Differentiated Science Inquiry

Facilitated By:

Christopher Howes
Science/Technology Facilitator
Durham District School Board

Agenda

Minds on:

- Welcome/Inclusion Activity
  - Goals of science
  - What is inquiry?
  - "Opening up" inquiry
  - PEOE Activity
  - Smarter Science Frame work

Action:

  - Investigate different inquiry structures
  - Construct Inquiry activity

Consolidation:

- Planning Next Steps

Goals of Science:

1. to relate science and technology to society and the environment
2. to develop the skills, strategies, and habits of mind required for scientific inquiry and technological problem solving
3. to understand the basic concepts of science and technology.

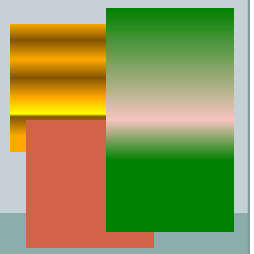
Why Differentiate?

- Student choice shown to be the most consistent way to increase student engagement and motivation
- Start where “students are”
- Take all students to highest level of inquiry possible
- Higher levels of student success

Session Learning Goals

By the end of this session participants will:

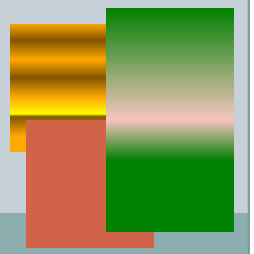
- be able to demonstrate an understanding of what various types of inquiry based learning look like in a science class
- Become familiar with the use of PEOE activities
- become familiar with the Smarter Science framework



Session Success Criteria

By the end of this session, we know we will be successful when we can:

- ✓ Identify & begin implementation of differentiated science inquiry in our programming;
- ✓ Demonstrate an awareness of the smarter science framework and the use of PEOE activities



Norms

- Take care of yourself and your neighbour
- Be an active listener
- Be open to new ideas and revisiting old ones

- Be reflective & a **synthesizer** of ideas - *How can the ideas be applied in my classroom?*

Signals for coming together:

- Hand & Voice

Imagine a world where…

In elementary school Children could:

Sit in a car seat and be driven in a car by a parent.

In high school students could:

Sit in the back of a car and ask a parent to drive to soccer practice.

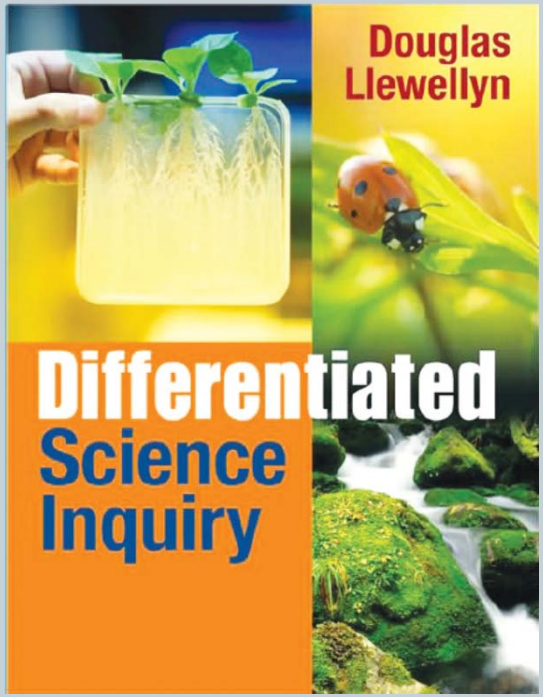
In University students could:

Practice driving a car only when told where and how to drive by a parent.

Only in graduate school could a student drive a car by himself/herself were ever he/she wants.

Differentiated Science Inquiry

By Douglas Llewellyn



Action: Types of Scientific Inquiry (pg. 11-22)

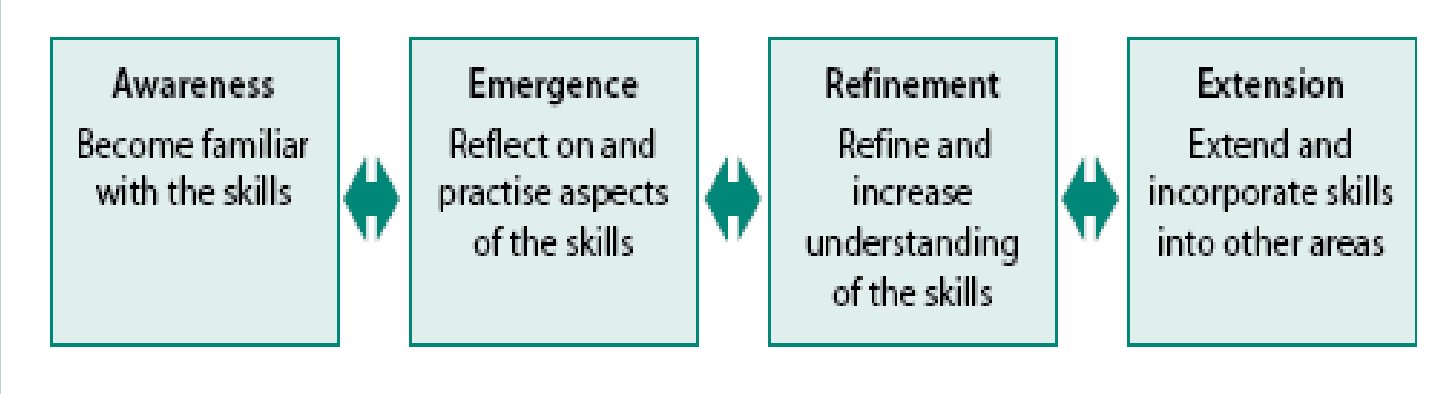
- Demonstration
- Structured inquiry (not just a cookbook lab!)
- Guided inquiry (teacher initiated)
- Open inquiry (student initiated)

Types of Inquiry

	Demonstrated Inquiry	Structured Inquiry	Guided Inquiry	Self-directed (Open) Inquiry
Posing the Question	Teacher	Teacher	Teacher	Student
Planning the Procedure	Teacher	Teacher	Student	Student
Formulating the Results	Teacher	Student	Student	Student

Inquiry and Research

- Students practice skills more fully and independently and in increasingly demanding contexts.



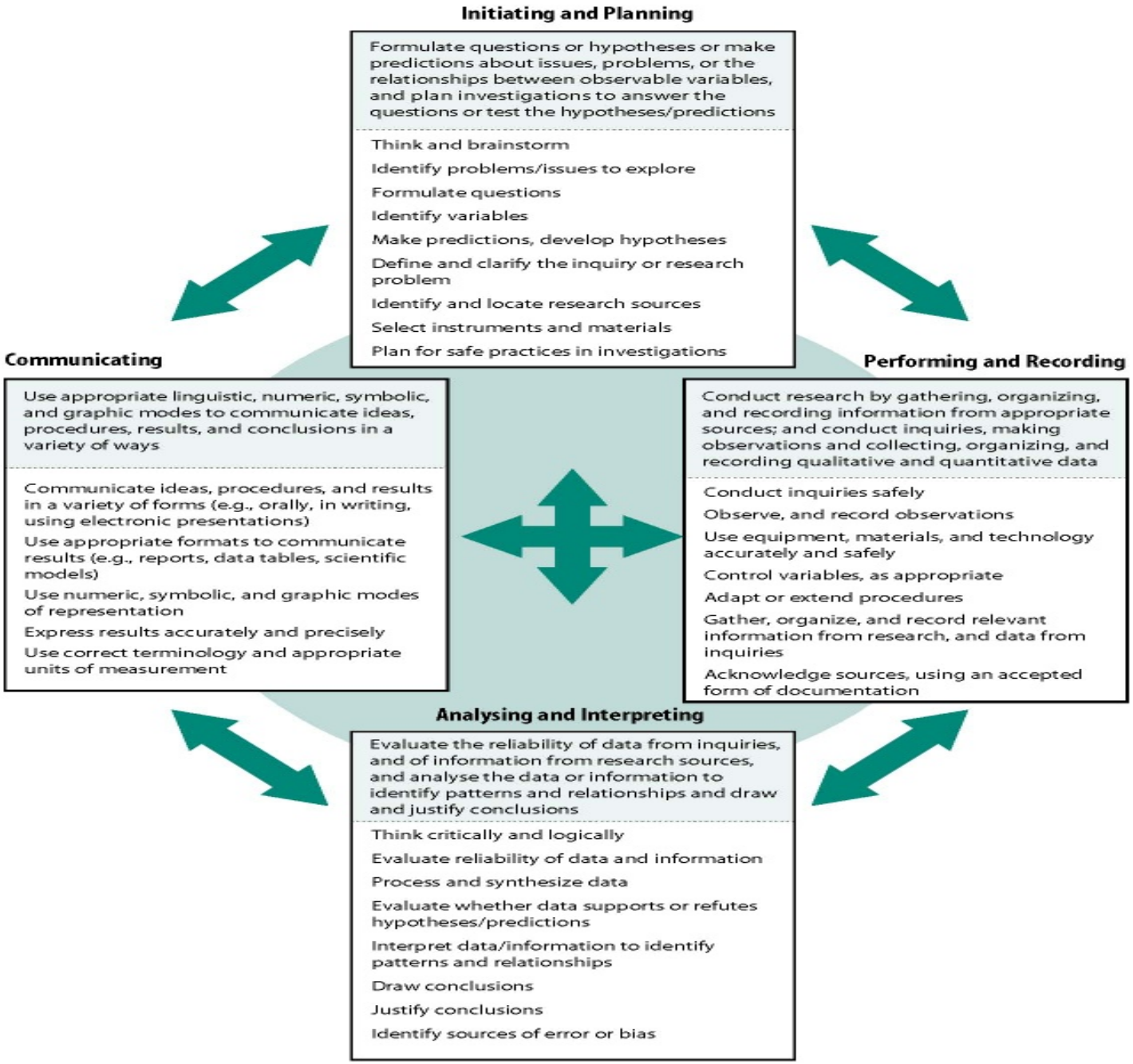
CONTINUUM FOR SCIENTIFIC INQUIRY/EXPERIMENTATION SKILLS

Beginning →	Exploring →	Emerging →	Competent →	Proficient
Initiating and Planning				
The student:				
asks questions that demonstrate curiosity about the world around him or her	asks questions that can be answered through tests/experimentation, and chooses one to investigate	asks questions that can be answered through tests/experimentation, and formulates a specific question to investigate	asks questions that arise from practical problems and issues, and formulates a specific question to investigate	
with support, follows the steps in a simple, teacher-prepared procedure for a test/experiment	follows the steps in a simple, teacher-prepared procedure for a test/experiment	creates, from a variety of possible methods, a plan to find an answer to the question he or she has formulated	plans for safe experimentation, showing some awareness of variables to be considered	
recognizes when a test is fair or unfair	recognizes when a test is fair or unfair	with support, builds fair testing elements into plans for an experimental procedure designed to answer the question he or she has formulated	builds fair testing elements into plans for an experimental procedure designed to answer the question he or she has formulated	
makes "guesses" about possible outcomes of simple procedures	with support, makes simple predictions about the outcome of the procedure prepared by the teacher	makes predictions, based on personal experience, about the results of the investigation	makes predictions, based on prior knowledge from explorations and investigations, about the results of the investigation	
Performing and Recording				
The student:				
safely uses teacher-selected tools and equipment to extend the senses for observation	selects, with support, and safely uses tools and equipment to extend the senses for observation	selects and safely uses tools and equipment to observe and measure	selects and safely uses tools and equipment to observe and measure	
records data orally, in pictures, in written words, and/or in tally charts	records data orally, in pictures, and/or in written words or sentences	records and organizes data using standard measurements, sentences, lists, and/or simple labelled diagrams	records and organizes data using standard measurements in simple tables, graphs, or charts, or in labelled diagrams	

Demonstration

- Discrepant event
- Attention grabbing observation
- Counterintuitive
- Diagnostic, misconceptions (assessment for learning)
- POE (PEOE)

Interactions Among the Four Broad Areas of Skills



Structured Inquiry

- Not just a cookbook lab!
- Douglas Llewelyn says…
- “the distinction between structured inquiries and cookbook labs is that with structured inquiries the student assumes more responsibility for determining how to collect and organize his or her data”
- Student:
- ~~Initiate and plan~~
- Perform and record
- Analyse and interpret
- Communicate

Guided inquiry

- Teacher: poses question or problem
- Suggests materials
- Student:
- ~~Initiate~~ and plan
- Perform and record
- Analyse and interpret
- Communicate

Open inquiry

- Student initiated
- Student:
- Initiate and plan
- Perform and record
- Analyse and interpret
- Communicate

So…

How do we get from here…

To there?

Douglas Llewelyn says...

- “Teachers... take into account the prior experience their students have in scientific inquiry”
- “For some classes, it may necessitate a gradual transition”
- “This, of course, is a very natural scaffolding process in learning science through inquiry”


Rolling Spheres

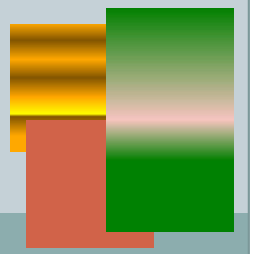
Ramp and Marble Lab:
A Differentiated Science Inquiry Lesson (pg. 31-40)

Problem: How does the height of an inclined plane affect the distance a marble will travel?

Thinking About Our Learning

- What did you notice during the stations? (Engagement, Communication etc.)

- Differentiating an inquiry lesson requires solid content and planning. What suggestions could you make to a new teacher who wants to attempt a DSI lesson?



Activity #2 (pg. 87-90)

Opening up the DSI Plant Growth **Zombie** Lab

Consolidation
How do I "Open up" an Inquiry Lab

- Consider the lab entitled "DSI Plant Growth Lab"
- How could you modify this lab to make it more open?
- How could you structure this lab to make it a guided inquiry activity?
- Could you make this an open inquiry Lab?

Smarter Science Framework

smarter science éduca sciences

Steps to Inquiry

Initiate & Plan

Step 1: Observing & Questioning

What did I observe?

(What do you notice about the object or event? Use your senses to describe the object or event.)

This is the control.

What am I wondering?

(What questions or predictions do you have about the object or event?)

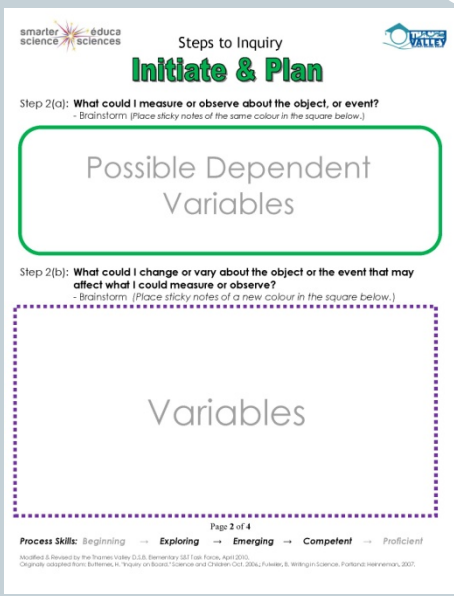
How can the questions be answered? (Question Sort)

Labelled diagram:

Page 1 of 4

Process Skills: Beginning → Exploring → Emerging → Competent → Proficient

Modified & Revised by the Thames Valley D.S.B. Elementary S&T Task Force, April 2010.
Originally adapted from: Buttemer, K. "Inquiry on Board." Science and Children Oct. 2006.; Fulwiler, B. Writing in Science. Portland: Heinneman, 2007.



smarter science éduca sciences

Steps to Inquiry

Initiate & Plan

Step 2(a): **What could I measure or observe about the object, or event?**
- Brainstorm *(Place sticky notes of the same colour in the square below.)*

Possible Dependent Variables

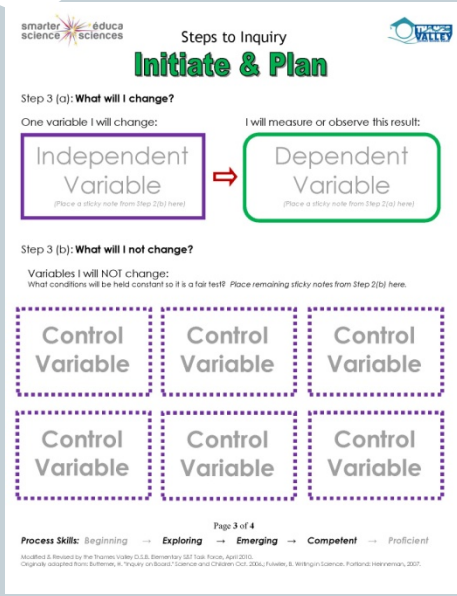
Step 2(b): **What could I change or vary about the object or the event that may affect what I could measure or observe?**
- Brainstorm *(Place sticky notes of a new colour in the square below.)*

Variables

Page 2 of 4

Process Skills: Beginning → Exploring → Emerging → Competent → Proficient

Modified & Revised by the Thames Valley D.S.B. Elementary S&T Task Force, April 2010.
Originally adapted from: Buttemer, K. "Inquiry on Board." Science and Children Oct. 2006.; Fulwiler, B. Writing in Science. Portland: Heinneman, 2007.



smarter science éduca sciences

Steps to Inquiry

Initiate & Plan

Step 3 (a): **What will I change?**

One variable I will change: Independent Variable *(Place a sticky note from Step 2(b) here)*

I will measure or observe this result: Dependent Variable *(Place a sticky note from Step 2(a) here)*

Step 3 (b): **What will I not change?**

Variables I will NOT change:
What conditions will be held constant so it is a fair test? *Place remaining sticky notes from Step 2(b) here.*

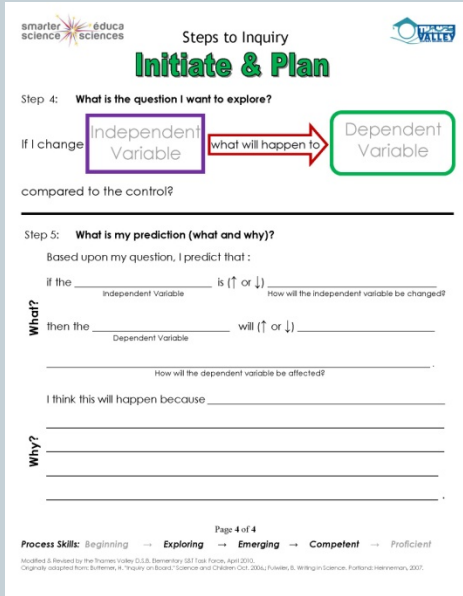
Control Variable | Control Variable | Control Variable

Control Variable | Control Variable | Control Variable

Page 3 of 4

Process Skills: Beginning → Exploring → Emerging → Competent → Proficient

Modified & Revised by the Thames Valley D.S.B. Elementary S&T Task Force, April 2010.
Originally adapted from: Buttemer, K. "Inquiry on Board." Science and Children Oct. 2006.; Fulwiler, B. Writing in Science. Portland: Heinneman, 2007.



smarter science éduca sciences

Steps to Inquiry

Initiate & Plan

Step 4: **What is the question I want to explore?**

If I change Independent Variable what will happen to Dependent Variable compared to the control?

Step 5: **What is my prediction (what and why)?**

Based upon my question, I predict that :

What?

if the _____ (Independent Variable) is (↑ or ↓) _____ (How will the independent variable be changed?)

then the _____ (Dependent Variable) will (↑ or ↓) _____

_____ (How will the dependent variable be affected?)

Why?

I think this will happen because _____

Page 4 of 4

Process Skills: Beginning → Exploring → Emerging → Competent → Proficient

Modified & Revised by the Thames Valley D.S.B. Elementary S&T Task Force, April 2010.
Originally adapted from: Buttemer, K. "Inquiry on Board." Science and Children Oct. 2006.; Fulwiler, B. Writing in Science. Portland: Heinneman, 2007.

Fishbone!

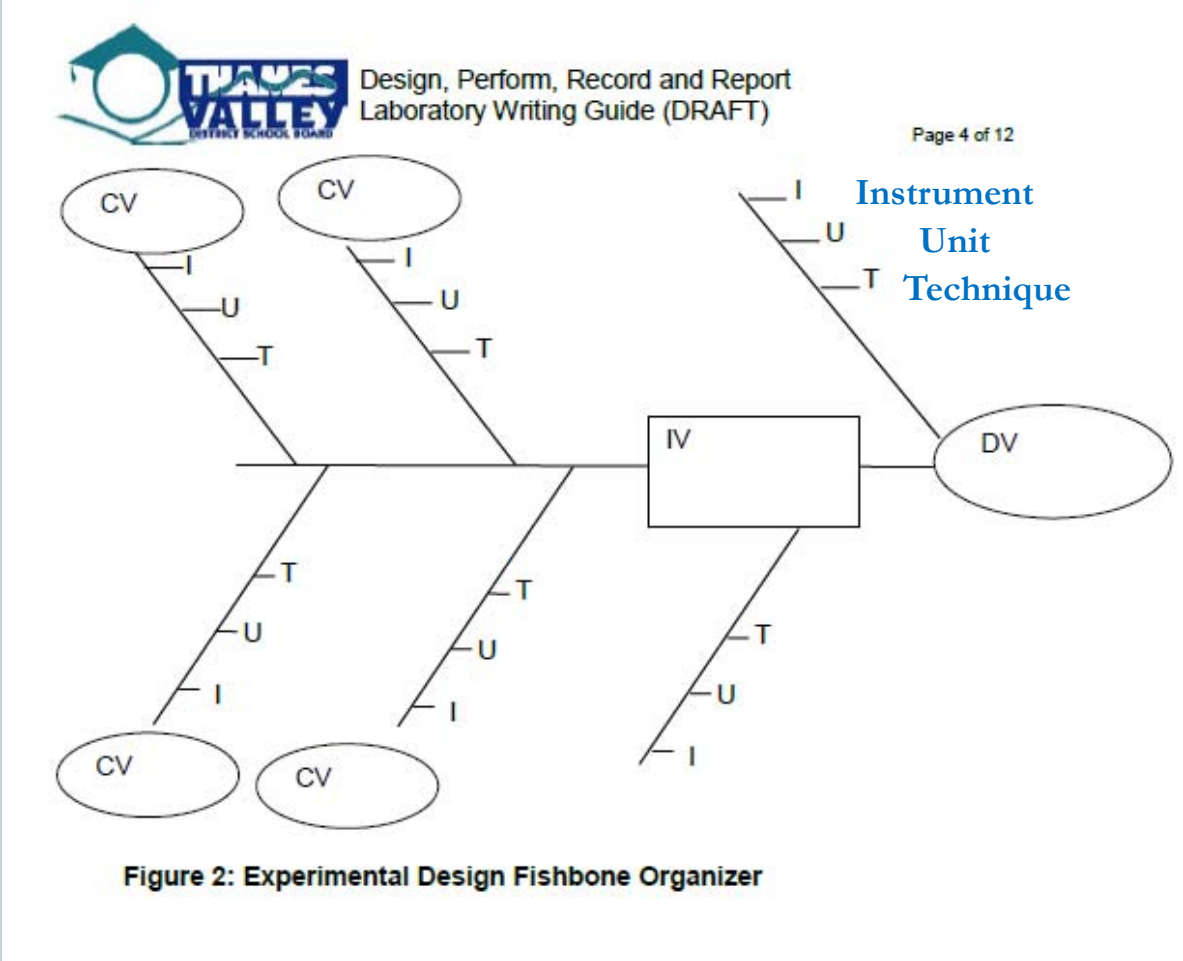
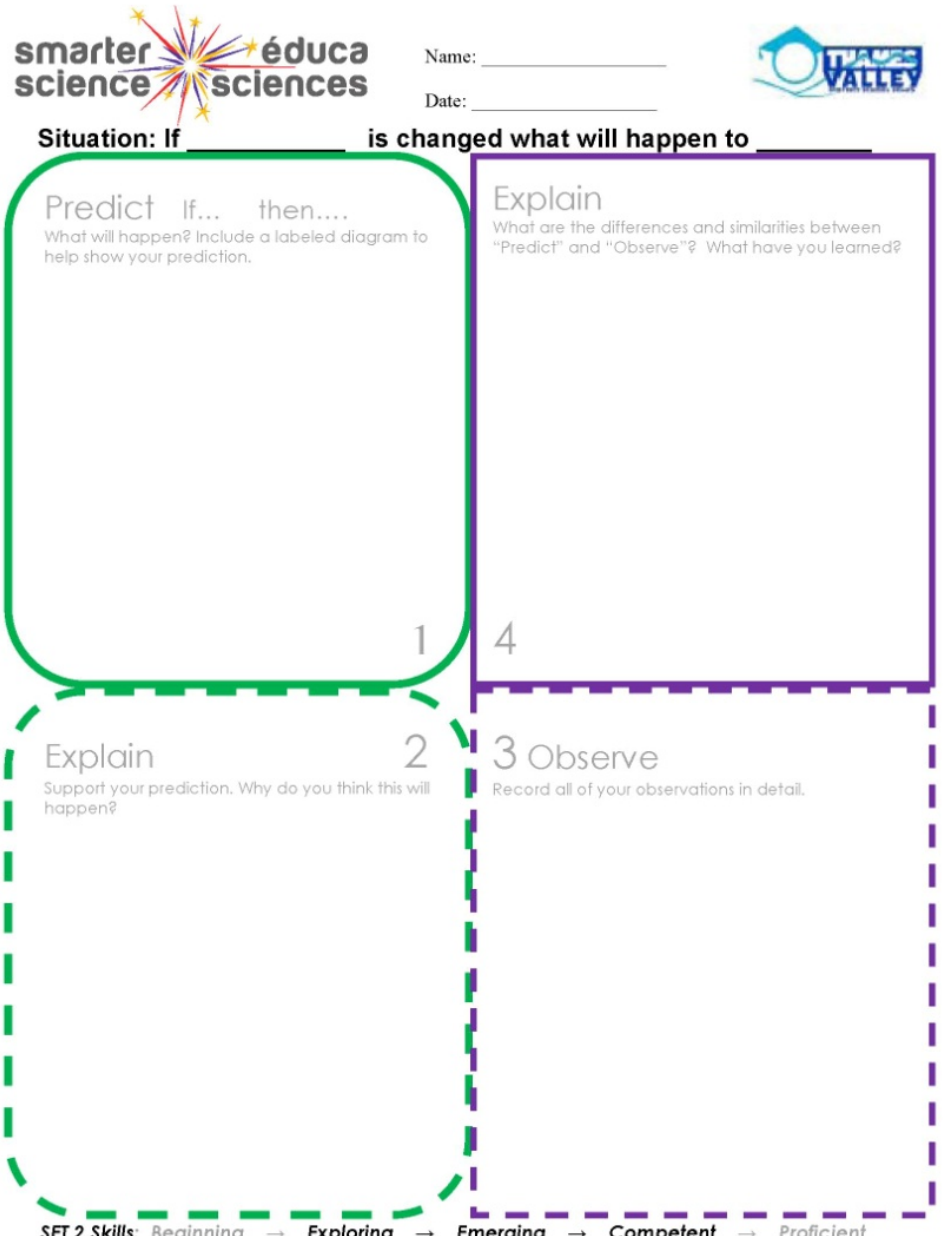


Figure 2: Experimental Design Fishbone Organizer

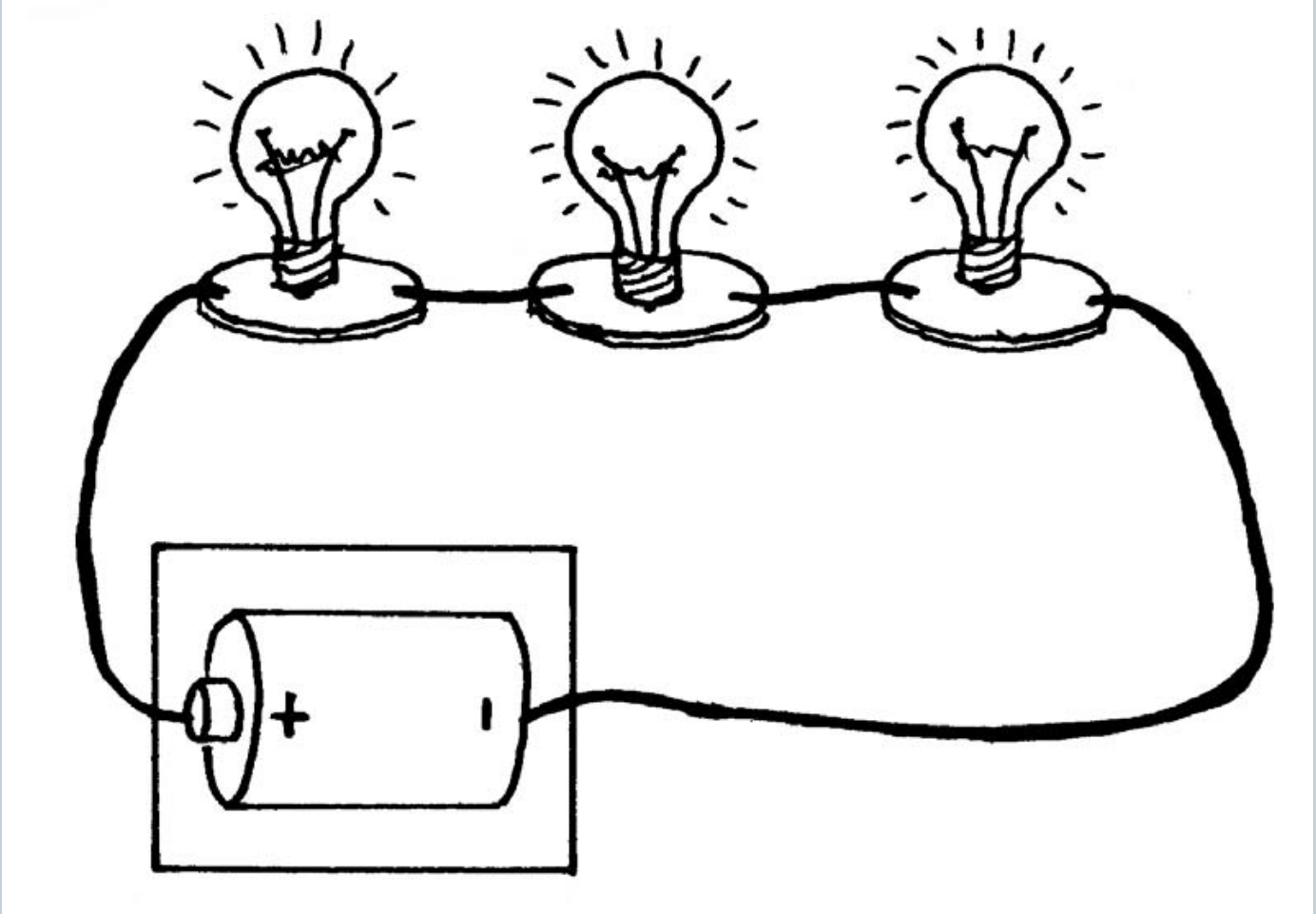
PEOE's (Predict Explain Observe Explain)

- PEOEs can provide assessment **for** learning diagnostic or formative.
- They involve the whole class.
- They encourage students to take risks.
- They can activate prior knowledge.
- They stimulate students to find out, if their prediction was incorrect, *why* it was incorrect.

Predict-Explain-Observe-Explain

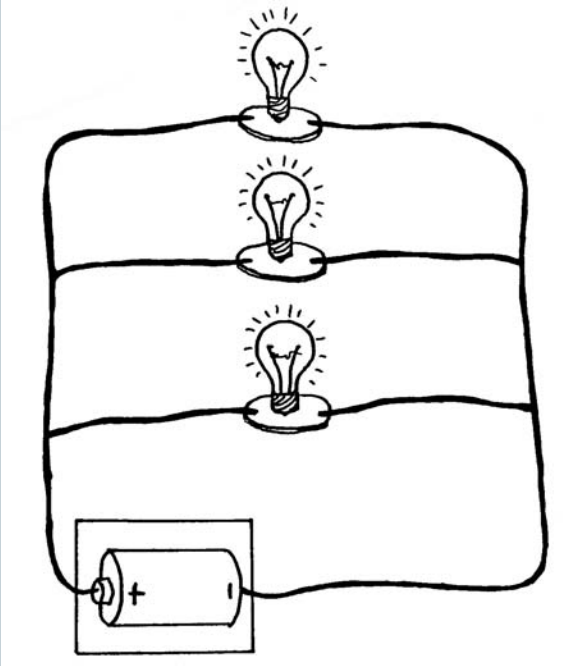


Activity #1: Demonstration (Series Circuits)



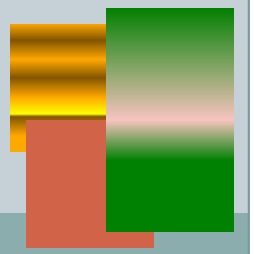
Grade 9 Electricity POE

- One of the bulbs in the circuit shown burns out. What will happen to the brightness of the other two bulbs?



DI Website- Ideas

- http://daretodifferentiate.wikispaces.com/Choice+Boards




Thank You!