Problem Solving Science: Focus on Primary and Intermediate Grades

Education Department
Antioch New England Graduate School
autumn, 2008 Fridays, 9:00-11:00
David Sobel

From birth, the growth of intelligence is a progression from the concrete towards the abstract. By concrete, I mean the physical substance of the living earth and its principles. By abstract, I mean the products of the mind-brain's own creativity rather than the actual material substance of the earth. Just as evolution has been a movement toward more complex thinking forms, the growth of thinking is a movement from concrete thought toward more purely abstract phenomena.

All thinking arises out of concreteness, which means out of the brain patterns resulting from actual body movements of interacting with actual things. To nurture intelligence in the young is to honor the progression from concreteness toward abstraction. Only out of this kind of knowing can abstract thought develop.

Joseph Chilton Pearce

There is nothing in the intellect that was not in the senses. *Aristotle*

This course is planned to provide an in-depth involvement with concrete materials as the basis for science curriculum in the primary grades. From this, we progress towards abstraction, discussions on how to structure science curriculum with children.

In aspiring to balance, we will both cover a wide range of topics and, tipping our hat to the **less is more** maxim, we will do a few topics in greater depth.

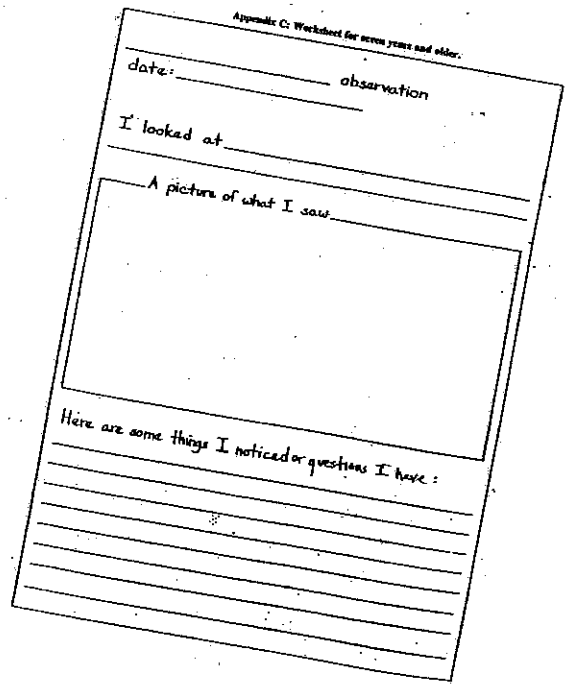
After an initial natural science exploration with mushrooms where we focus on observation-generating questions-answering questions-constructing an assessment, we will concentrate on the physical sciences. We'll do whole class studies on Conducting Scientific Investigations (Paper Towel Testing) and on Clay Boats (which leads us into a study of buoyancy, mass and volume, and density). Throughout the course we will integrate math and science, design investigable questions and then extrapolate rules for how to do good materials centered science with primary children.

BOOKS TO PURCHASE:

Wynne Harlen, (2001), *Primary Science: Taking the Plunge,* Heinemann, Portsmouth, NH.

Great Explorations in Math and Science (GEMS), (1987) *Paper Towel Testing Teacher's Guide,* Lawrence Hall of Science, Berkeley, CA.

5 September Doing What Scientists Do


Appendix C: Worksheet for seven years and older.

date: _____ observation

I looked at _____

A picture of what I saw

Here are some things I noticed or questions I have:

a. Reflecting on our elementary and middle school science experiences. Review of syllabus. Ellen Doris' technique for introducing science in her elementary classroom.

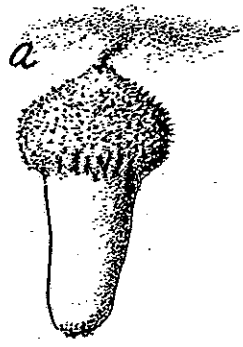
b. A focused mushroom observation, figuring out what we know about mushrooms and generating questions to answer for next week.

assignments:
- *Collect six mushrooms and bring them to class next time in a collecting basket.
- *Harlan, chapters 1 and 7.
- *Complete curriculum questionnaire and bring in curriculum materials.
- *Answer questions developed in class through internet research.
- *Find a mushroom guide.

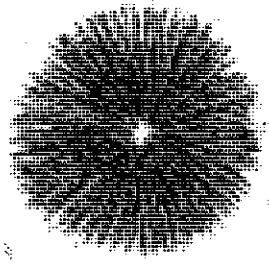
Toxicology - Danielle

12 September Curriculum Planning and Learning about Mushrooms

a. Science curriculum in classrooms. Choosing to do a curriculum project that is, if possible, developmentally appropriate, materials-based and has problem-solving elements at the core. Matching topic needs with appropriate curriculum materials.



b. Answers to questions generated during last class and development of some multiple choice questions for assessment.



c. Learning with mushrooms. One-of-a-kind and Kim's game-- two different observation challenges. Developing the vocabulary of talking about mushrooms. The Mushroom Market Exchange--creating a collection of mushrooms. Mushroom Taxonomy. Doing observations with children.

d. Choosing a topic for a 5 minute presentation

assignments: *readings in you mushroom guide about mushroom ecology and reproduction
*Harlan, chapter 2.

19 September Ecology and Biology of Mushrooms & Science Curriculum

a. Opportunities to investigate--excavating for mycelium, mapping schoolyard mushrooms, creating keys, using microscopes to find spores, mushrooms in children's literature.

b. Good Science Curriculum. The world is full of thoughtfully-designed kits and curriculum guides to teach hands-on science. If you're going to teach a science unit in your classroom, some one has created a really good set of curriculum plans. In other words, there's no need to re-invent the wheel, though you certainly will need to adapt the wheel for you specific vehicle. We'll look at packaged curricula and internet resources to help you find materials you can use in your own design process.

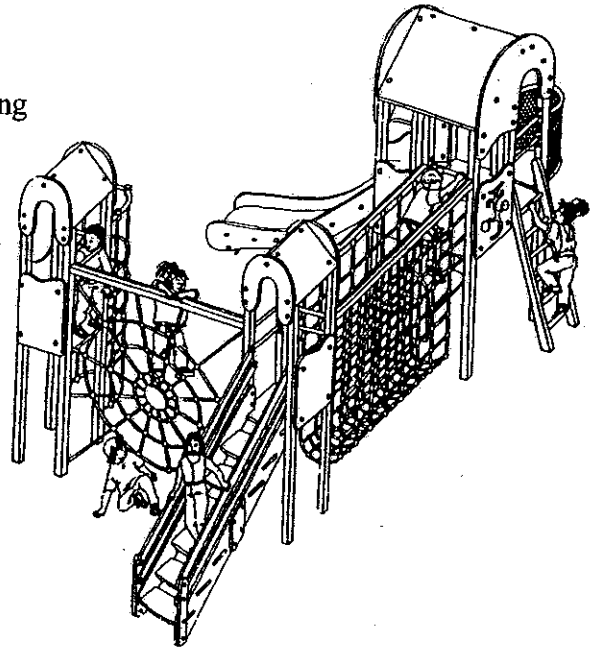
assignments: *Your challenge for Polly's Sept. 26 class is to prepare for the great "Tin Can Race". You will be meeting in Wheelock Park and using their playground as a place to explore science. Your challenge is this...You will be racing tin cans down the slide. You must use a full, 16 ounce can. Your goal is to have your can roll down the slide the slowest.

26 September Inquiry-based Science on a Playground

ATTENTION: Class meets from 9:00 to 11:00 on this day with Polly Chandler at Wheelock Park. *Directions- As you leave Antioch, turn left on West Street. Go under the by-pass and stay on West Street. You will come to a flashing light and Plotkins Furniture on your right, take a right and enter Wheelock Park. (This is also the entrance to Symonds School). Follow this road past Symond's School. On your left will be a ball field and small playground. We'll meet there at 9:00 If you have one, please bring a Frisbee or ball (softball, baseball, kickball). Come dressed for the weather. If it is questionable weather, check First Class and/or our classroom door for an announcement about where to meet.*

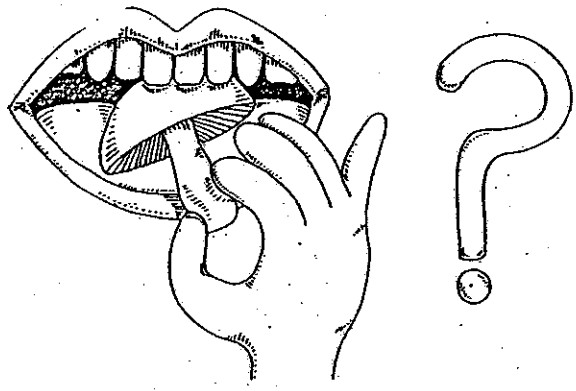
A school playground is a rich resource for exploring physical sciences. It is a great place to introduce the process of Inquiry-based Science. There will be four stations for you to explore and we will debrief our explorations after about an hour and 15 minutes.

assignments: *Harlan, chapter 3.
*Review Science Standards at the NH State Dept. of Ed web site or the appropriate state or district standards for your current internship. Be prepared to identify a specific standard that your presentation addresses.
*Create a presentation for the class which includes a white board drawing and a worksheet to be completed during your presentation.



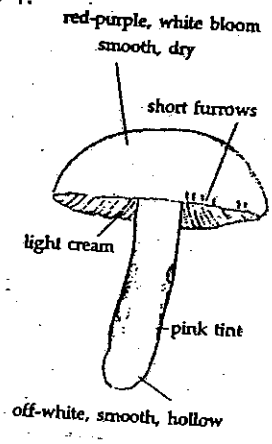
3 October Mushroom Presentations and Life Science Standards

Learning about fairy rings, stinkhorns, medicinal values of mushrooms, valuable culinary mushrooms, how mushrooms have shaped our cultural traditions and more.



Class presentations will be followed by an examination of which state standards we addressed. Then, we'll construct an assessment based on our original questions and on today's presentations to determine what we've learned.

assignments: *Harlan, chapter 9.
*Take New Hampshire Common Assessment in Science for grade 4.

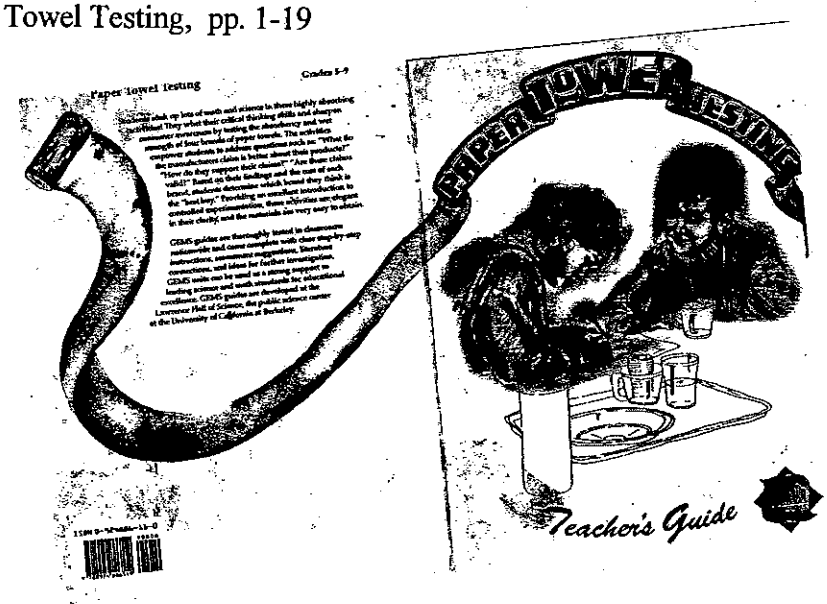


10 October Assessment #1: Mushrooms and Science Curriculum Test

a. What have we learned about mushrooms and can we construct an assessment that both assesses our content knowledge and our process skills?

b. Reviewing the New Hampshire science test for 4th graders. Is it a good test? Will the test drive the curriculum in good, or problematic ways? How should science curriculum be executed in order to prepare students for the test?

assignments: **GEMS Paper Towel Testing, pp. 1-19



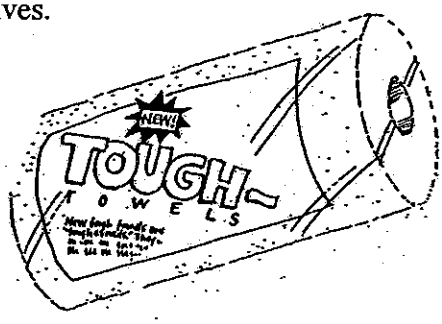
17 October Consumer Science and Paper Towel Testing

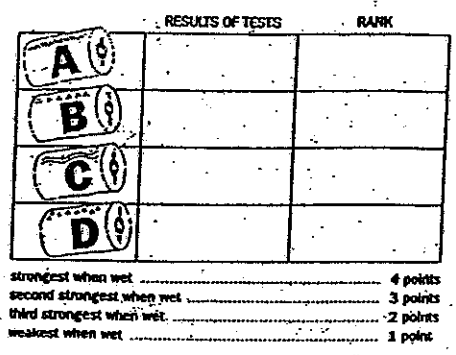
A wonderful, easy to conduct, well-organized science unit from GEMS (Great Explorations in Math and Science) for older children. This unit provides a good model for how to help students plan investigations and involves us all in consumer science and cost-benefit analysis. Conducting experiments and planning individualized explorations. Reviewing state standards.

assignments: *Harlan, chapters 4 & 6

*Bring materials to be used in consumer product testing.

*Review Science Standards at the NH State Dept. of Ed web site or the appropriate state or district standards for your current internship. Choose approximately four objectives that are relevant for Paper Towel Testing and determine which activities would meet these objectives.





24 October Consumer Product Testing #2

We'll take the process from Paper Towel Testing and extrapolate it. Either we'll devise other tests related to how we like paper towels to behave—clear tearability, flammability, lint-production, others?—or we'll identify other consumer products and devise investigable questions to see how they perform.

This is an example of "near transfer" or "application of learning." If we have learned how to design scientific investigations and if we understand the notion of investigable questions, then we should be able to conduct tests on other consumer products such as mouth wash or bubble gum or prophylactics or raincoats or fleece vests or whatever.

assignments: *Watson and Konicek, *Teaching for Conceptual Change: Confronting Children's Experience,* Phi Delta Kappan

*Harlan, chapter 5.

31 October Conceptual Change Theory and Clay Boats I

a. Viewing of video entitled: *A Private Universe* about the challenges of conceptual change and planning science teaching with a "constructivist" perspective. How does this shape lesson planning?

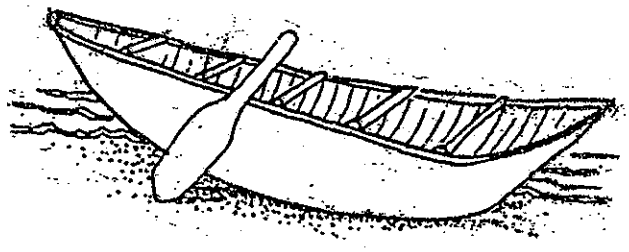
b. Sink and float activities with simple materials. Initiating simple problem solving with young children. Discussions that frame and facilitate learning. The balance between teacher and student directed activities. Integration of math and science.

assignments: * Bring in children's books on sinking and floating and on boats to the next class.
*Reading on buoyancy from Conceptual Physics

7 November Clay Boats II: Developmental Learning

Ways of focusing observations on the process. Investigable questions-- articulating questions and translating them into doable experiments. Adjusting the level of activities to the developmental capacities of the children you are working with.

assignments: *Clay Boats Teachers Guide, ESS
*Schwartz, Ellen, (1994) *Clay Boats Revisited,* Prospect Archive Newsletter.

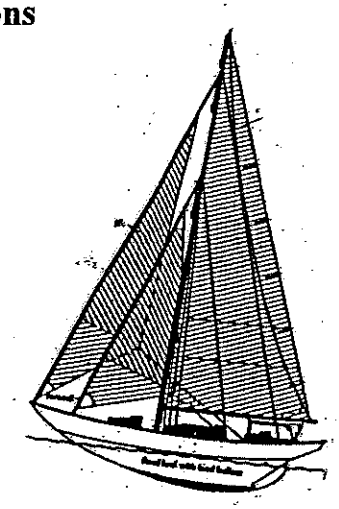


14 November Junior Solar Sprint Note: 8:30-11:30 class

Ariana Collins of the Northeast Solar Energy Association will train us to conduct the Junior Solar Sprint. Their website says, *"Highly engaging, Junior Solar Sprint is an educator's dream. It provides an ideal context to learn about timely energy issues. Given a standard motor and soar panel, middle school kids design and craft solar energy clars. In the process they learn and apply skills in engineering, physical sciences, mathematics, teamwork, problem solving and more."* We'll build solar cars, test them and redesign them to make them go faster. Pray for sun.

assignments: *Reading on weight, volume, density and displacement to be announced.

21 November Clay Boats III: Investigable Questions



Can we calculate the weight-carrying capacity of boats? Does the material a boat is constructed from affect its carrying capacity? Does the density of different liquids affect whether something will sink or float? The incremental movement from concrete to formal operational thinking.

assignments: *Harlan, chapter 9

28 November Thanksgiving: Be Thankful

5 December Clay Boats IV: Hard Science with Soft Materials

a. Understanding volume, density, surface area and the relationships between them. Investigations with displacement. A stacking liquids challenge—what does this have to do with density?

b. Developing assessment questions. What are some good content and process assessments for ourselves in relationship to sinking, floating, density and bouyancy.

assignments: *Work on Final Projects

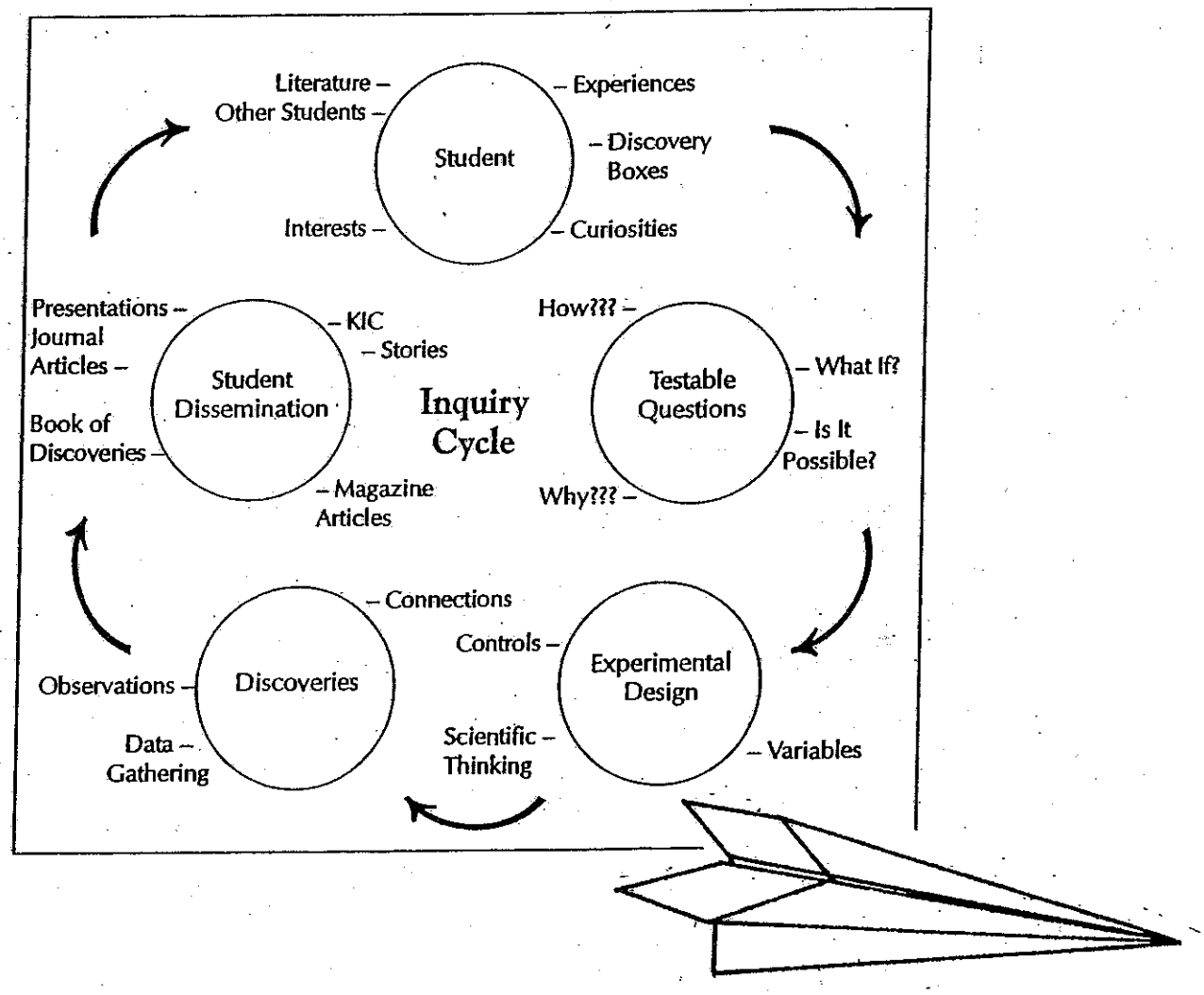
12 December *Clay Boats V and Assessment #2*

Assessment: An active assessment of your learning during Clay Boats. Do you really understand, or have you just developed a veneer of understanding? The Archimedes Challenge. The Heavy Cream Dilemma. And how do helium ballons work anyway?

assignments: Complete Final Projects

19 December **Paper Airplanes**

Everyone loves to make paper airplane and they also hold the potential for good science. We're explore a diversity of designs and then conduct controlled experiments on them to see what makes them fly farther or for greater amounts of time. Paper airplanes also provide a great metaphor for ending the program--taking flight.



Documentation:

I. Mushroom Research Question Presentation. Prepare a whiteboard drawing and a worksheet to be filled out during your presentation.

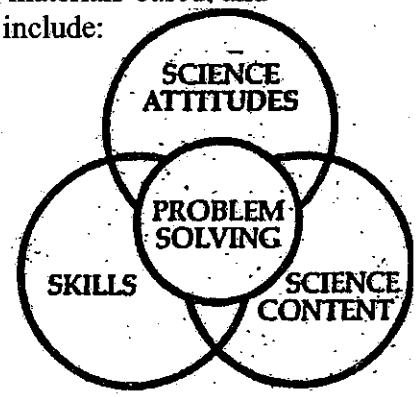
II. Good Science. A two page paper articulating both what and how you learned about mushrooms and what generalizeable principles you can extract regarding doing natural science curricula with elementary age children.

III. Science Journal: Each week, you'll make an entry in your science journal that focuses on:

a. science content you learned that week
b. observations about the process of teaching and learning science
c. questions you have about science teaching

IV. Science Curriculum Unit. Write an account of the science unit that you imnplement with students in your class. This unit should involve at least 4 or 5 meetings with the same group of children. In other words, the curriculum must evolve. No one shot deals! Optimally, you will choose a topic that is developmentally appropriate, is materials-based, and involves students in problem-solving activities. Your final paper should include:

a. your overview plans
b. detailed observations of children's' involvement
c. curriculum tree or flow chart
d. assessment tools used to assess student learning
e. developmental justification of why you did what you did using the New Hampshire Science Curriculum Frameworks.



Conceptualize this project as part of your interview portfolio. In other words, construct this piece of work so that you can use it to demonstrate how you teach science when you go for an interview. This means you should put energy into making it graphically accessible and aesthetically pleasing. It's more important for it to fit your professional needs than proving to me that you did a good job.

Apart from these four components, I expect you to complete the small week to week assignments and participate fully in all of our laboratory sessions.

All verification is due by 19 December. You will be evaluated on the basis of your projects and your participation in the class. Specifically, I will comment on the depth of your materials exploration and the extent to which your energy contributes to the richness of the class.