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

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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 = _____

1992-93 OAPT Section Executive

Past President
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Dept. of Math, Physics,
and Computer Science,
Ryerson Polytechnic U.,
350 Victoria St.,
Toronto, ON, M5B 2K3
416-979-5000 ext. 6961

President
David Marshall
Physics Department,
Trent University,
Peterborough, ON, K9J 7B8
705-748-1461

Vice-president
Greg Marshall
Rideau High School
815 St. Laurent Blvd.
Ottawa, ON, K1K 3A7
613-746-8196
fax: 613-746-7834

Secretary/Treasurer
John Wylie
The Toronto French School,
306 Lawrence Ave. East,
Toronto, Ontario,
Canada, M4N 1T7
416-484-6533 ext. 249

Newsletter Editor
Paul Laxon
Central Elgin C.I.
201 Chestnut St.,
St. Thomas, ON, N5R 2B5
519-631-4460
fax: 519-633-9014

Membership
Ernie McFarland
Dept. of Physics,
University of Guelph,
Guelph, ON, N1G 2W1
519-824-4120

Member-at-large
Alan Hirsch
2199 Parker Dr.,
Mississauga, ON, L5B 1W3
905-897-5546

Section Representative
Bill Konrad
Chatham Kent S.S.,
285 McNaughton Ave. East,
Chatham, ON, N7L 2G7
519-352-2870

Prize Exam Coordinators
Dave McKay & Bill Prior
3027 Balmorrow
Burlington, ON, L7N 1E3
705-634-8256

...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.

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

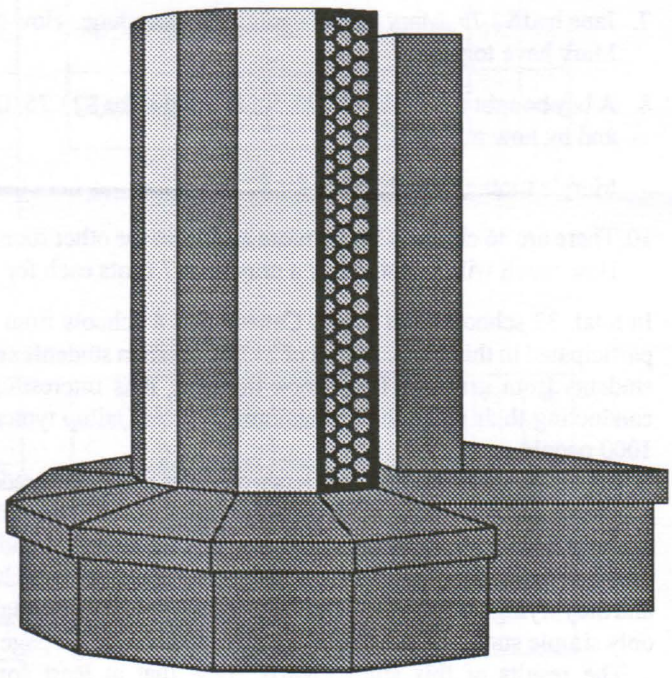
Renewal ☐ **Change of Address** ☐

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



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 each 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 improve-

ment 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

	Question # / Percentage INCORRECT									
GRADE <# STUDENT> [AVG. SCORE]	**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

	Question # / Percentage INCORRECT									
GRADE <# STUDENT> [AVG. SCORE]	**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.