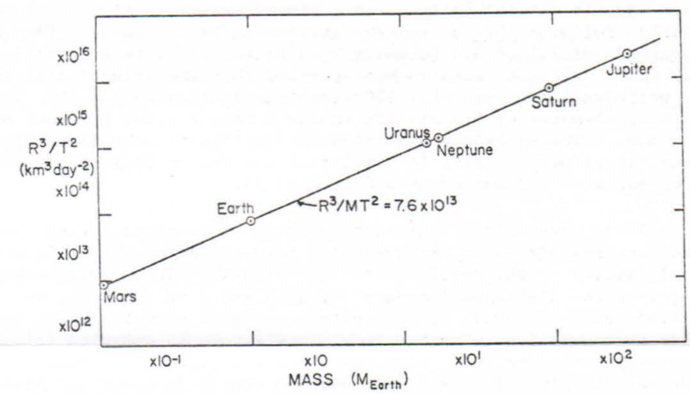
(b) Investigate, with the help of a graph, whether there is any systematic relation between the K values and the masses of the corresponding Central bodies of the above seven Central Force Systems.

(c) If the graph shows that there is a systematic relation, express the relation in a mathematical form.

NATURAL SATELLITES IN THE SOLAR SYSTEM *

Name or #	Orbital radius (10^3 km)	Orbital Period (days)
Satellite of Earth, M = 1		
Moon	384.4	27.322
Satellites of Mars (2), M = 0.107 x Earth's		
Phobos	9.38	.319
Deimos	23.46	1.262
Satellites of Jupiter (16), M = 318 x Earth's		
(Metis)	127.96	.295
(Adrastea)	128.98	.298
Amalthea	181.3	.498
Thebe	221.9	.675
Io	421.6	1.769
Europa	670.9	3.551
Ganymede	1,070	7.155
Callisto	1,880	16.689
Leda	11,094	238.7
Himalia	11,480	250.6
Lysithea	11,720	259.2
Elara	11,737	259.7
Ananke	21,200	631
Carme	22,600	692
Pasiphae	23,500	735
Sinope	23,700	758
Satellites of Saturn (17), M = 95.2 x Earth's		
(Atlas)	137.67	.602
1980S26	139.35	.613
1980S26	141.35	.629
Janus	151.47	.695
Epimetheus	151.42	.694
Mimas	185.54	.942
Enceladus	238.04	1.370
Tethys	294.67	1.888
Telest	294.67	1.888
Calypso	294.67	1.888
Dione	377.42	2.737
1980S6	377.42	2.737
Rhea	527.04	4.518
Titan	1,221.86	15.945
Hyperion	1,481.1	21.277
Iapetus	3,561.3	79.331
Phobe	12,954	550.4
Satellites of Uranus (5), M = 14.6 x Earth's		
Miranda	129.4	1.414
Ariel	191.0	2.520
Umbriel	266.3	4.144
Titania	435.9	8.706
Oberon	583.5	13.463
Satellites of Neptune (2), M = 17.2 x Earth's		
Triton	355.3	5.877
Nereid	5,510	360.21
Satellite of Pluto, M = 0.002 x Earth's		
Charon	19.7	6.387

* (1) "Planetary Satellites: An Update", Sky & Telescope, November 1983.
(2) "Orbital and Physical Characteristics of Planets and their Satellites", Astronomical Society of the Pacific, 1983, San Francisco, CA 94122.



STAR GAZING

by Doug Cunningham

THE DEMON STARS

To the casual observer of the heavens the stars that appear sprinkled over the clelestial sphere are fixed and unchanging...except of course for the seasonal variations and the normal atmospheric causes of twinkling. Indeed, for most of the 3000 or so naked eye stars the brightness remains constant. Although Wordsworth was refering to the north star, Polaris, his words certainly reflect this sentiment.

"...the pole star, as a guide
And guardian of thir course, that never closed
His steadfast eye".

There are, however, a group of stars that literally "close their eyes" and whose variations in brightness are a reular as clockwork. These stars are referred to as Eclipsing Binaries or Demon Stars. Imagine two stars born from the same cloud of gas and dust that are so close together that even the best of our earth based telescopes cannot reveal the duplicity. These stars revolve about a common center of gravity with periods measured in days and therein lies the key to determine their duplicity. If their orbital plane lies on, or very close to, the line of sight as seen from the earth then during the course of their orbital motion the components will mutually eclipse one another and an earth based observer will detect a diminishing of light. In the instance where the orbital plane does not lie close to the line of sight, astronomers can still determine the duplicity by observing the Doppler Shift in the spectral lines. The most famous of the Eclipsing Binaries and the first to be discovered is a naked eye star in the constellation Perseus called Algol, the "Demon Star". To ancient writers this star represented the serpent-haired head of Medusa whose mere glance would turn one to stone. Although the light variations were known to the medieval Arabs it was a young Englishman, John Goodricke, who in 1782 determined the period and suggested that the light variations were due to partial eclipses in a binary system. Algol can be easily followed by an amateur astronomer as it fades from a magnitude of 2.1 to 3.4 (dimming by a factor of 3) in a period of 2.9 days. Recent research has revealed that the primary star is a white main sequence star 100 times the luminosity of the sun with a diameter of 4.2 million kM and a mass 4 times the mass of our sun. The secondary companion responsible for the deep minimum at primary eclipse is similar to our sun in brightness and mass but with a diameter of 4.8 million kM.

There are other eclipsing binaries with deeper minima and shorter periods...one of particular interst during the Fall and early Winter is the rapid binary X Trianguli. This fascinating Algol- type star experiences a 7 fold dimming in its light in a period of 0.97 days. Unfortunately the star is not a naked eye star so one must have access to a 6" telescope in order to follow the brightness changes. The fascinating feature about this particular star is that the 7 fold dimming occurs in about 1.5 hours and in the space of just 4 hours the entire eclipse is finished. Needless to say, the sight of a star "winking" at you in real time is impressive.

Eclipsing Binaries have provided invaluable information to the astronomer...particularly information concerning the masses, diameters, and densities of a wide variety of suns. For thosae readers interested in observing and timing the eclipses of these Demon Stars, simply write to:

American Association of Variable Star Observers
187 Condord Avenue
Cambridge, Massachusetts, 02138

The months of December and January bring to the familiar winter constellations a number of close approaches by the moon to some of the familiar planets, two faithful meteor showers, and an annular solar eclipse (best observed in Africa, Europe and the North Atlantic), and a penumbral lunar eclipse. Clear Skies and Good Observing!

Celestial Events for December

Wed, Dec 14: Geminid Meteor Shower; (50 meteors per hour; best observed during the early morning hours of Dec 13, 14, 15).
Sat, Dec 17: Venus 0.2 deg N of Saturn.
Mon, Dec 19: Full Moon; Penumbral eclipse of the Moon..middle of the eclipse is 8hr, 49min PM.
Thur, Dec 22: Winter Solstice..winter begins.
Fri, Dec 23: Ursid Meteor Shower; (15 meteors per hour, best observed during the early morning of Dec 23..full Moon will interfere).
Mon, Dec 26: Last quarter Moon.
Wed, Dec 28: Mars 4 deg S of the Moon.
Thur, Dec 29: Saturn 0.6 deg S of the Moon.
Fri, Dec 30: Venus 0.7 deg N of the Moon.
Sun, Jan 4: Quadrantid Meteor Shower (40 meteors per hour; best observed in the early morning hours of Jan 4).

A NOTE FROM YOUR AAPT-ONTARIO ARCHIVIST

The job of the archivist for AAPT-Ont is to maintain records of historical interest to the association. In this regard photographs/slides/minutes of meetings/letters/conference annecdotes, etc. are desired. If you have any items relevant to the activities of AAPT-Ont that would/should be preserved in our archives would you kindly send them to:

Doug Cunningham
PO Box 35
Lion's Head, Ont. NOH 1WO

THE BACK OF THE ENVELOPE

(1) The carton containing a 50-watt light bulb promises an output of 900 lumens and a life of 750 hours. Is this bulb destined to emit as much as one mole of photons during its life?
(2) When you put cream in your coffee, which causes the larger increase in entropy, the mixng of cream and water or the heat exchange between cream and water?
(3) In order of magnitude, the energy stored in ocean waves is as much as the earth receives from the sun in what length of time?

Do you enjoy this kind of problem? Would your students be challenged by these problems? But you don't know the answer or how to solve them, you say? In each issue of the American Journal of Physics, Professor E. M. Purcell of Harvard University edits a column devoted to these and similar problems and their solutions. The column began in January, 1983 with a "Round Number Handbook of Physics" which in itself is a very useful compendium of data.

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume V, Number 3 Editor: Dean Gaily February 1984

AAPT-ONTARIO ANNUAL CONFERENCE

JUNE 14-16, 1984
(THURSDAY THROUGH SATURDAY)

ROYAL MILITARY COLLEGE, KINGSTON

Features
Thursday workshop led by George Van der Kuur on Demonstrations, Holograms and Cryogenics
Featured speaker, Dr. Tuzo Wilson, Ontario Science Centre
Invited Speakers
Contributed Papers; My Favourite Demonstration
Evening Boat Tour of the Thousand Islands

Accommodation at Royal Military College
all-inclusive, $15.00 per day!

DO NOT DELAY PLAN NOW

Complete information and registration form will be available in the next issue of this Newsletter. WATCH FOR IT!!

PAPERS PAPERS PAPERS

CALL FOR PAPERS

Now is the time to prepare your presentation for our annual June conference at Royal Military College on Thursday to Saturday, June 14-16, 1984. The program consists of contributed papers, software exchange and, of course, the popular "My Favourite Demonstration".

Organize your abstract for that particular topic or idea you do so well and share it with your colleagues as a presentation in the appropriate section. If you have not given a paper and are uncertain about what to do, just indicate this when you send in your abstract and we will send you a copy of an article from The Physics Teacher on "How to present a paper".

Send your abstract (150 words, maximum) to:

Brenda Molloy
Bayridge S. S.
1059 Taylor Blvd.
Kingston, Ontario K7M 6J9

It is essential that you respond soon as the program must be prepared for early distribution. Thus, the DEADLINE IS 7 APRIL, 1984 for the submission of abstracts.

PAPERS PAPERS PAPERS

NOMINATIONS FOR AAPT-ONTARIO OFFICE

Nominations are requested for the following executive positions in AAPT-Ontario
Vice-President
Member-at-Large
These offices are currently held by Brenda Molloy, Bayridge S.S., Kingston and Eknath Marathé, St. Catharines.
Any member of AAPT-Ontario may make a nomination, the nominee must be a current member of the Ontario Section. Please send all nominations, by 1 April, 1984, to :
T. Dean Gaily
Department of Physics
University of Western Ontario
London, Ontario N6A 3K7

PHYSICS CONTEST

Each year on the first Tuesday in May, the Ontario Section of AAPT sponsors its Grade Eleven Prize Physics Contest. May 1, 1984 marks the fourth year of the Contest. Any student enrolled in grade eleven physics is eligible to write. Information and entry forms are mailed to all Ontario high schools in late February. Students outside Ontario may also enter. Students should be in an introductory high school physics course, not the final year class of physics. Information and forms for those interested will be sent if you write to
Doug Fox
Belle River District High School
BELLE RIVER, Ontario NOR 1AO
The purpose of the Contest is to generate interest in Physics and to permit the best students to compete with each other.
We hope your students will be among the three thousand students who will write May 1, 1984.

From the editor...

On the front page of this Newsletter is the annual call for papers to be presented at our annual Conference in June. There may be a number of people reading this who well know the answers to the following questions, but then there may be some who aren't so sure:

What is a PAPER?
Who presents a PAPER?
How do I present a PAPER?

First, a paper is merely a 10 minute talk, given by you to the assembled group of physics teachers at the Conference. By giving the talk, you are obliged to first submit a brief abstract of your talk for publication in the Conference Program, to interest those of us attending into listening to what you have to say.

Any member of the Ontario Section of AAPT may present a paper, and anyone else, provided a member 'sponsors' that person by submitting the abstract in his or her name, and including that name on the paper as co-author.

Finally, to present a paper, first collect your thoughts, or research findings into presentable form, write a 150 word abstract summarizing these thoughts, send the abstract to Brenda Molloy and then prepare your 10 minute presentation. Be sure to include appropriate visual support materials, such as overheads or slides so that the audience can fully appreciate what you are trying to tell them; try to practice your presentation at least once before giving it and then be assured that you are really making a welcome contribution to physics teaching in Ontario!

T Dean Gaily

OAIP to USA

The Ontario Section of AAPT cooperated with the National AAPT Office in a large project late in 1983. Thanks to the Ontario Ministry of Education we were able to obtain about 640 copies of OAIP:Physics and mail them to AAPT members in the United States who are high school teachers. AAPT-Ontario and the National Office shared the distribution costs. We were happy to be associated with the project. Responses from the randomly selected high school teachers indicate that they were very pleased to receive the package and greatly admired its quality. Doug Fox of Belle River D. H. S. conceived and supervised the project.

MEMBERSHIP RENEWALS AND NEW MEMBERSHIPS 1984-85

On the mailing label for this Newsletter is the date of your membership expiration. To renew your membership or to become a member for the first time, complete the form below and send it along with the membership fee of $5.00 (cheques payable to AAPT-Ontario) to:

John Hlynialuk
Wiarton District High School
Box 580
Wiarton, Ontario NOH 2TO

NAME...

SCHOOL (UNIVERSITY)..

ADDRESS..

CITY...

POSTAL CODE..............**RENEWAL**...........**NEW MEMBER ?**........

APPARATUS COMPETITION-1984

The fourteenth biennial Apparatus Competition is being conducted by the AAPT Apparatus Committee during the 1984 Summer Meeting at the University of Maryland. Many entrants will be able to use the excellent facilities of the University to exhibit their apparatus in a effective manner.

Apparatus entered in the competition should be:

i) Either new in design or a modification of existing apparatus;
ii) Not commercially available;
iii) Not described in a previous written publication.

The apparatus may be set up by the participant (or an attending colleague) or may be shipped to the competition and assembled by the Apparatus Committee. Regrettably, difficulties with customs procedures, etc. make it impossible for the Committee to ship entries back to countries outside North America.

Judges chosen for the competition will make awards in both entry divisions: i) Pre-College Division (open to any pre-college teacher), and ii) College Division. Award winners who are able to be present will be recognized at the evening demonstration program of the summer meeting. Prizes will accompany awards given by the judges in each of the two divisions:

First Prize.............$300 (US)
Second Prize............ 200
Third Prize............. 100

At the discretion of the judges, all three awards are not necessarily given in each division. Judges are not informed of the school or name(s) of the entrants.

A short manuscript must be submitted which should include a brief account of the use of the apparatus and a description in sufficient detail to allow others to duplicate the apparatus. Entrants are encouraged to submit their manuscripts for publication by AAPT journals after the competition. A brief description of all accepted apparatus appears in the brochure published for the competition.

The deadline for entering the competition is May 4, 1984. Send your application form and manuscript to the Competition Director:

R. W. Peterson
Department of Physics
Bethel College
3900 Bethel Drive
St. Paul, MN 55112

NOTE: For local information, contact Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario.

IMPORTANT DATES TO REMEMBER

DESCARTES Math test for Grade 13
25 April, 1984
Faculty of Mathematics
University of Waterloo N2Z 3G1

CAP Physics Exam for Grade 13
26 April, 1984
Contact: T. W. W. Stewart
Department of Physics
University of Western Ontario
London, Ontario N6A 3K7

AAPT-ONTARIO GRADE 11 PRIZE EXAM
1 MAY, 1984
Contact: Doug Fox
Belle River D. H. S.
Belle River, Ontario NOR 1A0

SIR ISAAC NEWTON (SIN) Test for Grade 13
3 May, 1984
Contact: P. C. Eastman
Department of Physics
University of Waterloo
Waterloo, Ontario N2Z 3G1

AAPT-ONTARIO ANNUAL CONFERENCE
14-16 June, 1984
For Information: Brenda Molloy
Bayridge S. S.
1059 Taylor Blvd.
Kingston, Ontario K7M 6J9

AAPT Summer Meeting
25-29 June, 1984
College Park, Maryland
For Information: See AAPT ANNOUNCER

AAPT-APS-CAP Winter Meeting
20-24 January, 1985
Toronto, Ontario
Information Available in Sept. issue of
AAPT ANNOUNCER

ANNUAL WINTER MEETING OF AAPT
SAN ANTONIO, TEXAS
30 JANUARY-2 FEBRUARY, '84

Begun with numerous workshops, this winter meeting of AAPT was held in sunny, warm San Antonio, Texas. Numerous sessions of contributed and invited papers almost ovrwhelmed the participants but "something for everyone" was the certain outcome. Coffee hour, lunch time and corridor talk with new and old friends continues to make these meetings so profitable for all those attending. Having a joint meting with the American Physical Society allows one to interact fully with physicists at all levels and brings exposure to people like Sheldon Glashow discussing "Neutrino Exploration of the Earth" and John Wheeler on "The Mystery and the Message of the Qunatum".

Surprising news was the June relocation of the AAPT Executive Office from SUNY at Stony Brook to the University of Maryland and the resignation of Cliff Swartz as Editor of The Physics Teacher. Membership in AAPT appears to be attractive to many physics teachers as a 17% increase in active members was noted for '83 over '82. A new discount rate for Sky and Telescope magazine will soon be made available to AAPT members.

Dean Gaily, Ernie McFarland and Doug Fox attended this meeting in the sunny south. Dean was busy with the activities of the Nominating Committee (he was Chairman) and the Committees on International Education and Membership and Benefits. He also filled in for Neves Pereira as our Section Representative. Ernie gave a paper about Teaching Statistical Analysis in the Undergraduate Laboratory, chaired the Apparatus Committee and then left early to witness the Space Shuttle launch. Doug attended the Section Officers Exchange, the Test Pool Advisory Committee meeting, presented a paper about a new teaching strategy, and attended a luncheon for members of the Editorial Board of The Physics Teacher.

It was a good meeting, well planned and interesting to all.

You might find it easier to attend the next winter meeting of AAPT. It will be held in Toronto in January, 1985. AAPT-Ontario will not be holding its regular June meeting that year (1985) but will, instead, merge wth the annual winter meeting. Watch this Newsletter for details. If you wish to present a paper at this meeting you should contact a member of AAPT NOW about the procedure.

THE NOBEL PRIZE IN PHYSICS

The 1983 Nobel Prize for Physics was awarded jointly to Subrahmanyan Chandrasekhar of the University of Chicago and William A. Fowler of the California Institute of Technology, for work relating to the evolution of stars.

Explication of stellar evolution has been one of the greatest scientific success stories of the past half century. The transformations of stars, including our sun, are now better understood than the transformation of a tadpole into a frog. Two points of view have driven this advance; the microscopic, studying events on an atomic scale, and the macroscopic, treating a star as a whole.

In the microscopic domain it has been found that the process from which stars draw their energy--the fusion of light elements to form heavier elements--can take place along various pathways. Nuclei of elements like carbon and nitrogen can function much as catalysts do in a chemical reaction, accreting hydrogen nuclei and eventually returning them, fused into helium, to the gas. In other cases the intermediate nuclei may themselves be transformed. The amount of energy that a star can produce, and, hence, its temperature and general configuration, depends on a complex balance among the various processes.

At the time of the original Big Bang, almost no matter was created in the Universe except hydrogen and helium. In the furnaces at the centers of ordinary stars, these elements were forged into heavier nuclei. The elements were spewed back into space when the stars exploded, eventually forming the gas clouds that coalesced to make our solar system and, utimately, the substance of our bodies. Nucleosynthesis processes are so delicately balanced that if certain nuclei such as carbon had slightly different properties, most elements would never have been produced in abundance and life could not exist.

Very heavy elements like gold and uranium cannot be built up at the temperatures that prevail within an ordinary star. They must be created dring the giant explosions of supernovas, when tremendous swarms of neutrons pile onto nuclei and build up massive clumps, before the unstable intermediate nuclei have time to disintegrate.

Once one knows the amount of energy that nucleosynthesis will yield under given conditions, one can calculate how the entire star will behave. The calculations are complex. It turns out that as a star burns up its initial stock of hydrogen it must contract, growing hotter and denser. Meanwhile the outer layers cool and expand, so the star appears as a red giant. As the last of the hydrogen is used up the star begins a complex evolution, perhaps including explosions, eventually turning into a super-dense white dwarf. At each point there must be a balance between the gravitational force that pulls the mass together and the gas pressure that tends to blow it apart (it is the failure of this balance that causes supernovas). In the more massive stars, ordinary gas pressure cannot hold out against gravity. These stars contract until the nuclei touch one another, merge with electrons, and form a solid body--a neutron star.

The greater the mass of a star, the higher must be its temperature if it is to maintain enough pressure to hold up its outer layers against gravitational collapse. In particularly massive stars, the temperature may get so high that many of the electrons move at velocities near the velocity of light. Therefore, they show an increase of mass, following the laws of relativity. The extra, relativistic mass has all the properties of ordinary mass, including gravitational influence. Thus even as the temperature increases under the pressure of gravity, the pull of gravity itself increases. For a star whose mass is above a certain limit, roughly 1.5 times the mass of our sun, equilibrium is impossible and the star must collapse into a point, a black hole.

Fowler's contributions to our understanding of stellar evolution have been in the microscopic domain and have included both theoretical calculations and laboratory experiments on nuclear interactions. During the 1950s he and his co-workers helped to fill in many of the details of the main pathways of nucleosynthesis. His work has ranged from studies of the way particles in ordinary stars can build up intermediate elements such as carbon, to explication of the swift heavy-element processes in supernovas.

Chandrasekhar has done mathematical work, mostly in the macroscopic domain, covering many areas of astrophysics. In the field of stellar evolution he helped to explain how stars evolve into red giants and under what conditions neutron stars are formed. When he was a student in the 1930s he deduced that stars must collapse when their mass is beyond the limit mentioned above--"Chandrasekhar's Limit". In recent years he has returned to the study of how the equations of relativity may be applied to very massive stars.

From "Physics News in 1983", in Physics Today,
January 1984

STAR GAZING

by Doug Cunningham

I recollect a night of broken clouds
And underfoot snow melted to ice,
And melted further in the wind to mud.
Bradford and I had out the telescope.
We spread our two legs as we spread its three,
Pointed our thoughts the way we pointed it,
And standing at our leisure till day broke,
Said some of the best things we ever said.
Robert Frost

Midnight was approaching on this unseasonably warm March night...the smell of spring was in the air as Jamie, one of my Grade 11 students began to assemble the telescopes for a search which we hoped would end in the location of the earth crossing asteroid, Geographos. Initial studies have suggested a cigar shape for Geographos and its rapid rotation causes periodic variations in brightness that take it from a visual magnitude of 11.5 to 13.5. We had hoped to construct a light curve and perhaps model the asteroid's shape to match the light variations. It took us an hour to locate the star field that matched the maps we received from Tonight's Asteroids, a newsletter produced by Jay Gunter of Durham, North Carolina. The star field was searched with various magnifications until 4:00 am but not a trace of the asteroid was detected. As the telescopes were disassembled we concluded that the asteroid was either near the minimum brightness or the map supplied by Tonight's Asteroids was in error. We attempted to find Geographos on one other night but again no success...by then the asteroid's predicted motion had moved it out of star fields for which we had detailed maps. Only later did we learn that the published map was in error. Such are the problems of the amateur astronomer...one who pursues a love affair with the stars and is rewarded for his efforts by an intellectual and spiritual exposure to wondrous and beautiful celestial sights.

In a recent issue of the Journal of Variable Star Observers an article appeared intitled "Astronomers as Amateurs" by Thomas Williams. One of the athor's main points concerned a perception by amateurs that they cannot contribute to the science of astronomy in any substantive way; this at a time when opportunities for contributions are large and growing. As I read the article, thoughts of recent amateur contributions to the science of astronomy rapidly came to mind: the Problicom sky survey to detect Novae, the regular monitoring of literally thousands of fascinating variable stars, the dedicated efforts of an increasing number of amateurs to timing the occultations of distant stars by various solar system objects, the growing numbers of amateurs using photoelectric photometry to measure light variations of everything from asteroids to eclipsing binaries, the army of amateurs preparing to participate in the International Comet Halley Watch, just to cite some of the more active areas of interest.

The February, 1984 issue of Astronomy Magazine contained an article by Paul Maley on the recent successful attempt by amateur astronomers to measure the diameter of Pallas, the solar system's second largest asteroid. On May 29, 1983 this asteroid would pass in front of the 4th magnitude star 1-Vulpecula. The goemetry of the earth, asteroid, and star would produce an occultation shadow across North America somewhere between Mexico and Canada...across the greatest concentration of amateur astronomers in the world, in prime observing time and on a holiday weekend. Organization for this appulse (the close approach of a star or planet as seen from the earth) was conducted by IOTA, the International Occultation Timing Asociation, under the leadership of Dr. David Dunham and a group of regional coordinators. Because the asteroid lacks an atmosphere, an observer in the occultation zone will observe a sharp cut-off of the starlight, in the case of Pallas the light drop would be almost 5 magnitudes. Amateur astronomers, by positioning themselves within various sections of the predicted occultation zone and timing the star's disappearance and reappearance, can accumulate enough data to map the shape and size of the asteroid. It turned out that the occultation path crossed the southern States and close to 500 amateur astronomers, organized into various groups, set up observing fences. Despite numerous cloudouts and observers positioned outside the occultation path reporting misses, a record 124 successful timings were reported. Approximately 80% of the limb of Pallas was observed. The asteroid's profile was found to be slightly elliptical with preliminary measurements of a 520 kM major axis and a 516 kM minor axis. It is interesting to note that more than 90% of all data obtained was by amateur astronomers.

Clear skies and Good Observing!

MARCH

Fri, Mar 2: New Moon
Sat, Mar 10: First Quarter Moon
Sat, Mar 17: Full Moon
Tue, Mar 20: Srping begins-Vernal Equinox; Saturn 0.6° N of Moon
Wed, Mar 21: Mars 0.4° N of Moon
Thu, Mar 22: Uranus 0.5° N of Moon
Sat, Mar 24: Last Quarter Moon; Jupiter 3° N of Moon
Sun, Mar 25: Occultation of 8.8 mag star by Saturn beginning at 1:00 am, this occultation will last about 4 hr.
Fri, Mar 30: Venus 4° N of Moon

APRIL

Sun, Apr 1: New Moon
Tue, Apr 3: Mercury 6° N of Moon
Mon, Apr 9: First Quarter Moon
Sun, Apr 15: Full Moon
Tue, Apr 17: Saturn 0.6° N of Moon: Mars 0.04° S of Moon
Thu, Apr 19: Uranus 0.6° N of Moon
Fri, Apr 20: Neptune 3° N of Moon
Sat, Apr 21: Jupiter 3° N of Moon
Sun, Apr 22: Lyrid Meteor Shower, 15 meteors per hour, best observed before moon rise Sat night-Sun morning
Mon, Apr 23: Last Quarter Moon
Mon, Apr 30: Mercury 0.7° N of Venus

SELECTIONS from the SCIENCE CORNER
Volume 3

Since 1977 Nigel Bunce and Jim Hunt, Professors of Chemistry and Physics respectively at the University of Guelph, have been writing a weekly column "The Science Corner" in The Guelph Daily Mercury. In 1981 their first collection of articles appeared in the form of "Selections from the Science Corner"; this selection contained articles dealing with physics and chemistry as applied to medicine and biology. A year later a seond volume appeared--articles relating chemistry and physics to astronomy and earth science.

These collections of articles, well written and informative, have been tremendously popular: requests for them have poured in from all over Canada, from the U.S., Britain, and even from distant coutries such as Israel and Chile. The Ontario Science Centre uses them in its Science School, and many Ontario schools have requested class sets. With such a response, it is not surprising that "Volume 3" of "Selections from the Science Corner" has been produced.

The present volume, while still concerned with science, has as its focus, "People, Places and Things". Fascinating stories are told of people such as Galileo, Lavoisier, Einstein, and Newton ("Was Newton Mad?"). In the section on "Places and Things", we read about items as diverse as margarine, the Manhattan Project, and Troy. This selection of articles is sure to provide something interest for everyone.

To obtain your free copy of "Selections from the Science Corner, Volume 3", write to

Ernie McFarland
Coordinator of Student Relations
Department of Physics
University of Guelph
Guelph, Ontario N1G 2W1

American Association of Physics Teachers

AAPT Ontario Section
NEWSLETTER

Vol. VII No. 1

The Annual Meeting

On June 21-22, 1985, the annual meeting was held at McMaster University in Hamilton. Approximately 115 AAPT members that were on hand were treated to many stimulating presentations.

The invited papers began with a presentation by William Harris, McMaster University, titled "Star Clusters and the Age of the Universe". He described some recent research techniques with results indicating that the current estimate of the age of the universe is 14 billion years ($\pm$2 billion years). John Dobson, of the San Francisco Sidewalk Astronomers, followed with a lively talk called "Cosmological Fossils" in which he argued that gravity, electricity, and inertia are the fossils that can be used to interpret the universe. His theory led to several interesting conclusions, including the statement that protons should not decay. Stuart Smith, Chairman of the Science Council of Canada, gave an enlightening talk on "The Effect of Technology on Canada's Economic Prospects". He strongly advised Canada to place a greater emphasis on knowledge intensive industries to help reduce our dependence on the export of our natural resources. Craig Bohren, Pennsylvania State University, took us on a photographic tour to such fascinating places as Iceland and the Antarctic to illustrate his explanations of the color blue in ice, water, snow, and the sky. In his paper, which was titled "Reflections on the Blues", he showed clearly why scattering and absorption are important when explaining color phenomena in nature. William Goruk, Mohawk College of

Applied Arts and Technology in Hamilton, described the physics courses taught in both the technical and technological programs offered at the college. This information will help high school physics teachers plan their curricula. Wally Pieczonka, from a private company called Linear Technology Incorporated, discussed how the training and education of physics relates to the manpower needs of industry. Eric Stevensson, Chalk River Nuclear Laboratories, brought to life his favorite fluid in a presentation titled "Superfluid Helium - A Most Fascinating Material". He supplemented his talk with a movie showing the superfluid action of liquid helium at temperatures below 2.17°K. High school teachers Dave Wright, Brenda Molloy, and Stan Percival presented draft outlines of two courses proposed in the new curriculum guidelines. These courses, called Applied Physics and Technological Science, are intended to help students prepare for courses in community colleges. Denny Pierce, from P.J. Spratt and Associates, described a teaching resource kit called "Focus on Fission - Unlocking the Nucleus". The kit consists of film strips, cassette tapes, a nuclide chart, and a teacher's guide. Merv England and Stefan Dubel, Parkdale High School, demonstrated applications of VELA (Versatile Laboratory Aid), a commercially-available device that can be linked to a computer, an oscilloscope, or a chart recorder.

The interest level at the meeting remained high with a variety of short contributed papers.

- "Measuring Frequency with a Microcomputer", Stuart Quick, University of Toronto
- "An Undergraduate Experiment to test Einstein's Second Postulate", Robert Stone, University of Guelph
- "Using Logo in Teaching Vectors", Peter Scovil, Waterford District High School
- "Millisecond Timing with a Commodore Computer", G. S. Rose, University of Western Ontario

- "Grade 11 Physics Prize Contest", Don Murphy, Sydenham High School
- "Is Spinning an Inherent Characteristic of Everything in the Natural World?", E. V. Marathe, Grantham High School
- "Curing Calculatoritis", Ernie McFarland, University of Guelph (Try finding the number 1.000 000 1 to the power 27 on different types of calculators and comparing answers!)

On Friday evening, a sumptuous banquet was followed by one of the invited speakers, more tours of McMaster's facilities, and star gazing with Steve Dodson, from Science North in Sudbury, Ontario, who brought his 56 cm reflecting telescope more than 400 km to the meeting!

Congratulations to David McKay, M.M. Robinson High School, Burlington, for organizing our rewarding meeting, and many thanks to the hosts at McMaster University.

Alan Hirsch

Grade 11 Physics Contest Results

This year the "torch was passed" from Doug Fox, first co-ordinator of the contest, to Don Murphy of Sydenham High School. Don did a great job of effecting a smooth transition - the questions were as challenging as ever. From some 3,000 entries, the top ten were:

1st at 100% (our first ever "perfect paper"):
- M. Rajagobal, Earle Haig S. S., Willowdale

2nd at 92%
- R. Brezina, George Vanier S. S., Willowdale
- I. Walker, Etobicoke C. I., Islington

3rd at 88%
- M. M. Easson, Gloucester H. S., Ottawa
- J. E. Fry, Woburn C. I., Scarborough
- K. A. Gordon, Woburn C. I. Scarborough
- M. F. Greaves, West Hill C. I., West Hill
- C. K. Hadlock, Sir Winston Churchill, C. I., Vancouver
- Y. C. Ngai, Upper Canada College, Toronto
- J. S. Sachdeva, Toronto French School

Altogether, Don awarded 23 prizes of these 4 went to students at Woburn C. I. in Scarborough and 3 to Sir Winston Churchill C. I. in Vancouver. Congratulations to these schools.

Don is now organizing his 2nd contest, and sends forth a plea for good questions, which are always in short supply. If you have a question (or questions) which you feel would be suitable for the contest, please send them to:

Don Murphy,
Sydenham High School,
Syndenham, Ontario.
KOH 2TO

Physics Contests and Semestering - The Section Presidents View

Like a number of others, my school has been semestered for some time. This has given me some difficulties in handling the S.I.N. and AAPT Physics prize tests - my second semester students had not covered a good chunk of the material and my first semester students had forgotten it or were busy with other things. As you perhaps have, I asked myself - "why can't they have two contests per year - more and more schools are being semestered after all".

Then, as a member of the Section Executive, I saw how much work it is for the Contest Co-ordinator to put together one contest per year.

(a) A set of 30 challenging but fair questions have to be put together and approved by a number of University Profs.

(b) Many hundreds of "invitations" have to be sent out.

(c) Booklets of tests must be sent to the several hundred schools that respond.

(d) Returned cards must be carefully kept track of and sent in batches to the University of Guelph for marking.

(e) Winners must be chosen, notified, prizes obtained and sent.

(f) A set of books must be kept accounting for funds received and expended.

This is a major voluntary commitment on the part of anyone; to ask them to do it twice a year is "beyond reason". To find a second person appears equally difficult and then there is the problem of balancing the two tests.

Perhaps we need to realize that these are PRIZE tests, meant for the best half dozen students in the school who are interested enough in Physics to overcome the difficulties of date. At least, as more of us "go semestered", then, more of us are "in the same boat".

I would emphasize that these are my own views (though the executive shares my feeling that we cannot at this time operate the contest on a "twice a year" basis), and I would welcome any comments or suggestions that you might care to direct to me.

- D. McKay

AAPT (ONTARIO) EXECUTIVE 1985-86

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Executive Profile

Each Newsletter this year will feature a brief profile of one or two members of the AAPT-Ontario Executive. This issue we are proud to present:

1. Ross Hallett - Vice-President

Ross was born in the small town of Nanton, Alberta. As a teenager he developed an allergy to grains and decided that a career other than farming was indicated. So it was off to the University of Calgary for a degree in Chemistry followed by a Masters in Physical Chemistry.

Ross now felt it was time for other places and other branches of science so he took a PhD in biophysics at Pennsylvania State University. From here Ross went to the University of Guelph where he was appointed a full professor in 1982.

His research interests include the scattering of laser light from biological molecules and motile cells; as well as small angle neutron scattering from biological macromolecules, for which he uses the McMaster University Reactor. Ross has published a number of articles relating to computer aided instruction in the American Journal of Physics, an educational interest which led to his involvement in the AAPT-Ontario Executive.

Ross is married with 2 children and enjoys music, hiking and sailing. As Vice-President he is chief organizer of the 1986 summer meeting and will then serve as president in 1986-87.

AAPT-Ontario Summer Meeting 1986

Our 8th Annual Meeting will be held June 13th and 14th at the University of Guelph under the chairmanship of Dr. Ross Hallett, Section Vice-President. It will be preceded by a one-day, single topic workshop on Thursday, June 12th. Mark these dates on your calendar and watch for details early in 1986.

STAO Holds Regional Conference Nov. 23

Physics Teachers in the Toronto area will be interested in the Science Teachers Association of Ontario Region 7/8 one-day conference to be held Saturday, November 23rd at Don Bosco High School, near Islington and Dixon Road in Toronto. Programs for the conference are in most high schools in Regions 7/8; if you have not seen one and would like to, call:

Michael O'Keefe,
Don Bosco S. S.,
416-241-3581

HALLEY'S COMET

A 21-pg. "Guide for Ontario Teachers on Halley's Comet" has been written by Prof. Jim Hunt of the Physics Department of the University of Guelph, and is available free of charge. This timely guide includes articles and student exercises, and will be of interest to elementary and secondary school teachers. Any of the items may be copied for educational purposes, provided that suitable credit is given.

To receive a copy of the guide, write: Halley's Comet, Dept. of Physics, University of Guelph, Guelph, Ontario N1G 2W1, or phone (519) 824-4120, ext. 2261.

Membership Renewals

On your mailing sticker is the date of expiry of your membership; all those who are "paid up" have a date of June '86, any others are in need of renewal. If your membership expired in June of '85 or '84 we are sending this Newsletter as a reminder and, hopefully an incentive, but we cannot afford to keep doing so! Please use the attached form to renew TODAY. (If you have renewed, why not give this form to a fellow physics teacher and encourage them to "swell the ranks".)

Membership Form

Name: ____________________

Address: ____________________

____

____

Postal Code: __________

Affiliation:
- ☐ Secondary School
- ☐ University
- ☐ College
- ☐ Other

The membership fee for one year is $5.00

Please send this completed form and a cheque or money order for $5.00 payable to AAPT-Ontario to:

Mr. Dave McKay,
President, AAPT Ontario,
3027 Balmoral Ave.,
Burlington, Ontario.
L7N 1E3

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. VII No. 2

ANNUAL CONFERENCE

Our Annual Conference will take place at the University of Guelph on June 13 and 14, 1986 so mark your calendars now. The Physics Department of the University will be our hosts and will be assisting with the organization of many sessions.

Although many sessions are still in the planning stages, we can give you some highlights.

********** On the day prior to the conference (i.e. June 12, Ernie McFarland will lead a workshop on the teaching of relativity. This workshop is expected to take most of the afternoon.

********** A keynote speaker is Dr. Gregg Herken from the University of California. Dr. Herken is an historian with special interests in the role that physicists have played in determining arms policy, from the likes of Oppenheimer and Teller to those involved (mainly as critics) with the Strategic Defense Initiative.

********** A second keynote speaker will be Dr. Gabriel Karl from the University of Guelph, a member of the Royal Society of Canada and one of Canada's leading theorists in the area of elementary particles.

********** There will be a session on "Your Favorite Demonstration", so shine up that new experiment you've been using and bring it along. Physics Department technicians will provide assistance and storage locations for your equipment.

********** Many other sessions and tours are being arranged.

********** SEE YOU THERE! **********

From The Editor...

If anyone out there has any short physics items of interest be they serious or funny, and feel they would make a worthwhile addition to the newsletter, please send them to:

A. McEachern,
c/o M. M. Robinson H. S.,
2425 Uppermiddle Road,
Burlington, Ontario.
L7P 3N9

1986 AAPT-ONTARIO GRADE 11 PHYSICS CONTEST

Don Murphy, our contest co-ordinator is busy putting together this years contest, despite being incapacitated with a broken hip (Don temporarily forgot some of the physics of low friction ice surfaces, falling objects, and the compressive strength limits of bones).

We had received some concerns from members concerning the expense of class sets of tests. After reviewing the cash flow from this part of AAPT's operations, we feel that the best we can do at this time is:

First 20 papers	$1.00 each
All others	$0.50 each

Beyond this the revenue might not cover our printing, mailing prizes, computer processing, etc. We will review the situation again after this years contest.

Don will be mailing out contest request forms in early March. If you have not received yours by late March, contact Don at Sydenham High School, Sydenham, Ontario KOH 2TO.

NOTE - As a convenience, Don includes a membership form; please note that this is for the 1986/87 membership year.

Executive Profile

Grace Daminato - Member-at-Large

Grace wanted to be Nobel Prizewinner in physics but marriage during her undergraduate tenure followed by the birth of twins during her Master's Degree studies indicated a more practical career direction.

So Grace went to Teachers' College, obtained a high school teaching position in Sarnia...and was promptly laid off!

Her present position at Lambton College came through answering an ad in the paper.

Grace views the Community College Physics course as a "practical OAC" in which the content must support the various programs offered at the college. Many Lambton College graduates find employment in the "Chemical Valley" of Sarnia.

Grace's goal as a physics instructor is to "present physics to everyone, and make it interesting to all". As the AAPT-Ontario Executive's Member-at-Large, she represents the Community College Physics Teachers and is responsible for increasing their membership and involvement with AAPT-Ontario.

WANTED: AAPT-ONTARIO VICE-PRESIDENT FOR 1986-87

The beginning of a new year is a time for looking forward and so it is time to bring to the memberships attention the vacancies on next years executive:

1. Vice-President - Although the Vice-President serves a one-year term, it is our tradition that the Vice-President moves on to the position of President and then Past President, so that a three year commitment is involved.

   This newsletter is not the place for detailed job descriptions, but in essence it is the role of the vice-president to serve as "head honcho" of the June meeting and that of the president to prepare the quarterly newsletter. The past president's chief function is to provide sage advice to those that he or she feels are in need of it.

   I may say from personal experience that both these positions are interesting and fulfilling, and that the size and informality of the organization keeps red tape and paperwork to a minimum.

2. Member-at-Large - This position, with a one-year term, is open to any section member teaching at a community college. The role of the member-at-large is to bring the concerns of community college physics teachers to the Section Executive and membership and to encourage the involvement of community college physics teachers in the Section.

   The strength of an organization such as ours depends upon people being willing to step forward to take on positions such as these. If you would like to know more about either of these positions and/or volunteer to serve in either capacity please call me at

   416-335-5588 (school)
   or 416-634-8256 (home)

   or write me at: 3027 Balmoral Avenue,
   Burlington, Ontario. L7N 1E3

   Applications (written or verbal) should be received by March 15, so that, should a ballot be necessary, it may be included in the next newsletter, to be published at the end of March.

Dave McKay

MEMBERSHIP RENEWALS

Thanks to the fifty of you who renewed your membership in response to our last newsletter. If I received your renewal by December 31st, your mailing label has been updated, if it came after that the update will be done for the next issue.

For those who have not gotten around to renewing, this is your last call for 85/86 renewals. Our next letter will contain full details of the June meeting at Guelph, an article on unified field theory and other delights.

For $5.00 why not "stay in the pipeline"? If you have renewed why not pass this letter and membership form on to another physics teacher?

INTER-AMERICAN CONFERENCE ON PHYSICS EDUCATION

Occasionally some of us are fortunate enough to be able to attend a National AAPT Winter or Summer meeting, if its not too far away. But here's a chance to go "one step beyond" - by attending an Inter-American Conference on Physics Education in Mexico in July of 1987.

Preliminary plans call for an emphasis on developing cooperative arrangements in physics education among the countries of the Americas. Topics will include applying educational research in physics, the role of the physics textbook, low-cost physics experiments, etc.

Dr. Larkin Kerwin, head of the NRC is a member of the steering committee for this conference. I have written him to see if there is any role AAPT-Ontario, as a leading physics educational organization, can play in this conference.

Further information in succeeding newsletters - meanwhile think about how you can persuade your Board to sponsor you to Mexico in 1987!

MINI COURSE(S) FOR PHYSICS TEACHERS

At the June meeting some interest was expressed in the organization of short duration, single topic courses for the updating of physics teachers, and the role that AAPT-Ontario might play in organizing these.

Arrangements have been made through Ross Hallett, our vice-president, to offer a "pilot project" course at the University of Guelph if a suitable time and topic can be found. To do this we need your help. If you are at all interested in taking a five-day updating course, please complete the attached form and return it to me by March 15th. The form is not a binding commitment, but is rather an expression of sincere interest in one or more topics or times. It is not our intent to limit this to Section members, so feel free to share the form with other physics teachers.

Based on the response we will make a formal offering of one or more mini courses through the next Newsletter.

Suppliers take note

This news letter goes to perhaps the BEST 500 physics teachers in Ontario. For a cost of only $10.00 we will include a small calling card size advertisement in our news letter. We appreciate your interest in physics teaching and want to maintain a good working relationship with you.

MINI-COURSE INTEREST SURVEY

This survey is to gage interest by physics teachers in a one-week, single topic course to be offered at the University of Guelph. The course would not be a "credit course". Course fee would include tuition, materials, residence accommodation and meals.

If indicating an interest in more than one time or topic, please prioritize as 1st, 2nd, etc.

Your name and address have been requested so all survey respondents may be contacted directly.

Return this form to: Dave McKay
3027 Balmoral Avenue
Burlington, Ontario
L7N 1E3

by March 15, 1986.

DATES:

LAST WEEK OF JUNE ______
1ST WEEK OF JULY ______
LAST WEEK OF AUGUST ______
2ND LAST WEEK OF AUGUST ______

Please place name and address on lower form. Thank you!

TOPICS:

RELATIVITY ______
OPTICS, ESP, LASERS ______
SMALL PARTICLE PHYSICS ______
BIOPHYSICS ______
QUANTUM PHYSICS ______
ELECTRONICS ______
ENERGY ALTERNATIVES ______

Membership Form

Name: ______________________________

Address: ______________________________
____
____

Postal Code: ______ ______

Affiliation: ______ Secondary ______ University
______ College ______ Other

The membership fee for one year is $5.00!
Please send this completed form and a cheque or money order for $5.00 payable to AAPT - Ontario to:

Mr. D. McKay
President, AAPT - Ontario,
3027 Balmoral Ave.,
Burlington, Ontario.
L7N 1E3

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume VI, Number 1 Editor: Brenda Molloy March 1985

Editors Comments

The AAPT Ontario Section is alive and well. Events planned for the immediate future in our section are:

1. The AAPT Ontario Physics Prize Contest, Tues. May 7, 1985, coordinated by Don Murphy of Sydenham H.S., Sydenham, Ontario, K0H 2T0 (1-613-376-3612)

2. A Second Newsletter in May. Please send Articles, reviews of conferences and other information you wish to share, to the editor. B. Molloy, at Bayridge S.S., 1059 Taylor Blvd, K7M 6J9. Thank-you.

3. The AAPT Ontario-85 Annual Spring Conference; arrival and registration on the evening of Thurs. June 20, all-day Fri., June 21, until 3:00 PM Sat. June 22; in Hamilton at McMaster University, with programme Planner Dave McKay (Vice President) of 3027 Balmoral Ave; Burlington, Ont., L7N 1E3, (School 1-416-335-5588)

Dave has included in the Conference Programme some new items, such as the poster session (see the next article for information) and has such notables booked as Stuart Smith for our after luncheon speaker on Friday and Dr. Svenson to speak about liquid helium after our Barbeque Friday evening. Join us, send Dave your ideas for posters and papers, and come to make new acquaintances and renew old ones.

4. Call for Nominations for AAPT Ontario offices of: Vice President, Section Treasurer, and Section Representative,

Please mail all nominations to the editor.

What is a Poster Session

Do you have a favorite demonstration? Do you save physics-related cartoons? Do you have a favorite lecture technique you'd like to let others know about? Consider the "poster session". Bring your own easel. Just put your cartoons, or explanations, or pictures illustrating your ideas on one or several sheets of poster paper. It is helpful to be as complete in your explanations as possible, so you don't have to stand next to your poster the entire session, but can wander around to see others' ideas and exchange thougths with them. Refreshments are usually available to stimulate this type of discussion.

It is fun and informational -- the more you talk, the more you learn. Plan to bring one or more posters to this June's AAPT Ontario Conference. Book a spot through Dave McKay, our programme planner.

AAPT ONTERIO ANNUAL CONFERENCE JUNE 1984

The sixth annual conference of the ontario section was held at the ROYAL MILITARY COLLEGE in KINGSTON ONTARIO. From June 14th to 16th 1984.

The Royal Military College is situated near the picturesque surroundings at the mouth of the St. Lawrence river and adjacent to the historic 'Old Fort Henry'. The college with its mixture of old and new provided a delightful and to date one of the best surroundings for our annual meeting.

The preconference workshop lead by George van der Kuur on making Holograms and doing Cryogenic experiments was a big success. All of the 37 participants went home with a white light hologram that they had personally made. I thought at first that I had "blown" my effort, I could see nothing and was about to throw my glass slide away when some one suggested I look at it in direct sunlight. What a thrill, the creature lunged at me from the deep dark green depths.

The main conference was opened by Dr. Al Bartlett with his now famous and updated version of "The forgotten fundamentals of the energy crisis" The conviction with which Dr. Bartlett puts his material across and his rapid fire style is already begun to inspire and manifest itself in other physics teachers. The same style was evident in his interesting "Television, Football and Physics: An Experiment in Kinematics. Other papers followed.

Technician Technology Programmes by Mr. Paul Van Nest: Computerized Test on Error Analysis by Dr. John Petri: "Halley's Comet, Light Pressure, and the Lorentz Force" by Dr. Paul Rochon and Dr. Napoleon Gauthier: The use of microcomputers in the teaching of Statistical Mechanics by Dr. John Harrison: The new TV Ontario Physics Series and a card system for efficient use of multiple choice questions by Bill Konrad: Our Science centre by Dr. Tuzo Wilson: Relativity in ten minutes by Dr. Neves Pereira: The nature of Physics by Dr. David Baird: Physics coordinating high schools and community colleges by Dave Hollis. Then came a most welcome break - the Thousand Island cruise: band, cash bar, entertainment sunset and starlight. Need we say more?

Back to work with "The new Ministry Guideline" by Jack Bell this was followed by the ever popular 'free for all' My favourite Demonstration, where anyone can bring in a piece of apparatus or just stand up and describe how he or she teaches physics, which may also include an addition to what someone else has just presented. This item has become the most popular feature of our meetings. Next came "Microcomputer control of building heating and ventilating by John Trant: Physics and Art by Dr. Reuben Alley: Physics and the Atari, or Why I Adore The 64 by Murray Kucherawy: A one year monitoring of a solar water heater by Peter Shaw: An experiment on statics and errors by Ernie McFarland: Physics and society by Dr. Eknath v. Marathe.

Life memberships and free attendance at all future conferences were presented to Dr. Al Bartlett and to George Van de Kuur for their past services to the Ontario Section.

In the past we have been fortunate enough to have many U.S. physics teachers at our annual conferences and this year was no exception we welcome their participation and invite others to join, what we consider an annual Physics family gathering.

Doug Fox one of the backbones of our sections has moved upwards into administration. He and his brand of physics is going to be sorely missed, and we cannot pretend that he will be easily replaced. Nevertheless we wish him well and thank him for all he has done for our section since its inception. In particular we must mention the grade XI physics contest which was the brain child of Doug and which he nutured into the flourishing concern that it now is. Thanks Doug we are sure going to miss you. Thanks go to Don Murphy of Sydenham High School near Kingston for taking over Doug's administration of the contest.

Credits go to Brenda Molloy for planning the programme and for overseeing its smooth running and to Dr. Napoleon Gauthier for the superb arrangements at the Royal Military College at Kingston.

Neves Pereira

Section Representative
Ontario Section.

STAR GAZING

By Doug Cunningham

"I'm sure what I could have seen today would have changed my entire life... had i seen it !"
Frances Liverance

Grade 11 student BPDS

The principal of Bruce Peninsula District School came out of his office with the good news ..."Doug, the Superintendent's permission for the solar eclipse expedition came through today!" Although the snows of winter still blanketed the Bruce Peninsula my thoughts focused on 4 days around May 30/84 ... what an opportunity for our students ! The last solar eclipse to be seen from North America this century would occur within a good day's driving distance from Lion's Head. At 12:43 PM on May 30 the shadow of an annular eclipse would pass over Petersburg, VA. For many of our students this would be their first time out of Ontario and this expedition would provide an opportunity to visit points of historical, geographic, political, and scientific interest.

Through the efforts of John Hlynialuk and myself the trip itinerary was gradually confirmed. The expedition would involve students from both BPDS and the Wiarton High School. From our base camp at Big Meadows in the Shenendoah Mountains National Park we planned side trips to Washington to view the National Air and Space Museum, to Luray for a guided tour of the Luray Caverns, to the Petersburg National Battlefield for a lecture on the siege of Petersburg followed by the eclipse, to the new Science Centre and Planetarium at Richmond, and finally on our way home to Corning, NY where a tour of the Corning Glass Museum would complete the trip.

This eclipse promised to be a rare breed of annular eclipse; for instance, when the geometry of the earth, moon, and sun are such that the apparent diameter of the moon exceeds that of the sun you have a normal solar eclipse with its attendent views of the corona, chromosphere, and prominences; when the situation is reversed and the moon's apparent diameter is less than the solar disk one will experience a totality in which the moon is surrounded by a bright ring of sunlight (annulus) which is usually too bright to permit views of the solar corona, chromosphere etc; however, in the rare instance when the moon's apparent diameter is just fractionally smaller than the disk of the sun the previous bright annulus will be broken by the lunar limb mountains into a string of bright beads known as the "diamond necklace" and as the eclipse progresses these beads should fuse into arcs while previous arcs will be broken into beads resulting in a "kinetic eclipse". In addition to the rare opportunity to view the diamond necklace this eclipse offered one other main attraction ... because over 99.8% of the solar disk would be obscured at totality there was the chance of viewing simultaneously the solar corona, chromosphere, and any attendent prominences. It is no wonder that spirits and anticipation were high as the telescope cameras, solar filters, and personal gear were loaded onto the bus.

At our noon hour meetings the expedition was planned in detail ... why eclipses occur, safety viewing procedures, photography, camping regulations, points of interest, and customs regulations all came up for discussion. The chances for good weather at the eclipse broken clouds. I remember saying to the students that we could really hit a string of bad luck and have rain every day we were gone. Little did I know how close to the truth this statement would come.

Eclipse day dawned cloudy at our Big Meadows campsite; two previous days of rain, combined with a weather forecast that called for clearing only after the eclipse, did little to raise our hopes for seeing the eclipse at Petersburg. We faced a difficult decision, we could drive south into North Carolina in the hopes of catching clear skies or continue to Petersburg. We choose Petersburg, after all, if the weather cleared that would be the ideal location with the best chance of viewing a spectacular diamond necklace; as well , we had arranged for the students to receive a lecture on the Seige of Petersburg at the Petersburg National Historic Park after which we would leave for Richmond with its world class Planetarium and shopping centres. At least if the clouds persisted this part of our expedition would not be a total loss.

Shortly after 12:00 noon on eclipse day, our group of 32 students and 7 adults could be found climbing a small knoll at Fort Stedman (part of the Petersburg National Historic Park) under overcast skies. Ray Koenig, physics and astronomy professor at Wilfrid Laurier University, pointed out the direction from which the moon's shadow would approach. It was already quite dark but at 12:43 it got really dark and noticeably cool... we were beneath the moon's shadow and a few miles of overcast. At the darkest part of the eclipse one of our supervising teachers, Danah Oliver, opened a poster of the eclipsed sum ... everyone cheered, took pictures, and put on their Solar Skreen glasses... a nice touch of humour. Just as quickly as it came the Moon's shadow moved off to the east and it became noticeably brighter... the birds began to sing.

On a personal note, the overcast which prevented us from seeing, what we later learned was a truly spectacular eclipse, stayed with me as a cloud of disappointment until later that night around the campfire when the students signed an eclipse book I had purchased at the Science Centre in Richmond. As I read their comments concerning the many wonderful memories they would take home from the expedition it placed again the entire trip in perspective. There are many joys to teaching young people!

Clear skies and Good observing

See you in Hamilton in June 20 to 22 at our annual conference.

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume VI, Number 1

Editor: Brenda Molloy

March 1985

American Association of Physics Teachers

Ontario Section

NEWSLETTER

Volume VI, Number 2 Editor: Brenda Molloy May 1985

AAPT- Ontario Annual Spring Conference

On June 21st and 22nd the AAPT (Ontario Branch) will be holding its seventh annual meeting at McMaster University in Hamilton, Ontario. The organizers have assembled an interesting group of speakers from inside and outside the physics teaching profession. They include:

Dr. Stuart Smith
President of the Science Council of Canada

Dr. Eric Svensson,
Atomic Energy of Canada, Chalk River

Mr. John Dobson
Founder of the San Francisco Sidewalk Astronomers and Worldwide Lecturer on Physics & Eastern Religions

Dr. Bill Goruk
Mohawk College of Applied Arts and Technology

Dr. Wally Piesczonka
Founder and President of Linear Technology, one of Canada's fastest growing "high-tech" industries.

Ms. Gilles Turner
Physics and Math Graduate & wife of Liberal Leader John Turner

Mr. Stan Percevel & Dr. Dave Wright Halton Board of Education writing team leaders of the Technological Science and Applied Physics Guidelines.

There will be also contributed papers, tours of the McMaster Research Reactor and Tandem Van de Graaff Accelerator facilities, two wine and cheese receptions, an outdoor barbecue and, most importantly, a chance to meet old friends and make new ones in the teaching profession.

There is accommodation in the university residences for a full fee of $120 (single occupancy) of $110 (double occupancy) for members. Or if you wish to commute each day the fees are $65 for members. The conference is open to non-members of the AAPT but it is cheaper to join and take advantage of the members' rates.

Anyone wishing to attend or wants further information should contact

Mr. A. McEachern
c/o M.M. Robinson H. S.
2425 Upper Middle Road
Burlington, Ontario
L7P 3N9

Or David McKay
3027 Balmoral Drive,
Burlington, Ontario
L7N 1E3
(1-416-335-5588)
School

AAPT Grade 11 Contest

This year about 3000 or so grade eleven students participated in the fifth annual contest held on Tuesday, May 7th. This contest was in the form of 25 multiple choice questions based mainly on the curriculum laid down by the government but including a few questions on Physics, History, current events and general knowledge. We thank Don Murphy at Sydenham H.S., Sydenham, Ontario, Canada K0H 2T0 for running the contest for us and look forward to seeing the results.

Last year 2676 students entered and not just from Ontario.

A Status Report on the Intermediate /Senior Science Curriculum Project

For high School Science Courses (extract)

In the fall of 1982, work began on the development of an Intermediate/Senior Science Curriculum Guideline with the formation of a Project Team, an Advisory

Committee, and a Franco-Ontarian Group. Additional writers and resource personnel have been involved in the creative process.

The task has involved the writing of several drafts of each of 27 courses and a comprehensive section on the overall program and policy.

At present, of the 27 courses, 15 have been validated, 7 are now out for validation, and the remaining 5 will be distributed for reaction before the summer. All validation returns will be in by the end of this calendar year.

It is anticipated that the Intermediate and Senior Science Curriculum Guideline will consist of nine parts, each in a separate booklet, as follows:

Part 1:
Science Program and Policies

Part 2:
Science, Grade 7 & 8, and 9 & 10 General and Advanced
- Science, Grade 7
- Science, Grade 8
- Science, Grade 9, General Level
- Science, Grade 9, Advanced Level
- Science, Grade 10, General Level
- Science, Grade 10, Advanced Level

Part 3:
Basic-Level Science
- Science, Grade 9, Basic Level
- Science, Grade 10, Basic Level
- Science, Grade 11, Basic Level
- Science, Grade 12, Basic Level

Part 4:
Environmental Science
- Environmental Science, Grade 10, General Level
- Environmental Science, Grade 10, Advanced Level
- Environmental Science, Grade 11, General Level
- Environmental Science, Grade 12, General Level
- Environmental Science, Grade 12, Advanced Level

Part 5:
Geology
- Geology, Grade 12, Advanced Level

Part 6:
Senior Biology
- Applied Biology, Grade 11, General Level
- Biology, Grade 11, Advanced Level
- Biology, OAC

Part 7:
Senior Chemistry
- Applied Chemistry, Grade 11, General Level
- Chemistry, Grade 11, Advanced Level
- Chemistry, OAC

Part 8:
Senior Physics and Technological Science
- Applied Physics, Grade 12, General Level
- Technological Science, Grade 12, General Level
- Physics, Grade 12, Advanced Level
- Physics, OAC

Part 9:
Science in Society
- Science in Society, OAC

Part 1, which is now being distributed for validation, contains sections as follows:

1. Introduction to the Guideline
2. Introduction to Part 1
3. The Goals of Education
4. Why Science Education?
5. The Aims of the Science Curriculum
6. The Nature of Science
7. Scientific Literacy
8. The Science Program Framework
9. Teaching Policy
10. General Considerations
11. Curriculum Emphases - Blending Curricular Aims with Content
12. Language and Science
13. Values in Science Education
14. Implementing the Science Program
15. Staff Development
16. Resources
17. Modes of Delivery
18. Courses of Study
19. Measurement
20. Safety
21. Evaluation

Four Appendices
A. Physical Quantities
B. Metric Editorial Practice
C. Some Poisonous Plants
D. Course Codes

Some of the features that distinguish the new science courses compared to former courses are as follows.

. They are more prescriptive, that is, they have, as a rule, a higher percentage assigned to core units and less to optional units.
. They prescribe attitudinal, skills, and knowledge objectives.
. They contain mandatory student activities.
. They include the teaching of applications and societal implications.
. In Grades 7 to 10 Science, each year consists of a mosaic of biology, chemistry, physics, and environmental science.
. There are courses for all three levels of difficulty in Grades 9 through 12.
. It is recommended that the Grade 9 general or advanced-level course or any basic-level course is compulsory towards the earning of a diploma; one other science credit is also compulsory.
. There are prerequisites to the OACs.
. Science in Society is a new course developed as an OAC particularly for students planning to enrol in the arts at a university.
. Technological Science is a new Grade 12, general-level course developed particularly for students who are not taking senior advanced-level chemistry and physics and who wish to enrol in technology courses in the colleges of applied arts and technology.

It is anticipated that present science courses based on current intermediate and senior science guidelines will be phased out and that the new courses will be phased out and that the new courses will be phased in according to the following schedule:

. Grade 7 and 8 courses by September 1, 1988;
. Grade 9 to 12 courses and the OACs by September 1, 1989.

Implementation prior to these dates is encouraged whenever it is feasible to do so.

Reactions of a constructive nature to this SCINFO are welcomed by the Curriculum Branch of the Ministry which deeply appreciates the assistance of Don Garratt and John Pettit Curriculum Project.

At present, Regional Office personnel in the Ministry, publishers of textbooks, science coordinators, and STAO Councilors are becoming aware of the curriculum guideline drafts and their revisions. All who are concerned with the new courses will have opportunities to be fully informed. In the meantime, our efforts in the Ministry are focussed on steering the document through its final stages realizing that much has yet to be done. We sincerely appreciate the efforts of all who have helped.

Jack Bell
Science Project Manager
Curriculum Branch
Ministry of Education
16th Floor, Mowat Block
Queen's Park
Toronto, Ontario
M7A 1L2

HOW TO MAKE THE BEST OF A POSTER PRESENTATION

Robert F. Garrison, Judith A. Irwin and John R. Percy

Department of Astron omy
University of Toront o
Toronto, Ontario
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The poster or display presentation is an increasingly common way of giving a paper at a scientific meeting. Many and sometimes all contributed papers are given in this manner. The poster presentation has some advantages over the oral presentation - especially the five-minute oral presentation currently used by some scientific societies. The audience can view the poster at leisure, and the presenter can discuss it in depth with the audience, without stage fright or rehearsal.

It is our experience that the poster presentations given at most meetings range from excellent to abominable. Those in the latter category do not convey their information effectively and do not create a good impression. An established scientist may not need to create a good impression, but a more junior one - especially if job-hunting - cannot afford not to. A good poster presentation does not require much more in the way of time and materials than a bad one, especially with the advent of new technology in computers and photocopiers. It does require a bit more forethought and concern. The following suggestions may be useful.

BEFORE THE MEETING

Find out how much space you will have for your poster. Standard sizes are 1 m x 2 m (clearly it makes a difference). Start to gather and organize the photographs, diagrams, tables and text which you will need.

Choosing Your Material

Avoid the temptation to include too much material in the body of your poster. Two or three pages of text, plus a few diagrams, are usually adequate. The captions for the diagrams should be self-contained. Often, they can take the place of some of the text. Ideally, each diagram should illustrate a single point, and should be contained on a single sheet. You could include two diagrams together if you were comparing them. Avoid long formulae, derivations or calculations in the text. These can be posted as an appendix, to be read by those who are particularly interested. The same goes for long tables of data. Often, these are better replaced by bar graphs. One of the advantages of the poster presentation is that you can have more detailed information on hand for those who want it. It doesn't hurt to include an abstract or summary in your poster, even though this may also appear in the meeting abstract book.

Organizing Your Material

It helps to lay out and organize your material ahead of time. Find an arrangement which is both clear and aesthetically pleasing. Arrange the text and diagrams in logical order. This can be done, if necessary, with page numbers or with arrows to guide the viewer's eyes.

Constructing the Poster

Legibility is a primary concern. The lettering on the poster should be readable from a distance of a metre or more. Letters should be 5mm or more in size. This can be accomplished by photographic enlargement (expensive and time-consuming), by use of IBM Orator typing ball, by computer graphics or by photocopying ordinary typescript with one of the enlarging photocopiers which are widely available today.

Your diagrams and captions should be clear and easy-to-read. Avoid small, faint dot-matrix printing. Make sure that graph symbols are large and clear. Some computer-generated diagrams are very poorly-formatted. Colour can add clarity as well as getting the viewers' attention (as discussed below).

It helps to mount your diagrams and text on sheets no larger than what you can carry easily in your briefcase. Some people put their poster on a single sheet and carry it rolled-up. It may be more cumbersome to carry this way but, since the material is pre-organized, it can be posted quickly, Take a supply of thumb tacks. The meeting may not proved them.

Getting the Viewers' Attention

Although some viewers will find and read your poster no matter how bad it is, others (even some with good intentions) may pass it by. You can help your viewers by having a large, clear title which includes your name and institution. You can further attract an audience by using a bit of colour in the text or diagrams, or as a border or background. Mounting your material on sheets of coloured construction paper, for instance, can be very effective. You could even use a bit of whimsy or humour, if you like. Consider including a photograph or two of the objects being discussed in your paper, even if this is not absolutely necessary. People still relate to a visual image.

AT THE MEETING

Find out when you are required to be with your poster, and when you are to put it up and take it down. Putting up the poster late is a waste of valuable time, and reflects poorly on your professional image. Failing to take it down on time may result in its unceremonious removal by the meeting organizers. If you cannot be with your poster when required, post a sign stating when you will be there, or when you will be back. Also post your mailing address, so that interested viewers can get in touch with you. You may want to distribute preprint versions of your paper, but remember that you will have to transport them to the meeting, and that some viewers will use them for scrap paper. A useful alternative preprints by mail. This is especially appropriate if your poster contains preliminary results, and a preprint is not yet available. It has the additional advantage of providing you with a mailing list of persons who are interested in your work.

AFTER THE MEETING

If you have followed our suggestions, your poster will be too good to throw out. Post it on a bulletin board or wall outside your office, and encourage your colleagues to do likewise!

Nomination For AAPT - Ontario Executive 1985-1986

(If no further nominations have been received by May 23/85 this will be our new executive)

President: Dave McKay

Vice-President: Ross Hallett

Secretary/Treasurer: Bob Bassett

Section Representative: Al Hirsh

Member at Large: Grace Dominato

Thank-you, all,
Brenda Molloy

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. VII No. 1

The Annual Meeting

On June 21-22, 1985, the annual meeting was held at McMaster University in Hamilton. Approximately 115 AAPT members that were on hand were treated to many stimulating presentations.

The invited papers began with a presentation by William Harris, McMaster University, titled "Star Clusters and the Age of the Universe". He described some recent research techniques with results indicating that the current estimate of the age of the universe is 14 billion years ($\pm$2 billion years). John Dobson, of the San Francisco Sidewalk Astronomers, followed with a lively talk called "Cosmological Fossils" in which he argued that gravity, electricity, and inertia are the fossils that can be used to interpret the universe. His theory led to several interesting conclusions, including the statement that protons should not decay. Stuart Smith, Chairman of the Science Council of Canada, gave an enlightening talk on "The Effect of Technology on Canada's Economic Prospects". He strongly advised Canada to place a greater emphasis on knowledge intensive industries to help reduce our dependence on the export of our natural resources. Craig Bohren, Pennsylvania State University, took us on a photographic tour to such fascinating places as Iceland and the Antarctic to illustrate his explanations of the color blue in ice, water, snow, and the sky. In his paper, which was titled "Reflections on the Blues", he showed clearly why scattering and absorption are important when explaining color phenomena in nature. William Goruk, Mohawk College of

Applied Arts and Technology in Hamilton, described the physics courses taught in both the technical and technological programs offered at the college. This information will help high school physics teachers plan their curricula. Wally Pieczonka, from a private company called Linear Technology Incorporated, discussed how the training and education of physics relates to the manpower needs of industry. Eric Stevensson, Chalk River Nuclear Laboratories, brought to life his favorite fluid in a presentation titled "Superfluid Helium - A Most Fascinating Material". He supplemented his talk with a movie showing the superfluid action of liquid helium at temperatures below 2.17°K. High school teachers Dave Wright, Brenda Molloy, and Stan Percival presented draft outlines of two courses proposed in the new curriculum guidelines. These courses, called Applied Physics and Technological Science, are intended to help students prepare for courses in community colleges. Denny Pierce, from P.J. Spratt and Associates, described a teaching resource kit called "Focus on Fission - Unlocking the Nucleus". The kit consists of film strips, cassette tapes, a nuclide chart, and a teacher's guide. Merv England and Stefan Dubel, Parkdale High School, demonstrated applications of VELA (Versatile Laboratory Aid), a commercially-available device that can be linked to a computer, an oscilloscope, or a chart recorder.

The interest level at the meeting remained high with a variety of short contributed papers.

- "Measuring Frequency with a Microcomputer", Stuart Quick, University of Toronto
- "An Undergraduate Experiment to test Einstein's Second Postulate", Robert Stone, University of Guelph
- "Using Logo in Teaching Vectors", Peter Scovil, Waterford District High School
- "Millisecond Timing with a Commodore Computer", G. S. Rose, University of Western Ontario

- "Grade 11 Physics Prize Contest", Don Murphy, Sydenham High School
- "Is Spinning an Inherent Characteristic of Everything in the Natural World?", E. V. Marathe, Grantham High School
- "Curing Calculatoritis", Ernie McFarland, University of Guelph (Try finding the number 1.000 000 1 to the power 27 on different types of calculators and comparing answers!)

On Friday evening, a sumptuous banquet was followed by one of the invited speakers, more tours of McMaster's facilities, and star gazing with Steve Dodson, from Science North in Sudbury, Ontario, who brought his 56 cm reflecting telescope more than 400 km to the meeting!

Congratulations to David McKay, M.M. Robinson High School, Burlington, for organizing our rewarding meeting, and many thanks to the hosts at McMaster University.

Alan Hirsch

Grade 11 Physics Contest Results

This year the "torch was passed" from Doug Fox, first co-ordinator of the contest, to Don Murphy of Sydenham High School. Don did a great job of effecting a smooth transition - the questions were as challenging as ever. From some 3,000 entries, the top ten were:

1st at 100% (our first ever "perfect paper"):
- M. Rajagobal, Earle Haig S. S., Willowdale

2nd at 92%
- R. Brezina, George Vanier S. S., Willowdale
- I. Walker, Etobicoke C. I., Islington

3rd at 88%
- M. M. Easson, Gloucester H. S., Ottawa
- J. E. Fry, Woburn C. I., Scarborough
- K. A. Gordon, Woburn C. I. Scarborough
- M. F. Greaves, West Hill C. I., West Hill
- G. K. Hadlock, Sir Winston Churchill, C. I., Vancouver
- Y. C. Ngai, Upper Canada College, Toronto
- J. S. Sachdeva, Toronto French School

Altogether, Don awarded 23 prizes of these 4 went to students at Woburn C. I. in Scarborough and 3 to Sir Winston Churchill C. I. in Vancouver. Congratulations to these schools.

Don is now organizing his 2nd contest, and sends forth a plea for good questions, which are always in short supply. If you have a question (or questions) which you feel would be suitable for the contest, please send them to:

Don Murphy,
Sydenham High School,
Syndenham, Ontario.
KOH 2TO

Physics Contests and Semestering - The Section Presidents View

Like a number of others, my school has been semestered for some time. This has given me some difficulties in handling the S.I.N. and AAPT Physics prize tests - my second semester students had not covered a good chunk of the material and my first semester students had forgotten it or were busy with other things. As you perhaps have, I asked myself - "why can't they have two contests per year - more and more schools are being semestered after all".

Then, as a member of the Section Executive, I saw how much work it is for the Contest Co-ordinator to put together one contest per year.

(a) A set of 30 challenging but fair questions have to be put together and approved by a number of University Profs.

(b) Many hundreds of "invitations" have to be sent out.

(c) Booklets of tests must be sent to the several hundred schools that respond.

(d) Returned cards must be carefully kept track of and sent in batches to the University of Guelph for marking.

(e) Winners must be chosen, notified, prizes obtained and sent.

(f) A set of books must be kept accounting for funds received and expended.

This is a major voluntary commitment on the part of anyone; to ask them to do it twice a year is "beyond reason". To find a second person appears equally difficult and then there is the problem of balancing the two tests.

Perhaps we need to realize that these are PRIZE tests, meant for the best half dozen students in the school who are interested enough in Physics to overcome the difficulties of date. At least, as more of us "go semestered", then, more of us are "in the same boat".

I would emphasize that these are my own views (though the executive shares my feeling that we cannot at this time operate the contest on a "twice a year" basis), and I would welcome any comments or suggestions that you might care to direct to me.

- D. McKay

AAPT (ONTARIO) EXECUTIVE 1985-86

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Executive Profile

Each Newsletter this year will feature a brief profile of one or two members of the AAPT-Ontario Executive. This issue we are proud to present:

1. Ross Hallett - Vice-President

Ross was born in the small town of Nanton, Alberta. As a teenager he developed an allergy to grains and decided that a career other than farming was indicated. So it was off to the University of Calgary for a degree in Chemistry followed by a Masters in Physical Chemistry.

Ross now felt it was time for other places and other branches of science so he took a PhD in biophysics at Pennsylvania State University. From here Ross went to the University of Guelph where he was appointed a full professor in 1982.

His research interests include the scattering of laser light from biological molecules and motile cells; as well as small angle neutron scattering from biological macromolecules, for which he uses the McMaster University Reactor. Ross has published a number of articles relating to computer aided instruction in the American Journal of Physics, an educational interest which led to his involvement in the AAPT-Ontario Executive.

Ross is married with 2 children and enjoys music, hiking and sailing. As Vice-President he is chief organizer of the 1986 summer meeting and will then serve as president in 1986-87.

AAPT-Ontario Summer Meeting 1986

Our 8th Annual Meeting will be held June 13th and 14th at the University of Guelph under the chairmanship of Dr. Ross Hallett, Section Vice-President. It will be preceded by a one-day, single topic workshop on Thursday, June 12th. Mark these dates on your calendar and watch for details early in 1986.

STAO Holds Regional Conference Nov. 23

Physics Teachers in the Toronto area will be interested in the Science Teachers Association of Ontario Region 7/8 one-day conference to be held Saturday, November 23rd at Don Bosco High School, near Islington and Dixon Road in Toronto. Programs for the conference are in most high schools in Regions 7/8; if you have not seen one and would like to, call:

Michael O'Keefe,
Don Bosco S. S.,
416-241-3581

HALLEY'S COMET

A 21-pg. "Guide for Ontario Teachers on Halley's Comet" has been written by Prof. Jim Hunt of the Physics Department of the University of Guelph, and is available free of charge. This timely guide includes articles and student exercises, and will be of interest to elementary and secondary school teachers. Any of the items may be copied for educational purposes, provided that suitable credit is given.

To receive a copy of the guide, write: Halley's Comet, Dept. of Physics, University of Guelph, Guelph, Ontario N1G 2W1, or phone (519) 824-4120, ext. 2261.

Membership Renewals

On your mailing sticker is the date of expiry of your membership; all those who are "paid up" have a date of June '86, any others are in need of renewal. If your membership expired in June of '85 or '84 we are sending this Newsletter as a reminder and, hopefully an incentive, but we cannot afford to keep doing so! Please use the attached form to renew TODAY. (If you have renewed, why not give this form to a fellow physics teacher and encourage them to "swell the ranks".)

Membership Form

Name: ______________________

Address: ______________________

____

____

Postal Code: __________

Affiliation:
- ☐ Secondary School
- ☐ University
- ☐ College
- ☐ Other

The membership fee for one year is $5.00

Please send this completed form and a cheque or money order for $5.00 payable to AAPT-Ontario to:

Mr. Dave McKay,
President, AAPT Ontario,
3027 Balmoral Ave.,
Burlington, Ontario.
L7N 1E3

American Association of Physics Teachers
ONTARIO SECTION

1985

Dear fellow member of AAPT-Ontario and/or fellow Ontario Physics Teacher:

It has been several months since you received our initial flyer confirming that there would be a seventh annual AAPT-Ontario meeting and that it would be June 21 and 22nd at McMaster University in Hamilton.

We haven't had time to write you since then because we've been busy organizing what we think will be a fine conference and we want to tell you about it in the hope that you'll be able to join us.

First, we have an interesting and varied group of featured speakers to bring us views on physics and physics teaching from inside and outside the profession:

- Dr. Stuart Smith, President of the Science Council of Canada
- Dr. Eric Svensson, Atomic Energy of Canada, Chalk River
- Mr. John Dobson, Founder of the San Francisco Sidewalk Astronomers and Worldwide Lecturer on Physics and Eastern Religions
- Dr. Bill Goruk, Mohawk College of Applied Arts and Technology
- Dr. Bill Harris, Dept. of Astronomy, McMaster University
- Dr. Wally Piesczonka, Founder and President of Linear Technology, one of Canada's fastest growing "high-tech" industries
- Ms. Gilles Turner, Physics and Math Graduate and Wife of Liberal Leader John Turner
- Mr. Stan Perceval and Mr. Dave Wright; Halton Board of Education writing team leaders of the Technological Science and Applied Physics Guidelines.

In addition to these there will be, of course, contributed papers by our section members. (If you are receiving this material as an AAPT-Ontario member, you'll find attached a "call for papers" outline and submission form.)

Other features of the conference include tours of the McMaster Research Reactor and Tandem Vander Graaf Accelerator facilities, two wine and cheese receptions sponsored by the University, an outdoor beef and salmon barbecue and, of course, the chance to renew acquaintances with physics teachers from all over the province.

You will note from the registration form that we are offering two "packages".

#1 for those who prefer to commute, a package of three meals, a reception and the conference registration fee.

#2 for those staying in residence, a full package - two nights, five meals, two receptions, free parking, and of course the conference registration fee.

continued...

Notice that its cheaper to register for the conference if you join AAPT than if you don't. That's because we want as many physics teachers as possible to be part of the second largest of all the AAPT sections. So join, or renew, and receive next years newsletters and information about the 8th Annual AAPT Conference in 1986.

If you really can't come to the June meeting but wish to join AAPT-Ontario, or renew your membership, please complete the separate registration form and send it to us, along with the $5.00 fee.

I'm sorry that there hasn't been a Section Newsletter to give you earlier details of the June meeting; hopefully you will be able to arrange the time and the funds to join us; we look forward to meeting you at McMaster this June.

Best regards,

Dave McKay.

Dave McKay,
Vice-President AAPT-Ontario
and the Conference Committee

P.S. Don't forget to register by May 31st; sooner - if you can!

AAPT (ONTARIO) SECTION ANNUAL MEETING

JUNE 21-22-23, 1985

(Please print or type)

NAME Mr/Miss/Mrs/Ms ______________________________________
Surname First Name

HOME ADDRESS ______________________________________
No. Street City Postal Code

BUSINESS ADDRESS c/o ______________________________________
Institution

____
No. Street City Postal Code

HOME PHONE ( ) - ________ BUS. PHONE ( ) - ________

MEMBERSHIP

Membership in AAPT (Ontario) is a real bargain at $5.00 per year.

( ) I wish to renew my membership for the year 1985/86

( ) I wish to become a member for the first time

MEAL & ACCOMMODATION PACKAGES

Package #1

Conference Registration
Friday Lunch, Reception
and Banquet
Saturday Lunch

Members	$65.00
Non Members	$75.00

Package #2

Conference Registration
Thursday Reception
Friday Breakfast, Lunch, Reception & Banquet
Saturday Breakfast, Lunch
Accommodation Thursday & Friday Night

	Single Occupancy	Double Occupancy
Members	$120.	$110.
Non Members	$130.	$120.

If you have requested double occupancy please give room mates name:

____

TOTAL FEES

Membership 1985/86 $________.____
Meal & Accommodation
Package 1 2 ________.____
(Please circle one)
Total $________.____

Please send a money order or cheque made payable to AAPT ONTARIO for the above total and this form to:

Mr. A. McEachern
c/o M. M. Robinson H.S.
2425 Upper Middle Rd.
Burlington, Ontario L7P 3N9

P.S. To ensure your place please have this registration form postmarked no later than June 1, 1985.

American Association of Physics Teachers
ONTARIO SECTION

Membership Application Form

USE THIS TO RENEW OR JOIN IF YOU ARE NOT ATTENDING THE JUNE CONFERENCE

Name: ______________________

Address: ______________________

____

____

Postal Code: ____________

Affiliation:
- [ ] Secondary School
- [ ] University
- [ ] College
- [ ] Other

The membership fee for one year is $5.00

Please send this completed form and a cheque or money order for $5.00 payable to AAPT-Ontario to:

Mr. John Hlynialuk
Secretary-Treasurer, AAPT-Ontario
Wiarton D.H.S.
Box 580
Wiarton, Ontario
NOH 2TO

AAPT-ONTARIO 7TH ANNUAL MEETING

CALL FOR PAPERS

Contributed papers by our Section members are an important part of our annual meeting. This year we will be using two formats for these papers:

a) the traditional "oral" method of presentation we have used in the past, with a 20 minute time limit. About 10 of these presentations can be accomodated.

b) a "poster session" approach. About 12 of these can be accomodated - a display board, table and, if necessary an electrical outlet will be provided in a large room which will also house exhibitors displays. This room will be near the conference meeting room and there will be 45 min. time slots on Friday morning, Friday afternoon and Saturday morning in which refreshments will be available in the poster session/exhibitors room.

We have two reasons for this approach.

a) An increasing number of conferences are using the poster session format - it allows delegates and presentors the discussion time missing from the "oral presentation" approach. As well, demonstrations using equipment where a "close-up view" is needed are better presented in this way.

b) Using the two formats increases the number of contributed papers we can accomodate and thus the scope and interest of the conference.

If you have a paper you would like to present, please complete the attached form and send it to me as soon as possible, but no later than May 15th so that our conference program may be prepared.

AAPT-ONTARIO SEVENTH ANNUAL MEETING

OUTLINE OF CONTRIBUTED PAPER

AUTHOR(S) ______________________________

BUSINESS ADDRESS ______________________________

____

BUSINESS PHONE ______________ HOME PHONE ______________

TITLE OF PAPER ______________________________

ABSTRACT (50 WORDS OR THEREABOUTS)

____

____

____

____

____

____

PRESENTATION FORMAT PREFERRED: (check one)

_____ ORAL (20 MIN. MAXIMUM)

_____ POSTER SESSION

_____ EITHER

(NOTE: The conference committee reserves the right to determine format offered if space or time limitations require it. Anyone who cannot be given their preferred format will be contacted as soon as possible.)

EQUIPMENT REQUIRED:

The main conference room will be equipped with an overhead projector and slide projector. We will attempt to acquire other items as requested. Please describe them fully in the space below:

____

____

____

____

____

Send this form to: Mr. David McKay
c/o M. M. Robinson High School
2425 Upper Middle Road
Burlington, Ontario
L7P 3N9

(NOTE: All presentors of contributed papers are expected to be registered conference delegates.)

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

VIII No. 4

FROM THE PRESIDENT:

How fast time flies when you're having fun (or is it just middle age)? As I finish my term, some thanks to some special people - to Alden McEachern for a tireless and uncomplaining year as Newsletter Editor; to Ross Hallett for organizing yet another super conference; to Bob Bassett for keeping us "in the black" (I hope!); to Ernie McFarland for handling all the membership renewals and obscure footnotes I send him, and to you, the membership for supporting the section. I've enjoyed the chance to work with all of you, and look forward to next year as "Past President" - as soon as I know what that entails!

The Membership of AAPT - Ontario extends its sincere sympathy to treasurer Bob Bassett on the recent loss of his father.

CONFERENCE UPDATE

There's still time to make it! If you want to register "at the door" use the map below to find the registration desk location for Thursday night and Friday morning - poster sessions, exhibitors, invited and contributed papers, receptions and a banquet - its all there at Guelph - can you be there too?

Guess what no map but a lot of instructions! Registration Thursday night is at Lennox-Adington Hall and on Friday morning Physics building. (Just follow the LARGE brown signs.)

Relativity in a Minute?????

The length of a minute depends on what side of the bathroom door you are on ·

Physics Department University of Guelph

Physical Constants

Magnitude of electronic charge, e	1.602×10^{-19} C
Mass of electron, m_e	9.110×10^{-31} kg
Mass of proton, m_p	1.673×10^{-27} kg
Speed of light in a vacuum, c	2.998×10^{8} m/s
Planck's constant, h	6.626×10^{-34} J.s
Gravitation constant, G	6.672×10^{-11} N.m^2/kg^2
Avogadro's number, N_A	6.022×10^{23} mol^{-1}
Coulomb constant, $k = \frac{1}{4\pi\epsilon_0}$	8.988×10^{9} N.m^2/C^2
Molar gas constant, R	8.314 J.mol^{-1}.K^{-1}
Boltzmann's constant, $k = R/N_A$	1.381×10^{-23} J/K
Atomic mass unit, μ	1.661×10^{-27} kg

Some Physical Data

Radius of earth (avg.)	6.37×10^{6} m
Mass of earth	5.98×10^{24} kg
Speed of sound (in dry air at 20°C and 1 atm.)	343 m/s
Earth-sun distance (avg.)	1.49×10^{11} m

SI Prefixes

Factor	Prefix	Symbol
10^{18}	exa	E
10^{15}	peta	P
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10^{1}	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

... and from Alan Hirsch (Section Representative)

AAPT/APS Joint Winter Meeting, 1986

The 1986 AAPT/APS Joint Winter Meeting was held in Atlanta, Georgia, from January 26 to January 30. Two red-blooded Canadians, Ernie McFarland and myself, left Ontario clad in our finest spring outfits, anticipating a warm reception in the deep south. To our dismay, we arrived concurrently with the coldest weather Atlanta has experienced in recent history. Despite windchill equivalent temperatures as low as -30°C, we enjoyed a stimulating and rewarding conference at the Downtown Marriott Hotel.

In attending the committee meetings and open house receptions as Ontario's section representative, I was impressed by the professionalism and complexity of the AAPT. The association is deeply concerned about the quality and quantity of physics education in the Western Hemisphere, and it is my opinion that Ontario's physics educators can benefit from as well as contribute to the efforts of the AAPT.

In attending the contributed and invited presentations and the commercial displays at the conference, I noticed the following general trends in physics ecucation.

- The use of television videotapes is becoming more common, and teachers are able to attend workshops on how to produce their own videotapes.
- Video laser discs, which can be interfaced to microcomputers, are in the earliest development stages, but efforts to make them accessible and affordable are progressing.
- Physics educators are sharing their interest in the history of the development of physics and their concern about the equality of opportunity in physics for women and minority groups.
- Computers continue to be important as more uses are developed for curriculum instruction and laboratory investigation.
- Much research is being carried out into "chaos" in physical systems. (I think we'll be hearing more about chaotic systems in the near future.)
- In trying to make physics come alive, teachers are relating physics to the day-to-day activities and career possibilities of their students.
- Equipment and textbook prices continue to rise rather dramatically.

The specific details of the conference would occupy several pages. Because of space limitations here, I will comment on only a few of the details.

- Two names familiar to Ontario AAPT members appeared on the presentation list. Ernie McFarland of Guelph University gave a talk titled Curing Calculatoritis, and T. Dean Gaily, currently at the University of Washington in Seattle while on leave from the University of Western Ontario in London, reported on an investigation of the abilities of students to apply concepts taught in physics to actual physical systems.
- Another Canadian, P.F. Hinrichsen of Quebec, gave two papers, one on measuring the weight distribution of a sailboat and the other on the design of a photogate for air track experiments.
- I atended some excellent presentations on "amusement-park physics", but the enthusiasm and examples of successful field trips to parks did not dispell my fear of safety problems associated with such trips.
- Several interesting papers on the application of physics to music, medical practice, and sports were given.
- Howard Head, who developed the famous metal skies, gave a delightful speech about the practical nature of physics in his own life. He shared the story of the development of his second major contribution to the world of sports - the Prince tennis racket.
- An Inter-American Conference on Physics Education is being planned for 1987. It will take place in Mexico.
- Plans are under way to try to get students from the United States involved in the International Physics Olympiad. We in Canada should be proud that our high school students already have the opportunity to be involved, thanks to the efforts of a few teachers.
- The next Joint Winter Meeting will be held in San Francisco in January, 1987. The meterologist has forcast warmer weather than we experienced in

TORONTO FRENCH SCHOOL SPEARHEADS CANADA'S INVOLVEMENT IN THE INTERNATIONAL PHYSICS OLYMPIAD

In Alan's article on the AAPT National Winter meeting he noted that the U.S. is working towards involvement in the International Physics Olympics.

We in Canada are ahead of that point, thanks mainly to the efforts of Harry Giles of the Toronto French School. Over the past several years, Harry has developed a series of Saturday lectures at the school to help bridge the gap between our physics curriculum and the material covered in the physics olympiad (our curriculum is only about 25% of what the kids need - according to Harry, the level of difficulty at the olympiad is about that of 2nd year University).

This year the lectures, given by John Wylie of the University of Toronto, involved some 50 students from 35 schools in the Toronto area. Through some testing, Harry will select the best 5 (the maximum allowed) and take them to England for this years olympiad, from the 13th to the 20th of July. Here the students (who must be no more than 19 years of age and finishing a "pre-university" year) will write two five hour exams - one theoretical and one practical.

The cost, a significant one, is borne entirely by the Toronto French School - a substantial contribution to the development of future physicists. Harry is hoping to improve on last years 16th place finish in Yugoslavia.

Not content with these achievements, Harry has established another olympiad preparation center at UBC and is working on one at Ottawa.

Where do we fit in?

1. Harry hopes to have a booth at our Guelph meeting - if you're there, stop by for a chat and say thanks for all he's done.
2. We will be providing him with the names and schools of our top finishers in the Grade 11 contests in hopes that they may become involved.
3. If you teach in Metro Toronto, make sure your top students are aware of this opportunity and encourage them to get involved...
4. If you're in another part of the province, is it possible to set up other preparation centers? Bring the matter up at your local subject council or with your co-ordinator. I'm sure Harry has materials on what's needed.
5. The executive will be discussing whether we can make at least some small contribution to this years trip.

Suppliers

From the Editor

Have a great summer and IF you come across any phunny fizzicks articles etc. please pass them on to

A. McEachern,
c/o M.M. Robinson H.S.,
2425 Uppermiddle Rd.,
Burlington
L7P 3N9

Many thanks!

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. IX No. 1

REPORT ON THE ANNUAL JUNE MEETING

On June 12-14, 1986, the Ontario Section of the AAPT held its annual meeting at Guelph University in Guelph, Ontario. Approximately 140 members, a record for Ontario, attended the main part of the meeting. They were treated to several stimulating presentations, both invited and contributed, and displays by book publishers, equipment supply companies, and other members.

On Thursday afternoon, Ernie McFarland of Guelph University and Tony French of MIT conducted a superb 5-hour workshop on relativity attended by 34 teachers. Using a variety of media, they brought the teachers up to date on a topic that is included as one of the options in the new educational guidelines for senior high school physics. This was followed in the evening by a cordial reception for AAPT members at the Guelph University President's House.

On Friday, the Dean of Science at Guelph University, Jack McDonald, officially welcomed the members. Then the invited papers began with a presentation by Tony French of MIT titled "Using History in Teaching Physics". He shared with us many reasons for including historical aspects, as well as humorous anecdotes of misleading history and useful examples of correct history.

William McGowan, director of the National Museum of Science and Technology in Ottawa, Ontario, followed with an informative talk which answered the question "Has Canada a Past and a Future in Science and Technology?". He cited many examples of scientific developments in Canada's past and present, and he expressed cautious optimism for the future as well as hope for increased financial input.

Gabriel Karl of Guelph University gave an enlightening talk called "Elementary Review of Elementary Particles". He presented a balance of historical developments, information about current elementary particle research, and projections for the future of this important area of physics.

Gregg Herken, an American author and historian, gave detailed information on a controversial subject in his presentation titled "Thick Smoke and Rubber Mirrors: Origins of SDI". He examined the political, technological, and human origins of "Star Wars", and prepared us for the panel discussion on the same topic held Friday evening. (Gregg was one of the members of the panel.)

Bob Stasko of the Canadian Fusion Fuels Technology Project talked about "Canada's Contribution to Fusion Technology". He discussed Canada's expertise in tritium production, handling, and safety, and Canada's role both nationally and internationally in the future of nuclear fusion research.

The invited papers ended with an inevitable voyage for any 1986 meeting, "What Did We Learn about Halley's Comet", given by Murray Alexander of Guelph University. He used exciting visual aids to share the findings of the space probes that came within close range of the comet.

A variety of contributed papers, each 15 minutes in length, were interspersed among the invited papers. Following is a list of these papers and the presenters.

"Rutherford and Radioactive Decay"; Don Stephen, Barrie, Ont.

"Understanding Fusion Energy: A Filmstrip for Science Teachers"; Jim Hunt, Guelph, Ont.

"Hazards, Risks, and Their Management"; Eknath Marathe, St. Catharines, Ont.

"Science Anxiety - A Preliminary Report"; Patricia Hughey, Lansing, Michigan

"Brainstorming, Changing Gears, Pre-testing, Conceptual Gaps, Applicability and Good Teaching"; Doug Fox, Essex, Ont.

"The Search for Halley's Comet Flight"; Steve Dodson, Sudbury, Ont.

"Statistics of Counting with a Microcomputer"; Stuart Quick, Toronto, Ont.

The invited and contributed papers were followed by the traditional se-sion called "My Favorite Demonstration". This year, 7 useful and sometimes entertaining demonstrations were presented by teachers. This was supplemented by a tour of the modern computer lab run by the Physics Department at Guelph University.

A highlight of the meeting was the Friday evening banquet followed by a 3-person panel discussion on "Star Wars". The panel consisted of a research physicist, a military expert, and a historian, each of whom was articulate and well informed.

Congratulations to Ross Hallett of Guelph University for organizing our annual meeting, and many thanks to all the hosts at Guelph.

Alan Hirsch

Section Representative

MEET SCIENCE NORTH, AAPT!

Steve Dodson

Six years ago, while a physics teacher in North Bay, I took on a challenge of a lifetime: to propose and develop exhibits from Alchemy to Astrophysics that would form an exciting part of a visitor's participation in a new "open science lab" coming into being in Sudbury - Science North. Having been a full-time staff member since 1982, I am both operating a range of public programs that you won't see elsewhere and developing new ones at an ever increasing rate. I am hoping in the next few paragraphs to whet your appetites for some hands on physics fun that I hope you will experience next spring when AAPT-Ontario comes to Sudbury.

All visitors encounter a hint of things to come on the path from the parking lot to the entrance building: two 10-foot parabolic dishes 35 meters apart so well coupled you could swear your friend at the other focus was inches from your ear.

The tunnel, cavern, and spiral ramp that take you to the main exhibit areas constitute between them one of the best "indoor" geology exhibits in the world, clearly displaying the faulting, intrusion, and glaciation that shaped the site.

From the very top of the ramp a colourful 14-foot geodesic dome is seen suspended a few feet off the floor. This is our new "starspace", a radical departure in planetarium design which allows the people inside to see the solar system from the inside out (Geocentric) or from the outside in (Heliocentric), thus reconciling visually the two views of the "universe". The key to this is a solar system model that is correctly oriented in space using tonight's sky as a frame of reference. The planets are frequently advanced to their correct positions, and when a new bright comet appears its orbit will be added to the model.

A few steps from the dome is our solar observator theater. As a theatre it presents a brand new type of presentation rain or shine about the sun, using real objects and instruments arrayed in front of the seating area that are operated or illuminated each in turn. Following this 10 minute "object theatre" presentation the sun, when available, is brought right into the darkened theatre by three separate lens and mirror systems which penetrate the outer skin of the building. While still seated you will see an intense slanting beam of sunlight rising from floor to ceiling before reflecting back down to an 8-foot diameter rotating screen, where it forms a large image of the suns disc and any sunspots present. Beside this white-light solar image you will see a brilliant solar spectrum which is over 15 feet long when the 2nd order is considered. You will be invited to step around behind the rotating screen to look through our hydrogen alpha telescope at solar prominences and prolific disc details seen in this narrow-band red light.

The Solar observatory was the first project I introduced to Science North and it has been the longest in the making. Volunteers from the Sudbury Astronomy Club worked with me to set up an Optical Workshop (which you will see on the exhibit floor) and there we made the major optical components, with over 2,000 hours of work being contributed by the Club. Without them the observatory would not exist in anything like its present form.

Exhibits nearby demonstrate lenses, mirrors, and telescope making. Two one-meter square concave mirrors make the focus of this area clear while mystifying and baffling most people with puzzling aerial images. Also nearby you can climb on a rotating platform to try a variety of experiments or "float" on a pneumatically operated bed of nails.

Next the Faraday Lab awaits you with a variety of electrical, magnetic, electomagnetic and wave analogy hands-on activities. Also in the Faraday area we have built a charcoal-fired bellows aspirated forge similar to the one Faraday used for metallurgical experiments. Once a day we demonstrate the preparation of sand casts, and pour molten brass.

More than two years after opening Science North is still growing and developing rapidly. There is a great deal to try out and enjoy and great things just around the corner!

GRADE ELEVEN CONTEST RESULTS

This year the AAPT-Ontario Section Grade Eleven Contest was written on Tuesday, May 6th. The credit for the organization goes to Don Murphy of Sydenham H.S., Sydenham.

This year the number of schools participating rose to 240 and the list of the top 27 contestants are shown below. Although the contest is run by the AAPT-Ontario section it is open to everyone outside Ontario too and you will see Winston Churchill High School in Vancouver on the list (as it was last year). So join the fun and contact Don for next year's contest.

Our list shows the top contestants, their mark out of 25, their school and, in brackets, their teacher's names. We should all congratulate these students, and their teachers, on their fine achievement.

23	B. Freedm	Nepean H. S., Ottawa (D. Ramsden)
22	J.D. Chrisen	Malvern C.I., Toronto (W. Prior)
20	R.F. Paige	Lord Elgin, Burlington (K. Allan)
20	R.J. Bodki	Nepean H.S., Ottawa (D. Ramsden)
20	M. Ho	Riverdale C.I., Toronto (F. Mustoe)
20	A. Wickman	Woburn C.I., Scarborough (D. Bell)
19	Z. Margalic	A.B. Lucas S.S., London (E. Hill)
19	O.K. Dahlbe	Glebe C.I., Ottawa (D. Gault)
19	G.C. Chong	Laura Secord S.S., St. Catharines (E. Umbrico)
19	J.R. Levitt	North Toronto, Toronto (R. Raymer)
19	A.A. Low	Paul B. Smith, Willowdale (L. Lemmer)
19	T.H. Cheung	Upper Canada College, Toronto (P. Crysler)

EDITORIAL

It's Time To Remind You about "The Forgotten Fundamentals of the Energy Crisis"*

Gas is cheap! Large automobiles and campers are once again clogging the highways during holidays and vacation times! Has the world suddenly acquired a new plentiful supply of petroleum? . . . How easily we forget!

At no other time in the history of the world has there been a greater need for a scientifically literate citizenry. This is the age of uncertain world energy supplies, social disruptions, economic problems, overpopulation, and outright starvation of a significant portion of the population. This is also the age of an unprecedented rate of scientific and technological advancement. The energy factor plays an important causal role in the continuation of many of these problems and achievements.

With an adequate scientific knowledge base and an awareness of the varied and complex linkages between energy and environmental, political, economic, health, and social issues, tomorrow's adults will be better equipped to participate in helping to solve their nations' energy problems. This may be through the participation in decision-making processes or through some energy conversion technological breakthrough.

Teachers will play a significant role in ultimately solving energy problems. Attitudes along with technology are important in working towards solutions. Studies have shown that attitudes and ideas instilled in childhood can easily become habits. It is likely that the students entering our primary schools will be the first generation to feel the full impact of the approaching era of energy shortages. It is important that they, unlike a large segment of today's adult population, respond in a rational way based upon a realistic appreciation of the many and often related factors which are now beginning to govern national energy policies and the search for and development of alternate energy sources.

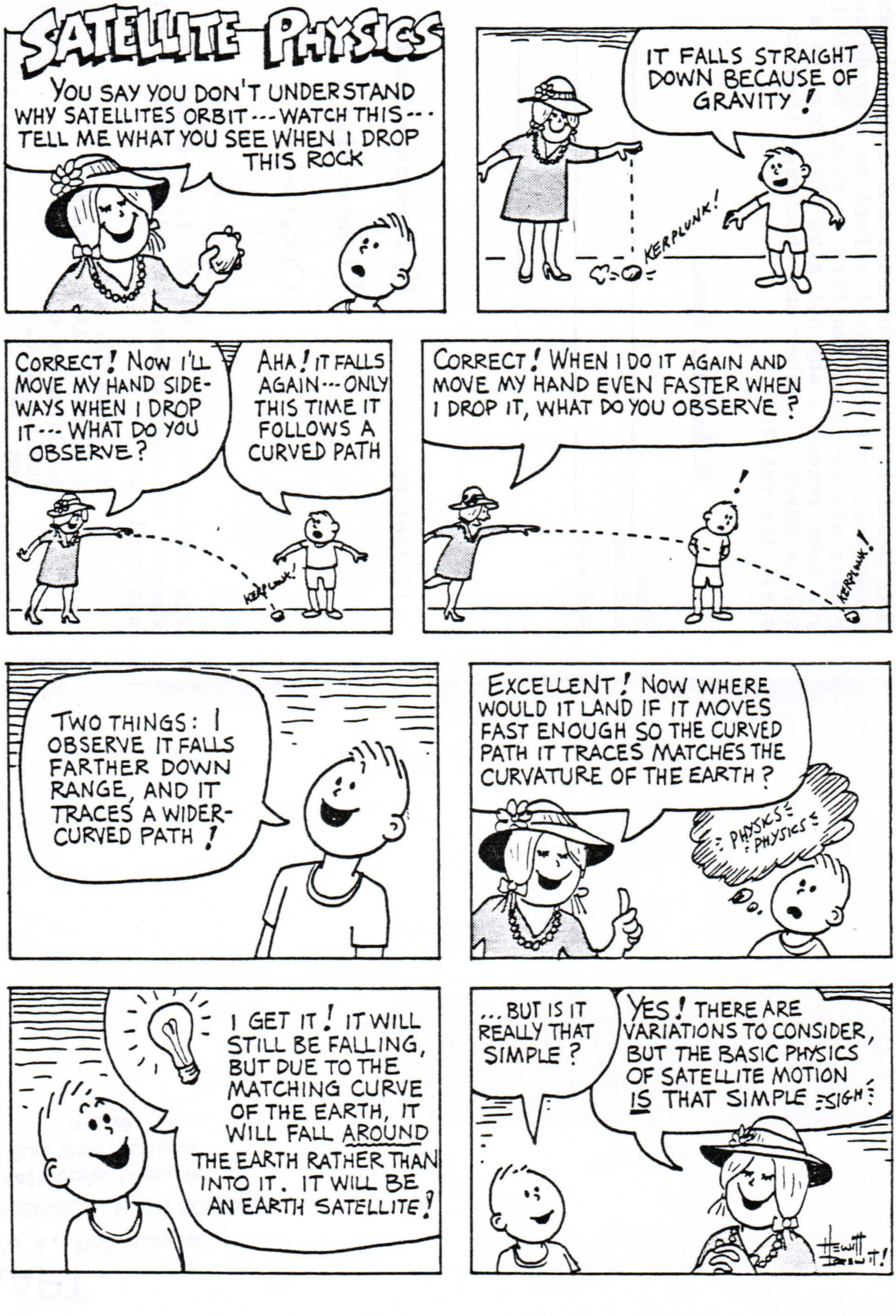
The teachers' responsibility is a critical one in teaching about the sources and uses of energy, the multifaceted energy problem and the energy conservation and environmental preservation ethic.

The use of energy conversion technologies and physics-related principles make effective examples when used as enhancements to elementary physics courses. Why not use them? There is still a wealth of educational material available! Let's not forget . . the "Forgotten Fundamentals."

*A.A. Bartlett, *Amer. J. Phys.* **46**, 876(1978).

AAPT-Ontario Executive 1986-87

Past Past President:	Brenda Molloy RR3 Bath K0H 1G0 613 389 6406	Loyalist CVI 153 Van Order Dr Kingston K7M 1B9 613 546 5575
Past President:	David McKay 3027 Balmoral Ave Burlington L7N 1E3 416 634 8256	MM Robinson HS 2425 Uppermiddle Rd Burlington L7P 3N9 416 335 5588
President:	Ross Hallett 36 Columbus Cr. Guelph N1G 3H7 519 821 7766	University of Guelph Dept of Physics N1G 2W1 519 824 4120 x 3989 x 2261
Vice-President:	Peter Levan 232 Walford Rd E Sudbury P3E 2G9 705 522 1828	Lockerby CS 1391 Ramsey View CT Sudbury 705 522 1750
Secretary-Treasurer:	Robert Bassett Northfield RR 2 Annan N0H 1B0 519 371 1028	West Hill Secondary School 750 9th St W Owen Sound N4K 3P6 519 376 6050
Member-at Large:	Grace Daminato 66 Fairview Cr Sarnia N7S 4C9 519 336 8625	Lambton College Box 969 Sarnia 519 542 7751 x 375
Section Rep:	Alan Hirsch 1566 Lovelady Cr Mississauga L4W 2Z1 416 624 3052	Brampton Centennial SS 251 McMurchy Ave S Brampton L6Y 1Z4 416 451 2866
Contest Rep:	Don Murphy RR 1 Sydenham K0H 2T0 613 376 3641	Sydenham High School Sydenham K0H 2T0 613 376 3612
Newsletter:	Alden McEachern 104 Sanderson Dr Guelph N1H 7L9	M.M. Robinson High School 2425 Upper Middle Rd Burlington L7P 3N9


SATELLITE PHYSICS
YOU SAY YOU DON'T UNDERSTAND WHY SATELLITES ORBIT --- WATCH THIS --- TELL ME WHAT YOU SEE WHEN I DROP THIS ROCK
IT FALLS STRAIGHT DOWN BECAUSE OF GRAVITY!
KERPLUNK!
CORRECT! NOW I'LL MOVE MY HAND SIDEWAYS WHEN I DROP IT --- WHAT DO YOU OBSERVE?
AHA! IT FALLS AGAIN --- ONLY THIS TIME IT FOLLOWS A CURVED PATH
KERPLUNK!
CORRECT! WHEN I DO IT AGAIN AND MOVE MY HAND EVEN FASTER WHEN I DROP IT, WHAT DO YOU OBSERVE?
KERPLUNK!
TWO THINGS: I OBSERVE IT FALLS FARTHER DOWN RANGE, AND IT TRACES A WIDER-CURVED PATH!
EXCELLENT! NOW WHERE WOULD IT LAND IF IT MOVES FAST ENOUGH SO THE CURVED PATH IT TRACES MATCHES THE CURVATURE OF THE EARTH?
PHYSICS PHYSICS
I GET IT! IT WILL STILL BE FALLING, BUT DUE TO THE MATCHING CURVE OF THE EARTH, IT WILL FALL AROUND THE EARTH RATHER THAN INTO IT. IT WILL BE AN EARTH SATELLITE!
... BUT IS IT REALLY THAT SIMPLE?
YES! THERE ARE VARIATIONS TO CONSIDER, BUT THE BASIC PHYSICS OF SATELLITE MOTION IS THAT SIMPLE SIGH
HEWITT DREW IT!

Membership Renewals

On your mailing sticker is the date of expiry of your membership; all those paid up have a date of June '87, any others are in need of renewal. If your membership has expired we are sending you this Newsletter as a reminder and hopefully an incentive, but we cannot afford to keep doing so! Please use the attached form to renew TODAY! (If you have renewed, why not give this form to a fellow physics teacher and encourage them to swell the ranks.)

Membership Form

Name: ______________________________

Address

Address: ______________________________

____

Code: ________

Affiliation:

○ Secondary School

○ University

○ College

○ Other

The membership fee is $5.00 (Please make cheques or money orders payable to AAPT-Ontario) and send to:

Mr. Ross Hallett
President, AAPT Ontario
36 Columbus cr.
Guelph, Ont.
N1G 3H7

FROM :
AAPT
c/o A. McEachern
M.M. ROBINSON HIGH SCHOOL
2425 Upper Middle Rd.
Burlington, Ontario
L7P 3N9

CANADA POSTAGE 0034

BURLINGTON 20.X.86 ONT.

EXP:Jun 0

Ernie McFarland
Department of Physics
University of Guelph
GUELPH, Ontario
N1G 2W1

To:

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. IX No. 3

MUSINGS FROM THE PRESIDENT

Now that Spring is upon us, the annual conference in Sudbury is only a few months away. Peter Levan, your vice president, has really impressed the executive with the proposed agenda. Not only are the formal activities interesting, but the social activities, including the boat cruise look spectacular! I hope that this will be our largest conference ever and that it will leave favourable and long lasting memories.

Many members had a very enjoyable evening with Dr. Robert Resnick in February. As President-elect of AAPT in the States, he was very interested in our section and its operation. He also wanted to become more aware of the Canadian perspective regarding physics and physics instruction. He noted that there are soon to be four Canadian AAPT sections and that the organization is developing a more international flavour to its membership. On the other hand he was concerned that in terms of much of its business, the organization has tended to focus mainly on problems in the American system. He would like to maintain a dialogue on the subject so that our ideas and concerns are always considered. There was some hope that he might be able to attend one of our conferences in the next year or so.

At this time of year we are always looking forward to next year and the potential location of our conference. Since the traditional function of the vice-president is to organize the conference, this decision also relates to the composition of our executive. In this context, the nominating committee of the executive will be nominating Stuart Quick from Scarborough College in Metro Toronto as incoming VP. Of course other nominations can be made by the membership. These can be made in the form of a letter to me (Ross Hallett), but should have the prior agreement of the candidate.

Another matter regarding the executive bears consideration by the membership. As you know Don Murphy has performed a momumental task at operating the Grade 11 Prize Examination for several years. Don has asked that he be relieved of this task next year. The nominating committee is, therefore, looking for one or more persons to take on the job. Perhaps the thing we should be doing is establishing a Prize Exam committee to run the examination and thereby share the load. This will be a matter for serious discussion at the June meeting, but any prior concerns or comments on the matter would be appreciated.

Ross Hallett

NINTH ANNUAL - AAPT-Ontario - CONFERENCE

Sunday, June 21st - Tuesday, June 23rd

Sudbury

The ninth annual American Association of Physics Teachers (AAPT) conference will be held from Sunday June 21st to Tuesday June 23rd at Laurentian University, Sudbury. To date the conference has been held in southern Ontario and so has not been accessable to many physics teachers of northern Ontario.

Here is a chance for physics teachers in mid-northern Ontario as well as southern Ontario to meet others in their field.

Conference highlights include:

- a "Path of Discovery" **bus tour** of the Sudbury Basin and Big Nickel mine
- a three day **pass to Science North**...our science center of the north
- **reception** at Science North and a **boat tour** on Lake Ramsey
- **informative speakers**
  - Doug Hallman - Doug Hallman, a physicist at Laurentian has participated extensively in the **proposed Sudbury neutrino observatory** that may be implemented near Sudbury in one of the deepest mine shafts of the world. He will be explaining and describing this exciting project.
  - Peter Hinrichsen - Dr. Hinrichsen, a physics instructor from Montreal, is a teacher with lots of sailing experience. He will be talking about various applications of **physics to sports**.
  - Brian Kaye - Brian Kaye is another professor at Laurentian University, well known for his research in the physics of fine particles. His talk at the conference will be "**A Random Walk Through Fractal Dimensions**". This could prove interesting to any who have wondered what fractals are and whether they have any role in science or physics.
  - Dave Mckay - Dave McKay, head of science at M.M. Robinson H.S., Burlington, is currently seconded to TVO. He is helping TVO integrate its current and future programming to the new Ontario Science Guidelines. He will be talking on **how TVO can be used in our classrooms with the new physics curriculum.**
  - Tom Semadeni - Tom Semadeni is the Director of Science North. He will describe Science North's structure and function.

- George Vanderkuur - George Vanderkuur is the chief scientist with the Ontario Science Center. Recently he has spent time and thought on the applications of science in art. He will be talking on "**Physics in Art**".

- a special **banquet in the Science North cavern** with **Steve MacLean, a Canadian Astronaut** on our Space Team. Steve will be talking on the current state of space technology and research.

- **demonstrations** and **short talks** by physics teachers on topics they have found interesting and effective in their teaching

- an opportunity to **meet publishers and suppliers** of science equipment

In addition to these highlights here is your chance to see Science North, Laurentian University and its physics labs, and to meet with people who teach the same thing you do.

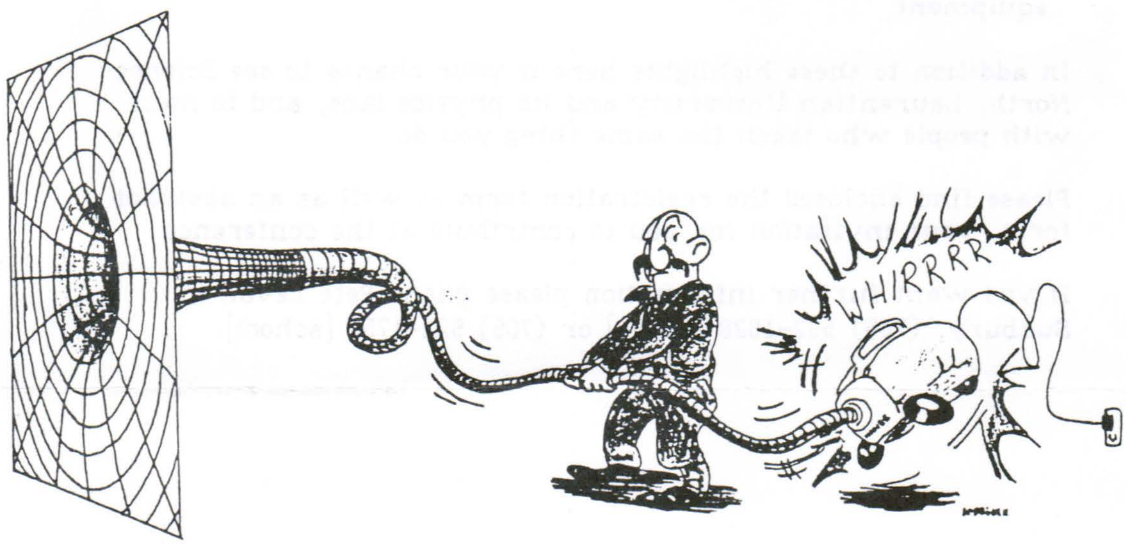
Please find enclosed the registration form as well as an abstract form, your invitation for you to contribute at the conference.

If you want further information please phone Pete Levan in Sudbury, (705) 522-1828 [home] or (705) 522-1750 [school].

Relativity Workshop Update

Elsewhere in this newsletter you will find the registration form for the Relativity Workshop to be held at the University of Guelph from July 2nd to July 4th (the general nature of the workshop was described in the last newsletter issue).

As registration is limited to 24 persons, if you are interested in attending please return the form to Ross RIGHT AWAY! He is aware of the vagaries of Canada Post service to various parts of the province and will handle conflicts with the clinical impartiality that only a highly trained physicist can bring to bear on such a problem. But don't delay - register today! - David McKay



Elementary Energy Saving

The University of Nebraska's energy extension service reports the following energy-saving suggestions proposed by elementary school children.

1. Find out if oil has another name besides petroleum and look for it under that name.

2. Lower people's body temperature to 68°F (20°C).

3. Dip everything that is made in stuff that glows in the dark.

4. Make it a rule that there has to be at least two people in every big bed that uses an electric blanket.

5. Put more hot sauce in the food.

6. Don't have so many days of school.

7. Don't stay in more than one room at a time.

Abstract Form - AAPT (Ontario) Section - Sudbury
June 21-22-23, 1987

We are eager to have you make a short presentation at the conference. Your presentation could take the form of a short talk with or without AV equipment or physics apparatus, on a topic of interest to you, or it could take the form of a demonstration that you use in teaching physics.

[PLEASE PRINT]

Name(Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No Street City Postal Code

Business Address ______________________________
Institution

____
No. Street City Postal Code

Home Phone ______________ Business Phone ______________

Session:

Oral presentation [ ] (5 to 15 minutes)
My Favourite Demonstration [ ] (2 to 5 minutes)

Title of Presentation: ______________________________

Short description or abstract:

____
____
____
____
____
____
____

Required Equipment:

We can provide AV equipment. We may provide microcomputers or other support equipment such as VCRs. For demonstrations, some technical help will be available.

Please check or list your requirements.

[ ] slide projector [ ] overhead [ ] 110 V(AC)

[ ] other ______________________________

Send this form **by May 22** to

Peter Levan,
232 Walford Rd. E.,
Sudbury, Ontario
P3E 2G9

UNIVERSITY of GUELPH

WORKSHOP ON RELATIVITY

July 2-4 1987

R E G I S T R A T I O N   F O R M

NAME____

HOME ADDRESS____

____

HOME TELEPHONE________________

SCHOOL ADDRESS______________________________________

____

SCHOOL TELEPHONE______________

FEES

REGISTRATION FEE________________$50.00

ACCOMMODATION AND MEALS

Registrants have the option of booking dormitory accommodations or staying at local motels. We can make dormitory booking on behalf of registrants, but those wishing motel rooms will have to make their own arrangements. Suggested motels are Holiday Inn, College Motor Inn and the Biltmore Inn all of which are near the campus. Meals can be purchased at University cafeterias.

Dormitory Room (meals not included)
(single @ $20.00/night)
(double @ $17.00/night per person) $___________

Total Registration and Accommodation Fees submitted $___________
(Make cheques payable to AAPT-Ontario)

Workshop address: Ross Hallett
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1
Telephone 519 824-4120 Ext. 3989

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. 9 #4

NINTH ANNUAL - AAPT-Ontario - CONFERENCE

Sunday, June 21st - Tuesday, June 23rd

Sudbury

Arrangements for the June Conference are proceeding well. The committee organizing the conference thinks that physics instructors attending will have a good time!

Here are some of the highlights:

- a "Path of Discovery" **bus tour** of the Sudbury Basin and Big Nickel mine. [For those that want the tour on the geology and physics of the Sudbury region, we have arranged a coach and tour guide. The tour starts at 1:30 PM SHARP starting from the Laurentian University residence and lasting until 5:30 in the afternoon. If you are going on the tour then you will be going down a mine shaft at one point in the afternoon.]

- a three day **pass to Science North**...our science center of the north. See the exhibits, and talk to the knowledgable staff.

- **reception** at Science North and a **boat tour** on Lake Ramsey. We have made arrangements for a reception at Science North. It will start at 7:30 in the evening. You get a one hour boat ride on Lake Ramsey if you attend the reception, seeing Sudbury by twilight from the point of view of the lake.

- **informative speakers**
  - Doug Hallman - Doug Hallman, a physicist at Laurentian has participated extensively in the **proposed Sudbury neutrino observatory** to be implemented near Sudbury in one of the deepest mine shafts of the world. He will be explaining and describing this exciting project. This is sure to be interesting because of the results of other neutrino observatories with the recent supernova.

- Peter Hinrichsen - Peter Hinrichsen, a physics instructor from Montreal, is a teacher with lots of sailing experience. He will be talking about various applications of **physics to sports**: golfballs, baseballs, and sailboats.

- Brian Kaye - Brian Kaye is another professor at Laurentian University, well known for his research in the physics of fine particles. His talk at the conference will be "**A Random Walk Through Fractal Dimensions**". This could prove interesting to any who have wondered what fractals are and whether they have any role in science or physics. His talk is sure to motivate us to program computers to draw our own fractals!

- Dave Mckay - Dave McKay, head of science at M.M. Robinson H.S., Burlington, is currently seconded to TVO. He is helping TVO integrate its current and future programming to the new Ontario Science Guidelines. He will be talking on **how TVO can be used in our classrooms with the new physics curriculum.**

- Tom Semadeni - Tom Semadeni is the Director of Science North. He will describe Science North's structure and function.

- George Vanderkuur - George Vanderkuur is the chief scientist with the Ontario Science Center. Recently he has spent time and thought on the applications of science in art. He will be talking on "**Physics in Art**". Scientists and artists have a lot in common; such things as creativity, appreciation of patterns, a need for simplicity and elegance etc. George will be describing and demonstrating nature as both artlike and scientific at the same time.

- a special **banquet at the Science North** and talk by **Bjarni Tryggvason, a Canadian Astronaut** on our Space Team, in the Science North cavern. Bjarni will be talking on the current state of space technology and research.

- **demonstrations** and **short talks** by physics teachers on topics they have found interesting and effective in their teaching

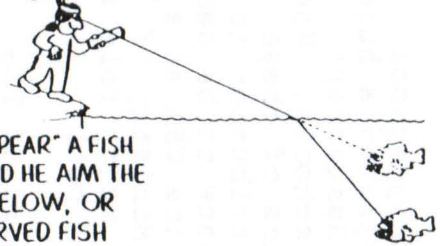
- an opportunity to **meet publishers and suppliers** of science equipment

In addition to these highlights here is your chance to see Science North, Laurentian University and its physics labs, and to meet with people who teach the same thing you do.

There is still time to register if you hurry! Mail the registration form provided with this letter.

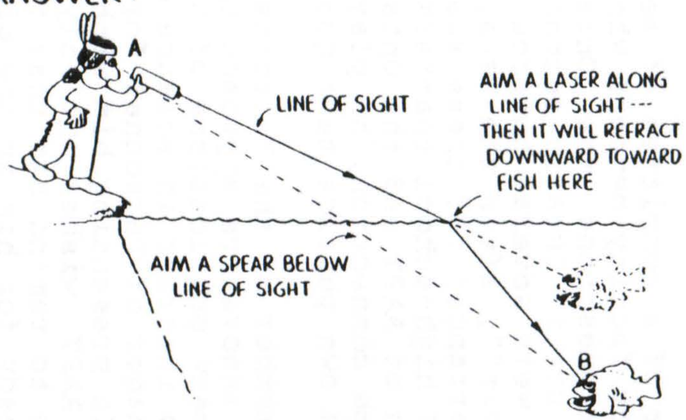
If you want further information please phone Pete Levan in Sudbury, (705) 522-1828 [home] or (705) 522-1750 [school].

FIGURING PHYSICS



TONTO WISHES TO "SPEAR" A FISH WITH A LASER. SHOULD HE AIM THE LASER BEAM ABOVE, BELOW, OR DIRECTLY AT THE OBSERVED FISH TO MAKE A DIRECT HIT ?

ANSWER:

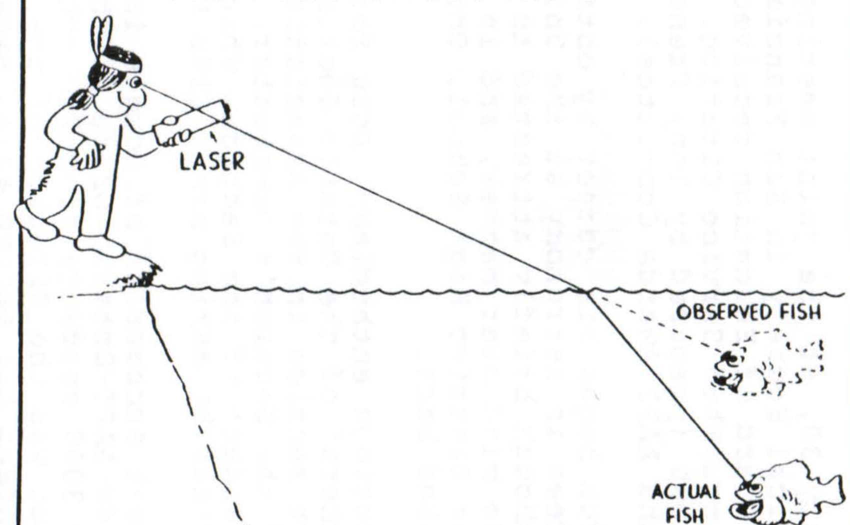


TONTO SHOULD AIM DIRECTLY AT THE FISH HE SEES. IF HE WERE INSTEAD THROWING A SPEAR, HE'D HAVE TO COMPENSATE FOR THE REFRACTION OF LIGHT AND AIM BELOW THE OBSERVED FISH. BUT NOT IF THE "SPEAR" IS A LIGHT BEAM! A LIGHT PATH IS REVERSIBLE, AND WILL GO FROM A TO B ALONG THE SAME PATH IT TAKES FROM B TO A.

Hewitt Drew it!

FIGURING PHYSICS

TONTO WISHES TO "SPEAR" A FISH WITH A LASER. SHOULD HE AIM THE LASER BEAM ABOVE, BELOW, OR DIRECTLY AT THE OBSERVED FISH TO MAKE A DIRECT HIT ?



Hewitt Drew it!

Doug Fox Receives Distinguished Service Citation from AAPT

On January 30, at the joint meeting of the AAPT and the American Physical Society in San Francisco, Doug Fox of the Essex County Board of Education received a prestigious award: an AAPT Distinguished Service Citation. The text of the Citation follows (prepared by Tony French of M. I. T., Chairman of the AAPT Awards Committee).

"Douglas R. Fox began his career by obtaining bachelor's and master's degrees in astronomy at the University of Western Ontario. Although briefly attracted to the world of finance, he nobly chose mind over matter, and in 1971 became a teacher at Belle River District High School, Ontario; since then he has never looked back.

With his infectious enthusiasm, Doug Fox was one of the true "Founding Fathers" of the Ontario Section of the AAPT (now the second largest section in the Association); he also created and published the Section's Newsletter. During 1980-81 he served as President of the Section, which has since honored his many services by making him a Life Member.

Perhaps the most successful of Doug's ideas was the creation of a province-wide AAPT-Ontario Grade 11 Physics Contest, in which approximately 3000 students from 250 schools now participate annually. Doug was the Director of the contest from 1981 to 1984. The contest has served as an excellent vehicle for promoting physics in Ontario secondary schools, and also for improving the visibility of AAPT-Ontario. In 1985 and 1986 the national AAPT operated a contest, modelled on Ontario's, which will reach across North America and into many foreign countries.

Doug was also a member of a committee of secondary-school teachers and university faculty members who developed a huge set of multiple-choice questions (the "Ontario Assessment Instrument Pool") for use in Ontario secondary schools. When he learned that there were several hundred copies of these question sets "left-over"", after the usual distribution to Ontario teachers, he arranged for these spare sets to be sent to a selection of AAPT high-school teachers in the USA as a gift of the Ontario Section of AAPT and the Ontario Ministry of Education. In the same connection, he played a major role in the creation of AAPT's own physics test question pool.

Doug has served as a member of the Editorial Board of The Physics Teacher. His innovative approach to physics teaching has also resulted in many publications of his own. Beyond this, however, he has a deep interest in science education at all levels, and is now Manager of Personnel for the Essex County Board of Education. In presenting him with a Distinguished Service Citation, the AAPT wishes not only to thank him for past services but also to remind him that there will always be an honored place ready for him in the classroom."

Registration Form - AAPT (Ontario) Section - Sudbury
June 21-22-23, 1987

[PLEASE PRINT]

Name(Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No. Street City Postal Code

Business Address ______________________________
Institution

____
No. Street City Postal Code

Home Phone ______________ Business Phone ______________

Membership ($5.00): Membership includes a newsletter published four times a year and reduced rates to the annual conference.
I wish to renew my membership for the year 1987-88. [ ]
I wish to become a member for the first time. [ ]
Secondary School [ ] University [ ] College [ ] Other [ ]

Program, Meal, and Accommodation Packages:

Package A - Includes Banquet and keynote speaker (Note: This amount isn't deductable or refundable from other packages.)

Members $25.00 [ ] Non-members $35.00 [ ]

Package B - Includes Package A, conference registration, Sunday evening dinner, Sunday evening reception at Science North, breakfast and lunch both Monday and Tuesday

Members $80.00 [ ] Non-members $90.00 [ ]

Package C - Includes Package B, and a residence room for Sunday and Monday nights (Note: If you wish motel instead of residence accommodation then the Travelway Inn, just across the road from Science North, accepts reservations (705) 522-1122.)

Residence Accommodation:	Single Occupancy	Double Occupancy
Members	$140.00 [ ]	$130.00 [ ]
Non-members	$150.00 [ ]	$140.00 [ ]

If you specify double occupancy then please give the room mate's name.

____

Package D - 3 hour "Path of Discovery" bus tour of the Sudbury Region

Members $10.00 [ ] Non-members $15.00 [ ]

Total Fees:

Membership	$ ______
Package A or B or C	$ ______
Package D	$ ______
Total	$ ______

Send this form **by June 5th** with your money order or cheque, payable to "AAPT-Ontario" to

Peter Levan
232 Walford Rd. E.,
Sudbury, Ontario
P3E 2G9

Abstract Form - AAPT (Ontario) Section - Sudbury
June 21-22-23, 1987

We are eager to have you make a short presentation at the conference. Your presentation could take the form of a short talk with or without AV equipment or physics apparatus, on a topic of interest to you, or it could take the form of a demonstration that you use in teaching physics.

[PLEASE PRINT]

Name(Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No Street City Postal Code

Business Address ______________________________
Institution

____
No Street City Postal Code

Home Phone ________________ Business Phone ________________

Session:

Oral presentation [ ] (5 to 15 minutes)
My Favourite Demonstration [ ] (2 to 5 minutes)

Title of Presentation: ______________________________

Short description or abstract:

____
____
____
____
____
____
____

Required Equipment:

We can provide AV equipment. We may provide microcomputers or other support equipment such as VCRs. For demonstrations, some technical help will be available.

Please check or list your requirements.

[ ] slide projector [ ] overhead [ ] 110 V(AC)

[ ] other ______________________________

Send this form **by May 22** to

Peter Levan,
232 Walford Rd. E.,
Sudbury, Ontario
P3E 2G9

American Association of Physics Teachers

AAPT Ontario Section NEWSLETTER

Vol. X No. 1

Ontario Section Annual June Meeting

The ninth annual June meeting of the Ontario Section of the AAPT was held in Sudbury, Ontario, from Sunday, June 21 to Tuesday, June 23, 1987. The meeting was co-hosted by Laurentian University and Science North, the unique science center in Sudbury. Approximately 65 members were treated to a well organized and rewarding meeting, filled with a variety of stimulating events.

Several people began the meeting on Sunday with a guided tour of some of the facilities of the International Nickel Company (INCO). The tour combined concepts from physics, chemistry, geology, and technology in a way that helped us appreciate the complexity of such a large operation. The first day ended with a reception at Science North and an hour-long cruise on Lake Ramsey.

On Monday, the first full day of the meeting, Dr. Daniel, President of Laurentian University, and Dr. Goldsack, Dean of Science, officially welcomed the participants. Dr. Goldsack emphasized how physics research is an important factor in trying to improve productivity in mining.

Tom Semadeni, Director of Science North, prsented a brief history of the science center, including descriptions of how the center was constructed to suit the geological setting, and how the exhibits continually evolve. The underlying philosophy of Science North is to have visitor participation in the "action of science". Anyone older than 40 years is warned to be careful when taking the fitness test.

George Vanderkuur, chief scientist at the Ontario Science Center in Toronto, gave an exciting talk titled "Physics as Art" which included numerous demonstrations covering a variety of topics such as light, mechanics, music, and art.

Dr. Peter Hinrichsen, who teaches in Quebec and is an avid sailor in his spare time, presented a talk on the "Physics of Sports". He applied physics principles to the analysis of the trajectory of a golf ball and the measurement of the weight distribution of sailing boats.

Dr. Brian Kaye, a physics professor at Laurentian U., presented a paper on "A Random Walk Through Fractal Dimensions" in which he illustrated the nature of random walk statistics, Brownian motion, fractals, and the use of computers to draw fractals.

The day sessions ended with the following short presentations:
- Alan Nursall: "A Closer Look at the Superstack"
- Gerald Guzzo: "Run Like a Horse"
- Tom Patitsas: "Size Determination of Asbestos Fibers"
- John Wylie: "The International Physics Olympiad"

A wine-and-cheese reception and the annual banquet were held Monday evening at the Science North Cafeteria which overlooks Lake Ramsey. Then Bjarni Tryggvason, a Canadian astronaut, gave an informative talk on "Physics in Space" in which he discussed proposed plans for a manned space station which would be approximately 3% Canadian and the remainder American, European, and Japanese.

On Tuesday, Dr. Doug Hallman, assistant professor of physics at Laurentian U., brought us up to date on the developments of the Sudbury Neutrino Observatory to be built deep in the Creighton Mine where background radiation is very low. The neutrino detector will be unique in its use of heavy water in the core, surrounded by ordinary water.

David McKay, currently the Science Projects Utilization Officer with TVOntario, presented a visually pleasing workshop on the use of videos in the physics classroom. He related the new science curriculum guidelines to video materials available both now and in the future.

Finally, a talk by Gilles Gaudet called "Microwaves, Particles, and Photons" was followed by the popular "Favorite Demonstrations" session which included:
- Peter Levan: "Efficiency of Mousetrapmobiles"
- Al Hirsch: "Nitinol and the Amazing Icemobile"
- Don Bosomworth: "Internal Reflection of Laser Light"
- Peter Hinrichsen: "A Bistable Cartesian Diver, An Inexpensive Audio Source, and A Plumbing Fixture Resonance Tube"

The meeting also featured displays by scientific supply companies and book publishers, and the usual friendly atmosphere.

Congratulations to Peter Levan and the members of his conference committee who organized a superb meeting. The next annual meeting will be held at the Scarborough Campus of the University of Toronto in June, 1988.

AAPT/APS Winter Meeting, 1987

The 1987 AAPT/APS Joint Winter Meeting was held in San Francisco, California, from January 28 to January 31. You will recognize the names of some or all of the following people who attended.

- Doug Fox (Windsor) gave two presentations and received a Distinguished Service Citation.

- Don Ivey (Toronto) presided over a session.

- N. Gauthier (Kingston) gave two presentations.

- P. F. Hinrichsen (Quebec) gave a presentation.

- Dean Gaily (on leave from the University of Western Ontario) was involved in two presentations.

- Ernie McFarland and Stuart Quick were seen dashing from one session to another.

Following is a list of the meeting highlights.

1. There were workshops on:
   - Interactive Videodisc Lessons Development
   - Producing and Using Videotapes in Physics Curricula
   - Apple Assembly Language and Animation
   - Teaching and Learning Physics with Personal Productivity Software

2. There were demonstration sessions and the annual "Physics Show" of apparatus and publications.

3. Plenary sessions included:
   - Particles and Fields
   - Fractals in Physics
   - Frontiers in Astronomy

4. There were several symposia, including:
   - Women in Astronomy
   - Computers as Teaching Tools
   - Museums and Science Centres
   - Big Telescopes
   - Research at Small Institutions
   - Science Fiction
   - The Physics Olympiad
   - Report on the Far East Physics Conference

5. A panel discussion titled "The Current Status of Physics and Society Courses" concluded that such courses should be available for non-science majors, but societal implications should be integrated into all regular physics courses as well.

6. A popular symposium on "First Year College Physics Texts" revealed excellent arguments for including the use of computers and the study of modern physics in physics courses. However, the most positive audience response was given when one panel member called for a "back to the basics" approach to a broad range of topics, such as surface tension, colour, music, and fluids in motion.

7. We visited the <u>Exploratorium</u>, which is San Francisco's "hands-on" science centre. Although the visit was very interesting, I came away proud of our science centres in Toronto and Sudbury.

8. The multi-course banquet in Chinatown on the Friday evening was a resounding success. It was followed by an exciting and entertaining presentation on the physics of ballet dancing by Dr. Kenneth Laws of Dickenson College. As a ballet dancer from San Francisco demonstrated a variety of manoeuvres, Dr. Laws explained the physics involved, sometimes becoming entangled in the microphone cord as he augmented the dancer's spinning with examples of his own. (Dr. Laws has written a book titled <u>The Physics of Dance</u>, published by Schirmer Books, a division of MacMillan Inc., N.Y.)

On a more personal note, the most topical session I attended was one on earthquakes. (Yes, there was a minor tremor reported in San Francisco during the conference!) I attended committee meetings of the AAPT Council and Section Representatives, as well as the High School Committee. I also met various physics teachers from Michigan and Ohio who expressed interest in having a joint meeting in Windsor, Ontario, in a few years. (If this does occur, the first possible date would be June, 1989.) Finally, I learned that the "Canadian connection" is increasing, with Alberta being the newest section to join the AAPT. (Ontario and B.C. are the other provinces, with Quebec considering joining as well.)

The summer meeting of the AAPT was held in June in Bozeman, Montana, and the next Joint Winter Meeting of AAPT/APS will be held in Washington, D.C., in January, 1988.

Alan Hirsch, Section Representative

<u>Selections from the SCIENCE CORNER</u>.

Volume 6 of "SELECTIONS from the SCIENCE CORNER" is now available by writing to:

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(A cost-recovery donation of $3.00 would be greatly appreciated.)

AN ASTRONOMER once remarked to Bishop Fulton J. Sheen:

"To an astronomer, man is nothing but an infinitesimal dot in an infinite universe."

"An interesting point of view," remarked the bishop, "but you seem to forget that your infinitesimal dot of a man is still the astronomer."

— *The Wit and Wisdom of Bishop Fulton J. Sheen* (Prentice-Hall)

Just remember .... فیزیک خوبه !!!

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THE DEMONSTRATION CORNER

Editor: Ernie McFarland, Physics Dept.
University of Guelph
Guelph, Ontario N1G 2W1

This marks the first appearance of this column, which has been prompted by the great popularity of the demonstration sessions at our annual conference. Submissions describing demonstrations will be gladly received by the editor.

This first column is adapted from an article in the *Guelph Daily Mercury*, by Jim Hunt of Guelph's Physics Dept.

The Bistable Diver

A fun toy which teaches a lot about hydrostatics and Archimedes' principle can be made from some very simple items. You will need 1) a large transparent dishwashing detergent plastic bottle (see A in Fig.) with a plastic valve cap, and most importantly, with an oval cross section; 2) a cap from a ball point pen; 3) a few small paper clips.

First thoroughly clean the detergent from the bottle and valve and fill the bottle with water to within 2-3 cm of the top (B in Fig.).

Drill a small hole in the pocket clip of the pen cap and hang a paper clip in the hole (C in Fig.). Put this "diver" in a pot of water; with one clip the diver will float easily. The job is now to hang additional paper clips on the first one until the diver just barely does not sink. You might have to trim a bit off the last clip with wire cutters. The model tested for this project required in total two 3-cm clips and three 2-cm clips.

The "just floating" diver should be carefully floated in the water in the bottle, the cap replaced, and the valve closed.

If you now squeeze the bottle gently in its narrowest direction, the trapped air in the diver will be compressed and the diver will sink. Release the pressure and the diver will rise. You have now constructed a standard "Cartesian Diver", which is interesting enough in itself.

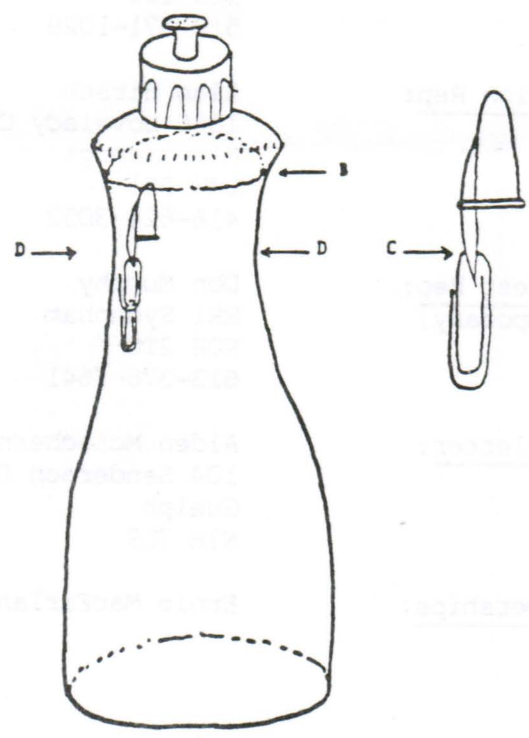
However, we want to go further. Open the valve and put your mouth over the cap and blow — the diver sinks. Now comes the tricky part — with your mouth over the cap and the diver sunk by blowing, close the valve either with your tongue or with a finger also inserted in your mouth and sealed with your lips (we said it was tricky!) The diver now stays on the bottom instead of the top.

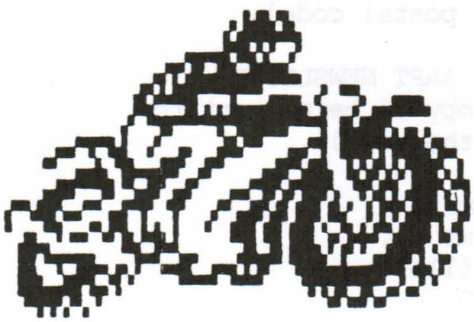
Here comes the surprise — gently squeeze the bottle at the wide part of the "waist" (D in Fig.) and the diver will rise! If it does not rise, you blew too hard originally and will have to try again. With a bit of fiddling around with your initial blowing pressure, you should be able to arrive at a situation in which the diver will rise from the bottom with a squeeze at the wide part of the "waist", and will sink from the top with a squeeze in the narrow direction.

The valve always leaks somewhat and the pressure will have to be adjusted periodically. You can make a more permanent arrangement with a stopcock replacing the original valve.

HOW IT WORKS — When the diver is floating at the top, squeezing the bottle in the narrow direction compresses the air trapped in the diver, the buoyancy is reduced and the diver sinks. At the bottom of the bottle the hydrostatic pressure of the water is enough to keep the air in the diver compressed so it cannot rise. But the surprising thing about these particular bottles is that squeezing them in their wide dimensions does not decrease their internal volume, but increases it. Thus, with the diver at the bottom, a squeeze at D decreases the pressure in the bottle and causes the air inside the diver to expand with the result that the diver floats to the top.

Another demonstration which involves bottle-squeezing requires a small glass liquor bottle (a "mickey"), topped by a tight-fitting holed stopper with a fine capillary tube inserted in the hole. Squeezing the bottle in its narrow direction causes liquid to flow up the tube; squeezing in the wide direction causes liquid to flow down the tube. Students are often surprised to learn that a solid such as glass is deformable.





$$d = \frac{at^2}{2}$$

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No Match for It

SCIENCE is a match that man has just got alight. He thought he was in a room — in moments of devotion, a temple — and that his light would be reflected from and display walls inscribed with wonderful secrets and pillars carved with philosophical systems wrought into harmony. It is a curious sensation, now that the preliminary sputter is over and the flame burns up clear, to see his hands lit and just a glimpse of himself and the patch he stands on visible, and around him, in place of all that human comfort and beauty he anticipated — darkness still.

— H. G. Wells

Ontario Association of Physics Teachers

Vol. X No.II

A RANDOMWALK THROUGH FRACTAL DIMENSIONS

Synopsis of a presentation to the American Association of Physics Teachers, Ontario Section, Annual Meeting, Sudbury, Ontario, June 22, 1987.

By Brian H. Kaye, Professor of Physics, Laurentian University, Sudbury, Ontario P3E 2C6.

In 1982 I was privileged to address you at your annual meeting in London, Ontario. At that time I discussed how classical physics such as properties of matter had tended to be overlooked in our teaching of physics in favour of some of the apparently more glamorous solid-state nuclear physics systems etc. At the end of the lecture I was approached to ask if some of the material on the applied physics of instruments I presented was available in written form. The answer was no but the question stimulated me to plan a book to be entitled "Delightful Instruments" and "Exciting Moments in Applied Science". The idea being that I would describe some of the more modern instruments that embody exciting aspects of physics. I am afraid that I have only produced one chapter of the book which I have titled "Harmonious Rocks and Infinite Coastlines" in which I discuss some rather novel applications of Fourier Analysis and fractal geometry. I have brought a copy of this chapter along for you to inspect. The reason the project has not developed further is that my involvement with fractal dimensions has escalated to the point where at times I wonder what I did before I began exploring the infinite patterns of fractal geometry. [Fractal geometry studies rugged systems such as fragmented rocks and extends the concepts of dimensional description of a system to include a fractional addition to the classical dimension of a system to describe its space filling abilities.] When I was asked to address you again this year I thought it would be a good opportunity to introduce fractal geometry to a wider audience. The problem with a subject such as fractal geometry is that it is so different from the traditional way of thinking that it takes a mental effort to swing around to gain a fresh perspective of geometry, dimensional analysis and its exciting concepts. My book on fractal goemetry entitled "A Randomwalk Through Fractal Dimensions", to be published by VCH Publishers of Germany early next year, is almost finished. The rather odd title comes from the fact that one soon discovers that randomwalk modelling and fractal geometry are intimately linked. I have expressed this fact to my students by saying that if you scratch a fractal set you will probably find a randomwalk underneath. Fractal goemetry is finding many applications in applied science and its elegant simplicity if one can get past its strangeness, means that it can be used even at the pre university level. Over the last year a guest student in the gifted mathematics program of Lasalle High School here in Sudbury has spent one day a week exploring fractal dimensions and I am pleased to say that already some of the data she generated will be incorporated in my book. I can assure you that although high school students find fractal geometry intriguing and stimulating they have semantic problems and mental concept problems to start with. We have so conditioned them with calculus that they find it strange to discover curves that have no differential function and they have come to expect that there is one goemetry and one algebra handed down by God to Moses on Mount Sinai. They need to be re-educated that there are more geometries and more algebras than they have ever dreamed of.

My teaching of fractal geometry at the introductory level has reinforced my impression that one of the reasons that the majority of students in science programs dislike physics is because they are not used to symbolic logic and find it difficult to use a Latin/Greek base vocabulary that is remote from their everyday experience. The mastery of symbolic logic requires a different part of the brain to that used to process verbal information and unfortunately western education bypasses symbolic pattern recognition leaving Chinese students trained in pictographic writing (a form of symbolic logic) to walk away with our mathematic prizes). The students who survive our physics programs go on to teach others in the same way that they were taught and so we have bred a generation of students who wallow in acquired symbolic logic but who are almost illiterate when it comes to describing the poetry of physics and the wonder of the universe. Like the dinosaur we have specialized ourselves almost out of existence since the mainstream of general students pass us by and the bread and butter of physics departments is becoming rigid service courses for engineers. If we are to ever have students clamouring to get into physics courses we must teach students to love words and to collect them and use them as precious things. We must also explain to them the beauty and elegance of symbolic logic not as an obscure language necessary for the initiated but as elegant pictorial summaries of fascinating facts. We could have students from a broad range of abilities enjoying physics if we would only stop wallowing in symbolic logic and start to teach the human history of physics as an exciting story of discovery of the universe. I know that after I managed to graduate in physics I became so fascinated with the intellectual elegance of the subject that I am sure that the first year I taught the University physics course at Laurentian using Halliday and Resnick it was as abstract as Picasso's pictures. It probably left many students wondering about its connection with reality in the same way that many of us react to the abstract paintings of Picasso. I intend over the next few years to specialize in developing physics courses for non science majors and to this end I have started work on several projects. Some of the early stages of these projects are available for you to inspect at the close of this lecture.

First of all, to enrich the vocabulary levels of the students, I have started to work on a book that is called "Word People of Science". A chapter from this book called from "Euclid to Mandelbrot" has been especially prepared to enable students in the gifted program to explore fractal mathematics. I have also started to work on a book called "Face Powder and Quantum Physics". I am finding that the work I have done with the mixing of powders is in fact quantum physics only one deals with glass beads instead of Plank's constant. I am convinced that quantum physics is only difficult because everybody said it should be and that one can sneak into the subject by the back door by looking at the applied physics of mixing. The problem with an invitation such as this to speak to such an assembly of physics teachers is that time is so limited - and so, having introduced these area concepts and projects, I will now show you some diagrams from Euclid to Mandelbrot then I will show you how randomwalk modelling can be carried out on an average lab computer to simulate the gaussian distribution and a fractal front of interest to oil recovery scientists. Hopefully these illustrations will encourage you to follow up these topics when the written material I am preparing becomes available in published form.

Display Summary

1. Sample chapter from Delightful Instruments and Exciting Moments entitled Harmonious Rocks and Infinite Coastlines an Exploration of Fourier Analysis and Fractal Geometry fo Characterizing Rock Fragments. Copies available for student and personal use at the cost of copying and postage $8.50.

2. From Euclid to Mandelbrot. A semantic survival kit for those who would like to begin to explore fractal geometry.

   [Draft copies available for student and personal use at the cost of copying and postage $11.00. Combined order for 1 & 2, $15.00.]

3. Face Powder and Quantum Physics. An introduction to the quantized universe of applied sciences uses experience from powder mixing.

4. Efficient Symbolic Communication In the Work Place. A discussion of how the eye-brain system processes symbols.

5. Excerpts from Chapter 4 and 5 of "A Randomwalk Through Fractal Dimensions" by Brian H. Kaye, to be published by VCH Publishers, Weinheim, Germany.

References

1. B. B. Mandelbrot, Fractal Geometry of Nature, W. Freeman, San Francisco, 1983.

2. Art Matrix, P.O. Box 880, Ithaca, N.Y., 14851, U.S.A. (Fractal postcards and computer programs).

SCARBOROUGH - JUNE 1988

The tenth annual conference will be held at the University of Toronto, Scarborough Campus, from Sunday June 26 to Tuesday June 28.

Talks in the planning stages include new findings in high-temperature superconductivity and Supernova Shelton 1987A. As usual, contributed papers, "My favorite demonstrations", and posters will be welcome. So take part in your conference!

See you at Scarborough in June!

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THE DEMONSTRATION CORNER

Editor: **Ernie McFarland**
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This is the second appearance of this column, which has been prompted by the great popularity of the demonstration sessions at our annual conference. Submissions describing demonstrations will be gladly received by the editor.

The Belt-Hanger

One category of good physics demonstrations involves the "disorientation" or "disequilibrium" of students. The demonstrations in this category cannot be explained by most students, and thus serve to disorient the students and put them into a state of disequilibrium from which they wish desperately to escape.

Such demonstrations pique the students' curiosity and gain their attention. Some students have been known to throw up their hands and say that these demonstrations can be explained only by magic. At this point, the students are like putty in the teacher's hands — they are eager to learn the real explanation.

The belt-hanger described below is a nice disorientation demonstration, and it is cheap to make and easy to use.

Fig. 1 shows a belt-hanger in (full-size) cross-section, and can be used as a pattern from which to make your own belt-hanger. It can be made from a variety of materials: wood, metal, thick cardboard, etc. The ideal thickness is about 1 cm (the aluminum one I have currently is 9 mm thick).

Once the belt-hanger has been made, position it on the end of a fingertip as shown in Fig. 2. It is unstable in this position and falls to the floor.

Now remove your belt or have a student remove his/her belt (teachers who are "hams" can embellish this step in various ways — music, clapping, etc.). A firm leather belt with a reasonably large buckle is best. Fasten the belt buckle so that the belt forms a closed loop, and place the belt on the hanger (on your fingertip) as shown in Fig. 3, with the buckle at the bottom of the belt.

Instead of the hanger and belt falling to the floor, the entire system is quite stable! For added effect, you can place the hanger (and belt) on the edge of a table or on the top of a door frame instead of on your fingertip.

Students are surprised that the hanger is unstable by itself, but stable when the belt is hung on it.

HOW IT WORKS — If an object (which is free to rotate) is to be in stable equilibrium, the centre of mass (CM) of the object must be below the pivot point.

When the hanger alone is placed on a fingertip, it is impossible for the CM to be positioned below the pivot point without the hanger sliding from the finger and falling. (The pivot point is just the contact point between the hanger and the finger.)

When the belt is on the hanger, the CM of the system (hanger + belt) is now positioned somewhere in the middle of the loop formed by the belt, and it is "easy" for the CM to be under the pivot point, with stable equilibrium being the result.

WHY DO IT? — First, it engages the students' minds in attempting to explain a physical phenomenon. Second, although centre of mass is not a topic which is taught in detail at the high school level, it is useful to point out to students that the acceleration a in Newton's Second Law ($\Sigma F = ma$) is the acceleration of the CM of the object, and it is then nice to have at least one demonstration related to CM.

At the university level, the topics of CM, torque, stable and unstable equilibria are considered in detail, and CM demonstrations related to equilibrium are very useful.

WANT MORE CM DEMONSTRATIONS? — refer to an article "Centre of Mass Revisited" in *The Physics Teacher*, January 1983.

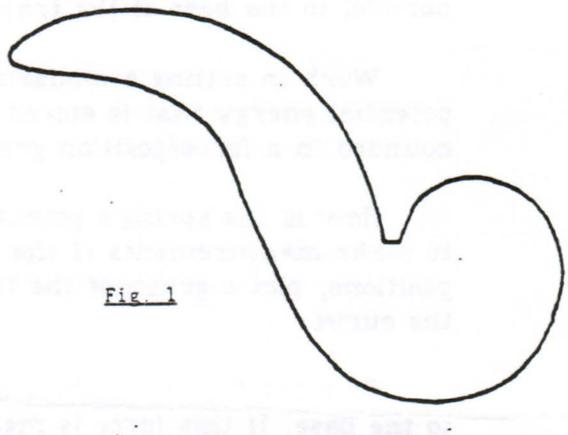


Fig. 1

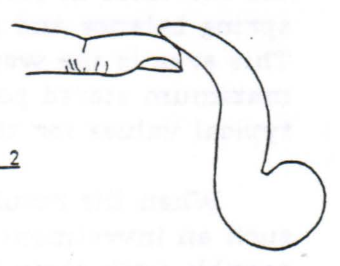


Fig. 2

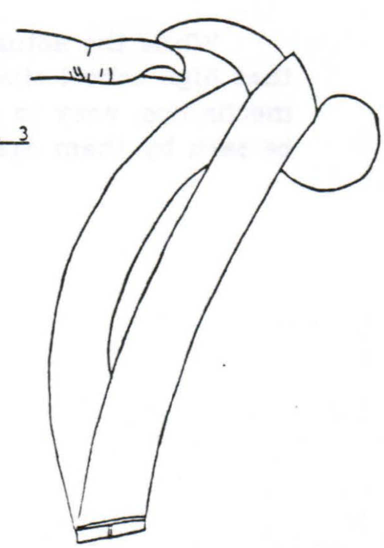


Fig. 3

Setting a Mousetrap

In recent years mousetrap mobile contests have been very popular in high school science. This contest encourages thinking unlike the analytical thinking that students do so much of the time in solving physics problems. Students are left with an open ended problem of invention: Devise a home-made "car" that is powered solely by the energy in the spring of a mousetrap. Usually these cars are tested, the car moving the greatest distance winning the contest.

To make the mousetrap's spring the source of energy for a home-made car offers students a lot of physics, fun, and advantages. Here's a device providing a good example of Hooke's law. If the force of the spring is measured tangent to the arc swept out by the trap then the force is directly proportional to the angle of the trap. Yet if the force is measured parallel to the base of the trap it's a good example of a nonlinear force.

Work in setting a mousetrap can be measured. The maximum potential energy that is stored in its spring can be calculated from the area bounded in a force/position graph.

How is the spring's potential energy calculated? The basic procedure is to make measurements of the force parallel the base of the trap at various positions, plot a graph of the force versus position, and find the area under the curve.

To avoid the dot product in work, students measure the force parallel to the base. If this force is measured at enough positions along the base then a graphical exercise of finding the area under the curve bounded by the extremes in position of the trap is reasonably accurate. Only a 20 N spring balance and a ruler or protractor are needed to get useful data. This area is the work done in setting the trap and so is equal to the maximum stored potential energy in the trap. For the mousetrap we use, typical values for this energy are 0.65 J ±0.05J.

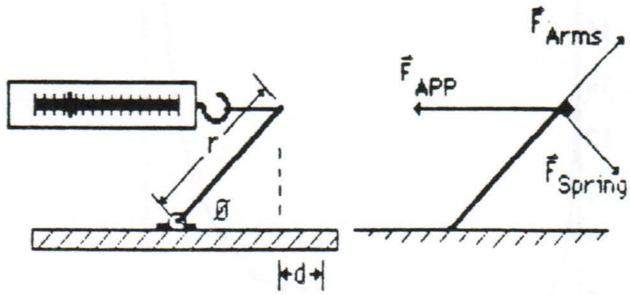
When the results of this exercise are completed most students feel that such an investment of effort requires that they build the best mousemobile possible with their trap.

While the actual materials and measuring devices are crude, the ideas that high school students grapple with here are all from elementary mechanics, easy to understand, and fun to apply. The concepts will likely be seen by them again if they deal with other machines or engines.

The Energy in a Mousetrap

Aim: To find the potential energy that can be contained in the spring of a "standard" mousetrap.

Diagram:



Procedure: Each laboratory pair of students will be given a mousetrap. This mousetrap is to be retained by the group after the end of the exercise. There is some danger in this exercise so keep your fingers out of the reach of the trap as you attempt to set it!

In order to find the energy in the trap, the total amount of work done on the trap by setting it will be calculated from a graph of force versus distance. This work done on the trap is the same as the total potential energy contained in the trap's spring when completely set.

a) Measure the length of the spring action of the trap, "r", in metres. Express "d" as a function of "r".
b) Attach a wire to the trap so that a 20. N spring balance can be used or pulling. Calibrate the 20. N spring balance before starting. Be sure that when measuring the force applied you have no friction between moving parts in the spring balance.
c) Clamp the trap down to your desk and have a protactor ready on one side to measure angles.
d) Displace the trap 20° and measure the applied force, holding the balance horizontally. Record the information in the table below. Repeat this procedure to complete the table.
e) Plot a graph of force versus distance and find the area under the curve of the graph from initial position of the trap to its final position. In finding this area some estimating needs to be done.

Data:

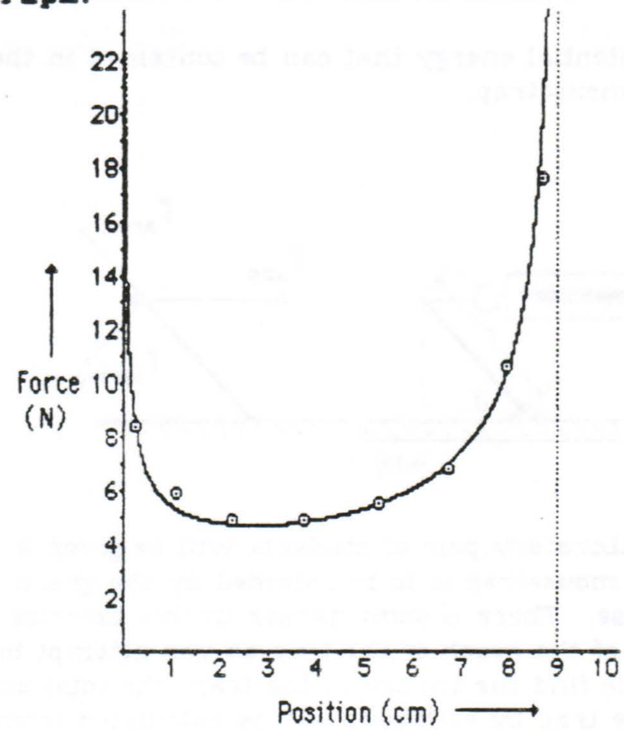
a) r = ______ m d = ________________________

d)

Angle	d (m)	F (N)
20°		
40°		
60°		
80°		
100°		
120°		
140°		
160°		

The area under the "F vs d" graph is ______ J.

Expected Graph:



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On your mailing sticker is the date of expiry of your membership. All those paid up have a date of June '88 - any others are in need of renewal. If your membership has expired we are sending you this Newsletter as a reminder and hopefully an incentive, but we cannot afford to keep doing so! Please use the attached form to renew TODAY! (If you have renewed, why not give this form to a fellow physics teacher and encourage them to swell the ranks.)

Membership Form

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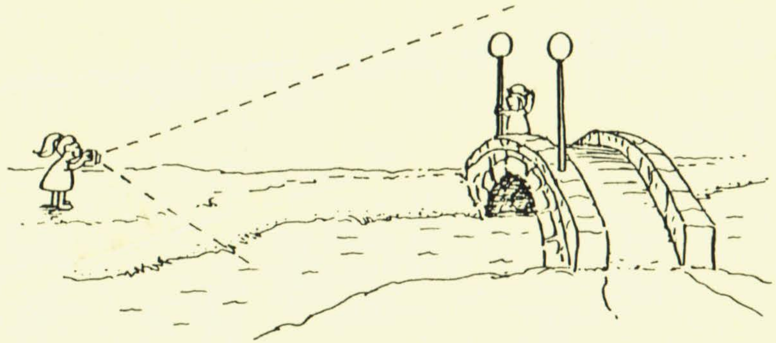
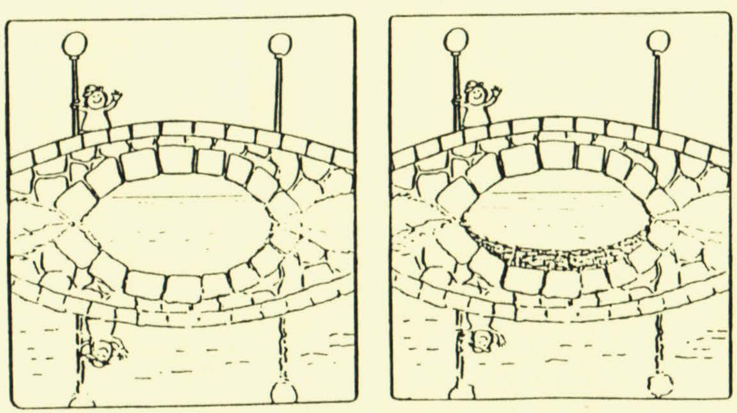
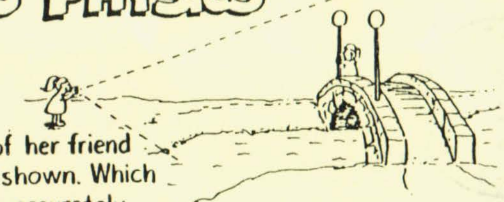
Figuring Physics



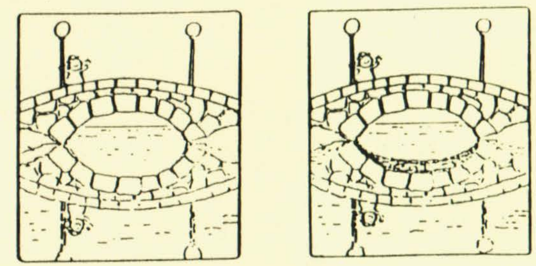
She takes a photograph of her friend standing on the bridge as shown. Which of the two sketches more accurately shows the photograph of the bridge and its reflection?



Figuring Physics

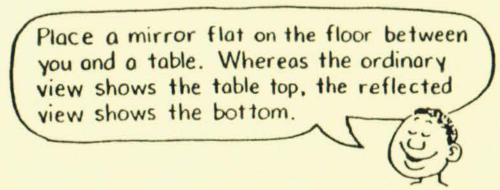


She takes a photograph of her friend standing on the bridge as shown. Which of the two sketches more accurately shows the photograph of the bridge and its reflection?



Answer:

The sketch on the right shows a more accurate reflection of the bridge. The reflected view is not simply an inversion of the scene above, as some people think, but is the scene as viewed from a lower position -- from the water surface. The reflected view of the bridge is the view the girl would see if her head were upside down at the water surface where the light is reflected. Hence the reflected view shows the underside of the bridge.



Ontario Association of Physics Teachers

Volume X No. 3

Annual Conference
University of Toronto—Scarborough
June 26, 27, 28

The tenth annual conference of the OAPT will be held on the Scarborough Campus of the University of Toronto, June 26, 27 and 28. Here are the highlights confirmed to date.

Thomas Timusk, of McMaster University will kick off the formal proceedings on Monday morning with a lecture on one of the most talked-about discoveries of 1987: "High-Temperature Superconductivity". In addition to his talk, Prof. Timusk will demonstrate the Meissner and other effects at liquid nitrogen temperature. On Monday afternoon the second phenomenon of 1987 "Supernova Shelton 1987A" will be described by two astronomers of the U. of T. **Ian Shelton**, the man himself, will outline the responsibilities of a professional astronomer in the U. of T. observatory in Chile, and the hectic events surrounding the discovery of the supernova. **John Percy**, of the Department of Astronomy, will discuss the meaning of the supernova and provide an update of new findings. On Tuesday morning, ~~Ron Hancock~~, Director of the Slo-Poke Reactor facility, will talk about something a little different, but no less interesting "The Chemistry and Physics of Archaeology".

Other activities should prove of equal interest. On Sunday afternoon a tour has been organized of the Darlington nuclear power station. This will be followed by a talk on power generation at Pickering. On Sunday evening, after the reception, a number of demonstrations of computer-related materials will be held in the Scarborough physics labs. A representative of **Apple Canada** will be on hand to demonstrate their new educational laser disk system. Our friends from **Merlan Scientific** will show off their Champ interface. Lab personnel of Scarborough College will demonstrate new software in physics and mathematics on a network of Macintosh computers.

But there is plenty of time left over in the schedule. We invite the membership to contribute to the exchange of ideas with a contributed talk on a subject of interest, a demonstration, or a poster. A poster can be an effective way to convey your ideas informally with lots of discussion and useful feedback.

Participate in your conference. Preregister early. See you at Scarborough.

American Association of Physics Teachers

ONTARIO SECTION

Agenda
Tenth Annual OAPT Conference
University of Toronto—Scarborough
26 - 28 June 1988

Sunday - 26 June

12:00 -	Registration at Scarborough College
12:30 - 4:00	Tour of Ontario Hydro Plant, Darlington, and talk at Pickering
7:30 - 8:00	Reception
8:00 -	Demonstrations of applications of computers in physics teaching, physics labs Scarborough. Participation by Apple Canada, Merlan Scientific

Monday - 27 June

7:30	Breakfast
8:45	Welcoming Remarks
9:00-10:00	**Thomas Timusk**, Department of Physics, McMaster University "High Temperature Superconductivity" (talk and demonstrations)
10:00-10:30	Refreshment break, publishers, displays, poster sessions
10:30-12:00	Contributed talks and "My Favorite Demonstrations"
12:30-2:00	Lunch
2:00-3:30	**Ian Shelton and John Percy**, Department of Astronomy, University of Toronto "Supernova Shelton 1987A"
3:30-4:00	Refreshment break, publishers, displays, poster sessions
4:00-5:00	Contributed talks and "My Favorite Demonstrations"
6:30	Reception
7:00	Annual Banquet

Tuesday - 28 June

7:30	Breakfast
9:00-10:00	**Ron Hancock**, Director, Slowpoke Nuclear Reactor, University of Toronto "Physics and Archaeology"
10:00-10:30	Refreshment break, publishers, displays, poster sessions
10:30-12:00	Contributed talks, "My Favorite Demonstrations", Results of the Prize test
12:00	Lunch

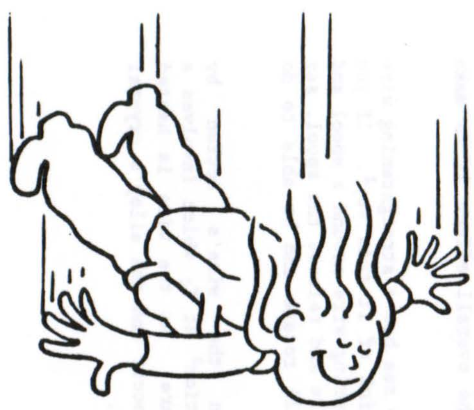
Figuring Physics

As she falls faster and faster through the air, her acceleration

a) increases

b) decreases

c) remains the same



Hewitt Drew it!

Figuring Physics

As she falls faster and faster through the air, her acceleration

a) increases

b) decreases

c) remains the same

The answer is b:

Acceleration decreases because the net force on her decreases. Net force is equal to her weight minus her air resistance, and since air resistance increases with increasing speed, net force and hence acceleration decrease. By Newton's 2nd law:

$$a = \frac{F_{NET}}{m} = \frac{(mg - R)}{m}$$

where mg is her weight, and R is the air resistance she encounters. As R increases, a decreases. Note that if she falls fast enough so that $R = mg$, $a = 0$, then with no acceleration she falls at constant velocity.

Go an extra step in the equation for Newton's 2nd law (divide mg and R by m) and get

$$a = g - \frac{R}{m}$$

Note that the acceleration a will always be less than g if air resistance R impedes falling. Only when $R = 0$ does $a = g$.

Hewitt Drew it!

THE DEMONSTRATION CORNER

The Thermobile and Icemobile

by **Peter Levan**,
Lockerby Composite School, 1391 Ramsey View Cresc.,
Sudbury, Ontario P3E 5T4

At last year's conference in Sudbury, Al Hirsch demonstrated his icemobile[1] and I mentioned the action of a thermobile[1]. Some people were interested in more explanation and information on these little toys and the physics behind them.

The secret is in the alloy of the wire that turns the pulleys. This alloy, Nitinol (Nickel Titanium Naval Ordnance Laboratory), has a curious property. It can retain an apparently plastic deformation if held below a critical temperature, T_C, but if it is heated above this temperature it returns to an earlier shape, a shape given to it by special heat treatment. For example, if a wire is manufactured straight, and T_C is 35°C, then at 20°C it might be quite flexible, while at 50°C it will straighten itself to its manufactured shape exerting some force in doing so.

Refer to the schematic diagram of the thermobile. The Nitinol is a continuous loop around two pulleys. The lower, brass pulley, is immersed in warm water at a temperature greater than T_C, while the upper pulley is at room temperature. The engine is given a turn to start it (in either direction). The pulleys of the engine now will continue to turn.

The power that runs this comes from the strong internal straightening force in the wire as the wire leaves the small pulley in the warm water. The wire "remembers" that it was originally manufactured to be straight. This power isn't balanced off by the power needed to bend the wire because the wire is bent at a temperature below T_C. The overall effect is to make the small pulley rotate.

Since it's not easy to see how a straightening wire makes a pulley rotate, think of it this way[2]. If you wrap a piece of ordinary spring wire around a spool and you hold one end of the wire and release the spool, say on a table, the spool will rotate and be able to do work.

Metallurgists explain the wire's action by describing a phase transition[3] at T_C which involves a change in crystal structure. As the wire is heated above T_C, lattice shears occur and the alloy's crystal type and dimensions change.

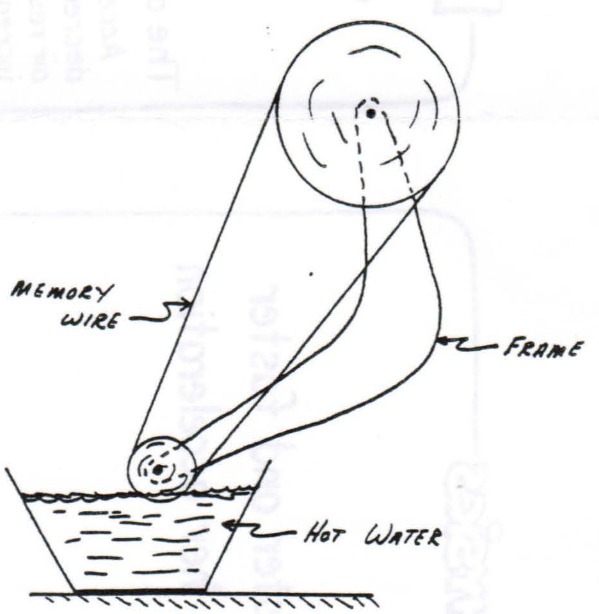
From the standpoint of physics teachers this is a super toy. Here is a device that easily illustrates the major principles of engines...the need for hot and cold reservoirs, and use of heat energy to do work. It can certainly be compared to other forms of engines in terms of efficiency, and work output. Perhaps this topic could make an interesting science fair project for your student.

References

[1] Both devices are produced by Innovative Technology International Inc., 10747-3 Tucker St., Beltsville, MD 20705, for about $30 US
[2] H. Richard Crane, Physics Teacher, 23, 238 (1985)
[3] Ahmad A. Golestaneh, Physics Today, 37, 62 (1984)

Column Editor: Ernie McFarland
Physics Dept., University of Guelph
Guelph, Ontario N1G 2W1

Submissions describing demonstrations will be gladly received by the editor.



Schematic diagram of a thermobile

Tenth Annual
Ontario Association of Physics Teachers Conference
University of Toronto—Scarborough **June 26-27-28**, 1988

Abstract Form

Attendees are encouraged to make a short presentation at the conference. Your presentation could take the form of a short talk on a topic of interest to you, the form of a demonstration you use in teaching physics, or a poster. Let us know of your requirements for AV equipment and physics apparatus.

Participate in your physics conference!

[PLEASE PRINT]
Name (Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No. Street City Postal Code

Business Address ______________________________
Institution

____
No. Street City Postal Code

Home Phone ______________ Business Phone ______________

Session:

Oral Presentation ☐ (12 minutes + 3 minutes questions) Poster ☐

My Favourite Demonstration ☐ (5 minutes)

Title of Presentation: ______________________________

Short Description or Abstract:

____

____

____

____

____

Equipment Required: ☐ slide projector ☐ overhead ☐ 110 VAC

☐ other requirements, VCR etc.? ______________

Please send this form by **May 20** to
Stuart M. Quick
Physical Sciences Division, University of Toronto, Scarborough Campus
1265 Military Trail, Scarborough, Ontario, M1C 1A4 Tel: (416) 284-3231

Ontario Association of Physics Teachers

Vol. X No. 4

Annual Conference
University of Toronto—Scarborough
26 - 28 June

As the time for the annual conference approaches, here is an update of events finalized since the last newsletter.

Geraldine Kenney-Wallace, Professor of Chemistry and Physics at the University of Toronto, and Chairperson of the Science Council of Canada will be guest speaker at our annual banquet on Monday evening, June 27. Geraldine has kindly agreed to take time out from her busy schedule to speak on the topic "From Research to Markets: The Challenges for Science for 2001". She is keen to meet with teachers at the pre-banquet reception.

Contributions for posters, my favorite demonstrations and short talks are still coming in. Here are a few that will give you an idea what to expect (and which might encourage you, too—its not too late!). Pauline Plooard, from Fenelon Falls Secondary School, will display a poster of a collection of puns on the word ohm and its symbol Ω as created and drawn by her Grade 11 Physics students. Alan Hirsch, from Brampton Centennial Secondary School, has a number of favorite demonstrations including "Happy and Sad Balls". (He says don't miss this one—some pairs will be given away and others will be available for $3.50 per pair.) There will be at least four video presentations. Douglas Cunningham, from Bruce Peninsula District School, will show "Using Video Segments to meet the New Curriculum Objectives". Edward Gregotski, from Midland Avenue Collegiate Institute here in Scarborough, will show one describing the National Science Olympics. Sound interesting? Do you have an equally interesting idea? Then let us know!

This is just an update. Don't miss the talks on high temperature superconductivity, the supernova, the chemistry and physics of archaelogy, the tour of the Darlington nuclear power station, and the computer demonstrations in the Scarborough Physics labs on Sunday evening, which were described in the previous newsletter. As regards the demonstrations, 9 Macintosh Plus computers will be available for hands-on workouts throughout the entire conference period. Software running will include the "Calculus" and "Physics" packages by Brøderbund, simulations in mechanics, electromagnetism and modern physics from Blas Cabrera's group at Stanford University, space-time software in collisions and special relativity from Edwin F. Taylor's group at MIT, and HyperCard stacks in electric circuits and astronomy. And much more.

Registrations will be received in the Student Village Centre from 12 noon to 6 pm Sunday, and outside room S309 (in the "S" wing), the main lecture theater, from 8 to 12am Monday. With reference to the map attached, take the Morningside exit from the 401 and go south on Morningside to Military Trail (first traffic light). Once in the main entrance follow the "OAPT" signs to the Student Village Centre. Parking is FREE on all lots. The tour bus leaves at 12:30.

Remember, this is the tenth annual conference of the OAPT (formerly AAPT-O!). This organization exists for the support of teachers of physics in the province at the high school, community college, polytechnic and university levels. It can only develop with the interest and efforts of its membership. If you believe in the aims of the organization spread the word. Pass on a copy of the registration form to a colleague who is interested in good physics and good talk!

Stuart Quick
Vice-President

Agenda
Tenth Annual OAPT Conference
University of Toronto—Scarborough
26 - 28 June 1988

Sunday - 26 June

12:00 -	Registration at Student Village Centre, Scarborough College
12:30 - 4:00	Tour of Ontario Nuclear Power Plant, Darlington, and talk at Pickering
7:30 - 8:00	Reception
8:00 -	Demonstrations of applications of computers in physics teaching, physics labs Scarborough. Participation by Apple Canada, Merlan Scientific

Monday - 27 June

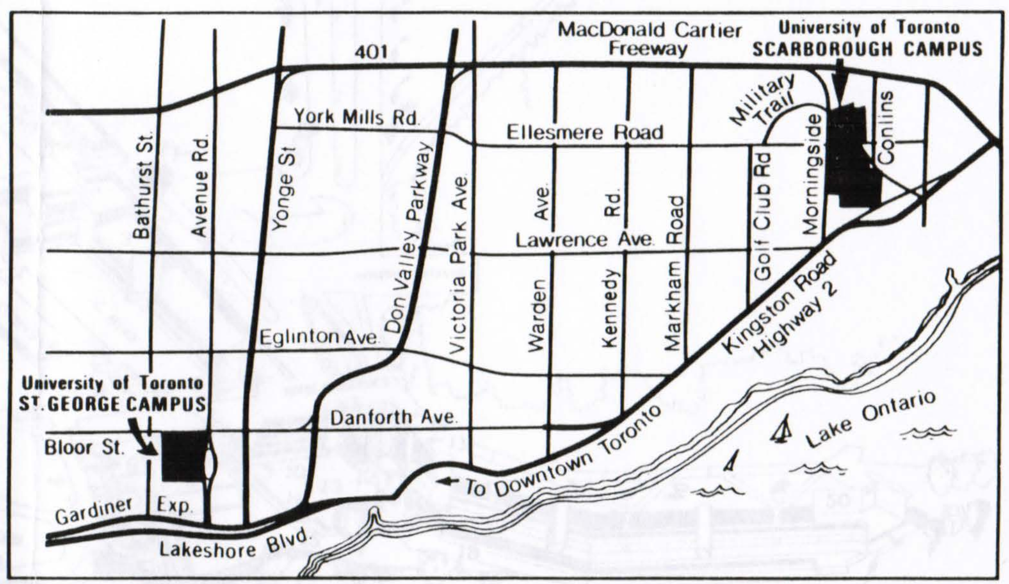
7:30	Breakfast
8:00 - 12:00	Day registration, Room S309 ("S Wing"), Scarborough College
8:45	Welcoming Remarks
9:00 - 10:00	**Thomas Timusk**, Department of Physics, McMaster University "High Temperature Superconductivity" (talk and demonstrations)
10:00 - 10:30	Refreshment break, publishers, displays, poster sessions
10:30 - 12:00	Contributed talks and "My Favorite Demonstrations"
12:30 - 2:00	Lunch
2:00 - 3:30	**Ian Shelton and John Percy**, Department of Astronomy, University of Toronto "Supernova Shelton 1987A"
3:30 - 4:00	Refreshment break, publishers, displays, poster sessions
4:00 - 5:00	Contributed talks and "My Favorite Demonstrations"
6:30	Pre-Banquet Reception
7:00 -	Annual Banquet. Speaker: **Geraldine Kenney-Wallace**, Department of Chemistry, University of Toronto and Chairperson of the Science Council of Canada "From Research to Markets: The Challenges for Science for 2001"

Tuesday - 28 June

7:30	Breakfast
9:00 - 10:00	**Ron Hancock**, Director, Slowpoke Nuclear Reactor, University of Toronto "The Chemistry and Physics of Archaeology"
10:00 - 10:30	Refreshment break, publishers, displays, poster sessions
10:30 - 12:00	Contributed talks, "My Favorite Demonstrations", Results of the Prize test
12:00	Lunch

University of Toronto
Scarborough Campus

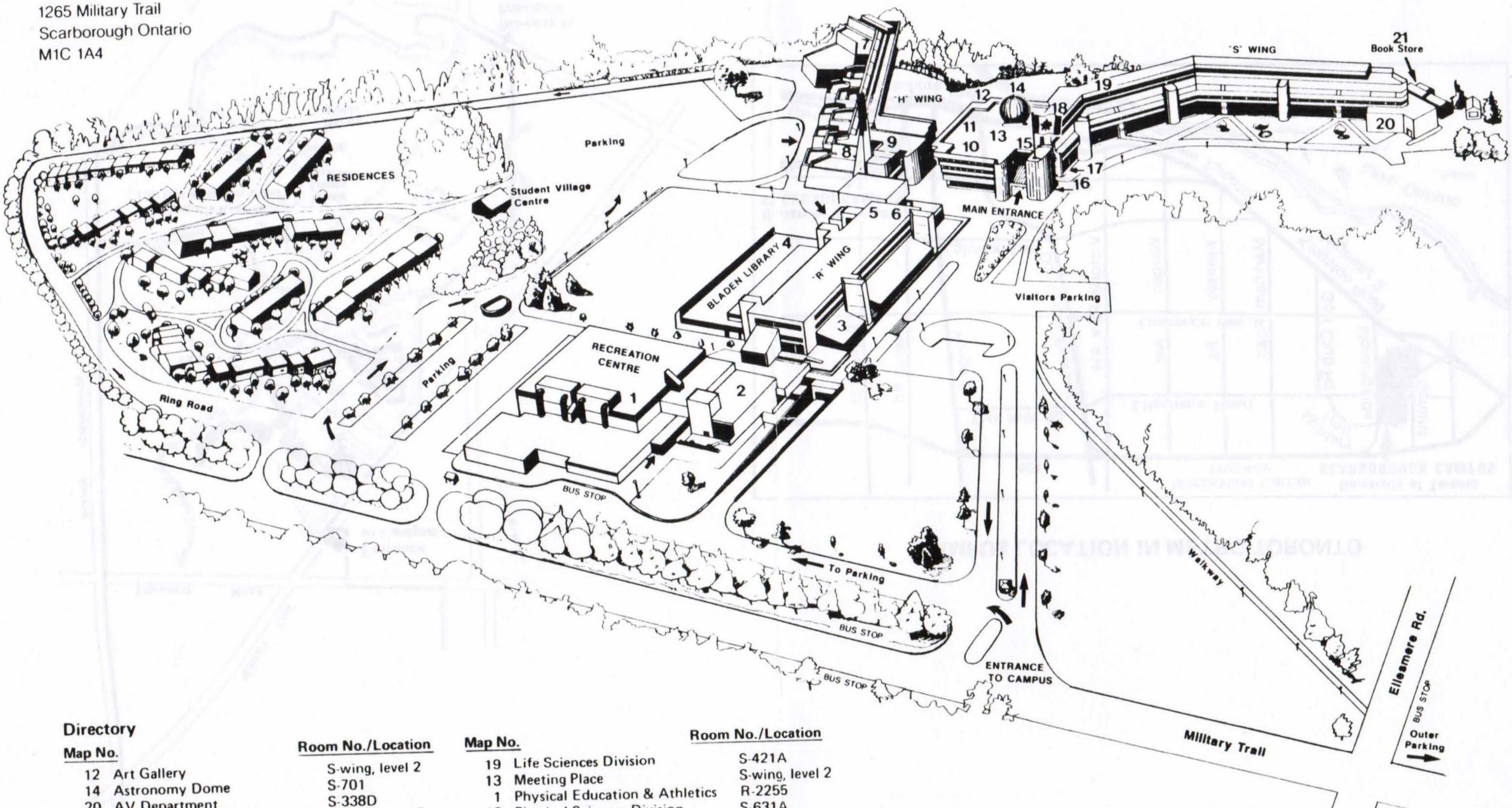
CAMPUS LOCATION IN METRO TORONTO



University of Toronto

Scarborough Campus

1265 Military Trail
Scarborough Ontario
M1C 1A4



Directory

Map No.		Room No./Location
12	Art Gallery	S-wing, level 2
14	Astronomy Dome	S-701
20	AV Department	S-338D
8	Bank (CIBC)	H-wing, level 2
21	Bookstore	S-360
9	Cafeteria (main)	H-206
16	Campus Police/Information	
15	Computer Centre	S-624-628
6	Co-op Programs	R-5008
10	Counselling & Student Services	S-302-304
7	Humanities Division	H-525A
4	Library	L-208

Map No.		Room No./Location
19	Life Sciences Division	S-421A
13	Meeting Place	S-wing, level 2
1	Physical Education & Athletics	R-2255
18	Physical Sciences Division	S-631A
17	Post Office	S-wing, level 2
2	Pub	R-3268
11	Registrar/Admissions	S-417
5	Social Sciences Division	R-5111
3	Students Council Office	R-3042

Passageways on level 2 connect all wings
Room location: First letter indicates wing
First number indicates Floor level

→ Entrance

Section Representative Report on the AAPT/APS Joint Winter Meeting
January 25-28, 1988, in Washington, D.C.

Following are my comments on the events and general trends observed at the Winter Meeting, and some indications of future plans that will affect the Ontario Section of the AAPT.

1. I am happy to report that I met with representatives from Ohio and Michigan and they are excited about a proposal to have physics educators from those states join their counterparts from Ontario at our annual June Meeting in 1989. The proposed meeting will take place in Windsor, Ontario, on dates that will be announced later. The timing for this event is appropriate because the annual Summer Meeting of the AAPT will take place out west, and few of the eastern teachers will be attending it. Plan in advance to join us for what promises to be a unique opportunity and experience.

2. Alberta and Quebec are the most recent provinces to join the AAPT, following the lead teken by Ontario and British Columbia.

3. The executives of the AAPT have indicated a trend to becoming less "American" and more international. For example, mention was made of a possible name change. Also, some section representatives expressed concern that certain workshops and side trips were closed to non-U.S. citizens.

4. In the past, the APS portion of the Joint Winter Meeting was larger and more important than it is now. Currently, the APS meeting later in the spring has a much greater attendance. The AAPT appears to want to continue its affiliation with the APS, so the AAPT executives have indicated that they may choose to alter the Winter Meeting dates to coincide with the larger APS meeting.

5. A government-sponsored program in the U.S. titled the <u>Physics Teachers Resource Agents</u> (PTRA) appears to have been very successful. The program provides funding for qualified teachers to attend workshops and seminars, then share their knowledge and experiences with other teachers back in their home regions and at conferences. Several PTRA's have travelled abroad and many gave presentations at this Winter Meeting. The ultimate goal of this program is to try to solve the problems common throughout North Ameerica of having too few physics teachers and students. (On a personal note, I think we in Canada could benefit by the experiences gained in setting up and operating the PTRA program. We do have isolated examples of professional development, such as the SEEDS Shell Fellowships, the Guelph University Physics Workshops, and the Chalk River Seminars. However, certainly we could use more funding and opportunities. Any ideas?)

- continued

6. As usual, the workshops and presentations at the conference were varied, but there were four general themes that seemed to predominate.

   (a) The crises in physics education are not yet solved and may, in fact, be getting worse. The main crises are a lack of well-qualified physics teachers and low enrollment in physics courses. Researching the causes and cures of these crises is continuing, as are the attempts to solve them.

   (b) Computer use continues to be developed more each year, and laser-disc use is becoming more common.

   (c) Superconductivity is a relatively hot (or at least warm) topic. Scientific supply companies now have available various kits that can be used to demonstrate this phenomenon.

   (d) The supernova of 1977 and other topics in astronomy were popular items at this conference.

7. Various physics educators from Ontario attended the conference, including Ernie McFarland who gave a talk on Guelph University's MPC^2 program which combines elements of math, physics, chemistry, and computer science.

8. Anyone who has visited D.C. need not be told of the benefits of visiting the Smithsonian National Museums. A highlight of particular interest is the Air and Space Museum.

9. The AAPT Summer Meeting will be held June 22-25, 1988, at Cornell University in Ithaca, New York. This location, in the beautiful Finger Lakes Area, is probably the closest the Summer Meeting will be to Ontario for a long time, so if you have ever wanted to attend the Summer Meeting, this would be a good opportunity.

Alan Hirsch
Section Representative

"Hurry up, Archimedes! Stop yelling 'Eureka' and let someone else in the bath!"

THE DEMONSTRATION CORNER

Real Image Demonstration

by Don Murphy,
Sydenham H. S.
Sydenham, Ontario   K0H 2T0

Many demonstrations can be made not just interesting but truly memorable by "setting up" the students a bit beforehand. A rather well-known demonstration involves a real flowerpot and a flower suspended upside down inside a box placed 2 focal lengths in front of a large concave mirror. The viewer sees an illusion of the flower being on top of the box but the image disappears when the viewer approaches too close. The apparatus on hand at our school for a similar demo is illustrated below, but in this case a real image of a light bulb is formed.

The box portion of the apparatus is commercially available[1] or could easily be made. Large concave mirrors (40 cm diameter, 28 cm focal length) are also available for about $45.

The students are set up by first having the box sitting on the teacher's desk at the front of the room with the open side of the box away from the students. A low power light bulb is already in place in the dummy top socket. A marker may be used to doodle a face on the bulb with a few hairs on top. The students are then sent from the classroom. (The doodling could be done at the end of the class the day before the actual demonstration is to be done.)

While the students are out, the bulb is placed in the live socket inside the box and the concave mirror set in place. (The apparatus is set up across the room from the entrance door.) The students are then let in, a couple at a time, and asked if they can sketch a few more hairs on the top of the bulb. They usually say "Sure!" and grab the marker handed to them only to have the bulb "disappear" as soon as they get within "drawing distance". The first students to enter the room gleefully await the reaction of those to follow.

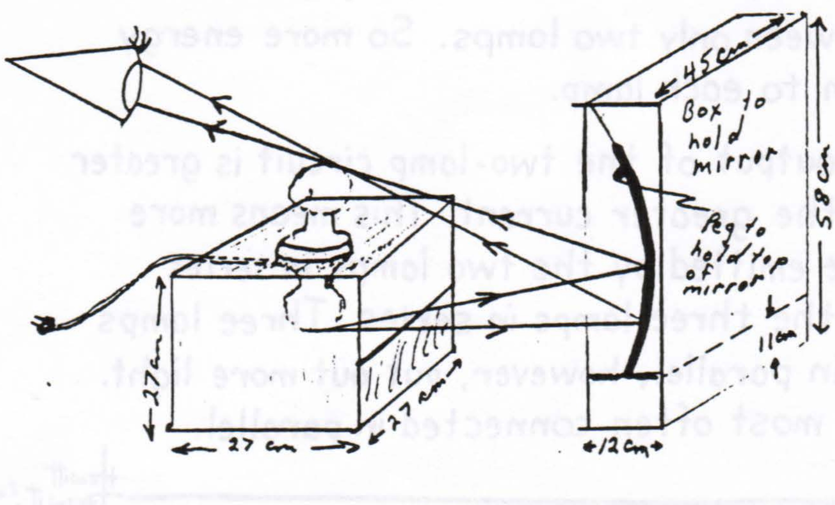
It is interesting to note that, when surprised in this way, *all* students say that they see the image in *front* of the mirror. The fact that a real image is formed is readily shown by placing a piece of paper at the top socket. However, in past years, when the mirror has been clearly shown to students and an object placed at a location to give an image in *front* of the mirror, many students would still say they see the image *behind* the mirror. Perhaps we are too accustomed to "behind-the-mirror images" to see otherwise.

References

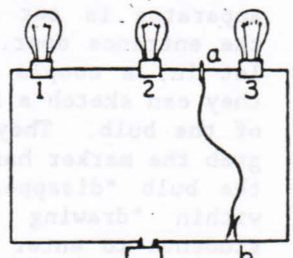
[1] Available from Sargent-Welch. It is incorrectly described in the catalogue as forming a virtual image.

Column Editor: Ernie McFarland
Physics Dept.
University of Guelph
Guelph, Ontario N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



Figuring Physics



The simple series circuit consists of three identical lamps powered by battery. When a wire is connected between points *a* and *b*,

a) what happens to the brightness of lamp 3?

b) does current in the circuit increase, decrease, or remain the same?

c) what happens to the brightness of lamps 1 and 2?

d) does the voltage drop across lamps 1 and 2 increase, decrease, or remain the same?

e) is the power dissipated by the circuit increased, decreased, or does it remain the same?

Answers:

a) Lamp 3 is short circuited. It no longer glows because no current passes through it.

b) The current in the circuit increases. Why? Because the circuit resistance is reduced. Whereas charge was made to flow through three lamps before, now it flows through only two lamps -- $2/3$ the resistance results in $3/2$ the current (neglecting temperature effects).

c) Lamps 1 and 2 glow brighter because of the increased current through them.

d) The voltage drop across lamps 1 and 2 is greater. Whereas voltage supplied by the battery was previously divided between three lamps, it is now divided between only two lamps. So more energy is now given to each lamp.

e) The power output of the two-lamp circuit is greater because of the greater current. This means more light will be emitted by the two lamps in series than from the three lamps in series. Three lamps connected in parallel, however, put out more light. Lamps are most often connected in parallel.

Hewitt
Drewit!

Ontario Association of Physics Teachers

NEWSLETTER Volume XI, Number 1
September/October, 1988

Section Executive
President: Stuart Quick, 100 Spadina Rd., #804, Toronto, M5R 2T7
Past President and CAP Liaison: Peter Levan, 232 Walford Rd. E., Sudbury, P3E 2G9
Vice-President: Bill Konrad, Ridgetown D.H.S., Box 970, 9 Harold St., Ridgetown, N0P 2C0
Conference Chairperson: T. Dean Gaily, Department of Physics, University of Western Ontario, London, N6A 3K7
Secretary-Treasurer: Peter Scovil, 363 Howard St., Waterford, N0E 1Y0
Section Rep.: Alan Hirsch, 2199 Parker Dr., Mississauga, L5B 1W3
Contest Chairperson: George Kelly, 18 Shoemaker Cres., Guelph, N1K 1J8
Memberships: Ernie McFarland, Department of Physics, University of Guelph, Guelph, N1G 2W1
Member-at-Large: This position remains unfilled. If you have suggestions please contact any executive member.

Newsletter Editor: Sincere thanks are expressed to Alden McEachern for his devotion in editing and mailing the OAPT Newsletter in the recent past. We are looking for a volunteer to replace Alden. In the interim, I will act as temporary editor/mailer. Please let me know if you are interested in this role. (A. Hirsch)

Membership Dues: PLEASE look at the address label - the expiry date as of this mailing is shown in the lower right-hand corner. If the date is June 88 and you want to renew your membership for this year, please send $5.00 to the address below. If the date is June 87, this is a final reminder in the hope you will join again. If the date is June 89 oy later, please pass the membership application on to a colleague who may be interested in joining the OAPT.

Membership Application and/or Renewal

NAME ____________________

ADDRESS ____________________

Please send to: Prof. Ernie McFarland, Department of Physics,
($5.00/year) University of Guelph, Guelph, Ontario N1G 2W1

SECTION NEWS

Annual Meeting: The annual meeting of the OAPT was held on June 26 to 28, 1988, at the Scarborough Campus of the University of Toronto. Some of the highlights of the meeting were:

· a tour of the nuclear power plant at Darlington
· demonstrations of applications of computers in physics teaching
· a talk by Thomas Timusk of McMaster University on "High Temperature Superconductivity"
· a presentation by Ian Shelton and John Percy of the University of Toronto on "Supernova Shelton 1987A"

· the annual banquet with special guest speaker Geraldine Kenny-Wallace, currently Chairperson of the Science Council of Canada
· a lecture on "The Chemistry and Physics or Archaeology" by Ron Hancock, Director of the Slowpoke Nuclear Reactor, U. of T.
· several contributed talks and "my favorite demonstrations"
· poster sessions and displays by publishers and scientific supply companies
· barbeque lunches in a picturesque outdoor setting

All who attended agreed that the meeting was stimulating. A special thank you is extended to Stuart Quick, chairperson of the conference.

Michigan Meeting: Ontario Section members within driving distance of Sault Ste. Marie, Michigan, were invited to attend the fall meeting of the Michigan Section of AAPT at Lake Superior State College on Saturday, Oct. 8/88. The executive members of OAPT hope that this type of interaction can continue and perhaps grow.

Summer Meeting, June, 1989: Plans for the next annual meeting of the OAPT are well under way. Dean Gaily and Bill Konrad have promised a super conference. See the advertisement attached and watch for more information in subsequent issues of this newsletter.

PHYSICS AND CHEMISTRY OLYMPIADS

(Following is a condensed version of a report from Dr. John Wylie.)

In the summer of 1988 Canada sent 9 high school students overseas to take part in the International Physics and Chemistry Olympiads held in Austria and Finland, respectively. The week-long events included two days of theoretical and practical axams as well as social, sightseeing, and cultural activities. Thirty-one countries participated in the Olympiads and Canada was proud to win four bronze metals.

This year marked the fourth year that Canada has joined in the Physics Olympiad. Hundreds of students from across Canada competed to try to join the physics team. Winners were from B.C., Ontario, New Brunswick, and Saskatchewan.

Next year's Physics and Chemistry Olympiads will be held in Poland and East Germany, respectively. Students aiming to be part of either team must take part in training programs at a participating university in their province or at the Toronto French School. All programs will culminate with the writing of exams next May, and selected students will attend a one-week Olympiad training camp.

The rewards of these students' efforts are many. Besides the honor of representing Canada at an international event, the students may win scholarships and they gain by interacting with scientists and other top students.

The Canadian teams receive assistance from participating universities and Ministries of Education, and financial support from various companies. For further information, please contact: Dr. John Wylie, The Canadian Physics and Chemistry Olympiads, Toronto French School, 306 Lawrence Avenue East, Toronto, Ont. M4N 1T7 (phone 416-484-6533, extension 249)

CONFERENCE

PLAN **NOW** FOR THE ANNUAL

AAPT–ONTARIO CONFERENCE

TO BE HELD IN LONDON AT UWO

ON JUNE 25, 26 & 27, 1989.

(THAT'S SUN., MON. AND TUES.)

CONFERENCE

CONFERENCE

PLAN AHEAD

CONFERENCE

CONFERENCE

- CLASSROOM DEMOS BY TEACHERS
- FEATURED SPEAKERS
- COMPUTER SOFTWARE FOR PHYSICS
- WORKSHOP
- MEET TEACHERS FROM MICHIGAN, OHIO AND NEW YORK.

CONFERENCE

THE DEMONSTRATION CORNER

The Electrostatic Precipitator

by **Roland Meisel,**
Ridgeway-Crystal Beach High School
Ridgeway, Ontario

Introduction:

An electrostatic precipitator can be assembled in less than half an hour using parts commonly found around the science department in a high school. I have used it as a demonstration in classes ranging from grade 10 general science to grade 13 physics. In addition, it has spawned several senior science projects using it as an investigative tool.

The precipitator uses a strong electrical field to remove particles from air. I use it to "condense" cigarette smoke.

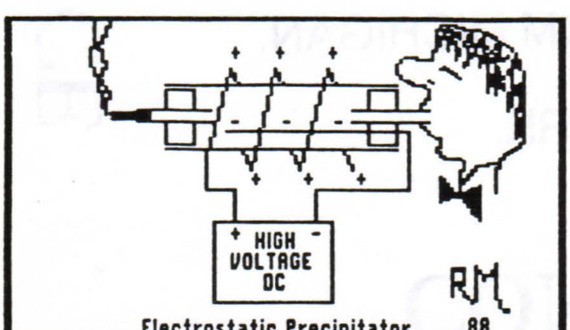
Construction:

I used a glass tube about 4 cm in diameter and about 30 cm long. If you can't find one, cut the bottom off a graduated cylinder of suitable size and use that.

Each end of the tube was fitted with a one-hole rubber stopper. I inserted a short glass tube into each stopper, and added a piece of rubber hose to one end sufficient to hold a cigarette. I also used a length of rubber hose on the "student" end to keep my "volunteer" a safe distance from the high voltage wires.

I used stiff single-conductor wire, about #16 gauge or thicker, to connect the high voltage. One wire went through the hole in one stopper, and stayed inside the glass tube. The other wire was wrapped around the outside of the tube. I used about ten turns. Note that the wires are NOT connected to each other. The inner wire ends inside the tube, while the outer wire ends outside the tube.

The power supply can be any DC, or quasi-DC, high voltage source. I use an old induction coil from CENCO. The higher the voltage, the stronger the effect. However, too high a voltage can cause arcing.



Electrostatic Precipitator

Operation:

I solicit both a cigarette and a volunteer from the class. The cigarette is lit, and the volunteer puffs until the glass tube is full of smoke. The high voltage is turned on, and the smoke "disappears". I usually leave the voltage on, and encourage the volunteer to puff away. The tube receives a noticeable deposit of brown tar on both the glass and the wire in the centre.

This usually generates some discussion, and provides an excellent opportunity to develop some of the curriculum emphases that are mandated in Part I of the new Science Guidelines. I usually work in a little chemistry as to some of the compounds to be found in cigarette smoke, and also a little biology as to the effects of smoke on those who breathe it in.

Notes:

Since you are working with a high voltage source, care must be taken to keep students (and yourself!) away from possible shocks.

When I first came upon this demonstration a number of years ago, I had no trouble finding a volunteer to smoke the cigarette for me. However, in the past couple of years, there have been several occasions on which no one in the class would admit to using tobacco. In order to complete the demonstration, I was forced to do it myself. A way around this is to use an inexpensive air pump, like the kind used to inflate air mattresses.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Ontario Association of Physics Teachers

NEWSLETTER

Volume XI, Number 2
December, 1988

AAPT MEETS IN SAN FRANCISCO IN JANUARY, 1989

The winter meeting of the American Association of Physics Teachers will be held in San Francisco from Sunday, January 15 through Thursday, January 19, 1989. The meeting will be joint with the American Physical Society and the American Association for the Advancement of Science. The program includes an open house at the Exploratorium, a visit to the Lawrence Hall of Science in Berkeley and many workshops.

AIP RELEASES MAJOR SURVEY OF HIGH SCHOOL PHYSICS TEACHERS

The first national survey of public, private and parochial high schools in the U.S.- a project conceived and planned by the American Institute of Physics and the American Association of Physics Teacher - has just been completed and published by the AIP. About 2/3 of the schools offer physics every year, and another 17% offer it every second year. 90% of the schools with physics classes have only one physics teacher and four out of five provide only a basic introductory course in physics. Copies of this report are available from AIP, Education and Employment Statistics Division, 335 East 45th Street, New York, NY 10017. The report will be available for viewing at the OAPT Conference in June.

OAPT PHYSICS CONTEST

George Kelly and his committee are presently preparing the 1989 version of the OAPT Physics Contest. The contest will be written on Tuesday, May 9, 1989, which falls in the week after the SIN test. The contest is designed for students presently taking the Grade 12 (or Grade 11) Physics course or who will be taking it during the second semester. The topics tested will be the same as in last year's contest. However, an attempt will be made to include questions based on laboratory work.

NEWSLETTER EDITOR

Malcolm Coutts will be the new editor of the newsletter. Thanks to Alan Hirsch for acting as temporary editor. If you have any materials to contribute or any suggestions for the newsletter, please send them to

Malcolm Coutts,
6 Swanwick Ave.,
Toronto, Ontario,
M4E 1Z1

THE DEMONSTRATION CORNER

Falling Faster Than 'g'

by T. Dean Gaily,
University of Western Ontario
London, Ontario

A simple lecture demonstration to illustrate that some objects do 'fall' with an acceleration greater than 9.8 m/s^2 is constructed from two pieces of 2.5 cm x 15 cm lumber approximately 1 m in length (1" x 6" x 39"), hinged together at one end. A small marble placed in a notch at or near the end of the "falling" board can be made to fall slower than the board and land in the cup strategically placed on the falling board. [See the sketch below.]

Construction is very straightforward, but here are some tips and precautions:

1) Arrange to release the falling board smoothly, using either a support thread that can be burned or an electromagnet and a piece of soft iron on the falling board. Interrupting the current to the magnet causes the board to fall smoothly.

2) Provide some form of sticky substance in the catching cup to prevent the marble from bouncing out when the board reaches the bottom of its fall.

3) Provide a cushion for the falling board, again to keep the marble from bouncing out of the cup. You might use plasticene or 'duxseal' warmed and worked by hand just prior to the performance of the demo.

This demonstration has been the subject of a recent article in the *American Journal of Physics* [August, 1988, pg. 736]. Here is a much simplified (and less accurate) analysis of the demonstration. The falling board is a rigid body and the gravitational torque acting on the center of mass of the board equals its moment of inertia times its angular acceleration.

$$\tau = I\alpha$$

$$(mg)\left(\frac{\ell}{2}\right)\cos\theta = \left(\frac{1}{3}m\ell^2\right)\alpha$$

Hence, the angular acceleration is

$$\alpha = \frac{3g}{2\ell}\cos\theta$$

The tangential acceleration of the end of the board (approximately where the marble is placed) is obtained from the angular acceleration of the board by

$$a_T = \alpha\ell = \frac{3}{2}g\cos\theta$$

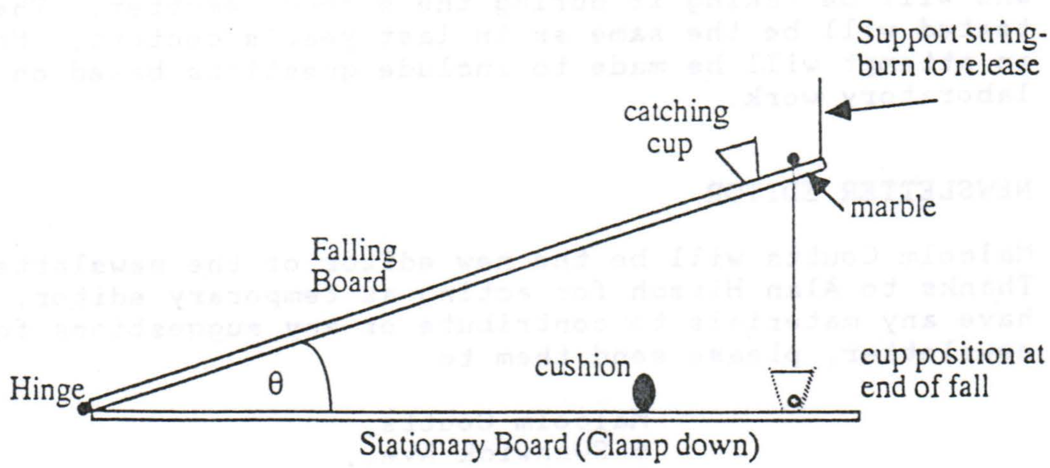
The vertical component of this tangential acceleration is then

$$a_v = a_T\cos\theta = \frac{3}{2}g\cos^2\theta$$

When $\cos^2\theta > 2/3$, $a_v > g$ and the end of the board falls with an acceleration greater than g. Thus for angles of release of less than about 35°, the marble will be caught in the cup. You might wish to experiment with other angles of release, especially greater than 35-45°, to see if the acceleration of the board's end is *less* than that of the freely falling marble.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



CONFERENCE

PLAN **NOW** FOR THE ANNUAL

AAPT–ONTARIO CONFERENCE

TO BE HELD IN LONDON AT UWO

ON JUNE 25, 26 & 27, 1989.

(THAT'S SUN., MON. AND TUES.)

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- Reasonable Costs
  ($25/$20 per night accommodation)
  ($20 per day meals)
  ($25 Registration Fee)
- Sunday Afternoon Workshop
  (Low–cost Electrostatics)
- Demonstrations; Featured Speakers
- Tours of UWO Laboratories

CONFERENCE

Ontario Association of Physics Teachers

NEWSLETTER

Volume XI, Number 3
March, 1989

AAPT WINTER MEETING

(report by Alan Hirsch, Section Representative)

San Francisco was the site of the Annual Winter Meeting of the AAPT/APS (American Physical Society). The meeting was held from Jan. 15 to Jan. 19, 1989, and was combined with the meeting of the AAAS (American Association for the Advancement of Science), resulting in a total registration of nearly 10 000. I would like to share with you some general observations of the themes and events of this meeting.

Increased Number of Workshops

The trend at recent winter and summer meetings has been to offer more workshops prior to the start of the formal sessions. At this meeting, a large portion of workshops related to the use of computers in the classroom. Other workshops included the use of digital timers, teaching electricity with capacitor-controlled light bulbs, and the usual selection of commercial workshops.

Invited and Contributed Papers

Most contributed papers in the sessions lasted for 15 minutes, while invited papers lasted for 15 minutes to one hour. Several papers were presented on astrophysics, synchroton radiation, educational research, and women and minorities in physics. At the high school level there were numerous papers related to teaching methods and demonstrations. Many of these were given by the "graduates" of the highly successful PTRA (Physics Teachers Resource Agents) program. These teachers have taken workshops in physics education and are expected to "spread the good word" to other physics teachers by giving presentations at conferences and workshops in their local regions.

Ontario members will be pleased to learn that Doug Fox was one of the presenters. Although he is no longer directly involved in physics, his heart is still in the right place, as revealed in his talk, which was titled "Ten Timely Tips Toward Terrific Testing."

In one session a summary of the *National Survey of Teachers of Physics*, which had been conducted by the American Institute of Physics, and reactions to it by the chairperson of the AAPT High School Committee and other teachers were given. (See the note below for more information about this major survey.)

THE Highlight

Undoubtedly, the highlight of the winter meeting was the Memorial Session devoted to Richard Feynman who devoted much to physics and physics education. (He shared the Nobel prize in physics in 1965 with two other physicists for work in quantum electrodynamics.) An estimated 1500 to 2000 people filled the auditorium where speeches about and in honour of Feynman electrified the air. Included among the speakers were Nobel prize winners John Wheeler, Julius Schwinger, and Murray Gell-Mann, all of whom knew Feynman, as well as Freeman Dyson from Princeton who also knew Feynman and delivered a magnificently entertaining talk. The February, 1989, issue of *Physics Today* is devoted to Feynman, with articles written by the same people mentioned here. If you are interested in reading more about Richard Feynman, look for two books written by him called *What Do You Care What Other People Think?*, published by W. W. Norton and *Surely You're Joking Mr. Feynman*, published by Bantam Books.

Publications and Equipment

Because the AAPT and AAAS had joined together for this meeting, the number and variety of books, magazines, software, and physics equipment displayed were greater than usual. A few new college and university physics texts are now available as well as new editions of old favorites.

OAPT is affiliated with the American Association of Physics Teachers

AAPT Future Meetings

June 26-July 1, 1989: San Luis Obispo, California
January 22-25, 1990: Atlanta, Georgia
June 25-30, 1990: Minneapolis, Minnesota
February, 1991: San Antonio, Texas
June, 1991: Vancouver, B.C. (proposed)

Survey of Secondary School Teachers of Physics

In 1986/87 the AIP in collaboration with the AAPT surveyed nearly 20 000 teachers of physics in the USA to discover details regarding their schools, training, experiences, and attitudes. The results of the survey have been published; they are interesting and informative and, it is hoped, they may lead to understanding ways that can be used to increase the number of physics students and teachers. There appears to be a chance that the AIP may consider helping to conduct a similar survey in Canada and other countries outside the USA.

A few of the many facts found in the survey are:
-96% of all high school students are in schools where physics is available, but only 20% of all high school graduates take physics.
-About 33% of the teachers were trained initially in physics.
-Over 80% of the teachers are the only physics teacher in their school, and fewer than 10% have personal or professional contact with science teachers at other high schools or universities.
-About 1% of high school students in USA take 2 years of physics.
-23% of the teachers were female, 77% were male.
-The mean school-year salary was $24 500 (US).

The survey report is available from AIP, Division of Education and Employment Statistics, 335 East 45th St., New York, NY 10017-3483 USA

Laser and Lightwave Sciences

Summer Workshop for High School Science Teachers, 21-25 August, 1989

Apply to: Suite 331, McLennan Physical Laboratories, 60 St. George St., Toronto, Ont., M5S 1A7 by April 15, 1989. tel. (416) 978 3923

OAPT JUNE CONFERENCE

Information about the June conference is given on the opposite page. If you or your family would like some variety during the conference, consider the following possibilities:

Stratford Festival

Stratford, Ontario, is a short drive from London. You may wish to attend the Stratford Festival. An early booking is advisable both for theatre tickets and hotels. For further information, write to

The Stratford Festival,
P.O. Box 520,
Stratford Ontario,
N5A 6V2

Blyth Festival

Also a short drive from London is the Blyth Festival in the town of Blyth. This festival features Canadian plays. For further information, contact

Blyth Festival,
Box 10,
Blyth, Ontario,
N0M 1H0

Camping

There are two large campgrounds in the London area.

Fanshawe Conservation Area - 650 sites
10 km N of Hwy 401 at 100. P.O. Box 6278, Station D, N5W 5S1. tel. (519) 451 2800

London-401 KOA Kampground - 120 sites
8 km E on Hwy 401 at 74. RR7 N6A 4C2
tel (519) 644 0222

Membership Application and/or Renewal

NAME ____________________

ADDRESS ____________________

____

$5.00 per year, payable to OAPT
Send to Prof. Ernie McFarland, Dept. of Physics
University of Guelph, Guelph, Ont., N1G 2W1

CONFERENCE

PLAN **NOW** FOR THE ONTARIO

ASSOCIATION OF PHYSICS TEACHERS

(OAPT) CONFERENCE TO BE HELD IN

LONDON AT UWO

ON JUNE 25, 26 & 27, 1989.

MARK IT DOWN!!

- Reasonable Costs
- Sunday Afternoon Workshop (Low–cost Electrostatics)
- Demonstrations; Featured Speakers; Short Contributions
- Tours of UWO Laboratories
- Meet teachers from Michigan & Ohio

For more information:
Bill Konrad, Kent Cty. Bd. of Ed., Chatham, Ont. (519) 354 3770 or
Dean Gaily, Physics, UWO, London (519) 661 2111 x 6426

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THE DEMONSTRATION CORNER

Overhead Projector Wave Simulator

by Bill Konrad,
Kent County Board of Education

The demonstration described in this column is one I learned as a teacher in summer school at the beginning of my teaching career. It is one that I have found to be very useful in teaching a number of concepts related to waves.

I would stress that it is important for students to see and experience a number of real waves such as those on slinkies, in water, or on a Bell Wave Demonstrator, and so this demonstration is not meant to replace any of these hands-on activities. However, the overhead projector model described below is very useful in teaching concepts such as vibrating in phase, direction of particle motion versus direction of wave motion, and the universal wave equation. To make your own overhead projector wave demonstrator, first make a transparency of the sheet of parallel black lines found on the sheet attached to this newsletter. Next you will need to draw a sine wave on a sheet of Bristol board that is about 80 cm by 20 cm. Use a wavelength of 10.2 cm (4 inches). After drawing the wave on the Bristol board, cut it out so that a gap is left on the sheet. Now use acetate transparencies (a portion of a roll from an overhead is best) to cover the gap. If you have access to a laminating machine, it is even better to laminate the sheet that has the sine wave cut out of it.

Tape the transparency consisting of alternate black lines to the top surface of the overhead. When the opaque Bristol board (with the sine wave cut out of it) is moved across the transparency, a moving transverse wave will be seen on the screen.

Some suggestions for using the wave simulator are as follows:

1. Colour two blank spaces on the transparency that are one wavelength apart with an overhead projector pen. Colour another space that is a distance other than one wavelength from the two previously coloured spaces. (Use a different colour for each of the spaces.) Now when the wave motion is simulated, the terms "vibrating in phase" and "not vibrating in phase" can easily be illustrated.
2. To emphasize the difference between particle motion and wave motion, ask one student to follow the motion of a specific coloured particle with the end of a metre stick. (One of the particles created by the coloured spaces mentioned in step 1 can be used.) Another student could be asked to follow the motion of the crest of a wave. The difference between particle motion and wave motion is clearly illustrated.
3. To teach the universal wave equation, proceed as follows. Ask a student to say "STOP" after a particle on the wave has gone through exactly one complete vibration. Repeat this a few times and ask students to note how far the wave itself moves as the particle goes through one vibration. Students should see that this distance is one wavelength. It becomes clear then that, if a specific particle goes through f vibrations, then the wave will move f wavelengths. If f represents the frequency or the number of vibrations per unit time, then the distance travelled in that unit time is the speed of the wave.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

DIAGRAM OF OVERHEAD PROJECTOR WAVE SIMULATOR

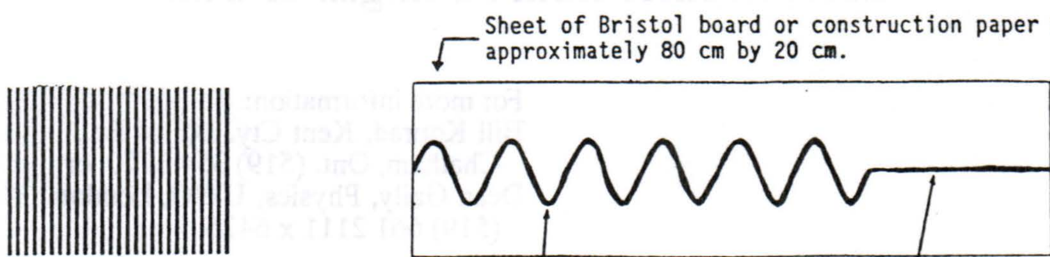


Diagram of transparency that is placed on overhead.

Sine wave that is first drawn on Bristol board and then cut out.

Straight section where no wave action occurs. (This is useful for illustrating some concepts.)

[redacted]

Ontario Association of Physics Teachers

NEWSLETTER

Volume XI, Number 4
May, 1989

OAPT is affiliated with the AAPT

THE DEMONSTRATION CORNER

Electrostatics with Ping Pong balls

by Gyula Lorincz,
Scarborough Campus,
University of Toronto,
1265 Military Trail,
Scarborough, Ont. M1C 1A4

Introduction

Many of our old favourite electrostatics demonstrations can be improved using ping pong balls painted with graphite to replace pith balls. In particular, a simple but very sensitive electrostatic torsion balance can be used to demonstrate both the attraction of opposite charges and the repulsion of like charges.

Construction

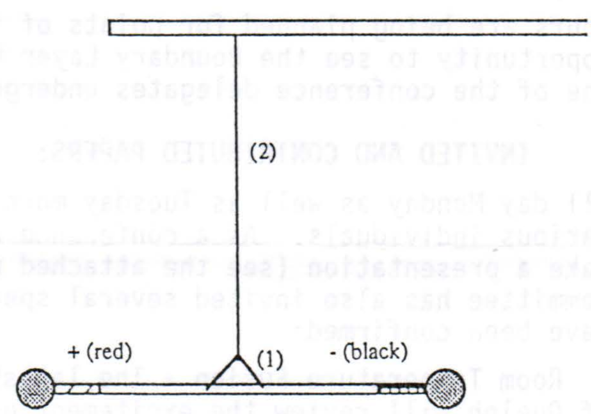
Glue a ping pong ball to each end of a plastic drinking straw with model cement. The balls are then painted with graphite. Make two holes through the straw about 5 cm apart, one on each side of the center. Then thread a short length of string (1) through the holes, tying it at each end. A second length of string (2) can then be tied to this string in such a way that it can be slid back and forth to balance the suspended straw. One end of the straw should be coloured red and the other black in order make it easier to remember the polarity of the charge on each ball.

The only part that is not readily available is the graphite. I used a graphite solution called CARBON-X manufactured by GC Electronics, which is intended to be used to repair potentiometers. Colloidal graphite aqueous suspension (cat # 31338-01, $10.49) is also available from:

CENCO (Central Scientific),
1830 Mattawa Avenue,
Mississauga Ont. L4X 1K1.

Operation

Both charging by contact and by induction can be demonstrated. Rub a glass rod with silk, and charge the red ball positive by contact. Similarly the black ball can be charged negative using a plastic or rubber rod and some wool (I use part of an old scarf). The repulsion between the glass rod and the red ball, and the attraction between the glass rod and the black ball are easily shown. When a ball is charged by induction, it is first grounded by holding it; the charged rod is brought next to it; and the ball is released. The ball now has a charge of opposite sign to the rod, as can easily be seen from the attractive force between them.



Column Editor: Ernie McFarland
Physics Dept.
University of Guelph
Guelph, Ontario N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

ELEVENTH ANNUAL
ONTARIO ASSOCIATION OF PHYSICS TEACHERS' CONFERENCE
UNIVERSITY OF WESTERN ONTARIO - LONDON -- JUNE 25, 26, 27, 1989

CONFERENCE PROGRAM

WORKSHOPS:

Two workshops are being planned for this year's conference - one at the beginning on holography and one at the end on electrostatics. *Attendance at both of these workshops is limited. If you are interested in attending either one or both, you should register promptly.*

HOLOGRAPHY WORKSHOP - SUNDAY, JUNE 25, 1989 - 2:00 p.m. - 5:00 p.m.
This workshop will be conducted by Dr. Tung Jeong from Lake Forest College in Lake Forest, Illinois. Dr. Jeong is well known in international circles for his expertise in the area of holography. If you attended his session at the STAO Conference you witnessed his ability to produce a hologram in about five minutes using a very simple technique. Dr. Jeong will teach this technique to workshop participants and share other dimensions of his vast knowledge of holography. Physics teachers who would like to incorporate holography into their classroom will find this session most worthwhile.

ELECTROSTATICS WORKSHOP - TUESDAY, JUNE 27, 1989 - 1:30 p.m. - 4:30 p.m.
This workshop will be conducted by Bill Wreitz from Cuyahoga Falls, Ohio. It is billed as a workshop on electrostatics for high school teachers by a high school teacher. Bill Wreitz will provide instruction and "hands on" experience on demonstrations and activities that can be used in teaching electrostatics to students. The techniques he uses are guaranteed to work in humid weather and utilize inexpensive materials. In view of the fact that electrostatics is now part of the grade 10 curriculum in the new science guideline this workshop is sure to benefit general science teachers as well as physics teachers.

TOURS:

Tours are being planned for points of interest on and off campus. This is your opportunity to see the Boundary Layer Wind Tunnel at the university or to watch one of the conference delegates undergo examination using ultrasound.

INVITED AND CONTRIBUTED PAPERS:

All day Monday as well as Tuesday morning are devoted to presentations by various individuals. As a conference delegate you are given the opportunity to make a presentation (see the attached pages). The conference planning committee has also invited several speakers. The following conference features have been confirmed:

* Room Temperature Fusion - The latest word! Dr. Innes MacKenzie, University of Guelph will review the excitement of recent weeks and provide us with an update.
* Motivating Students in Science - Larry Butt, Stratford, will share some of his novel ideas about getting students excited about science.
* Lasers and Holography - Dr. Tung Jeong, Lake Forest College, Illinois will show how and why lasers, light, and holography are assuming great importance in modern technology.
* General Level Physics - Bill Tallman, Saunders Secondary School - London, will provide some ideas for teaching physics to general level students.
* Science R Us - Gene Easter and Bill Wreitz both from Ohio will illustrate the use of toys in teaching physics concepts.
* Computers and Rocketry - A representative from Spacebound (Mississauga) will show how computers can be used in data collection in a model rocketry program.

ELEVENTH ANNUAL
ONTARIO ASSOCIATION OF PHYSICS TEACHERS' CONFERENCE
UNIVERSITY OF WESTERN ONTARIO - LONDON -- JUNE 25, 26, 27, 1989

Delegates Registration Form

[PLEASE PRINT]
Name (Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No. Street City Postal Code

Business Address ______________________________
Institution

____
No. Street City Postal Code

Home Phone ______________ Business Phone ______________

Membership ($5.00): Membership includes a newsletter published four times a year and reduced rates to the annual conference. I wish to

renew my membership for 1988-89 ☐ become a member for the first time ☐

Secondary School ☐ University ☐ College ☐ Other ☐

CONFERENCE FEES

REGISTRATION: $35...(members) $40...(nonmembers)

WORKSHOPS:

Sunday afternoon (June 25) Holography (Make your own hologram)
$30...(members) $33...(nonmembers)

Tuesday afternoon (June 27) (Low cost Electrostatics)
$10...(members) $12...(nonmembers)

ACCOMODATION:

Single Room (...nights) at $24 per person per night = $.....
Double Room (...nights) at $19 per person per night = $.....
(Please specify roomate if known) ....

*MEALS:
(available on Monday and Tuesday)
Breakfast: .....(no.) at $5.25 = $.....
Lunch: .....(no.) at $8.95 = $.....
Banquet: .....(no.) at $20.00 = $.....

SUMMARY:	
Membership	....
Registration	....
Workshops	....
Accomodation	....
Meals	....
Total	....

Please send this form by May 31 with your money order or cheque, payable to OAPT to:

T. D. Gaily
Physics and Astronomy Building
University of Western Ontario
LONDON, Ontario
N6A 3K7
Telephone: (519) 661-2111 ext 6426

ELEVENTH ANNUAL
ONTARIO ASSOCIATION OF PHYSICS TEACHERS' CONFERENCE
UNIVERSITY OF WESTERN ONTARIO - LONDON -- JUNE 25, 26, 27, 1989

Abstract Form

Conference attendees are encouraged to make a short presentation at the conference. Your presentation could take the form of:

* a short talk on a topic of interest to you
* a demonstration that you use in teaching physics (which can become part of the "My favourite demonstration session")
* a computer program that has become an integral part of your teaching program
* a teaching strategy that works well for you and that you would like to share with others

Participate in your physics conference!

[PLEASE PRINT]
Name (Mr/Miss/Mrs/Ms) ______________________________
Surname First Name

Home Address ______________________________
No. Street City Postal Code

Business Address ______________________________
Institution

____
No. Street City Postal Code

Home Phone ________________ Business Phone ________________

SESSION:

Oral Presentation ☐ (12 minutes + 3 minutes questions)

My Favourite Demonstration ☐ (5 minutes)

Title of Presentation: ______________________________

Short Description or Abstract:

____

____

____

____

____

Equipment Required:
slide projector ☐ overhead ☐ 110 VAC ☐ IBM Computer ☐
other requirements, VCR, etc.? ☐ ______________________________

Please send this form by May 31 to:

T. D. Gaily
Physics and Astronomy Building
University of Western Ontario
LONDON, Ontario
N6A 3K7
Telephone: (519) 661-2111 ext 6426

Ontario Association of Physics Teachers

NEWSLETTER

Volume XII, Number 1
October, 1989

ANNUAL MEETING

(report by Alan Hirsh, Section Representative)

The annual meeting of the OAPT was held on June 25 to 27, 1989, at the University of Western Ontario in London. Among the 100 registrants were several visitors from the U.S., particularly from Ohio, Michigan and New York. Their contributions and enthusiasm were most welcome.

The featured guest at the meeting was Dr. Tung Jeong from Lake Forest, Illinois, one of the worlds best-known specialists in holography. On Sunday afternoon he conducted a holography workshop during which he explained the physics of various types of holograms, including one involving motion. (Watch for the Ronald McDonald action hologram.) The workshop participants produced their own holograms that were visible in white light.

Dr. Jeong was also the after-dinner speaker at the traditional banquet, held on Monday evening. He presented numerous examples and explanations of holography as well as a look at the future of this exciting field. His enthusiasm, humour and love of teaching were an inspiration.

Another highlight of the meeting were the tours offered, first on the Sunday night (at the imaging department of St. Joseph's Hospital) and then on Tuesday afternoon (at the Boundary Layer Wind Tunnel).

On Tuesday afternoon, Bill Reitz conducted a workshop on the teaching of electrostatics. This workshop was fun, practical and well received by the participants.

The following list reveals the variety of titles and presenters during the sessions on Monday and Tuesday:

"Science R Us" by Bill Reitz, Ohio

"How I Teach Centripetal Force" by John Beach, Ohio

"Room temperature Fusion" by Dr. Innes MacKenzie, U. of Guelph

"Room Temperature Fusion In Secondary School?" by Andrew Blaber, Oakville

"Light Wave Communications For Under $50" by John Pitre, U. of Toronto

"Motivating Strudents in Science" by Larry Butt, Stratford

"An Alternate Approach For Starting A Physics Course" by John Reichart, New York

"Using Light Wave Technology To Measure Force" by Walter North, U. of Windsor

"Probing Societal Impacts of Science and Technology", from P.J.Spratt and Associates, Toronto

"Model Rocketry" by Taras Tataryn and Paul Wolosszanskyj

"Teaching General Level Physics" by Bill Tallman, London

"Dividing by Vectors" by Huschilt and W.E.Baylis

"Canadian Physics Olympiad" by John Wylie, Toronto

"Math CAD" by Paul Zitzewitz, Michigan

"The New Sun Scope" by John Daicopoulos, Sudbury

"The OAPT Contest" by George Kelly, Guelph

"My Favorite Demonstration" by Bill Konrad, Kent County

Congratulations and many thanks are extended to Dean Gaily and Bill Konrad who together organized, hosted and chaired a very successful meeting.

OAPT is affiliated with The AAPT

Laser and Lightwave Sciences Workshop

(Report by Bill Konrad)

This past summer from August 20 till August 25, 28 physics teachers from across the province participated in the first Laser and Lightwave Research Centre in Toronto. This centre is one of seven centres of excellence established in 1987 by the provincial government. The purpose of this centre is to put Ontario in the forefront of international research and development in the fields of Lasers, Quantum Electronics, Modern Optics and Lightwave Science, and Engineering. In addition to research, the centre has organized a variety of educational programs designed to meet various levels of scientific understanding. The five day summer program was specifically designed for secondary school physics teachers.

As a participant in this five day workshop, I would highly recommend it as a very worthwhile experience. The Laser and Lightwave Research Centre is located at McLennan Physical Laboratories at the University of Toronto. The workshop was also held at this location and had the following features:

(1) Lectures: Four major lectures were presented during the five day workshop. Each lecture started at the grade 13 (or OAC) physics level and built from that point. From my perspective the lecturers gauged their depth of treatment perfectly. They increased our knowledge and stretched our minds without burying us in abstract mathematics. The lectures dealt with the interference of light including holography, the interaction of radiation and matter, propagation of light, and fibre optics.

(2) Two afternoons were devoted to lab exercises. Participants could choose from a number of laboratory exercises. In some cases we dealt with equipment we would never be able to purchase on our secondary school budget, such as a Raman spectroscope. But we also saw a number of examples that could be adapted to the secondary school, such as the acoustical interferometer.

(3) Field trips to a holography studio, to a laser machining centre, and to a laser light show gave us a number of examples of how light is being used in numerous applications in business and industry.

(4) A tour of a number of labs in the laser and lightwave research centre as well as the physics and chemistry departments showed us specific examples of how lasers are being used in scientific research today.

(5) An evening session in which participants shared teaching ideas of various types enabled everyone to teach as well as benefit.

There are a number of benefits in participating in such a workshop. These include:

* giving a teacher a chance to be a student. This is probably a healthy experience for us to have from time to time. Many physics teachers are the only "physics expert" in their school. As a result, their knowledge is seldom challenged. A five day immersion experience with other physics teachers reveals that we are not the absolute experts that lack of challenges at the school level had led us to believe we were.

* giving us a first hand glimpse of the technology being used in research today. In touring the facilities it soon became obvious that lasers have become an indispensable tool. Using ingenious methods and a variety of lasers, scientists can generate almost any wavelength of laser light that they wish, within a given range. They are constantly trying to extend this range by developing lasers which produce shorter and shorter wavelengths. One physics post-graduate student was trying to isolate atomic hydrogen and then freeze its motion by trapping it with laser light.

* upgrading outdated knowledge. For example during the lab tour we encountered a student working toward his Ph D in chemistry, studying the photoemission of electrons from metals. He stated that it is possible for two or three photons to act together to emit an electron and that with the equipment he was using, it was easy to detect when it happened. (This is contrary to what I have been teaching for a number of years.)

The Ontario Laser and Lightwave Research Centre plans to run this program again next year. By using the feedback provided by this year's group it plans to improve the program. I would highly recommend this experience as a very worthwhile professional development exercise. Watch for advertisements at the school level next spring and then get that application in.

Section Executive for 1989-90

President: Bill Konrad, Kent County Board of Education, Box 1000, Chatham, N7M 5L7

Past-President: Stuart Quick, 100 Spadina Rd., #804, Toronto, M5R 2T7

Vice-President and Conference Chairman: Nigel Hedgecock, Department of Physics, University of Windsor, Windsor, N4B 3P4

Secretary-Treasurer: Peter Scovil, Box 1169, Waterford, N0E 1Y0

Section Representative: Alan Hirsch, 2199 Parker Dr., Mississauga, L5B 1W3

Contest Chairperson: George Kelly, 18 Shoemaker Crescent, Guelph, N1K 1J8

Memberships: Ernie McFarland, Department of Physics, University of Guelph, Guelph, N1G 2W1

Member-at-Large: This position is currently unfilled. Ideally, it should be someone who can provide liason with the CAAT's. If you are interested or have any suggestions, please contact any member of the executive.

More Physics Teachers Wanted

A joint committee representing CAP-OAPT-STAO has made a submission to the Minister of Education regarding the shortage of qualified physics teachers in Ontario. More information about this issue will appear in the next issue of the newsletter.

Suggestions?

This newsletter is published four times a year to keep the membership informed about the activities of the OAPT and its umbrella organization, the AAPT. If you have any suggestions for items to be included in the newsletter, feel free to contact the editor. Malcolm Coutts, 6 Swanwick Ave., Toronto, Ontario, M4E 1Z1

June Conference, 1990

The annual conference of the OAPT will be held at the University of Windsor, June 17 - 19, 1990. Mark your calendar to-day and look for more information in subsequent newsletters.

Honk If You're Aristotle

A Grade 12 Physics class was assigned a project which consisted of designing and performing an experiment to measure the acceleration of some object. One pair of students proposed to measure the acceleration of an automobile. They would do this by marking the position of the accelerating car at regular time intervals. But how? They came up with an ingenious suggestion. A passenger in the car would have a stopwatch and a handful of darts. Every three seconds, he would drop a dart out the window. Thus, a trail of darts would be left sticking in the road. They could come back and measure the distances between darts at their leisure.

Membership Due?

The date on your address label is the expiry date for your membership. If it says June 89, your membership has already expired. You may use the coupon below to renew it.

Membership Application and/or Renewal

Name ______________________

Address ______________________

____

____

$5.00 per year, payable to the OAPT

Send to: Professor Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario, N1G 2W1

Bloody Ballistics

by George Vanderkuur
Ontario Science Centre
(Premier's Council 1989-90
56 Wellesley Street
Toronto, Ontario)

Introduction:

The heart is a mechanical pump that is used to move an incompressible fluid (i.e., blood) through a very elastic closed network of tubes. With each cycle of the "pump," the whole system expands and contracts.

Construction:

None is required. All you need is an ordinary (probably cheap) bathroom scale and a barefoot volunteer. Bare feet may be optional, but it's the only way I have done this.

Operation:

When you stand on the scale in bare feet, you will be able to observe a periodic movement of the dial. This movement corresponds to your pulse rate.

I do not have an explanation for this effect. This gives opportunity for discussion and perhaps some experimentation. I believe one of the following explanations applies:

* a shift in the centre of mass of the body during each heart beat as the volume of blood changes in different parts of the body (Fig. 1.);

* a slight swelling of the feet and straightening of the legs as blood pressure increases during part of the heart beat cycle.

Notes:

1. There is a diagnostic procedure that uses this principle. I am not sure what it measures, perhaps the elasticity of the artery walls.

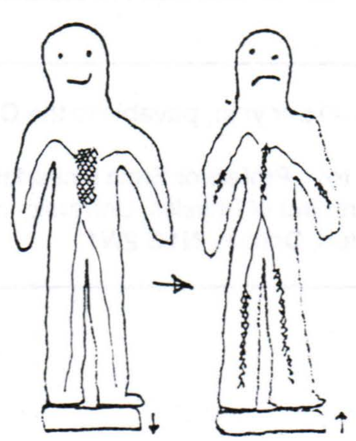
2. It should be possible to measure the energy transferred to the scale during each half cycle and hence the power expended. This could be compared to the power output of the heart. (The reason for using the half cycle is that, when the scale rebounds, it does not do work on the circulatory system.)

3. A laser beam could be used to amplify the motion optically by fixing a mirror to the scale (Fig. 2).

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Fig. 1



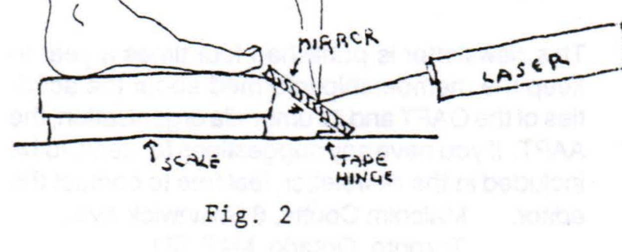


Fig. 2

Ontario Association of Physics Teachers

NEWSLETTER

Volume XII, Number 2
December, 1989

OAPT ANNUAL CONFERENCE, 1990

It is traditional for our association to hold its annual conference at an Ontario university during the month of June. It is the responsibility of the vice-president to organize the conference. In 1990, the conference will be organized by Nigel Hedgecock at the University of Windsor, June 17 - 19.

This will be the 12th annual conference of the OAPT. Following is a list of previous conferences.

1989 University of Western Ontario
1988 University of Toronto (Scarborough)
1987 Laurentian University
1986 University of Guelph
1985 Royal Military College
1984 University of Waterloo
1983 McMaster University
1982 University of Western Ontario
1981 University of Toronto
1980 Trent University
1979 University of Guelph

RASC CELEBRATES CENTENNIAL

The Royal Astronomical Society of Canada celebrates its 100th anniversary in 1990. As usual, The Observer's Handbook compiles current information about the sky for amateur astronomers. It also includes a wealth of data charts and other useful reference material. The 1990 edition features a fascinating cover photograph showing the David Dunlap Observatory as it appeared in 1935 and a brief history of the Society written by Helen Hogg.

Membership includes a copy of the OBSERVER'S HANDBOOK, the bimonthly JOURNAL and NATIONAL NEWSLETTER. The national office is located at 136 Dupont Street, Toronto, Ontario, M5R 1V2, telephone (416) 924 7973.

OAPT is affiliated with the AAPT

OAPT PHYSICS CONTEST

George Kelly and his committee are presently preparing the 1990 version of the OAPT Physics Contest. The contest will be written on Tuesday, May 8, 1990. It is designed for students presently studying the Grade 12 Physics course or for students who will be studying it during the second semester.

CONTEST CHAIRPERSON NEEDED

In its early days, the OAPT contest was set and administered by a single person, first Doug Fox and then Don Murphy. At the annual meeting in 1987, George Kelly was appointed to a three-year term as contest chairperson, with power to choose his own committee. The committee helps to set policy, select appropriate test items, and proof read the final version. However, the administration has been handled by George with expert assistance from the Physics Department at The University of Guelph. His term will expire in June and our association is looking for a replacement. Any interested person should contact George or a member of the executive.

MEMBERSHIP FEES

If you have not renewed your membership, this is your last chance to do so at the archaic price of \$5.00. As of January, 1990, the annual membership fee will rise to \$8.00, the first increase since 1983. To renew, you may use the coupon below.

Name ______________________________

Address ____________________________

____

\$5.00, payable to the OAPT

Send to: Professor Ernie McFarland,
Depatment of Physics, University of Guelph,
Guelph, Ontario, N1G 2W1

THE DEMONSTRATION CORNER

The D.C. Motor

by Peter Scovil
Waterford District High School
Box 370
Waterford, Ontario N0E 1Y0

Introduction

Have you had difficulties explaining to students the complexities of the D.C. motor? Try simplifying the concept by using a turntable, such as from the old PSSC moment of inertia experiment set. It is large enough to fit two bar magnets end to end across it. You then hold like poles of two other bar magnets at each end, letting the turntable rotate away. Opposite poles meet (Fig. 1). What must be done to keep the rotation going? Students give some very interesting suggestions. These can be tested right away. The need for continually alternating poles can then be shown to be the best solution. The obvious problem of worn-out wrists from switching the poles leads the class directly into the need for commutators and brushes.

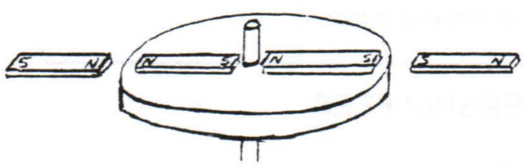


Fig. 1 Turntable motor

Overhead Projection Model

Once the students have the introductory idea, you can show them the details of operation using an overhead projection model like the one illustrated (Fig. 2). The armature coil is mounted using a brad so that it is free to rotate. One end of it is marked. Once the class is familiar with the main parts, place a blank acetate over the armature, and draw in the direction of electron flow from the dry cells, through the brush, onto the commutator, and round the coil. The students can easily predict the polarity and rotation. You can move the armature accordingly. Each step can be shown, drawing in electron flow for each armature position on a new acetate sheet.

The first time through, try to line up the armature to match the diagrams in the current text. (Ed. question — pun intended?) However, it is easy to change the initial conditions and see if the students can predict the rotation. You can make a similar overhead model for the A.C. generator.

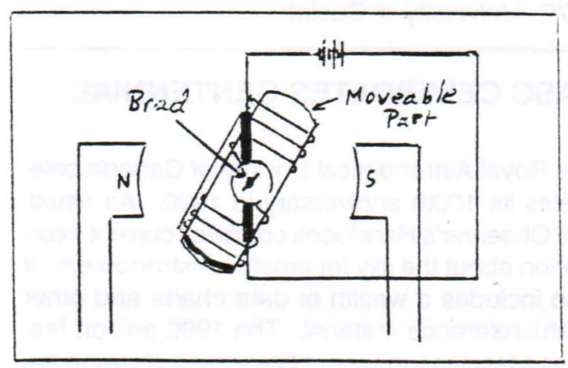


Fig. 2 Overhead Model of D.C. Motor

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Ontario Association of Physics Teachers

NEWSLETTER

Volume XII, Number 3
March, 1990

WINTER MEETING OF THE AAPT/APS

(Report by Alan Hirsch, Section Representative)

The joint annual winter meeting of the AAPT (American Association of Physics Teachers) and APS (American Physical Society) was held in Atlanta, Georgia, from January 20 to 24, 1990. Important changes are being planned for the future of the AAPT as well as for science education in the U.S. A brief description of these changes as well as highlights of the meeting are summarized below.

- The Council of the AAPT approved a proposal to go from a two-meeting model to a three-meeting model starting in 1992. The winter meeting will change from being the administrative and joint meeting (with APS) to a smaller AAPT meeting with an experimental format that will vary from year to year. The joint meeting will be held in April to coincide with the large APS meeting, traditionally held in the Washington, DC, area. The summer meeting will change from June to August (probably the second week). It will continue to be held at a university campus, with the location varying across North America. It is expected that this meeting may attract the greatest number of AAPT members.

- The NSTA (National Science Teachers' Association) is introducing major changes in science education in the U.S. A program called Scope, Sequence, and Coordination will attempt to have science made compulsory for Grades 7 to 12. Four sciences, biology, chemistry, physics, and earth science, will be presented in Grades 7 and 8 at the experiential level, then again in Grades 9 and 10 at a concrete, experimental level with a little math included, and finally a third time in Grades 11 and 12 at a more abstract, analytical level. This mammoth undertaking will be expensive, controversial, and challenging. It will be interesting to see if such changes will have an impact on Canadian science education.

- The executive officer of AAPT, Jack Wilson, will resign from the position as of June 30, 1990.

- Numerous workshops were given at the meeting. Many related to computers in the physics lab. One popular workshop enabled participants to learn how to take high-speed photographs using an electronic flash.

- One session of invited and contributed papers dealt with collaborative (or cooperative) learning. It was comforting to learn that the difficulties in using this mode of learning can be overcome.

- Another session dealt with physics education in countries other than the U.S. Canada's situation was described by none other than Don Ivy from the University of Toronto. His talk was both entertaining and informative.

- Among the numerous other sessions were some that focused on women in physics and the transition from high school to college.

- A major address on environmental issues was given by Carl Sagan who was this year's recipient of the Oersted Medal.

- Future meetings of the AAPT are:

June 25 - 30, 1990 University of Minnesota
Minneapolis, MN

January 21 - 24, 1991 San Antonio, TX

June 24 - 29, 1991 UBC, Vancouver, B.C.

OAPT is affiliated with the AAPT

OAPT PHYSICS CONTEST

The OAPT Physics Contest for Grade 12 students will be written on Tuesday, May 8, 1990. Keep in mind that a new contest chairperson will be required for next year. It is possible that the responsibilities could be divided, with one person responsible for assembling the test and another person responsible for the administration and mailing. If you are interested, please contact George Kelly, any other member of the executive, or this newsletter.

CAP PRIZE EXAMINATION

The CAP Ontario High School Prize Examination will be written on Tuesday, April 24, 1990. This year's examination will be co-ordinated by the Physics Department at the University of Guelph. Information will be sent to all secondary schools in Ontario. For further information, contact Ernie McFarland at the University Of Guelph.

N.Y. SECTION OF AAPT TO MEET AT ROCHESTER IN APRIL

The New York Section of the AAPT will be meeting at the University of Rochester on Saturday, April 28. Members of the Ontario Section (i.e. the OAPT) are welcome to attend. It's only a short drive to Rochester from many areas of southern Ontario, so why not plan to spend a day sharing ideas with our American colleagues? To receive more information, contact:

Ken Evans
Kingston H.S.
403 Broadway
Kingston, NY 12401
U.S.A.
(914) 331-8186 (home)

SECRETARY-TREASURER REQUIRED

Peter Scovil will be completing his term as Secretary-Treasurer in June, 1990. Anyone willing to take on this position should contact Peter, any member of the executive, or this newsletter.

SUMMER WORKSHOP IN VIRGINIA

Virginia Military Institute conducts an annual two-week workshop in the effective use of lecture demonstrations. This year's workshop will be held from July 9 to July 20. Tuition is $595.

For more information, write:

Professor D. Rae Carpenter, Jr.,
Department of Physics & Astronomy,
Virginia Military Institute,
Lexington, VA 24450

or call 703-464-7503

12TH ANNUAL OAPT CONFERENCE

UNIVERSITY OF WINDSOR

JUNE 17, 18, 19, 1990

PROGRAM HIGHLIGHTS

ELECTRONICS MEASUREMENT WORKSHOP
Edwin A. Karlow
Loma Linda University, Riverside, California

Dr. Karlow is one of the developers of the CHAMP Interface now sold by Merlan Scientific and so has considerable expertise in electronics. He will illustrate how a variety of electronic devices and circuits can be utilized to teach physics concepts.

COMMERCIAL WORKSHOP - SUPERCHAMP
Merlan Scientific

This workshop will introduce the next generation interface, the SUPERCHAMP developed by Merlan Scientific and available for the next school year. Numerous possible uses in the physics lab will be illustrated.

1. DEMONSTRATIONS
2. ACTIVITY CENTRES IN PHYSICS
Frank Allen
Ottawa Board of Education

Mr. Allen is a creative physics teacher who will share his ideas on the effective use of demonstrations and activitity centres in physics classrooms.

FIBRE OPTICS
Jack Dyment
Bell Northern Research, Ottawa

Dr. Dyment will describe the current state of the art in fibre optics technology and predict the impact it will have on our lives in the next decade.

STUDENT MISCONCEPTIONS IN INTRODUCTORY PHYSICS
Ernie McFarland
University of Guelph

A familiar face to OAPT regulars, Mr. McFarland will describe some of the common misconceptions first year physics students bring with them.

AMUSEMENT PARK PHYSICS
Carole Escobar
Bellport Senior High School
Brookhaven, New York
[followed by a trip to BobLo Island Amusement Park]

Ms. Escobar has done a lot of work in developing activities that can be utilized in a field trip to an amusement park. She will share some of these with us and prepare us for our own trip to BobLo Island Amusement Park.

FOR INFORMATION, CONTACT:

N.E. Hedgecock
Department of Physics
University of Windsor
Windsor, Ontario N9B 3P4
(519) 253-4232 x 2661

W. Konrad
Kent County Board of Education
P.O. Box 1000
Chatham, Ontario N7M 5L7
(519) 354-3770 x 308

THE DEMONSTRATION CORNER

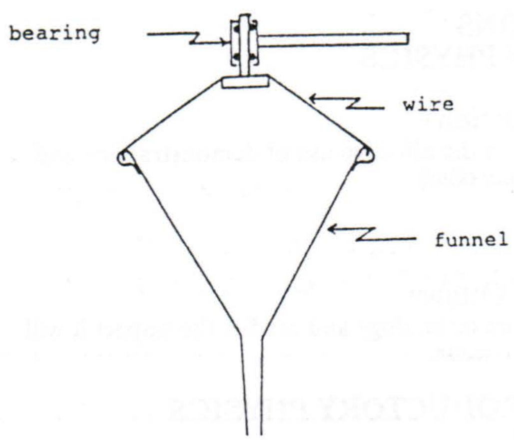
Sand and Soup

by Patrick Whippey
Department of Physics
University of Western Ontario
London, Ontario, N6A 3K7
(519) 661-2111-6431

Materials

Funnel, small bearing, fine sand, two coffee tins, wire

Our funnel is metal with a large lip, and we used soft solder to fasten the wire to the funnel and the bearing. Make sure that the axis of the bearing lines up with the axis of the funnel.



Method

Put your fingers over the top of the funnel and pour in some sand from a coffee tin. As you let go, rotate the funnel. As the sand falls inside the funnel, it is forced inwards towards the centre. To conserve angular momentum, the funnel and the sand inside it speed up. At a sufficiently high speed, the friction forces on the grains of sand are large enough to prevent the sand from falling. Friction in the bearing gradually slows the rotation until more sand slides down the walls of the funnel. As it does so, the system speeds up again because angular momentum must be conserved. The cycle repeats until all the sand has fallen from the funnel.

We originally saw this demonstration written up in The Physics Teacher[1]. Our contribution was to use a good quality bearing to support the funnel. This is essential for a good demonstration. It is also important to use very fine sand. Be careful when you pour in the sand not to pour it over the bearing and cause it to seize up. Catch the sand in the second coffee tin.

Soup

How can you tell the difference between a can of chicken soup and a can of mushroom soup if the labels have been removed? Roll them down a gentle slope and see which one wins! I have just been playing on my kitchen counter, which is not quite level, and the difference is very obvious. We have also filled two transparent plastic bottles with water and put some crumpled plastic sheeting into one of them. As with the soup cans, one rolls much faster than the other.

The speed at which things roll down slopes depends how the initial potential energy at the top of the slope is shared between the translational kinetic energy and the rotational kinetic energy at the bottom. Spheres beat cylinders, which beat hoops. The chicken soup beats the mushroom soup because the chicken soup does not rotate inside the can, so the kinetic energy is mostly translational.

[1] David L. Mott, The Physics Teacher 22, 391, 1984.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

TWELFTH ANNUAL OAPT CONFERENCE

UNIVERSITY OF WINDSOR

JUNE 17, 18, 19, 1990

**** ABSTRACT FORM ****

Conference participants are invited to make a short presentation at the conference. This could be in the form of:

* a short talk on a topic of interest to you
* a demonstration that you use in teaching physics
* a description of a computer program useful in teaching
* a teaching strategy that works well for you.

PLEASE PRINT OR TYPE

NAME: ____
(Surname) (First Name)

HOME ADDRESS: ______________________________________
No. Street City Prov./State Code

BUSINESS ADDRESS: __________________________________
No. Street City Prov./State Code

HOME PHONE: ________________ BUSINESS PHONE: ________________

SESSION: Talk (10 min.) □ My favourite demonstration (5 min.) □
Topics for Independent Studies in OAC Physics (5 min.) □

TITLE OF PRESENTATION: ______________________________

SHORT DESCRIPTION: __________________________________

EQUIPMENT REQUIRED:

Slide Projector □ Overhead □ IBM Computer □ VCR/Monitor □

Other (please specify) ______________________________

PLEASE RETURN THIS FORM BY MAY 31 TO:

N.E. Hedgecock
Department of Physics
University of Windsor
Windsor, Ontario N9B 3P4

Telephone: (519) 253-4232 ext. 2661 FAX: (519) 973-7075

Ontario Association of Physics Teachers

NEWSLETTER

Volume XII, Number 4
May, 1990

COME TO THE CONFERENCE

Included with this newsletter is a registration form for the 12th annual OAPT conference. Also included is a list of special events and a map showing the location of Vanier Hall at the University of Windsor. An outline of the program and a call for contributed papers was enclosed with the March newsletter. In addition to relevant professional development, the conference provides many opportunities for conversations with fellow physics teachers in the relaxed setting of a university campus.

The Sunday afternoon workshop commences at 2:00 p.m. Even if you are not attending the workshop, make an effort to arrive in time for the evening reception. It is a great way to start the conference.

VOLUNTEER NOW

There has been, I believe, only one occasion in the history of our organization when an election was contested. Usually, the positions are filled by volunteers. Our vice-president is, de facto, someone who takes on the responsibility of organizing the annual conference in conjunction with the other members of the executive. Every year, at this time, such an individual must come forward and we are confident that it will happen again.

There are two other positions that need to be filled.

Secretary-Treasurer

Peter Scovil has completed a three-year term as secretary-treasurer. We thank Peter for his quiet, efficient, dedicated service to the OAPT. A successor will have to be found in time for the post-conference executive meeting. Peter offers the following job description:

- Maintaining and reporting on OAPT accounts
- Maintaining a record of all financial transactions
- Paying bills and expenses as they arise
- Checking the financial statement and accounts of the OAPT Contest
- Recording and distributing minutes of the executive meetings (twice yearly)
- Dealing with correspondence as the need arises

Contest Chairman

George Kelly has completed a three-year term as chairman of the OAPT contest. George is one of the founders of the OAPT and has continued to serve the organization after his retirement from teaching. We are grateful for his contribution and wish him well in his future endeavors.

It may be that the duties can be divided amongst several people. However, it would be convenient if one of these people lived in the Guelph area since the Physics Department at the University of Guelph plays a central role in the administration of the contest.

Here is the job description:

- Oversee the planning of the contest, including finances
- Assemble the test questions with the help of a committee and arrange for the paper to be checked and printed
- Arrange for mailing to the schools (three mailings)
- Receive and compile orders for test papers, arrange for computer marking, etc.
- Make a report to the annual conference

OAPT is affiliated with the AAPT

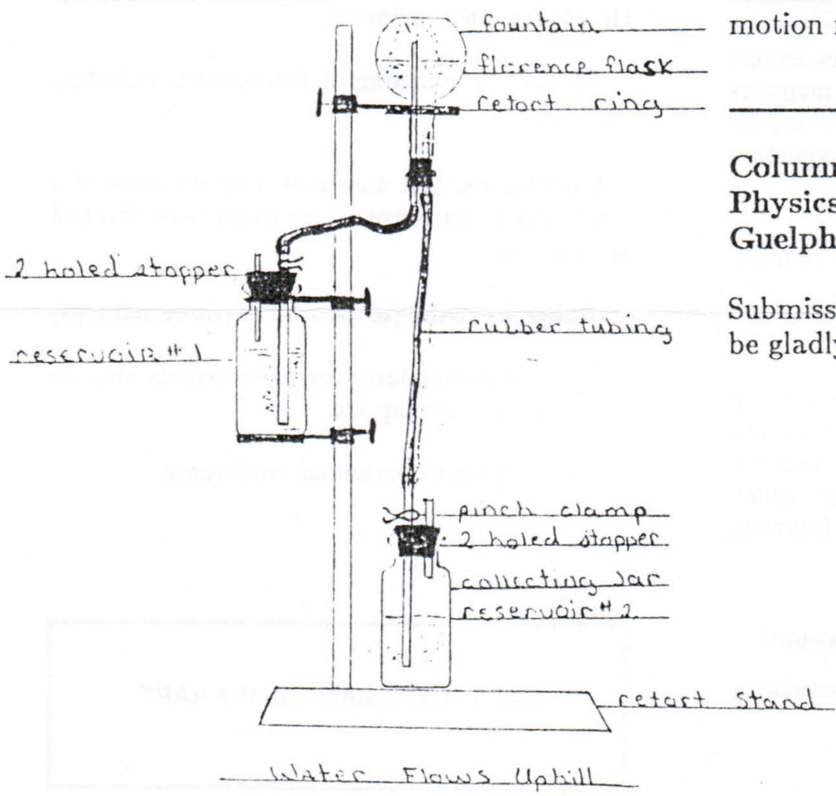
Keeping Alive the Sense of Wonder ... Counter-Intuition

by **DOUG CUNNINGHAM**
Science Head
Bruce Peninsula District School
Lion's Head, Ontario
N0H 1W0

"... The whole art of teaching is only the art of awakening the natural curiosity of young minds ..."

Anatole France
1921 Nobel Prize, Literature

I have always been interested in finding demonstrations that provoke and awaken the natural curiosity of students. Demonstrations that provide unexpected results, or appear on the surface to violate common sense, are particularly effective vehicles for motivation. These demonstrations or experiments are known as counter-intuitive.



Water Flows Uphill

diagram by Clifton Pedrosiquotte
SNC 3B

One such clever demonstration makes use of air pressure and gravity acting on water in the simple apparatus shown. The demonstration shows coloured water flowing uphill and producing a fountain effect in an inverted florence flask ... the uphill motion of the water appears to proceed without any visible impetus. Water flowing uphill by itself!

The apparatus is primed by having the florence flask initially 2/3 filled with the coloured water and reservoir #1 is filled with the same coloured water. The water's motion is started by opening the pinch clamp leading to reservoir #2 and it will continue until reservoir #1 is empty. The counter-intuition effect is enhanced if the students are shown the fountain only after it has been started.

The demonstration is useful for Intermediate Grades when talking about air pressure ... and provides an interesting starting point for brain storming with Senior Physics students regarding counter-intuition, conservation of energy, and perpetual motion machines. I recommend it.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Ontario Association of Physics Teachers

NEWSLETTER

Volume XIII, Number 1
October, 1990

June Conference Report

by : Alan Hirsch
Section Representative

The twelfth annual conference of the Ontario Association of Physics Teachers was held at the University of Windsor from Sunday, June 17, to Tuesday, June 19, 1990. Although the number of registrants at the conference was a relatively small 65, the comraderie and stimulation were grand.

The conference began with a demonstration workshop on "Teaching Physics through Electronics" presented by Dr. Edwin Karlow of Loma Linda University, California. Dr. Karlow began by demonstrating several aspects of the operation of an oscilloscope. Then he used the oscilloscope and various other devices to demonstrate topics in sound, electricity, and magnetism. The electronic equipment as well as the demonstrations ranged from simple to complex.

A Sunday evening reception was held in a lounge on the top floor of Electa Hall overlooking the Detroit River and providing a panoramic view of the lights of Detroit.

Monday was perhaps the busiest day in the history of our June conferences. After a brief welcome by Dr. Gordon Wood, Vice President, Academic, of the University of Windsor, we watched Frank Allen of the Ottawa Board of Education present numerous physics demonstrations, many of which utilized toys and other inexpensive, everyday apparatus. Frank also described activity centres that promoted cooperative learning.

During the coffee break, the line-up to view the sun through each of two telescopes set up for that purpose was longer than the line-ups for coffee or the displays of books and equipment so kindly set up by publishers and scientific supply companies.

The morning concluded with the following presentations:
Darcy Dingle : "Teaching Spacial Thinking through Naked-Eye Astronomy"
William Baylis : "Why i"
Andrew Blaber : "Rocketry by Computer"

The afternoon began with a demonstration workshop of The New SUPERCHAMP Interface by a representative from Merlan Scientific. This was followed by a lively presentation on the newest rage in Ontario, "Amusement Park Physics." The main part of the presentation was given by Carole Escobar from Brooklyn, New York, who has taken students for several years on trips to amusement parks. We also had a brief introduction to the Physics Day at Canada's Wonderland (located just north of Toronto) given by Nancy Grant, who is in charge of this growing event. (On May 29, 1990, Canada's Wonderland held its first annual Physics/Science Day. It was attended by about 1300 students. I predict that next year's event will be enjoyed by at least 6000 students.)

During the amusement park presentations, everyone began assembling their vertical and horizontal accelerometers, which were manufactured by Pasco Scientific and donated by Merlan Scientific. We carried the accelerometers onto waiting buses, and some teachers were seen testing their accelerometers as the buses transported us toward Windsor's amusement park on Boblo Island. After an enjoyable meal, we took a ferry to the island. Most participants verified that experiencing acceleration and forces on amusement park rides helps make physics understandable, exciting, and fun. Although our time on Boblo Island was short, it was a most enjoyable excursion.

The Tuesday sessions began with an up-to-date and stimulating talk on "Fibre Optics" by Jack Dyment from Bell Northern Research, Ottawa. He described how glass fibres are manufactured and assembled into cables, and how lasers provide multiple signals through digitized coding. He also gave an overview of the social and economic implications of the use of fibre optics in communications.

George Kelly from Guelph presented a report on the OAPT physics prize contest which was written by about 2500 students in May. This is George's third and final year as contest chairperson. We sincerely thank him for all his hard work and support.

Ernie McFarland from the University of Guelph presented a paper titled "Common Student Misconceptions in Introductory Physics." Pretesting and posttesting students in first year university reveal that large numbers of students have misconceptions about basic physics principles. Ernie described four examples from mechanics and suggested ways of reducing the problem.

The afternoon included these presentations:

John Wylie : Report on the "Canadian Physics Olympiad"

Petrusia Kowalski : An independent study unit on "Machines and Gadgets"

Malcolm Coutts : "Topics for Independent Study in OAC"

Frank DiPietro : Demonstration of the computer software "Interactive Physics"

John Braun : "War Games Lab" using springs

For those who were able to stay, two tours were available, one to a Ford Motor Company plant and the other to the imaging department of a hospital.

All who attended the conference agreed they were happy they had done so. Thanks to Nigel Hedgecock and Bill Konrad for a successful conference.

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President :
Nigel Hedgecock
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Malcolm Coutts
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Toronto, Ont.,
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Membership Due?

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$8.00 per year, payable to the OAPT

Send to: Professor Ernie McFarland,
Department of Physiics,
University of Guelph,
Guelph, Ontario,
N1G 2W1

June Conference, 1991

The annual OAPT conference will be held at Queens University in Kingston from Sunday, June 23 to Tuesday, June 25. Mark your calendar now and plan to attend.

Section Executive for 1990-1991

President : Nigel Hedgecock,
Department of Physics,
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Windsor, Ont.,
N4B 3P4

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Kent County Board of Educaton,
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N7M 5L7

Vice - President and Conference Organizer :
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Department of Physics,
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Kingston, Ont.,
K7L 3N6

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The Toronto French School,
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M4N 1T7

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Malcolm Coutts,
6 Swanwick Ave,
Toronto, Ont.,
M4E 1Z1

Memeberships : Ernie McFarland,
Department of Physics, University of Guelph,
Guelph, Ont.,
N1G 2W1

Member-at-Large:
This position is currently unfilled. Ideally, it should be someone who can provide liason with the CAAT's. If you are interested or have any suggestions, please contact any member of the executive.

Laser Workshop

In the September, 1989 issue of this newsletter, Bill Konrad wrote an article about a summer workshop in laser and lightwave sciences held at the University of Toronto. This worthwhile endeavor was offered once again in 1990 for a week during the month of August. There were lectures on the theory of lasers, holography, environmental monitoring, chemical applications, medical applications and the impact on society. Tours were taken to research laboratories, a holographic art gallery and a laser machining centre. Laboratory activities were also provided.

This workshop will be offered once again in the summer of 1991. For further information, write to

Summer workshop co-ordinator,
Ontario Laser and Lightwave Research Centre
McLennan Physical Laboritories,
60 St. George St., Suite 331,
Toronto, Ontario
M5S 1A7

Amusement Park Physics

Amusement park physics was the major theme of the June conference. Those of us who were foolhardy enough to make the trip to Boblo Island, survived a few of the rides with our accelerometers. (If your accelerometer reads less than one "g", don't look down, you are probably upside down.) The October, 1990 issue of The Physics Teacher carries an article **Amusement Park Physics** by Carole Escobar, who was a speaker at our conference. You may also wish to look up the article **Physics In Wonderland** by Eli Honig in the centennial issue of the Crucible, February, 1990. More than 1000 students visited Canada's Wonderland on a science day in May of this year and the event will be repeated in 1991. Information will be mailed to the schools by Canada's Wonderland.

MAKING SOUND WAVES VISIBLE

by
Bill Konrad
Kent County Board of Education

The demonstration described below was demonstrated at the OAPT conference in London in June 1989. Since there was a fair bit of interest in the details of construction of the apparatus, I thought this column would provide a convenient opportunity to give the specifications. Essentially, a speaker at one end of the closed air column is used to set up a standing wave of sound inside the column. Natural gas enters the device through two copper tubes. The gas is lit and burns at numerous holes drilled across the top of the duct. Due to differences in pressure at the nodes and loops of the standing wave inside the air column, the flames that are generated vary in height giving a visual outline of the wave inside.

The device can be constructed using round heating ducts which can be purchased from a heating contractor, a hardware store, or from Canadian Tire Ltd. If the ducts are flat sheets of metal when purchased, they must be assembled. It is also a good idea to solder all seams so that they become air tight. A metal plate, also made of sheet metal, is soldered at one end. A wooden frame is constructed for the other end. Simply cut two pieces of plywood that are the same size as the metal plate that is soldered to the one end. Cut a circular hole equal in diameter to the heating duct in the middle of each of these two wooden pieces. Mount the speaker (5") to one of these pieces. Insert a piece of flexible rubber (available as rubber dam from Boreal Scientific Ltd.) between the two pieces of wood. Bolt the two pieces of wood together using a carriage bolt in each of the four corners. Now slide this assembly over the remaining open end of the duct. Use caulking to seal the space between the wooden frame and the duct and to attach the duct to the wood.

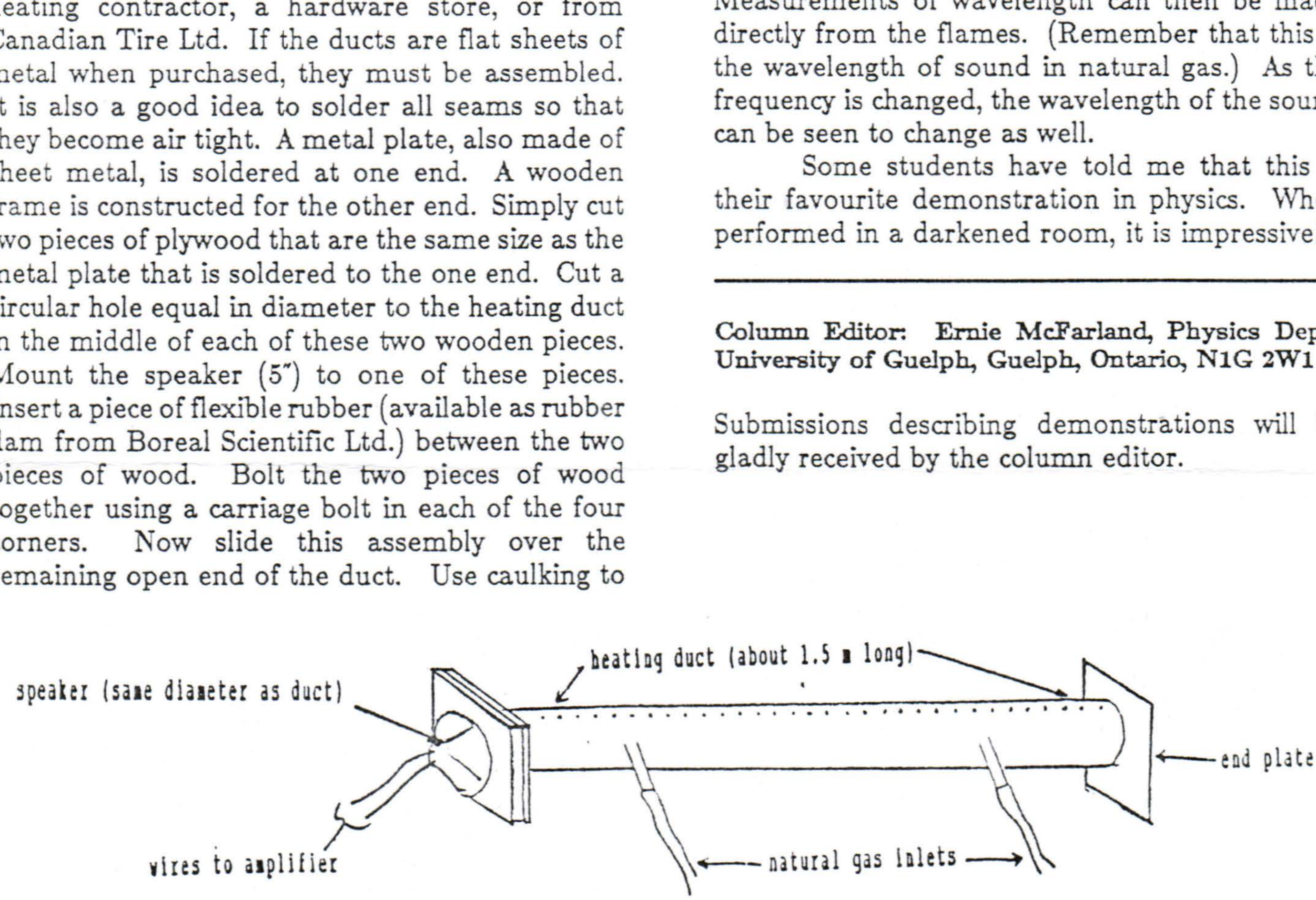
Drill holes in the top of the duct so that they are spaced about 1/2" or 1 cm apart. In the model I constructed, these holes are quite small (3/32"). A piece of copper tubing must be inserted and soldered in place at each of two locations on the duct so that natural gas can be forced into the device.

To operate this demonstration, simply turn on the gas and then light the gas escaping from the numerous holes across the top. Once all the air has been expelled from the duct, the flames will be yellow in colour. Now switch on the signal generator and amplifier that power the speaker. At low frequencies (below 100 Hz), the flames can be seen to vibrate at the audio rate. If the volume is turned up, the flames begin vibrating so vigorously that they are easily blown out. For the model I constructed, resonance could readily be demonstrated between 200 and 300 Hz. Carefully adjust the frequency until the numerous flames of various heights trace out a sine wave. Measurements of wavelength can then be made directly from the flames. (Remember that this is the wavelength of sound in natural gas.) As the frequency is changed, the wavelength of the sound can be seen to change as well.

Some students have told me that this is their favourite demonstration in physics. When performed in a darkened room, it is impressive!

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



Ontario Association of Physics Teachers

NEWSLETTER

Volume XIII, Number 2
December, 1990

Richard E Taylor-Co-recipient of the 1990 Nobel Prize in Physics

RICHARD E. TAYLOR was born on November 2nd, 1929 in Medicine Hat, Alberta. He studied Physics at the University of Alberta in Edmonton, where he received the B.Sc. degree in 1950 and the M.Sc. degree in 1952. He went for graduate studies to Stanford University, where he received a Ph.D. During his graduate work he spent three years at the Ecole Normale Superieure in Paris working on the building of the linear accelerator at Orsay. He returned to California, where he worked in Berkeley and Stanford, helping build the linear accelerator at Stanford, and especially the detectors to be used in experiments with this accelerator.

At Stanford he became head of an experimental team which studied in 1967-68 the inelastic scattering of high energy electrons from protons and neutrons. The study of these scattered electrons suggested a substructure of much smaller particles within the protons and neutron. These small particles came to be identified with the "quarks" of Gell-Mann and Zweig. Following this landmark experiment, his group also conducted a very important electron scattering experiment, which showed that a basic mirror symmetry of nature is violated in these interactions.

R.E. Taylor is a Professor at Stanford University and is involved at the moment in experiments conducted at a new machine (HERA) in Hamburg, Germany. Professor Taylor is a Fellow of the Royal Society of Canada, recipient of an honorary doctorate from the University of Paris, and recipient of the Panofsky prize of the American Physical Society

by Gabriel Karl, Dept. of Physics, University of Guelph

June Conference

The calender which accompanies this newsletter reminds us that the annual OAPT contest conference will be held at Queen's University in Kingston, June 23-25, 1991. Details will be available in the March newsletter. However, if you need to make early application for funding, assume that the total cost will be less than $200. This will include conference registration, Sunday workshop, accommodation for two nights, meals, tours and dinner cruise.

OAPT Contest

This year's OAPT contest for Grade 12 physics students will be held on Tuesday, May 7. The contest committee is composed of the following people:

Peter Scovil----------Waterford District H.S.
Malcolm Coutts-------Riverdale C.I., Toronto
Chris Howes----------Pickering High School
Don Murphy---------Sydenham High School
Dianne Ness----------Humberside C.I., Toronto
Ron Taylor-----------Woburn C.I., Scarborough

Grade 12 physics teachers are asked to promote the contest by giving out copies of previous papers, especially to students who take physics in the first semester. Interested students from the first semester could be contacted during April and reminded of the contest.

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University of Guelph,
Guelph, Ontario
N1G 2W1

<u>*THE DEMONSTRATION CORNER*</u>

THE WORLD'S SIMPLEST MOTOR

by
Robert Ehrlich
Physics Department
George Mason University
FAIRFAX, VA 22030 USA

Ed. note: This article has been excerpted, with permission, from a delightful 225-pg. book on physics demonstrations, ***Turning the World Inside Out***, by Robert Ehrlich. This book (ISBN 0-691-02395-6) is a treasure-trove of good, inexpensive demonstrations. You can order it through your favourite bookstore or, while supplies last, at a 20% discount directly from the author. (Send a cheque for $13 (U.S.) payable to "GMU Foundation: Physics Teaching Fund".)

Demonstration

The world's simplest motor can be constructed in less than five minutes.

Equipment

A "D"-size 1.5 V battery; a small disk-shaped magnet; some wire; and a thick rubber band.

Construction

You need to make a small field coil (the rotating part of the motor) and two supports in which to place the ends of the field coil. Make the field coil of the magnet by winding 10 turns of varnish-coated noninsulated number-22 wire. Make the ends of the wires that extend from the field coil into hook shapes, as shown in the illustration. Scrape the varnish off the *top half* of the two wire ends. Shape two paper clips (or some stiff noninsulated wire) into two rigid supports that have small loops at the top. With a strong rubber band, hold the two supports fixed against the two ends of the battery. Insert the hook-shaped wires coming out of the field coil into the loops at the tops of the two rigid supports, so that the field coil lies just above the disk-shaped magnet, which is placed atop the battery at its middle. Current flows through the field coil as long as its ends are in electrical contact with the supports.

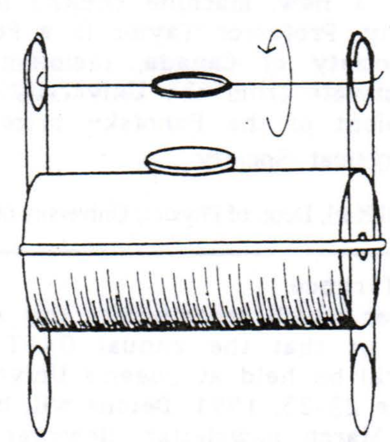
Comment

If you give the field coil a little push, it should keep spinning for a while. The motor doesn't require split rings or a commutator because the field-coil wires make electrical contact with the loops during only half of the cycle, and the coil's rotational inertia carries it through the other half of the cycle. The motor can be held sideways on an overhead projector and shown to a large group. Take the field coil off when you're done so you don't run the battery down completely, since the field-coil resistance is very small. For more details on this ingenious demonstration, see the following two articles in *The Physics Teacher (TPT)*: Rudy Keil, *TPT 17*, 308 (1985), and Scott Welby, *TPT 23*, 172 (1985).

There are other devices that can also lay claim to being the world's simplest motor. Among them is "Top Secret", made by Andres Manufacturing Company, Inc. of Eugene, Oregon, and sold in novelty stores. This intriguing device consists of a small top that can be given a spin on a platform that comes with the top. An initial spin causes the top to spin for days. The device is actually a motor. It has a battery-powered transistor and coil in its base that provide an alternating magnetic field, and there is a permanent magnet inside the top. The spinning magnet top induces a small current in the coil which the transistor amplifies. The magnetic field produced by the amplified current attracts (and accelerates) the spinning magnet top, thereby offsetting frictional losses.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



Ontario Association of Physics Teachers

NEWSLETTER

Volume XIII, Number 3
March, 1991

AAPT Winter Meeting Report

by Alan Hirsch, Section Representative

The annual winter meeting of the AAPT was held from January 19 to January 24 in San Antonio, Texas. The first two days, Saturday and Sunday, were filled with workshops, many of which related to the use of videos and computers. The main part of the conference, from Monday to Thursday, consisted of invited and contributed papers, round-table discussions, commercial workshops, awards and ceremonial sessions, poster sessions, and committee meetings.

In a short report, I cannot provide many details of the conference, but I would like to share with you the general themes and trends that I observed.

- Computers continue to find more and more uses at all levels of education. Some educators predict that within the next decade the teacher will be a facilitator rather than an instructor. Many new software packages and video disc packages are available for the MacIntosh and IBM computers.

- Innovative ideas have been developed for using video cameras and VCR's in the physics laboratory and classroom. One impressive idea was to take videos of students acting out demonstrations of physics principles, such as standing wave patterns, simple harmonic motion, and the law of conservation of momentum. (The latter was done in a swimming pool with students walking, etc., on a large floating exercise mat). The ideas I saw at this conference were not, in my opinion, as varied and useful as the "Freeze-Frame Physics" ideas presented at the November, 1990, STAO Conference.

- More attention is being paid to the interaction between different levels of physics instruction. Some groups are focusing on the relationship between elementary school science and secondary school science. Other groups are concerned with the liaison between high school physics and college or university physics. I was asked by a committee member if Ontario teachers would be interested in a workshop on this topic to be funded by an American institution. As your representative, I replied "Yes." I will follow up on this kind offer.

- Some of the most popular audio-visual materials produced many years ago (such as Frames of Reference) are being edited for reproduction onto the video (VHS) format. Teachers who currently have the old silent version of The Tacoma Narrows Bridge Collapse may want to order the new video version which is accompanied by narration as well as a detailed teacher's guidebook. This video is available from the AAPT Publications Sales Department for U.S. $42.00 less 20% for AAPT members.

- One of the very popular sessions at the conference had as its theme the link between physics and the arts. The physics of music, the physics of ballet dancing, and the hints of quantum mechanics found in the poetry of Robert Frost were among the more memorable presentations. At some time in the future, I'm sure that Ontario teachers would welcome workshops or invited talks by Thomas Rossing (on the physics of music or musical instruments) and Kenneth Law (on the physics of dance). Both are excellent speakers.

-Among the talks given by Canadians was that of T. Dean Gaily of the University of Western Ontario who reported on research comparing the achievements of students who had studied an area of kinematics using computer software with the achievements of students who had studied the same topics by attending traditional lec Conference as well as the annual executive meeting in October.

- For the foreseeable future, the AAPT will hold three meetings annually: the main Winter Meeting (which will continue to include meetings of the executive committees), the Spring Meeting held in April in Washington, D.C., as a small part of the APS Conference, and the popular Summer Meeting, traditionally held on a university campus in late June. (This meeting will be moved to about the third week in August starting in 1992.) Dates of the AAPT meetings and other conferences are listed below.

- APS/AAPT Spring Meeting — Washington, D.C.
  April 22 - 25, 1991
  (plus a workshop on "Global Warming", April 20 and 21)
- ASP Annual Meeting — University of Wyoming
  June 21 - 27, 1991
- AAPT Summer Meeting — Vancouver, B.C.
  June 24 - 29, 1991
- Inter-American Conference on Physics Education — Caracus, Venezuela
  July 14 - 19, 1991
- AAPT/APS Winter Meeting — Orlando, FL
  January 6 - 9, 1992
- APS/AAPT Spring Meeting — Washington, D.C.
  April 20 - 23, 1992
- AAPT Summer Meeting — University of Maine
  August 10 - 15, 1992
- AAPT/APS Winter Meeting — New Orleans
  January 4 - 7, 1993

Note: The 1990 Summer Meeting at U.B.C in Vancouver is shaping up to be a major event. Abstracts for contributed papers must be received by March 7, 1991. Further information may be found on page 113 of the December, 1990, Announcer.

The **OAPT** newsletter is published four times a year by the *Ontario Section of the American Association of Physics Teachers*

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Newsletter Editor :
Malcolm Coutts
6 Swanwick Ave.,
Toronto, Ont.,
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Two OAPT Executive Officers Required

As Section Representative of the Ontario Section of the AAPT, I have enjoyed working with the other AAPT executive members as well as fulfilling my responsibilities within the AAPT. My term as Section Representative expires prior to our June Conference in Kingston, so the OAPT is looking for a replacement who will commence duties at that conference. A second executive position, that of Member-at-Large, has remained open for at least three years. Following are details of these positions.

Responsibilities of the Section Representative

The OAPT Section Rep must be a member of the AAPT and acts as the liaison between the Ontario Section and the AAPT. The Section Rep sends reports to the AAPT providing details of the activities of our section. He or she is expected to attend the annual Winter Meeting of the AAPT in January and to contribute to various aspects of that meeting. At the very least, the Rep must attend three executive meetings held in the evenings at the Winter Meeting. Section Reps are also invited to share other responsibilities at the meeting. The Ontario Rep reports general trends of the Winter Meeting to the Ontario membership as well as specific items for consideration to the OAPT executive. Of course the Rep is expected to attend the annual June Conference held at some Ontario university and to contribute to the planning and organization of that conference as well as report to the general membership on the main events of the conference. Traditionally, two executive meetings are held each year: one at the June Conference and the other in October. Other responsibilities, including ones listed in the OAPT constitution, will be passed on to the next Section Rep in June.

Responsibilities of the Member-at-Large

The most important responsibility of the Member-at-Large is to act as a liaison between the OAPT and physics teachers at community colleges in Ontario. The OAPT is hoping to increase interest and membership among these important physics teachers. Like other executive members, the Member-at-Large is expected to attend the annual June Conference as well as the annual executive meeting in October.

If you are interested in serving on the OAPT executive as either the Section Rep or the Member-at-Large, please write a note to Malcolm Coutts, as soon as possible. If more than one person is interested in a single position, an election will be held.

A. Hirsch

Al Hirsch has served more than four years as Section Representative. During that time, he has kept us well informed about the activities of the AAPT and has given us strong leadership in our own section. Thanks, Al.

Some Dates To Remember

OAPT contest, 1991 - Tuesday, May 7

OAPT Conference, 1991 - Queen's University, Kingston, June 23-25

OAPT Conference, 1992 - Ryerson Polytechnical Institute, Toronto, June 28-30

Ontario Association of Physics Teachers Annual Conference

June 23-25, 1991
Queen's University, Kingston, Ontario

Program Highlights: A Sunday workshop on computerized test and exam construction; a cruise and banquet through the famous 1,000 islands; an array of guest speakers with talks ranging from international standards in physics education to current research in polymer physics; presented papers from OAPT members.

Cost: All expenses including conference and workshop registration, accomidation, board and cruise/banquet will be well under $200. For more information and registration forms, contact; John Wylie, Ontario Association of Physics Teachers, c/o The Toronto French School, 306 Lawrence Ave. E., Toronto, Ontario, M4N 1T7, Telephone (416) 484-6533, Fax (416) 488-3090.

Plan to be there !

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Department of Physiics,
University of Guelph,
Guelph, Ontario,
N1G 2W1

A COMMON STUDENT MISCONCEPTION IN INTRODUCTORY PHYSICS

by Ernie McFarland
Dept. of Physics, University of Guelph

This article is based on part of a presentation at the 1990 OAPT Conference, held at the University of Windsor.

Many students studying physics at the secondary school and introductory university level suffer from a number of misconceptions. One of the strongest of these is that "**motion implies force**," that is, if an object is moving, even at constant velocity, then this motion must be the result of a (net) force on the object in the direction of motion.

This misconception is neither new nor Canadian — it has been demonstrated by careful studies in a number of countries — and it is not unreasonable for students to have this belief. After all, in everyday life, a moving object will gradually slow down and come to rest unless some force is provided in the direction of motion.

Here is a question from the 1988 OAPT Physics Contest (Gr. 11 & 12):

"A ball is thrown vertically upward. As it travels up after being released by the thrower, which describes the force(s) that act(s) on the ball, other than air resistance?

(A) the force of gravity, vertically downward
(B) the force that maintains the motion, vertically upward
(C) the downward force of gravity and a constant upward force
(D) the downward force of gravity and a decreasing upward force
(E) no net forces"

Only 22% of the students correctly chose "A," whereas 66% chose "D," an answer that includes an upward force on the ball in flight. Students would undoubtedly have done much better if asked a numerical question about the position or velocity of the ball during its motion. In other words, students' ability to solve numerical problems does not necessarily indicate a clear understanding of the physics in a given situation.

I have used a number of similar questions in first-year university courses, both as pre-test questions and as short examination questions, and have always been disappointed with the student performance. In one exam question, students were asked to show the correct free-body diagram for a woman standing on a moving walkway in an airport. The walkway is moving at constant velocity, and air resistance is negligible. In spite of the constant velocity stipulation, many students included a horizontal force on the free-body diagram. Again, to them, motion implies force.

So **what can we do to help** our students leap over this misconception hurdle?

- ask more non-numerical questions about forces on objects, and engage students in discussion about these questions
- give students the opportunity to experience and measure forces and accelerations in real-life situations (have them make accelerometers[1] to use in cars, elevators, amusement park rides, etc.)
- make students aware of the misconception
- remind students that "forces have sources" (What could be the source of a decreasing upward force on a ball in flight?)
- discuss the misconception again later in the course (perhaps for charges moving in a uniform electric field)
- listen to students when they describe how they are thinking, and adapt teaching strategies to help them
- finally, buy a copy of Arnold Arons' book, *A Guide to Introductory Physics Teaching* (Wiley, 1990, ISBN 0-471-51341-5) and reflect on what he has written.

---

[1]available from Merlan Scientific in Georgetown. (See also Carole Escobar's article on amusement park physics in *The Physics Teacher*, Oct. 1990.)

THE DEMONSTRATION CORNER

THE WORLD'S SIMPLEST SPEAKER

by
FRANK ALLAN
Science Co-ordinator
Ottawa Board of Education
2675 Draper Ave.
Ottawa, Ontario K2H 7A1

Demonstration

The world's simplest speaker can be constructed in a matter of seconds.

Equipment

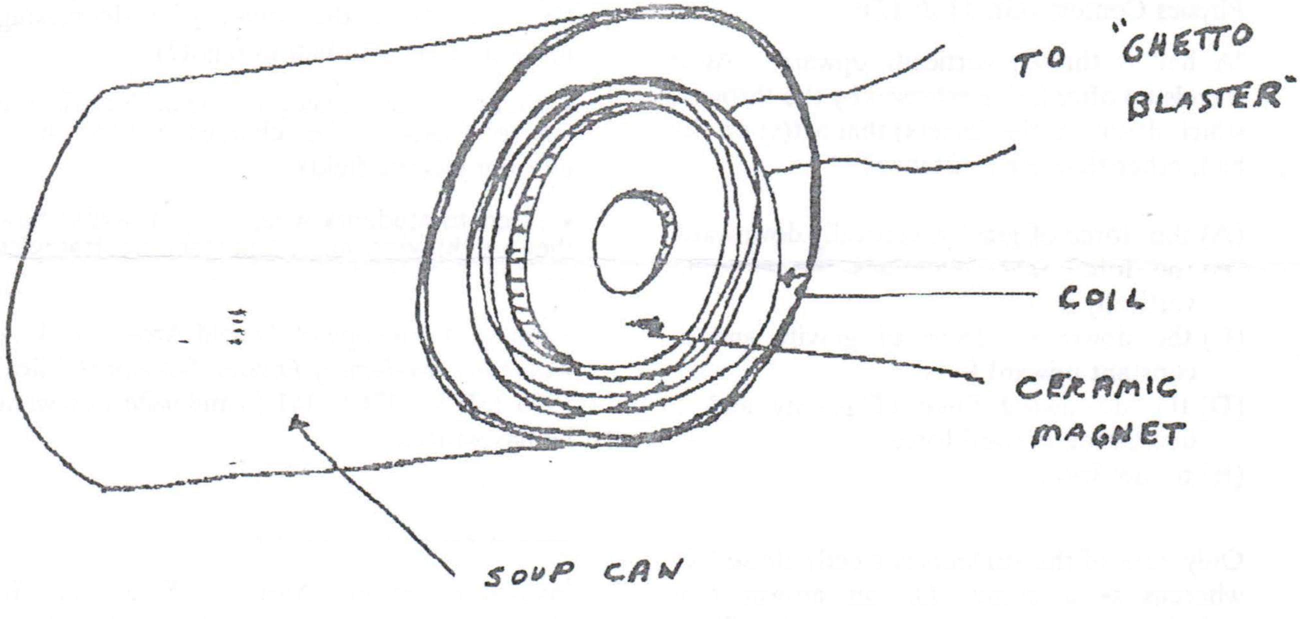
A soup can (10 cm in diameter, 12 cm high), a circular ceramic magnet (7 cm in diameter), a coil of wire (about 50 turns of motor-winding-gauge wire made into a coil with a mean diameter of about 6 cm), a "ghetto blaster" with an external speaker jack, and connector wires to attach the coil to the speaker jack.

Construction

Simply connect the coil to the speaker jack, place the ceramic magnet on the closed end of the soup can and tuck the coil in underneath it. Disconnect the speakers of the "ghetto blaster" and plug in the coil's speaker jack to it. Sit back and enjoy the ultimate in sound; well, not quite.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



Ontario Association of Physics Teachers

NEWSLETTER

Volume XIV, Number 1
October, 1991

June Conference Report

Alan Hirsch and Malcolm Coutts

Sunny, temperate weather greeted some eighty delegates to the thirteenth annual conference of the Ontario Association of Physics Teachers at Queen's University on Sunday, June 23, 1991. As usual, the format of this three day conference allowed plenty of time for mingling, socialization and informal conversations.

The procedings began with an afternoon workshop on computerized test construction presented by Patrick Whippey of the University of Western Ontario. Dr. Whippey has developed a "test engine" for storing test questions and assembling tests in the environment of Word Perfect 5.1. The participants spent their time at the computer keyboard retrieving questions from the test bank and putting together a test.

A Sunday evening reception at the Queen's Faculty Club gave us an opportunity to renew old acquaintances.

Following words of welcome from Don Taylor, Head of the Physics Department at Queen's University, Monday's program began with a fascinating talk by Reginald Smith of Queen's University and the Canadian Space Agency. Dr. Smith does materials research and is particularly interested in phase transitions which take place in the absence of convection in a weightless environment. A high quality environment of 10^{-6} g can be maintained for a few seconds in a drop tube. Much longer time periods can be obtained by using rockets or a space shuttle but the cost rises dramatically and the quality of the environment is not always so high.

Andrew Blaber reported on the Canadian entry in the 1992 Space Sail Cup, an international race to Mars using a solar sail propulsion system. The design theory involves photon momentum and orbital mechanics. Formidable practical problems will be encountered in deploying an aluminized kapton sail 8 μm thick and several hundred square metres in area.

Bill Collins, representing Telecommunications Research In Ontario, showed an "upbeat" video designed to encourage young people to pursue the study of mathematics and science. Schools will be notified when the final version of the video is available.

The afternoon session featured two talks dealing with polymer physics. Marsha Singh of Queen's University, spoke about phase transitions in co-polymers. She showed that a very large scale lattice -like ordering may occur. Jim Stevens of Guelph University spoke about his research on "smart windows", electrochromic devices which change their reflectivity at various wavelengths in response to a stimulus such as temperature.

Peter Scovil and Malcolm Coutts reported that 2300 students from 185 schools took part in the OAPT Contest. Some schools have requested an earlier reporting of the results and the committee is considering sending out test answers immediately following the day of the contest

Peter Scovil distributed copies of an independent study for OAC physics students dealing with operation and applications of an oscilloscope. Bill Tallman presented some more of his imaginative ideas for motivating students by using objects from everyday life.

(continued)

Glen Main showed two clips from videos designed to teach physics through real physical events. These are available from Physics Curriculum and Instruction in Bloomongton MN. David McLay outlined the Queen's University Summer Program for Science Teachers and showed slides of some typical activities. The theme for the 1992 program will be Energy and the Environment.

The dinner cruise through The Thousand Islands provided further fellowship and an opportunity to view the conjunction of Jupiter, Mars and Venus.

Tuesday's sessions began with a presentation on International Perspectives of Physics Education by Michael Matthews of the Toronto French School. Having taught physics in various European countries before coming to Canada, Michael is well qualified to judge how Canadian physics education compares internationally. The media might have us believe differently when it emphasizes that Canada placed 11th out of 13 countries on an international science exam for 17-year olds, whereas Hong Kong placed first. What should be added is that in a similar test given to 14-year olds, Canada placed 4th out of 17 countries and Hong Kong placed 16th. The apparent discrepancy stems from the fact that Canada keeps a far higher proportion of students in high school than Hong Kong or most other countries.

The second invited speaker, Allan Brown of Queen's University, discussed the philosophy and organization of the International Baccalaureate program. This program emphasizes education of the "whole" person in its offering of senior high school courses. In Canada, there are 41 schools (mostly private) that offer this international program.

John Wylie of the Toronto French School brought us up-to-date on the International Physics Olympiad. Canada's team, chosen after many challenging steps, represented our country very well in the 1990 competition. This year's event is hosted by Cuba.

The remainder of the conference was spent with contributed papers. Patricia Hughey from Lansing College in Michigan talked about Conceptual trees in Physical Science. This method of classifying vocabulary helps both students and teachers gain a more complete perspective of course material. Ross Getsinger from Oakville Trafalgar School demonstrated several examples of marble launchers built by his senior students, and he described how the project was integrated into the physics course. Jeff Culbert of the University of Western Ontario discussed alternatives to traditional problem solving techniques. Sharad Tembe of Uxbridge Secondary School shared several well organized ideas on independent study projects in his senior physics course.

Three teachers who are currently working at the Ontario Science Centre also gave presentations. Bill Prior demonstrated how to prove that a soap film adopts a configuration that has minimum energy. David Kroeker demonstrated a home-made hovercraft big enough to carry a person. This "human air-puck" is powered by a small shop-Vac, and can be seen at the Science centre. John Caranci described the exciting senior level (OAC) courses offered at the Science Centre.

Many thanks are due to John Wylie of the Toronto French School and David McLay of Queen's University for their dedication and hard work in organizing and hosting this year's stimulating conference.

Bill Konrad Stays On

We are pleased to announce that Bill Konrad has accepted the position of section representative for the OAPT and will act as our liason with the AAPT. Having served as president and having helped in the organization of two OAPT conferences, Bill is well qualified to represent us.

The **OAPT newsletter** is published four times a year by the Ontario Section of the American Association of Physics Teachers.

President:	*Newsletter Editor:*
Nigel Hedgecock,	Malcolm Coutts,
University of Windsor,	6 Swanwick Ave.
Windsor, Ontario,	Toronto, Ontario,
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P.O. Box 1169,
Waterford, ON N0E 1Y0

The next OAPT conference will be held at Ryerson Polytechnical Institute, Toronto, June 28 - 30, 1992. Plan to be there.

VIRTUAL IMAGE FORMED BY A PLANE MIRROR

by

T.J. Elgin Wolfe

Faculty of Education
University of Toronto
371 Bloor St. W.
Toronto, ON M5S 2R7

An interesting demonstration that makes use of the location of the virtual image formed by a plane mirror can be done with a black cloth, a small candle (about 2 cm in height), a dull dark opaque shield about 3.5 cm tall and bent at right angles, a large pane of thin window glass, two retort stands, 4 adjustable clamps, a 400 mL beaker, and coloured water. To highlight the beaker in the dim light, outline the outer edges (as viewed by the class) with masking tape.

Set up the apparatus as shown in the diagram (top view). Place it on top of the dark, non-reflective cloth before the class arrives. Make the room as dark as possible by closing the drapes, and cover the apparatus with a blanket or sheet.

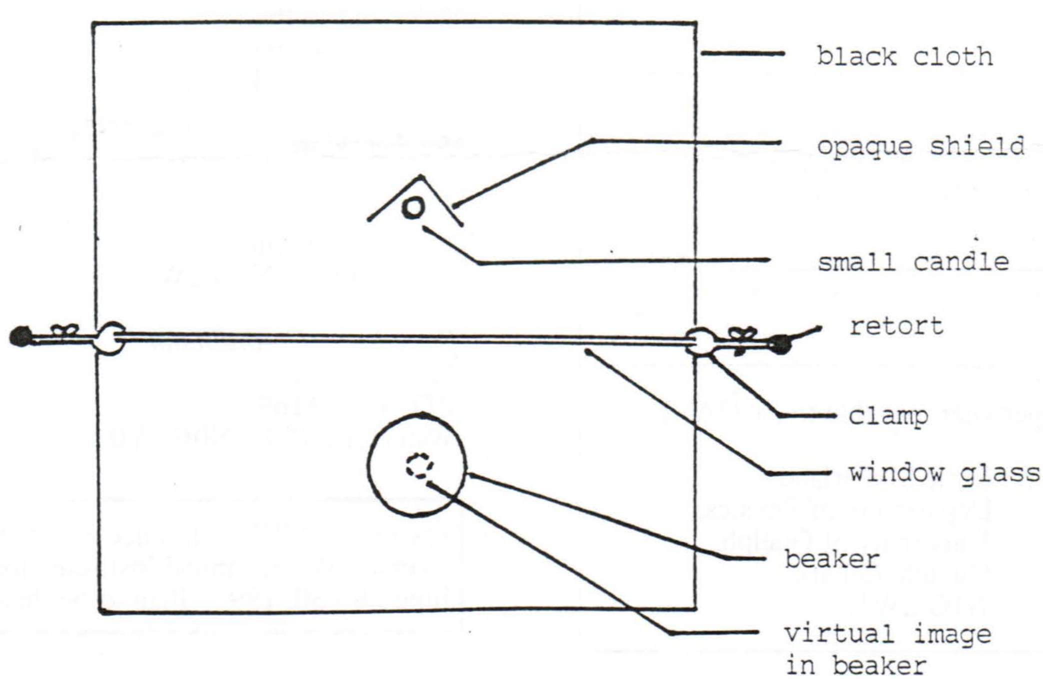
Have the students close their eyes and rest their heads on the desk. Turn off the overhead lights and light the candle. Mask the candle and its flame from the class using the bent shield. When the students lift their heads and look, a candle will appear to be burning inside a beaker. The mask will obscure the real candle from view.

Ask students to suggest ways to "extinguish" the candle without blowing on it. They will propose covering the beaker with a glass plate, or pouring water into the beaker. Pour coloured water into the beaker until the water covers the "flame." Ask students to explain why the candle remains lit.

Have students close their eyes and rest their heads on the desk while you extinguish the real candle and cover the apparatus with a sheet. Divide the class into pairs and challenge each pair to draw a sketch to explain the discrepant event. Discuss their ideas and introduce the term virtual image.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



Ontario Association of Physics Teachers

NEWSLETTER

Volume XIV, Number 2
December, 1991

OAPT Contest

The OAPT contest for Grade 12 physics students will be held on Tuesday, May 12, 1992. The contest committee is composed of the following people:

Peter Scovil	Waterford District H.S.
Malcolm Coutts	C.A.L.C., Toronto
Chris Howes	Pickering H.S.
Dianne Ness	Humberside C.I.,Toronto
Pauline Plooard	Fenelon Falls H.S.
Ron Taylor	Woburn C.I., Toronto

The format of the contest will be the same as in the past. In response to requests from several teachers, there has been a change in the procedure for sending out the results. Provincial winners and statistics will be sent out in June as in past years. However, the answers to the questions will be sent out shortly after the contest so that schools can determine local winners at an earlier date.

Students taking physics in the first semester are encouraged to write the contest, unless they are taking OAC physics in the second semester. in which case they will be ineligible. However, they may wish to write the SIN test which will be held on May 7.

June Conference 1992

Plan to attend the OAPT Conference at Ryerson Polytechnical Institute, Toronto, in 1992. The theme of the conference will be Physics and the Arts. Secondary school teachers who have found that our conference frequently conflicts with final examinations and other year-end activities will be pleased to note that the 1992 conference takes place after the end of the school year, June 28 - 30. More details will be available in the February newsletter.

An Introduction To Ryerson

In this issue of the newsletter, we have included some background information about the Ryerson Polytechnical Institute, the host of this year's conference. The following material has been prepared by R.J.Stagg and F.N.Hainsworth.

The Name

Egerton Ryerson, born into a United Empire Loyalist family in Norfolk County, Upper Canada, in 1803, developed a strong interest in Methodism early in life. Accepted on trial as a minister in that faith in 1825, at age 22, he was ordained in 1827. Soon he became recognized as the foremost speaker for the large Methodist sect in its struggle to gain recognition from the provincial government, which favoured the Church of England. While his reputation was established by his writings in the late 1820's and the 1830's, Ryerson is chiefly remembered today for his work in building the Ontario school system. As Superintendent of Education, from 1844 to 1876, he did much to make elementary education universally available and tuition free. Ryerson also introduced compulsory attendance and teacher training, improved the quality of secondary education, and introduced textbooks which he hoped would provide a high quality education, stressing moral and nationalistic values.

The Location

Under Ryerson's supervision in 1850, a parcel of semi-rural land, St. James Square, was purchased. The noted architects F. W. Cumberland and T. Ridout designed a classical building, with a vaguely Roman look, to house the Department of Education, and the Normal School which trained teachers. In 1857, a model elementary school and, for a brief period, a model grammar school were added to give practical experience in teaching. Also housed in the building were a Department of Education library, and Education Depository which sold school materials at cost to local schools, and a museum and art gallery. The extensive grounds around the building were the site of early agricultural experiments.

When the Depository was phased out in 1882, an art school replaced it. In this century, the various activities associated with the building were gradually transferred elsewhere until 1941, when the Normal School was moved, the model school closed, and the building was used for air force training. In 1944, the old building and several temporary buildings erected during the war became the headquarters for a province-wide program which had been established in 1940 to train men and women for war industry, and to teach service personnel various trades. At the end of the war H.H. Kerr, who had headed this program, was put in charge of retraining returned service personnel at the Normal School building and elsewhere. In 1948, this program in turn was phased out, but the government decided that technical training was needed to improve the quality of the Ontario work force. The old building and the wartime structures became Ryerson Institute of Technology, with H. H. Kerr as its first principal. With all the buildings decaying, replacement was begun in 1958. In 1963, the original education building, except for the central facade which provided a link with the past, was demolished. Howard Kerr Hall (the Quadrangle) was erected in its place.

The Institute was renamed Ryerson Polytechnical Institute and transferred to the department of colleges and universities in 1967. It was now governed by an independent Board and an Academic Council was responsible for all academic matters. The big question to be addressed was; whether to become the flagship of the community colleges or to become Degree-granting and eventually a complete university. Gradually it became clear that Ryerson was following the latter route; the first degrees were conferred in the early seventies and just this fall a team from CEAB formally considered the Engineering school for accreditation. Several new or renovated buildings were opened in the seventies and eighties, including an Arts and Administration building, Library, the school of Architectural Science, CATE, the underground athletic facility, and most recently the Rogers Communication Centre and the first major residence.

With the opening of the Centre for Advanced Technology Education, the faculty confirmed its desire to embark on relevant applied research. In order to obtain a mandate and funding for research it was necessary first to show interest and capability. Professors from geography, community services, applied arts and engineering sought and received grants totalling several millions of dollars. The formal request for full university status is now before the Minister and his response is expected sometime in spring of 1992. If positive, Ryerson could look forward to many more exciting changes in the nineties.

In 1948, principal Kerr opened his trade school with a clear vision for its future. Now in 1991, president Grier will open a state-of-the-art computer and communications centre, confident that the vision is being fruitfully pursued. Ryerson has come a long way in 43 years and is still on the road. We would like to welcome you in June of '92.

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Ivars Peterson Wins Award

Some of our members may remember Ivars Peterson, a physics teacher who was active in the OAPT in its early days. At that time, he published a student newsletter, PHOTON: PHYSICS FOR FUN. Ivars left teaching in 1980 to pursue a career in journalism in the United States.

Ivars has recently been named as the recipient of the Mathematics Communications Award for "his exceptional skill in communicating mathematics to the general public over the last decade." The citation referred to his "fascinating, yet down-to-earth writing style in SCIENCE NEWS and his two books, *The Mathematical Tourist: Snapshots of Mathematics* (1989) and *Islands of Truth: A Mathematical Mystery Cruise* (1990).

No Calendar

In recent years, a calendar has accompanied the December newsletter. However, inflation, G.S.T., etc. have caught up with us. The calendar has become too expensive and the executive has decided that we can no longer afford it.

Membership Due?

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Department of Physics,
University of Guelph,
Guelph, Ontario,
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THE DEMONSTRATION CORNER

A NOT-SO-SERIOUS PARALLEL CIRCUIT

by
Peter Zuech
Mother Teresa S.S.
40 Sewells Rd.
Scarborough, ON M1B 3G5

This idea was born while watching the Tonight Show. A popular entertainer demonstrated a wooden board upon which four coloured light bulbs in sockets were mounted along with a corresponding set of four coloured switches. No matter how the bulbs were rearranged in the sockets, the blue switch turned the blue bulb on and off, the red switch operated the red bulb, and so on. Johnny examined the bulbs, found them to be "normal" and was convinced that it was magic. Unable to determine how the four-bulb unit operated, we designed a simpler two-bulb version for use as a discrepant event in current electricity. Our unit used two white bulbs but coloured ones could be used as in the original unit. The only skills required to construct the unit are an ability to solder and the willingness to tinker a little.

Figure 1 shows the circuit diagram of the setup. Ordinary household 40 W bulbs (modified as described below) are used. The bulb sockets are standard flush mounting fixtures and the switches S1 and S2 are normal momentary-contact push buttons (rated for 120 V AC). The entire assembly is mounted on a small piece of plywood with the switches and sockets visible on the front and the wire and diodes D3 and D4 hidden on the back.

Diodes D1 and D2 are placed inside the base of the light bulbs B1 and B2 by first removing the centre contact on the bulbs using a disk sander. Once the metal is removed, the insulation is chipped away leaving one of the filament leads free. The other end of the filament remains attached to the threaded base of the bulb. The diodes in the bulbs are connected with their banded ends (cathodes) in opposite directions and pushed into the space inside the base. Be careful not to have any wires touch in the base when crowding everything in. Use a glue gun to fill the base and hold the leads in place so that only the free lead of the diode sticks out from the end of the bulb. Solder a brass washer to this lead to form the new centre contact of the bulb. Using more glue, put the washer in the centre of the base and restore the cone-shaped appearance of the insulator. Colour the visible glue with a black marker to further disguise your work.

Because of the orientation of the diodes, only one bulb will light up when the switches are closed one at a time. The alternating current will flow in only one direction through the switch, and only the bulb with its diode in the same orientation as that in the switch path will light. In order to throw a further red herring into the demonstration, put false wires on the front of the plywood which would lead the students to believe that the components are connected in a normal series/parallel circuit.

One way to introduce the demonstration is to start with the bulbs inserted in the opposite sockets. After an embarassed pause, "fix" the circuit by switching the bulbs around, show surprise at the result, and ask for an explanation. Students will probably ask you to try the bulbs in different sockets and to close different combinations of the two switches. You can explain the operation of the circuit by drawing the diagram of the connections, stating that the sockets are electrically identical, and explaining that the alternating current can only flow through the diodes in one direction.

This demonstration can be used in a Grade 12 Advanced Physics class to stimulate interest and in technology or electronics classes to illustrate the concept of the diode as a one-way electrical valve.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

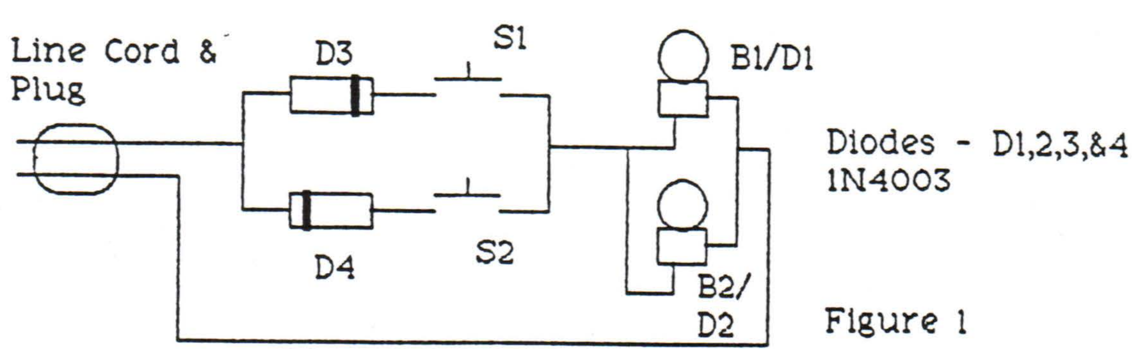


Figure 1

Ontario Association of Physics Teachers

NEWSLETTER

Volume XIV, Number 3
March, 1992.

Winter Meeting - Orlando - Report

Bill Konrad - Section Representative

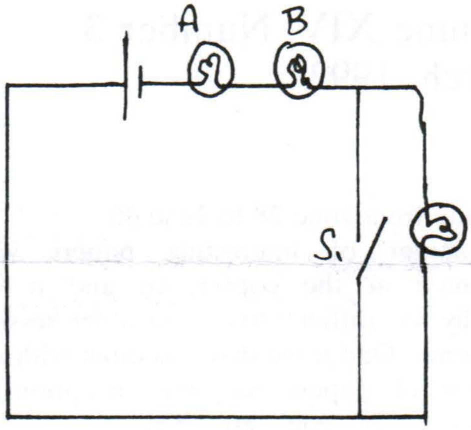
Sunny Orlando in Florida was the site for this year's winter meeting of the American Association of Physics Teachers which was convened from January 4 to January 9, 1992. As your newly appointed section representative I represented the Ontario Association of Physics Teachers at this conference. I was one of approximately 1100 delegates present for the six day event. There was a healthy mixture of university, college, and high school physics instructors.

Although attending a conference in Florida in the middle of winter might seem like a fantasy for most Ontario physics teachers, the cost actually compares favourably with a conference in downtown Toronto. Consider the following factors; a registration fee of \$100, a hotel rate of \$60 per room (no change in rate for two, three, or four people in the room), and a flight for \$300. Although these prices are in US funds, a conference in Florida is not necessarily that much more expensive than one of the larger conferences in Ontario held in a posh downtown hotel.

One attractive feature of the conference is the two solid days of workshops that precede the actual sessions. This years' delegates could choose from a total of 29 workshops which were either half day or full day sessions. I selected the full day workshop entitled "Light and Color/Sound and Music". This workshop was filled with practical suggestions that could readily be utilized in the grade 12 physics course. I will share some of these at our conference to be held at Ryerson Polytechnic Institute from June 28 to June 30.

A number of interesting papers were presented at the conference and it was actually very difficult to choose which sessions to attend. One topic that was dealt with in a number of papers was misconceptions in physics. If you attended the OAPT conference in Windsor in June of 1990 you may recall Ernie McFarland's presentation on "Misconceptions in Physics". Ernie illustrated a number of misconceptions that first year university students bring to their course. In the United States a number of research projects have actually investigated the topic of concept formation and misconceptions in a systematic way. The March issue of the "Physics Teacher" will feature a major article on this topic written by some of the individuals who presented at the conference. I have also contacted some of the teachers and professors who presented at Orlando and hope to get material from them which can be shared at our own conference in June. To give you a specific example I would like to summarize a presentation given by Eric Mazur, a physics professor at Harvard University. He stated (and other presentations also emphasized) that research has shown that we must change our teaching methods if we are to help students grasp fundamental concepts. Mazur stated that he was beginning to recognize that too often physics stresses mathematical problem solving at the cost of concept formation. Students become very proficient at solving problems similar to those solved in class but in actual fact may not understand the concepts involved very well at all. He illustrated this hypothesis by giving a specific example. He gave the following problem to his students on their final examination thinking that they would find it very easy.

Consider the circuit shown below:



What would happen to the following if the switch S_1 is closed?

- the brightness of bulbs A, B, and C
- the current through each bulb and the total current in the circuit
- the effective resistance of the circuit
- the power dissipated by A, B, and C
- the total power dissipated by the circuit

Much to Mazur's dismay his students performed very poorly on this question. The average mark was about 20%. Remember that these are physics students at Harvard.

Mazur also indicated that by all conventional measurements (student comments, formal reviews, etc.) he was seen as an excellent professor and the ability of his students to solve conventional problems was quite good. You would also agree that the question above could be asked at the grade 12 physics level in Ontario.

As a result of the poor performance of his students on solving a conceptual problem on the final examination Mazur changed his teaching style. Although he still lectures students in a conventional lecture room he has introduced an element of cooperative learning into his presentation. Part way through his lecture he will pause and give students a conceptual problem like the one shown above. The question is usually in multiple choice format. He then asks them to record their answer. He also asks them to indicate the degree of confidence with which they are responding. The choices in this case are: very sure, not sure, or just guessing. Students are then given a specific period of time, such as a few minutes, to discuss their answer and reasoning with another student sitting close to them in the lecture theatre. After this consultation they again record the answer to the question as well as their degree of confidence. The mark sense cards are then collected. He has been able to track the progress of concept formation. Explaining their reasoning to a peer and listening to the explanation of a peer has improved the ability of these Harvard students to improve their understanding of fundamental physics concepts.

Another presentation given by a team from the University of Massachusetts described a program in which undergraduate science and engineering majors, enroled in an introductory physics course, were required to write qualitative strategies for solving problems prior to actually solving them. A substantial portion of the mark for a solution on a test or examination was given for the description of the strategy. Students were expected to indicate factors such as the following:

- the principle being used (e.g. energy conservation)
- assumptions made
- why the principle being used was legitimate for the situation at hand.

As you can imagine there was some initial resistance from students asked to use this approach. However, by the end of the course students showed increased ability to analyze problems based on principles.

Some time at the June conference will be spent on this fascinating topic of concept formation by physics students. If there is sufficient interest it could become a major focus for a future OAPT coference.

June Conference

By now, all members should have received a colourful poster advertising the 1992 conference at **Ryerson Polytechnical Institute, June 28, 29 30.** The theme of the conference is **Physics and the Arts** and the keynote speaker will be Ken Laws, an authority on the physics of dance. A secondary theme is **Teaching Concepts in Physics** and contributed papers are invited. (See call for papers.)

Features of the Conference

- Registration fee $50 for members
- Residence accommodation $45 per night, singles only
- Chelsea Inn or Ibis Hotel nearby. $65 to $80, double
- Parking $10 per day (24 hours)
- Meals available at residence cafeteria, breakfast about $3, lunch $4 - 5
- Monday evening buffet $25, followed by presentation from Ken Laws
- Sunday workshops:
  (1) Ryerson's physics labs will be open for active participation, complete with demonstraters, lab outlines and computers for data reduction.
  (2) Lasers, photonics & fibre optics at CATE
  (3) Wave optics, Fourier transforms and spatial filtering at CATE
- Tours of High-tech graphics: typography or video
- Theatre tickets for Phantom, etc. may be obtained from Fred Hainsworth if you contact him as soon as possible.

Registration forms will be included in the May newsletter. Alternatively, you may write, telephone or FAX Fred Hainsworth at the following address:

OAPT Conference,
c/o Fred Hainsworth,
Ryerson Polytechnical Institute,
350 Victoria Street,
Toronto, Ontario, M5B 2K3
FAX (416) 979-5308
Tel. (416) 970-5079

Call For Papers

Contributed papers are hereby solicited on any topic of interest to physics teaching, especially those addressing one of the two themes of the conference. Presenters should specifically request a 15 or 30 minute time period. Strict adherence to the final time schedule will be maintained. Please specify any special requirements for AV. Your favorite demonstration (5 min) is always welcome.

Presentations of a marketing nature are not normally accepted. Assignment of a conference time slot is the decision of the conference managers. Exhibit booths will be across the hall from the main lecture theatre. Poster areas in the hall (coffee break area) can be arranged.

Abstracts should be sent to Fred Hainsworth at Ryerson Polytechnical Institute.

Physics Cinema Classics

A collection of your favorite physics films is available on three video disks for $425 U.S. if you order before April 8, 1992. The topics are Mechanics I, Mechanics II and Heat, Waves I, Waves II & Electricity & Magnetism, Conservation Laws, Angular Momentum & Modern Physics. Contact:

AAPT,
University of Nebraska,
110 Ferguson Hall,
Lincoln, NE, 68588-0128
Tel. 402-472-1100
FAX 402-472-6234

Newsletter Editor Required

We need a volunteer to take on the position of Newsletter Editor as of September, 1992.

The **OAPT newsletter** is published four times a year by the Ontario Section of the American Association of Physics Teachers.

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PARALLAX AND IMAGES

by

T.J. Elgin Wolfe

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(a) Parallax

Parallax is the apparent motion of one object with reference to a second object caused by a change in position of the viewer. Involve the class in the following way to introduce this concept.

Have each student extend his/her right arm horizontally to arms length with the thumb pointing upward. Then extend her/his left arm to half arms length with the left thumb pointing downward. With one eye open, have the student align the thumbs. Tell them to move their heads to the left and then to the right and describe what they see. When the head is moved to the left, the near thumb will appear to move to the right against the background of the far thumb.

Introduce the definition of parallax. Then ask students to repeat the process as they move the nearer thumb closer and closer to the far thumb. Establish that, when the two thumbs are at the same position with reference to the eye (but one above the other), there will be no apparent shifting of two thumbs with reference to one another when the head is moved from side to side.

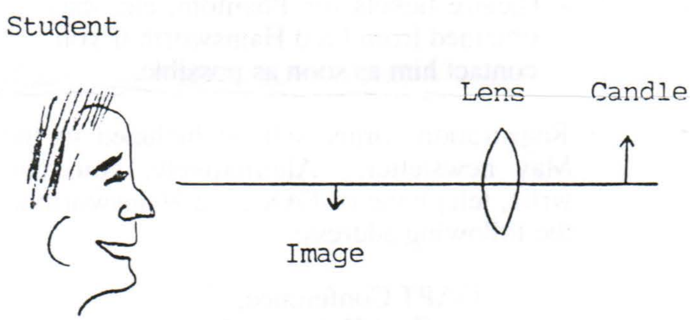
(b) Zero-parallax and Virtual Images

The method of zero-parallax can be used to locate virtual and real images formed by mirrors and lenses. To demonstrate the method of zero-parallax for plane mirrors, place a candle about 20 cm in from of a large pane of clean glass. The virtual image of the candle will appear behind the plane mirror (glass). Use a finder candle the same size and shape as the object candle to locate the image. Begin with the finder candle behind the glass and off to the side of the image, but position it closer to the glass than the virtual image. Have a student sitting on the right side of the class tell you how far to move the finder candle parallel to the glass until the finder candle and the virtual image coincide. Then have a student sitting on the left side of the class tell you how far to move the finder candle back and forth perpendicular to the glass until the finder candle and the virtual image coincide from this location. Continue the process until the finder candle and the virtual image coincide from both locations. The finder candle and the virtual image must then be at the same location because there is zero-parallax between the two. Have students walk slowly across the back of the room to verify that the finder candle and the virtual image do not shift with reference to each other as they move.

(c) Seeing a Real Image Suspended in Space

Students know how to locate the real image formed by a converging mirror or lens by "catching" it on a paper screen. But when they remove the screen and look at the real image from some distance from the lens or mirror, they think they see the image in the instrument rather than inverted in space between their eye and the instrument. To help them visualize the suspended inverted image, and to illustrate the method of zero-parallax for locating real images, proceed as follows.

Position the student along the principal axis of the optical bench system as shown. "Catch" the real image formed by the mirror or lens on a small paper screen. Have the student look at the image on the paper screen from the side of the screen opposite the instrument. Shift the screen up and down until half the image is caught on the screen and half is suspended in space. Have the student look at both parts of the image and move his/her head from side to side to see that the half of the image caught on the paper screen and the half suspended in space do not shift with reference to each other. Then slowly remove the screen completely. The student will see an inverted real image suspended in space between the eye and the instrument, not "in the instrument."



Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(AN AFFILIATION OF THE AMERICAN ASSOCIATION OF PHYSICS TEACHERS)
VOLUME XV, NUMBER 1 OCTOBER 1992

EDITORIAL:
And They're Off...

The Lonely Life of a Physics Teacher

As you start the second month of a new school year, and the momentum of teaching your courses builds, and you begin to think you're the only one who is spending every evening (and most of the weekend) worrying about making your lessons exciting to your students, but you don't have time to build that neat apparatus you saw in the last OAPT newsletter because your department head wants you to help update the chemical store room to meet WHIMIS standards and you're on a curriculum committee to try and plan for the destreaming of grade nine next year, and your spouse is working the night shift and your youngest son came home with a scraped knee while your oldest needs to use the computer to do an English essay and...

This time of year can be very stressful, and finding time to revamp even a small part of your course can be difficult. Make sure you take some time to talk with your colleagues about what they're doing and what you're doing. As the only physics teacher in my high school I know you can start to feel out of touch with what's taking place in the other schools in the county, never mind the rest of the province. If you're in that position, maybe you can plan a get-together with other physics teachers in your county—discuss the interesting things you've done in your class, invite a physics professor from a near-by university to give a talk, or go to a lecture sponsored by the university. And one event you really shouldn't miss is the OAPT Conference. It's a great opportunity to get together with other high school, college and university teachers and find out what's going on in Ontario schools. This past June's conference at Ryerson was well worth the admission price (which is always reasonable compared to

(see *EDITORIAL* , page 3)

At Ryerson...

Report on the Ontario Association of Physics Teachers Annual Conference -- June 28-30, 1992

This year's annual conference was held in the heart of downtown Toronto, namely at Ryerson Polytechnic Institute. About sixty physics educators attended the conference that had carefully been planned by the Vice-president, Fred Hainsworth and by his colleagues at Ryerson. This was the first year that the conference was actually held outside of the academic calendar year. While the thought of attending a conference during their summer vacation may have inhibited some potential delegates those who did attend were able to relax and enjoy the presentations knowing that a critical educational deadline did not await them on their return to their home. Secondary schools, community colleges, and universities were all represented by the delegates in attendance.

As has been the case at past conferences the presentations consisted of a mixture of invited and contributed papers. The presentations varied in length from ten minutes to one hour. Presentations were made by secondary school teachers, Ryerson Faculty, McLaughlin Planetarium personnel, and invited guests.

Ian McGregor from the McLaughlin Planetarium gave us an historical overview of the development of planetariums as well as all of the personnel and hardware that is involved in the production of a show at the McLaughlin Planetarium. He revealed the interesting fact that the McLaughlin Planetarium is one of the

(see *RYERSON*, page 2)

...Ryerson (from page 1)

largest planetariums in North America. Delegates who were present on Sunday night attended a planetarium show. A smaller group of delegates returned on Tuesday afternoon to have a "behind the scenes" tour of the facility.

Presentations designed to provide us with additional background and food for thought were provided by David Rowe and Helmut Burkhardt. Dr. Rowe's presentation was entitled "Symmetry, Art and Nuclear Physics" and Dr. Burkhardt's presentation dealt with the need to improve physics curriculum by establishing a clearer link between physics and other branches of knowledge. He suggested that by unifying fragmented knowledge structures, and translating general scientific principles into a common language a simpler, basic physics curriculum is possible.

Several presentations were designed to give teachers specific ideas for teaching certain topics or for developing effective and proven instructional strategies. John Wylie presented some of the basic principles involved in mountain climbing and actually demonstrated how these could be employed to climb a door jamb.[1] Bill Konrad shared ideas he picked up at the winter meeting of AAPT in Orlando. Several science olympics ideas as well as an inexpensive colour mixer were demonstrated. Watch for some of these in the demonstration column of this publication. Elizabeth Dunning described how a physics poster contest could be used with a grade 12 physics class to generate interest and to help create a physics atmosphere in the classroom. John Van Aalst described how he utilizes microcomputers as part of an inquiry-based instructional program for his grade 12 physics class.

The advantage in having the conference change its location each year is that delegates get a chance to get a glimpse of the research that is being conducted at the host institution. Paul Dunphy described his studies of the effects of weightlessness on the level of cerebral blood flow. This study is an effort to understand why some shuttle crew members experience nausea and vomiting during their flight and occasionally loss of consciousness during re-entry and post flight. His collaboration with Canadian astronaut Roberta Bondar made the presentation particularly interesting.

A number of sessions at the winter meeting in Orlando dealt with student misconceptions in physics. Ernie McFarland's presentation about general student misconceptions echoed the experiences related in Orlando. The response of delegates also indicated that this topic could be explored in greater depth at future conferences.[2]

The conference highlight was the presentation entitled "The Physics of Dance" by Dr. Kenneth Laws.[3] Dr. Laws was assisted in his presentation by a ballet dancer. The presentation was videotaped by the Ryerson Communication Arts department. It is hoped that this videotape can be made available to Ontario Association of Physics Teachers members in the near future. Watch this publication for further information.

The 1993 conference will be held in late June at Trent University. Watch this publication and special mailings for more information about program and costs.

Editor's Notes

1 *John Wylie's article on mountain climbing appeared in a recent issue of Quantum Magazine (see blurb below).*

2 *Two references of interest that were mentioned: "A Guide to Introductory Physics Teaching," Arnold Arons, Wiley 1990, ISBN 0-4741-51341-5 and "Physics by Inquiry" Lillian McDermott, University of Washington.*
As well, there is an interesting article in the May 1992 issue of the Physics Teacher on students concepts of force and mechanics (it includes two tests that were used in the study).

3 *Kenneth Laws has a book on the Physics of Dance; see the blurb below.*

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1992-93

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Write to us!

Do you have something you'd like to say about physics teaching or education in general? Have you done something interesting in your class? Have a question you'd like answered? Read a good book you think other physics teachers (and/or students) should read? Send us a letter. We want to hear from you.

Address any Newsletter correspondence to:

Paul Laxon
OAPT Newsletter
Central Elgin C.I.
201 Chestnut Street
St. Thomas, ON
N5R 2B5

(519) 631-4460

...Editorial (from page 1)

other conferences). The 1993 conference is being held at Trent University in Peterborough. There will be more information in an upcoming issue.

If there are any physics teachers in your area who don't know about us, make sure you show them the newsletter: the $8 membership fee is really very small compared to the benefits (especially with the Demonstration Corner), and it might help to make them feel a little less isolated. The more the merrier.

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 92**, your membership has already expired. You may use the coupon below to renew it.

Membership Application Renewal

Name ____________________

Address ____________________

____

$8.00 per year, payable to the OAPT
Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1

AAPT

Join the AAPT and receive a one year subscription to *Physics Today* plus *The Physics Teacher* and/or the *American Journal of Physics.* You also get discounts on teaching materials, computer software and books.

For more information write to:
AAPT
5112 Berwyn Road,
College Park, MD
USA 20740-4100
(301) 345-4200

Upcoming Events:
AAPT Winter Meeting
New Orleans
January 2-7, 1993

APS/AAPT Meeting
Washington, D.C.
April 12-15, 1993

THE DEMONSTRATION CORNER:

I: A TIMELY SUGGESTION FOR MAKING WAVES

II: THE CAN THAT ALWAYS COMES BACK

by

Pauline Plooard

Fenelon Falls Secondary School
Box 460
Fenelon Falls, ON K0M 1N0

I: A Timely Suggestion For Making Waves

Standing waves can be quickly and easily created on the front demonstration bench even if you don't have a genuine string vibrator. Simply tie a length of white butcher cord to the "clapper" of an old Stark[1] recording acceleration ticker-timer. Clamp the timer near one end of the front bench. Knot the other end of the string to a tap, rod, or other fixed object at the opposite end of the front bench so that the string is somewhat taut. Turn on the power supply to the timer and adjust the position of the timer and tension of the string to produce standing waves. Given that the timer frequency is 60 Hz, the speed of propagation of the waves can be easily calculated from the number of antinodes (loops) in the standing wave pattern. This is particularly useful in the class after "standing waves in a coiled slinky spring investigation" as reinforcement of the principles learned.

1 *The Stark recording acceleration ticker-timer is essentially an electric bell with the gong gone. Alternatively you could easily modify an electric bell to perform as above. Even a class set is possible.*

II: The Can That Always Comes Back

The difference between a property and a theory can often be vague for high school students. But describing the Roll-back Can and postulating why it always rolls back is fun and should help clear up the problem.

The Roll-back Can is constructed from an empty Ovaltine can, or one similar. Pop rivet a loop of wire on the inside of the lid and another on the inside of the bottom of the can. Between the loops, attach a slightly stretched heavy elastic band with a weight (large nut or washers) knotted onto its middle. Put the lid on the can, and draw happy or unhappy faces in black marker on the ends of the can to disguise the pop rivets.

Show the class the can and ask them to describe it. Eventually roll it away from you on the front bench repeatedly. You can even get a ramp and roll it downhill at increasing slopes to see just what it can do. (If you wear long sleeves or a lab coat, it's possible to imply a hidden magnet or strings.)

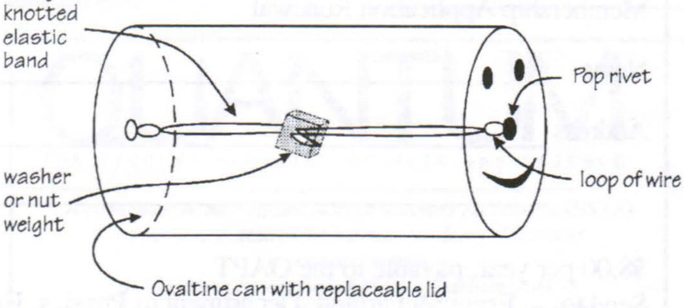
Sort the answers for a description into properties and theories. Eventually you will get properties such as metallic, shiny, cylindrical solid that when rolled away always comes back. Invariably there is a student who "knows" and is eager to offer a theory - I usually entitle any explanations "Johnny's Theory", "Joanna's Theory", etc. Students then have their name above that of Einstein or Darwin when I list names of any other theories they have heard about.

Finally, just like the atomic theory which explains the internal structure of a solid, emphasize they cannot look inside the Roll-back Can to see why it always rolls back anymore than they can cut open the metal to see the atoms.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, NIG 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Roll-back Can



NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XV, Number 2 **Winter 1993**

EDITORIAL:

I Teach Physics, Therefore I Am...

Contemplating OAPT's existence while typing an editorial at midnight

I was at my first OAPT executive meeting. It was a beautiful fall day in a hidden subdivision in Mississauga; you could not see the sky for the trees with their red and gold leaves. It was a good day to be a member of OAPT.

One of the concerns raised at this meeting was the slow decline in membership over the last few years from over 400 to approximately 300 today. We estimated that there are 10^3 high school physics teachers, plus 10^2 or so university physics teachers involved with first year students in Ontario, only a third are members of the OAPT. Since the two main benefits for OAPT members are the newsletter and the summer conference my first task as newsletter editor was to look into ways of promoting OAPT.

The Newsletter should inform physics teachers about what's going on in physics education, help physics teachers by printing demonstrations, reviewing teaching materials, allowing physics teachers to ~~"touch base"~~ (I don't think this buzz word is being used any more, but you know what I mean) and discussing future trends in education.

Over the next year we hope to implement some of these things, but we need your input. So call us, write us, fax us. Let us know what you want, what you don't want; be critical (well...not too critical, how about "constructively critical"). Help form the direction of the Newsletter (otherwise I'll be making it up myself, and who knows where that will lead).

In this issue we have information about the upcoming OAPT Conference (get your p.d. requests in now before the money runs out), where to write to get your video tape of Kenneth Laws lecture on the Physics of Dance, ideas for computer hardware and software for those of us on a budget (some of it free!).

Remember to pass this newsletter on to other members and encourage them to join.

Fax Us!

We want to hear from you
Send correspondence to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

work: (519) 631-4460
fax: (519) 633-9014

1993 OAPT Contest

This year's OAPT contest for Grade 12 Physics students will be written on Tuesday, May 18, 1993. The answers will be sent out shortly after the contest, enabling schools to determine local winners at an early date. Consequently, we have scheduled the contest a week later than in previous years. This will enable teachers to get further along in the course. Prizes will be awarded to provincial winners.

The committee members are:

Peter Scovil	Waterford District H.S. (administration)
Malcolm Coutts	City Adult Learning Centre, Toronto (test paper)
Greg Marshall	Lisgar C.I., Ottawa
Dianne Ness	Humberside C.I., Toronto
Pauline Plooard	Fenelon Falls S.S.
Peter Spencer	Stephen Leacock C.I., Scarborough
Ron Taylor	Woburn C.I., Scarborough

Both Peter and Malcolm will be stepping down at the end of this year. Volunteers will be needed to fill their positions.

40th Annual Conference

Michigan Science Teachers Association

Feb. 26-27, 1993

Westin Hotel, Detroit, MI

Hands-On Science
Across the Border

For more information write to:
Western Michigan University
Office of Conferences and Institutes
Division of Continuing Education
Kalamazoo, MI 49008-5161

Adaption of a Zen Koan you can tell your students before beginning a study of Newton's Laws of motion and force.

Before you study Physics, mountains are mountains and rivers are rivers; while you are studying Physics, mountains are no longer mountains and rivers are no longer rivers; but once you have had enlightenment, mountains are once again mountains and rivers again rivers.

High Tech on a Low Budget

Greg Marshall
Lisgar Collegiate
29 Lisgar Street, Ottawa
K2P 0B9, (613)239-2696
(This article was part of a talk given by Greg at the 1992 STAO Conference)

Hardware

Computers:

Local Bulletin Board Systems have Trade/Sell sections that often list parts and computers for sale. Recent sales on the BBSs that I subscribe to include:

- i286-12 in large flip-top case
- 1 MB RAM
- math coprocessor
- 40 MB SCSI HDD w/controller
- Imtec EGA monitor w/ATI EGA Wonder card
- 1.44 MB FDD (Panasonic)
- 360k FDD
- 1 parallel, 2 serial ports
- 101 keyboard
- DOS 5.0

In excellent condition...Asking $350
The actual selling price of this unit was $285

Parts Prices:

These same services often serve as a good source of parts. As long as you get the right sort of assurances from the seller regarding the operability of the parts, you should be okay. I've picked up the following parts to use in a system I put together.

- 386SX-25 motherboard with 1 MB RAM: $135
- Serial-Parallel-Hard/Floppy drive card: $19
- VGA video card, 512K video RAM: $25
- Case and power supply: $35
- Floppy drive (3.5"): $35
- Hard drive (20 MB IDE): $75
- VGA Gray-scale monitor (IBM!): $70
- Keyboard: $15
- Game cards: 5 for $25
- 4 meg SIPP RAM: $100

Some of these parts can now be had for as little or less, purchased new form assemble shops that import parts in bulk from SE Asia.

A check of low-end Mac systems has shown:

- Mac SE, 20 MB HD, 4 MB RAM, keyboard, mouse: $600
- Mac Plus, 45 MB HD, 4 MB RAM, keyboard, mouse: $550

Software

Vernier Software provides some the best value for the money of any supplier. Most programs are in the range of $39 to $59 US, and you get a site license so that you can install the program on any computer in your school. My favourite and most used are Graphical Analysis (also available for the Mac), Precision Timer, and Millikan. They also sell the curriculum materials for Workshop Physics, which are a bargain if you're interested in moving to activity-based learning for either grade 12 or the OAC course.

Vernier Software, 2920 S.W. 89th St., Portland, OR, 97225, (503) 297-5317

Physics Academic Software has a broad selection of material, mostly for OAC and up. *Mathplot*, *Fit Kit*, *Gradebook*, *Physics Simulations*, *Orbits*, *Spacetime*, and *Maxwell* are some of their titles. I've used *Spacetime* (also available for the Mac) as a graphic simulation of length contraction and time dilation for teaching an optional unit on relativity for OAC. Prices are variable, but *Spacetime* cost $149.95 US for a lab pack of ten.

Physics Academic Software, TASL, Box 8202, NCSU, Raleigh, NC, (919) 515-7447

Microsoft Canada will sell your school their top-of-the-line business software at very deep discounts, at least equivalent to the educational price charged university students and faculty. Microsoft Excel for the Mac, for example, can be had for $129.95, which about 1/3 to 1/2 what even the best corporate purchasers have to pay. This can be considerably reduced if you can purchase through the Ontario Software Assistance Program (OSAP). This program is usually publicized to your board computer coordinator or responsible superintendent. The price list may or may not percolate down to the science department.

Health and Welfare Canada has an on-line database for the International Registry of Potential Toxic Chemicals.Register by calling (800) 267-3364. This is useful for health and safety, environmental science, or Science in Society. You get an operations manual when you register, and there is no charge.

Applied AI Machines and Software is one of the Canadian distributors for the program Derive, which is a general purpose mathematics program. It allows you to plot functions on the computer screen, solve equations, do matrix operations, and

do most of the math stuff that senior physics requires. It is not as ornate as Mathematica or MathCAD, but it is a lot cheaper, and will run will on basic PC-compatibles. I use it for doing graphical solutions to kinematics problems, so that while the kids crunch the numbers, I make the graphs. Then when we discuss the problems, we can look at the effects of changes of value for things like initial velocity, position, and so on. Derive tends to do things the "right" way, form a math point of view. It does a good job of differentiating and integrating, and allows you to have many graphs on screen at a time, either in separate windows or as overlays. Cost is around $300 for a single copy, but goes down to $85 per copy when network licenses are purchased in groups of 10 or more. Stand-alone licensing is a bit higher.

Applied AI Machines, Suite 504, Gateway Business park, 340 march Road, Kanata, ON, K2K 2E4, (613) 592-7729

(see BUDGET, page 3)

...**Budget** (from page 2)

Materials, Equipment, Supplies

Lasers:

Meredith Instruments, 5035 N. 55th Ave, #5, PO Box 1724, Glendale, AZ, 85301, (602) 934-9387

Cheap lasers, tubes, power supplies, optic parts. e.g. He Ne laser: $59 US (12-volt supply), Diode laser Module (runs off batteries): $99

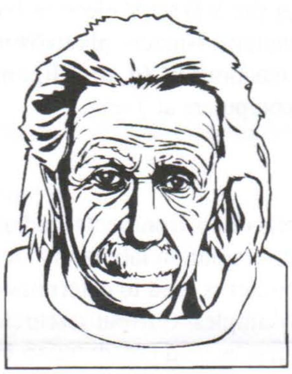
Midwest Laser Products, PO Box 2187, Bridgeview, IL, 60455, (708) 460-9595

Editors Note:

There are a couple of good programs that I should mention. These programs were developed by Toronto Image Technologies Ltd. and are licensed by the Ontario Ministry of Education for educational use only by its elementary and secondary schools and faculties, schools and colleges of education.

Electronics Workbench allows you to construct a schematic for an electronic circuit (analog or digital) on a computer display, simulate the activity of that circuit, display its activity on test instruments contained within the program, and print a copy of the circuit, the instrument readings and parts list.

Autoelectric is a similar program for automobile electrical systems.



Physics Day at Cedar Point

Annual workshop for teachers—April 24, 1993
$10 fee for workshop
For more information contact:

Dr. Robert R. Speers
BGSU—Firelands College
Huron, OH 44839
(419) 433-5560

Physics Day—May 19, 1993
To be placed on the mailing list, and for information about tickets, call (419) 627-2237.
For information about the educational aspects contact Dr. Robert Speers at (419) 433-5560.

JOINT REGIONAL SPRING MEETING
of the
Detroit Metropolitan Area and the Ohio Sections
American Association of Physics Teachers

hosted by the
Bowling Green State University--Firelands College
and
Plum Brook Station of NASA/Lewis Research Center
March 19-20,1993

In order to encourage communication between members of regional AAPT organizations, this joint regional meeting will be held at Plum Brook Station of NASA/LeRC on March 19 & 20, 1993. All physics teachers and faculty in the Indiana, Michigan, Ohio and Ontario regions are invited to attend.

The featured speaker will be Dr. Richard E. Berg, of the physics department at the University of Maryland and an editor of The Physics Teacher. He will present "The Physics IQ Test", a series of demonstrations---that are often counterintuitive. Tours of several of the "big physics" research facilities at Plum Brook Station (Bob Kozar, manager) will be conducted Saturday afternoon.

In order to accommodate Dr. Berg's presentations, regular section business, and the tour of the research facilities of Plum Brook--the conference will be held from Friday evening through Saturday afternoon. Please note especially that "off-season" motel rates are in effect during this weekend.

SCHEDULE

Friday—

6:00—7:00	Registration, Wine and Cheese Reception.
7:00—8:00	Buffet Dinner
8:00—9:45	"Physics IQ Test"—by Dr. Richard Berg, University of Maryland

Saturday—

8:00—9:00	Registration Follow-Up Meeting of the 1992 CWRU Workshop Participants
9:00—10:30	Physics of & Answers to "The Physics IQ Test"-- -Dr. Richard E. Berg
10:30—10:45	Break (with coffee & donuts)
10:45—11:05	Project Discovery, Larry Badar, CWRU
11:05—12:05	How-I-Do-It (or whatever) Send a brief description for a ten minute presentation by 3/10/93 to: Barbara Bates, Lakeland Community College, 7700 Clocktower Drive, Mentor, OH 44060, (s)216/953-7104
12:10—12:30	Section Business Meetings
12:30—1:15	Lunch
1:15—4:00	Discussion & Tour of the Research Sites at Plum Brook B-2—A facility to "soak" a rocket engine (up to Saturn in size) in the cold and vacuum of space (with a sun beating on one side) and then start & restart the rocket engine. SPF—The largest space simulation tank on Planet Earth. K-2—A mach 7-8 engine test facility. Will be used to test ram- & scram-jet rocket engines

Questions regarding the Meeting should be directed to:
Dr. Robert Speers, BGSU--Firelands College, Huron, OH 44839 ----- (s) 419/433-5560
Bob Sledz, President, OS/AAPT, 12000 Maple Leaf Dr., Garfield Heights, OH 44125 --- (h) 216/333-7827
Chris Deyo, Editor, DMAPT Newsletter, 5597 Oregon Rd., Lapeer, MI 48446 --- (s) 313/652-0122
Plum Brook Station - NASA, Sandusky, OH 44870 --- 419/625-3205
Preregistration (in the mail by March 1 0) is requested so that we can properly accommodate attendees.

Cut off Registration Form

Name ______________
Address ______________
City, State,ZIP ______________
School Phone ______________
Home Phone ______________
Registration -------$5.00 ______________
Friday Dinner -----$8.50 ______________
Saturday Lunch -----$5.00 ______________
TOTAL ______________

Make checks payable to: OS/AAPT

Mail with this form to arrive by 3/15/93 to:

Don Cope, Secretary
Firelands Area Physics Alliance
407 Indiana Avenue
Sandusky, OH 44870

Spouses are welcome to attend at no charge for registration, but we need to charge for the meals.

Trent University Research Areas

The following is a description of some of the physics research that is taking place at this year's OAPT Conference host university

Astronomy

The main emphasis is on the study of the stellar population structure in the immediate neighbourhood of the Sun. Spectroscopic and photometric observations of stars of high proper motion (some as faint as V = 19) are analysed to obtain their space velocities and, where suitable theoretical models are available, their chemical compositions and ages. After statistical selection effects have been accounted for (typically by Monte Carlo simulation), the data are used in an attempt to determine the density normalizations and other parameters of the local stellar populations and, ultimately, to shed some light on the formation and evolution of the Galaxy.

P.C. Dawson, R.G. Johnson

Atmospheric Physics

Measurements are carried out of the ozone layer and the greenhouse effect using remote sensing technology form the space shuttle, satellites, balloons, aircraft and ground based locations. The effect of chlorofluorocarbons on the depletion of the ozone layer and contributions to the greenhouse radiation budget are studied. Model simulations of these effects are carried out by computer. The consequences of depletion of the ozone shield on ultra violet radiation at the earth's surface are researched.

W.F.J. Evans

Condensed Matter

Surface Physics

The experimental side of this program investigates the electronic and topographical structure of clean metal surfaces, and the oxides which form on these surfaces. Measurements are carried out in two ultrahigh vacuum chambers, using a range of analytical techniques including scanning tunnelling microscopy and spectroscopy, Auger electron spectroscopy, low energy electron diffraction and electron energy-loss spectroscopy. Some of this work is carried out in collaboration with industry.

Theoretical models of surface adsorbates are constructed to provide insight into the interactions in adsorbates. Monte Carlo simulations of these models provide results which may be directly compared with experiment. Current work is closely linked to the experimental work on surfaces in this department.

K. De'Bell, A.J. Slavin

Theory of Magnetic Systems

Magnetic systems display a wide variety of ordered structures. The interactions between ions which give rise to ordering in specific magnetic materials are studied by a number of theoretical methods. Computer (Monte Carlo) simulations are used to provide results which may be directly compared with experiment. Current work includes the study of magnetism in layered rare earth compounds such as the high T_C superconductors.

K. De'Bell

Theory of Phase Transitions

A phase transitions occurs when a system undergoes an abrupt change of state as a physical parameter is varied. Theoretical studies of phase transitions in a variety of systems, including polymers, magnetic systems and surface adsorbates, are being carries out. Methods used include Monte Carlo simulation and the application of field theory (and renormalization group) methods.

K. De'Bell

Thermal Conductivity of Ceramics

Measurements are made of the thermal transport through packed beds of ceramic spheres under a range of gas pressures. These studies are carried out in collaboration with industry, and have applications in development of fusion nuclear reactors and high-temperature thermal insulation.

J.W. Earnshaw, F.A. Londry (Research Associate), A.J. Slavin

Subatomic Physics

Electronuclear Reactions

Research into the nature of the hadronic interaction is being carried out using the tagged photon spectrometer at the Saskatchewan Accelerator Laboratory (SAL). Experiments are performed using the 300 MeV electron beam of the SAL facility to create monochromatic photons. Nuclear photodisintigration studies using these photons include the reactions $^{12}C(g, p)$, $^{2}H(g, np)$ and $^{16}O(g, np)$. Data analysis is done using computers at Trent.

J.W. Jury

Environmental Radiation

Studies of the extent and changes in levels of environmental radiation are being carries out at Trent's environmental radiation laboratory. A supersensitive, large volume liquid scintillation counter is used to determine the nature and degree of radiation in natural water samples. Current research is investigation the hypothesis that mineral leeching by acid precipitation can increase the level of the isotope ^{222}Rn in natural waters.

J.W. Jury

Theory of Ion Dynamics in the Quadrupole Ion Trap

The research is concerned with the dynamics of ions inside a quadrupole ion trap when they are excited by an auxiliary electric field. The collisions of the excited ions with molecules and ions present in the ion trap are also being investigated. This work is being carries out in collaboration with the Mass Spectrography Research Group in the Department of Chemistry at Trent.

L.C.R. Alfred

1993 OAPT Conference

Physics and the Environment

Thursday (evening), June 24 — Saturday (afternoon), June 26

Tentative Information:

Registration	
Members	$50
Non-members	$65
Student teacher	$25
OAPT membership	$8
Residence accommodation (includes bed & breakfast)	$45
Lunch	$9
BBQ Banquet	$20
Liftlock boat cruise	$15
Parking	free

For three full days you will need:

1 Registration (member)	$50
2 Residence Accommodations $90	
2 Lunches	$18
1 BBQ	$20
1 Cruise	$15
Total	$203

Other Accommodations:

Holiday Inn (close to the water, walk to downtown)
$81 + tax (double)
(705) 743-1144

Ramada (formerly Red Oak, close to downtown)
$77 + tax (double)
(705) 743-7272

Some details:
Three speakers have been lined up so far.

Wayne Evans World renowned theoretical physicist doing work at the cutting edge of atmospheric ozone research

Anne McMillan Physicist doing practical physics implementing laws involving the Air Toxics Program on the Great Lakes

Kenneth McNeill Health physicist advisor on radiation who has studied the environmental impact of the Chernobyl incident

The boat cruise leaves shortly after the BBQ from the University campus and will take us down the river/canal system through the liftlocks to the harbour downtown, near the Holiday Inn. Buses will transport us back to the campus after a brief city tour.

Schedule:

Thursday	4:00 - 6:00	Check in/Registration — Lady Eaton College
	6:00 - 8:00	Equipment Supplier/ Teacher experiment demos — Science Complex
	8:00 - 10:00	Reception (Lady Eaton)
Friday	7:30 - 8:20	Breakfast
	8:30 - 8:45	Opening remarks — Science Complex Lecture Hall
	8:45 - 10:15	Papers
	10:15 - 10:30	Break / exhibits — Native Studies Lounge
	10:30 - 12:00	Papers
	12:00 - 12:50	Lunch / exhibits
	1:00 - 2:30	Papers
	2:30 - 2:45	Break / exhibits
	2:45 - 4:30	Papers
	5:00 - 6:30	BBQ
	6:45 - 9:15	Boat Cruise / tour
	9:15 - 11:00	Reception
Saturday	7:30 - 8:20	Breakfast
	8:30 - 10:15	Papers
	10:15 - 10:30	Break
	10:30 - 12:00	Papers
	12:00 - 12:50	Lunch
	1:00 - ?	Papers

"Papers" include invited speakers, submitted papers, "My Favourite Demonstrations," etc.

Not confirmed are post conference tours on Saturday of:
University owned Hydro Electric Power Station
Physics Research Labs of some of the professor's

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 92**, your membership has already expired. You may use the coupon below to renew it.

Membership Application Renewal

Name ______________________________

Address ______________________________

____

$8.00 per year, payable to the OAPT
Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1

Physics of Dance Lecture

The video tape of Kenneth Laws lecture from the 1992 OAPT conference is available for $25 if ordered from North America, $30 overseas

Send your orders to: Physics of Dance Video, c/o John Wylie, The Toronto French School, 306 Lawrence Ave. East, Toronto, Ontario, Canada, M4N 1T7

THE DEMONSTRATION CORNER

THE CLASSROOM WAVE

by

Bonnie Edwards

Our Lady of Lourdes High School
54 Westmount Rd.
Guelph, ON N1H 5H7

How about a physics demonstration with hundreds of moving parts that never needs to be fixed and doesn't require storage space? Hard to believe? Try doing THE WAVE in your grade 12 physics classes.

The following variations on THE WAVE let the students feel first-hand some of the points we try to teach in the Waves and Acoustics Unit. However, a caution is appropriate: I use only a few of these variations in a given year to liven things up and make a few points. As any regular Blue Jays fan knows, too many WAVES can become tedious.

Unit Opener

On the first day of the Waves Unit, I start the class by choosing something to celebrate (excellence on the last test, a great snowfall, the school football team). "To show our joy," I state, "we are going to do THE WAVE." I move my arm up and down along the rows of lab benches and we do THE WAVE a couple of times. By now, the students who were half asleep have realized that something is happening and we are ready for the unit introduction.

Movement of a Wave vs. Movement of the Medium

Students sometimes have difficulty separating a wave from the medium the wave travels in. I use a question/answer routine following a WAVE to help distinguish the two: which way did you move; which way did THE WAVE move; after THE WAVE passed you, where were you? A wave is a disturbance that passes by, leaving the medium more or less back where it started.

Wave Speed

Leading up to the universal wave equation, it is important to understand wave speed. On occasion, we do THE WAVE and measure the wave speed a good example of "How far did it go and how long did it take?"

As often as not, someone is not paying attention and THE WAVE stumbles going past the guilty party. This is a good opportunity to talk about wave speed being related to the interaction between neighbouring people or molecules in the medium. Wave speed is a property of the medium, not of the particular wave. Any factor such as density or temperature that can affect the response time between neighbours affects the wave speed.

Wave Amplitude

We make big WAVES and little WAVES and discuss wave amplitude. I was concerned the first time I tried this, that the students would unintentionally adjust the wave speed too. This doesn't happen, and it encouraged me to explore the properties of a classroom WAVE further.

Universal Wave Equation

Actually THE WAVE is a wave pulse but my classes can make respectable continuous waves too: the first student simply starts a new WAVE at regular time intervals. This is great for a discussion of period and frequency of the motion of an individual student. Furthermore, crest-to-crest distances are easy to estimate and we're set to discuss wavelength. Trying two different periods, we can verify the universal wave equation.

Transverse and Longitudinal Waves

With three dimensional visualization being difficult for some students, I use three weird versions of THE WAVE to discuss transverse and longitudinal waves. The students stand in a U around the edge of the room to perform these WAVES. In the first version, each student steps forward and back into line. In the second, each student does a small knee-bend. In the third, each student steps sideways to GENTLY bump the next student. The obvious follow-up questions are "Which way did you move?" and "Which way did the wave go?" This experience also leads naturally to a discussion of polarization.

A Model Stretched Too Far!

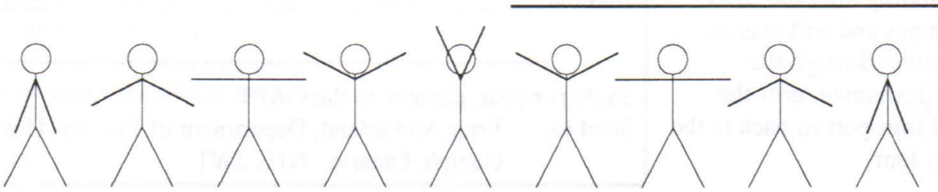
One year, I tried to show the effect of two colliding wave pulses. The students at the point of collision were so baffled that they did nothing and both pulses died. To this day, those students believe in their hearts that the superposition principle is a hoax. I still regret that I wasn't fast enough on my feet to turn the experience into a lesson on the breakdown of analogies in scientific thought!

A Field Trip?

Doing THE WAVE a few times is good fun. Almost every year, a student suggests that we put our theories into practice and plan a visit to the Sky Dome. And hardly a WAVE goes by without someone adding "GO, JAYS, GO!"

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.



NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XVI, Number 1 **Fall 1993**

EDITORIAL:
The New Frontier
Entering the Information Age

We are only a few years from the twenty-first century—January 1, 2001—my oldest son will be in grade four, and I wonder how different classroom instruction will be for him, compared to 1972, when I was in grade four. I remember reading about Dick and Jane and Spot, doing my multiplication-tables and playing the recorder. Today, computers are becoming more commonplace, and one school—River Oaks P.S. in Oakville—has a phone line in every classroom, and one computer for every three students.

When I was in the last two years of high school the Commodore PET computer was making it's debut, with an amazing 4K of RAM and a tape drive you could use to store programs. The exponential increase in the power of the computer in the last 15 years makes any speculation about what my son will be using in high school pure science fiction (at the very least they'll be hand-held and will have voice recognition).

I began thinking about these things at I workshop I attended this summer at the Bell Institute for Professional Development in Toronto. The purpose of this pilot workshop was to introduce transition years science teachers (grades 7-9) to a working Canadian scientist (Dr. Ursula Franklin, Professor Emerita of Massey College of the University of Toronto), to demonstrate existing and new telecommunications technologies and discuss their use and possible use in the classroom, and to discuss how Bell Canada could better serve the needs of the educational community. Though two days was not enough time to have a thorough discussion of every topic, the organizers of the workshop were enthusiastic and obviously committed to making this a worthwhile event.

One of the presenters was Gerry Smith, the principal of the afore mentioned River Oaks Public School. River Oaks opened in September 1990, and was built with a restructured curriculum in mind. "Preparing students for the workplace of the 21st Century" is the goal of the new curriculum, and Science/Technology is one of the three "strands" used to teach the four

(see EDITORIAL, page 3)

WE'RE SORRY!

Things got a little out of sync at the end of last year, so our final issue didn't get out. We've increased the size of our Fall issue to—hopefully—make amends.

MAKE YOUR PLANS EARLY

This year's OAPT conference will be held in Ottawa, organized by the new OAPT VP, Greg Marshall.

The theme of the conference will be Technology and Telecommunications, and there are plans for several practical workshops as well as tours of area museums and industries.

Watch for details in upcoming issues of the Newsletter.

Report on the Annual Conference

Trent University, Peterborough

reported by Bill Konrad, Section Representative

This year's OAPT conference took place at Trent University in Peterborough, a beautiful spot at the end of June. Between fifty and sixty physics educators participated in this event. Although the group was on the small side the camaraderie that developed was excellent and the sessions presented were very helpful to physics teachers trying to broaden their range of teaching strategies as well as trying to update their knowledge in the field of physics. It is difficult to give adequate coverage to a two day conference in a single article like this one so I will concentrate on two presentations that were of particular value to me as a physics teacher in an Ontario secondary school.

John Childs, a teacher from Grenville Christian College in Brockville presented a paper entitled "Fractals, Chaos and the Mandelbrot Set". John illustrated his talk with some computer slides that were very impressive in a visual sense. In addition to making a very polished and excellent presentation John convinced me that this is a topic that could be investigated by a high school student. It would make an excellent independent study topic for a keen student. John made several suggestions as far as resources are concerned. He suggests the following book as an excellent introduction to the field: *Turbulent Mirror*, by John Briggs & F. David Peat, ISBN 0-06-016061-6, Harper and Row. John describes this book as an excellent, non-technical introduction to the entire field of chaos theory. It is the perfect book for anyone who wants to get an overview.

John is also willing to send you a computer disk which has a combination of freeware and shareware programs on it. One for example, entitled Mandelbrot Magic v4.0 is a full featured program that generates the Mandelbrot Set and Julia Sets. The documentation is 60 pages long.

In his paper John suggested that you contact him by

(see TRENT, page 2)

Fax Us!

We want to hear from you: your comments, criticisms, observations...

Send correspondence to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

work: (519) 631-4460
fax: (519) 633-9014

...TRENT (from page 1)

mail or fax and specifically requests that no telephone calls be made. He is willing to share additional resources for a modest fee and I am sure would be pleased to see other physics teachers show an interest in this whole field that has fascinated him. His address and fax number are given below. As a starter I suggest that you ask him for a copy of a computer disk containing the freeware and shareware that he used as part of his demonstration at the conference. Also ask for a copy of the handout he distributed at the conference. In addition to the resources mentioned above there are a number of additional books and addresses provided.

John Childs
Grenville Christian College
Box 610
Brockville, ON, K6V 5V8
FAX (613) 345-3826

A second brief (5 minutes) but neat presentation was made by Al Hirsch, member at large for OAPT. Al demonstrated small white boards about the size of a clipboard which he uses with his class. He has found them particularly effective with ESL students because these students are reluctant to respond orally. However, as he indicated in his presentation they could be used with any class. As a teacher you could ask students to draw circuit diagrams or give simple definitions. When a student or group of students has answered a question they simply hold up the white board for the teacher to see the response. The array of responses quickly indicates whether or not the students have caught on to the concept being covered. If you wish to try these boards they will be available at a very low price through the OAPT (see advertisement on this page).

The 1994 conference will be held in June in the Ottawa area. This is the first time in the history of OAPT that we have gone that far east. We hope to attract our regulars as well as Ottawa area physics teachers who have not attended an OAPT conference in the past. Watch for further news about this conference. OAPT provides one of the best values per professional development dollar available in Ontario.

Whiteboards

The whiteboards, as demonstrated by Al Hirsch at the 1993 OAPT Annual Conference, are now available.

Total cost for each set (whiteboard, pen, brush, taxes and delivery) is $6.50. **Minimum order of 8, please.**

Fill in the order form below (or a reasonable copy) and send your cheque (or money order)—payable to OAPT—to:

Whiteboards
c/o John Wylie
The Toronto French School
306 Lawrence Ave. East
Toronto, ON M4N 1T7

Name: ____________________

School: ____________________

Address: ____________________

____

City: ____________________

Prov.: __________ Postal Code: __________

# of whiteboards____ x $6.50 = ______

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...EDITORIAL (from page 1)

areas of focus (Literacy, Life Skills, Arts and Creative Applications). The curriculum attempts to be more integrated (for example, by including a set of math and language skills with each unit), and uses technology throughout the learning process as a tool to help students gather and manage information.

The school has partnered itself with several major corporations to help in the acquisition of equipment and the training of staff in its use. The University of Toronto and York University are conducting research to help understand the results of restructuring not only the curriculum, but also the organization of the school itself.

You may be thinking what I and others at the workshop first thought: 1) my school doesn't have the money to bring technology to every classroom; 2) finding a corporation to be a partner with is not an easy thing in my area (this assumes, of course, that having a corporate partner is desirable at all); 3) this kind of change requires the co-operation of the entire staff (some of the teachers at my school are very territorial about what and how they teach). But the idea that educational practices must change and develop as society does is a valid one.

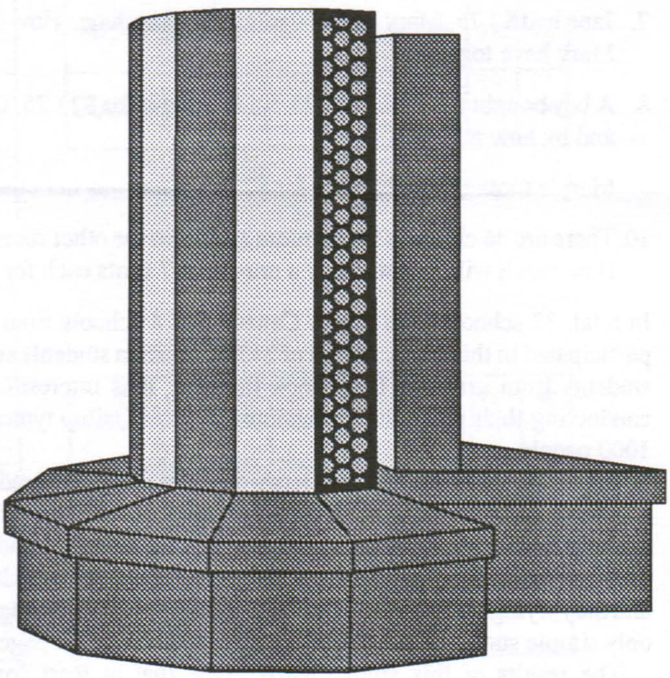
Part of the workshop was spent looking at new and existing telecommunications technologies, and suggesting ways they could be used in the classroom. One of these new technologies was VISIT (I've forgotten what the acronym stands for), which uses your phone line and personal computer to allow you to see, hear and share information with someone anywhere in the world. Although I don't think my son will be video conferencing with his teachers in the near future there are many possible applications for this technology in education.

The main reason I like to attend conferences and workshops is to meet and share ideas with other teachers. I became involved with OAPT because the annual conference is well organized, I always know I'll meet people a lot like myself, and I always come away with a few ideas that I can try in the classroom right away. With this in mind, my own idea for an immediate, simple (?) and inexpensive (?) way in which Bell could help educators was to contribute to a teachers' bulletin board by way of equipment, personnel and/or a 1-800 number that teachers could call into.

Several boards do have their own teacher bulletin boards—at the Bell workshop we logged into the SCRIBE bulletin board of the Scarborough Board of Education, and one of the presenters at the June conference mentioned a bulletin board run by the Peterborough Board of Education—but I think that the wider the area of access, the more ideas that are down loaded, the more useful it becomes. Cost is a big factor. I belong to CompuServe, and find it very useful; but my time to browse the many areas on the bulletin board are limited by the hourly service charges while logged in, and the long-distance charges from having to call Toronto, which is the closest access node. A 1-800 number would allow teachers to call in from all over Ontario (Canada?, North America?,...). This kind of service would be especially useful to those of us who don't have anyone else with which to readily discuss ideas. (If you have other ideas about how Bell might contribute to education, send me a letter or fax and I'll pass it along.)

Understanding telecommunications technology is no longer a luxury, it is a necessity. The exponential growth of scientific journals means that becoming specialized in a certain area is impossible; stocking magazines becomes ridiculously expensive for small school libraries. To be able to obtaining relevent information means being able to access an electronic database, bulletin board, or CD ROM.

To give our students an advantage we need to expose them to the changing world around them. I've read that 15 years from now we will be using technologies that haven't been invented yet. If we're lucky the people that will develop that technology are the ones in our classroom right now.



The good old days-- more fact than fiction?

Lou D'Amore
Father Redmond High School
300 Valermo Drive
Etobicoke, Ontario M0W 2L1

On November 6, 1992, I administered the following ten question test to my grade 9 science class. These questions were taken directly from a book entitled *THE OPPORTUNITY PLAN* which was published in 1932 and consists of a series of lesson outlines and exercises, based on the prescribed course of study for Grade 3 Arithmetic in the Province of Ontario. I invited teachers to use this test and this report is a summary of their results.

NAME ____________ SHOW YOUR WORK!!!

1. Subtract these numbers: 9864
   5947
2. Multiply: 92
   34
3. Add the following: \$126.30
   \$265.12
   \$196.40
4. An aeroplane travels 360 km in three hours. How far does it go in one hour?
5. It a pie is cut into sixths, how many pieces would there be?
6. William bought 6 oranges at 5 cents each and had 15 cents left over. How much had he at first?
7. Jane had \$2.75. Mary had 95 cents more than Jane. How much did Jane and Mary have together?
8. A boy bought a bicycle for \$21.50. He sold it for \$23.75. Did he gain or lose and by how much?
9. Mary's mother bought a hat for \$2.85. What was her change from \$5.00?
10. There are 36 children in one room and 33 in the other room in Tom's school. How much will it cost to buy a crayon at 7 cents for each child?

In total, 32 schools from across Canada and 4 schools from the United States participated in this study. A total of 2436 Canadian students and 1082 American students from grades 5 to 12 took this test. It is interesting to note that, in conducting their polls, the professional pollster Gallup typically surveys about 1000 people.

My expectation was that teachers would test only their grade 9 students. I was surprised and pleased to see that many teachers took this project on with such exuberance, that they went beyond my original intention and proceeded to test many grades and levels. Keeping in mind the diversity in which data was reported and the varying sample sizes, I found it necessary to regroup the data and calculate only simple statistics as a summary. [See data tables on page 5]

The results of this study clearly show that at least some students have significant trouble with what I think most people will agree, are relatively simple arithmetic problem. I realize that there are shortcomings in my procedure, but keep in mind that by using a grade 3 test in my study, this investigator is allowed a large margin of error.

Considering the fact that Canada spends 7.2 % of its gross domestic product on education, the highest percentage of any developed country , I find the performance of our students on my test unacceptable. I shudder at the thought of our youth struggling through the complexities of mortgage tables and income tax forms, and wonder if this lack of understanding will lead to their further alienation from society.

Teacher reactions to my findings have fallen into two admittedly overlapping camps. There are those who believe my study is not revealing anything new. They often accompany this belief by feelings that the decline in arithmetic skills, and in our education system is real; however, the problem are too big to correct. I will address this position later.

More disturbing to me is a second group of what I see as misplaced student advocates who quite frankly, react to my findings by making excuses.

Let me paraphrase some of the comments made by this group and respond to them -in turn.

1/ "The student could do the arithmetic but did not understand the question being asked."

The ability to add and multiply are not in themselves very valuable skills , a calculator can easily be used to compensate. The ability to problem solve is valuable, and by necessity requires the student to successfully manage both language and arithmetic skills. The fact that such a large percentage of our students have great difficulty solving questions 7 and 10 on this test is, in the words of several teachers, nothing short of appalling.

2/ " Students made silly mistakes."

This is true, but the fact that less than 30 % of students trying my test were able to obtain a perfect score suggests that these mistakes may be more than just silly. The need for students to do their work carefully and to strive for perfection, where possible, seems to me a worthwhile goal that the education system does not encourage in its students.

3/ "Students will eventually learn to do their arithmetic later on in school or in life."

I was very surprised to find that the average score of the grade 8 students was not very much different from those in grades 10 through 12. As one teacher pointed out, there should be an automatic improvement in scores by the fact that there is an attrition of the weaker students as we go to higher grades. One must ask, what do these students learn about problem solving during their 4 years of high school ?

4/ *"Students in 1932 would probably have performed just as poorly m this test as our students today."*

Of course these statistics are not available to me, but I have met many older adults with barely a grade school education, who can solve the problems on my test with ease; and I'm not convinced that our students ever will.

Can anything be done to correct what some teachers believe to be an inevitable decline in student performance? The fact is, that something is being done, in some schools. I wonder if our leaders in education are aware that a grade 6 class from Toronto scored 86 % on my test, and that there is an Ontario high school whose grade 9 general level class scored 84% ,well above the average. Equally impressive was a class of 44 grade 8 students from an American private school, who averaged 88 %, and in what proved to be a rather singular accomplishment, reported no failures. I speak from the perspective of an Ontarian when I ask, why don't officials from our education ministries do more to identify programs that work and then learn from them ?

Do we have a right to expect more from our students ? The fact that some students in grade 5 can still score 100 % on my test, convinces me that the skills involved are not beyond the potential of most high school students. Perhaps students should not be promoted to higher grades and asked to solve much more difficult and abstract problems until they have mastered the simpler ones. We might have more success in teaching higher order, problem solving skills to our weaker students if we stayed with simple examples that are clear and relevant.

There are many things that can be done to improve our education system, but the first step must be to recognize, and admit that a problem exists. Offers of help will not improve the lot of a substance abuser, until they see themselves ready to accept it. Likewise, the Canadian education system will continue to crumble if it remains entrenched in its stage of denial.

Let me take this opportunity to thank all those teachers who participated in this study. I was very pleased to hear from many teachers who care and are willing to give of themselves to improve our education system. Many teachers went beyond my expectations.

Reference: W.E. Hume, The Opportunity Plan, Thomas Nelson and Sons, Toronto, 1932

Canadian Schools

GRADE <# STUDENT> [AVG. SCORE]	Question # / Percentage INCORRECT 1	2	3	4	5	6	7	8	9	10
GRADES 5-7 < 156 > 76 %	12%	24%	8%	24%	24%	20%	50%	15%	16%	44%
GRADE 8 < 178 > 82 %	10%	16%	5%	18%	21%	12%	39%	8%	13%	40%
GRADE 9 Gen. < 328 > 72 %	18%	28%	14%	28%	40%	24%	44%	19%	20%	49%
GRADE 9 Adv. < 1112 > 84 %	12%	15%	9%	11%	19%	12%	30%	8%	11%	32%
GRADES 10-12 < 662 > 84 %	11%	18%	9%	14%	16%	10%	33%	9%	13%	32%

Total Score	10	9	8	7	6	5	<5
GRADES 5-7	16%	28%	16%	17%	10%	7%	6%
GRADE 8	19%	33%	19%	18%	4%	3%	4%
GRADE 9 Gen.	13%	17%	19%	20%	9%	11%	11%
GRADE 9 Adv.	28%	28%	20%	14%	5%	3%	2%
GRADES 10-12	27%	28%	23%	9%	6%	3%	4%

U.S. Schools

GRADE <# STUDENT> [AVG. SCORE]	Question # / Percentage INCORRECT 1	2	3	4	5	6	7	8	9	10
GRADES 5-8 < 213 > 85 %	13%	13%	8%	14%	12%	12%	33%	7%	10%	29%
GRADE 9 < 329 > 86 %	9%	10%	5%	5%	12%	12%	39%	4%	10%	30%
GRADES 10-12 < 540 > 90 %	8%	9%	4%	7%	6%	7%	25%	5%	6%	22%

Total Score	10	9	8	7	6	5	<5
GRADES 5-8	28%	32%	21%	9%	7%	1%	2%
GRADE 9	Not Available						
GRADES 10-12	Not Available						

Canada at the XXIV International Physics Olympiad

reported by John Wylie

Canada won an unprecedented three bronze medals at the XXIV International Physics Olympiad held in Williamsburg, Virginia in the United States. Robert Kry, Xiao Dong Yang and Jurgen Hissen all won bronze medals and Paul Tupper won an honourable mention award as well. Canadian teams have never won three medals before and never have four students taken home awards. In addition, the 1993 team totalled the highest Canadian team score since starting participation in 1985.

Forty one countries took part in the XXIV IPhO which was held from July 10—18 at the College of William and Mary in Williamsburg. The American Physical Society and The American Association of Physics Teachers in cooperation with the College put on a fine show for the nearly 200 top physics students from around the world. In the end, top honours and gold medals went to two students from Germany and China. These students scored an impressive 80% on ten hours of examinations on both theoretical and laboratory problems.

The Canadian Team was composed of four students from Western Canada; Paul Tupper and Ari Benbasat of Vancouver and Jurgen Hissen from Victoria represented British Columbia and Robert Kry was from Calgary, Alberta. The fifth team member was Xiao Dong Yang from Toronto, Ontario. Xiao Dong is thrilled to see his Olympiad dream come true as he once tried for the Chinese Olympiad Team before coming to Canada.

The Canadian program starts each fall when every high school in the country is sent a poster and information.

Participating students take part in one of a number of provincial programs working on problems throughout the year and many attend a Provincial Final where in addition to talks, tours and laboratory exercises, a National Selection Exam is written. On the basis of this Exam, written by all Olympiad hopefuls across Canada, 20 of the top students are invited to the National Olympiad Finals. Paul Tupper is the "old man" of the Canadian program having attended four B.C. Provincials, three Canadian Nationals and two International Olympiads winning a bronze medal in the 1992 Finnish competition.

The 1993 Canadian National Olympiad Final was held during the last week in May at Memorial University of Newfoundland in St. John's, North America's oldest town. The Finals are an intensive week of advanced training in which students are examined on world class olympiad problems, both theoretical and experimental. The five member Canadian Team is chosen at the end of this week. Just for fun, some of the students were challenged to estimate the mass of the iceberg still in the St.-John's harbour. Amongst their non-academic activities were a cruise to a North Atlantic island bird sanctuary, a visit to Cape Spear (the eastern most point in North America) and a climb up Signal Hill where the first transatlantic radio signal was sent.

The International Olympiad gave the students an exciting schedule of tours and events including visits to NASA at Langley, the Continuous Electron Beam Accelerator Facility in Newport News and Busch Gardens theme park near Williamsburg. At this event, the park opened early to allow the 200 students to perform experiments while riding the three impressive roller coasters on the site. A Canadian, Ari Benbasat, distinguished himself by winning an Amusement Park Physics contest analyzing the dynamics of the Big Bad Wolf suspended coaster. Of course, visits to the site of colonial Williamsburg were a highlight of the week.

The Canadian Chemistry and Physics olympiad organization is looking forward to 1997 when it will be hosting both the International Physics and Chemistry Olympiads. This will be the first time that both events will be held in the same Country simultaneously. The 28th International Physics Olympiad will be held at Laurentian university in conjunction with Science North, both of Sudbury, Ontario. Participants from perhaps 50 nations will be treated to the beauty and geology of the Canadian Shield, and a visit to the Sudbury Neutrino Observatory 2 km underground. These projects represent a significant fund-raising challenge and the Canadian organization is looking for eager corporate partners willing to share in the funding and planning for 1997.

The Olympiads in Canada were founded by The Toronto French School and the Principle sponsor is the Natural Sciences and Engineering Research Council of Canada. The Canadian olympiad program is supported by; Merck Frosst Canada, The Governments of Quebec, Ontario and British Columbia, Imperial Oil, Dow Chemical, Bell Canada, Du Pont Canada, Shell Canada, Bombardier Inc., Celanese Canada, Ciba Geigy Canada, The Boland Foundation, The Mclean Foundation, Investors Group, The Royal Bank of Canada, AECL Research, Canadian Society for Chemistry, Canadian Association of Physicists. The Olympiad also recognizes the University of British Columbia, University of Manitoba, University of Toronto, McGill University, The Royal Military College, Bishop's University, Dalhousie University and Memorial University of Newfoundland for their work in training and selecting students for the program.

1993 Canadian Physics Olympiad Team

Ari Benbasat
Vancouver, B.C.
St. George's School
Teacher: Robert Bacon

Paul Tupper
Vancouver, B.C.
Point Grey S.S.
Teacher: Axel Kellner

Robert Kry
Calgary, Alberta
Western Canada H.S.
Teacher: Mr. B. Head

Jurgen Hissen
Saanichton, B.C.
Stelly's S.S.
Teacher: Lionel Sandner

Xiao Dong Yang
Toronto, Ontario
Harbord C.I.
Teacher: Mr. T. Jutcovich

REVIEW:

Kenneth Laws-- The Physics of Dance

(VIDEOTAPED AT THE 1992 OAPT CONFERENCE, RYERSON POLYTECHNIC UNIVERSITY)

Kenneth Laws is a physics professor at Dickinson College in Pennsylvania. He started ballet lessons with his children 16 years ago, and has been involved with it ever since. He has written a book titled "The Physics of Dance" (ISBN 0-02-873360-0, Macmillan Publishing) and has given his talk on the subject over a hundred times.

Professor Laws starts by telling the audience that building a relationship between physics and the arts can be an important way of communicating science to young people who are turned off by science. Many people believe that science is cold, analytical, logical, unlike the arts which are aesthetic, emotional and full of subjective reactions; but by showing that science can be the subject of art (e.g. Holtz's "The Planets," kinetic sculptures), or provide tools for the arts (e.g. acrylic paints, computer generated images), or contribute to the understanding of the arts (e.g. analyzing the movement of the body with computers, determining what materials go into a Stradivarius violin) educators can help "turn on" kids who have been "turned off" by science. To this end Professor Laws sets up a demonstration which shows how two notes of certain frequencies will interfere to produce a third note (the beat frequency of the two original notes) which is part of the musical composition (e.g. an F sharp and an A produce a D).

The application of physics can be a qualitative one, as Professor Laws demonstrates with some simple insights into the movement of the body (for example: why do we run with our arms bent and our legs up?). A ballet dancer is on hand when Professor Laws discusses the physics involved with ballet movements. A brief dance sequence is demonstrated and then taken apart. Center-of-gravity and torque are invoked to explain how a dancer keeps her balance. The question of who provides more energy during a lift, the man or the woman, is answered. The use of the arms in doing a turn is analyzed, and the secret behind the "floating-through-air" illusion that dancers and basketball players produce is explained.

The hour-long lecture is very entertaining; Professor Laws is a confident speaker, and his lecture is set at a level that students with even a slight background in physics can follow along easily.

THE DEMONSTRATION CORNER

OPTICS, DENSITY, HOLOGRAPHY AND CURVE-FITTING

by

Dianne Ness

Humberside C.I.
280 Quebec Ave.
Toronto, Ontario M6P 2V3

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

Focal Point of a Mirror

Use a large concave mirror and several lasers (even two will do). Set the lasers to make beams parallel to the axis of the mirror, turn out the lights, and use chalk dust to shown the location of the beams. Have students measure the position of the focal point of the mirror—they love it.

Density Rod

I bought a density rod from Boreal Scientific that floats in cold water but sinks in hot water. At the beginning of a class I just have it floating in cold water and add hot, but then go ahead and teach my lesson. Gradually students notice what is happening. Lots of questions! (Boreal Scientific #61402-10; $17)

Holography

I would like to recommend a kit on holography "Holokit," available from Integraf for $73 (This includes developing chemicals, instructions, etc.). I ordered it last year and with a bit of effort our OAC classes made holograms. It fit into our light-interference part of the course, and took about two 45-minute classes. It generated lots of enthusiasm in the whole school. The only problem is that you need a fairly high-power laser (about 5-6 mW); however, these are available from MKS Industries in the U.S. for about $250. Altogether a worthwhile investment. (Integraf, P.O. Box 586, Lake Forest, IL, U.S.A. 60045, FAX 708-615-0835; MKS Industries, 1269 Pomona Rd., Corona, CA, U.S.A. 91720, phone 714-278-0563)

Curve-Fitting

Dave Stock, the former head of physics at Humberside C.I., wrote a BASIC program for curve-fitting that allows students to input (x,y) data and perform a fit to an equation of the type $y = mx^n + b$. We use it on all the computers that we have available from PETs to 486s. Please write me at Humberside C.I. if you would like to receive a copy of the code. There are no graphics included with the code, since graphics are computer-dependent, but I have a compiled version with graphics available for IBM. If you would like a copy, please send me a formatted high-density disk.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XVI, Number 2 **Winter 1994**

From the President

by David Marshall
Trent University, Peterborough

Your OAPT membership allows you to provide the executive with valuable input. Any suggestions, questions on current OAPT practices, constructive criticism, etc., are always welcome. As we all tell our students: "If you have a thought, odds are a couple of others have the same thought and everyone will benefit from hearing it."

There is also another avenue for supplying input to the OAPT and that is to take a position on the executive. Geographical separation is not a factor when communication is largely done via phone, fax and mail. The time commitment is not a great one. No one has extra time they need to fill up, but setting aside a few hours a month is a worthy sacrifice if you are serious about sharing physics education ideas.

You can also do a presentation (short or long) at the annual conference, you can write to Paul at the newsletter or submit articles on demonstrations to Ernie at the Demonstration Corner. We want to hear from you. As you may have heard me say during the OAPT Conference at Trent University: "This is your association, help us give you what you want."

I look forward to seeing you all in Ottawa next June.

WHY WAIT UNTIL IT'S TOO LATE?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

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Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1

EDITORIAL:
You Are What You Teach

Like Teacher, like Student, like Teacher...

I had the pleasure of attending a talk given by Lillian McDermott at the University of Western Ontario's faculty of education at which she posed the following problem: given several circuits with identical batteries and bulbs (see figure 1), rank the relative brightness of the bulbs. She has used this question in a study of the understanding of physics concepts.[1]

Originally, McDermott asked for the question to be placed on a university physics test, but the professors teaching the course felt it was too simple. After giving the test to over 500 people (including physics professors) only 15% answered correctly (try it yourself; the answer's at the end of the editorial[2]).

Many people try to apply Ohm's Law to the problem, but the formulaic solution is complex, and is usually completed incorrectly. One typical error gives the brightness of bulb B as brighter than bulb C, indicating that the person believes current is used up; another common belief is that the battery always produced the same current.

McDermott then described how you might use batteries and bulbs to model the concepts necessary to understand the question , and, after spending only a few minutes on it asked some of the non-physicists in the room to rank the brightness of another

(see EDITORIAL, p. 3)

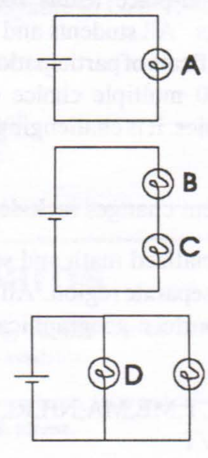

Figure 1

OAPT Technology Conference

Make Plans for the **1994 OAPT Conference.**

This year's conference will be held at Carleton University in Ottawa, Thursday, June 23 to Saturday, June 25.

The tentative schedule of events will be as follows.

Thursday and Friday evening: Workshops on electronics in your physics class, fractals in the classroom, and using telecommunications.

Friday day: Tours are being planned of the Bell Northern Integrated Circuit Fabrication Lab, and the National Research Council Acoustical Engineering lab, Wind Tunnel, and Biophysical Engineering Lab.

Saturday day: Contributed papers.

AAPT News

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PHYSICS BOWL

The 1994 AAPT/Metrologic PHYSICS BOWL Contest will be held Thursday, April 21. Entry forms will appear in winter editions of *The Physics Teacher and The Announcer* or can be obtained by writing PHYSICS BOWL, AAPT, P.O. Box 989, College Park, MD 20741-0989. Entry forms must be received at the national office by March 21, 1994. First and second year physics students compete in separate divisions. A school's score in a division is the sum of the four highest student scores. The thirty first place schools receive a laser donated by Metrologic. First and second-place teams receive PHYSICS BOWL T-shirts. All students and teachers who enter receive a certificate of participation. The contest exam consists of 40 multiple choice questions from all areas of physics. It is challenging, with an average score about 50.

Recent changes include:

Specialized math and science high schools compete in a separate region. All other schools compete in one of fourteen geographical regions. The regions are:

02 CT,ME,MA,NH,RI, VT	10 MN,ND,SD,WI
03 NY, Maritime Prov., ONT, QUE	11 AR,LA,MS,TN
04 NJ, PA	12 CO,KS,M0,NE,OK, WY
05 DE,DC,MD,NC,VA	13 AZ,NM,TX,UT
06 AL,FL,GA,SC,PR,VI	14 CA,HI,NV,Am Samoa, Guam
07 KY,OH,WV	15 AK,ID,MT,OR,WA, AB,BC, MAN, SAS
08 IN,MI	
09 IL,IA	20 Math & Science Sch.

First and second year physics students compete in Divisions I and II, respectively, without regard to AP status.

You may request a list of the top scoring schools and/or students in your region. This could be used to award section prizes or certificates. Last year the South Dakota Section, in conjunction with the South Dakota Academy of Science, used the results of PHYSICS BOWL for a regional physics contest. This year the Southern California Section plans to use PHYSICS BOWL results to award scholarships to top scoring students. Or, present the physics teacher of your top scoring team with a certificate at your section meeting.

I would be happy to discuss using PHYSICS BOWL results for a local contest.

1994 AAPT INTRODUCTORY PHYSICS EXAM

The 1994 Introductory Physics Exam will be available this spring. Ads will appear in The *Physics Teacher and The Announcer* or write 1994 Introductory Physics Exam, AAPT, P.O. Box 989, College Park, MD 20741-0989. The Introductory Physics Examination is designed to be a test of basic physics concepts. It consists of seven sections:

Mechanics	24 multiple choice questions	25 minutes
Waves, Optics, Sound	16 multiple choice questions	20 minutes
Heat and Kinetic Theory	8 multiple choice questions	10 minutes
Electricity and Magnetism	20 multiple choice questions	25 minutes
Modern Physics	12 multiple choice questions	15 minutes
Mechanics	Do 2 of the 3 problems	25 minutes
Electricity and Magnetism	Do 2 of the 3 problems	25 minutes

A teacher may use all or some of the sections. Recent changes include:

☐ Easier and more conceptual than previous editions,

☐ Physics formulas are provided on a separate sheet for use with the exam.

☐ In addition to the five multiple choice sections, there are two new free-response sections (Mechanics and Electricity & Magnetism). Scoring standards will be provided for these problems,

If you have questions, please contact me by mail, phone, FAX, or email. The Examinations Editorial Board meets at the winter and summer national meetings, see the Announcer for the time and place. These meetings are open to all and I strongly encourage anyone who is interested to attend.

...EDITORIAL (from page 1)

circuit (see figure 2)[3]. She suggested that this type of modeling/reasoning should precede a study of Ohm's Law, and stressed that teaching these concepts was not something to be completed in a day

McDermott stated that a facility in solving standard quantitative problems does not mean that the student has an understanding of physics concepts. According to McDermott how we teach does not match how students learn.

Does this mean we need to produce a new elementary/high school physics curriculum and arm the new physics teachers with it? The problem with most of these existing programs is that they are either not developed with the teacher's background in mind (elementary school) or are incongruent with the average student's ability. This leads to a disillusionment and degeneration in the adoption of the new curriculum.

McDermott believes that it is the university physics department that determines how we teach, not the faculty of education. Those students who eventually become teachers find it difficult to teach differently from how they learned. For the most part this style of science learning has been through fast paced top-down lectures which stress theory and formalism instead of scientific reasoning. Curriculum development has, therefore, been based on the curriculum author's present understanding of the subject matter, and their perception of the student (which is based on personal recollection). This leads to an emphasis on the physicist, not the student. The student ends up seeing the physicist as a collection of facts and formulas, and fails to recognize the critical role of reasoning in physics.

This brings us back to the original problem: how do you introduce curriculum change that is useful and long-lasting? McDermott believes that university departments should be more responsible for helping teachers gain knowledge on how to teach the material that they do, through practical in-service for teachers and by changing the methods of undergraduate education. With this in mind, the University of Washington physics department, where McDermott teaches, offers an education option to students in their graduate programs.

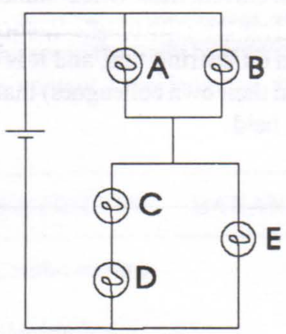
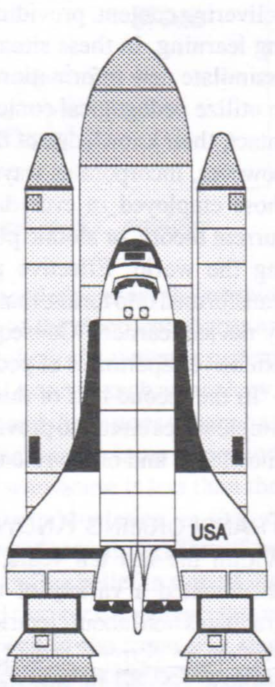


Figure 2

There is a lot of inertia to overcome before any changes of this magnitude would be possible, but I think that, as individual teachers, it is always a good idea to have a critical look at our own courses and to consider what exactly our students are taking away with them when the year is over—a life-long understanding of the physics of nature, or a head full of equations that evaporate as soon as the final exam is written.

Notes:

1. McDermott, Lillian C. and Shaffer, Peter S. (1992). *Reasearch as a Guide for Curriculum Development*. American Journal of Physics, 60(11), 994-1013.
2. E=D=A>B=C
3. E>A=B>C=D



The Demonstration Corner

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Toronto French School
306 Lawrence Ave. E.
Toronto M4N 1T7

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OAPT Newsletter
c/o Paul Laxon
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work: (519) 631-4460
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Whiteboards

The whiteboards, as demonstrated by Al Hirsch at the 1993 OAPT Annual Conference, are now available.

Total cost for each set (whiteboard, pen, brush, taxes and delivery) is $6.50. **Minimum order of 8, please.**

Fill in the order form below (or a reasonable copy) and send your cheque (or money order)—payable to OAPT—to:

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Building a Professional Memory: Articulating Knowledge About Teaching Physics

by Art Geddis
Faculty of Education, University of Western Ontario
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Fax: 519-661-3833
Office: 519-661-2083

In many ways teaching is a profession without a memory. Unlike professions such as architecture and engineering, there are few detailed records of what teachers do and how they do it. Architects leave behind drawings, specifications, models, contracts, and the buildings themselves. Such artifacts provide a record of the problems that were faced, the solutions tried, and the product produced. Teachers, however, leave few records of their struggles with this year's destreamed nine, or last year's Applied Physics, and the records that are left do little to capture the complexity of their pedagogy.

An integral part of the education of doctors, lawyers, and business students, is the study of "cases" that record the history of their profession. Presently there is no comparable body of literature to which beginning and practising teachers can turn to discover the wisdom of their predecessors. Interestingly, there is a substantial literature devoted to demonstrations and experiments. Irwin Talesnick's <u>Idea Bank</u>, Tik Liem's <u>Invitations to Science Inquiry</u>, and Ernie McFarland's <u>Demonstration Corner</u> are just a few that come immediately to mind. This literature, however, focuses primarily on the presentation of phenomena and captures only a portion of the complex pedagogy involved in classroom teaching.

A useful focus for articulating more of the complexities of subject matter pedagogy is provided by Lee Shulman's view that effective teachers **transform** knowledge of subject matter into forms accessible to their students. The ability to perform such transformations is based on knowledge particular to subject matter teachers; Shulman (1987) calls this knowledge **pedagogical content knowledge.** Pedagogical content knowledge is an amalgam of subject matter and pedagogical knowledge. It arises from deliberation about how to teach particular content to particular students in particular contexts, and consists (among other things) of: **misconceptions** students typically bring to instruction, alternative **ways of representing** subject matter, and effective **teaching strategies** for changing misconceptions. To a significant degree, it is the acquisition of the relevant pedagogical content knowledge that distinguishes effective physics teachers from fresh physics graduates.

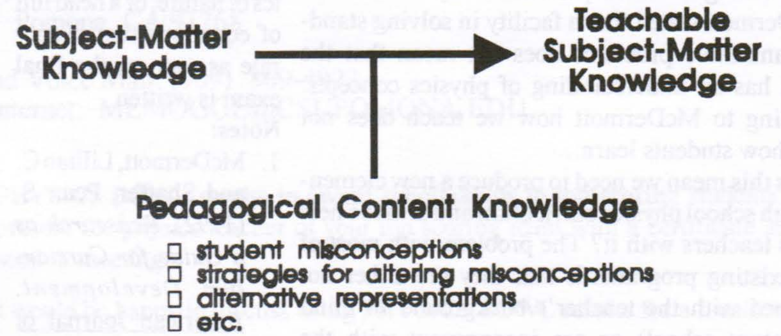

Figure 1. Transforming Subject Matter Knowledge

When learning primarily involves acquiring information, instruction can proceed in a **transmission mode**. This typically involves motivating students, delivering content, providing opportunities for students to practice, and evaluating learning. In these situations, students employ familiar ways of thinking to assimilate new information presented by the teacher. Teachers have little need to utilize pedagogical content knowledge because they can **transmit**, relatively intact, their knowledge of the subject matter to their students. Much of physics, however, incorporates ways of thinking that are fundamentally different from those employed in everyday life. Learning Newtonian mechanics, electrical current theory, or atomic physics involves mastering new ways of conceptualizing the world. Effective physics teaching demands that subject matter be transformed into forms, that while still valid physics, can be learned meaningfully by novice learners. Consequently, physics teachers find themselves in need of extensive repertoires of pedagogical content knowledge.

In the second half of this article I will use the flow of electrical current in a simple series circuit to provide an example of the need to transform subject matter knowledge and of the role that teachers' pedagogical content knowledge plays.

Transforming Knowledge: Electrical Current Flow

Within the last ten years, researchers (e.g., Osborne & Tasker 1985) have documented a variety of misconceptions that even some university physics graduates hold about electrical current flow. One common misconceptions is that the "return current" must be less than the outgoing current. Beginning physics teachers are usually surprised on hearing this, and it is only after questioning a variety of school students (and their own colleagues) that they are convinced that this misconception is widely held.

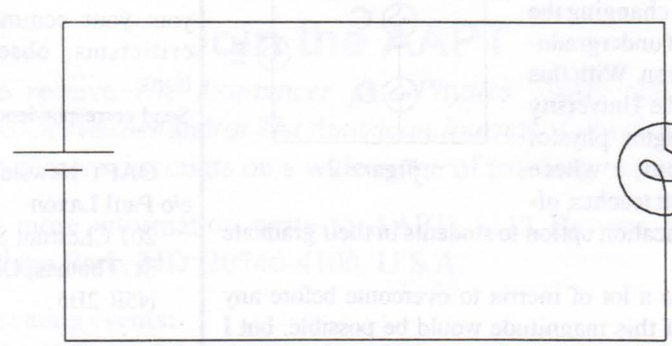

Figure 2. A Simple Series Circuit

Knowledge of this misconception is important pedagogical content knowledge, but in itself it is not enough to enable teachers to transform their subject matter knowledge about electrical current into forms that are meaningfully understandable by novice physics students.

Generally, widely held misconceptions about scientific knowledge are not simply naive mistakes, but conceptions held for good reason in that they serve everyday situations quite adequately. It is quite evident to any novice student that the bulb in figure 2 is giving off light. Consequently it is not unreasonable to think that something is being "used up" (transformed) in the bulb. (This is an especially reasonable position for the student who is aware of the Law of Conservation of Energy.) Why then should the student believe that the "rate of flow of electricity" is the same returning as going out? Here the root of the problem can be seen to lie in the everyday use of the term "electricity" to refer to both electrical **charge** and electrical **energy**. While the return rate of flow of electrical energy is indeed less, the return rate of flow of electrical charge is the same. Electrical energy is being "used up" in the bulb but electrical charge is not!

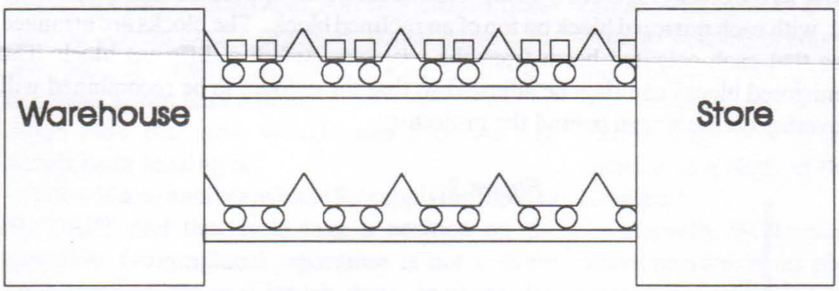

Figure 3. The "banana cartons on the conveyor trucks" analogy

One way for teachers to transform their scientific knowledge about the current around a series circuit is by devising a representation of the electrical charge as a "carrier" of electrical energy--perhaps by using an analogy of a conveyor system moving cartons of bananas from a warehouse to a retail store. In such an analogy, the conveyor trucks correspond to the electrical charge and the cartons of bananas to electrical energy, so that while the rate of flow of trucks is the same all around the circuit the rate of flow of cartons returning to the warehouse is less than the rate of flow going out. The advantage of such a representation is that it incorporates students' knowledge that the return flow (of something) "must" be less. Consequently it does not strain credulity by demanding belief in something that appears to be patently wrong. It might be objected that such a representation is "incorrect"--i.e., that electrical energy is not carried in the same way that bananas are. While in one sense this may be correct, it ignores the pedagogical imperative to transform content knowledge to make it accessible to novice students.

	ELECTRICITY	BANANA CARTON ANALOGY
CURRENT	coulombs/second	trucks/second
VOLTAGE	joules/coulomb	cartons/truck
POWER	joules/second	cartons/second
P=VxI	J/s=J/C x C/s	cartons/s=cartons/truck x trucks/s

Table 1. A banana carton analogy for electrical current

I do not want to claim that these ideas incorporate the "best" way of teaching electrical current flow, but they do provide a basis for transforming subject matter for learners. Certainly teachers who are aware of a **misconception**, cognizant of the **origin** of the misconception, and are in possession of one or more **representations** that deal with the misconception, have the pedagogical content knowledge to engage the problem of knowledge transformation in instruction. Seldom, however, is this sort of knowledge shared in any systematic manner with colleagues. If each generation of teachers is to be spared having to discover the relevant pedagogical content knowledge on their own, it is important that we begin the task of recording what present teachers know about teaching their subject matter.

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Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. Harvard Educational Review, 57(1), 1-22.

Tasker, R. and Osborne, R. (1985). Science teaching and science learning. In R. Osborne and P. Freyberg (Eds.), Learning in science: The implications of children's science (pp. 15-27). Auckland, New Zealand: Heineman.

Art Geddis spent 22 years as a secondary science teacher before moving to the Faculty of Education at the University of Western Ontario in 1989. At Althouse he teaches physics and chemistry methods courses to pre-service students, curriculum and science education courses to graduate students, and also conducts research into various aspects of learning about teaching.

COLOUR MIXING THE ECONOMICAL WAY

by

Bill Konrad

Chatham Kent Secondary School
Chatham, Ontario

I am sure that, in the schools of Ontario, the range of equipment presently in place to demonstrate colour mixing varies all the way from ray boxes with colour filters to expensive projectors specifically designed for that topic. Many of these may be effective but frequently one finds that the resulting colour is not exactly what theory predicts. For example, a blue light, a green light, and a red light projected onto the same area of a white screen may produce a "yellow" white or a "greyish" white. The demonstration described below gives excellent results and, in keeping with current budget constraints, is very economical. To carry it out, proceed as follows.

First cut two squares of cardboard from a box (such as a discarded cereal box or shoe box) that are the same size as a 35 mm slide. Now use a paper punch to punch 3 holes in these squares as shown in Fig. 1. (The holes should coincide when the squares are placed back to back.) Now cut a narrow strip from a red filter gel, a green filter gel, and a blue filter gel. These gels should be sandwiched between the pieces of cardboard so that the blue filter gel is in the middle and the green and red are on opposite sides.

This slide, when inserted into a 35 mm projector, will produce the three beams of light that are required, namely, red, blue and green.

To enable colour mixing to occur, these beams must be recombined. Have the carpentry shop in your school create three wooden blocks with top surfaces that are inclined slightly to the horizontal. An additional set of three blocks is required measuring roughly 5 cm x 5 cm x 5 cm. Onto each of this second set of blocks glue a plane mirror that is about the same size as the block (i.e. 5 cm x 5 cm). Now arrange the apparatus as shown in Fig. 2, with each mirrored block on top of an inclined block. The blocks are arranged so that each coloured beam from the projector strikes a different block. The mirrored blocks can then be adjusted so that the colours to be recombined will overlap on the screen behind the projector.

Figure 1

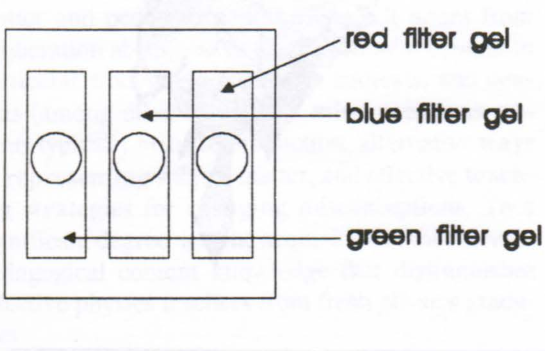
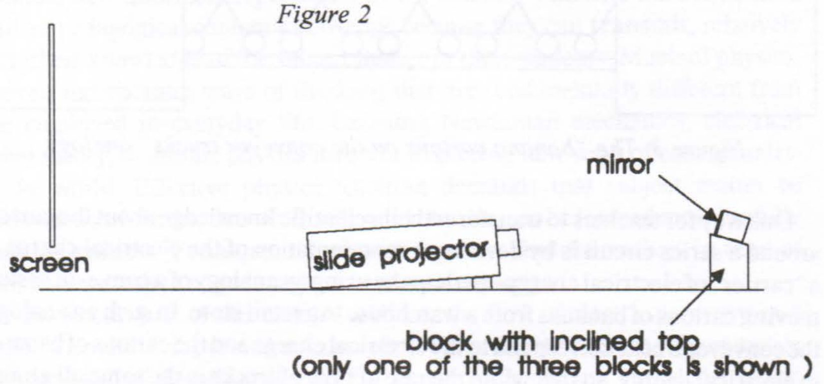


Figure 2



The demonstration works very well. I want to give credit for it to Lorraine Maynard who presented it at the winter meeting in Orlando, Florida, in January of 1992. Lorraine explained that the white resulting from the recombination of the three primary colours is very white because the three colours being recombined all come from the same source and therefore have the correct relative intensity. In many demonstrations where different light sources are used for the three primary colours, the intensity of the sources is not the same, and so the recombined colours do not always live up to expectations.

A second critical factor is to have good quality filter gels in the first place. A good source for these is theatrical supply companies. You may wish to check with your theatre arts teacher. I found an outlet about 2 km away from my school and I am sure that such filters are available in most large towns and small cities. When I tracked down the source, I made an additional discovery. For each of the many filters available, a transmission graph is available. This graph shows percent transmission as a function of wavelength in nanometres. This is a great combination of physics and art, the potential of which I have not yet fully exploited with my classes.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVI, Number 2 **Spring 1994**

REPORT ON AAPT WINTER MEETING, SAN DIEGO CALIFORNIA

by Bill Konrad, Section Representative, OAPT

With its average year round temperature of about 21° C San Diego is a pleasant place to visit at any time. However, with this years' cold January temperatures across virtually all of North America, San Diego was especially inviting as a site for the winter meeting of AAPT, January 3 to 8. The first two days of the conference were devoted to half and full day workshops and the remaining four days to regular conference sessions. A feature of this years' conference that I found particularly attractive was the opportunity to participate in some very interesting field trips. Three possibilities were offered. They were a visit to the Mount Palomar Observatory, home of the 200-inch reflecting telescope; a tour of the $100 million San Diego Supercomputer Center, one of four such centres in the U.S.; and a tour of General Atomics, an international leader in fusion energy research and development. Selecting a particular tour means missing all of the workshops and presentations that have been slated for the conference during that time so I decided to make the Mount Palomar tour and miss the other two. For the remainder of this report I would like to share some of the insights I gained as I joined a bus load of other conference delegates for a behind-the-scenes tour of the Mount Palomar facility.

The observatory is located 5500 ft above sea level. The funding for the construction of the telescope was secured by a $6 million donation from the Rockefellers. This donation was made a year before the depression hit. A great deal of planning and some preliminary construction such as the construction of roads leading to the top of the mountain preceded the actual construction of the telescope. The telescope itself was constructed in the early 1940's and it was formally dedicated in 1948. It is estimated that today such a project would have a price tag of about $100 million. The glass blank from which the 200 inch mirror was ground had a mass of 20 tons. As you may be aware the first blank, poured by Corning Glass in Corning New York, cracked on cooling and may still be viewed in the Corning Glass museum. The second attempt was successful because the blank was cooled more slowly. It was then shipped to California, where the laborious process of grinding away about 5.5 tons of glass to form the parabolic reflecting surface took place. The final adjustments in the parabolic shape were made when the glass was already in place on the telescope. Current astronomers and physicists have great respect for the individuals who designed and built the telescope. We must remember that they carried out all of the required calculations with slide rules and logarithms rather than with calculators and computers. Great care is taken when working near the glass surface. Accidentally dropping something which could chip or crack the surface would constitute a major catastrophe. A third glass mirror blank (for backup) was never poured.

The mirror itself is washed twice a year and resurfaced every three to four years. When it is to be resurfaced the existing reflective aluminum coating is dissolved with a mixture of nitric acid and copper sulphate. A large cylinder is then placed over the

see AAPTon page 3

OAPT Technology Conference

23 June, Thursday, 19:00 to 21:00	Workshops
24 June, Friday, 08:30 to 15:00	Tour of Bell Northern Research, with complementary lunch
24 June, Friday, 15:30	Visit to David Florida Labs (CRC)
24 June , Friday, 18: 00	Supper with Speaker to Follow
24 June, Friday, 21: 00	Reception and Cash Bar
25 June, Saturday, 08:30 to 12:30	Workshops and Lectures
25 June, Saturday, 12:30 to 14:00	Lunch
25 June, Saturday, 14:00 to 16:00	Workshops and Lectures
25 June, Saturday, 16:00	Speaker and Conference Closing

Workshops/Lectures confirmed or to date include

Teaching Electronics; Chaos and Fractals;
Internet, Schoolnet, Freenet and the Information Superhighway;
Using multimedia to teach physics; Physics and Medicine; Particle Physics;
High Tc Superconductor Research; Radon Surveying by High-school students

Major speakers have not yet confirmed, but we will do our best to get the info to you as it accumulates. Thanks for your patience.

Costs

Registration: $80 for members
$90 for non-members
(This includes bus transportation, lunch Friday and Saturday, and supper on Friday night)
Accomodation: $70
(Thursday and Friday night in Carleton University dorms, includes breakfast both mornings)

THE ANNULAR SOLAR ECLIPSE OF MAY 10, 1994

by J.L. Hunt
Department of Physics
University of Guelph

The phenomenon of a solar eclipse is such a rare occurrence in a given geographical location that, when one occurs, it affords an opportunity to science teachers that should not be missed. Unfortunately, there will not be a total solar eclipse whose path of totality falls on North America until Aug. 1, 2008, and that one only in the high arctic. Aug. 24, 2017, will see a beautiful one whose path crosses the central United States, and not until Aug. 23, 2044, will a path of totality traverse central Canada. In the interim, we must be satisfied with partial eclipses and one spectacular annular eclipse.

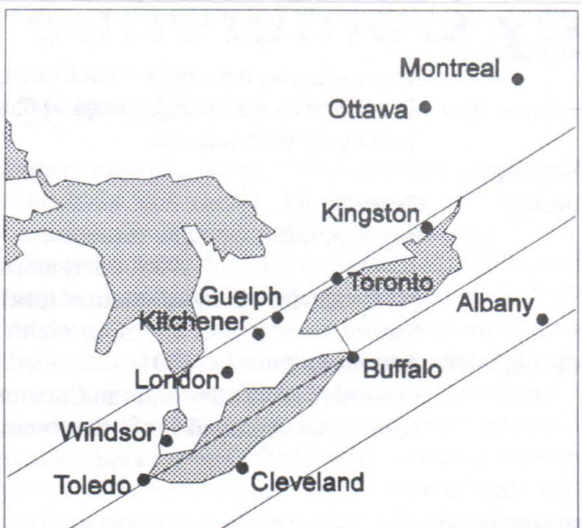
The annular eclipse occurs on May 10 of this year and Southern Ontario is the ideal region from which to witness it. An annular eclipse occurs when the Moon is somewhat further than the average distance away and its apparent size in the sky is slightly less than the apparent size of the Sun. As a result, the Moon cannot, at any time, completely cover the Sun. Instead of a narrow path of totality across the surface of the Earth, there is a narrow path where the Moon will be seen to be completely surrounded by a ring (annulus) of light for a short period.

On May 10, this path originates in the Pacific Ocean at longitude 150° W and enters the continent in California. It crosses the U.S. and enters Canada at Windsor. The path of annularity is shown in the Figure. The northern limit of the path is just to the north of Kitchener, Guelph, Toronto and Kingston. To the north of this line, some portion of the Moon will be seen to pass south of the Sun's lower limb and a complete annulus will not be seen. All of the rest of Ontario will witness a partial eclipse. For those within the path, the coverage of the Sun will be 89%.

At Guelph, the first contact of the Moon will be at 11:40 EDT; centrality will be at 13:22 and final contact at 15:06 EDT. Across Southern Ontario, the times will vary by about 20 minutes with Guelph being about midway.

Observing an eclipse safely is quite possible and relatively easy but must be done properly to avoid damage to the eyes. Without proper filters, direct observation is not advised. Exposed negatives and crossed polaroids are **NOT** safe as they transmit infrared radiation. Indirect (or projection) techniques are the preferred method.

A package of materials about eclipses in general, this eclipse in particular, and suggestions for safe observation and topics for discussion are available free of charge to teachers by writing to the author c/o Dept. of Physics, University of Guelph, GUELPH, ON, N1G 2W1.



PARAMOUNT CANADA'S WONDERLAND

SCIENCE AND PHYSICS DAY FRIDAY MAY 6, 1994

On Friday, May 8, 1994, thousands of students will attend the 5th annual Science and Physics Day at the biggest and most exciting physics laboratory available anywhere. This year's event promises to be the biggest and best ever at Paramount Canada's Wonderland.

The park will be open exclusively for science and physics students. The rides will be operating from 9:30 a.m. to 4:00 p.m.

Physics students may enter a contest in which they will be required to solve three or four Fermi estimation questions showing their solutions in detail. Prizes will be awarded to students as well as schools. There will also be prizes for nonphysics students entering other contests.

Student ticket prices will be approximately $16.00 (pricing to be confirmed). Teachers who bring a minimum number of students will be admitted free.

The student activity workbook and teacher's guideline have been updated. A copy of each will be available free to each participating school.

A free teacher information meeting will be hold for high school teachers at Paramount Canada's Wonderland on Thursday, April 7, 1994, to discuss details of the contest and many other aspects of Science/ Physics Day. Refreshments will be served at 3:45 p.m., and the meeting will begin at 4:00 p.m.

Physics teachers who have not included amusement park physics in their curriculum are urged to try doing so. Students learn to apply numerous physics principles in a real-life situation, some of the many concepts related to experiments on the rides include: displacement, velocity, and acceleration; Newton's laws of motion; Work, energy, and power; the law of conservation of energy; electrical energy and power; free-body diagrams; vectors; centripetal acceleration and force; inertial and non-inertial frames of reference; Fermi (estimation) questions.

Furthermore, students can build vertical and horizontal accelerometers (using commercially available kits) and learn how to use them to perform measurements on and off rides.

Teachers who have not received the information package from Wonderland by April 1 should contact the Group Sales Department at 905-832-7400 (phone), or 905-832-7499 (FAX), or write to:

Paramount Canada's Wonderland
Group Sales Department
P. 0. Box 624, 9580 Jane St.
Vaughn, ON, L6A 1S6

...AAPT (from page 1)

mirror. This cylinder is evacuated to a very high level (about 10^{-6} torr). Located within the cylinder are 360 filaments of aluminum. These are vaporized using electrical current. The aluminum vapour then condenses on the glass surface and the mirror is once again ready to go to work. An interesting bit of folklore surfaced while we were told about the cleaning and resurfacing project. Technicians in charge of this process at observatories throughout the world believed that Wildroot Cream Oil Hair Tonic was especially effective in the cleaning process. A number of years ago the company producing this hair product panicked these technicians by announcing that it was planning to change the formulation of Wildroot Cream Oil Hair Tonic. Astronomy technicians at a number of observatories rushed out and purchased as much of the existing stock of this hair tonic as they could find. To emphasize this point our tour guide leaned over and pulled a full bottle out of the cupboard, a bottle that had been purchased many years ago when extra bottles of hair tonic had been purchased and stored for future use.

The astronomers and technicians currently in charge of the observatory are quick to point out that the telescope has some remarkable design features. For example the 530 ton telescope is so well balanced and lubricated that it can be moved by a 1/12 horse power tracking motor. The three pillars that support the telescope go down to bedrock and are designed to withstand an earthquake. Little did we realize that a test of this hypothesis was only about a week away. The telescope was also designed in a manner that has made the introduction of new technology fairly easy to accomplish. When the telescope first went into operation photographic plates were used to record observations. Today charge coupled devices (TV cameras) carry out this function. The telescope has also been equipped with a Norris spectrograph. This is a large steel plate with 176 tubes. Each tube is equipped with a mirror and fibre optics. Suppose an astronomer wishes to observe a cluster of galaxies. The location of 176 galaxies within this cluster are determined and the information is stored in a computer. On a particular night the computer provides the robot arm on the Norris spectrograph with sufficient information to enable it to position the 176 tubes so that each one is aimed at a different galaxy within the cluster being observed. The spectrum collected by each of these tubes is then conducted by fibre optics cable to a large analyzer somewhere within the observatory. Rather than recording the spectrum a galaxy at a time 176 readings can be taken in a relatively short time.

The 200 inch reflector is one of four telescopes located on the mountain. It has a very narrow field of view. If aimed at a full moon the moon will more than fill the field of view. An 18 inch telescope is devoted to the study of comets and earth crossing asteroids. Within the recent past an asteroid was observed crossing the space between the earth and the moon. Apparently it was only detected as it was leaving. A 48 inch spherical mirror telescope, which has a wide field of view, has been used to conduct the Palomar sky survey. This survey was a painstaking effort carried out in the 1940's to map the entire sky as viewed from Mount Palomar. The results of this survey were distributed to observatories around the world. A repeat of this survey was again started in 1985. Exposures in blue, red, and infrared are to be taken by 1997. When completed a collection of between 3000 to 4000 plates will be available. Better photographic materials and a new corrective lens for the telescope are resulting in better resolution. Also, it can be seen that nearby stars have shifted slightly in their position relative to more distant stars since the last survey was taken. This results of this massive project will again be shared with observatories around the world. The fourth telescope on the mountain is a 60 inch reflector. It is used when possible to free up the 200 inch reflector for more pressing work.

Suppose you are an astronomer and wish to use the 200 in reflector. How do you gain access? You submit your project to a committee. This committee reviews all requests. Requests out number available nights by a factor of 2 or 3. If you are successful you are assigned a specific night or nights for your project. If that night happens to be cloudy (only about 15% are unsuitable for viewing) that's tough! You must go through the whole application procedure again.

One of the main problems faced by the observatory is the increase in population density in the surrounding communities and the increased threat of light pollution. The population has increased by a factor of ten since the telescope was built. Communities are requested to use low pressure sodium vapour lights in their municipal lighting, a request with which most but not all comply.

Although larger telescopes have been built and are under construction there seems to be no shortage of work for the majestic telescope on top of Mount Palomar. As new technology is installed this instrument continues to evolve in its ability to gather data for fundamental research on what is found in the heavens.

E-Mail Us!

I'm on the Electronic Village. Drop me a line through Internet. Your comments, criticisms, observations are welcome.

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or
Send correspondence to:

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c/o Paul Laxon
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St. Thomas, ON
N5R 2B5

work: (519) 631-4460
fax: (519) 633-9014

1994 OAPT Physics Contest

The OAPT contest for grade 12 physics students will be held this year on Tuesday, May 17. The format of the test will be similar to last year with about 30 questions based on the content of the grade 12 physics course, the physical science portions of the grade 9 and 10 science coourses, the history of physics, current events and general knowledge. The test will last one hour and the questions will range from easy to fairly challenging. The answers will be sent out shortly after the test enabling schools to determine local winners at an early date. Prizes will be awarded to provincial winners. The committee members are:

Malcolm Coutts	City Adult Learning Centre, Toronto
Fred Hainsworth	Ryerson Polytechnic University, Toronto (administration)
Dianne Ness	Humberside C.I., Toronto
Pauline Plooard	Fenlon Falls S.S.
Bill Prior	Malvern C.I., Toronto (test paper): 416-393-0765
Peter Spencer	Stephen Leacock C.I., Scarborough
Ron Taylor	Woburn C.I., Scarborough

PENDULUM, CENTRE OF MASS, AND MAGNETIC FORCE

by

John Earnshaw

Trent University
Peterborough, Ontario

A HUGE PENDULUM

When studying the physics of a pendulum, we have used a long (4-m) wire in a lecture room with a high ceiling in two effective ways.

First, using a very heavy iron ball (mass > 10 kg) as the bob, the pendulum is swung right to the edge of the room where the instructor puts the ball next to his/her nose while resting his/her head against the wall. (This is a real test of your confidence in the laws of physics!) If the bob is released WITHOUT ANY PUSH, it returns exactly to the starting point, neither crushing the instructor's nose, nor falling short. Students are asked to time the period using their own watches (there's always someone with a stopwatch who is proud to show it off), and then determine either the acceleration of gravity or the length of the pendulum. The period is sufficiently long for quite accurate values of "g" to be obtained from 10 oscillations.

Second, the bob is replaced with a short length of pipe on which the instructor sits. IT IS IMPORTANT TO BE SURE THAT THE ANCHOR SUPPORTING THE PENDULUM IS SUFFICIENTLY STRONG TO DO THIS. The instructor is left swinging long enough in front of the class for the period to be measured. Since your centre of mass is close to your buttocks, the period is almost identical to the one obtained before, in spite of the fact that the mass is much greater. Class discussions can expand to cover air resistance; it leads to the instructor's amplitude getting smaller, but not to a significantly different period of oscillation. This demonstration always leads to an interesting discussion of simple physics, and will be long remembered by students.

CENTRE OF MASS

Where is the centre of mass of a person? Most of us know that it is between the knees and the shoulders, but where? To determine this, and to do a class experiment using simple lever principles, we use a standard 2" × 12" piece of lumber, balanced over a simple fulcrum (a short piece of angle iron with its right angle up) at its centre. A student (whose mass is known) is asked to lie down on the previously balanced "plank" which is set in front of the class on the work bench, while other students locate a known mass (cement block, brick, etc.) along the other end of the plank to re-establish the balanced condition. Appropriate distances are recorded on the chalk-board. The class is then asked to draw a force diagram, to determine the location of the student's centre of mass on the plank, and then to determine the location of his/her centre of mass relative to the student's feet, and as a percentage of the student's height. If you use a 10'-long plank, part of the student's body will be "across the other side of the fulcrum." Good discussion will take place if you ask if this has been omitted (or even subtracted) in the experiment. Also, why can the mass of the plank be ignored? I am told that the results of this experiment taken from large samples of students show conclusively that the centre of gravity of females is significantly lower in the body than for males, when the results are presented as a percentage of overall height.

MAGNETIC FORCE

The influence of a magnetic field on a beam of electrons can easily be seen by bringing a magnet up to the screen of a black and white TV picture tube, a monochrome computer monitor, or an oscilloscope screen. (DO NOT DO THIS WITH A COLOUR TV or a COLOUR COMPUTER MONITOR; it will damage the screen.) A horseshoe magnet has the strongest lateral field (perpendicular to the beam), and produces a deflection according to the appropriate right or left hand rule. A bar magnet, while weaker, will show some evidence of rotation of a recognisable image on the screen, and this rotation depends on the direction of the magnet.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVI, Number 4 **Summer 1994**

MORE FROM SAN DIEGO

by Bill Konrad, Section Representative, OAPT

In the last newsletter I reported on the winter meeting of AAPT in San Diego, California. The whole article was devoted to the Mount Palomar Observatory. The visit to the mountain top was one of the highlights of the conference for me. In this issue I would like to report on one of the other conference sessions and share some ideas with you that you might find useful for your own classroom. The session was entitled, "Quick and Dirty Demonstrations". Many of the demonstrations were "quick" but I do not believe that any of them were "dirty". In most cases, however, they could be conducted using commonly found materials. A number of individuals contributed to this session and it was thoroughly enjoyed by all that were present. In the notes that I made during the session I placed more effort on getting the details of the presentation than on the names of the presenters. In addition to presentations from individuals significant comments that added to the demonstrations were also made by members of the audience. Below are some of the ideas that made an impression on me and may be of use to you.

Levitation and Bernoulli:

You may be aware that you can levitate a ping pong ball if it is placed in the exhaust stream from a hose connected to the output of a vacuum cleaner but did you realize that with a little practice you can also levitate a light bulb. With even more practice you can levitate three ping pong balls in one stream. The balls must be carefully placed one above the other and the stream must be vertical. Plastic 2 L pop bottles can also be supported in such a stream. Further it was suggested that by placing a plastic U tube through the such a pop bottle and filling it with coloured liquid the pressure difference between the inside and the outside (when the bottle is in the air stream) can be seen.

If you really want to get into this demonstration you may want to use a light dimmer switch to regulate the speed at which the vacuum cleaner motor runs so that you can regulate the output of air.

More on Bernoulli:

This demonstration requires a paper wind tube (a paper wind sock that is about 15 cm in diameter and about 2.5 metres long). This tube is available from Steve Spangler, c/o KCNC-TV, 1044 Lincoln St. Denver, CO 80203, 303-830-6347.

Ask a student to inflate the wind tube with his/her breath. After letting the student add 20 or 30 breaths take the tube away from the student and tell him/her that you will fill it with just one breath.

Instead of holding the tube tightly against your mouth as the student did hold the end open end near your mouth and actually use your hands to keep the end completely open. Ask the student to hold the other end of the wind tube so that the wind tube is extended and is parallel to the floor. Now take a deep breath and blow as hard as you can into the wind tube. You will see the entire wind tube fill with air. Think about it! The low pressure created by your moving breath causes the air into the room to rush into the wind tube and fill it. A simple but very impressive demonstration!

If you can not order the wind tube, make your own using tissue paper.

Cheap Magedeburg Hemispheres:

Glue an empty spool from a roll of thread over one of those long playing LP's which you do not use any more. The hole in the spool should line up with the hole in the record. Now place the record on a smooth

see AAPT on page 2

SUMMER READING LIST

If you're for some interesting and informative books to read this summer try one or two of the following:

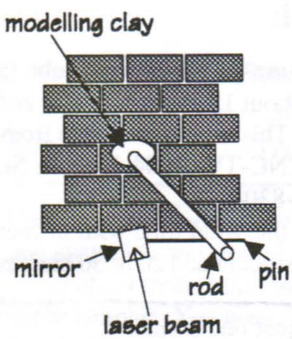
- "Surely You're Joking Mr. Feynman," by Richard P. Feynman (transcribed by Ralph Leighton):A collection of adventures about a 'curious character'.
- "What Do You Care What Other People Think?" by Richard P. Feynman: More tales from Feynman.
- "Genius," James Gleick: A biography of Richard Feynman.
- "Albert Einstein," by Ronald Clark: A biography of Albert Einstein.
- "The Sacred Beetle and Other Great Essays in Science," edited by Martin Gardner: Includes essays by such scientists as Charles Darwin, Carl Sagan, J. Robert Oppenheimer and Albert Einstein.
- "Chaos," by James Gleick: A history and overview of this new area of science.
- "The Tao of Physics," by Fritjof Capra: An exploration of the parallels between modern physics and Eastern mysticism.
- "Einstein's Universe," by Nigel Calder: A simple description of Einstein's Theory of Relativity.
- "A Brief History of Time," by Stephen Hawking: A look at black holes and the origin of the universe.
- "The Cosmic Code," by Heinz Pagel: A history and overview of relativity and quantum physics.
- "Perfect Symmetry," by Heinz Pagel: A history of modern astronomy and astrophysics and theories about the origin of the universe.
- "Gödel, Escher and Bach an Eternal Golden Braid," by Douglas R. Hofstadter: A study in logic, art, music, genetics, strange loops and how they relate to the development of artificial intelligence.
- "The Emperor's New Mind," by Roger Penrose: A look at modern physics and the possibility of developing artificial intelligence.

If you have any other titles that you think other physics teachers and students would be interested in, give me a shout (the address is on page 3) and I'll compile them into a list (include a very short description of what the book is about).

...AAPT (from page 1)

flat object. When you cover the hole in the spool with your finger there will be a fairly effective seal between the object and the record permitting you to pick up the object. Take your finger off the spool, air enters, and the object is dropped.

Immovable (?) Walls



Set up the apparatus shown at the left. Any slight movement of the wall will be amplified by the system and the spot formed by the light reflected from the mirror onto the ceiling or another wall will move when someone leans or pushes on the rigid wall.

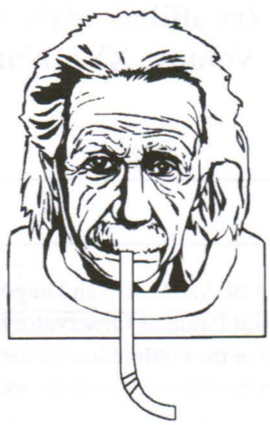
A Shocking Demonstration:

This demonstration requires a Tesla coil. A properly adjusted Tesla coil produces a vicious looking spark when held near a ground such as a water tap. Did you realize that the output of this coil is not dangerous to you. This is because of its high frequency. If you want to impress your students first have the Tesla coil throw an impressive spark at a water tap. Now take the coil and grab the metal end quickly with your bare hand. You will only experience a small shock. Now if you touch a fluorescent tube with the other hand the tube will light up. With a little bit of leg work you may be able to find a fluorescent tube from an old photo copier that gives off green light.

Where is that image?

Students often have difficulty believing that the image they see in the mirror is behind the mirror. Because of the ability of their young eyes to accommodate very quickly to different image distances they sometimes fail to realize that the images they are seeing are located in very precise positions. You can help them realize that images are in very precise locations by having them look at the images through a single lens reflex camera. The teacher advocating this demonstration suggested going to a camera store and asking the owner to donate cameras of this type that were no longer of any value for taking pictures because of a variety of failures but that still had optics that worked. If for example a student writes the word physics on a gummed label and pastes it to the surface of a plane mirror and then looks into the mirror through such a camera he/she will find that either their image or the label are in focus but that it is impossible for both to be in focus at the same time. This technique can be used with curved mirrors and lenses and can even be used to determine the apparent depth of something in an aquarium.

An Action-Reaction Brain Twizzler



Have a student place a flexible straw in his/her mouth. Have them blow through the straw as it hangs loosely from their lips and ask them to explain their observations. Most will not have too much difficulty in explaining that as the air is forced from the straw the straw pushed on the air in one direction and the air in turn pushes on the straw in the opposite direction.

Now ask them to predict what will happen when they suck on the straw. How do you explain the result?

The water hammer - A dramatic inertia demonstration

This demonstration was conducted with a long necked beer bottle filled to within 2 cm of the top with water. The demonstrator then held the bottle with one hand and rapidly jammed down on the open neck with the palm of the other hand. The result was that the bottom of the bottle broke.

The hand forced the bottle down quickly. The inertia of the water caused it to remain behind. This however created a vacuum between the bottom of the water and the bottle. This vacuum pulled the water down quickly. The inertia of the water now broke the bottom of the bottle.

There were some in the audience who felt that the demonstrator risked hurting his hand. It was suggested that a rubber mallet be used instead of the hand.

Moments to Remember

Find an old broom and find the point at which it balances. Now carefully cut the broom at this point and then by drilling a hole in one side and placing a pin in the other put the broom back together. Have students respond to the following riddle. Assume that this broom is made of gold and that two people each want an equal share of the gold. Could we divide it like this: Balance the broom, pull it apart at the balance point and give one half to each of two students. A quick mass determination will of course reveal that the two halves are not equal in mass.

Eye Defects and Glasses

This is an idea that does not originate at AAPT in San Diego but one that just came to me recently. Students are usually amazed that I can tell them what eye defect their glasses are correcting sim-

see AAPT on page 3

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 93**, your membership has already expired. You may use the coupon below (or a reasonable facsimile) to renew it.

Membership Application Renewal

Name ______________________

Address ______________________

____

$8.00 per year, payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1

...AAPT (from page 2)

ply by looking through the glasses as I hold them at arms length. I hesitate to take one students glasses and then have the whole class take turns looking through them as they are passed around the room. I am now in the process of collecting old, used, lost, etc. glasses from optometrists so that I can make this a quick exercise for them without embarrassing anyone and without running the risk of damaging someone's glasses. The diverging lenses used to correct myopia will cause a distant object such as a clock across the room appear smaller when viewed through these glasses as they are held at arms length. The smaller the image the greater the correction required. The converging lenses used to correct hypermetropia also give predictable results. Of most interest are the lenses used to correct astigmatism. If you look at a distant object when you hold these at arms length a distorted image is seen.

This exercise also quickly shows that in most cases the prescription for the left eye is different from the prescription for the right eye.

E-Mail Us!

Some days I feel like the Maytag Repairman.

Drop me a line through the mail, fax, or Internet. Your comments, criticisms, observations are welcome.

Send correspondence to:

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St. Thomas, ON
N5R 2B5

work: (519) 631-4460
fax: (519) 633-9014
e-mail: paullaxo@vef.north.net

1994 CAP CONGRESS

UNIVERSITY OF REGINA, June 26-29,1994

Name: ____________________

Institution: ____________________

Address: ____________________

Telephone: ____________________ Fax: ________

Name of Companion: ____________________

I/we plan to stay: ( ) in residence ( ) at the____________ Hotel.

Information to appear on name tag:

Name: ____________ Institution: ________

EVENTS INCLUDED IN THE REGISTRATION FEE. Please check box if applicable:

( ) I will attend the ( ) Plasma Physics / ( ) Condensed Matter Physics Symposium on Sunday, June 26

( ) I will attend the Welcome Reception on Sunday evening, June 26 (refreshments will be served)

REGISTRATION FEE (all prices include GST):

		Amount
( ) CAP/APS members and invited Speakers	260.00	____
( ) Non-Members	330.00	____
( ) Student Members	75.00	____
( ) Non-Member Students	90.00	____
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THE DEMONSTRATION CORNER

Flipping for Physics

by

John Wylie

The Toronto French School
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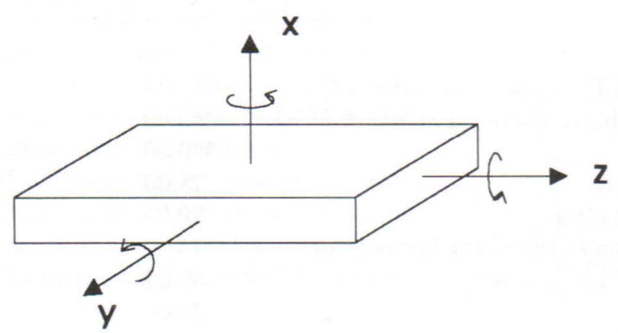
Toronto, ON M4N 1T7

Here is a good demonstration that can be used in its simplest form to show stable and unstable equilibria or, in a more advanced version, to illustrate some finer points about moments of inertia and angular motion. The material needed could not be simpler. You need a board. There are no special requirements here except that the board be rectangular and have three distinctly different dimensions. In a pinch, I have used a good-sized physics text book held closed by a strong elastic. Most brief cases work and if students feel lucky, they can try out their calculators.

The demonstration starts out by showing that a rectangular object has three principal axes (label them x, y, and z) about which it can rotate.



If you are teaching moments of inertia, you might have the students classify these axes by increasing moments. For our purposes, we note that $I_x > I_y > I_z$. Now toss the board up into the air giving it a good spin about the x-axis and have the students note its nice stable rotation. You will have to practice this a bit to give the board enough spin and hang-time for the stability to be evident to the whole class. Do the same for the z-axis and then pick a volunteer from the class and challenge him or her to repeat the trick for the y-axis. A rotation about this axis is unstable and will quickly decompose into a combination of rotations about the other two.

Students are always curious about unstable systems. At the very least, it is worth getting across the concept that an unstable equilibrium will (due to the slightest perturbation from anywhere in the universe) degenerate. Let them try the y-axis spin until they have satisfied themselves of this. The explanation of the effect follows and uses concepts from angular momentum and energy, both of which must be conserved while the object is spinning freely in the air. Conserving energy is the easiest and gives us

$$\frac{1}{2}I_y\omega_0^2 = \frac{1}{2}I_x\omega_x^2 + \frac{1}{2}I_y\omega_y^2 + \frac{1}{2}I_z\omega_z^2.$$

We assume here that the board was given an initial spin about the y-axis with initial angular speed ω_0. We look for a final situation in which the board may be simultaneously spinning about any and all of its principal axes. Since angular momentum is a vector, it is a bit pesky to write its conservation equation directly. It is much easier to write the equation corresponding to the conservation of the square of the angular momentum. This gives

$$I_y^2\omega_0^2 = I_x^2\omega_x^2 + I_y^2\omega_y^2 + I_z^2\omega_z^2.$$

If we multiply the energy equation on both sides by I_y and combine it with the angular momentum equation to eliminate $I_y^2\omega_0^2$, we can arrive at

$$(I_x^2 - I_x I_y)\omega_x^2 = (I_y I_z - I_z^2)\omega_z^2.$$

Since $I_x > I_y > I_z$, both sides are positive and a solution exists for ω_x and ω_z. If we repeat the above calculation to ask for the case where the initial spin was about, say, the x-axis, we find

$$(I_y^2 - I_x I_y)\omega_y^2 = (I_x I_z - I_z^2)\omega_z^2.$$

In this case, the left side must be negative but the right side is positive. The only solution is $\omega_y = \omega_z = 0$. One would find the same thing for an initial spin about the z-axis.

The above analysis does not require that we be studying a rectangular board. Generally, objects spinning about axes corresponding to their greatest and least moments of inertia will be stable whereas a spin about its third axis will be unstable. Objects with enough symmetry to give identical moments of inertia for one or more of their axes do not have any unstable spins. Cubes, cylinders and spheres fall into this category. Imagine the problems if a high-speed flywheel had an unstable rotation about one axis. Satellites are also manufactured to avoid these problems.

On the other hand, some objects are made specifically so that when spun, a complex tumble will result. I have seen at least one amusement park ride incorporate this concept: the one where a rider straps into a seat mounted within two gyroscope-like gimbals. The operator gives the rider an initial spin and physics takes over (with usually a little biology mixed in for good measure).

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVII, Number 1 **Fall 1994**

OAPT in Ottawa

by Paul Laxon

The OAPT conference has always been the highlight of my year as far as professional development is concerned, and this year's Technology and Physics conference at Carleton University in Ottawa was no exception. I dare anyone to point out a conference that gives you a 2.5 days worth of workshops, tours and presentations with 2 nights accomodations and all your meals included for $160 (Canadian). Only with the OAPT.

The sessions started out Thursday evening with hands-on workshops. I attended the "Teaching Electronics in High School Physics" by John Wiley and, after trying out the experiments, ended up with a package of instructions and a parts list to use in the classroom.

Friday morning and early afternoon was a tour of Bell Northern Research. Our hosts were very organized and accomodating, offering several tour packages that included computer modelling, stereolithography, the fabrication of integrated circuits, fibre-optics, etc. And, almost as important, BNR served a wonderful lasagna and pasta lunch.

After a tour of Carleton's Science Technology Centre. Everyone rested up for another wonderful meal (did you get enough shrimp Al?), a thoughtful presentation by Dr. Chong Chan, Associate Dean of Engineering at Carleton, and a wildly entertaining don't-do-this-at-home-kids Cryogenic Cabaret by Dr. Marcel Leblanc (entertaining enough to induce a seizure in every health and safety officer within 5 km).

Saturday morning's festivities began with a graphic slideshow presentation by a sargent from the RCMP on murder scene analysis of blood spattering, followed by Dr. Fred Carter's talk on computer software he developed to help in this analysis.

Thanks and congratulations to Greg Marshall and his assistant Diana Hall for planning and running the conference. It was a great success. *(More details on the sessions in the next issue)*

OAPT Conference 1995

University of Guelph
June 22 - 24, 1995

Help us celebrate
100 years of Physics teaching
on the Guelph campus

For more information please contact:
Ernie McFarland, Dept. of Physics, U. of Guelph
Telephone: (519) 824-4120, ext.3653
Fax: (519) 836-9967

An Historical Perspective on Science

I know it's a little late into the year to be contemplating what you did this summer, but I hope you had a little time to do some reading. In the last issue I printed a list of books that I have read, or that I was in the middle of reading, and I wanted to mention a couple that I finished as a lead-in to next June's OAPT conference (I know it's a little early to be contemplating next summer) which will be held at the university of Guelph.

The theme for the conference is "100 Years of Physics Teaching at Guelph" in honour of the university's one-hundredth anniversary, and I think that the historical perspective on physics is an important one in helping to understand the development of physics, especially in looking at the dividing line of classical and modern physics which has occured in the 20th century and which has lead us into the fast-changing technological developments of today.

This summer I finished reading Ronald Clark's "Einstein: The life and times" and James Gleick's "Genius: The life and science of Richard Feynman." Both books look not only at the personal lives of two great scientists, but also at some of the details of the physics they helped develop, and at the relationships between them and the other physicists of their time.

Having a historical context which you can use to introduce a topic is tremendously helpful: Einstein and Bohr's arguments about complementarity and the use of statistical probability; Millikan's hundreds of thousands of experimental data of which he threw out thousands; Galileo's use of the telescope to make money from Venice merchants; Newton's dislike of Hooke. These relationship's between scientists and the stories about their lives can add a little flavour as well as a better understanding of the topic.

Even today there is a great interest in the influences on a scientist's life and work, as is attested to by the title of one of the latest *Physics Today* articles: "Of Love, Physics and Other Passions:The Letters of Albert and Mileva."

PHYSICS DEMOS

compiled by Pat Cannan
Physics Institute
Woodrow Wilson National Fellowship Foundation
Box 642
Princeton, NJ 08542

(I found a large list of demos on CompuServe's Science forum, these are just a few of them—Ed.)

Banana Drop

When introducing acceleration of gravity, discuss it in terms of a falling banana (or rutabaga, or whatever). Demonstrate the fall and then compare to a heavy banana (filled with lead shot and rubber latex or aquarium sealant). Drop both bananas at once by quickly pulling a book out from under them.

Conclusion: All bananas accelerate at the same rate. This can then be quoted for the rest of the year to remind students of the demonstration.

And/or another variation

Galileo's home country—Italy. National fruit of Italy—Grapes. So all grapes fall at the same rate whether dropped individually or in a bunch. Show it. Bunching them makes no difference! Each atom accelerates at g regardless of its companions.

Centripetal hang-ups

Bend a coat hanger and its hook so that a penny will balance on the upturned hook. Hold the hanger by your index finger and swing it in a circle. The penny will (with practice) remain in place.

Swingin' big scare

Suspend a small (25cm diam) board from three strings so it can be vertically swung around. Place objects on the board and scare everyone! Practice this before trying beakers of water etc.

TP Rip-off

Single-ply toilet paper takes a force of about 10 newtons to separate. A rapid linear acceleration of the paper takes advantage of the rotational inertia of the roll to help stretch and tear the paper. The build-up to the breaking point must occur quickly so that angular velocity of the roll is kept small and paper is not dumped onto the floor. As the roll is used up, the moment of inertia decreases making it increasingly difficult to get paper off with one hand.

Place a new roll of TP and an almost empty roll on a bar held by two students. Give the new roll a yank, and the paper should tear nicely. Give the small roll a yank, and it should unravel onto the floor.

Discuss the moment of inertia. The new roll approximates a disk, the old roll a hoop.

Sound Thinking

With a small transistor radio blaring away, enclose it in a cage of wire mesh. The Faraday cage will shield the radio from any electric fields and hence will shield it from radio waves. (The electric waves of light enter and leave the cage because their wavelengths are much smaller than the mesh size.)

New Astronomy materials in ASP Catalog

The nonprofit Astronomical Society of the Pacific has recently published a new catalog that includes materials for teaching and exploring astronomy. To obtain a free copy of the new catalog, send your name and address to: Catalog Requests Department, ASP, 390 Ashton Ave., San Francisco, CA 94112 or call 415-337-1100.

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 94**, your membership has already expired. You may use the coupon below (or a reasonable facsimile) to renew it.

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E-Mail Us!

Drop me a line through the mail, fax, or Internet (sorry about the sudden change in address, I didn't realize it had happened until the end of the summer). Your comments, criticisms, observations are welcome.

Send correspondence to:

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e-mail: paullaxo@village.ca

We Get Mail!

I enjoy receiving the OAPT newsletter and I saw your request for comments in the Summer issue.

The action-reaction brain twister is a variation of the "inverse sprinkler" problem—one that Feynman worked on. There have been articles and notes about this in the American Journal of Physics.

Al Bartlett
University of Colorado

There is also an interesting account of how Feynman tested his solution in Gleick's book *Genius*.—Ed.

Canadian Shares Nobel for Development of Neutron Scattering Techniques

Canada's second Nobel prize in physics was shared by Bertram Brockhouse of McMaster University for neutron spectroscopy, and Clifford Shull of MIT for neutron diffraction. The prize was based on work they did nearly 50 years ago. Since then neutron scattering has become indispensable in the study of light-atom crystallography, atomic motion in solids, and magnetic materials.

Archimedes

Archimedes, b. c.298 BC, d. 212 BC, was the greatest mathematician of ancient times. A native of Syracuse, Sicily, he was killed during its capture by the Romans in the Second Punic War. Stories from Plutarch, Livy, and Polybius describe machines including the CATAPULT, the compound pulley, and a burning-mirror invented by Archimedes for the defense of Syracuse.

He spent some time in Egypt, where he invented a device now known as ARCHIMEDES' SCREW. Archimedes made many original contributions to geometry in his work on the areas of plane figures and the areas and volumes of curved surfaces. His methods anticipated INTEGRAL CALCULUS 2,000 years before it was "invented" by Newton and Leibniz. Archimedes proved that the volume of a sphere is two-thirds the volume of a circumscribed cylinder. Evidently he considered this one of his most significant accomplishments, since he requested that a representation of a cylinder circumscribing a sphere be inscribed on his tomb.

He was also known for his approximation of pi (between the values 310/71 and 31/7) obtained by circumscribing and inscribing a circle with regular polygons having 96 sides. In theoretical mechanics, Archimedes is responsible for fundamental theorems concerning the centers of gravity of plane figures and solids, and he is famous for his theorem on the weight of a body immersed in a liquid, called ARCHIMEDES' PRINCIPLE. A famous story, unfortunately with no foundation, relates that having discovered this while in the bath, he ran naked through the streets crying, "Eureka," or "I have found it."

Archimedes' treatises are remarkable for their original ideas, rigorous demonstrations, and excellent computational technique. His surviving works include *On the Sphere and Cylinder, Measurement of a Circle, On Conoids and Spheroids, On Spirals, On Plane Equilibriums, The Sand Reckoner, Quadrature of the Parabola, On Floating Bodies*, and *Stomachion* (fragment only).

Bibliography: Dijksterhuis, E. J., *Archimedes* (1987).

REFLECTIONS[3]

by

George Vanderkuur

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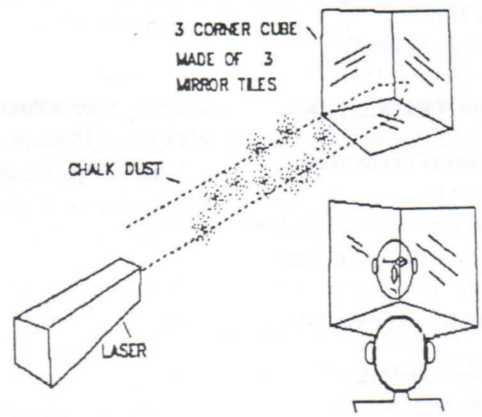
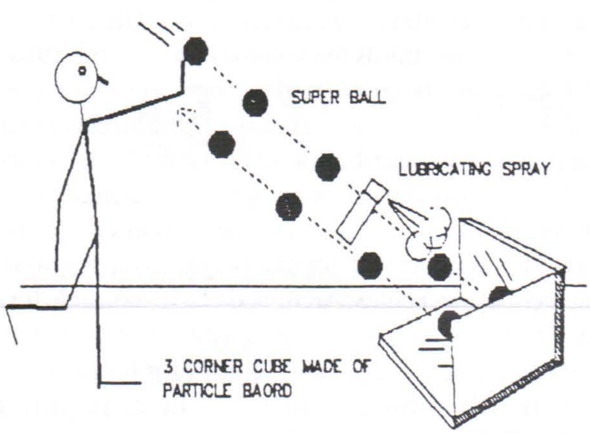
A laser, chalk dust and right-angle corner made of mirror tiles show the retro-reflection of light from a corner cube mirror. (Safety note: use a low-power laser beam and take care to avoid directing the beam into the audience.) Students will also enjoy looking into the mirror and observing that the image of their face (or open eye) is always in the corner. Try this with one eye closed.



An array of corner cube "mirrors" (actually they were solid glass cubes) was left on the moon to retro-reflect a pulsed laser beam, making possible very accurate measurements of the earth-moon distance.



The retro-reflecting property of a corner cube can also be demonstrated MECHANICALLY with a "super ball" or similar ball with a high coefficient of restitution. For this you need an unobstructed corner of a room or a corner constructed from formica or smooth particle board. Because of friction and spin, a ball thrown at this corner will normally not return on a parallel path. To remove the effect of spin and friction, the corner needs to be made very slippery. Soap solutions or silicone sprays work well on painted or formica covered surfaces. The best results are obtained when the corner is loosely lined with polyethylene film which has been sprayed with soapy water or WD-40.

The demonstration works even better out-of-doors where you can throw the ball faster and at a greater distance. Have your students try this and watch out -- the ball bounces straight back. (Please use common sense and caution here.) With a little practice, you can nonchalantly throw the ball and have it return directly to your throwing hand. Throwing two or three balls at once adds to the excitement and "risk".

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

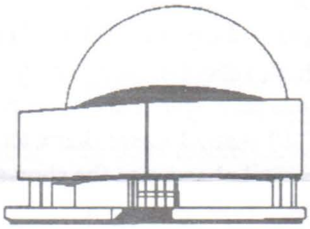
ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVII, Number 2 **Winter 1995**

McLaughlin Offers New Programs

Ian G. McGregor, Educator, McLaughlin



Background

Since the McLaughlin Planetarium opened in 1968, a variety of programs have been available for high school students. For many years we had two school shows which were simply titled the "Physics" show and the "Geography" show. The "Physics" show worked in support of the PSSC/Harvard Physics and various "Space and Man" courses being offered in Ontario schools and had a strong focus on planetary motions. The "Geography" show supported the Grade 11 physical geography programmes. The shows were presented live in the 340 seat 23 metre diameter Theatre of the Stars and basically were a 60 minute illustrated presentation making use of the special abilities of our giant star projector as well as up to 100 other projectors.

Over the years changes took place in the school curriculum in Ontario as well as the profile of the students visiting the Planetarium. A new show titled "The Cosmic Question" designed for intermediate level students used the search for life in the universe as a means to introduce a broad number of topics including the earth as a planet., a tour of the solar system, the search for planets orbiting other stars as well as ideas about travel between the

McLaughlin continued on page 2

1995 OAPT Physics Contest

The OAPT contest for grade 12 physics students will be held this year on Tuesday, May 16 in the morning. To assist students and teachers who would like to prepare for it, a list of the content on which most of the questions will be based has been prepared and circulated. The test will be similar to last year with 30 questions to be done in one hour, but it should be a bit easier. If you would like to buy some copies of old papers, or have questions about administrative details, contact Fred Hainsworth, OAPT Contest, 350 Victoria St. Toronto, M5B 2K3 or fax a message to him at (416) 979-5064. If you have any questions about the exam, the content, or if you would like to contribute questions, please write Bill Prior at Malvern C.I., 55 Malvern Ave, Toronto, M4E 3E4; phone him at (416) 393-0765; or fax him at (416) 393-1493. The committee consisting of Bill Prior, Malcolm Coutts, Dianne Ness, Pauline Plooard and Peter Spencer will meet in the middle of January to start selecting the questions. Fred Hainsworth will send out a mailing early in March to all schools with information about registration.

1995 OAPT CONFERENCE UPDATE

Plans are well underway for the 1995 OAPT Conference, to be held June 22-24 at the University of Guelph.

Thursday evening (June 22) will feature a choice of four workshops: Chaos & Fractals, Teaching Electronics in High Schools, Making Holograms, and Using the Internet. A social get-together will follow the workshops.

Invited and contributed papers will be presented on Friday and Saturday. Invited speakers have been contacted and we even have some contributed papers already promised. Topics so far include: Using CD-ROMs in Teaching Physics, Update on the Sudbury Neutrino Observatory (SNO), Weather Research, Wind Tunnels and Urban Design, Teaching Large Introductory University Physics Classes, Physics Day at Canada's Wonderland,, and The Electric Hotdog & the Electric Pickle (see the "Demonstration Corner" in this Newsletter) . As always, Friday night will be highlighted by the banquet, followed this year by an entertaining presentation, "100 Years of Physics Teaching on the Guelph Campus," given by Jim Hunt of the University of Guelph's Physics Department.

A "Call for Papers" is being mailed with this Newsletter. If you have a useful physics-teaching technique, demonstration, or other tidbit that you could share with other teachers at the conference, please complete the information requested on the "Call for Papers" sheet and return it by March 31, 1995.

Registration costs have not yet been finalized, but it is expected that the registration fee will be about $100. This would include all sessions, two lunches, and the banquet. Bed and breakfast on campus will cost about $45 per night (more in local motels).

Detailed conference information will be mailed out with the April Newsletter. Any enquiries about the conference should be directed to Ernie McFarland, Dept. of Physics, University of Guelph, Ontario, NIG 2Wl. (Phone: (519) 824-4120, ext. 3653; Fax: (519) 836-9967; E-mail: elm@physics.uoguelph.ca)

PHYSICS DEMOS

compiled by Pat Cannan
Physics Institute
Woodrow Wilson
National Fellowship Foundation
Box 642
Princeton, NJ 08542

(a continuation of demos found on CompuServe's Science forum; these are just a few of them—Ed.)

When Chocolate Chip Speaks, Students Listen

Take about 50 turns of fine, insulated wire and tape to the back of an ice cream carton (or whatever), leaving the two leads of the wire to be attached to the output of an amplifier. Bring a large magnet up to the back of the voice coil when the amplifier is signaling appropriate music.

You may construct the speaker in class, discussing it in abstract terms so students are taken by surprise.

Running Interference

Concentric ring patterns may be purchased from drafting suppliers for about $3 per sheet. Make different wave lengths by enlarging or reducing the pattern. With these made into overheads, you may demonstrate (1) 2-slit interference, (2) the effect of changing slit spacing or wavelength (3) n-slit interference (4) diffraction grating (5) effect of telescope aperture and incident wavelength on resolving power.

Back to Normalcy

Clamp a weight to a kitchen scale and tilt it to show normal force variance with angle. In general, you will find a kitchen scale to be a frequently used piece of apparatus for all sorts of phenomena. They are available with metric readouts.

Bubble Dome

Make a soap solution as follows: 70 mL of Joy, 200 mL glycerin, 230 mL water. Roll a cone from a piece of paper and blow a large bubble onto a glass plate on an overhead projector. Ignore projection on screen and look at beautiful, iridescent interference on the bubble itself. With the right mixture of bubble soap the bubble should get thin enough to become totally transparent to reflected light, just before it breaks.

. . . **McLaughlin**, from page 1

stars, UFOs, and communication across the great depths of space. Then, four years ago, the Planetarium introduced another new school show titled "Discover the Universe" for all levels of high school students which discussed the process and methods of the human discovery of the universe from ancient times to the present. A major part of the show is observationally oriented with demonstrations of the phases of the Moon and the motions of the planets as well as modern observations with the Hubble Space Telescope.

Sky Observing Workshops

This school year the McLaughlin Planetarium is introducing a new program for high school students titled "Sky Observing Workshops". Unlike our regular high school shows, which feature a live 60 minute presentation in the 340 seat 23 metre diameter Theatre of the Stars in which the students listen and observe as the shows are presented, the Workshops are participatory-oriented programs in which the teachers have direct input in choosing the actual content of the activities which will be conducted in the Theatre.

The Workshops are conducted for a maximum of 80 students. Teachers can choose from 11 different activity modules which last from 20 minutes to 60 minutes and feature the students observing, estimating, mapping, and/or recording events in the Theatre using worksheets and red reading lights. Topics can range from reading star maps to discover the night sky to demonstrations of the retrograde motion of Mars, the seasonal motions of the sun and moon, the precession of the equinoxes, and the discovery of the zodiac. As well, classroom sessions at the Planetarium choosing from at least eight classroom modules can form a part of the Workshop which when combined with a program in the Planetarium's display gallery can add up to a 2-1/2 hour intensive workshop in astronomy. The cost for a Workshop is $5.00 per person.

To the end of November six workshops had been conducted for six different schools. The students came from a variety of backgrounds. Four of the Workshops were for grade 10 science students while one was for grade 11 geography students and one was for grade 10-12 Latin students. The response has been very positive from the teachers involved as the Planetarium is an unique laboratory environment.

Teachers interested in setting up a Workshop for their students can write. phone or fax the Planetarium and a brochure describing in detail the Workshops can be sent out by the Planetarium Box Office. The actual scheduling, coordination, and dialogue between teacher and Planetarium on the content of a specific Workshop is handled by myself. To obtain a brochure you can write to:

McLaughlin Planetarium
School Bookings
100 Queens Park
Toronto, Ontario M5S 2C6

Or phone (416) 586-5736 and ask for School Bookings. The Planetarium's fax number is (416) 586-5887. Apart from our current eleven Theatre modules and eight classroom modules I would be interested in hearing of ideas for other modules ranging in length from 20 minutes to 60 minutes.

Clear skies!

We get more letters!

Your article entitled "Eye Defects and Glasses" reminded me of two other ways of determining whether a person is hyperopic or myopic, which may be of interest for your readers. You can tell if a person is near-sighted or far-sighted by comparing the brightness of the skin behind the glasses with the brightness of the person's cheek. The skin behind a hyperopic person's glasses appears to be brighter than the person's cheek skin. The skin behind a myopic person's glasses appears to be dimmer than the person's cheek skin. The effects are due to the converging lens that is used to compensate for hyperopia and the diverging lens that is used to compensate for myopia. The converving lens that is used for a hyperopic person converge the light that is reflected from the person's skin behind the lens to the observer. The converged light has a higher intensity. Similarly a diverging lens that is used to compensate for myopia causes the light that is reflected from behind the glasses is diverged therefore has less intensity. The other technique is the use of laser light speckle. Speckle is the grainy appearance of coherent light that is reflected from solid surfaces. It is readily observed by expanding a laser beam with a simple lens and reflecting it off of a solid smooth surface. (How intriguing that an extremely expensive "light bulb" should yield the observation of grainy light.) I ask students to observe the speckle. Then I ask them to remove their glasses and observe the speckle while they move their heads from side to side. I have them raise their hands if the speckle is stationary, moves in the same direction as their heads, or in the opposite direction as their heads. Students with perfect vision observe that the graininess is stationary in the spot of light. Students with hyperopia observe that the graininess moves in the spot in the same direction as their heads. Students with myopia observe that the graininess moves in the opposite direction as their heads. This leads to a very interesting discussion of vision, the uniqueness of human observations, and opens up their minds to new views about light.

Bob Speers, Firelands College of Bowling Green State University

Send comments, compliments, constructive criticisms and complaints to:
Paul Laxon, 201 Chestnut Street, St. Thomas, ON, N5R 2B5
fax: 519-633-9014
e-mail: paullaxo@village.ca
(Yes, I did have another problem with my e-mail, but it is fixed now. If you want you can also send e-mail to me at plaxon@edu.uwo.ca)

Physics Day at Cedar Point,Ohio

Physics Day at Cedar Point will be held on Wednesday, May 24, in 1995. The attractions are lots of great roller coasters and rotating rides. We are working on and hoping that an astronaut can again be at Cedar Point that day and give talks for the students and the teachers. For information about tickets, contact Group Sales, Cedar Point, Sandusky, OH 44871. For information about the educational program contact Dr. Robert R. Speers, Firelands College—B.G.S.U., Huron, OH 44839.

We'd love to have some of the Canadian students and teachers join us in this fun and educational day. Similarly, I would hope that some of the U.S.A. physics students and teachers go to Wonderland. Cultural diversity in physics is essential, also.

Evolution of the Math Problem

1960: A logger sells a truckload of lumber for $100. If his cost of production is 4/5 of this price, what is his profit?

1970: (Traditional Math) A logger sells a truckload of lumber for $100. His cost of production is 4/5 of this price, or in other words, $80. What is his profit?

1970: (New Math) A logger exchanges a set L of lumber for a set M of money. The cardinality of Set M is 100, amd each element is worth a dollar. Make 100 dots representing the elements of set M. The set C of the cost of production contains 20 fewer points than set M. represent the set C as a subset of M, and answer the following question: What is the cardinality of set P of profit?

1980: A logger sells a truckload of lumber for $100. His cost of production is $80, and his profit is $20. Your assignment is to underline the number 20.

1990: (Outcome Based Education) By cutting down beautiful forest trees a logger makes $20. What do you think of this way of making a living? (Topic for class discussion: How did the forest birds and squirrels feel?)

THE DEMONSTRATION CORNER

THE ELECTRIC HOTDOG

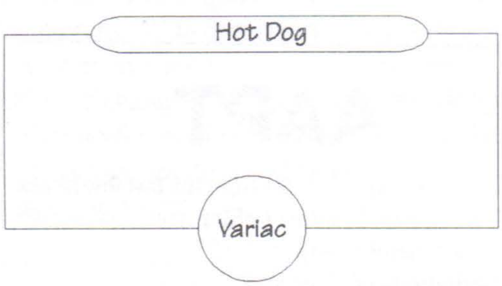
(followed by the Electric Pickle)

by

Roland Meisel

Ridgeway Crystal Beach High School
576 Ridge Rd., Box 310
Ridgeway, ON L0S 1N0
Email: rolameis@village.ca

A current can be run through a hotdog in order to cook it. There are commercial hotdog cookers that make use of this principle. I use it near the end of the unit on resistance in the Grade 12 Physics course. I have a couple of projection metres which I add to the circuit so that students may monitor and record the voltage and current during the minute or two that the hotdog cooks. This is a nice example of a decrease in resistance with an increase in temperature. At the end of the demonstration, students may calculate the total energy required to cook the hotdog, and compare it to other methods of cooking. I usually do the cooking on a porcelain plate, and then cut the hotdog into small pieces for the consumption of those who wish to try. Mustard is optional.



Probes from voltmeters or ammeters make good connecting wires.

This is followed by a similar demonstration using a pickle. A nice, salty kosher pickle seems to work best. I like to use Strub's ®, which are easily available in any grocery store. The room should be darkened for this one, since the pickle will light up with a ghostly greenish-orange glow. Since the next unit is Optics, a brief mention of the yellow-orange light produced by sodium is in order.

(Ed.—If you get several packages of hotdogs you can have a lunch-time physics party. You can cook several hotdogs in parallel, depending on the maximum safe current available from your power supply. I won't get into all the safety hazards, just remember that these dogs have a powerful bite while they're "plugged in.")

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Andre Ampère

Andre Ampère, b. Jan. 10, 1775, d.June 10, 1836, was a French physicist who laid the foundations for the science of electrodynamics through his demonstration that electric currents produce magnetic fields, and through his subsequent investigation into the relationship between these two phenomena.

The son of a well-to-do merchant, Ampère educated himself through diligent reading in the family library. He survived the French Revolution to become a science teacher, first in Lyons and then in Bourg. He later took a post at the Ecole Polytechnique, and in 1808 became inspector general of the university system in Paris. Beginning in 1824, he also taught physics at the College de France and philosophy at the Faculte des Lettres, pursuing diverse scientific interests in the midst of personal tragedy. He was greatly affected by his father's execution by guillotine during the Revolution and, after his first wife's early death, had a catastrophic second marriage.

Ampère's most notable achievements were his independent determination (1814) of Avogadro's law and his work from 1820 to 1827 based on Oersted's discovery, announced in 1820, that a magnetic needle moves in the vicinity of an electric current. Ampère succeeded in explaining the latter phenomenon by assuming that an electric current is capable of exciting a magnetic field. He further demonstrated that the direction of the magnetic field is determined by the direction of the current. He developed a quantitative relationship for the strength of a magnetic field in relation to an electric current (Ampère's theorem) and propounded a theory as to how iron becomes magnetized. Ampère also devised a rule governing the mutual interaction of current-carrying wires (Ampère's law) and produced a definition of the unit of measurement of current flow, now known as the Ampère.

Bibliography: Ampère, Andre, Correspondence, 3 vols.(1936-43);
Bordeau, Sanford P., Volts to Hertz: The Rise of Electricity (1982);
Williams, L.P., "Andre-Marie Ampère," Scientific American, January 1989.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVII, Number 4 **Summer 1995**

Report: AAPT Winter Meeting

Orlando January 14 - 19, 1995

reported by Peter Scovil, Section Representative

This year's winter meeting was held in Orlando, a city that has grown by leaps and bounds over the past few years. Apart from tornado warnings on the 14th, the weather was better than Ontario, and actually got quite warm towards the end of the conference. The first two days were involved in workshops. I attended one on light wave communications, and I intend to demonstrate how to use inexpensive materials in demonstrating how light can carry information, at the conference in Guelph next June. A good photocell attached to a small amplifier with speaker can give some interesting effects. You can listen to the 120 Hz hum of lights, or the flicker of a candle flame. A LED can be easily modulated by a signal generator, a microphone, or a pocket radio. The signal can then be picked up by the photocell, and the students can hear the results. It is interesting to "hear" your TV remote or a bar code. I will prepare a parts list so you can make a similar set of equipment as well. You may even be able to make up enough sets for a student lab. I think with fibre optic communications being so widespread, students should be exposed to how it works. And it fits very well into our grade 12 curriculum in the units on sound and on refraction of light.

Texas Instruments gave a very interesting workshop on their new Calculator-Based Laboratory (CBL). The CBL will accept data from a number of compatible sensors. This is then processed by a TI82 or 85 graphing calculator. It has a number of advantages over computer-based labs because of its much lower cost, and its portability. They are available in current catalogues.

There were some excellent plenary sessions by scientists in various fields related to physics. Jeffrey Hoffman, NASA astronaut talked about fixing the Hubble Space Telescope. The main mirror was out by a thickness of 1/50 the thickness of a human hair, but had to be within 1/10 of the wavelength of light. A repair mission was planned fo 1995 anyway to make other repairs and replace various pieces of equipment to allow for new experiments. Another such mission is planned in 1997. Astronaut training involved 400 hours of working underwater, and virtual reality simulations to choreograph each step of the repairs. The object is to keep time outside the space vehicle to a minimum. The result is a telescope of incredibly good resolution. We saw this as Heidi Hammel, a very animated astronomer from the Naval Astrnomical Lab, described her team's work in studying the impact of the Shoemaker-Levy 9 comet on Jupiter. The pictures from Hubble revealed the different impacts in great detail, and even showed Jupiter's aurora in an ultraviolet scan. The Imax film, "Destiny in Space", apparently includes much of the repair work.

OAPT Conference Details

Starting on page 4 is the programme for the June OAPT Conference in Guelph. Get your registration in early.

See you there!

PHYSICS DEMOS

Compiled by Pat Cannan
Physics Institute
Woodrow Wilson National Fellowship Foundation
Box 642, Princeton, NJ 05842

The Swing Era:
Hang several pendula of different lengths from a semi-rigid support. Challenge students to get a particular pendulum swinging to the exclusion of the others by pulling on a rubber band attached to the support.

Spring String:
The classic demonstration of a mass suspended between two strings, protecting the upper string from breaking by its inertia does not communicate the importance of a stretchable string. If the string were absolutely unyielding, the upper string would break every time. By replacing the upper string with a spring, a slow motion of the mass downward stretches the spring and visibly puts tension on it. A rapid jerk on the string breaks it without significant stretch of the spring.

The Big Attraction:
With a charged lucite rod, rubber rod, or golf tube, attract an empty pop can. Balance objects on the dome of a watch glass and observe the effects— everything up to a 2-meter 2X4 will work. Small charged objects may be discharged with an anti-static gun available at a record store. The gun has a piezoelectric crystal connected to a sharp pin. The potential developed on the point creates ions that stream off the point and discharge whatever.

Funneling Momentum:
Suspend a large funnel from a support so that it can spin freely. Fill it with sand and release it, giving it a small initial angular velocity.

Splitting Hairs:
A human hair held in the laser beam will produce a single-slit interference pattern. (The hair forms a single thin barrier.) The width of the hair can be

THE PRISONER

by

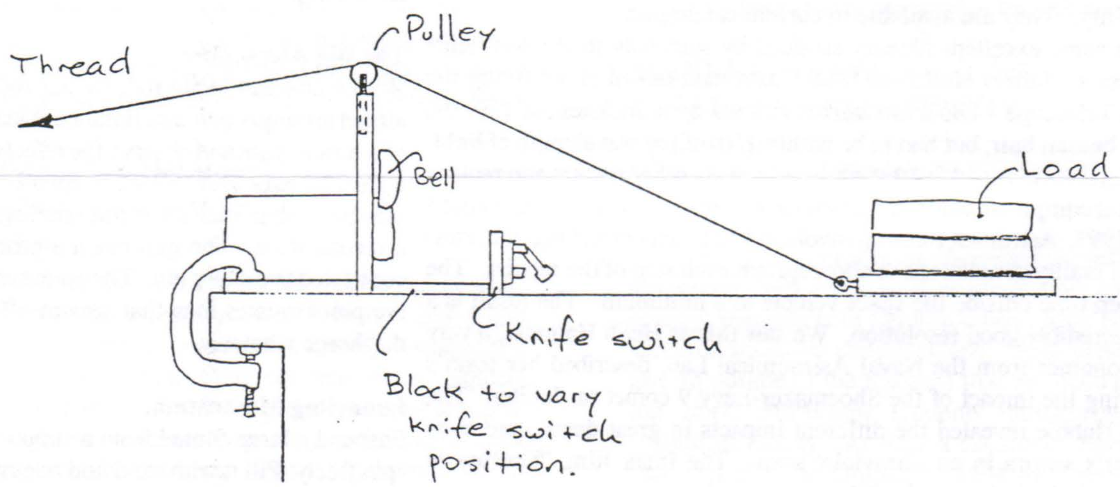
John Childs

Grenville Christian College
P.O. Box 610
Brockville, Ontario K6V 5V8

This is an exciting force vector demonstration, which is guaranteed to create some pandemonium in your classroom! It can be done just as a visual demonstration, or as the introduction to a stimulating and challenging problem to get everyone in the class working. Your better grade-12 students can pursue the solution to a considerable length.

Set up the apparatus as shown in the diagram. The basic idea is to mount a low-friction pulley wheel (such as the PASCO smart pulley) about 40 cm above the edge of a table. It should be rigidly mounted, so as not to flex. Three pieces of wood as shown, with the vertical piece drilled to accept the rod of the pulley, work well and allow for a C-clamp to hold it down. Arrange a push button or knife switch near the base of the pulley. Wire a loud bell to ring if the switch is closed. A plastic box or wooden slab that allows for a variable mass load is then pulled toward the pulley with a doubled thread. By looping the thread through a hole or screw eye, you can avoid a knot which would significantly reduce the tensile strength of the thread.

the setup to your class, and diagram the forces and their components. Pull the load up to the switch and ring the bell. A good loud ringing bell always helps for an effective demonstration! Now slap a \$5 bill on the table and announce that you'll give it to the student who can repeat the demonstration, making the bell ring. Your "ace in the hole" is that you get to substitute the thread for the string! To pull on the thread, you will need to wind it around a pencil, or supply a glove. As the force required to move the load increases, the tension in the thread and the classroom increases dramatically. The student doing the pulling knows from experience when the breaking limit of the thread is near, and will become more and more desperately careful to try and win the prize. I am always amazed at how everyone in the class seems to hold their breath, or even gather around the table to cheer on their friend. I have had students repeatedly come within a millimetre of the switch when the thread broke! The snapping thread brings down a chorus of hoots and hollers as students yell "let me try!"



With some testing before class, you can arrange things pretty easily so that the string <u>always</u> breaks before it rings the bell. (Except for Murphy's Law!) You can modify the load to increase or decrease friction, or move the switch in or out from the base to change the angle necessary to reach it. Using a strong cord, display

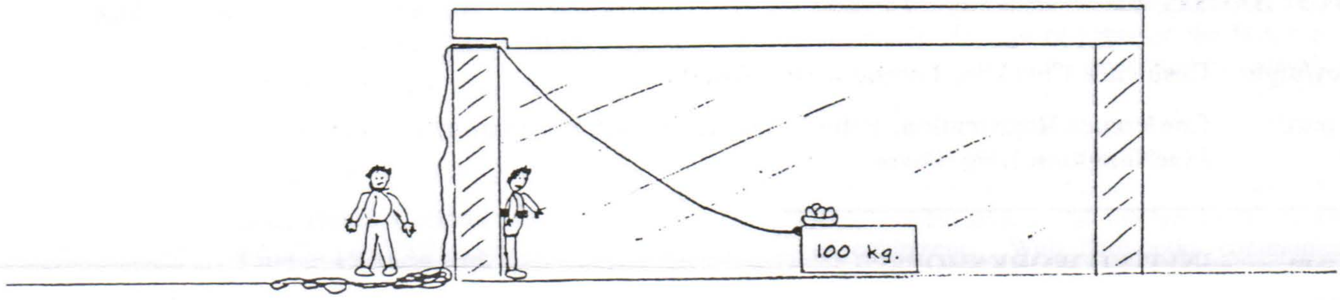
The analysis of the force vectors shows that, when the load is far away (about a metre or more to start), the applied force is nearly the same as its horizontal component, due to the small angle. As the box approaches the switch, the applied force acts at a greater angle, so it must increase considerably in order to apply the same horizontal component to keep the box sliding against friction. Of course, as the vertical component also increases, it reduces friction, and makes things even more interesting.

With a load of two bricks (3 to 5 kg), the thread should break when it is about 10 cm out from the base of the pulley. As the load gets closer to the switch, and more likely to break, students invariably slow down the motion of the box for fear of "overdoing it". If the dimensions are set up to bring the box within millimetres at the breaking point, a good student may realize that this is the most crucial time not to stop, as static friction is greater than kinetic friction, and could easily mean the difference between success and failure.

The demonstration can be set in the form of a test or extra credit problem in an interesting "Indiana Jones" format, as below. As the problem has several ways of arriving at a solution, it lends itself to a thorough discussion and analysis. I have prepared detailed notes that I use as student handouts, covering the solution explanations, that I would be glad to send to anyone requesting them.

"The Prisoner"

Your wealthy friend has been chained to the wall of a dungeon, without food, for many days. You cannot get into the room, and the only way to save him is to pull on the rope and drag the 100 kg box with the food and keys on it so they can reach him. Your friend can reach out only 1 m, and the top of the box is 1 m above the floor, and 7 m away from the wall where he is chained. The rope goes through a hole in the wall 5 m above the floor. The coefficient of friction between the box and the floor is 0.55. The rope is old and rotten, and will break if you pull on it with more than 500 N of force. Can you save your friend? Prove your conclusion in detail, using short explanations as you work. If you can save your friend, you will be rewarded with one million dollars! If you cannot save him, how close does the box get before the rope breaks?



Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, NIG 2Wl.
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Talk to me!

(But not through the Village. More E-mail problems. If you sent me I message and you didn't hear back from me—my reply is floating around in cyberspace somewhere...Sorry...try my UWO account, its more reliable)

Send comments, compliments, criticisms to: Paul Laxon, 201 Chestnut Street, St. Thomas, ON, N5R 2B5

fax: 519-633-9014
e-mail: plaxon@edu.uwo.ca

Membership Due?

The date on your address label is the expiry date for your membership. If it says **June 95**, your membership will be expiring soon. You may use the coupon below (or a reasonable facsimile) to renew it.

Membership Application Renewal

Name ____________________

Address ____________________

____

$8.00 per year, payable to the OAPT
Send to: Ernie McFarland, Department of Physics,
University of Guelph, Guelph, Ontario N1G 2W1

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (OAPT) CONFERENCE

June 22 - 24, 1995

University of Guelph

Celebrating 100 Years of Physics Teaching on the Guelph Campus

DETAILED PROGRAM

THURS. JUNE 22

All day/night **Residence Check-in, Lambton Hall Residence**

6 - 9 p.m. **Conference Registration, Folder Pickup, Workshop Assignments, etc., MacNaughton Bldg. Foyer**

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7 - 9 p.m. **INVITED WORKSHOPS:**

CHAOS AND FRACTALS

John Childs (Grenville Christian College, Brockville)

Discover the unimaginably beautiful, complex, exquisitely stunning world of fractal geometry and chaos! This fascinating new subject is storming every area of modern science. The new laws of chaos describe everything from heartbeats to hurricanes, forest ferns to continental coastline. The fractal images that can be generated from the Mandelbrot set (discovered in the early 1980s and called the most complex object in mathematics) reveal an infinitely large world to explore. We will look at the wonderfully simple means to generate these images and demonstrate a half-dozen computer programs that explain and describe their formation. These programs are available free of charge to anyone interested. This topic can be a wonderful independent study for the OAC Physics course, and this workshop can provide enough background to get you started. (MacNaughton Bldg. Rm. 101)

USING INTERNET TOOLS AND RESOURCES IN SCIENCE TEACHING

Tom Craig (Administrative Consultant, Wellington County Board of Education)
and **Susan Moziar** (Microcomputer Software Co-ordinator, College of Physical and Engineering Science, University of Guelph)

This workshop will focus on the use of the Internet resources in science teaching. It will be aimed at beginners and explain the use of tools such as ftp, gopher, and the WWW (World-Wide Web) for finding and downloading useful scientific information. (MacNaughton Bldg. Rm. 306)

MAKING HOLOGRAMS

Dianne Ness (Humberside C.I., Toronto)
and **Bill Konrad** (Chatham Kent S.S.)

A limited budget need not keep holography out of reach for your students. Attend this workshop and see first-hand how about \$200 to \$250 will equip your lab for holography. The benefits to physics enrolment and interest is fantastic. And it's a lot of fun! Workshop participants will make holograms using a simple process that has been proven to be effective in the classroom. (MacNaughton Bldg. Rm. 301)

TEACHING MODERN ELECTRONICS TO HIGH SCHOOL STUDENTS

John Wylie (Toronto French School)

The International Baccalaureate program in physics has an optional unit on modern electronics in which the students experimentally investigate a variety of simple solid state circuits and learn about switching, memory, signal amplification, and logic. The unit could easily be used as a locally designed unit for the OAC course in physics. Participants in the workshop can work through four labs used in the unit as well as play with a number of demonstration circuits. A shopping list, unit syllabus, and sample examination questions will be provided. It is a relatively inexpensive experimentally-based unit -- a set of five lab setups can cost less than \$150. (MacNaughton Bldg. Rm. 302)

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9 - 11 p.m. **Social (hosted by Physics Dept., U. of Guelph), University Club, Level 5, University Centre**

FRI. JUNE 23

All day/night **Residence Check-in, Lambton Hall Residence**

8:30 a.m. - 3 p.m. **Registration, Folder Pickup, MacNaughton Bldg. Foyer**

8:30 - 9 a.m. **Exhibitors: MacNaughton Bldg. Foyer**

Addison-Wesley Publishers

Boreal Labs Ltd.

Canadian Nuclear Association

D.C. Heath Canada Ltd.

Luctor Canada Ltd.

Merlan Scientific Ltd.

Northwest Scientific Supply

Tangent Scientific Supply Inc.

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9 - 10:15 a.m. **Welcome & Invited Paper, MacNaughton Bldg. Rm. 105**

SIMULATION OF WIND AND SNOW ENVIRONMENTAL PROBLEMS BY SCALE MODELS AND ANALYSIS BY PHYSICS AND ENGINEERING

Frank Theakston (F.H. Theakston Environmental Control Inc., Consulting Engineers, Fergus, Ont.)

By applying the fundamental principles of physics and engineering (particularly fluid mechanics and hydraulics), the simulation of environmental problems and solutions related to city planning, high-rise buildings, architecture, airports, Arctic townsites, hospitals, schools, ski resorts, agricultural projects, highways, etc., has been made possible by laboratory techniques. The presentation will be accompanied by some rather exciting slides to show the development of this type of simulation, with the conceptual research beginning at the University of Guelph.

10:15 - 11:00 a.m. **Exhibitors, coffee, and 100th Anniversary Unveiling, MacNaughton Bldg. Foyer**

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11 a.m. - 12 noon **CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105**

LIGHT-WAVE COMMUNICATION

Peter Scovil (Waterford D.H.S.)

11:00 - 11:30 a.m.

This presentation will show the use of inexpensive materials in demonstrating how light can carry information. A good photocell attached to a small amplifier with speaker can give some interesting effects. You can listen to the 120-Hz hum of lights or the flicker of a candle flame. An LED can be modulated by a signal generator, a microphone, or a pocket radio. The signal can then be picked up by the photocell, and the students can hear the results. It is interesting to "hear" a TV remote-control unit or the reflection of a laser from a bar code. A parts list will be available so that teachers can make a similar set of equipment. With fibre-optics communications so widespread, it is important for students to see what light modulation is and how it works. It fits very well into our grade 12 curriculum in the units on sound and refraction of light.

DOING SOMETHING ABOUT THE WEATHER

Stuart Quick

(Scarborough College, University of Toronto)

11:30 - 11:45 a.m.

The hardware and software now exist at reasonable cost to enable teachers in the schools to receive real-time weather pictures from the polar orbiter satellites, NOAA12 and NOAA14. This activity could support the teaching of aspects of physics, meteorology, geography, and other sciences. In this talk I will display some samples of the pictures I have received with the station at Scarborough College, and provide hard-copy details of suppliers of the equipment and resource people one can call upon for (free!) advice.

I UNPACKED MY GRANDMOTHER'S TRUNK -- A LOOK AT PHYSICS TEACHING IN THE 1890s

Malcolm Coutts

(Retired, but not inactive; Guelph)

11:45 a.m. - 12 noon

I will give a brief description of the Ontario Secondary School system as it was in the 1890s. Copies of old textbooks, and perhaps examination papers, will be on display. Using the overhead projector, I will show excerpts from old physics texts and comment on them.

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12 - 1:30 p.m. **Lunch, South Residence, Mountain Cafeteria**

Exhibitors, MacNaughton Bldg. Foyer

FRI. JUNE 23 (continued)

1:30 - 2:50 p.m. **INVITED PAPERS: MacNaughton Bldg. Rm. 105**

HIGH TECH AND HIGH TOUCH: TEACHING PHYSICAL SCIENCE TO NON-SCIENTISTS

Richard Jarrell (York University)

1:30 - 2:30 p.m.

This presentation gives a description of an experimental course in astronomy for non-science students, given during two summers at York University to classes of 140 and 165. It combined high-tech multi-media lectures with high-touch group work and should be applicable to any teaching of science to non-scientists.

WHAT'S NEW ON PHYSICS DAY AT CANADA'S WONDERLAND?

Alan Hirsch (Port Credit S.S., Mississauga)

2:30 - 2:50 p.m.

Physics and Science Day at Canada's Wonderland has become very popular. This presentation will address several questions, including the following:

(a) What are ways of getting the most out of a field trip to Canada's Wonderland?
(b) What changes are planned for 1996?
(c) What suggestions can physics teachers make to help improve the event?

BONUS: door prizes will be given at this presentation.

2:50 - 3:20 p.m. **Exhibitors and coffee, MacNaughton Bldg. Foyer**

3:20 - 5 p.m. **CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105**

TEACHING OBSERVATIONAL ASTRONOMY FOR GRADE 10 SCIENCE USING SKYGLOBE

Dianne Ness (Humberside C.I., Toronto)

3:20 - 3:35 p.m.

Skyglobe is shareware software that is available for PCs. It is a wonderful tool to let students investigate the night sky over hours, days, months, and years. Using sheets written especially for the purpose, students at Humberside C.I. investigated the motion of stars over a night, the retrograde motion of Mars through Leo this winter, and the phases of the moon. In light-saturated Toronto, our students made their observations using our cross-curricular computer lab. This computer program has changed the way we teach astronomy.

THE UNFOLDING OF THE UNIVERSE

Presiding: **Greg Marshall**
(Ottawa Board of Education)

3:35 - 4:00 p.m.

This talk will provide information about a number of issues of importance and relevance to physics educators in Ontario.

THE SPEED OF 1.25-MeV PHOTONS IN SOLIDS

Kari Dalnoki-Veress, John Dutcher, and **Innes MacKenzie** (University of Guelph)

4:00 - 4:15 p.m.

It used to be a common practice to calibrate time-to-amplitude converters (TACs) by measuring the flight time of gamma rays over a pathlength of the order of 50 cm. Because gamma rays cannot be refracted appreciably to form collimated beams, these measurements depended on positron annihilation for the production of anti-parallel pairs of 0.511-MeV gamma ray photons. From that background, there evolved an experiment for undergraduate students in which the "refractive index" of solid rods having low atomic number (Z) could be measured for these annihilation photons. Absorption limited the range of possible media to those having $Z \leq 12$ (magnesium).

Replacement of the conventional plastic scintillators by very efficient, fast, inorganic scintillators allows us to use the photon pairs (mean energy of 1.25 MeV) from the radioactive decay of ^{60}Co. The improvement in time resolution permits a reduction in the flight path to 10 cm, and the increased penetration permits a choice of media with Z up to 40 (zirconium). The apparent speeds, precise to about 0.3% in a 5-hour measurement, will be shown for a range of densities up to 7.8 g/cm^3. The deviations of up to 3% in the "refractive index," depending on density and rod diameter, are caused by scattering.

GENERATING FORCE VS. TIME GRAPHS OF MODEL ROCKET ENGINES

John Childs (Grenville Christian College, Brockville)

4:15 - 4:30 p.m.

A highly motivating investigation into the impulse of a model rocket engine is possible using a simple apparatus setup. Using a home-made device that mounts a model rocket engine on a spring-loaded sliding arm, and a record player to drag a strip of paper under a felt-tipped pen, an accurate and reliable force vs. time graph can be generated. After calibrating the force and time apects of the equipment setup, students can analyze the area under the curve to find total impulse. These graphs compare favourably with those made by the engine manufacturer. Your students are not likely to forget watching and hearing the static test firing of a model rocket engine!

FRI. JUNE 23 (continued)

USING CD-ROMs IN TEACHING PHYSICS
Judy Evans (Streetsville S.S., Mississauga)
Bill Konrad (Chatham Kent S.S.)
Alan Hirsch (Port Credit S.S., Mississauga)
4:30 - 5:00 p.m.

CD-ROM technology provides a valuable research tool for both students and teachers. Our talk will focus on the skills required to find information using CD-ROMs as well as the advantages of doing so. This will be followed by practical, hands-on experience using CD-ROMs.

5:00 - 6:30 p.m. **Free time [Optional: trying CD-ROMs (see previous paper), or research lab tour]**

6:30 - 9 p.m. **Banquet, Peter Clark Hall, Level 0, University Centre**

Guest speaker:

Jim Hunt (University of Guelph)

100 Years of Physics Teaching on the Guelph Campus

(Spouses & Friends Welcome)

SAT. JUNE 24

9:00 - 10:00 a.m. **INVITED PAPER: MacNaughton Bldg. Rm. 105**

HIGH LATITUDE CYCLOGENESIS AND AIR-SEA INTERACTION: A LINK BETWEEN THE FAST AND SLOW CLIMATE SYSTEMS
Kent Moore (University of Toronto)

The scientific community has identified the need to improve our understanding of both the ocean circulation and the global atmospheric transport of water vapour (the predominant greenhouse gas), if we are to refine our predictions of anthropogenic climate change. An important unknown pertaining to the circulation in the ocean is the mechanism(s) responsible for the formation of the cold, salty, and dense water that forms in the high-latitude marginal seas of the Arctic Ocean and which sinks to the bottom of the ocean. It has been recently observed that the formation of this dense water is a highly episodic event that occurs in convective plumes that may be only 10 km in diameter. Concerning the transport of atmospheric water vapour, more information is needed on the mechanisms responsible for the formation and evolution of coherent cloud systems. At high latitudes, the short-lived and intense atmospheric phenomena known as polar lows represent an important class of such cloud systems about which we know very little. Fluxes of heat, moisture, momentum, and trace gases across the air-sea interface play a key role in coupling the ocean's circulation to the transport of water vapour in the atmosphere.

In this talk, I will discuss the idea that the very large surface fluxes of sensible and latent heat associated with polar lows and other cyclonic systems may be sufficiently large so as to trigger the formation of these oceanic plumes. If this is so, then it represents a potential coupling between the "fast" climate system and the "slow" climate system that warrants further study.

10:00 - 10:30 a.m. **CONTRIBUTED PAPERS: MacNaughton Bldg. Rm. 105**

A LAB TO MEASURE AND COMPARE THE ACCELERATION OF A CART AND A BALL-BEARING AS A FUNCTION OF TRACK ANGLE
Dianne Ness (Humberside C.I., Toronto)
10:00 - 10:15 a.m.

Using a track, two photogates, a Y-adapter (available from Pasco for $40) and a software program (free from Humberside C.I.), students measure the acceleration of first a cart and secondly a ball-bearing as a function of track angle. An instruction sheet is available outlining the experiment and how to use the apparatus.

THE GUELPH-WATERLOO-McMASTER INTERACTIVE VIDEO-LINK
Jim Hunt (University of Guelph)
10:15 - 10:30 a.m.

The development and operation of the Guelph-Waterloo-McMaster interactive Video-link will be described. The link was built to service primarily senior and graduate courses in physics and chemistry, and so particular attention has been paid to the transmission and legibility of graphic material and the layout of the classrooms. In addition, the system has been designed to operate without technical attendance, using microprocessor control to simplify the lecturer's control functions.

10:30 - 11:00 a.m. **Coffee MacNaughton Bldg. Foyer**

Video-Link Room open (see previous paper), MacNaughton Bldg. Rm. 101

SAT. JUNE 24 (continued)

11 a.m. - 12 noon INVITED PAPER:
MacNaughton Bldg. Rm. 105

SUDBURY NEUTRINO OBSERVATORY (SNO)

John Simpson (University of Guelph)

SNO is an international project led by Canadian universities to build a detector of solar neutrinos in a mine near Sudbury. This project has been ten years in the proposal, planning, and construction phases, and is now about one year from completion. The scientific purpose, technical aspects, and construction progress will be reviewed in this talk.

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12 - 1:15 p.m. **Lunch,**
South Residence,
Mountain Cafeteria

1:15 - 3:10 p.m. **CONTRIBUTED PAPERS:**
MacNaughton Bldg. Rm. 105

THE ELECTRIC HOT DOG AND THE ELECTRIC PICKLE

Roland Meisel (Ridgeway and Crystal Beach H.S.)

1:15 - 1:30 p.m.

A nice example of a change in electrical resistance with heating occurs when 120-V AC is directly applied to a hot dog. This can be extended to a kosher pickle whereupon an additional interesting phenomenon occurs.

MAGNETIC MONOPOLES

John Wylie (Toronto French School)

1:30 - 1:55 p.m.

While magnetic monopoles do not officially exist, there are compelling reasons to believe that they might. Starting with a simple comparison amongst magnetism, gravity, and electostatics, the concept of a magnetic monopole is developed and its properties characterized. By understanding how monopoles may be detected (should they exist), and touching upon the concept of superconductivity, insight is gained into one of the great mysteries of nature: charge quantization. This talk is based on an article written for "Quantum" magazine, and uses only basic high school physics to develop a topic that is fascinating to most young physicists, but rarely touched upon at the high school level.

MY EXPERIENCE USING "PRESENTATION SLIDES" IN THE CLASSROOM

John Earnshaw (Trent University)

1:55 - 2:15 p.m.

Here's how I taught an entire lecture course with nothing but a notebook computer. I'm overwhelmed at how easy it was, and at the student responses.

I will describe what "presentation slides" are, give two or three examples from my actual classes, and show how easy it is to make them and show them.

SEARCHING FOR SOMETHING FUNDAMENTAL IN BODE'S RULE

Elio Covello (Huron Heights S.S., Newmarket)

2:15 - 2:30 p.m.

Bode's rule is a curious relationship discovered by Titius and popularized by Johann Bode in 1772. It is used in predicting or memorizing the distances of the planets from the Sun. My students and I have been trying to express Bode's rule as a rational physical relationship that contains the gravitational constant, G, so that this "rule" is not just an empirical descriptive coincidence. This is the story of that exercise, its successes and failures.

PHYSICS AND ART

George Vanderkuur (Toronto Board of Education)

2:30 - 2:55 p.m.

Art and science are both creative activities which are surprisingly similar. While scientists see aesthetic merit in their work, artists may find satisfaction in applying scientific principles to communicate their message.

This talk uses soap bubbles, birefringence, optical activity, random numbers and trajectories to describe projects where students integrate Physics and Art.

ALTERNATE CONCEPTIONS IN CURRENT ELECTRICITY

Elgin Wolfe
(Faculty of Education, University of Toronto)

2:55 - 3:10 p.m.

Alternate conceptions (sometimes referred to as misconceptions) refer to a person's understanding of a concept that differs in significant ways from the commonly accepted scientific understanding. This presentation will give an outline of the research that has been done around the world concerning students' misconceptions about current electricity. As well, a classroom research project that took place in Ontario in 1994 with over 400 stuents will be described. A selection of the instruments used and the results will be shown, the findings will be summarized, and strategies and activities will be suggested for helping students narrow the gap between their understandings and scientists' and engineers' views. Students' conceptions ranging from the Intermediate Level to the Senior Level and beyond will be discussed.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVIII, Number 1 **Fall 1995**

EDITORIAL:
Practical Work
Valuable Pedagogical Tool or Recipe for Mediocrity

Several years ago I heard Derek Hodson speak at a Science Teachers Association of Ontario (STAO) conference in Toronto. He questioned the usefulness of lab activities as practised by most science teachers, and made a plea for a more critical appraisal of practical work in the classroom.

With increasing class sizes, decreasing budgets and aging equipment, I think it is important to ascertain the pedagogical importance of using practical work in the science classroom. Practical work itself has been more broadly defined by Hodson (1993) and others to include any method that requires learners to be active, rather than passive, in accordance with the belief that students learn best by direct experience. Some alternatives to the lab bench activities that are the usual fare in science classes include interactive computer-based activities, case studies, interviewing, debating, writing, making models, posters and scrapbooks, library-based research, taking photographs and making videos.

Practical work is only one part of what should be an integrated and inter-related set that defines a science curriculum. Hodson (1993) proposes that science education has three major aspects: 1) learning science—acquiring and developing conceptual and theoretical knowledge; 2) learning about science—developing an understanding of the nature and methods of science, and an awareness of the complex interactions between science and society; 3) doing science—engaging in and developing expertise in scientific inquiry and problem-solving. But, "if education in science is about making sense of the physical world and understanding (and using) the conceptual and procedural knowledge that scientists have developed to assist them in that task, a first step in science education must be familiarization with that world," (p. 110). Here bench work is essential in order to build up a supply of personal experiences. Solomon (1988) states that "most practising science teachers...think that experiment has a key role to play in [teaching about scientific models] because it so clearly illustrates and brings to life the ideas that would otherwise be confined to words on paper," (p. 104). She also argues that experiment can be a powerful conceptual learning tool in science when it strives to connect 'word meaning' with 'practical perception'.

In general, the readings I have done affirm the use of practical work (and, as part of that, bench work) as a pedagogically sound method of teaching science. The contentious issue is not whether bench work should be used, it is the way in which it is currently being used in the science classroom. Hodson (1991) declares that "Laboratory work often provides little of real educational value," (p. 176). Sentiments similar to these are echoed by many researchers (for example: Hegarty-Hazel, 1990; Millar, 1987; Tobin, 1990). One of the main problems is that lab work is used unthinkingly by many teachers, without a specific purpose or goal which is explicitly formulated. Hodson (1993) lists five possible questions to ask when considering the necessity of practical work:

1. Does practical work motivate students? Are there alternatives or better ways of motivating them?
2. Do students acquire laboratory skills from school practical work? Is the acquisition of these skills educationally worthwhile?
3. Does practical work assist students to develop an understanding of scientific concepts? Are there better ways of assisting this development?
4. What view/image of science and scientific activity do students acquire from engaging in practical work? Is that image a faithful representation of actual scientific practice?
5. Are the so-called 'scientific attitudes', such as open-mindedness, objectivity and willingness to suspend judgement, likely to be fostered by the kinds of practical work students engage in? Are they necessary for the successful practice of science?

In considering laboratory activities as a pedagogical tool Tobin (1990) states:

> Theory and research suggest that meaningful learning is possible in laboratory activities if all students are provided with opportunities to manipulate equipment and materials while working cooperatively with peers in an environment in which they are free to pursue solutions to

see **Editorial** on page 2

Make plans to attend the

1996 OAPT Conference

YORK UNIVERSITY

Thursday, June 20 to Friday, June 22, 1996

Report on the OAPT Conference

University of Guelph
June 22-24, 1995

by Peter Scovil, Section Representative

This year, the physics department at the University of Guelph was celebrating 100 years of physics education, and the OAPT Conference was a fitting celebration of the event. We had a great turnout of about 100 members. In keeping with the theme, Malcolm Coutts, now retired and residing in Guelph, gave us a glimpse of physics teaching 100 years ago. At the banquet, Jim Hunt described changes in the teaching of physics in the old Ontario Agricultural College—not your typical physics program!

Teaching has changed in 100 years and does not only involve new material, but also new methods. Richard Jarrell (rjarrell@yoku.ca) at York described using multimedia presentations and group work instead of the traditional lecture. John Earnshaw at Trent uses a notebook computer and Lotus Freelance Graphics 2.0 for Windows to prepare lecture slides. Judy Evans, Bill Konrad, and Al Hirsch showed us various resources available on CD ROM. Jim Hunt of Guelph showed us the Guelph-Waterloo-McMaster Interactive Video-link for teaching small graduate classes from the three campuses together using a very user-friendly video linkage.

There were four excellent workshops on Thursday evening. Unfortunately, we could only choose one, so I hope they will be offered again in other years. I attended the one on making holograms by Dianne Ness (dianness@village.ca), and picked up some very useful ideas for doing this in my own school. Other workshops involved chaos & fractals (John Childs), internet tools and resources (Tom Craig and Susan Moziar), and electronics (John Wylie).

The weather played a significant role in this conference. Frank Theakston started off with a fascinating talk on his companies that are involved in simulation of wind and snow environmental problems by scale models. He has been involved in designing such things as barns for livestock, airports, city buildings, highway windbreaks. He showed slides of his work. Teachers not far from Guelph might be interested in taking tours of the facilities. Stuart Quick (U of T, Scarborough) outlined how he was able to obtain and use weather satellite data from the visible and infra red scanners. A receiver plus software is available for about $1000 US. Kent Moore (U of T) described the interactions of hot and cold air masses, and the effects of increasing fresh water in the oceans on our weather patterns.

SNO is not snow. It is the Sudbury Neutrino Observatory, and John Simpson (U of Guelph) updated us on the project and its purpose. Other astronomical topics included using the shareware program Skyglobe in teaching grade 10 astronomy (D. Ness) and Bode's Rule (Elio Covello). John Childs showed us a piece of apparatus that he built to work with a phonograph turntable to give a force-time graph of model rocket engines.

To shed more light on the conference, Peter Scovil (petescov@village.ca) showed demonstrations of using LEDs and lasers to transmit signals using relatively inexpensive materials. K. Dalnoki-Veress, J. Dutcher, and I MacKenzie (U of Guelph) described how to measure the speed of gamma photons. George Vanderkuur showed us aesthetically pleasing physics demonstrations which could add some real interest to a lesson. We had electrifying presentations of hot dogs and pickles—a great attention-getter—by Roland Meisel, magnetic monopoles (J. Wylie), and "alternate conceptions" in current electricity by Elgin Wolfe. Dianne Ness describe a set-up to measure acceleration of objects on inclined tracks, using two photogates. Al Hirsch brought us up to date on the Physics Day At Canada's Wonderland. This year a math component was added. About 10,000 students attended. New contests will be set up for next year's May outing.

The University of Guelph physics department did an excellent job in organizing the conference, getting excellent speakers, feeding us royally, and housing us. Thanks for a great time! Next year, the conference is to be held at York University. For information contact David Logan, 108 Stacie Blvd, York University, 4700 Keele St, Downsview, ON, M3J 1P3, phone: (416) 736-5051, fax: (416) 736-5950, e-mail: dave@unicaat.yorku.ca.

...EDITORIAL (from page 1)

> problems which interest them. A crucial ingredient for meaningful learning in laboratory activities is to provide for each student opportunities to reflect on findings, clarify understandings and misunderstandings with peers, and consult a range of resources which include other students, the teacher, and books and materials. (p. 414).

Practical work should not be just a cookbook recipe that students follow mindlessly before doing some number-crunching and then writing down some numbers that they don't really understand. There should be a clear purpose in mind, and this purpose should not be over-shadowed by problems in setting up equipment, or difficulties in obtaining accurate data, or anything else that is not explicitly part of the objective of the lab work.

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THE PHYSICISTS' SOCIAL

One day, all of the world's famous physicists decided to get together for a tea luncheon. Fortunately, the doorman was a grad student, and able to observe some of the guests...

- Everyone gravitated toward Newton, but he just kept moving around at a constant velocity and showed no reaction.
- Einstein thought it was a relatively good time.
- Coulomb got a real charge out of the whole thing.
- Cavendish wasn't invited, but he had the balls to show up anyway.
- Cauchy, being the only mathematician there, still managed to integrate well with everyone.
- Thompson enjoyed the plum pudding.
- Pauli came late, but was mostly excluded from things, so he split.
- Pascal was under too much pressure to enjoy himself.
- Ohm spent most of the time resisting Ampere's opinions on current events.
- Hamilton went to each of the buffet tables exactly once.
- Volt thought the social had a lot of potential.
- Hilbert was pretty spaced out for most of it.
- Heisenberg may or may not have been there.
- The Curies were there and they just glowed the whole time.
- van der Waals forced himself to mingle.
- Wien radiated a colourful personality.
- Millikan dropped his Italian oil dressing.
- de Broglie mostly just stood in the corner and waved.
- Hollerith liked the hole idea.
- Stefan and Boltzman got into some hot debates.
- Everyone was attracted to Tesla's magnetic personality.
- Compton was a little scatter-brained at times.
- Bohr ate too much and got atomic ache.
- Watt turned out to be a powerful speaker.
- Hertz went back to the buffet several times a minute.
- Faraday had quite a capacity for food.
- Oppenheimer got bombed.

E-Mail Us!

We want to hear from you: your comments, criticisms, observations...

Send correspondence to:

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c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5
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WHAT'S NEW

by Robert L. Park
THE AMERICAN PHYSICAL SOCIETY
(Note: Opinions are the author's and are not necessarily shared by the APS, but they should be.)

Health and Cellular Phones

It all started, you will recall, when a grieving widower brought suit against cellular phone companies in 1993 after his wife died of brain cancer (WN 29 Jan 93). "She talked on the phone all the time and put it against her head," he mourned on Larry King Live. How much proof do you want? Well, if you're into statistics, a massive study is underway that will eventually include a million users. Preliminary results based on a cohort of 260,000 found no difference between cellular-phone users and a control group of mobile-phone users. Since the mobile-phone antenna is external, there is no brain exposure. But the most striking finding is that age-specific mortality of cellular-phone users is significantly below that of the overall U.S. population. So skip the broccoli, and spend a little extra time with your cellular phone.

Nobel Laureate Dies

S. Chandrasekhar, who shared the 1983 Nobel Prize in Physics, died on Monday, August 21 at the age of 84. His work on collapsed stars led to the theory of "black holes." Subramanyan Chandrasekhar was on the University of Chicago faculty for nearly 60 years. A highly cultured man, he looked on physics as an aesthetic experience.

Measuring the Height of a Roller Coaster

J.L. Hunt
Dept. of Physics,
University of Guelph
Guelph, ON
N1G 2W1

At the OAPT conference in Guelph in June/95 during a discussion following a presentation on "Science Day" at "Canada's Wonderland", it was mentioned that it was difficult to find the height of the various rides because it was difficult to measure angles with a precision of at least 1 degree.

A very ancient and simple device that does exactly this easily to a precision of 1/4 degree might be of interest to Ontario Physics teachers. The device is the "cross-staff" which has been used since ancient times for latitude determination and sun elevation. One form of the device is shown in the figure. This simple device can be easily made from smooth wood lath, screws and cardboard. Instructions for construction, assembly and use will be sent on request.

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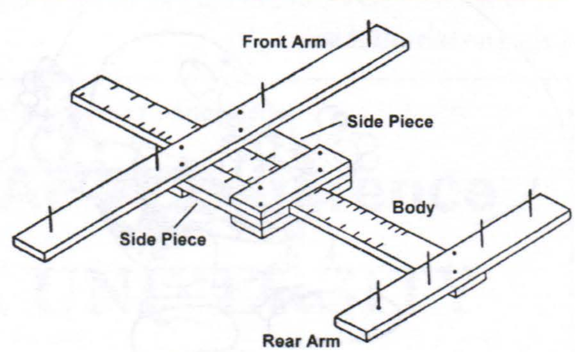


cross-staff

THE DEMONSTRATION CORNER

Flying Time

by

Dave Erb

Red Lake District High School

Red Lake, Ontario P0V 2M0

This is a demonstration of centrifugal force.

MATERIALS

- two 3-minute egg timers (the type with falling sand)
- string

PROCEDURE

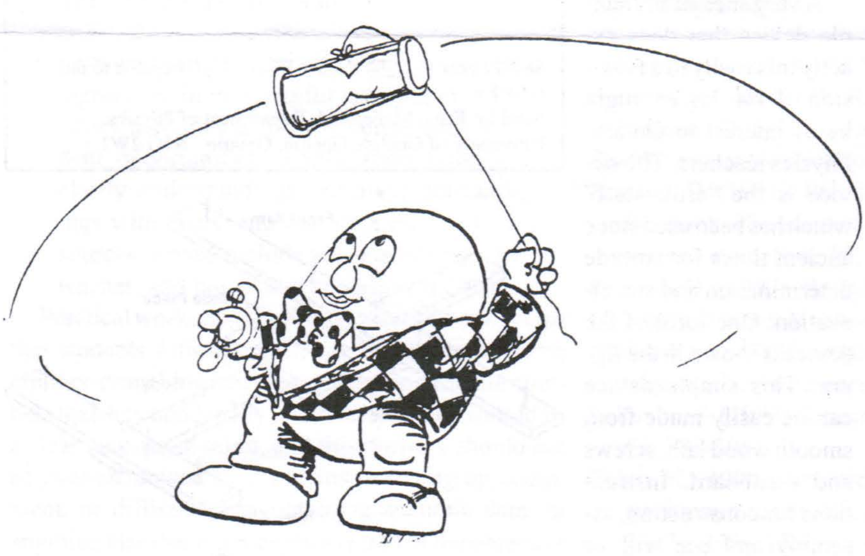
1. Ask the question "How can I get the sand to the other side of the egg timer faster?" This could be given as a challenge question to the students the night before.

2. Tie a string to one of the egg timers.

3. For comparison, turn over the timer without the string so that the sand begins to drain from one end to the other.

4. Ensure the sand of the other timer is near the string. Then swing the egg timer in a circle which is in a vertical plane pointing away from the students. A horizontal plane of swing is too dangerous because, if the timer should break, there is no way of predicting the direction the pieces will fly. You do not have to swing the timer very fast (2 to 3 Hz works well). Make sure you check the construction of the timer before you swing it. The timer may require additional glue to ensure it does not fly apart.

5. After less than one minute, you should be able to stop swinging the timer and the sand will be all in the other side. The sand in the other timer will still be falling and make a nice comparison.



Drawing by Patrick McWade

DISCUSSION

In order to make the demonstration quantitative, we will assume that the rate at which the sand falls is proportional to the force acting on it. Therefore, the time (t) required for all the sand to fall is inversely proportional to the force (F).

Let:

t_1 = time required for sand to fall under gravity alone (3 minutes)

F_1 = force of gravity = mg

t_2 = time required for sand to fall under centrifugal force alone

F_2 = centrifugal force = $4m\pi^2r/T^2$

where

m = sand's mass

r = radius of curvature

T = period of rotation

To compare the times, since $t \propto 1/F$

$$\frac{t_1}{t_2} = \frac{4m\pi^2 r / T^2}{mg} = \frac{4\pi^2 r}{gT^2}$$

therefore,

$$t_2 = \frac{gT^2 t_1}{4\pi^2 r}$$

Using a radius of curvature of 30 cm (r = 0.3 m) and swinging the timer around twice a second (T = 0.5 s) causes the 3-minute egg timer to drain in about 37 s, which agrees well with what is actually observed. (Therefore, our assumption that the rate of fall is proportional to the force must be pretty good.)

I have not included the effect of gravity on the vertical plane on swing because the effect of gravity at the top of the swing cancels the effect at the bottom.

QUESTIONS

1. How long would it take an hour glass to drain if swung at 5 Hz using a string 40 cm long?
2. Does shaking an egg timer speed the rate at which the sand falls?
3. How could you stop an hour glass from draining?
4. Does the force of gravity affect the rate at which the sand falls when the timer is swung in a vertical plane? If so, how?
5. How long would it take an hour glass to drain if it was on the moon where the force of gravity is about 1/6 that of Earth's?

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XVIII, Number 2 Winter 1996

EDITORIAL:

Mixing Education and Politics

At least they're letting us choose which arm to cut off

I had no illusions that the January 13 march by 35,000 teachers (myself included) and parents from every corner of Ontario would cause any immediate visible change as the Conservative government begins its attempt to dismantle public education in Ontario. I heard some talk that it was too early to begin to protest the government's announcement that it is cutting $400 million from the education budget, but I don't think that is true. This is only the beginning.

The assignment of Snobelen as Minister of Education—a man who has proven his financial ingenuity by making millions in the trucking business after dropping out of high school—shows that the government has only one priorty, and has only one item on its agenda...money. While no one can deny the need to keep an eye on the financial side of all public spending, when cost is the only consideration, and is not weighed against the needs of the individual student, education will be hurt, no matter what Snobelen says.

In my mind, using a business model to define education is very limiting. I have, on occasion, visited the local fast food restaurant, but I do not think it would be very healthy to eat there everyday, and I don't think Snobelen's views on edcuation have moved us onto a healthier path. After reading about his videotaped comments that he wanted to invent a crisis in education to make it easier for him to impose the Conservative economic philosophy, everything he says in explanation of his views comes across as insincere and facitious. Remarks by Snobelen about putting a computer on every student's desk, while at the same time talking about massive cuts, are either ignorant and unthinking, or are deliberate attacks on the Ontario teaching profession. In either case, we need to stand up so that the government realizes we are concerned and should be listened to.

Let's try for 100,000 at the next rally.

Make plans to attend the

1996 OAPT Conference

YORK UNIVERSITY

Thursday, June 20 to Saturday, June 22, 1996

Look for a mailing to your school in February.

We are interested in teacher submissions. See the "Call for Papers" insert.

1996 OAPT Physics Contest

by Diana Hall

Now that the year has rolled over its time to start thinking about the OAPT Contest for grade 12 students. This year's exam promises to be every bit as much fun and as challenging as in previous years. I would like to encourage more participation in the contest by better publicizing the cash scholarships and calculator prizes which increased significantly in 1995. Look for more details with the first mailing in March. The contest date has been set for **Tuesday, May 14**, so mark it on your calendars and let your students know.

Please note that I am taking over the administration of the contest from Fred Hainsworth who has held the position of Contest Convenor for the last 2 years. Thank you Fred, you have done a super job. I hope that I can be as effective as you have been. Any questions or correspondence should be addressed to me at the address below. Bill Prior continues as Contest Coordinator. Contest question submissions should be sent directly to Bill at the address below.

All the best for 1996.

Bill Prior
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PHYSICS NEWS UPDATE

The American Institute of Physics Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

A PLANET ORBITING A NEARBY STAR has been discovered. Astronomers with the Geneva Observatory in Switzerland reported the finding at a recent meeting in Florence, Italy. Planets around pulsars have been detected before, but in the present case the star (51 Pegasus, 40 light years away) is similar to our own sun. The planet is estimated to have a mass at least half that of Jupiter. Its orbit, only about 5% of the earth-sun distance, places it uncomfortably within the star's corona. Following up the announcement in Florence, astronomers at the Lick Observatory in California have confirmed the presence of the planet. At the Florence meeting the possible sighting of another planet was also announced. The star is GL229 (about 30 light years from Earth) while the orbiting object has a mass about 20 times that of Jupiter. An alternative interpretation is that the object is a brown dwarf. (Science News, 21 October 1995.)

ISOTOPE EFFECTS IN SONOLUMINESCENCE have been observed by Seth Putterman and Robert Hiller at UCLA. Sonoluminescence (SL) is a mysterious phenomenon in which acoustic energy is transduced into light energy; high frequency sound waves are absorbed by tiny bubbles in water. The bubbles, oscillating wildly, re-emit the energy in the form of tiny, focused light bursts. Many things about SL are still unknown, such as the nature of the light-emitting process or why the light pulses are so short. The UCLA work has established one new fact: substituting heavy water (D2O) for ordinary water (H2O) as the liquid medium causes the SL spectrum to dramatically shift from ultraviolet toward red wavelengths. This result seems to represent yet a new mystery. According to the researchers, "The shift is remarkably large, especially in view of the small difference in chemical and elastic properties between light and heavy water."

GALILEO ARRIVES AT JUPITER TODAY after a 6-year, 2.3-billion mile journey. At this hour the craft is proceeding normally (at a relative speed of more than 22,000 mph) toward its rendezvous. The spacecraft's first job will be to receive data from a small detachable probe sent on ahead and now parachuting into Jove's atmosphere. Data will later be relayed back to Earth (radio waves take 52 minutes to span the distance) at a rate of only 10 bits per second, a constraint which comes about because of the defective main antenna. Launched in 1989, Galileo's 2-year mission at Jupiter will include repeated close-up flybys of several moons. The latest information on Galileo can be found at the following World Wide Web address: http://www.jpl.nasa.gov/galileo.

PHYSICS NEWS UPDATE MAILING LIST: You can add or subtract yourself automatically by sending a message to listserv@aip.org. n the body of the message specify either "add physnews" or "delete physnews."

RECOGNIZING CONTRIBUTIONS

Have you made a contribution to OAPT in the past, through working on a committee or on the executive? If you have, and would like a letter of recognition to keep on file, contact OAPT's president, Diana Hall, at the address listed on page 2. In your message give the details of your involvement.

INTERNET INTEREST

There is now a Workshop Physics Discussion Forum on the Web. It can be reached via:

http://physics.dickinson.edu

The official statement of its purpose is:

The Workshop Physics Discussion Forum is strictly a place for the discussion of topics directly related to the use and adaptation of the Workshop Physics Curriculum. The forum participants should be college faculty, instructors and administrators from schools, colleges or universities where all or part of Workshop Physics have been implemented or are under very serious consideration for implementation.

Note: Postings that are deemed to be outside the scope of the above guidelines will be removed from the forum.

Even those of you who are not already using components of Workshop Physics might be interested in following the dialog between those who are.

Yahoo! Science Web Sites
http://www.yahoo.com/science/

WHY WAIT UNTIL IT'S TOO LATE?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

Membership Application

Renewal ☐ **Change of Address** ☐

Name ____________________

Address ____________________

____

$8.00 / year x ____ years = $ ______ , payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

THE DEMONSTRATION CORNER

Bernoulli Lost His Marbles

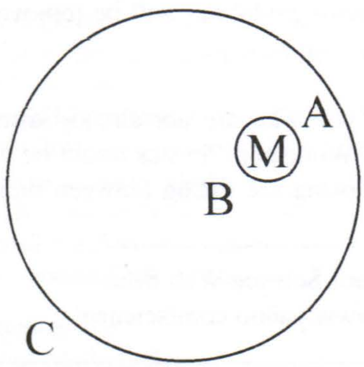
by

Al Bartlett

University of Colorado
Boulder, Colorado, USA 80309

Fill a one-litre graduated cylinder with water; the cylinder should be about 5 to 8 cm in diameter and 30 to 40 cm tall. Take an ordinary glass marble and try to drop the marble into the water in such a way that the marble will fall all the way to the bottom without first hitting the side of the cylinder. The marble makes an audible click every time it hits the glass wall.

The marble is always drawn to the wall it bounces off and then hits the opposite wall. I have never seen one go down without first hitting the wall.



I believe the explanation is this. If C is a horizontal cross-section of the cylinder and M is the marble, then an observer on the marble will see water flowing upward all around the horizontal equator of the marble. But, because of the proximity of the wall, the upward flow velocity at A will be greater than at B. By the Bernoulli principle, the pressure at A is less than at B, and the ball is moved to the nearest wall. As the gap narrows, the force increases and the marble strikes in an approximately elastic collision, and bounces away from the wall with sufficient velocity to cause it to move out.

In principle, one should be able to drop the marble exactly on centre just as you should be able to make a sharpened pencil stand on its point. In practice, of course, this is impossible.

I first saw this demonstration performed by William B. Pietenpol of the University of Colorado (Boulder).

Column Ed. Note: Al Bartlett sends his best wishes to all his friends in the OAPT. He still goes out on the road giving his exponential-growth talk, which he presented 62 times last year.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1; Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

PHYSICS DEMOS FROM THE WOODROW WILSON PHYSICS INSTITUTE

compiled by Pat Cannan

Physics Institute: Woodrow Wilson National Fellowship Foundation
Box 642
Princeton, NJ 08542

Shifting to Doppler:
Get a code oscillator circuit (e.g. Radio Shack #20-115), a 5cm speaker, a small switch and a 9 volt battery clip. With a sharp knife slice into a Nerf ball and imbed all parts inside. Turn on the switch and throw the ball to students in the class. Pitch will change noticeably depending on whether the ball is approaching or receding. (Total cost is about $9).

Splitting Hairs:
A human hair held in the laser beam will produce a single-slit interference pattern. (The hair forms a single thin barrier.) The width of the hair can be determined by measuring the spacing of the secondary maxima and using the single-slit equation.

Learning the Ropes:
A convincing session in vectors:
Have two burley guys pull a rope between them as tight as they can. Then have your smallest kid pull sideways in the center of the rope. He will have no trouble pulling the burleys toward each other.

WHY WAIT UNTIL IT'S TOO LATE?

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Name ____________________

Address ____________________

____

$8.00 / year x _____ years = $ _______ , payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVIII, Number 3 Spring 1996

EDITORIAL:

LETTING RESEARCH INFORM PRACTICE

Don't knock it 'til you try it

When I started teaching I remember clearly listening in on the conversations of the more experienced teachers, hoping to hear any educational important scrap that I could use in that day's classes (I couldn't just ask outright for help, I had a piece of paper telling me I could teach, it would have been embarrassing if my colleagues found out that I was struggling to survive in the classroom; they didn't appear to be having any problems—but that's another editorial). One of the first things I learned was that educational research was useless as far as the practicing teacher was concerned. Researchers lived in their ivory towers and, if they had had any teaching experience at all, it had been so long ago that they had no idea of what they classroom was like now.

It has taken me the better part of ten years to unlearn this 'fact'. Educational research is not performed in a sterile lab environment with the results extrapolated to the classroom. Most of the research literature I have read has a very practical nature. In many cases researchers work in the classroom with teachers, trying out and evaluating their models.

The idea that the only way to learn about teaching is to teach needs to be modified by adding two conditions. The first condition is that, when designing and implementing curriculum, teachers need to have more than a passing knowledge of the research into learning. For example, a lot of studies have been done on students' alternative conceptions in mechanics, electricity, heat and temperature and other areas. Many of these alternative conceptions are formed over many years by a student's observations of his or her environment, and are very resistant to change through instruction—even when the student is confronted with a demonstration that directly contradicts one of these conceptions. Many of these concepts are similar for students across different cultures (e.g., in mechanics, many of the features of the Aristotelian view of the universe are found in students around the world), and some are persistent enough to still be found in university physics professors.

The second condition for improving teaching practice is through the deliberate reflection on a particular unit or lesson when evaluating its educational value. This reflection needs to be more than a 'gut' feeling that things went well—perhaps by having a colleague come into your class, or by video-taping some of the key lessons during a unit. Evaluation of the students needs to be more than a summative paper and pencil test. It might include interviewing students about a concept, having students predict and explain the outcome of a demonstration, or using some of the other techniques researchers and teachers have created for this purpose.

PHYSICS NEWS UPDATE

The American Institute of Physics Bulletin of Physics News. Number 262. March 14, 1996 by Phillip F. Schewe and Ben Stein

THE SURFACE OF PLUTO HAS BEEN IMAGED for the first time. The Hubble Space Telescope has snapped a series of high-resolution pictures throughout Pluto's 6.4-day rotation period. The photo sequence reveals that Pluto possesses more visible large-scale features than any planet except for Earth. The features include a variety of dark and bright spots and a dark stripe across the frosty north pole. Pluto had not previously been imaged clearly before, even with the bigger Earth-based telescopes, because its angular size on the sky is only a tenth of an arcsecond across. All of this comes at a time when some astronomers want to take away Pluto's status as a planet. (NASA press release, 7 March 1996.)

IN THE LATE HEAVY BOMBARDMENT (LHB) EPOCH, a span of about 200 million years some 4 billion years ago, the Moon sustained many large impacts. Some astronomers believe that the projectiles responsible may have pestered Mercury, Venus, Earth, and Mars as well. Others assert that the LHB phenomenon was unique to the Earth-Moon system or that it did not happen at all, at least not so suddenly. Now, a group of scientists at the University of Manchester (UK) has dated a rock found here on Earth but which is believed to have been a meteorite originating at Mars. The 4-billion-year age of the object, determined by isotope dating, is much older than previously studied Martian meteorites. The antiquity of the rock, say the researchers, provides evidence for a widespread LHB effect. (R.D. Ash et al, Nature, 7 March 1996.)

You should have received a mailing about the June conference at York, and the OAPT Physics contest in May. If you did not get this mailing, please send me a note (the address is on page 2) and we will get the information to you.

UNIVERSE!

A Hands-On Astronomy Workshop for Teachers

Saturday April 20, 1996; 10 am - 5 pm

Ontario Science Centre*

770 Don Mills Road, North York, Ontario

The workshop includes exciting lecture and planetarium presentations, practical demonstrations, displays, hands-on activities, resources and discussions designed to help teachers understand astronomy concepts, and implement them in their classrooms. Target audience is grade 5-10 teachers, but all educators will benefit from the workshop. Presenters include Michele Gerbaldi (Université de Paris), John Percy (University of Toronto) and others to be confirmed.

En Francais: A parallel workshop in French will be held at the same time and place. Presenters include Michele Gerbaldi (Université de Paris), and others to be confirmed.

Sponsors

Ontario Science Centre
Marc Garneau Collegiate Institute
Metro Toronto Science Coordinators Association
Ontario Secondary School Teachers' Federation
Royal Astronomical Society of Canada
Royal Ontario Museum
Science Teachers' Association of Ontario
University of Toronto

For more information or registration forms
Contact Kirsten Vanstone (voice: 416-696-3177; fax: 416-696-3197), Ontario Science Centre, 770 Don Mills Road, North York, Ontario M3C 1T3. Renseignements en francais, composer le 416-696-3136. Pre-registration fee of $25 includes lunch, am and pm snacks, and handouts. On-site registration fee: $30.

This event is part of International Astronomy Week 1996

* NOTE: If the OPSEU strike continues past March 25, the workshop will be moved to the University of Toronto. Registration will go to John Percy, Erindale College, University of Toronto, Mississauga, ON, L5L 1C6, FAX 905-828-5425, phone 905-828-5351.

PHYSICS DEMOS FROM THE WOODROW WILSON PHYSICS INSTITUTE

compiled by Pat Cannan

Physics Institute: Woodrow Wilson National Fellowship Foundation
Box 642
Princeton, NJ 08542

Baffle the Speaker:
Purchase an ear phone attachment for a cassette player. Cut off the ear piece and in its place solder a small (5cm) speaker (Radio Shack). Plug this speaker into the cassette player and listen to the musical sounds before and after the speaker is placed near the opening of each of the following objects: plastic pipe, bottomless styrofoam cup, a sheet of 60 cm square cardboard with a 5cm hole cut in the center.

Football Spin:
Try spinning the following objects on a bare floor or on a smooth table top: Small toy football, hollow egg-shaped plastic container (l'eggs), full-size football. Though the football begins its rotations about its short axis, it reorients itself to a lower energy state by standing up and rotating about its longer axis. (See The Physics Teacher, Vol. 15. p 188, 1977).

The Levitating Screwdriver:
When various objects are individually placed in a narrow stream of fast moving air, they seem to float. Objects which have been used include: golf balls, small footballs, styrofoam balls, rubber balls, steel balls, hollow egg-shaped plastic containers, and smooth handled screwdrivers.

E-Mail Us!

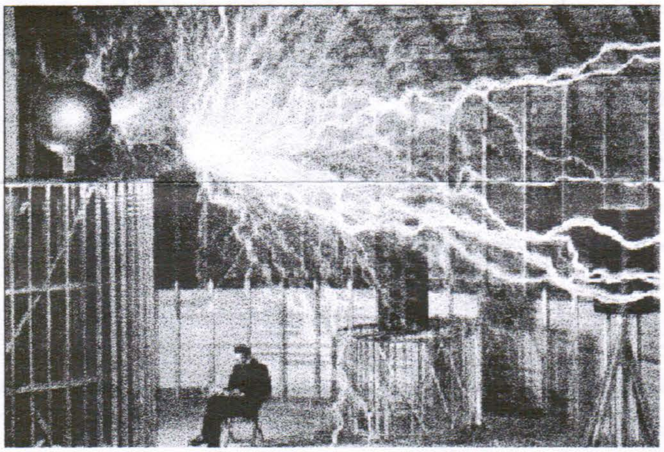
We want to hear from you: your comments, criticisms, observations...
Send correspondence to:

OAPT Newsletter, c/o Paul Laxon
201 Chestnut St., St. Thomas, ON N5R 2B5
(519) 631-4460, fax: (519) 633-9014
e-mail: plaxon@edu.uwo.ca

Recommended Reading

by Alan Hirsch

If you want to interest your students with intriguing stories of the ultimate "mad physicist," you do not have to look beyond the real-life stories of Nikola Tesla. Although physicists and physics educators are well aware of the Tesla coil, and Tesla has been honoured by having the unit of magnetic flux density named after him, most people are unaware of this man's important contributions to our world and of his eccentric, almost unbelievable, lifestyle.



You can find an excellent introduction to Nikola Tesla's life and contributions in Pierre Berton's *Niagara—A History of the Falls* (McClelland & Stewart, Toronto, 1992). The entire book is fascinating, but Chapter 7 is of special interest to physics educators because it delves into harnessing the falls to produce electricity. Berton brings to life the intellectual battle between Thomas Edison, who stubbornly argued for the generation of direct current, and Nikola Tesla, who could foresee the advantages of generating and transmitting electricity using alternating current. As we know, Tesla won the battle. But did he become a celebrated hero of invention, as did his opponent and former employer, Edison? No. And did Tesla become rich through his inventions, as did the industrial giant, the George Westinghouse Corporation, which manufactured his designs? Again, the answer is no. However, the stories behind these negative answers are exciting and unusual in a way that is stranger than science fiction.

Berton devotes pages 210 to 221 to Tesla, and there he mentions one important biographer, Margaret Cheney, who wrote the book *Tesla: Man Out of Time* (Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1981). I recently bought this book for only $7.50, and I highly recommend it for physics teachers who want to go beyond the lay person's understanding of Tesla's life. This book was written after research revealed findings about Tesla's life that previous biographers had not known. The book includes numerous references, eight pages of rare photographs, and a comprehensive index.

In the bibliography near the end of Berton's *Niagra* are references to other resources about and by Tesla. (See the following entries: Goldman, Hunt, Ratzlaff, Tesla and Tribute to Nikola Tesla.) If any reader has access to any of these resources and is willing to review one or more of them, I am sure the readers of this newsletter would be interested in your comments.

Internet Interest

The Proceedings of the Third International Seminar on Misconceptions and Educational Strategies in Science and Mathematics.

http://meaningful.education.cornell.edu/

This seminar, held in 1993 (the first was in 1983, and the second in 1987), brought some 500 people to Ithaca. They presented 283 papers on a variety of topics relevant to dealing with alternative conceptions (see the Editorial on p. 1). All of the papers from this conference are online. Ascii text files can be downloaded, or the completely formatted paper. To view the formatted papers you need to download the viewing software: BINHEX (which converts the downloaded file into a .DP file) and VIEWER (which views the .DP files). The files are organized by author and subject.

ASTRONOMY SITES

AstroWeb: http://stsci.edu/net-resources.html
Advanced Space Studies: telnet://cass.jsc.nasa.gov (login: cass, password: online)
Einet Galaxy's Astronomy Collection: http://www.einet.net/galaxy/Science/Astronomy.html
Guide to Stars and Galaxies: http://www.eia.brad.ac.uk/btl/
The Nine Planets: http://www.atklab.yorku.ca/tnp/nineplanets/nineplanets.html

How About That?

by

Murray D. Kucherawy

A.B. Lucas S. S., 656 Tennent Ave.
London, ON N5X 1L8

Effective classroom demonstrations often require tinkering with temperamental equipment. With the permission of the editor, I would like to share a "thought demonstration" that requires no equipment, but which still makes a surprising point.

A physics teacher's wife took her gold wedding ring to a jeweller for repair. It was her 25th wedding anniversary and the jeweller who originally had sold the ring noted that the wear amounted to 0.25 g. The physics teacher decided to calculate the rate of wear in the interesting units of atoms/second. Estimating the molar mass of 14k gold to be 120 g/mole, we get:

$$0.25\text{ g}/25\text{ yr} = (0.25\text{ g}/(120\text{ g/mole})) \times 6.02 \times 10^{23}\text{ atoms/mole}$$

$$\div (25\text{ yr} \times 365\text{ days/yr} \times 24\text{ hr/day} \times 3600\text{ s/hr})$$

$$= 1.6 \times 10^{12}\text{ atoms/s}$$

Before beginning the solution, do ask your students what they consider to be "reasonable" answers. You'll be surprised.

End the session by asking why you are not knee-deep in gold atoms as you walk around the class.

(based on an article by J. Shull, Alfred University.)

NOTE: If, during the solution, your students can tell you coherently what a "mole" is, treat your local chemistry teacher to a coffee. He/she will have earned it!

Editor's Note: Fermi questions are an excellent way to get students to practise estimating (which is a good excuse for putting a large picture of Fermi here).

Now, a second thought experiment your students will enjoy.
A monkey hangs onto a long, massless rope which passes over a large-diameter, massless, frictionless pulley and is connected to a mirror equal to the monkey's mass directly opposite the monkey. On seeing his image, the monkey is frightened and wishes to escape. Can he?

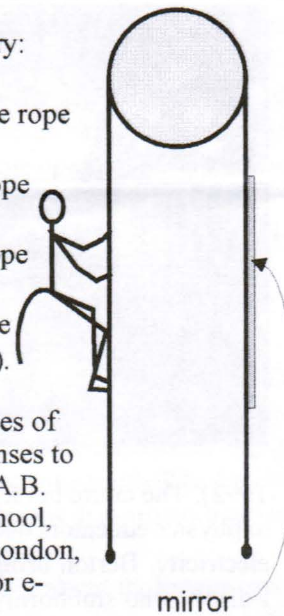
The monkey might try:

(i) climbing down the rope

(ii) climbing up the rope

(iii) letting go of the rope

(iv) something else (should be interesting).



Please send in samples of your students' responses to (iv). Contact me at A.B. Lucas Secondary School, 656 Tennent Ave., London, Ontario, N5X 1L8, or e-mail to murrkuch@village.ca.(*Editor's note: this may not be possible at the moment; see the notice on below about Village e-mail*) The best answers will appear in a later edition of this *Newsletter*.

ELECTRONIC VILLAGE DOWN

As many of you may know, the *Electronic Village*, through which many Ontario teachers had an e-mail address, was shut down. I have heard that they are trying to get it running again, but you cannot send e-mail to Village addresses at the moment.

You can reach me at: plaxon@edu.uwo.ca

Paul Laxon, Editor

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XVIII, Number 4 **Summer 1996**

AAPT Winter Meeting Report

Reno, January 13 - 18, 1996

by Peter Scovil, Section Representative
E-mail: petescov@enoreo.on.ca

This year's winter meeting was held in very different surroundings—at a casino in Sparks, just outside Reno, Nevada. The weather was like early April in Ontario. The first two days were involved in workshops. I attended three on programmable calculators and calculator based labs. We worked with TI-82 calculators along with CBL units that Texas Instruments has designed for gathering data using various sensors available from them or a Vernier distributor. A new sensor is the accelerometer probe which is very interesting to use. I tried it out on an elevator ride. A roller coaster would be incredible. There is great potential in using this system because of its lower cost and much greater portability compared to a computer. They would be great for Science Day at Wonderland. Information can be transferred from calculator to calculator using a link cable so more students can share lab results and do their own individual spreadsheet and graphical analysis. Programming is more difficult, but a Graph Link can be purchased through a Vernier supplier allowing you to transfer data and programs between the calculator and a computer. A lot of programs are already available for almost every topic in the physics curriculum. I intend to give more details at the conference at York University in June.

Keith Jackson of Lawrence Berkeley Laboratory talked about microtechnology. Examples he gave included 19 x 19 μm horseshoe magnets for read/write heads, ($1.3 billion sales in '92), and 5.6 μm thick micromotors that can fit through the eye of a needle.

Several sessions related to the early history of X-rays, commemorating the centenary of their discovery. The first diagnostic X-ray took 20 minutes exposure time. Medical X-rays did not catch on for about 20 years because the early tubes depended on gas ions in the tube to hit the cathode and release electrons. This made them very tricky to use, and involved dangerous levels of excess exposure in checking their operation. The first *vacuum* X-ray tube was not developed until 1914. Now 120 million X-rays are taken per year, along with 9 million nuclear medicine scans and 7.7 million MRIs.

More Summer Reading

In the last newsletter Al Hirsch talked about Pierre Berton's book about Niagra, and his view on Nikola Tesla. Denis Brian's new biography of Einstein, Einstein: A Life (John Wiley & Sons, Inc., 1996), tells how Tesla rejected Einstein's view on gravity, called atomic power an illusion, and mocked the idea that energy could be obtained from matter according to the formula $E=mc^2$. Tesla's credibility was erroded, though, when word of some of his eccentricities leaked out (he was afraid of billiard balls and pearl necklaces, and was reluctant to shake hands for fear of catching a disease), and when he began working on devices such as a camera to photograph thoughts and a death ray. "But what finally brought his critical faculties into question was his confession to being romantically involved with a pigeon," (p. 104).

Brian's book is full of interesting asides about the people that touched on Einstein's ideas. It also contains many items (for example, that Einstein and his first wife Mileva had an illegitimate child) that have only been discovered since the release of controversial material withheld from researchers by Eintein's close friend and executor, Otto Nathan, and his long-time secretary, Helen Dukas.

I found this book to be a wonderful complement to other biographies, like that of Ronald Clark. It shows more of the human side of Einstein's life—his relationships with women for example—without undermining the greatness of what this one man accomplished.

Read any good physics books lately? Send us a review and let other teachers read about it.

OAPT Web Site

Guleph University is now the host of an OAPT web site. The URL is:

http://www.physics.uoguelph.ca/OAPT/index.html

Address Correction

Any correspondence for Bill Prior should be sent to:
Malvern College, 55 Malvern Road,
Toronto, Ontario, M4E 3E4

PHYSICS NEWS UPDATE

The American Institute of Physics Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

INTERSTELLAR DUST PARTICLES ENTERING EARTH'S ATMOSPHERE have been detected by astronomers in New Zealand. Their radar scanner not only spots the tiny objects (tens of microns in size) but also determines the meteoroid velocities. Those with speeds of more than 100 km/sec (about 1% of the sample), well above the solar escape velocity of 73 km/sec, are believed to come from other planetary systems. The researchers, furthermore, use the annual variability in the flux of these fast meteoroids to identify several possible discrete extra-solar sources. (A.D. Taylor et al., Nature, 28 March 1996.)

THE FIRST X RAYS EVER SEEN COMING FROM A COMET have been observed by the orbiting Rosat x-ray telescope. Without really expecting to see much signal, the Rosat scientists monitored Comet Hyakutake, the brightest comet in more than 20 years, on its swing past Earth a few weeks ago. One provisional explanation for the phenomenon is that x rays from the sun were absorbed by and then reradiated by gas clouds at the comet. Another theory holds that the x rays result from solar wind particles striking the comet. (NASA press release, 27 March.)

TWO EFFORTS TO MEASURE THE HUBBLE CONSTANT are converging somewhat. Wendy Freedman of the Carnegie Institution reported at a NASA press conference today that she and her colleagues were finding that values for the Hubble constant (H), a measure of the expansion of the universe, hovered in the range 68 to 78 km/sec/Mpc. (In 1994, they reported a preliminary value of 80.) A separate group led by Allan Sandage, also of Carnegie, recently reported a Hubble constant of 57. Freedman's team is midway through a 3-year program of measuring the distance to 20 distant galaxies by observing Cepheid variable stars, whose intrinsic brightness is related to the rate at which their luminosity varies. These observations in turn can be used to calibrate other means for determining distances to objects at even larger scales where local gravitational interactions have a lesser impact on a calculation of H. The secondary yardstick methods include the determination of the peak brightness of type-Ia supernovas and the use of the Tully-Fisher relation, according to which a galaxy's luminosity is related to its rotation rate. The latest entry in Freedman's inventory is galaxy NGC1365 in the Fornax cluster, at a distance of 60 million light years. (NASA press release, 8 May 1996.)

THE OLDEST STARS IN THE MILKY WAY ARE 15 BILLION YEARS OLD. An important adjunct to the debate over the Hubble constant is the notion that the universe cannot be younger than its older stars, which appear to be those in globular clusters, spherical clumps of hundreds of thousands or millions of stars found near and around our galaxy. Don VandenBerg of the University of Victoria (davb@uvvm.uvic.ca, 614-721-7739) uses the Canada-France-Hawaii telescope to view the ancient, metal-poor stars (they largely lack the elements heavier than helium which many younger stars inherit from earlier supernova explosions) in globular clusters. By plotting the stars' luminosities versus their colors, and by employing the standard model for stellar evolution, the age of the stars can be calculated. VandenBerg, speaking at last week's meeting of the American Physical Society in Indianapolis, said the oldest reliably dated stars, in globular cluster M92, were most likely 15 billion years old. Uncertainties in the determination of the distances to the clusters (effecting calculations of the stars' luminosities) might permit an age of 13 or even 12 billion years. But VandenBerg asserted that the ages could not be much younger than that. New observations of his in globular cluster M13 did not alter this assessment.

It's not too late to register for this year's

OAPT Conference at York University

If you didn't receive a mailing with details of the conference,get in contact with us at one of the following numbers/addresses:

OAPT Newsletter, c/o Paul Laxon
201 Chestnut St., St. Thomas,
ON N5R 2B5
(519) 631-4460, fax: (519) 633-9014
e-mail: plaxon@edu.uwo.ca

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Membership Application

Renewal **Change of Address**

Name ____________________

Address ____________________

____

$8.00 / year x ____ years = $ _______ , payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

"Demo Corner" **(continued from page 4)**

2. The direction of the wind impact force on the sail is not in the direction of the boat's motion, but is perpendicular to the surface of the sail. Generally speaking, when any fluid (liquid or gas) interacts with a smooth surface, the force of the interaction is perpendicular to the smooth surface.

The boat does not move in the same direction as the perpendicular force on the sail, but is constrained to move in a forward (or backward) direction by a deep, finlike keel beneath the water. In our demonstration, the four wheels determine this direction. The component of the force perpendicular to the keel is a useless force that tends to tip the boat over or move it sideways. Again, maximum speed of the boat can be no greater than the wind speed. However, because the acceleration is less, the time required to attain the maximum speed is greater.

Keeping the angle of the sail relative to the boat the same as in Fig. 3, suppose now you direct your boat so that it sails directly across the wind (Fig. 4), rather than directly with the wind. Will you sail faster or slower than before? The answer is faster.

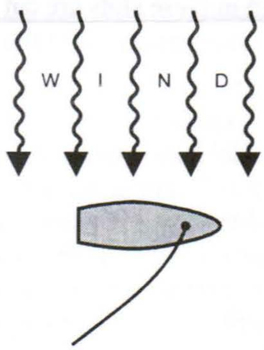

Figure 4

As before, the force vector perpendicular to the surface of the sail can be broken into components, one along the direction in which the boat can move, which drives the boat, and the other which is perpendicular to the boat's motion and is almost useless. (This transverse force is not entirely useless the generation of a small angle of "heel" increases the waterline length, and because of complex hydrodynamic effects, increases the boat speed somewhat.) Now, if the principal force vector in this case were not greater than before, the speed of the boat would be the same. But the force vector is greater. The reason is that the sail does not catch up with the wind speed so it will not eventually sag like before. Even when the boat is travelling as fast as the wind, there is an impact of wind against the sail. This drives the boat even faster, so it can sail faster than the wind in this position. It reaches its terminal speed when the ‘relative wind’ the resultant of the ‘natural’ wind and the ‘artificial’ wind due to the boat's motion blows along the sail without making impact (Fig. 5).

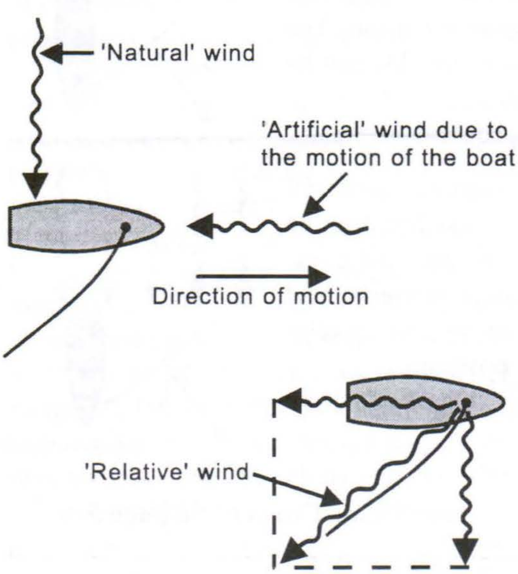

Figure 5: When the angle of the relative wind is the same as the sail angle, the wind impact is zero

It is very interesting to note that, if the wind speed is doubled, the impact against the sail is more than doubled. This is because in one second twice as much air strikes the sail and at twice the speed, so twice the mass moving twice as fast produces four times the force.

As strange as it may seem, maximum speed is attained by cutting into (against) the wind, that is, by angling the sailboat in a direction upwind. Although a sailboat cannot sail directly upwind, it can reach a destination upwind by angling back and forth in a zigzag fashion. This is called **tacking** (Fig. 6).

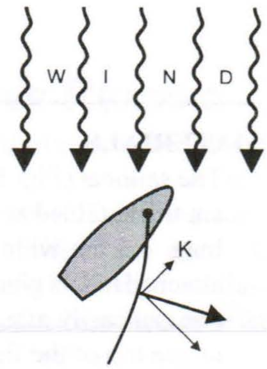

Figure 6

Component **K** will push the boat along in a forward direction, angling into the wind. In this situation, the boat can sail faster than the speed of the wind. This is because, as the boat travels faster, the impact of wind is increased. The boat reaches its terminal speed when opposing forces cancel the force of wind impact. The opposing forces consist mainly of water resistance against the hull of the boat. The hulls of racing boats are shaped to minimize this resistive force, which is the principal deterrent to high speeds.

Because of its minimal drag on the surface, an ice boat can go up to an estimated five times the speed of the wind. The official iceboat speed record, 230 km/h, was set by an old-fashioned stern-steerer in 1938, but the unofficial record is claimed by a giant yacht which covered 1.9 km in 25 seconds, reaching about 274 km/h.

The Sailboat Problem

by

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MATERIALS

1. The sailboat (Fig. 1): a block of wood 24 cm long, 7 cm wide, and 2 cm thick. Glued at the centre of this is another wooden block, 20 cm long, 4.5 cm wide, and 2.5 cm thick. Four roller-skate wheels are attached to this glued block. Slots of 1 cm depth and of width such that one can easily mount and remove the cardboard in these slots are cut on the top of the first block one parallel to the wheel axles but at the centre of the block, another perpendicular to the axles along the keel but at the centre of the block (call it the keel slot), a third at about a 20° angle to the keel slot but at the centre, and the fourth at about a 45° angle to the keel slot but again at the centre.
2. The sail: stiff cardboard of area 929 cm^2 (one square foot) to be placed in the slots, at various angular positions.
3. An electric fan.

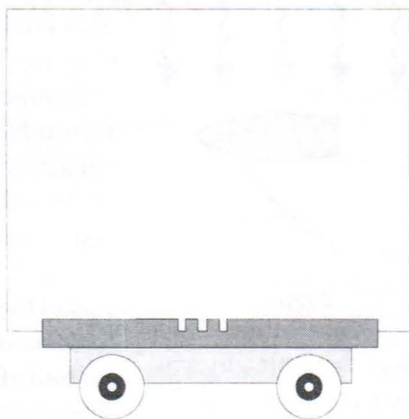


Figure 1

DISCUSSION AND DEMONSTRATIONS

The sailboat provides one of the most interesting illustrations of vector resolution. Some of the many questions raised are:

1. Suppose you are sailing directly downwind with your sails full, in a 30 km/hr wind. What maximum speed would you hope to attain?
2. You are sailing downwind and you pull your sail in so that it no longer makes a 90° angle with the keel of the boat. What will this tactic do to the speed of the boat?
3. Keeping the angle of the sail relative to the boat the same as in the previous question, suppose you now direct your boat so that it sails directly across the wind, rather than directly with the wind. Will you sail faster or slower than before?
4. Can a sailboat travel against the wind?

Consider first the case of a sailboat sailing downwind (Fig. 2). The force of the wind impact against the sail accelerates the boat. Even if the drag of water and all other resistance forces are negligible, the maximum speed of the boat is the wind speed. This is because the wind will not make an impact against the sail if the boat is moving as fast as the wind. The sail will simply sag. If there is no unbalanced force, then there is no acceleration. The force vector decreases as the boat travels faster. The force vector is minimum when the boat travels as fast as the wind. Hence the boat, when driven only by the wind, cannot exceed the wind speed.

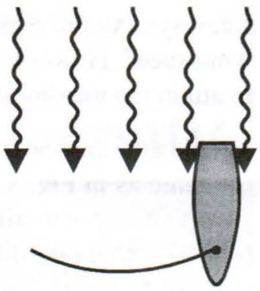
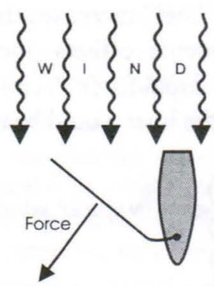
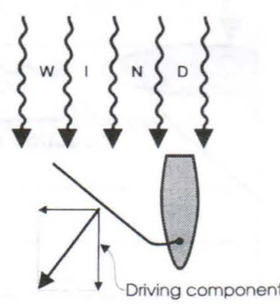


Figure 2: A sailboat sailing downwind

If the sail is oriented at an angle as shown in Fig. 3, the boat will move forward, but with less acceleration. The reason for this can be stated in two different, but equivalent, ways:



1. The force on the sail is less because the sail does not intercept as much wind as in this angular position.



See "Demo Corner" on page 3

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Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XIX, Number 1 Fall 1996

OAPT Conference Report

York University, June 20-22, 1996

by Peter Scovil, Section Representative
E-mail: petescov@enoreo.on.ca

A taped message from Robert Thirsk on board the space shuttle Columbia opened our annual conference at York University. We had good turnout of over 100 members who enjoyed talks and workshops on the theme of space and communications. We were able to tour Spar Aerospace. The computer and robotics technology they have is incredible.

There were three excellent workshops on Thursday evening. I attended the one on astronomy by Dr. Paul Delaney. We were introduced to CLEA (Contemporary Laboratory Experiences in Astronomy) which is available at: http://www.gettysburg.edu/project/physics/clea/CLEAhome.html

Dr. Michael De Robertis (mmdr@yorku.ca) of the Department of Physics & Astronomy, York University has adapted several of these labs for his undergraduate program. Other astronomy resources were listed, including Sky & Telescope, Sky News (Canadian), and web sites for Sky & Telescope, York U., Dominion Astrophysical Observatory, and NASA. The York U. Astronomical Observatory is open Wednesday, May to September, 9-11:30 pm for viewing and other presentations. Call 736-2100, ext 77773. An interesting project used at York involved photographing a constellation using a 35 mm camera with about 20 s time exposure and ASA 100+ film. Contact Dr. Delaney (Dept. of Physics & Astronomy, York U.) for details.

Another workshop was about atmospheric monitoring, by Shiv Pal and Don Hlang, where people learned about and tested ground based sensing technologies and saw the results of LIDAR measurements. The third workshop was on the internet - a popular topic also given at the last two conferences—given this year by Judy Libman and Ian Lumb. York has an information service for science educators at nucleus@science.yorku.ca

The conference sessions were started with Professor Marshall McCall (York U) showing us a clearer view of our galactic neighbourhood, a view needing clarifying when 15% of students identify the moon as a star. Elio Covello (Huron Heights S.S.) showed amateur science is not dead by giving us a look at the base *e* nature of Kepler's third law, suggesting there may be "allowed" orbits for planets around the sun. John Caldwell (York U) updated us on the 2.4 m diameter Hubble Space Telescope. We have heard about the correcting mission (the mirror was out by about 2 im). One problem now is diffraction about the secondary mirror supports, causing a "cross" about off-axial stars. An upgrade mission is planned for 1997, and a boost for orbit will be needed in 1999. (The Hubble Telescope website is http://www.stsci.edu/pubinfo/Latest.html)

To prove that we are open-minded, we were brought back to earth by Professor Geoff Harris of the Centre for Atmospheric *Chemistry* - York U. He described how he used tunable diode lasers to measure the trace gas nitrous oxide. Agriculture and the increased use of fertilizers is causing an increase of 0.3% per year. Nitrous oxide is a greenhouse gas and also breaks down the ozone layer.

Our banquet speaker was Dr. J. Megaw who spoke to us on Chernobyl: Ten Years After. What was the human cost? We hear fantastical claims from both extremes. We know 31 died immediately or within weeks. 237 were highly irradiated, with most still alive. 135 000 were in a 30 km radius, and show no symptoms, although 280 are expected to die as a result of the accident. There has been no increase in leukemia. There are increases in childhood cases of thyroid cancer with one death. The worst problems are psychological. Poor information handling by the Soviet government resulted in a loss of confidence. Problems with nuclear reactors occur during shutdown, not during routine operation. The positive side of the accident is the much heightened awareness of reactor safety throughout the world. And too little is said about the deaths due to coal-powered plants. Dr. Megaw demonstrated his expertise in this field in a most interesting manner.

Conference continued on p. 2

OAPT Web Site

Guleph University is now the host of an OAPT web site. The URL is:

http://www.physics.uoguelph.ca/OAPT/index.html

Conference continued from p. 1

From research to the classroom, quite a number of talks were devoted to educational issues. Alan Slavin (Dept. of Physics, Trent U, aslavin@trentu.ca) talked about using flow charts to help students decide what method to use in solving problems. Most students try to memorize a specific procedure and set of equations for each "problem type". Instead, physics should involve building a solution from fundamental concepts and laws. The flow chart leads students from starting conditions to the final answer using basic principles and laws, NOT memorized formulas, resulting in improved student performance. Elgin Wolfe summarized research on steps individuals take in solving problems and pedagogical methods for improving problem solving skills. Planning is a key, as experts take longer to assimilate information than novices, and work from general principles rather than starting with formulas. We can help students organize knowledge in hierarchical form (e.g. see above), to look for similarities and differences. We can encourage them to verbalize problem solving in pairs. (Think - pair - share) Analogies are very helpful and should be used carefully and frequently. Jan Van Aalst (OISE) demonstrated CSILE, a network system that provides across-the-curriculum support for collaborative learning and inquiry. See http://csile.oise.on.ca/armstel/mst.html

Don Bosy and Nagy Riad were unable to share much of their experience in improving physics teaching due to a programming glitch. Sorry, fellows. Perhaps next year? Contact Don through C.C.S. (CCS@IO.ORG)

Bob Loree (Oakville Trafalgar High School) described the Co-operative Education Science/Technology Project with the Halton board, giving students opportunities to experience science in the workplace. You may also wish to contact McMaster regarding their Engineering Fireball Show.

Other useful ideas and demonstrations were presented. Bob Tkach (Cawthra Park SS) explained how he used bonus marks to encourage students to do extra preparation for the SIN contest. Ernie McFarland (elm@physics.uoguelph.ca) used electromagnetic induction to flash an old-style camera flashbulb. Irwin Talesnick dazzled us with an incredible variety of demonstrations. Roland Meisel (Ridgeway-Crystal Beach HS - rollym@iaw.on.ca) showed us different ways of using a Tesla coil, such as a radio transmitter, lighting up fluorescent tubes and discharge tubes, producing streamers on a regular light bulb due to the argon in it. Kim Maynard (Montcalm SS, London) described an outline of an ISU on friction. And Ronald Lewis (Lively DHS, Sudbury Bd gave us an informative primer on fractals with good examples of their applications in many fields, and hands-on activities that you could use with students. He has a course of study, text and lab manual available. (705-566-3264 - ronalewi@enoreo.on.ca)

In recognition of 10 years of service on the OAPT executive, Al Hirsch was presented with a Life Membership Certificate by OAPT president, Diana Hall.

Dave Logan and the York University physics department did a great job in organizing the conference, getting excellent speakers, feeding us and housing us. Thanks for a great time! Next year, the conference is to be held at Brock University. Our Conference host will be Dr. F. Razavi. Dates are June 19-21. P.O. Box 1169 Waterford ON N0E 1Y0

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

POSSIBLE EVIDENCE FOR LIFE ON MARS has been reported by a team of scientists studying an ancient rock found in Antarctica in 1984. Minerals in the rock suggest that it came from Mars, where it was probably ejected by a giant meteor impact event some millions of years ago. The rock itself, referred to as ALH84001, was formed billions of years earlier, at a time when Mars was warmer, wetter, and presumably more hospitable to life. What does the rock tell us? Team leader, NASA scientist David McKay, says that several strands of evidence, none of which is conclusive by itself, together point toward the existence of ancient life forms on Mars. Microscopic inspection of the rock shows, for example, the presence of organic molecules called polycyclic aromatic hydrocarbons, which can come from the breakdown of biological or non-biological sources. Also present in the sample were minerals sometimes (but not always) associated with bacteria, namely carbonate granules, magnetite, and pyrrhotite. Finally, sample images show 100-nm-sized ovoid shapes which, McKay suggests, might be the fossilized creatures themselves. Various outside scientists have been impressed by the data but skeptical of a biological interpretation; they argue that non-biological causes could account for all of the new findings. Meanwhile, government officials, including President Clinton and NASA administrator Daniel Goldin, have expressed great interest in this research, and proposals for new Mars-oriented projects will doubtless receive great attention. (David S. McKay et al., Science, 16 August 1996.)

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Trent Professor Wins National Teaching Award

OTTAWA — Trent University professor Al Slavin received the Canadian Association of Physicists (CAP) Medal for excellence in teaching at CAP's annual conference.

Slavin is the second recipient of the national award given by the association. It is his fourth teaching award in four years. He won Trent's Symons Award for teaching excellence in 1992, the national 3M Fellowship for excellence in teaching in 1993 and Ontario's Lieutenant Governor's Award for teaching excellence the same year.

A physics professor at Trent since 1973, Slavin is considered an outstanding and innovative lecturer whose mission to make physics understandable for first-year undergraduates has inspired more than the usual proportion of students to pursue further studies in the field. He uses a student-centred approach to learning, encouraging students to help each other in small groups and giving them problem-solving strategies to make learning physics easier. Swinging on the end of a pendulum has made his in-class demonstrations the stuff of legend. In their end-of-year evaluations, students consistently rave about his ability to make physics relevant, interesting and unintimidating.

He shares his teaching techniques with secondary school, college and university instructors at meetings of the Peterborough Physics Teachers Association, a forum he initiated.

An advocate for women in a male-dominated domain, Slavin has fostered a women-in-science support group at Trent and regularly speaks at high schools about the need for women to pursue science careers. He encourages physics students to see themselves in a wider world context and has organized a year-abroad program for third-year physics students.

Slavin also leads an active research life, supervises graduate students, is an adjunct professor in Queen's University and serves on a national research grant selection committee. He is founding chair of Trent's graduate program in Applications of Modelling in the Natural and Social Sciences.

Internet Inerest

Check out the Physics Education Research Papers at: http://www.physics.umd.edu/rgroups/ripe/perow.html

Demo Corner...continued from p. 4

27 Make static electricity.
28 Use a prism to make a rainbow.
29 Use a fine net curtain to make a rainbow.
30 Look at different street lights with your prism or your fine net curtain.
31 Split up the colours in a felt marker. Use paper towel with one end in water. Drape the towel over the edge of the glass, and colour it just above the water level. (This is chromatography.)
32 Float a needle on water.
33 Explain why battleships float, but pennies sink.
34 Make a cardboard boat to hold lots of pennies.
35 Blow a big bubble.
36 Blow a little bubble.
37 Use a piece of paper to demonstrate lift.
38 Make a paper aeroplane. Explain how you improved its design.
39 Make a kite and fly it class.
40 Make a parachute.
41 Make a windmill.
42 Do an experiment on centre of mass.
43 Do an experiment on levers.
44 Do an experiment on tension in strings.
45 Make a sundial.
46 Make a pendulum. Use different masses and lengths.
47 Make a coupled oscillator. We have a few film loops on this.
48 Compare how quickly a glass of water (the Oceans) and an identical glass of sand (the continents) heat up.
49 Compare how quickly a black covered glass of water heats up compared to a white covered glass.
50 Build a wind vane.

If you try the One-Minute Experiment, please let me know how you find the experience.

One-Minute Experiments

by

Patrick Whippey

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Something wonderful happened in my Physics 21 class just before Christmas last year. There wasexcitement, wonder, great mutual support, and just plain fun as one hundred and twelve studentsdemonstrated 52 experiments in 52 minutes. Are you familiar with the idea of the one-minute paper? At the end of the class, students areasked in one minute or less to write down the best thing, or the worst thing, or the obscuresttthing that happened that day. It is one way of getting a read on the mood of the class, and findingout what went well and what didn't. In Physics 21, Physics for Non-Scientists, most students arefrom the Faculties of Arts or Social Science and are taking the course because they have to takeat least one course from the Faculty of Science. This is not a lab course, but I have wonderedhow to encourage everyone to try some experiments at home, perhaps in the kitchen using thematerials from the grocery store, such as plastic wrap or aluminum foil. Then came the idea of aOne-Minute Demonstration.

I challenged the students to do a One-Minute Experiment at the last lecture before Christmas,either in pairs or alone. Would this experiment work? Could we really do demonstrations at therate of one every minute? Would they be interesting? Would we see an aluminum can filled withsteam collapse 52 times? This occasion was a highlight of my teaching career, an hour that I shall always treasure. Canscollapsed. Volcanoes erupted. Lasers lit. Rainbows glowed. Prisms parsed light into colour. Battleships floated in bathtubs. Pennies sank. Balloons popped. Aeroplanes flew. Paper bridgescollapsed in the wind. Bubbles drifted over us all.

To get started, I made a list of 50 experiments. A trip to any science or children's museum willturn up a book or two of suggestions. I happened to use Science Is by Susan Bosak, published byThe Communications Project, 164 Tomlinson Circle, Markham, Ontario L3R 9K2, and ScienceWizardry for Kids, Margaret Kenda & Phyllis Williams, published by Barrons 1992. Both ofthese are marvelous books.

1 Find the Invisible Spaces between molecules. 1 Cup of water + 1 cup of rubbing alcohol does not equal 2 cups
2 Prove that the invisible molecules are moving. Leave a glass several hours. Put in a drop of food colouring. After several hours, the water is all 1 colour.
3 Prove that molecules move faster when hot. Repeat the above with hot and cold water.
4 Make a model of the water molecule.
5 Make models of other molecules or crystal structures.
6 Make a volcano out of baking soda, vinegar and food colouring.
7 Make an acid-base indicator from red cabbage.
8 Use it to test for acids and bases.
9 Does (your favourite pop) really dissolve teeth?
10 Burn a candle inside a glass inverted and sitting in water.
11 Put some steel wool inside an inverted glass sitting in water. Leave it a week.
12 Put vinegar, salt, copper pennies and a nail into a glass and let it sit for a while.
13 Make a pinhole camera.
14 Show that water expands when it freezes.
15 Find the freezing point of salt water.
16 Hang a piece of wire over an ice-cube and show the wire goes through the cube.
17 Grow a crystal.
18 Make a kaleidoscope.
19 Explain how a mirror works.
20 Why does a mirror reflect left to right, but not upside down?
21 Demonstrate how light bends when it enters water.
22 Put out a candle with a sound wave.
23 Make music with bottles filled to different depths with water.
24 Make waves on a string or on water or in air.
25 Make a musical instrument.
26 Make a battery from a paper clip, copper wire and a lemon.

Demo Corner continued on p. 3

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Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XIX, Number 2 **Winter 1997**

Spacing Out with your Students

by Diana Hall

I recently took my OAC Physics Class to Cosmodome's Space Camp in Montreal. We had a Blast so I thought I'd share it with everyone.

The Space Camp has a life size model of the Endeavour complete with computer simulators. There are also 6 NASA type simulators which allow the students to experience some of what it might be like to live and work in space, weightlessness and disorientation. Although some of them were more realistic than others, and you really can't escape completely the effects of earth's gravity, the students found the simulators exciting and educational. The highlights were the zero gravity wall, which allowed them to float beside a wall and attempt to do various tasks while Newton constantly threw his third law at them. A similar feeling of frustration was obtained in the 5 Degrees of Freedom Chair which floats on a cushion of air. Students were put to work on the outside of the space shuttle while floating on a cushion of air. (Newton's 3rd once again). They had to manoeuvre themselves upside down in order to maintain their position next to the wall while having hands free to complete a task. In the MMU's they had to manoeuvre using joy sticks to accurately position themselves next to a satellite (again, no friction).

While strapped into the multi axis giro, the animators asked questions which required them to focus on a calculator to solve a problem or read a sign while moving with 6 degrees of freedom. (They made me try that one. It rattled my brains and left my legs very shaky for a long time after.)

There was a tour of ground control and two workshops on Space Suits and Launch and Reentry. My students were divided into groups of 12 each with their own animator (group coordinator). The students thoroughly enjoyed the day. They found the animators, knowledgeable as well as entertaining. Cosmodome runs a number of programs at Space Camp ranging from a half day to a six day sleep over camp. During the longer programs, the students actually plan and execute a complete mission. I strongly recommend the Space Camp, especially for students in Eastern Ontario, although they say that they get groups coming from Canada's West and the States as well. For one day, the cost was $32 per student. My students each paid $42 including the bus and reported that the price was about right!

For information call 1-800-565-2267 or check out their web site at http://www.sim.qc.ca/Cosmodome

Internet Interest: http://bonsai.physics.perdue.edu/getdb.html
This web site allows you to search for any articles from the *American Journal of Physics* and *The Physics Teacher*.

Why AAPT?

by Peter Scovil, Section Representative

OAPT is a great organization - and at a great price! For that you get a newsletter, and an opportunity to share in an organization that gives you the OAPT Physics Contest and the annual conference. So why would you want more? Why would you want to join the AAPT which costs quite a bit more money? (No, your OAPT membership does not make you an automatic member of AAPT.)

The biggest reason is "The Physics Teacher". It is a magazine devoted to our favourite subject, with articles for all levels from elementary teaching to university. The November issue contains articles such as "Chair Lift Physics" to get you in the mood for ski season. There are also ones on automatic night lights, the Coriolis effect, "What is a Photon?", using a computer mouse as a motion interface, electrostatic motors, superluminal velocities, teaching in Russia, and air bag sensors. Our new vice-president, John Petre has an article on Chladni Plates, picking up on an idea that George Vanderkur demonstrated at our Guelph conference. Two pages later, we have a picture of Ernie McFarland (our membership person) in an article describing "The Fantastic Physics Fun Show" which he and Tom Kehn take to elementary schools. These articles are designed to inform you, delight you, challenge you, and impress you with the ideas and concepts that attracted you to physics in the first place. There are more good ideas in each issue than you can possible implement. You need "The Physics Teacher".

You also receive "Physics Today", a magazine that brings you up to date on some of the more recent research. It can provide useful research material for your OAC independent study units. You are also kept up to date on conferences for AAPT and the various sections.

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OAPT Web Site

Guleph University is now the host of an OAPT web site. Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more! The URL is:

http://www.physics. uoguelph.ca/OAPT/index.html

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

Laser manipulations of artificial cell membranes: An Israel-U.S. research team has discovered that lasers can cause artificial versions of cell membranes to expel inner objects as large as 3/4 their diameter. A cell membrane is made of lipid molecules that arrange themselves into a closed, sac-like structure (a vesicle) to prevent energetically unfavorable contact between water and the water-repelling lipid tails. For this reason, it's difficult to rip open a vesicle, let alone expel interior objects. In the experiment, researchers focus a laser spot onto an artificial vesicle. The light's electric field pulls lipid into the spot. The light also causes some of the lipid inside the vesicle to break off into a suspension of smaller objects which escape the laser spot. To increase the entropy (amount of disorder) in the system, water rushes into the vesicle to disperse the smaller structures, driving out an inner object through a reclosable pore in the vesicle. Manipulating membranes with lasers may someday allow researchers to transform living cell membranes in desired ways. (J.D. Moroz et al., upcoming article in Phys. Rev. Lett.; Figure and movie to appear at www.aip.org/physnews/graphics)

Demo Corner...continued from p. 4

2) ***Discharges***: The radio waves can also be used to light up a fluorescent tube without a discharge. Just holding it near the tube produces noticeable light in a semi-darkened room. Of course, following this with an arc discharge to the light increases the light output considerably. Since we have a high-frequency AC output, no damage occurs to the person holding the light. Just to be safe, I usually pick someone with rubber soles, and caution him/her to stand away from desks, blackboards and especially water taps.

Different coloured discharges can be produced using the standard helium, hydrogen, mercury and other discharge tubes used in spectroscopy. I also like to use a neon lamp due to its bright colour. This leads to the "Uncle Fester" demonstration. A student is invited to hold the lamp in his/her mouth, and it is lit using the coil.

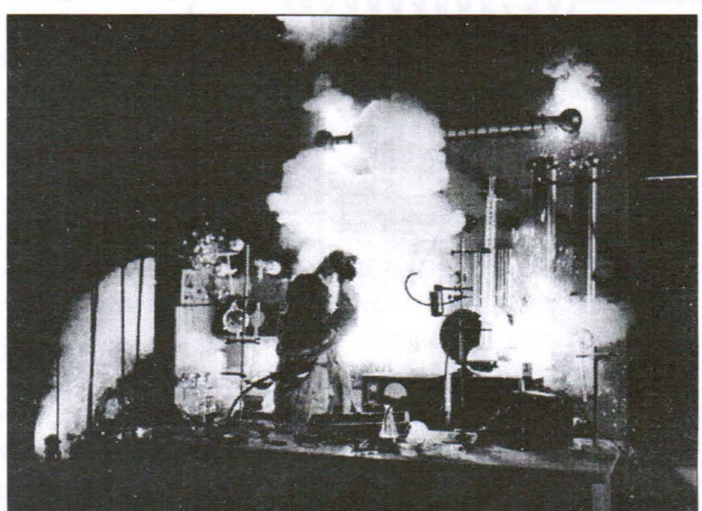
3) ***Potential Difference***: The Tesla coil can be used to place a potential on the filament of a lamp. This will cause arcing inside the bulb, and since most bulbs are filled with argon, beautiful streamers are produced. Placing fingers at ground potential on the glass will attract stronger streamers which will follow the fingers around. I like to use one of the "Fat Albert" bulbs available at lighting stores.

Cautionary Notes:

1) Since we are using high-frequency AC, current does not flow through the subject, but mainly back and forth in the arc. Arcing should always be done to metal or another conductor, rather than bare skin. Arcing to bare skin may cause radio-frequency burns. Most receivers of the arc report a mild tingling, indicating that a surface current is penetrating a little way away from the point of arc.

2) The B-10 coil is isolated from the 60 Hz AC line with a teflon spacer, so there is no danger of direct electrical shock. Without this spacer, danger of shock exists. It is best to insulate the subject anyway.

3) Like most electrical demonstrations, an untrained demonstrator can find ways to make it dangerous. It is not recommended for those without some background in electricity and electronics.



THE DEMONSTRATION CORNER

Demonstrations with a Tesla Coil

by

Roland Meisel

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Theory in a Nutshell: A Tesla coil circuit generally consists of some sort of step-up transformer along with a tuned oscillator. The B-10 coil sold by Cenco Scientific is a compact device which produces 40-50 kV at frequencies of 3-4 MHz. The schematic diagram shows an inductance connected to an AC circuit. As the AC goes through its cycle, the inductance builds up a high reverse potential (similar to the arcing at the commutator of an electric motor) which can exceed the breakdown resistance of the spark gap in the oscillator circuit. When this happens, the resistance across the gap drops effectively to zero, and causes the tuned circuit to "ring" electrically, much like hitting a tuning fork. A high-voltage high-frequency AC potential is induced at the tip. This is the "simple" explanation which high school students can usually follow. For those who wish to see the differential equations describing what is going on, may I suggest an advanced book on electrical physics!

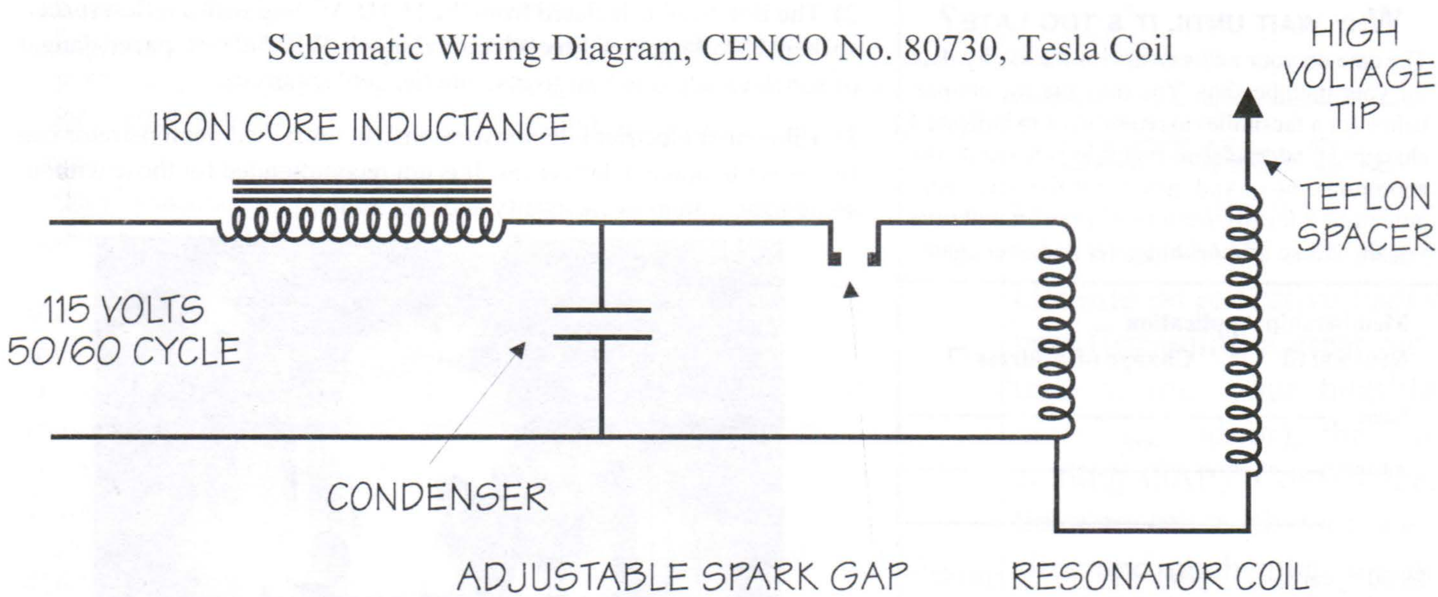
Demonstrations:

This Tesla coil is generally intended to be used to test for leaks in vacuum systems by causing a "glow" which can be seen by the naked eye. I use it in several places in the Grade 12 and OAC physics curricula. I have chosen three particular demonstrations to describe:

1) ***Radio Waves***: The tip of the Tesla coil acts as a radio transmitter even if no spark discharge is being produced. To demonstrate this, I use an AM or a SW radio, and am able to show that there is radio frequency radiation coming from the coil. I then create a spark discharge, and demonstrate the large increase in signal. Morse code can be sent this way. With a portable radio, students can check on the range of the signal. If you do it outside, and a car is available, the range can be checked using the car radio and the odometer. I've gotten up to half a kilometre under good conditions.

Demo Corner continued on p. 3

Schematic Wiring Diagram, CENCO No. 80730, Tesla Coil



Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

Ontario Association of Physics Teachers

(an affiliate of the American Association of Physics Teachers)

Volume XIX, Number 3 — Spring 1997

AAPT Winter Meeting

Phoenix January 3 - 8, 1997

Reported by Peter Scovil, Section Representative

Phoenix is a very clean city, whose modern downtown area belies its two million population. Palm trees line the streets, and cacti are everywhere. But physics dominated for six busy days. Good, sound physics. In fact Brian Holmes (San Jose State U) gave us a fascinating presentation of the physics of brass instruments, starting with the concept of an open ended tube and explaining the effects of the flared end and the mouthpiece. Because the flared end is essential to the sound, a trumpet must use valves to change the sound. Keys like in woodwind instruments would not work. He demonstrated how French horn players got different sounds before valves were invented by using their right hand inside the bell to affect which part of a standing wave occurs there. As an accomplished musician, he gave a very entertaining performance. We hope we can get Dr. Holmes to come to an OAPT meeting as a banquet speaker in the near future. I'm sure his talk would have wide appeal to anyone interested in music, regardless of their physics background.

Keeping with the topic of sound, I attended a workshop on that topic by Clarence Bakken. He had suggestions, like assigning homework on waves to be done in the bathtub. Rows of students can participate in transverse or longitudinal waves. A copy of the Tacoma Narrows video can be purchased from AAPT for $US 35.00. Chladni plates work very nicely without bowing if they are mounted at the centre to a wave driver such as Pasco has. I have plans for home-made tuning forks from extruded aluminum tubing. I also have plans for a speaker-driver which is very useful for standing waves. Contact me for details. I will publish or present some of them in the near future.

The other workshop I attended was on Interactive Physics 3.0. As opposed to 2.5, it allows curved shapes and force fields. Cindy Schwarz has a good Players Workbook through Prentice-Hall for $US 25. (schwarz@vassar.edu) She has also developed a CD-ROM using simulations, animations, videos and problems. It's called Interactive Journey through Physics, and includes mechanics, electricity and magnetism, thermodynamics, and light and optics. It would be useful in secondary or university physics, and is expected to sell for around $US 25.

Dr. E.D. Dahlberg (dand@physics.spa.umn.edu) talked about magnetic force microscopy, including some videos of magnetotactic bacteria in action looking for their food which is magnetic. To show your students magnetic domains, take a refrigerator magnet, and cut a narrow strip off one end. Drag one end of this strip across the refrigerator magnet, and you will feel vibrations as it encounters the differently-oriented domains.

Dr. Edward Redesh (redesh@quark.umd.edu) talked about the Maryland Physics Expectations Survey of over 2000 students in a dozen institutions, revealing that less than 3% will ever take another physics course. What does this mean in terms of first year physics? There has been a lot on Force Concept Inventory, but gains in this area do not necessarily imply improvement in other areas.

There were a lot of other very interesting talks, but I have touched on a few that I felt I could share most easily. Future AAPT conferences are April 18-21 in Washington, D.C., August 11-16 in Denver, and Jan. 3-8 in New Orleans...and maybe Guelph in 2000!

1997 OAPT Conference

Brock University

June 19-21, 1997

Expanding the Boundaries of Physics

Physics Dept, Faculty of Math and Sciences
500 Glenridge Avenue, St.Catharines, Ontario L2S 3A1

voice: (905) 688-5550 ext. 3412
fax: (905) 682-9020
email: oapt97@physics.brocku.ca

See the conference website for more details http://www.physics.brocku.ca/oapt97/

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

A BLACK HOLE'S EVENT HORIZON HAS BEEN DETECTED. Ramesh Naryan and his colleagues at the Harvard-Smithsonian Center for Astrophysics have used the orbiting ASCA x-ray telescope to study x-ray novas, binary systems in which gas from one star is pulled toward an accretion disk and the spherical region surrounding a compact companion. These systems occasionally flash prominently at x-ray wavelengths (hence the name x-ray nova), but Naryan is more interested in what happens during the quiescent intervals between upheavals.

His recent theory, called the advection-dominated accretion flow (ADAF) model, suggests that if the accretion rate is slow enough the inspiraling gas will refrain from radiating away its accumulating energy. Instead the gas continues to get ever hotter, reaching temperatures as high as 10^12 K. Eventually this enormous energy buildup is dealt with in one of two ways: if the compact object is a neutron star, the gas will fall onto its surface, where it heats the star, causing it to radiate. In contrast, if the object is a black hole, there is no surface for the gas to fall upon; instead, like a prisoner being led to execution, the gas crosses the black hole's event horizon, never to be seen again. In effect, 99% of the gas energy disappears from the universe. Because of this, x-ray binaries containing a black hole should be dimmer than those with neutron stars. Naryan, speaking at this week's meeting of the American Astronomical Society in Toronto, reported on 9 binaries which fit the ADAF pattern of behavior. Four of these were thought to harbor black holes (because of their higher masses), and indeed these are all dimmer than the five neutron-star binaries. Naryan judges this dimness, and the binaries' x-ray spectra, to be the sign that an event horizon is at work, and that this in turn constitutes the most direct evidence yet for the existence of black holes.

IMPORTANT PROCESSES IN SINGLE DNA MOLECULES have been observed for the first time by using the atomic force microscope (AFM), in which the deflections of a tiny stylus over the contours of a surface can be turned into molecular-scale images. At the APS Meeting this week in Kansas City, Carlos Bustamante of the University of Oregon (541-346-1537) and his colleagues presented movies showing the first stages of DNA replication, in which a protein is seen to slide on DNA like a bead on a string to find the exact site where it could attach and start the replication process.

Binding DNA and RNA polymerase (the protein that mediates the transcription of DNA into RNA) to a mica surface, Neil Thomson of UC-Santa Barbara (805-893-4544) and his colleagues produced 5-nm-resolution movies of the transcription process, in which RNA polymerase pins down the middle of a single DNA strand and then pulls the strand through as it starts transcribing the DNA into RNA using RNA-building-blocks called NTPs (Biochemistry, 21 Jan. 1997).

Using an AFM, Gil Lee of the Naval Research Laboratory (202- 763-5383) found that a force of about 600 piconewtons was required to tear apart two complementary strands of DNA, namely a 20-base-pair-long strand of polycytosine (a form of single-strand DNA) from single strands of polyinosine averaging 160 base-pairs long.

Why Wait Until It's Too Late?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

Membership Application

Renewal ☐ **Change of Address** ☐

Name ______________________

Address ______________________

____

\$8.00 / year x ____ years = \$ _______ , payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

OAPT Executive Address Correction:

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http://www.grenvillecc.ca/jchilds

OAPT Web Site

Guleph University is now the host of an OAPT web site. Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
The URL is:
http://www.physics. uoguelph.ca/OAPT/index.html

SCIENCE ON THE INTERNET:

Here are a couple of interesting internet sites you might want to check out.

Astronomy Picture of the Day

http://antwrp.gsfc.nasa.gov/apod/astropix.html

A different picture posted daily, with a short explanation included, and an index of archived pictures.

A Comet In The Sky

Credit: Alessandro Dimai (Col Druscie Obs.)

It has been suggested that Comet Hale-Bopp will become the most viewed comet in Human history. Presently, for denizens of the Earth's northern hemisphere, this bright comet is certainly a lovely and inspiring sight — visible here crowning the sky above Cortina d'Ampezzo, Italy on March 20. Based on orbital calculations, this comet's last passage through the inner Solar System was approximately 4,200 years ago. Principally because of changes caused by the gravitational influence of Jupiter, Hale-Bopp should pass this way again in a mere 2,380 years. Comets come from the outer reaches of the Solar System where they reside, frozen and preserved. Astronomers analyzing their structure and composition as comets swing near the Sun seek a glimpse of the conditions during the Solar System's formative years.

Science Teachers Lounge

http://www.deepwell.com/~ccimino/index.html

Resources for Secondary Science Teachers

The Science Teachers Lounge has been recognized by the Eisenhower National Clearinghouse for Science and Mathematics as one of the top Internet sites for science education and resources and has listed the STL in it's "Digital Dozen" for February 1997.

This site is a resource for secondary science instructors but will contain info useful to all teachers (after all we can't all be science teachers). The STL includes teacher tools and educational software, classroom demonstrations, lessons, labs, Internet utilities, childrens software, links to other cool science and education sites, and a message board. Feel free to send your favorite lessons, labs, demos, links, etc for inclusion in this site via email at the address listed below. I hope you enjoy the site and find it useful.

MENU

- Teacher Tools - Software (Win/DOS): Grade and classroom management software.
- Message Board: Announcements concerning education and educational events on the Internet.
- Cool Classroom Demos: Science demos that motivate students (and teachers)
- TOPS Learning Systems: Check out a FREE TOPS Activity!
- Chemistry Labs: New labs added periodically (get it?)
- Educational Software: Contains FREE educational software, tutorial programs, and teacher utilities.
- Internet Utilities: Utility programs that will enhance your use of the Science Teachers Lounge and many other cool sites on the Internet
- Popular Search Tools: A collection of some of the most popular search engines on the Internet.

The STL would like to encourage you to submit lessons or recommend software that would be beneficial to other science teachers.

1997 Grade 12 Contest!

Contest Date: Thursday May 8
Registration Deadline: April 11
Cost: $3.00 per student

Packages were sent out to all high schools on March 1, addressed to "Grade 12 Physics Teacher". If you do not receive yours, email me at diana_hall@ocebe.edu.on.ca.

THE DEMONSTRATION CORNER

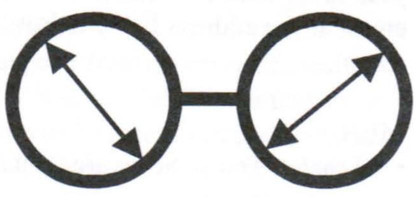
Two Kinds of Polaroid Glasses

by

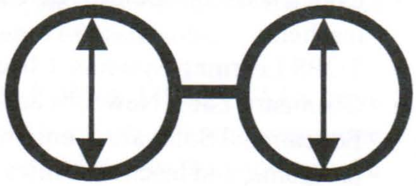
John Pitre

Department of Physics, University of Toronto, Toronto, ON
Email: pitre@faraday.physics.utoronto.ca

When polarized light is discussed, polarizing plastic sheet filters are always mentioned. Dur ing manufacture,this material which contains long chain molecules is mechanically stretched into sheets resulting in the alignment of the molecules. Electrons can travel along the axis of the molecules but cannot jump from molecule to molecule. When light is incident on a polaroid sheet, the component of the electric field which is parallel to the axis of the long chain molecules causes the electrons to move, and that component is absorbed; the component which is perpendicular to the axis of the molecules is unaffected. Thus, polaroid sheets have a preferred direction, or transmission axis, which is perpendicular to the axis of the long chain molecules.



Polaroid 3D Glasses



Polaroid Sun Glasses

When light reflects from a non metallic surface, components of the electric field parallel and perpendicular to the plane of incidence, called parallel and perpendicular components, are reflected differently and the amount of reflection depends on the angle of incidence (the plane of incidence is the plane containing the incident ray and a normal to the reflecting surface). For the perpendicular component, the amount of reflected light increases with the angle of incidence but for the parallel component, at any given angle, the amount of reflected light is less than for the perpendicular component. In particular, there is one angle of incidence called Brewster's angle (53 for water) for which none of the parallel component is reflected. Note that the vibrations of the electric field of the perpendicular component are in the plane of the reflecting surface, so at Brewster's angle, reflected light is completely polarized and the vibrations of the electric field are in the plane of the reflecting surface. By wearing polaroid sun glasses with the transmission axis of both "lenses" vertical as in the diagram, the majority of the reflected light from surfaces which we experience as glare can be eliminated.

On a recent scientific expedition I discovered another kind of polaroid glasses while viewing "Terminator-3D", a 3D film staring Arnold Swartzenegger at Universal Studios in Orlando, Florida. Depth perception is a result of binocular vision since objects subtend slightly different angles at either eye. Older 3D glasses were fitted with coloured filters, red for one eye and green for the other. Two slightly displaced pictures, one red and the other green were projected and each eye saw its appropriate picture although the composite colour was completely unrealistic.

The new 3D glasses have polaroid filters in place of the lenses with the transmission axes perpendicular to each other as shown in the diagram. Two pictures are transmitted with mutually perpendicular polarizations rather than different colours, but the principle is the same. Because both my wife and I saved our glasses as souvenirs I have two pairs to demonstrate in class. When two pairs of glasses with the same orientation are placed on an overhead the image is bright, and colour is rendered faithfully when a coloured tranparency is used underneath the glasses. If one of the pairs of glasses is rotated 180 the lens areas become black.

I don't know if glasses of this sort can be purchased but since this is the 25th anniversary of Disneyland I'm sure that someone in your school will be in Orlando this year. Why not encourage some scientific collecting to increase your repertoire of demonstrations!

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XIX, Number 4 Summer
1997

A Brief History of OAPT

MOVING TOWARDS AN ELECTED EXECUTIVE

Bill Konrad—Archivist

OAPT traces its origin back to 1978. It owes its existence to some enthusiastic Ontario Physics Teachers which include the following: Ernie McFarland, Jim Stevens, and Doug Fox. It was started as a section of the American Association of Physics Teachers. You may find it of interest that in 1931 the American Association of Physics Teachers (AAPT) approved a policy that *a regional chapter of AAPT may be established, upon approval of the AAPT Executive Committee, by ten AAPT members in a suitable geographic area. Whenever the membership exceeds 24 the chapter shall be entitled to be represented by one member on the national Executive Committee.* In 1947 the word *chapter* was changed to *section.*

According to the AAPT membership directory, *from the beginning the rationale for local sections was primarily to provide meetings accessible to AAPT members and others interested in physics teaching. Each section must have well-defined geographical boundaries, devise its own constitution (which must be compatible with that of AAPT), and set its own dues. Individuals may be members of the section without being AAPT members, but they may not represent the section on the Council.*

The decision in the late 1970's to establish an Ontario section has certainly benefited Ontario Physics Teachers. OAPT tries to promote physics education through three main initiatives. It plans an annual conference, it conducts a physics contest and it publishes a Newsletter four to five times a year. In order to get the program going the group that founded the organization divided up the tasks. In time other interested physics teachers were identified and were invited to take on certain tasks on the Executive. Early in its existence it was agreed that the annual conference should be held on a university campus during a time of the school year when teachers would find it relatively easy to get away. There are several reasons for this. Generally room rates are much lower than in a large city hotel. It gives the university a chance to showcase its physics education and research programs. Reasonable conference costs make it easier to get significant numbers of teachers out. In order to be fair to the universities and to make it easier for teachers from various sections of the province to attend it was also agreed that the conference should be moved around the province. To facilitate conference preparation someone at the university that was planning to host the next conference or someone in the adjacent educational community was asked to take on the position of vice-president. This person would then move on to the position of president the following year, thus providing continuity. Periodically, however, individuals would wish to be involved in conference planning but did not wish to take on other OAPT Executive responsibilities.

OAPT is approaching its twentieth birthday. It has stood the test of time and has become an important organization for physics teachers in the province. We would like to move from appointing new Executive members to electing them. This is easier said than done. We are able to maintain our low membership fee by keeping bureaucracy to a minimum. The executive meets at the conference and at one other time in the year. To make the transition from appointment to elections it feels that, initially at least, it should invite the membership to express their availability for various executive positions. When two or more members show interest in a specific position the executive can conduct an election for that position.

In addition to the initiatives described above OAPT also maintains a page on the "net". Its address is http:/www.physics.uoguelph.ca/OAPT/index.html. Among other items of interest the executive positions are listed. Why not take a look and see if you want to become more directly involved in this organization?

1997 OAPT Conference

Brock University

June 19-21, 1997

Expanding the Boundaries of Physics

Physics Dept, 500 Glenridge Avenue,
St.Catharines, Ontario L2S 3A1

voice: (905) 688-5550 ext. 3412
fax: (905) 682-9020
email: oapt97@physics.brocku.ca

See the conference website for more details
http://www.physics.brocku.ca/oapt97/

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

THE EARLY FAINT SUN PARADOX goes as follows: 4 billion years ago the sun (its fusion fire not yet having worked up to present levels) was 25-30% cooler than now. Terrestrial temperatures would have been sub-freezing, precluding liquid water. How then did life form in these early eras? Carl Sagan, in a posthumous paper co-authored by Chris Chyba (Science, 22 May) suggests a possible scenario. Ultraviolet radiation from the sun, they argue, would combine with existing methane to form solid hydrocarbons in the upper atmosphere. This in turn would shield ammonia (otherwise broken up by the UV) long enough for the ammonia to produce a greenhouse warming adequate for liquid water. Sagan and his interest in life in extreme environments was the subject of a session at the meeting of the American Geophysical Union in Baltimore. According to David Morrison of NASA Ames, there are only two places on Earth where life has not been found—on the Antarctic ice sheet and in the upper atmosphere. Everywhere else, whether in hot springs (even above boiling temperatures) or a kilometer below the surface, life seems to thrive. One speaker, Todd Stevens of the Pacific Northwest Lab, asserted that some subsurface "rock-eating" microbes constituted an ecosystem independent of photosynthesis and that their metabolism (in some cases amounting to a biomass doubling time of millennia) was perhaps the slowest of all life forms.

AN EXCITED ATOMIC STATE WITH A 10-YEAR LIFETIME has been discovered in the ytterbium atom, raising hopes for atomic clocks 1000 times more accurate than now possible. The Heisenberg uncertainty principle states that the longer a system can be observed, the smaller the uncertainty in its energy can be; therefore, it is extremely desirable to tune an atomic clock to a long-lived high-energy (excited) state.

Researchers at the National Physical Laboratory in the UK laser cool and trap a single ytterbium ion. They then use a laser photon to boost the atom's outermost electron to the long-lived state. With additional laser light, the researchers subsequently induce the electron to return to its lowest-energy (ground) state. By noting the characteristics of the laser light interacting with the electron, the researchers determine a 3700-day lifetime for the state. In addition to being the longest living excited energy state yet detected in an atom, it is the first observed "octupole" transition, a very rare transition in which the electron changes its angular momentum by a relatively large amount of three units. Once in this state, the electron (in the absence of external perturbations) can only decay via the octupole transition, which is why the state lasts so long. An atomic clock based on the transition would be very precise but requires much additional development. (M. Roberts et al., Physical Review Letters, 10 March 1997; see also Nature, 20 March 1997.)

Why wait until it's too late?

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Membership Application

Renewal r **Change of Address r**

Name ____________________

Address ____________________

____

$8.00 / year x ____ years = $ ______ , payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc. (besides, it lets me know that someone is reading this thing).

You can reach me—the editor—by e-mail:

plaxon@edu.uwo.ca

or, if the mood strikes you, by mailing a letter to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

OAPT Web Site

Guleph University is now the host of an OAPT web site.

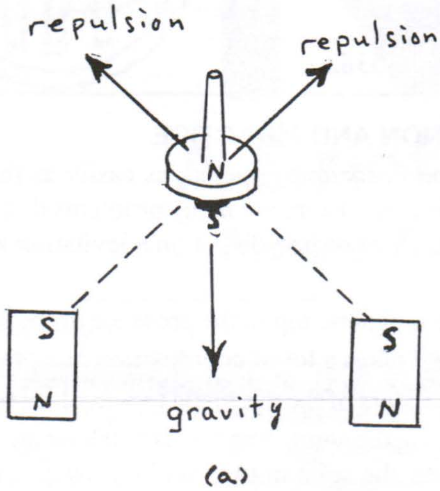
Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!

The URL is:
http://www.physics.uoguelph.ca/OAPT/index.html

(...**Demo** continued from page 4)

Enhancing Your Demonstration

While you are demonstrating this amazing toy to your class, pose the questions listed below as well as others you may think of:



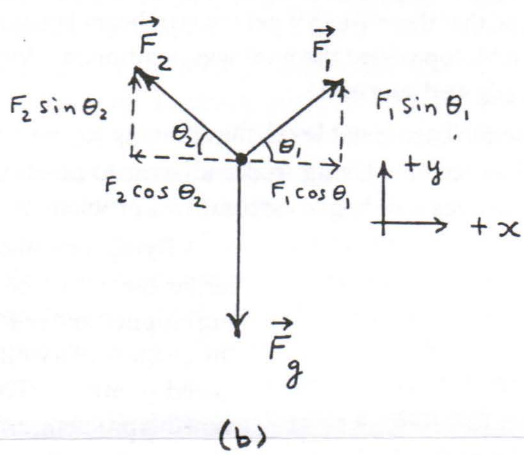


Figure 2 Forces acting on the top during levitation.

(a) Sketch of the situation (showing two of the four base magnets).

(b) A free-body diagram of the top.

- What is the shape of the magnet in the top? What are the possible arrangements of its poles? (The magnet is disc-shaped, with N on the top and S on the bottom, or *vice-versa*.)
- How can we discover the number and arrangement of the magnets in the wooden base? (This question confuses me because when I test the box with a magnetic compass or magnetic filings, I find that there are four separate permanent magnets in the base, whereas some references suggest there is one large disc magnet in the base.)
- When the magnetic top is spinning, what would happen if we were to try to pass our fingers (or a pen, or a ruler, or an aluminum bar, or a copper bar, or an iron bar, etc., etc.) between the magnet and the wooden base? (Try it and see!)
- Would the *Levitron* operate whether the base contained a single ring magnet or four smaller disc magnets arranged in a square?
- Can you draw a two-dimensional, free-body diagram of the levitating magnet to explain the forces acting on the spinning magnet during levitation? (Refer to Figure 2.)

Availability

The *Levitron* is sold at The Nature Company, which has numerous stores in the USA and the following two outlets in Canada:

- The Eaton Centre on Yonge Street in Toronto, First Level: Phone 416-971-5858
- Sherway Gardens at the intersection of Highway 427 and the QEW in Etobicoke: Phone 416-621-2700

The price of the *Levitron* is $ 57.95, although The Nature Company offers a 15% discount on all items to teachers.

References

Besides the instructions that accompany the *Levitron*, there are various resources in magazines and on the Internet that you may find interesting and useful. For example, if you use the Internet search engine called *Metacrawler* and enter the key search words "Levitron magnetic levitation," you will discover about one dozen articles, some of which are pertinent to the toy. It is interesting to find that some other purchasers of the toy discovered that the top would levitate only if the base was turned over! One serious article describes the physics of the top's motion, including the precession, and even describes how to set up a synchronous drive using Helmholtz-like drive coils to cause the top to remain perpetually levitated. The address for this site is:

http://www.physics.ucla.edu:80/marty/levitron/node8.html

A highly-recommended magazine article that mentions the *Levitron* as well as several other interesting demonstrations is called "Playthings of Science" by Fred Guterl, in the December, 1996, edition of *Discover*.

There have been at least three articles in *The Physics Teacher* that relate to magnetic levitation. These are:

Edge, Ron. "Levitation Using Only Permanent Magnets," *Phys. Teach.* Vol. 33, 252 (1995).

Kagan, D. "Building a magnetic levitation toy," *Phys. Teach.* Vol. 31, 432 (1993).

Rossing, T. and Hull, J. "Magnetic levitation," *Phys. Teach.* Vol. 29, 552 (1991).

THE DEMONSTRATION CORNER

The Levitron

by

Alan Hirsch

Port Credit SS, Mississauga, ON 905-278-3382

What physics toy have you seen that can attract the attention of every passerby in a mall during the December shopping rush? And what toy can you expect your physics students to exclaim "hey, cool" when they see it? The answer to each of these questions is the same: The *Levitron*: The Amazing Antigravity Top.

Design and Operation

The *Levitron* consists of a magnetic top, a clear plastic lifter plate, and a wooden base in which are embedded some permanent magnets. Accessories include some wooden wedges to help keep the base level, and several washers to vary the mass of the magnetic top.

To operate the *Levitron*, the physics genius places the plastic lifter plate squarely on the wooden base, and twirls the magnetic top above the circle painted on the lifter plate (Figure 1). Once the top is spinning, the user gently raises the lifter plate about 2 cm until the top levitates and the lifter plate can be slipped away from under the top. The top will levitate in mid-air for two to three minutes, until the rotation rate is too low to maintain stability.

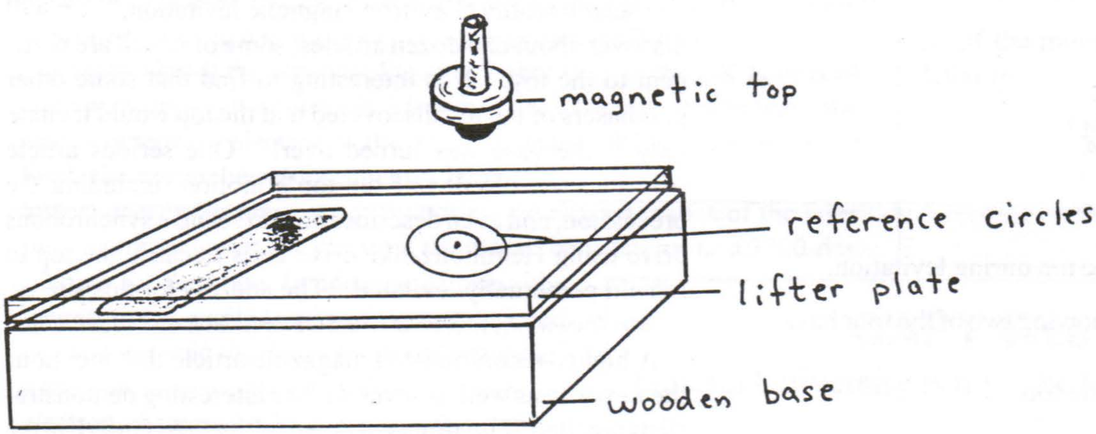


Figure 1 The arrangement of the *Levitron* components.

Co-ordination and Practice

Don't expect the *Levitron* to operate as easily as the above description indicates. There are many problems that must be avoided or overcome before you put on a levitation show for your students.

- Spinning the magnetic top in the presence of the repelling magnetic field takes a lot of coordination and practice.
- Adjusting the mass of the magnetic top involves trial-and-error by varying the number and sizes of the washers. With too little mass, the spinning top will fly away; with too much mass, the top will not levitate. Success at one location and on one day does not ensure success at a different location or on a different day. Fine tuning may be necessary at different locations or on different days. (One day when the top would not levitate at a certain location, I discovered that there was a steel support beam beneath the wooden tabletop where the base was positioned. Moving the base allowed success!)
- If the wooden base is not level, the spinning top will move to one side easily. Using trial-and-error to position the wooden wedges will help overcome this problem.
- A flying top can easily strike the floor, becoming chipped and reducing the chances of a well-balanced rotation. To prevent this problem, arrange a barrier on the desktop to prevent the top from falling to the floor.
- A major problem is buying a *Levitron* that never has worked properly. I recommend that you have the store salesperson prove that the device works before you pay for it. I had to exchange the first *Levitron* I bought because the top didn't levitate!

(**Demo** continued on page 3)

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Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XX, Number 1 Fall 1997

REPORT ON THE OAPT CONFERENCE

Brock University June 19-21, 1997

by Peter Scovil, Section Representative
petescov@enoreo.on.ca

The theme of this year's conference was "Expanding the Boundaries of Physics". Dr. F.S. Razavi (saar@newton.physics.brocku.ca), our conference coordinator, welcomed us, stating that this is how we can renew our excitement for our subject. The boundaries were expanded into technology, computer applications, chemistry, biology, environmental science and beyond. We also crossed the international boundary with several speakers coming from New York State.

Dr. R.A. Hinrichs (SUNY, Oswego) spoke on "Energy, a Vehicle for Change". With the recent concern about nuclear fission energy, he talked about the increased use of natural gas, especially as more resources are being discovered. It is much more efficient than coal and less polluting, although it still contributes to global warming. There is increased use of photovoltaics, mostly in developing countries. Wind generation is increasing by 20% a year worldwide, mostly outside the U.S. and Canada. Developing countries are increasing their energy use as they try to catch up. Unfortunately, they can't afford to be as environmentally friendly. As energy is an important topic in the N.Y. State school system, Dr. Hinrichs holds an award-winning Institute in Energy Education at SUNY Oswego and runs workshops for N.Y. high school teachers.

Dr. Edwin Goldin, manager of the American Institute of Physics' Career Services Division looked at areas where physics graduates are being employed. More and more are going into industry in areas such as radio communications, computers, graphical technology (HDTV, etc.), petrochemicals, food/drugs/medical, materials industry, energy. Often they are involved in small businesses, sometimes in very creative ways.

The closest we got to an actual boundary was when we visited the Sir Adam Beck Generating Station. Along with the tour we were treated to a look at the history of this site. There are still three generating units operating at 25 Hz feeding Dofasco and Stelco.

Crossing discipline boundaries, Dr. E. Lemon gave us a real look at using physics in the natural treatment of waste water with cattails and bulrushes. These plants can transport oxygen to their roots. The oxygen-rich areas near their roots help aerobic bacteria oxidize the waste organic matter, while further from the plants' roots, anaerobic bacteria reduce excess nitrogen compounds. Contact The Friends of Fort George, Box 1283, Niagara-on-the-Lake, ON, L0S 1J0 for more information. Dr. Ira Blevis (Sunnybrook Health Sciences Centre, Toronto) gave us an historical look at x-rays, describing the latest improvements using digital radiography. This allows radiologists to tailor the x-ray dose for the picture required, reducing doses by a factor of 100. It also permits computer enhancement to improve contrast, and the storage and retrieval of images with computers. The new devices are much more compact and easy to work with.

Going further afield was John Caranci (j_caranci@NYNET.nybe.north_york.ca). He has some very interesting ideas for physics ISU's that are truly creative such as drama, a children's story book, a radio mystery and many more. John Blair extends the time boundary for the school term by giving students summer reading assignments. He recommended books such as <u>Nobel Prize Women in Science</u> by Sharon McGayne, and <u>The Physicists</u> by C.B. Snow. The boundary that Roland Meisel (rollym@vaxxine.com) dealt with was the one at the end of an open air column as he talked about impedance matching in wind instruments and how flaring the ends decreased the reflection from the ends. He has students make musical instruments from household materials. Daniel Peat (neufpeat@iaw.on.ca) demonstrated his flaming tube to demonstrate pressure variations due to standing waves.

(... **Conference** continued on page 3)

Plan to attend the 1998 OAPT Conference

University of Waterloo

June 18-20, 1998

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

TRAPPING A SINGLE NANOPARTICLE BETWEEN TWO ELECTRODES has been controllably achieved for the first time, enabling researchers to deposit individual nanoparticles onto surfaces and offering possibilities such as single-nanoparticle switches. Researchers (Cees Dekker, Delft University of Technology, dekker@qt.tn.tudelft.nl) construct a circuit containing two platinum electrodes separated by as little as 4 nm--a gap that the researchers believe to be a world record. To trap nm-scale molecules or clusters, they immerse the electrodes in a solution containing the nanoparticles. Applying a voltage to the electrodes polarizes each particle and attracts a particle to the gap between the electrodes. Once a particle bridges the gap, current flows through the circuit, and a resistor then sharply reduces the electric field, discouraging any additional nanoparticles from entering the gap. In principle, this electrostatic-trapping technique can work for any polarizable nanoparticle; it has been demonstrated for nanometer-scale clusters of palladium (Pd) atoms, carbon nanotubes, and a 5 nm-long chain of thiophene (a conducting polymer). The researchers have also studied the properties of single electrons as they cross a Pd nanocluster between the electrodes. (A. Bezryadin et al., Applied Physics Letters, 1 September; images at www.aip.org/physnews/graphics)

QUARK STARS represent one segment on the sliding scale of collapsed stars stretching from white dwarfs to black holes. In between lie neutron stars, in which self-gravitation has forced electrons to merge with protons to form neutrons. At higher density, some of the nuclear matter may exist in the form of hyperons, heavy versions of neutrons which can be made artificially at accelerators on Earth. Hyperons are normally unstable and quickly decay, but would survive indefinitely inside neutron stars. Up to this point, the nucleons inside a neutron star are still baryons; that is, they each consist primarily of three quarks. But at higher density still, the baryons can melt, creating the quark-gluon plasma state being sought at the CERN collider in Geneva and (in the next few years) at the RHIC collider on Long Island. However, if physicists don't hurry, astrophysicists might spot evidence for the quark matter first. Rapidly spinning neutron stars (pulsars) gradually shed energy and angular momentum in the form of radio emissions and an electron-positron stellar wind. This causes the star to contract, jacking up the pressure a bit, making conditions more favorable for the creation of hyperons and quark matter. According to Norman Glendenning of LBL (nkg@csa.lbl.gov) and his colleagues S. Pei (Beijing Normal University) and F. Weber (Ludwig-Maximilians University of Munich) one in a hundred pulsars is undergoing the baryon-melting phase transition. They suggest ways in which this transition could be detected, "quark astronomy."(Norman Glendenning et al., 1 September Physical Review Letters.)

Why wait until it's too late?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

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Name ____________________

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____

$8.00 / year x ___ years = $ _____, payable to the OAPT

Send to: Ernie McFarland, Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc. (besides, it lets me know that someone is reading this thing).

You can reach me—the editor—by e-mail:

plaxon@edu.uwo.ca

or, if the mood strikes you, by mailing a letter to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

OAPT Web Site

Guleph University is now the host of an OAPT web site. Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!

The URL is:

http://www.physics.uoguelph.ca/OAPT/index.html

OAPT Executive 1997-98

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NEEDED: Volunteers for the Executive

The OAPT needs you! In order to keep the association vibrant we encourage you to volunteer for service on the executive committee.

If you have a special expertise you may wish to apply for a particular position but if you are like most of us, (no expertise but a willingness to do a little work) then just submit your name and we can discuss the various options open to you. Hopefully we will reach the stage where we have enough volunteers so that we can hold elections. The time commitment is small enough to fit into your busy schedule. So apply! It's a good thing!

Send your name to John Pitre, Dept. of Physics, University of Toronto, 60 St. George Street, Toronto, Ontario M5S 1A7.
Email: pitre@physics.utoronto.ca
Telephone (416)-978-8803

Conference continued from page 1...

Crossing the boundary into cyberspace, Bill Konrad (willkonr@wincom.net) described two projects he is working on. One is a CD ROM for electromagnetic radiation and wave-particle duality using computer simulations, videosnippets and animation. This should be available in Ontario schools through the Ministry of Education. The second project is the OAIP Test Bank in electronic form. He intends to include the Force Concept Inventory, the past OAPT contest questions (by topic) and OAIP questions for both OA and 4A physics (by topic). The questions can be organized into a test using a test engine such as "Testmaster" by Keith Young (ygk@ebtech.net, www.sarnia.com\testmaster\). Bill also demonstrated a program called Vidshell that allows digital analysis of videos.

Anthony Pignatelli and Elizabeth Dunning (St. Joseph's College School, Toronto) encouraged us to use data analysis programs in grade 12 physics. Students see their graphs immediately after they have completed their experiments. Elio Covello (eliocove@enoreo.on.ca) has an Einstein screensaver ($3) and a CD ROM with photos of 150 Nobel physicists. He is working on physics 4A using computer-aided instruction. If you are interested in purchasing the programs, helping with the 4A course, or in making your own programs, contact him.

There were a number of interesting workshops on Thursday evening on materials physics, making web pages, using CBL interfaces, energy and the environment, searching strategies for the internet, and a digital electronics project. Contact me or Dr Razavi for more details on these or other conference items. Dr. Razavi and the Brock University physics department did a great job in organizing the conference, getting good speakers, feeding us and housing us. Thanks for a great time! Next year, the conference is to be held at the University of Waterloo. Dates are June 18-20, 1998.

THE DEMONSTRATION CORNER

Dumb Tricks with Metre Sticks

by

John Wylie

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Here are two tricks, sorry, demonstrations that you can store away for when you have a few minutes to kill and all you have available is a metre stick, or when you just feel the need to show off in front of impressionable young students. They both are opportunities to prove that a knowledge of physics is better than being young and co-ordinated.

Trick 1: Challenge a student to balance the metre stick vertically on his/her open flat palm. Even a co-ordinated young athlete will be doing very well to manage 5 seconds or so. In the end, they are dancing back and forth wildly trying to keep the thing from toppling over. Now it's your turn, and being a physicist and understanding the nuances of nature, you will not only beat 5 seconds, but you will do it the hard way. You will do it while at the same time balancing on the end of the stick the massive physics text book that you make your students carry around with them. Of course you have actually given yourself an advantage in disguise.

The period of oscillation of a simple pendulum (whether hanging from a fixed pivot or balanced vertically above a fixed point as in our case) is given by $T = 2ð(/g)^{1/2}$, where g is the acceleration due to gravity and is the radial distance from the pivot to the centre of mass of the pendulum. Really we should be worrying about the moment of inertia of a rigid body here, but this simple analysis will suffice to get the point across. For the unencumbered meter stick, is about half the length of the stick. By putting a very heavy object on the top of the stick, you have effectively doubled the length and increased the period of oscillation. The stick will not only wobble more slowly, but you will have more time to react and keep your hand under the centre of mass of the system. With only a small amount of practice, you can easily beat 5 seconds.

Of course, circus performers and jugglers exploit this principle when they balance plates on the end of a stick. The longer the stick, and the closer to the top of the stick the centre of mass is, the easier the trick is to perform. For more examples of this, think of tight rope walkers and their balance poles and ballet dancers who invariably do their hardest *en-point* manoeuvres with their arms above their heads.

Trick 2: Begin by placing your metre stick horizontally on your two outstretched index fingers, one at each end. You should wonder out loud how hard it would be to slide your fingers toward each other and keep the stick in balance at all times, finally ending up with your fingers touching each other at the centre of the stick (and then you could remove one finger and end up balancing the stick on the other). But wait, this is too easy. Confidently, you ask a student to place their "door stop of a physics text book" anywhere upon the length of the stick. You begin sliding your fingers toward each other, and you will find automatically that first one finger will slide, then the other, and so, until your fingers are touching one another and the book has remained in balance at all times.

The catch is that the force of friction opposing the motion of each finger is proportional to the normal force acting on the finger. The one closer to the book will not slide initially because of the larger normal force and, hence, larger friction force. The other finger will slide until the dynamic force of friction opposing its motion becomes greater than the static friction opposing the other. When this happens, the other finger (now farther from the book) will begin sliding and the finger that was originally sliding will cease to slide. Only one finger will slide at a time. It will appear that you are concentrating very hard on which finger to slide and on how far to slide it when, in fact, the laws of physics are taking care of all of this for you.

It is possible, in this way, to devise a simple experiment to measure the ratio of the static and dynamic coefficients of friction between wood and flesh. Or, if you outfit each student with a metre stick and two pencils (to replace your fingers), it makes a very inexpensive experiment to study frictional forces.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
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Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XX, Number 2 **Winter 1998**

1998 Conference - University of Waterloo
June 18 - 20

Plans are well underway for this year's conference. "Tools to Teach Physics" is the theme, and we hope to bring you lots of practical ideas to take home. Here's what's shaping up so far.

WORKSHOPS:

- Interactive Physics for Beginners (Bill Syniura)
- Computer Done Tutorials (June Lowe)
- Eureka Software (Shawn Leclair)
- Pasco Physics Interfaces (Bill Konrad)
- Making Holograms (George Vanderkuur)

SPEAKERS:

- "Complex Fluids; The Physics of Goo" (Stefan Idziak U of Waterloo)
- "Physics of Manufacturing Automobiles" (Walt Duley U of Waterloo)
- Future of Physics Education in Ontario (Ministry of Education Rep)
- Role of Physics Contests (Reps from Contests - discussion)
- Computer Assisted Instruction - Pros/Cons
- "Sound Advice" (John Vanderkooy U of Waterloo)

TOURS: Dalsa - Imaging Charge Couple Devices
Unitron - Major Hearing Aid Manufacturers

BANQUET SPEAKER: "30 Years of SIN" - Phil Eastman

CONTRIBUTED PAPERS: TBA (See Call for Papers in this issue)

The University of Waterloo will set up a display of University Demos covering vaious topics. they will also be giving away some surplus equipment such as string vibrators and em magnetic field detectors.

It might be of interest to note that the CAP Annual Conference will be held at Waterloo in the days immediately preceding the OAPT and the Nuclear Technology Workshops will be held at McMaster June 22-25.

For schedule updates check out the following website:

http://www.science.uwaterloo.ca/physics/physics.html

OAPT Conference Committee

This year the annual June conference will be held at the University of Waterloo from Thursday June 18, 1988 to Saturday June 20, 1998. The OAPT conference this year will follow the CAP conference also being held at Waterloo. The end date for the CAP conference is Wednesday, June 17 and the start date fior the OAPT conference is the evening of Thursday June 18. It is hoped that some participants from the CAP will join the OAPT conference.

This year the conference host will be John Vanderkooy, from the University of Waterloo. As well, the following persons from the OAPT executive will be assisting John in the conference planning:

- John Pitre, President OAPT, Chair, conference committee, invited speakers

  pitre@faraday.physics.utoronto.ca

- Terry Price, Vice President OAPT, exhibits for the conference

  tprice@yorku.ca

- Diana Hall, Past President OAPT, Contest Convenor, Contributed Papers for the conference

  Diana_hall@ocebe.edu.on.ca

- Peter Scovil, AAPT Section Rep, Workshops for the conference

  petescov@enoreo.on.ca

- John Vanderkooy, Conference Host, Univeristy of Waterloo

  jv@audiolab.uwaterloo.ca

OAPT members with suggestions for the conference may contact these individuals at the e-mail addresses indicated

OAPT Web Site

http://www.physics.uoguelph.ca/OAPT/index.html

OAPT 1998 Conference Call for Papers

Do you presently use Computer Lab interfaces in your classroom? Do you have a favourite Classroom Demo?

The theme to this year's conference is "Tools for Teaching Physics." In keeping with this theme, we are particularly looking for members who would be interested in presenting a short paper on either of these topics. Many members are struggling to incorporate hands-on, computer activitites into the curriculum on a short budget. If you have tools which have been implemented succesfully, we would like to hear from you.

Members indicate that they like to take from the conference simple, new (or old) tricks or demonstrations to use in their classrooms. If you have one that works well, we hope that you will consider sharing it.

As always, we invite members to present papers on other topics which are of interest to high school and university physics teachrers. The paper should be 5-15 minutes in length. Please send an abstract of your proposed paper as soon as possible to:

John Vanderkooy, University of Waterloo Physics Department,
Waterloo, ON, N2L 3G1
e-mail: jv@audiolab.uwaterloo.ca

Call for Questions:

Now is your chance to contribute to the 20th aniversary of the OAPT Prize Contest! have your name acknowledged on the front page! If you have an interesting or creative question, simple or challenging, send it to Contest Coordinator Doug Abe at:

Agincourt C.I.
2621 Midland Ave.
Scarborough, ON
M1S 1R6
or via e-mail to dougabe@echo-on.net

All donations are cheerfully accepted! Send in those pet questions and see your name in print!

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc. (besides, it lets me know that someone is reading this thing). You can reach me—the editor—by e-mail: pdlaxon@julian.uwo.ca (NOTE: e-mail address has changed)

or, if the mood strikes you, by mailing a letter to: OAPT Newsletter c/o Paul Laxon, 201 Chestnut St., St. Thomas, ON, N5R 2B5

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

THE UNIVERSE WILL EXPAND FOREVER. This prediction is based on new studies of distant supernovas. Because Type Ia supernovas (supernovas in which material falling onto a white dwarf from a companion object ignites violently) brighten and fade in such a predictable way, their intrinsic brightness (and their distances from Earth) can be determined by carefully watching light emission over time. Combining these distances with the velocities of the host galaxies (determined from redshifts) allows one to calculate the expansion of the universe with some confidence. And the result appears to suggest that the universe does not have enough matter (visible or dark) to halt the current expansion. This view emerged two weeks ago at the meeting of the American Astronomical Society in Washington, where optical data for many new supernovas (including the most distant supernova ever observed, one with a redshift of 0.97) were reported by a group from LBL (led by Saul Perlmutter) and one from Harvard-Smithsonian (Peter Garnavich). The new findings are consistent with an age estimate for the universe of 15 billion years.

COSMIC INFRARED BACKGROUND DISCOVERED. The Cosmic Microwave Background Explorer (COBE) collaboration, which six years ago reported the first evidence for structure in the microwave background, has now finished a mapping of the whole sky at ten different infrared wavelengths, from 1 to 240 microns. After carefully subtracting the expected contributions from our own solar system and the Milky Way galaxy (understanding the foreground sources of infrared was itself a process that took years) what is left over is the cosmic infrared background, the cumulative IR radiation (amounting to one-half to two-thirds of the total light) coming from all the stars that have ever existed. Much of the light that reaches the detector has been scattered in transit by dust. The cosmic IR background appears uniform (no structure is apparent) and bears no information about when during the history of the cosmos the radiation was emitted. Nevertheless, the observations have helped to provide rough limits on the amount of star formation in the universe and confirms the suspicion that a lot of star birth has been obscured by dust. Michael Hauser, now at the Space Telescope Science Institute, delivered the main COBE report at last week's meeting of the American Astronomical Society (AAS) in Washington, DC.

A 2.6 MILLION SOLAR MASS BLACK HOLE lurks at the center of the Milky Way. New measurements carried out with optical and radio telescopes have zeroed in on the heavy monster long known to exert a huge gravitational pull at the heart of our galaxy in the constellation Sagittarius. Andreas Eckart of the Max Planck Institute in Garching, Germany presented a film at the AAS meeting showing the proper motions (recorded over five years) of several stars within a few light days of the heavy object. The measured velocities of these stars, some as great as 1000 km/sec, lead to a mass estimate for the object of 2.6 (with an uncertainty of only 0.3) million solar masses. Considering that all of this mass must fit into a volume much less than the distance between us and the nearest star, Eckart asserted that the object could only be a black hole.

THE DEMONSTRATION CORNER

A Crazy Cantilever

by

George Vanderkuur

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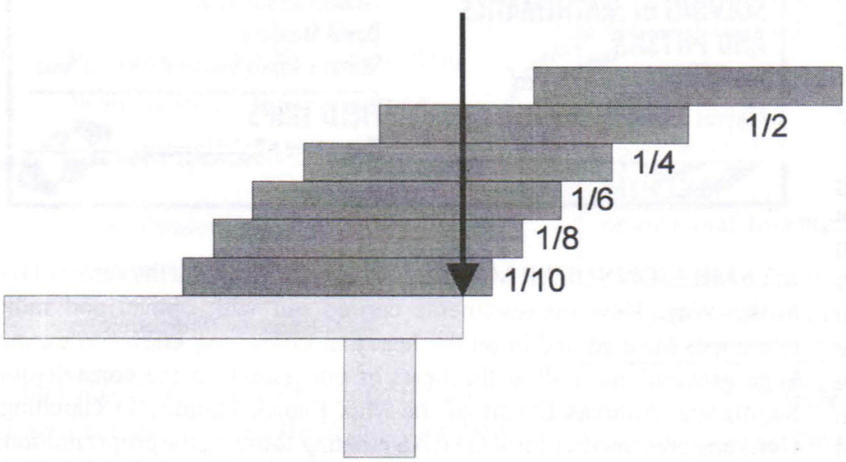
Bricks, books, or metre sticks are all you need for this neat demonstration. As illustrated, the top brick projects by half its length and subsequent bricks project 1/4, 1/6, 1/8, etc., brick lengths. After n bricks, the cantilever will project a distance $d = 1/2 + 1/4 + 1/6 + ... + 1/(2n)$. This may be simplified to $d = 1/2(1+1/2+1/3+...+1/n)$. For four bricks, the projected distance is 1.04 brick lengths, and for $n = 5$, the distance is 1.14 brick lengths (so that the top brick is clearly out beyond the edge of the table).

There are complicated ways of determining the maximum projection for each brick. Even though the physics is simple, the equations soon become unwieldly, requiring clever techniques that I have forgotten. There is, however, an easy way to look at the problem. Just consider the total projected mass at various levels in the stack. Above the second brick from the top, there is one-half brick mass projected. Above the third brick from the top, there is the half brick mass just mentioned, plus two quarters (one quarter from the second brick and another quarter from the top brick). Above the fourth brick from the top, the total projected mass is one half plus two quarters plus three sixths. This arrangement ensures that the cantilever exactly balances on the front edge of each brick because at each stage an additional half brick mass is added to the total overhang. The centre of mass of the projected portion is balanced by the centre of mass of the rest of the stack. (You might want to think in detal about how this scheme works once one or more bricks are completely projected beyond the table edge, so that they can't contribute any more projected mass.)



Is This Device Practical?

Not really -- the structure soon fails because the load is carried entirely at the front edge. The compression forces are greater than what normal materials are able to withstand. Disregarding this, the cantilever could extend to infinity because the sum $1/2(1+1/2+1/3+...+1/n)$ has no limit. It would take 100 bricks to extend 3 brick lengths, and to extend about ten brick lengths would take over 1,000,000 bricks!

It is hard to imagine how a loose stack of bricks could extend out infinitely far. It should make for a lively discussion.

Physics Internet Sites

These sites contain help and information for all levels of physics enthusiast, from novice to expert: with essays on how to "Think like a physicist" and e-mail connections to physicists who will answer any questions on physics related topics (but not specific questions about homework problems) and links to physics humour and cartoons.

Ask the Physics Guy
http://www.gwi.net/~eiko/physicsguy.htm

Ask Dr. Neutrino
http://odin.phy.bris.ac.uk:8080/dr_neutrino/index.html

Help for Math and Physics Students
http://www2.ncsu.edu/unity/lockers/users/f/felder/public/kenny/home.html

The Math and Physics Help Home Page
http://www.cyberspc.mb.ca/~dcc/phys/physhelp.html

The Physics Connexion
http://www.servtech.com/public/wkimler/

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Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XX, Number 3 **Spring 1998**

A Course for Science Teachers

The Canadian Nuclear Society has developed a four-day course on the science of nuclear energy and radiation for elementary and high school science teachers geared to enabling them to provide factual information (and explain how to use facts) to all their students. The course is modeled on the successful course developed by Professor Albert Reynolds at the University of Virginia, and is based on his book, "Bluebells and Nuclear Energy" (Reynolds, 1996). For the past 14 years, he and his colleagues have given it in Virginia each summer to a new group of ~30 teachers. One thing he discovered quite early is that most science teachers are aware that they do not know enough about the subject to do it justice. A second thing he discovered is that the teachers who take the course are extremely eager to learn about nuclear energy and radiation. And learn they do. Their understanding and enthusiasm go a long way toward dispelling fear of the unknown among their students. Reynolds states, "There is no better way to appreciate our public school science teachers than to observe them learning new material and sense their eagerness to introduce it into their curricula."

Science teachers attempting to teach these topics have a problem. They can devote only a few weeks of their course to nuclear energy and there is a limit to the amount of time they can spend learning about and preparing the material. This problem has guided the design of the textbook. It covers the most pertinent material that is needed for the various levels and branches of science offered in middle and high schools. Since students are informed through TV and newspapers and ask questions about nuclear topics, the book covers controversial issues related to nuclear energy and radiation in addition to basic technical information. A teacher will not know all of the answers after reading this book. Science teachers who take this course are aware of this, however, they gain confidence. The course is intended to be the beginning of a rewarding ongoing relationship for everyone. Teachers will have contacts to get answers to new questions and to guide interested students towards future careers in science and engineering.

The lecturers are highly qualified and experienced scientists, engineers and educators. Many are CNS members who have volunteered their time to give this course. The course (contents in Table 1) will be presented next June 22-25 by McMaster University and the Canadian Nuclear Society, in cooperation with AECL, Ontario Hydro and Oakville Trafalgar High School. McMaster University has a 5 MW pool-type reactor, and is located near AECL and several nuclear power stations. It has been giving courses in nuclear science and engineering for more than 50 years. It also has a nuclear medicine department in its hospital and medical sciences centre.

The course material avoids technical jargon and mathematics, so as not to be a burden. The concepts are simple, practical, interesting and relevant to current issues in Canadian society. Teaching aids and materials will be provided that can be readily used in the classroom. The lecturers have excellent credentials and will provide rational presentations on the science and technology. The teachers will have heard and will hear different messages from the anti-nuclear groups, and the course will help them make informed decisions.

The teachers will be encouraged and given opportunities to ask critical questions - to challenge the lecturers with information and ideas that they have acquired from other sources.

The tuition fee is $200 and includes a copy of the textbook: Bluebells and Nuclear Energy by Albert B. Reynolds. On-campus accommodation at the university student residence and a daily breakfast are included in the registration fee. Enrollment in the course is limited to 30 teachers.

The course brochure and registration form can be found at the CNS web site under the "Education" Section:

http://www.cns-snc.ca.

Persons wishing to apply for registration should contact:

Jan Nurnberg
Faculty of Engineering, location JHE 201
McMaster University
1280 Main Street West
Hamilton, Ontario, L8S 4M1
Tel: (905) 525-9140 ext. 24910
Fax: (905) 577-9099
E-mail: nurnberg@mcmaster.ca

(see "Nuclear" on page 2)

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

MOVING FORWARD INTO THE PAST. Many novelists and not a few scientists have pondered the possibility of returning to a point in one's past. In principle physics does allow time travel via closed timelike curves (CTCs). Along such a warped spacetime trajectory the traveler is always moving into the future (locally) but eventually finds himself back where he started from. (Think of sailing around the world; heading west you return from the east.) J. Richard Gott and Li-Xin Li at Princeton have speculated on whether spacetime could both allow travel into the past and insure a consistent chronology (the traveler must remember shaking hands with his older self as he sets off). They have determined that in part of space no time travel would be allowable, but in another part (separated from the first by a surface called a Cauchy horizon) a time machine could be built, subject to this restraint: if you build a time machine in the year 3000, you might be able to use it to go from 3002 to the year 3000, but not back to the year 1998 because that would have been before the machine was built. Of course even this limited sort of time travel would be very difficult because you would need a lot spacetime warp for it to work, and this could only be provided through the agency of a black hole or a decaying cosmic string loop. For example, to move even one microsecond back into the past would require the presence of a space-warping mass equal to one tenth the mass of the sun! And then there's no guarantee the black hole wouldn't swallow you and the space around you. Then, as Gott says, you'd be able to circle around and meet your earlier self, but you wouldn't be able to escape to boast about it. (Physical Review Letters, 6 April)

NANO-ELECTROMECHANICAL SYSTEMS (NEMS) will be faster, smaller, and more energy efficient than the present day micro-electromechanical systems (MEMS), an example of which is the accelerometer that triggers airbags in cars. At last week's American Physical Society meeting in Los Angeles, Michael Roukes of Caltech (626-395-2916) described the leading edge of NEMS research. Using lithography and etching techniques, he has fabricated a 10x10x100-nm suspended beam of silicon which oscillates at an estimated frequency of 7 GHz (although no detector can yet "hear" the vibrations). Such a resonator will eventually be used in microwave signal processing (for modulating or filtering signals). The speed and stability of nanoscopic silicon arms might even facilitate the advent of some new kind of Babbage-type computer in which mechanical levers once again serve as processing or memory elements.(In other words, a machine with "moving parts" may not be so bad.) Silicon structures in this size regime will also be used as cantilever probes in magnetic resonance force microscopy (the goal being atomic-resolution NMR imaging; see Update 313) and as calorimeters for the study of quantized heat pulses (Update 320). Roukes' colleague, Andrew Cleland of UC Santa Barbara, described a paddle-shaped silicon structure (whose smallest lateral feature was 200 nm) for detecting very small amounts of electrical charge, with a potential application in highsensitivity photodetection (see also Nature, 12 March 1998). At the same APS session, Rex Beck of Harvard reported a NEMS force sensor which integrates a field effect transistor into a scanned probe microscope. The present sensitivities are about 10 angstroms for displacement and 5 pico-Newtons for force (per square root of the frequency), but Beck expects improvements as the size of the device shrinks. The smallest transistor-probe structure Beck reported had dimensions of 3x2 microns x 140 nm.

Nuclear(continued from page 1)

For further course information, contact:

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McMaster University
1280 Main Street West
Hamilton, Ontario, L8S 4L7
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Fax: (905) 528-4339
E-mail: garlandw@mcmaster.ca

List of Course Contents:

- Introduction to the Course
- Introduction to Development of Teaching Unit
- Nuclear Energy Concepts
- Introduction to Radiation
- Health Physics Orientation
- Security Orientation
- Tour of McMaster Reactor
- Laboratory: Radiation Detection
- Biological Effects of Radiation
- Nuclear Reactor Concepts
- Nuclear Fuel Cycle
- Laboratory: Startup of McMaster Reactor
- Laboratory: Neutron Activation Analysis
- Workshop: Develop Teaching Unit
- Nuclear Reactor Safety
- Risk Analysis and Relative Risks
- Nuclear Energy and the Environment
- Introduction to Nuclear Medicine
- Tour of the Nuclear Medicine Facilities
- Course Evaluation and Wrap Up
- Day Trip to AECL and to Pickering NGS

Prices at Wonderland: One teacher's complaint

A few weeks ago, I booked my annual physics trip to Canada's Wonderland. And once again the price has increased!!! When we started attending this event the cost was $13.00 per student !! Now it is $19.00 per student!!!

As a teacher in an inner city Toronto school, I know that many students find this cost a hardship. However, they want to go and do the assignment and as well to share the experience with their friends. I feel that the park should give the students more of a break.

I would like to suggest that the OAPT members write to Maxine Terrier at Canada's Wonderland (FAX number 905 832 7419) to protest the constant increase in price - If a sizeable number of students did not attend the park from across the province then the park would have very poor attendance on those days. Perhaps a 1 year boycott would get their attention.

What do other OAPT members think?? Let the editor know or email me at dianness@sympatico.ca. If members are planning to attend the June conference may be we can discuss this issue further.

Too Many Physics Contests - one teacher's opinion

I would like to appeal to the universities to keep the number of contests, for the OAC level only, in check!! The Grade 12 OAPT contest is in my view terrific - not too hard - a balanced view of physics - emphasis on the real world - and good prizes too !!.

At my school for many years, the only senior level contest written was the Waterloo SIN contest. This was fine - challenging but fun - although I have heard complaints from some teachers that it was biased in favour of mechanics. SIN prizes only apply if a student intends to study physics at Waterloo - somewhat limiting the appeal. A few years ago when the format of the CAP contest changed we started writing the CAP. The "new" format is very good some multiple choice questions and usually 3 written problems. I like the contest but it is 3 hours long and most students are deterred by that fact. CAP prizes apply across the country at many universities but only to the top students. And now there is the University of Toronto daVinci contest. It encompasses Math, Chemistry and Physics and entrance scholarships to U of T's engineering faculty are based on the results of this contest. Last year it was a 2 hour exam of 24 questions that were very unreadable and I think would take at least 1 hour just to read the questions - they promise an improved paper this year.

In addition there are Chemistry contests, myriads of math contests!! The poor OAC student is being swamped with contests all occurring in April or May !! Lets get together and run one contest - perhaps from the OAPT - or from one university but supported by all!! Let's have prizes like the Grade 12 contest to recognize outstanding ability of more than the top student. Let's discuss this openly at the June conference.

Apparatus Competition

Open to all AAPT members
Cash Awards up to $1000
For more information visit the Apparatus Competition web site:

http://www.dean.usma.edu/physics/aapt/contest.htm

or contact the competition directors:

Bob Dorner
(973) 655-7349
dornerr@saturn.montclair.edu

Tom Lainis
(914) 938-3014
ht8134@usma6.usma.edu

Competition Address:
AAPT Apparatus Competition
Department of Physics
US Military Academy
West Point, New York 10996
FAX (914) 938-5803
Apply by e-mail: ht8134@usma6.usma.edu

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:

pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

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201 Chestnut St.
St. Thomas, ON
N5R 2B5

OAPT Web Site

Guleph University is now the host of an OAPT web site. Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
The URL is:
http://www.physics. uoguelph.ca/OAPT/index.html

A Multi-Purpose Instrument

by

Tomasz Dindorf and Wojciech Dindorf

Donaufelderstr. 252/24, 1220 Wien, Austria

(Editor's note: This article is reproduced, with permission, from a delightful little book, "The Sun on the Floor -- Physics experiments that can be performed at home." This 68-page book describes 58 experiments that can be accomplished with simple apparatus. There are many drawings and photographs to illustrate the experiments. A single copy of the book can be ordered for only $10 U.S. from the authors at the address above, and 20 copies can be obtained for $100 U.S.)

A table tennis ball bearing is an interesting and easy-to-make physical instrument that can be used for demonstrations as well as for measurements. Take a bicycle spoke or a similar straight steel wire and sharpen it at one end. Take a table tennis ball and pass the spoke through its centre. Bring the spoke into contact with a magnet for a while in order to magnetise it. Find a container (like an egg-cup) that has only a slightly larger diameter than the ball. Fill it up with water and place the ball in it. Balance the wire by sliding it delicately through the ball one way or the other. Enjoy playing with it to check how sensitive a magnetic needle it is. It points toward North and reacts to distant magnets.

(A special note: Have you noticed that hydrometers tend to stick to the side of a dish? This disturbs the measurement a lot. If you fill a container up to the very top, a convex meniscus will assure a central position of the hydrometer. This "discovery" helped in inventing the "bearing" described above.)

Experiment with the magnetic field of a current-carrying wire

You will need a 4.5-V or 9-V battery and a lead of about 1 m to demonstrate and study the effects of interaction between the compass needle and the electric current. Check the "right hand rule," and see that the best effect is achieved when the wire is above the needle and initially parallel to it.

Polarisation of a solenoid

The same wire, but this time coiled, can be used to show the similarity between a current-carrying solenoid and a bar magnet. The role of a magnetic material inside a coil can be easily checked by placing different materials inside the solenoid.

Reaction to static electricity

Would you expect steel wire to interact with a rubbed plexiglass ruler or a comb? It certainly does. A piece of styrofoam fastened at the end of the pin (with correction for balance) was found to be an interesting tool for the investigation of electrostatic effects.

This instrument can be made out of materials other than steel wire: a drinking straw or a wooden stick, aluminum or copper wire. If, instead of steel wire, a wooden stick or a drinking straw is used, samples of various materials can be stuck at the end, and having a strong magnet, one can find out whether the material is diamagnetic or paramagnetic.

Physics Web Site Focus

Berkley Physics Demonstrations

http://www.mip.berkeley.edu/physics/physics.html

This physics WWW site is an effort to make available an on-line source of information and pictures used for preparing and performing undergraduate lecture demonstrations at the University of California Physics Department at Berkeley. This site deals with demonstrations for the subjects of:

- Mechanics
- Waves
- The Properties of Heat and Matter
- Electricity and Magnetism
- Optics
- Modern and Contemporary Physics
- Astronomy and Perception

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Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XX, Number 4 **Summer 1998**

AAPT Winter Meeting

New Orleans January 3 - 8, 1998

by Peter Scovil, Section Representative

New Orleans is a very interesting city, due to early French and Spanish colonizations. The historic French Quarter is a fascinating blend of history, jazz, good eating and good shopping. But physics dominated for six busy days. Naturally, there is a lot going on on the World Wide Web. There were workshops on how to access and use the web, how to create web pages. In one, by Wolfgang Christian (wochristian@davidson.edu) has created Java applets for physics, calling them physlets. These can be accessed at webphysics.davidson.edu. They consist of interactive single-concept programs which may be animated. My computer doesn't have much in the way of internet support apart from Microsoft Explorer 3.0, but I was able to access at least half of them. If your school has internet access for students, check this out. You may find you can modify these or create your own. In a similar vein, Andrew Gavrin (agavrin@iupui.edu) uses actively uses the web in his lectures, for example, to ask questions based on reading assignments. The answers are due before the lecture with enough time for him to analyse the responses and see where students are having difficulties. He calls it Just-In-Time teaching. This has led him to change his lectures when he discovered that a concept he assumed was well understood was not clear at all to the students. This makes the students feel directly involved in their learning process. Rolf Enger (engerrc.dpf@usafa.af.mil) uses the JIT idea as well at an air force academy. Larry Martin (martin@northpark.edu) uses the web to deliver assignments, collect and automatically grade responses. See www.northpark.edu/~martin/WWWAssign or www.assign.physics.ncsu.edu/demo for a free version. Francis Hart (fhart@sewanee.edu) has students present term papers in astronomy as e-mail attachments. Edward Wright (wright@astro.ucla.edu) has cosmology and relativity tutorials on line at www.astro.ucla.edu/~wright/cosmolog/htm. Maria Dworzecka (dmaria@vms1.gmu.edu) has multiple choice questions on the web at http://physics.gmu.edu/~wmillis/MAPPS/. Cathy Colwell (colwell@freenet.tlh.fl.us) is using the web for high school (see www.mainland.volusia.k12.us/physicslab). Neil Fleishon (nfleisho@calpoly.edu) is part of the Connected Curriculum Project, a storehouse of course materials in physics, math and engineering on the web (see http://prisma.foe.calpoly.edu/conncurr/).

If you are involved with Wonderland, some possible activities presented by Randolph Peterson (rpeterso@seraph1.sewanee.edu) suggests students ride a Ferris Wheel or swing ship type ride sitting on a set of bathroom scales. Would we be able to do that at Wonderland, Al? Try rolling a tennis ball on a rotating merry-go-round to see frame-of-reference effects.

The Exploratorium Science Snackbook 2 is a wealth of great science ideas, especially for younger children. It encourages inquiry-based, co-operative, concrete, conceptual learning. Check out their web site: www.exploratroium.edu. Videotapes of toys done on the Space Shuttle missions show the effects of microgravity. These are available from NASA.

There were a lot of other very interesting talks, but I have touched on a few that I felt I could share most easily. Future AAPT conferences are August 3-8 in Lincoln, Nebraska and Jan. 9-14 in Anaheim, California...and Guelph July 29 - August 3 in 2000! The AAPT half price offer yielded 108 new members world wide - and 13 of those were from Ontario alone. We Ontarians know a good deal when we see it! The special price is good to the end of August in case you missed it.

OAPT Web Site

Guleph University is now the host of an OAPT web site. Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
The URL is:
http://www.physics. uoguelph.ca/OAPT/index.html

A Detailed Investigation of the Standard Rounding Rule for Multiplication and Division

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Wei Lee, Department of Physics, Chung Yuan Christian University Chung-Li, Taiwan

(Editor's Note: This "lay paper" is one of several from the A.P.S. meeting held in April. These papers and other physics news can be found at the A.P.S. Virtual Press Room at http://www.aps.org/BAPSAPR98/vpr/index.html. This paper caught my eye because I have the students spend several days investigating experimental error: which they always complain about.)

Introduction

The use of rounding rules and significant figures is taught to students in virtually all high school and introductory college-level science courses. Despite its widespread use in the education of science students, there is still much confusion about the origin, accuracy, and safety-of-use of these "rules". In a recent note to *The Physics Teacher*, R. H. Good [1] raises serious questions about the validity and safety of standard rounding rules by pointing out a division problem where the rule causes valuable information to be lost in the calculation. In his note, Good describes a fictional situation where a physicist receives a large grant to determine an important physical constant more precisely than previously known. After much work, the data are given to a technician who, using the standard rounding rules, proceeds to throw away some of the hard-earned information in the calculation of the constant. This situation is clearly unacceptable!

The purpose of this work is to test the accuracy and safety of the standard rounding rule for multiplication and division. While it has been shown that this rounding rule can be inaccurate (Schwartz [2]), this work is the first to quantify its accuracy in a reliable way. Our investigation will show that the standard rounding rule in highly inaccurate, predicting the correct number of significant figures in the result less than 50% of the time! When the rule does fails, it almost always predicts 1 less significant figure in the result than is warranted. Thus, the use of the standard rule often causes valuable information to be discarded in calculations.

Background Information

The concept of a rounding rule is closely related to that of significant figures. When a number is written in significant figures, as they often are in the physical sciences, each digit is considered to be certain and the number has an implied uncertainty of ± 1/2 in the last decimal place. Because of this implied error, there is an approximate relationship between the number of significant figures and the precision (percent uncertainty) in the quantity. A number written with 1, 2, and 3 significant figures has a precision of approximately 10%, 1%, and 0.1% respectively. This approximate relationship is the justification for the standard rounding rule for multiplication and division.

The standard rounding rule states that the result from a multiplication or division should be written with the same number of significant digits as the least precisely known number used in the computation. For example, the product of a 2-significant-figure number and a 3-significant-figure number should be written with 2 significant figures according to the standard rule.

Testing the Rounding Rule

A statistical method was used to investigate the accuracy of the standard rounding rule. This method involved the random generation of millions of multiplication and division problems. For each randomly generated problem, the result was calculated and the predictions of the standard rounding rule were applied to the result. If the standard rule predicted the minimum number of significant figures needed to contain all of the valuable information in the result, the rule was said to "work". If the standard rule predicted more or less than this number of digits, then the rule was said to "fail". This method was applied to 1 million multiplication and 1 million division problems and statistics were computed.

Besides the standard rounding rule, there is an often used alternate rounding rule. This alternate rule states that one should always use one more significant figure than suggested by the standard rule. In the division problem discussed by R. H. Good [1], this alternate rule would have protected against the loss of valuable information. In order to investigate this alternate rounding rule, for comparison to the standard rule, it was subjected to the same statistical method described above.

Results

The application of the standard rule was found to work only 46.4% of the time. The standard rule is, indeed, highly inaccurate. The standard rule was found to predict 1 less significant digit than warranted 53.5% of the time. The standard rule is very dangerous to data, causing valuable information to be lost over half of the time. On very rare occasions (0.05% of the time), the

(continued at the top of page 3)

standard rule was found to predict 1 digit too many. The fact that the standard rule can fail is due to its approximate nature, but this is the first work to quantify the accuracy of the standard rounding rule in a reliable way.

The accuracy of the alternate rule was found to be 58.9%, about 13% more accurate than the standard rule. The most important aspect of the alternate rule is, however, the fact that it never discards valuable information. This is supported by a mathematical analysis (not described in this presentation) that shows that the standard rule can, at its worst, be wrong by only ± 1 significant figure. The "extra" significant digit that the alternate rule calls for ensures that it never discards valuable information. Thus, the alternate rule is more accurate and completely safe for data.

Conclusion

It is shown that the standard rounding rule is highly inaccurate, causing valuable information to be lost over 50% of the time. The alternate rounding rule is shown to be more accurate than the standard rule and completely safe. With no perfect rounding rule possible, the best rounding rule is the simplest rule that is relatively accurate and safe. The alternate rule is superior to the standard rule and should be adopted as the new standard.

References

[1] R. H. Good, "Wrong Rounding Rule", The Physics Teacher, 34(3), p.192 (1996)

[2] L. M. Schwartz, "Propagation of Significant Figures", Journal of Chemical Education, 62, p.693 (1985)

Physics Simulations Web Site

Edouard Tcherner (tcherner@interlynx.net) a teacher at Northern Secondary School, http://www.krev.com/ed/index.html, Toronto, has posted Interactive Physics simulations developed and designed by 1998 OAC Physics students. All the necessary links and instructions are provided.

The computer experiments are designed to run on the IBM computers at 1024 by 768 pixel resolution.Clipart has been attached to the object to make simulations more attractive and meaningful for students.

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

THE FIRST SNAPSHOT OF AN EXTRASOLAR PLANET? The existence of extrasolar planets around several stars has been inferred from the wobble in the stars' emissions, but the planets themselves have not been seen amid the glare of the parent stars. Now, the Hubble Space Telescope has taken a picture of an object (named TMR-1C) that might, depending on how the data is interpreted, be either a brown dwarf star or a protoplanet (perhaps with a mass several times that of Jupiter).

The object, about 450 light years away and glowing in infrared light, was glimpsed at all because it has apparently been ejected from a nearby binary-star system, and therefore stands apart from any stellar brilliance. This and the object's youth (it might be only 100,000 years old) might redirect thinking on how gas giant planets form. According to NASA scientist Edward Weiler, "If the planet interpretation stands up to the careful scrutiny of future observations, it could turn out to be the most important discovery by Hubble in its 8-year history." (NASA press release, 28 May 1998.)

TUMBLE AND FLUTTER: how paper falls to the ground is impossible to describe exactly with the laws of physics because of the mathematically intractable equations governing the fluid flow of air. To gain at least some understanding, scientists beginning in the 19th century, have modeled this problem in 2 dimensions. Now, experiments at the Weizmann Institute in Israel (Andrew Belmonte, University of Pittsburgh, 412-624-9385) have provided the first quantitative tests of these 2-D theories. In the experiment, researchers dropped thin strips of metal, plastic, and brass into a thin fluid-filled tank, which forced the strips to move in a two-dimensional plane. What determined whether the falling strips predominantly oscillated from side to side (flutter) or rotated end over end (tumble) was the Froude number, the ratio of the time it takes for the strip to fall its own length to the time it takes for the strip to move from side to side. Longer or lighter strips, which have a low Froude number (like an 8.5 x 11" page) flutter while smaller or heavier strips (e.g., a business card) tend to tumble. (Try it yourself.) The study of vorticies set up by the falling slips may be relevant to the question of how airplanes stall, and may be exploited by insects to enable them to fly with great efficiency.

THE EARTH VIBRATES CONTINUOUSLY even without help from earthquakes. A collaboration of scientists from UC Santa Barbara and Tokyo Institute of Technology has analyzed gravimeter data from 1983 to 1994 and found 61 days to be seismically "quiet" enough for the purpose of searching out Earth's natural oscillation modes. They identify several such modes in the 2 to 7 milli-Hz range (that is, vibrations with periods of hundreds of seconds). The acceleration of material in the solid Earth produced by these spheroidal waves is tiny, on the order of nano-gals, or 10^{-9} cm/s^2. The researchers suspect that the cause of the vibrations is atmospheric turbulence. (Tanimoto et al., Geophysical Research Lett., May 15; contact Toshiro Tanimoto, UC Santa Barbara, toshiro@magic.geol.ucsb.edu.)

THE DEMONSTRATION CORNER

Lenz's Law with Plumbing Pipes

by

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In the January 1997 issue of *The Physics Teacher*, two articles appeared detailing the use of rare earth magnets to demonstrate Lenz's Law in the classroom. The principle involved is that a permanent magnet falling through a tubular conductor will induce a current in the conductor and hence a magnetic field which will oppose the magnetic field of the permanent magnet and thus slow its rate of fall. This article gives variations of the methods discussed in those papers.

Arbor Scientific (1-800-367-6695) sells two rare earth magnets. The smaller magnets (P8-1123) are 0.5 inch in diameter and 0.25 inch in length and are sold in pairs for \$20 U.S. The larger "Giant Neodymium" magnet (P8-1124), which is sold individually, is 2.2 cm in diameter and 2.5 cm in length and costs \$35 U.S. We have tried dropping the smaller magnets, individually and in pairs, through .75-inch copper plumbing pipe and also dropping the larger magnet through 1-inch pipe. Although both illustrate Lenz's Law dramatically, unless cost is a limiting factor there is no doubt that the larger magnet provides a much more spectacular demonstration.

We start the demonstration by dropping a non-magnetic "dummy" of the same size as the magnet through a 1-inch Type L copper pipe which is available through local plumbing supply centres. The time to fall through our 1.73 metre long tube is 0.6 s. We use stainless steel because it looks just like the magnet and when the dummy and magnet are held together there is no mutual attraction, and with some verbal distraction, you can convince students that you have two identical pieces of iron (that is, if you want to fool the students and make the demonstration seem even more amazing). The time for the large magnet to fall through the pipe is 15 s. Students are surprised to the point of disbelief!

Be aware that the most common commercial copper pipe is Type M which is thinner walled than Type L and the time taken to fall through a 1.73 meter Type M tube is only 9.2 s. The factor in time of $15/9.2 = 1.6$ is to be expected because the wall thickness of Type L is greater than that of Type M by a factor of 1.4 (not equal to 1.6 but close) and the resistance to current should be inversely proportional to wall thickness.

We next use a 0.58-metre section of Type L (one third of the original length) and the time of fall is now 4.6 s, which is only slightly less that one third of the original 15 s. This illustrates that terminal velocity is reached very quickly. We created another variation which allows the students to actually see the magnet falling. A 3/16 inch bit was used to mill a slot along the length of a 0.58 metre length of Type L pipe. The time to fall is only reduced from 4.6 to 3.5 s. This surprises most students because they think that eddy currents must go all the way around the pipe and they expect the magnet will fall through the slotted pipe in much less time.

The fact that terminal velocity is reached very quickly allowed us to create another spectacular variation of this demonstration. Clear plastic pipe of the same inside diameter as the 1 inch copper pipe was used to make a composite tube of alternating lengths of plastic and copper. Our tube has two sections of plastic, each about 30 cm, and two of copper, each of about 40 cm (lengths are not critical). The sections are held together with brass sleeves. The demonstration is most dramatic when the magnet falls through the sections in the order plastic-copper-plastic-copper. The time to fall through the plastic sections is a fraction of a second whereas the total time for the whole tube is between 5 and 6 s. It's the alternation between speeding up and slowing down which the students find most interesting.

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:
pdlaxon@julian.uwo.ca

or at: OAPT Newsletter, c/o Paul Laxon,
201 Chestnut St., St. Thomas, ON N5R 2B5

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XXI, Number 1 **Fall 1998**

Report on the OAPT Conference

University of Waterloo
June 18-20, 1998

reported by Peter Scovil, Section Representative
petescov@enoreo.on.ca

The theme of this year's conference was "Tools to Teach Physics". A number of tools for teaching physics were introduced at the workshops Thursday evening. They were *Interactive Physics* by Bill Syniura, *Computer Delivered Tutorials* by June Lowe, *Pasco Physics Interfaces* by Shawn Clement, and *Holography* by George Vanderkuur. Dr. James Downey, the president of the university, and Dr. John Vanderkooy, conference host, welcomed us as the regular program started Friday morning.

Of great concern to us is the future of high school education in Ontario. It may not be rosy, but we must learn to cope with the changes as well as possible. Denis McGowan of the Ministry of Education spoke on the direction of the science curriculum. The documents we can expect will be similar to the Science and Technology, 1 - 8 document. It is likely to be highly consistent with the Pan-Canadian Common Framework. It suggests that physics topics in 11 and 12 be force, motion, work, energy, momentum, waves, fields, radioactivity and modern physics. In grades 9 and 10, physics-related topics would be atoms and elements, electricity, motion, space exploration, and weather dynamics. Heat, optics and mechanical efficiency will now be in grades 7 and 8. There will still be 2 compulsory science credits with an additional one other from either science (11/12) or technology (9-12). In grades 9 and 10 there will be two streams for science (applied and academic). Documents should be in schools by March 1999, especially for grade 9. Information on curriculum development can be followed on the STAO web site http://www.stao.org . The present suggestion for grade 11 is to have one stream for college/ university and another stream for workplace, instead of four different streams. In grade 12, the ministry had suggested a college stream and a university stream, but the committee felt that only a single college/ university stream was necessary. The workplace stream could involve two years of a science credit, or a single year of each of the individual sciences in either 11 or 12.

Several people did presentations on using computer applications as tools for the classroom. Roberta Tevlin discussed how she used spreadsheets and interfaces to produce motion graphs of physics concepts, and then explored how air resistance would affect the results by inserting air resistance functions into the spreadsheet. This would allow study of drag and terminal velocity and the effect on projectiles. Simple harmonic motion can be studied with and without damping. Peter Scovil presented Graphical Analysis, a program by Vernier that he has used in class for motion graphs. It is easily mastered by students and a single copy gives a site licence at a very reasonable cost. This allows it to be put on the school network for access in the library and computer labs. It also takes data from TI82/83/92 programmable calculators. Joseph Saikali uses Maple V's mathematical and graphical capabilities to show waves in motion, superposition, reflection at fixed and open ends and standing waves. This helps students to 'see' what happens at each instant in a wave. His web site is http://www.delasalle.toronto.on.ca/~jsaikali.

Acoustics and waves were involved in a number of presentations. John Petrie talked about how the cochlea in our ear is a Fourier analyser with high tension, high frequency response near the oval window, and low response at the free end. He then demonstrated his famous Chladni plate to get two-dimensional standing wave patterns using nylon fishing line on his bow. Peter Scovil described a demo he uses involving a small Radio Shack woofer ($20) as a driver for standing waves, and

Waterloo continued on page 2

Waterloo...continued from page 1

how, using a light spring on an overhead, he can demonstrate a longitudinal standing wave. John Vanderkooy, an acoustics specialist, discussed the basic principles of a loudspeaker, the importance of the box and the tweeter. He also discussed digital audio and how a signal is digitized.

Doug Abe's described and showed videos of how he used Rube Goldberg Machines as very interesting projects for ISUs. Patrick Tevlin from Ontario Science Centre promoted the new Scream Machine show which will be on for the next year on the science of amusement park rides. It included a bicycle in a 5.5 m vertical circle with an accelerometer, and a 5 m rotating platform with a 20 s period on which students can roll bowling balls and see the effect of the rotating frame of reference. Students can make their own roller coaster and see the effects of klothoid versus circular loops, and the effects of height. E-mail him for handouts. Doug Hayhoe suggested that we need to capture student's imaginations with one of the great themes of science, specifically the Standard Model (now the M theory). He has prepared a unit, available from STAO (web site above) for $20 on neutrinos, quarks, leptons and the rest of the particle zoo, and the principles and conservation laws that apply. John Petrie talked briefly about using fridge magnets for demonstrating magnetic domains. They work well as the domains are in alternating strips on the back. Dragging one magnet over the other causes the one to bounce up and down noticeably due to the changing fields. Iron filings will line up along the domain walls.

A couple of people described research projects they were working on. Serena Schlueter discussed her research in microgravity on the effect of a laser beam on an absorbing medium, e.g. to improve welds. Fluid flow is no longer dominated by sedimentation, buoyancy or convection, but by surface tension and conduction. In a single plane flight, the researchers flew 40 parabolic trajectories of about 20 s each to obtain microgravity, sandwiched between valleys of higher than normal gravity. Stefan Idziak described his research in complex fluids (the physics of goo), with a lot of attention into how liquid crystals work in polarizing light with and without electric fields. It has applications as well in work with polymers, in drug delivery systems that don't get attacked by the immune system, in getting burn treatments to stay on, and in gene therapy to replace a defective gene.

On a more personal level, two long-time OAPT members were given life memberships for all the work they have put into the organization and physics education in general. Malcolm Coutts was honoured especially for his past work on the newsletter, the physics contest and as a presenter at conferences. Bill Konrad was recognized for his work on the executive in many roles over the years and for many presentations at conferences that we all have found useful and entertaining. Phil Eastman entertained us at the banquet with stories of SIN. Next year, the conference will be held June 24-26 at Queen's University in Kingston. Hamish Leslie of Queen's and David Gervais of Sharbot Lake School are the organizers. The executive would appreciate any comments and suggestions arising from this year's conference to guide us in planning for the next one. An e-mail list is included should you wish to contact any of the speakers.

OAPT Executive 1998/99

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- Ernie McFarland: Membership elm@physics.uoguelph.ca
- Dianne Ness: Member-at-large dianness@sympatico.ca
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- Terry Price: President tprice@yorku.ca
- Peter Scovil: Member-at-large petescov@enoreo.on.ca
- Kevin Soltes: Secretary/Treasurer (416) 394-7750
- John Wylie: Vice President flipper@helios.physics.utoronto.ca

A RESPONSE TO THE GRADE 11 AND 12 POLICY DOCUMENT FOR SCIENCE

The OAPT is planning to make an informed response to the latest science curriculum deliverables which are available at the stao website (http://www/stao.org/gr11prt2.htm).

We invite those members interested in contributing to this response to contact Dianne Ness via email at dianness@sympatico.ca or by fax at 416-393-0009.

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

THE 25 GREATEST ASTRONOMICAL FINDINGS of all time, according to the editors of Astronomy magazine (October 1998) are as follows: the discovery of quasars (1963); the cosmic microwave background (1965-66); pulsars (1967); Galileo's observations of the phases of Venus, Jupiter's moons, and craters on the moon (c 1609); extrasolar planets (1992); supermassive black holes (early 1990s); Newton's Principia, formulating the mathematics of our heliocentric system (1687); the discovery of Uranus (1781); the first known asteroid (1801); discovery of Pluto (1930); Neptune (1846); spectroscopic proof that nebulae are gaseous in nature (1864); recognition of galaxies beyond our own (1923); the advent of radio astronomy (1931-32); studies of globular clusters help to map the Milky Way (1918); cometary explosion over Siberia (1908); an accurate measurement of the speed of light (1675); Southern Hemisphere celestial objects cataloged (1834-38); Cepheid-variable period-luminosity relationship worked out (1912); Copernicus' De Revolutionibus sets forth the heliocentric system (1543); Laplace's theory on how the solar system formed (1796); a transit of Venus suggests Venus has an atmosphere (1761); the Hertzsprung-Russell diagram for understanding how stars age (1913); scheme for classifying star types (1890); the use of parallax for finding a star's distance from Earth (1838).

ECONOPHYSICS is the application of physics techniques to economics problems. Like a collection of electrons or a group of water molecules, the world economy is a complex system of individual members (in this case, countries) that interact with each other. In a situation that many experimental physicists would surely envy, the world economy produces an incredible amount of data—one year of US stock-exchange transactions results in 24 CD-ROMs of data. These data provide the opportunity for extensive statistical analyses which can lead to a better understanding of the behavior of these complex systems. In an earlier study of business firms (Stanley et al, Nature, 29 Feb. 1996), physicists and economists found that the probabilities associated with observing a given growth rate for a firm could be described with a single mathematical function for firms of all types and sizes (from sales of $100,000 to $1 trillion). Furthermore, they found that the width of the curve showing the probability distribution follows a "power law,"in which the width is proportional to the firm size raised to a power of approximately 1/6. Now, a Boston University-MIT physics team (Youngki Lee, Boston University, 617-353-8051) collaborating with a Harvard economist (David Canning, 617-495-8401) has found the same universal patterns and power law for the fluctuations in the growth rates of the gross domestic products (GDP) of 152 countries from 1950-1992. (Lee et al., Physical Review Letters, 12 October 1998.) These models raise the exciting possibility that complex human organizations can be studied with methods and concepts developed in statistical physics. (Amaral et al., Phys. Rev. Lett., 16 Feb. 1998.

WHY WAIT UNTIL IT'S TOO LATE?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

Membership Application

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Send to: Ernie McFarland, Dept. of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

Call for Questions:

Now is your chance to contribute to the 21st OAPT Prize Contest! Have your name acknowledged on the front page! If you have an interesting or creative question (or even an idea for a question), simple or challenging, send it to Contest Coordinator Doug Abe at:

Agincourt C.I., 2621 Midland Ave.
Scarborough, ON M1S 1R6
or via e-mail to dougabe@echo-on.net

All donations are cheerfully accepted! Send in those pet questions and see your name in print!

OAPT WEB SITE

Guleph University is host to the OAPT site.

Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
The URL is:

www.physics.uoguelph.ca/OAPT/index.html

THE DEMONSTRATION CORNER

An Inexpensive Vibrator for Standing Waves

by

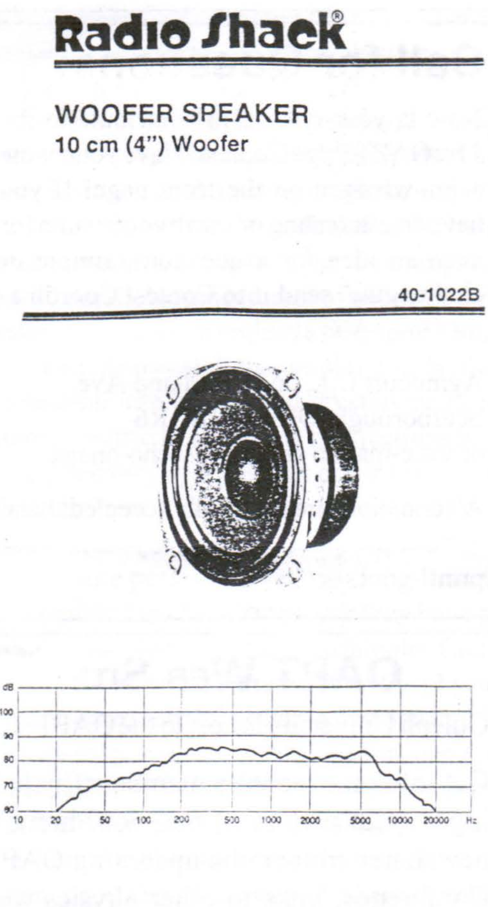
Peter Scovil

Waterford District High School, Waterford, ON, 519-443-8657

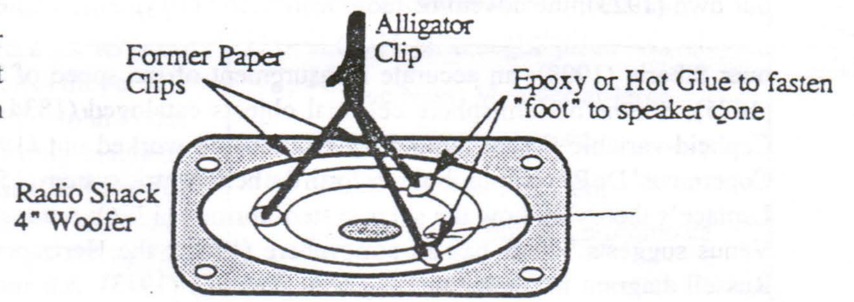
e-mail: petescov@enoreo.on.ca

At the OAPT Conference this past June at the University of Waterloo, I gave a short demonstration of a vibrator I built from a Radio Shack speaker. It allowed me to produce longitudinal as well as transverse standing waves. This is based on an idea from one of the AAPT conference workshops.

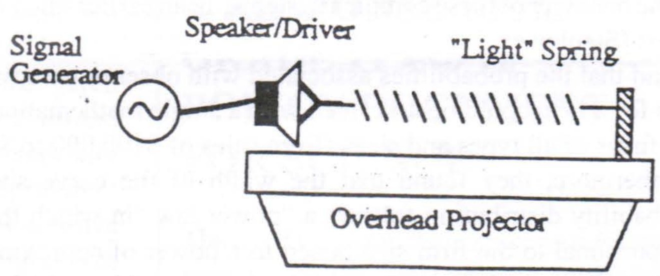
The speaker I used is the Radio Shack 10 cm (4") woofer 40-1022, which cost me $19.99. It is quite compact, but gives good low frequency response so that vibrations can be clearly visible.



To connect this speaker to a spring or a cord, you can make a tripod using straightened out paper clips and an alligator clip, and epoxy or hot glue to fasten things together. See diagram. Make a 90° bend in the end of the paper clip that is fastened to the speaker so that it won't pull out of the glue when tension is applied.



For longitudinal vibrations, use a light spring, and place the demonstration on an overhead projector (see diagram). I found the spring from my Pasco dynamics cart set worked very well. You can illustrate the characteristics of nodes, antinodes, and changing mode number with changing frequency. It is possible to use a hand stroboscope to slow the action down so that the motion of the coils at the nodes can be studied.



Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XXI, Number 3 **Spring 1999**

Response to Secondary Policy Document, Science

Grades 11 and 12 Physics, University Stream (Released Dec. 31, 1998)

by Peter Scovil

On April 24, a group of secondary and university physics teachers got together in Toronto to look over the fourth draft of the physics policy document. It included OAPT and STAO members: Dianne Ness (chair), Bill Konrad, Peter Scovil, John Pitre, Stuart Quick, John Harrison, Doug de la Matter and Stan Kosior. Other people were also consulted.

Our first concern was the amount of material to be covered in the courses, forcing us to take a rote facts and formula approach to teaching. This flies in the face of research in physics education over the past 30 years. We also felt the "one shot at a topic" approach was inadequate, preferring a more sequential approach.

We suggested making the modern physics strands in each year optional. This is not to say they are unimportant. Teachers would be strongly encouraged to cover at least some of the modern physics topics that they feel would stimulate the interest of the students. This would allow more in-depth treatment of the other four strands.

Another suggestion was that for the Specific Expectations, we build in some flexibility. For "developing skills of inquiry and communications" the word "will" would be replaced by "should", recognizing the difficulty some schools may have due to lack of equipment or of training. This still emphasizes the importance of laboratory work. For "relating science to technology, society and the environment" the word "will" would be replaced by "may", allowing teachers to use examples in areas where they have experience, and giving time to deal with a few topics well. This may not fly with the ministry, but if the courses are overloaded, we will be cutting topics whether it is permitted or not. We would like the emphasis to be on the basic concepts.

In specific areas, we recommended coefficient of friction, and Hooke's Law be moved from the grade 11 to the grade 12 course, and that Newton's Third Law be placed back in the grade 11 course. As optics and electricity are previously covered in grades 8 and 9, they needed to be included again at the grade 11 level. Numerous changes were suggested in the order of topics in the grade 12 course to make it flow more logically. For example, we felt gravitation fit better with dynamics and energy than with electric and magnetic fields, and the nature of light was more suitable after electric and magnetic fields. The expression "wave-particle duality" was rejected in favour of "the nature of light and matter".

We recommended quite a few other changes, but this gives you an idea of the main ones. We hope the ministry will listen to our suggestions and give us a more manageable curriculum.

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

MEASURED VALUES FOR THE HUBBLE CONSTANT are converging nicely. At a press conference on May 25, Wendy Freedman of the Carnegie Institution reported a new value of 70 km/sec/megaparsec (with an uncertainty of 10%), down from a value of 80 reported back in 1994. She is one of the leaders of a group that uses the Hubble Space Telescope (HST) to track the light emission of Cepheid variable stars in nearby galaxies.

Another Carnegie astronomer, Allan Sandage, has been a leader of a group that consistently measures a smaller value for the Hubble constant, the latest number being about 59, up from an earlier value of 57. Thus the observed Hubble constant, which is a measure of the overall expansion of the cosmos, is now providing an estimate for the age of the universe about 12 billion years that is no longer in contradiction with the apparent age of the oldest stars.
(NASA press release, 25 May 1999.)

OBITUARY NOTICE

Dr. Robert Sears, the AAPT President Elect, died Wednesday, April 14. Dr. Sears was previously AAPT Treasurer and Chair of the Section Representatives, and would have become the AAPT president next year. He was 57 years old.

OAPT Conference

June 24th, 25th, 26th—1999

Queen's University
Kingston, Ontario

Features Tours To

ALCAN
DuPont
Bombardier

Guest Speaker June 25th
Mr. Terence Dickinson
Editor of Sky News

"The Universe and All That Is In It"

Contacts

Dr. Leslie (613) 545-2713
Dave Gervais (613) 279-2131

OAPT Executive Positions

The OAPT is looking for members interested in serving on the executive. Several positions are opening up this year (including the Newsletter Editor). If you are interested in finding out more information, contact Terry Price (tprice@YorkU.CA).

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:

pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

OAPT Newsletter
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201 Chestnut St.
St. Thomas, ON
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OAPT Web Site

Guleph University is host to the OAPT site.

Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
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ONTARIO ASSOCIATION OF PHYSICS TEACHERS

ANNUAL CONFERENCE June 24-26 1999

PROGRAM

Thursday June 24

6:00 - 9:00 p.m. Registration Desk Open in Stirling Hall

7:00 - 9:00 p.m. **Workshops**

Senior Level

Pasco Interfaces	Bill Konrad
Vernier Interfaces	Dianne Ness
Interactive Physics	Kevin Soltes
Grade 9 Astronomy	Chris Burns

Junior Level

Electricity
Heat, and Structural Strength and Stability
Hydraulics

9:00 - 10:30 p.m. Reception

Friday June 25

8:30 a.m. - 12:30 p.m Registration Desk Open in Stirling Hall

9:00 a.m. Opening Remarks and Welcome

9:15 a..m. "Dynamics of Solar Systems", Martin Duncan (Queen's University)

10:00 a..m. "The Transform of Anamorphic Art and the Art of Anamorphic Transforms", James Hunt (University of Guelph)

10:30 a.m. Refreshments and Displays

11:15 a.m. "Using Energy-bar Diagrams in Teaching the Conservation of Energy", Glenn Wagner (Central Wellington District HS)

11:30 a.m. "Physics Software Demonstration", John Berrigan (Oakville Trafalgar High School)

Noon "Diana's Demos", Diana Hall (Bell HS, Nepean)

12:20 p.m. Lunch

1:30 p.m. Board Buses for Industry Tours to ALCAN, Bombardier or DuPont

4:00 p.m. Free Time

6:00 p.m. Pre Banquet Reception in University Club

6:30 p.m. Banquet with after Dinner Talk by Terrence Dickinson - "The Universe and All That Is In It"

Saturday, June 25

9:00 a.m. "The Light Fantastic - Demonstrations in Optics",John B. Johnston (The Faraday Center)

9:45 a.m. "Freshman Physics Lab with Take Home Kits", Tony French (MIT)

10:15 a .m. "Helmholtz Resonance in an Industrial Application", John Earnshaw (Trent University)

10:30 a.m. Refreshments and Displays

11:00 a..m. "An Education Leading to a Career in Industrial Physics", Darcy Poulin (NORTEL)

11:35 a.m. "Medical Applications of Acoustic Imaging", Marc Lukacs (Queen's University)

12:15 p.m. Lunch

1:30 p.m. DEMOS TBA

1:45 p.m. "Fun with Newton's First Law", Roland Meisel (Ridgeway Crystal Beach HS)

1:55 p.m. "A Machine that Differentiates", John Coenraads (Regiopolis Notre-Dame, Kingston)

2: 15 p.m. OAPT Business Meeting

2:30 p.m. "AAPT Summer Meeting 2000", Ernie McFarlane and Jim Hunt (University of Guelph)

2:45 p.m. "Draft Senior Physics Science Guidelines" Tom McCaul (Bayview S.S. Richmond Hill)

3:05 p.m. "The Sudbury Neutrino Observatory - First Observations", George Ewan (Queen's University)

3:50 p.m. Final Remarks and Close.

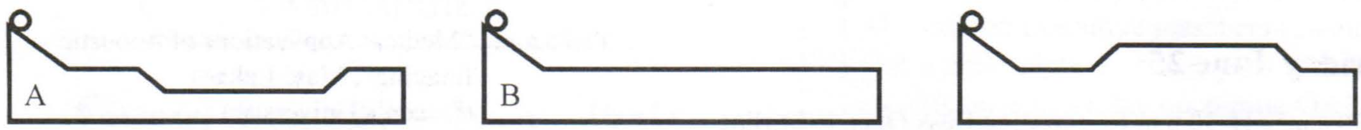
Which Ball Gets to the End of the Ramp First

by

John Childs

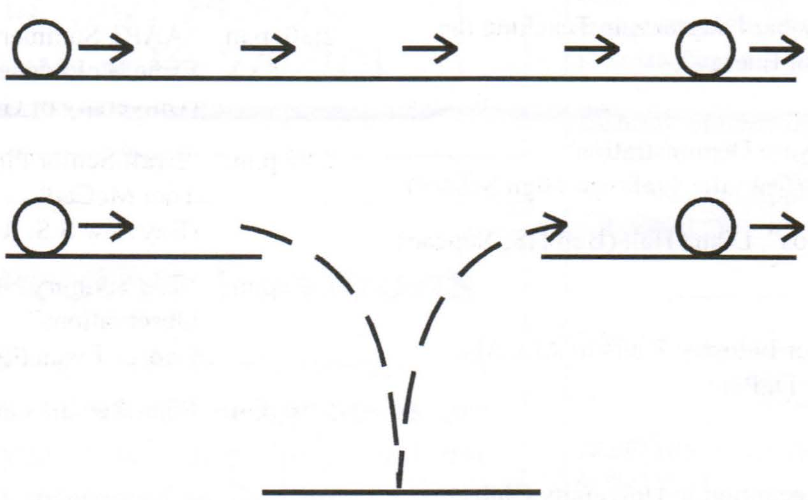
Grenville Christian College, Brockville, ON
e-mail: jchilds@grenvillecc.ca

This is a good exercise to use after you've done kinematics, dynamics and energy. We all talk about the kinetic and potential energy of roller coasters and their speeds, and the demonstration will let your students apply their critical thinking skills to this kind of situation. Be sure to have your students examine the setup and predict the outcome, *before* you run the demo. The question is, "Which ball gets to the end of the ramp first?" I give this demo as a quiz, asking students to predict a result (A, B or C), and write a paragraph defending their choice. I give some points for a correct answer and some more points for a correct, logical argument.



Most students seem to choose B, since it is the shortest distance. Some will choose A, B and C, or that all will get to the end at the same time. This is perhaps a mixup with the concept that they all have the same speed when they arrive at the end, at whatever time. The correct answer, of course, is A, since it travels its "valley" at a higher speed, more than making up for the fact that it has a little farther to go.

You can build these ramps using curtain rods and plywood (email me for plans), or you can simulate the ramps using Interactive Physics. The computer simulation allows some interesting extensions to be added to the demo. Imagine two side-by-side tracks of path B. Place a gap in one track so that the ball free falls to a "perfect" bounce and returns to its original height. As long as the gap-depth ratio is correct, both balls get to the end of their tracks at the same time, no matter how deep a bounce the one ball takes! It is quite striking to watch the computer demo and see the balls actually do what is predicted. If you use interactive Physics, I can email you the simulations.



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Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an affiliate of the American Association of Physics Teachers)
Volume XXI, Number 4 **Summer 1999**

AAPT Winter Meeting

Anaheim, California January 8-14, 1999

by Diana Hall, Section Representative

Heading out on the first day of this year's major winter storm I was fortunate to get to Anaheim with a delay of only 5 hours. Many travellers were delayed up to a day. From the start of the first workshop to the end of the last session I felt continually re-energized and remotivated by this conference. The calibre of teachers there was such that everyone had something to share, no matter who you spoke to.

I was very glad not to have missed the workshop which I attended on Saturday on "Video Capture" given by Priscilla Laws, featuring the Videopoint program produced by Lenox Softworks (www.isw.com). This technology allows students to make their own motion movies, digitize them using capture cards and load them into the Videopoint program (many premade movies are included in the program). From there the program allows you to obtain data from the movie. The capabilities are extensive, including position, velocity, acceleration, momentum, kinetic energy and lots more. Incidentally this software appeared on the recent government issued shopping the list so hopefully many of you knew enough to purchase it. It was unfortunate that no information was given out with the list. I found the process very easy to learn and it seems to be very versatile. I recommend it and others at the workshop recommended it over other similar programs like "Motion Graph". Pricilla Laws (lawsp@dickinson.edu) gives many workshops and mini courses and has written books on Real Time Physics.

I also attended the PRISMS workshop given by Roy Unruh (unruh@uni.edu) which is an activity based program and includes lots of neat demos, labs and discussion activities to encourage thinking using low budget materiels. He sells this in the form of a big binder. There were other workshops involving CBL's and interfaces, Amusement Park Physics.. and on..so many to chose from so few choices.

Wolfgang Christian (wochristian@davidson.edu) was there with his Physlets. I notice Peter mentioned these last year. He presented his CIPE (Committee on Computers in Physics Education) grand prize winning physlet, a cool one on electric fields "EField and Poisson". It allowsthe student to visualize the fields around charge configurations, to determine current from an inside view of charge flow or to determine charge size based on forces. All windows are interactive and all pages can be adapted to reflect the emphasise desired. He has 25 applets now downloadable at no charge. They will run in standard html page. I'm having trouble accessing them but I emailed him and he replied promptly. It may be a Mac/PC thing. I haven't tried a PC yet. Look for them on webphysics.davidson.edu/applets/applets.html.

Another CIPE winner was Michael Lee who's "Optics Bench" appears on Wolfgang's website. This is a very practical program which allows you to create images from lens or mirror systems, change parameters etc. Check it out! Others to investigate are "Atom in a Box" by Dean Dauger, UCLA (dauger@physics.ucla.edu) or do a Yahoo search on "dauger" for the program. This program shows atomic orbitals in 3D and more.

Highlights of the conference were the two lectures given by David Goodstein, Oersted Medal Recipient. The Oersted Lecture was entitled "Now Boarding: The Flight from Physics" where he discussed the declining enrolment in Physics programs and the reasons for it and the use of physics to weed out students from other science areas. An interesting and controversial topic.

If you have read "Surely You're Joking Mr. Feynman" or any of Feynman's other books you will know what a brilliant, captivating and funny man he was. David Goodstein was lucky enough to be both a colleague and a good friend of Feynman's. In his second talk he shared some of his experiences with this great man. It was a thrill to be there.

I didn't attend it but there was a very popular session on the "Physics of Magic". Check "DJ1-The Physics of Magic and Vice-Versa" AAPT Announcer,28 p.107, (July 1998). Also check http://members.aol.com/sciencetrix/index/html.

There were lots of demo session and I learned many neat tricks that I will share with you through demo corner and at the June Meeting. It was a privilege to be able to represent OAPT at such a fulfilling conference. Thank You OAPT!

Ontario Association of Physics Teachers

21st Annual Conference

May 25, 26, 27 2000

McMaster University Hamilton, Ontario

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WEB PAGE - AVAILABLE IN SEPTEMBER

Physics News *continued from p. 3*

each other at higher velocities, such as those associated with friction between tectonic plates during earthquakes. Observing the jerky "stick-slip" motion of a steel block riding on a rotating steel table, the researchers carefully measured the friction forces for relative velocities up to 0.35 m/s, by monitoring the expansion and compression in a spring attached to the steel block. At these high velocities, they noted that the significantly increased production of sound waves (largely neglected in past analyses) dissipates a large amount of energy, stealing away some of the energy of motion required for two surfaces to slide past each other and thereby amounting to an increase in friction. This suggests that the generation of sound waves between two sliding fault surfaces during an earthquake may provide a significant feedback mechanism that mitigates a quake's effects, by converting energy of motion (friction which might otherwise have caused fracturing in the Earth) into sound energy. (Johansen and Sornette, Physical Review Letters, 21 June 1999.)

ANYBODY OUT THERE?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:

pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

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N5R 2B5

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Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
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Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

PERCEIVING MUSICAL PITCHES may require much less neural processing and occur at a lower level of the nervous system than previously thought, according to a new explanation, offering possible insights into designing better hearing aids. A musical note is defined mainly by its lowest pitch, known as its "fundamental frequency," but a note also typically contains higher-pitched "overtones" with frequencies that are some multiple of the fundamental. Even when the fundamental frequency is completely removed from a note, the overtones often allow listeners to perceive the missing fundamental anyway. Being able to perceive missing frequencies may explain why hearing a classical symphony through a tiny radio, which cannot satisfactory reproduce the lowest-frequency pitches, sounds reasonably faithful to a live version heard in a concert hall. Recent explanations of how we perceive "residue tones" require extensive amounts of neural processing, which can only take place in the cerebral cortex. However, researchers in Spain and Italy (Julyan Cartwright, Higher Council for Scientific Research, Spain, 011-34-958-243360, julyan@galiota.uib.es) propose that residue perception may result from a "nonlinear" process, involving the generation of frequencies that are not multiples of the original signal. Much more efficient than previous linear models, their proposed mechanism can take place at neural centers much earlier than the cerebral cortex. Specifically, they propose a "three-frequency resonance" that takes place in some neural processing center before the cerebral cortex, in which the electrical signals generated by two overtones stimulate a population of nerve cells to fire electrical signals at a third frequency different from those of the two overtones. Better understanding of pitch perception may lead to applications in medicine; it is already known, for example, that hearing aids which concentrate on making the fundamental frequencies more intelligible produce better results than simple amplification alone. (Cartwright et al., Physical Review Letters, 28 June; sound samples at http://www.imedea.uib.es/~piro/PitchPage/)

LONG BASELINE NEUTRINO OSCILLATION EXPERIMENTS have now gotten underway with the announcement that the Super-Kamiokande detector (near Tokyo) has recorded the arrival of a neutrino launched in its direction from the KEK proton accelerator 250 km away (near Tsukuba). Last year Super-Kamiokande established the important fact that neutrinos (made by cosmic rays striking the atmosphere) transform, or oscillate, from one type to another on their way through the Earth (see last week's Update 436 for more recent results). In the new experiment (dubbed "K2K") physicists attempt to confirm the oscillation phenomenon by allowing neutrinos made artificially at an accelerator to pass through a nearby detector and also the much more distant Super-Kamiokande detector, aligned so as to receive the same neutrino beam. If, for example, muon neutrinos oscillate into another type of neutrino, adjusted event rates would be different for the two detectors. (K2K website: http://neutrino.kek.jp; for background see Physics Today, February 1996.) HOW DO COMPLEX ORGANISMS FORM? A Darwinian mechanism of natural selection plus random mutation is not quite enough to explain the complex features of life on earth. For example, it does not predict or anticipate the fact that an ecosystem or a global community has a hierarchical structure, with interactions that take place at several size scales. For example, people communicate with each other in an organization; and organizations communicate with each other in a larger community. Barbara Drossel of the University of Manchester in England (011-44-161-275-4201, barbara.drossel@man.ac.uk) has introduced a simple mathematical model for describing how originally independent units may develop into a complex organism with a hierarchical structure. In her model hierarchy comes about because of the increase of a quantity she calls "productivity" (similar to "fitness" in biology and "utility" in economics). Individual units communicate with each other to increase productivity which leads, at the very least, to larger groups. Drossel's model incorporates the additional idea that the size of a group is restricted by the limited capacity of individuals to communicate and to travel. Therefore, she introduces a "communication cost" per partner and per unit distance to the partner. This encourages the formation of groups and ultimately the formation of supergroups and groups of supergroups which interact with each other. (Drossel, Physical Review Letters, 21 June 1999.)

ACOUSTIC-DEPENDENT FRICTION. Studies of friction are often carried out at modest relative speeds: the two moving surfaces in question typically slide past each other at 1 cm/s. However, researchers at UCLA (Anders Johansen, 310-825-2863) wondered if new mechanisms might appear when surfaces slide against

continued on p. 2

THE DEMONSTRATION CORNER

Two Sound Demonstrations

by

James L. Hunt

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e-mail: phyjlh@physics.uoguelph.ca

The following two sound demonstrations have the virtue of being inexpensive; in fact the first one costs the teacher nothing. Although I have seen the first referred to somewhere, I do not recall seeing the second. Both demonstrations rely on the human ear's remarkable ability to distinguish changes in pitch.

Dependence of Resonance Frequency on Column Length.

Have the student roll two pieces of 8½ × 11 inch notepaper into cylindrical tubes: one the long way and the other short. Hold both tubes up to the ear and gently scratch them alternately; first one and then the other. The enhancement of the sound at the resonant frequency of the tube produces a distinct difference in pitch (higher for the shorter tube).

The resonant frequencies are 608 Hz (a very sharp D') and 791 Hz (a slightly sharp G'). Only the rare musical student with perfect pitch will be able to come close to the absolute pitch; however, the interval is almost a perfect 4th (slightly flat) which is easy to distinguish. If a chromatic instrument is available (piano, flute, etc.), playing a 4th starting on D' (D' - G' in the second octave above middle C) will match closely the interval heard in the paper tubes.

For the non-musical teacher:

A semitone frequency ratio is given by the 12th root of 2 which is 1.059463. Therefore, any frequency f multiplied by (1.059463)n is n semitones higher. A perfect 4th is an interval of 5 semitones so 608(1.0059463)5 = 812 Hz. As stated above, the interval from the tubes is flat from this.

Dependence of Sound Speed on Medium Density.

Take an 8 oz tumbler and put a heaping teaspoonful of a fine wetable powder in the bottom. I have used cement and, separately, psyllium (Metamucil, a common laxative); the latter works better. Carefully fill the tumbler with water and start stirring vigorously, including striking the glass. The sounds of the stirring action will rise in pitch as the powder is mixed. As the powder is mixed into the water, the mean density of the medium increases and so the sound speed increases. Since the resonant length is unchanged, the pitch (frequency) rises. The Metamucil can then be drunk in safety.

The Exam

Instead of studying for the last exam of their college careers, the four seniors spent the night partying in the house they had rented off-campus. The next morning they waited until the test was be almost finished, and then they made their way to class. Along the way they all put grease on their hands to support the story they were going to tell their professor.

The class was almost done with the exam when all four seniors burst into class. They told the professor that they had had a flat tire along the way, and could they please retake the test? The professor said that he was a reasonable man, so he scheduled a testing date the following week.

Their plan had worked! They studied diligently for the next week, making the most of their time. The day of the make-up came, and they were ready for anything.

The first question, worth 5 points, was easy. The second question was worth 95 points. It simply read, "Which tire?"

from http://www.physics.unlv.edu/~farley/humor/

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Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XXII, Number 1 Fall 1999

AAPT News

- AAPT is once again offering half price memberships to new members.
- AAPT Winter Meeting is being held in Kissimmee, Florida January 15-19
- AJP (American Journal of Physics) is now available on the web. For info on subscriptions visit http://www.aapt.org/pubs_catalog/pubs.html or contact Member & Subscriber Services at 301-209-3333 or email aapt-memb@aapt.org
- Radio JOVE Project - Students have an opportunity to participate in the exciting field of radio astronomy by joining the Radio JOVE Project. Observations of radio emissions from Jupiter will be the highlight of this activity. Radio JOVE will provide teachers and their students opportunities to participate in any of three ways.

a Build a radio receiver and antennae and make observations,
b Use the Radio JOVE Online website to make observations with radio telescopes at the University of Florida or
c Investigate these interesting radio signals using the archivaed data found on teh Radio JOVE site.

For more info visit the Website at http://radiojove.gsfc.nasa.gov or contact Bill Pine at the INSPIRE Projet, Inc., Chaffey High School, 1245 N. Euclid Avenue, Ontario, California 91762

IS THERE A SANTA CLAUS?

(from http://physics.wm.edu/Courses/Phys101/santa.html)

No known species of reindeer can fly, BUT there are 300,000 species of living organisms yet to be classified, and while most of these are insects and germs, this does not COMPLETELY rule out flying reindeer, which only Santa has ever seen.

There are 378 million children for Santa to deliver to according to Population Reference Bureau. At an average (census) rate of 3.5 children per household, that's 91.8 million homes. One presumes there's at least one good child in each.

Santa has 31 hours of Christmas to work with, thanks to the different time zones and the rotation of the earth, assuming he travels east to west (which seems logical). This works out to 822.6 visits per second. This is to say that for each household with good children, Santa has 1/1000th of a second to park, hop out of the sleigh, jump down the chimney, fill the stockings, distribute the remaining presents under the tree, eat whatever snacks have been left, get back up the chimney, get back into the sleigh and move on to the next house. Assuming that each of these 91.8 million stops are evenly distributed around the earth (which, of course, we know to be false but for the purposes of our calculations we will accept), we are now talking about .78 miles per household, a total trip of 75-1/2 million miles, not counting stops to do what most of us must do at least once every 31 hours, plus feeding and etc.

This means that Santa's sleigh is moving at 650 miles per second, 3,000 times the speed of sound. For purposes of comparison, the fastest man-made vehicle, the Galileo Jupiter probe, moves at a poky 29.72 miles per second - a conventional reindeer can run, tops, 15 miles per hour.

The payload on the sleigh adds another interesting element. Assuming that each child gets nothing more than a medium-sized lego set (2 pounds), the sleigh is carrying 321,300 tons, not counting Santa, who is invariably described as overweight. On land, conventional reindeer can pull no more than 300 pounds. Even granting that "flying reindeer" (see point #1) could pull TEN TIMES the normal amount, we cannot do the job with eight, or even nine. We need 214,200 reindeer. This increases the payload - not even counting the weight of the sleigh - to 353,430 tons. Again, for comparison—this is four times the weight of the Queen Elizabeth.

353,000 tons traveling at 650 miles per second creates enormous air resistance - this will heat the reindeer up in the same fashion as spacecrafts

See *Santa* on page 4

Ontario Association of Physics Teachers

2000 Annual Meeting

Thursday May 25 - Saturday May 27
hosted by
McMaster University Engineering

OAPT is now welcoming your input for the following...

- Workshops: is there something you'd like to learn about?
- Classroom Demos: do you have a favourite demo old or new to share?
- ISU share-athon: how about sharing your 4A or OA ISU ideas?
- Contributed papers: would you like to present a short paper on current research of teaching tools?

If you would like to contribute to any of the above, or have any comments or requests, please e-mail or fax them to:

Diana Hall
diana_hall@ocdsb.edu.on.ca
fax: 613-828-9002

NOTE: Thursday night workshops will include 2 special sessions for Elementary teachers

AAPT Summer Meeting in Guelph

The American Association of Physics Teachers (AAPT), of which the OAPT is the Ontario Section, will be holding its Summer Meeting at the University of Guelph from July 29 to August 2, 2000. More than 1000 physics educators from across North America (and England, Australia, Mexico, etc.) will be attending this five-day conference, which presents an exciting opportunity for Ontario teachers to attend workshops and talks on all aspects of physics teaching. The conference registration fee is considerably less for AAPT members; membership information is available from the AAPT website (http://www.aapt.org/). (Membership in the Ontario Section does not constitute membership in the AAPT.)

Information about the Guelph conference can be accessed at http://aapt.physics.uoguelph.ca/

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

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pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

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Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

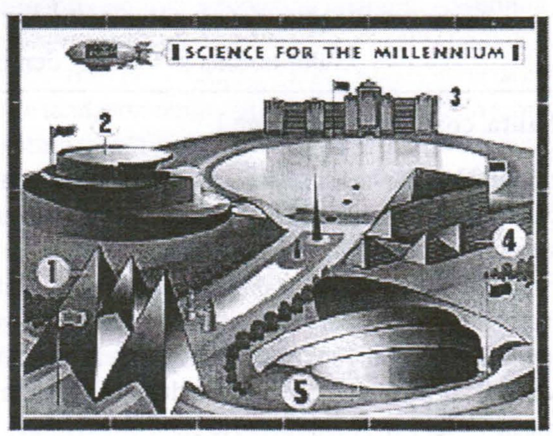
X-RAY CRYSTALLOGRAPHY OF NON-CRYSTALS has been carried out by a group at Stony Brook. X rays have long been used to determine the structure of crystalline objects: when the waves strike periodic arrays of atoms or molecules the waves diffract into patterns which, when analyzed by Fourier-transformation algorithms, provide a map of the sample's structure with approximately angstrom resolution. In the Stony Brook experiment x rays are shone onto a non-crystalline micron-sized specimen (a tiny array of letters spelled out with 100-nm gold nanoparticles). By pushing the algorithms a bit, images could be formed from the x rays scattered from this patently non-crystal object. The resolution, about 75 nm, is not nearly as good as for traditional x-ray crystallography, but still much better than could be achieved with visible light. The researchers believe their method can be applied to imaging biological specimens at the level of cells or even subcelluar objects. (Miao et al., Nature, 22 July 1999.)

GRAVITY'S GRAVITY. A new experiment at the University of Washington seeks to determine whether the gravitational binding energy of an object generates gravity of its own. As formulated by Albert Einstein, the Equivalence Principle (EP) states that if we stand in a closed room we cannot tell whether the weight we feel is the result of gravity pulling down or the force of a rocket carrying us forward through otherwise empty space. All of this gets complicated in some theories of gravity, which predict that the EP will be violated to a small degree since in addition to the usual gravity, carried from place to place by spin-two particles called gravitons, there should exist another, fainter kind of gravity carried by spin-zero particles (sometimes called dilatons). For this reason, and because recent observations of supernovas suggest that some repulsive gravitational effects might be at work in the cosmos, scientists want to explore the possibility of EP violations. Three decades of lunar laser ranging (bouncing light off reflectors placed on the Moon) show that the Moon and the Earth fall toward the Sun with the same acceleration to within half a part in a trillion (10^12). What the Washington physicists (Eric Adelberger, 206-543-4294, eric@gluon.npl.washington.edu) have done is focus attention on the subject of gravitational binding energy, or self-energy, and whether it too obeys the EP. To illustrate the concept of binding energy, consider that the mass of an alpha particle is actually about 28 MeV less than the sum of its constituents. This energy (about 7.6 parts in a thousand of the alpha mass) represents the energy (vested in the strong nuclear force) needed to hold two protons and two neutrons together inside the alpha. Gravity being very much weaker than the strong nuclear force, the gravitational binding energy, the self-energy of gravity attraction, is almost infinitesimal. For example, self- energy effectively reduces the mass energy of the Earth by a factor of only about 4.6 parts in 10^10. Is this tiny "mass" also subject to the EP? Supplementing existing lunar laser ranging results with new data from special test masses mounted on a sensitive torsion balance (see www.aip.org/physnews/graphics) to take into account the different compositions of the Earth and Moon, the Washington physicists show that gravitational self energy does obey the equivalence principle at the level of at least one part in a thousand. Thus gravitational self energy does indeed generate its own gravity. (Baessler et al., Physical Review Letters, 1 November; see also Clifford Will's article, Physics Today, Oct 1999.)

THE TOP PHYSICISTS IN HISTORY are, according to a poll of scientists conducted by Physics World magazine, 1. Albert Einstein, 2. Isaac Newton, 3. James Clerk Maxwell, 4. Niels Bohr, 5. Werner Heisenberg, 6. Galileo Galilei, 7. Richard Feynman, 8. Paul Dirac, 9. Erwin Schrodinger, and 10. Ernest Rutherford. Other highlights of Physics World's millennium canvas: the most important physics discoveries are Einstein's relativity theories, Newton's mechanics, and quantum mechanics. Most physicists polled (70%) said that if they had to do it all over again, they would choose to study physics once more. Most do not believe that progress in constructing unified field theories spells the end of physics. Ten great unsolved problems in physics: quantum gravity, understanding the nucleus, fusion energy, climate change, turbulence, glassy materials, high-temperature superconductivity, solar magnetism, complexity, and consciousness. (December issue of Physics World, published by the Institute of Physics, the British professional organization of physicists celebrating its 125th anniversary this year.)

PHYSICS ON THE INTERNET

Check out this virtual tour of a science expo
http://www.ncsa.uiuc.edu/Cyberia/Expo/



THE DEMONSTRATION CORNER

D-Ball

by

Diana Hall

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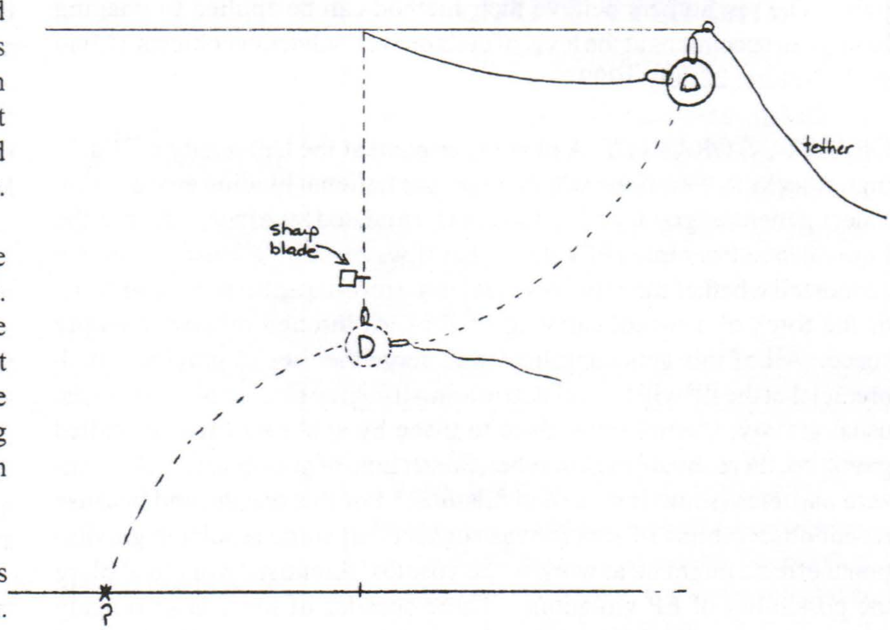
Diana_Hall @ocdsb.edu.on.ca

This is a very popular game I have played with my OAC physics class. It incorporates the concepts of conservation of energy and projectile motion.

"D-Ball" is a baseball with a D marked on it. if your name doesntt start with the letter "D," you will have to make appropriate changes. D-Ball is hung from the ceiling on a piece of very thin fishing line or fine thread tied to a paper clip that is hooked through the threads on the ball. A razor blade is clamped at a position just barely above the ball as it hangs straight down. A second paper clip and thread are used to tether the ball to the side just below the ceiling.

To launch the ball, burn the thread tethering the ball allowing it to swing down, pendulum style. When the string meets the blade, it is cut and the ball becomes a projectile. The students must make appropriate measurements before the launch and calculate a prediction of the landing position of D-Ball. We mark the predictions on the floor and then launch D-Ball.

The horizontal distance travelled by the ball turns out to be within 2% of the theoretical prediction. Students reported that this was one of their favourite activities.



It is easy to make this demonstration into an exam question. I gave them a scale diagram of the set-up and they had to calculate and mark the landing position on it.

Thanks to Brian Wegley, Glenbrook South HS, Glenview, illinois, for sharing this idea.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Santa, continued from page 1

re-entering the earth's atmosphere. The lead pair of reindeer will absorb 14.3 QUINTILLION joules of energy. Per second. Each.

In short, they will burst into flame almost instantaneously, exposing the reindeer behind them, and create deafening sonic booms in their wake. The entire reindeer team will be vaporized within 4.26 thousandths of a second. Santa, meanwhile, will be subjected to centrifugal forces 17,500.06 times greater than gravity. A 250-pound Santa (which seems ludicrously slim) would be pinned to the back of his sleigh by 4,315,015 pounds of force.

In conclusion - If Santa ever DID deliver presents on Christmas Eve, he's dead now.

(A rebuttal to this classical interpretation can be found at http://physics.wm.edu/Courses/Phys101/santa.html)

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XXII, Number 2 **Winter 2000**

AAPT Winter Meeting Report

Kissimmee, Florida January, 2000

by Diana Hall (diana_hall@ocdsb.edu.on.ca)

This year's AAPT winter meeting provided a welcome opportunity to escape the extreme temperatures of Ontario. The traditional first two days of workshops provided lots of fun and entertainment. I attended one at the Theme Park and two on the Physics of Magic.

At Universal Studio's Islands of Adventures we were given a behind the scenes tour of a roller coaster called "The Hulk." We saw the amazing generators which are used to power the ride and learned about the unique mechanism used to shoot the cars up the initial incline. Afterwards Vernier equipped us with CBLs and accelerometers and sent us off to collect data. I'm not an experienced rider but I did get up the courage for the Hulk and learned a very important lesson about the CBLs. "You have to push the button hard to start the data collection." Oh well, others actually got some.

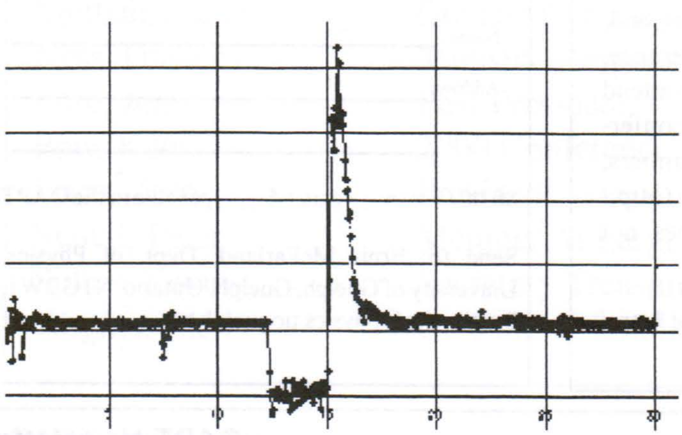
The graphs at the bottom of the page are examples of the type of data obtainable with the Vernier accelerometers and CBLs. Both are vertical tower type rides.

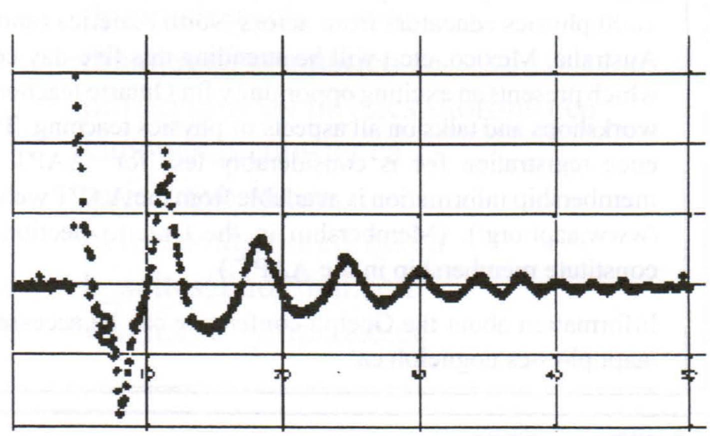
Observe the data and speculate as to the difference between the two.

Robert Freinhoffer (author of Magic Tricks, Science Facts) conducted a workshop on the Magic of Science and then collaborated with Dave Wall (famous for rope tricks), Tom Zepf and Marshall Ellenstein on a second session, more focussed on the Physics of Magic where I learned a number of nifty magic tricks which use physics principles. We made crystal balls with shot glasses and large clear marbles. The marbles are glued into the glasses just leaving enough space that water could get underneath and fill the air gap. A corner of a card (e.g. 5♣) was glued to the bottom. With the glass empty you cannot see anything. Add water and the indices of refraction are just similar enough that viewer sees the 5♣ appear in the bottom of the glass. Combine this with a 'forced cut' of the deck and you have magic! I tried this and it went over well with my class.

Highlights of the week were the Keynote Speakers, Jill Tarter from SETI (Search for Extra-terrestrial Intelligence). William Phillips (william.phillips@nist.gov) gave the Richtmyer Award Lecture, on Time, Einstein, and the Coldest Stuff in the Universe. He explained a new technology for cooling atoms without causing condensation of a gas called 'Laser Cooling'. This was done in order to cool down cesium atoms to around 700nK which corresponds to a thermal velocity of around 7 mm/s with the objective of making more accurate clocks. Brian Greene explained the latest on Superstring Theory. He was a captivating speaker who's book *The Elegant Universe* is available in bookstores.

See *AAPT* on page 3





Ontario Association of Physics Teachers

2000 Annual Meeting

Thursday May 25 - Saturday May 27 hosted by McMaster University Engineering

OAPT is now welcoming your input for the following...

- Workshops: is there something you'd like to learn about?
- Classroom Demos: do you have a favourite demo old or new to share?
- ISU share-athon: how about sharing your 4A or OA ISU ideas?
- Contributed papers: would you like to present a short paper on current research of teaching tools?

If you would like to contribute to any of the above, or have any comments or requests, please e-mail or fax them to:

Diana Hall
diana_hall@ocdsb.edu.on.ca
fax: 613-828-9002

NOTE: Thursday night workshops will include 2 special sessions for Elementary teachers

AAPT Summer Meeting in Guelph

The American Association of Physics Teachers (AAPT), of which the OAPT is the Ontario Section, will be holding its Summer Meeting at the University of Guelph from July 29 to August 2, 2000. More than 1000 physics educators from across North America (and England, Australia, Mexico, etc.) will be attending this five-day conference, which presents an exciting opportunity for Ontario teachers to attend workshops and talks on all aspects of physics teaching. The conference registration fee is considerably less for AAPT members; membership information is available from the AAPT website (http://www.aapt.org/). (Membership in the Ontario Section does not constitute membership in the AAPT.)

Information about the Guelph conference can be accessed at http://aapt.physics.uoguelph.ca/

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:

pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

OAPT Web Site

Guleph University is host to the OAPT site.

Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!

The URL is:

www.physics.uoguelph.ca/OAPT/index.html

Why wait until it's too late?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

Membership Application

Renewal ❐ **Change of Address ❐**

Name ______________________

Address ______________________

____

$8.00 / year x __ years = $ ___, payable to the OAPT

Send to: Ernie McFarland, Dept. of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

AAPT Meeting (cont. from p. 1)

It was great to see Al Hirsch, now retired, attending the conference. He, his wife Judy and I went on the quest for the 'Sound Bite' which was written about in January's The Physics Teacher. We drove a long way but were successful. I'll be bringing some in the 'prize bag' to MacMaster. Al went on to a conference at NASA which apparently was a fantastic experience and which I'm hoping he will share with us in May. I look forward to seeing you all there and sharing some more neat stuff.

2000 APPARATUS COMPETITION

The annual AAPT Apparatus Competition will be held in Guelph, Ontario on July 30, 2000, during the AAPT summer meeting.

There are two categories - Low Cost Apparatus and Introductory Laboratory Apparatus. Prizes range from $100 to $1000.

Plan now to enter, and notify the Competition Director by May 1 of your intention to enter (for details, see http://www.rose-hulman.edu/~moloney).

Physics News Update

The A. I. P. Bulletin of Physics News
by Phillip F. Schewe and Ben Stein

SNOWBALLS SURVIVE IN HELLISH CONDITIONS. Many of the unique and unusual properties of liquid water at ambient conditions are due to the ability of water molecules to form hydrogen bonds, which in turn causes the oxygen atoms to be arranged in a three dimensional diamond-like network. However, under extreme pressures the properties of water can change drastically. For example, although water ice normally melts at 0 C at ambient conditions, at a pressure of 10 Giga-pascals (10,000 atm) water remains "frozen" up to 320 C! New computer simulations carried out at the Lawrence Livermore National Laboratory have explored what happens to the microscopic structure of the compressed liquid, in a region of the phase diagram where experimentally determined structural data do not exist. These simulations indicate that when the liquid is squeezed up to a pressure of 10 GPa, the hydrogen bonds and oxygen network are substantially altered. At this high pressure, each water molecule is close packed and surrounded by 12.9 molecules, as opposed to 4.5 neighbors for ambient conditions. (E.Schwegler, G.Galli, F.Gygi, Phys. Rev. Lett., 13 March 2000; figure at www.aip.org/physnews/graphics. Select Article.)

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THE DEMONSTRATION CORNER

Two-Minute Impromptu Demos

by

Ed van den Berg & Rosea van den Berg

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edberg@durian.usc.edu.ph

This article was excerpted (with the authors' permission) from a longer article in *The Physics Teacher* (Sept.1998, p. 356-8).

What can we do to have clear and exciting lessons without a great amount of demonstration apparatus and hours of preparation each day? We present here a collection of small and quick demos that require no equipment beyond what is present in a classroom (chall4 chairs, students, books, paper, backpacks and their contents). Some are to prove something, but most are to illustrate, visualize, or simulate. These basic and well-tried ideas will stimulate the students and revive the insrtuctor who has spent a late night checking student papers. Have fun!

Fig. 1

Free fall and independence of mass. Break a piece of chalk into two pieces, one longer than the other. Hold them between thumb and index finger, with lower ends at the same level (Fig. 1). Ask students to predict which one will hit the floor first if chalks are released simultaneously. Discuss predictions and reasons. Then let go; repeat until all observers agree. Explain.

Kinematics. Walk across the front of the room (a) at constant speed, (b) accelerated and decelerated, (c) stopping and going. Let students draw position-vs-time and velocity-vs-time graphs. Of course you should have brought a motion sensor, but the walking will do just as well. Make sure to walk by the students to see their graphs, discover conceptual errors, and react.

Parallax. Have students close their right eye and hold up a pen at arm's length such that it is in line with a mark on the blackboard. Have students then close the left eye and open the right one. The pen is no longer in line with the mark on the board.

Projectile motion, relative motion. Walk with constant velocity while throwing a piece of chalk straight up. It lands in your hand, not behind you. So the chalk had the same horizontal velocity as you did!

Torque. Illustrate torque using a door. With torque we make things turn around an axis. Push the door at the free end with your finger and it moves easily, but the finger has to move a great distance to move the door 90°. Now push the door close to the axis. The force to be exerted is much greater, but the finger has only to move a short distance to move the door 90°.

Reflection. It's easy to imagine many demonstrations using reflecting objects such as windows, metals, and so on. A spectacular one is to suggest to our class that your whole body will be visible in any mirror as long as you increase your distance from the mirror. Then you disprove the idea by using a mirror that one of the students can surely produce. Beware of convex and concave mirrors here!

Fig. 2

Fall and air drag. Let a piece of paper drop. It falls slowly. Then crumple it; it drops faster. Take a small sheet of paper and put it on top of a book and drop the book (fig. 2). The paper will reach the floor simultaneously with the book! (No need for the awkward vacuum tube with feather and lead ball.)

Acknowledgment

Illustrations for this paper were done by Renante C. Embalzado, who is studying to become a physics teacher.

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

(an affiliate of the American Association of Physics Teachers)

Volume XXII, Number 3 **Spring 2000**

McOAPT

OAPT Annual Meeting Report

McMaster University, Hamilton June, 2000

I hope I can speak for the attendees of this year's annual OAPT meeting in reporting that it was a resounding success. The Departments of Science and Engineering, of McMaster University kindly hosted us and the hospitality provided was outstanding.

As per usual, the meeting started out with the Thursday night workshops. We added several sessions for elementary school teachers and I believe all were well attended and informative. For those who attended my Videopoint workshop, I neglected to mention that the creators of the software are offering an advanced workshop at the AAPT summer meeting at Guelph. They will be showing us techniques such as working with panned and zoomed clips that I briefly outlined in my session. This workshop will be a half-day session and coming right from the source, I know it will be worthwhile.

Sandra Witelson with Terry Price and Bob Loree

Martin High, President of Applied Physics Specialties, started off the session Friday morning. APS manufactures specialized optical systems and he explained techniques used for obtaining aspherical lenses and reflectors as well as the processes for applying reflective coating. We were exposed to some direct applications of the optics studied currently in high school courses.

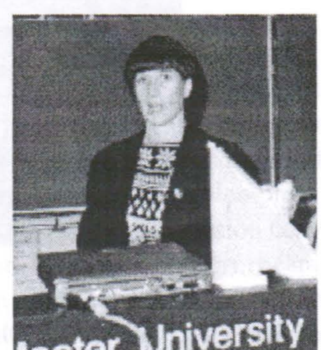
Al Hirsch followed with an account of his recent experience at the NASA conference in Houston. We all envied the opportunity he has as a recent retiree. Information on this conference for next year can be obtained from Susan Tortorici, suetort@spacecenter.org.

After a fantastic buffet dinner, we had a truly special opportunity to listen to Dr. Sandra Witelson enlighten us about her research on the physical structure of the brain and whether there is a correlation with the personality traits of the individual.

Dr. Witelson and her colleagues maintain one of the only brain banks in the world, which do studies on the brains of so called "normal" individuals. Some of her discoveries include the correlation between sexuality and anatomical differences in the brain and the relationship between handedness and the parts of the brain used for various tasks.

The McMaster University brain bank through Sandra has acquired a piece of Einstein's brain and have concluded several ways in which Einstein's brain was physically different from all of the other brains in their collection. Does this physical difference account for his extraordinary intelligence and creativity? A list of Dr. Witelson's publications can be found on her web site www.fhs.mcmaster.ca/psychiatryneuroscience/faculty/witelson/.

Several industry tours were offered. I attended the tour of McMaster Health Centre. Dr. Jerry Gill guided us through the Radiology department where we learned about the new digital X-Rays and CAT scans. Dr. Collin Webber who took us through the Nuclear Medicine department led



See *OAPT* on page 2

OAPT Meeting (cont. from p. 1)

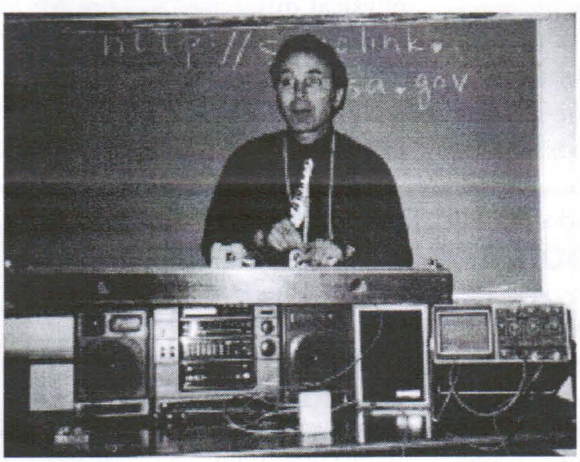
the second half of the tour. We saw the full range from PET scans to MRI. Both guides were enthusiastic leaders and we really appreciated the time these highly qualified professionals took from their days to meet with us. Although I only attended one of the tours, I heard that the CRS Robotics, Defasco, the Undergraduate Lab Tours and the Demo session were also excellent options.

Saturday's program featured new topics that have been added to the new grade 10 curriculum. Two speakers from Environment Canada got us thinking about the Weather. David Phillips discussed whether the climate is actually changing as drastically as we seem to think or if it is merely a function of the increased reporting of the weather. Are we now just made more aware of the events happening around the world than we were in the past?

Mike Leduc, a tornado expert showed us amazing pictures and videos including one where the photographer, seemingly unconcerned, risked his own life to film a tornado as it destroyed the buildings nearby. Mike was an enthusiastic speaker from whom we might hear more in the Future.

Many grade 10 teachers have indicated a concern for the addition of the motion unit to the curriculum. John Earnshaw of Trent University shared some techniques used in his program designed for elementary teachers with little or no science background. He discussed how he uses motion sensors to introduce basic motion concepts. His course is very 'discovery based' and follows the AAPT 'PIPS' program. He provides more information about his course on his web site www.TrentU.ca/physics/jearnshaw.

Peter Scovil demonstrated an electromagnetic guitar pickup using a coil, a standard horseshoe magnet and a Radio Shack amplifier speaker. He uses this to show nodes and antinodes for different harmonics on the string. The magnet created magnetic fields in the steel guitar strings that then induced current in the coil as the strings vibrated back and forth. Very Cool!



Peter Scovil

Speaking of electromagnets, we found a bonus physics problem in the residence security system. The front door of the residence is opened by

continued on page 3

Anybody Out There?

Don't forget that I'm always interested in hearing your comments, criticisms, etc.

You can reach me—the editor—by e-mail:

pdlaxon@julian.uwo.ca

or, if the mood strikes you, by mailing a letter to:

OAPT Newsletter
c/o Paul Laxon
201 Chestnut St.
St. Thomas, ON
N5R 2B5

OAPT Web Site

Guleph University is host to the OAPT site.

Get info on executive members (including a great picture of me, your humble newsletter editor), the upcoming OAPT Conference, links to other physics web sites, and much, much more!
The URL is:

www.physics.uoguelph.ca/OAPT/index.html

Why wait until it's too late?

The date on your address label is the expiry date for your membership. You may use the coupon below (or a facsimile) to renew it, or to indicate a change of address (or both) by checking the appropriate box. And, hey, what the heck, why not renew it for two (or more!) years; it will save you the hassle of renewing over and over again.

Membership Application
Renewal ❐ Change of Address ❐

Name ____________________

Address ____________________

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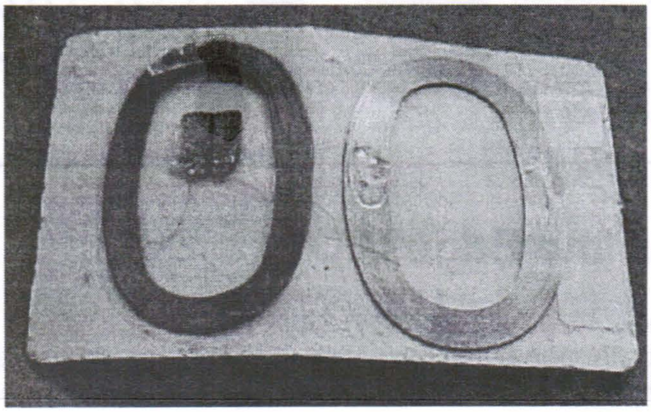
$8.00 / year x years = $, payable to the OAPT

Send to: Ernie McFarland, Dept. of Physics, University of Guelph, Guelph, Ontario N1G 2W1; Email: elm@physics.uoguelph.ca

OAPT Meeting (cont. from p. 2)

holding a wallet with a thick 'credit type' card inside, up in front of a small light. This unlocks the door. Glen Wagner was the only one who proposed a solution. I managed to get a hold of the



'guts' of one of these cards and show it here. Was this what you were thinking Glen? Perhaps it will get the rest of you thinking about it. You never know what you will discover when you get let out into the world!

Thank you to Kim Maynard, Anita Drossis and Kevin Soltes for sharing their enthusiastic Independent Study Ideas. I guess we should be very careful if ever driving by Kevin's school (Scarlett Heights CI). I also would like to thank John McMillan-Jones and Daria Filip for their electrifying demos. The idea of using Xmas lights for circuit labs is great... I tried it yesterday. We had fun drawing diagrams, predicting the relative brightness of the bulbs and then testing it. Thanks! Now we have a use for those strings that no longer work.

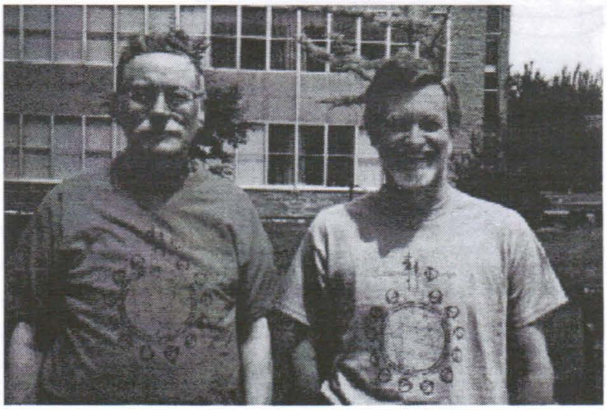
I would like to extend a personal thank you on behalf of OAPT to Bob Loree, Director of Engineering and Kate Pow who works with the McMaster Engineering touring Fireball show for their hard work in organizing the conference. The support provided by the team at McMaster was fantastic.

The group shown above was so energized by the sessions of the day that they continued their discussions downtown Friday night. What's their secret?

For those who attended, I hope you took home lots of motivating new ideas and for those who weren't able to make it we hope perhaps you will attend next year which will be held at Trent University, May 24-26, 2001. If you have any comments regarding the change of dates or if you have ideas for workshops or sessions you would like to see or give, I invite you to send them to me at diana_hall@ocdsb.edu.on.ca. Don't wait to be invited step up to the plate! We want your ideas.

Don't forget about the exciting and unique opportunity that we have this summer. Ernie McFarland, Jim Hunt, the rest of the gang at Guelph along with the OAPT are hosting the AAPT summer meeting this at the University of Guelph, July 29-August 3. You won't want to miss it, it's sure to be great. Note that the Early Bird discount deadline has been extended for Ontario Members to June 10. Thanks AAPT!

That's all for now. See you in Guelph!



Jim and Ernie

Physics News

INTENSITY MODULATED RADIOTHERAPY (IMRT) is an up-and-coming radiation therapy technique for cancer. Instead of employing radiation beams of uniform intensity, IMRT enables physicians to modify the intensity of each radiation beam in a sophisticated fashion. Firing non-uniform beams from several angles can allow physicians to deliver a higher dose of radiation to all parts of the three-dimensional volume of a tumor while sending less radiation to healthy surrounding tissue.

"Balancing on the Edge" and "Inexpensive Accelerometers"

by

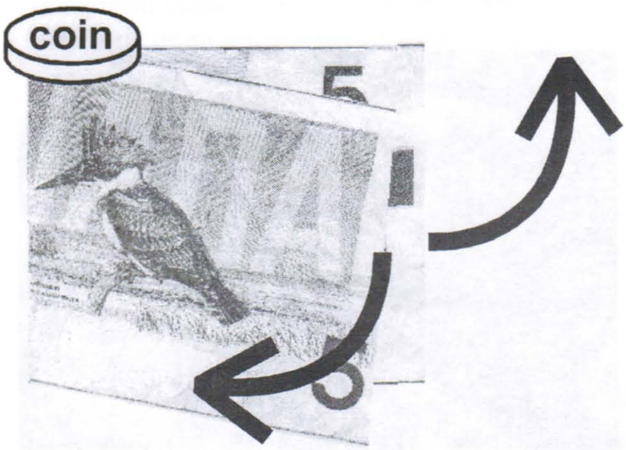
Diana Hall

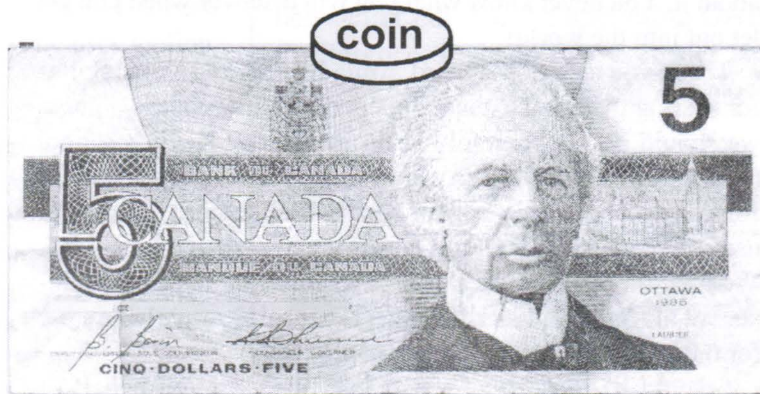
Bell High School, Nepean, Ontario K2H 6K1
Diana_Hall@ocdsb.edu.on.ca

"Balancing on the Edge"

Many of you will know you can find the centre of mass of a metre stick (for example) by supporting the stick on your two index fingers and moving your fingers together. They will naturally meet at the centre of mass. I hadn't seen this variation on the idea. Did you know you can balance a coin on the edge of a dollar bill?

Fold the bill in half and open it so that it forms a V. Place the coin on the V-shaped edge. Now carefully open the bill until the coin is balanced on the single straight edge of the dollar bill. It works! COOL!





"Inexpensive Accelerometers"

This is a cheap version of the commercial liquid-filled plexiglass accelerometers. A qualitative accelerometer can be made using a ziplock bag, 4 bendable straws, 4 thin dowels (that fit into the straws) and a large elastic band.

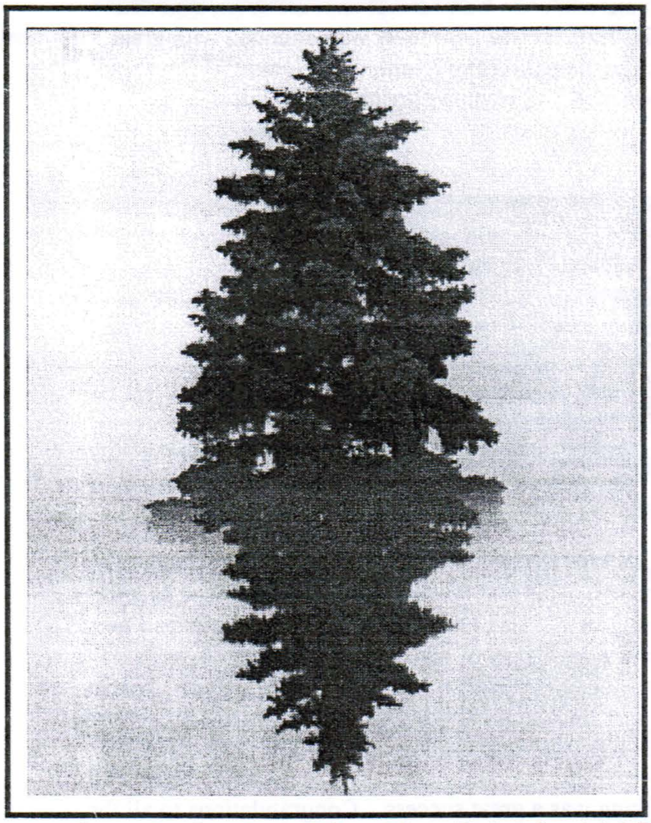
Make a frame that fits inside the bag using the bendable straws at the four corners with the dowels along the sides. The dowels should be the correct length to frame the bag. Fill the bag up to about 2 inches with coloured water. Elastic bands can be used around the outside of the bag at the level of the water to mark the horizontal (which shows zero acceleration).

Column Editor: Ernie McFarland, Physics Dept., University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(an Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 1 Fall, 2000



Ontario Student Wins First Prize in AAPT Photo Contest!

Stephanie Hill from Port Credit Secondary School, student of Alan Hirsch won first prize in the contrived category in this years AAPT photo contest.

The winning photo was taken with a small plane mirror held perpendicular to the camera lens giving the illusion of the observer looking across a very foggy, still lake at a tree and its reflection in the water.

Vernier Software and Technology kindly awarded a $100 prize and plaque to Stephanie and a $100 credit to Port Credit Secondary School. Congratulations to Stephanie and to Al who designed the project for which the photo was produced.

Report on AAPT Summer Meeting 2000 University of Guelph By Diana Hall

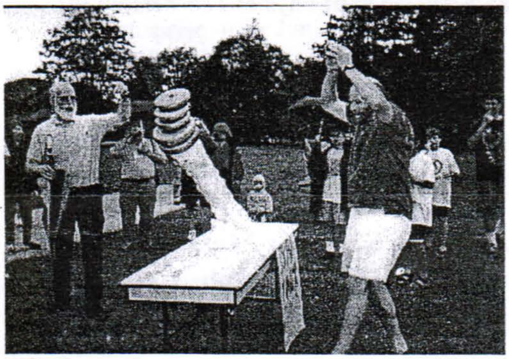
The University of Guelph and the OAPT were hosts to the AAPT annual summer meeting. I hope that several of you were able to take advantage of this unique opportunity to attend this meeting so close to home.

Saturday and Sunday provided a full selection of workshops. I attended the advanced Video Capture session where I continued to practice techniques for analysing motion movies involving panning and zooming. I also learned about new digitizing software available soon through Lenox Softworks, the makers of Videopoint. This program allows you to digitize, edit and then open your movie in Videopoint all with one program… much more convenient and quicker than the old way where you had to digitize with one application, then edit in another and then open the movie in Videopoint. Recently I had been having timing problems which were messing up my data and giving apparently random quantitative results and this new software seems to have solved that problem. (….so far anyway). That's a relief. I'll keep you posted.

Snowball Launch

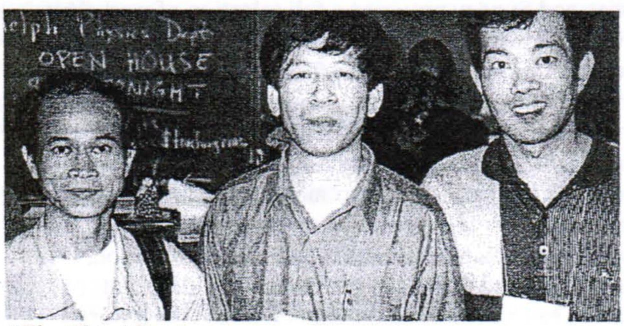
The University of Guelph's participation in the Sudbury Neutrino Observatory Project was highlighted during John Simpson's talk on Sunday evening.

Later in the week the theme continued at the SNO Olympics, organized by Glen Wagner and Kevin Soltes. Although the weather was lousy, a group of enthusiastic participants, launched snowballs and built snow towers in the pouring rain.



The Snow Tower

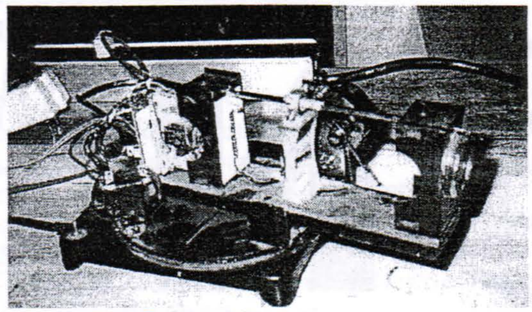
Among other highlights of the week was a very popular demo session presented by a trio from China called "The Third Eye".



"The Third Eye"

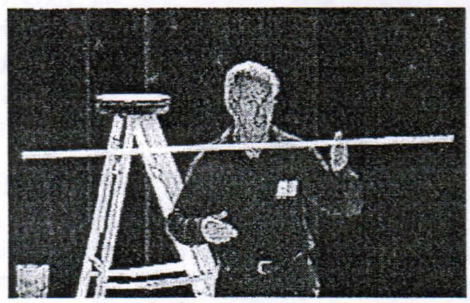
The Third Eye, has several meanings in Chinese culture one which is "Clairvoyant". Xingkai Luo spoke about students ideas about Physics and Physicists and the importance of motivating student learning through demonstrations. He brought several unique and innovative apparatus constructed from basic materials. A very simple example involved a cart containing a concealed mass. The mass had a sticky side which when placed this side down caused the cart to bounce back after colliding with a fixed object. When placed on a smooth side, the mass continues to move forward, relative to the cart, after the collision and so the cart bounces back more. Students have to figure out what could be different about the two situations …..a good thinker.

One not so simple apparatus was a "Smart Fire Extinguisher" which sought out candle flames which were located across the table and squirted water to extinguish the fire. Very Cool!



"Smart Fire Extinguisher"

After the SNO Olympics on Wednesday evening, George Vanderkuur and John Caranci put on a demo show in War Memorial Hall. It was extremely well attended with great audience participation and I smiled as I looked around at all the grown men and women playing with balloons in the audience.



George Vanderkuur

George showed the results of his extensive research on firing elastic bands. This was fascinating. I couldn't wait to try his new technique….. alas I had limited success. Perhaps I need a lesson or two. Many of our old favourite demos were revisited along with several I had never seen before. Thanks George and John for your hard work and hours of preparation which clearly went into putting together the show.

The meeting was a great success. Congratulations to all the 14 members of the University of Guelph Physics Department who formed the Hosting Committee. The amount of organization required to allow so many different sessions to run smoothly at the same time is overwhelming. I can only imagine. An excellent job everyone. Thanks to Ernie McFarland and Jim Hunt for heading up that committee. Your team rocks!

I think that the OAPT presence was well received. Thanks to John Beattie for organizing a team of representatives to provide information at the OAPT hospitality table. Many further thanks to the OAPT volunteers themselves who are John Pitre, Mike Los, Rocco de Vuono, John Diacopoulous, Kim Maynard, Malcolm Couts, Stuart Quick, and George Kelly. Many of the meeting participants were able to take opportunities to visit surrounding tourist attractions and received excellent tips from the local OAPT members.

That's all for this year.... next year the meeting will be held in Rochester (not so far) from July 21-25. I for one, won't be missing it. The OAPT annual meeting will be May 24-26 at Trent University....See you there!

2001 CONFERENCE:
"2001 Physics Odyssey"
Trent University May 24-26, 2001
Join us at the conference!
See the OAPT Website
http://www.physics.uoguelph.ca/OAPT

Join the Ontario Association of Physics Teachers

Members receive a Newsletter and **reduced registration rates at the annual conference.**

Want to become a member?

As well, from time to time the Association makes available special resources; examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

Membership is *ONLY* $8 per year.
To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to: Ernie McFarland
OAPT Membership Secretary
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

Annual Meeting
May 24-26, 2001
Trent University, Peterborough

CALL FOR PAPERS

Do you wish to share an idea technique of interest with your fellow teachers? Have you a special demonstration, computer program or teaching concept? Do you have interesting ideas and results from, and for, student's projects, or from studies you have done related to teaching and physics? Please consider sharing these with your colleagues by making a contributed presentation at the conference.

If you wish to make a presentation at the 2001 OAPT Conference, please return this form to:

Diana Hall
Conference Coordinator
Bell High School
40 Cassidy Road
Nepean, Ontario
K2H 6K1

Or FAX to 613-828-9022
Or E-mail to: diana_hall@ocdsb.edu.on.ca

Name: ______________________

School or Institution: ______________________

E-mail address: (I need this) ______________________

Phone: (home)______________ (school) ______________

(fax) ______________

TITLE OF PRESENTATION: ______________________

Time Required: 10 min: __15 min: __20 min: __30 min: __

SPECIAL NEEDS:

Do you require any audio-visual or special equipment besides an overhead projector? yes ___ no____

If yes, please describe your needs

____

Will you be bringing any equipment yourself? yes __ no __

If yes, describe what you will be bringing:

ABSTRACT: Please include a brief summary of the specifics of your presentation on the back of this form. (*If faxing, be sure to fax both sides)

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Grade 12 Physics Contest held in April

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Demonstration Corner

To show standing waves in the classroom with a minimum of fuss or equipment I use the cord of the classroom's standard appliance – the overhead projector. Use the cord in skipping rope fashion seen in profile: at one rotational rate half waves are formed, a bit faster and whole waves are formed, and I have even got one and one half waves to form. Sometimes the Aha!'s are audible.
(John Caranci)

(Hooks, Discrepant Events, Items of Cognitive Dissonance, or as a friend of mine always says "sometimes as you walk down the road you find a shinny pebble")

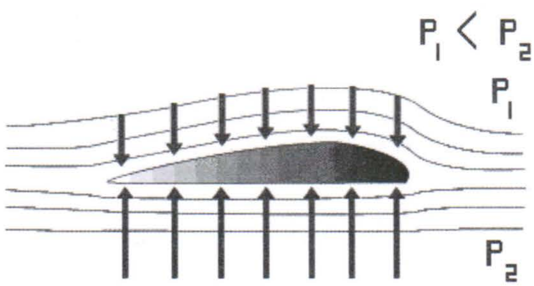
This corner is for you – the physics teacher with the sparkle, the jazz, the shoulder that others stand on. Please submit items for this corner to: **John Caranci 126 Charmaine Rd, Woodbridge, Ontario L4L 1K2 or to: physix@iprimus.ca**

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 2 Winter, 2001

Textbook Misconceptions: Misconception #1
How an Airplane Flies.

Many introductory texts in physics explain the lift generated by an airfoil solely in terms of Bernoulli's principle. The following is quoted from a sample text. The identity has been withheld to protect the reputation of the author:

"Lift is produced by a lower pressure created on the upper surface of an airplane's wing compared to the pressure on the wing's lower surface, causing the wing to be "lifted" upward. The special shape of the airplane wing (airfoil) is designed so that air flowing over it will have to travel a greater distance faster, resulting in a lower pressure area (see illustration) thus lifting the wing upward. Lift is that force which opposes the force of gravity (or weight)."



If we consider the diagram, we can see that there is no possible way that lift can be produced from an airfoil under these conditions. The reason harks back to a violation of Newton's Third Law of Motion. In order to produce an upward force on the wing, there must be a downward force on the air flowing past the wing. This would give the air a downward acceleration, and result in a downward movement of the airflow, which is not shown in the diagram. In fact, the airfoil cannot produce any lift unless it is angled upward a bit, the so-called "angle of attack". This results in air being deflected downward by the airfoil, and creates an upward force on the wing, satisfying the Third Law in the bargain.

In addition, the air moving over the top of the wing ends up with a downward component to its motion for reasons a bit too wordy to include in this short article, adding to the lift and increasing the efficiency of the airfoil.

Surprisingly, it is not necessary to use the classic airfoil shape at all. If enough power is available, a flat board can be used as a "wing" for an aircraft, although the drag induced would make such an aircraft very thirsty for fuel. As a last point, the above textbook explanation would preclude this aircraft from ever flying upside down, which is never-the-less a common mode of flight for many aircraft which possess the necessary structural strength.

Those who wish more discussion on this topic may consult the eminently readable "Stick and Rudder" by Wolfgang Langeweische, or almost any text on fluid dynamics.

Implementation of the Grade 10 Motion Topic

By John Caranci
physix@iprimus.ca

Earl Haig Secondary School is one of the largest secondary schools in the province.. We have 25 sections of Grade 10 Science non-semestered of which 3 are congregated ESL classes, 2 are Applied classes and 8 are Enriched classes. Eleven teachers of the staff of 20 science teachers have Grade 10s. Some of these teachers are very young with less than four years in the teaching profession, some are nearing retirement, and only three have a physics background. All eleven have now started Motion as their third topic or had completed Motion as one of their first two topics. I am very proud of the staff of the science department because they did not shy away, in any way, from accepting suggestions in Motion.

Budget and timetable restrictions do not to allow us the luxury of having all classes doing the same topics at the same time. There is little money for additional equipment other than was ordered through the ministry two years ago. Photocopying also comes directly out of the science budget. Because of these factors, we decided to go with a flexible model that involved flexible sequencing of units. Some teachers started with a topic with which they were familiar. Some chose a less familiar topic because their energy was higher at the beginning of year.

One of our experienced physics teachers, generously, set up a day-to-day implementation guide for teachers unfamiliar with the topic. The other two physics teachers and myself reviewed the guide. There was also an exchange of assessment instruments, teaching hints, and project rubrics.

One of the key things that assisted teachers was having carts or trolleys dedicated to Motion with boards and equipment. These carts and trolleys have to remain intact throughout three-quarters of the year. A second physics teacher set up the carts and gave teachers a 'quick and easy' in-service (sometimes happening just minutes before the activity was to take place in class). We set up the physics prep room with the same activities so that if the teacher is teaching in a non-science classroom they could rotate their class through. This happens in our school a lot. This Prep room set-up also helps students that missed activities in class due to absence. This was necessary because our school has 550 Grade 10 Science students.

Since the topic of Motion has so many misconceptions associated with it, we followed the principle of simple and clear concepts (KISS). As all physics teachers know, developing a conceptual understanding in the minds of the students is key. Many staff teaching this topic may not have experienced physics activities of this type since their own high school years. A gentle approach works exceptionally well. We tried to keep the number of concepts delivered to a minimum.

We have a January assessment timetable. Four days are set aside for assessments. In senior, this is considered the mid-year exams. Assessments activities in January for 10's were different for each class and provided an opportunity for a topic assessment without using class time. Since these are not at the end of year they were topic tests generated by the individual teachers for their own classes. Some of assessments are still to be decided on, like the summative assessment.

Culminating activities and projects were many and varied. Some teachers decided on having students do presentation on parts of the topic (eg. an interesting one using PowerPoint to relate advertising of cars to the actual motion and performance of cars). Some were products like a car, a hovercraft, or a roller coaster. Some teachers still rely on a culminating test.

Here are some anecdotal observations. Some of the strategies teachers used for coping with the new curriculum were: sticking to the text, accessing the experience of physics teachers, and completing the minimum set of expectations. The most difficult parts for teachers to deliver were: developing pedagogical methods for presenting vectors, relating direction of acceleration with the direction of the velocity, and relating graphs to velocity direction. Most difficult parts for students were: the relative amount of mathematics for students weak in mathematics, relating experiments to concepts, and the obvious - putting the time into their homework. As a physics teacher, I found that I was doing more than the required expectations. Surprisingly, it was also noticed that teachers whose background is physics took longer to implement the topic.

As an organizational model, having one lead teacher with experience in each topic setting the framework for that topic was successful. After discussions with the teachers, we found that the lead teacher must be teaching Grade 10 to understand the difficulties of the students. Even though the topic is very similar to Grade 12 Kinematics, the level of conceptual understanding of students does not seem to be very different. And this level of the conceptual understanding is paramount, when learning the topic of kinematics. Demonstrations, kinesthetic presentations, and cooperative small group instruction were very successful. Less successful was the effort by teachers and students to relate experiments to conceptual understanding. Implementing mathematical algorithms, as expected, did not help conceptual understanding either. An interesting side point was that drilling mathematical problems seemed to increase student confidence!

I would like to acknowledge two physics teachers whose selfless work made the implementation of the Grade 10 Motion topic smooth: Donald Rallis and Tony Kwan. I also thank Doug Hayhoe for giving me some assistance with this article.

NEWS

AAPT APPARATUS COMPETITION

Applications are now being solicited for the annual AAPT Apparatus Competition. Entries will be displayed and judged at the 123rd AAPT National Meeting, July 21–25, 2001. Prizes are $100 each in the Low-Cost category ($65 or less to build), and up to 6 low-cost prizes may be awarded. In the Lecture Demo / Advanced Lab category the prizes are 1st: $1000, 2nd: $600, and 3rd: $200. PASCO Scientific provides the prize money for the apparatus competition.

The application deadline is May 1, 2001. The application, contest rules, and additional information are available at http://www.rose-hulman.edu/~moloney/AppComp/CompetitionPage.htm

PHYSICS VIDEO CONTEST
The video contest is open to any student or faculty member. Videos should be sent to Beverly T. Cannon, 4220 Emerson Ave., Dallas, TX 75205-1099, to be received no later than May 15. Entries will be displayed and judged at the 123rd AAPT National Meeting, July 21–25, 2001. For additional information and contest rules, see the AAPT website at *http://www.aapt.org/programs/HSphoto.html*

HIGH SCHOOL PHYSICS PHOTO CONTEST
There are two categories: Natural and Contrived. Vernier Software & Technology has contributed prizes for first, second, third places, and a certificate for honorable mention, as well as prizes for the teachers of winning students. Photo submissions should be sent to: Mary M. Winn, 2623 Watrous Ave., Tampa, FL 33629 no later than June 10, 2001. Entries will be displayed and judged at the 123rd AAPT National Meeting, July 21–25, 2001. For additional information and contest rules, visit the AAPT website at *http://www.aapt.org/programs/HSphoto.html*

ARIZONA STATE UNIVERSITY IN TEMPE OFFERS:
A new summer program of graduate courses for inservice high school physics and physical science teachers. It can lead to a Master of Natural Science degree. Two sessions: June 11-29 and July 2 - Aug. 3. The program includes a Modeling Workshop on June 11-29. A pending grant may defray costs. Contact Jane.Jackson@asu.edu, 480-965-8438,
http://modeling.asu.edu.
and
A Modeling Workshop for post-secondary physics instructors on June 4-22.
Contact Michael.Politano@asu.edu, 480-965-3214, http://modeling.asu.edu.

AAPT NATIONAL MEETING
Will be held in Rochester from July 21-25

2001 OAPT CONFERENCE:
"2001 Physics Odyssey"
Trent University May 24-26, 2001
Join us at the conference!
See the OAPT Website
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Do you wish to share an idea technique of interest with your fellow teachers? Have you a special demonstration, computer program or teaching concept? Do you have interesting ideas and results from, and for, student's projects, or from studies you have done related to teaching and physics? Please consider sharing these with your colleagues by making a contributed presentation at the conference.

Membership
Join the Ontario Association of Physics Teachers
Members receive a Newsletter and **reduced registration rates at the annual conference**. As well, from time to time, the Association makes available special resources; examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.
To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:
Ernie McFarland
OAPT Membership Secretary
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

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Past Conferences
Opportunities -- for Junior and High School Science Teachers)
Grade 12 Physics Contest held in April

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THE DEMONSTRATION CORNER

"AN ELECTRIC GUITAR PICKUP"

by
Peter Scovil
Waterford, ON
petescov@enoreo.on.ca

I like music, and enjoy playing the guitar, so the following demo caught my eye (or ear?). It was in the Jan. '95 issue of *The Physics Teacher* (p.58) by G.R. Davies of South Africa. It is a good example of electromagnetic induction that is easy for students to understand. I use my sonometer (which conveniently has a steel wire) and a coil with a magnet inserted inside it. The pole of the magnet and the coil are placed very close to the wire. Davies suggested a bar magnet (see diagram), but I have a strong horseshoe magnet, and it works fine. I run the wires from the coil to a Radio Shack mini amplifier-speaker (cat #227-1008C), and get a good sound out of it. A better amplifier is even more impressive. The students can easily understand that the magnet magnetizes the portion of the steel wire near the magnet. The vibrating magnetized wire provides a changing magnetic field that will induce an alternating voltage in the coil at the same frequency as the wire itself. The magnet and coil form essentially an electric guitar pickup.

Last year, as I was teaching harmonics on a vibrating string, I was (after 32 years teaching physics!) trying to think of a better way to show nodes and antinodes on a vibrating string when the amplitudes involved are too tiny to see. Obviously, a microphone will only pick up the dominant sound of the resonance box. But the guitar pickup only responds to the vibrations of the string, not the sound itself. I connected the coil to the mini amplifier input, but then connected the output to an oscilloscope. Then, when the coil was placed near a node, no wave patterns were seen, whereas at an antinode,

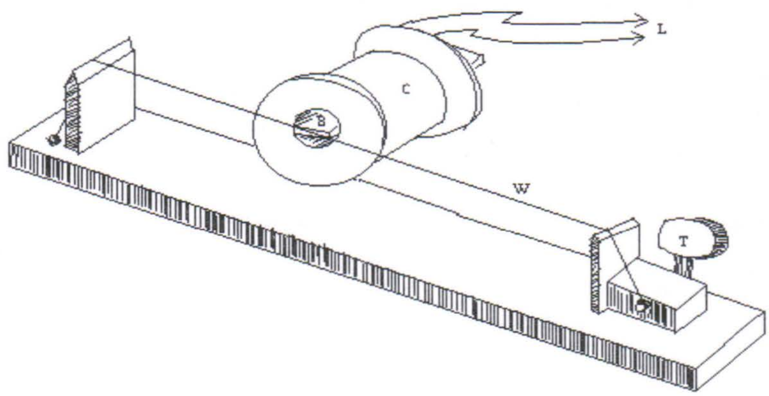


Fig. 1: ELECTRIC GUITAR PICKUP MODEL
W: wire; C: coil; B: bar magnet; T: tensioner;
L: leads from coil to power amplifier and loudspeaker

the waves had a reasonable amplitude. This can be confirmed by replacing the oscilloscope with a speaker. With an understanding of harmonics, students should be able to predict where nodes and antinodes occur, and then test their predictions. This set-up is good for showing the vibration of the string right at the point where the pickup is located. A microphone is better for showing overall waveform of the sound that you actually hear.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca
Submissions describing demonstrations will be gladly received by the column editor.

ERRATA: The Banquet Dinner on the Ontario Association of Physics Teachers Conference Options Sheet for **2001 a physics odyssey** is for Friday not Saturday.

2001

a physics odyssey

Ontario Association of Physics Teachers Conference
Trent University - Peterborough - May 24,25,26, 2001

Last Name:________________________ First Name:________________________

Address to which conference material will be sent:

School/Institution ____
Street/PO Box/Dept ____
City ____
Province/State ____
Postal/Zip Code ____

Attendance Fees

Registration (includes cruise)	$90	_______
Banquet	$25 per person	_______
Extra cruise tickets	$15 per guest	_______
Thursday overnight residence	$70	_______
Friday overnight residence	$70	_______
Friday non-residence ancillary	$8	_______
Saturday non-residence ancillary	$8	_______
OAPT one year membership	$8	_______
	Total	_______

The non-residence ancillary fees cover break supplies, parking etc., which are already included in residence fees.

Please submit Registration Forms **by April 6, 2001** to:

David Marshall
Physics Department
Trent University
Peterborough ON K9J7B8

Fax: 705 748-1652
Make cheques payable to Trent University OAPT 2001 Conference
Questions? David Marshall, telephone 705 748-1461, email: dmarshall@trentu.ca

Be sure to also complete the Workshop / Tour Options sheet and fax to:

Diana Hall (613) 828-9022
diana_hall@ocdsb.edu.on.ca

[redacted]

Annual Meeting
May 24-26, 2001
Trent University, Peterborough

CALL FOR PAPERS

Do you wish to share an idea technique of interest with your fellow teachers? Have you a special demonstration, computer program or teaching concept? Do you have interesting ideas and results from, and for, student's projects, or from studies you have done related to teaching and physics? Please consider sharing these with your colleagues by making a contributed presentation at the conference.

If you wish to make a presentation at the 2001 OAPT Conference, please return this form to:

Diana Hall
Conference Coordinator
Bell High School
40 Cassidy Road
Nepean, Ontario
K2H 6K1

Or FAX to 613-828-9022
Or E-mail to: diana_hall@ocdsb.edu.on.ca

Name: ______________________________

School or Institution: ______________________________

E-mail address: (I need this) ______________________________

Phone: (home)__________ (school) __________ (fax) __________

TITLE OF PRESENTATION: ______________________________

Time Required: 10 min: ______ 15 min: ______ 20 min: _____ 30 min: ______

SPECIAL NEEDS:

Do you require any audio-visual or special equipment besides an overhead projector? yes ___ no____

If yes, please describe your needs ______________________________

Will you be bringing any equipment yourself? yes ___ no ____

If yes, describe what you will be bringing:

ABSTRACT: Please include a brief summary of the specifics of your presentation on the back of this form. (*If faxing, be sure to fax both sides)

2001

a physics odyssey

Ontario Association of Physics Teachers Conference

Options Sheet

Please fax this sheet to: Diana Hall (613-828-9022)

Name: ______________________________

School and Address: ______________________________

E-mail address (please include in case communication re workshops is required): ______________________________

Phone Number: (   )______________________

WORKSHOP Selection [Please indicate 1st, 2nd and 3rd choice]

- Grade 10 Motion Unit (Kevin Soltes) ☐
- Scanning Tunneling Microscope (Alan Slavin) ☐
- Starry Night Software Hands on Workshop, followed by Real life Observatory Viewing (John Earnshaw) ☐
- Weather Station ☐

TOUR Selection [Please indicate 1st, 2nd and 3rd choice]

- General Electric – Large Motors Division ☐
- General Electric – Nuclear Division ☐
- Bryston Amplifier Technology ☐
- Trent University Power Dam ☐

BANQUET

Do you plan to attend the Banquet Dinner Friday Night? Yes ☐ No ☐

Will you be bringing a guest(s)? If so how many guests will accompany you? ___________

OAPT Annual Meeting Feedback / Input

Please Fax or email to: **Diana Hall**
613-828-9022 or diana_hall@ocdsb.edu.on.ca

This year's Annual Meeting will be held at Trent University in Peterborough, May 24 – 26. In order to provide a program that meets your needs and interests, we invite you to provide some feedback and/or input. In order that your ideas and opinions can be considered, please submit this form as soon as possible.

Did you attend last year's meeting at McMaster? YES NO

If YES to above…..

Please check each of the following:	Didn't Like				Liked
Talks on current research at McMaster	1	2	3	4	5
My Favourite Demo	1	2	3	4	5
Invited Speakers	1	2	3	4	5
Contributed Papers	1	2	3	4	5
Banquet Speaker	1	2	3	4	5
Other: ______________________________	1	2	3	4	5

What, if anything, disappointed you about the conference?

Please comment on the workshop(s) you attended.

Do you plan to attend this year's meeting at Trent? YES NO NOT SURE

What workshop(s) would you like to see offered?

What topics would you like to see highlighted in the program?

Do you know of a Banquet Speaker that you would like us to invite? (Please give details)

We welcome any further comments you may have about the annual meetings.

(Feel free to add a page if this space is insufficient)

Name (optional): ______________________________

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 3 Fall 2001

2001 - A Physics Odyssey
The Annual Conference of the Ontario Association of Physics Teachers
by Terry Price

Another year and another very successful OAPT conference. Approximately 80 physics teachers, many of who were attending for the first time, spend three enjoyable and productive days Trent University in late May. David Marshall our host from Trent, Dianna Hall, the conference coordinator and the OAPT executive once again put on an excellent conference program. Some of the highlights of the program were:

- Four - two hour evening workshops on Thursday night including the Grade 10 motion unit (Kevin Soltes, OAPT president for 2001 - 2002; Scanning Electron Microscope (Alan Slavin of Trent University); Astronomy for the Grade 9 Curriculum (John Earnshaw of Trent University); and Weather Station Science (John Palcik of Boreal). These Thursday workshops have become a very popular beginning to our conference, perhaps partly because of the wine and cheese social that follows them.
- A keynote lecture by Dr. Ralph Chou of the School of Optometry, University of Waterloo on Protecting the Eyes from the Sun. Dr. Chou very effectively showed us how important it is to protect the eyes from the UV spectrum.
- A short session by a second year teacher from York Region, Steve Auger, on using video clips from popular television shows to grab your students interest
- Glen Wagner from Centre Wellington DHS shared some ideas on the effectiveness of exposing students to modeling instruction in the classroom
- Delegates attended one of four tours in the afternoon and then combined for an interesting boat cruise from downtown Peterborough to the University campus.

Our Friday night banquet began with a delicious meal prepared by the University Chef and ended with a very enjoyable after dinner talk by Dr. Michael DiRobertis of York University. Michael shared some ideas on how science teachers could use the topic of pseudoscience (ever popular with our students) to teach real physics topics and the scientific process.

Although I couldn't attend the sessions on Saturday due to a family commitment I'm told that the day was just as successful as Friday. The sessions were:

- A keynote lecture by Jim Jury of Trent, "From Landmine Detection to Human Diagnostic Radiography"
- A keynote lecture by Johann Beda of Physiciens Sans Frontieres, "Photonic Programs at Ontario Colleges – the PET Project"
- A short session by Diana Hall OAPT Conference Coordinator, "Crackerbarrel on Grade 10 Motion"
- A short session by Professor Tony Key of the University of Toronto, "Transforming the Traditional Laboratory"
- A short session by Doug Hayhoe of the Toronto District School Board, "Mapping Misconceptions Before Writing Textbooks"
- A keynote lecture by Dr. Uwe Erb of the University of Toronto, "Nanoworld 2001"
- A keynote lecture by Elliot Coleshill, of M.D. Robotics, "Canada's Contribution to the International Space Station"

After lunch the conference concluded with the ever popular "My Favourite Demos" (Alan Slavin from Trent with his 'Human Oscillator'; Rolly Meisel from Crystal Beach HS with 'Three Fun 'must do' demos', Dave Barrowclough and Chris Howes showing their 'Wine Cork Motors'; Kevin Soltes of Scarlet Heights SS discussing' 'Friction Experiments on the computer' and Johanne Christensen of Glenforest HS discussing 'The Internet Science and Technology Fair'.

Another highlight of the afternoon was the awarding of a Life-time Membership Award to Dianna Hall of Bell High School in Ottawa. Dianna, an active member of the executive for many years, has taken a leave of absence from her school board to take a position at a new school in Illinois.

I know that all delegates appreciated the efforts of Dave and Dianna and the rest of the committee in the planning this conference.

SEE YOU NEXT YEAR AT ERINDALE CAMPUS OF THE UNIVERSITY OF TORONTO

Addressing Student Misconceptions in Sound with Refutational Text

Douglas Hayhoe, Ph.D.,
Instructional Leader,
Toronto District School Board

Refutational text is one way to address student misconceptions in physics.[1] Write a scenario where a student expresses a misconception, while another student refutes this 'faulty' idea and presents a scientific viewpoint. The students argue back and forth. The story can end with the students actually doing the experiment. When other students read this refutational text, they see their own misconception clearly explained, not by the teacher, but by one of their "peers," and immediately identify with it ("that's just what I think!"). But they are then confronted with another viewpoint, again by one of their "peers," the alternative 'scientific' viewpoint. The following example of refutational text is based on research conducted by Michael Wittmann at the University of Maryland regarding students' misconceptions of sound as a longitudinal wave.[2]

Anita and Juan are sitting in front of a speaker pondering the physics of life! They turn on the speaker and listen to the burst of sound coming out. They know that sound travels from the speaker to their ears by means of the air molecules, because they have seen the Bell Jar demonstration showing that air is the medium for sound.

They try to analyze the minute details of the situation, taking advantage of a ray of light shining into the dusty room through a window. They focus their attention on a single dust particle sitting at rest in the air in front of the speaker (Figure 1 – redrawn from slide 22 a of Wittmann.). Anita challenges Juan to predict the motion of the dust particle, when the speaker is first turned on and the sound travels out from the speaker. To make the problem simpler, they assume that the speaker plays a single note with a fixed loudness and pitch.

At first, Juan replies that the dust particle will be pushed away from the speaker, as the sound moves across the room. He illustrates his answer by sketching the dust particle being hit by the force of a sound wave (Figure 2 – redrawn from slide 23 of Wittmann). Juan also says that if the speaker is turned up to a louder volume, or to a higher frequency, the dust particle will be kicked further out.

Anita isn't entirely happy with this analysis. She replies, "But isn't sound a wave? What did we learn about waves in physics class? What happens to a single particle of a medium when a wave passes through it? Doesn't it vibrate back and forth? And after the wave has passed through it, doesn't it return, again, to its initial rest position?"

Juan thinks for a minute and then replies, "Yes, sound waves **are** longitudinal. Therefore, each particle of the medium including this dust particle should vibrate out and back, in the same direction as the direction of movement of the sound wave."

Both students finally agree that when the speaker is first turned on to a single note, the dust particle should move out and back horizontally, as the wave passes through it, returning to its initial rest position. Two years later, when Juan is studying high-speed videography at college, he places a burning candle in front of a speaker and films the movement of the candle flame when the speaker is turned on (Figure 3 – redrawn from slide 22 b or 26 of Wittmann). Sure enough, when he plays the film back at normal speed, he sees the candle flame vibrating out and back in a horizontal direction, parallel to the direction of the sound wave, and always returning to its initial position.

[1] Galileo employed refutational text in his *Dialogues*, over three hundred years ago.
[2] See Wittmann's slide presentation at www2.physics.umd.edu/~wittmann/research/9806_tyc/sld001.htm.

THE DEMONSTRATION CORNER

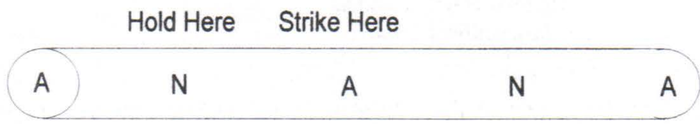
"Cheap and Easy Sound Demos with Rods and Tubes"

by

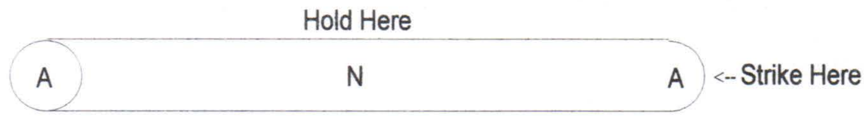
Rolly Meisel
Ridgeway Crystal Beach High School
rollym@vaxxine.com
Phone: 905-894-3461 / Fax: 905-894-3390

Visible standing waves with a node at each end are fairly easy to demonstrate. You can use a long spring such as a slinky (cheap way), or even order a nice transducer-based demo from one of the scientific supply companies (expensive way). However, I also wanted to demonstrate antinodes at both ends, or even one node and one antinode.

To get antinodes at both ends, I use an aluminum rod about two metres long. I was able to obtain this at no cost to the science department by a begging campaign aimed at the machine shop teacher. I learned this technique while watching PBS. It can also be done using the rod from a retort stand. You can create transverse standing waves in the rod by holding it at a point ¼ of its length from one end and hitting it in the middle. Another node appears at the ¾ point, with antinodes at the end. These are all easily visible in the two-metre rod, and can even be seen as "blurs" in the retort stand. I usually do the big rod as a demo and then let the students do it with the retort stand.



Transverse Standing Waves



Longitudinal Standing Waves

The same rod can be used for longitudinal standing waves. Hold the rod in the middle, and tap one end against the floor or other hard surface. Although the standing waves aren't visible, they are very audible. I then push one end slowly against a chalkboard to show that the vibrations are indeed longitudinal, and produce an irritating, spine-tingling noise as a bonus. You can extend this by holding the rod at the ¼ point, and generating a note one octave above the first. I am also usually able to get one more octave by holding it at the 1/8 point, although it is very sensitive to any error in the holding point.

Another bonus with the longitudinal vibrations is a Doppler Effect demo. Tap the end against the floor to excite the longitudinal standing waves. Then hold the rod horizontally over your head and start twirling it. You will get a beautiful vibrator effect from the shift in frequencies between the end moving away from the observer, and the end approaching the observer.

For a node at one end and an antinode at the other, I purchased a 12-ft length of rigid copper tubing from a hardware store. I brace one end against the floor (or a wall, if I'm in a room with low ceilings), and hold it at the closest antinode to the wall, which is 1/3 of its length from the forced node. Moving my hand back and forth at this antinode produces the desired pattern. One must be careful not to do it for too long or at too great an amplitude, since the copper will bend permanently. This demo would work better with a solid aluminum rod of similar length. I couldn't beg one using the above technique since I am now in a school without a machine shop, but I plan to buy such a rod with the greatly increased science budgets expected next September.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor

The Ontario Association of Physics Teachers needs you...

New people for this exceptional organization.

From:
The Executive to volunteers,
presenters and help at conferences,
organizers to writers,

and all aspects of the Association.

From Peter Scovil <petescov@enoreo.on.ca>

I found this website fascinating on the negative index of refraction. http://www-physics.ucsd.edu/lhmedia/

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To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:

Ernie McFarland
OAPT Membership Secretary
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

HIGH SCHOOL PHYSICS PHOTO CONTEST
There are two categories: Natural and Contrived. Vernier Software & Technology has contributed prizes for first, second, third places, and a certificate for honorable mention, as well as prizes for the teachers of winning students. Photo submissions should be sent to: Mary M. Winn, 2623 Watrous Ave., Tampa, FL 33629 no later than June 10, 2001. Entries will be displayed and judged at the 123rd AAPT National Meeting, July 21–25, 2001. For additional information and contest rules, visit the AAPT website at *http://www.aapt.org/programs/HSphoto.html*

AAPT NATIONAL MEETING
Will be held in Rochester from July 21-25

Find the Ontario Association Of Physics Teachers WEB SITE at:
http://www.physics.uoguelph.ca/OAPT

Copy, Copy, Copy

We are looking for articles and items for the newsletter – no matter how small or large. Have you got an interesting demo, a unique project development, a fascinating web site, an off the wall summative, or informative piece. Send them to: **Glenn Wagner or John Caranci** GWAGNER@cwdhs.ugdsb.on.ca, physix@iprimus.ca, or demos to **Ernie McFarland,** Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1 Email: elm@physics.uoguelph.ca

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 3 Winter, 2002

String Theory—A Unified Theory of Forces, Matter and Spacetime

By Geoff Potvin

String theory is a field that has had a significant impact on the physics community even though it is only 30 years old. It is designed as a unified field theory, and its main postulate is that all the known fundamental "particles" are tiny loops of a one-dimensional string. All particles are made of the same kind of string: different vibrational modes and energetics behave like different particles, and the strings can be closed (like an elastic band) or open (having two endpoints). This description of objects as strings is very powerful: extreme gravitational objects like black holes also have a stringy, fully-quantum description which gives researchers the ability to count the entropy of certain gravitational systems and resolve the spacetime singularities for some black holes. It also gives the hope of studying what happens when black holes evaporate, and finding a solution to the black hole information problem—the apparent loss of coherent information, other than mass, charge and angular momentum, when matter falls into a black hole of General Relativity.

An important component to modern string theories is the necessity for spacetime "supersymmetry". Supersymmetry describes a sort of pairing between the usual matter in the Universe (fermions) and the force-carriers (bosons), and involves mixing up our concepts of spacetime coordinates and particle descriptions. Though it is clear that there is no unbroken supersymmetry at the energies we have probed (we would see at least twice as many particles in the Standard Model!), most researchers in the field expect that there must be supersymmetry in the correct unified field theory and that the supersymmetry breaks at energies just beyond the current capability of particle accelerators. So it is expected that in the next generation of particle accelerators, supersymmetric particles will be detected. This is not a necessary and sufficient condition for the existence of a string theory description of the Universe, but will lend a great deal of support to this way of looking at high energy physics.

A well known prediction is that a consistent, supersymmetric string theory lives in ten dimensions. Since we seem to live in only four dimensions, much effort is spent working on compacting six of the dimensions in various models. This leads to a plethora of phenomenological predictions and various cosmological models. It turns out that there are other objects that exist in string theory, notably D-branes. D-branes are dynamical objects analogous to higher dimensional membranes, and can be thought of as surfaces upon which the endpoints of all open strings must lie. One of the popular alternatives to full compaction is that the Universe is five dimensional (four space, one time), with the physics of the Standard Model existing only on a three dimensional brane and evolving with time, with gravity interacting in all five dimensions.

The difficult aspect of testing the predictions of a unified field theory is that it seems quite unlikely that it will be possible to build accelerators big enough to generate the required energies. Gravity, for example, is expected to become very "quantum" only near the Planck energy, which corresponds to probing at a distance of 10^{-33}cm! So string theorists have also turned their attention to astrophysical data, especially the cosmic microwave background radiation (CMBR), and studies of the relation of string theory to cosmology. The CMBR is the "echo" of the Big Bang that was emitted when the young expanding Universe had just become transparent to light. The small variations in temperature of the CMBR can tell us important information about the level of quantum fluctuations in the very early Universe. Furthermore, recent data supports the idea that our Universe is in a period of exponential expansion driven by some sort of dark energy, which makes up nearly 70% of the total mass-energy of the Universe. This was an unexpected finding, and researchers are working hard to understand how such a Universe could arise from string theory.

In the Department of Physics at the University of Toronto, the group of researchers (consisting of faculty members, post-doctoral fellows and graduate students) who are studying physics beyond the Standard Model, including string theory and closely related topics, is currently around a dozen people. Geoff Potvin is a Ph.D. Candidate in the Department. His research focuses on the resolution of spacetime singularities in string theory.

The Demonstration Corner
A Simple Demonstration of the Photoelectric Effect
By Eknath V. Marathé, St. Catharines, Ontario

INTRODUCTION

Following the work of Gustav Kirchhoff, James Maxwell, Heinrich Hertz, Wilhelm Hallwachs, Philipp Lenard, John Rayleigh, and James Jeans, Wilhelm Wien worked at finding out the distribution of energy radiated by a black body. Wien's energy radiation equation for a black body failed to agree with the observed values in the low frequencies (long wavelengths) region of the blackbody energy radiation spectrum (Wien's displacement law). Also, the Rayleigh-Jeans energy radiation equation for a black body failed to agree with the observed values in the high frequencies (short wavelengths) region. This failure is known as the ultraviolet catastrophe.

In 1900, Max Planck worked out a relatively simple energy radiation equation for a black body that described the distribution of radiation accurately over the entire range of frequencies. His equation was based on a crucial assumption: radiant energy is not infinitely sub-divisible. Like matter, it exists in "particles." These particles Planck called quanta, or in the singular, "quantum." He further suggested that the size of the quantum, also known as "photon," for any particular form of electromagnetic radiation, was in direct proportion to its frequency. In the visible spectrum, a photon of violet light would therefore contain more energy than a photon of red light. The small constant that is the ratio of the energy of a photon (E) and the frequency(ν) of the photon radiation is called Planck's constant and it is symbolized as h ($h = E/\nu$). It is now recognized as one of the fundamental constants of the universe. Planck's theory, known as Quantum Theory, was applied by Einstein in explaining the photoelectric effect.

DEMONSTRATION

Remove the knob of a gold-leaf electroscope and attach a zinc plate about 10 cm × 10 cm in dimensions[1]. The sharp corners of the plate should be turned into a circular arc to eliminate the possibility of leaking the charge through sharp points. The electroscope will function properly in whatever weather, if polystyrene insulation is used. A source of ultraviolet light, such as a quartz mercury lamp, or carbon arc, or a spark discharge between zinc or aluminum electrodes, or PSSC course ultraviolet light source, is arranged to illuminate the zinc plate[2]. The zinc plate must be cleaned by sandpaper (never by emery paper) immediately before using for the demonstration, so as to remove the oxide layer that forms on the surface of the plate because of exposure to the air[1].

Charge the electroscope positively. There should be no appreciable difference in the natural rate of leak determined both with and without illuminating the zinc plate by white light[3]. The plate is then charged with negative charge. Illuminate the plate with ultraviolet light; the leaf of the electroscope falls. This happens because electrons are ejected from the plate under the action of the ultraviolet light. Charge the plate again with negative charge. A glass plate is held a short distance from the source of ultraviolet light and the light is directed through the glass towards the plate; the deflection of the gold leaf does not change. This confirms that photons of the ultraviolet light were responsible for ejecting electrons from the zinc plate.

Other materials, such as aluminum or brass, may be used, but the effect is much smaller; all clean metals will show the photoelectric effect, to some extent, with ultraviolet light.

DISCUSSION

Einstein maintained that a minimum frequency of light (the threshold frequency), which corresponds to a minimum photon energy, is required to force an electron out of a given metal. Brighter light (more photons) would bring about the emission of more electrons. Light of higher frequency, however, would have more energetic photons and would bring about emission of more energetic electrons. Light that has a lower frequency than the threshold frequency would be made of photons with such little energy as to bring about no electron emission at all. The energy content of such low-frequency photons would be insufficient to break an electron away from the metal. Of course, the threshold frequency would be different for different metals.

When the plate is charged positively and then illuminated by ultraviolet light, a few electrons may be ejected but the plate's attractive field pulls them back in[4]. On the other hand, if the plate is charged negatively and then illuminated with ultraviolet light, the leaf falls, and if the illumination is continued for a short time after that, one may see the leaf diverging again. Removing the light source and then testing the type of charge on the plate in a usual manner, one would find that the charge is positive. This is because, after a large number of electrons have been ejected from the zinc plate, the plate has a net positive charge for a short while, sufficient enough to be shown by the deflection of the gold leaf. This charge is then slowly neutralized by the natural absorption of electrons from the surrounding air.

If one of the glass faces of the electroscope is marked with angular calibration (projection electroscope), one can project the deflection of the leaf on a screen.

The photoelectric effect obeys the Einstein photoelectric equation:

$h\nu$	=	W	+	$\frac{1}{2}mv^2$
Energy of the incident photon.		Minimum energy required to remove an electron from its atom (threshold energy, or work function)		Maximum kinetic energy of the ejected electron.

Some electrons in a given metal will be more tightly bound to the metal than will others. These electrons will require more energy than the minimum to release them from the metal. Thus, for photons of a given frequency, ν, there is a range of kinetic energies that the released electrons will have, with the maximum kinetic energy corresponding to electrons that were loosely bound and were ejected with only the minimum energy (W) being required.

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[3] Richard Manliffe Sutton, Ed., *Demonstration Experiments in Physics* (McGraw-Hill Book Company, Inc. New York, 1938), pp.488-489.

[4] Eric M. Rogers, *Physics for the Inquiring Mind* (Princeton University Press, 1960) p.724.

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Who Said Air Resistance Was a Drag?

By Paul Passafiume

The concept of air resistance, while fun for teachers, can be perhaps a little dry and somewhat confusing for our students. The topic, though rich, is usually covered briefly and often using Socratic methods, which may leave our students in an unenthused haze. Myself, and a clever math teacher at our school, thought of a way to bring clarity and enjoyment to the subject. Here's what you'll need:

- A computer, motion sensor, interface box, and DataStudio software (or equivalent)
- Some string (I used butcher twine), a large diameter plastic straw, a Styrofoam dinner – sized plate
- A couple quarters (kids will have these!)

Poke a hole through the centre of the plate, and feed the straw through it until the plate is at the centre of the straw. Using duct tape, secure the plate to the straw. Cut enough string from the roll to reach from the floor to nearly the ceiling (should be about 3 m, or so). Feed the string through the straw and lift the plate up to the ceiling. The student holding the plate should also hold the motion sensor above it so the sensor can 'see' the plate as it falls. This can be done easily by pressing the string to the front of the sensor with one hand, and holding the plate with the other. When ready, drop the plate and begin collecting data. You'll want to send the data to a velocity – time graph. When that trial is complete, repeat the activity two more times by taping one quarter, and then a second to the centre of the plate. I had three stations up so that all the students could be involved.

The results obtained are really quite amazing. Each trial has a very well defined period of acceleration, which gradually tapers off as the plate reaches terminal velocity. It is clearly seen that the more massive plates have a longer period of acceleration, and therefore reach a larger terminal velocity. Also, the more massive the plate the steeper the velocity – time curve (now why would that be?!).

I tried this activity for the first time with my 4U class, and it was a real success. This kids absolutely loved it, and discussion it generated was just amazing. Having completed the exercise, I was sure that they both understood the material and had fun doing it! And who said air resistance was a drag? ☺

Let's Play: Quotable Quotes!

Here's the deal. Identify the famous scientist who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"It's a true miracle that modern education hasn't yet completey smothered the curiosity necessary for scientific study. For without the required encouragement, and especially freedom, this fragile plant will wither. It is a grave mistake to believe that the pleasures of observation and inquiry can be induced by constraint and a sense of duty."

Quote sumitted by Miss. Connie Chang, Markville Secondary School.

Attention ALL teachers: The next OAPT conference will be held May 22 – 24, and hosted by the University of Western Ontario. The theme of this year's conference is 'medical physics'. With FREE workshop presentations covering grade 9 electricity, grade 10 motion, and using computers in the classroom the conference is sure to be of interest to all. Workshops begin Thursday evening, from 7 – 9, after the BBQ.

Do you want to give back to your profession? Participate in the OAPT!

This wonderful organization needs volunteer help in the following capacities:

- Guest presenters
- Conference organizers, and facilitators
- Members of the executive committee
- Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (glenn.wagner@ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

Membership Matters!

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As well, from time to time, the Association makes available special resources. Examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

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Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

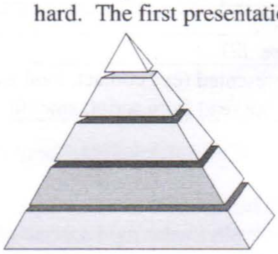
Attention physics teachers: Arizona State University in Tempe is offering summer graduate courses in physic pedagogy, interdisciplinary science, and contemporary physics. These courses may be suitable for Ontario's PLP program (verification required). Courses are offered mainly in July, 2003. More information is available from Jane.Jackson@asu.edu, 480.965.8438, or from http://modeling.asu.edu.

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXIII, Number 1 Winter, 2002

Physics Research Presentation

By Janice Gladstone

Although the curriculum has not changed very much from the old to the new physics courses, there are some significant new expectations regarding evaluation and assessment. Also, where some content has been removed (e.g. nuclear radiation), the STSE (science, technology, society and environment) has been added. In response to these requirements, I created an assignment for my students at the end of the course. I completed the basic curriculum (less the STSE components) a few weeks before the end and will spend the last two weeks working on projects, reviewing and, best of all, having student presentations. The presentations -- generated from STSE segments in the text -- are 10 minutes long plus 5 minutes for an interactive component. In the student handout, I make several suggestions about how to get the class involved. I will grade the students while they are presenting (saves marking time) on the quality of their presentations, visual aids and interactive component. Students know that there may be quiz or exam questions (student generated) arising from the presentations. This was designed to encourage attentiveness. So far the kids are excited about their topics and are working hard. The first presentation went well.



Yep! It's a Physics Research Presentation

The Project

Physics has to be one of the most intrinsically interesting subjects to study. What could be of more interest than how the world around you works? The first questions little children ask are almost always physics questions: Why is the sky blue? Where do rainbows come from? Why does lightning come before thunder? Where does electricity come from? Where does rain come from?

Physics is interesting because it can be used to explain so many phenomena in the world around us. You have a chance to research and present how physics relates to our daily lives. In this project you should focus on societal impacts and history of physics.

The Expectations:

I. You will work as <u>individuals or in pairs</u> and will choose a topic from a chapter we have studied.
II. The focus of your work will be <u>Science – Technology – Society – Environmental Interrelationships</u> found at the end of each chapter in our text (Irwin Physics Concepts and Connections).
III. Confirm your topic choice with the teacher.
IV. Prepare a fabulous 10 minute information and idea packed <u>presentation</u>. Note: great presentations require practice. Be sure to practice your presentation beforehand so it is smooth and on time. It's better if you have an audience for practicing.
V. Create great <u>visual aids</u> either on computer (we do have a projector for that—so you could use Powerpoint or whatever software – check with the teacher) or with a poster.
VI. You will be expected to use at least one Internet web site *and* one other book for <u>reference material.</u>
VII. To hand in: 1. One page of notes including the references you used, a very brief description of your topic, key points in how you will do your presentation.
2. Three sample questions (easy, medium and challenging) on your topic including answers for the questions. These may be used on the final exam.
VIII. Your presentation must include an interactive component for your classmates. You will know you have been successful in this if all your classmates are actively engaged in the activity or discussion related to your presentation material.

SOME SUGGESTIONS FOR INTERACTIVE ACTIVITIES:

Think/pair/share

1. You pose a question. 2. Students think alone for a specified amount of time (depending on the complexity of the question – maybe up to a minute). 3. Students form pairs to discuss their ideas. 4. Pairs then share responses with the class.

Voting or Survey Ask students to put up their hand to indicate if they agree or disagree with a statement (or if they think the answer is…or not). This works well if you think a lot of students might have a misconception about an idea. After the vote, discuss, as a class, why people voted the way they did. Tell them the correct answer.

Brainstorm If you want the class to solve a problem as a group, this is a great way to generate ideas. Have students put up their hands to give suggestions and write them down. Rules: 1. There is no such thing as a bad idea. All suggestions are good so no criticism allowed (until this step is finished.) 2. Ideas should lead to other ideas. Piggybacking or adding to other people's ideas is good. 3. After there is a reasonable list, you can start to criticize and eliminate impractical suggestions.

Numbered Heads Students discuss your question in groups of 3 or 4. Have students in the groups number themselves 1, 2 or 3 (and 4 if there are 4 people in the group). After the students have had a few minutes to discuss and record their ideas, you select a number. That person in each group reports to the class.

Four Corners If you have a controversial question, you can get good debate going using this method. Place large labels in each corner of the room saying: Strongly Agree; Agree; Disagree; Strongly Disagree. Have students go to the corner that suits them. The 4 groups discuss why they chose their corner. The groups then share their ideas with the rest of the class.

Card Quizzes 1. Students make cards or slips of paper with 1, 2, 3, and 4 written in large letters on each piece (or If you prefer the papers and answers could be A, B, C, and D). 2. You pose multiple-choice questions and have students hold up the card with what they think the answer is. 3. Make a note of how many students got the right answer. 4. Have students discuss their answer with a neighbour who has a different answer from them. After a minute or less, have students hold up their cards again. 5. Now note how many got the correct answer. Give the correct answer to the class.

Evaluation [30 Marks Total]

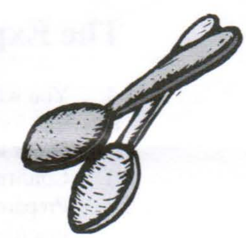
Peer Involvement (5)	Hand in questions and written outline (5)	Visual Component: (8)
Presentation: (12)	Attractive (2)	Clear (3)
Obvious Effort (2)	Informative (3)	Concise (2)
On time (2)	Informative (2)	Well presented (eye contact, loud and clear voice, not read from script, smooth) (4)

THE DEMONSTRATION CORNER

"Demos for Fun"

by

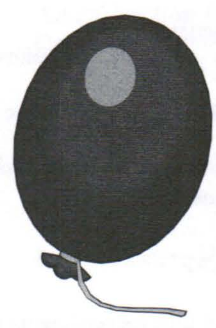
Rolly Meisel
Ridgeway Crystal Beach High School
rollym@vaxxine.com



The three demos described here are, to the best of my knowledge, nowhere in the Ontario curriculum, although I stand to be corrected. Sometimes we need to do things because they are interesting and fun, and not solely because they are "on the course". ☺

Hang a Spoon From Your Nose:

If you try to hang a spoon from your nose, most of the time it will just fall off. We could use epoxy or other glue to hold it on, but that's a bit too permanent. It is a little-known fact that a thin layer of water will act as an adhesive, although thicker layers usually act as a lubricant. Before doing this lab, it is important to clean oils from the nose using a towelette or other cleaner. Also ensure that the spoon is clean. Breathe lightly on the spoon to fog it, place the bowl on the bridge of your nose, and press lightly to set the adhesive. If you do it right, the spoon will stick so well that you can even walk around with it. When you get really good at this, you can do it with a ladle.



Use a Balloon as an Air Conditioner:

Rubber has a negative coefficient of thermal expansion. If you hang a weight from a rubber band, and then heat the band, you can watch it contract. On the other hand, if you stretch a hand, if you stretch a rubber band, it heats up. You can do this with a balloon. Stretch the balloon, and then touch it to your lip. You should feel a dramatic warming effect. While it is stretched, wave it around to dissipate the heat into the air. Once it's back to room temperature, let it contract, and press it to your lip again. It should feel quite cool. No doubt you can think of a way to engineer an air conditioner using this effect. Please send me 10% of the gross as a fee for giving you the idea.

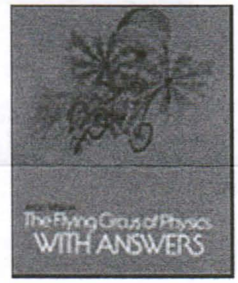
Make Your Face "Explode" or "Shrink":

Make a spiral design as shown on this handout, and find a way to spin it, but not too fast. A few hertz will do. Watch the spinning spiral for thirty seconds, and then immediately look at someone's nose. Spin the spiral the other way, and repeat the experiment. One direction will cause an "exploding" (actually an exfoliating) effect, while the other will cause a "shrinking" effect. A computer version of this demo can be found at: http://msr.bmr.com.au/fun.html.

More Fun Stuff:

There are many sources for fun demos like these. Two that I have found particularly useful are:

The Flying Circus of Physics by Jearl Walker
Invitations to Science Inquiry by Tik Liem



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Submissions describing demonstrations will be gladly received by the column editor.

News – News - News

ASU'S SUMMER GRADUATE PROGRAM FOR TEACHERS of the PHYSICAL SCIENCES

The Department of Physics and Astronomy at Arizona State University (ASU) offers a summer program of courses specifically designed for in-service high school physics, physical science, and chemistry teachers nationwide. Teachers may want to enroll in these courses to earn credit towards re-certification, or to pursue a Master of Natural Science degree (MNS). Take one course or many! In summer 2001, 70 teachers (3/4 of whom don't have a degree in physics) participated in 8 courses.

The ultimate target for the MNS program is not the teachers themselves but their students. Therefore each course addresses the subject at a level that prepares teachers to entice and inform their students. The teachers are engaged in activities and projects that they can set up for their students. As the standard high school curriculum does not include "contemporary physics," teachers need the material developed in a modular form that can be used for extracurricular projects and interest groups or in advanced enrichment courses for seniors.

Two summer sessions: June 10-28, July 1 - Aug. 2, 2002. Visit <http://modeling.asu.edu for details and to apply to Arizona State University. Or reply to Jane.Jackson@asu.edu.

Its important to note in the newsletter that we (ie Canadians) are usually not eligible for the funding that they talk about. An interested teacher would need to contact Jane Jackson at ASU for more info for out of country participants. Jane Jackson, Co-Director, Modeling Instruction Program Box 871504, Dept. of Physics & Astronomy, ASU, Tempe, AZ 85287 480-965-8438/fax:965-7331
http://modeling.asu.edu

Physics/Environmental Resource

I would like to compile a resource for the Ontario Society for Environmental Education dealing with environmental expectations in grade 11 (this year) and 12 (next year) physics. Transportation, energy sources and transformation, noise, electrical energy, magnetic fields, radiation, nuclear energy, and technology. This resource will refer to material in the new textbooks and add more. Please send me ideas, lessons, activities - anything you would like to share. Contributors will be credited and will receive a copy. The resource is a non-profit venture by OSEE. It will be available online free or hardcopy at cost.
Example: A physics teacher/environmentalist colleague says his Mechanics lesson on tendency to disorder or entropy, technology and inefficiency always has a huge personal impact on his students decision-making around environmental issues.
Send to: Dave Arthur, 32 Springdale Drive, Kitchener ON, N2K1P9 or davidarthur@rogers.com by February 28, 2002.

Contests - Contests - Contests

Would some of your students like to get into the Physics Olympiad? The address to contact the Physics Olympiad Canadian Team is Professor Bailey, Coordinator of POPTOR at U. of T. dbailey@physics.utoronto.ca

Last year, in Turkey, the Canadian Team earned one silver and two bronze medals. This has not happened before. Names are posted on International Physics Olympiad web site.

How about the OAPT Physics Contest? Get in touch with Terry Price. **Find the Ontario Association Of Physics Teachers WEB SITE at: *http://www.physics.uoguelph.ca/OAPT***

Copy, Copy, Copy

We are looking for articles and items for the newsletter – no matter how small or large. Have you got an interesting demo, a unique project development, a fascinating web site, an off the wall summative, or informative piece. Send them to: **Glenn Wagner or John Caranci** GWAGNER@cwdhs.ugdsb.on.ca, physix@iprimus.ca, or demos to **Ernie McFarland,** Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1 Email: elm@physics.uoguelph.ca

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As well, from time to time, the Association makes available special resources; examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

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Ernie McFarland
OAPT Membership Secretary
Department of Physics
University of Guelph
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Ontario Association of

Physics Teachers

2002 Annual Meeting

Thursday May 23 – Saturday May 25

Hosted by

Department of Physics (Erindale College)

University of Toronto at Mississauga

Meeting Highlights

- Informative Hands on Workshops
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- Excellent Speakers on Current Topics
- Fellowship with Other Teachers

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
Annual Meeting
May 23-25, 2002
University of Toronto at Mississauga, Erindale College

CALL FOR PAPERS

Do you wish to share an idea or technique of interest with your fellow teachers? Have you a special demonstration, computer program, culminating activity or teaching concept? Do you have interesting ideas related to the new curriculum, or connecting the grade 9,10 Science courses to the Grade 11 Physics? Have you used your computer or the web in an innovative way in your classroom? Please consider sharing these with your colleagues by making a contributed presentation at the conference.

If you wish to make a presentation at the 2002 OAPT Conference, please return this form to:

John Beattie
Conference Coordinator
Blenheim District High School
163 Chatham Street
Blenheim, Ontario
N0P1A0

Or FAX to 519-676-4919
Or E-mail to: jbeat123@aol.com

Name: ______________________________________

School or Institution: ____

E-mail address: (I need this) ____

Phone: (home)_____________ (school) ______________ (fax) ____________

TITLE OF PRESENTATION: ____

Time Required: 10 min: _____ 15 min: _____ 20 min: ____ 30 min: _____

SPECIAL NEEDS:

Do you require any audio-visual or special equipment besides an overhead projector? yes ___ no____

If yes, please describe your needs ____

Will you be bringing any equipment yourself? yes ___ no ____

If yes, describe what you will be bringing: ____________________________________

ABSTRACT: Please include a brief summary of the specifics of your presentation on the back of this form. (*If faxing, be sure to fax both sides)

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 3 Fall, 2002

Spring 2002 - A Conference to Remember
The Annual Conference of the Ontario Association of Physics Teachers
By John Pitre

Some days you are lucky and everything seems to go right. That seems to describe the OAPT Annual Conference held this year at the University of Toronto's Mississauga campus. From superb accommodation, guest speakers, workshop leaders, and contributed papers to fine warm weather, we had it all.

Local organizers, Wagih Ghobriel, Fraser Code and myself were happy to welcome about 80 participants to Thursday evening's opening barbeque on the patio of the Blind Duck Pub. After that it was immediately down to business with five workshops, the most popular of which was *Computers in the Curriculum* (Kevin Soltes, OAPT 2001-2002 president). It seems that computer interfaced motion and force sensors continue to gain in popularity with adoption in the classroom hindered only by lack of funding. Glenn Wagner's workshop, *Modeling Instruction*, employed computers also, but emphasized the interaction of the student with graphing software. Ted Groves was able to fill in the blanks for those of us who are unfamiliar with some aspects of the new grade 12 curriculum such as *Pneumatics and Hydraulics*. For teachers who just wanted to learn more about *Teaching Physics Without Fancy Math*, Fraser Code was able to help in areas such as time and time keeping, waves, and complex physical systems. For those who know it all, or least who have students who seem to know it all, David Bailey explained how to participate in *POPTOR, The Physics Olympiad Preparation Programme*. After all this work, it was back to the Blind Duck Pub for a well deserved reception sponsored by the Department of Physics.

Rather than take you through the conference program (available at the OAPT web site: http://www.physics.uoguelph.ca/OAPT/index.html), let me share with you some of the contributions of the invited speakers that I found most appealing. I apologize in advance for omitting to mention the excellent ideas in the contributed papers that would have been surely included by another writer.

For me, the intellectual fireworks started with the opening speaker Professor Robert Birgeneau, president of the University of Toronto. I was expecting a warm, friendly talk on the cold topic of *High Temperature Superconductivity*, but instead received a candid appraisal on the nature of research. President Birgeneau discussed all the predictions he made that were dead wrong, in addition to discoveries that were made quite accidentally. He was able to put a personal touch on the topic since he knew, and had worked with many of the top researchers in superconductivity. He explained how research is a very human enterprise and how, in the end, we should not take ourselves, or our ideas too seriously.

I guess that I am still a concrete thinker because I seem to forget ideas, but I do remember things that I have interacted with. That's why I remember *Motivating Students to be Excited about Science*, by Tom Coyle and Troy Lassau. They demonstrated how to include engineered materials in the classroom to excite students. Their premise was that a student's natural curiosity about how and why things work should be accessed in the classroom in a unique way. Well, their demonstrations certainly caught my attention. I especially liked the pieces of milk container polyethylene that they passed around to all participants. Stretch it in one direction and it stretches easily up to a point as the molecules line up, but no further as you try to stretch the molecules themselves. At this point we were amazed to find that it stretched easily in the other direction. Do you remember why? (This is a test!)

An open bar, courtesy of the office of the dean at UTM, was a very welcome prelude to the conference banquet. Some banquets have a smorgasbord, but we opted for a cyborg, Professor Steve Mann. His chief interest is in interfacing humans and computers. It's not often that an after dinner speaker comes with so much technical equipment, or that the speaker is so fascinating. As he spoke to us he was seeing the world through his glasses which were connected to a computer. This meant that a remotely connected person could see what he sees and could interact with him by typing in some message that he could view as he watches the world. Whether you agree or not with his vision, you have to be impressed by his dedication to his research. This is not just a part time area of study. It's his life.

Saturday morning saw two new speakers. Ted Nugent spoke to us about nanotechnology in his *Illuminating the World of the Small – Nanophotonics*, and Murray Stewart spoke about fusion research (*Fusion - Bringing the **Iter** Project to Canada*). It's now Saturday afternoon, and we still have a full house! Now that's dedication! Jerry Mitrovica was the last speaker, and spoke to us about *Taking the Fingerprints of Global Sea-Level Rise*. The beauty of this talk was that it could have been understood by any of our students who understand the simplest ideas about the force of gravity. For many years the measurements of global sea levels around the world seemed to be inconsistent with one another until Jerry's complex model (which includes, among other things, the melting of polar ice complexes) reconciled them. It achieved this by showing how the gravitational attraction between the ice masses and the nearby ocean water altered the local and remote sea levels. People were still talking about this later in the parking lot as I was leaving for home!

Ah, but maybe we all stayed to the end so that we would have a chance to win one of the many door prizes in the great conference giveaway. This feature/gimmick, initiated years ago by Diana Hall, continued this year through the efforts of John Beattie. John was also responsible for much of the organizational effort that went into the running of this conference. Many thanks John, and many thanks to all those who made this year's conference a terrific success. Well done!

SEE YOU NEXT YEAR AT THE UNIVERSITY OF WESTERN ONTARIO!

Do you want to give back to your profession? Participate in the OAPT!

This wonderful organization needs volunteer help in the following capacities:

- ∞ Guest presenters
- ∞ Conference organizers, and facilitators
- ∞ Members of the executive committee
- ∞ Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (GWAGNER@cwdhs.ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

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OAPT Contest Reminder

This year's contest is open to grade 11 students *only*, and will be held on May 6, 2003.

Last year's contest, with answers, is available from the OAPT web site (see page 2).

The previous five contests may be obtained from Terry Price (thprice@sympatico.ca) if teachers wish to have some student practice.

Teachers should encourage their 1st term students to register during the 1st term to ensure there are lots of participants.

The Demonstration Corner

Classroom Demonstration of Spectra

By Jim Hunt
Physics Department, University of Guelph
phyjlh@physics.uoguelph.ca
Phone: 519-824-4120 x3993 / Fax: 519-836-9967

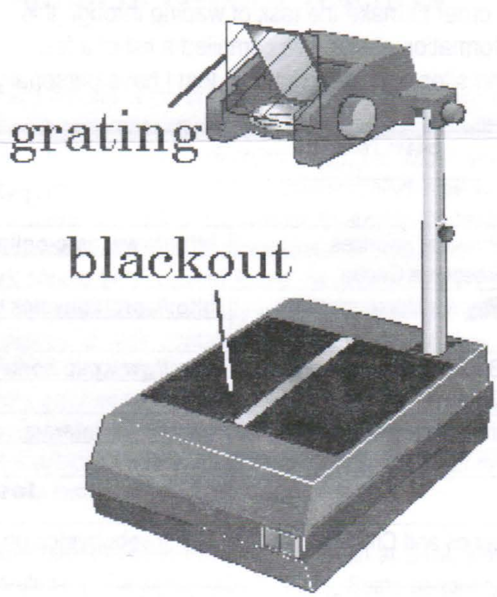
The availability of large sheets of plastic replica gratings has greatly increased the ability to show spectra to classroom-sized groups and, in the process, put on a nice light-show.

One way to do this is shown in the figure. A piece of grating is mounted in a stiff cardboard frame (to prevent curling or warping) and hung or taped in front of the objective mirror of an overhead projector. Be sure that the grating lines are vertical. Using opaque cardboard, mask off all of the light-base of the overhead except for a slit about 1 cm wide down the centre as shown. The result on the projector screen will be two spectacular continuous spectra, one on each side of centre.

So far the demonstration is obvious and perhaps already well known, but here are a few interesting wrinkles. It is easy to demonstrate absorption spectra by laying transparent coloured materials over the slit. The coloured transparency sheets are particularly good for this. It is best to put the absorbing material over just half of the slit so that the contrast with the pure white-light spectrum is apparent. Even shallow trays of absorbing solutions can be used, e.g., fluorescin, $CuSO_4$, chlorophyll, etc.

Another interesting demonstration is to reverse the blacking on the overhead projector, that is, leave the entire light table uncovered except for a 1 cm wide opaque strip where the slit used to be. This shows the subtraction of colours. With no blackening the white splash of light on the screen can be thought of as the superposition of a number of white-light spectra. The opaque strip subtracts one of these leaving a spectrum of tints on the screen. Again, it is most effective if one half of the light table is left as shown and the lower half is reversed.

Sheets of diffraction grating 6" square can be obtained from Efstonscience in Toronto. See http://www.e-sci.com and search under "diffraction sheet."



Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

126th AAPT National Meeting
Will be held in Austin, TX, January 11-15, 2003

Teachers: Do you have particular topic that you would like to see covered at the next OAPT meeting? If so, please email Vida Ghaem-Maghami at vida.ghaem-maghami@tel.tdsb.on.ca

Useful Web Sites for Physics Teachers
By Paul Passafiume

Teachers are always interested in ways of bringing innovation into their classroom, and a great way of doing this for physics teachers is to make use of available technology. The internet is a wonderful source of such technology, and can really add spice and variation to the way you deliver your lessons. The trouble is, of course, that there's almost too much information; it's not well organized, and is therefore difficult to access.

In order to make the task of wading through this information easier, I've compiled a list of a few web sites (with descriptions) that I have personally found quite useful. I think they will be very useful for any new teacher, and perhaps of value for the seasoned one as well.

If you have a site, or sites, that you feel are worth visiting please forward me the URL and perhaps I can generate a similar column every issue. My email is paulpassafiume@hotmail.com.

Happy surfing!

Site Name	Site Address	Brief Description
Physics Demonstration/Lab Sites		
Physical Sciences Resource Centre	http://www.psrc-online.org/	Labs, demos, evaluation tools
Physics Demonstrations	http://sprott.physics.wisc.edu./demobook/intro.htm	Demos mainly for senior physics
Berkeley Physics Lecture Demos	http://www.mip.berkeley.edu/physics/index.html	Demos mainly for senior physics
Interactive Physics	http://www.interactivephysics.com	IP simulations, and similar links
Java Applet Sites for Physics		
Jones and Childers…	http://webphysics.ph.msstate.edu/jc/library/	Many good applets covering many areas
Java Applets on Physics	http://www.physics.uoguelph.ca/Fendt_app/phe/phe.htm	An excellent source of applets.
Physlets	http://webphysics.davidson.edu/Applets/Applets.html	Create your own physlet!
General Education Related Sites		
Curriculum Services Canada	http://www.curriculum.org/	Curriculum data, & board course profiles
Ontario Ministry of Education	http://www.edu.gov.on.ca/eng/webmap.html	course profiles, 'raw' ministry documents
Science Associations		
Ontario Association of Physics Teachers	http://www.physics.uoguelph.ca/OAPT/	Conference, contest, general physics info.
Science Teachers Association of Ont.	http://www.stao.org/	Science, education, and conference info.
Miscellaneous		
Discovery School's Puzzlemaker	http://www.puzzlemaker.com/	Create a puzzle, or worksheet.
Marshall Brain's How Stuff Works	http://www.howstuffworks.com/	'Nough said!
Famous Physicists and The History of Physics		
Center for History of Physics	http://www.aip.org/history/	The history of U.S. physicists
Feynman Online	http://www.scs-intl.com/online/	The work and life of a great physicist

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
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Volume XXII, Number 3 Winter, 2002

String Theory—A Unified Theory of Forces, Matter and Spacetime

By Geoff Potvin

String theory is a field that has had a significant impact on the physics community even though it is only 30 years old. It is designed as a unified field theory, and its main postulate is that all the known fundamental "particles" are tiny loops of a one-dimensional string. All particles are made of the same kind of string: different vibrational modes and energetics behave like different particles, and the strings can be closed (like an elastic band) or open (having two endpoints). This description of objects as strings is very powerful: extreme gravitational objects like black holes also have a stringy, fully-quantum description which gives researchers the ability to count the entropy of certain gravitational systems and resolve the spacetime singularities for some black holes. It also gives the hope of studying what happens when black holes evaporate, and finding a solution to the black hole information problem—the apparent loss of coherent information, other than mass, charge and angular momentum, when matter falls into a black hole of General Relativity.

An important component to modern string theories is the necessity for spacetime "supersymmetry". Supersymmetry describes a sort of pairing between the usual matter in the Universe (fermions) and the force-carriers (bosons), and involves mixing up our concepts of spacetime coordinates and particle descriptions. Though it is clear that there is no unbroken supersymmetry at the energies we have probed (we would see at least twice as many particles in the Standard Model!), most researchers in the field expect that there must be supersymmetry in the correct unified field theory and that the supersymmetry breaks at energies just beyond the current capability of particle accelerators. So it is expected that in the next generation of particle accelerators, supersymmetric particles will be detected. This is not a necessary and sufficient condition for the existence of a string theory description of the Universe, but will lend a great deal of support to this way of looking at high energy physics.

A well known prediction is that a consistent, supersymmetric string theory lives in ten dimensions. Since we seem to live in only four dimensions, much effort is spent working on compacting six of the dimensions in various models. This leads to a plethora of phenomenological predictions and various cosmological models. It turns out that there are other objects that exist in string theory, notably D-branes. D-branes are dynamical objects analogous to higher dimensional membranes, and can be thought of as surfaces upon which the endpoints of all open strings must lie. One of the popular alternatives to full compaction is that the Universe is five dimensional (four space, one time), with the physics of the Standard Model existing only on a three dimensional brane and evolving with time, with gravity interacting in all five dimensions.

The difficult aspect of testing the predictions of a unified field theory is that it seems quite unlikely that it will be possible to build accelerators big enough to generate the required energies. Gravity, for example, is expected to become very "quantum" only near the Planck energy, which corresponds to probing at a distance of 10^{-33}cm! So string theorists have also turned their attention to astrophysical data, especially the cosmic microwave background radiation (CMBR), and studies of the relation of string theory to cosmology. The CMBR is the "echo" of the Big Bang that was emitted when the young expanding Universe had just become transparent to light. The small variations in temperature of the CMBR can tell us important information about the level of quantum fluctuations in the very early Universe. Furthermore, recent data supports the idea that our Universe is in a period of exponential expansion driven by some sort of dark energy, which makes up nearly 70% of the total mass-energy of the Universe. This was an unexpected finding, and researchers are working hard to understand how such a Universe could arise from string theory.

In the Department of Physics at the University of Toronto, the group of researchers (consisting of faculty members, post-doctoral fellows and graduate students) who are studying physics beyond the Standard Model, including string theory and closely related topics, is currently around a dozen people. Geoff Potvin is a Ph.D. Candidate in the Department. His research focuses on the resolution of spacetime singularities in string theory.

The Demonstration Corner

A Simple Demonstration of the Photoelectric Effect

By Eknath V. Marathé, St. Catharines, Ontario

INTRODUCTION

Following the work of Gustav Kirchhoff, James Maxwell, Heinrich Hertz, Wilhelm Hallwachs, Philipp Lenard, John Rayleigh, and James Jeans, Wilhelm Wien worked at finding out the distribution of energy radiated by a black body. Wien's energy radiation equation for a black body failed to agree with the observed values in the low frequencies (long wavelengths) region of the blackbody energy radiation spectrum (Wien's displacement law). Also, the Rayleigh-Jeans energy radiation equation for a black body failed to agree with the observed values in the high frequencies (short wavelengths) region. This failure is known as the ultraviolet catastrophe.

In 1900, Max Planck worked out a relatively simple energy radiation equation for a black body that described the distribution of radiation accurately over the entire range of frequencies. His equation was based on a crucial assumption: radiant energy is not infinitely sub-divisible. Like matter, it exists in "particles." These particles Planck called quanta, or in the singular, "quantum." He further suggested that the size of the quantum, also known as "photon," for any particular form of electromagnetic radiation, was in direct proportion to its frequency. In the visible spectrum, a photon of violet light would therefore contain more energy than a photon of red light. The small constant that is the ratio of the energy of a photon (E) and the frequency(ν) of the photon radiation is called Planck's constant and it is symbolized as h ($h = E/\nu$). It is now recognized as one of the fundamental constants of the universe. Planck's theory, known as Quantum Theory, was applied by Einstein in explaining the photoelectric effect.

DEMONSTRATION

Remove the knob of a gold-leaf electroscope and attach a zinc plate about 10 cm $\times$ 10 cm in dimensions[1]. The sharp corners of the plate should be turned into a circular arc to eliminate the possibility of leaking the charge through sharp points. The electroscope will function properly in whatever weather, if polystyrene insulation is used. A source of ultraviolet light, such as a quartz mercury lamp, or carbon arc, or a spark discharge between zinc or aluminum electrodes, or PSSC course ultraviolet light source, is arranged to illuminate the zinc plate[2]. The zinc plate must be cleaned by sandpaper (never by emery paper) immediately before using for the demonstration, so as to remove the oxide layer that forms on the surface of the plate because of exposure to the air[1].

Charge the electroscope positively. There should be no appreciable difference in the natural rate of leak determined both with and without illuminating the zinc plate by white light[3]. The plate is then charged with negative charge. Illuminate the plate with ultraviolet light; the leaf of the electroscope falls. This happens because electrons are ejected from the plate under the action of the ultraviolet light. Charge the plate again with negative charge. A glass plate is held a short distance from the source of ultraviolet light and the light is directed through the glass towards the plate; the deflection of the gold leaf does not change. This confirms that photons of the ultraviolet light were responsible for ejecting electrons from the zinc plate.

Other materials, such as aluminum or brass, may be used, but the effect is much smaller; all clean metals will show the photoelectric effect, to some extent, with ultraviolet light.

DISCUSSION

Einstein maintained that a minimum frequency of light (the threshold frequency), which corresponds to a minimum photon energy, is required to force an electron out of a given metal. Brighter light (more photons) would bring about the emission of more electrons. Light of higher frequency, however, would have more energetic photons and would bring about emission of more energetic electrons. Light that has a lower frequency than the threshold frequency would be made of photons with such little energy as to bring about no electron emission at all. The energy content of such low-frequency photons would be insufficient to break an electron away from the metal. Of course, the threshold frequency would be different for different metals.

When the plate is charged positively and then illuminated by ultraviolet light, a few electrons may be ejected but the plate's attractive field pulls them back in[4]. On the other hand, if the plate is charged negatively and then illuminated with ultraviolet light, the leaf falls, and if the illumination is continued for a short time after that, one may see the leaf diverging again. Removing the light source and then testing the type of charge on the plate in a usual manner, one would find that the charge is positive. This is because, after a large number of electrons have been ejected from the zinc plate, the plate has a net positive charge for a short while, sufficient enough to be shown by the deflection of the gold leaf. This charge is then slowly neutralized by the natural absorption of electrons from the surrounding air.

If one of the glass faces of the electroscope is marked with angular calibration (projection electroscope), one can project the deflection of the leaf on a screen.

The photoelectric effect obeys the Einstein photoelectric equation:

$h\nu$	=	W	+	$\frac{1}{2}mv^2$
Energy of the incident photon.		Minimum energy required to remove an electron from its atom (threshold energy, or work function)		Maximum kinetic energy of the ejected electron.

Some electrons in a given metal will be more tightly bound to the metal than will others. These electrons will require more energy than the minimum to release them from the metal. Thus, for photons of a given frequency, ν, there is a range of kinetic energies that the released electrons will have, with the maximum kinetic energy corresponding to electrons that were loosely bound and were ejected with only the minimum energy (W) being required.

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[1] Harry F. Meiners, Ed., *Physics Demonstration Experiments* (AAPT and The Ronald Press Co., New York, 1970, Vol. 2) p.1169.

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[3] Richard Manliffe Sutton, Ed., *Demonstration Experiments in Physics* (McGraw-Hill Book Company, Inc. New York, 1938), pp.488-489.

[4] Eric M. Rogers, *Physics for the Inquiring Mind* (Princeton University Press, 1960) p.724.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca
Submissions describing demonstrations will be gladly received by the column editor

Who Said Air Resistance Was a Drag?

By Paul Passafiume

The concept of air resistance, while fun for teachers, can be perhaps a little dry and somewhat confusing for our students. The topic, though rich, is usually covered briefly and often using Socratic methods, which may leave our students in an unenthused haze. Myself, and a clever math teacher at our school, thought of a way to bring clarity and enjoyment to the subject. Here's what you'll need:

- A computer, motion sensor, interface box, and DataStudio software (or equivalent)
- Some string (I used butcher twine), a large diameter plastic straw, a Styrofoam dinner – sized plate
- A couple quarters (kids will have these!)

Poke a hole through the centre of the plate, and feed the straw through it until the plate is at the centre of the straw. Using duct tape, secure the plate to the straw. Cut enough string from the roll to reach from the floor to nearly the ceiling (should be about 3 m, or so). Feed the string through the straw and lift the plate up to the ceiling. The student holding the plate should also hold the motion sensor above it so the sensor can 'see' the plate as it falls. This can be done easily by pressing the string to the front of the sensor with one hand, and holding the plate with the other. When ready, drop the plate and begin collecting data. You'll want to send the data to a velocity – time graph. When that trial is complete, repeat the activity two more times by taping one quarter, and then a second to the centre of the plate. I had three stations up so that all the students could be involved.

The results obtained are really quite amazing. Each trial has a very well defined period of acceleration, which gradually tapers off as the plate reaches terminal velocity. It is clearly seen that the more massive plates have a longer period of acceleration, and therefore reach a larger terminal velocity. Also, the more massive the plate the steeper the velocity – time curve (now why would that be?!).

I tried this activity for the first time with my 4U class, and it was a real success. This kids absolutely loved it, and discussion it generated was just amazing. Having completed the exercise, I was sure that they both understood the material and had fun doing it! And who said air resistance was a drag? ☺

Let's Play: Quotable Quotes!

Here's the deal. Identify the famous scientist who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"It's a true miracle that modern education hasn't yet completey smothered the curiosity necessary for scientific study. For without the required encouragement, and especially freedom, this fragile plant will wither. It is a grave mistake to believe that the pleasures of observation and inquiry can be induced by constraint and a sense of duty."

Quote sumitted by Miss. Connie Chang, Markville Secondary School.

Attention ALL teachers: The next OAPT conference will be held May 22 – 24, and hosted by the University of Western Ontario. The theme of this year's conference is 'medical physics'. With FREE workshop presentations covering grade 9 electricity, grade 10 motion, and using computers in the classroom the conference is sure to be of interest to all. Workshops begin Thursday evening, from 7 – 9, after the BBQ.

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Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

Attention physics teachers: Arizona State University in Tempe is offering summer graduate courses in physic pedagogy, interdisciplinary science, and contemporary physics. These courses may be suitable for Ontario's PLP program (verification required). Courses are offered mainly in July, 2003. More information is available from Jane.Jackson@asu.edu, 480.965.8438, or from http://modeling.asu.edu.

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Volume XXII, Number 3 Winter, 2003

International Thermonuclear Experimental Reactor: An Update

By Elzbieta Muir

ITER, International Thermonuclear Experimental Reactor, the world's largest fusion energy research centre and the world's largest international project after the International Space Station, is well under way! In September 2002, a group of international experts from Canada, the European Union, Japan, and the Russian Federation met in Toronto to negotiate the implementation of the project and to assess our proposed Canadian site in Clarington, near Toronto. The adjacent Darlington Nuclear Station would be an ideal source for tritium. Tritium, a by-product of the nuclear plant, and deuterium, found in all water on the planet, are the fuel for the ITER. The other proposed sites in Japan, France, and Spain are being assessed in October and December 2002. The draft of the Joint Implementation Agreement is planned to be finalized by mid-2003.

Fusion research projects started about 50 years ago. The world's first TOKAMAK (an acronym for the Russian words: toroid-kamera-magnit-katushka) was constructed in 1954 in Russia. Today, with 100 tokamaks worldwide (the largest research centres being at JET - Joint European Torus, Princeton, Japan, and Moscow), 30 countries are working to prove fusion can be a viable, large-scale energy source. The largest reactor to date, JET, produced 18 MW of fusion power in 1997. The design of the next generation of plant, ITER, started in 1987. ITER will be three times the height of JET and is expected to produce 500 to 700 MW at an estimated cost of $20 billion.

Are the cost, time, and resources involved in fusion research worth the effort? Obviously the Earth does not have an infinite supply fossil fuels, and other sources of energy like the wind and sun are not easily scaled to meet increasing demands. So, from this perspective alone, the investment seems justified. Fission energy, currently providing about 15% of the world's energy, is a well-established technology and will continue to be part of the energy mix for a long time. However, with nuclear power come concerns over long-term waste storage and security. The up-front capital cost of a fusion plant is high, but it does not have the hazardous waste associated with fission energy or the greenhouse gas emissions of coal and oil. The waste product of fusion is helium, and the radioactive metal remaining after a fusion reactor like the tokamak has reached maturity will not leak into the air or ground, making safe storage much more feasible.

The benefits of hosting the largest Energy R&D Centre on Earth will be significant. The project would bring billions of dollars in economic spin-offs; would attract top scientific and academic people; and would bring jobs, opportunity and reputation. The operation of the research centre of ITER is expected to begin around 2012 and run for about 20 years. Therefore, the fusion electricity generating plants will not be around earlier than the middle of the 21 century.

Technical information on ITER can be found at www.iter.org (there are sections on the Physics and Design of ITER and Fusion Research with links to Frequently Asked Questions; see also the 7-min 5MB film "Star Makers"). Teacher resources on fusion are at http://fusioned.gat.com (see the Fusion Slide Show).

The Demonstration Corner

Acoustical Wheel With Christmas Tree Balls

By Christian Ucke
Technical University Munich
Email: cucke@ph.tum.de

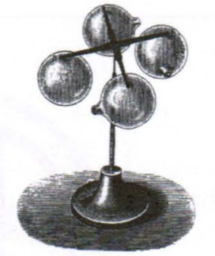


Fig. 1 Acoustical wheel from an old physics book

Figure 1 was taken from an old German physics textbook [1] dating from from 1906. So-called Helmholtz-resonators are fixed on a cross which can rotate easily on a needle bearing. With the right resonance frequency of the Helmholtz-resonators and enough acoustical power from a loudspeaker, this device starts to rotate anticlockwise (view from above).

Using the following formula, the resonance frequency of a Helmholtz-resonator can be calculated (fig. 2; derivation in [2])

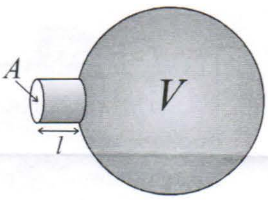


Fig. 2: Helmholtz Resonator

$$f_{\text{Resonance}} = \frac{c}{2\pi} \cdot \sqrt{\frac{A}{V \cdot (l + \frac{\pi \cdot r}{2})}}$$

(V = volume of the sphere; l = length of the cylinder; r = radius of the cylinder; A = area of the cylinder; c = velocity of sound)

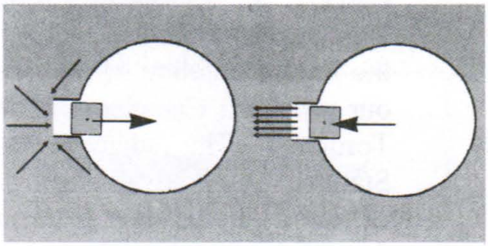


Fig. 3: Explanation of the force

The explanation of the rotation is very similar to that of the well-known water-jet-boat (put-put-boat): The sine-stimulated loudspeaker causes a pressure variation inside the sphere at the resonance frequency. If the pressure in the sphere is smaller than outside, the air is sucked into the sphere from all directions (fig. 3).

If the pressure in the sphere is higher, the air is pressed out of the cylinder and has a preferred direction. Thus, a net force to the left side results.

This object can be realized in a entertaining way with appropriate Christmas tree balls. The balls must have an open, cylindrical part. They can be fixed and balanced very easily with adhesive tape on a simple cross made of rectangular wood rods (fig. 4). One can even combine two crosses with different ball sizes and opposite rotation sense. These crosses have to be hung on a string with swivel snaps (as on fishing lines) so that they can rotate freely.

Fig. 4: The acoustical double wheel with Christmas tree balls. At the bottom the loudspeaker can be seen.

What you need now is a powerful amplifier with hundred-watt power, a good loudspeaker and a frequency generator. A computer loudspeaker (about 50 W) connected with a soundcard works also, but then the wheel rotates only slowly. The resonance frequency of the Christmas tree balls can be calculated only roughly with the formula because often the cylindrical part is not complete and not entirely cylindrical. Then one can find the best resonance frequency simply by experimenting. I was successful with

Christmas tree balls with diameters of 4.4 cm ($f_{resonance} \approx 380$ Hz) and 5 cm ($f_{resonance} \approx 580$ Hz). The resonance frequency of a Christmas tree ball is relatively sharp.

It is also possible to operate the whole device with the right music which contains the resonance frequency. The power of music in contemporary discothèques is probably high enough. It is not recommended to use powerful Christmas music under the Christmas tree because this might disturb the meditative atmosphere of the festival of Christmas.

References:

[1] Mueller-Pouillet's Lehrbuch der Physik und Meteorologie, Braunschweig, Vieweg 1906, page 790

[2] Bergmann-Schaefer, Lehrbuch der Experimentalphysik Bd 1, Mechanik, Akustik, Waerme, Berlin 1975, page 523

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Simulation Experiments for Teaching Physics

By Rolly Meisel

The new version of Geometer's Sketchpad, GSP4, has recently been licensed for use in Ontario schools. Although it was designed as a dynamic geometry program, it is also a powerful tool for creating interactive physics demonstrations. For example, one of the "canned" files bundled with the software simulates refraction and dispersion of light in a triangular prism. The student can use a slider to adjust the relative indices of refraction among the colours, and instantly see the effect.

In addition, GSP4 includes an Export utility that allows a simulation to be saved as a Java applet. Students do not need to have GSP4 installed on their computers in order to run the applet. The applet runs under standard web browsers such as Netscape or Microsoft Internet Explorer. You can store these applets on a web site accessible to students through the Internet, and assign virtual experiments to be done at home.

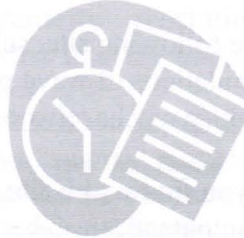
If the full version of GSP4 has not yet reached your school, you can download an evaluation version at www.keypress.com. It is fully functional, other than Save and Print functions. The site also contains information on creating Java applets using GSP4.

OAPT Grade 11 Physics Contest

This year's OAPT Prize Contest will be written on **Tuesday, May 6, 2003**. This contest is for students who have taken or who are taking SPH3U1. Students who have taken SPHOA or SPH4U are ineligible.

For information on the contest e-mail Terry Price at: thprice@sympatico.ca

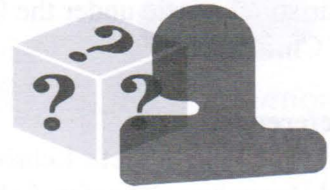
Applications and information is also available on the OAPT web site at: http://www.physics.uoguelph.ca/OAPT/contest/contest.html



Schools must register by April 4, 2003.

Let's Play: Quotable Quotes!

Here's the deal. Identify the famous scientist who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!



"Nothing in life is to be feared. It is only to be understood."

Bonus round. Bragging rights only!

"It is only with the heart that one can see rightly. What is essential is invisible to the eye."

Do you want to give back to your profession? Participate in the OAPT!

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- Conference organizers, and facilitators
- Members of the executive committee
- Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (glenn.wagner@ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

Membership Matters!

Join the Ontario Association of Physics Teachers! Members receive a Newsletter and reduced registration rates at the annual conference.

As well, from time to time, the Association makes available special resources. Examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:

Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

Useful Web Site for the Physics of Waves

The following site, submitted by John Childs, contains an extraordinary amount of information about and simulations of wave phenomena. Thanks for your input, John!
http://www.hazelwood.k12.mo.us/~grichert/sciweb/waves.htm

If you find a web site that is particularly useful, send it to the editor, Paul Passafiume (paulpassafiume@hotmail.com) , so that it can be included in the next release of the NewsLetter.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
Spring, 2003

Pedagogically Useful Applets in Elementary Physics

By: J. L. Hunt

There are a lot of physics applets available today on the internet - so many that there are at least three large indices of them complete with search engines. The pedagogical value of these applets varies considerably from those that are just fun to serious lessons. Building applets into student's curricula can be a very useful addition to physics courses; indeed some are so good that they can be the central experience for the students around which the topic may be structured. There are a few caveats however:

1. Many applets on the internet are ephemeral -here today and gone tomorrow. My advice is to try to avoid such material; you may expend much effort constructing lessons around them only to have them disappear. Of course you can't avoid them completely but it is best to try to use ones from sites that look stable (e.g., a university teaching site as opposed to a private address on a public server, like Geocities).

2. Elaborate artwork and animation is not a guarantee of good pedagogy, although stodgy layouts are off-putting. Some of the best are simple single-concept lessons.

3. The best applets are those from large suites by single authors who have a coherent plan and style.

4. The very best are those from authors who permit you to download the applets and run them on your own machine or network.

I would like to offer some examples of the latter:

1. Walter Fendt of Germany has created a large number of applets in all areas of Physics and Astronomy at various levels. The artwork is excellent and the animations work well. Many can be used as animated problems or as a problem checker (rather than supply answers to assigned problems). These can be downloaded from

http://www.walter-fendt.de/ph11e/

2. Michael Fowler of the University of Virginia has also made his applets in Mechanics available at

http://www.phys.virginia.edu/classes/109N/more_stuff/Applets/home.html

3. Finally, what I think is the most interesting and generous effort is that of Ron Green collectively titled "Physics Illuminations". This is an on-going project (updated monthly) with dozens of simple tutorials in Kinematics, Dynamics and Vectors. They are all single-concept, simple and progressive. They include graphing exercises, calculations, concept understanding and tests. They can be downloaded from

http://www.uno.edu/~rgreene/illum.html

These are highly recommended and Ron is to be commended for his generosity in granting blanket rights to the Physics teaching community. They are highly recommended. (They run best on Explorer. Netscape cuts the activation buttons in half but they will still run.)

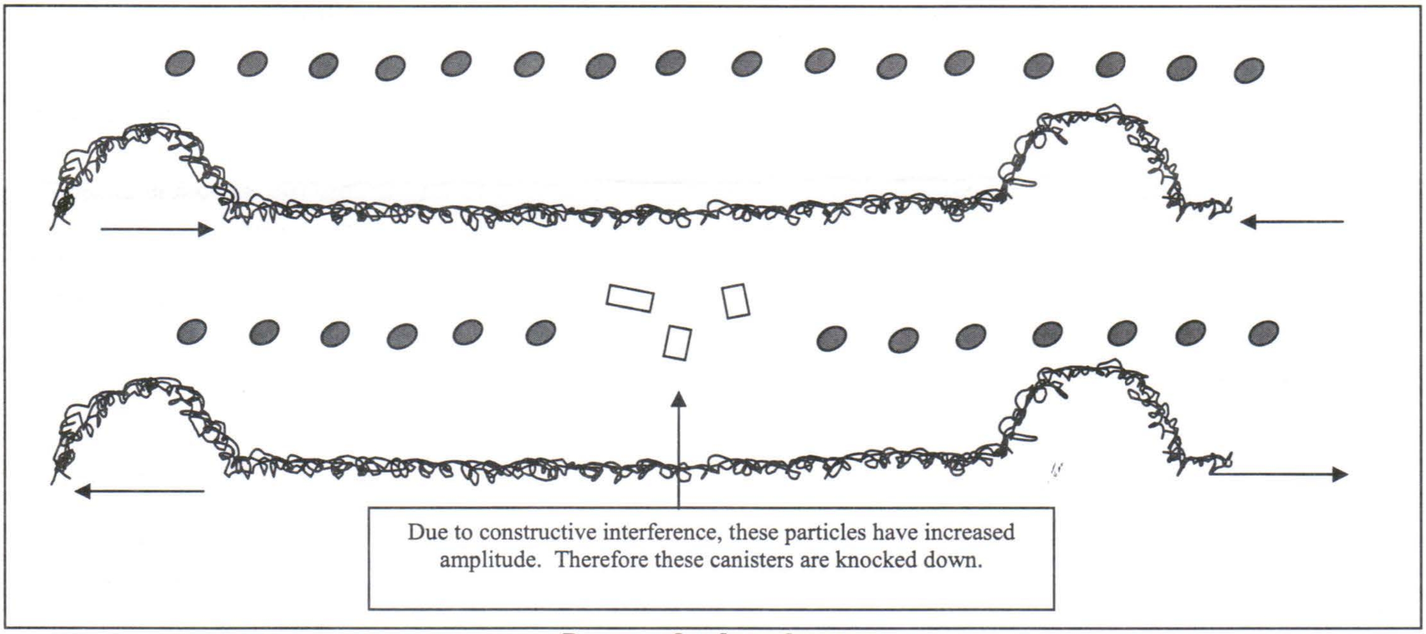
The Demonstration Corner

Superposition Principle – Kicking the Canister

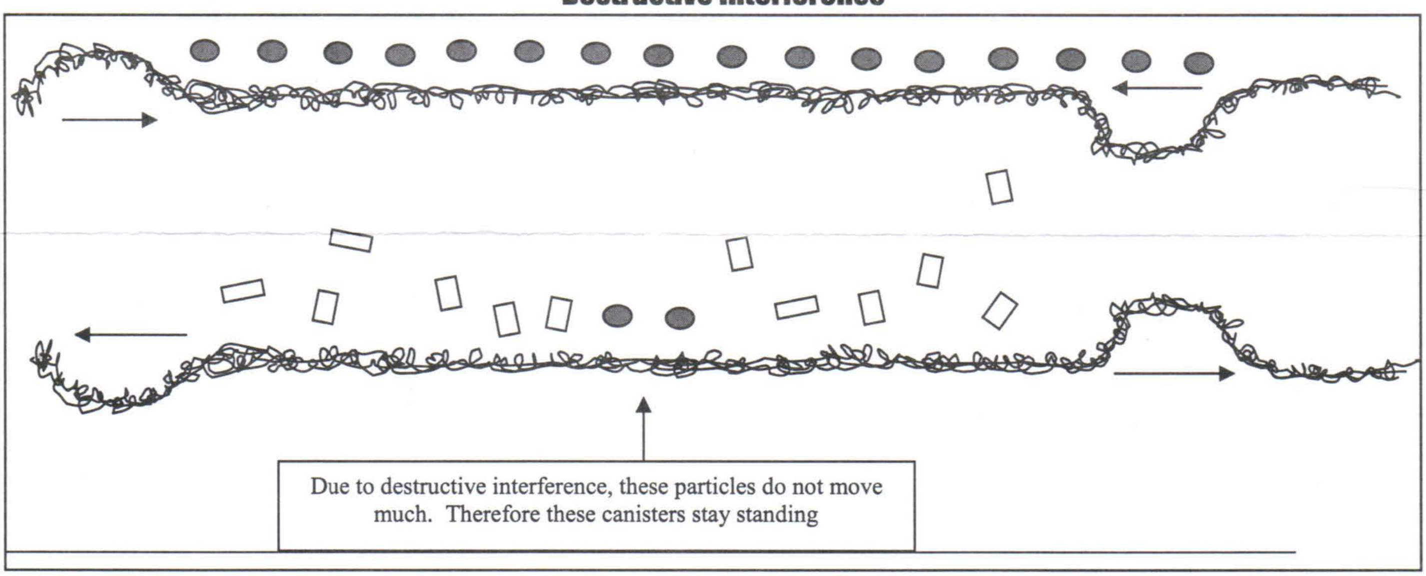
by Diana Hall, St. Charles North HS, Illinois

My students have fun predicting which canisters will get knocked down in an interference demonstration. We stretch out a long spring across the classroom floor. We then line up film canisters (or other substitutions) alongside the spring. Students predict which ones will get knocked over and which will be left standing. They must also say why.

Constructive Interference



Destructive Interference



Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Extra Dimensions in String Theory
by Geoff Potvin, M.Sc., Ph.D. candidate

Every day we experience the passage of time and the extent of three dimensional space (usually only two!). When Newton formulated his laws of mechanics and gravity, he implicitly used this experience to assume a uniform, rectangular four-dimensional (three space, one time) grid upon which objects interact. In this way, space and time are absolute.

However, Einstein forced people to reconsider this notion. Trying to align Maxwell's theory of electromagnetism with the laws of mechanics led him to show that: a) the speed of light is constant, and b) different observers must observe space and time passing differently, depending on their relative velocity. This is the essence of special relativity. Generalizing this for all observers (moving with any velocity or acceleration) led to the conclusion that massive objects also distort space and time, like the bending of a large sheet when a heavy object is placed in the centre. Einstein named this theory general relativity, and it is known today as classical field theory. Classical field theory states that objects interact via fields, but the quantization (discreteness) of energy levels and fields is ignored.

Early attempts to unify General Relativity with the quantum theory of electromagnetism were ambitious, if somewhat premature. It was shown very early that if the Universe was five dimensional (4+1) then these two theories could be beautifully put together, except that there needed to be an extra dimension! The most logical thing to do is "roll" it up: compactify it so it does not extend like the other space - time dimensions. [Analogously, a two-dimensional plane can be compactified so it looks like a very long cylinder: far away, this looks like a one-dimensional line.] However, this will lead to a spectrum of particles with identical properties (charge, spin, etc) but with increasing masses, loosely called a "tower" of states. Since no tower of states is actually observed, this theory was discarded.

With the success of quantum field theory in the decades that followed (the efforts of which resulted in the Standard Model of Physics), theoretical physicists were led to the idea that all forces in nature will unify at a high energy scale. This includes gravity, which must have a quantum field theory description. The leading (and so far only) theory of unified physics and quantum gravity is string theory, which has remarkable features and beautiful mathematical structure. However, it has again forced theoretical physicists to reconsider our notions of space and time: string theory only lives consistently in TEN (9+1) dimensions! Researchers came back to the early work in general relativity to compactify the extra six dimensions. Again, this compactification leads to the possible existence of a spectrum of massive particles, none of which have been observed. However, the theory is saved since even the lightest state in the tower will be too massive to see, if the dimensions are rolled up tight enough!

A great and useful discovery of the 1990's was that there are many other objects in string theory, which are like higher-dimensional membranes, called D-branes. In essence, the "particles" (read: strings) that correspond to our usual matter/fields such as electromagnetism are stuck on a D-brane, while gravity can interact in the full ten-dimensional bulk of string theory. One such possibility is that we live on a D3-brane (this has three space dimensions and propagates in time), which is embedded in some higher number of dimensions.

It is a fact that the behaviour of gravity at short distances is not well measured. It is possible that one or more of the extra dimensions of string theory is rather loosely rolled up, just beyond our current detection. Then precision experiments could detect small deviations at short distances from the Coulomb-type potential (force is inversely proportional to separation-squared) between two massive bodies. Our current limitations on this sort of scenario is that the compactified dimensions must be less than about 1/10 of a millimetre (large by the standards of particle physics in which protons and neutrons are about 10^{-15} mm!)

This research has left unanswered the burning question, How many dimensions do we live in? Recent progress suggests that this question may not have a meaningful answer, from a technical point of view. While it is obvious that our low-energy, large distance Universe is four-dimensional, at least to a very good approximation, the complete field theory of physics may not be. A recent postulate, called the AdS/CFT correspondence throws our intuition of dimensions into doubt. This postulate states that a certain TEN-dimensional string theory construction (on an Anti-de Sitter background) is equivalent to a FOUR-dimensional quantum field theory (a Conformal Field Theory). "Equivalent" means that the physics described by these theories is the same, even if the description of any particular object/particle/string/state looks very different in each. From this we conclude that the number of dimensions of a theory may not be meaningful, rather it may be a theoretical tool like any other used to describe the objects and interactions of our Universe.

***Geoff Potvin** is a Ph.D. Candidate in the Department of Physics at the University of Toronto. His research focuses on the resolution of space - time singularities in string theory.*

The Ontario Association of Physics Teachers Presents:

The Twenty Fifth Annual Conference
22-24 May 2003

Hosted by the University of Western Ontario

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Program

Thursday Evening	Renew friendships at the Barbecue Empower your teaching at one of the Workshops
Friday	Medical Physics - talks by internationally known London Scientists Afternoon Tours; the Banquet; Star Gaze at Cronyn Observatory
Saturday	Physics Education in Canada; Traffic Accident Analysis; Kinematic Illusions in Motion Pictures. Contributed papers by teachers.

"I have attended the conference 6 of the last 9 years and have always enjoyed it (despite the hassle of arranging coverage and scrounging for PD funds). I have made some lasting professional friendships and as a new teacher was very appreciative of the support offered by my Physics teacher colleagues keen to pass on their expertise" Kim Benke

We are looking forward to meeting you at this great conference. For full details and to register, visit this web site: http://www.physics.uwo.ca/news/conferences/oapt_2003/. If you cannot access the web, contact: Professor Whippey, Department of Physics & Astronomy, UWO, London ON N6A 3K7.

For those of you who remember the classic "Powers of Ten" video, there is a reasonable facsimile on the web:

http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/

Thanks to Ernie McFarland for this submission. If you have a useful web site that you would like to share, please submit to the editor, Paul Passafiume (paulpassafiume@hotmail.com), for inclusion in the next edition of the NewsLetter.

Do you want to give back to your profession? Participate in the OAPT!

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Editorial Note

Congratulations to all for yet another wonderful year as an educator, and proud member of the OAPT! Special thanks to those people who contributed papers, or ideas that have helped enrich all of our classrooms. Well done!

Ontario Association of Physics Teachers

Twenty Fifth Annual Conference
22-24 May 2003

Highlights

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	Empower your teaching at one of the Workshops
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Contributed Papers

We need your contributions to make this a vibrant experience for all. Share your experiences in the classroom with others. We have room for more contributed papers. Contribute **on-line** using our website below.

!!!Register On-Line!!!!

Or use the enclosed Registration form. Either way, we are looking forward to meeting you at this great conference!

For full details and to register, visit this web site:

http://www.physics.uwo.ca/news/conferences/oapt_2003/

If you cannot access the web, contact:

Professor Whippey, Department of Physics & Astronomy, UWO, London ON N6A 3K7.
Voice (519)-661-2111 ext. 86431
Fax (519)-661-2033
pwhippey@uwo.ca

Ontario Association of Physics Teachers
Annual Conference Registration Form
22-24 May 2003

Fill in this form and return it to:
OAPT c/o P. W. Whippey
Department of Physics and Astronomy
The University of Western Ontario
London ON N6A 3K7
Tel: (519)-661-2111 x 86431 Fax: (519) 661-2033 Email: oapt@physics.uwo.ca

Last Name		
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Email Address		
Address Line 1		
Address Line 2		
City		
Province		
Postal Code		
Phone		Extension:
School		
Dietary restrictions		
Conference Fee		$95 Required; Student teachers $45; Students $20.
Banquet Friday evening		$30 Optional.
Lunch Saturday Elgin Hall		$12 Optional. Little food is available on campus on weekends.
OAPT Dues		$ 8 Optional. Many people renew their annual dues here.
Total Due		Make cheque out to Ontario Association of Physics Teachers.
Workshops	You can attend one Workshop. Give your top 3 choices: 1 2 3	
A OPETA Optics		
B Dave Doucette HOTS		
C Bill Konrad Pasco		
D Rolly Meisel IP 2000		
E Jim Ross Box Diagram		
Tours	You can attend one Tour Give your top 3 choices: 1 2 3	
F Diamond Aircraft et al.		
G Observatories		
H Robarts Research Inst.		
I Wind Tunnel & Fowler K.		
J Integrated Manufacturing		
Notes		

Registration for Residence Accommodation is done separately.
Please visit the following web site: http://www.uwo.ca/hfs/cs/oapt.htm:

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
September, 2003

The OAPT Conference of May 2003
By: Patrick Whippey

Wow, what a conference! Eighty physics teachers from as far away as Ottawa and British Columbia gathered at Western for a Physics-fest of workshops, tours and talks that featured medical physics, material science, analysis of traffic accidents, teaching tips, optical illusions, Dan Falk on the Theory of Everything, plus, most importantly, the camaraderie of a shared purpose and vision. Jerry Battista, Blaine Chronik and Aaron Fenster gave a series of talks on Friday morning devoted to medical physics that painted a canvas with vibrant pictures of the research and progress being made in medical imaging. The three dimensional ultrasound images of twins were stunning. At the banquet, David and Jean Surry reflected on a shared lifetime in engineering. Pedro Goldman has toured many of the universities across Canada to talk about the state of physics education, and out of this has grown a major initiative to try to persuade NSERC that we need their support to promote the health of Physics in Canada, just as the National Science Foundation does in the United States. What could you do if you could get a grant of $5000 to do a small research project in your school? John Twelves showed us how to build a drag sled to measure the coefficient of kinetic friction between tire and road, and how modern accelerometers are used to analyze traffic accidents. If every teacher spends a lesson doing this, and interleaves the message that speed plus inexperience kills, then we can truly save lives. Jim Hunt gave a beautiful presentation of some subtle optical illusions, providing a graceful end to a wonderful two days of talks. Whenever we see a picket fence, we will look for a wagon to travel behind it so that we can see the illusion of the curved spokes, common in the days of Ann of Green Gables, but now rarely seen. Nine teachers gave wonderful contributed papers, which can be viewed here: http://www.physics.uwo.ca/news/conferences/oapt_2003/index.html .

As we return to our classrooms, let us ask what we can do as an association to promote the vision so marvellously articulated by Pedro Goldman. Please do come to the next conference to be held at the University of Ontario Institute of Technology, in Oshawa.

About the author: *Patrick* is a professor of physics with the Department of Physics & Astronomy at The University of Western Ontario. It is primarily through his effort, and the hospitality shown by the U of W that this conference was such a success. Many thanks Patrick!

President's Message
By: Elzbieta Muir

WELCOME to the new year 2003/2004!

First of all, a big Thank You to the past executive and our President Vida for all their involvement, leadership and interesting initiatives.

It is a great pleasure to have an organization like the OAPT to which to belong. Particularly in these challenging times of labour unrest, hostility, and change, it is good to belong to an association which provides professional motivation and development, encouragement, and happy camaraderie.

Our OAPT Conferences in May are the highlight of each year where we satisfy our intellectual curiosity, update our knowledge in Science and Technology, learn new things to take to our students, and have invaluable professional interaction that keeps us strong in the whole chain of educating new generations of Canadians. OAPT has just completed its 25th annual conference. We are already looking forward to continuing this tradition with the 26th conference in May 2004.

Our OAPT Newsletters keep us in touch throughout the year and provide an on-going forum to exchange ideas in teaching.

Our OAPT Contest, written by thousands of students each year, with such a long tradition reminds us that we are there for all of our students, irrespective of their abilities.

Members of the OAPT are volunteers. Thank you to all who chip in their expertise, ideas, and organizational efforts. Your contributions are greatly appreciated by all.

With many friendly greetings,

Elzbieta Muir
OAPT President 2003/2204.

Controlling Light with Photonic Crystals

By: Jessica Mondia

(article previously published in U of T's Dept. of Physics newsletter InterActions)

To an outsider's eyes it is "only a speck of silicon, glinting with blue-green iridescence" similar in appearance to an opal gem or the multi-coloured scattered light from butterfly wings. In fact many things in nature have these types of beautiful hues but to people in the photonics community it takes on new meaning, particularly for those working in the field of photonic crystals.

This relatively new field of optics research first began in 1987 with a paper published by Professor Sajeev John in which he describes materials with the ability to trap light in 3D.
The idea of controlling light on micron scale opened the door to the idea of the all-optical chip, a replacement to current electronic devices. Not only could these materials localize light and be used as devices to guide light, but they also have interesting dispersion relations making them ideal optical devices for amplification and wavelength division multiplexing.

Photonic crystals are materials fabricated with a periodicity in the refractive index on the order of the wavelength of light. For example in 1D one could imagine a stack of alternating materials such as Si, SiO_2. Most light at normal incidence on this structure will be transmitted. However, when the wavelength of the light is comparable to the periodicity of the stack, Bragg scattering will take effect and that component of light will be reflected. The larger the refractive index contrast the wider the stop gap, i.e., range of reflected light frequencies. This idea also extends to 2D and 3D.

As can be imagined the field of photonic crystals took a brief hiatus while the experimentalist were hard are work trying to produce good quality crystals with a periodicity on the micron scale similar to that of telecommunications wavelength of 1.5 microns. By the end of the 1990's the field flourished once more as crystals were being produced all around the world and in particular here at the University of Toronto. In a collaboration between Prof. G. Ozin from the Chemistry department, Prof S. John and Prof. H. van Driel and Prof F. Meseguer in Spain the first 3D Si-inverted photonic crystal with a stop gap at 1.5 microns was developed.

A clever fabrication process was used to make this crystal which consisted of inter-connected air spheres surrounded by silicon. First, Silica spheres of ~850 nm were placed in a viscous solution. The spheres then settled into the lowest entropy state being a face centered cubic lattice. The solution was then allowed to evaporate and the structure sintered (heated). This provided a link between spheres. The sample was then placed into a chemical vapour deposition chamber infiltrated with silicon. Finally the structure was inverted by placing the sample in HF acid which seeped through the sample to etch away the silica spheres. Work using this method of inversion is on going with the final goal of designing an optical-chip that could potentially work in 3D.

Since then several new groups on campus and in Canada are working hard to develop better quality crystals and discover new and interesting properties related to them. Our group (under the supervision of H. van Driel) has taken to studying various types of switching effects using nonlinear properties of the materials. It has often been said that photonics crystal are the next big telecommunication revolution. Only time will tell but until then it is an exciting place to be.

About the author: *Jessica* is with the Department of Physics at the University of Toronto. Her email address is mondia@physics.utoronto.ca.

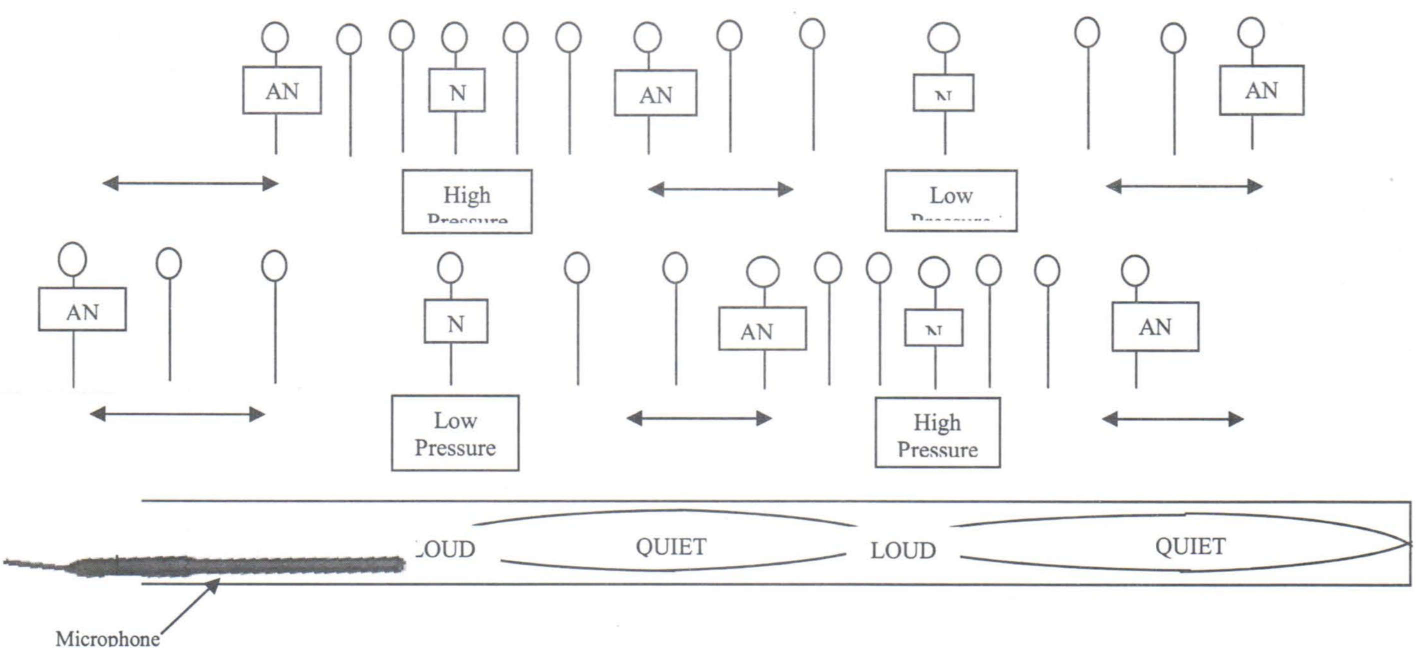
The Demonstration Corner

Pressure vs. Particle Movement – The Dance

by Diana Hall, Bell High School
40 Cassidy Rd., Nepean, ON K2H 6K1, Canada

When discussing standing waves in air columns most textbooks focus on the movement of particles and show nodes at closed ends and antinodes at open ends. When thinking about the loudness of sound at different points we have to remember that the sound is loud when the pressure difference is the greatest and that sound is a longitudinal wave. This occurs at nodes (where particles move least) and not the antinodes (where particles move most). I use my students to demonstrate this difference.

Have students line up. Individual students represent particles at different positions along an air column. We know that a series of nodes and antinodes will be set up. If we label the students according to the motion of the particles, the nodes will not move while the antinodes will move most. I actually label the nodes and antinodes with masking tape. Since sound is a longitudinal wave, the antinodal particles will move back and forth from side to side by the most (greatest amplitude). The particles beside the antinodes will move less etc. The antinodes will alternate left to right. I then ask the nodes what they felt. It turns out that the nodal people report the biggest difference in pressure while the antinodes report the least. This means that the loud points actually occur at the nodes for particle movement. Using a large tube and a computer interface equipped with microphone, this phenomenon can be tested and confirmed.



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Here's the deal. Identify the individual who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"Never seem more learned than the people you are with. Wear your learning like a pocket watch and keep it hidden. Do not pull it out to count the hours, but give the time when you are asked."

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- Conference organizers, and facilitators
- Members of the executive committee
- Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (glenn.wagner@cwdhs.ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

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Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

The Art of Physics Competition 2003 !

This competition, organized by the Canadian Association of Physicists, challenges any student, class, or teacher to capture in a single photograph any physics phenomenon and then explain it in less than 200 words. Great prizes are up for grabs!

Details may be found at the following web sites: http://www.cap.ca , or cap@physics.uottawa.ca. Also, you may email Elzbieta Muir at emuir@sympatico.ca.

Beta Testers of Physics Software Needed

Are you looking for physics software to augment your lessons this year? Shawn Leclaire has coded three programs that investigate the solar system, waves, and optics and is looking for users to test them before making them generally available. Details may be found at http://www.LivingGraphs.com/.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
December, 2003

Bose-Einstein Condensation - Cooling Atoms Into Matter Waves

By Ana Jofre

Perhaps one of the most fascinating and mind-boggling phenomena in quantum physics is the idea of wave-particle duality, and it is most exciting to visually observe such abstract effects. The relatively new field of atom-optics investigates wave-like behaviour in atoms. The key condition to making atoms behave this way is to cool them to near-absolute-zero temperatures. If one cools the atoms far enough, a phase transition is reached, whereupon the atoms are then said to be in a Bose-Einstein Condensate (BEC). Drawing on the analogy of light, which is also both a particle and a wave, one can think of cold atoms as ordinary light, and of atoms in a BEC as the matter equivalent of laser-light. Atoms in a BEC and photons (light particles) in a laser both possess the property of coherence, which is to say that these particles are all completely identical and they move in step with one another.

The idea that particles are also waves came from DeBroglie's theory, which postulated that particles have a wavelength of $\lambda=h/p$, where h is Plank's constant, and p is the particle's momentum. Since momentum (p) is the product of the particle's mass and velocity, then it follows that the slower the particle moves, the longer its wavelength. As the DeBroglie wavelength becomes longer, the quantum-mechanical properties of the particle become more apparent.

The typical velocity of an atom or molecule at room temperature is about 300m/s. In most atom optics experiments that study quantum effects, atoms are slowed down to a few centimeters per second. Since temperature is a measure of the kinetic energy of the atoms, such slow velocities imply a temperature of a millionth of a degree above absolute-zero.

The method by which a vapour cloud of atoms is cooled to such temperatures doesn't require the use of any refrigeration or cryogenics. Instead, lasers are used to cool them. This may seem counter-intuitive since most people associate lasers with heating. However, in this scenario, lasers slow atoms down with the radiation force they exert on them. This radiation force arises because light is composed of many tiny particles called photons, and as with any other particle, there is a momentum exchange that occurs when a photon collides with an atom. One can imagine that the atom is a freely rolling car, while the laser-light is a continuous stream of ping-pong balls being thrown at the car. The car, as with the atom, will eventually slow down as a result of all these collisions. Techniques for laser-cooling atoms were developed by C. Cohen-Tannoudji, W.D. Phillips, and S. Chu , for which they were awarded the Nobel Prize in 1997.

Laser-cooling is only the first step required to reach BEC, and other methods are used to cool the atoms further. Reaching the temperatures necessary for Bose-Einstein condensation earned E.A. Cornell, W. Ketterle, and C.E. Wieman the Nobel Prize in 2001.

Once the atoms are laser-cooled, they are trapped into a localized region with magnetic fields, and the atoms are then cooled further by selectively expelling the hottest atoms from the trap. This method is known as evaporative cooling, the physics of which is similar to the cooling of a cup of coffee, where the hottest molecules escape through the steam.

In 1925, Albert Einstein made a striking prediction that if a group of particles, such as atoms, are cooled down sufficiently, they will all fall into the lowest energy state (the ground state). This prediction applies only to particles that are called bosons, these being particles whose total spin is an integer number. Particles of the other type are called fermions, whose total spin is a half-integer number. The difference between bosons and fermions is that fermions never occupy the same state, whereas bosons do. A Bose-Einstein condensate is formed when atoms, that are bosons, are cooled until they all fall into the ground state.

The effects of having all atoms in the ground state are striking. Since the atoms are indistinguishable and they all occupy the same state, they no longer behave as a cluster of atoms, but as a single entity. It is because atoms occupying this state are indistinguishable that a BEC is the matter equivalent of a laser and gives it the property of coherence. It is this coherence that makes the dynamics of atoms in a BEC particularly interesting, as there are very clear analogies with lasers. For example, if one were to overlap two laser beams, an interference pattern of bright and dark fringes would form in the region of overlap. It is the same with atoms in a BEC. In an experiment done at MIT in 1995, it was shown that two over-lapping BECs produce an interference pattern that is exactly analogous to that of two overlapping laser beams. There are currently no practical applications for atoms in a BEC, for the most part because it is an extremely fragile state that is currently very difficult to produce. However, that doesn't mean they won't someday be useful. Remember, no one even dreamed of any applications for lasers until 20 years after their discovery!

Ana Jofre is a PhD candidate in the Dept. of Physics at the University of Toronto. Her current area of research is Bose-Einstein Condensation, and her email address is jofre@physics.utoronto.ca.

The University of Ontario Institute of Technology, Canada's Newest University

By William Smith

The University of Ontario Institute of Technology (UOIT) is pleased to host the 2004 OAPT annual conference next May. UOIT, the first brand-new university in Ontario in 40 years, was established by an Act of the provincial legislature on June 27, 2002, and opened to more than 900 students in September 2003. At Ontario's first fully laptop-based university, students enjoy networked, state-of-the-art classrooms and wireless learning spaces. UOIT offers a variety of innovative undergraduate programs, with additional new programs planned for the 2004-05 academic year. UOIT is on a path to become a full research-oriented university with graduate-level programs under development. Located in the beautiful northeastern reaches of Oshawa directly across from Windfields Farm, the university is less than an hours drive east of Toronto. A spectacular, student-focused campus is being built, including a new research library, state-of-the-art academic buildings and a new residence village, all surrounded by beautiful outdoor spaces. Designed by one of Canada's leading architectural firms, the campus is modeled on the concept of an academic village with outdoor quadrangles, connected interior and exterior walkways and a reflecting pond which can be used for skating in winter. The construction site at UOIT is the second largest in the province, exceeded only by that at the Toronto Airport!

UOIT's primary orientation is science and technology, and it has seven Schools: Science, Business and Information Technology, Education, Energy Engineering and Nuclear Science, Health Science, Criminology and Justice, and Manufacturing Engineering. Liberal studies electives for students are offered by Trent University on the UOIT campus. UOIT shares much of its infrastructure with Durham College, including its main physical campus and IT, registrarial, library, and student services, providing an innovative example of college-university cooperation. Joint programs involving the College and the University are a special feature of this cooperative venture, and are under active development.

The UOIT School of Science offers undergraduate programs in Physical Science and in Biological Science, currently encompassing biology (with streams in pharmaceutical biotechnology and environmental toxicology), chemistry, mathematics, and physics. A Concurrent Education program will begin in Fall 2004, through which students may acquire combined BSc and BEd degrees. New programs in Energy and Environment Science and in Computing Science are in the advanced planning stages. A secondary specialization area of study in Computational Science is available in combination with any of the primary areas. Computational Science is a "third way of doing science", in addition to the traditional methods of theory and experiment. It seeks to gain insight through the development and implementation of mathematical models of phenomena by means of their computer simulation. Computer visualization of the results of such simulations is a key ingredient of the methodology.

There are no Departments in the School of Science, and interdisciplinary teaching and research are emphasized, according to Dean William Smith, who joined UOIT from his former position at the University of Guelph, where he held appointments in Mathematics and Statistics, Engineering, and the Guelph-Waterloo Physics Institute. All teaching faculty in Science use Tablet computers in the classrooms and tutorials, a technology at the forefront of current practice (eg., write original lecture notes or annotate previously prepared material directly on the Tablet computer screen connected to the classroom data projector, and subsequently save the entire lecture for posting on the course web site). A key feature of the student laptop program entails the installation of several thousand dollars worth of sophisticated scientific software on all student computers (dual-boot Windows /Linux machines), which is integrated into the pedagogy of all science courses, right from the first year of the programs. The software includes: Maple, MATLAB, SigmaPlot, LaTeX, and many other packages.

The UOIT Science faculty currently numbers 13, and expects to grow to a complement of about 40 in four years. Faculty currently have over $300,000 in research funding, and several Postdoctoral Fellows and Visiting Professors will be in residence from January, 2004. Current research areas include analytical chemistry, aquatic toxicology, computational science, materials science, mathematical finance, mathematical biology, neutraceutical and functional foods, and photonics. Computational Science is a major focus, and UOIT is a member of SHARCNET (Shared Hierarchichal Academic Research Computing Network), a consortium of 14 universities, colleges, and research institutes in southern Ontario. SHARCNET is a geographically distributed computer network consisting of state-of-the art equipment at the host institutions.

For more information about the University of Ontario Institute of Technology in general, see http://www.uoit.ca, and for the School of Science, see http://www.uoit.ca/schoolofscience

William Smith is the Dean of UOIT, and can be reached at William.smith@uoit.ca.

The Demonstration Corner: Seeing the Speed of Sound

by Diana Hall

This demonstration allows students to get an idea for how slow sound actually travels. I take students outside and have them line up about 1 m apart. They should have their eyes closed. A bicycle horn is sounded at one end of the line. When each student hears the sound, he/she should raise their arms and then drop them again. A video camera can capture the motion of the sound wave down the line of students so that they can view it back in the classroom.

Diana Hall is a teacher at Bell High School in Nepean, ON.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

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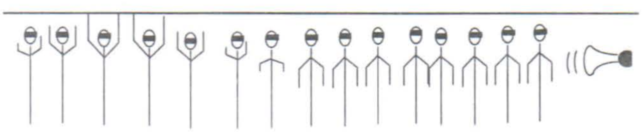
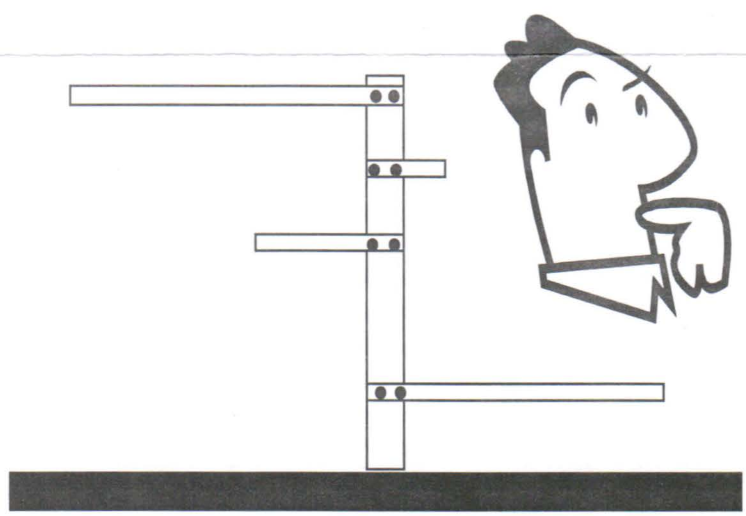


Mind Games!

By Paul Passafiume

Here's a little mind boggler I cooked up while playing with IP2000, the physics simulation software package. The idea is to place each of four masses (of size 2 kg, 100 kg, 20 kg, static equilibrium. The beams are made of different material so that each has a mass of 0.5 kg. Have fun! For the solution, turn to page 4.



If you have an idea for a *Mind Game*, please submit it to the editor, Paul Passafiume (paulpassafiume@hotmail.com), along with your name and school.

Annual OAPT Conference May 27-29, 2004: Call for Papers!

This year's conference will be hosted by the *University of Ontario Institute of Technology (UOIT)*, in Oshawa. The conference theme has yet to be determined; however, we're looking for individuals who would like to share their ideas with colleagues.

All physics educators are invited to contribute a presentation at the conference. Possible ideas include: demonstrations, teaching tips, reports on advances in physics and related fields, or useful information pertaining to physics education.

Interested participants please e-mail the following to **Elzbieta Muir** (emuir@sympatico.ca)

a) an abstract (please include your name and school/university/institution),
b) the approximate presentation length (10, 15, 20, or 30 minutes), and
c) audio-visual requirements

by **January 2004**, if possible. The deadline for submissions is **April 30, 2004**. Conference details are available at http://www.uoit.ca/schoolofscience/OAPT2004.

Let's Play: Quotable Quotes!

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"What we observe is not nature itself, but nature exposed to our method of questioning"

Last issue's winner: David Sutherland, from Guelph. Congratulations David!

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Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

Solution to *Mind Games* on page 3:

- Place 50 kg mass on top beam
- Place 100 kg mass on beam second from top
- Place 2 kg mass on beam third from top
- Place 20 kg mass on bottom beam

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
February, 2004

Why Does Gravity Slow Time?

By Richard Epp

Imagine a pair of twins, Alice and Bob, who will live to exactly the same age. Rather than giving this age in years, which might be confusing in what follows, let's say each will live for one billion heart beats, and their hearts beat at 60 beats per minute. Alice, a hurricane hunter by trade, has become bored with Earth's puny storms and has moved to Jupiter to chase its Great Red Spot, a centuries old cyclone of truly mammoth proportions.

Now gravity is stronger on Jupiter than on the Earth, one consequence being that Alice weighs more. But more interestingly, Albert Einstein's theory of general relativity—his theory of space, time and gravity—says that, due to the lower gravitational potential on Jupiter than on Earth, time as experienced by Alice is moving more slowly *relative* to time experienced by Bob back on the Earth. What does this mean? First, the word 'relative' is crucial here: it means that as far as Alice is concerned, nothing in her own experience indicates to her that time is moving more slowly. The point is, more slowly *relative to what*? Alice herself feels nothing out of the ordinary, for instance her heart still beats at 60 beats per minute according to *her* wristwatch. It is only when Alice and Bob *compare* their experiences of the passage of time that they notice something very strange.

For example, when they speak with each other over the satellite link, Bob notices that Alice's voice is a bit deeper and she is speaking more slowly—exactly like a tape recording replayed at a slightly slower speed. But Alice does not feel that she is speaking slowly, or thinking slowly, or anything else for her is happening more slowly. And from Alice's point of view, she notices that Bob's voice is *higher* pitched than she remembers, and he is talking (and thinking, and doing everything else) a bit *faster*—exactly like a tape recording played back at a faster speed. More to the point, when Bob puts the microphone up to his heart, Alice hears it beating at *faster* than 60 beats per minute according to *her* wristwatch (and *her* heart); conversely, Bob hears Alice's heart beating more slowly than his. Both agree that Alice could return to Earth before her billion heart beats run out and attend Bob's funeral.

How is this possible? Why does gravity affect the rate at which time moves? One of the simplest ways to understand this begins with Einstein's equation $E = mc^2$, which says that mass is a form of energy. As a consequence of this, Einstein reasoned that it would be possible to build a perpetual motion machine (and thus get energy from nothing) *unless gravity slows time*. This machine consists of a vertical conveyor belt stretched between two pulleys which, to keep things simple, we imagine to be frictionless. Attached to the belt are a number of identical, equally spaced buckets, each of which contains a single atom of mass m. Now suppose each of the atoms on the left side of the belt have absorbed a photon of energy ΔE. These excited atoms have more energy, *and hence more mass*. The increase in mass is $\Delta m = \Delta E/c^2$. With the whole apparatus in the gravitational field of the Earth, the force of gravity will be greater on the excited atoms (each with mass $m+\Delta m$) than the ground state atoms (each with mass m), resulting in a net force causing the conveyor belt to begin to rotate counter clockwise.

To keep the conveyor belt moving we arrange for the excited atoms to emit a photon of energy ΔE as they reach the bottom, leaving them in their ground state (with mass m). We then use a mirror to direct the emitted photons up to the top, and use these photons to re-excite the ground state atoms as they arrive at the top of the conveyor belt. *Assuming* the energy of the photons received at the top is ΔE (the same energy they had at the bottom), clearly this is a perpetual motion machine: the heavier, excited atoms will always be on the left, the lighter ground state atoms on the right, resulting in a constant, net tendency for the belt to rotate counter clockwise. We could use this tendency to make our machine do useful work. Energy for nothing! All the world's energy problems solved!

Of course, this must be impossible. But where is the mistake in our reasoning? A bit of thought reveals that the mistake is in assuming that the energy of the photons received at the top is ΔE. In fact it must be *less* than ΔE; call it $\Delta E'$. How much less? In being lowered from the top to the bottom (through a height h, say), each excited atom yields up its gravitational potential energy of $(m+\Delta m)gh$, where $g = 9.8$ m/s^2. However, for each excited atom thus lowered, there is a ground state atom raised, which uses up an amount of energy mgh. The net gain in energy is the difference: Δmgh. To avoid this net gain (energy for nothing), it must be true that Δmgh is precisely equal to the energy lost by the photon as it travels from the bottom to the top, i.e. $\Delta E - \Delta E' = \Delta mgh$. One may imagine the photon losing energy as it climbs against the Earth's gravitational field much like a rock thrown upward loses kinetic energy as it slows down, the main difference being that the photon does not slow down; it always moves at the speed of light. Using $\Delta m = \Delta E/c^2$, the previous equation reads: $\Delta E - \Delta E' = \Delta Egh/c^2$. Dividing both sides by ΔE and rearranging terms we get: $\Delta E' / \Delta E = 1 - gh/c^2$. Finally, we also know that the energy of a photon is proportional to its frequency (the proportionality constant being Planck's constant). So we can rewrite our equation as: $f' / f = 1 - gh/c^2$, where f (resp. f') is the frequency of the photon at the bottom (resp. top). Since $1 - gh/c^2$ is less than one it says that the frequency of the photon received at the top (as measured by a clock at the top) is *less* than the frequency of the photon that left the bottom (as measured by a clock at the bottom).

This is a very strange result. To appreciate why, it will help to switch from the particle picture of light (photons) to the wave picture, and recall that electromagnetic waves can be produced by an oscillating electric charge. Our result says that if Bob is standing on the surface of the Earth holding an electric charge in his hand, and waving his hand back and forth once per second ($f = 1$), then Alice, standing at the top of a tower of height h, will receive electromagnetic waves of frequency $f' < 1$. Said more directly, wave crests of light leaving Bob's hand once every second (one second according to *his* wristwatch), will arrive at Alice's position at a rate of *less than* once every second (one second according to *her* wristwatch).

Wouldn't this require the number of wave crests *between* Bob and Alice to be continually increasing with time? Can't be! With a fixed distance h between the two, such a continual bunching up of wave crests would require the wavelength of the light (distance between crests) to be getting smaller and smaller as time goes on. Since the speed of light is always the same, smaller wavelength means higher frequency, which means Alice would be seeing light of higher and higher frequency as time goes on. This is definitely not happening; Alice sees light of *constant* frequency, f'. (Also notice that $f' < f$ means the wavelength is longer for Alice than it is for Bob; the wave train 'stretches out' as it moves upwards) But if there is no bunching up of wave crests, how do we explain that Alice sees fewer than one wave crest per second according to her wristwatch (equivalently, more than one second of Alice-time elapses between crests), *unless time itself is moving more quickly at Alice's location than at Bob's*? This is the effect of gravity on time!

Here is an alternative way to see this. As Bob is waving his hand back and forth, a wave crest leaves the electric charge in his hand each time it reaches the right end of its back and forth arc. Any other light illuminating Bob's hand (that allows Alice to see Bob) will travel to Alice at the same speed as the wave crests of light leaving the electric charge in his hand. This means that when Alice looks down at Bob she must see his hand waving back and forth at the *same* frequency that the crests of light from the electric charge are reaching her, i.e. at the frequency $f' < 1$. Thus, Alice sees Bob waving his hand at a rate of *less* than once per second according to *her* wristwatch. Bob appears to be waving his hand in slow motion! Indeed, everything about Bob and his surroundings on the ground will appear to Alice to be happening in slow motion. Conversely, Bob will see Alice in fast motion, like a video on fast forward.

Notice, also, the longer Alice waits at the top of the tower, the greater the difference that will accumulate between the number of seconds (and heart beats) she experiences and the number Bob experiences. Eventually climbing back down from the tower and comparing notes, both will agree that more seconds (and heart beats) have elapsed for Alice than for Bob. Alice will be older than Bob because she has spent time in a place (height h above the Earth) where time itself moves more quickly *relative* to time on the Earth's surface! In the case of Alice going to Jupiter, the gravitational potential will at first increase as she leaves the Earth's surface (her time will move more quickly relative to Bob's time, as just discussed), and will continue to increase as she travels away from the Sun towards Jupiter. But eventually the gravitational potential will decrease to a value *lower* than that on the Earth's surface as she descends into Jupiter's very strong gravitational field. On Jupiter her time will be moving more *slowly* relative to Bob's time, as described at the beginning of this essay.

So how big is the effect of gravity on time? Very tiny, at least as far as we are able to experience here on the Earth. For example, taking $h = 100$ metres gives $f' / f = 1$

$- gh/c^2$ 0.9999999999999. This means that Bob's clock is running 99.99999999999% as fast as Alice's, meaning we would have to wait a very long time for a noticeable difference in age to accumulate. Nevertheless, the effect has been measured using very accurate atomic clocks and the results are in excellent agreement with our formula. Indeed, the Global Positioning System (GPS), which relies on very accurate atomic clocks both on the Earth and carried by satellites high above the Earth, must account for this effect in order to work with the accuracy it does. It should be emphasized, however, that the effect is quite noticeable in more interesting parts of the universe than our solar system. A black hole is an extreme example, where gravity is so strong at the event horizon that time is slowed to a stop relative to anyone outside the horizon! But this is another story...

Richard is the outreach Program Coordinator at ***Perimeter Institute for Theoretical Physics.*** *His PhD degree is in theoretical physics, specializing in general relativity and quantum gravity. For information on research and outreach at Perimeter Institute please see www.perimeterinstitute.ca*

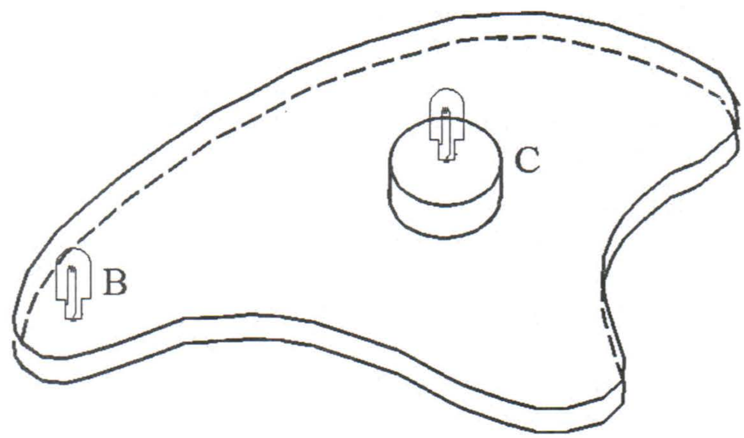
The Demonstration Corner

Motion of the Centre of Mass

by Patrick Whippey, Department of Physics & Astronomy,
The University of Western Ontario.

Do we really believe Newton's Laws? This demonstration was born many years ago when a perceptive student challenged the assertion that a body free to move always rotates about its centre of mass. This demonstration requires an air table.

The figure shows a piece of plastic about 0.5 cm thick. It is about 20 cm long and 15 cm wide, and has an irregular shape. Mounted on the plastic are a battery and two bulbs. We use a pair of flat batteries of the kind used in small electronic devices together with some light-emitting diodes (LEDs), but a pair of AA batteries plus a pair of flashlight bulbs will serve just as well. Bulb C is located at the centre of mass, while bulb B is way off to one side.



We first cover bulb B. We give the "amoeba" a push and watch it travel over the air table. Bulb C travels in straight lines, changing direction only when the "amoeba" bounces off the edges of the air-table.

Then we cover bulb C. Bulb B travels in complex curved paths, making striking patterns of light. Finally, we expose both light bulbs. We can then see that bulb C travels in straight lines, while bulb B makes circles around it. This is a striking demonstration that the centre of mass travels in a straight line while all other points rotate around the centre of mass. This demonstration is best seen in the dark.

If you use LEDs, they may require a current-limiting resistor of about 150 ohms in series.

Column Editor: *Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1*
Email: elm@physics.uoguelph.ca

Submissions describing demonstrations will be gladly received by the column editor.

Conference Reminder!

This year's conference is hosted by the University of Ontario Institute of Technology (UOIT) in Oshawa, and will be held May 27 – 29, 2004. Presenters are still welcome, and invited to forward information (see Dec. letter for details) to Elzbieta Muir (emuir@sympatico.ca) by April 30.

Participants may find additional information regarding the conference and registration at the following web site: www.uoit.ca/schoolofscience/OAPT2004.

Call for Conference Resources

This year's conference will run the "Share & Exchange Resources" Session on Saturday, May 28 to encourage collegiality and to facilitate the exchange of high school physics resources. Please participate actively in the conference by contributing your favourite worksheet, test, or exam. Your resource should be classroom proven, and come complete with an answer key. It should be neat and have a pleasant layout. Please bring photocopies (30 or more) to the Session for distribution. If photocopying is not possible, then please bring one copy of your resource to the Session; you will be asked to forward it electronically to interested teachers after the conference. To assure that the Session runs smoothly, you are asked to forward, *at your earliest convenience*, to Elzbieta Muir (email: emuir@sympatico.ca) the following:

a) your name, school, and city;
b) the title of your worksheet/test/exam; and
c) the course and textbook title in which your resource is used.

The first 10 teachers will be recognized and listed in the conference program. Deadline: **April 30, 2004.**

Annual Election, 2004

The OAPT membership at large is asked to nominate members for the following three positions of the OAPT Executive Committee for 2004-2005:

- **Vice-President** (chairman of the Section, succeeds the President the following year),
- **Secretary-Treasurer** , and
- **member-At-Large**.

Please submit your nominations to Elzbieta Muir (emuir@sympatico.ca) by e-mail by April 30, 2004.

Membership Matters!

Join the Ontario Association of Physics Teachers! Members receive a Newsletter and reduced registration rates at the annual conference.

As well, from time to time, the Association makes available special resources. Examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:

Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
April, 2004

Information, Entropy and String Theory

by Geoff Potvin

When physicists consider a system that is a collection of many smaller objects, such as a gas of molecules or a star or an evolving galaxy, the tools of statistical physics usually turn out to be quite useful in determining the system's important properties and behaviour. When the number of constituent objects is very large there will be many microstates of the system corresponding to a given configuration. Entropy corresponds to a measure of the number of these microstates, and so is a rough measure of the information contained in the system.

In the last century, the tools of statistical physics were applied with great success to highly exotic systems; prominently, black holes. It was shown that black holes, contrary to expectations, have non-zero entropy that is proportional to the area of their event horizon (the place where the interiors and exteriors of black holes are separated). Later, compelling arguments were made to suggest that a black hole is the object with the highest entropy for a given size and mass.

However, one would naively expect that the entropy of a black hole would be proportional to its volume. If spacetime is quantized, then there should be a shortest length scale (the quantum length scale of gravity) and so a given volume of space could be divided into a number of fundamental volume-units. But this is in contradiction to the findings of general relativists! Somehow the information that can be trapped in a region should be bounded by the surface area of the region not its volume. This is rather analogous to a hologram (in which the information to make an image "look" three-dimensional is actually contained on a two-dimensional surface), and so is loosely called "holography". A successful theory of quantum gravity, or at least a successful cosmological model of our Universe, would be expected to give a fundamental reason for holography.

About ten years ago string theory, the best theory of quantum gravity so far, underwent the "duality" revolution, the second revolution since it was originally cast. The five theories of "superstrings", previously thought to be distinct, were shown to be dual to each other. When two theories are dual, it means that they are two descriptions of a single physical system and, generally, one theory is a good description of physics just where the other theory is not, and vice-versa. Also, the five superstring theories were shown to be limits of a single, badly understood theory. Called M-theory, it looks like an eleven dimensional theory of gravity at low energies, but the full formulation is not yet understood.

Another wave of duality hit soon after, which showed that certain gravity theories (containing strings) were dual to certain quantum field theories (not gravitational at all, more like the Standard Model of particle physics). In a controlled way, the gravitational theory living in a region breaks down near its boundaries. But the quantum field theory starts to be a good description (mathematically) exactly when the gravity theory breaks down. So it is loosely said that the quantum field theory "lives on the boundary" of the gravity theory. Again, these are two theories that describe a single physical system in different regions, and contain the same information, even though they look very different. Since the quantum field theory lives on the boundary, we can see that the information in the gravity theory is limited by the information living on its boundary. This is like a particular technical example of the principle of holography.

The search for other dualities continues because they could be of primary importance in understanding exotic regions of spacetime (such as the interiors of black holes, or the very tiny, early Universe), or to make predictions about extremely difficult problems in quantum field theory. For example, it is hoped that a gravity theory can be found that is dual to the quantum field theory of the quarks—constituents of protons and neutrons. At energies accessible to experiments, quarks tend to stick together very strongly (which is why we only see quarks in bound states of two or three), so it is extremely hard to measure individual characteristics of quarks. It is equally hard to make mathematical predictions for the interactions of quarks. But if we knew what the dual theory was, we could make very simple predictions of quark behaviour.

***Geoff Potvin** is a Ph.D. Candidate in the Department of Physics at the University of Toronto. His research focuses on the resolution of space - time singularities in string theory.*

Conference Reminders!

1. Please be sure to register for the upcoming conference! Registration details can be found at www.uoit.ca/schoolofscience . Cheque details are as follows:
Payable to: University of Ontario Institute of Technology.
Send to: Carol Slaughter, School of Science, UOIT, 2000 Simcoe St. North, Oshawa ON L1H 7K4

2. Conference accommodation must be phoned in separately.

3. Remember that there is a Share & Exchange session as part of the program (see web site for details). Please participate by bringing your best activities, tests, and exams. This is an opportunity to show case what you've done, and bring resources into your department!

Annual Election, 2004

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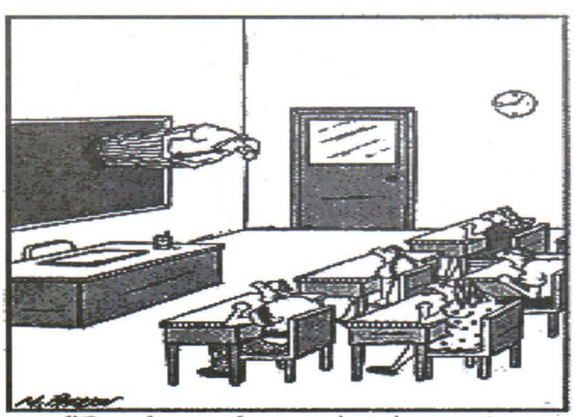
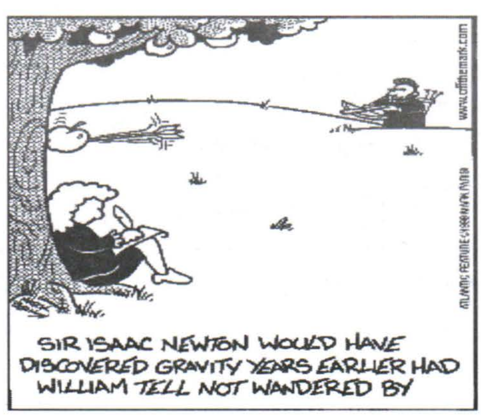


"Good morning, and welcome to The Wonders of Physics."



Looking for a new source of physics simulations? Be sure to check out this site, which boasts a number of smooth simulations.

http://webphysics.ph.msstate.edu/jc/library/

The Demonstration Corner

Motion of the Centre of Mass 2

Patrick Whippey, Department of Physics & Astronomy,
The University of Western Ontario.

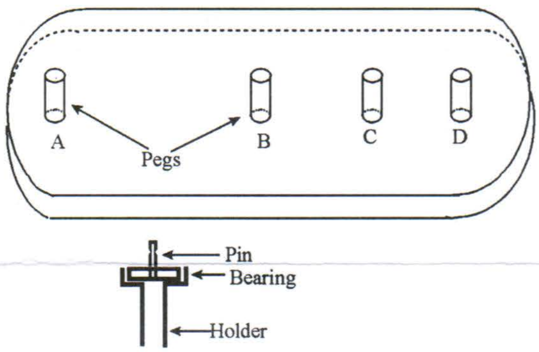


Figure 1: Plastic Base with Four Pins

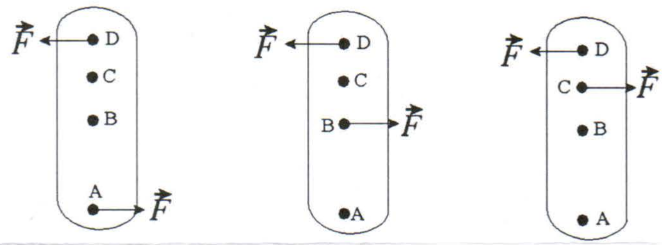


Figure 2: It Rotates about Where?

Do we really believe Newton's Laws? This demonstration was born many years ago when a perceptive student challenged the assertion that a body free to move always rotates about its centre of mass. This demonstration requires an air table.

Figure 1 shows a piece of plastic 15 cm long, 10 cm wide and 0.9 cm thick. It has four pegs attached, each 1.0 cm high and 0.6 cm in diameter. There are also two holders 2.0 cm high and 1.2 cm in diameter. These are a snug fit over the pins, so that the holders can be put over any of the four pins A, B, C and D. The holder has a small bearing in the top, with a pin in the middle, so that the pin can rotate with a minimum of friction. The pin has a small notch in it so that a loop of string can be put over it. You may find it useful to get help from your machine shop to make the holder. The other end of the string hangs over a pulley, not shown, with a 20 gram mass attached. Thus each string exerts a force of magnitude $F = 0.2$ N on the system.

The piece of plastic is placed on the air table, and forces are applied as shown in Figure 2. In each case, about which point does the object rotate?

The system always rotates about the centre of mass, regardless of which pair of pins is used for the strings.

Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca

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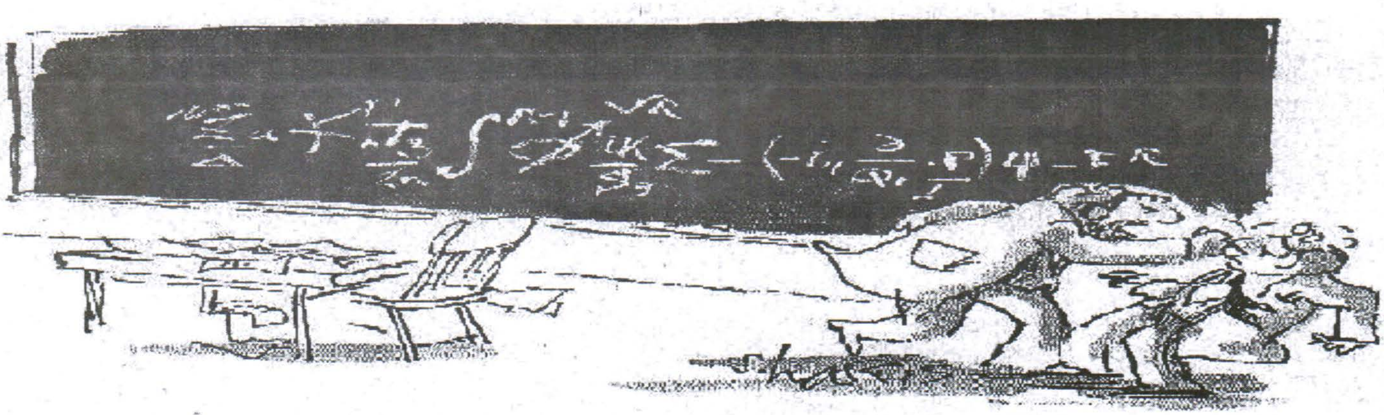

"YOU WANT PROOF? I'LL GIVE YOU PROOF!"

Let's Play: Quotable Quotes!

Here's the deal. Identify the famous scientist who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"It is the supreme art of the teacher to awaken joy in creative expression and knowledge."

Think you know it, eh?!

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The *University of Ontario Institute of Technology* is proud to host:

Ontario Association of Physics Teachers

Twenty Sixth Annual Conference
27-29, May, 2004

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Thursday Evening	Renew friendships at the Barbecue Empower your teaching at one of the Workshops
Friday	Physics Education Research: Joe Redish, University of Maryland Afternoon Tours. Banquet. Donald Schmitt Architect
Saturday	Canada in Space – Douglas Staley Carleton University Wind as an Energy Source – William Russell Contributed papers by teachers.

Contributed Papers

We need your contributions to make this a vibrant experience for all. Share your experiences in the classroom with others. We have room for more contributed papers.

We are looking forward to meeting you at this great conference.

For full details and to register, visit this web site:

http://www.uoit.ca/schoolofscience/OAPT2004/index.html

If you cannot access the web, contact:
Professor Whippey, Department of Physics & Astronomy, UWO, London ON N6A 3K7.
pwhippey@uwo.ca (519) 661-2111 x 86431

School of Science
University of Ontario Institute of Technology
2000 Simcoe St. North
Oshawa, ON L1H 7L7

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
September, 2004

Ontario Association of Physics Teachers News

by: Rolly Meisel

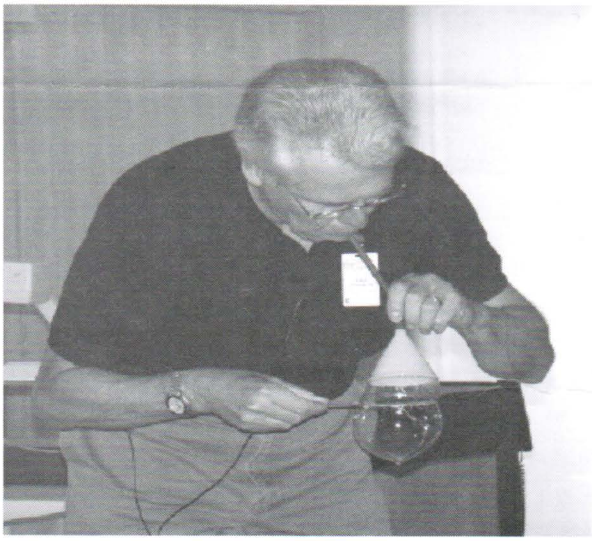
The OAPT annual conference was held at the newly-opened University of Ontario Institute of Technology (UOIT) in Oshawa, Ontario from May 27-29, 2004. The conference opened Thursday evening with a welcome barbecue, followed by workshops on practical applications in the grade 12 College physics course, assessment and evaluation, and Interactive Physics software. A wine & cheese allowed workshop participants to share their experiences. Friday morning featured Dr. Joe Redish of the University of Maryland, speaking on how students learn physics. Follow up workshops were available in the afternoon, as well as tours to the Darlington nuclear station, the Pickering Wind Turbine, and the Canadian Regional Engineering Centre at GM Canada. Friday evening participants enjoyed a banquet, with guest speaker Donald Schmitt, of Diamond and Schmitt Architects, Inc. The topic was the design and construction of UOIT, including some of its unique features, such as a geothermal heating/cooling system. Sessions continued on Saturday, including Canada in Space, rubber band dynamics, soap bubbles and films, software for teaching physics, the new OAPT photography contest, wind as an energy source, the Sudbury Neutrino Observatory, women in science and engineering, and others. Exhibits and demonstrations of apparatus for teaching physics were on display during coffee breaks and lunch.

Veteran physics teacher George Vanderkuur (also former chief scientist at the Ontario Science Centre) demonstrates one of the many uses of soap bubbles and films in the teaching of physics.

The next OAPT conference will be held from May 26-28, 2005 at Laurentian University in Sudbury, Ontario, which is also home to Science North and the Sudbury Neutrino Observatory. More information will be posted on the OAPT web site at http://www.physics.uoguelph.ca/OAPT

Several thousand physics students wrote the OAPT grade 11 prize contest in May. The next contest will be written on Tuesday, May 3, 2005. Information on how to enter the contest is posted at the OAPT web site http://www.physics.uoguelph.ca/OAPT. Past exams and solution sets are also available on the site.

About the author: ***Rolly Meisel****, a retired physics teacher, is now the OAPT section rep for AAPT. His email address is: rollym@vaxxine.com.*



2005 World Year of Physics

By: Diana Hall

www.physics2005.org

Next year, the international physics community will be celebrating the World Year of Physics. The year 2005 was selected in recognition of the 100th anniversary of the publication of Einstein's famous three papers on the theory of relativity, quantum theory, and the theory of Brownian motion. Events and celebrations are being organized everywhere and Ontario is no exception.

Apart from festivities recognizing the centennial, this is an opportunity to bring physics to the community and promote the subject within and outside our schools. Let's increase the 'phriendliness phactor' of physics. It's time to start thinking about how to get your school involved.

Here I share with you some ideas that my students and I have come up with and I hope that you will also share your plans.

- We are putting together a web site where teachers and students can go to share plans and report on events that have taken place. Using this venue, we won't have to each reinvent the wheel as we develop activities that might be going on elsewhere as well. When this is up we will link it to the OAPT site, www.physics.uoguelph.ca/OAPT/.

- All physics students in both grade 11 and 12 courses will participate in the NEW OAPT Photo Contests. We have a lot of physics students and so we will hold an in-school competition and select entries to send in for the provincial competition.

- This year our SPH4U's and 4UG's will be working on projects that emphasize a cross-curricular connection. Communication with students in other courses is a big part of this project. Knowing their audience and keeping the physics manageable will be crucial in keeping things positive.

    - Students will present to grade 9 music students concepts related to their musical instruments and similarly for a dance class.
    - Rocket Scientists will design rockets, prepare detailed specifications and pass them on to the construction class for manufacture.
    - Artists will create a mural for the Library reflecting physics concepts and WYP.
    - Exercise Science uses impulse and momentum as well as work and energy concepts so an interactive cross-curricular presentation can be made to this class.
    - I'm hoping the marketing class will participate in promoting the stage production coming to our local theatre.
    - Students will organize a physics day for students of feeder schools.

- OAPT is sponsoring a one-man show called "Einstein: A Stage Portrait", performed by Tom Schuch of New Mexico. It will be performed May 13-14th, 2005 at Centrepointe Theatre in Ottawa. (Any interest in bringing him to your town should be directed to Tom or me). Check his website at www.spoli.com.

- A special effort will be made to encouraged more students to get involved in the OAPT grade 11 physics contest, the CAP and SIN physics contest and the Leonardo DaVinci Engineering Contest.

- Our students will also participate in organizing and promoting events less content based. Such as:
    - Design and sales of school World Year of Physics baseball shirts. We will organize events for the 5th day of the month when all physics students in the school will wear their shirts.
    - Movie Nights
    - Trivia Contests
    - Circus acts

We will be making an effort to let the entire school know what physics students are doing and invite them to participate or watch. Sometimes I forget to do this.

The Canadian Association of Physicists, CAP, is sponsoring events on a local, regional, provincial and national level. Please check their website http://www.cap.ca.

The American Association of Physicists, AAPT, also maintains a web site with ideas and links to other WYP sites. See www.aapt.org.

I believe this is an opportunity that should not be passed by. Let's make sure that everyone knows that 2005 is World Year of Physics and that people in our communities have a chance to experience the joy of physics in some small way. Please also spread the word of OAPT and World Year of Physics to your physics teacher friends in case they are not already members and or are not aware of the significance of 2005. Any photo fanatics will certainly be interested in the one time WYP version of the photo contest for members.

Good Luck everyone and don't forget to share your ideas.

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*About the Author: **Diana Hall** is a teacher of high school physics at Bell High School. She's been teaching for 14 years.*

Physics Photo Contest

By: Alan Hirsch

A great opportunity has been initiated to allow students (and teachers!) to display their photography skills while illustrating physics principles. To coincide with the World Year of Physics, the OAPT is pleased to announce an OAPT Physics Photo Contest for senior high school physics students and, for 2005 only, a separate contest for OAPT members.

The student contest is open to anyone enrolled in a day school Grade 12 physics course in Ontario in the 2004 – 2005 school year. There are four categories in the contest, one for students enrolled in the university preparation course, SPH4U, one for students enrolled in the college preparation course, SPH4C, and two separate categories for members of the OAPT. The photos will be judged by physics educators at the annual OAPT Conference in May, 2005, in Sudbury.

The specific rules are described in detail on the photo contest website where entry forms are also available. The website, maintained at the University of Guelph, can be found at:

www.physics.uoguelph.ca/~omeara/photocontest

Students in SPH4U will submit two or three photographs of the same subject showing the effects of changing a specific photographic variable. Examples of variables are polarization of light, interference and/or diffraction of light, controlling depth of field, controlling film speed, and controlling special effects. The photos must be accompanied by an explanation of the physics principles involved. Before attempting to take their photographs, students should research how the variables can be controlled. The camera's instruction manual is an obvious place to begin research. Other resources include photography magazines, photography reference books (such as *Digital Landscape Photography*, by Tim Gartside, published by Muska & Lipman Publishing, 2003), science encyclopedias, the Internet, first-year university textbooks (such as *Physics for Scientists and Engineers,* by Raymond A. Serway, published by Saunders College Publishing), and people such as photographers who have both equipment and experience. In order to be sure that they understand how physics principles relate to photography, students should refer to the part of the SPH4U course that involves the wave nature of light. For example, in order to explain why a polarizing filter has to be oriented a specific way and at a specific angle to minimize the glare off a non-metallic horizontal surface, students should understand such phrases as plane-polarized, polarization by reflection, axis of polarization, polarization angle (or Brewster's angle), and the electric component of an electromagnetic wave. Finally, students should be aware that the best type of camera for controlling variables is a single-lens reflex camera, now available in digital format.

Students in SPH4C will submit one or two photographs (along with an explanation of the related physics principles) that feature this year's theme, "The Physics of Motion, Forces, and/or Machines." Examples of physics principles in this theme are acceleration, Newton's laws of motion, friction, simple machines, and domestic and industrial machines. (The theme for this category will change each year.) Students can get ideas regarding this theme by referring to the topic of "Mechanical Systems" in their physics course. (In the textbook *Nelson Physics 12, College Preparation*, the topic is covered in Chapter 1, Motion and Forces, and Chapter 2, Machines.) Students will get more out of this photography challenge if they study the camera's instruction manual. For example, if they want to take a photo that shows water moving slowest at the top of a fountain and accelerating toward the bottom of the fountain, students have to understand how to take a photo with a relatively long exposure time, as seen in the accompanying photograph.

Prizes (provided by me) for each student category are:
First prize: $200.00 cash
Second Prize: $100.00 cash
Third Prize: $50.00 cash

The teacher of the First Place student winners will also receive a Computerized Assessment Bank for 4U Preparation or 4C Preparation donated by Nelson Publishing.

The criteria for the photo contest for OAPT members are the same as those for the SPH4U students. However, there will be two sets of three prizes ($200.00, $100.00, and $50.00, provided by Nelson Publishing and me), one for sets of photos illustrating polarization and the other for all other photographic variables.

For more details and sample photographs, please refer to the website mentioned above. Notice that the entries must be submitted between April 4 and May 2, 2005.

I would like to express my gratitude to the following for their contributions: Diana Hall for helping to set up and promote the contest, and coordinating the judging of the entries; Joanne O'Meara for setting up and maintaining the photo contest website; Ernie McFarland for his ideas and support; and Paul Masson from Nelson Publishing for donating two software items and $350.00 cash.

About the Author: ***Alan Hirsh*** *has been an active member of the OAPT since the second of its inception. He has been involved in writing physics and science textbooks for many years, and he retired in 1999 after 31 years of teaching high school physics in Ontario.*

This photo was taken with a telephoto lens on a digital single-lens reflex camera with an exposure time of 1/200th of a second and an aperture setting of f-5.6. The water droplets become more streaked toward the bottom of the fountain as their speed increases.

Attention all Physics Teachers!

The next International Commission on Physics Education (title: World View on Physics Education in 2005: Focusing on Change) will be held in New Delhi, India from August 21 – 26, 2005. The host of this conference, The University of Delhi, is extending an invitation to all physics teachers. Conference details may be found at:
http://education.vsnl.com/pjolly,
http://education.vsnl.com/pjolly .

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
January, 2005

The Physics of Scuba Diving

By: Roland W. Meisel

A note about units: in North America, British units are used in scuba diving. In this essay, I will use PSI for pressure and feet for depth, in accordance with common practice. However, I will include equivalent SI or other units where appropriate.

Introduction

There are many applications of physics in sport diving. Divers need to understand these to dive safely, and avoid adding themselves to the accident statistics. During diver training, these physical principles are introduced as needed. In this essay, I have arranged them in a sequence more familiar to the physics teacher.

Pressure

Boyle's Law ($P_1V_1 = P_2V_2$) has a prominent position in scuba diving. In order to carry enough air for a reasonable dive time, the air must be compressed. The pressure inside a scuba tank is about 3300 PSI, which is 225 atmospheres (atm) or nearly 23 000 kPa. This allows 80 cubic feet (2820 litres) of air to be compressed into the tank. If this air is breathed at the surface, i.e. at a pressure of 1 atm, it will last about 140 minutes.

However, pressure increases by 1 atm for every 33 feet (10 m) of depth. At 33 ft, twice as many air molecules are being taken into your lungs as at the surface. As a result, the air will only last about 70 minutes. By the time you reach 130' (40 m), which is considered the limit for sport diving, you will be breathing air at 5 atm, emptying your tank in 28 minutes. The air is also 5 times the density at the surface, and takes on a distinctly syrupy nature as you try to inhale.

As you descend, the pressure of the water around you is rising. To prevent your lungs from collapsing, you must breathe air at the same pressure. Since the air you breathe under the surface is at higher than atmospheric pressure, you must be careful not to hold your breath while ascending. If you try to ascend without exhaling, the alveoli in your lungs will burst, known as an "air embolism". A change in depth of as little as a metre can make this happen. Never hold your breath while breathing compressed air. Some instructors advise "humming" during an ascent, especially an emergency ascent, to prevent damaging your lungs. This rule does not apply to free diving, when you take a breath at the surface, and then hold it while under water, since you are not breathing compressed air.

If you try to breathe air directly from the tank, the high pressure in the tank will easily explode your lungs. The pressure is reduced in two stages. The first stage, attached to the top of the tank, reduces pressure from 3300 PSI to 120-140 PSI. The second stage, in the diver's mouth, is known as the regulator, and contains a demand valve. A slight aspiratory pressure opens this valve, releasing air at 44 PSI to your lungs. Exhaling closes the valve, sending exhaled air out holes in the sides of regulator.

Oddly enough, even a breath of air at 1 atm contains enough oxygen for several minutes. One would think that humans should need to breathe far less often than we do. However, the urge to breathe is not controlled by the level of oxygen in the body, but by the level of carbon dioxide. Holding your breath for as little as 15 seconds causes enough escalation in the level of carbon dioxide to trigger the urge to breath.

Archimedes' Principle and Buoyancy

An object immersed in a liquid feels a buoyant force equal to the weight of water displaced. If the buoyant force exceeds the weight of the body, it floats. A diver in a wet suit usually floats. It is necessary to wear lead weights in order to descend easily. More weight is required when diving in salt water compared to fresh water.

As the diver descends, the air bubbles in the wet suit are compressed, decreasing buoyancy. To compensate for differing buoyancy at different depths, divers wear "buoyancy compensators", or BCs. The BC is connected to the air tank. Air can be let in to increase buoyancy, or let out to decrease buoyancy. Usually, the diver experiments to determine the minimum amount of weight needed to begin the descent.

Heat Transfer

Water removes heat from the human body much more efficiently than air does, since it has 3200 times the specific heat capacity of air. A diver must wear protection while diving, even though the same temperature in air would feel comfortable.

Light Absorption

Light is absorbed as it passes through water. Different colours are absorbed at different rates, with red being absorbed the most, and violet the least. As a diver descends, the world gets darker and bluer, as all of the colours other than blue and violet are absorbed. Taking photographs below 10 m requires a strobe, or flash, both for illumination, and to "replace" the missing colours. Otherwise, all photos come out in shades of blue and violet, with very little of the other colours.

Magnification

Since water has a refractive index of 1.33, compared to 1.00 for air, objects seen through a diver's mask appear magnified by the ratio 1.33:1.00, or 4:3 using integers. Sharks, for example, look bigger than they really are.

Sound

Sound travels about 4 times faster in water than in air. This can lead to errors in estimating the direction of a sound. Most sounds reach each the ear at a slightly different time. The brain uses this difference in time as one of the clues in determining the direction that the sound came from. However, this time is shortened by a factor of four in water, leading to errors in interpretation. To a diver, a sound can often seem to be coming from all directions at once.

If you try to talk under water, the sound from your vocal chords is not transmitted efficiently from the air in your mouth to the water. Hence, talking under water doesn't work well. There are some devices available that attach to a regulator, permitting talk under water.

Gases in Solution

Henry's Law states that the amount of a gas that will dissolve in a liquid is directly proportional to the partial pressure of the gas. As a diver descends, the partial pressures of the gases in the lungs increase, resulting in a larger amount of these gases dissolving in the blood and tissues of the body.

Oxygen Toxicity

Compressed air is 21% oxygen, and 78% nitrogen, with traces of other gases. At 1 atm, the partial pressure of oxygen is 0.21 atm. However, as pressure increases with depth, the partial pressure of oxygen increases in direct proportion. If the partial pressure of oxygen exceeds 1.4 atm, enough dissolves in the blood and tissues of the body to have a toxic effect on the brain. At normal limits for sport diving, 40 m, the partial pressure of oxygen is 1.05 atm, below the toxic limit. However, if a diver wants to go much deeper, a different mixture of gases is required. Usually a mixture of oxygen and helium is used for deep dives. The mixture is adjusted to avoid oxygen toxicity for the desired depth limit of the dive. Helium is used as a mixing gas to avoid nitrogen narcosis, explained below.

Nitrogen Narcosis

As a diver descends, the nitrogen in the compressed air also dissolves in the blood and tissues of the body. At depths of 100' or more, this dissolved nitrogen can have a narcotic effect on the diver, known as nitrogen narcosis, or "rapture of the deep". The diver may forget important issues, such as ascending before the air in the tank runs out.

Decompression Sickness

The dissolved nitrogen in the blood and tissues can also lead to decompression sickness. A diver must ascend slowly, to allow some of the dissolved nitrogen to leave the blood and tissues during the ascent. If too much nitrogen has been absorbed, the diver must make decompression stops at one or more stages of the ascent. Tables for sport diving limit the amount of time that a diver spends at any particular depth such that decompression stops are not required. However, most divers will make a safety stop at a depth of 15' (5 m) for several minutes, just to be sure. At the limit for sport diving, 40 m, allowable no-decompression time is only about seven minutes. If a diver ascends too rapidly, or does not make required decompression stops, the nitrogen can come out of solution as bubbles in the blood and tissues. This causes pain, especially in the joints, and is known as decompression sickness, or the "bends". Bubbles move through blood vessels, but usually get stuck when they reach capillaries. If enough bubbles accumulate, the diver may die. Treatment for the bends is either a return to depth (if sufficient air is available), or a quick trip to a decompression chamber, if one is available.

You may wonder why fish don't get the bends. Since they don't breathe air, they do not have nitrogen dissolved in their blood and tissues, making decompression sickness impossible.

At the end of a dive, some residual nitrogen is still dissolved in the blood and tissues. The next dive must take this into account, if it is made before the residual nitrogen leaves the body.

Dive Computers

Since the amount of nitrogen dissolved depends both on depth and the time spent at that depth, common safe practice is to assume that the entire dive was made at the maximum depth reached. You can also purchase an electronic dive computer, which takes into account the differing times spent at differing depths, allowing more time in the water.

Nitrox

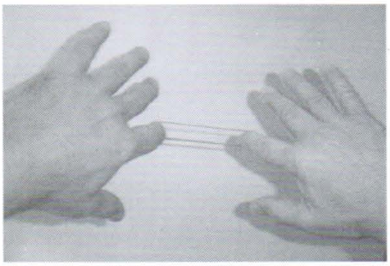
A diver may take a special course to learn how to use enriched air, commonly known as Nitrox. The ratio of oxygen to nitrogen is increased, allowing for longer bottom times before reaching no-decompression limits. However, the danger of oxygen toxicity is also increased.

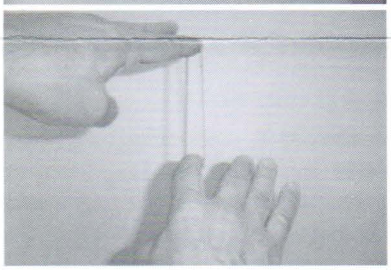
Conclusion

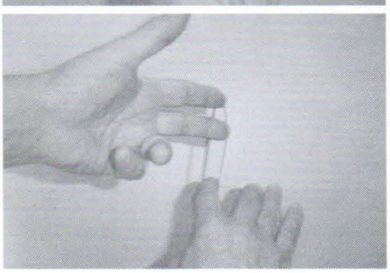
As you can see, there are many physical principles that play a part in sport diving. Diving is not dangerous, but is very unforgiving of any stupidity or neglect. The diver must learn and practice safe procedures to ensure that the sport does not result in injury or death.

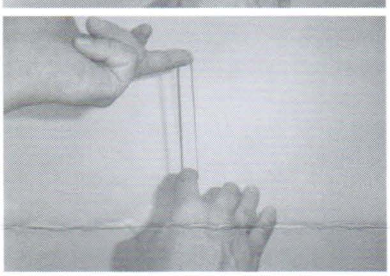
The Demonstration Corner

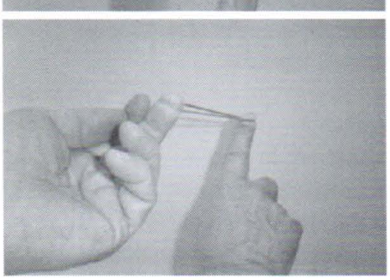
Rotational Motion and the Chain Saw
By: John Caranci











This demonstration is used to introduce rotational motion by using the complex motion of a chain-saw chain. You probably have seen many demonstrations over the years but this is one that can be done with the simplest equipment: one elastic band and a sheet of newsprint.

It might be disadvantageous to do this in middle school or junior secondary classes for obvious safety concerns but it can be used at any level with appropriate safety cautions. This is an exciting introduction to complex rotational motion.

The technique is simple, but requires a little practice. The elastic band is held at the tips of the index fingers with palms facing out (first picture). The left hand is rotated 90 degrees counterclockwise (second picture) so that the two index fingers are right above each other, palms facing down. This gives the right strand of the elastic a slight bit more tension than the left strand. The left hand is then rotated 180 degrees counterclockwise, but while the movement is done the second finger of the left hand is placed inside the elastic at about ¼ to ⅓ of the way down the right strand (pictures three and four). The second finger of the left hand is now the active finger and the index finger is relaxed and let go. This produces a right strand that is much tauter than the left one. It is now ready for launching.

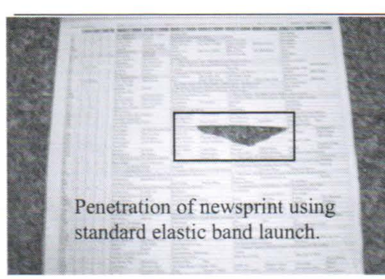
When launched, the elastic forms a flattened ring that moves as a chain saw moves.

The first launch is to compare distance. An elastic band is fired at the back of the class in the normal fashion. Then the band as described above is fired. The results are very different. Try it for accuracy and the results are also very different.

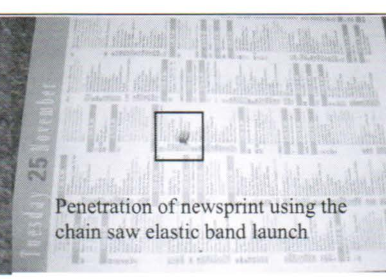
The most telling phenomenon is power to move through a barrier. A piece of newsprint held taut is shown below.

Many senior secondary and first-year students can analyze these phenomena in many ways. Be true to the demonstration and do not give away solutions.

John is a retired Toronto teacher/consultant. He now works for Scientists in School and is the instructor for the OISE Honours Physics AQ Summer Program.



Penetration of newsprint using standard elastic band launch.



Penetration of newsprint using the chain saw elastic band launch

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Column Editor: Ernie McFarland, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1
Email: elm@physics.uoguelph.ca
Submissions describing demonstrations will be gladly received by the column editor.

Let's Play: Quotable Quotes!

Here's the deal. Identify the famous scientist who said the quote below. Be the first person to email your response (c/w mailing address) to the editor, Paul Passafiume, at paulpassafiume@hotmail.com and you'll win a prize! It's that easy. Here we go!

"I think I can safely sat that nobody understands quantum mechanics."

OAPT Conference Reminder!

Just a reminder of this year's OAPT conference hosted by Laurentian University from May 26 – 28, inclusive. This year's conference is sure to be a thrill with such features as the Sudbury Neutrino Observatory (SNO). Be sure to apply for funding from your board, and OSSTF. See you there!

Do you want to give back to your profession? Participate in the OAPT!

This wonderful organization needs volunteer help in the following capacities:

- Guest presenters
- Conference organizers, and facilitators
- Members of the executive committee
- Article, and classroom idea contributors for the Newsletter

New articles, ideas, or other information items may be sent to Glen Wagner (GWAGNER@cwdhs.ugdsb.on.ca) or Paul Passafiume (paulpassafiume@hotmail.com). Ideas for demos may be sent to Ernie McFarland (elm@physics.uoguelph.ca).

Membership Matters!

Join the Ontario Association of Physics Teachers! Members receive a Newsletter and reduced registration rates at the annual conference.

As well, from time to time, the Association makes available special resources. Examples have included reprints of **"Demonstration Corner"** articles from the **Newsletter**, and the videotape, **"The Physics of Dance,"** from a presentation at one of the annual conferences.

To become a member of the OAPT, send a cheque for $8 (or a multiple thereof) payable to OAPT to:

Ernie McFarland
OAPT Membership Coordinator
Department of Physics
University of Guelph
Guelph, Ontario
N1G 2W1

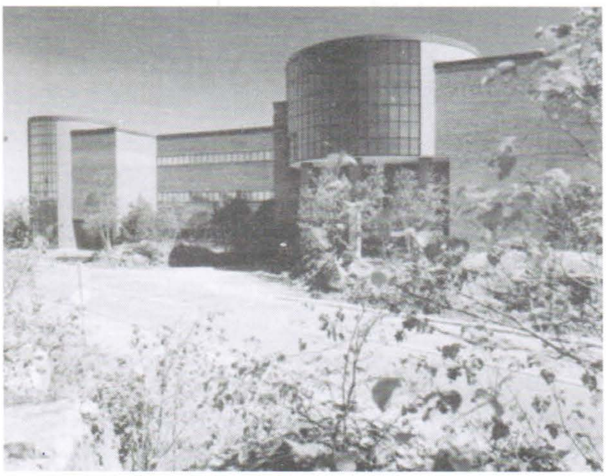
NEWSLETTER

Ontario Association of Physics Teachers

February 2005

The 27th Annual OAPT Conference

Thursday, May 26 to Saturday, May 28, 2005
Laurentian University, Sudbury Ontario



We hope you'll plan to attend

On behalf of the local committee, I invite you to come to Sudbury for what should be a great conference.

We are working hard on the program – some highlights are given inside this newsletter – our facilities for hosting the conference are excellent, and we have planned field trips to the ***Sudbury Neutrino Observatory***, to **Science North** and its ***Dynamic Earth*** underground facility and to explore the unique **Sudbury Basin** which hosts Canada's largest mining camps. Keynote talks will include SNO and physics of our area and the workshop themes include climate change and astronomy.

University residence accommodation and car pooling should help keep costs down, and Sudbury is only a four hour drive from Toronto with some great scenery late in May.

In this newsletter, we outline the program for the conference and give some background on the university, the Sudbury region and the facilities you may visit when you come.

Please visit the conference web site:
www.physics.uwo.ca/news/conferences/oapt_2005
for updated program, workshop and field trip information.

You can register from March 4th onward, using an Excel® spreadsheet form from our host website:
www.laurentian.ca/physics/oapt2005

General enquiries about the conference, and any registration and accommodation forms should be sent to oapt2005@laurentian.ca

We look forward to seeing you in Sudbury in May.

Doug Hallman, Chair
Department of Physics & Astronomy
Laurentian University
(705) 675-1151 Extension 2202
FAX (705) 675-4868

The Conference Program and Schedule at a Glance (preliminary)

Thursday, May 26
1:00 pm – Early bird tour A of SNO
3:00 – 7:00 pm – Registration – Fraser Cafeteria
5:30 pm – Barbeque – grounds of Science North
7:00 – 9:00 pm – Workshops
9:00 pm – Wine and Cheese welcome reception & tour of Science North.

Friday, May 27
7:30 – 8:45 am – Breakfast – Great Hall
Exhibits and poster session open
9:00 am – Welcome – Fraser Auditorium
9:10 am – SNO & SNOLAB – Canada's unique contributions to particle astrophysics.
10:10 am – Keynote theme 2
10:40 am – coffee and exhibits/posters - cafeteria
11:05 am – Session 2 A,B,C
Contributed papers – Fraser classrooms
11:40 am – Session 2 D,E,F
Contributed papers – Fraser classrooms
SNO Tour field trip B
12:10 pm – Lunch and exhibits/posters - cafeteria
1:15 pm – Tours
- Science North & Dynamic Earth
- SNO Tour field trip C
- Sudbury Basin
5:00 pm – plenary session
6:00 pm – reception – cafeteria
6:30 pm - Banquet
8:30 pm – *Einstein: A Stage Portrait* – Tom Schuch
Fraser Auditorium

Saturday, May 28
7:30 – 8:45 am – Breakfast – Great Hall
Exhibits and poster session open
9:05 am – Physics of Mineral Exploration & Mining
10:10 am – Keynote theme 3
10:40 am – coffee and exhibits/posters
11:05 am – Session 4 – contributed/invited papers
OAPT business meeting
12:10 pm - Lunch
1:15 pm – Session 5 – contributed/invited papers
4:15 pm – *The Great Give-Away*
4:30 pm – End of Conference

Workshops

With the OAPT Executive, we are in the process of finalizing plans for the workshops. Suggestions are welcome. When the program is finalized, we will ask you to give your order of preference for the alternatives available, with choices assigned according to your date of registration – please register early.
Current workshop list (preliminary)

- Climate Change (Science North personnel)
- Astronomy (P. Legault, Doran Planetarium)
- Teaching Motion (Jim Ross, London)
- Einstein in the Classroom

Field Trips

- **Sudbury Neutrino Observatory**

Two groups of 16 visitors each will tour the SNO laboratory on Friday afternoon, 2000 m underground at INCO's Creighton Mine, about 25 minutes from the Laurentian Campus. We'll also have an early bird tour on Thursday afternoon. Visitors must wear mine coveralls/safety equipment, walk about 1.5 km underground to the lab and shower/change to cleanroom gear at the lab. Contact lenses are not allowed underground, safety glasses (over regular glasses) will be supplied. Register early to ensure yourself a place. We will have a separate tour for local teachers after the conference.

- ***Dynamic Earth* Visit**

Dynamic Earth is Science North's new feature at the Big Nickel site in the west end of Sudbury. An underground visit gives a history of mining in the area and shows the equipment and techniques used then and now. Displays give the latest developments in mining and earth science.

- **Sudbury Basin Tour**

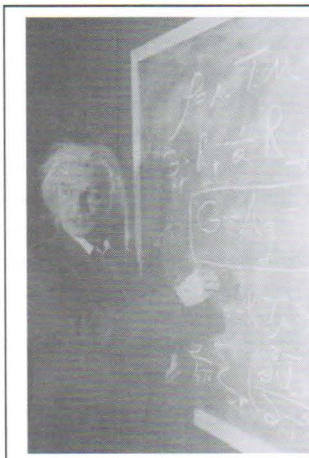
A bus tour will take visitors to key places in the unique Sudbury Basin (see a description of this structure below), and highlight the unique geology and Sudbury's award winning reclamation/regreening work in the region.

Einstein: A Stage Portrait

On Friday evening, after the banquet, we will present actor Tom Schuch in his much-acclaimed one person show: **Einstein: A Stage Portrait**, written by Willard Simms. See Tom's web site (www.spoli.com) for lots more information about this unique show, perfect for the World Year of Physics in 2005.

SPOLI PRODUCTIONS

"The perfect balance of entertainment and education"



The Local Organizing Committee

Doug Hallman, Laurentian University – co-chair
Robert Leclair, Laurentian University – co-chair
Gennady Chitov, Laurentian University
Aaron Barry, Sudbury District Catholic School Bd.
Terry Luoma, Rainbow Board of Education
Teresa Kneller, Astronomer, Science North

Laurentian University

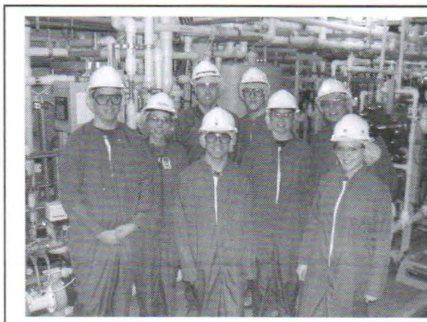
Founded in 1960, Laurentian University is Northeastern Ontario's bilingual comprehensive university. With 8200 full & part time students and a full range of academic programs, it serves a wide local area and attracts students to specialty programs from across Canada and internationally. Laurentian is ranked 35th in research funding among Canadian universities with over $ 12 million annual funding, and it has recently introduced three Ph.D. programs, in addition to Master's programs across many disciplines. In the fall of 2005, a full class of medical students will begin study in a new building at the Northern Ontario School of Medicine – a joint venture with Lakehead University in Thunder Bay. The campus adjoins two lakes and has residence accommodation for over 1000 students, and full recreational facilities including an Olympic size pool as well as hiking and cross-country skiing trails. Research links are established with the nearby Northeastern Ontario Regional Cancer Centre, the Ontario Geosciences Centre and mining companies and the Cooperative Freshwater Ecology unit.

The J.N. Desmarais library (left) and the H.J. Fraser Science Complex (centre and right) which houses the Physics Department at Laurentian.

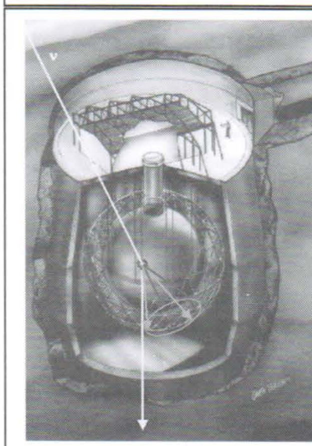
The **Department of Physics & Astronomy** has B.Sc. programs in Physics, Biomedical Physics and Radiation Therapy (in partnership with the Michener Institute), as well as an M.Sc. graduate program. Facilities include the 72 seat Doran Planetarium, two telescope observatories, links with radiation physics research at the Cancer Centre and access to SNO and SNOLAB. Research is focused in the areas of Particle Astrophysics (SNO and SNOLAB, including new double beta decay and dark matter experiment development), medical physics (radiation therapy, nuclear medicine and x-ray scatter imaging) and condensed matter research in correlated fermion systems and high T_c superconductor theory.

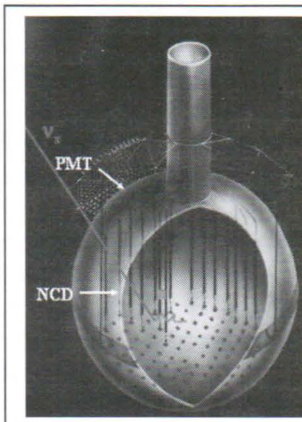
The Sudbury Neutrino Observatory,

Funded in 1990, the Sudbury Neutrino Observatory is a unique facility which is measuring neutrinos from the sun in a $ 75 million laboratory, 2000 meters underground in Inco's Creighton Mine about 25 minutes from the university. Planned and operated by scientists from 12 institutions in Canada, the United States, and the United Kingdom, SNO began its measurements in 1999, and in 2001 published major findings which showed that neutrinos oscillate from one species to another on their way from the sun. When neutrinos of all species are included, the total measured flux of solar neutrinos now agrees with the best solar theories – the *solar neutrino problem* – a large discrepancy of earlier experimental measurements at other laboratories with predictions – has been solved. Over a five year measurement period, precision measurements of this *neutrino mixing* have been made, and a small mass (actually a mass difference) is now assigned to neutrino species. The SNO experiment is now in its third phase of neutrino measurements, in which ^{3}He neutron counters are inserted in the heavy water core, to add to the precision of SNO's neutral current reaction measurements. See the SNO web site (www.sno.phy.queensu.ca) for lots more information.

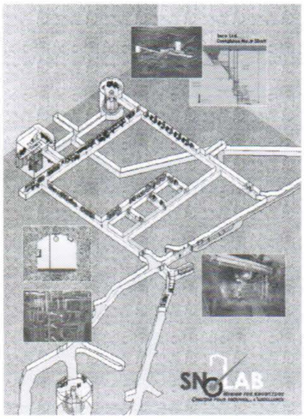


Each year, a group of undergraduate Laurentian students are given a unique visit to the SNO laboratory.





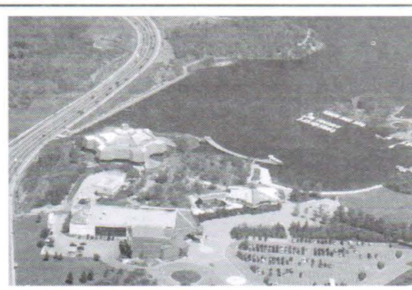
SNOLAB – an International Laboratory for Underground Science



With funding from the Canada Foundation for Innovation and the Province of Ontario, SNOLAB - a $ 50 million doubling of the size of the underground SNO laboratory - and a new surface building is now under construction. Fifteen planned experiments have already submitted letters of interest in being sited at SNOLAB, and by 2007, 4 to 5 experiments will be under assembly. A refurbishing of the SNO detector will be a part of the laboratory development, after SNO's measurements are completed at the end of 2006. More information on SNOLab is at www.snolab.ca .

Science North

Sudbury's science centre is 20 years old this year, and still on the forefront of science interpretation and education. New exhibit development has included object theatres on SNO, on climate change and mining/geology at Dynamic Earth, as well as the production of several IMAX films and traveling exhibits. A proposed new Master's program in Science Communications at Laurentian will involve extensive further collaboration with Science North personnel and facilities.



The Sudbury Region

The Sudbury region, with a total population of 165,000 has always been noted for its large nickel & copper mining, smelting and refining activities and as a transportation and service hub. Although mine technology and automation has reduced the workforce over the past 40 years to about 25% of its earlier size, the region has diversified through the additions of government service centres, educational institutions, mining & mineral technology companies and service industries. Platinum group metal exploration and development has expanded rapidly in recent years. Sudbury is working to become the Canadian centre of excellence in mines research and technology. More information is at www.city.greatersudbury.on.ca .

The Sudbury Basin

Sudbury's mining activities occur in about 15 nickel-copper mines in the unique and enigmatic geological structure known as the *Sudbury Basin*. The 60 km by 27 km elliptical formation shown is all that is left of a once much larger crater nearly 70 km in diameter blasted out of the Canadian Shield about 1.8 billion years ago. Most scientists who have studied Sudbury's geology believe the crater was formed by a meteorite of diameter between 1 and 3 km, travelling at 15 km/s. The impact shock energy created a huge explosion and vaporized much of the shattered country rock and the meteorite. Other rock was either melted and sprayed on to the crater walls or broken and flung far from the impact site. Between 1000 and 2000 km^3 of fragments which fell back into the crater are still preserved. The Apollo 17 astronauts examined Sudbury surface rock, because of its similarity to moon crater debris. Two or three minutes after the explosion, the floor of the crater, 20 km deep originally, rebounded elastically like the peak in the centre of a bouncing raindrop, and then collapsed to form the first Sudbury Basin. The release of overburden pressure on nickel and copper-rich rock many km below the impact site caused this rock to melt and rise into the crater, then cool to form the valuable ore as well as the rugged rim around the edges of today's basin. Mountain-building stresses in the intervening years and several km of erosion as well as glacier action have distorted the crater into its present elliptical shape, reduced its size and created fertile farmland in its centre.

Please help us publicize the conference

Pass on a copy of this newsletter to your colleagues, set up transportation pools and download the conference poster/flyer at www.laurentian.ca/physics/oapt2005 .

Conference Call for Papers:
All physics educators are invited to contribute a presentation at the conference. Possible ideas include: demonstrations, reports on advances in physics and related fields, or interesting information pertaining to particle physics. Interested participants please e-mail the following to **Elzbieta Muir** (emuir@sympatico.ca):

a) an abstract (please include your name and school/university/institution),
b) the approximate presentation length (10, 15, 20, or 30 minutes), and
c) audio-visual requirements

The OAPT Photo Contest

Sponsored by A.J. Hirsch and Nelson Publishing

To coincide with the World Year of Physics, 2005, the OAPT is pleased to announce the first annual OAPT Physics Photo Contest for senior high school physics students. The contest is open to any student enrolled in a day school Grade 12 physics course in Ontario in the 2004/2005 school year. There are two categories in the contest, one for students enrolled in the university preparation course, SPH4U, and the other for students enrolled in the college preparation course, SPH4C. Physics educators at the annual OAPT Conference will judge the photos in May 2005, in Sudbury.

Grade 12 University Category
Controlling Photographing Variables

Polarization of light
- polarization of reflected light
- polarization of scattered light
- polarization by double refraction
- determining stress in plastic models

Interference and/or diffraction of light
- Reflection and/or transmission in thin film interference
- using "star filters"
- using diffraction gratings with different numbers of lines per cm

Depth of field
- changing the focal length of the lens
- changing the lens aperture

Shutter speed

Film speed

Requirement: Two or three photos of the same subject with title and a double-spaced written explanation (150 to 250 words)

Grade 12 College Category
2004/2005 Theme:
The Physics of Motion, Forces, and/or Machines

for example:
- acceleration
- Newton's laws of motion
- friction
- simple machines
- domestic and industrial machines

Requirement: one or two photos with title and a double-spaced written explanation (100 to 200 words)

OAPT Members Category
Controlling Photographing Variables

This is a one-time opportunity for teachers in celebration of World Year of Physics.

Subject is the same as for 4U students.

Special inaugural contest for teachers!

Prizes for 4U and 4C Contests
- **1st place - $200 to the student and a Computerized Assessment Bank for 4U or 4C to the teacher**
- **2nd place - $100**
- **3rd place - $50**
- **An Honourable Mention will also be awarded**

Members' Contest
Photos illustrating polarization:
- **1st place - $200**
- **2nd place - $100**
- **3rd place - $50**
- **Honourable Mention**

Photos illustrating all other photographic variables:
- **1st place - $200**
- **2nd place - $100**
- **3rd place - $50**
- **Honourable Mention**

For more details on rules and submission see OAPT website at http://www.physics.uoguelph.ca/OAPT/

Photos must be received no later than May 2, 2005

Ontario Association
of
Physics Teachers

World Year of PHYSICS 2005 · Année Mondiale de la PHYSIQUE 2005
www.cap.ca/wyp2005.html

27th Annual Conference
Department of Physics & Astronomy
Laurentian University
Sudbury Ontario
May 26-28 2005

http://www.wyp2005.org/

- keynote speakers
- workshops
- contributed talks and demos
- tours - visits
  - Sudbury Neutrino Observatory
  - *Full underground tour!*
  - Science North
  - mining facilities

Welcome to the Conference. You will meet some great teachers.

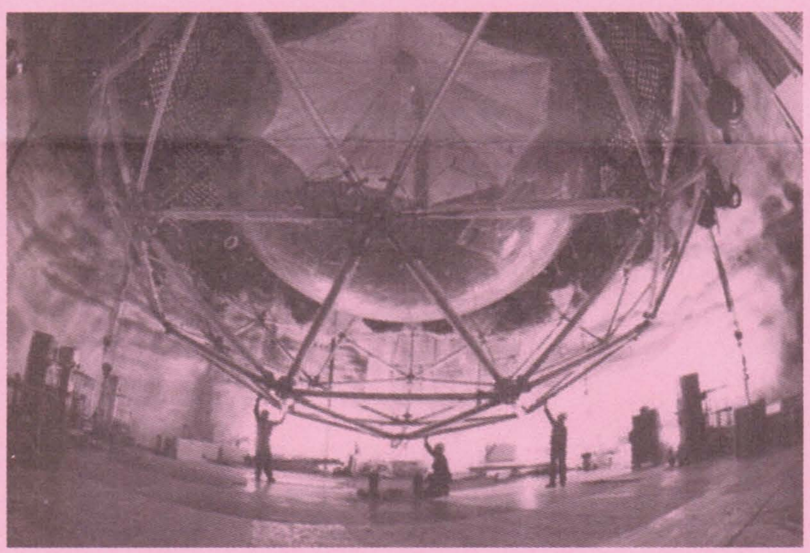


Photo courtesy of SNO

- Photo Contest
  New for 2005
- Grade 11 Physics Contest
  Tuesday May 3 2005

SCIENCE NORTH · SCIENCE NORD · 1984 20 2004

Photo Contest - Grade 11 Contest - OAPT - http://www.physics.uoguelph.ca/OAPT/

Conference Web Site: http://www.laurentian.ca/physics/oapt2005

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
November, 2005

Physics and Cognition

Sequential Vectors in Grade 10

Jim Ross
Catholic Central H.S.
jim@rosslattner.com

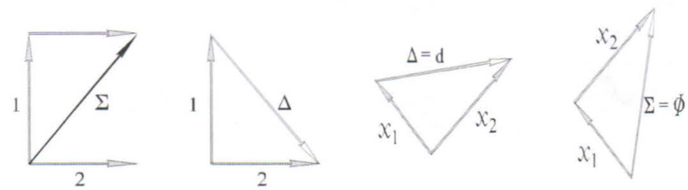
We want our students to be familiar with several concepts that are vector quantities. The current syllabus organizes the concepts in this order: *position*, *displacement*, *velocity*, *acceleration*, *force*, *momentum* and *impulse*.

Along the way, students must learn the *vector operations* needed to support textbook exercises in the *concepts*. We teachers plan for the students to arrive at an understanding of the *concepts* by repeated application of the *skills*. The two basic vector operation skills are sum Σ and difference Δ.

But there is a problem. Not all vectors behave in the same way. The *operations* and the *concepts* have a subtle set of inter-relationships that make systematic learning of them more difficult than it first appears. Some vector pairs are treated sequentially. Others are handled simultaneously. That makes four possibilities of vector operations, as indicated in the matrix below.

	Σ	Δ
Sequential		
Simultaneous		

Let's consider two sequential position vectors, $\mathbf{x}_1$ at one time, and $\mathbf{x}_2$ at a later time. The vector operations are $\Sigma\ (\mathbf{x}_1,\ \mathbf{x}_2)$ and $\Delta\ (\mathbf{x}_1,\ \mathbf{x}_2)$. The first thing we notice is that $\Delta\ (\mathbf{x}_1,\ \mathbf{x}_2)$ results in a physically meaningful vector, but $\Sigma\ (\mathbf{x}_1,\ \mathbf{x}_2)$ results in a physically meaningless vector.



In fact, if we look at the whole set of vector concepts in the curriculum, many of the sequential Σ's and Δ's are meaningless! (Meaningless Σ's and Δ's are indicated with a Φ).

In the current grade 10 syllabus, as our students proceed from position to acceleration, they are likely to get conceptually meaningless answers 5 attempts out of 8, even when they do the operations correctly. If we expect our students to learn the concepts by doing operations on various vector diagrams, then we have set them up for failure. Students typically begin with a low level of personal confidence in both their conceptual knowledge, and their operational skills. How will they know whether they have the concept wrong, the operations wrong, or both? (Or both right, in the case of the 0.07% who actually "get it.")

Let's leave this in an unresolved state for the time being. I'd love to hear responses from you. Perhaps we can set up a forum for discussion. Next issue: the case of the simultaneous vectors. And, a suggestion for a curriculum that is easier to learn.

	Position $\mathbf{x}$	**Displacement** $\Delta\mathbf{x} = \mathbf{d}$	Velocity $\mathbf{v} = \Delta\mathbf{x} / \Delta t$	Acceleration $\mathbf{a} = \Delta\mathbf{v} / \Delta t$	Force $\mathbf{F} = m\mathbf{a} = \mathbf{j} / \Delta t$	Momentum $\mathbf{p} = m\mathbf{v}$	Impulse $\mathbf{j} = \Delta\mathbf{p}$
Sum	$\Sigma\mathbf{x} = \phi$	$\Sigma\mathbf{d} = \mathbf{d}_T$ Total displacement, or total change of position	ϕ	ϕ	ϕ	ϕ	$\Sigma\mathbf{j} = \mathbf{j}_T$ Total impulse, or total change of momentum
Difference	$\Delta\mathbf{x} = \mathbf{d}$ Displacement, or change of position.	ϕ	$\Delta\mathbf{v}$ is related to a, E, j, and other changes of state	ϕ	ϕ	$\Delta\mathbf{p} = \mathbf{j}$ Impulse, or (ex)change of momentum	ϕ

Digital Physics

Exploring the Law of Conservation of Energy

Paul Passafiume
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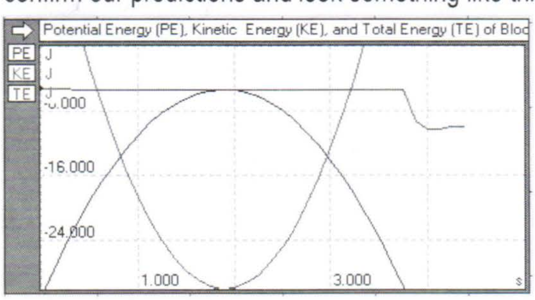
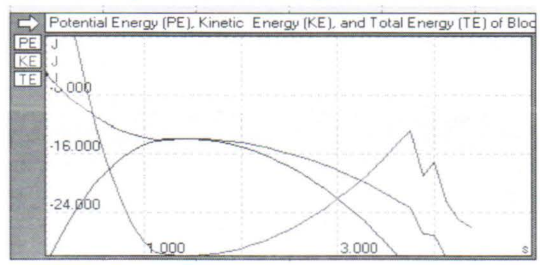
Hello all, and welcome to yet another opportunity to use computers in the classroom! In this session, we'll take a look at how we can use the program IP2000 (or something similar) to fortify an existing understanding of energy conservation and conversion. We'll do this by using an IP script I wrote that models a cart rolling up and then back down a ramp.

Because this analysis is fairly sophisticated, I reserve this discussion for my grade 12 students (and only after we have pretty much completed our discussion on energy). I begin by introducing them to the IP script and discuss with them what it is intended to model. After this, we talk about the type of energy the crate has as it moves up and down the ramp and what happens to this energy as the crate moves along this path. The kids are pretty much all over the fact the crate's energy (consisting of both E_k and E_g) will ideally remain constant and that there will be a transformation of energy from E_k to E_g and vise versa as the cart moves. I then ask the students to predict what the E_k, E_g, and E_T curves for the cart might look like as functions of time as it goes up and then down the ramp. This is, ostensibly, a trivial matter but most kids don't realize that both E_k and E_g (and thus E_T) are quadratic functions in time. After some discussion, this point should be clarified; however, some students may still struggle with it and it's important for them to realize that it's not so much the shape of the graph that is key but rather the trend illustrated by it (i.e.: as E_k decreases, E_g increases and vise versa). With this under our belts, we run the simulation and generate three beautiful graphs that confirm our predictions and look something like this:



I then up the ante of our discussion slightly by introducing the idea of friction. We begin by reviewing the effect that friction has on the energy of the crate (it decreases it), and how this energy is ultimately lost (as thermal energy).

With this in mind, I then ask the students to consider how the total energy curve for a real crate might differ from that of our idealized one above. They are quick to suggest that the total energy curve should decrease (as opposed to remaining horizontal). We then move to the next part of the simulation and generate graphs for a real crate that is experiencing friction. These graphs are illustrated below:



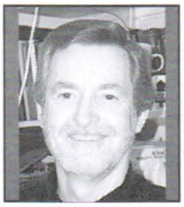
From these graphs it is clear that the energy of the crate is certainly decreasing. In fact, one can almost see the energy being drained from the crate just by examining the shape of each curve. As an interesting corollary, we can introduce at this stage the meaning of the slope of the E_T graph. Students with calculus will almost immediately interpret the slope as being the rate of change of total energy, and those without can be made to see this through an examination of the units obtained after finding the slope of this line. In either case, we see that the rate of change is negative, indicating that energy is being removed from the crate.

I do this activity with my students as a demonstration following a probeware lab involving an actual cart and ramp. In this way, I can augment what happens in reality by something that allows the variables to be more easily controlled and their affects, therefore, more readily seen.

Stay tuned next issue as we use the same simulation to have students explore the subtle, but important differences between the Law of Conservation of Energy and the Work – Energy Theorem. As always, anyone interested in having a closer look at how I address these topics with my students is more than welcome to contact me at paul.passafiume@sympatico.ca. Also, if you'd like to try the simulation (and avoid the drudgery of creating one yourself) let me know and I'll ship it off to you.

Until next time, happy teaching!

The Demonstration Corner



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Demonstration Cart, or "Happy Wagon"

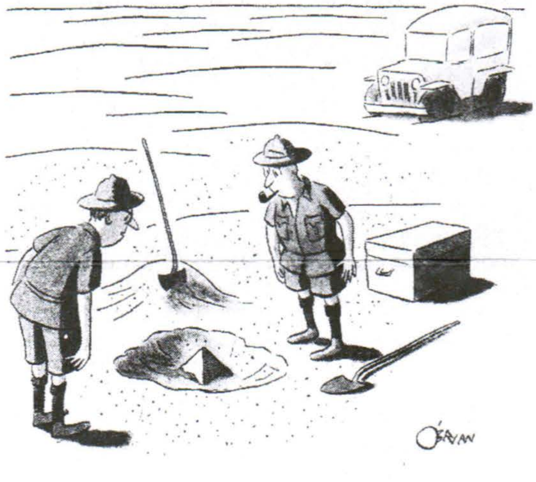
**By: Stuart Quick, Department of Physical & Environmental Sciences
University of Toronto @ Scarborough**

Some teachers might find it awkward and inconvenient to set up demonstrations on lab stands and take them down again in the time at their disposal. Lab stands tend to be weak affairs that wobble with even small loads. Or teachers may find setting up more than one demonstration at a time impractical.

I have used a demonstration cart which I call my "happy wagon" for some years. The body of the cart is one of the larger lab trolleys fitted with good-sized wheels. I have a square piece of plywood about three-quarters of an inch thick and some four feet square mounted in an upright position so one side of it faces the class. It is attached in such a way that it can be removed quickly. The side facing the class is mostly covered by a thin sheet of galvanized steel. Dead centre in the steel and board is a hole with a reinforcement on the reverse side so I can slip the axle of a bicycle wheel through it, holding the wheel perpendicular and enabling it to spin with little friction.

The use of the steel enables me to attach all manner of stuff on the board with magnetic fasteners – thin magnetic indicators (arrows) of different colours, holders for masses on springs, simple pendulum, etc, etc. For one of my opening lectures on the "unity" of physics I have the wheel spinning, the mass on the spring bouncing up and down and the pendulum swinging back and forth all at the same time.

The board is also useful as a backdrop to show the spot of your laser pointer, and to provide a contrast for other demonstrations, such as the waves on a string apparatus. I can even imagine for this coming term talking about buoyancy with balloons I have attached to the thing. Of course, the trolley gives you the space for transporting the stuff and for storing it too. Our Science Outreach kids like the wheel. I have the wagon parked outside my office door in the summer and I often see the wheel spinning after a bunch of them have passed by.



"This could be the discovery of the century. Depending, of course, on how far down it goes."

OAPT CONFERENCE 2006 ANNOUNCEMENT!

The OAPT is proud to announce that this year's conference will be hosted by the **Perimeter Institute** in Waterloo. Stay tuned for details, or visit us on the web!

Highschool Teaching Strategies

Police Officers in Your Physics Classroom

James Ball
John F. Ross C.V.I.
james.ball@ugdsb.on.ca

Many high schools in Ontario have community police officers that spend some time each week in the school building. One of their goals is to build positive relations with our students. Most of these officers have had training in the use of both radar and laser speed guns. In addition, they are often more than happy to come in to our classes and give our students both a lesson and an actual demonstration on their operation. Students get a real thrill pointing the radar gun at passing vehicles (though they are occasionally disappointed that they can't hand out a ticket).

Besides the obvious physics behind the Doppler radar and laser (often called Lidar) the officers can provide insight into the actual operation. Students particularly like the details about when a radar gun is not effective and why laser is much more accurate in high traffic areas. Our officer also talked about the calibration process and why you never try and hide the radar gun behind the dashboard. It turns out that the rotating metal engine fan produces an excellent signal! Our officer also showed the class how the radar was calibrated using a simple tuning fork.

Students can also learn the about how momentum and Newton's laws apply to automobile collisions. Most large departments (for cities over 100 000 people) have specialist officers who analyze accident scenes. Bringing these officers into the classroom often only takes a simple phone call. These officers bring with them real world applications of physics principles that can often be the "hook" that really grabs our students' interest.

Below is a list of where these "officers in the classroom" can fit into the Ontario curriculum.

Curriculum links:

Grade 10 Applied and Academic Science: Motion unit

Grade 11 University physics: Motion and Forces unit, Sound unit, Light units

Grade 12 University physics: Energy and Momentum units

Grade 12 College physics: Mechanical Systems, Communication units

What's New at OAPT?

The New Physics Funding Formula

Elzbieta Muir
Albert Campbell Collegiate
emuir@sympatico.ca

Announcing OAPT discussion group: Listserv!
The main function of the group is to promote dialog among teachers of physics at all levels, from junior science to graduate school. You can post questions, news that would be of interest to the group, or any other suitable messages. Current hot topic: 'teaching physics with new curriculum'. Subscribe now!
To subscribe, send an email to oapt-subscribe@yahoogroups.ca

Grade 12 Physics Photo Contest:
In SPH4U category there are maximum 10 entries per school, in SPH4C category max 15 entries per school. Although the deadline to mail in your entries is between April 3 and May 1, students ending their semester one in January may want to prepare their photos now! See OAPT web-site for the last year's winning entries.

OAPT Physics Contest:
In semestered schools it is a good idea to register semester one grade 11 physics students, for the contest written on May 2, 2006, before the semester ends. With a collected fee of three dollars, students are more committed to show up on the contest day.

OAPT at AAPT:
American Association of Physics Teachers' 2006 Winter Meeting will take place in Anchorage, ALASKA, January 21-25 with the theme: "Celebrating AAPT's 75th Anniversary". To see the program and the beautiful views of Mount McKinley (6194) go to www.aapt.org/Events/WM2006/index.cfm.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) September, 2006

Digital Physics

Exploring Relative Velocity Using the Web

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Hello fellow fizzies and welcome back from what I hope has been a wonderfully relaxing and rejuvenating summer! As we ease our way into September, I thought I'd touch on a subject of immediate relevancy to the first unit of the 4U program. The topic: Relative Motion.

This topic is fraught with challenges for our students – challenges that sometimes lead to misconceptions, and these misconceptions are remarkably transferable to other areas within the course. So, we try to avoid these misconceptions by paying special attention to clarity and detail in our lessons. Sometimes, however, this is not enough, and we are forced to rethink our mechanism of delivery. In this article, I describe a different approach – a web-based approach, that I found quite effective last year. My hope is that you, too, will find it so. So, let's get at it!

This activity, called a Peer Learning Session, is performed by the students following a variety of instruction and problem solving in relative motion. It is meant to augment learning toward the end of the topic's discussion. The first part of the activity addresses the idea that velocity is a relative, not an absolute, concept. Working in groups of two, students access the following web-site: www.phy.ntnu.edu.tw/ntnujava/viewtopic.php?t=227 depicting a river (with boats moving on it), and a bystander walking along the shore. This applet allows students to modify object velocities and the frame from which these velocities are observed. I have the students predict, and then verify velocities from various perspectives to really solidify the concept being addressed. Casual assessment of the students at work can be surprising! While most seem to understand the idea, it is clear that some have

Visit us on the web at www.oapt.ca

The second part of this investigation has the student address the problem of the path of least time when a boat crosses a river. Initial assessment sees the students almost unanimously choose the incorrect answer. This applet (in conjunction with a well-planned worksheet), however, allows the student to correct this misunderstanding.

Students can adjust the heading of the boat (while keeping its speed constant), and 'see' first-hand that the path of least time across a river is the one that is straight across it. What's more, is that they have a chance to see why that is the case. Sometimes no amount of verbal explanation and diagrams can do the trick. Some kids just don't seem to be able to get this idea. This applet, though, animates your language and diagrams – which for some is all they need.

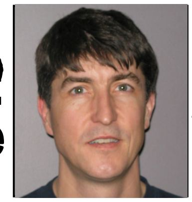
Again, the results of this portion of the investigation are remarkable. I have given test questions on the least time idea in the past, and found the results to be marginal at best. Following this approach, however, the same question sees nearly the entire class get a correct answer. No kidding!

For me, the success this little experiment in peer learning speaks volumes. It's an approach to teaching that can make the lives of both student and teacher easier. In short, it works. And my hope is that it will work for you, too.

Until next time, happy teaching!

HighSchool Teaching Strategies

Learning Modern Physics at the Perimeter Institute



James Ball
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james.ball@ugdsb.on.ca

The Perimeter Institute for Theoretical Physics has two primary mandates. First it provides a state of the art facility for theoretical physicists to do what they do best; think. Secondly it does community outreach to help the general public better understand the world of modern physics. As part of this outreach the institute offers one week institutes for high school physics teachers. The aim of the institutes (called Einstein Plus) is to deepen the high school teacher's understanding of modern physics and to encourage them to increase its presence in the high school curriculum. Perimeter Institute (PI) offers two of these one week sessions during the first two weeks of the summer. Teachers from across the country (and around the world as we had an Australian and a US attendee in the first session) apply to participate. PI pays for the teacher's travel, food and accommodation .

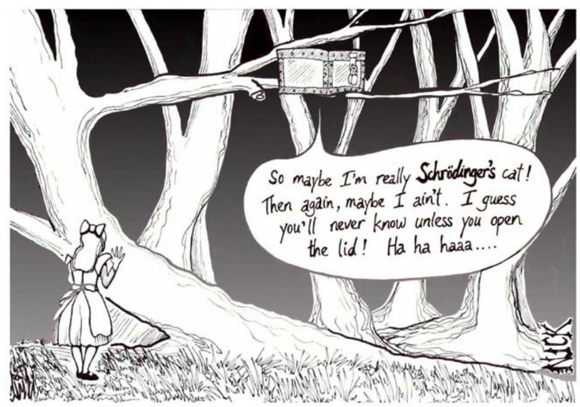
The days are full. In the morning Damian Pope the director of community outreach introduces a core concept in modern physics (for example special relativity or superposition). These sessions are interactive and involve a lot of useful discussions. The afternoons are more varied consisting of talks by experts on topics like Dark Matter or Different Interpretations of Quantum Mechanics followed by workshops or field trips to the nearby institute for Quantum Computing. The workshops were moderated by an excellent group of high school teachers who have been past participants at Einstein Plus.

PI has many visiting scientists. We were fortunate enough to be able to listen to a talk by Nobel Laureate Tony Leggett on his work with superfluids.

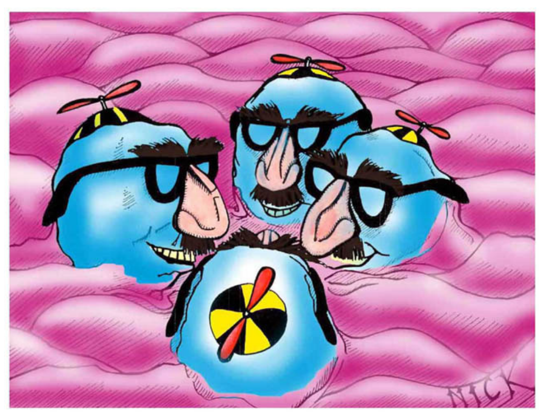
The first evening involved a number of activities that helped the group get to know each other. Future participants are forewarned that you need to know your physics and math trivia! Other evening sessions were either less formal or social. The entire group was taken to a performance at Stratford. By the end of the session the entire group had enjoyed a challenging, stimulating and very worthwhile session. If you are interested in more information got to

http://www.perimeterinstitute.ca/activities/community/teachers/index.php

PERIMETER PI INSTITUTE FOR THEORETICAL PHYSICS



Alice's Adventures in Wonderland, Chapter VI:
The Cheshire Cat gets Weirder.



At a resolution of 10^{-24} metres, isolated clumps of Strange Matter pop briefly out of the quantum foam to debate the possible existence of Particle Physicists.

cartoons from
http://www.nearingzero.net/sci_physics.html

The Demonstration Corner

Induction Puzzle

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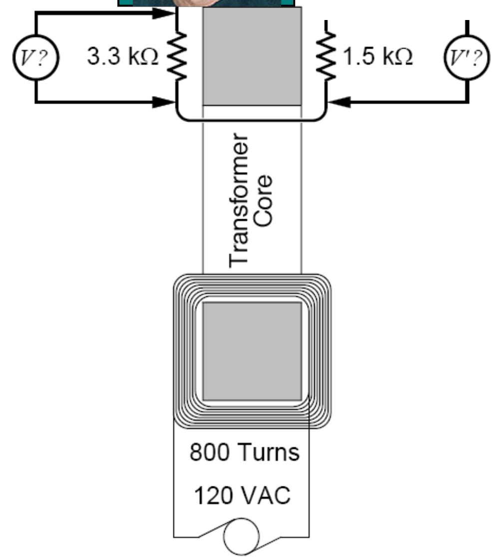

by Leigh Palmer
Simon Fraser University

Here's a demonstration that will make your students think more carefully about the meanings of the terms voltage, electromotive force, and potential difference. A transformer is necessary for the demonstration. Any discarded transformer with 120-volt primary winding is suitable. If the secondary can be stripped and the core left bare it will greatly improve the clarity of the apparatus. At SFU we use a dissectible transformer.[1]

Two resistors with different resistances are soldered together as a one-loop secondary as shown in the diagram. Two digital AC voltmeters are connected across the resistors as shown. The primary is then connected to the mains, and *the voltmeters read different values*! The calculation (shown below) is straightforward, but the student must think long and hard to understand why two voltmeters connected to the same terminals in a circuit should exhibit different readings. The student who does so will learn much about the difference between "emf" or "voltage," and the concept of "potential difference" which is inapplicable in this time-dependent case.

$$\mathrm{emf} = \frac{120\ \mathrm{V}}{800} = 150\ \mathrm{mV}$$

$$I = \frac{150\ \mathrm{mV}}{3.3\ \mathrm{k\Omega} + 1.5\ \mathrm{k\Omega}} = 31.3\ \mu\mathrm{A}$$

$$V = 31.3\ \mu\mathrm{A} \times 3.3\ \mathrm{k\Omega} = 103\ \mathrm{mV}$$

$$V' = 31.3\ \mu\mathrm{A} \times 1.5\ \mathrm{k\Omega} = 47\ \mathrm{mV}$$

[1] A similar apparatus is listed by Sergeant-Welch. See http://www.sargentwelch.com and search for "Dissectible Transformer."

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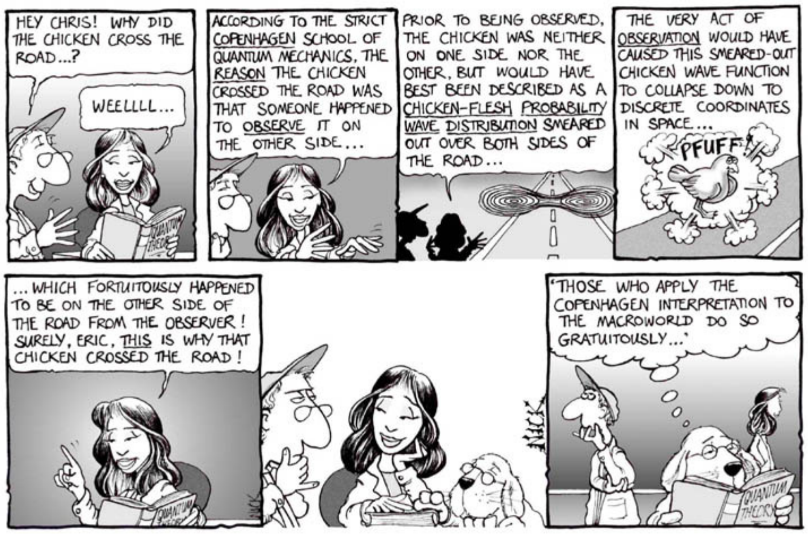
Submissions describing demonstrations will be gladly received by the column editor.



Do you have physics questions that you'd like answered. Do you have some great demos or labs that you'd like to share? Then join the OAPT group by sending a message to the moderator at

oapt-subscribe@yahoogroups.ca.

Note you will need a free yahoo ID to subscribe. Join the discussion!

OAPT Photo Contest

Sponsored by Alan J. Hirsch

As another school year begins don't forget to incorporate the OAPT Photo Contest into your SPH4U program.

Controlling Photographic Variables

polarization – interference – diffraction - depth of field – shutter/film speed

… connected to Wave Nature of Light Ontario Curriculum topic

Great Prizes - $200, $100, $50 plus several honourable mentions

<u>Quick Tips for successful participation.</u>

- Hold an in-school contest and make participation a mandatory part of the course. Evaluate under either "Making Connections" or "Communications".
- Have students vote for favourite entries to send in to the provincial contest.
- Run a separate contest in each semester and compile entries in January and April.
- Set a deadline that is well in advance of April 1 in order to leave time to compile materials and meet the deadline of May 1, 2007.Don't hesitate to contact me *(Diana Hall, Contest Coordinator)* with questions or ideas.*Please visit* ***www.OAPT.ca*** *and read complete contest details, see past winners and sample photos diana.hall@ocdsb.ca*

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T.. and a charitable organization) November 2006

High School Physics

Rolly Meisel
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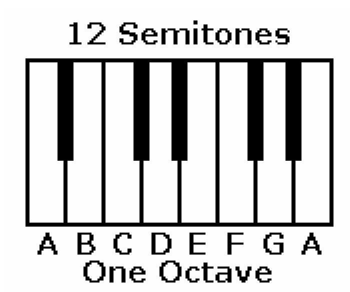
Lies My Physics Text Told Me

My grade 11 physics text told me that middle A on the piano is tuned to a frequency of 440 Hz. This is true. Four hundred and forty hertz is the international orchestral standard tuning for middle A. The text also told me that the next A above middle A makes an interval of one octave, that is, eight notes. The frequency doubles every time you go up an octave. This is also true.

What frequency would a piano tuner use for the A one octave above middle A? If you said 880 Hz, you would agree with my grade 11 physics text. You would also be quite wrong. If you tune a piano using a doubling of frequency for each octave, it is unplayable. How do I know this?



After signing the contract for my first paid position as a physics teacher, I decided to invest part of my salary in the purchase of a piano, a 1906 Mendelssohn upright grand. It was in poor condition, and I didn't have much cash, so I purchased some parts from a piano supply shop, and reconditioned the instrument, replacing the rather rusty strings, fixing broken hammers, and updating the old, yellowed ivory on the keys with bright, white imitation-ivory plastic.

When it came time to tune the piano, I smugly relied on my B. Sc. in physics to develop the procedure. I purchased a tuning hammer, borrowed a signal generator from my lab at the school, and used my Hewlett Packard scientific calculator to make up a table of frequencies using 440 Hz for middle A as a starting point. The scale used in western music is the equally-tempered scale. Each octave consists of twelve semi-tones, so the ratio of the frequencies for any two consecutive semitones is the twelfth root of two. I checked the middle few octaves with the table in my physics text, and the frequencies matched.

Forging ahead, I adjusted the signal generator for each key in turn, and tuned it to the calculated frequency.

Eighty-eight keys and three hours of careful tuning later, I sat down to try out my handiwork. Mouth watering, ears twitching, I poised fingers over the keyboard in a basic C chord pattern and played. The result was atrocious: atonal, sour, and thoroughly unpleasant. The piano was unplayable.

What had gone wrong? I swallowed my pride in my hard-won university degree, and slinked off to the local library, where I found a text on piano tuning. What I discovered amazed me: more lies from my physics text!

Let's return to the 440 Hz middle A. According to my physics text, the second harmonic is 880 Hz, the third is 1320 Hz, and so on. Lies! The second harmonic is more than 880 Hz, and furthermore, varies from one piano to another.

A vibrating string possesses a property called stiffness. One can see this in a plastic ruler. Take a 30 cm ruler, and it is fairly easy to bend. Cut it in half, and each half is much more difficult to bend. Cut a piece in half again, and it is almost impossible to bend. This property is called stiffness.

When a stretched string vibrates, the fundamental frequency, 440 Hz in this case, results from a standing wave with a single loop. The second harmonic arises from two loops in the standing wave. However, the stiffness of the half-string forming each loop is higher than the stiffness of the entire string. The frequency of the second harmonic is more than twice the fundamental.

When tuning a piano, the A above middle A must be tuned to the first harmonic of the A below it, not to twice the fundamental. Otherwise, it will cause a dissonant beat when the two notes are played simultaneously, as in a chord. This correction to the tuning is sometimes known to piano tuners as "octave stretch". Since it varies from piano to piano, each piano must be tuned in a custom manner. Old-fashioned piano tuners relied on a keen sense of hearing coupled with a number of rules of thumb regarding beat frequencies (continued on next page) to produce a pleasing compromise in the tuning of the strings.Younger piano tuners rely on electronic tuners as tuning aids. These electronic tuners can be programmed to employ different octave stretches for different makes and models of pianos.

Armed with these revelations, I retuned my piano using my ears rather than a signal generator. It sounded much better.

References for further information:
Piano Servicing, Tuning, and Rebuilding, Arthur A. Reblitz, The Vestal Press, Vestal, NY.
http://members.aol.com/chang8828/contents.htm,
(an excellent online guide to the fundamentals of piano practice.)

The Demonstration Corner

Variable Tension in a Pendulum's String

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Marina Milner-Bolotin
Department of Physics and Astronomy
University of British Columbia, Vancouver

A very effective demonstration of a variable tension in a swinging pendulum can be performed using very simple equipment (Figure 1). Connect a large scale to a pendulum, pull it to the side and let go. As the pendulum swings the scale shows variable string tension values. The maximum tension will be observed at the bottom point of the swing (B). At this point, the mass will have its maximum speed and according to Newton's second law the string tension will exceed the pendulum's weight and will reach its maximum value: $T_B = mg + m\dfrac{v^2}{l}$. Notice that for all other points of pendulum's trajectory not only will the pendulum move slower, but also the tension and gravitational forces will not be aligned.

This demonstration can be turned into an interactive lecture experiment [1] using *Tracker: Open Source Physics Java Video Analysis Software* developed by Doug Brown at Cabrillo College [2] or using a video analysis feature of the Logger *Pro* software [3] and a video clip of the demonstration such as the one recorded by Doug Brown, the snapshot of which is shown on Figure 2.

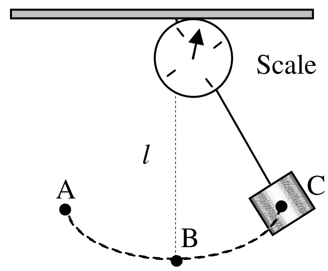

Figure 1: Demonstration – tension in the pendulum.

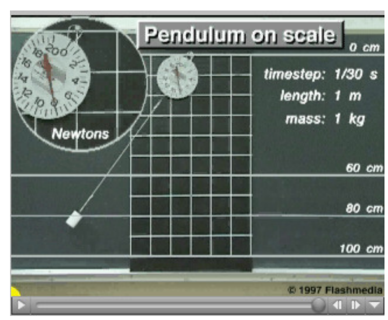

Figure 2: Video clip snapshot: tension in the pendulum.

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Email: elm@physics.uoguelph.ca
Submissions describing demonstrations will be gladly received by the column editor.

References:

1. Milner-Bolotin, M., A. Kotlicki, and G. Rieger, *Can Students Learn from Lecture Demonstrations: The Role and Place of Interactive Lecture Experiments in Large Introductory Science Courses.* Journal of College Science Teaching, 2007. **Accepted for publication**.
2. Brown, D., *Tracker: Open Source Physics Java Video Analysis*. 2006, Doug Brown: http://www.cabrillo.edu/~dbrown/tracker/.
3. Vernier Technology, *Logger Pro*. 2006, Vernier Technology: Portland Oregon.

Quantum Physics

Beyond the Two-Slit Experiment

Roberta Tevlin
Perimeter Institute Development Teacher
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The usual vehicle for looking at wave-particle duality in high school is the two-slit experiment. However, there is another fabulous example sitting right smack in the middle of the grade-12 physics curriculum that is usually ignored. Polarization.

If unpolarized light is sent toward a polarizing filter - half of it will get through. This can be explained by referring to components of the electric field portion of the EM wave. Now, what happens if you send one unpolarized photon towards a polarizing filter?

I had never thought of this question until I attended the Einstein+ workshop at the Perimeter Institute for Theoretical Physics in Waterloo*. The answer is that the photon either goes through or it doesn't - with a 50% chance for either possibility. There is no way to predict which of the two possibilities will occur - the process is intrinsically random in the same way that nuclear decay is random. Thus polarized light is a great example of the statistical nature of quantum events.

Now, so far, the polarized photon analysis doesn't seem terribly difficult or even all that interesting - but stick with me a bit longer. If light is sent towards two filters oriented at 90° to each other, we find that no light gets through. You can explain this by saying that the first filter stops the horizontally polarized photons and the second stops the 'vertical' photons. Or can you? If you put a third filter in between those first two and orient it at 45° to each of them, you find that light now gets through. You've added a third filter and the result is that more light gets through! How does quantum mechanics explain this? Suppose the first filter is vertically polarized. This vertical filter doesn't select vertically polarized photons - it causes some of them to become vertically polarized. This is an example of how measurements change the very thing we are measuring. This change is not due to sloppy experimental technique but is a core feature of quantum mechanics. Next the vertically polarized photons are sent toward a 45° polarizing filter and half photons of these photons pass through. Finally, these photons approach the horizontal filter. They aren't vertical photons anymore - they are 45 photons. Finally, these photons approach the horizontal filter.
Instead of all of these photons being blocked, half of them get through. In the end, ½ x ½ x ½ = 1/8, of the original photons pass through the three filters.

An examination of polarized photons can be used to deepen students' understanding of the fundamental ideas in quantum mechanics: intrinsic randomness, the connection between the observer and what is observed and wave-particle duality. It is also needed to understand quantum computing, teleportation and cryptography - three technologies that are in development now. Polarized photons are also needed to explain entanglement - considered by many physicists as being the key concept in quantum mechanics. If you want to learn more about these topics I highly recommend Jim Al-Khalil's book "Quantum: A Guide for the Perplexed". If you are going to STAO you should check out the talk by Damian Pope from the Perimeter Institute on " Teaching Quantum Physics via Hands on Games and very little Math" on Saturday Nov. 18, 2:30 –3:30.

I have been working on a game that allows students to explore entanglement. If anyone would like more information on this or if anyone else is working on introducing entanglement to their students, they can contact me at roberta@tevlin.ca. I'd love to exchange ideas.

* These are free weeklong workshops held at the beginning of the summer for teachers across Canada interested in bolstering their understanding of modern physics.

OAPT Conference 2007 *"Experiencing Physics"*
May 31st, June 1st, June 2 Ontario Science Centre, Toronto

Call For Speakers!
Here is your chance to share your favorite "experiencing physics" idea! We are looking neat demonstrations, lesson ideas or laboratories that are hands-on and/or interactive in the following areas:

Talks Demonstrations Workshops Poster Session

Please send your presentation idea and the approximate amount of time needed to **paul.passafiume@sympatico.ca**. And remember, what you may think of as being "old" maybe new to many of the members of our association. So get involved and share your terrific ideas!

Dave Doucettes PER Corner

An Introduction To P.E.R.

Dave Doucette
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Coming soon…to a Canada near you!

PER stands for 'physics education research', a PhD program amalgamating cognitive and educational psychology with physics education. This has become an option for M.Sc. (physics) graduates seeking a PhD path other than theoretical or applied physics. Researchers examine the ways in which physics is presented to students and compare pre and post test scores to determine conceptual gains. Primarily U.S. based, it is now poised to enter Canada – big time!

One of the pre-eminent supporters of this movement is Dr. Carl Weiman, 2001 physics Nobel prize winner. Dr.Weiman's passionate stance on the need for science education reform was poignantly presented to the U.S. House of Representatives Science Committee on March 15, 2006, where he began by stating flatly:

"*My main points are simple.*

1) Undergraduate science education is based on an obsolete model and is doing a poor job at providing the education that is needed today.

2) We now know how to fix it.

3) Until it is fixed, you can't fix K-12 science education."[1]

This committed and persuasive advocate for P.E.R. is coming to Canada, joining the University of British Columbia (UBC) faculty in January 2007. He was successfully lured by a $12 million dollar commitment to science education reform, his current primary research interest.

This unexpected coup may rattle some American physicists but it is a tremendous lift to those of us toiling to improve awareness of P.E.R. in Canada. It is easy to dismiss our impassioned pleas for change as naive enthusiasm but quite another to hear the compelling arguments of a Nobel laureate[2]. Thank you, UBC, for the boost to Canadian physics education and to Carl Weiman for adding his stature to PER reform.

In future articles, Dave will present examples of how P.E.R. plays out in his high school classroom. In the meantime, for a peek inside, see Dave at STAO session 2502 [Martial Arts can give you the H.O.T.S.] on Friday November 17. Yagottaloveit!

1 http://www.house.gov/science/hearings/research06/march%2015/wieman.pdf

2 For this and many other excerpts and broadcasts on Dr.Weiman, visit the following website: http://www.ubc.ca/announce/

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the American Association of Physics Teachers)
March, 2006

President's Message

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Hello to all OAPT members.

Since we were last together in Sudbury, May 2005, your executive has undertaken a number of projects on behalf of OAPT. The beginning of the New Year is a good time to give you a report of the activities so far.

1. The conference 2006

The annual conference has been moved to the Perimeter Institute in Waterloo. Damian Pope of PI is organizing the conference as part of the outreach program of the Institute.

The title of our annual conference this year is: "**Innovative Teaching Strategies for Modern Physics**."

Two themes have been chosen:

1. Quantum Physics and Relativity
2. Authentic Inquiry

The Perimeter Institute is contributing at least one speaker to the lineup, and there are a number of modern physics education specialists on the agenda. As always, we are interested in having your participation (as a talk, or presentation) in an effort to make this conference a memorable one. If you would like to address one of the topics below, please contact me.

* Teaching exemplary courses in quantum/relativity

* Experimenting and demonstrating Q/R principles

* Effective use of media, simulations, etc for Q/R

* Theorists and engineers who can work with teachers to locate fruitful starting points

We have contacted the Photonics Institute for a possible set of demos/teaching strategies, and we will have some outstanding astronomers who use quantum based imaging techniques. Anyone interested in participating in the efforts of the conference committee is welcome and asked to contact Jim Ross.

2. Conference 2007, 2008 and beyond

In order to avoid the last minute rushing, we have begun to lay down the groundwork for conferences one, two and more years in advance. We are still talking of Kingston for 2007 (either RMC or Queens) and Ryerson is interested in hosting 2008. If we can settle upon the themes for these conferences this year, we can work much more effectively at securing top-notch speakers and presenters.

Once again, please contact me if you wish to become active on one or more of these committees.

3. Ministry of Education Review

Early in 2005, OAPT executive members had heard of a planned MoE physics curriculum review to begin in Sept. 2005. OAPT sent a letter to the MoE at that time, indicating an interest in participating. We did receive a reply indicating receipt of our letter, and advising us to wait for further notice. When no notice had arrived in September, other messages were sent. By November, we had been contacted by the MoE, but the review was already well underway.

We made contact with Maureen Callan in late November 2005, and began to prepare a submission at that time. I received a number of valuable contributions from Rolly, Paul, Vida and Elzbieta. With only weeks to go, our submission obviously could not be as thorough as we would like.

When we met with Maureen Callan in December 2005, we were able to engage in a very wide and frank discussion of the review process. It appears that the MoE dropped the ball on us. They had received our letters, to be sure, but they had no records of OAPT having been a registered educational organization. In fact, OAPT had been fully recognized years ago, and had been active participants in other MoE curriculum initiatives in the past.

In February, the Curriculum and Assessment Policy Branch of the Ontario Ministry of Education notified us that they have renewed our membership. We are now back on the list, and will be invited to participate in the next physics curriculum meeting on May 12, 2006.

John Caranci will organize and coordinate OAPT's contribution to the MoE physics review. He plans to consult with members more extensively. His report is once again going to be quite quick (Feb., 2006) but there will be another opportunity to participate in Sept., 2006.

4. Newsletter

Paul Passafiume has done a great job of preparing and distributing the newsletter. The new format is pleasing to all, and the column format appears to be well received. The newsletter is poised to grow. If we maintain the existing columns, we can add to the format as new people come aboard.

5. Membership List and Tracking

At the present time, Ernie McFarland and Carol Croft at U Guelph have been maintaining the membership list. As our membership grows, that task grows as well. It's important to keep close contact with the members as they drop in and drop out, change schools or residences, change emails, and so on. This is the time to make some major changes to the organization of the membership database. For example, it would be very useful to have one database containing Ontario's secondary schools (about 900 of them) so that we know which of the schools have OAPT members (numbering about 400) and which to not. A relational database with those capabilities would support our other organizational projects.

5. Web Site

Rolly Meisel has done an outstanding job maintaining and improving upon the web site. We have some money for a major overhaul, and the executive committee believes that is the most effective way to use the cash. The plans include

* our own domain name, and independent hosting

* a web site built upon an appropriate database that controls conference registration, and records

* physics contest registration, communication

* photo contest registration, communication

We are, of course, concerned about membership privacy. The number of ID's and passwords that could access this information would be very tightly limited. We would consult with the larger membership on appropriate ways of maintaining security of that information.

In closing

There are, as usual, a number of very essential projects running this year, for the benefit of the whole OAPT organization. Diana has the photo contest well in hand, Terry is putting the physics contest on the tracks, and the world looks great.

Thanks for all of your contributions!

Jim Ross

The Case for Modern Physics

Dr. Damian Pope
Director of Scientific Outreach
Perimeter Institute for Theoretical Physics
www.perimeterinstitute.ca

On a frosty December day in Murray Hill, New Jersey in 1947, two scientists gathered in their lab to show their boss a device they had just built. It amplified electrical signals and, after much effort, they had just got it working. John Bardeen and Walter Brattain were very proud of their achievements. Their boss was impressed.

In weeks that followed, the new invention was given a name, the *transistor*. At the time, everyone thought it would be of some use, but no one predicted just how big it would eventually become.

As the years passed, more and more engineers and technicians began using transistors in various electronic devices. Today, 59 years later, they are everywhere.

Think of your cell phone, your computer or your students' IPODs. Each of them contains thousands upon thousands of tiny transistors jammed into minute circuits. Worldwide, 10^{18} transistors are manufactured annually.

Transistors are like tiny electronic switches. Send a current through one part of them and a larger current flows elsewhere ('ON' mode). Without the initial current, the larger one is absent ('OFF' mode).

Arguably, transistors form the backbone of the multi-billion dollar electronics industry. They are an important part of modern life and have billions of dollars of economic impact annually.

Both Brattain and Bardeen had strong backgrounds in physics. But, what particular sort of physics guided them as they struggled to build the first transistor? Was it Newtonian physics? No. This set of theories predicts that the transistor is a physical impossibility as it should fall apart within a split second due to electrons emitting radiation upon accelerating.

Instead, Brattain and Bardeen relied significantly on the recently developed theory of quantum physics. In particular, they employed quantum models of how many, many electrons within solids behaved. Without these models, they may not have been able to build their prototype. They would have lacked a fundamental understanding of the materials they were dealing with.

This story is just one of many examples that illustrate of the immense practicality of modern physics. Today, in 2006, such physics is an integral part of our daily lives.

Presumably, one of our goals as teachers is to prepare students for the real, day-to-day world. One important aspect of this world is modern physics. And as emerging technologies such as quantum computers, quantum teleporters and quantum secret codes (the last of which is already a commercial reality) develop more and more, the significance of relativity and quantum physics will only grow.

Given this, whilst also acknowledging the importance of first giving students a solid foundation in Newtonian physics, isn't it desirable that we ensure that they are adequately exposed to modern physics in high school?

I believe that one can make a good case to support this notion.

And I invite you to join me at this year's OAPT conference at Perimeter Institute in Waterloo to further explore modern physics at the high school level, along with innovative teaching strategies for *all* topics, modern or otherwise.

I hope to see in you here in late May.

Digital Physics

Exploring the Work-Energy Theorem

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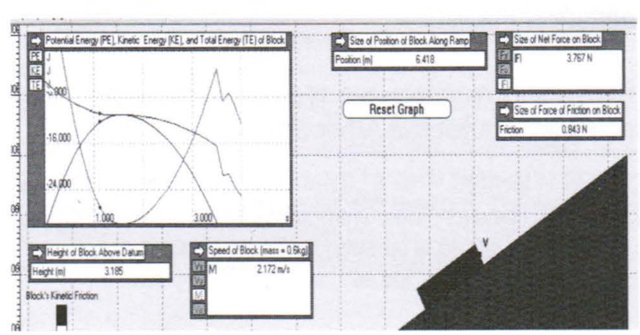
Hello everyone, and welcome to another edition of Digital Physics! These words come to you at a particularly busy time for us all – the dreaded exams! May they find, and serve you well! In this column, as promised, we'll take a look how we can lead our students to a functional understanding of the subtle difference between the Law of Conservation of Energy, and the Work-Energy Theorem. Once again we'll solicit the power of Interactive Physics 2000 as a means of assistance along our journey. All set? Here we go!

As we all know, the Law of Conservation of Energy states something like this: the total mechanical energy of a system remains constant unless non-conservative forces act to increase or decrease it through the mechanism of work. Mathematically we might write: $E_i + W_{i\to f} = E_f$ (1), where E_i is the total energy of the system in its initial state, E_f is the total energy of the system in its final state and $W_{i\to f}$ is the amount of energy that is transferred to or from the system by non-conservative forces as it moves from its initial to final state. Now, what about the Work-Energy Theorem – what is it all about, and does it differ substantially from the Law of Conservation of Energy? Well, of course we know that the Work-Energy theorem states something like this: the total kinetic energy of a system remains constant unless a net force acts to increase or decrease it through the mechanism of work. Mathematically, we might write this as: $E_{ki} + W_{i\to f} = E_{kf}$ (2), where E_{ki} is the total kinetic energy of the system in its initial state, E_{kf} is the total kinetic energy of the system in its final state, and $W_{i\to f}$ is the amount of kinetic energy that has been transferred to or from the system as work done by the net force. Essentially the Work-Energy Theorem is just a statement of the conservation of kinetic energy. When we frame this sort of discussion for our students it seems (for us) to be fairly straight forward, but for many of them it is not. Much of this discomfort stems from difference between the two work terms in each of equations (1) and (2). Ratifying this difficultly is possible by examining (using Work-Energy Theorem) the derivation of gravitational potential energy of, say, a cart coasting up a frictionless ramp (this clarifies the difference between conservative and non-conservative forces). Given how little time we have in which to teach these ideas, this option is not very practical.

Another possibility is to give the students some practice with this concept (following its introduction) using IP2000. Unfortunately there was no "canned" script that would enable me to do this with my class, so I had to write one of my own (not an easy task). I am by no means an expert on writing IP scripts, but I do have some experience in the area and can tell you this: the software is hard to program, the manual is even more elusive and the whole experience can just about put you in the clink. *However*, once you have a simulation that actually works the results can be fantastic and very rewarding. Students get a lot out of it – much more than you might at first think given uncooperative nature of the software. The simulation I made is simple enough: a block of set mass and initial speed slides up a ramp. The script measures block speed, position, height above datum, net force and frictional force. Although initially set to zero, the coefficient of sliding friction may be adjusted to reasonable values (weird things start happening beyond this!).

Now, here's how I work things. I'll have the kids set up in small groups huddled around a computer. We have five computers in our classroom which usually means at least five students to a computer. I'll have the students run the simulation and stop it at some arbitrary point in time as the block slides up the ramp. They will then use the information displayed by the simulation to determine the speed of the block in its final position. This is done using both the Law of Conservation of Energy, and the Work-Energy Theorem. The answers obtained can be verified with the output of the simulation. At this stage it is worth noting that, at least with this simulation, wild things begin to happen if the block is stopped too near to the top of the ramp. This likely indicates a limitation of the software, and can be avoided by stopping things farther down the ramp.

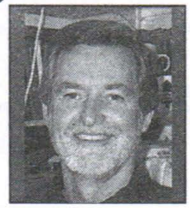
Included below is a sample screen capture from the simulation that I use. It has been cropped to fit into this article, but the essential information is there. This simulation also plots the energy curves as functions of time, which is a neat little visual that may bring some clarity to the math.



As always, I'm eager to see how some of these ideas might work for others. If you'd like to try them, let me know and I'll send you the simulation and any work sheets that go along with it. Feel free to email me at the above address.

Until we meet again!

The Demonstration Corner



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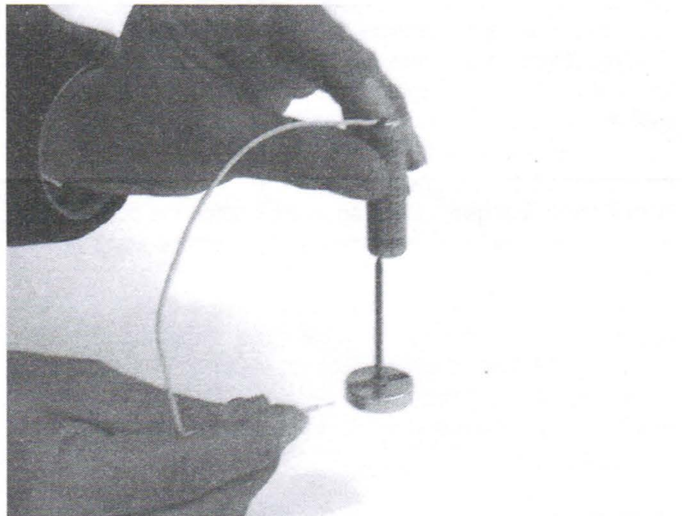
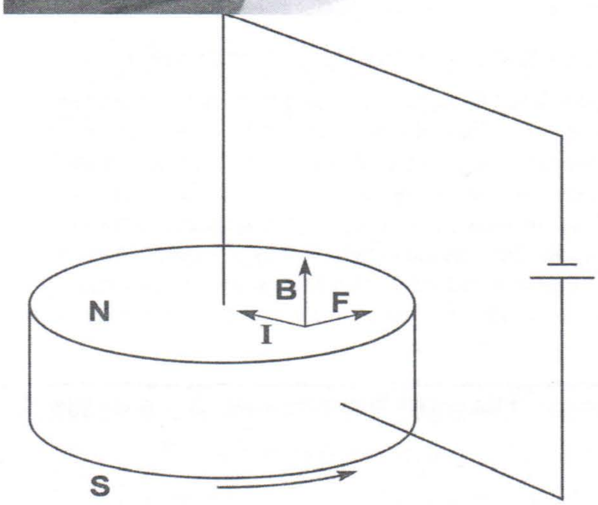
The Word's Simplest Motor

By: John Pitre, University of Toronto, St. George Campus

In the December 2004 issue of *The Physics Teacher,* Christopher Chiaverina described a motor consisting of four components: a battery, a cylindrical rare earth magnet, a small piece of copper wire, and a steel nail. Since I know that many of our members do not have ready access to this journal, I have essentially reproduced his article here.



The picture on the right shows the motor that we built at the University of Toronto. The left hand holds the battery and the forefinger holds one end of the wire against the positive end of the battery. The magnet sticks to the head of the nail and the tip of the magnetized nail is attracted to the ferromagnetic bottom of the battery. The right hand touches the other end of the wire to the side of the magnet. That's it! You'll be amazed at how quickly the cylindrical magnet spins.



It's easy to understand how the motor (technically called a homopolar motor) works by referring to the schematic diagram on the right. Current flows through the magnet and along its surface and the charge carriers experience a Lorentz force since they are moving in a magnetic field. The direction of the force $\vec{F}$ which determines the sense of rotation is given by the right hand rule or by the direction of the cross product $\vec{I} \times \vec{B}$. Of course, one can reverse the sense of rotation by simply flipping over either the battery or the magnet.

Rare earth magnets are readily available from any scientific supplier like Arbor Scientific and, for many of you, they are available locally at Lee Valley Tools. Get one soon and impress your students!

Grade 12 Physics Photo Contest:
In SPH4U category there are maximum 10 entries per school, in SPH4C category max 15 entries per school. Although the deadline to mail in your entries is between April 3 and May 1, students ending their semester one in January may want to prepare their photos now! See www.oapt.ca for the last year's winning entries.

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the A.A.P.T., and a charitable organization)
April, 2006

Physics and Cognition

Teaching Grade 10 Students Physics

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Last issue, we examined the difficulties that beginning physics students face as they attempt to learn both *vector operations* and *physics concepts* at the same time. The biggest problem appeared to be that students would choose to add vectors they should subtract, and vice versa. Beginning students would lack the ability to recognize that certain sums or differences were physically meaningless quantities. When we looked at the *sequential* vectors, we found that we should expect our students to get a wrong answer over 60% of the time.

Now let's consider the case of two vectors which occur *simultaneously*. Meaningless quantities are indicated with a ϕ. The set of physically meaningful sums and differences is surprisingly small.

The top left box would then mean " the sum of two simultaneous position vectors of a bowling ball." The first thing we notice is that this operation results in a physically meaningless vector. It is not possible for a bowling ball to have two simultaneous positions that can be added or subtracted. Likewise, it is not possible to have two different displacements at the same instant.

Simultaneous velocities are next. Students first encounter them in navigation problems: a boat motors North while the river flows East, or an airplane flies Southeast while the wind blows West. These are frame-of-reference calculations, not kinematics calculations. Suddenly, the vectors mean "velocity of the water with respect to the earth" and "velocity of boat w.r.t. the water."

Sums and differences of simultaneous acceleration vectors... Do they have a proper application?

Simultaneous force vectors are used in free body diagrams! I agree that FB diagrams are an indispensable tool, and students must learn how to construct them. I'm betting that you have got a student to draw FB diagrams, only to find that he or she makes a miserable showing on the kinematics questions on the final exam. Why? Well, if they can add simultaneous forces, why not simultaneous positions?

In the traditional physics curriculum, we expect students to become competent at vector math at the same time as acquiring competency in the concepts. But as we proceed from **x** to **d** to **v** to **a** to **F** to **p** and **j** through the traditional physics curriculum, we switch physics concepts, vector methods, and time-related grounds approximately once every three days or so. Sum or difference? Position or displacement? Simultaneous or sequential? The changes are so frequent and abrupt that students are confused.

	Position $\mathbf{x}$	Displacement $\Delta\mathbf{x} = \mathbf{d}$	Velocity $\mathbf{v} = \Delta\mathbf{x} / \Delta t$	Acceleration $\mathbf{a} = \Delta\mathbf{v} / \Delta t$	Force $\mathbf{F} = m\mathbf{a} = \mathbf{j} / \Delta t$	Momentum $\mathbf{p} = m\mathbf{v}$	Impulse $\mathbf{j} = \Delta\mathbf{p}$
Sum	ϕ	ϕ	$\Sigma\mathbf{v}$ is meaningful in relative velocity and frame-of-reference analysis	?	$\Sigma\mathbf{F} = \mathbf{F}_T$ Total force, Newton's 2° Law Free Body Diagrams	ϕ	$\Sigma\,\mathbf{j}$ Two simultaneous impulses on the ball will act as one impulse
Difference	ϕ	ϕ	$\Delta\mathbf{v}$ is meaningful in relative velocity and frame-of-reference	ϕ	$\Delta\mathbf{F} = \mathbf{F}_?$ Infer "missing" force by subtraction in FB diagrams	ϕ	ϕ

Teachers want students to succeed, so we provide only problems that can be solved by application of limited procedural knowledge to limited situations. Students are unable to understand those limits, and therefore cannot successfully apply their learning outside the most limited kinds of problems.

So... what are we to do? I would propose the following:

Begin in grade 10 with position and displacement. Provide students with plenty of experiences of measuring real two-dimensional position and displacement vectors. Emphasize the fundamental relationship that unites $\mathbf{x}_1$, $\mathbf{x}_2$ and $\Delta\mathbf{d}$. Provide lots of exercise in making representations, and solving problems with this relationship. This would provide the student with a familiar reference point with which to organize all vector sums and differences. Ideally, the vector operations Δ and Σ would become as familiar as their scalar counterparts.

Continue grade 10 with velocity. Do not spend time on sums and differences with velocity vectors! Provide only enough instruction in velocity to support the student moving to an understanding of momentum and impulse. Minimize the mathematical treatment of acceleration. Leave it for one year, as it is a subtle concept, and difficult for a young person to learn correctly.

Spend considerable time on momentum and impulse. Students have a profound intuitive understanding of momentum and impulse, far deeper and more certain than any of their personal knowledge of velocity, acceleration or force. We should use that knowledge, formalize it, and reinforce it through many applications in the students' world. Students experience many hundreds of these every day, all of them much more accessible to young people via a simple set of representations.

The momentum / impulse vector set behaves exactly as the position / displacement vector set. The operations in both vector sets can be directly and easily confirmed by students' experience. This is simply not possible with velocity, acceleration or force.

Think how much time you spend telling kids that they have it wrong! In fact, telling kids that "you have it wrong" is so much a part of the physics teaching culture that we actually include whole sections of "you probably have it wrong" in physics text books! Why not start with what they can get very right?

Next issue, I will fill in some ideas for the rest of the secondary syllabus. I'll stop here, and invite more responses. To those who have written, my deepest thanks. To those who have felt an urge to respond, please do.

Digital Physics

Exploring the Impulse-Momentum Theorem

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G'day everyone, and welcome to this year's final installment of Digital Physics! Last issue, we investigated a way of communicating to our students the subtle difference between the law of conservation of energy and the work-energy theorem. In this issue, we'll help our students draw an analogy between the work-energy theorem and the principle of impulse and momentum. The analogy that I wish my students to pick up from this activity is the following: just as kinetic energy is transferred as work done by the net force (W_{net}), momentum is transferred as impulse ($\vec{J}_{i\to f}$) delivered by the net force. Making such a comparison helps students gain a deeper understanding of physics in general, and impulse-momentum in particular.

My approach in drawing this comparison involves the use of IP2000, and the script that was discussed in the previous issue (block moving up a ramp). I begin by recalling with my students the work-energy theorem, namely: $E_{ki} + W_{net} = E_{kf}$. That is, the total kinetic energy of an object in its initial position plus the kinetic energy that has been added to it as work done by the net force is equal to the total kinetic energy of the object in its final position. With this review in place, we proceed to explore the principle of impulse and momentum (taught in the previous lesson): $\vec{p}_i + \vec{J}_{i\to f} = \vec{p}_f$. In words, this equation expresses that the total momentum of an object in its initial position plus the momentum that has been transferred to it as impulse by the net force as it moves from its initial to final position is equal to the total momentum of the object in its final position.

Now, here's where the simulation comes in. Students are given the initial conditions (or state) of the block, and then manually calculate the block's initial momentum. The simulation is then run and stopped some arbitrary time later as the block is moving up the ramp. Using the net force acting on the block as it moves, and the time over which that net force is applied, students can determine the momentum transferred to the block as impulse. Adding $\vec{p}_i$ to $\vec{J}_{i\to f}$ gives students what should be the final momentum of the block. Students can calculate, using data obtained from the simulation, the momentum of the block in its final position – thus verifying the principle of impulse and momentum and completing the analogy.

I have found this approach to be successful so long as the delivery is slow and methodical, but this is key.

As always, those interested in trying the simulation and worksheets are welcome to contact me at the above address. Comments are welcome, too, and many thanks to those that have! Happy teaching and see you at the conference in May!

The Demonstration Corner

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A Versatile and Inexpensive Physics Demonstration

By: by Debbie Chaves and Bruno Tomberli, Physics Department, University of Guelph, Guelph, Ontario, N1G 2W1

A versatile and inexpensive demonstration tool for every physics teacher is the "sound tube," also known as the whirly, Hummer and corrugahorn. Its puzzling properties span many different physics topics.

What is a sound tube? The sound tube is a corrugated plastic tube that is about 75 cm long and 3.5 cm in diameter. The most amazing property of the sound tube is its ability to "sing." By holding one end of the tube and swinging the other end around in a circle, you will hear a loud clear sound. As it is twirled faster, different frequencies are heard. The toy's packaging indicates that five frequencies are possible although this seems to be from only the most skilled "twirlers," as we could produce only four.

How do you investigate the sound tube? You can ask students to play with the tube and determine some physical principles associated with it. You could even ask them to take it home for continued experiments, but this might require a sound tube for each student. Our investigations determined the following properties.

1. If you close either the stationary or the twirled end of the tube there is no sound produced. To produce singing, the tube must be open at both ends.

2. A smooth tube of similar length and diameter does not sing when twirled.

3. The frequency of the lowest resonance does not correspond to a smooth open tube's fundamental frequency. In fact, the sound tube's fundamental is closer to the second harmonic of a smooth tube.

4. As the spin rate of the tube is increased, there are sudden upward jumps in the frequency. Intermediate frequencies are not heard.

5. Driving a car with the sound tube out the window will produce no sound if the tube is held perpendicular to the airflow, but will produce sounds if the tube is held parallel to the wind. Therefore, airflow is necessary for the singing sound but it is not produced by Bernoulli's effect. Frequency jumps are produced at the same driving speed as the tangential component of the velocity of the twirled end (Crawford, 1974).

Figure 1 One of the authors demonstrating use of sound tube. Inset: Close-up of sound tube.

Why does the sound tube sing? The singing is caused by turbulent air driven over the tube's crenulations by centrifugal pumping. The speed of the air flow through the tube is equal to the tangential component of the velocity of the spinning end (Crawford 1974). Laminar (low speed) flow produces no sound. The amplification of only particular frequencies is associated with the standing wave resonance produced by the tube open at both ends.

Where can you use this demonstration in the curriculum? Obvious places would be waves and sound. However, the sound tube demonstration can be used for topics such as centrifugal force, Bernoulli's principle, turbulence and Reynolds' number. The quantized sound tube frequencies also make for interesting demonstrations in quantum mechanics (Griffiths and Steinke, 2001). What more could you ask for $2.99?

References:

Crawford, F.S. (1974) Singing Corrugated Pipes. Am. J. Phys. 42:278-288

Griffiths, D.J. and Steinke, C.A. (2001) Waves in locally periodic media. Am. J. Phys. , 69(2):137-154

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HighSchool Teaching Strategies

Roller Coasters in the Classroom

James Ball
John F. Ross C.V.I.
james.ball@ugdsb.on.ca

Roller coasters provide wonderful examples of physics in action. Roller coasters link classroom concepts with the "real world". They are the "hooks" that grab the interest of our students and can fuel animated discussions. A trip to Canada's Wonderland is a school trip that is both educational and entertaining. Unfortunately for students taking physics in the first semester such a trip is not possible. Designing and building a classroom roller coaster is a viable alternative.

To introduce my students (I do this with both my grade 11 university physics and grade 12 college physics students) I use the Internet to show them this year's latest thrill machines. This year it was the monstrous Kingda Ka coaster at Six Flags in Ohio. This beast reaches a maximum height of 139 m (45 stories) and attains a maximum speed of 204 km/h. An onboard video[1] gives the students a taste of what it would be like to ride the actual coaster. Next year the park will be opening the world's steepest (76 degree) wooden coaster called El Toro and has a simulation [2] available for viewing. The students then use the Internet (and any other resources) to help them design their coasters.

For the actual construction I have found that 6 ft long hot water pipe insulation (split in half) to be ideally suited to the task. It is both economical and reuseable. Duct tape seems to do a good job of joining the lengths together. One inch thick sheets of foam insulation provide an economical base. Retort stands, furniture (desks, stools) and walls provide good vertical supports. Marbles can be used as coasters, but metal bearings do a better job. As part of the evaluation students must log their progress (successes and failures). In addition the students are evaluated for ***safety*** (the coaster cannot leave the track) ***efficiency*** (a ratio of the height gained to the height lost) ***thrills*** (features like loops, corkscrews, "negative g" hills etc).

The advent of economical digital cameras with video capability has meant that this project can be taken one step further. Students can then take a short video of their coaster in action (this often works better if the bearing or marble is painted white or yellow). This can then be imported into any number of video analysis programs like Logger Pro[3] or Physics Toolkit[4]. This allows students to track the coaster's position, speed and ultimately gravitational, kinetic and total energy. The depth of the analysis will depend on both the students and the time available. Regardless of the depth of the project the students benefit from this hands-on relevant project.

1. http://themeparks.about.com/od/photoandvideogallery/v/kingkavideo.htm
2. http://www.sixflags.com/video/shared/eltorohs.mov
3. http://www.vernier.com/soft/lp.html
4. http://www.physicstoolkit.com/index.html

What's New at OAPT?

The New Physics Funding Formula

Elzbieta Muir
Albert Campbell Collegiate
emuir@sympatico.ca

OAPT Conference May 26, 27, and 28 of 2006

Location: Perimeter institute for theoretical physics. On the Web: perimeterinstitute.ca

Themes:

1. Innovative Teaching Strategies for Modern Physics

Quantum theory and relativity form the bedrock of much of physics research done today. They are also immensely practical. These two theories were crucial to the development of numerous advanced technologies such as modern electronics, nuclear medicine and the GPS. In addition, Nobel prize winner Leon Lederman has estimated that 70% of the US's gross domestic product depends on quantum theory. In Ontario, quantum and relativistic physics occupy 20% - 40% of the prescribed syllabus, but rarely receive more than 10% of the time. Given their critical importance, how can we change high school physics education so as to ensure that they we do justice to them?

2. Authentic Inquiry

For the past 150 years, physics teaching has been dominated by content. We are now gradually realizing that this is not very effective in achieving our goals, and we are beginning to explore the Process Model. Real scientists don't do science by sitting in a classroom listening to lectures. Rather, they hive off a bit of the universe, poke it, and observe what happens. How do we allow our students the opportunity to model what real scientists do? This second theme of the conference will involve critically analyzing the merits and drawbacks of a number of innovative approaches to teaching physics. We know that members of OAPT are doing exciting work in the classroom. We invite you to share it.

Details and Reg. at: OAPT.CA. Don't miss this stellar conference!

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) April 2007

The Demonstration Corner

A Demonstration of the Production of Sound

Column Editor:
Ernie McFarland
University of Guelph, Physics Dept.
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John Vanderkooy
Distinguished Professor Emeritus
Department of Physics and Astronomy
University of Waterloo

For this demonstration, a small open loudspeaker driver is necessary, driven from a sound source with output power sufficient for a loudspeaker. A ghetto-blaster is convenient if it has an output jack or can be modified to direct the loudspeaker output to an external device. For best results the small driver should be of moderate or better quality. It helps if its compliance is high so that bass notes cause substantial cone motion.

When listened to by itself, the sound is thin and wispy, with largely treble output and no bass. If several square sheets of cardboard are provided with dimensions of, say, 40×40 cm, and 1×1 m, these can have holes cut into their middle so that the small driver will seal relatively well to these baffles. The smaller baffle causes the sound to improve dramatically, with much more midrange balancing the sound. The larger baffle will restore even more of the bass. With rock music the effect is very dramatic! You can listen to either side of the baffle

If you have the resources, try to build an exponential horn such as shown in Fig. 1. It not only gives a balanced full-range sound, but the loudness is much higher.

As a final demo, place the driver over a sealed container, say a small dewar, or a closed cardboard box with a hole cut into one face (Fig. 2). The sound will be rich and full again.

With the baffles, horn or box, the sound will revert to its poor condition very quickly if the driver is moved even a centimetre or two from a good seal with the baffle.

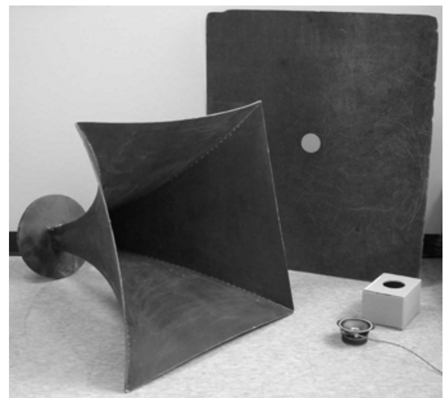
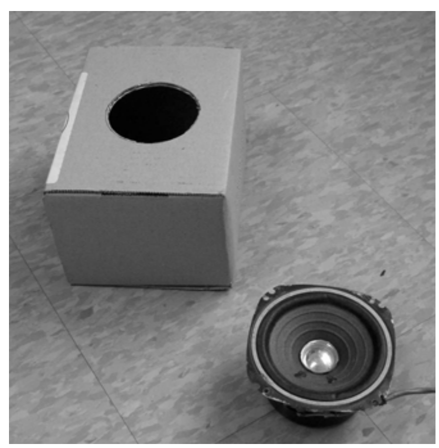


Figure 1 *Equipment: speaker, baffle, cardboard box, and exponential horn.*



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$$p = \rho S\,a/(4\pi r),$$

where ρ is the density of air, and the factor 4π comes from the fact the sound is spreading out over a solid angle of 4π steradians.

The problem with our open driver is that it produces two sound sources, one on each side of the cone, that are exactly 180° out of phase. This causes cancellation at those frequencies where the path difference between front and back sources is less than half a wavelength, and thus the lower frequencies, having longer wavelengths, are progressively more cancelled, leaving only the treble. A baffle increases the path difference, reduces the cancellation of the lower frequencies and improves the midrange and bass response. For a 1-m square or round baffle, the path difference of 1 m progressively causes only those sounds below about 150 Hz (corresponding to 1/2 wavelength) to be cancelled, and that makes it sound good in a demonstration.

The horn causes the efficiency of the sound source to rise remarkably, since the confinement of the air in the throat increases the pressure there. Thus the moving cone does more thermodynamic work on the air, producing more acoustic energy. The horn eventually spreads out and allows this energy to move into free air. Although we have stated that for a free source spreading sound into 3 dimensions, the pressure amplitude is given by the volume acceleration, in a horn the sound is more 1-dimensional, and then the pressure amplitude is proportional to the volume velocity of the source (units m^3/s), with much higher efficiency.

The small box prevents the sound inside the box from cancelling that which comes from the front, so the sound has a full-range character. Naturally we would mount the driver with its cone facing outwards, but all students will see that this is the origin of the box loudspeaker. Of course there are refinements; the box may be filled with sound absorbing material, or it may have a port to give resonant enhancement of the bass. Only the bass creates the need for a box of substantial size; in fact for normal loudspeakers the size of the box is inversely proportional to the cube of the lowest frequency it will reproduce. Halving the lower cutoff frequency requires eight times as large a box! That is why satellite speakers, which respond only down to say 80 Hz, can be quite small. The single subwoofer accompanying the satellite speakers often has a reduced-size box as well, but then it must have a powerful amplifier that just pushes and pulls harder on the air in the box, giving good bass.

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Don't miss the deadline for the OAPT photo contest

submit your entries to ***Diana Hall****, Contest Coordinator (diana.hall@ocdsb.ca)* ***by May 1st***
Please visit www.OAPT.ca and read complete contest details, see past winners and sample photos

QUANTUM PHYSICS

Experimentally Determining Relativistic Momentum

Roberta Tevlin
(Danforth C.T.I., Perimeter Institute Development Teacher)
roberta@tevlin.ca

I don't know about you, but I have always had trouble dealing with momentum in Special Relativity. I have yet to find a theoretical derivation for it that is sufficiently rigorous and yet relatively easy to understand. N. David Mermin's treatment in his new book "Its About Time" is getting close, but is still too difficult. Most textbooks simply say that the derivation is beyond the scope of the book and then present the formula, p = γmv. I'm especially uncomfortable with this approach in relativity where the consequences are so counterintuitive. We want our students to be sceptical of wild claims and we aren't doing this properly if we resort to "It must be true because Einstein said so."

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After 15 minutes you should stop the DVD and have the students analyse the data provided. This data consists of a dozen histograms. Each one shows the different arrival times of electrons, muons and pions with a set momentum. The students use these graphs to calculate the speeds of the particles.

Next, the students plot momentum against speed. If momentum is equal to mass times velocity, then the graph should yield a straight line. It clearly doesn't. I like to challenge the students to find out what the relationship is by trying to linearize the graph. They plot momentum against v^2 and then v^3 and then v^4 etc. but no power of velocity works. This exercise is not tedious as long as the students use graphing calculators or a spreadsheet program. Sometimes one group figures it out on their own but usually I need to give them a hint by asking them how time and space are altered in relativity. They then plot momentum against γv and voila! a straight line. They have shown that momentum is proportional to γv and the last thing they do is find the slope of the straight line which turns out to be the mass of the particle, so p = γmv.

I have put together a worksheet for my students that differs from the one provided with the DVD and I would be happy to send it to anyone who is interested. I'd also like to hear from anyone who has found a theoretical derivation for relativistic momentum that works at the high school level.

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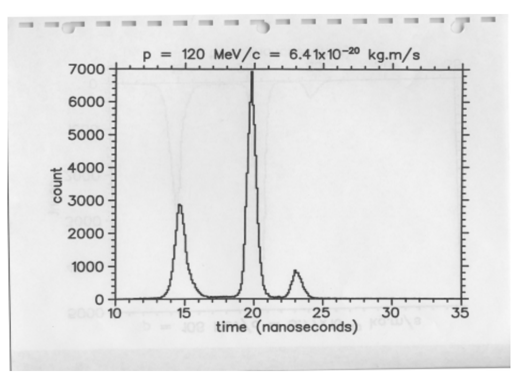

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FUN With PHYSICS

Uniform Circular Motion Misconception Rap

Sandy Evans
Northview Heights
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sandra.evans@tel.tdsb.on.ca

In our classroom you might get the notion
That we're sitting here still and there is no motion.
The illusion that you experience
Is due to your frame of reference.

On the perimeter of the earth we ride
From this fact we can't hide.
Speed demons would get their fix
To know we're going 1600 klicks.

Our motion story isn't done
We're also in orbit around the sun.
At a speed that would make Paul Tracy cower
We're moving at 107,000 kms per hour.

Speed and velocity are another misconception
Where kids today don't make the right connection.
Speed is just a magnitude
But velocity is a vector with attitude.

When an object 'tis in circulation
It has a perpendicular acceleration.
The source of the centripetal force
Causes the inward acceleration, of course.

Next time you take a roller coaster ride
You might think you're being forced against the side.
Your body just wants to continue in a straight line
Which Newton's 1st law states is just fine.

But from the coaster's non-inertial point of view
It has got to accelerate you to.
Up and down and Side to side
A fictitious force you feel on this ride.

Centrifugal…is the name
In this accelerated, non-inertial….frame.

Banked curves and inclined planes
Cause students' headaches in vain.
All they need to remember
Is where the net acceleration is

For curves the acceleration is in the horizontal plane
But for inclines it is along the plane.
So for curves resolve your vectors horizontally and vertically

But for planes resolve them parallel and perpendicularly (to the plane)

In orbit you may think there's no gravity at all,
But you're really in free fall.
You might drift off into space
If gravity didn't keep you in your orbital place.

This ends the misconception rap
Now you wear the expert uniform circular motion cap.

The Demonstration Corner

A Demonstration of the Production of Sound

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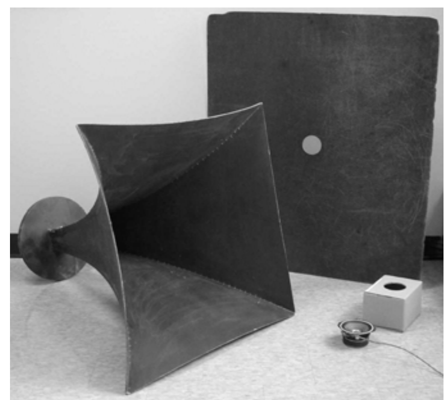

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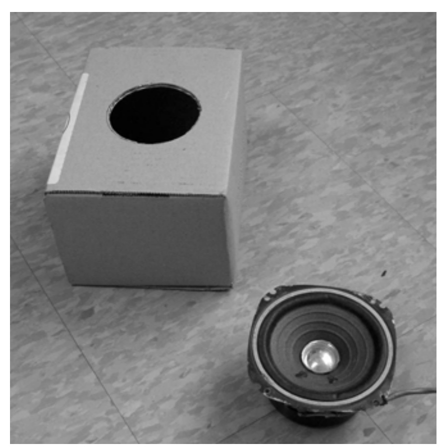

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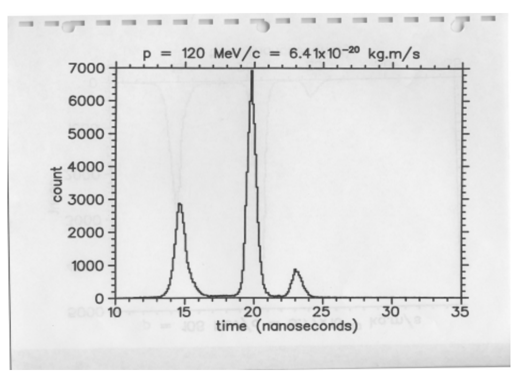

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Sandy Evans
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The illusion that you experience
Is due to your frame of reference.

On the perimeter of the earth we ride
From this fact we can't hide.
Speed demons would get their fix
To know we're going 1600 klicks.

Our motion story isn't done
We're also in orbit around the sun.
At a speed that would make Paul Tracy cower
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But for inclines it is along the plane.
So for curves resolve your vectors horizontally and vertically

But for planes resolve them parallel and perpendicularly (to the plane)

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But you're really in free fall.
You might drift off into space
If gravity didn't keep you in your orbital place.

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Now you wear the expert uniform circular motion cap.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) September, 2007

The Demonstration Corner

Seeing and Photographing High Speed Events

Column Editor:
Ernie McFarland
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Martin Fischer
Science Education Branch, Ontario Science Centre
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See the shards of a popping balloon, watch water drops suspended in the air or witness glass shattering — all of it seemingly frozen in time. Some of these events last less than one thousandth of a second but you can see them with your own eyes, thanks to the persistence of vision and a homemade sound trigger that releases a camera flash at exactly the right moment.

Figure 1 shows the setup. A high-speed event creates noise (A). When the sound reaches the microphone (B), the tape recorder (C) will send a current through the earphones wire (D). The current closes an electronic switch (E), which will trigger the flash (F).

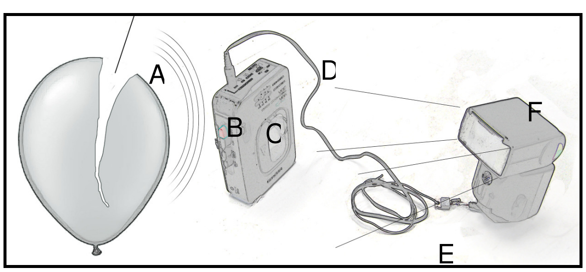

Figure 1

Figure 2 shows how to connect the wires to the electronic switch, which is a silicon controlled rectifier (SCR). Take a broken headset and cut off one ear bud. Strip the end of each lead, and then solder the leads to the anode and gate of the SCR. Then, solder the leads of a flash sync cord to the cathode and gate. If a flash has no sync connectors, connect the wires to the contacts on the hot shoe.

Let's say we would like to observe a popping balloon. Place the flash so that it will illuminate the balloon, but not blind yourself or your audience. Plug the headset jack into the voice recorder and turn on both the recorder and the flash. Snap your fingers to test the setup. After filling a balloon almost to the bursting point, turn off the lights (ensuring the room has no outside light) and then stab the balloon with scissors. The popping sound triggers the flash and you'll see a still image for a fraction of a second. By varying the distance between the balloon and the recorder, you can adjust the timing of the flash. Your students might be surprised at how close or far you have to place the microphone to capture the right moment, and they are left with a very tangible impression of the timing. They can also calculate the timing of high-speed events using the speed of sound.

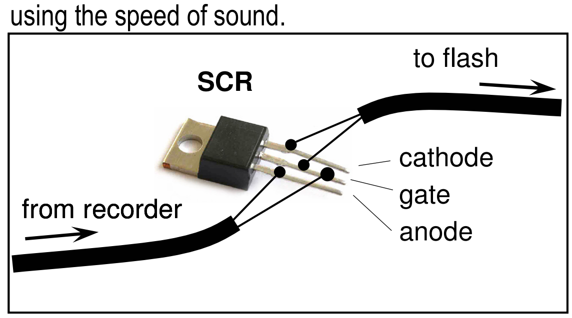

Figure 2

Sometimes you may get more than one flash in very short consecutive order. Most likely that is because the popping sound of the balloon reflects off the room's walls and triggers the flash again. We can solve this problem by adjusting the sensitivity of the recorder. If your recorder does not have that feature, wrap some foam around the microphone to dampen the loudness of the echo.

Most flash units can provide flashes as short as one 20-thousandths of a second. If they allow for manual setting, set it to the lowest power setting (e.g. 1/16). If they are fully automatic, put a reflective surface behind the object — the flash's circuit will stop the light more quickly.

Of course, even with persistence of vision, you only get a short-lived glimpse at the event. Taking a picture allows you and your students to see all the detail. Recording pictures with a camera is quite simple, especially if it is fully manual. We use the self-timer and an exposure time of ten seconds on our digital SLR camera. First, focus on the balloon. Then turn off the light, start the self-timer and when you hear the shutter of your camera, pop the balloon. Wait until you hear the shutter of the camera closing, and turn the light on again.

We were also able to get good pictures with consumer digital cameras, as long as they allow turning off of the built-in flash. To take a picture, turn off the room light, focus the camera by pressing the shutter release halfway and then press all the way. Another person then pops the balloon. Wait maybe twenty seconds until you turn the room lights back on, because you want to record only the light from the triggered flash, but no other light. Many things can be photographed that way, as long as they make a sound. Ask students to come up with questions that could be answered with this setup. For example, does a tennis ball flatten when hit by the racket? Are falling drops of water spherical or tear-drop-shaped? Enjoy!

The Ontario Science Centre uses science as the lens to inspire and actively engage people in new ways of seeing, understanding, and thinking about themselves and the world.

Links:
http://www.hiviz.com/ Fantastic source of information on high speed photography. Sells cheap kits for sound triggers (including one with a variable delay).
http://www.diyphotography.net/ All kinds of tricks to create your own photography equipment without spending lots of money.

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Submissions describing demonstrations will be gladly received by the column editor.

OAPT Conference Report

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Last year's OAPT conference was held at the Ontario Science Centre (OSC). The conference began with a "bang" as Rolly Meisel showed us some of his favourite demos. Dave Fish then showed us how our Universe was much like an iceberg. Matter being the tip of the iceberg while dark matter being what makes up the majority of our universe and lies "beneath the surface". Bob McDonald, host CBC's popular radio program Quirks and Quarks finished the evening with an amusing and educational talk entitled "Sports in Space" Bob showed us that the ultimate swimming pool would be found on a cylindrical rotating space station. The water would form a layer on the inner surface of the cylinder allowing the swimmers to swim continuously without ever having to turn! The evening was rounded out with a wine and cheese in conjunction with the judging of the OAPT photo contest (the last year that this will run). Friday began with a presentation by Canadian astronaut Bjarni Tryggvason. Bjarni elicited a great deal of discussion about our definition of weight. Unlike most high school texts the conclusion was that we should define weight as the upwards response to the gravitational force (usually referred to as the normal force). The OSC then demonstrated its expertise providing us with some excellent demonstrations as well as a behind the scenes look at how exhibits are created. Friday afternoon was an opportunity for delegates to attend workshops. Dave Doucette gave a dynamic workshop on using martial arts as a way of having our students use their higher order thinking skills (HOTS). Martin Gabber presented a session highlighting the use of simulations in the physics classroom while Roberta Tevlin showed us how Spacetime diagrams allowed for student centred learning. The day finished off with Professor Ernie McFarland from the University of Guelph presenting a thought provoking talk on energy. Saturday morning began with a presentation by Professor Norbert Bartel from York University. He discussed his work associated with the Gravity Probe B mission. The goal of this mission is to precisely test Einstein's theory of general relativity. Stuart Bislan, an adjunct professor from Ryerson University, demonstrated how photodynamic therapy could be used in the treatment of cancer. The morning concluded with a presentation by Tetyana Antimirova about a unique outreach program between the Ryerson Physics department and the high school physics teachers from the greater Toronto area. After lunch Ben law engaged us and showed us how to engage our students with some explosive demonstrations. Anjuli Ahooja reminded us that everything is physics and that we don't have to look far to find its relevance in everyday life.

Gunter Ladewig, president of PRIMA performance introduced us to TRIZ a systematic approach to innovation and the design process. Jim Ross, past president OAPT, gave us an update on the new high school curriculum and as has been a tradition for the last four years, Professor Jim Hunt from the university of Guelph concluded this year's conference with a fascinating discussion of anamorphic art.

A dynamic demonstration of inertia: Photo by Rolly Meisel

Dave Doucette's PER Corner

'Bridging Research into Practice'

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This is the 3rd in a series of articles using physics education research (P.E.R.) to modify instructional practice.This article considers a fundamental concept underlying both uniform motion and uniform acceleration – the 'time interval,Δt.

Begin at the Beginning

The time interval is often introduced cursorily as students measure distances or displacements to develop the ratio underlying the concept of *uniform motion*, $\Delta d/\Delta t$. It is an *a priori* assumption high school students easily handle such ratios. This assumption is not borne out by research. Arnold Arons cautions, "…one of the most severe and widely prevalent gaps…at secondary [school]...is the failure to have mastered reasoning involving ratios…This disability…is one of the most serious impediments to their study of science."[2]

How can we develop the concept of uniform motion,$\Delta d/\Delta t$, if ratio reasoning is so poorly discriminated? One suggestion is to have students develop the utility of this ratio through an active-learning paradigm.

Constant motion vehicles are available from many science suppliers and department stores at less than $10 an item. The next crucial item is a metronome, borrowed from the music department, or a freeware program downloaded from the net - to be played on a computer with speaker output. Simply tapping a stick on a table at one-second intervals will suffice.

Students mark the position of the vehicle with each one-second beat, for several seconds. They are asked to verify if their cars are 'constant speed vehicles' as advertised, using data to support their conclusion. Each group delivers an oral summary, with every member expected to contribute. This brings an element of group and individual accountability and provides a necessity for 'student discourse'. It is a method to gain cognitive engagement, an opportunity for students to verbalize with minimal risk, and according to Ed Redish is the 5th principle of cognitive instruction "For most individuals, learning is most effectively carried out via social interactions".[3]

Once complete the class is ready to operationalize a definition for uniform motion. Since you specified a one-second interval to locate vehicle positions, students naturally define uniform motion as relatively equal distances traveled in each one-second interval (*period*, *measure* or other student-suggested terms are equally useful).

This is an opportunity for guided-questioning to lead to richer insights. Groups are assigned to re-examine how their data would appear if they were assigned a time interval of 2.0 s, or 5.0 s, ½ s or 1.0 min, etc…to record their vehicle positions. This provides an opportunity for students to recognize position values, Δd, will scale up or down in **direct proportion** to the time interval, Δt. (This incidentally prepares the way to expressing this proportionality as a straight line on a position-time graph)

Students are led to recognize a 1.0-s interval is a *convenient* choice for developing terms such as velocity, acceleration, and impulse, and not a requisite. A step towards scientific literacy by underscoring physics concepts as a matter of invention and convention rather than necessity! “This approach immediately confronts students with the fact that scientific concepts are not objects ‘discovered’ by an explorer but are abstractions deliberately created or invented by acts of human intelligence [Arons, p.24].

To consolidate and extend the learning a work sheet is needed. Permutations of uniform motion should be explored, moving from simple and concrete to more abstract and challenging applications. For example, position-time data for a faulty constant-motion vehicle could be provided, with students distinguishing from the data when the motor was operating efficiently and the motion uniform. Data for a vehicle traveling from a level surface to inclines could allow students to identify different intervals of uniform motion. It is crucial in these examples for students to identify the distinct time intervals,Δt_1,Δt_2 and the associated position changes,Δd_1, Δd_2, etc and to defend why it is inappropriate to use Δt_{total} in such circumstances. Identifying the limits of a concept or algorithm also point towards improved science literacy.

Word problems should be appended to include consecutive time-interval descriptions such as, “An air puck with a small fan motor attached is started from rest. The puck requires 4.0 s to reach a speed of 20 cm/s at which point the fan motor stops. The puck continues forward at 24 cm/s on the frictionless surface until a small ‘parachute’ is deployed, slowing the puck steadily until it comes to rest at a time of 16 s.”

i) Identify the different intervals of time involved in the motion described. Describe the type of motion ideally occurring in each interval.

ii) Create a chart of data for the entire trip, choosing a time interval which seems appropriate. Explain why you chose the time interval for your chart. Suggest one other time interval you might have used instead. How would that choice change your data?

iii) Can you calculate Δd/Δt for any or all of your intervals of motion? In which case would the ratio be most accurate and appropriate? Would it have any meaning whatsoever in the other intervals?

iv) Create a position-time graph for the motion of the vehicle. Label the different intervals of motion. Justify the shape of the graph in each interval by referring to the type of motion involved. Then sketch a second graph of the same motion, but containing al least one significant error. Explain why this must be in error and contradicts the data, and why, in your opinion, a student might make this type of error.

These questions are not prescriptive but to showcase the level of thinking – and literacy- expected of the student. Of course, the same scaffolding is applied when t occurs in acceleration and impulse, by providing successively richer contexts in which students are lead to discriminate appropriate Δt’s and discard others. The habits of mind suggested by judicious development of Δt may move students to higher levels of scientific literacy and improved success as scientists – and citizens.

To provide feedback or share resources, particularly any developed with this article’s theme, contact Dave Doucette at doucettefamily@sympatico.ca.

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1. *America's Lab Report: Investigations in High School Science* The National Academies Press, 500 Fifth Street, N.W., Washington, D.C. 20001, ISBN: 0309096715

2. Arnold Arons, *A Guide to introductory Physics Teaching*, University of Washington. John Wiley and Sons, 1990. ISBN 0-471-51341-5, p.3.

3. Edward Redish, *Teaching Physics with the Physics Suite*, University of Maryland, John Wiley & Sons, 2003. ISBN 0-471-39378-9, p.39.

Email Addresses

We send timely information of interest to Physics Teachers by email to all members. If you have not received any messages from the OAPT in 2007, it means that we do not have your current email address on file. Please send an message to Patrick Whippey <pwhippey@uwo.ca> and we will update our records.

The OAPT does not share members' data with anyone. You can find our privacy statement here: http://www.oapt.ca/members/privacy.html.

Come and join us at Ryerson University May 22nd-24th for this year’s conference focussing on medical physics and physics education research

Newsletter Editor James Ball (contact james.ball@ugdsb.on.ca)

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) November 2007

The Demonstration Corner

Newton's Third Law and Water Rockets

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Having students construct and launch a water rocket is an entertaining way to investigate Newton's Third Law of motion. Students can construct the rockets at home for an in-class launching session.

Apparatus: two-litre pop bottle, range enhancers (see below), launching pad, bicycle pump with basketball-inflator "needle," rubber stopper.

Procedure for Students:

1. Find an empty two-litre pop bottle. You may glue on a "nose cone", some "fins" and anything else that you think might help your "rocket" fly farther. However, you may not use a set of "wings" or other form of lifting airfoil, like an airplane.
2. Decide how much water you want to place in the rocket. Put this much in.
3. Attach the rubber stopper firmly, and place your rocket in the launcher. Pump air into the rocket until it "fires."
4. Your "score" is the distance flown horizontally, in metres.

Notes to the teacher:

1. The launcher can be as simple as two boards, angled at 45º, with guide rails on the launch board (Fig. 1).

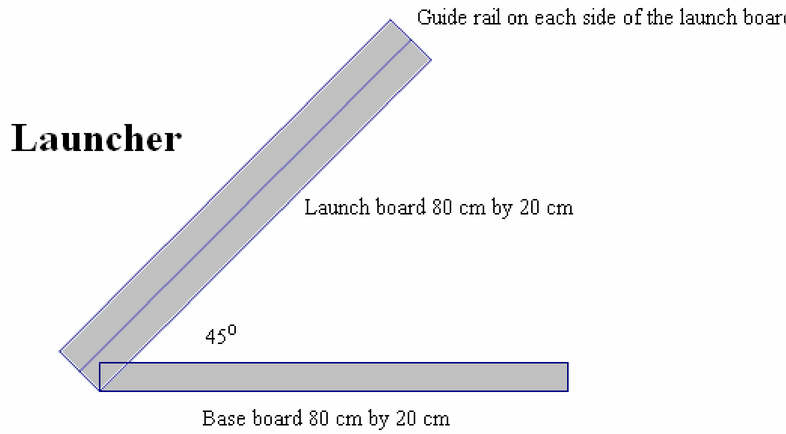

Figure 1 *A typical launcher.*

2. Ensure that the firing range is clear. A good water rocket can fly over 100 m horizontally.
3. Use a basketball inflator pushed through a rubber stopper to attach the bicycle pump to the rocket (Fig. 2).

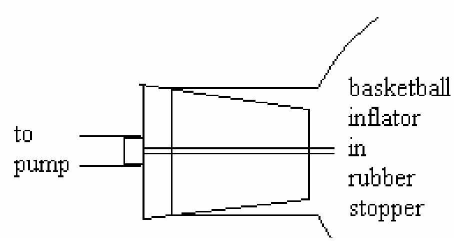

Figure 2 *Connection between the pump and the rocket.*

4. I usually do not warn students not to stand directly behind the rocket while pumping. A little water won't hurt them, and will reinforce the workings of Newton's Third Law.

Possible Follow-up or Report Questions:

1. Explain how the rocket works in terms of Newton's third law.
2. Why doesn't the rocket work well if there isn't much water in it?
3. Why doesn't the rocket work well if there isn't much air in it?
4. Which mixture seems to work the best?
5. A real rocket for use in space must carry both fuel and oxygen. Why is this?

Other Notes:

1. Just after launch, a "cloud" will often form inside the bottle, and persist for several seconds. Why this cloud forms makes for an interesting discussion or research question.
2. A more sophisticated launcher can include a way of changing the angle of the two boards, allowing an investigation of range versus angle of launch.

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Submissions describing demonstrations will be gladly received by the column editor.

The PhET WebSite

A Gold Mine of Physics Simulations

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I avoided using computer simulations in physics for many years because I felt that they were just a way to avoid the hassle of setting up a real hand-on experience. However, two years ago, Carl Weiman's brilliant summary of Physics Education Research in Physics Today* put me straight on that misconception. Simulations are a critical complement to real experiments for two key reasons. First, a simulation can remove the many irrelevant pieces of information that can distract the student from the key concepts. For example, many students think that the colour of the wires in a circuit is significant. Secondly, the simulations help them build the abstract mental models that are needed to analyse a real experiment. The concepts of current and potential difference are very difficult for students to grasp. A simulation that shows charges moving in a circuit can really help.

Having grasped the importance of simulations I went hunting around for useful examples - googling applets, simulations or physlets is a good way to start. However, this takes a lot of time and many of these are really just simple animations with very little opportunities for interaction. Furthermore, when you do find one that is good and work a regular place for it in your course, you often find that the website has disappeared. Once again, Carl Weiman's article had a great suggestion – the PhET (Physics Education Technology) website** of the University of Colorado. This one site is full of interactive simulations ranging from university level quantum mechanics to an elementary level John Travoltage.

I use these simulations in a variety of ways. The electric circuit simulation is great to use <u>before</u> working with real circuits. The students get to fry batteries and blow up light bulbs and generally experiment freely with no risk to equipment or life. I like to demonstrate things qualitatively with a ripple tank and then have the students collect data with the wave simulation. In other areas, I use the simulation in a full-class format to explore the concepts using the Predict Explain Observe Explain technique. Finally, the simulations can be great motivators when used as open-ended physics games. My students' favourites so far are the Lunar Lander and Electric Field Hockey. I get dozens of students hanging around at lunch and after school trying to win and incidentally building their understanding of physics.

* **Weiman, C., & Perkins, K.** 2005, "Transforming Physics Education," *Physics Today*, 58(11), 36.
** http://phet.colorado.edu/new/index.php

Dave Doucette's PER Corner

'Bridging Research into Practice'

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This is the 4th in an series of articles using physics education research (P.E.R.) to modify instructional practice, ie, 'Bridging Research into Practice'.

Having a Ball With Physics

(gr. 11 university physics)

As experienced physics teachers, we are fully aware of the difficulty students have in applying equations to simple phenomenon. Students select values for time intervals, displacements, mass and so on that are puzzlingly inappropriate. In the 3rd article of this series I discussed challenges in selecting the correct Δt in concrete applications and suggested adaptations to help students explicitly identify correct and incorrect time intervals. This article examines similar difficulties selecting appropriate Δd values while throwing a tennis ball.

Throwing a tennis ball seems a direct and relatively simple application of an external force (your hand) doing work on an object (the ball) to produce a change in kinetic energy. Where students commonly err is in selecting the correct 'Δd' to apply in 'F·Δd'. The majority choose the displacement of the ball after the ball is released from the hand, and not the displacement of the hand while throwing the ball. To combat this misconception I developed a sequence of scaffolded questions.

The activity was preceded by a discussion of the difficulties students have in applying formulae to phenomena, with examples. They were instructed to throw the ball, measuring the distance the ball moved while the force was applied by the hand. They measure time and the horizontal distance the ball travels to determine the average velocity. Neglecting friction, this allows them a reasonable approximation for the ball's kinetic energy.

The 1-page worksheet was as follows:

EW1.02 identify conditions required for work to be done, and apply quantitatively the relationships among work, force, and displacement along the line of the force

m_{ball} = ____ g = ____ kg Δd_{arm} = ____ m
Δd_{tossed} = ____ m   Δt = ___ s V_{av} = ___ m/s

1.You do ***work*** *when you throw a ball, F·Δd. In this formula:*
i) what does F refer to? acting on what? by what?
ii) what does Δd refer to?
iii) what changed about the ball as a result of the work you did on it?
2. To measure the V_{av} above, you used 'Δd/Δt'. How is this 'Δd' different from the 'Δd' you used to measure the work done? Does it matter which 'Δd' you use to determine the work done on the ball? Explain.
i) calculate the change in kinetic energy of the ball: $\Delta KE = KE_f - KE_i$
ii) assume the ΔKE was a result of the work done by you on the ball. Use this relationship to determine the $F_{average}$ you applied to the ball.
iii) Why do we call it the average force, $F_{average}$, instead of a 'constant force'?
3. Imagine you did the same amount of work on the ball, but threw it straight upwards. What would happen to the kinetic energy of the ball? How high would it rise?

The results were encouraging and illuminating. During the activity phase in our hallway students peppered me with clarifying questions, such as: '*Is F the force the ball exerts on my hand or my hand exerts on the ball?*' '*Is F the force of my hand when I'm holding the ball or when I throw the ball? Aren't they the same thing*?' '*Is the delta d when I am throwing the ball different from the delta d to where the ball lands on the ground*?' '*Doesn't the force of your throw continue until gravity takes over*?' Sobering questions, reinforcing the need to provide myriad opportunities to apply seemingly simple concepts.

The worksheet results were mixed, with a small percentage of students correctly applying both work and kinetic energy change formulae. The majority of students demonstrated inconsistencies – or worse – in their responses. Some incorrect examples were:

Question *You do* ***work*** *when you throw a ball, F·Δd. In this formula: i) what does F refer to? acting on what? by what?*
Answer*: F refers to the force applied on the hand, from your arm*.
Question: *ii) what does Δd refer to?*
Answer: *The displacement is how far the ball traveled. From when it was tossed to where it landed.*

More encouraging were responses such as: *'ΔD refers to the displacement of how far my arm extended, when the ball was in contact with my hand, not when the ball flew away from my hand.*' '*The Δd_{tossed} is the distance the ball traveled. The other Δd_{arm} is the distance measured while the force is being applied. In order to determine the work done you would need to use the Δd_{arm} because that is where the force is being applied*.' The latter was written by a student who to date was failing in the course.

Misconceptions of force and kinetic energy were also revealed. A common phrase was, '*The ball gained kinetic energy which caused it to accelerate forward*', which reveals a failure to discriminate between force as a cause and kinetic energy increases as an effect. However the worksheet provides an opportunity for a formative dialoque between teacher and student, moving the student towards a deeper understanding of fundamental concepts.

Sometimes you have to read responses carefully to recognize a misconception! In answer to the question *Why do we call it the average force, $F_{average}$, instead of a 'constant force',* one student wrote, '*You call average force, F_{av}, instead of constant force because you want the total force you applied on the ball. Constant force would mean that you are referring to the force applied through the whole traveled time*.'

The reference to a force *applied through the whole traveled time* suggests the persistent notion of the force of your hand traveling along with the hand until it 'dissipates', much as 'heat dissipates from a heated object' - to use layman's logic. Until Newton's time this was the prevailing orthodoxy and continues to this day among naïve learners. Only a deep appreciation of the Newtonian concept of forces causing accelerations that tends to put this misconception to rest.

What was truly surprising was a significant number of students correctly identifying the Δd to use in F·Δd, explaining why it was incorrect to use Δd_{tossed}, yet using the incorrect Δd in the subsequent calculation for $F_{av}= \Delta KE/\Delta d$!

The results overall are encouraging. The challenge will not be overcome by any single application. A progressive emphasis on distinguishing correct values for time, force, mass, displacement is demanded. This includes word problems in which multiple values are provided and differentiation is necessary. A colleague, Gord Ridout, has already included this in a recent quiz by asking "To throw a 145 g baseball a pitcher applies a force of 35 N for a distance of 1.8 m. If the ball travels 30m, find the amount of work done by the pitcher on the baseball." One could add, 'Identify a value for Δd which does not belong in the formula W= F·Δd.'

The hope is that, by directed attention to the problem students have in mapping formulae onto real-world phenomenon, we will produce graduates with richer insight and who more readily perceive physics in the world around them.

Who thought throwing a tennis ball could be so enriching? It certainly was – for me!

If you wish a 'Word' copy of the worksheet, or would like to exchange similar efforts, contact the author at the email enclosed.

Please direct questions or comments to the editor James Ball james.ball@ugdsb.on.ca

Please join us May 22-24th at Ryerson University for our Annual OAPT conference

- Participate in interactive workshops
- Tour Ryerson's Medical Imaging Facilities
- Tour Toronto's deep water cooling facility
- Engage in discussions with colleagues from across the province
- Learn about the new high school physics curriculum
- Take home practical ideas for teaching physics
- Improve your physics teaching through Physics Education Research

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the A.A.P.T., and a charitable organization)
February 2007

Editor's note: The following article was written in response to Rolly Meisel's article in our November newsletter . Responses are encouraged and can be sent to james.ball@ugdsb.on.ca

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Pianos and Inharmonicity

The amusing article "Lies My Physics Text Told Me" by Rolly Meisel in the November 2006 OAPT Newsletter points out important differences between idealized systems discussed in school texts and real applications. Rolly's experience revisited the famous contest in 1706 between Johann Nickolas Bach (an organist in Jena, Germany, and a cousin of Johann Sebastian Bach) who used only his ear to tune an organ and Johann Georg Neidhardt, who used a monochord with carefully worked out mathematical ratios. Bach won hands down, both on speed and on musical results. Reality does tend to complicate simplified scientific analyses, but details can illuminate subtleties of deeper physical principles. This is especially true in music, where I've had an enduring interest, and I felt some further discussion of tuning was appropriate.

It is important to distinguish between harmonics and natural modes of resonance. Not all texts or websites do this well. Any steady periodic tone can be analyzed into Fourier components at integer multiples of the fundamental frequency. The inverse of the fundamental frequency is the period at which the wave form repeats. The fundamental frequency is also known as the first harmonic, and the nth harmonic refers to the component at exactly n times the fundamental frequency.

Every physical object (string, drum head, xylophone bar, air cavity, block of wood, ...) has natural (or normal) modes of resonance, in which all parts of the object vibrate sinusoidally and in phase when appropriately excited. In melodic instruments, selected modes of resonance are usually aligned closely with some of the lower harmonics of a fundamental, but frequently some harmonics are not supported by resonant modes. In the clarinet family, for example, there are no resonances to support the lower even harmonics. When excitation stops, vibrating modes decay, as energy is radiated away as sound and lost as heat. The decay of isolated modes is typically exponential decay, but different modes have different decay times. Since decaying modes are not steady and thus not exactly periodic, their frequencies--as displayed in a Fourier or spectral analysis--are not precisely defined but have some spread or width.

The vibrating strings treated in high-school or first-year university texts are idealizations, like frictionless motion and massless pulleys. They are approximated not only as frictionless, having lossless vibrations, but also as being completely flexible, that is, having zero stiffness. One also approximates the both ends of the string as perfectly rigid whereas the bridge must move to transfer energy to the sound board, whose vibrations produce most of the audible sound. As Rolly points out, true strings all have some stiffness, and piano strings are much stiffer than violin or harpsichord strings. Stiffness is bad because it adds a restoring force that increases with frequency and raises the natural resonances above the corresponding harmonics, making them inharmonic. Thick strings are stiffer than thin ones, and in order to have sufficient mass without excessive stiffness, low strings on pianos are overwound with copper.

When a single note is played on a piano or practically any musical instrument, several modes are excited together. The strengths of the contributing modes depends on details of the excitation and damping conditions. To the extent that the excitation is steady, as can be approximated in a bowed string or a held tone on a wind instrument, the frequency components are harmonic, that is at integer multiples of a fundamental. Any harmonic whose frequency lies outside the natural width of any natural mode will not contribute appreciably to the sound. On a percussively excited instrument such as a piano or church bell, the several modes can contribute and their resonant frequencies are not restricted to a harmonic series.

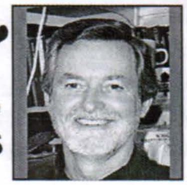
When two or more notes are played together, components with similar frequencies can interfere and produce beats that musicians use in tuning. Rapid beats are perceived as harshness and dissonance. As the frequencies of the principal beating components are brought together, the primary beat rate decreases to zero and the notes are perceived as being tuned to each other. However, softer beats between nearly matching frequencies of higher modes can often still be heard. When two notes an octave apart are tuned on a piano, the first (fundamental) mode of the upper note is tuned to match the second mode of the lower note. Because of stiffness in the string, the second-mode frequency is slightly higher than the second harmonic, and the best-sounding tuning occurs when the beats vanish and the octaves are slightly "stretched" relative to the harmonic frequencies. The resulting inharmonicity on a good piano is not great, usually only a fraction of a per cent on octaves near middle C, but it is more extreme near the ends of the keyboard and can add up to half a semitone (about

There are many other details of piano tuning that reflect subtleties in the physical phenomena and in our perception of sounds. These include the prompt and aftersound arising from degenerate modes with different polarizations, the effects of multiple stringing and the possibility of tuning them so well that the sound is dead, and the necessity of choosing a temperament. An introduction to these can be found in a couple of my favourite references:

Donald E. Hall, Musical Acoustics, 3rd edition, Brooks/Cole 2002; and

Arthur H. Benade, Fundamentals of Musical Acoustics, Oxford Univ Press, 1976.

The Demonstration Corner



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Physics and Music: Harmonics

Diane Nalini de Kerckhove

Diane Nalini de Kerckhove is an Assistant Professor in the University of Guelph's Department of Physics. She is also a singer/songwriter and recently launched her third CD, "Songs of Sweet Fire", a collection of Shakespeare songs and sonnets set to her original jazz and blues music.

I have never met anyone who doesn't like music. After teaching the physics of waves at various levels over the years, I've come to realize that demos involving music have a wide appeal with students, especially since most of them have studied an instrument at some point or another. Here are two options for exploring harmonics of standing waves. When first introducing the idea of a standing wave, I like to dig out a long spring (at least 2 metres long) and ask a student to hold one end steady. By moving the other end in simple harmonic motion, it is a simple matter to set the spring moving in the fundamental mode (and visually, it looks very much like a giant guitar string). Using a stopwatch, students can then find the average frequency. Finding the second harmonic (shown in Figure 1) is easy enough, and it is useful to slowly increase the oscillating frequency. The erratic movement of the spring as you ramp up from f_1 to $f_2 = 2f_1$ is helpful in demonstrating that a string of a given length will not sustain waves at frequencies other than multiples of the fundamental. The appearance of the first node between two antinodes always elicits an 'a-ha!' reaction. And, with a bit of practice, the third and fourth harmonics can be achieved, demonstrating very readily how nodes are evenly spaced, and added one at a time as one moves through the harmonic series. At this point I like to remind students that real strings on instruments oscillate in all modes simultaneously, with varying amplitudes. As a jazz singer myself, I first noticed this fifteen years ago when a bassist I was working with plucked an open G string and quickly 'tapped' the octave above the note as he slid through an intricate solo sequence.

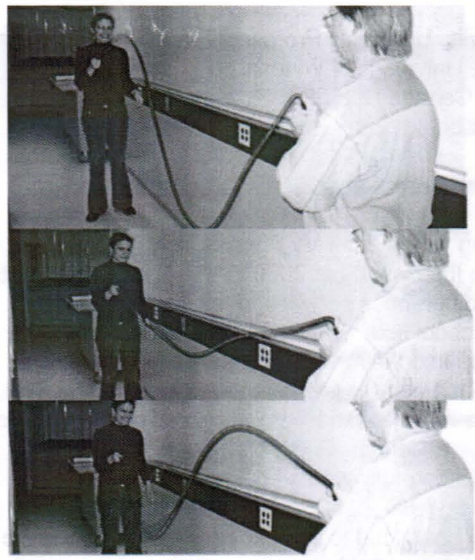

Figure 1 *Demonstrating the second harmonic on a long spring.*

Afterwards, I asked him to show me again how he did it: he simply touched the string (which was still sounding low G) at its midpoint. This damped out the fundamental in the exact position of the node for the second harmonic, which continued to sound, thus producing the octave above the low G.

Using a microphone connected to an oscilloscope with a Fast Fourier Transform setting (for example, the Tektronix TDS 1002), one can monitor sound waves in both the time and frequency domains. If you do not have access to such a scope, there is some simple Freeware software (such as "Frequency Analyzer" available for free download at: http://www.relisoft.com/Freeware/freq.html). This will produce a frequency spectrum for either a microphone input to your computer or pre-recorded sounds (they must be .WAV files). Shown in Figure 2 is a spectrum of a soprano sliding up a scale, using one of the files available from the website for the University of New South Wales's Acoustics Lab. See: http://www.phys.unsw.edu.au/music/ for more details. Standing waves and Fourier series can be dry and abstract for many students, but applying them to the acoustics of voices and instruments can help make the subject come alive.

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Submissions describing demonstrations will be gladly received by the column editor.

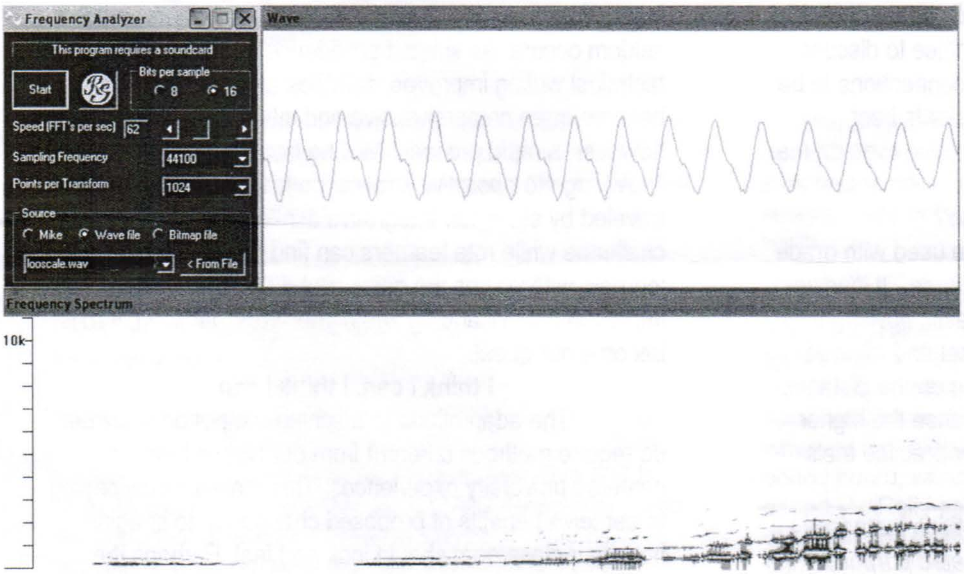

Figure 2 *A screen capture of the wave form above) and the frequency spectrum (below) for a soprano sliding up a scale, using the software "Frequency Analyzer." Time is on the horizontal axis in both displays, and the vertical axis in the lower display is frequency in hertz. Note the significant presence of higher harmonics.*

Dave Doucettes PER Corner

An Introduction To P.E.R.

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Hot off the press is 'America's Lab Report, 2006', an insightful look at the current state of science literacy in North America. The chair of the committee is 2001 physics Nobel prize winner Carl Weiman(previously University of Colorado, now at U.B.C.), The report cites primary reasons for failure to achieve improved literacy and points to current research for promising steps forward.

Carl Weiman's presence on this committee is not coincidental. Obviously an outstanding researcher and thinker, he is also a committed PER supporter. Under his auspices the University of Colorado physics education group has developed a public domain site offering research papers and excellent java applets to aid with physics instruction internationally. I urge all physics teachers to check out this marvelous teaching aid. Go to http://phet.colorado.edu/web-pages/index.html .I have summarized some key points on the report recommendations in the following concept map:

Integrated Learning of Science Concepts and Processes *content and process are seamlessly woven in learning activities*

Clearly Communicated Purposes: *transparent learning goals for laboratory experiences maximize student engagement and learning*

Principles for Design of Highly Effective Laboratory Experiences

Ongoing Discussion and Reflection: *students need opportunity to discuss and reflect, make sense of data, refine and clarify mental models*

Sequenced into the Flow of Instruction: *laboratory activities are explicitly linked to prior and subsequent learning experiences*

At first blush, teachers may feel they are doing all of this. In fact, they often are. That is the problem – teacher centered learning! Instructors are often the only ones in the classroom connecting the distinct modes of thought required in a physics classroom: algorithms, terms and concepts, graphical analysis, free body diagrams. These *habits of mind* are processed in separate areas of the brain and do not easily cross-connect. Students must be given multiple opportunities to make the linkages themselves, through carefully sequenced activities and guided inquiry worksheets, in sequentially richer contexts. These need to be coupled with opportunities to discuss and reflect . It is not sufficient for these connections to be lucidly explained by a passionate instructor.is best achieved by being 'a guide on the side, not a sage on the stage.'

What Does it Look Like?

Below is an example of an activity I have used with grade 11 students near the beginning of the course. It involves 1.5 V, DC 'constant motion' cars and plastic bowling pins (dollar store). Each team is provided a set and allowed five 'shots'. They score points depending on the distance from the car to pin – the greater the distance the higher the point value. I provide five minutes for practice trials before the competition gets underway.

Pitching it as a friendly competition increases student engagement (*clearly communicated purposes*). They pay careful attention to the actual path taken, as this is crucial to scoring well. It is also crucial to distinguish *distance* from *displacement* – the actual agenda *(integrated learning of science concepts and processes)*. The activity is followed with a guided-inquiry worksheet [below].

Activity: Car Bowling
Literacy 1 2 3 4 Understanding 1 2 3 4
Overall Level ___ Score _/10

1. How did today's activity differentiate between the terms *distance* and *displacement*?
2. Would the term *uniform velocity* (aka *uniform motion*) be appropriate to describe your car's motion across the table? Explain.
3. How does the term average velocity, v_{av} defined as d / t, apply to the motion of your car across the tabletop? Do you think it is an accurate representation of the entire trip?
4. How was the motion of your car different at the moment you released your car from rest? Or the moment it struck the bowling pin? Speculate as to the causes of the change in motion.
5. Speculate as to how the motion of the car striking the pin might change if the plastic bowling pin was made of solid wood instead of hollow plastic. Explain your reasoning.

Coaching students to produce a detailed, grammatically correct report requires persistence and patience. To this end, they must be guided specifically as to what to write about, evidenced in questions 1-3 of the worksheet. Questions 4-5 allow for speculation and serve as a diagnostic about forces before this topic is introduced. These questions serve to link previous (gr 10) learning and foreshadow future topics (*sequenced into the flow of instruction*). A quick perusal of student reports informs instructors of the extent to which deep understanding of basic concepts has occurred.

Students are encouraged to discuss in groups as they prepare their worksheets (*ongoing discussion and reflection*). If activities are sequenced in the flow of instruction, there is little need to copy from others and this seldom occurs. As subject confidence and the level of technical writing improves, activities and questions can become more comprehensive and integrative. It is not, however, a rapid process. Moving from *declarative* knowledge to *operative* knowledge is a route seldom traveled by students. Integrative thinkers enjoy the challenge while rote learners can find it stressful. It is a journey, with you as the guide. But if the grail we seek is improved understanding and higher-order-thinking, it must become our quest.

I think I can, I think I can

The adaptations to teaching are not onerous but do require methods different from our typical teacher-centered university experiences. This makes it challenging to perceive benefits of proposed changes or to imagine how your classroom should look and feel. Perhaps the easiest way to get a sense is to attend a workshop where these techniques are incorporated. Incorporated, not merely discussed or explained! Participation is key, as the comments of a leading PER researcher attest, "Teachers should be given the opportunity to learn the content they will be expected to teach in the manner they will be expected to teach." [2] Look for opportunities in STAO, OAPT and other conferences. Scan the wealth of literature on the internet (start with the PhET site mentioned earlier, then check out some of the links).

In a future article, we will examine results of a culminating egg launch activity, and the misconceptions revealed in student reports.

1. America's Lab Report: Investigations in High School Science The National
Academies Press, 500 Fifth Street, N.W., Washington, D.C. 20001, ISBN: 0309096715
2. ***Lillian C. McDermott*** *Department of Physics, University of Washington, Seattle, Washington, U.S..A. Connecting Research in Physics Education with Teacher Education. An I.C.P.E. Book © International Commission on Physics Education 1997,1998*

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- Have students vote for favourite entries to send in to the provincial contest.
- Run a separate contest in each semester and compile entries in January and April.
- Set a deadline that is well in advance of April 1 in order to leave time to compile materials and meet the deadline of May 1, 2007.
- Don't hesitate to contact me *(Diana Hall, Contest Coordinator)* with questions or ideas.

*Please visit **www.OAPT.ca** and read complete contest details, see past winners and sample photos*

diana.hall@ocdsb.ca

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) February 2008

Editor's note: As physics educators we must take some action to help reverse a dangerous trend. Our students are steering away from taking high school physics in particular grade 12 university physics as they feel it will lower their averages. Please pass the open letter below onto your principals and guidance counsellors. Your students will thank you for it!

Letter from the Canadian Association of Physicists to high-school principals and guidance counsellors re physics courses

Alan J. Slavin, Department of Physics and Astronomy, Trent University, aslavin@trentu.ca

Research we have carried out at Trent University over the last year (to be published in the Canadian Journal of Physics) has shown that students who have not taken the 4U physics course (or equivalent), but then must take a physics course at university, are failing or dropping out at a rate up to four times as great as for those who have taken high-school physics.

To draw this problem to the attention of the high schools, Professor Louis Marchildon, President of the Canadian Association of Physicists, has sent the letter below to all provincial ministers of education (except for Québec, which is different due to the cégep system), asking them to forward it to high school principals and guidance counsellors.

Open letter to high-school principals and guidance counsellors concerning physics courses

It has come to our attention recently that a number of high schools are recommending that their students not take upper-year physics because of concerns it may bring down their averages, hurting their chances for entry into university. In some cases, this has so reduced the number of students taking those courses that schools have even cancelled them, reducing even further the number of students who take physics.

However, physics is required for many university professional programs as well as for science programs, which means that such students in these programs will be taking their first formal physics course at university. Recent evidence shows that these students are largely unprepared for the subject and are failing or dropping out at a rate up to four times as great as for those who have taken high-school physics. Even when a university does provide a make-up course for students without previous physics training, this can prolong by a year the student's university career, at great expense. **Our strong recommendation is to advise a student who is likely to take a university physics course, for whatever reason, to take the high-school physics courses.**

Programs requiring a physics background

A physics background is required by many disciplines and professional programs, because it provides knowledge essential for the discipline while developing strong numerical and analytical skills. Such programs include the following:

1. Medicine, where knowledge of basic electricity, mechanics and optics is required to understand the functioning of the human body. Reflecting this, the MCAT (Medical College Admission Test), required for entrance to most medical schools in Canada, has a high physics content.
2. Optometry, for the same reasons as for medicine.
3. Architecture, for which a good understanding of physics of structures is clearly crucial.
4. Engineering of all types.
5. Chemistry. Accreditation by the Canadian Society for Chemistry requires a university physics course.
6. Forensic Science. Accreditation by the American Association of Forensic Scientists requires a full-year university physics course.
7. Other sciences, in addition to physics.

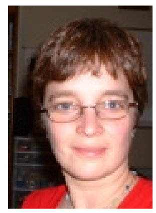
Evidence that high-school physics is essential

Many university programs, including some in the life sciences, require high-school physics (SPH4U in Ontario) as one of the entrance requirements. However, a number of programs which require a physics course at the university level do not require high-school physics as an entrance requirement, as the high-school material is repeated at university although at a much accelerated pace. Our statistics, derived from a range of universities of different sizes, indicate that the group without high-school physics is severely disadvantaged at the university level. **The drop-out and failure rate of these students from their university physics course is typically in the range of 20%, compared to about 5% for those students in a similar course that does require high-school physics.** Dropping out or failing a course is a major setback for a university student, as it means an extra year of study or retaking the course over a summer which is a major commitment in time and cost. Moreover, students who have high-school physics perform substantially better than their peers in the same course who have not had high-school physics. Of course, some capable and highly motivated students without high-school physics perform well in university physics courses, but these are the exception to the rule.

Louis Marchildon, P.Phys.
President Canadian Association of Physicists
10 January 2008

High School Physics

10 Things Physics Teachers Can Do to Help Their Students Succeed at University Physics



Marina Milner-Bolotin
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This article is a brief summary of the workshop presented at the Toronto School Board Science Conference "A Celebration of Discovery" on November 30, 2008. The idea of the workshop came out of the discussion with one of the first year students in an introductory physics course for science majors I taught last fall. The student was doing particularly well in my class and it was not hard to notice him. Once we had a chance to walk to class together, and I asked the student, what helped him excel in this class? His response was clear – he had an amazing high school physics teacher. This teacher not only helped the student to gain excellent physics problem solving skills, but also sparked his interest in physics as a future career. So what can high school teachers do to help their students succeed at university physics? The list presented below is neither an exhaustive compendium of successful high school physics activities or concepts, nor it should be treated as a recipe for success at university physics. I hope rather that it will focus our attention at some things that can be treated a little more extensively in high school to help the students succeed at their first university physics courses.

1. Try to emphasize that **physics is not about memorizing meaningless formulae**, rather physics is a science that studies how the world around us works and how physics concepts (that are often described using mathematical formulae) can explain it. So if your students are stuck on formulae memorization, ask them to explain these formulae in their own words **without** using math. This might help them think differently about physics. **Being able to plug numbers into the math formulae isn't physics**. Students' expectations of what physics is significantly affect their study strategies and as a result s success in the course. In the words of one of the first year undergraduate students: "*I feel that Physics is a lot harder to understand than I had expected. Going into this course I expected it to be a lot of math because that's what I was told by my older sister but in Dr. M's class it was mostly concepts which threw me off a lot*".

2. **Help the students learn how to organize their knowledge**. One of the most important findings of physics education research is that novices and experts organize knowledge very differently (Bransford, Brown et al. 2002). While experts operate with the concepts and ideas, the novices are often stuck with the unimportant (from the physics point of view) features of the problem. These findings emphasize the importance of concept maps or any other way of helping the students to identify important physics concepts and the relationships between them. Being able to see underlying concepts is a very powerful skill in a physics problem solving.

3. **Physics as any science is about asking the *why* question**. As the students become more sophisticated, their *why* questions will get more complicated and might be harder to answer. However, asking a good question in science is often more important than being able to answer it. This is how one of my students described how her opinion of physics changed during the course: "I feel that everyone is capable of learning physics as long as they change the way they think about the course. People need to realize that it is okay to ask the question "why?" and when they ask the question they need to be willing to spend the time to solve the problems associated with the question."

4. This brings me to the next point. **Spending the time to figure things out**. Somehow, students often think that if they cannot solve the problem during the first few seconds after they skimmed through it, they are not capable of solving it and doing physics in general. I believe that partially we are responsible for their attitude as we often solve problems which we have solved many times before. Rarely do our students see us stumbling or thinking aloud about a problem which is somewhat challenging to us. I think that "drive through" mentality is counterproductive in science learning. Problem solving requires time and not being able to figure things out right away is OK. There is no scarcity of examples from the history of physics showing that many ideas we are trying to teach our students took hundreds and thousands of years to develop, so it is alright if it takes the students time to understand how to apply them to problem solving.

5. This point brings us to helping the students **adopt a systematic approach to problem solving and use of multiple representations**: diagrams, graphs, pictures, equations, verbal or pictorial problem descriptions (Kohl and Finkelstein 2007). Novice problem solvers often stumble even before they have identified the given, drawn an appropriate picture or diagram, or thought of the concepts involved in the problem. I often remind my students that I am not going help them solve the problem unless I see a list of givens, a diagram and all the relevant information including the question asked in the problem. In addition I ask the student to write a list of possible concepts involved. Often these steps will help them get started, which will eventually boost their confidence and satisfaction of independent problem solving.

6. Another important point I try to make with my students is **"If you cannot explain what a concept means in your own words, using a scientific term to label it, will not get it any clearer"**. Very often the students use terms they don't understand and as it becomes part of a bad habit, it stops bothering them after a while and they stop asking questions. For instance, the terms such as acceleration, weight, energy, momentum, impulse, gravity, electricity, power, etc. are often used differently in everyday life and in a physics context. What is even more bothersome, that some everyday life terms, for instance, such as *weightlessness* are plainly misleading. Try to make sure the students really understand what they mean prior to using new terms.

7. **Help students examine their prior as well as newly acquired knowledge.** Make sure that the new knowledge they acquire in your class fits within their prior knowledge framework. One way of doing that is to keep asking "If-Then Questions". For example, Newton's first law often is counterintuitive to many of the novice learners. To help them think about it, you might ask the students to ponder about why it is so difficult for us to believe that there is no need for an unbalanced force in order for an object to keep moving at constant velocity. Sometimes, you might even play a devil's advocate and ask them, what if the opposite was true? How would the objects move then? How will the world around us change? The worst thing that you can do is to perpetuate the myth that physics laws and concepts learned in class are only useful to solving end of chapter problems and they do not apply to everyday world.

8. **Avoid overgeneralization and clearly identify when the things work and when they don't.** For instance, when talking about friction, try not to tell the students that friction always opposing motion (the force of friction opposing the relative motion). This might lead the students to think that friction is always going to be directed in the direction opposite to motion. Think about how you walk. What propels you forward is the force of friction between your feet and the floor, which is directed … forward! Another example, might be the claim that the normal force is always equal mg. This is true sometimes, but not always. Think of the inclined plane or of riding in an elevator or even of a "*weightless*" astronaut.

9. **Assess what you value.** If you believe that conceptual understanding is important, use conceptual questions in your quizzes and tests. There are lots of resources on the web with conceptual questions. One of them was created by David Harrison from the University of Toronto and is called Canadian In-Class Question Database (http://cinqdb.physics.utoronto.ca/). Give your students a chance to see that understanding concepts is important and is valued by you. We will continue doing it at the university and it will make student adjustment to college physics easier.The workshop sparked interesting discussion and provided a great opportunity to start building bridges between high school and university physics teaching. After all, many of the concepts and problems discussed in a first year introductory physics course are also discussed in a high school classroom. I would be very interested to hear what you think about this article. If you have comments or ideas, please e-mail me:

References:

Bransford, D., A. L. Brown, et al. (2002). How people learn. Washington, DC, National Academy Press.Kohl, P. B. and . D. Finkelstein (2007). Expert and Novice Use of Multiple Representations During Physics Problem Solving. 2007 Physics Education Research Conference, Greensboro, NC, American Institute of Physics American Association of Physics Teachers.

The Demonstration Corner

Simple Centre of Mass Demonstrations

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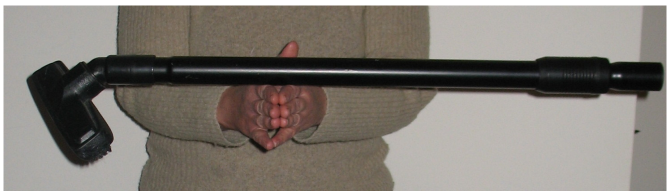
There are several very simple demonstrations on centre of mass that can be performed with everyday objects. In this article I describe a couple of demonstrations that I do with my students. The first one is balancing a long object. I ask



one of the students to hold a metre stick or any other object that is long enough on the top of her hands when the hands are far apart. Then I ask the students to predict what happens if the person tries to bring the hands together, moving the forefingers supporting the object from beneath towards one another very slowly. Many students will assume that it is very difficult to do because the stick will become unbalanced in the process of moving the fingers. Is this the right answer? Surprisingly for many, it is rather difficult to make the long stick lose its balance. If you ask the student to move her forefingers towards each other very slowly, the class will soon discover that it is possible to move one finger at a time along the stick, but not both! In the case of a standard metre stick the centre of mass is at the mid-point. It is even better to attempt to balance an elongated object other than a stick or rod, when it is not known beforehand where the centre of mass is located. If you are using a metre stick and want the centre of mass to be somewhere other than the 50-cm mark, just attach one or more clamps to the stick. Balancing the object on the fingers allows the students to find the location of the centre of mass. On the photo above, the vacuum cleaner brush and holder are balanced on the top of my forefingers. This is where the centre of mass of the brush-holder system is located.

The detailed explanation of what happens when we try bringing the fingers together while balancing the long object involves friction and normal force. In the case of a metre stick without any attachments, if the fingers are initially positioned even at slightly different distances from the centre of the stick, the normal forces that the fingers exert on the stick are not equal. As a consequence, the values of the maximum static friction force to overcome are slightly different for each of the fingers. The first finger to slide under the stick is the one that was farther away from the centre of mass initially, until it stops a bit closer to the centre of mass than the other finger. The next attempt to move the fingers will result in the motion of the other finger which initially remained at rest. The process will repeat itself until the stick is balanced, with both fingers located right underneath the centre of mass.

There are a number of interesting demonstrations that involve the centre of mass of an object being situated below the point at which the object is being supported. My favorite demo in this category is balancing two forks with a coin inserted between their teeth on the outer edge of a wine glass. The forks are balanced outside the glass, and it appears as if they defy gravity. Because the handles of the forks point downward and toward the glass, the centre of mass of the "object" consisting of the coin and forks is directly below the point of contact between the coin and glass, producing stable equilibrium. The demonstration is very easy to set up, and the photograph speaks for itself. This demo was shown to me by the Stanford University graduate student Guillaume Chabot-Couture.

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Submissions describing demonstrations will be gladly received by the column editor.

Please join us for OAPT's annual conference at Ryerson University May 22-24 2008

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- Tours of Ryerson Research facilities, Enwave Deep Water Cooling, The Rogers Centre and The Wind Turbine at the CNE
- Hands on Workshops

Welcome to the 47 preservice teachers who joined OAPT at TDSB PD session in November

newsletter editor James Ball james.ball@ugdsb.on.ca

The Demonstration Corner

When is The End Not The End?

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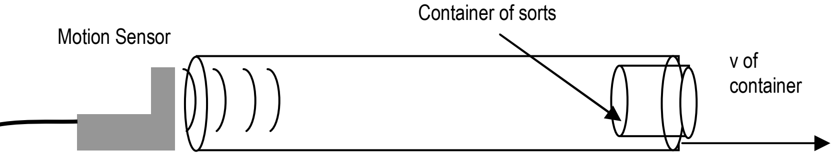
Here's a really easy way to show students that the pressure at the end of an open-air column doesn't change exactly at the physical end of the tube. It requires a motion sensor, a tube, and the right-sized insert for the tube. I happen to have a plexiglass tube into which a tub of play-doh fits just nicely. First set up the following…



Now, while collecting position vs. time data, slowly draw the play-doh container out of the tube. When you get to the physical end of the tube, stop and hold a few seconds. Now slowly continue to draw the container out further.

What you should see is that the sound waves from the motion sensor reflect off the container as it is drawn out. Once the container passes the physical end of the tube, the waves continue to reflect off the container until it is a few millimetres past the end. Then the sound waves will stop "seeing" the container as they notice the change in air pressure outside the tube and now reflect off the open end.

What's the point? On the d-t graph you will see that the place where the sound waves reflect off the open end is beyond the physical end of the tube. Not by much mind, but nevertheless beyond. (See Fig. 1)

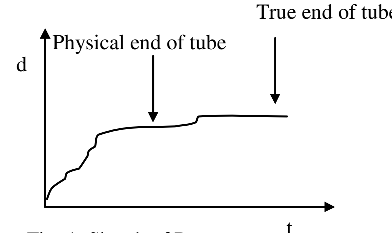
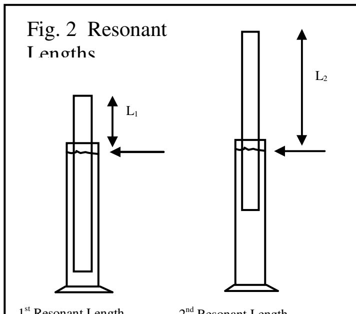


Fig. 1 Sketch of Data

Who Cares? When conducting a lab to determine the speed of sound using a tuning fork of known frequency and an air column open at one end, you will get better results by finding two resonant lengths and subtracting them to find $\lambda/2$ (where λ is the wavelength), instead of using the first resonance length (for example) to give $\lambda/4$. Each of the two resonant lengths measured will have the same error at the open end, and subtracting the lengths to give $\Delta L = \lambda/2$ also subtracts the open-end error. Fig. 2 shows two resonant lengths L_2 and L_1 measured from the top of water in the bottom container.

Student results for the speed of sound found by subtracting resonant lengths are typically within a few percent of the correct value, whereas results using a single resonant length can deviate by 10% or more from the correct value.

Fig. 2 Resonant Lengths



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Submissions describing demonstrations will be gladly received by the column editor.

MOdern PhYSiCS

Spacetime Diagrams: Seeing Special Relativity

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In the past I have found relativity really frustrating to teach because it consisted almost entirely of me explaining stuff to the students with very little for the students to do for themselves. A few years back I was introduced to using Minkowski spacetime diagrams. These diagrams allow you to visualize what's happening in different frames of reference and they can let the students explore simultaneity, the Doppler shift, the twin paradox and many other topics. To give you a brief taste of what can be done with spacetime diagram, we will look at relativistic velocities.

A spacetime diagram shows time and only one dimension of space. To distinguish it from a position-time graph, the time axis is vertical not horizontal. In order to show very fast speeds, the scales of the axes are in years and light-years.

Figure 1 shows the x and t axes for the Earth, a beam of light and the t' axis for a rocket moving at ½ c relative to the Earth. Notice how the choice of scale puts a light beam halfway between the two axes and how the rocket's slope is greater than that of the light because the time axis is vertical.

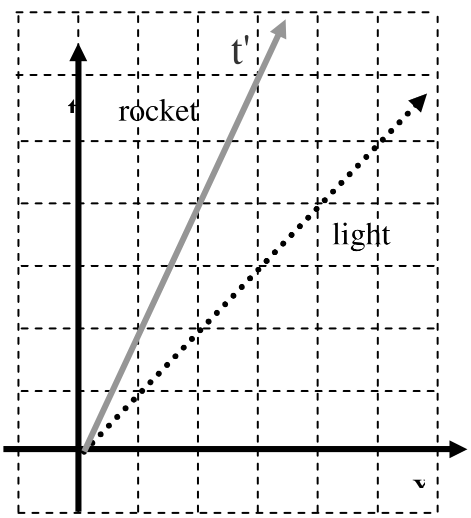


Figure 1

The speed of light is c in the Earth's frame but it must also be c in the rocket's frame. This won't be true if the two frames have the same x-axis. You can see this in figure 2, where the distance and time intervals are no longer the same.

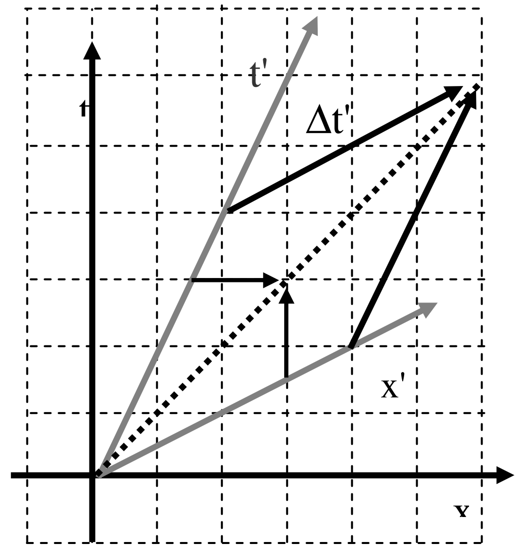


Figure 2

A constant speed, c, means that space and time must be connected together and they must be different in frames moving relative to each other. As Hermann Minkowski said in a lecture in 1908 " Henceforth space on its own and time on its own will decline into mere shadows, and only a kind of union between the two will preserve its independence…"

The x' axis must be placed symmetrically relative to the light ray as shown in figure 3

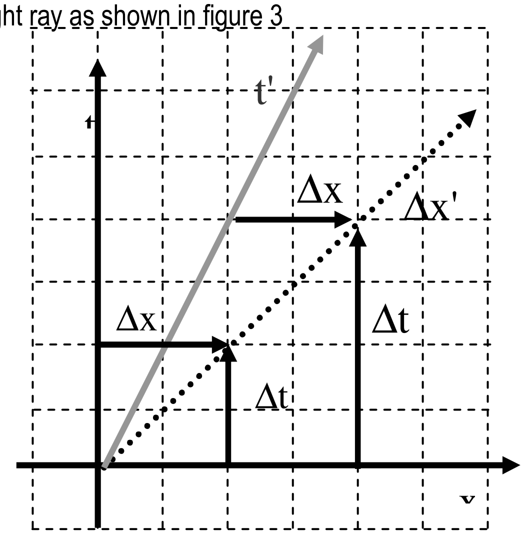


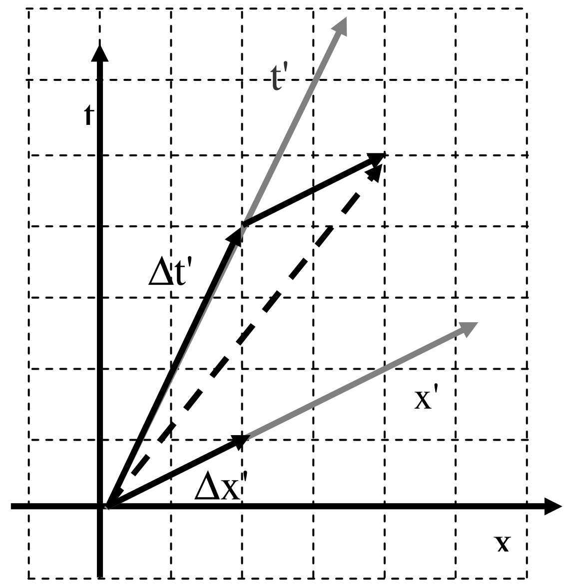
Figure 3

Notice how the space and time intervals are now symmetric, whether they are measured in the Earth's frame or the rocket's frame.

Now that we have a diagram for both frames, we can determine what happens when we add velocities. Suppose that the rocket launches a space pod at ½ c relative to itself. How fast will the Earth see it moving?

It can't be v = ½ c + ½ c = c, can it?

The pod will travel two units of space in four units of time in the rocket's frame as shown in figure 4. Therefore, the pod follows the dashed line.



How fast is the pod moving relative to the Earth? This can be determined by using intervals in the Earth's frame. The dashed line shows that in 5 years it has gone 4 light-years. This means that it is travelling at 4/5 c, which is faster than ½ c but not c.

This value can be checked against the equation for adding velocities in relativity

$$
\begin{aligned}
v &= (v_1 + v_2)/(1 + v_1 v_2/c^2) \\
&= (½ + ½)c /(1 + ¼) \\
&= 4/5\ c
\end{aligned}
$$

The website at www.cco.caltech.edu/~phys1/java/phys1/Einstein/Einstein.html animates the addition of velocities for a tossed textbook and car headlights from the car's frame and the road's frame. As well as animating the motion, it also provides the related spacetime diagrams. Dave Harrison has great animations for relativity and some diagrams at http://www.upscale.utoronto.ca/GeneralInterest/Harrison/Flash/#relativity . I have posted a set of exercises at http://roberta.tevlin.ca. For a more thorough treatment, I strongly recommend that you get "Very Special Relativity: An Illustrated Guide" by Sander Bais or Thomas Moore's "A Traveller's Guide to Spacetime". Please contact me if you have any suggestions or questions at roberta@tevlin.ca.

High School Physics

How to Create Simulations for Physics Using The Geometer's Sketchpad® (GSP)

Rolly Meisel
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The Geometer's Sketchpad® (GSP) is a powerful dynamic geometry software package that is licensed for use in Ontario public schools, including student and teacher home use. It can be applied to many purposes, including the creation of dynamic simulations of some of the concepts on the Ontario physics curriculum.

A tutorial for creating a GSP sketch that simulates the superposition of two pulses travelling in a spring in opposite directions has been posted on the OAPT web site at www.oapt.org, in Word and PDF format. The final sketch has also been posted. Note: you must have GSP installed on your computer in order to use the sketch. The site administrator at your school can provide you with a copy of the educational version of GSP.

You can apply the skills that you learn by working through the tutorial to the creation of other simulations.

Many GSP sketches have already been created for simulations in physics. You can find them by performing a search using the keywords "sketchpad" and "physics". Add other keywords if you are looking for something specific.

Some starter sites are:

www.dynamicgeometry.com/general_resources/advanced_sketch_gallery/index.php
www.teacherlink.org/content/math/relatedlinks/sketchpad.html
mathgateway.maa.org/do/SearchForm?search=sketchpad

Students can use GSP to create simulations as possible projects. The learning curve is short and not very steep. Furthermore, many students will already have experience with GSP from mathematics classes. GSP sketches can be used like Java applets, but are much easier to create. Simple GSP sketches can be converted to Java applets using the Java Sketchpad feature included with GSP.

Although GSP is not as powerful, from a physics point of view, as dedicated software such as Interactive Physics®, it is freely available to Ontario teachers and students, whereas IP requires expensive site licences.

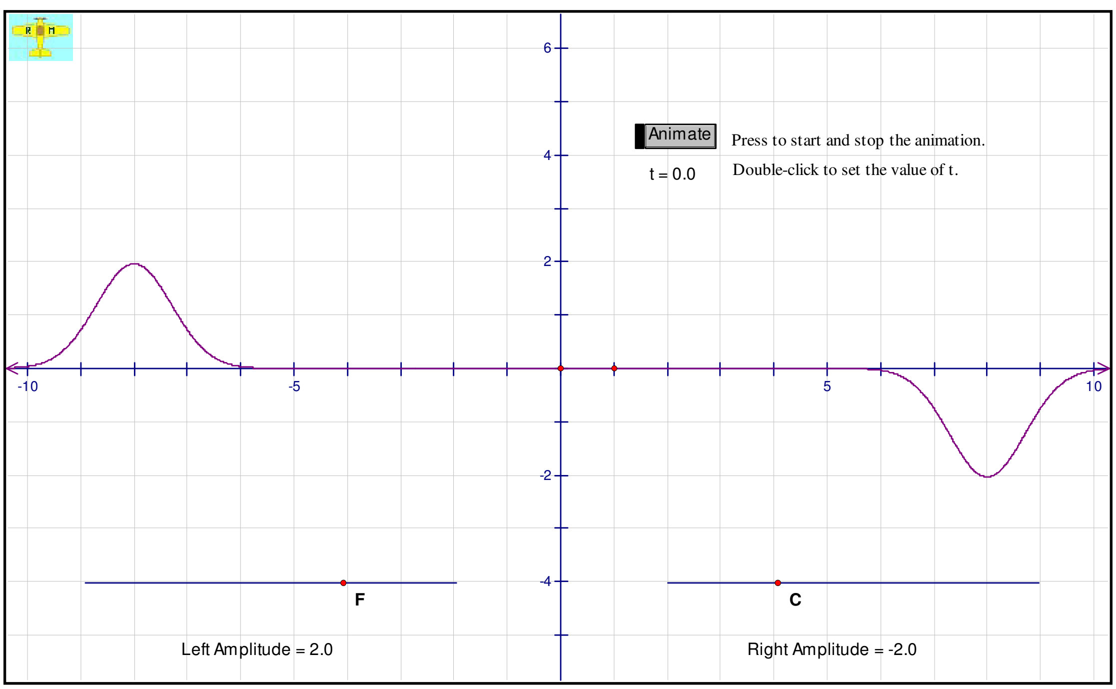

Figure 1: Screen Shot of the Superposition Sketch

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) September, 2008

The Demonstration Corner

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To See Or Not to See - TIR is the answer

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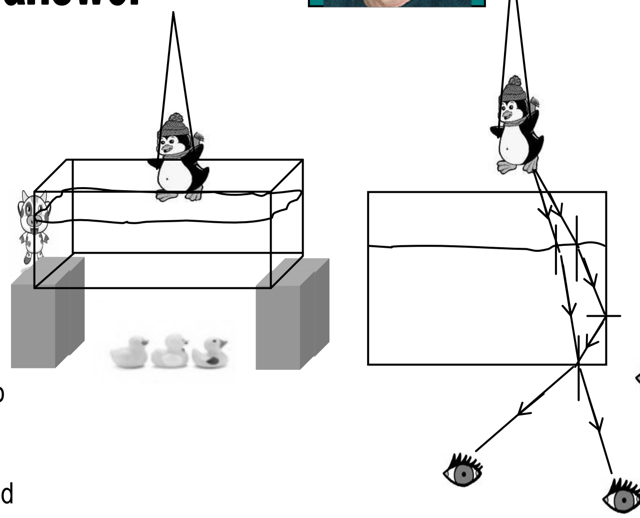
A fun example of total internal reflection can be created with an aquarium tank or similar transparent container filled with water. Students enjoy wandering around the tank with objects placed around on all sides including above and below.

Sometimes you can see what you appear to be looking at and sometimes not. Students are challenged to draw ray diagrams to show why you cannot see certain objects but can unexpectedly see others from certain angles. One example is shown here. It's definitely a good seed for discussion. Probably a good coffee table display for your parties too.



Instead of seeing what's behind this side, see TIR of the Penguin… To See something unexpected!

Incident Angle much smaller here. No TIR…To See!

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Section Representative Report

Submitted by Marina Milner-Bolotin, OAPT Section Representative, July 2008

Canada was the host of the Summer AAPT National Meeting. The meeting took place on July 19-24 in Edmonton, Alberta and was hosted by the University of Alberta and the local APT Section. More than 700 physics educators from 14 countries attended the meeting. Canada was represented by a few dozen attendees, the bulk of whom not surprisingly were from western Canada. The meeting was a success, which was clear from the level of presentations and interest from the audience. The list of invited speakers included Prof. Eric Mazur from Harvard University (Peer Instruction), Prof. Carl Wieman (a Nobel Physics Laureate from UBC), Prof. Michio Kaku (from the City University of New York), Prof. Janis McKenna (from UBC), Prof. Gary Gladding (from the University of Urbana Champaign), etc. A popular CBC science show "Quirks and Quarks" received an AAPT award for an outstanding science reporting. For more information about the meeting, visit the AAPT web site (see www.aapt.org). The next meetings will take place in Chicago, IL in February 2009, and in Ann-Arbor, MI in July 2009. We hope to see you there.

Dave Doucette's PER Corner

'Bridging Research into Practice'

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Not Quite Ready for Broadway

Who thought the photoelectric effect could prove entertaining and even hilarious? Well, it certainly can be when role-played by physics teachers at Perimeter Institute's (PI) 2008 EinsteinPlus[1] program. Four groups of teachers in this summer Outreach program scrambled to come up with a skit illustrating the central features of the photoelectric effect. Ten minutes later they danced (believe it!), skipped, and generally hammed it up as electrons, photons and metal atoms. Not quite Tony material but it was challenging to keep from laughing aloud. Actors struggled to remember lines, timing and choreography. They had altogether too much fun.

The failure of traditional classroom lecture and cookbook lab activities to produce effective student learning is well documented. In response, a variety of instructional strategies have been created to engage students, cognitively and socially. One of the less explored methods is role playing. On a broad scale role-playing can imply staging an ethics-based scenario with complete stakeholder roles. This article examines a less ambitious example, choosing a modern physics concept and mechanical roles.

The Play's the Thing

'America's Lab Report: Investigations in High School Science, 2006'[2] [flow chart below] identified four broad principles to maximize science learning.

One of these - *community centered environments* - involves listening and articulating to peers in safe, active learning environments. The critical importance of *student discourse* is identified in brain-compatible research as well as PER and is core to role-playing. In order for a group to prepare their play, they must communicate and listen effectively. As one researcher notes, "The interaction between the students as they play their roles in the role-play develops the students' social competence as the students become an active part of a social scenario. Playing a role and arguing with the other students develops the students' communicative competence as they need to express themselves in a precise manner to get their arguments accepted by the other students."[3]

Assigning discreet roles to members of the group, such as director, choreographer, principal actors, and prop manager can help get the show started. Sufficient time for planning and rehearsal is required, ideally with each group in a discreet location. I frequently utilize role-playing for layered concepts such as superposition, velocity selectors or the photoelectric effect. When concepts involve multiple components, students need time to incubate and organize the discreet elements into a conceptual whole – a schema. Role-playing, exemplifying a *learner centred environment*[2], encourages such focused conceptual discussion, as the cast works to ensure their scenario is a reasonable representation of the physics involved. "It is much more important to allow time for the concepts to be truly understood and learned, even if this means including less content, versus loading more content into a lesson to catch up. Allow time for repetition, as this strengthens learning."[4]

Learner Centered Environments
engage students with activities to challenge misconceptions

Knowledge Centered Environments
ground knowledge through
multiple contexts, scaffolding and reflection

<u>How Students Learn</u>
Principles of Learning Informing Integrated Instructional Units

Community Centered Environments
listening and articulating to peers in safe, active learning environments

Assessment to Support Learning
opportunity to revise and improve learning combined with flexible teaching

So, You Think You Can Act Physics?

Ensuring a non-threatening, active learning experience precludes summative assessment of the role-playing. To encourage compliance, however, formative assessment can be tactfully employed. Taking advantage of popular talent contests, this could be staged as a 'So You Think You Can Act Physics' competition, using a rubric for overall cast performance. Effective staging requires myriad modalities such as creative, dramatic, linguistic, kinesthetic and spatial. Teams can be judged against a rubric designed to focus on multiple intelligences[5]. In modern lexicon, this would be an example of differentiated instruction with rich interpersonal dimensions. "Adding a sympathetic, generally human element to science is often encouraging to students with science and math anxiety. Lessons can use role-playing to emphasize the value of feelings and of creativity as well as of knowledge"[6].

All the World's a Stage

At PI, the role play was followed by an impromptu challenge. Each group was given a photoelectric effect scenario to mime. Observing groups had to accurately describe the scenario. For example, one group was challenged to mime a situation in which the ejected electrons had insufficient energy to cross against the 'stopping potential'. To turn this into a friendly competition, other groups write down their interpretation and are scored (formative only) on accuracy and detail.

This impromptu challenge is an example of a *knowledge centered environment*[1], in which multiple contexts for a concept are provided, with time for reflection, student discourse and scaffolding of ideas. The unique structure of role playing to socially bond members of your classroom can produce improvements in attitude which go on to generate gains in attention and learning, "Emotions directly influence attention, meaning, and memory, all of which are enhanced when we create lessons to engage emotions in a productive way."[4] Needless to say, role-playing should not replace lab activities, simulations or Socratic instruction but is scripted in as a supplement.

The last element to maximize the role playing experience is *assessment to support learning*[1]. It is critical to formulate questions which speak to the experience. In addition to standard numerical questions involving $KE = h \cdot f - W_o$, also require students to interpret or describe behaviour of photons and electrons. For example, 'You are directing an actor playing the part of an electron being struck by a photon with energy greater than the stopping potential. This actor is confused about the physics involved. Explain to this actor how he will interact with the photon and how he will behave after being struck. Be certain to elaborate on the physics principles involved.' Or, 'You are watching a mime of the photoelectric effect. An actor, playing an electron, is thrown a red ball which she catches and immediately runs across the stage to the prop representing a negative electrode. She speeds up as she runs across the stage to the electrode. I)What did the red ball represent in this scenario? ii)What does the actor's behaviour tell you about the red ball's energy level? iii) Why was the actor incorrect in speeding up as she ran across the stage? How should she behave, and why?'

Broadway bound?

As with any new learning venture, take role playing in small steps, allowing you and your students to become familiar with the exercise. Then progress in depth and detail according to needs and comfort level. Who knows, you might find the hidden director inside you and go on to author a Tony-winning Broadway physics production like Michael Frayn's, *Copenhagen*. Or perhaps just settle back to watch and grin, as we did this summer at PI's EinsteinPlus, watching middle aged teacher-electrons scamper across the stage, screaming 'I'm free, I'm free'. Break a leg.

References

1. The EinsteinPlus workshop is a one-week, intensive residential workshop for international high school teachers that focuses on key areas of modern physics — including quantum physics, special and general relativity, and cosmology. It also incorporates sessions on innovative teaching strategies suitable for all areas of physics. See website: http://www.perimeterinstitute.ca/Outreach/Teachers/EinsteinPlus/
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Come join us this coming May for our Annual Conference which will be held at the Royal Military College in Kingston

Creating a Dialogue

between High School-University Teachers and University Undergraduate Students

By Tetyana Antimirova, John Atherton, David Doucette, James Ball, Marina Milner-Bolotin, Glen Wagner and Patrick Whippey

The OAPT Annual Conference hosted by Ryerson University featured many events that could have become a focus of this report. However, there was one event that in our view deserves special attention: a student-teacher panel that took place on Saturday, May 24th, 2008 during the lunch. The goal of the discussion was to start a dialogue between physics teachers from high schools and universities and college undergraduates from the sciences and engineering. This dialogue was our attempt at building bridges between high school and university physics courses in order to make high school-university transition more successful, and as a result help retain more students in sciences and engineering. During the discussion the participants raised various issues such as the difference in the teaching styles in high schools and colleges; the use of different notations and representations for physical quantities; gaps in assessment used in high school and at the university, such as open ended assessment, versus the multiple choice; student lack of experience of independent work in high school and bad study habits such as procrastination, late assignment submissions, relying on memorization and rote learning, etc.; the lack of knowledge of university instructor of the high school curriculum; poor mathematics and laboratory skills, etc. During the discussion, the participants not only outlined problems, but also brainstormed possible solutions that are described in detail in the extended paper published on the Ontario Association of Physics Teachers Web site (www.oapt.ca).

The participants of the Panel came up with the list of behaviors that often characterize the students who are successful at the high-school – university transition. High school and university instructors should be aware of it, so they can discuss it with their students. For the list of behaviors of successful students read the complete paper (www.oapt.ca).

Some of the panelists suggested developing a workshop of an hour or so that would enable students to create their personal plan for college success. The students would be asked to report back early in the semester on how they were doing, and where necessary, faculty/teachers would gently suggest some strategies to help those who were struggling.

Comments from the undergraduate students were passionate and revealing - a litany of complaints about the disconnect between high school and university experiences. At first blush, one wonders how such a wide gap can be narrowed! But this gap may already narrowed by acknowledging it, identifying and publishing the results. Our dialogue begins. How we foster this dialogue will determine the depth and effectiveness of our next steps forward! These steps must involve richer, more frequent meetings between univerty, high school and elementary teachers; sharing experience and expertise, with an eye on developing concrete steps towards more coherent student programming. This coincidentally develops important networking opportunities. High school or elementary teachers establish familiar contacts for questions on subject content or enrichment. The university professors similarly gain contacts to inquire about student pre-knowledge or emerging methods of instruction, for example, differentiated instruction - which are common in elementary classrooms but decidedly rarer in a university setting. To facilitate dialogue, PD days could be allocated to begin focused dialogues - assuming administrative support!

In this era of data-based decision making, it would be strategic to undertake the effort with short and long-range plans for measuring success. We need to establish baseline scores on current student attitudes, knowledge and skills as they transition into first year university programs. These can be compared to any 'pilot' projects that emerge from the dialogue. Clearly this transition initiative will require a generation to produce lasting, systemic benefits. But by narrowing the scope initially, including anecdotal reports, we can nourish support and inform our progress by closely tracking student transition from high school to university and their achievements and struggles in the first year university physics courses.

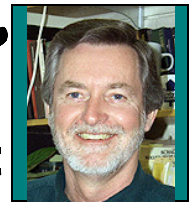
So what? This may be our biggest hurdle - the 'so what' factor. The physics community is passionate about the importance of physics education. How do we convince important shareholders - from Ministry officials to principals - that this is a priority interest? We must pursue support at these levels while at the same time develop grass-roots connections between classroom instructors. And the significance of political and press support cannot be underestimated. Such a broad-based campaign has significant challenges but will yield significant rewards. The goals we seek will produce systemic changes to the education system.

As physicists of Ontario, we have a real-life 'rich context' problem to solve: How do we help our undergraduate students succeed in their physics courses? Luckily problem-solving is the heart of our discipline, so let us get on collectively with the business of solving it. Let's talk.

NEWSLETTER
ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) November, 2008

The Demonstration Corner

The Ultimate Elevator Ride: Weight and Apparent Weight



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We all know that some concepts are harder for students to comprehend than others. The concepts of *weight, apparent weight* and *weightlessness* are often stumbling blocks for many of our students. Apparently they are also somewhat confusing for the seasoned scientists and engineers. While visiting the Lyndon B. Johnson NASA Space Centre in Houston, TX, I had a unique opportunity to have lunch at the “Zero-G Diner”[1]. Apparently, the Space Centre Houston is located at a special place where Newton’s Law of Universal Gravitation does not hold and should be modified.

When discussing the concepts of weight and apparent weight I like to bring a bathroom scale to class. Then I ask a volunteer to draw a Free Body Diagram for a person standing on a scale. I make sure the students label all the forces using two indices: the force of the scale on the person (aka apparent weight or normal force); the force of Earth on a person (aka weight).

Then we discuss what happens when the person has acceleration directed downwards or upwards. Notice that downward acceleration can happen either when the person is moving down while speeding up or when the person is moving upward while slowing down. This can be illustrated when a student starts squatting while standing on a scale. The scale will show a student’s real weight only when the student is standing still or when she is moving with constant velocity (which is hard to achieve while on a scale). However, as soon as the student starts squatting or even jumping, the values of the normal force

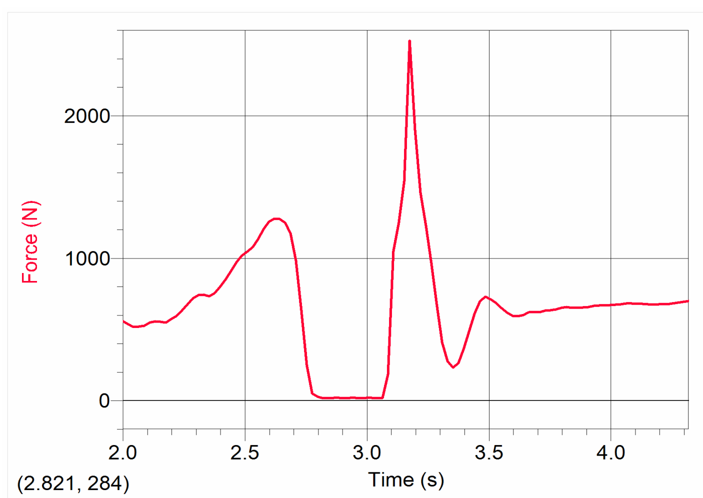

Figure 1: Recording of the normal force (apparent weight) for a student jumping off a scale.

(apparent weight) and the weight will differ.

This demonstration can be performed even more effectively if instead of a regular bathroom scale you can use an electronic scale connected to a computer, such as a Vernier Force Plate[2]. Ask a student to stand on such a scale and then jump up. The scale readings during the jump (Figure 1) will differ dramatically from the student's weight.

For even a more dramatic demo, invite your students to ride an elevator with you … while standing on the Force Plate and recording the data (Figure 2)! This ultimate elevator ride will provide your students with an opportunity to **discuss and experience** the concepts of weight, apparent weight and ultimately of weightlessness (hopefully you will discuss "weightlessness" only theoretically as nobody wants to experience weightlessness while riding in an elevator). I did it with my students and based on their feedback this was one of the most memorable experiences in the physics class.

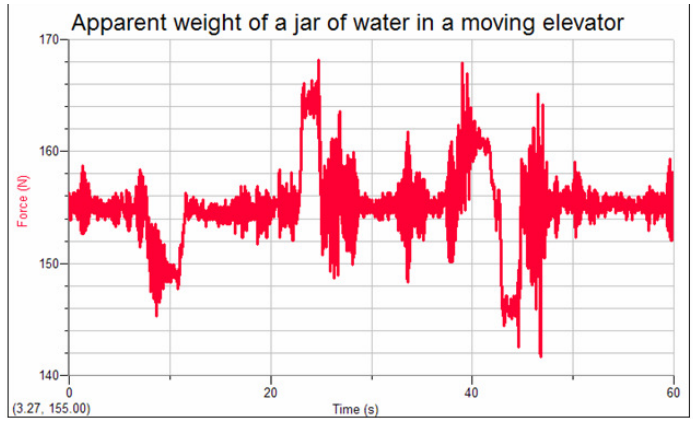

Figure 2: Recording of the apparent weight of a jar of water in a moving elevator.

References:

[1] Space Centre Houston, Houston, TX: http://www.spacecenter.org/

[2] Vernier Technology, 2008. www.vernier.com

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Submissions describing demonstrations will be gladly received by the column editor.

MOdern PhYSiCS

CERN Large Hadron Collider

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The LHC was all over the news this fall and will be again in the spring. Your students are going to be asking you lots of questions about it. To understand what the particle physicists do, you need to use lots of physics from the grade 12 curriculum: circular motion, conservation of momentum, electromagnetism, relativistic momentum and energy etc. There are many resources on the Internet but many of these are hard to follow or goofy or just a bunch of words on a computer screen. Here are the best resources that I've found so far. These will get your students actively engaged in learning about particle physics.

1) There are many particles other than protons, neutrons and electrons. Let your students be bubble chamber detectives during the EM unit. They can figure out quite a lot by applying the right hand rule for a charged particle in a constant magnetic field, conservation of momentum and charge. Two good sources of bubble chamber photos from CERN and their analysis can be found at http://education.web.cern.ch/education/Chapter2/Intro.html and http://quarknet.fnal.gov/biblio.shtml

2) Bubble chambers aren't used very much anymore because they are too slow. To get up to date you should have your students visit Fermilabyrinth at

http://ed.fnal.gov/projects/labyrinth/games/index1.html. There are 12 games there. In “Warp Speed” I recommend “Push the Particle” where they can try to build the best linear accelerator. In “Ghost Bustin’” I recommend “Particle Trappin’” and “Detector Detail” where they can learn about calorimeters which are very important for the LHC.

3) From 1989 to 2000 CERN was running the LEP in the 27 km ring that now houses the LHC. It collided electrons and positrons instead of protons and antiprotons, but was otherwise very similar. It was used to discover the W and Z particles that transfer the weak nuclear force. Your students can analyse 3-D data from these experiments at http://keyhole.web.cern.ch/keyhole/. I recommend that you avoid the two annoying animated ducks that try to teach the physics. Go to the index and then to “Projects”. There are ten sets of 100 events that the students can analyse. Also in the index is “Projects, teacher’s instructions” which contains answers! You can get this program on a CD ROM by emailing Antonella.Del.Rosso@cern.ch

4) In 1995 physicists at Fermilab discovered the sixth and final quark – the top quark. If you go to http://ed.fnal.gov/samplers/hsphys/activities/summary.shtml your students can use conservation of momentum in 2-D and come up with the mass of the top quark themselves.

The best books dealing with this material are “**Understanding the Universe: from Quarks to the Cosmos**” by Don Lincoln, 2004, "**The Quantum World: Quantum Physics for Everyone**" by Kenneth W. Ford, 2004 and **Quarks, Leptons and the Big Bang**" by Jonathan Allday, 1999. If you want more details of how to use these in the classroom you can visit my website http://roberta.tevlin.ca. If you know of some other great resource in this area please let me know about it! Thanks Roberta Tevlin, roberta@tevlin.ca

Transitions

Factors affecting the Drop Out Rate in First Year University Courses

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A recent paper [1], with an abridged and updated version [2], discuss the increase in drop-out rate from the introductory physics course at Trent University (Physics 100) from the 1980's to the present, primarily with the same instructor and the same content and rigour. Over this time, the drop-out rate rose gradually from about 8% to about 16% in 1998. This was followed by a more abrupt rise to over 25% in the last 9 years with the exception of the double-cohort year (2003-04) and the following year which included the 22% of double-cohort students who stayed in high school for an extra year. For these two years, the drop-out rate plummeted back to 9% before rebounding in 2005-06; a similar decrease in these years was seen at Brock University and the University of Guelph. The paper considers possible reasons for these changes. It also investigates ways to decrease the drop-out rate once students reach university, based on a survey of students who stayed in the course or dropped it. The main conclusions are the following.

1. The most likely cause of the dramatic decrease in the drop-out rate for the double-cohort students was their improved work habits developed in high school, driven by four years of trying to ensure a place at university when it seemed likely that the competition for these places would be extreme. This raises the question of how to ensure that students develop good work habits in the absence of the double-cohort pressures.

2. The large increase in drop-out rate, particularly over the last 9 years, is likely caused by a combination of grade inflation at the high-school level and the primary goal of many university students to gain a credential for a job rather than learning for its own sake [3]. The paper documents

grade inflation in two ways: the average grade of Ontario students applying to Ontario universities rose an average of 0.23% per year from 1998 to 2006, and the percentage of Ontario Scholars (graduating high-school students with an average of at least 80%) has risen at one (presumably typical) high school from about 5% in the 1960's to about 30% now. Since the replacement of grade 13 by the OAC system in 1990, the percentage of Ontario Scholars at that school has increased by 1% per year. As the *de facto* entrance requirement to university has remained roughly constant at about 70% since 1990, this implies that students entering university have been progressively weaker on average. This is substantiated by their performance over the years on the same test in some courses at university.

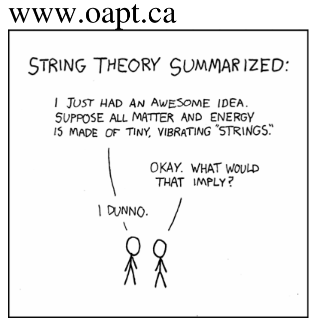
3. High-school preparation in physics and mathematics does not seem to be a major factor in the drop-out rate, as the percentage of students entering Physics 100 with calculus and physics has remained fairly steady at about 90% and 80%, respectively, from the 1980's to at least 2001. However, the percentage of students in Trent's Physics 100 with 4U/OAC physics fell to 66, 72 and 63% in 04-05, 05-06 and 06-07, respectively, which may partly explain the very high drop-out rates of 27% and above in the last three years.

4. We carried out a survey in Physics 100 in March of 2005-06, to try to determine which of a variety of potential causes might have contributed to the drop-out rate that year, including (1) hours per week students spent on paid work (to finance their education), (2) commuting times, (3) a culture of dropping courses in high school and in university, (4) years off after high school, (5) high-school physics background, (6) high-school math background, (7) whether or not a student lived in residence at university, and (8) whether or not students worked on assignments with their peers. The only three factors which were statistically correlated, at the 95% level or better, with students remaining in the course were the following: living in residence, working with other students on their physics problems assignments, and having taken the 4U/OAC physics course. The first two results are consistent with other studies that show that students who are well integrated socially and intellectually into university life are more likely to complete their degrees. The dependence on high-school training in physics (even when the university course begins by repeating all of high-school physics) is substantiated by data from the University of Calgary which show that students without the senior high-school physics course were four times more likely to drop their university physics course as were student who had taken that high-school course, even when the former group was enrolled in a course specifically designed for students without prior physics preparation.

5. Finally, the updated version of this paper in *Physics in Canada* includes new data, derived from the records of the Ontario Universities Application Centre, showing that the percentage of applicants to Ontario universities (from Ontario high schools) who took the 4U/OAC physics course has fallen from 35% in 1999 to 27% in 2007, a decrease of 23% over this time. Over the same period, the number of students attending Ontario universities has doubled, with the result that the absolute number of students taking 4U/OAC physics has remained roughly constant. However, Trent's Physics 100, like most introductory university physics courses, has grown in enrolment by about 30% over this period, implying that fewer of our students have a physics background, as verified in point 3. above. In contrast, the percentage of high-school students taking the senior physics course in British Columbia has remained roughly constant over this period, so the decrease in the percentage of Ontario students taking this course seems likely to be an Ontario phenomenon. One has to wonder if this is related to the Ministry's drive, beginning in 2000, to have more students graduate from high school, and the concomitant changes in student assessment practices.

[1] Canadian Journal of Physics **86**, 839-847 (2008).
[2] Physics in Canada, July – Sept. issue (2008).
[3] J.E. Côté and A.L. Allahar, *Ivory Tower Blues - A University System in Crisis.* (University of Toronto Press) 2007.

Go to the OAPT website for full article !
www.oapt.ca



from xkcd.com

NEW!! Readers Corner

Brunelleschi's Dome

Column Editor:
Marina Milner-Bolotin
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In this issue we are piloting our new "Readers' Corner". We hope it will provide an opportunity for our readers to share information about exciting science-teaching related books.

Rating: * highly recommended;**
**** recommended; *not recommended**

Our debut review is from Jim Hunt, University of Guelph, jhunt@uoguelph.ca

Brunelleschi's Dome by Ross King
Penguin Books. ISBN 0 14 20.0015 9

RATING : ***

In case you missed this incredible story in 2000 this will remind you. It is the life of Filippo Brunelleschi (1377-1446), ("Pippo" to the few friends he had) great mathematician, equally great artist, genius architect, treacherous friend, implacable enemy, plotter and inventor. In spite of the close rivalry of the renowned sculptor Lorenzo Ghiberti, Pippo won the competition that would make him the greatest architect of the renaissance and perhaps of all time. The competition was to construct the great dome on the Cathedral of Florence "Santa Maria del Fiore".

Brunelleschi contracted to construct the largest masonry dome in the world which would be exceeded in span only by the Roman Parthenon and that was concrete and didn't count. This gargantuan dome was to be 115 m from the crowning cross to the ground and have a span of 42 m. The great marvel however was that Pippo vowed that he would build it without "centering" (the timber support for domes and arches that is removed after the completion of the work); there wasn't enough timber in Italy to permit that. Construction started in 1420 and took only 16 years to build - a short time considering that the Cathedral took 170 years to complete.

King tells the story of Brunelleschi's lifelong struggle against the force of gravity and containment of thrust forces, to have a brick-and-mortar shell creep out over a vast empty space with nothing to support it but itself and his genius for design. The technical details are important to understand Pippo's triumph and King explains them clearly. The real story, however is that of the malignant genius who contracted to do the impossible and did it. The dome has not been exceeded to this day.

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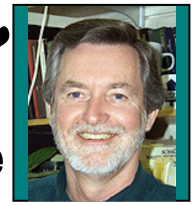
Book recommendations and short reviews will be gladly received by the column editor.

The Demonstration Corner

Bernoulli's Principle: Under Pressure



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In this demonstration, we utilize simple everyday household items to test Bernoulli's principle and verify the apparent counterintuitive nature of its predictions.

Bernoulli's principle, after the Swiss scientist Daniel Bernoulli (1700-1782), relates the pressure P, flow speed v, and the elevation of a fluid. The equation that expresses this principle quantitatively (assuming the fluid does not change elevation) is

$$P + \tfrac{1}{2}\rho v^2 = \text{constant},$$

where ρ is the density.

A major prediction of Bernoulli's principle emerges from this equation: where the velocity of a fluid is relatively high, the associated fluid pressure is relatively low, and vice versa.

This demonstration requires a blower (a shop vac, electric leaf-blower or air mattress pump can be used), large cork stopper with small hole (~ 0.5 cm diameter), and a metal disc (bristol board disc can be substituted) with a small nail stuck to the surface.

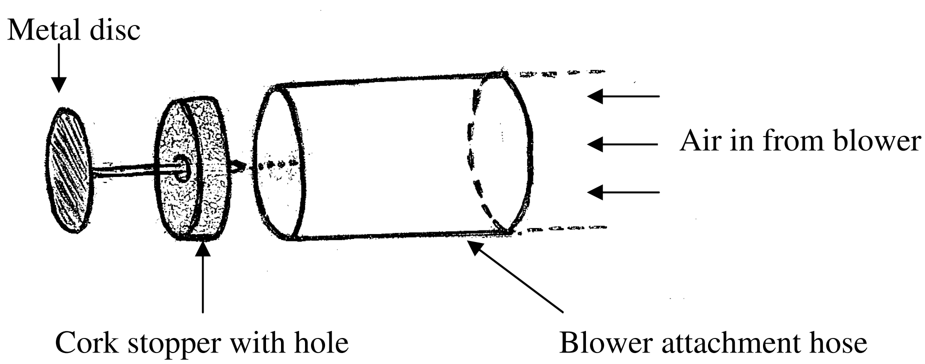

Figure 1. Equipment setup for demonstration.

Figure 1 illustrates the equipment: the cork stopper is fitted into the blower attachment hose and held in place so that air from the blower is forced through the small hole at the centre of the stopper, at high velocity. Before moving the metal disc towards the hole in the stopper, I usually ask the class to predict the outcome and also to confirm that the blower is indeed blowing air outwards and not in vacuum mode, i.e., not sucking air in. (A quick blast of air at a few students confirms this.) Most students predict that the disc would be blown away due to the high pressure generated as a result of the high velocity of air issuing from the hole in the stopper, with the logic of their prediction (based on experience) being that a rapidly moving fluid has a high pressure.

When the disc is brought close to the hole it is clear that it is attracted to, and remains suspended close to, the cork stopper (Fig. 2). This counterintuitive result is a consequence of Bernoulli's equation. Because the air speed is very high as the air moves through the narrow gap between the cork and the disc, the pressure is low. Consequently, the air pressure above the disc is less than the atmospheric air pressure beneath the disc, resulting in a net upward air-force on the disc, which balances the downward weight of the disc.

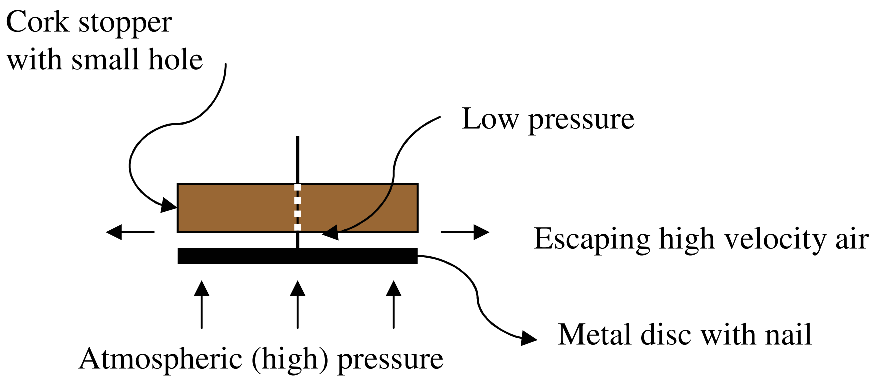

Figure 2. With the metal disc close to the cork stopper the pressure difference across the disc causes it to be attracted toward the stopper and remain suspended below the small hole through which high-velocity air is escaping. The small nail stuck to the disc surface and inserted into the hole in the stopper prevents lateral movement of the disc.

A useful explanation for students as to why their prediction — that high fluid velocities give rise to high pressure — is incorrect, and to clarify any misconceptions, is the example of a person being hit and knocked over by fast-moving water out of a fire-hose. The force that knocks you over is indeed due to fluid pressure, and you would justifiably conclude that the pressure was high. However the pressure is not high until you slow down the water by getting in its way. The rapidly moving water in the jet is approximately at atmospheric pressure before it hits you, but as you stop the water, its pressure increases dramatically.

Bernoulli's principle explains many other common phenomena such as the (perfume) spray atomizer, the dynamic lift experienced by aircraft wings and the motion of "curve balls" in baseball.

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Submissions describing demonstrations will be gladly received by the column editor.

CHECK OUT WHAT'S NEW AT WWW.OAPT.CA

Timely Topics Sourced by: Donald Messenger

Timely Topics is a list of topical articles of interest to Members. Examples are:

- Lasers to create mini sun in hunt for clean energy
- U of O scientist wins $1M Herzberg prize
- NASA searches for next Earth
- Scientists closer to making invisibility cloak a reality
- Dedicated physics teacher makes house call in another country
- Antimatter in the movies

High School Physics

Rolly Meisel
rollym@vaxxine.com

Turning a Motorcycle: The Curious Case of the Counter-steer

There you are, riding your motorcycle down the street in a straight line at a constant speed of 50 km/h while mouthing the lyrics of Born to Be Wild and imagining yourself as Peter Fonda in Easy Rider. As you approach the next corner, you want to initiate a sharp left turn.
How do you do it?

a) steer the handlebars to the left
b) shift your weight to lean the motorcycle to the left
c) both a) and b) are required
d) either a) or b) will initiate the left turn
e) steer the handlebars to the right

My current Iron Horse: 1982 Kawasaki KZ250LTD

Even seasoned veterans of the two-wheeled vehicle will more often than not pick the incorrect answer. The correct answer is e).

Just before you fire off an abusive email questioning where I might have purchased my undergraduate degree, let me hasten to add that I rode a number of different motorcycles for many years before this simple proposition was presented to me. How did I come to accept that it was true?

Consider the operation of a motorcycle. The front wheel acts like a gyroscope. The faster you go, the more stable it becomes. Below about 20 km/h, its angular momentum is low enough that you can steer the motorcycle to the left by turning the handlebars to the left. You might even be able to shift your weight enough to make that work, although you will be unlikely to make a really sharp turn unless you are riding a very light motorcycle.

Go faster, and at some point the unexpected happens. Shifting your weight has little effect on the direction of travel. Hard steering to the left results in a surprisingly violent lean to the right. The only way you can initiate a safe turn to the left is to momentarily countersteer, i.e., apply pressure to turn the handlebars to the right. The result? A lean to the left, making as sharp a turn as you desire.

Since this is a newsletter for physics teachers, I'll leave it to you to apply the right hand rule to determine the direction of precession of the gyroscopic front wheel of the motorcycle as you turn the handlebars left, and then, right, applying a torque to the axis of rotation through the front forks. Any elementary college or university text can help you, if it's been a while since you considered the physics of rotating bodies.

Of course, pencil, paper, and the right hand rule are not as satisfying as a real experiment. If you don't have access to a motorcycle, you can get almost the same effect from a bicycle. Being much lighter, you can turn a bicycle to some extent by weight shifting even at higher bicycling speeds. However, try riding along in a straight line, as fast as you can. Then, gently apply pressure to turn the handlebars to the right. The result may surprise you.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) September, 2009

The Demonstration Corner

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An Inexpensive Magnetometer

Dave Doucette (OAPT President)
Richmond Hill High School,
Richmond Hill, Ontario

Several years ago I was in need of a cheap, easily assembled, sensitive magnetometer. The intent was to design a tool for students to palpably observe the magnetic field around a current carrying conductor. Deflection of a compass needle lacked the 'wow factor' I sought. The solution turned out to be beautiful in its simplicity.

A plastic petri dish is the central component, consisting of a circular bottom dish with a slightly wider dish acting as the lid. Begin by taking the top dish and sitting it flat, like a tiny swimming pool. Fill it nearly to the brim with water (place the dish on a paper towel for spillage). The bottom dish is then floated on top of the water-filled top plate. A small wooden stick, with a wafer magnet hot-glued on each end, is set across the centre of the top dish so that it balances easily. Give this a tiny torque and it should spin freely without the edges grinding. Adjust the amount of water and the position of the wooden stick until friction is essentially eliminated. You now have a sensitive (qualitative) magnetometer (Fig. 1). Any standard magnet can be used to gauge the sensitivity.

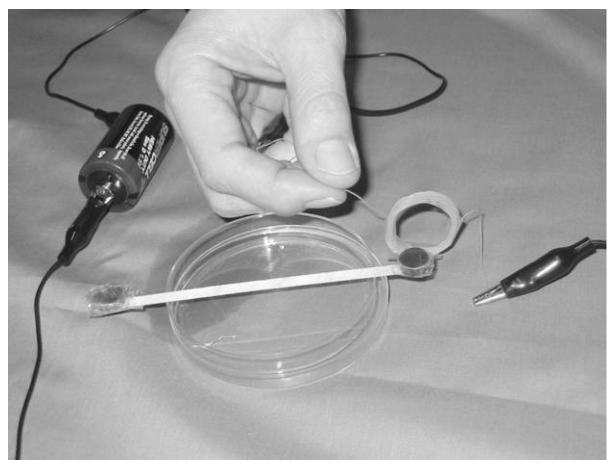

Figure 1: A coil of wire (10 windings) is held near one of the wafer magnets glued to the wooden stick. This causes the dish/stick assembly to rotate, depending on the position of the coil, direction of current, and wafer polarity.

Students first test a disconnected wire for magnetism — this gives a null result. Then they attach the wire leads to the terminals of a 1.5-V battery. The wire should be stretched flat and held directly overtop one of the wafer magnets. The orientation of the wire is critical. When placed parallel to the wooden stick, and directly over one wafer magnet, the resulting rotation of the dish/stick apparatus is maximized.[1] The rotation is reversed by switching the leads. The alligator clip ends of the wire need to be kept away from the wafer magnets, as the steel leads are magnetic.

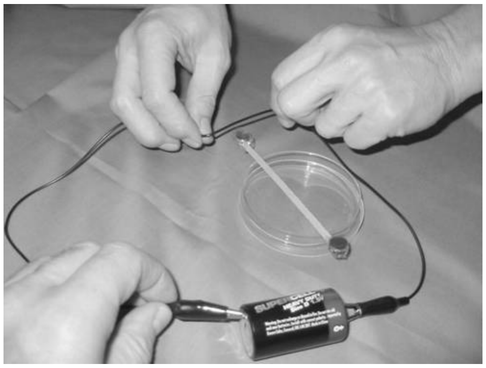

Figure 2: The conducting wire, when perpendicular to the wooden stick, produces zero torque but causes the stick/magnet assembly to accelerate linearly. This halts quickly as the petri dishes make contact.

When the wire is perpendicular to the stick (Fig. 2), but still directly above a wafer magnet, the rotation is zero. In this case the magnetic force is directed along the long axis of the stick, and careful observation will reveal the entire assembly to accelerate linearly for a brief time, halting when the floating dish butts against the bottom dish. Students can coil up the wire to see the notable increase in attraction or repulsion. By "flipping" the coil, they begin to visualize the coil's N-S magnetic polarity, mimicking the magnetic field about the wafer magnet. A ceramic magnet can be substituted for the coil to underscore this similarity.

Teachers can scaffold this activity into the SPH3U *electromagnetism* unit. The new curriculum emphasis on inquiry learning would support a minimal introduction, if any, and an opportunity for students to present whiteboard observations and explanations to their peers. It would be a simple matter for class groups to try wires and coils and list a series of observations. Each group could then select a different observation to explain. As discussions ensue, groups should be free to modify their explanations. This mirrors the fluid, provisional nature of science modeling and reinforces the student-centered instructional approach recommended on page 31 in the **2008 11/12 Ontario Science Curriculum**: "*A much more effective way to learn is for students to be actively involved in thinking and discussing during both class and investigation activities, with the goal of having the students develop a deep understanding of scientific concepts*."[2]

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[1] The force on a charge q moving with velocity $\vec{v}$ in the wire in the magnetic field $\vec{B}$ above the wafer magnet is given by the vector cross product $\vec{F} = q\vec{v} \times \vec{B}$. The magnetic field above the magnet is essentially vertical, and since $\vec{v}$ is along the direction of the horizontal wire, the direction of the force on the wire will also be horizontal but perpendicular to the wire. Therefore, when the wire is parallel to the stick, this force will be perpendicular to both the wire and the stick. By Newton's third law of motion, the force on the magnet (and attached stick) will be in the opposite direction to the force on the wire. Thus, the force on the magnet is also perpendicular to the stick and this force provides a torque that rotates the stick/magnet assembly.

[2] Kathleen Falconer et al., *Effect of Reformed Courses in Physics and Physical Science on Student Conceptual Understanding* (American Educational Research Association, April 2001, p1).

Ontario Association of Physics Teachers

AAPT PHYSICS EDUCATION American Association of Physics Teachers

FREE - AAPT/PTRA Workshop for Physics Teachers

The OAPT and AAPT are offering a 6-hour Physics Teaching Resource Agent (PTRA) workshop on Laboratory Activities for Physics Teachers in Ontario.

When: Saturday, November 21, 2009, 9:00 – 4:00pm
Where: Victoria Park Collegiate Institute, 15 Wallingford Rd, North York

Presenters: Diana Hall, PTRA (OCDSB) and Sarah Torrie (TDSB)

Please visit **www.OAPT.ca** - home page under “What’s New” for more information.

MOdern PhYSiCS

The Safety of Laser Pointers

Roberta Tevlin
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Lasers are fabulous tools that clearly show many key properties of light from basic optics to interference and quantum erasers[1]. However, the safety of laser pointers is in need of clarification. Lasers of Classes I and II have beam powers of less than 1 mW and are generally considered safe for supervised classroom use. Lasers that are Class III or IV are considered to pose unacceptable potential danger. Now, check the labels on your laser pointers. You will find that they are all Class IIIA – even the cheap dollar store versions!

This is because there is a problem with the classification system. Class IIIA lasers are restricted to 5 mW while Class IIIB can put out up to 500 mW. That’s two orders of magnitude greater! So, should we be concerned about using these lasers? Dennis M. Robertson, an opthamologist at the Mayo clinic, has done some very clear studies on laser pointers and eye safety. In 2000 he pointed a 5 mW laser pointer at a human eye for 15 minutes (it was due to be removed for medical reasons) and he couldn’t find any effect[2]. In 2005 he repeated the experiment with a green laser pointer. In this case, after 60 seconds, the patient reported no change in vision, but Dr. Robertson was able to detect changes to the retina. This makes lots of sense. Your retina is red, which means it absorbs green and reflects red. If it absorbs the light, it heats up. This is something that the classification system doesn’t address. I found a website selling a Class II green laser pointer. It stated “This pointer is visually the brightest laser one can find

[1] If you visit my website http://roberta.tevlin.ca you can find out how to use a laser pointer to make a quantum eraser.

[2] You can find the articles at the website of the Archives of Opthamology - http://archopht.ama-assn.org/ - Dec. 2000; 118: 1686-1691 and 2005; 123: 629-633.

with a CDRH Class II rating … the highest class rating that many school systems permit.”[3]

So, it appears that the red laser pointers are safe to use in the classroom and the green laser pointers are questionable. It is really easy for students to purchase a dangerous laser over the Internet.[4], so when we use a laser pointer we should take the opportunity to point out the real hazards of other lasers and model clearly how to use a laser so that the beam is never pointed or reflected near anyone’s eyes

Roberta Tevlin

[3] http://www.i-fiberoptics.com/laser_detail.php?id=115

[4] www.dealextreme.com - This site has many Class IIIB green lasers that put out 100’s of mW as well as some very cheap Class II red.

Spring Meeting

Highlights from Kingston May 2009

James Ball
J.F. Ross, Guelph

This past May The Royal Military College of Canada hosted our annual meeting. Our hosts Jean-Marc Noel and Mark Labrecque put together a terrific three day event. It began in style with a barbeque at the officer’s mess. The evening kicked off with Rolly Meisel myself and Glenn Wagner sharing some of our favourite demonstrations. The evening finished with a excellent talk on remote sensing (an RMC specialty) by Dr Joseph Buckley.

Friday morning began with our keynote address by Randy Knight author of “Five Easy Lessons: Strategies for Successful Physics Teaching”. Randy showed us that in order to transform student learning we must transform physics teaching. Randy’s session was followed up by the first of three workshop sessions (one of which he also gave). These sessions covered such topics as electrostatics, hands on quantum mechanics and practical Newtonian physics labs. Tom Russell and Eric Finn took us through some excellent examples of POEs (Predict Observe Explain). Sarah Torrie shared with us the wonderful teaching and learning opportunity available to us (and our students) at the Canadian Light Source in Winnipeg. Jim Hunt amazed us with another investigation into Anamorphic art. The day ended with a tour of old Fort Henry where, after an excellent dinner, Terrence Dickinson shared his passion for Astronomy with us.

Figure 1: Jim Hunt and a Refractive Anamorphic Viewer

Saturday began with our final set of workshops. John Berrigan took us for a ride with his session “Rockets for Dummies”. The day concluded with Jean-Marc Noel sharing his research with us helping us to understand how Auroras influence satellites.

Please come and join us next year at U of T as we see how they have transformed undergraduate physics teaching using lab practicals.

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NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) November 2009

Reader's Corner

Second Edition

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Readers are invited to share information about exciting science-teaching related books. *This month's review is from the column editor, Marina Milner-Bolotin, Ryerson University*

Rating: * highly recommended;**

**** recommended; *not recommended**

The Trouble With Physics; The Rise of String Theory, the Fall of Science and What Comes Next by Lee Smolin
Penguin Books. ISBN 0713997990

RATING : ***

Lee Smolin's fascinating book *The Trouble with Physics* focuses on the recent developments of physics and examines the lack of progress achieved in our fundamental understanding of nature during the past three decades. Lee Smolin, a leading theoretical physicist and a co-founder of the Perimeter Institute for Theoretical Physics in Waterloo, ON has been working on the foundational physics problems for decades. As a result, his examination of the progress of physics is written with such clarity and passion that it grabs your attention. Smolin makes the reader relive the recent history and struggles of physics by asking the fundamental questions that are often neglected in our science education: What are the major unanswered questions that the physics community has been working on? What progress has been made on answering them in the last thirty years? How do we know that current scientific theories are true? What are the limits of our current understanding of nature? What are the philosophical underpinnings of different theories? How does a scientific community support scientists who decide to work on alternative theories? What should we do as a community to support advances in physics? Lee Smolin's major claim is that in the last few decades physicists have failed to advance our fundamental understanding of nature. He argues that this happened not because we did not have talented people attracted to science, but because of the way the mainstream theoretical physics community has attacked fundamental scientific problems and allowed itself to stick with theories [i.e. a String Theory] that were in principle not testable by the experiment. This approach diverted resources from the scientists who wanted to pursue alternative theories discouraging young theoretical physicists from exploring anything but mainstream theories. According to Smolin, this protectionism of the "accepted theory" has significantly impeded the progress of science.

In a time when the Large Hadron Collider news transcended the realm of scientific journals and often appears in mainstream newspapers, when many high school students and teachers are excited about the search for the Higgs boson, Lee Smolin's book is a true gift. It will help laymen and scientists alike to see a bigger picture of the modern physics, not only by shedding light on what we failed to discover, but more importantly, on what might be there to discover for the new generations.

Column Editor: Marina Milner-Bolotin, Physics Department, Ryerson University, Toronto ON
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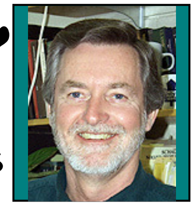
Book recommendations and short reviews will be gladly received by the column editor.

The Demonstration Corner

Making Speakers



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I prefer to do this as an activity as opposed to a demonstration, and have found that it works very well for students in Grades 7 to 12 visiting the University. I start with a discussion about sound and then compare a speaker to the human ear. In the discussion on speakers, I also talk about magnets and how they work, and I explain the difference between permanent magnets and electromagnets. After this discussion, I explain how to make speakers using a plastic cup, a magnet, and a coil of wire. Each student makes his/her own speaker and then tests it.

Figure 1: Materials required

The speaker requires a coil of wire to make the electromagnet. I use 40 feet of 32-gauge wire. This wire tangles very easily so I've had wire winders built (Figs. 1, 2, and 3). A paper strip approximately 3 cm wide is used to create a spool. Slits 1 cm long are cut into both sides of the strip and then the strip is wrapped around the wide part of the spindle and taped. The sides of paper are folded up to form a spool to hold the wire. The diameter of the spindle is used to calculate the number of revolutions needed to obtain 40 feet of wire.

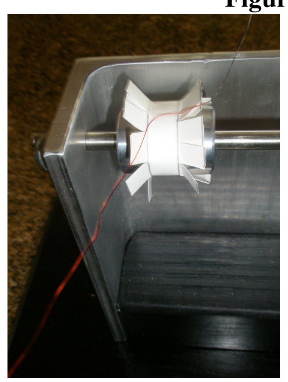

Figure 2: Attaching wire to paper spool.

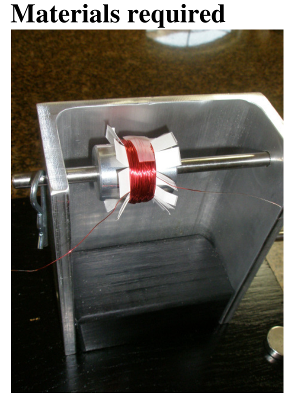

Figure 3: Finished wire spool.

Wire is taped to the spool as shown in Figure 2. Approximately 5 cm at the start and end of the wire must be left exposed. The ends of the wire are scraped with steel wool to remove the protective coating and expose bare wire.

Once the wire spool is complete with 40 feet of wire with bare ends (Fig. 3), the spool is removed from the spindle. A plastic cup is prepared by covering the bottom of the cup with double-sided tape. The paper on one side of the spool is folded back and pressed to the double-sided tape so that the spool is centred on the bottom of the cup. A magnet is pressed onto the tape in the middle of the spool. I've used both neodymium and ceramic magnets. (Although the neodymium magnets give better sound from the speakers, the ceramic magnets are safer to use. Neodymium magnets are so strong that they can snap together and shatter and/or pinch skin hard enough to draw blood.) The other side of the paper spool is folded in and a piece of heavy paper is attached with tape.

A set of wires with alligator clips is plugged into the output of an amplifier. The alligator clips are attached to each end of the speaker wire (Fig. 4). An input device such as an iPod is attached to the amplifier and both are turned on. The amplifier should be set so that sound comes only from the output wires and not from any speakers built into the amplifier.

The speakers are almost fool-proof. Rarely have they not worked, even if the wire spools are not wound properly. If the speaker does not work the first time it is hooked up, make sure that the wire ends are scraped well to ensure a proper connection between the wire and alligator clips.

The time and effort it takes to set up this activity is worth it when you see look of amazement on the students' faces when they hear sound coming from their plastic cups.

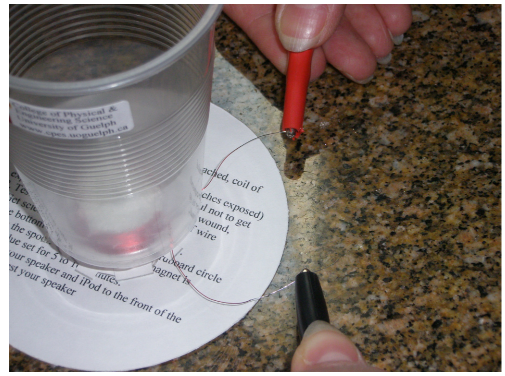

Figure 4: Connecting speaker to amplifier.

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Submissions describing demonstrations will be gladly received by the column editor.

High School Physics

Polarization of Light and 3D Movies

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Polarized light is a key aspect of **Unit E: The Wave Nature of Light** and it is a great vehicle for **Unit A: Scientific Investigation Skills** – especially in interpreting observations with vector analysis.

1) Exploration of Low-Tech Cardboard 3-D Glasses

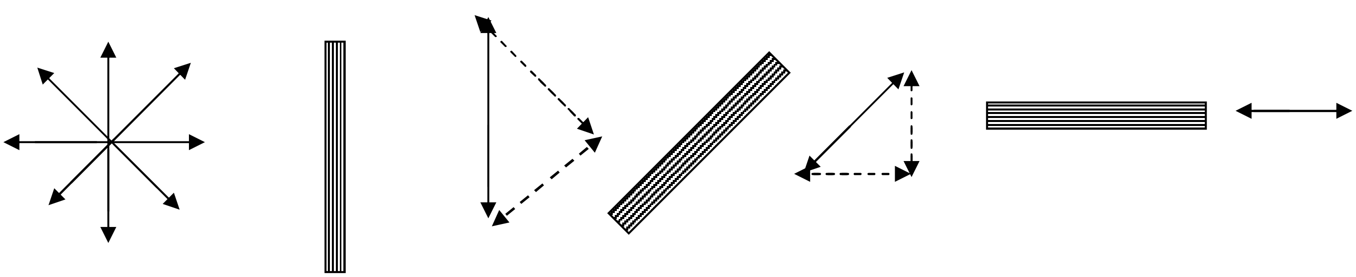
Put on the glasses. Close one eye and look at your partner's eyes through their glasses. What do you notice? One eye looks black and if you tilt your head by 90^o the other looks black.

The glasses have polarizers for lenses, one at $+45^o$ and the other at -45^o. A $+45^o$ polarizer will have no effect on light that has come through a $+45^o$ polarizer but it will block the light coming through a -45^o one. What about other angles? Have small groups use whiteboards to explain why half of vertically polarized light will pass through a polarizer at 45° to it. (The relevant component passes. The intensity is proportional to the amplitude squared. The square of this component is ½ for 45°.) What about 30° or 60°? (1/4, 3/4)

2) Exploration of a Third Filter

Put on the glasses and look at your partner so that you are looking at a completely blacked out eye. Hold a third filter in between your eyes. What do you notice? The addition of a third filter allows more light through!

Have small groups draw arrows and components to explain how this is possible. How much of the original light gets through all three filters? (½ x ½ x ½ = 1/8)

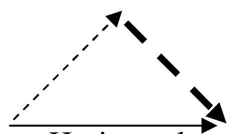


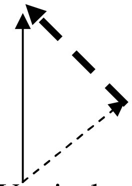
½ passes ½ * ½ passes ½ * ½ * ½ passes

3) Exploration of a Birefringent Material

Put on the glasses and look at your partner so that you are looking at a completely blacked out eye. Hold the material between your eyes. The material can be plastic sandwich bags, several layers of scotch tape or overhead transparencies. What do you notice? The addition of the material allows more light through – even more than a third filter. Colours are sometimes seen, especially if you stretch the sandwich bags.

These are birefringent materials, which have two indices of refraction – one for each polarization axis. Because the two components travel at different speeds, they get out of phase with each other. This allows a vertical polarization to turn into a horizontal polarization by having one component shifted by a half a cycle. Essentially, this means a birefringent material can rotate the polarization of light.





4) Projecting Polarized Light

These polarized glasses let in light that is polarized at +45 in one eye and at -45 in the other eye. In the theatre there is one camera rapidly alternating images from one polarization to the other. Project a bright light through a filter onto a white wall or screen. View the spot through the glasses. Both eyes can see the spot. Now, try it with a tin foil screen. Only one eye can see the spot.

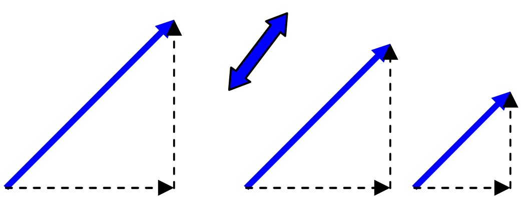
The reflected light from a metal screen remains polarized and is brighter. Originally all movie screens were metal because the dim projectors needed the brighter reflection. This is why it is referred to as the 'silver' screen. However, the angle of view is smaller and when projectors got brighter the screens were changed to non-metal. At a movie theatre that is showing a 3-D movie, go up and touch the screen – it is metal.

5) Exploration of the New High-Tech 3-D Glasses

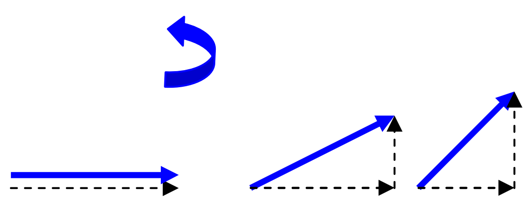
Put on a pair of the better plastic glasses from a theatre. Close one eye and look at your partner's eyes through their glasses. Tilt your head. What do you notice? It doesn't change much as you tilt your head

These glasses have two layers. The inside layer is a standard polarizing filter. The outside layer is a birefingent material thick enough to slow one component until it is 45° out of phase with the other. This is called a ¼-wave plate and this turns the linearly polarized light into circularly polarized light. Suppose the filter produces light polarized at +45°. Have students model this by moving one hand up to the left and then down to the right a la John Travolta. Have the students model this same wave as the horizontal and vertical components using both hands. The ¼-wave plate will slow the vertical component by 45° relative to the horizontal. Now instead of the components moving in and out at the same time, one hand goes in while the other goes out. What does the sum of the two look like? Have students try drawing a series of diagrams to show what it forms.

Linear Polarization Components



Circular Polarization Components



The light has become **circularly polarized**. It then enters the circular polarizer of your glasses. The quarter-wave plate slows it down again so that the +45° polarization has become -45°. This is exactly what is needed to pass through your glasses because when you look through a +45° polarizer from the other side it looks like it is at -45°. Why does tilting your head have so little effect? If you tilt your head, a vertically polarizing lens becomes horizontal, but a clockwise polarizer is still clockwise. This means that the viewer doesn't have to keep their head vertical while watching the movie. (Note: The cheap glasses are also somewhat vertically polarized – just not as much as the plastic glasses.)

Supplies

1) Polarizers - 17" wide, $15.00/foot - http://www.polarization.com
2) Cardboard (linearly polarizing) Glasses - $0.50 each - http:// www.rainbowsymphonystore.com
3) Plastic (circularly polarizing) Glasses - Go to a 3-D movie and ask the manager for some or you can order them from http://www.the3Dmarket.com for about $2 each.

Further Information: Feel free to contact the author at addresses listed above AND…

There is a lot more to be explored in polarization. **Physics 2000** is a great site which combines the PhET simulations of the University of Colorado with well-organized explanations. It has a very good interactive lesson about polarization. First it goes through linear polarization and then it looks at LCD screens in great detail. http://www.colorado.edu/physics/2000/index.pl

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
(An Affiliate of the A.A.P.T., and a charitable organization)
February 2009

The Demonstration Corner

Wire Fire !

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This demonstration is a nice way to illustrate the $P = I^2R$ relationship that is discussed in electric circuits. Figure 1 illustrates the equipment: a Variac transformer takes the wall output of 120 V and generates a variable voltage from 0 to 140 V. This is then sent through a Hammond Manufacturing transformer (167X5), converting down to 5 V output. We use this second transformer in order to increase the current through the wires. The output from the second transformer is connected to three wires in series: approximately 10 cm in length of each of ~18 gauge Nichrome, steel and copper. A piece of folded paper is placed on each wire.

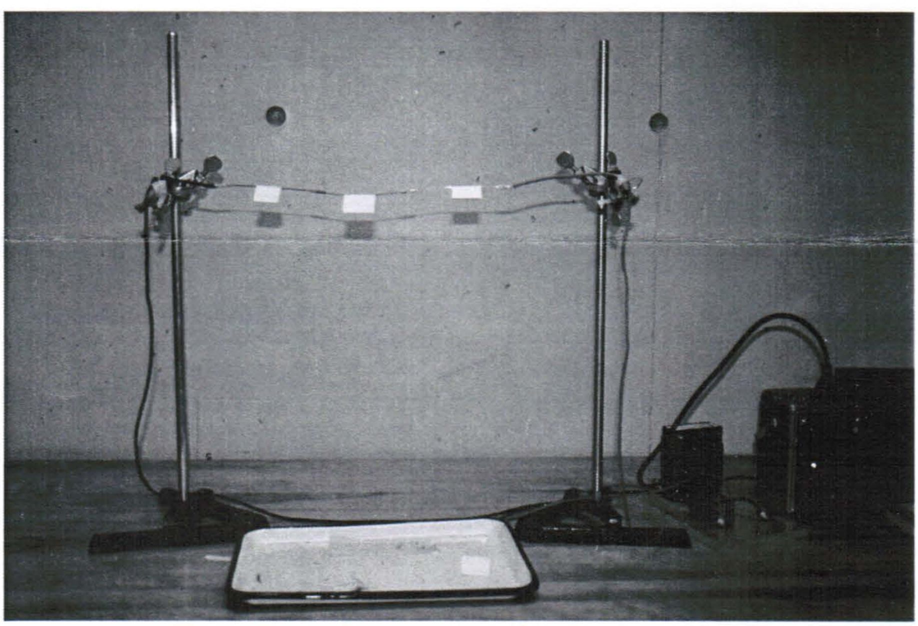

Figure 1: equipment setup for demonstration.

Because the wires are connected in series, the same current will flow through each one. This means that the relative power output of each wire depends on the relative resistance, which varies with the wire material. Table 1 gives the approximate resistivities (ρ) of the materials involved. (Recall that the resistance R of a wire of length L and cross-sectional area A is given by $R = \rho L/A$.)

Material	Resistivity ρ (Ω m)
Nichrome	100×10^{-8}
Steel	20×10^{-8}
Copper	1.7×10^{-8}

Table 1: resistivities of wire materials.

Before we turn on the Variac to conduct the demonstration in class, I provide the students with the values given in table 1 and I ask them to rank the power output of the three wires. The majority of students indicate that the Nichrome will have the greatest output while the copper has the smallest.

We then turn on the Variac and increase the output voltage to approximately 80 or 90 V. With a video camera zoomed in on the wires displayed on the lecture hall screen, it is clear that the paper on the Nichrome wire begins to smoke and eventually burns through and falls from the wire to the enamel plate below. The paper on the steel and copper wires is unchanged. See figure 2.

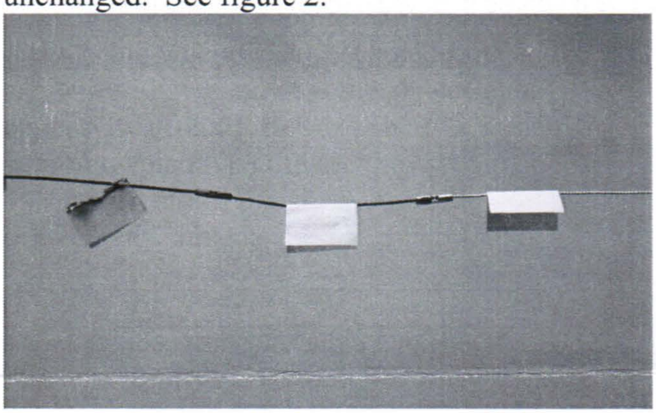

Figure 2: With the Variac output at ~90 V, the paper on the Nichrome wire (far left) burns and falls off. The paper on the steel wire (middle) and the copper wire (far right) are unchanged. (Note that the copper wire has a tin coating.)

I then ask the students what we need to do to get the other pieces of paper to ignite. They tell me to turn up the voltage on the Variac, so we increase the output to approximately 115 V. The paper on the steel wire now burns and falls off, while the paper on the copper wire remains intact (figure 3).

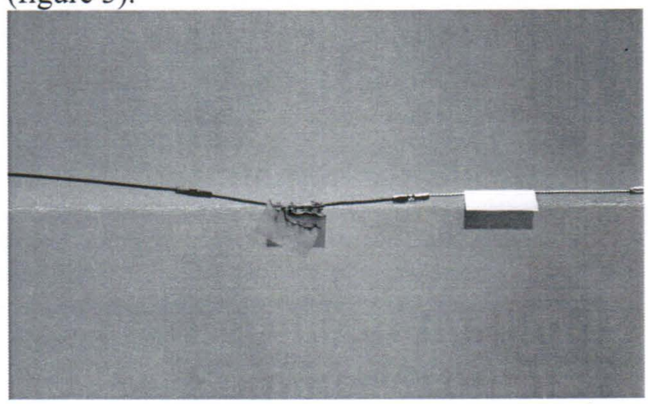

Figure 3: With the Variac output at ~115 V, the paper on the steel wire burns and falls off. The paper on the copper wire is unchanged.

They always want me to turn the Variac up all the way, and when we do, the Nichrome and steel wires glow nicely but the paper on the copper wire is unaffected. I usually ask them at this point which type of wire they would choose to send current through the walls of their house – not too many students opt for Nichrome!

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!! CONFERENCE REMINDER !!!

This year's workshops and meeting will be hosted by **RMC** in **Kingston, May 28 to 30th** .

AS ALWAYS, GREAT PRACTICAL FUN CLASSROOM READY IDEAS FOR LESSONS, LABS AND IMPROVED LEARNING !

WORKSHOP by Randy Knight, author of **Five Easy Lessons: Strategies for Successful Physics Teaching**

Check out www.oapt.ca for details on all OAPT happenings!

Perimeter Institute for Theoretical Physics Offers Free Summer Programs for Teachers and Students

The 2009 International Summer School for Young Physicists (ISSYP) is an exciting and challenging two-week program for Canadian and international students, 17 to 18 years of age, with a keen interest in theoretical physics and who intend to pursue a degree in physics at the university level.

This summer school super-charges potential "Einsteins" with presentations by Perimeter Institute researchers on *cutting edge* theoretical physics – *hot topics* such as superstring theory, quantum computing and dark matter. Students will have opportunities to work with leading international theoretical physicists in small group *mentoring* sessions and participate in l*ab tours* and other activities with like-minded students from around the globe. Students are provided with insights into their own potential as possible *future researchers* in theoretical physics.

ISSYP 2009 will be held on-location at Perimeter Institute from August 8 to August 22, 2009. The deadline for applying to the program is Thursday, March 19, 2009.
Visit www.issyp.ca for details.

The 2009 EinsteinPlus International Workshop for Teachers is a one-week, intensive residential workshop for Canadian and international high school teachers that focuses on key areas of modern physics — including quantum physics, special and general relativity, and cosmology.

After the workshop, Perimeter Institute supports teachers participating in the program, to conduct follow-up activities with other teachers at home for the benefit of the wider education community.

EinsteinPlus 2009 will be held, on-location, at Perimeter Institute from Sunday, August 2nd – Saturday, August 8th, 2009. The deadline for applying to the workshop is March 31st, 2009.
Visit www.einsteinplus.ca for details.

For more information about these programs, please contact Julie Taylor, Outreach Coordinator, at 519-569-7600 ext. 5080.

Modern Physics

Heisenberg Uncertainty Principle and Diffraction

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Here is a way to introduce HUP in a simple and concrete way through diffraction.[1] In high school physics we usually treat diffraction as an example of classical wave behaviour and for sound and water, that's exactly what it is. However, if electrons, photons or other quantum objects are showing diffraction, then there must be a quantum mechanical explanation. Why? Because when we turn the intensity of our source down until there is only one object at a time, we see that the diffraction remains. To explain the 'diffraction' of a single electron or photon you need HUP.

To give students a real tactile experience of diffraction, I recommend that you have them take two round pencils and join them with elastics as shown in Figure 1.[2] Direct a laser pointer at the wall and ask them to predict what the laser spot will look like when they look at the spot through the horizontal slit. Before looking, have them sketch what they expect and their reasons. Have them compare their answers with their nearest neighbours etc. Then let them look.

My students predicted many things, but none of them predicted that the spot would be stretched vertically. It's a great 'ahah!' moment. Next, have them predict what will happen if you squeeze the pencils closer together and then have them try it.

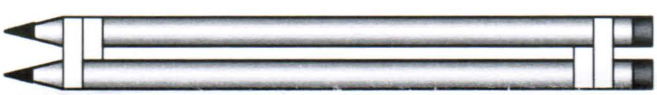

Figure 1

OK, so how does the HUP explain this?[3] HUP says that there is a limit to how precisely we can know the momentum and position of a photon. Specifically, $\Delta x\ \Delta p >= h/2\pi$. When a photon passes through a slit our uncertainty in its location, Δx, is just the width of the slit, w. However, this measurement of position results in an uncertainty in its momentum after the slit. Instead of hitting the screen at the same level as the original beam it has a probability of landing well above or below that spot. You can even make this quantitative and turn it into an experiment if you have a set of slits of known width like the Cornel plates.[4] Figure 2 shows the range of paths of the light after the slit. Let's call the length from the slit to the screen, L, and the spread of the central maximum, s. This diagram could also represent the photon's momentum. In that case the length is the momentum of the original photon, $p = h/\lambda$, and the spread is the uncertainty in momentum, Δp. By similar triangles, $\Delta p/p = s/L$ and therefore $\Delta p = ps/L = hs/\lambda L$. Substituting this and $\Delta x = w$ into HUP we have $\Delta x\ \Delta p = (w\ h\ s)/(\lambda L)$. Use the given values of λ and w and the measured values of s and L. You'll find that $\Delta x\ \Delta p$ is definitely more than $h/2\pi$ and will be around 2h.

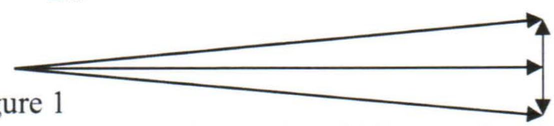

Figure 2

I have written a full lesson plan around this idea which you can find on my website http://roberta.tevlin.ca. Let me know if you have any suggestions to improve this. You can reach me at roberta@tevlin.ca.

[1] Dr. Damian Pope at the Perimeter Institute first introduced me to this approach.

[2] I found this demo in the "Diffraction of Light" resource from Cornell's Center for Nanoscale Systems Institute for Physics Teachers at http://www.cns.cornell.edu/cipt/labs/DiffractionofLight.html.)

[3] Prof. Walter Lewin of MIT explains this from minute 32 to 42 at http://ocw.mit.edu/OcwWeb/Physics/8-01Physics-IFall1999/VideoLectures/detail/embed34.htm

[4] Boreal has a set of two slides with many different slit patterns for $63. One of the two slides is the classic Cornell set of gratings which has single slits with 4 different widths. http://sciencekit.com/diffractionandndash%3Binterference-resolution-kit/p/IG0023801/.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) February 2010

The Demonstration Corner

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How to Make a Lighted Throwing Stick

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This article is reprinted from *Physics in Canada*, Volume 65, No. 3, pg.141 (2009), with permission of the Canadian Association of Physicists (CAP).

Illustrating the concepts of centre of mass and centre-of-mass motion to an introductory physics class can be a challenge to a physics instructor. The topic can be very mathematically complex and is not necessarily intuitively obvious. A device that demonstrates how the centre of mass of an object moves as compared to the motion of a point on the object away from the centre of mass would provide an excellent qualitative illustration of this. At Dalhousie University we have constructed just such a device, our lighted throwing sticks (Fig.1).

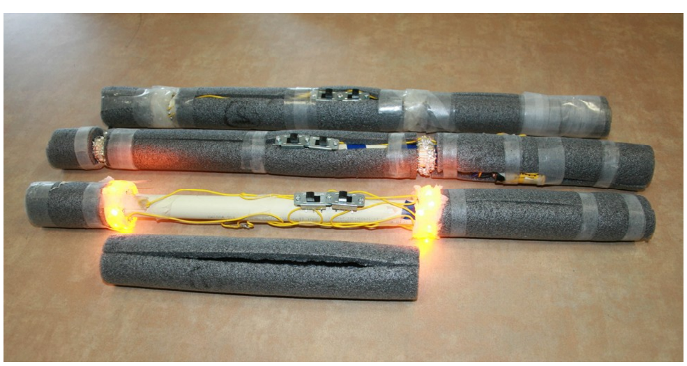

Fig. 1 Three throwing sticks at various stages of assembly.

These throwing sticks are long rods with lighted bands located at one end and at the centre of mass of the rods. By throwing such a rod with the centre of mass lights on, the students see a smooth trajectory of the centre of mass motion, while the end lights demonstrate the complicated motion of points away from the centre of mass (Fig. 2). Jeff Dahn demonstrated our lighted throwing sticks at the 2009 CAP Congress in Moncton, NB.

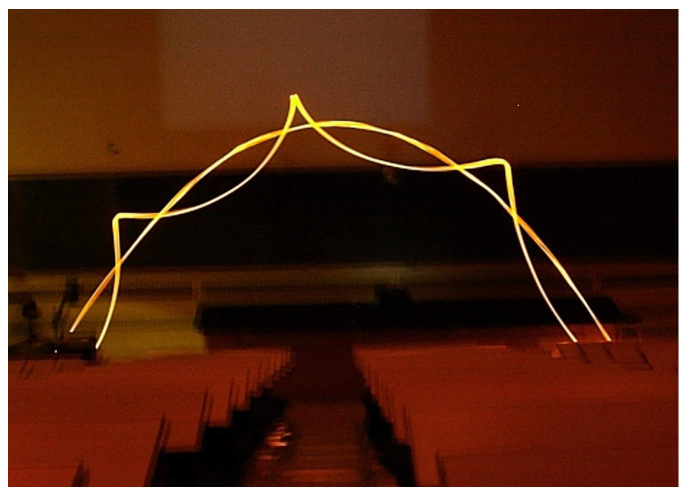

Fig. 2 Stick thrown with both lights on.

At Dalhousie we made throwing sticks from white water pipe (3/4" outside diameter). The lights are made from about 10 to 30 LEDs, oldered around the circumference of two rings as in Fig. 3. The pipe is padded with 3/4" id foam pipe insulation. The LEDs are protected by potting

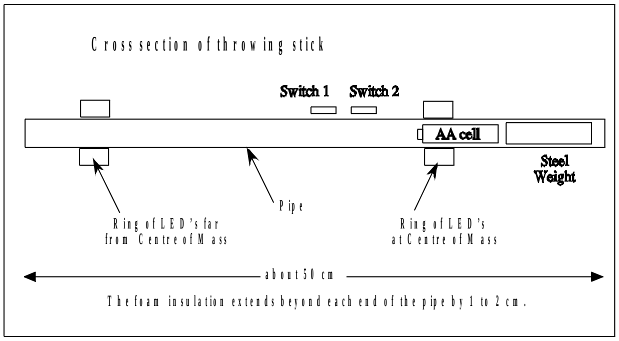

Fig. 3 LED details.

them in clear caulking. A steel mass near one end ensures that the centre of mass is not at the centre of the pipe. One light is at the centre of mass; the other is far from the centre of mass. Each light has an on/off switch. Figure 4 shows the layout of the stick.

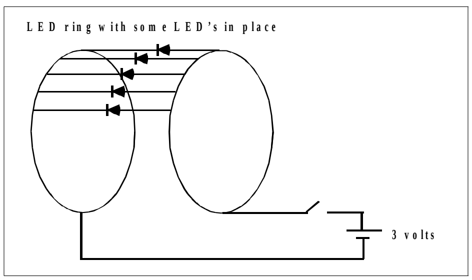

Fig. 4 Details of throwing stick.

Landings are very harmful to the throwing stick. We felt we were doing well if a stick survived 10 throws without failing. We usually operate in lectures with two spares.

Things that helped sticks survive are:

1. We used flexible, braided wire.
2. We used AA cells with solder tabs.
3. We twisted, soldered and taped all electrical joints.
4. We wrapped the pipe insulation with transparent first aid tape.
5. A rubber stopper in each end of the pipe helped but never stayed in place very long.

How to use:

* Throw the stick with only the off-centre light switched on and you see a complex tumbling path.
* Switch on only the light at the centre of gravity. Throw the stick with a tumbling motion and the light will follow a simple parabolic path, demonstrating that the centre of mass is a special place.
* Throw the stick with both lights on and you see both motions as shown in Figure 2.

Supplies: We bought LEDs (in packages of 100) and slide switches from Jameco Electronics, Belmont, California. Everything else came from local hardware stores or pharmacies.

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MODERN PHYSICS

LEDS and Plancks Constant

Roberta Tevlin
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Quantum physics is firmly part of the new 12U curriculum. It also is one of the most difficult topics to teach because it leads to such counter-intuitive ideas and there are almost no experiments or demos that you can do in the classroom. Fortunately, there is one really simple and cheap experiment. This involves measuring Planck's constant with LED's. Different versions of this experiment have been around since 1974[1]. Details about this experiment and

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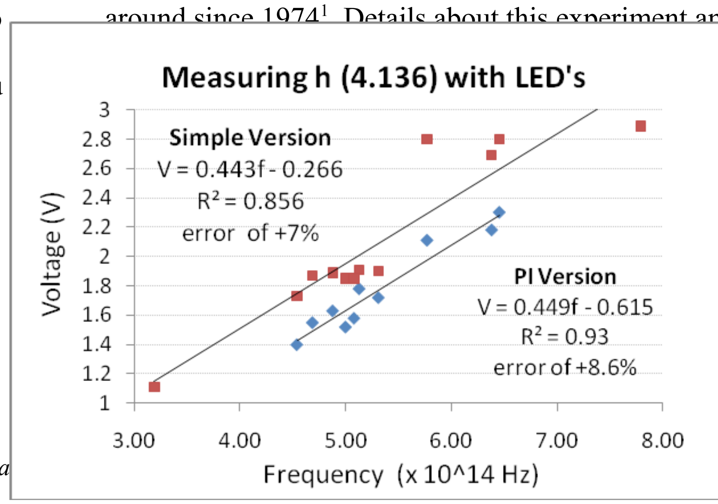


Figure 1: Comparing results of the two versions.

1 LED.

Source charges \$5 per LED but they are only \$0.25 each from http://alan-parekh.vstore.ca/ . You also need a variable power supply. If you don't have a set of these - and I don't - you can use batteries and potentiometers. What if you don't have the potentiometers? Never fear! Recently I learnt of an even simpler version of this lab through the Alberta Physics Teachers Association. It doesn't need a variable power supply - just a couple of batteries to provide an constant 3V. The LED is attached to the batteries in series with a resistor of 10's to 100's of ohms. The voltage drop across the LED is measured. This is repeated with several different LED's but the same voltage and resistor. A graph of the voltage drop vs. the frequency of the light yields a straight line with a slope of h in units of eV.s. Figure 1 shows results for this simple version and for PI's version.

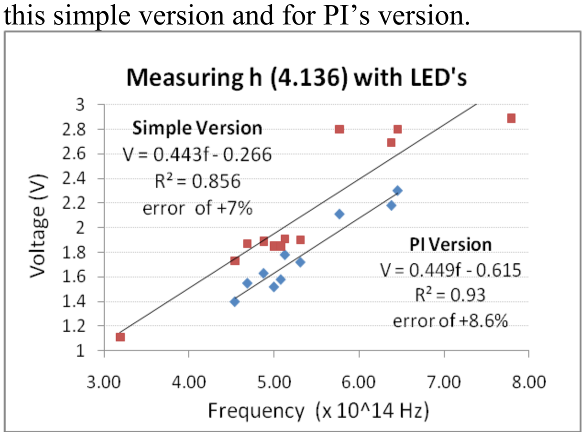
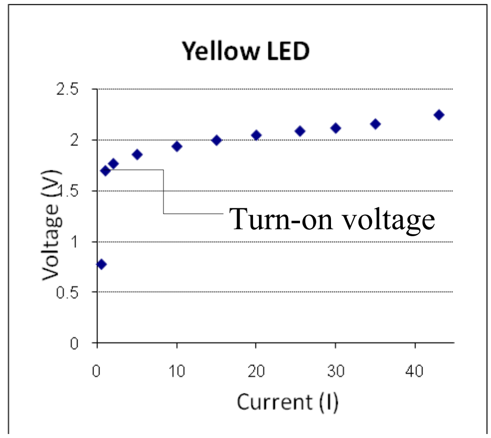


Figure 1: comparing results of the two versions



Why do the slopes give Planck's constant? In an LED, the energy of an electron, eV, is changed into the energy of a photon, hf. An LED is like the photoelectric effect run backwards. There are resistive energy losses and so the graph of V vs. f has an intercept. This intercept is equivalent to the work function. Similarly, just as the photoelectric effect has a threshold frequency, the LED has a turn-on voltage. Figure 2 shows the response of a typical LED to various voltages. When there is not enough energy, then there is almost no current and there is no light emitted. However, when there is enough energy, there is lots of current. Increasing the voltage further makes the light get brighter but it doesn't change its colour. More photons are emitted but they do not have more energy. PI's version of

Figure 2: Response of a typical LED

the experiment has the students adjust the voltage to find the minimum voltage that will cause the LED to emit a photon. This is like adjusting the voltage in the photoelectric effect to find the maximum kinetic energy of the photoelectrons.

Why does the simple experiment still work, when the batteries are providing up to three times the turn-on voltage required? First of all, most of the extra energy is soaked up by the resistor in the circuit – that's what it is there for. The voltage drop across the LED also increases somewhat, but if you look at figure 1, you'll see that each LED is uses roughly the same amount more – around 0.3 V. Because this increase is constant, it increases the intercept but doesn't change the slope. It takes more time, care and equipment to perform PI's version of the experiment but it has many advantages that make it worth the added effort. It results in more reliable data. It allows the students to observe the effect of a changing voltage on the LED, which is so different from an incandescent bulb. It also provides more similarities to the photoelectric effect – a key part of the curriculum – and it is easier to explain. However, if you are strapped for time or equipment the simpler version is an excellent alternative. This version also allows you to incorporate ir and uv LED's more easily. I recommend that you use them because the added data range from these LED's will help ensure that your results are still pretty good.

There are a number of workshops being presented by the Perimeter Institute coming up in February and March around southern Ontario. At these workshops teachers will receive free materials and training for this LED lab PI's new resource package - The Challenge of Quantum Reality. If you are interested in attending one of these workshops and want more details, please contact me at roberta@tevlin.ca .

Reader's Corner

Third Edition

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Physics of the Impossible. Kaku, M., New York:
Reviewed by Keith Poore and Edna Sacay
(Physics Students at Ryerson University)

As you read a science fiction book or watch a sci-fi movie and wonder if it is possible to travel in time, see the future with precognition or hide yourself in an invisibility cloak, reading the *Physics of the Impossible* by Michio Kaku will help you answer some of your most burning questions. In his reader-friendly book Kaku applies the laws of physics to science fiction in order to understand why some of the science fiction inventions will never become a reality, while others might materialize once new technologies become available. The author reveals the milestones that need to be overcome by the current technology and civilization in order to make some of the current science fiction "impossibilities" happen. Kaku is a theoretical physicist specializing in String Field Theory. He received his Ph. D. in theoretical physics from the University of California, Berkeley. He has been teaching for more than 25 years at City College of New York, has been a host of numerous TV and radio shows and had given a large number of public talks

The *Physics of the Impossible* is aimed at the general public and will be of greater interest to high school students and their science teachers. Kaku explains the fundamental laws of physics before explaining the barriers that must be overcome before the "impossible" become possible. The book naturally has many science fiction references such as Star Trek, Harry Potter and Superman, for the readers to relate to when explanations appear to be complex. The absence of mathematics allows for the general audience to grasp ideas that are portrayed without getting caught up in the numbers.

Kaku intrigues the reader by covering topics that appear commonly in science fiction such as time travel and artificial intelligence. The book conveys great mental imagery so it can be understood to a better extent. He also leaves 11 pages of notes allowing the reader to understand material better. An index is also included to help find specific topics like *metamaterial* which will help to show the relation between different topics. The reader will soon realise that the book opens doors to a more in depth exploration of the topics thanks to the references in the bibliography.

The book is well organized because of how Kaku presents the information within three different classifications of impossibilites. Class 1 impossibilities are technologies that can be achieved within a decade to a century. Class 2 impossibilities are technological advances which could be possible anytime from a millennium to multi-millennia from now. Class 3 impossibilities are the ideas and concepts of technology that will never be attained unless there are drastic shifts in our understanding of the fundamental laws of physics. Kaku has also thoughtfully organised concepts in such a way that builds from previous knowledge explained within preceding impossibilities.

In our view the lack of diagrams and mathematics weaken the book's overall portrayal of concepts. For example, when explaining different types of spacecrafts that could theoretically be built, diagrams would have been sufficiently helpful in understanding the theory behind each spacecraft. Simple mathematics would include showing the formulae describing fundamental physical concepts and explaining what the variables and constants were.

For example, referring to Snell's Law would have been ideal when introducing the idea of invisibility.

This book could help teachers explain physics to students, even if the students have not taken a physics course before. Topics that are usually hard to understand such as, special relativity and quantum mechanics, are explained using imagery that helps the reader understand the concept. This is made apparent in the Perpetual Motion Machine impossibility when Kaku compares the three Laws of Thermodynamics to a game.

Overall, Michio Kaku does an excellent job in conveying the physical impossibilities of science fiction of today illuminating what could be possible in the future. The *Physics of the Impossible* is recommended to anyone who is remotely interested in physics. Although some concepts are hard to grasp, this book exposes the general public to what is currently physically impossible.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) April, 2010

MOdern PhYSiCS

Quantum Tic-Tac-Toe

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Quantum physics is weird but it does have rules – they are just different from those of classical physics. These rules involve the three key concepts of **superposition, entanglement** and **measurement-disturbance**. One great way to get a feel for these rules is Quantum Tic Toe. It is similar to classical TicTac Toe – but with quantum-like rules. When you make a move, you select two boxes where you might be – not one box where you definitely are. This is like an electron in a double-slit experiment – it could have gone through either one slit or the other. Your move, like the electron, is in a superposition of states. One possible first move is shown in Figure 1. Next, your partner makes a similar, indeterminate move as in Figure 2. You can then respond as in Figure 3.

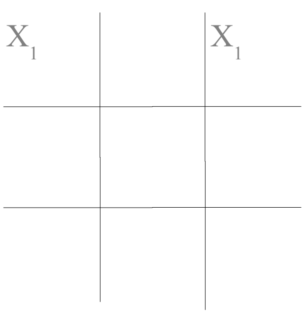


Fig. 1

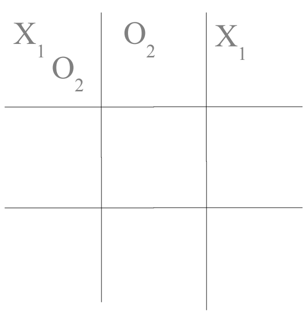


Fig. 2

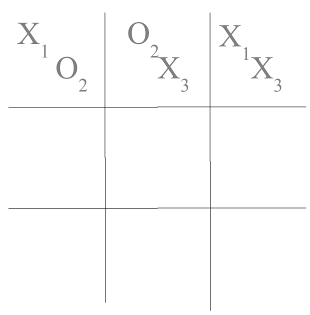


Fig. 3

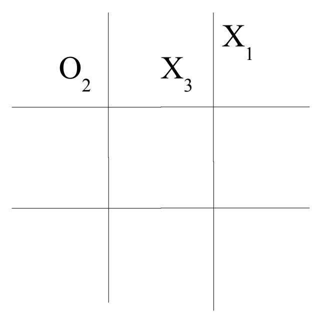


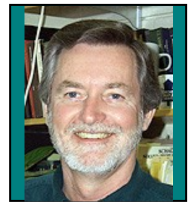
Fig. 4

But wait! Now there are three boxes and three letters. There is no further room in these boxes and the moves are entangled. Entanglement is probably the weirdest feature of quantum physics. Measuring the state of one entangled particle instantly determines the states of the others. In classical physics, properties or states exist objectively. In quantum physics they often don't exist until we measure them and our measurements change the outcome. That's why if you measure which slit an electron goes through – you lose the interference pattern.

Consider the middle box. There is a 50:50 chance that it will contain an X. Let's flip a coin. Suppose it is an X. That means that the right corner must contain the first X and so the O must be in the left box. The game now looks like Figure 4. If the middle box had contained an O, then the game would show X, O, X across the top. Before the measurements there were two possible games being plated - now there is just one. This models how quantum computers can be so powerful. They do many calculations at once, just as we can play many games at once. You will find more information about this game at http://www.paradigmpuzzles.com/QT3Play.htm. If you play it on line, it will keep track of the superpositions and entanglements and show you all the classical games that you are playing at once.

The Demonstration Corner

Can You See Sound ?



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This demonstration is a nice way to show that sound is vibration of molecules. Figure 1 shows the equipment required for this demonstration. The setup consists of an amplifier attached to an input device (laptop, iPod, mp3 player, etc) and a set of small speakers (described below) as well as a bar clamp and red and green laser pointers.

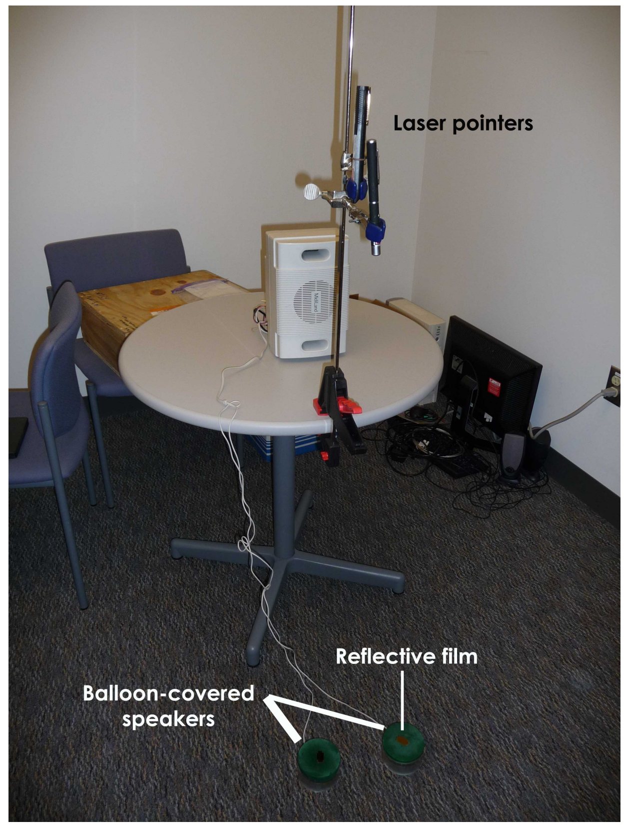

Figure 1 Equipment setup for demonstration.

Two small speakers are mounted inside plexiglass tubes so that there is space above and below the speaker. A groove is etched around the outside of the tube about 1 cm from the top of the tube. Latex balloons with the ends cut off are stretched across the top of the plexiglass tube. The balloons can be held in place by stretching the balloon past the groove and then wrapping elastic bands around the tube in the groove. A reflective film is attached to the balloon in the center of the speaker. I use gold-coated mylar film as tin-foil diffuses the light too much. You can try using a small piece of a CD or mirror. The speakers are set on the floor and plugged into an amplifier that has some input device attached. I use an iPod but you can also ask students to use their own input device with their favourite music. A bar clamp is attached to the table or bench with the amplifier. Laser pointers are attached to the bar clamp so that the green laser shines on the reflective film on one speaker while the red laser shines on the reflective film on the other speaker.

I ask students what sound is and initiate a discussion about sound, as well as how and where sound waves travel. I have them put their ear against a desk and knock lightly on the desk so that they realize that they can feel as well as hear sound. I then ask them if they can see sound and if they want me to demonstrate the ability to see sound. I dim the room lights and then turn on the iPod and amplifier. As the speaker emits the sound waves, the vibrating air molecules cause the balloon to vibrate which in turn moves the reflective film. The laser beam, which is reflected from the film onto the ceiling, moves with the music. To reinforce that the movement of the laser beam is due to the sound waves, I change the volume. As the volume increases, so does the movement of the laser beam.

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Submissions describing demonstrations will be gladly received by the column editor.

High School Physics

Faster than Gravity: The Curious Case of the Bungee Jumper

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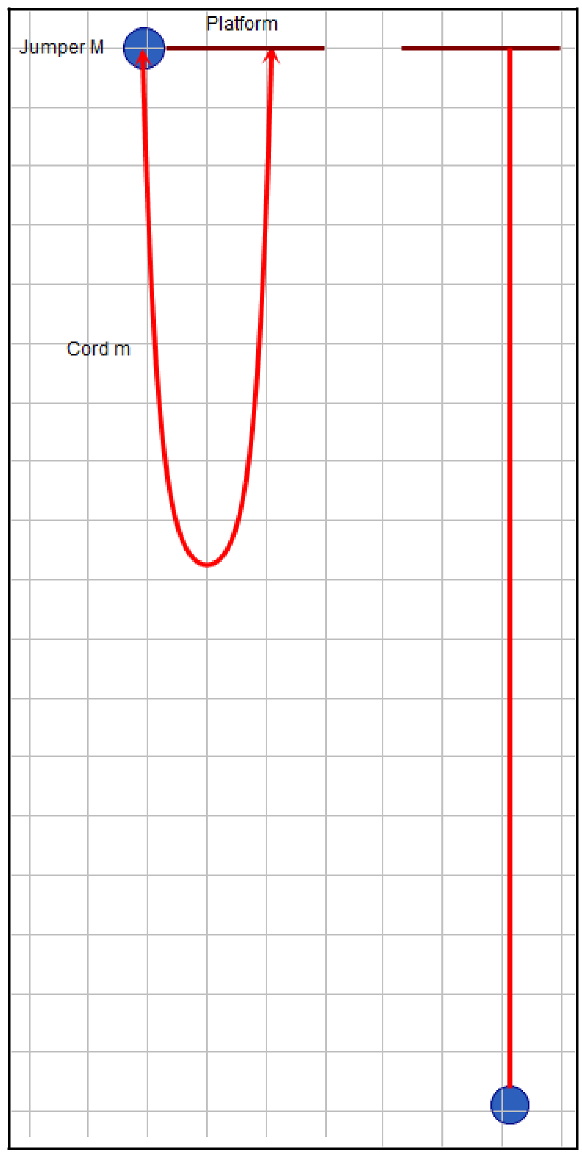
On a recent trip to New Zealand, I stopped in at the A. J. Hackett bungee jumping centre near Queenstown, the world's first commercial bungee jump. The chance to experience Hooke's Law from the point of view of the hanging mass was too good to miss, so I plunked down my credit card for an exciting jump off the historic Kawarau River bridge (see the action picture), a drop of 43 m (or 15 storeys, if that is easier to imagine). On my return home, I did some research on bungee jumping, and came across a curious anomaly.

Consider a bungee jumper of mass M, tied to a bungee cord with mass m, jumping from a platform, and falling until the bungee cord reaches its rest length. During this part of the jump, how can you describe the acceleration of the jumper?
As usual, ignore air resistance.

a) constant acceleration g
b) zero increasing to g
c) zero
d) g increasing to kg, $k > 1$
e) g decreasing to kg, $k < 1$, $k \geq 0$



The most attractive answer is usually a), since the jumper appears to be in free fall during this part of the jump, and we are ignoring air resistance. However, the correct answer is d). The acceleration of the jumper begins at g, but then increases to a value greater than g.

The theoretical equation that governs the value of k is[1]:

$$a = \left[1 + \frac{m(4M + m)}{8M^2}\right] g$$

For example, a jumper with a mass of 100 kg using a cord of mass 25 kg will have an instantaneous acceleration of 1.13g at the time the cord reaches its rest length.

Why does this happen?

Consider the jumper just as he steps off the platform. The bungee cord hangs more or less as a catenary. The gravitational potential energy of the cord in this position is higher than the gravitational potential energy when it is hanging at its rest length.

As the jumper falls, part of the cord is falling, and part is not. The former decreases to 0 as the rest length of the cord is reached. The extra potential energy that the cord possessed initially has been transferred to the jumper through internal elastic forces within the cord. Just how this takes place is not trivial. Refer to the article below for more detail.

As a result, the speed reached by the jumper at the instant the cord reaches its rest length is higher than it would be for a freely-falling jumper. The average acceleration during this part of the jump must be greater than g.

This effect can be demonstrated in the classroom, or assigned as a student project. Set up a falling "jumper", perhaps a 1 kg mass, and use a heavy chain as the bungee cord. Measure the position and time for the jumper using a sonic sensor or a video camera. Use the position-time data to determine the instantaneous acceleration at convenient points during the jump, and graph the results.

The greater the ratio between the mass of the chain m and the mass of the jumper M, the greater the deviation from free-fall acceleration g. If the mass of the chain exceeds M, the change in acceleration is dramatic. If, for example, if $m = 2M$, $a = 2.5g$. This is visible to the human eye. You can demonstrate the effect by dropping another mass without a chain in parallel with the mass attached to a chain.

The oldest person to perform the Kawarau jump was 94, and the youngest was 10. The heaviest had a mass of 235 kg. The tallest of the jumps available in Queenstown drops 234 m. You can visit A. J. Hackett at http://www.ajhackett.com/.

For more detail and a rigorous mathematical derivation, see the reference below. For video action visit www.youtube.com, and search using the keywords bungee kawarau.

[1] *The Physics Teacher* Volume 34 September 1996

OAPT Annual Conference
April 29 – May 1, 2010
"Research into Practice"
University of Toronto

Don't forget to register to register for this year's conference. This year's theme looks at Physics Education Research and how we can use it to revolutionize how we teach physics. We will be using U. of T's new Lab Tutorials and there are **over 18 different workshops that will provide you with lots of classroom ready resources** and opportunities to interact with other physics teachers. Go to www.oapt.ca for full details. **Early bird rates end April 11**. Don't delay!

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) Sept 2010

My Experiments with PER

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Editor's note:
This is the first in a series of articles by Chris Meyer describing his experiences implementing a Workshop Physics program. To help guide Chris's ensuing articles, please give him feedback or ask him questions by emailing him directly.

What physics teacher doesn't like a good experiment? Over the past few semesters my classroom has become one elaborate trial in an experiment to determine whether there is a better way to teach grade 12 physics. My attempt has been a new physics course built around concept-focused group activities with an almost complete elimination of the traditional lecture.

Around seven years ago I became acquainted with the body of pedagogical work called Physics Education Research[1] (PER) after attending a presentation[2] by Edward F. ("Joe") Redish, one of PER's leading lights. I discovered a whole new world of strategies and techniques that I began to incorporate into my class. Despite many small successes with these techniques, in general things didn't work out. My application of the techniques was inconsistent and my expectations of students were continually changing and sometimes unclear. Students never had a chance to 'get the hang' of things. I decided it was time for a radical change that brought everything together into a cohesive framework for the entire course.

The inspiration for the transformation of my course comes from a variety of sources, but primarily from the Workshop Physics[3] program developed by Priscilla Laws at Dickenson College. She and a number of other pedagogical leaders have established an extensive body of research. Setting this work apart from other pedagogical studies is the natural impulse of physicists to quantify their research. They tested new teaching techniques against a variety of standardized and widely used assessment tools, the most well known being the Force Concept Inventory (FCI)[4]. The results of this work point strongly to three conclusions:

1. Lecturing, even with new pedagogical supports, is a relatively ineffective way to teach physics;
2. Students benefit greatly by focusing on concepts and working in small groups; and
3. Quality beats quantity. Teachers should aim to cover less material, but in greater depth.

From Inspiration to Implementation

The next challenge was to figure out how to implement such a program in my classroom. While my source of inspiration was the Workshop Physics program, there was no single resource or pre-made map that was directly applicable to my situation. Most of the PER resources have been developed in the United States for the college or university levels. Many resources had to be adapted for the Ontario curriculum, to eliminate the use of calculus, to work around differences in equipment and to meet the needs of my particular school and students.

The best way to explain the workings of my course is to describe how students approach a new concept. They go through a process of group activity, text readings, homework problems, and finally group problem solving. The group activity is the typical starting point. The emphasis is, as much as possible, on concrete investigation. This offers students direct experience with the physics at hand, which helps them to make sense of the emerging concepts. They study the patterns, offer explanations and draw simple conclusions that lead them towards the mature ideas.

[1] *Physics Education Research Central*: http://www.compadre.org/per/
[2] *Teaching physics: figuring out what works*, Edward F. Redish and Richard N. Steinberg, *Physics Today* **52**, 24-30 (January, 1999), http://www.physics.umd.edu/perg/papers/redish/pt.htm
[3] *Workshop Physics Homepage*, http://physics.dickinson.edu/~wp_web/wp_homepage.html
[4] The Force Concept Inventory http://modeling.asu.edu/R&E/research.html

Interspersed with class discussions, these activities take up the full class time.

One example is an activity introducing pulleys. Students begin my measuring the force of tension with a variety of pulley configurations and draw conclusions about tension in a string and how pulleys affect it. Then they apply those conclusions to an exploration of an Atwood machine. For homework, a reading is assigned which helps them relate what they observed in class with the framework of physical laws and the mathematical formalism found in the text. This is followed up with a small set of practice problems. Questions are generally chosen to require students to further unravel the concept and are less frequently of a ‘plug and chug’ variety.

Finally, students participate in a group problem solving session that sums up the ideas of a number of classes. Here they work on a context-rich[5] challenge typically involving the physical measurement of an apparatus, planning and solving a problem on paper, and then verifying the results using the apparatus – seeing if their theoretical prediction holds up. Lecture time in class has been pared down to the bare essentials necessary to start off an activity, to the summary of the day’s work, to the clarification of a textbook reading, or to the outline of a problem-solving tip. This seldom consumes more than ten minutes per class.

My students’ experiences have changed considerably from mostly listening and repeating to continuous investigation, discussion and explanation. They are wrestling with physics ideas for a good 60 minutes per class – especially on the group problem solving days when they really sweat! The transition to this new classroom ‘culture’ can be challenging for student, may of whom might be quite comfortable and “successful” with the traditional ways and are not used to the demands of my new regime. I spend a good amount of time at the start of the course explaining how group structure, dynamics, and roles work and how to avoid typical problems. I teach them the learning skills that are necessary for success in an environment of greatly increased student responsibility. Doing this reduces the number of students who may feel lost, resentful or under-served by their teacher in this new format.

My experiment with PER is ongoing and hasn’t yet reached the quantification stage. At the moment, I judge its success mostly by my observations and feelings. A few positive outcomes seem quite clear, however:

1. Student engagement in class is much improved. This may be due to the appeal of working in a social environment with their peers, and to the many ‘hands-on’ activities, all of which may appeal to a wider range of learning styles. Supply teachers consistently note an unexpectedly high degree of diligence.
2. Students are constantly using their own words to describe physics verbally and in writing, greatly improving their physics literacy.
3. Traditional student problem solving skills remain very high, even though I rarely model a problem solution in class.
4. Course enrolment is very stable this past semester – the attrition has been less than 10% amongst 89 students.

I have found this change in teaching quite a gratifying development for me and I heartily encourage others along this path. I am currently working with the OAPT to make my complete set of resources for the grade 12 course available online. Perhaps the best way to start your own experiments would be trying out a few of these resources. Then maybe you will take the plunge and say farewell to lectures and the old way of teaching!

Upcoming Events...

STAO2010
Inclusive Science:
Difference, Diversity and Equity
DoubleTree by Hilton – Toronto Airport
November 11 – November 13, 2010

Physics at Work
OAPT Annual Conference
McMaster University
May 12 – May 14, 2011
Visit www.oapt.ca for updates.

OAPT Grade 11 Physics Contest
Visit www.oapt.ca for contest details.

OAPT Newsletter
We continue to encourage teachers to contribute articles. Visit www.oapt.ca for contact

[5] *Cooperative Group Problem Solving*: http://groups.physics.umn.edu/physed/Research/CGPS/CGPSintro.htm

Everyday Einstein: The GPS and Relativity

Roberta Tevlin

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Did you know that the GPS must take into account special and general relativity?

If engineers didn't adjust for the motion of the satellite relative to the receiver on Earth the receiver's clock would gain 7 microseconds each day due to special relativity. Reverse adjustments to compensate for the weaker gravity at the high altitude of the satellite (general relativity) prevent the loss of 45 microseconds per day. Who cares about 38 microseconds? You do. The GPS receiver calculates your position using $d = vt$. The radio signals travel at the speed of light, causing a timing error of 38 microseconds to translate to a distance error of more than 11 km! Without careful attention to the effects of both special and general relativity, the GPS simply would not work.

A useful resource about an amazing technology

The Perimeter Institute`s latest resource for physics teachers deals with this everyday application of relativity. This resource consists of a six-minute video and a generous selection of worksheets and activities designed to make this resource useful in a variety of places in the curriculum. There is a hands-on activity in which students emulate the work of the GPS system using the Pythagorean theorem, $d = ct$ and large-scale maps. This is a nice fit for grade 9 astronomy, grade 11 kinematics or grade 12 Earth & Space science. In grade 12 physics the most obvious connections are with orbital energies and special relativity, but it might best be used when dealing with frames of reference. Suggested activities involving leaky bottles of water tossed into the air and trays whirling around with glasses of water on them are fun (and only slightly messy) examples of accelerated frames of reference. They connect directly to Einstein's equivalence principle, the `happiest thought` of his life. Concept questions following these activities allow the students to do what Einstein did in 1908: predict that a gravitational field will slow time. Who knew that general relativity could be made so simple?

Get your FREE copy now!

You can order this free resource from PI`s website: **www.perimeterinstitute.ca/Perimeter_Inspirations/General/Perimeter_Inspirations/** .

Also keep an eye out for after school GPS workshops in southern Ontario this fall. At these events you can enjoy some social time with other physics teachers, make and take some equipment and enjoy asking difficult questions of the presenters :) For dates and locations of these workshops visit **www.oapt.ca**.

The Demo Corner

The Belt-Hanger (1987 Revisited)

Ernie McFarland, column editor

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Submissions describing demonstrations will be gladly received.

This article first appeared in the OAPT Newsletter in 1987. It is being repeated here for three reasons: the demonstration is a classic, 1987 was a long time ago, and now this demo (and others) can be seen online (use the link at the end of the article).

One category of good physics demonstrations involves the "disorientation" or "disequilibrium" of students. The demonstrations in this category cannot be explained by most students, and thus serve to disorient the students into a state of disequilibrium from which they wish desperately to escape.

Such demonstrations pique the students' curiosity and gain their attention. Some students have been known to throw up their hands and say that such a demonstration can be explained only by magic. At this point, the

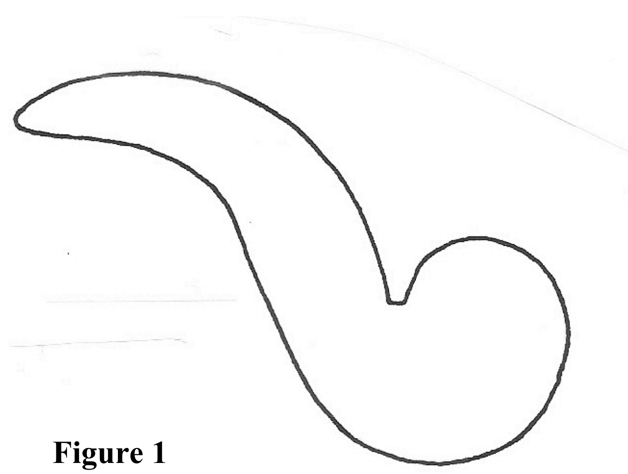


Figure 1

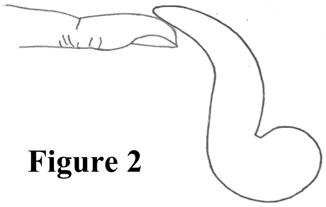
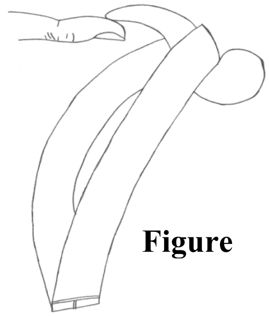


Figure 2

students are like putty in the teacher's hands, and they are eager to learn the real explanation.



Figure

The belt-hanger described here is a nice disorientation demonstration, and it is cheap to make and easy to use. Figure 1 shows a belt-hanger in (full-size) cross-section, and can be used as a pattern from which to make your own belt-hanger. It can be made from a variety of materials: wood, metal, thick cardboard, etc. The ideal thickness is about 1 cm (the aluminum one I have is 9 mm thick).
Once the belt-hanger has been made, position it on the end of a fingertip as shown in Fig. 2. It is unstable in this position and falls to the floor.

Now take a belt (preferably a firm leather one with a reasonably large buckle), and fasten the buckle so that the belt forms a closed loop. Place the belt on the hanger (on your fingertip) as shown in Fig. 3, with the buckle at the bottom of the belt.
Instead of the hanger and belt falling to the floor, the entire system is quite stable! For added effect you can swing the hanger and belt gently from side to side, or place it on the edge of a table or the top of a door frame.

Students are very surprised that the hanger is unstable by itself, but stable when the belt is hung on it.

HOW IT WORKS — If an object (which is free to rotate) is to be in stable equilibrium, the centre of mass (CM) must be below the pivot point.

When the hanger alone is placed on a fingertip, it is impossible for the CM to be position below the pivot point without the hanger sliding from the finger and falling. (The pivot point is just the contact point between the hanger and the finger.)
When the belt is on the hanger, the CM of the system (hanger + belt) is now positioned somewhere in the middle of the loop formed by the belt, and it is "easy" for the CM to be under the pivot point, with stable equilibrium being the result.

WHY DO IT? — First, it engages the students' minds in attempting to explain a physical phenomenon. Second, although centre of mass is not a topic which is usually not taught in any depth at the high-school level, it is useful to point out to students that the acceleration $\boldsymbol{a}$ in Newton's Second Law ($\Sigma \boldsymbol{F} = m\boldsymbol{a}$) is the acceleration of the CM of the object, and it is then nice to have at least one demo related to CM.

At the university level, the topics of CM, torque, stable and unstable equilibrium are considered in detail, and CM demonstrations related to equilibrium are very useful.

WEBLINK — To see this demonstration performed, go to www.physics.uoguelph.ca/outreach/ and click on "Videos" and then "Balancing act." To see another CM demo, click on "Centre of Mass".

The President's Corner

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Preparations for the annual spring OAPT conference are already well underway. McMaster University will host the conference, running May 12-14, 2011. Online registration will be available very soon.

The *OAPT Newsletter* has added eager volunteers brimming with new ideas. One suggestion is to offer the Newsletter as a pdf, reducing our carbon footprint and allowing for colorful editions. Watch for a survey to follow.

The annual Grade 11 Contest is in transition. A robust new server and IT support, again courtesy of U of T Electrical & Computer Engineering, is being adopted to address past problems. We'll keep you posted!

Many thanks to two Executive members who are taking a hiatus – Marianne Franklin as *Newsletter Editor* and Nick Keehn as *Contest Manager*. Shawn Brooks is switching portfolios, from *Treasurer* to *Contest Manager*. Thanks to these and our many volunteers who keep the OAPT fresh and vibrant.

The OAPT exists to support physics teachers and promote sharing of ideas and talents. Many hands make for light work and a strong association. Email me to share your ideas, offer your services, or provide constructive criticism.

I feel privileged to collaborate with so many dedicated physics educators. It's truly a labour of love. Have a great year, everyone.

Answer to "Buoyancy and Newton's Third Law"

in THE DEMONSTRATION CORNER, Nov. 2010 issue of the *OAPT Newsletter*

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The question: What will happen to the apparent mass of a beaker of water once a dowel clamped into a nearby retort stand is submerged in the water?

The answer: the apparent mass, as indicated by the balance, of the water + beaker + submerged dowel is greater than the mass of just the water and beaker. ***The physics***: Archimedes' principle states that the water exerts an upward buoyant force on the dowel, and by Newton's third law of motion, the dowel must therefore exert a downward force on the water. This additional downward force is transmitted to the balance pan. Another way to think about this is that as the dowel is submerged in the water, the water level rises, and hence the pressure exerted by the water on the bottom of the beaker increases.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS (An Affiliate of the A.A.P.T., and a charitable organization) Nov 2010

Making Groups Work

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Editor's note:
This is the second in a series of articles by Chris Meyer describing his experiences implementing a Workshop Physics program. To help guide Chris's ensuing articles, please give him feedback or ask him questions by emailing him directly.

"Life would be simple if not for other people".
"To really screw things up requires a committee".

We have all experienced the good, the bad, and the ugly of working in groups. By the time they reach our physics classes, so have our students. Their experiences are as varied as our own, and many students are justifiably concerned when the time comes to work in groups. How can we help students overcome bad or ugly experiences and derive the greatest benefits from group work? This installment will describe how to:

1) Make clear the value of cooperative group work,
2) Provide coaching and strategies for effective habits, and
3) Create an environment that encourages collaborative learning.

Changed Teaching Practice
Physics Education Researchers have measured student gain in conceptual understanding for a variety of instructional models[i]. One of the findings is the significant educational value of working in groups. Edward Redish of the University of Maryland calls this the *social learning principle*. "For most individuals, learning is most effectively carried out via social interactions." [ii] Social learning helps students who don't yet have the inner mental debate that allows them to effectively probe, explore and confront new ideas on their own.

The outstanding learning results produced by courses founded upon group work far outstrip those achieved by the most carefully reformed lecture-based courses[iv]. Two examples of very successful collaborative learning programs are *Physics by Inquiry*[v] at the University of Washington and Dickinson College's *Workshop Physics*[vi]. The evidence strongly suggests the shift from teacher- to student-centred learning needs to be made.

Explain the benefits
In a traditional physics course we may place students in cooperative small groups (to perform lab work, for instance), implicitly expecting them to acquire the skills of collaborative learning simply by virtue of working in groups. If, instead, the teacher explicitly addresses these skills students will better understand the value of group work and will improve their experiences in small groups.

Cooperative small group work generates skill building and ancillary benefits in the following areas:

(i) **The Power of Explanation**. If we cannot use our native tongue to explain new ideas to a friend, then we simply don't understand those ideas. In a teacher-centred classroom students have very little opportunity to apply their own powers of explanation and even less opportunity to get feedback on their ability to explain. In contrast, in a small group environment application and feedback are constantly taking place between students and with the assistance of the facilitating teacher.

(ii) **Peer Tutoring**. A weak student working in a small group has the opportunity to get regular assistance through group discussion that exposes him to others' thought processes. Strong students benefit equally. Many traditionally "strong" students are quick to memorize and recite answers but may possess surprisingly little understanding. The obligation to discuss and explain allows them to confront inconsistencies in their own thinking, furthering their understanding.

(iii) **More Teacher Attention**. Liberated from the demands of lecturing, teachers can turn their attention from their own train of thought to that of their students. A few tours of the classroom during a 60-minute activity can provide time to check in with every student, if only briefly, every day.

(iv) **Teamwork**. Oft cited as a highly prized skill[vii].

(v) **Responsibility**. Students begin to learn that it is their effort and energy that produces understanding and helps build skills. The traditional "lazy" way of learning - copying down notes, and memorizing laws and solutions has been largely eliminated.

Explain how groups work

What can the teacher can do to allay student concerns about group work and encourage a positive group experience? Begin by providing a detailed introduction to the group work programme of the course. Discuss:

(i) **Consistency and Regularity.** Making group work an everyday feature of the course will allow student get used to this structure. In time they will consider it normal and accept it. Using group work infrequently is problematic: students can choose to "wait it out" and not invest themselves in the process.

(ii) **Structure**. Provide clear structure for and training in the functioning of a group. This is often done using a system of rotating specialized roles and responsibilities. A typical cooperative small group has three members: a manager, a recorder and a sceptic[viii].

(iii) **Composition**. A group of three students of heterogeneous ability is the best composition and should be chosen carefully by the teacher when possible. Shuffle the groups periodically – every unit or every three to four weeks. The group is together long enough to commit to one another, but not so long that the group interactions get stale.

(iv) **Seating**. Group members need to sit facing one another. Working side by side often leaves one student out. A common workspace, such as a large whiteboard or chart paper, facilitates participation by every member.

(v) **Problems.** What do you do when a group is not functioning at its best? Most students simply don't know. Typical problems that crop up in small groups are: one member dominating, one member not contributing or lacking commitment, the group wandering off track, or a personality conflict. Address these potential problems at the outset, before they occur, and provide helpful suggestions for their resolution[ix].

(vi) **Time constraints**. Most students have evolved, by the senior grades, to be *competitive*. The goal of group work is to deepen students' understanding through *collaboration*. Encouraging this requires a fine balance. Provide enough time for vital discussion and tutoring to take place, but not so much that a sense of exigency disappears. Adequate time pressure will encourage the group to remain on task; unreasonable time pressure will simply encourage the dominant student to take over just to 'get it done' in the time allotted.

(vii) **Assessment**. Assessment must be carefully balanced between process and product. Students need to be allowed to make mistakes; otherwise, the especially marks-anxious individuals will take over the group. Analyze the activities in advance to judge which ones lend themselves to the assessment of care and thoughtfulness in process and which ones would be better assessed based on the accuracy of students' results.

Positive results

I have designed and constructed an active-learning grade 12 physics course based on group work, using guided inquiry activities and problem solving challenges. (See my resources freely available at: www.meyercreations.com). I invest a considerable amount of time and energy, especially at the beginning of the course, in instructing my students on the value of group work and techniques for its success. The results compare as day to night with my old teaching practices. The level of student engagement is considerably higher; students remain intellectually active for the majority of the class. Problems still arise, and no strategies work for everyone, but when my students aren't sweating too much they often give away how much they enjoy physics in groups.

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[i] See Force Concept Inventory as one example: http://se.cersp.com/yjzy/UploadFiles_5449/200607/20060705142003187.pdf

[ii] Redish, E. *Teaching Physics with the Physics Suite*, Hoboken, NJ: John Wiley & Sons, 2003, pg. 39, http://www2.physics.umd.edu/~redish/Book/

[iv] Redish, E., pg. 176 and 179

[v] http://www.phys.washington.edu/groups/peg/pbi.html

[vi] http://physics.dickinson.edu/~wp_web/wp_homepage.html

[vii] One recent example: Toronto Star, Sept 27, "Toronto scientist shaking up field of infectious disease", http://www.healthzone.ca/health/newsfeatures/article/866651--toronto-scientist-shaking-up-field-of-infectious-disease

[viii] An excellent manual describing many aspects of group work: http://groups.physics.umn.edu/physed/Research/CGPS/Green%20Book/chapter3.pdf

[ix] U of T Practicals: Teamwork Module – Student Guide, http://www.upscale.utoronto.ca/Practicals/Modules/Modu

Readers' Corner

Back-of-the-Envelope Physics

By Clifford E. Swartz

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Swartz, C. (2003). *Back-of-the-Envelope Physics*. Baltimore and London: The John Hopkins University Press. ISBN: 0-8018-7262-6, 155 pages. **Sample chapter available at Google books.**

Rating: **** Highly recommended

For a half century Clifford Swartz (1925 – 2010) was a prominent figure in physics education in the United States and worldwide. His books have been translated into many languages. Swartz was an active member of the AAPT and long-time editor of *The Physics Teacher* (1967-1985). For his numerous contributions to physics teaching Professor Swartz was honoured with numerous awards, including the AAPT Oersted Medal (1987) and Melba Newell Phillips Award (2007).

Back-of-the-Envelope Physics is a 'must read' for every physics educator and curious physics student. Its aim is to help students and teachers *make meaning* of the principles of physics. Swartz's method is application of these principles to practical problems from everyday life. He wanted his students to develop a 'physics intuition' and tried to steer them away from 'formula picking' or 'pattern matching'. Swartz realized that the art of order-of-magnitude estimation, also called 'back-of-the-envelope' estimation, needs to be a major component of physics teaching if we want to help our students develop a true physics intuition and to see physics as a vehicle for exploring the real world around us. In this short (155 page) and very accessible book, Swartz provides more than 100 examples of how these estimates can be done using a few fundamental physics principles and a few lines of basic algebra.

The book is divided into ten chapters reflecting common topics included in most introductory physics curricula: Forces and Pressure, Mechanics and Rotation, Sound and Waves, Heat, Optics, Electricity, Earth, Astronomy, Atoms and Molecules, and Particles and Quanta. Each chapter has a number of interesting problems in which the reader is asked to make a simple estimate. Example are the safe spacing of nails in the "bed of nails" demonstration, the tension force provided by the biceps when you hold a rock, and the amount of money you could save if you could stop using batteries and replace them by the electrical energy "coming out of the wall".

Clifford Swartz helps us find answers to the strangest questions our students might have asked us or we might have been thinking about, such as a negative calorie diet that consists of ice, the variation of your weight with the location on Earth, or the relationship between the height of the mountain, the strength of the planet's gravitational field and the latent heat of fusion of the mountain rock.

I strongly recommend this book to physics teachers and students alike. You will enjoy every page of it! It will inspire you and make you excited to come to class and share your love for physics with your students, classmates, and colleagues.

The President's Corner

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32nd OAPT Annual Conference was Outstanding!

'If you build it they will come'. And come they did: more than 140 enthusiasts, including a wave of new and pre-service teachers. From the Thursday night barbeque to the tours of the U of T physics labs, to **Dr. Stephen Morris'** clever and compelling address, to Dave Doucette's impassioned closing, it was non-stop physics in action. **Dr. David Harrison's** Friday morning keynote workshop was a perfect launch to *Research into Practice*, as he masterfully articulated the need to support reforms to physics education. Thirty busy sessions followed, the majority modeling best practices: with teachers in the role of active, engaged students. The presenters took to heart the PER adage, *"Teachers should be taught in the manner they are expected to teach.[1]"*

The energy was so palpable as to prompt past-President (2004) Patrick Whippey to gush "I haven't seen such synergy in years!" Numerous participants echoed Patrick's sentiments. Many thanks to the more than 20 presenters who conducted stellar workshops. And a tremendous thank you to **Dr. Jason Harlow** who was our 'point person' at U of T, handling TA's, workshops, food and beverages and an array of logistical concerns. And, of course, our gratitude to **Perimeter Institute** for continuing to act as co-sponsor.

So, what say we do all this again sometime – like **May 12-14**, 2011, at **McMaster University**?

Physics rules!

[1] McDermott, L.C., P.S. Shaffer, & C.P. Constantinou (Nov., 2000). "Preparing teachers to teach physics and physical science by inquiry". *Physics Education,* 35 (6), 411.

The Demo Corner

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Submissions describing demonstrations will be gladly received.

Buoyancy and Newton's Third Law of Motion

This article is excerpted from *Physics in Canada*, Volume 61, No. 2, (2005), pg. 87-89, with permission of the Canadian Association of Physicists (CAP).

Since the publication of Eric Mazur's book *Peer Instruction* (Prentice Hall, 1997) the active engagement of students in physics classes has become increasingly common. A classic Mazur strategy is to pose a multiple-choice question, ask the students to discuss the question in small groups, and then survey the students for their individual answers by a show of hands or remote-control technology ("clickers"). This strategy can be used to elicit predictions about the possible outcomes of a lecture demonstration. The instructor displays the demonstration apparatus and describes what will be done with it but does not perform the demonstration nor hint what the result will be. Students discuss the possible outcomes in small groups, make their own personal judgments, and select an outcome from a multiple-choice list. The demonstration is then performed to show what actually happens, and the relevant physics is discussed, usually with the instructor leading a full-class discussion this time.

Figure 1 shows the apparatus for one of my favourite demonstrations. A beaker of water is balanced on a triple-beam balance sitting on a table and the mass of the beaker and water is noted. Beside it a wooden dowel is clamped vertically to a retort stand. The bottom of the dowel is at a vertical level below that of the water surface, as shown. The question is: What will happen to the balance if the dowel and stand are picked up and moved sideways and then downward, so that the bottom end of the dowel is now submerged in the water? The dowel will still be attached to the retort stand, which will again be resting on the table. Will the apparent mass, as indicated by the balance, of the water + beaker + submerged dowel be greater than, equal to, or less than the previously noted mass of water + beaker only? This particular demonstration almost always produces a roughly equal split among the three possible answers, even if the audience consists of professional physicists! What do *you* think will happen to the apparent mass? To find out, try the demo yourself. A couple of ways to think about the physics that's involved will be given in the next Newsletter and (if you can't wait that long) will also be available at www.oapt.ca (click on the "Newsletter" button).

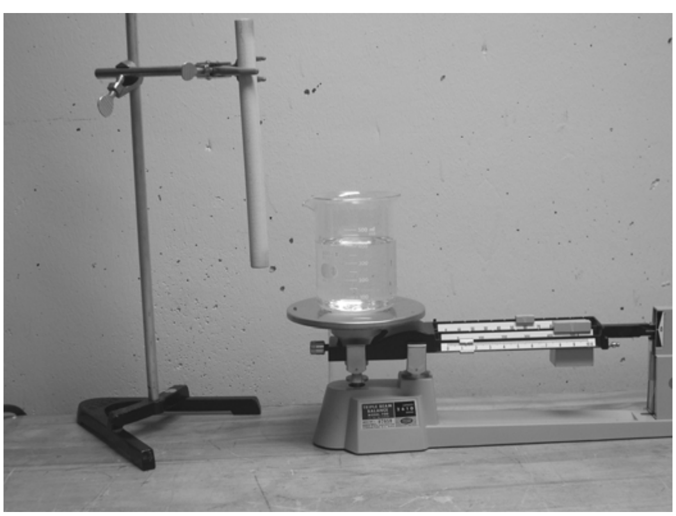

Figure 1: The apparatus: a wooden dowel attached to a retort stand, and a beaker of water on a pan balance.

We Want Your Input!
New Name? Go Green!

Dear OAPT members,

The OAPT Steering Committee thinks it may be time for the Newsletter to jump into the 21st century. Here are the changes we are considering:

- Drop the word "Newsletter" from the name and choose a **catchy new name** for this publication;
- Go with an **e-Newsletter** format to reduce our paper usage, reduce mailing/printing costs, and offer colour and imbedded digital tools.

We want your opinion! Please visit http://www.oapt.ca/ to vote on a new name and tell us whether you'd like an e-version of the newsletter.

Five New Name Suggestions*

"Quark Quarterly" "The Little Bang" "The Laser"
"The Vector" "The Comet"

***Make your own suggestion** for a new name for the newsletter at http://www.oapt.ca/. If your suggestion gets adopted you will not only have bragging rights but will receive a **free two-year membership** to the OAPT.

A Solution to the Problem-Solving Problem

Chris Meyer
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This is the third in a series of articles by Chris Meyer describing his experiences implementing a reformed physics program. Please e-mail him directly if you have any questions or feedback

Problem solving ability is a set of skills coveted by students who do not possess it, taught often perfunctorily by high school physics teachers, expected of students by post-secondary instructors, and demanded by employers. In traditional physics instruction very little explicit instruction in how to go about solving problems is typically offered. This in itself is a problem to be solved! How might we nurture in our students the sophisticated problem-solving skills of the scientists, engineers and technicians who experts at solving problems? In this instalment of the PER Column I propose an approach that my students know as the “Physics Challenge”: a context-rich, story-like practical problem requiring careful analysis, planning, teamwork, time management and the physical verification of the students’ results.

Two skills associated with problem solving readily distinguish an expert from a novice:

1) the ability to quickly identify the relevant ideas and information (defining the problem), and
2) the ability to determine the *essence* of what is required to solve it (planning the solution).

Experts accomplish these tasks almost instinctively. Novice physics students typically struggle mightily with them. The Physics Challenge focuses on these oft-overlooked skills. Over the last seven years, I have built upon the work of Pat and Ken Heller from the University of Minnesota[i]. The Hellers developed an excellent structure for Cooperative Group Problem Solving (CGPS) that I modified for the high-school level and to which I have added my own empirical twist.

A typical Physics Challenge presents a group of students with a problem concerning a practical situation involving simple equipment. Its description uses everyday language, not physics terminology, to explain the scenario. Here is an excerpt from my favourite example, the “Washer Challenge”:

Your group will be given a length of string, five washers and some tape. Your challenge is to attach the five washers such that when you release the string and the washers hit the ground, there is a steady sequence of sounds. This means a steady “clink-clink-clink-clink-clink.” Not “clink, … clink ……... clink, clink, clink.”

This is a real-world problem, not a mere academic exercise or trumped-up textbook problem. Several difficulties of the Washer Challenge are *implicit* in the wording of the problem and will likely become apparent to most students only after discussion with their group:

1) No measurements are given. The students must decide as a group what are the important quantities to measure;
2) Translation from colloquial language to physics terminology and symbols will be needed. For example, what do each of the two patterns of “clinks” as written above *mean* with respect to the physical quantities involved?
3) There is no obvious, quick solution. Physics Challenges are always multi-step problems and typically offer few overt clues pointing to a correct approach.

Considerable discussion and formal planning is crucial before jumping into the mechanics of solving a Physics Challenge. Few individual students would be able to solve one in the time allotted; the efforts of an organized group are required to succeed. To tackle these problems, the groups follow a series of general steps that help them focus on key problem-solving skills:

A. *The Picture:* Draw a clear picture, measure the important information and indicate it using symbols and simple descriptions;
B. *The Question*: Create a specific physics question that will give the solution to the problem;
C. *The Plan*: Identify key concepts, steps and equations that may be useful;

D. *The Work:* Choose and/or develop specific equations and algebraically manipulate them;

E. *The Results:* Calculate a final result, justify it and then physically verify it using the apparatus.

Three elements of the Physics Challenge – the style of problems, the structure of the problem-solving process, and the cooperative small group approach - combine to yield substantial improvements in students' understanding over traditional problem solving sessions. Adopting the Physics Challenge system does involve a learning curve for the teacher as well as for the students, but the outcomes it produces will greatly reward the teacher who invests the energy and takes the plunge. For examples of more problems, please download the package of teacher resources[ii] available from my website. For a presentation introducing cooperative group problem solving and a sample solution to the Washer Challenge, please download my active learning course [iii]presentation. Good luck!

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[i] This is an excellent starting point for any teacher interested in learning more about these techniques: http://groups.physics.umn.edu/physed/Research/CGPS/CGPSintro.htm

[ii] http://meyercreations.com/Physics/PER%20Gr12.htm

[iii] http://meyercreations.com/Physics.htm

UPCOMING EVENTS…

THE OAPT CONFERENCE

Go to http://www.oapt.ca/ to Register!

Date:

Thursday May 12 to Saturday May 14, 2011

Location:

McMaster University

Special Offer:

McMaster Accommodation:

- $19.99 per night for 2 nights
- $29.99 for one night

Courtesy of the Edward S. Rogers Sr. Department of Electrical and Computer Engineering - University of Toronto.

Moving to the other side of the desk: One physics teacher candidate's experience

Joshua Wood
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Making the transition from being a physics student to being a high school physics teacher is a challenging yet very rewarding endeavour. As a teacher candidate at Queen's University, I've been in the (somewhat painful) process of tackling the many challenges involved. I'm sure all readers of this article remember the very first time they switched to the other side of the desk and the feelings that went along with that transition. *Excitement* was what I felt the most. (Of course, it could have been nervousness in disguise…). Some months later, I now find myself stumbling less and less with each passing week. I'm glad that I still feel excited as I look ahead to my final four-week practicum.

I have been privileged to have a great deal continuity between my educational theory classes at Queen's and my practicum experiences. This and the creative freedom to explore different ways that physics concepts can be taught have helped me immensely. My first associate teacher's attitude that "anything can be fixed, so don't worry" may have been the single most important motivator for me so far. That simple reassurance that taking risks and making mistakes is okay has speeded my learning and my progress towards success as a teacher candidate.

In my first eight weeks of practicum I got the chance to teach both the Waves and Sound and the Forces units in Grade 11 Physics. I followed Knight's *Five Easy Lessons: Strategies for Successful Physics Teaching* closely and made it my main source of strategies for addressing misconceptions the students brought to each topic. The most rewarding moments during my practicum came when students experienced demonstrations that conflicted with their previous conceptions and left class with a new view of their world.

It has been a great start to what I know will be an extremely rewarding and exciting career. I'm starting to gain traction, and I'm starting understand what education is really about.

What's Up Down in SNOLAB?

Dennis Mercier

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Thumbs up from 2 km underground!

"Sudbury is the perfect place to study snow!" asserted my aunt when I announced that I was coming to my hometown to present one of Perimeter Institute's *Search for Dark Matter* workshops. Confused, I agreed. But then she asked why I would arrive in early November "because we don't get much snow until December". Smiling to myself, I patiently explained that SNOLAB (Sudbury Neutrino Observatory LABoratory) is getting a face lift and that this would be a wonderful opportunity to visit all the experiments while the apparatus was being renovated and expanded for further underground particle astronomy. "Oh!" said she…

35 teachers from northern Ontario attended the Perimeter Explorations Session hosted by Samatha Kuula, Education Outreach Officer for SNOLAB. Where better to attend such a workshop than the world's deepest physics laboratory!

Arriving at 0600 h, we were hurried into underground mining gear after signing multiple waiver forms. We caught "the cage" in the active *Vale-Inco* Creighton mine to report for our 2.0 km descent into the Earth's crust. This rather jerky three minute experience was followed by a 1.5 km walk through the dimly lit horizontal shafts before arrival at the SNOLAB facility. The first and most essential order of business was taking a water and air shower and donning *Tyvek* clean wear. Having just walked 1.5 km through one of the world's dirtiest environments, we emerged into one of its cleanest: the heart of SNOLAB.

Since SNOLAB's success (2001-2006) in empirically proving that solar neutrinos come in three flavours (electron, muon and tau) that can interchange spontaneously, the facility has undergone a huge renovation. The original SNO project had ended, but the available space for research into the constituent make-up of dark matter has been more than tripled. Many new international experiments are being housed in the cavernous facility, shielded from cosmic rays by over two kilometres of norite overburden.

Dr. Chris Jillings, a staff scientist at the facility, was our expert guide for a tour of the experiments and the specialized environmental systems that support them. Since SNOLAB is a self-contained environment, it includes a bioregenerator as well as highly sophisticated water distillation, air purification and chilling systems. Only about 5% of the matter in the universe is visible matter while five times that amount is dark (or non-baryonic) matter. Dr. Jillings showed us, and described in detail, the dark matter experiments taking place in SNOLAB. He himself is involved in **DEAP-1**: the Dark matter Experiment with Argon and Pulse-shape discrimination. The world famous **PICASSO-1** experiment continues to run concurrently with DEAP-1, and there are plans for new, larger, experiments: **DEAP3600** and **miniCLEAN** (for details visit **http://www.snolab.ca/public/experiments**).

Jillings and Dr. Christina Kraus of Laurentian University also took the time to walk us through the former SNO (now called SNO+). Here a new scintillation technique using an alkylbenzene compound is has been designed to detect the poorly understood neutrinoless double beta decay. The goal is to determine whether neutrinos are Majorana particles (where the neutrino is its own anti-particle) or Dirac particles (with distinct particle and anti-particles). The neutrino has become a major suspect in the "Mystery of the Missing Matter". Our current understanding of the Standard Model suggests there ought to be a fine balance between matter and antimatter. Since observations show a heavy asymmetry towards matter, accounting for only a small fraction of the mass in the universe, scientists have been studying the neutrino, which interacts only through the gravitational and weak forces. The dark matter experiments are designed to detect WIMPS (Weakly Interacting Massive Particles), a postulated exotic particle that would interact only through the gravitational force. The difficulty with these delicate experiments is that all the evidence is indirect and circumstantial. By a process of elimination of other known processes, the mystery will be eventually revealed.

Re-donning our mining gear, we walked back to the cage while grilling the about the nature of reality, the proofs for the Standard Model and the state of research physics in Canada. My workshop needed to be cut short, as we had not foreseen that our first prolonged underground excursion would lead to widespread exhaustion amongst the participants. Dr. Nigel Smith, the director of SNOLAB, summarized current global efforts in astroparticle physics, including his own research at the soon to be completed IceCube neutrino detector in Antarctica. Dr. Smith left us with the many major questions that researchers at SNOLAB are seeking to answer:

- *What is the physics beyond the standard model?*

- *What is the nature of the neutrino?*
- *What is the mass, and mixing parameters, of the neutrino?*
- *How do stars 'burn'? How do stars explode?*
- *Where does the heat of the Earth come from?*
- *Where does the matter-antimatter asymmetry in the Universe come from?*
- *How do fault slips develop?*
- *How does life evolve in extreme environments?*
- *How do the most extreme astronomical events evolve?*
- *What constitutes most of the mass of the Universe?*

To have a virtual experience of our tour, watch the 8-minute long "Neutrinos Uncovered" on YouTube: http://www.youtube.com/watch?v=WE565jXuVuM

The Demonstration Corner

GPS Meets Einstein

QuickTime™ and a decompressor are needed to see this picture.

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Submissions describing demonstrations will be gladly received.

Column Editor's Note: *The author of this article presented a fascinating talk about this topic at the 2010 OAPT Conference. Via the weblink provided in the article, readers can obtain access to a very useful student activity that demonstrates the importance of relativity in the operation of GPS.*

The Global Positioning System (GPS) is one of the twentieth century's greatest engineering marvels. Today, it's the backbone of billions of dollars of economic activity. It's used by a vast array of occupations including farmers, construction workers, doctors and even professional athletes. And all this comes on top of the more familiar personal applications like satellite navigation in cars and for hiking.

As well as being immensely practical, the GPS also involves some pretty cool physics — even, strangely enough, Einstein's theory of relativity.

The GPS is based on network of 30 or so satellites that continually send out ultra-precise timing signals in the form of radio waves. By picking up a signal from one satellite, you can calculate your distance d from the satellite via the equation $d = v\,\Delta t$, where v is the radio wave's speed (the speed of light) and Δt is the time the wave takes to get from the satellite to you. Repeating this process for four satellites, you can pinpoint your location anywhere on Earth to within a few metres. To me, this level of accuracy is simply amazing.

But, where does relativity fit into the picture? The concept of *time dilation* in special relativity says the faster the speed of an object (relative to an observer), the slower the observer measures the object's time as passing. Interestingly, *general* relativity — Einstein's theory of gravity — also tells us there's another type of time dilation, one based on gravity. *Gravitational time dilation* says that the strength of a gravitational field affects the rate at which time passes. Clocks in weaker gravitational fields run faster than clocks in stronger fields.

Each GPS satellite houses a state-of-the-art atomic clock capable of measuring time to within a fraction of a nanosecond. The timing of the GPS signals is so precise, the system needs to take both types of time dilation into account for the GPS to work. The effects are tiny, just 7 microseconds a day from special relativity and 45 microseconds a day from general relativity. However, if these numbers are substituted into the equation $d = v\,\Delta t$, you get distances of 2 km and 12 km respectively over the course of a day[1]. That's more than enough to render GPS navigation completely useless if relativity is not properly factored in.

The GPS takes relativity into account by offsetting the timing of the atomic clocks slightly to compensate for the effects of time dilation. To me, this is a beautiful example of the usefulness of modern physics.

To help highlight the link between the GPS and relativity, Perimeter Institute has created a new classroom resource on the topic. "Everyday Einstein: GPS and Relativity" has a five-minute in-class video along with a 20-page teacher's guide. The guide includes extra information for teachers and five student worksheets and activities. Everything can be found on Perimeter's website at: http://www.perimeterinstitute.ca/en/Perimeter_Inspirations/GPS_%26_Relativity/GPS_%26_Relativity/

Teachers from across Canada can also order a physical copy for free from PI's website. I hope people find it a useful addition to their classrooms.

[1] To get the results 2 km and 12 km, you need to multiply the distances results by the number of seconds in a day, 86,400

The argument for change

Chris Meyer

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Editor's note:
This is the fourth in a series of articles by Chris Meyer describing his experiences implementing a reformed physics program. Please e-mail him directly if you have any questions or feedback

Through this series of articles I have been sharing my experiences with experiments in reformed physics teaching. I taught physics in a traditional, lecture-based manner for ten years, all the while dabbling with new strategies. I tried some cooperative group problem solving, experimented with a few guided-inquiry activities, and made a general effort to boost the hands-on components of my course. I really liked the direction of the new techniques, but my students weren't getting the enhanced learning that was my goal. They had difficulty understanding my changing expectations and didn't have time to adjust to the new strategies before we were back to the old routine of lecture-and-practice. After some deep reflection, I decided that it was time to 'jump in the deep end': to make a fundamental and dramatic change to my classroom pedagogy.

Visit my classroom today and you will not see me behind the teacher's lab bench talking at the students. Instead you will see students working in cooperative groups, tackling guided-inquiry activities and problem solving challenges. They have become the main actors in my class and I am now part writer/director and part curious audience. They do the vast majority of the demonstrating, writing and explaining; I listen and ask probing questions. It's no longer the 'Mr. Meyer physics show'; instead, it's a hive of student activity with the understanding of physics as the queen bee.

The ideas underpinning my new physics course come from Physics Education Research (PER). Over the past thirty years physicists have been engaged in the study and reformulation of their own educational practices. An important discovery[1] from their research is that students learn most effectively through social interactions. That discovery, combined with conceptually oriented constructivist activities, has led to a group-oriented model of physics teaching. The finest example of this is *Workshop Physics*[2], which serves as the primary model for my course. Data comparing student performance on standardized tests under the old and new teaching formats are very impressive and difficult to ignore (Figure 1)[3]. The spike at the right of the graph represents the results of the implementation of *Workshop Physics* by its founders at Dickinson College in Carlisle, Pennsylvania.

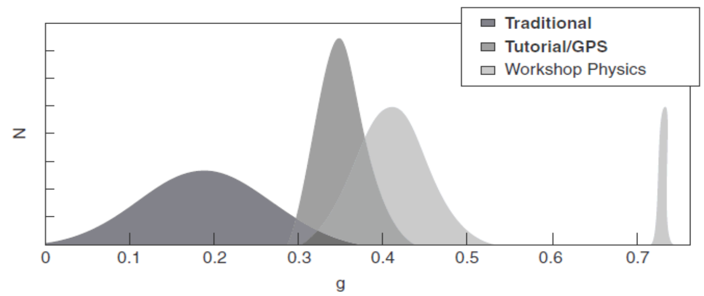

Figure 1: The proportion of students verses fractional gain, g (a measure of improvement), on the Force Concept Inventory for three instructional formats.

The evidence clearly demonstrates that lecturing is an inferior method of teaching. In the past, I sometimes rationalized the lacklustre achievement of my students by musing: "Well, physics isn't for everybody, especially those who are weak at math. Besides, I do have a handful of students who really get it, and that makes it worthwhile. But I am glad the others are in the course. I'm sure they will benefit from their experiences in the class."[4] With such thoughts I largely neglected my responsibility to frankly determine the needs of all my students and to teach in a way suited to their learning styles rather than in a way that was familiar or comfortable for me.

It is important to look at the big picture and decide why we teach physics. Both students and society have changed greatly over the last thirty years. Students enter our courses with a very unclear notion of what physics is or why it may have value aside from being a required course for post-secondary programs. They leave our schools and find themselves in a working world of great technical demand. Society as a whole depends keenly on the future success of science and requires a citizenry capable of informed decision-making. Physics has an important role to play as the 'liberal arts' of the sciences, with its strong focus on problem solving, mathematical analysis, logic, and experimentation. The fundamental science, physics offers the skills that are key to so many fields of science and technology. If, despite the growing need across society for these skills, student enrolment in physics is declining, we have an even greater obligation to rethink what we as teachers offer our students.

The need for better physics education may actually be most keenly felt in the field of biology. Biology is in the midst of a period of revolutionary change, as the disciplines of the physical sciences, mathematics and engineering are more and more closely incorporated into it. In 2009 the National Research Council in the Unites States issued a roadmap for a "new biology"[5], outlining the pressing need for an emphasis in biological instruction on problem solving, quantitative reasoning and fundamental physical understanding[6],[7]. Without these skills, students are much less able to participate in the blossoming of biology's cutting-edge, and often physics-related, disciplines[8]. These necessary changes are beginning to take place. The University of Toronto has recently reformed its physics course for life sciences students by replacing its tutorials and labs with "practicals": group activities similar in style to *Workshop Physics*.

With my own reformed course, I have observed very positive changes in my students' learning skills and attitudes. The level of commitment they demonstrate through their daily work is much higher than before. I teach about eighty grade 12 physics students a day and it is rare that I have to remind them to stay on task. Their diligence is remarked upon by supply teachers. This means that each day they have a good 65 minute physics 'workout'. The activities are designed to encourage students to talk and write about physics in their own words. Through their discussions, I hear evidence of them grappling with the key challenges and conundrums of physics that are often casually explained away or glossed over in a lecture. The hands-on activities allow for a regular back-and-forth between observations, principles and calculations such that students frequently experience the vital connection between theory and physical reality. The hands-on aspect also assists students in building a stronger concrete and intuitive foundation for the new ideas they are learning. Mathematics is still the backbone of physics in this course, but it takes a conscientious backseat to concepts and ideas. This allows many more students access to physics insight and it provides greater motivation for the supporting math when it is developed.

Bringing about change presents many challenges and requires the teacher to develop new skills. I needed to learn how to assist students with their interpersonal relationships and collaborative skills since I am now a leader of many small teams rather than one large class. I have had to become a guidance counsellor to help students adjust from a largely self-centred philosophy of learning to one where they begin to care about the understanding and involvement of their fellow group members.

It can be quite a challenge to write or assemble all the materials for a complete and coherent reformed course. I have drawn upon the best models from a variety of sources and adapted them to the needs of the students at my school. I hope to save others the need for this labour: all my resources are freely available online.

Veteran teachers will surely be familiar with the periodic educational fads that waft in from the faculties of education. Many of us have developed a healthy scepticism towards ideas that seem jury-rigged for the high school and physics environments. Physics Education Research is substantively different from anything I have seen in the past. It is a genuine science of teaching where physicists are tackling the problem of education using their most powerful tools: modelling, designing, testing and analyzing. All of this is done with the goal of improving student understanding, and results are tested as rigorously as is possible for the highly varying, non-linear system of adolescent humans.

If I have managed to pique your curiosity or to tempt you a little, and you would like to investigate a different way to teach, consider starting with the resources I have made available on my website: http://www.meyercreations.com/physics. There you will find all my digital materials including the grade 12 course activity book, PowerPoint lessons, pedagogical presentations and articles. I will be presenting two workshops at the OAPT Conference, May 12-14 at McMaster University where I can answer your questions in person. However, there is no substitute for seeing change in action. I encourage anyone interested in making a trek to my school to contact me and arrange for a visit. Make your own observations and draw your own conclusions. I wish you the best of luck with your own experiments in reformed physics teaching.

[1] Which was not really a discovery to anyone except physicists.

[2] The Workshop Physics homepage: http://physics.dickinson.edu/~wp_web/wp_homepage.html

[3] Redish, E. *Teaching Physics with the Physics Suite*. John Wiley. http://www2.physics.umd.edu/~redish/Book/09.pdf

[4] It is interesting to note that is his introductory lectures in physics, Richard Feynmann noticed the same thing and makes a similar self-justification. Feynmann, R. *The Feynmann Lectures in Physics.* Addison-Wesley (pg. 5)

[5] *A New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution*, Washington, DC: National Academies Press. www.nap.edu/catalog.php?record_id_12764

[6] *Integrated Biology and Undergraduate Science Education: A New Biology Education for the Twenty-First Century?* CBE Life Sci Educ 9(1): 10-16 2010. http://www.lifescied.org/cgi/content/full/9/1/10

[7] Dr. Monika Havelka at the University of Toronto, Mississauga has presented a report which shows the strongest predictor, by a substantial margin, of student success in first-year biology is their grade 12 physics mark.

[8] For example: http://www.healthzone.ca/health/newsfeatures/article/866651--toronto-scientist-shaking-up-field-of-infectious-disease

science student TALK science

Lisa Lim-Cole

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Uxbridge Secondary School is located northeast of Toronto in the Durham District School board. I have been teaching physics and science at Uxbridge Secondary School since September 2000 and am proud to say that science is truly alive at USS through the dedicated science teachers on staff and the enthusiasm for science that our students demonstrate throughout the school year.

On February 10, 2011, I had the pleasure of watching some of Uxbridge Secondary School's senior science students conduct presentations on Nanotechnology and Rocket Propulsion. The Uxbridge Secondary School Science Department organized its first ever USS Science TALKS event in the hopes of spreading the love of science to students and community members. Jeffrey Highet, Spencer Richards and Elena Routledge conducted themselves in a very mature and professional manner as they faced a large room of 150 people including students, staff, parents and community members. As I sat in the crowd, I realized that what we do as science teachers truly do have profound effects on our youth. Who would have ever thought that some of our students would be provided an opportunity to share their passion for science with an audience of that size! The event was not complete without a guest speaker. Richard Epp from the Outreach Team at The Perimeter Institute for Theoretical Physics was truly a highlight of the event. Students were fascinated as Richard walked the audience through the very nature of science – to question our reality. As the wonders of "Alice and Bob in Wonderland" launched the discussions, students and parents continued to question Richard about our Universe. The short animated clips used by Richard Epp can be found at the PI website and can be downloaded for use in your classrooms. http://www.perimeterinstitute.ca/Outreach/Alice_and_Bob_in_Wonderland/Alice_and_Bob_in_Wonderland/

Dinner with Richard Epp (PI Outreach). Elena Routledge, Heather Goodman Richard Epp, Spencer Richards, Jeffrey Highet, Katrina Pullia (missing: Hillary Geer)

Richard's enthusiasm for science was contagious. Our students continued to corner him after the presentation to ask questions. We would like to thank The Perimeter Institute for their generous support and Richard Epp's enthusiasm and patience. Our students found the experience memorable and many have already requested another USS Science TALKS.

Organizing an event does take time and planning. However, it did create an atmosphere that allowed our students to explore and question our universe for the weeks to come. Discussions exploded in our classrooms and students continued to do their own research to further investigate their own questions. It is through opportunities beyond the four walls of our classrooms that allow us to inspire our youth to question their own world and to seek out solutions to some of the world's most difficult problems that face us today. As we move forward into the next century, it is my hope that my role as a science educator is to inspire our youth to do great things. I do believe that teachers have a great power to influence, guide, inspire, encourage and challenge our youth to become The Great Thinkers of our future. Let's do this together!

Videos of Nonlinear Self-Organizing Phenomena

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Submissions describing demonstrations will be gladly received.

Many of the ordered structures that we see in the natural world are *self-organized* in the sense that they emerge spontaneously from the normal operation of the underlying laws of physics, but in a way which is not at all obvious from those laws, and with some regular order which is not due to external guiding forces. Ripples on the sand at the beach (Fig. 1) are an example: somehow the action of the turbulent waves on the individual grains conspires to form the ripples, a highly organized *patterned* state. The wavelength of the ripples is not at all obvious in the basic physics of water-sand interaction.

Figure 1: Ripples in sand.

Such phenomena are a rich source of fascinating physics, but are almost never discussed with undergraduates, much less high school students. They are almost always due to highly nonlinear feedback mechanisms which defy simple cause and effect theorizing. Despite much current research, their explanations are often contentious and elusive. But that only increases their attractiveness.

Meandering Syrup

If you dribble syrup or honey onto a pancake from a height, the syrup wraps itself into coils like a rope. But what happens if you move the pancake uniformly under the nozzle? It turns out that adding a translational motion *unfolds* the coiling into an interesting zoo of different states. In the following movie, syrup (Lyle's Golden Syrup works nicely) falls onto a moving belt, forming a device known as a *fluid mechanical sewing machine.* The belt continuously slows down, spanning a range of states from straight at high speed to coiling at low speed. These states are separated by abrupt *bifurcations* at which the form of the motion changes suddenly. The belt is 1 cm wide and the nozzle is a few centimetres above the belt.

Meandering syrup on YouTube:
http://www.youtube.com/watch?v=CMYISqxS3K4
Meandering syrup on Flickr:
http://www.flickr.com/photos/nonlin/3585645592/
Papers on this:
http://www.physics.utoronto.ca/nonlinear/papers_thread.html

Growing Icicles

Icicles are picturesque features of any Canadian winter. But what determines their shape? And why are some icicles covered with ripples? Remarkably, there is a theory stating that all icicles are isomorphic in overall shape that is, all icicles are rescaled versions of one another. In the physics lab at the University of Toronto we built an icicle growing machine to test this theory. We found that the theory is indeed upheld --- under certain conditions! The ripples, which are not included in the shape theory, are probably the result of a separate surface tension driven instability. They are observed to slowly climb up the icicles during growth. Given below are links to three time lapse videos of our experiment. In some runs, we rotated the icicle to encourage rotational symmetry. It takes about 10 hours to grow an icicle, and the rotation rate was once every 4 minutes, so it looks very fast in time-lapse but is actually quite slow.

A nearly ideal icicle on:
YouTube: http://www.youtube.com/watch?v=nfDdIFHmsc4
Flickr: http://www.flickr.com/photos/nonlin/4880941202/
A tap water icicle on:
YouTube: http://www.youtube.com/watch?v=Vx3zKpg4WLw
Flickr: http://www.flickr.com/photos/nonlin/4882839438/
Papers on this:
http://www.physics.utoronto.ca/nonlinear/papers_icicles.html

Washboard Roads

Anyone who has driven on gravel back roads knows they are anything but smooth. In fact, they quickly develop periodic bumps called *washboard road*. These bumps appear spontaneously above a certain threshold speed and, contrary to common opinion, are not simply related to the bouncing frequency of the suspension. Similar bumps, but with a smaller wavelength and amplitude, can even appear on the steel rails of Toronto streetcar tracks.

We built a lab version in which a wheel rolls around the circumference of a rotating table covered with a "road" made of sand. The wheel has no spring suspension; it simply falls on a lever under gravity. The washboard pattern moves slowly in the driving direction. There is a critical driving speed below which the flat road is stable, but it is too low to be a practical way to avoid washboard on real roads.

Youtube: http://www.youtube.com/watch?v=UHCJgh30kNE
Flickr: http://www.flickr.com/photos/nonlin/3597960161/
Closeup: http://www.youtube.com/watch?v=Hx7SHAlwR1Y

An even simpler version replaces the wheel with an inclined blade, forming a plough. The following is a stroboscopic movie in which the camera takes a picture once per table rotation, making the table appear stationary. In fact, it moves counterclockwise (seen from above), so the ripples move up rotation (i.e., clockwise or down the road in the driving direction). Notice how the ripple speed slows and the wavelength lengthens as the ripples grow to full amplitude.

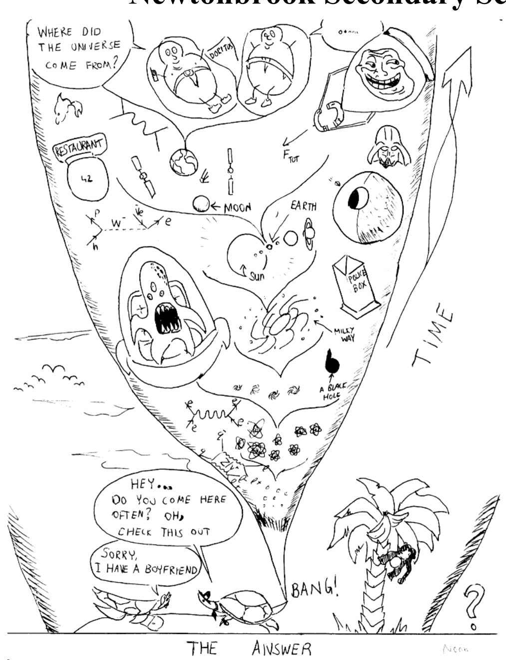
YouTube: http://www.youtube.com/watch?v=GduGTDWbc_M
Flickr: http://www.flickr.com/photos/nonlin/3663444274/
Papers on this:
http://www.physics.utoronto.ca/nonlinear/papers_sand.html

Students might enjoy reproducing these patterns, or observing them in the wild. For many other examples of nonlinear pattern formation, see

YouTube: http://www.youtube.com/user/smorris123
Flickr: http://www.flickr.com/photos/nonlin/
Homepage: http://www.physics.utoronto.ca/nonlinear/

There is also a wonderful series of books called Natures Patterns: a Tapestry in Three Parts, by Philip Ball: http://www.philipball.co.uk/naturespatterns.php

Cartoon By: Noam Sutskever
Newtonbrook Secondary School



Physics Teacher: Tim Langford

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

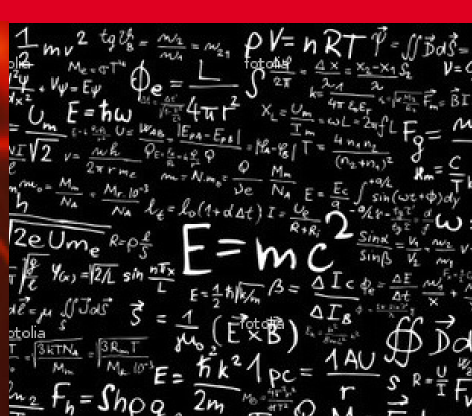
An Affiliate of the A.A.P.T, and a charitable organization

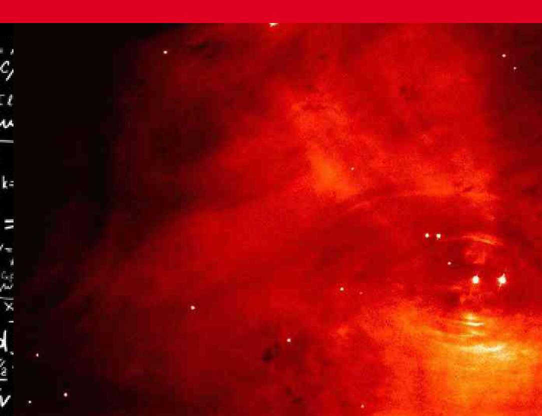
September 2011

Remembering the OAPT Conference at McMaster

A Summer of Physics Phun!

Gearing Up for Another Exciting Year of Physics Education!





Letter from the Newsletter Team

We are excited to present this year's first newsletter in electronic form. As we move forward with this new initiative, we hope to provide OAPT members with a valuable resource. The Newsletter Team would like to extend an invitation to all its members to write articles this year to be included in this new newsletter format. It is our hope that this newsletter will provide physics teachers with a multitude of information which will help teachers enhance their own teaching practices. If you wish to contribute to the Newsletter, please contact us through the OAPT website.

Looking forward to an exciting year in physics education!

Lisa Lim-Cole
Tim Langford
Robert Prior

The Prez Sez

Roberta Tevlin
Danforth C.T.I.
Toronto, ON
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We have an exciting year planned at the OAPT, one filled with changes and opportunities.

At the conference in April, which was fabulous, our volunteer base more than doubled! Check www.oapt.ca/contact.html. Email any volunteer by clicking on the job; click on the name to see a picture and brief bio. There are still many opportunities to be involved. Just drop me a line and let me know what your interest and availability is.

Plans for next year's conference are well underway. The Perimeter Institute will be hosting it, April 26-28. Mark these dates in your calendar now! We expect to have the program set by late September and to be able to once again offer accommodation at a rate of $19.99/night!

The newsletter and website are both being updated and the contest will be fully and smoothly online in the spring.

There will be many other opportunities for physics PD throughout the year:

- The Physics Teacher Association (PTA) in the GTA and the McMaster Community of Physics Teachers are two successful groups that have been meeting for a number of years.
- Two new PTA's are starting up - one in Durham and another in Guelph!
- The Perimeter Institute will be hosting after school workshops throughout Ontario, in the fall and spring.

We'll keep you posted on these and other opportunities throughout the year.

YouTube Physics

James Ball
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Based on his workshop presented at the 2011 OAPT Conference.

We all use videos in our classrooms. A long video provides passive learning; most students will tune in and out. YouTube videos are short (rarely more than 5 minutes) and can be used **to actively engage** our students. In the workshop session we explored a number of effective ways to use these short videos:

1. As **a hook** to capture student interest. The link below will take you to a video of wing suit base jumping. Most students will be awed by the beauty of the videography and the courage (or craziness) people flying at more than 160 km/h just metres from a cliff wall.
   http://www.YouTube.com/watch?v=ttz5oPpF1Js

2. To provide a source of **context rich problems**. The video linked below is of Dana Kunze completing a world record high dive (172 ft). Students can calculate this impact velocity. They can also measure the time his jump takes and determine how accurate their calculations were.
   http://www.YouTube.com/watch?v=paM5-nhr8Bc

3. As a means of introducing a concept. The photo above is from a commercial for Renault. The ad is intended to show how safe Renault cars are but it also clearly demonstrates conservation of momentum http://www.YouTube.com/watch?v=HbV98cnBbLg

4. YouTube videos can be used to **invite critical thinking**. Many of the videos on YouTube are "fakes". The link below is supposed to show Kobe Bryant jumping over a moving car. Students working is groups will usually determine both what is real and what is fake and if fake how it was done. http://www.YouTube.com/watch?v=TU2za57IOjw

5. YouTube videos can provide a **source of real world data** for video analysis. Students can import videos like the Kobe Bryant jump into programs like Logger Pro and analyse his motion.

6. YouTube has many clips from movies and TV shows. Below is a link to a clip from the TV show The Big Bang Theory. It has both excellent **physics and humour**.
   http://www.YouTube.com/watch?v=-PvwtS0htyk

It is important to **download the YouTube video before showing it** for several reasons. This prevents streaming issues and also means that students will not be able to see the comments associated with the videos. These comments usually have nothing to do with the video and are often filled with language that is not appropriate for the classroom.

There are many ways of downloading videos. At www.keepvid.com you simply paste in the URL of the YouTube video and click the download button. It will prompt you to select the format you wish and will then download the video for you. The free version of RealPlayer (www.real.com) comes with a feature that brings up a download button whenever you move your mouse over a video. Firefox comes with an add-on that displays a download button under the video.

Senses Working Overtime: The Physics of the Nervous System

Greg Macdonald
Laura Secord Secondary School
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The world is a busy place and as the band XTC says, “I’ve got one, two, three, four, five senses working overtime trying to take this all in”. At the May, 2011, OAPT Conference Dr. Deda Gillespie and Dr. Dan Goldreich of McMaster University showed us how three of those senses help us make some sense of the world. During their workshop, “Physics of the Nervous System,” participants learned how the body receives signals and creates a mental picture for the senses of touch, hearing and vision. Our perception of the world depends both on basic physics and on some fascinating processing by our brain.

For example, the ear contains a lever system (the small bones called ossicles) to amplify incoming sound signals and uses mechanical resonance in the inner ear (cochlea) to stimulate specific nerves for each frequency of sound. Pretty straightforward physics... but when it comes to determining where the sound is coming from, our brain has a few tricks up its sleeve. For high frequency sound the brain is ‘aware’ that one ear is shadowed by the head from the incoming sound wave if the source is to the side, while low frequency sound waves diffract around the head and are heard in both ears. The brain notes the time difference between when sound is detected at one ear vs. the other ear and uses this to determine the source direction.

For vision we can use Snell’s Law to understand how the cornea and lens focus light onto the retina and answer the question, “‘Which part of the eye provides the most refractive power?”. Straightforward physics. But our brain has a very complex processing task to make sense of the signals that light from two separate eyes provides.

An Easy and Fun Experiment

The sense of touch offers an opportunity for a simple yet powerful experiment outlined by Dr. Goldreich, which can easily be done in the classroom: measuring the speed of a nerve signal. The only materials you need are a stopwatch and some students! Signals from touch receptors travel through the nervous system very quickly but it’s still possible to measure their speed through a little gentle squeezing. The experiment has two parts:

In part one a group of at least ten students sits in a circle, eyes closed, one hand on the shoulder of the next student. The first student in the chain holds a stopwatch. Once everyone is ready, the first student squeezes the shoulder of the next student and starts the stopwatch. When the next student feels the squeeze s/he squeezes the next student’s shoulder, and so on around the circle. When the first student feels the final squeeze, s/he yells “done” and stops the stopwatch. Repeat the experiment until the group’s time is as fast as possible.

In part two the ‘squeeze’ is repeated, but this time each student squeezes the ankle of the next student. The signals will have further to travel: from the ankle to the brain instead of just from the shoulder. We can find the speed of the signal from $v = \Delta d / \Delta t$, where Δd = the difference in distance and Δt = the difference in the times recorded in part one and two. Finding Δd means measuring the shoulder to ankle distance for each student in the group and summing them.

How good are the results? Our group of teachers at the OAPT Conference got a speed result of about 30 m/s. This is at the low end of the range for a touch nerve fibre (30-70 m/s) but still respectable. One neat thing about this method is that errors introduced by reaction time and signal time from the brain to the arm to perform the squeeze are theoretically identical in both part one and two, minimizing this source of error.

A full set of the slides used in the presentation can be found at the OAPT website http://www.oapt.ca/conference/2011/workshops/deda_gillespie_dan_goldreich.pdf and at http://psych.mcmaster.ca/neuroclassics/OAPT.html

Many thanks to Dr. Gillespie and Dr. Goldreich for a very interesting presentation. This article only scratches the surface of some ideas they presented about how our brain interprets the world.

The Physics Education Research Column

To Improve, We Must Measure

Chris Meyer
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Editor's note:
This is the fifth in a series of articles by Chris Meyer describing his experiences implementing a reformed physics program. Please e-mail him directly if you have any questions or feedback.

Walk the Walk and Measure the Taught

Most of us feel that we know our students and their abilities. How often have you heard yourself or a colleague make a pronouncement that starts out something like, "My students like to …", or "My students would never …"? But what do we really know about our students?

Physics Education Research was founded on the principle that we can make useful measurements of our students' abilities and use those measurements to develop changed teaching practices. One standard measurement tool is the **Force Concept Inventory (FCI)**[1] , a math-free set of thirty multiple choice questions testing students' conceptual understanding of forces and motion, the core of introductory physics. Results from this test serve as a simple and widely agreed upon benchmark of teaching effectiveness

The Force Concept Inventory

The FCI was designed to measure the extent to which a student is a coherent Newtonian thinker. A low score indicates strong Aristotelian conceptions or other "commonsense" views typical of students prior to (and too often after!) physics instruction. A score of at least 80% identifies a confident Newtonian thinker[2]. A large study[3] of over 6000 high school, college and university students revealed that:

1) Before any instruction, **high school students on average score about 28%** on the FCI (but closer to 45% for American honours and AP students);
2) The average student starting a first year university physics class scores around 44%;
3) Harvard's beginning calculus-based physics students score 70%.

The FCI is typically administered at the start of a course (the pre-test) and again at the end (the post-test). The **average fractional gain**, **<g>**[4] , states what fraction of potential improvement over the pre-test scores the students achieved and is useful in assessing the quality of instruction. Traditional methods of instruction yield a fractional gain of 0.23 with little variance across high school, college and university. For example, students scoring 13/30 (43%) on the pre-test would average about 17/30 (57%) after a complete course of physics instruction.

Reformed physics teaching programs of various kinds have a typical gain, <g>, of about **0.48**, roughly double the success of traditional methods. Some finely tuned reformed programs, such as Workshop Physics at Dickinson College in Carlisle, Pennsylvania, routinely score gains of **0.74**. These results suggest strongly that a long history of poor student achievement in physics is a direct result of traditional teaching methods having been inadequate or inappropriate.

FCI Results at York Mills Collegiate

This past June I administered the FCI as a post-test in my reformed grade 12 physics course. Students were given no prior information about the test and it did not count for marks. Students completed the test in about thirty minutes with no aids or special instructions. 59 students wrote the FCI; 15 were away that day. The absentees were from across all mark ranges in the class[5]. The average score was **77%**. Three-fifths of the students achieved the level of Newtonian mastery (≥80%), while 93% scored at or above the level of an average incoming first year university physics student (44%). **Figure 1** shows a histogram of the results.

York Mills is an academic school with bright and highly motivated students, and I might reasonably assume an average pre-test score near the upper end of the high school range, 44%. (This school-year I will run the pre-test to find out how accurate this assumption is!) This gives an average fractional gain of **0.60** for the York Mills students. **Figure 2** compares the average gain for a number of teaching practises. These results help confirm the success of the reformed physics program at York Mills. Students showed a clear and sizeable improvement in their conceptual understanding of mechanics: almost triple the improvement generated by traditional teaching methods and better than a number of other reformed practices.

To Improve, You Must Measure

Try it out! I encourage you to run the FCI with your own classes. The test is generally not available online (to discourage curious students). To get a copy you may contact the authors[6] of the FCI, or contact me and I will send you a copy. Please **don't let the questions out amongst the students**.

To learn more about reformed physics teaching check out the resources on my website: www.meyercreations.com/Physics.htm and past OAPT newsletters, http://www.oapt.ca/newsletter/, for my articles. Or come and see reformed physics teaching in action: the door to my classroom is open and I welcome any and all visitors; please just send me an e-mail. Good luck and may you collect the courage and data to improve!

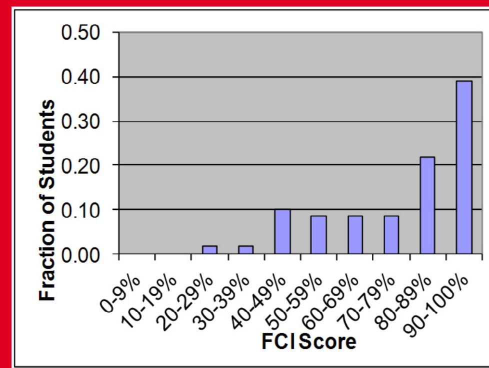

Figure 1: Histogram of FCI scores

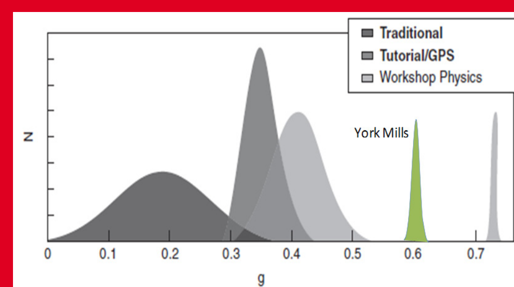

Figure 2: Average fractional gain values for different teaching practices including traditional instruction, the reformed Tutorials in Physics and Group Problem Solving programs, and Workshop Physics. (The distant spike is the Workshop Physics implementation at Dickinson College.) Source: Redish, Teaching with the Physics Suite. Wiley, 2003

[1]FCI "Home Page": http://modeling.asu.edu/R&E/Research.html

[2]FCI results and interpretation: http://modeling.asu.edu/r%26e/fci.pdf

[3]Large collection of FCI results: http://web.mit.edu/rsi/www/2005/misc/minipaper/papers/Hake.pdf

[4]$\langle g \rangle = (\langle S_f \rangle - \langle S_i \rangle)/(100 - \langle S_i \rangle)$, where $\langle S_i \rangle$ and $\langle S_f \rangle$ are the average class percentage scores on the initial and final tests.

[5]Please email me if you would like to see the raw data

[6]Using your school e-mail, please request the password from David Koch FCIMBT@verizon.net.

The Demonstration Corner

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Submissions describing demonstrations will be gladly received by the column editor.

Mystery of a Pulled Spool

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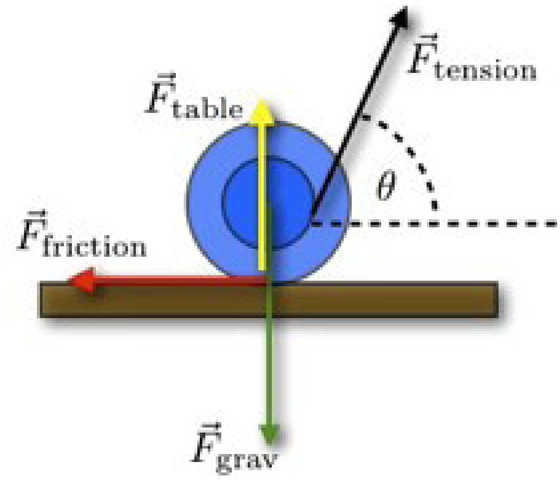
One of the ubiquitous simple physics demos that works equally well for all audiences from small children to the students in the introductory mechanics course is a plastic or wooden spool (or yo-yo) with a string wound around it. A virtually no-cost version of the “demo equipment” is a spool of common household sewing thread. Being curious, I did a Google search on yo-yo, and the search produced about 120,000,000 results!

There are many experiments that one can perform with such a spool, but perhaps the simplest one is the most striking. Set the spool on a table to that it is free to roll, with the free end of the string or thread being held at an angle to the horizontal (as shown). Ask your audience to predict in what direction and how the spool will move if you pull the string. If one pulls the string from below, the spool can be made to roll in either direction: forward or backward, depending on the angle of the string with respect to the horizontal surface. The real beauty of this experiment is that regardless of the majority of the audience’s predictions, the spool can be made to roll in the direction that is opposite to the predicted one simply by pulling the string at the appropriate angle! Moreover, while most of the audience usually predicts that the spool will roll, not many see the possibility of it sliding. Yet if you adjust the angle accordingly, the spool may even slide on the surface instead of rolling. If you do this experiment, you will discover that the spool will roll away when you keep the angle between the pulling string and the horizontal surface large enough. The spool will roll toward the string if you decrease the angle beyond some critical value.

If you keep the angle close to the critical value while pulling the string, your audience will not even notice the small change in the angle you make and will be quite puzzled by the fact that the direction of motion of the spool can suddenly change. In order to explore this mysterious behaviour, you can give the spool to small groups of students and ask them to find out on their own how the spool responds to being pulled. Repeating the experiment with a spool of different mass or dragging the spool across a smoother or rougher surface will demonstrate that neither the spool’s mass nor the friction coefficient affects the angle at which the direction of rolling changes. However, the critical angle will be different for the spools with different inner or outer radii. One can just stop here, but depending on the audience’s knowledge background, one can also develop a free-body diagram and proceed with the detailed force and torque analysis to predict the critical angle at which the behavior of the spool changes. The free body diagram shown here is borrowed from the web-site of Rhett Allain (Southeastern Louisiana University) at http://scienceblogs.com/dotphysics/2010/01/yo-yo_rolling_sliding_pulling.php and corresponds to the scenario where the spool is pulled to the right. Here, r_1 and r_2 are the inner and the outer radii of the spool. Let's first find out the conditions at which the spool is just on the verge of slipping without rolling. One can identify four forces that act on the spool: weight of magnitude $\mathbf{F}_{grav}$= mg (down), the tension $\mathbf{F}_{tension}$ in the string due to the pulling, the normal force $\mathbf{F}_{table}$ that is exerted on the spool by the supporting table (directed upward), and, finally, the static friction Ffriction force. The tension force makes angle θ with respect to the horizontal direction.



Note that the friction is static (not kinetic), since the spool is not sliding just yet. Close to the threshold of sliding, the magnitude of the static friction force is reaching its maximum value: $\mathbf{F}_{friction}=\mu\ \mathbf{F}_{table}$ where μ is the coefficient of static friction between the spool and table. If the spool is not yet moving, the net force in the horizontal direction must be zero. Therefore, Ftension cosθ = $\mathbf{F}_{friction}=\mu\ \mathbf{F}_{table}$. In addition to forces, the torques must be considered. Only two of the four forces (tension and friction) produce a torque about the centre of the spool. The spool does not rotate when these torques balance: $\mathbf{F}_{ension}\ r_1 = \mu\ \mathbf{F}_{table}\ r_2$. Dividing the previous equation into the last equation results in the equation that relates the ratio of the inner and outer radii with the critical angle at which the string must be pulled so that it just slides: $\cos\theta = r_1/r_2$. At larger angles the spool rolls away from the direction of pull, while at a smaller angle the spool rolls towards the direction of pull! Note that this equation confirms that the critical angle does not depend indeed on mass or the coefficient of friction.

An alternative qualitative explanation is available if we consider the torques with respect to the point where the spool touches the supporting surface. Only the torque due to the pulling force is non-zero. Even this torque disappears when the string is pulled at such an angle that the line of application of the force goes through the point of contact between the spool and the surface. If one considers the geometry, it happens when $\cos\theta = r_1/r_2$.

This simple inexpensive demo gives the opportunity to discuss several important concepts in mechanics, such as kinetic versus static friction, rolling versus sliding friction, and to analyze how the interplay of various forces and torque lead to different types of motion and more. Enjoy the toy!

Physics Camp in Sudbury: “Inquiry Based Physics”

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This summer, about 30 of us attended Physics Camp in Sudbury, August 10-12. Our “Camp Leaders” Roberta Tevlin, Dave Doucette and James Ball provided 3 days of jam packed workshops and many hands-on activities with the focus on Inquiry Based Physics. There was plenty of collaboration, networking and even role playing with colleagues from across Ontario and even a few colleagues from other provinces. Some of us even stayed up to hopefully see some Perseids streaking across the night sky, since we were in Sudbury during the peak of the Perseid Meteor Shower and we weren’t disappointed! We all arrived not knowing quite what to expect, but by the end we all agreed it was well worth the trip and that we would attend Physics Camp again if we had the chance.

Some of the highlights included:

- **James’ refraction exercise** where we had to collaborate in teams and physically act out what happens to light when it passes from a less optically dense medium (e.g. air) to a more optically dense one (e.g. water) and also when it passes from a more optically dense medium to a less optically dense one. Your students will really get a feel for what’s actually happening to the light as it moves from on to the other.
- **Roberta’s polarized light activity** where we all donned our 3D glasses and played. Great hands on activity that will allow your students to investigate the polarization of light. Check out the article in the November 2009 issue of the OAPT Newsletter where Roberta highlights the activities and also includes information and useful links. Here’s the link: http://www.oapt.ca/newsletter/2009_11_nl.pdf
- **Dave’s Dollar Store Physics**, including a “Big Circuits Activity” that can be used both in the grade 9 and grade 11 electricity units using large pieces of cardboard, aluminum foil, wires, batteries, resistors, Christmas lights, etc.

Also please take a minute to check out the “imovie trailer” Robert Prior put together from our three days at Physics Camp. It is great! The link is: http://www.flickr.com/photos/etherflyer/6047758436/

All of us left Physics camp feeling revitalized, re-energized and excited to go back to our respective schools to not only implement the many inquiry based activities that were presented to us into our classrooms this fall, but also share them with colleagues in our departments/in our school board. On behalf of all the teachers registered this year, I would like to extend a BIG thank you to Roberta, Dave and James . . . we look forward to more workshops like this in the future!!

How Do You Kick-Start a Physics Teacher?

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What do you do if you've been teaching physics for a while and feel like you need an injection of enthusiasm, excitement and great teaching ideas? You apply to EinsteinPlus - that's what you do! EinsteinPlus is a week long physics 'bootcamp' hosted by Perimeter Institute (PI) in Waterloo, Ontario. The Perimeter Institute itself is a think tank for over 100 theoretical physicists. It's a place where graduate students, post-docs and established professors and scientists work to further our understanding of modern physics. However, in the summer, it opens its door to us - educators who wish to learn more about physics and current physics research.

This past summer, I had the opportunity to be one of 40 teachers attending EinsteinPlus 2011. What an amazing experience! The best part was that it was physics all week long! What a unique opportunity it was to be taken away from the daily demands of running a house and to be given the chance to focus on personal learning. Quite often professional development opportunities are an hour or two squeezed in after school after which one rushes home. This was a chance to immerse, explore, share, discuss and then contemplate without interruption.

Like a well run classroom, our days were planned with a mixture of experiences. Lectures, activities, discussions, make-and-take sessions, quizzes, field trips and movies were all part of the package. We had it all! I appreciated Dr. Cliff Burgess' lecture on the Large Hadron Collider (why it was built and what it could tell us) and several days later, Dr. Louis Leblond's (P.I. post-doc student) presentation of his research on the finer details of the Big Bang. We particpated in activities on dark matter, polarization, black holes, relativity and particle physics. And what course is complete without a field trip? EinsteinPlus was no exception! We were treated to a tour of the Institute for Quantum Computing (IQC) where researchers are currently applying knowledge of quantum mechanics to build even more powerful computers.
My EinsteinPlus colleagues and I came from a wide range of backgrounds. Although we all currently teach physics, some were trained or had experience in engineering, biology, chemistry and even drama. Some are teaching in public schools, private school and virtual classrooms. Teachers attending EinsteinPlus came from across Canada (PEI to BC) and even from abroad (Australia, South Africa, UK). On two separate evenings there was an opportunity for all to share their best practises with each other. I came away with a wealth of ideas!
Now that I am a fully re-energized physics teacher, one might wonder how my classroom will change this fall? I am certainly more confident in my ability to teach and discuss modern physics (dark matter, black holes, relativity, quantum ideas). Since our workshops were presented with PER (Physics Education Research) in mind, my classroom will become more student-focussed and even more activity-based. Some of the P.I. resources I received make links to the physics strands of intermediate science and I plan to infuse modern physics into grade 9 and 10 where appropriate and help other intermediate teachers to do so. Let's get students excited about modern physics!

I know we all came away wanting to make changes in our classrooms and I hope to stay connected to my EinsteinPlus colleagues and work cooperatively as we transform our teaching practises. Finally, and perhaps most importantly, I will bring with me this fall a new sense of wonder and excitement about physics.
So if you've been teaching physics for a while and feel like you need a kickstart, I highly encourage you to apply to EinsteinPlus 2012. All information is posted at www.perimeterinstitute.ca . While you are there, surf around the site. By choosing the 'outreach' tab, you will find extensive resources available free for students and teachers. While guest lecturers are frequent at P.I. and upcoming events are posted on the site, you can also enjoyed viewing previously recorded lectures by choosing the 'PIRSA' tab. So get re-energized and excited about physics – its all there at the Perimeter Institute!

Two prominent OAPT Members Honoured

Past President of the OAPT **Glenn Wagner** has received the **2011 Canadian Association of Physicists` Award for Excellence in Teaching High School/CEGEP Physics - Ontario**. Teaching at Centre Wellington DHS, Glenn has developed skill in the use of peer instruction, collaborative group work, concept mapping and problem-based learning. A PhD candidate, Glenn is the author of several research papers on physics teaching.

Past Vice President of the OAPT **John Atherton** has received the **2011 Premier`s Award for Teaching Excellence in the category of Excellence in Leadership**. During his tenure as an Instructional Leader at the Toronto District School Board, John established the GTA Physics Teachers' Alliance. In 2007 John launched the TDSB Eureka Conference, attended by 600 science teachers and described by many as the most useful professional development they ever attended.

Join us for the 34th Annual OAPT Conference

“Physics; Opening Doors – Opening Minds”

on

April 26 to April 28th, 2012

at

The Perimeter Institute for Theoretical Physics

Registration opens January 2012

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS
An Affiliate of the A.A.P.T, and a charitable organization

November 2011

OTF Summer Physics Camp - 2011
Photo taken by Robert Prior

Letter from the Newsletter Team

Now Fully Digital

All future issues of the Newsletter will be in electronic format only. Please ensure that your OAPT membership is active in order to receive a copy by email.

The new digital version allows us to also include exciting photos and physics related artwork/photography. If you wish to share some of your own work or even some of your students, please feel free to send them to us.

Call for Articles

Have you or has a colleague of yours done something progressive or interesting with your physics teaching recently? Or perhaps you have the wisdom of many years of experience in teaching this difficult subject. Perhaps you teach Ontario's northland or in a rural area and have a different perspective or unique experiences to relate. SHARE your experiences! Write a brief (~400 word) article for the Newsletter and send it to newsletter_editor_8@oapt.ca.

Sudbury Neutrino Observatory, 2005
Photograph by Rolly Meisel

The Prez Sez

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There is an increasing number of opportunities to meet with physics colleagues and glean ideas for effective physics teaching. Unlike much PD that comes our way, Physics PD is useful and fun!

PI Workshops: Again this fall, Perimeter Institute's modern physics workshops are taking place across the province: http://www.oapt.ca/uploads/2011/pi_physics_workshops_2011.pdf. By the time you read this most of them will have already happened, so to be sure not to miss out next time email me at roberta@tevlin.ca. I will make sure that you are the first to hear about the spring workshops which will feature the new Particle Physics resource.

Local Physics Teachers' Alliances:

- GTA (Dec. 7, Feb. 8, April 11, June 6)
- McMaster (Oct. 6, March.7 http://www.science.mcmaster.ca/macsci/outreach/physics-astronomy/community-of-physics-teachers.html)
- Guelph had their first gathering on November 2.
- Plans are underway to start up similar groups in Durham and Halton.

See John Atherton's article, "Starting a Local Physics Teachers' Alliance" in this issue.

The OAPT is eager to support these local groups. If you want to be involved let me know and I will put you in contact with the right people.

Subject Specific Board PD: If your board provides time for subject specific PD you are fortunate. Make sure you let them know how much you appreciate it. Volunteer to give workshops and thank the other teachers that do workshops. This PD time is under fire and many boards are thinking that you need more of "the other" PD.

OAPT Annual Conference: Mark your calendars and book that supply coverage now! The conference is being held at the Perimeter Institute April 26-28. The theme is "Opening Doors – Opening Minds". We have over 30 sessions set featuring mind-expanding talks from PI researchers, PER in action, physics in the workplace and physics in the arts. Once again we are able to offer the amazing accommodation price of $19.99 per night! New this year: participants coming from Sudbury or further north are eligible for a grant to assist with their travel costs. Registration will start in the New Year.

Putting the “Science” in Space Science

Sean Clark
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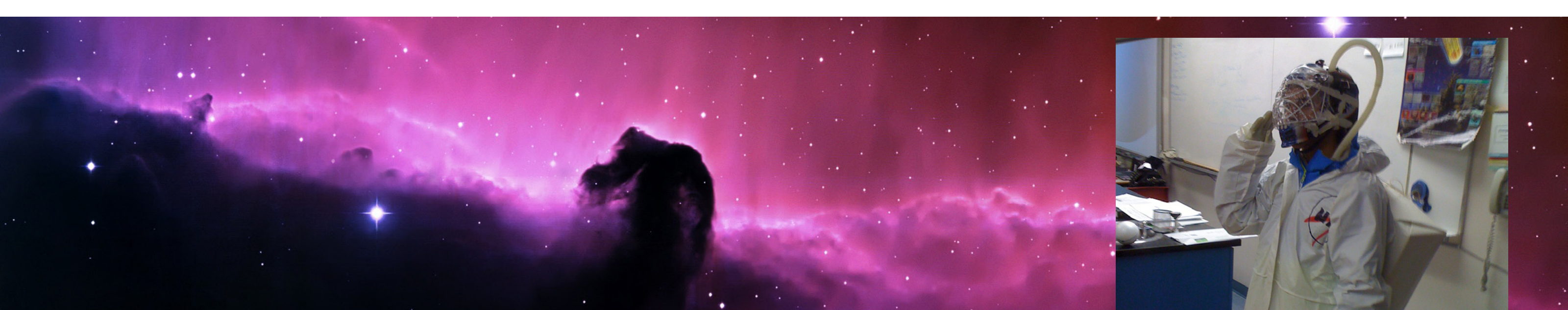
Recipient of a 2011 Prime Minister’s Award for Teaching Excellence

Gazing at the stars and planets was what first inspired the Babylonians to develop mathematics, Kepler to utilize the ellipse and Newton to describe falling bodies and momentum. But while the topic of space is usually enough to grab and hold the attention of high school students, finding opportunities to make meaningful science connections is something that many teachers struggle with. For this reason, I like to disguise other skills and learning as space learning. Students are often “knee deep” in an activity before they have any idea that they have really been learning to convert units, develop an accurate scale of measurements, describe spatial relationships, generate meaningful research questions or even find the density of irregularly shaped objects.

The math connections to space science are numerous and easily accessible. Teaching students to manipulate units by having them calculate the distance to the moon in centimeters or even light seconds will have them working with simple decimal shifts and then unit conversions before they even realize they are doing math. Once students start calculating the time it will take them to get to Alpha Centauri at the speed of our present day spacecraft they develop not only the ability to work with scientific notation but an appreciation for the vastness of space!

Teaching grade nine science is as much about teaching investigation skills and lab techniques as it is about content. After so many times through the same skill, I just couldn’t face another round of “you can find the volume of an object by measuring its displacement in a graduated cylinder”, so I decided to use a buddy approach. “Cell Phone Rovers” allows a “mission control” team to instruct “Schoolyard Rovers” on how to perform this or any other activity. After a brief discussion on the important parts of a spacecraft, which is always a hit in the middle of studying chemistry, I would equip students in pairs with water, balances and cylinders and send them out in the schoolyard with their cell phone. While they are en route, I teach their mission control team how to find the density of an object, read a meniscus and report with the correct number of significant digits. These experts now text instructions to their rovers to move, pick up rocks or other objects and then lead them through this new skill. By doing this with text instructions, students are not only forced to develop good skills in written communication – necessary for writing a procedure – but they also develop an appreciation for the communication lag between actual rovers and their controllers on Earth, a topic we return to in the space unit.

Guiding students through a research project is challenging, not because information is hard to come by, but because you need to train most students to “put the brakes on” once they find information. They have to ensure they are working with reliable sources, process the information and convert it into a form that is meaningful to both them and their intended audience. But before they do any of this, students first need to learn how to ask significant questions to guide their research. Having students design data cards on the known planets or stars is one way of doing this, but researching space programs and technology presents opportunities to provide students with general topics from which they must construct their own meaningful research questions depending



on whether they are trying to learn about the Apollo program or Martian rovers.

The most fascinating activity in space science is observing the night sky itself. Using a telescope is certainly fun, but not always feasible, so I suggest students start with the naked eye and look at the more apparent features of the sky: the moon and the recognizable constellations. Observing and recording the location of these objects in the night sky is well within the abilities of most high school students. With a little guidance in how to establish a reference point and measure angular separation in the sky, students are able to draw accurate diagrams of what they see and plot the location of the moon over the course of a night or how and where it appears over the course of a week. Before they know it, they have created their first field journal with a sequence of observations. Bringing these observations back into the class, you can use anything from balloons and overhead projectors to digital sky software and an LCD projector to simulate the relative motion of bodies in space that produced the changing vistas that they saw from their own backyards.

Whether you are looking to use space science as a context for teaching skills or as an exploration in its own right, there is potential for great richness in the tasks you can create and no shortage of resources and prepared lessons out there. Most importantly, you need not rely on a multi-media song and dance to keep your students engaged. The subject itself is enough to hold their attention.

Clear Skies!

Two Sides of the Same Coin: Fun with Motors and Generators

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The harnessing of electricity in the late 1800's laid the foundation for intense technological innovation and precipitated a radical transformation of society in the 20th century. Nearly all of our electricity generation employs the principle of Faraday's law: an electrical current can be created by a changing magnetic flux. Hydro-, nuclear-, thermal- and wind-powered electrical generators all rely on the movement of a magnetic field relative to a set of conducting coils. Many students are unaware of just how entwined their lives are with the physics of Faraday's law.

We often make use of generated electrical energy by converting it to mechanical motion in motors. From the gigantic industrial motors of manufacturing facilities to the miniscule motors that cause the vibrating alerts in most cell phones, all of these motors operate on the same principle. Students are often fascinated to discover that motors and generators are essentially the same machine: it just depends which end is the input and which is the output. A great example of this is the simple DC computer fan motor which can easily be converted from a motor (run with a 12 V DC input) to a generator (with a wind source as an input).

Michael Faraday

In a workshop at the 2011 OAPT conference I introduced participants to a set of activities designed to help their students discover the basic principles behind how motors and generators work. The set begins with some conceptual exercises introducing the students to the Motor Principle and allowing them to discover the need for commutation. The students then use a kit of simple materials (magnets, wire, battery, paper clips, etc.) to build their own DC motor. (The motor design used is similar to many others available, but has the advantages of simplicity and the potential for some serious rpm!) The final activity introduces students to electrical generation and how the same motor design could also be used for this purpose.

If you are interested in the notes and answer key for this set of activities, including a detailed part list for the motor kit, please contact me or simply download the files from http://www.oapt.ca/conference/2011/workshops/micah_stickel.html.

Be The Leading Edge of Change

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As teachers, our work influences the next generation of thinkers. What a powerful position we hold in society! Yet, as we work to inspire young people, who inspires us? We tend to treat professional development workshops like chores to be done. For years I eagerly anticipate the next PD day in the vain hope that it would offer a menu that might rekindle my energy – only to be disappointed one more time. For many of us, year upon year of disappointment leads to low expectations, complacency, and perhaps cynacism. I decided a few years ago that if the change I was seeking didn't arrive on my doorstep I would create the change myself. My school board has for the last few years continued to offer subject-based PD for teachers as long as teachers volunteered to provide the workshops. I have provided workshops on topics including the Use of Technology in Science, Math and Science Connections, and various Perimeter Institute Resources (Dark Matter, Everyday Einstein, Quantum Reality, Planck's Constant), to name a few.

The school year is a busy time and planning and organizing a teacher workshop might seem daunting, but I assure you that the effort is well worth your while. What I discovered is that I learned a great deal by delivering workshops to my colleagues. My colleagues often had just as much to offer me as I had to offer them. I have found that, filtered through the critical lens of my colleagues, my lessons have evolved to become more effective.

Our inspirations must come from each other. Our collective ideas and experiences provide for us a wide array of instructional tools. Why not take some time to share your experiences so that others can also learn from them? If your board offers subject-based PD opportunities, I strongly encourage you to volunteer to lead a session. You won't regret it. If your board does not allow for subject-based PD then I highly recommend that you form a Physics Teacher Alliance (PTA) in your region. We started a new PTA in Durham Region this fall. Our goal is to meet once a semester to start. Starting small is okay. All great things start with a small simple idea…

Starting a Local Physics' Teachers Alliance (PTA)

John Atherton
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In this issue Lisa Lim-Cole writes about a craving for good subject-based PD. Keenly feeling this craving myself as the lone physics teacher at a TDSB school, five years ago I founded the "Physics' Teachers Alliance of the Greater Toronto Area" (PTA(GTA)). We meet bimonthly after school and attract 15 to 35 attendees each time.

What follows is my abbreviated guide to starting a PTA in your jurisdiction.

Essentials:

Don't delay! My biggest regret is that I didn't get going sooner!

A venue. Often the easiest place to start is your own classroom, but you can use the following link to find the most central school in your jurisdiction or plan a rotating schedule of venues. http://www.edu.gov.on.ca/eng/sift/PCsearchSec.asp.

A time slot. Our PTA meets after school. The Western New York PTA (http://physicsed.buffalostate.edu/WNYPTA/) meets Saturday mornings because they draw teachers from a wide area. Ideas. They don't have to be original. The WNYPTA is a rich source of ideas for the agendas at your meetings. Email Dan, macisadl@buffalostate.edu, to get on their listserve.

An email distribution list. Use multiple channels:

1. Once you have the above details for your intended broadcast, email them to me and Roberta Tevlin, president_8@oapt.ca, and we will forward your message to the OAPT membership.
2. Send these details also to your board's science consultants and ask them to distribute it to the science teachers in your board. (Science Coordinators & Consultants Association: sccao@sccao.ca, http://sccao.ca/).
3. For private schools you can search using Google or the Ministry listings: http://www.edu.gov.on.ca/eng/general/elemsec/privsch/search.asp.
4. Advertise your meetings to textbook publishers, physics departments at local universities, and faculties of education (to attract teacher candidates).

Preferred But Not Essential:

An agenda. Our first meeting was very structured, but other alliances have used their first meeting to brainstorm ideas for future meetings. I recommend a combination: have someone present on a topic that will likely be of interest to attendees, but leave ample time for discussion and brainstorming afterwards.

Dates for all future meetings. This can be done using consensus. Rotating days of the week helps for those with prior periodic commitments.

A place to go to afterwards. Originally called "Physics and Pints," the PTA (GTA) has a tradition of following each session with a gathering in a local pub or restaurant. Having some refreshments on hand for after school sessions is polite and even expected. (See "Funding" below).

Funding. The TDSB has budgeted $500 per year for the past four years to support our PTA. Ask one of your local consultants (SCCAO) or look for other sources of support, such as textbook publishers and science equipment suppliers.

Support from a neighbouring PTA. PTAs are now springing up all over Ontario and there may be one close to you. Contact Roberta Tevlin, president_8@oapt.ca, to see if someone near you with PTA experience can help you get started.

A website. May not prove necessary, as many of the teachers attending will already have their own websites. Posting links to their resources in subsequent emails has sufficed for our PTA. The WNYPTA keeps archives of all their meetings which you could emulate if so inclined.

In Summary:

Making the first meeting happen is the hardest part of starting a PTA. The most important part, however, is keeping it relevant to students' learning. The attendees must see real value in what they are getting from these meetings. You achieve this by listening to the attendees and adjusting accordingly. Once you and your colleagues start sharing resources and best practices you will all see positive changes in your physics teaching. Like me, you will wish you had started a PTA earlier.

Physics@Mac Online Contest is now open for registration at http://www.science.mcmaster.ca/macsci/outreach/physics-astronomy/physicsmac-online-physics-competition.html

Date: Tuesday, December 6, 2011.

Registration is free

Cash Prizes and Certificates of Honourable Mention will be awarded in each grade category.

Details and past contest questions and answers can be found on the above website.

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Ernie Passes the Torch

In the May, 2012, issue of the Newsletter Ernie McFarland will present his final instalment of The Demonstration Corner. Our editor, Tim Langford, chatted with Ernie about his twenty five years of dedication to the column, to physics teaching, and to the OAPT that he helped found.

In the print verion of this issue, we mistakenly referred to "the historic 100th issue of the newsletter" in the preamble to the interview with Ernie McFarland. As the interview itself reveals, the newsletter published its first issue in 1979; thus, there have been more than a hundred issues. It is Ernie's 100th edition of The Demonstration Corner that we are celebrating.

TL: I recently learned that you are the founder of the OAPT.

EM: While it's true that I was the founding President, there were many people involved in starting up the OAPT. It all started in 1977 at an AAPT winter meeting in Chicago. At a workshop on the first day of this conference I met George Kelly, a high school physics teacher from Scarborough. We found that we had many common physics teaching interests. As the end of the conference approached, we both wondered aloud: "Why did we have to go to Chicago to meet each other? Why couldn't we have met at a physics teaching conference in Ontario?"

TL: But you didn't just leave it at the level of identifying the problem, did you?

EM: George and I started talking with various colleagues about the possibility of forming an Ontario physics teaching association, either as the Ontario section of the AAPT, or as part of STAO, or somehow affiliated with the CAP. We settled on the first option, and submitted a request in 1978 to the AAPT to have our section created. It was the first section outside the USA. The request was approved in early 1979 and our first conference was held in June 1979 at the University of Guelph. There are now sections in B.C., Alta., Sask., Man., Que., N.B., and Mexico.

TL: Congratulations on your success with that, and kudos to you and George and your other colleagues for your vision and hard work in making the OAPT a reality.

EM: Thank you. It was quite exciting.

TL: What about the newsletter? You have been editing The Demonstration Corner since 1987. There must have been a newsletter before then?

EM: The first issue of the newsletter dates from October, 1979. It was only two pages long, but it was a beginning. Within a few years it became a four-pager printed on one sheet of 11" x 17" paper.

TL: And what about The Demonstration Corner? How did that get started?

EM I'm not exactly sure where the idea arose, but it might have grown out a session called "My Favourite Demonstration" that was a part of the OAPT conference for many years. In this session several people would have a maximum of five minutes each to show a demonstration, and I think someone might have suggested that it would be nice if some of these demos were written up for the newsletter.

TL: And once again you turned "It would be nice if..." into a new reality.

EM: Well, I have always used a lot of lecture demonstrations to illustrate physics concepts and engage students actively, and in the early 1980s I was a member of the AAPT Apparatus Committee, which I chaired for a couple of years. So getting involved with something involving demos and apparatus was sort of natural for me. Either I volunteered to look after "The Demonstration Corner" or someone asked me if I would do it. And now it's almost 25 years later!

TL: From among the nearly 100 demonstrations that you have edited and published in that 25 years, do you have one or two favourites?

EM: The answer to that will have to remain secret until next spring. A number of people will participate in a session at the OAPT Conference called "The Best of The Demonstration Corner", in which we pay tribute to the column by performing our favourites from among the hundred or so that were good enough to make it into the column over the past 25 years.

TL: Well, Ernie, I know that you have done this 25 years of volunteer service out of a love for physics and a love for teaching. Nevertheless, I thank you warmly and deeply on behalf of 25 years' worth of readers of the Newsletter. The Demonstration Corner will continue as a regular, though it will not be the same without you.

EM: Thank you – and many thanks to all the people who wrote Demo Corner articles over the years!

Ernie McFarland
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Submissions describing demonstrations will be gladly received by the column editor.

Notes to the teacher:

1. One obvious problem with dropping apparatus in a stairwell is the sudden stop at the bottom. Usually one or more students will volunteer to act as "catchers".
2. If you happen to have access to a local flight school, you might be able to arrange a poor man's Vomit Comet ride. Even a common light plane such as a Piper Cherokee can produce a few seconds of "free fall" when flying over the top of a parabolic arc, long enough to try one of these demonstrations.
3. If you'd rather not drop laboratory apparatus down a stairwell, an alternate, but less exciting, option is to watch a video on a site such as Youtube. Visit www.youtube.com, and search using the keyword "microgravity".

Free Fall Fun

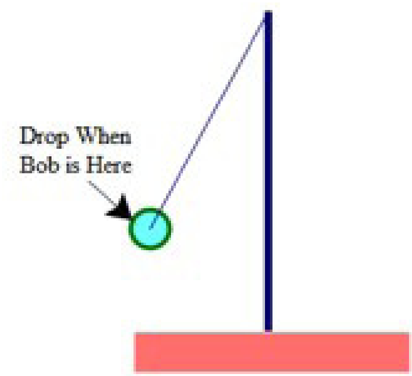
Rolly Meisel
rollym@vaxxine.com

Some processes that seem simple in the laboratory or everyday life yield unexpected results when conducted in a free-fall environment, such as a laboratory in orbit around the Earth or an aircraft flying a parabolic path, for example the famous astronaut training airliner known as the Vomit Comet. Three such processes can be demonstrated anywhere a clear vertical drop of at least 4 m can be found, such as in the stairwell of a school.

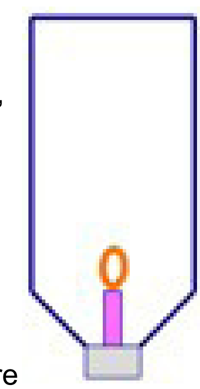
Apparatus:

- pendulum on a stand
- two-litre pop bottle, birthday candle
- water-filled plastic tube with a large air bubble, stoppered at both ends

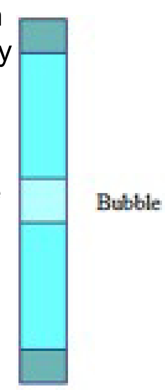
Procedure:



1. Start the pendulum swinging. Drop the pendulum when the bob is at or near maximum displacement. The swing will stop while the pendulum is in free fall. Pendula do not swing in a free-fall environment. Consider the implications for a grandfather clock



2. Tack, glue or wax a birthday candle into the cap of a two-litre pop bottle. Light the candle, and screw the cap into the bottle, holding the bottle inverted. Demonstrate that there is enough air in the bottle to keep the candle burning for at least 30 s.
3. Flush the bottle with fresh air, relight the candle, and screw the cap back in the bottle. Drop the bottle, inverted. The candle will extinguish quickly, usually within the first metre of free fall. Convection currents do not work in a free-fall environment, and candles will not burn normally. Consider the implications for a birthday cake. Could this be overcome in any way?



4. Hold the plastic tube vertically. Then, rotate it 180° and let the bubble rise. When the bubble is at the top, rotate the tube again, let the bubble rise about halfway, and drop the tube. While the tube is in free fall, the bubble will stop rising. Bubbles do not rise in a free-fall environment. Consider the implications for fizzy soft drinks.

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

An Affiliate of the A.A.P.T, and a charitable organization

February 2012

Canadian Light Source
Perimeter Institute
Uxbridge Secondary Schoool
Photos Taken by: Lisa Lim-Cole

Letter from the Newsletter Team

Now Fully Digital

We are now fully digitis! Please ensure that your OAPT membership is active in order to receive a copy by email.

The new digital version allows us to also include exciting photos and physics related artwork/photography. If you wish to share some of your own work or even some of your students, please feel free to send them to us.

Call for Articles

Have you or has a colleague of yours done something progressive or interesting with your physics teaching recently? Or perhaps you have the wisdom of many years of experience in teaching this difficult subject. Perhaps you teach Ontario's northland or in a rural area and have a different perspective or unique experiences to relate. SHARE your experiences! Write a brief (~400 word) article for the Newsletter and send it to newsletter_editor_8@oapt.ca.

The Prez Sez

Roberta Tevlin
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Run, do not walk, to your computer and register for the **OAPT Conference at the Perimeter Institute in Waterloo, April 26-28**! The theme this year is "Opening Doors - Opening Minds". The first half of the theme - Opening Doors - refers to the practical aspect of physics. Physics is useful. It can help get you a job or it can help you get the job done. Supporting this theme are such workshops as "Engineering with Electricity and Magnetism", a tour of the Institute of Quantum Computing, and an exploration entitled "Why Take Physics?". Other workshops explore how physics is connected to math, music, candy, art, games, and history.

The second half of the theme - Opening Minds – is what you would expect from a conference held at the Perimeter Institute. Many workshops will stretch your imagination in ways the other sciences can't match. Thursday evening features PI researchers in a panel discussion on "The Frontiers of Physics", followed by an opportunity to chat informally with these researchers over refreshments. Friday's highlights are a keynote by Dr. Neil Turok and a closer by Dr. Cliff Burgess, but in between there are 18 useful workshops.

This conference renews our commitment to support the physics strands in elementary and intermediate science. You are an important part of this work. Bring an intermediate science teacher to the conference or else go to the workshops that fous on the transition years and take the ideas and materials back to the teachers at your school. This will help the teachers, the students and you! The more we support our non-physics colleagues the more likely it will be that students choose physics in their senior years and succeed at it.

The financial support of PI and U of Toronto Engineering is helping make it easier for teachers to come to the conference. These funds are being used in two ways:

1) Again this year we are offering accommodation at just **$19.99 a night**. I strongly encourage you to make use of this bargain. Staying overnight allows you to take part in the more informal networking and discussions that can be just as valuable for your professional development.

2) **NEW!** We are offering travel subsidies of up to $500 for teachers coming from Sudbury or further north. Teachers in these areas are very isolated and rarely make it to the conference. Do you know of a teacher working in North Bay or Sault Ste-Marie etc? Let them know about this offer and have them email me for details.

A caveat: the conference has been growing rapidly over the past few years and the Perimeter Institute has only limited space. Don't delay and end up disappointed! This is going to be a great conference.

The Physics Education Research Column

Myth of a Great Teacher

Chris Meyer
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Toronto

Personality vs. Understanding

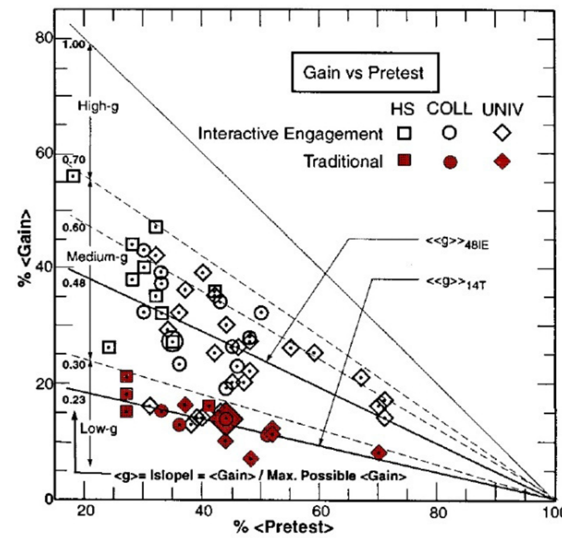
I had the very good fortune of starting my teaching career working alongside one of those teachers who had "the gift" for teaching. From my room next door I could hear his class routinely breaking out into laughter and whooping with excitement. Conversations with him revealed a deeply insightful and reflective practitioner who carefully crafted each lesson. Students adored his classes. He taught me a great deal about teaching and my role as the teacher. Perhaps the most important thing I learned was that I would never be a great lecturer. I could never conjure his wonderful combination of spontaneity, humour and insight.

A decade later I began to learn about physics education research (PER) and discovered something that shocked me. Physicists had been using standardized tests to measure students' gain in conceptual understanding over the duration of a physics course. The results revealed that even students of the most highly regarded lecturers had a surprisingly small gain in understanding. It was as if there was a limit to the educational power of even the most dazzling lectures.

"...students of the most highly regarded lecturers had a surprisingly small gain in understanding..."

Traditional Teaching vs. Interactive Engagement

The **research** I had come across was based on a widely used conceptual test: the **Force Concept Inventory (FCI)**. Six thousand students from high school, college and university wrote this test near the beginning and end of their physics courses. By comparing students' pre- and post-test scores, a learning gain[1] was calculated to serve as a measure of the effectiveness of instruction. These results are shown in the diagram below where traditional instruction has the coloured symbols. It came as quite a revelation to me that no matter how insightful or entertaining a traditional lecture might be, students have a very limited average gain of 0.23. "A gain of 0.30 seems to be an upper limit on understanding from this mode of teaching. Note, however, that physics programs using interactive engagement techniques show considerably better results.



The low gains resulting from lecture-format instruction were also a surprise to Eric Mazur, a reknowned physics professor at Harvard University. Mazur was an outstanding lecturers who garnered perennial glowing reviews from his first year students. In this **video** he recounts the transformational experience of using the FCI. Listening to Mazur shattered my long-held mental model in which students' understanding was the effect of a mythical "great teacher" at work.

An Experiment at UBC

The impetus to write this article came to me after PER recently made it into my local newspaper. The University of British Columbia conducted a **study** in their first year engineering physics classes that demonstrated the success of reformed teaching techniques in a clear and decisive way. All of the students were taught using the traditional lecture technique for the first 11 weeks of the course.

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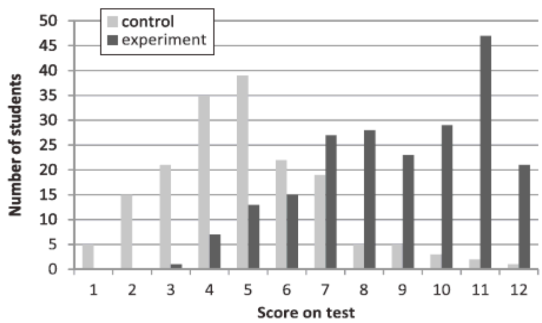
[1]<Gain>=(Posttest score – pretest score)/(100%-pretest score)

During the 12th week of the course half the students continued to be taught in this same fashion by a highly experienced and well regarded professor while the other half was taught by two inexperienced instructors who used interactive teaching techniques. After demonstrating the similarity of the two groups of students, the researchers measured students' engagement levels during the 12th week and used a standardized test to measure students' understanding of content introduced in the 12th week. The results were astounding; the control group scored 41% on the test while the experimental group scored 74%. The histogram below shows how little the two groups' scores overlapped. **Follow-up surveys** also demonstrated how the new interactive strategies were very well accepted by the students.

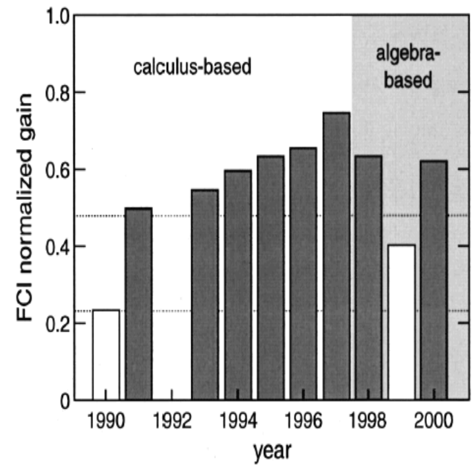


A New Hope

Our faculties of education must seize upon these results, which demonstrate that we really can "build a better teacher". We now know of clear, concrete ways to help teachers improve their students' understanding of physics. It may not be an exaggeration to say that there is an immediate improvement once a teacher steps away from the lecture podium or chalkboard and begins actively engaging her or his students.

> **"...decades of physics education research strongly suggest that the power of a teacher's personality cannot transform a poor way of learning into a good one."**

Consider the results of Eric Mazur shown in the **graph below**. He first used the FCI in 1990 and discovered how little his students were learning. The following year he introduced a reformed physics course and learning gains doubled. Gains steadily increased for a few more years as he gained skill using the new techniques and refined his course.



There is something very special about a teacher whose personality can enthral and energize students. I still admire these teachers. And I still believe that enthusiasm and inspiration are critical for helping students find their way and muster the energy to work hard. But decades of physics education research strongly suggest that the power of a teacher's personality cannot transform a poor way of learning into a good one. Where teaching charisma falters active engagement techniques succeed. A reformed teaching practise can dramatically change your classroom and help your students achieve levels of understanding and engagement that even great lecturers will envy. On a personal level, knowing this has freed me from trying to be the teacher that I am not. Instead, I can focus my energies on building my skills and developing materials for the active engagement of my students.

An Invitation

For four years I have been teaching lecture-free using guided-inquiry investigations and cooperative group learning. If you are interested in trying it my **website** contains all my teaching resources and materials to help you get started. If you would prefer to see these strategies in action please feel free to send me an **email** to arrange a time to visit my classroom. You might also want to attend one of my presentations on interactive learning:

- the Feb. 8 Toronto PTA meeting (at York Mills CI),
- the Feb. 17 TDSB Eureka Conference, and
- the April 26-28 OAPT conference at the Perimeter Institute for Theoretical Physics in Waterloo.

PER with Dave

Dave Doucette

Richmond Hill High School

Pardon my absence for the past two years as I was kept pretty busy with OAPT presidential duties. Good to be back. This article focuses on brain-based research and its application to the physics classroom. Why? Simple – it is the focus of my upcoming workshop at our 34th Annual Physics Conference at Perimeter Institute in April. So I thought it timely to give readers a heads up – and also to baldly plug my workshop.

Effective physics teaching is considered to be composed of 3 elements: content knowledge, pedagogical content knowledge[1] (PCK), and ***pedagogical knowledge.*** PCK refers to physics education research (PER) and its application to physics instruction. Pedagogical knowledge is not limited to physics - taking a broader view of the student as a social and physiological creature. And I do mean creature! I know – I have three of these at home! We're talking teens here. I'm assured they eventually emerge from their creature cocoon into young adults. I'm in a watch and wait mode.

Why is brain-based research (aka *pedagogical knowledge*) important? It is entirely complementary to content expertise and PCK – consider it a third pillar to be a maximally effective teacher. It puts into perspective the contradictory and puzzling (to us) nature of the adolescent brain. Even more importantly, it has the potential to grow sections. Physics sections, I'm talking. Important stuff.

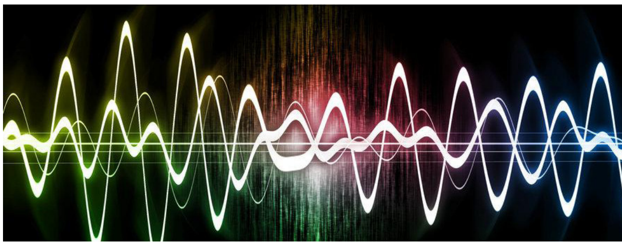
Physics content knowledge and PCK allow you to maximize the learning of physics concepts by strategic implementation of myriad instructional strategies. But these alone may not resonate with students if their social and physiological needs and interests are not met. Attention to brain-based research helps to ensure engagement of teen minds. Hate to admit it – but I see it in my own classes. Sometimes my best laid plans fail to galvanize students and basically fall flat. On reflection it is often a failure to consider emotional engagement – to 'set the stage' for learning to occur. Often because I am in a rush to finish some 'crucial content'. I know – bad teacher ! – my 'old school' roots showing.

But hope abounds. Brain-based research may serve as a compass to guide us through the shadowy world of the teen brain. The Science Teacher (January, 2007) advises "…neuroscience research can provide explanations for a plethora of behaviors in teenage students, ranging from emotional outbursts over seemingly trivial matters to disorganization and inability to plan ahead. As adults and science educators, we now have a growing understanding of the underlying neurological changes occurring during adolescence. Current advances in neuroscience can provide teachers with valuable understandings to help students navigate this time of rapid brain development."[2]

Author suggestions include: firm time lines for due dates (news to administrators!), providing choice in assignments/assessment (differentiated instruction), maintaining emotional neutrality (don't yell) and explicit organizational aids for completing assignments. Overall an implicit assumption is to not treat them as young adults, but rather as adolescents – the creatures I referred to earlier! They do not yet possess the cognitive architecture to be influenced by the same social and intellectual motivators that resonate with adults. We need to reach them at their level. The challenge is to find it. It can be a labyrinth.

Back to the baldfaced self-promotion . How will my upcoming OAPT workshop help participants to grow as professionals and firm up the 3rd pillar of effective teaching? I intend to refer to a leading researcher, Eric Jensen, and weave his 10 'brain-based learning strategies[3]'into activities. The workshop will, as always, model best practices, echoing Lillian McDermott's refrain, "Teachers should be taught in the manner in which they are expected to teach.[4]" The specific subject focus will be ***waves & sound***, as I have focused on electricity and optics in recent years am keen to present new material. Along the way, we will tour complementary ***inquiry learning*** activities (process of science) and ***guided-inquiry*** worksheets (concept attainment and application). And we will have fun. It's not just teens that need nourishment for the soul. I can't guarantee you will grow your physics sections, but I can at least make it an 'election promise'. That removes personal accountability, doesn't it? Sorry – couldn't resist.

So I hope to see you at our conference at Perimeter Institute, April 26-28, 2012. Perhaps even at my workshop! Forgive me – I have to plug this as the lineup of presenters is so impressive. So many speakers – so little time. Ah well, if you don't get to see us all – you'll just have to come back next year! What a hook. And don't forget to take advantage of the $19.99/night room rate. You can't even get a campsight for that price. And these are bear-proof. What a deal. Yagottaloveit.



References

1. "An especially critical aspect of teacher knowledge is the knowledge of how to help students master concept knowledge and the processes through which it is constructed, in a pedagogically appropriate environment; this is known as "pedagogical content knowledge" (PCK). PCK is what distinguishes a content expert from an effective teacher of the same subject matter."
Teacher Education in Physics Research, Curriculum, and Practice. David E. Meltzer, Arizona State University, Peter S. Shaffer, University of Washington. This book is available for free download at www.PhysTEC.org.

2. Megan Hall, Open School, St. Paul, Minnesota, and Georgia Brier, Department of Neuroscience, University of Minnesota, Minneapolis, Minnesota. The Science Teacher, January, 2007.

3. Eric Jensen, Brain-Based Learning Strategies. Website: http://feaweb.org/brain-based-learning-strategies. 'Brain-Based Education is the purposeful engagement of strategies that apply to how our brain works in the context of education.'

4. Lillian C. McDermott, Peter S. Shaffer, University of Washington. Physics Education, Volume 6, Nov 2000. Actual quote, "Teachers should study each topic in a way that is consistent with how they are expected to teach that material." p73.

Minute to Win It! In-Class Resource

By Nadia Camara
Richmond Hill High School

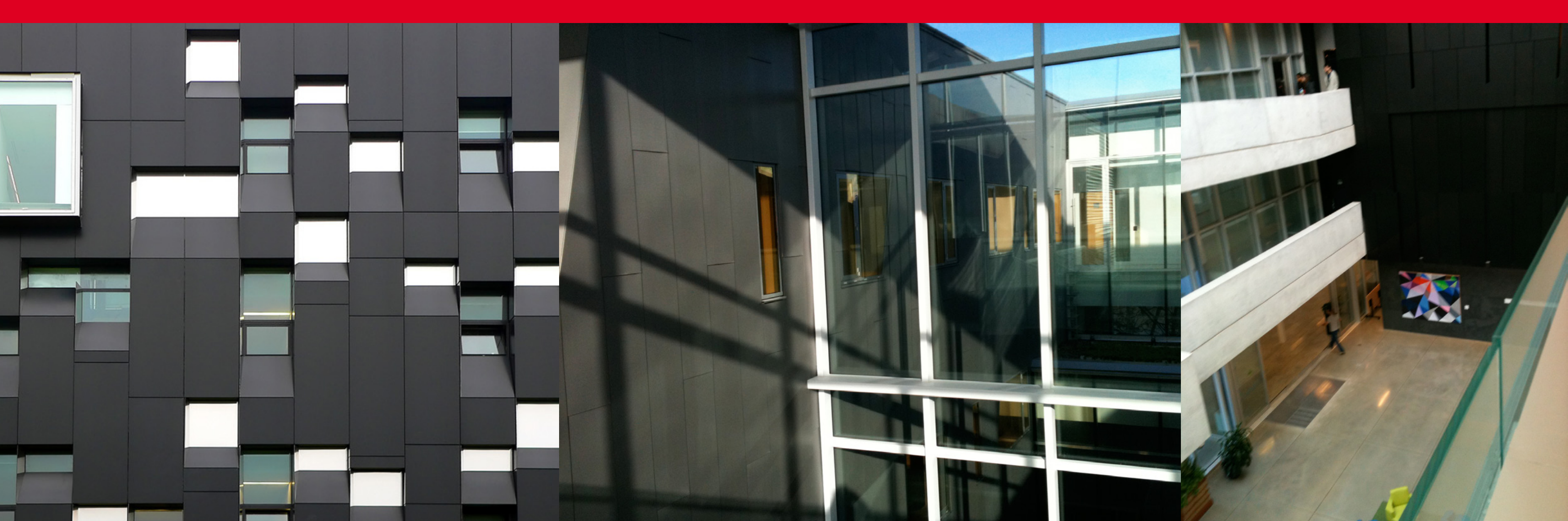
The start of every school year brings with it the question of how to make the first day effective. Among the goals you may have on the first day are to: 1) set the tone for expectations for effective classroom practices, 2) serve as a diagnostic to help you start appropriately, and 3) get students interested in the subject matter. I also want day to be fun and engaging. In an effort to fulfill all of these criteria, I have adapted a version of the game show *Minute to Win It* for use in physics class. The activity is to be used on the first day of school and revisited periodically, including as a culminating activity.

On the First Day:
Students are put into groups and instructed on expectations for group work in physics class. Each group is given a specially selected Minute to Win It challenge. They are asked to practice the challenge and discuss the physics of the challenge within their group, arriving at an explanation that all group members agree upon. Each group then presents their challenge and explanations to the class. **Diagnostic complete!**

Challenge Revisited:
During their study of mechanics the students encounter topics that relate to the challenge they examined on the first day. Students are excited to try the challenge again, this time focussing on the principles of physics, which they now understand better. As the course proceeds students periodically revisit and modify the challenge they were given on the first day. The groups are asked to use the new concepts they have learned to

explain the newly redesigned challenge. Each group presents these new challenges accompanied, by explanations of the physics involved, to the whole group. Culminating activity complete!

Generating Excitement:
We decided to make this a school-wide event to generate some excitement about physics amongst our younger students. Each group set up a booth during a class period and grades 9-11 were invited to attend. Visitors were given the challenge and had one minute to complete it. After the first attempt the senior students explained the physics to them and they were given a chance to retry the event. Our stats demonstrated that the challenge was easier to accomplish once people understood the physics. **Physics teachers' goal complete!**



What the Higgs is going on at the LHC?

Dave Fish
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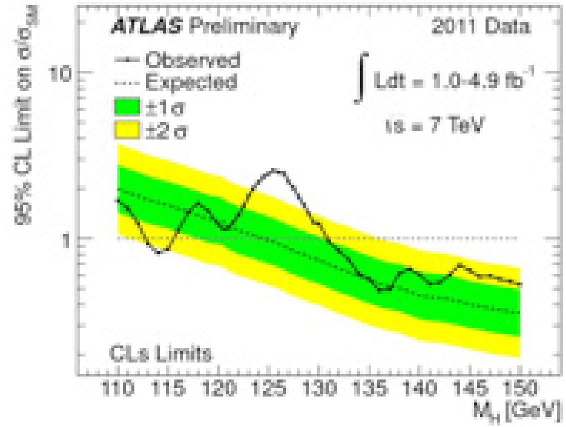
Educational Consultant
Perimeter Institute for Theoretical Physics

As teachers, our work influences the next genera-
Excitement about the Large Hadron Collider (LHC) at CERN is building with every rumour published in the blogosphere. One week the Higgs has been found, the next week it has been disproven. Throw in a few “faster-than-light” neutrinos and interest in high energy physics has never been higher!

What is all the excitement about? The Higgs boson is the only particle in the Standard Model of particle physics not yet observed. Finding the Higgs boson would be a huge step forward in our understanding of nature. The Higgs boson is associated with the Higgs field. Fundamental particles, like quarks and leptons, interact with the Higgs field and experience inertia. Inertia is the property of matter associated with mass. If the LHC is able to produce Higgs bosons it will confirm the existence of the Higgs field and give new insight into why fundamental particles have mass. The LHC is colliding particles at 7 Tev (in 2011), which is more than enough energy to create a Higgs boson if it exists.

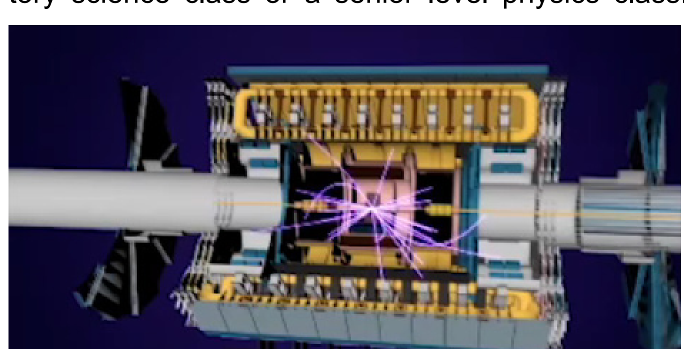
The LHC completed its 2011 proton collision run on October 30th, having far surpassed CERN’s original data goals. Results released in December (see the plot of ATLAS data, left) point to a possible Higgs candidate in the 124-126 GeV range. Researchers are now busy completing the analysis of over four hundred trillion collisions in search of the elusive Higgs and other new physics. Formal announcements from CERN are anticipated throughout 2012. The Perimeter Institute for Theoretical Physics (PI) is ready to respond to any significant findings. PI researchers involved in LHC projects have agreed to participate in interactive panel discussions to be live-streamed on the Internet whenever significant announcements are made. **Teachers and their classes will be invited to participate in these discussions.**



To coincide with these exciting developments PI is releasing a **new Perimeter Exploration** this spring. **Beyond the Atom: Remodelling Particle Physics** is a 30-minute video featuring state-of-the-art animations, researcher interviews and informative narration that introduce students to essential concepts of particle physics, starting with Rutherford and ending at the LHC. Researchers explain the basic science of particle physics in clear, easy-to-grasp language. Analogies are explored and animated to give the audience a scientifically valid description of how the Higgs mechanism explains the mass of fundamental particles.

The **classroom resource** that accompanies the video contains five classroom activities and extensive background material to help teachers bring the excitement of high energy physics into their classroom:

1) The Scattering Experiment activity engages students in a series of physical analogs of Rutherford’s famous gold foil experiment.
2) The Taming the Particle Zoo activity invites students to participate in the process of science by analyzing collision data to find patterns and predict the existence of new particles. These activities are adaptable and can be used in either an introductory science class or a senior level physics class.



3) In Bubble Chamber Detective students use conservation of charge, conservation of momentum and right hand rules to analyze two historical bubble chamber photographs. 4) In Finding the Top Quark students analyze data from Fermilab's DØ detector that leads to the measurement of the top quark. The second part of this activity has students working with a computer simulation to identify Higgs events.

The anticipation amongst physicists of forthcoming data from the LHC is palpable. Your students can share in the excitement. Physics did not stop with Newton, Maxwell, or Einstein; science is still moving forward with new discoveries at the LHC.

Go to **www.perimeterinstitute.ca/outreach** to order your copy of this new resource or attend one of our teacher workshops* to see what this newest resource has to offer.

*Workshops are being offered at the TDSB Eureka Conference on Feb. 17th , at the OAPT Conference at Perimeter Institute on April 28th, and at various locations throughout the province this spring.

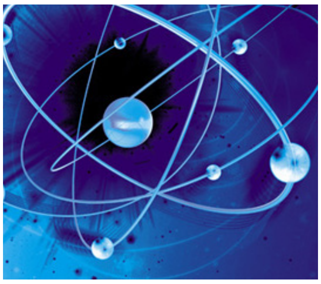
Why Take Physics?

An OAPT Workshop Sneak Preview

by **Caroline Burgess**
Outreach Coordinator
Departments of Chemistry & Chemical Biology,
Mathematics & Statistics and
Physics & Astronomy
McMaster University

High school students can be so focused on getting into university that they sometimes make career decisions that limit their options as undergraduates and affect their ability to get out and move on to satisfying careers. They may also tend to have a "silo mentality" when it comes to science: for example, while they understand that a major in biology has a prerequisite of grade 12 biology, they may not appreciate that a degree in biology will also require them to take at least one course in physics at the university level. University admission requirements do not help in this regard since their focus is on admission to a Level I program – "getting in" – and often do not include all of the prerequisites required to move on to honours programs in Level II. Many students in a Level I Science program find themselves having to take an "equivalent to 12U" physics course in their first year of university in order to have the prerequisite for the Level I physics course required for admission to an honours program in Level II. Apart from the extra cost, the more serious consequence is that they are placed in a non-standard stream, competing for a seat in a course where the number of seats is limited and in a term when it is more likely to conflict with another course required for their program of choice.

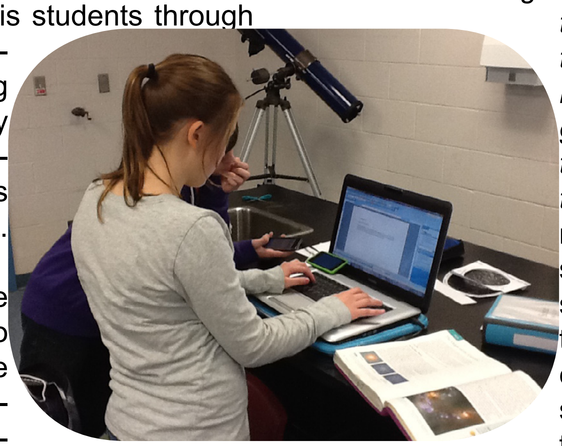
While there are potential negative consequences to dropping Physics in high school, my OAPT 2012 workshop, Why Take Physics?,will have a more positive focus. Over the past several years, I have been collecting statistical and anecdotal evidence that makes a compelling case for taking physics (and more physics) at the university level. Physics underlies all other sciences, including the life sciences. Its power comes from this fact and the fact that training in Physics includes transferrable skills in experimental design, modeling, computing, critical thinking and problem solving. Physics graduates are employed throughout the economy and, according to recent studies, 97% of graduates say their physics training has contributed to their career (regardless of what they do). They are well-prepared for teaching, law school and, with a strategic selection of electives, for medical school, dentistry, and graduate school in a number of areas, including physics, astrophysics, biophysics, engineering physics, geophysics, materials engineering, medical physics, meteorology, neuroscience, physical chemistry, economics and finance. **Physics graduates are 98 % employed and enjoy the highest mid-career salaries of any science.** In a recent salary ranking based on 50 majors, the Wall Street Journal placed physics graduates sixth, ahead of most engineering graduates and far ahead of business majors.



Less Teaching, Smarter Learning

by Sean Clark
Sacred Heart High School
OCCDSB, Stittsville

At the 2011 STAO I attended a session in which Neils Walko described his technique of teaching grade 11 chemistry using student-centred collaborative inquiry. Similar to Carl Wieman's project-based physics courses at UBC, Neils guides his students through tutorials and resources available on the Web, while holding them to the standards of mastery learning. He has stopped "teaching" (presenting notes), and has become a facilitator of learning.



I began to consider how these techniques could be applied to the grade 9 science unit on The Study of the Universe. The development of a modular unit using blended learning (employing both in-class and digital resources) and allowing students to explore the myriad of topics relating to astronomy was certainly possible while still meeting the expectations of the provincial curriculum. By letting students choose their individual topics and work in collaborative groups towards the learning objectives I could have the curriculum cake and they could eat it too!

I began by narrowing the Ministry Guideline for this unit down to 13 learning goals and a comprehensive vocabulary list. Each learning goal was given its own page on my website and a full buffet of learning resources was collected. Students could choose to watch a video from the Kahn Academy, read a relevant section from their textbook, check out a set of PowerPoint slides, work through a Gizmo from ExploreLearning or watch a podcast from the CSA or NASA website. Once students think they have achieved the learning expectation they choose a recommended assignment or simply picked a topic to demonstrate/explain to the teacher using any of a variety of methods.

The topics in the Study of the Universe unit can be learned in any order. This lack of a prescribed sequence makes the unit perfect for allowing students to explore whatever strikes their fancy, literally learning what they want, when they want, and in a manner that appeals to their personal learning style.

So, for this unit, I surrendered my whiteboard to my students. I still conducted the occasional class demonstration, but most of my teaching moved to small groups, which in many cases made for lunar phases was done with a couple of styrofoam balls and a flashlight for some students. *The next day, I got to watch as they repeated the demonstration for a couple of their classmates who had been researching the formation of the solar system the previous day. Seeing the styrofoam balls, one of the researchers then grabbed a glue stick and explained accretion to my lunar learners and the snowball started rolling.* A roomful of computers and a site license for an astronomy software package proved not to be necessary. I showed a couple of students how the software works and let the technology work its magic. By the end of the unit most of my students were proficient enough with the software to demonstrate retrograde motion of Mars or Venus over several weeks, all from just two old desktop computers.

Teaching the space unit in this manner might not be for everyone. A couple of ingredients are essential. The teacher needs to be familiar enough with the content to be able to answer questions and guide students "off the script". A bank of resources is vital to let students choose how they want to learn, but there need not be class sets of anything as scaffolding makes for more effective learning all around. Having well vetted videos, animations, etc., is essential as students can easily become mired in the cornucopia of fluff available on the Net. A familiarity with the overall curriculum is needed so that you can make sure that students are not spending too much time on topics that will be covered in subsequent courses or falling short of learning objectives critical for the following year.

I have my sights set on other units I want to teach in this manner: grade 9 electricity and grade 10 optics. Who says you need to know how a static charge forms before you build your first parallel circuit? Why is a lightning rod more important to understand than the grounding rod at a gas pump? And does a student really need to be able to draw the ray diagram for refraction through a diverging lens if she can manipulate the lens equation more effectively to find the properties of the same image? This teaching method may not be for everyone or every subject, but it certainly has exciting possibilities in the physics strands!!

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Submissions describing demonstrations will be gladly received by the column editor.

Fun with Ping Pong Balls

Rolly Meisel
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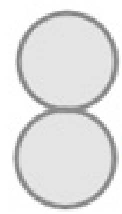
Ping pong balls make up an important part of the physics teacher's bag of tricks. Here are three disparate but entertaining and instructive uses for ping pong balls in the physics classroom.

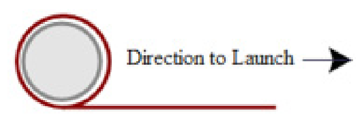
Apparatus:

- ping pong balls
- golf ball
- long rubber band
- mouse traps
- covered aquarium

Procedure:

1. Hold a ping pong ball on top of a golf ball as shown. Drop the two balls onto a hard floor, preferably concrete or similar. The ping pong ball will be launched some distance into the air. Try to find a room with a high ceiling, or do the demonstration outside. This should lead to an interesting discussion on ***energy and momentum conservation*** in elastic collisions. **More fun:** Perform the demonstration using two "superballs," a large one on the bottom and a small one on the top. You should do this one outdoors. The small one will fly quite a distance into the air.





2. A rotating ball flying through the air can generate lift. This is the "trick" behind a baseball pitcher's "floater." To demonstrate this wrap a long, thin elastic band around the ping pong ball, leaving some of it to be stretched. Stretch the band while holding the ball, and then release the ball to launch it horizontally. This may take a little practice, but you should be able to get it to gain altitude rather than losing altitude along the expected parabolic arc of a projectile. This method of generating lift is known as the ***Magnus effect***, and has been used on some experimental aircraft. The ball can be replaced by a rotating cylinder. For more information on the use of the Magnus effect in aircraft, ships, and high-altitude wind turbines search Google using the keywords "Magnus effect."
3. You can demonstrate a model of a ***nuclear chain reaction*** using a couple of dozen mousetraps loaded with ping pong balls. To ensure that the chain reaction occurs, you need to confine the mousetraps in a "reactor" such as a large dry aquarium with a rigid top to reflect the balls. The effect is quite dramatic after you drop in one ball to model a neutron "trigger" to split the first "atom." There are several dramatic video clips available, one of which features several thousand mousetraps. Search YouTube using the keywords "mousetrap ping pong ball."

Notes to the teacher:

Be careful loading the mousetraps. If one goes off unexpectedly, it can cause pain or even break a finger.

You can sometimes buy ping pong balls cheaply at larger dollar stores.

A Canadian Magnus effect experimental aircraft that actually used a giant analogue of a ping pong ball was the Van Dusen LTA (Lighter than Air). You can find images on the Internet by Googling "Van Dusen LTA."

NEWSLETTER

ONTARIO ASSOCIATION OF PHYSICS TEACHERS

An Affiliate of the A.A.P.T, and a charitable organization

April 2012

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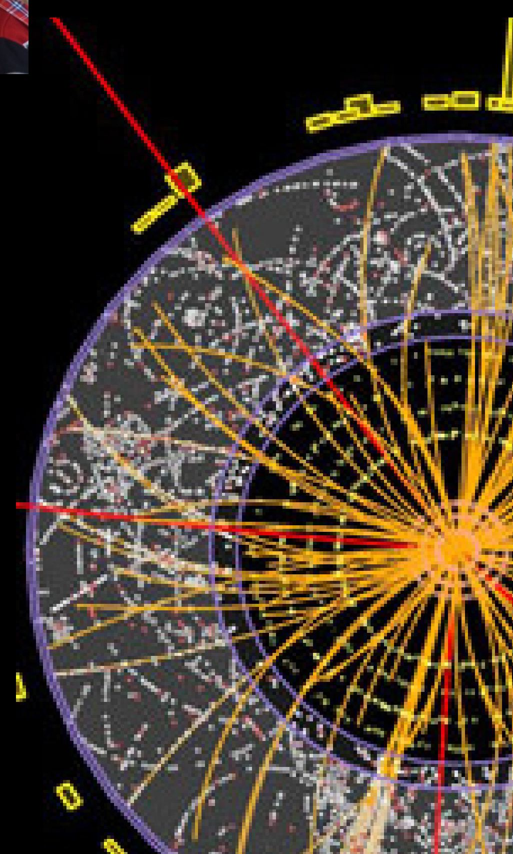
CERN People
by Nathen Wren

Demonstration Corner:
Demonstration of a Phase Change Between Solid Phases of Iron
by Dr. Albert A. Bartlett



Letter from the Newsletter Team

Let's Get Excited! OAPT Conference planned to be out-standing! Be there!

As the OAPT Steering Committee finishes preparing for the conference, the Newsletter team would like to present this short newsletter to get you thinking about what is to come at this year's conference. Join us as we "Open Doors and Open Minds". Mingle with us. Let's talk Physics!

Call for Articles

Have you or has a colleague of yours done something progressive or interesting with your physics teaching recently? Or perhaps you have the wisdom of many years of experience in teaching this difficult subject. Perhaps you teach Ontario's northland or in a rural area and have a different perspective or unique experiences to relate. SHARE your experiences! Write a brief (~400 word) article for the Newsletter and send it to newsletter_editor_8@oapt.ca.

The Prez Sez

Roberta Tevlin
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The OAPT Conference is all set to be a blast!

The Perimeter Institute is providing wonderful support and enthusiasm and our registrations are even greater than last year's fantastic conference. Over half of the workshops are already filled to capacity. But don`t worry – there is still space if you haven`t registered yet. Don`t forget that you can register for part of the conference or the whole thing.

There has been an exciting change to the program on Thursday. We still have lots of great food but rather than a panel discussion with some of the PI researchers we are introducing **Physics Speed Dating**. This is your chance to ask all those questions that have been keeping you up at night. How can the Big Bang make something (the universe) from nothing? Are those neutrinos going faster than c? Exactly what goes through the double slits? Why aren`t my socks entangled?

On Friday, **Dr. Neil Turok** is going to start us off with **Magic that Works** and **Dr. Cliff Burgess** will wrap it up with **Last Chance to be Wrong about the LHC**. In between we have some fabulous workshops about how physics can **Open Doors and Open Minds** from grades 6 and up.

The workshops continue on Saturday and include a special extra long workshop so you can really explore one of five great topics. Everyone and anyone interested in exploring being involved next year helping to run the conference, newsletter, contest, website and other plans is invited to adjourn afterwards for informal lunch/meeting at Heuther`s.

For full detail and to register go to **http://www.oapt.ca/conference/2012/index.html**

See Attached Conference Schedule! Don't miss out!

Pimp Your Classroom, Inquiry-Style!
(or, Equipping the Inquiry Classroom)

Chris Meyer
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York Mills Collegiate Institute
Toronto

I'm really tired of bumping my head on the cabinets in my kitchen when I wash the dishes. The genius who designed it (not me!) obviously never anticipated humans who stood over five feet tall. I now blame these cabinets, wholly, for my dish washing aversion. Good design (or bad!) can really make the difference in matters domestic and, of course, educational. The environment in which our students work can have a great effect on their motivation and their approach to learning, so we should do whatever we can to help our physical classroom reflect our learning goals.

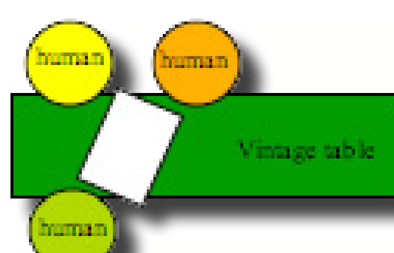
Two important goals in inquiry-based learning are collaboration within small groups and student or group independence. Both result from an overall shift to a student-centred approach to learning. There are a number of things we can do to any classroom to help our students realize these goals.

You Are How You Seat

My classroom at York Mills is vintage 1950's. You might expect its inhabitants to jump up on the tables and break into songs from Grease. It has never been renovated and, especially after the recent provincial budget, I don't expect it to be renovated in my lifetime. It is surely the flagship model of teacher-centred design. The experts on student-centred design are the people from **SCALE-UP**, Student-Centered Active Learning Environment for Undergraduate Programs, who have redesigned over 150 university classroom sites around the world. My dream classroom would look something like this one at the **U of T**:

However, my actual classroom looks like this:

So the best I can do with long skinny tables bolted to the floor is to have the students move around and work with their groups in a triangle formation:



This idea seemed simple to enough me, but as it turned out, inertia was a major obstacle. I found myself constantly harassing students to move. It took me almost three years to figure out that if I permanently put one extra chair on the front side of the front table, no physical chairs needed to be moved when going into “group work mode”. Now the harassing is down to an acceptable level.

To help out with the group organization, all the tables are **numbered** (and named!). And the room is “equipped” with a stack of **group self-evaluations** to help students assess the effectiveness of their groups. I find I remember to do this more often when the room has these amenities “built-in”.

Equipping the Masses

As part of the shift to student-centered learning, I want my students to have some latitude in deciding what equipment to use. The majority of the equipment I use is the low-tech, “standard” equipment – the typical flora and fauna of the vintage physics classroom – along with a set of large whiteboards. As much of this as possible is stored in convenient locations in the room and is carefully labeled.

After a brief introduction, students know where stuff is and if they decide they need to measure the mass of something, they head straight for the triple-beams. No one asks for permission and I don’t spend time dragging the basic equipment out.

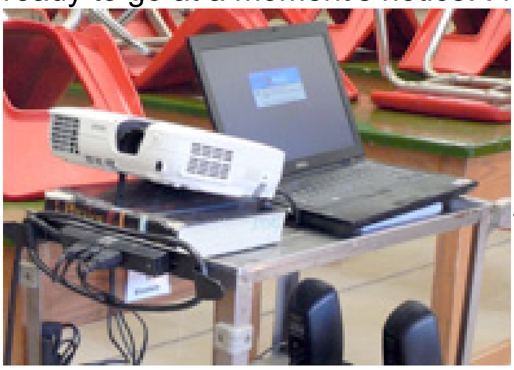
The careful layout of classroom equipment is not enough, however. It is a waste of time for students to walk across the room when they need a whiteboard marker or pair of scissors. Each table in the class is outfitted with a basket of goodies: whiteboard markers and an eraser, a ruler, a protractor, scissors, masking tape and three sets of multiple choice letters for concept questions.

Students’ time in my class is precious (at least I think so) and I want them to be able to work as efficiently as possible. Replacing missing items is a very small price to pay (thank you, China). Hanging from the side of each table is a small whiteboard – this was a very happy addition. I now see students, usually during particularly heated discussions, reach over the side and grab the whiteboard for quick illustrations and calculations. I was at one point trying to decide if I could actually bolt the white boards to the table surface, but I think this will do. With this layout of equipment, my hope is that students feel

that they are in charge of what they are doing and also feel empowered to follow their ideas and test their hunches.

Teachers Need Equipment Too

I finally have an effective setup for a computer and data projector that can remain in the room, ready to go at a moment's notice. I no longer



have the excuse that I have to drag the stuff out or that it gets in the way, so I use it much more regularly for quick simulations (Interactive Physics, applets) and also for **ConcepTests** (conceptually-based multiple choice questions often used with "clickers"). As a result, ConcepTests have become an important part of many of my lessons. Each group has in their basket a nicely laminated set of **multiple choice letters** ($1) that we use in the place of electronic clickers (>$1). I have never tried actual clickers and I don't plan to – my approach is cheaper, easier and I can decide to do a ConcepTest on a whim, as the situation demands.

Every semester since I started teaching inquiry-based physics, I find that my classes have run more smoothly than before and with fewer group or personality problems. I think this is due in part to the steady improvements in the classroom environment, along with improvements in my own teaching. While we can't renovate a classroom ourselves, with a bit of creativity, there are many changes we can make that will help our students to enjoy their time with physics and hopefully learn more than they thought possible.

Learn More than You Thought Possible

Would you like to see an inquiry-class in action? The door to my room is always open. I am happy to have visitors and if you e-mail me today, there is usually no problem in arranging a visit for tomorrow when you fall ill.

Would you like to learn more about teaching physics through inquiry? I will be giving a presentation at the **OAPT conference**, April 26-28 at the Perimeter Institute for Theoretical Physics. There you will have a chance to experience what it is like to learn this way and to learn what it is like to teach this way. You can find a complete set of classroom resources on my website: **www.meyercreations.com/physics**

Dragon's Den for Space Exploration Programs

by Sean Clark
Sacred Heart High School
OCCDSB, Stittsville

Old faithful: the research project! Using this time-honoured strategy you can expose students to a variety of applications from biotechnology to optical devices. Applying this strategy to the grade 9 Study of the Universe unit, in just two days of student presentations you can "cover" everything from Galileo's first telescope to the Hubble Space Telescope. The added bonus is that you doesn't necessarily have to be an expert on any one topic in order for the class as a whole to learn about it. But how can you be prepared to evaluate students on presentation day? You will need to be familiar with some of the intricacies of each research topic, but keeping up with even Nasa's space programs, let alone those of overseas nations, is a lot to accomplish on a prep period. Enter the "Investors".

Assigning a research topic is not nearly enough guidance for students embarking on a research project. The World Wide Web has made finding information easy enough that students no longer have to question and ponder in order to develop a flashy presentation. I look for ways to focus students on inquiry-based research rather than "stumble and find", placing more emphasis on the research process than on the presentation product. In this article I describe a hook to get kids thinking and wondering about their topics before they reach for Google.

I have students "sell" space technology programs that had already proven successful to an interested "investor", in order to complete just one more mission. The students have to be prepared to discuss not just the highlights of the program, but how challenges and setbacks were overcome and what side benefits or technological spinoffs resulted from that particular space program. Students, working in groups of three, immerse themselves in a space technology program, learning, for example, that the design of a lunar rover for the Apollo program resulted in the development of battery

operated tools and durable tires, and that these applications would translate to cash flow for those holding the patents on such designs. Students continue to question when they learn about the setbacks of a mission in order to show how solving a problem like the optical focus of the Hubble telescope might lead to the development of specialized lenses and computer enhancement software, perhaps setting their individual program off schedule, but ultimately advancing technology as a whole.

The key to making this work is a capable investor. This is a student I hand pick to research up to three different space programs (e.g., Mercury, Gemini, and Apollo) in order to identify some of the shortcomings, disasters or budget problems that those programs experienced. On presentation day that student is armed with questions designed to keep the presenters honest in their sales pitch. This creates incentive for the presenters, who have to be prepared to explain why people died, machines crashed or money was spent with nothing to show for it. The investors prepare a one-page analysis of each presentation, indicating how well their concerns were addressed, how good the return on their investment would be through spin off technologies, and what benefits they saw to the program as a whole. Each investor is given $1 billion to assign, and to date only one has ever suggested playing the ponies as a safer investment than any of the space programs presented by her classmates!

The added bonus of recruiting the best students to act as investors is that the rest of the research is spread more equitably among all the other students, rather than a few taking on the lion's share of the work. It's always impressive to see what students are capable of when their safety net is taken away, especially when the incentive is there for a little competition.

Researching space technologies and all of the ways that we have benefited from them is inspirational enough to keep students engaged. Crafting assignments that will hone students' inquiry and analytical skills does not have to mean teachers do all the researching themselves and design guided question sheets. Letting students' natural curiosity and their desire to prove themselves is often enough to direct their questions toward something meaningful. Of course, it helps to have a good investor in your corner!

Clear Skies!

Art, Drama, and Candy in Physics

Lisa Lim-Cole
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The OAPT Conference is coming up and I'm excited to share how I use art, drama and candy to bring physics alive in my classroom. Creativity, innovation and imagination are an integral part of science. Learning physics requires much more than just an understanding of the language of numbers and equations. As physics teachers it is easy for us to appreciate that mathematics is a linguistic tool used to communicate ideas in physics, just as the English language allows us to communicate ideas in words and sentences. However, many students have a difficult time understanding that the mathematics is simply a tool, not the physics itself. The concepts behind how nature operates are far more important than our students' ability to do algebra.

Using art and drama in my physics teaching has allowed me to explore these ideas with my students while "bracketing" the mathematics. When students are faced with preparing a skit or role play to simulate a physical process they need to discuss with their group what is really happening. When required to create a physics cartoon they will often bring to a conscious level their own buried preconceptions. In both cases they are forced to dissect the key ideas, confront their preconceptions and discuss these with their peers or their teacher. Join us as we explore science from an artistic and dramatic point of view – and with candy just for fun!

Let's play!

CERN People

A new Films of Record collaboration involving Google+ and YouTube

By: Nathan Wren

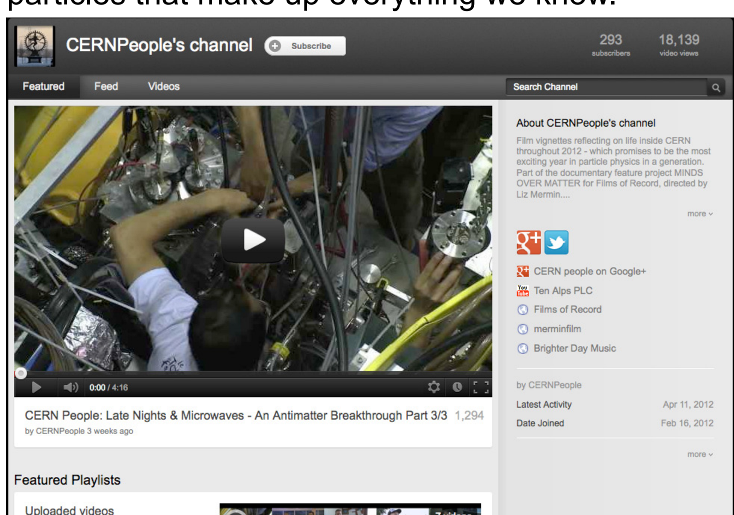
Google+: http://goo.gl/MBLrs
YouTube: www.youtube.com/cernpeople
Email: cernpeople@gmail.com
Twitter: @CERNPeople
www.filmsofrecord.com

CERN People is a Google+ page and YouTube channel at www.youtube.com/CERNPeople featuring short films about people inside the European Organisation for Nuclear Research at CERN – the biggest and most powerful scientific research institute in the world. These shorts will eventually be compiled into a feature documentary.

The filmmakers are following a handful of physicists throughout 2012, a year promising to be the most important one for physics in at least a generation. The Google+ page and hang-outs will offer a chance for users to comment on and interact with CERN researchers. The intended audience includes anyone curious for a behind-the-scenes peek at the workings of "the science of everything".

CERN People and the feature documentary that will emerge from it in 2013 explore the motivations, aspirations, fears, and desires that keep this extraordinary research facility going, deepening our knowledge about the most fundamental questions of existence.

CERN brings together some of the most brilliant and ambitious minds in science from over 100 nations – people who could be earning millions in the private sector – to pursue pure knowledge about the ghost-like subatomic particles that make up everything we know.



CERN People has the potential to be a unique scientific record of history in the making. The daily interest shown in all media, with or without new developments around popular topics like the Higgs boson, suggests that the Google+ page will draw substantial and diverse visitors. These followers will then be anticipating the feature length documentary.

Become one of them!

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Submissions describing demonstrations will be gladly received by the column editor.

Demonstration of a Phase Change Between Solid Phases of Iron

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Introduction

Solids can exist in different crystalline phases. When you add heat at a constant rate to a sample of a solid the temperature rises until the sample reaches the transition temperature from the low temperature solid phase to the high temperature solid phase. The sample then absorbs the latent heat of the transition without changing its temperature. When the transition to the higher temperature solid phase is complete, the temperature resumes its rise as heat continues to be added to the sample. The behaviour is reversed when you remove the source of heat.

The experiment below is designed to give a qualitative and spectacular demonstration of a phase transition between solid phases in a sample of ordinary iron wire.

Properties of Iron

At room temperature iron is in the **alpha phase** in the form of a body-centred cubic (BCC) crystal (ferrite). At 910°C the transition takes place to the **gamma phase**, a face-centred cubic (FCC) crystal, (austenite). The melting temperature is reached at 1528°C.

The Experiment

The sample is a piece of ordinary iron wire, no. 22 gauge, about 2 m long. The wire is an all-purpose bare iron wire that comes on small wooden spools that are sold in hardware stores. The wire is strung horizontally from two alligator clips each of which is fastened to a piece of wooden dowel rod. The wood provides electrical insulation and the wooden rods can be attached to lab stands with ordinary lab clamps. String the wire without too much sag about 70 cm above the lecture table. Connect the ends of the wire are to a variable output power supply that will give about 15 amperes at around 50 volts, either AC or DC.

When the wire is heated it will expand and sag. To make this more visible I have a partially straightened paper clip to which a ping-pong ball has been glued to the lower end. The upper end of this clip is hooked over the iron wire near its midpoint. A light source, directed away from the class, sends a horizontal beam of light to illuminate the ball so that the ball casts a shadow on the front chalkboard. On the chalkboard I make a few horizontal chalk marks perhaps 10 cm apart vertically to constitute a crude scale on which the shadow of the ball will be seen to move up and down as the amount of sag in the wire increases or decreases as the iron wire expands or contracts.

Bring up the current gradually in the wire. The wire expands and sags dramatically and it starts to glow. Continue slowly increasing the current until the wire is glowing hotter than red. The wire sags a great deal and the glow is impressive. It gets “Oooohs” and “Aaaahs” from the students. Ask the students to watch the vertical movement of the shadow of the ping pong ball on the chalkboard.

At the count of three turn off the current. As the wire cools and contracts the ball rises for a couple of seconds, pauses, drops slightly, and then continues its rise until the wire is at room temperature. The pause indicates that the iron of the wire is going through the transition from the high temperature solid phase to the low temperature solid phase. During the pause it is losing the latent heat associated with the transition. The increase in the sag of the cooling wire just after it passes through the phase transition suggests that the low temperature phase has a lower density than the high temperature phase.

I generally repeat the experiment two or three times so that students can have a better opportunity to see the effect.

Safety Precautions

1. The electrical connections to the ends of the wire should be insulated so the conductors can’t touch the lab stands that support the wire.
2. The experimenter should wear protective goggles in case the wire melts and globs of molten iron are scattered about.
3. Students watching the demonstration should be at least 3 metres from the hot wire.
4. Aluminum foil or some other metal should be on the table top in order to keep the table top from being burned in case the wire melts and breaks.

Acknowledgements

This demonstration is not original with me. I first saw it done in 1951 by Professor W.B. Pietenpol who was head of our Department of Physics for many years. Long after his death I published a description of his demonstration. (*American Journal of Physics*, Vol 13, December 1975, pgs. 545-547).

My thanks to Mike Thomasson who has maintained our physics demonstration equipment for many years.

Special Thanks

Let me offer my thanks to Ernie McFarland and to the OAPT for your kindness in hosting me and my daughter Carol at your meeting at McMaster University last spring. I appreciate the wonderful experience and thank all who were so very kind to me. I am very proud to be an honorary member of the OAPT.

Up Coming Conference

Opening Doors – Opening Minds

Ontario Association of Physics Teachers (OAPT)
34th Annual Conference 2012

When and where?

Opening Doors – Opening Minds will be held in **April 26 to 28, 2012** at Perimeter Institute for Theoretical Physics in Waterloo, Ontario, Canada.

Keynote Address

Neil Turok, Director, Perimeter Institute for Theoretical Physics

Opening Doors

- Why Study Physics? with Carolyn Burgess
  The Physics of the Nervous System with Dr. Deda Gillespie and Dr. Dan Goldreich
- Tour of the Institute for Quantum Computing with Martin Laforest
- Workshops for grades 6-10 science with John Atherton, Mike Newnham and Dr. Jason Harlow

Opening Minds

- Understanding the quantum world, the latest from the LHC and the earliest moments of the Big Bang with Perimeter Researchers Cliff Burgess, Lucien Hardy, Louis Leblond, and Michele Mosca
- Workshops exploring Physics Education Research with Chris Meyers, Glenn Wagner and Dave Doucette
- Unusual and fun connections with music, dance and drama with James Ball, Lisa Lim-Cole, Rolly Meisel

Thursday Night Barbeque, Wine & Cheese
Reduced rates for year 1-2 and pre-service teachers

Early Registration: $19.99 per night at University of Waterloo Residence

Residence Accommodation Sponsor

UNIVERSITY OF TORONTO The Edward S. Rogers Sr. Department of Electrical and Computer Engineering at the University of Toronto

Host Venue Sponsor PERIMETER PI INSTITUTE FOR THEORETICAL PHYSICS

Opening Doors – Opening Minds www.oapt.ca/conference/2012/

Don't Miss Out! It's Not Too Late! REGISTER TODAY!

Opening Doors - Opening Minds!

Neil Turok, Cliff Burgess, Lucien Hardy, Louis Leblond, Damian Pope and Richard Epp

OAPT Conference Schedule!

Thursday 26 April 2012

5:30 – 7:30 pm	Registration/BBQ at Bistro
7:30 - 7:40 pm	Welcome - Greg Dick and Roberta Tevlin
7:45 – 8:45 pm	Physics Speed Dating with PI Researchers
8:45 – 10:00 pm	Social

Friday 27 April 2012

8:45 – 8:55 am	Welcome - Roberta Tevlin, Greg Dick
8:55 – 10:15 am	**Keynote Address: Dr. Neil Turok**
10:15 - 10:45 am	Coffee break/vendors
10:45 - 12:00 pm	Session A Workshops
12:00 - 1:30 pm	Lunch
1:30 - 2:45 pm	Session B Workshops
2:45 - 3:00 pm	Coffee break/vendors
3:00 – 4:15 pm	Session C Workshops
4:15 – 4:30 pm	The Annual Great Giveaway (door prizes)
4:30 – 5:15 pm	**Special Address: Dr. Cliff Burgess**

Saturday 28 April 2012

9:00 - 10:15 am	Session D Workshops
10:15 - 10:30 am	Coffee break/vendors
10:30 - 12:15 am	Session E Extended Workshops
12:15 - 12:30 pm	Closing remarks in Theatre - Roberta Tevlin
12:30 – 1:30	Steering Committee Lunch: Heuthers

OAPT 2011 Conference Workshops and Speakers

Friday 27 April 2012

8:55– 10:15	**Keynote Address: Dr. Neil Turok** *"Magic that works"*					
Session A 10:45- 12:00 pm	**Dr. Lucien Hardy** *The Conceptual Challenges of Quantum Theory* **Bob Room**	**Martin Laforest** *Tour of the Institute of Quantum Computing* **Go to bus at 10:30 !!!**	**Dave Doucette** *Getting the H.O.T.S. for Brain Based Physics* **Sky Room**	**Lisa Lim-Cole** *Art, Drama and Candy in Physics* **Reflecting Lounge**	**Jason Harlow** *Grade 10: Optics* **Time Room**	**Chris Howes** *Differentiated Scientific Inquiry* **Elementary (gr 6 -8)** **Space Room**
Session B 1:30 - 2:45 pm	**Dr. Michele Mosca** *Quantum Computing* **Bob Room**	**Caroline Burgess** *Why Take Physics?* **Space Room**	**Dr. Richard Epp** *Revolutions in Science: Making Models in Science* **Sky Room**	**Dr. Micah Stickel** *Engineering With Electricity and Magnetism* **Time Room**	**Margaret Greenberg** *Grade 10: Biophysics Activities* **Reflecting Lounge**	**Marilyn Orszulik** *Creativity and Hands-On Learning* **Elementary (gr 6 -8)** **Alice Room**
Session C 3:00 – 4:15 pm	**Dr. Louis Leblond** *The Big Bang and the Biggest Things* **Bob Room**	**Dr. Deda Gillespie / Dr. Dan Goldreich** *The Physics of the Nervous System* **Time Room**	**Shawn Bullock** *Using the History of Physic to Teach … Physics* **Sky Room**	**Nadia Camara** *Minute To Win It* **Space Room**	**Greg Macdonald** *Grade 9: Beyond the Atom* **Reflecting Lounge**	**Mike Newnham** *Inquiry Learning with Smarter Science* **Elementary (gr 6 -8)** **Alice Room**
4:30-5:15	**Special Address: Dr. Cliff Burgess** *"Last Chance to be Wrong About the LHC"*					

Saturday 28 April 2012

Session D 9:00-10:15 am		**Glenn Wagner** *Physics Review: Teams, Games and Tournaments* **Sky Room**	**Rolly Meisel** *Music, Math and Physics* **Time Room**	**James Ball** *YouTube Physics* **Bob Room**	**Richard Taylor** *Can We Offer 12C Physics?* **Space Room**	**Graham Whisen** **Gotta Get Gizmo!** **Elementary (gr 6 -8)** **Alice Room**
Session E 10:30- 12:15 pm		**Damian Pope, Dave Fish** **Particle Physics** **Sky Room**	**Jim Hunt** **The Kitchener Anamorph: Creating Public Art with Math** **Bob Room**	**Ernie McFarland and Friends** *Best of Demo Corner* **Time Room**	**Chris Meyer** *Cooperative Group Physics – Experience the Difference!* **Alice Room**	**John Caranci** *The Frilly Bits* **Elementary (gr 6 -8)** **Space Room**
12:15–12:30	Closing Remarks: Roberta Tevlin **Theatre**					

Grade 11 Physics Contest 2012

OAPT PHYSICS CONTEST

Tuesday May 15, 2012
ABSOLUTELY FREE!!!

REGISTER TODAY!!!

This year's contest will feature:

- An UPDATED online contest system.
- No registration fee - the contest will be offered free-of-charge.
- Great prizes including DEEP scholarships.

CONTEST COORDINATORS / TEACHERS: Please follow the link, http://oapt.ece.utoronto.ca/, to register yourself and your school. If you already registered last year, you will not need to register again.

Your interested students will need to register on the website prior to the contest.

Prizes &Scholarships

ROGERS DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING UNIVERSITY of TORONTO

PERIMETER INSTITUTE FOR THEORETICAL PHYSICS

OAPT Newsletter

Summer 2012

The Prez Sez

by Roberta Tevlin
roberta@tevlin.ca

Record attendance at this year's conference at Perimeter Institute!

The conference was a huge success thanks to the effort and enthusiasm of all of those involved. We had to close off registration for the first time in the history of the OAPT. The 200 delegates at the conference represented nearly 80% of our membership, which is amazing.

The success of the conference is due to many people. We would like to recognize the contributions of:

- **The Perimeter Institute**: Try to imagine the conference without the building, the food, the technical support, the organizers (especially Marie), the northern travel subsidy, and of course, the speed dating of the researchers! PI was once again an incredibly generous host.
- **U of T Department of Electrical and Computing Engineering**: Once again they subsidized accommodation costs, allowing delegates to stay for just $19.99/night. This contributed to this year's record attendance and made more time for the important interactions that happen outside of the formal sessions.

Inside

Photo: Robert Prior

The Prez Sez (continued)

- **The Presenters**: We were very fortunate to have our two keynote speakers, Dr. Neil Turok and Dr. Cliff Burgess, and a remarkable lineup of workshop presenters. All of these people volunteered to share their expertise. The biggest complaint I heard from delegates was that they couldn't clone themselves and attend more than one session at a time. We will do our best to bring back the most popular presenters next year.
- **The OAPT Volunteer Team**: A small but dedicated team of volunteers handled registration, name tags, and other logistics. They introduced and thanked speakers, conducted and analyzed feedback surveys, and organized the extracurricular events..
- **The Delegates**: You are teachers who see value in equipping yourselves with the best ideas, principles and techniques to take back to your classrooms.

Volunteers welcome!

Your enthusiasm was infectious, your patience when things did not go smoothly was appreciated, and your feedback makes it all worthwhile.

Next year's conference will be at the University of Ontario Institute of Technology (OUIT) in Oshawa. Lisa Lim-Cole and Shawn Bullock are our new vice-presidents and will be organizing the UOIT conference. They are looking for volunteers! If you would like to be involved in helping the OAPT support physics teachers just drop me a line. I can find a task that suits your interests, abilities and time.

Snapshots from the conference…

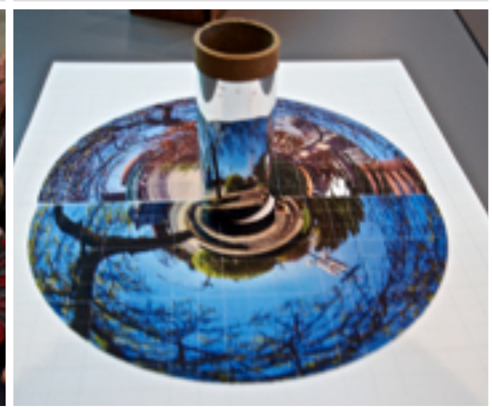
Tour of Perimeter Institute. These well-lit collaboration areas are liberally supplied with markers. Here, you’re expected to write on the walls.

Dr. Cliff Burgess, showing us what CERN is really like. Hint: a certain famous author got it very wrong…

Dr. Lucien Hardy valiantly explaining wave-particle duality, Heisenberg, many worlds, and other conundrums of modern physics.

Greg Dick, in his best cheesy voice, introducing the participants in the Physics Speed Dating event.

Physics Speed Dating. Fast, furious, and way more fun than the other speed dating.



The Kitchener Anamorph, a sculpture designed by Dr. Jim Hunt, and a really cool example of the intersection between art and science.

More photos…

You can find more pictures of the conference at these websites.

OAPT

Robert Prior


Photo: Robert Prior

After two years of administrative purgatory as OAPT president, Dave was looking relaxed and happy to be back in the saddle as a teacher of teachers.

Waves & Sound with Dave Doucette

by Tim Langford

Officially this session was called “Getting the HOTS* for Brain-Based Learning”. Dave, coming off two years of administrative purgatory as OAPT president, was looking relaxed and happy to be back in the saddle as a teacher of teachers.

Memories that stand out from being in Dave’s presence on this day:

Entry cards. This is Dave’s reversal of the strategy of “exit cards”, which he says never worked for him. His “entry cards” are sheets of four multiple choice questions.** (Perhaps he would have only two questions per card for the students: I found these questions a little tricky!) He says that he used to post the answers to them, but one day he didn’t have time and said to his class, “Just compare answers with someone nearby who is also finished.” A new strategy was born, one that creates more discussion and arguments, and thus more learning.

A lonnnnng pause by Dave. “Don’t talk while the students are talking,” advises Dave. This is perhaps a reversal of what most of us would say to our students. (“Don’t talk while the teacher is talking.”) Dave says he will just wait, sometimes for ten minutes at a time, until the students are quiet. (I have been skeptical when I’ve heard master teachers say this before). Somehow when Dave says this I believe it.

Hands on, minds on. Dave has four student stations set up, each with a “cool” self-guided demonstration of sound. Three of them use a technology that students can readily identify: a stereo speaker. One uses a laptop and software. All four have simple instructions and two questions that require the students to think about what is happening. It is a true marriage of theory and practice and a true test of understanding.

Textbook treatment of air columns. Dave laments how poorly most high school textbooks explain resonance inside a tube. “For one thing,” he says, “they lead you to believe that the tube is resonating, when it is actually the air inside it that is.” His second complaint is that many textbooks have the positions and effects of nodes and antinodes reversed when it comes to air. “The node is the point of highest air pressure,” he says. Dave went on to explain why exactly the open end of a column causes reflection. This is rather counter-intuitive. WHAT IS YOUR EXPLANATION?

* Higher Order Thinking Skills

** Dave’s multiple choice questions came from PhysicsLab Online: http://dev.physicslab.org

Download materials from the workshops

Revolutions in Science with Dr. Richard Epp

by Sandy Evans

How much time do we spend with our students discussing the force of gravity? Do we ever suggest to them that it is not really a force? Many of us have had the experience of attempting to model the fabric of space-time to our students with a stretchy piece of fabric. We spread out the fabric, indent the middle to simulate a large mass warping it, and roll balls around it to model the effect of gravity on an orbiting object. It wasn't until attending Dr. Richard Epp's session at this year's conference that I thought of simulating the effects of gravity and space-time with a beach ball!

We teach our students about apparent weight and how accelerating upwards in an elevator will increase the normal force. Dr. Epp urges us to extend this concept to ponder that perhaps the "force of gravity" we feel is not really a force but instead is the ground accelerating us upward with magnitude a = g. This is Einstein's Equivalence Principle. Many students will ask, "If that is so, then why is the Earth not expanding outwards?"

Dr. Epp was able to clearly explain this through the use of a beach ball simulating space-time. We usually teach that projectiles will follow a parabolic trajectory due to the force of gravity. However, Dr. Epp showed that a projectile follows a straight path in curved space-time! He described how acceleration warps time and how gravity is really a warping of space-time. He discussed the concept of considering our motion through not only space but through time by considering velocity in four-dimensional space-time. Through Dr. Epp's workshop and a beach ball, we accelerated our knowledge and ability to teach the concepts of General Relativity.

Download materials from the workshops

Photo: Éole Wind

It is crucial that students learn that there are no new laws for circular motion.

Fixing Our Physics: Circular Motion

by Chris Meyer
York Mills Collegiate Institute, Toronto

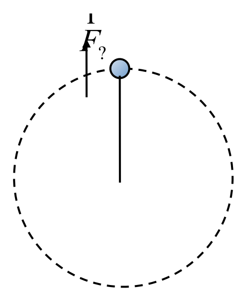
christopher.meyer@tdsb.on.ca

Ah, circular motion – I get dizzy just thinking about it. Everybody is doing it (even sometimes the LHC), but who understands it? This is a challenging topic for all of us. Fortunately, physics education research (PER) has many insights to offer us on matters topical as well as pedagogical. What does PER have to say about how to teach circular motion? Let's find out. For no extra charge I will throw in my own two cents' worth

A main goal of reformed physics teaching is the development of deep conceptual understanding within a robust interconnected framework. New ideas should not only "make sense"; they should be well connected to prior concepts and ideas. This is the antidote to rote algorithmic learning and disjointed knowledge. (I always say, "A little compartmentalized learning is a dangerous thing!") This goal can be realized through the careful exploration of the two aspects of circular motion: force and acceleration - cause and effect.

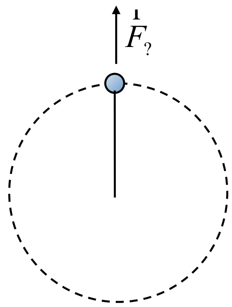
Curious Forces in Circular Motion

There are two persistent ideas that many students have regarding uniform circular motion: (1) that there must be a forward (tangential) force that keeps the object moving in a circle; and (2) there must be an outwards force keeping it from falling inwards. These ideas can very happily coexist in the fertile student mind along with the teacher-approved notion of a radially inward net force. For novice physics students all three possibilities may seem plausible and may not seem mutually exclusive. Only after repeated and explicit examination, followed up by careful reinforcement long after the circular motion unit is finished, will the misconceptions wither away.



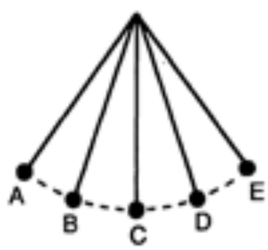
The appeal of a forwards force can stem from insecurity with Newton's 1st law in the context of two-dimensional motion. The idea that an external force is not required for an object to maintain a constant speed is strange enough. To compound things, physics suffers from very rich laws whose many consequences are not well unpacked for students. Mathematicians have theorems and their theorems' offspring: lemmas. We need these for physics! For example, Newton's 2nd Law should have a lemma, which I affectionately call the Orthogonality Principle, stating that "a net force in one direction does not affect the speed in a perpendicular direction." Obvious, right? Not for most students. This is a fundamental feature of the 2nd law that lies at the heart of understanding circular motion. Its earlier introduction when studying projectile motion can greatly help dispel the "forwards force" notion. Another useful lemma students should develop while exploring circular motion is "a force parallel to an object's direction of motion only changes its speed; a force perpendicular to its motion only changes its direction." Both lemmas are helpful ways of capturing the nuances of Newton's laws applied to two-dimensional motion.

The Outwards Force



The allure of an outwards force in circular motion is very great and surprisingly persistent (even amongst a number of teachers I have workshopped). We only have ourselves to blame for this, and by "ourselves" I mean our physical selves: when we travel in a circle we feel an outwards effect of some kind. It takes careful work to reinterpret this valuable observation. This work is a process that should begin long before the topic of circular motion is reached. The physical sensation of acceleration needs to be made sense of early on in the context of linear acceleration. The goal is the understanding that when accelerating due to any force other than gravity, our physical sensation is that of being pushed in a direction opposite to our acceleration. For example, we feel pressed into the seat of a car that is speeding up. This provides students with a familiar tool to help understand the sensation of being pushed outwards without having to conjure up an outwards force.

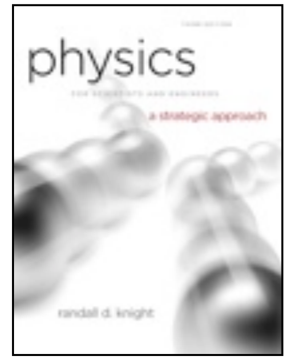
Especially in the case of an object being whirled on a string, another rationale students often invoke for the existence of an outwards force is the need to prevent the object from traveling directly inwards to the centre of the circular path. Another still is their attempt to explain why there is any tension in the string at all! These proposals need to be met with a careful kinematic exploration of circular motion. I find this is easiest in the context of orbits and the recognition of the need for orbital speed. Another valuable example is a rollercoaster loop with an unattached car upside-down at the top. The car could in fact fall straight down, but with a suitable tangential speed, it moves far enough forward while it "falls" that it remains in contact with the track.



A telling example of the challenges of understanding circular motion comes from a study by Sue Allen and Frederick Reif in which the researchers pose to a group of students and physics professors from UC Berkeley a simple question: What is the direction of the acceleration of a pendulum bob as it speeds up and reaches point C in the diagram to the right? Only 3 out of 5 of the veteran professors answered correctly, even when prompted to clarify their responses. Indeed, the matter of forces in circular motion can be very thorny. (What is the correct answer?)

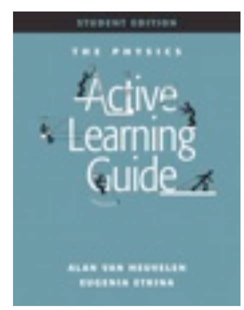
Unity and Diversity

One of the great things about physics is that a small number of ideas have the power to explain so many different things. Physicists toil to reduce the number of necessary ideas. It's kind of an obsession. Teachers do a bad, bad thing when we needlessly increase that number. This brings me to a dirty trick we pull on our students. By this point in their studies, students already have a name for the idea "the combined effect of all the forces in one direction" – known as the net force in, let's say, the radial direction. But then when circular motion comes along, we introduce this new thing "F_c" and our attempts at building a deep, robust understanding of circular motion lurches to a halt.



I am quite pleased to note that in Randall Knight's new textbook, which is deeply infused with physics education research, the mischievous Fc never appears. There are a number of very good reasons for never using this symbol or introducing an equation like $F_c = mv^2/r$. The main reason is that there is a perfectly good idea, $F_{net} = ma$, which really has this circular motion business well covered. Besides, you would never introduce a "handy" equation like $F_{net} = m(v_2-v_1)/\Delta t$, owing to your confidence in your students' ability to find a strategy to determine the acceleration. So why sell them short with circular motion? If students don't begin their thinking about circular motion with $F_{net} = ma$ they are not making vital reinforcements between prior understanding and this challenging new topic. It is crucial that students learn that there are no new laws for circular motion. Even if you introduce the centripetal force equation as a convenient short cut, students will memorize it, and in doing so will cut short their thinking (which is bad).

> *"One of the great things about physics is that a small number of ideas have the power to explain so many different things.… Teachers do a bad, bad thing when we needlessly increase that number.*

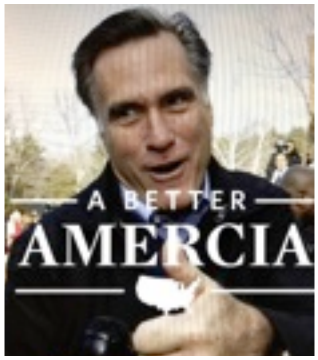


The Physics Union Mathematics program developed by Eugenia Etkina and Alan van Heuvelen at Rutgers University does a great job of emphasizing the deep connection between the kinematic and dynamic pictures of circular motion. If you email Professor Etkina you may receive a password to the website which has an astounding set of PER informed physics units. My own treatment of circular motion draws heavily upon their work. They take great pains to highlight how a velocity vector analysis of circular motion (acceleration points to the centre) agrees with a force diagram analysis (net force points to the centre) courtesy of, you guessed it, Newton's second law. These are not obvious results to be glossed over; they are pillars of a deeper understanding.

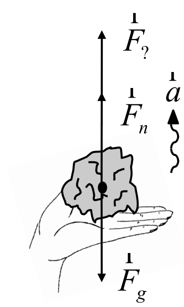
> *It is crucial that students learn that there are no new laws for circular motion.*

The Many Problems with F_c

I have other concerns with the gormless F_c. Textbook authors don't really seem to use it and its namesake, the "centripetal force", honestly. The adjective "centripetal" is a valuable label when describing a familiar force that has a component responsible for keeping an object moving in a circle (my definition). For example: "When Mitt Romney makes a 180° turn in policy, political expediency is the centripetal force". Traditional texts define the centripetal force as $F_c \equiv F_{net}$, which is a problem for non-uniform circular motion. But even if we understand that they really mean the radial component of the net force, authors seldom use it this way in their descriptions; they tend to describe single, inward forces as the centripetal force. Furthermore, this term and its notation seem to be no more than an affectation of high school and introductory physics texts. In more advanced studies the term is abandoned and central forces are described or angular motion and moments are used.



Unfortunately, students are often quite relieved when you provide them with a new force, F_c. Perhaps it provides a convenient scapegoat on which to blame the mystery of circular motion. Just as novice physics students will often invent a mysterious new force to explain the upward acceleration of a held object (see the FBD to the right), they are happy to have a brand new force to explain the peculiarities of circular motion. Perhaps you have noticed how F_c tends to appear in free-body diagrams in curious locations or in the place of other, reasonable forces. They will stop thinking carefully about how friction might be keeping the car going around the corner. Why should they: it's the F_c that's responsible! Other times the F_c appearing in their FBDs corresponds to no known physical interaction. But what can we expect: neither does their physical experience of circular motion! (The outward force, that is.)



Multiple Representations

Learning to represent the physics of a situation in a wide variety of ways is another key to developing a robust, well-connected understanding. Those in the know call this "multiple representations". Depending on the topic, there are a variety of possible representations. Shown below is an example for circular motion. A great exercise is to provide one or two of these representations and have students devise the others. This often involves quite a bit of good old know-how and also some amusing creativity!

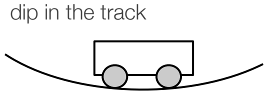
Chris's Razor: "If it's not necessary, don't teach it". Please, dispense with Fc.

Implementation and Invitation

All of the ideas discussed here can be used with any mode of classroom teaching: old-fashioned lecture or new-fangled group work (my modus operandi). But to be sure, your students will get more out of their experience the more they explain their own ideas to one another. I teach circular motion over five (yes, five!) classes using a variety of investigations and activities. Don't mess around: if you're going to do it, do it well. Follow this link to my website where you can explore my circular motion lessons and syllabus, amongst the other materials for my course. Finally, I re-issue my standing invitation: the door to my classroom is always open. Just email me if you would like to drop by and see a lecture-free, reformed physics class in action.

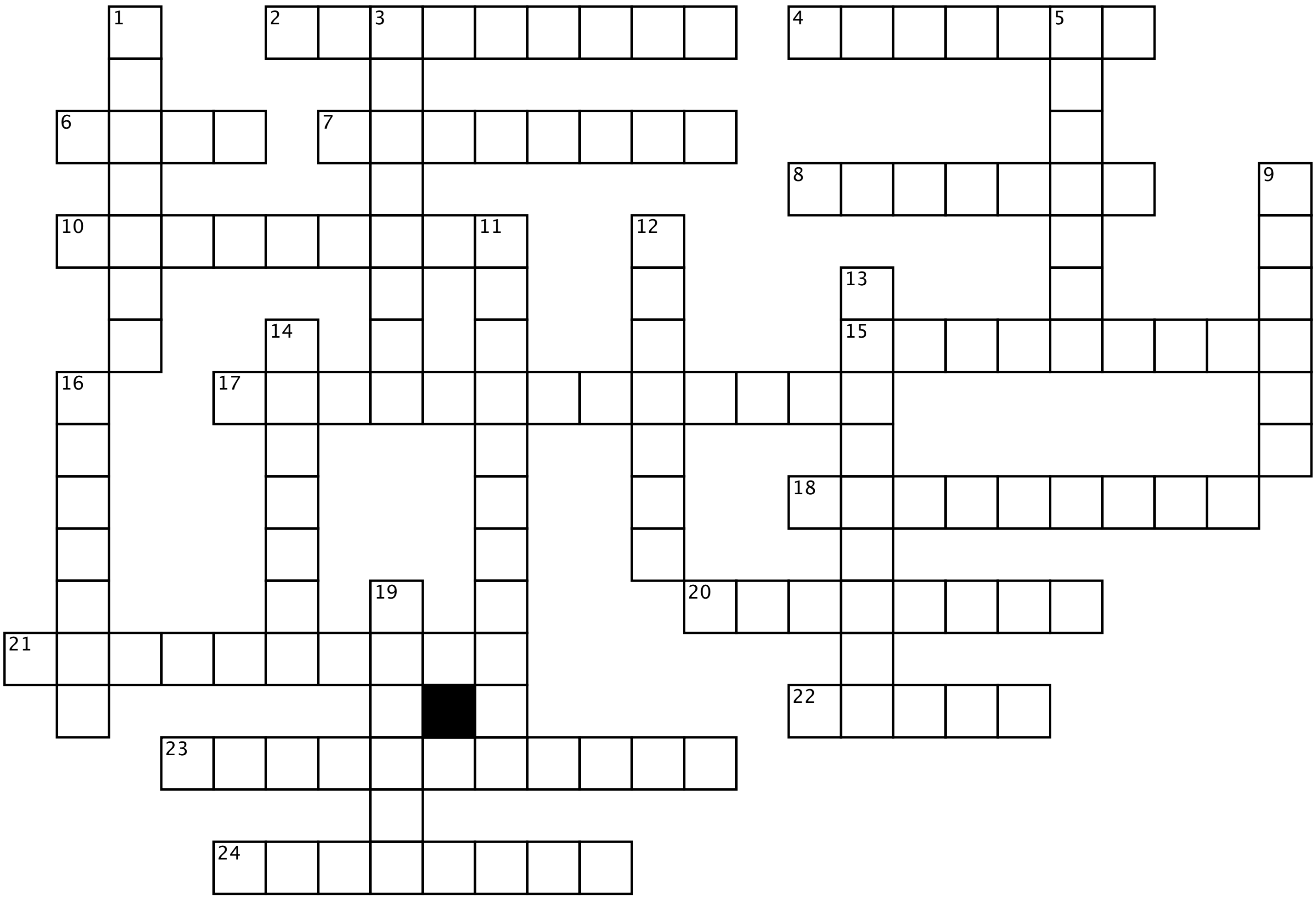
Executive Summary for Teaching Uniform Circular Motion:

- Use the terms radial and tangential whenever possible ($a_r = v^2/r$, $F_{net\,t} = 0$)
- Only use the term "centripetal" as an adjective for familiar inward forces
- Always start problems with $F_{net} = ma$; banish F_c
- Reinforce agreement between the kinematic picture and force picture
- Use multiple representations
- Provide activities that motivate the presence of an inward net force and that help refute the existence of forward or outward forces
- Help students explain why the object doesn't travel towards the centre of the circle and why we feel an outward force
- Create a lemma. Name it after yourself! "Parallel forces change speed. Perpendicular forces change direction."
- Make sure students' understanding will generalize easily to non-uniform circular motion

Words and Sketch	Velocity Vectors	Force Diagram	Newton's 2^nd^ Law	Sample Solution
A roller coaster car moves along a frictionless circular dip in the track 			$F_{net} = ma_r$ $F_n - F_g = mv^2/r$	$F_n - F_g = mv^2/r$ $F_n - (350\ kg)(9.8\ N/kg) = (350\ kg)(12\ m/s)^2/(7.8\ m)$

Phamous Physicists

Physics history. How well do you know it? Some of these physicists are famous, others are less well-known, but all have entries on Wikipedia.



Across

2. Has his own radiation
4. Bongo drummer
6. Also a high-quality speaker
7. Much bigger than his name
8. Excellent experimentalist, famous lecturer, but couldn't do trigonometry
10. Don't put before the horse
15. Limited stellar brightness
17. Stellar physicist
18. Threaded fasteners; male human
20. Scattering, but not bicycles
21. Knew where he was, or where he was going, but not both
22. Predicted the opposite of uncle-father
23. Heliocentric
24. "Of what use is a newborn baby?"

Down

1. Terracentric
3. The genetic physicist
5. On reflection, not as mad as he appeared...
9. Board
11. Not really a cat hater...
12. Famous contraction 13. Engineers' pub
14. Liked raisin buns
16. A big rock did it
19. The last alchemist

Ontario Association of Physics Teachers

An Affiliate of the A.A.P.T, and a charitable organization

New Materials on the Website

The OAPT website is fast becoming a must-go zone to get the best materials for your physics classes and physics-based units in intermediate science!

Due to be launched in September:

- A database of all the OAPT Contest questions since the contest's inception
- A database of all Demo Corner articles since the newsletter's inception

In development:

- A "DemoTube" database of short videos showing how to perform demonstrations and how to implement best practices in the physics or science classroom.

Stay posted. If you are interested in helping with this time-consuming project please email "The Prez": Roberta@tevlin.ca

Call for Articles

Have you or has a colleague of yours done something progressive or interesting with your physics teaching recently? Or perhaps you have the wisdom of many years of experience in teaching this difficult subject.Perhaps you teach Ontario's northland or in a rural area and have a different perspective or unique experiences to relate.

Share your experiences! Write a brief (~400 word) article for the Newsletter and send it to:

newsletter_editor_8@oapt.ca

Olga Michalopoulos honoured with the 2012 CAP Award

Olga Michalopoulos of Georgetown District High School in the Halton District School Board has been named by the Canadian Association of Physicists as the winner of the 2012 CAP Award for Excellence in Teaching High School/CEGEP Physics in Ontario. "I am humbled and deeply honoured," says Michalopoulos. "I have always been passionate about physics. I have also been fortunate and privileged to work with many outstanding colleagues who have continued to support me and help me grow as an educator. I thank them all. Most importantly, I want to thank my students for continuing to inspire me over the years and allowing me to touch the future."

The CAP Award for Excellence in Teaching High School/CEGEP Physics, which was introduced in 2010, is intended to recognize excellence in teaching physics in Canadian high schools or CEGEPs and to encourage and promote physics at the high school/CEGEP level in Canada. The award is sponsored at the national level by the CAP, TRIUMF, Merlan Scientific, Perimeter Institute, Institute of Particle Physics, Nelson Education, and Vernier, and at the regional level by the BC Innovation Council and the Association of Professional Engineers and Geoscientists of BC. The award honours physics teachers in Canadian high schools or CEGEPs who have a good understanding of their subject and who possess an exceptional ability to communicate their knowledge and understanding in such a way as to motivate their students to high academic achievement in physics.

See all the award winners on the Canadian Association of Physicists website:

- http://www.cap.ca/medal/publicity/recipients.php?year=2012&type=hs&lang=en

OAPT's 4th Annual Camp OTF

July 24 – 26 Carleton University, Ottawa

Looking for a phabulous professional development opportunity this summer? Don't miss this *justaboutfree* camp for physics teachers of grades 9 -12. For a paltry $100, you get:

- twelve hands-on workshops,
- two nights of accommodation,
- three full breakfasts, lunches and coffee breaks, and
- over $100 in teaching materials.

Our stellar lineup of presenters includes three past/present OAPT presidents: Glenn Wagner, Dave Doucette and Roberta Tevlin. Join their campfire while honing skills in building a research-based, conceptual physics program using differentiated instruction, inquiry-based learning, role playing, and dollar-store equipment to increase student understanding and physics enrolment. If you liked the conference, you'll simply love camping! It is easily the richest professional development program OAPT has offered.

Each year this camp has sold out, so **register now**! **Registration closes July 8th**.

For detailed information on the workshop sessions, go to our website at http://www.oapt.ca/ and click on 'The 4th Annual Physics Camp 2012'.