Introducing the Revised Modules for Grades 1–2

The revised modules for our first- and second-grade science students are available now from Delta Education. After a six-year run in schools across the country, it was time to open the files on the six modules and study the comments, corrections, and suggestions we had amassed and get to work. Once again we got down and viewed the natural world through the eyes of six- and seven-year-olds.

The modules actually didn’t require major overhauling. The primary modules were developed after the 16 modules for grades 3–6, so we had considerable experience by the time we started working on them. Even so, we were anxious to incorporate changes in science standards and new discoveries in inquiry pedagogy into the six modules for grades 1 and 2. The two most significant changes in the revision involve the teacher guide and the FOSS Science Stories.  

Continued on page 2
New Teacher Guides and FOSS Science Stories

**Teacher Guide.** The revised and reformatted teacher guides include discussions of national standards, new illustrations, enhanced inquiry procedures, improved assessments, math extensions, and home connections. Each investigation has a two-page spread called Investigation At-a-Glance, which starts with the inquiry questions. Each part of each investigation (activities are now called “investigations”) has one or more inquiry questions that guide the student actions. Student-initiated inquiry is encouraged by using a formal recording of student questions on a What We Learned chart during the Wrapping Up section of each investigation.

**FOSS Science Stories.**

FOSS Science Stories is a series of books developed to correspond to each of the modules. A revised kit includes eight full-color, 24-page student books (8" x 10") and one big book (14" x 17½"). The books are full of photos that invite discussion and extend the content introduced in the classroom investigations. The text is expository. The teacher guide includes a folio that provides suggestions for how and when to use each of the stories. The stories are also appropriate for use with the 1995 edition of the modules.

Changes to the materials kits for the modules were kept to a minimum. Those wishing to upgrade their earlier editions of the module for grades 1 and 2 can do so without purchasing new materials kits. Conversion kits include a revised teacher guide and teacher preparation video, eight copies of the student FOSS Science Stories and one copy in big-book format, a safety poster, and any new or revised materials (which are minimal). Conversion kits can be ordered from your FOSS regional sales manager.

Some examples of changes in instruction follow.

**Air and Weather Module**

Students tended to perceive air and weather as separate concepts and little emphasis was placed on asking students to build explanations. The order of Investigations 1 and 2 has been reversed to focus student thinking first on air, then on the movement and condition of air as it is experienced in weather. Additional changes were made throughout Investigations 3 and 4 to continually ask students to link air and weather and to build explanations of how air affects the movement of objects. Additional basins and vials have been included for students to investigate air trapped under water. Along with more emphasis on connecting air to weather, the investigations stimulate awareness of changes in weather over time, seasons, and objects in the sky, including patterns of movement of the Sun and Moon.

**Pebbles, Sand, and Silt**

There is more emphasis on soil and testing soil for its properties. Students are introduced to resources that we get from the environment, such as rocks and soil. They explore the physical properties of earth materials that make them useful in different ways, such as for building materials and for growing plants. Students make Geologist Tool Kits, interactive books that encourage language development and contain models and records of geological tools and skills presented throughout the module.

**New Plants**

The revision places more emphasis on the basic needs of plants and introduces the different structures of plants that function in growth, survival, and reproduction (how seeds travel). Students look at plants around the world through the FOSS Science Stories and discuss how plants have features that help them thrive in different kinds of places.

**Insects**

There is more emphasis on diversity of organisms—animals have different structures that serve different functions in growth and survival. Students are encouraged to look closely at the variety of insects brought into the FOSS classroom, as well as at insects in the local natural environment.

**Solids and Liquids Module**

The revision focuses more on property changes that can occur when substances are cooled or heated. The order of investigations has changed to allow immediate comparison of solids with liquids (Solids, Liquids, Bits and Pieces, Solids and Liquids with Water). And in the Wrapping Up section at the end of the last part of each investigation, students build on their definitions of liquids and solids as new information is learned.

**Balance and Motion Module**

There is more emphasis on a push or pull being a force and that force is needed to make things happen. Gravity is introduced as a pulling force. In order to investigate spinning designs on zoomers and tops, teachers were previously required to make the required cardboard disks themselves. Die-cut cardboard disks and squares are now included as part of the kit. Commercial drawing tops have been included for students to record the motion of spinning tops.

The information in the box on page 3 details the changes to the revised Balance and Motion Module. A similar display for the other five modules for grades 1–2, along with a more detailed general discussion of the revision, can be viewed or downloaded in pdf format from the Lawrence Hall of Science FOSS website, [http://www.lhs.berkeley.edu/foss/FOS_Gr_1-2_Revisions.html](http://www.lhs.berkeley.edu/foss/FOS_Gr_1-2_Revisions.html), or hard copy can be obtained by writing, calling, or e-mailing us here at the FOSS offices at LHS.

For ordering information, call Delta Education or your FOSS regional sales manager at 1-800-258-1302 or log on to www.delta-education.com.
BALANCE AND MOTION
3 boxes: 1 large, 1 small, 1 long (for runways)

1. Content emphasis enhancements
   • More emphasis on force—a push or pull is called a force. Force is needed to make results happen. Gravity is a pulling force.
   • Sound is made by vibrating objects and can be described by its pitch and volume (Center Instruction Card—Vibrations for Investigation 2).
   • Magnets can be used to make some objects move without being touched (Center Instruction Card—Magnetic Force for Investigation 3).

2. New duplication masters
   • Center Instruction Card—Vibrations (an extension of Investigation 2)
   • Center Instruction Card—Magnetic Force (an extension of Investigation 3)
   • Marble runways (an assessment for Investigation 3)

3. New equipment
   • 16 Cardboard disks, 12-cm, with slits in center
   • 16 Cardboard disks, 6-cm, 2-hole
   • 64 Cardboard disks, 7-cm, 2-hole (consumable)
   • 4 Drawing tops

4. Decreased quantities of equipment
   • 200 fewer paper clips (600 to 400)
   • 250 fewer jumbo straws (500 to 250)
   • 2 fewer rolls of transparent tape (6 to 4)
   • Omit all 1-L zip bags (20 4-L remain)

5. Teacher provided items added
   • Chart paper
   • Overhead projector and transparencies (optional)
   • Card stock (optional)
“Hey, volunteers can inventory the kits. It will be easy!”

This appears to be a simple solution to the problem of how to inventory hands-on kits at the school site before they are picked up for replenishment. This project can entail hundreds of kits, thousands of items, and schools scattered throughout the region! What is needed is a good system. This is the tale of one successful volunteer project that works for the teachers, the volunteers, and the district, all of which contributes to quality science for each student.

Sharry Monroe, the manager of the Instructional Resource Center (IRC) from the Evergreen School District in Washington, recognized that site-based inventory would be a problem. At Evergreen, the IRC contracts with a Science Materials Center (SMC), which is responsible for resupplying and distributing science kits for several districts. Sharry realized that she would first need to meet with all the parties concerned and delineate who was responsible for what. School principals, custodians, teachers, district staff, and staff from the SMC were all brought together to work out the process for using volunteers to inventory kits. Everything was clarified, from who would schedule the inventories to where the volunteers would leave their purses and get their coffee. The responsibilities of the teachers were kept as simple as possible: note any missing items when the kit arrives, teach the unit, and at the end, package up any broken items, list missing ones, and return the materials to the kit. The volunteers would then inventory the kits thoroughly before they were returned to the Science Materials Center for replenishment. The volunteers’ task was important in several ways. Missing items could be retrieved from classrooms before the kits were shipped off, teachers appreciated the help, and teachers who were not using their kits thoroughly could be identified and given additional support in teaching science.

The next step was to identify a location in each of the 23 schools that could be used three times a year for the inventory day. Sharry knew that it would be important to inventory the kits before they left the school site, so that classes could have a second chance to search for any missing items.

Then there were the volunteers to recruit. Volunteers were recruited by talking with teachers and placing announcements in school bulletins and community newsletters. The nature of the inventory task makes this especially suitable for people from the community that would like to make a difference by doing volunteer work in the schools and yet cannot easily make a regular commitment to a classroom. When the recruits come to help with the inventory, they’ve joined a small party of enthusiastic volunteers. By the end of the day, they leave with the satisfaction of having inventoried and made ready for refurbishment a mountain of kits that have been well-used by hundreds of budding scientists. The work of the volunteers makes it possible for the SMC staff to get the kits ready for more student investigations.

Experienced volunteers advance to volunteer project leaders. Project leaders take care of everything from arranging the timing of lunch (provided by the IRC), notifying the inventory volunteers and school custodians of the volunteer days, and welcoming the volunteers. Three project leaders share the tasks at 23 school sites. Sharry has put together a detailed instruction sheet and “to do” list for the project leaders, making this a job that a volunteer would feel comfortable taking on.

Sharry has kindly agreed to share her efforts with plans and checklists with others who are considering a similar project. Check out the FOSS Implementation heading at http://www.lawrencehallofscience.org/foss. There you will find her handouts for the Evergreen School District volunteer project, including:

- FOSS Responsibilities Overview
- Project Leader Instruction Sheet
- “To Do” Checklist for the Project Leader
- FOSS Kit Check-In Instructions for Volunteers
- Volunteer Day Summary
- FOSS Retrieval List (This is a kit-by-kit list of items that are difficult or costly to replace. If these are missing, the volunteer asks the school science liaison to go to the class for a second look.)

Sharry Monroe can be reached at smonroe@egreen.wednet.edu.
It was a dream come true. Walking through Woodland Primary and Pleasant Valley Elementary in Vancouver, Washington, evidence of scientific investigations was everywhere. FOSS boxes were in use in every classroom. Aquariums, terrariums, graphs, drawings, and recordings of investigations were present in equal measure to displays of math and language projects. How does this happen? Behind every successful science program is a busy science materials center.

These particular schools are two of 55 schools served by the three staff people of ESD 112’s Science Materials Center in Vancouver, Washington. They, along with a cadre of science specialists and volunteers, ensure that kits are inventoried, restocked, and delivered on time to every classroom. Critters also come and go from the materials center. Racks and racks of tubs with everything from snails to milkweed bugs are raised here and shipped out to the classes by their critter-care specialist.

On the day I visited, three large wading pools held adult crayfish, while another served as a nursery pool for minuscule crayfish young. Aquariums held aquatic plants, goldfish, guppies, and water snails. The center serves as a bit of a laboratory, too, for working out some of the “bugs” of critter care. The staff has discovered that corneal in the mealworm habitat makes an easy job of sifting out the mealworms. Zebrafish are replacing goldfish and surviving better in the classroom. When Elodea was difficult to obtain, they switched to hornwort. Periodic meetings of the SMC staff and the school science specialists provide an ongoing process for airing problems and working out solutions.

Last May, representatives from seven science materials centers in Washington and Oregon came together for a mini Nuts-and-Bolts conference, organized by Bo Haldeman, Anne Kennedy (see “Congratulations, Anne!” article on this page), and the staff of the ESD 112 Science Materials Center in Vancouver, Washington. The idea for this conference, and others like it, grew out of a Next Steps institute hosted by Highline School District (WA) in 1997. The Next Steps institutes are put together by the Association of Science Materials Centers (ASMC) and the National Science Resources Center (NSRC), whose purpose is to help science education reform leaders implement inquiry science programs. As part of the conference in 1997, Kathleen Kearns from Highline co-lead a Nuts-and-Bolts strand about the actual nitty-gritty of materials center management.

One of the greatest outcomes of the 1997 meeting came from the pairing of attendees from similar locations. The managers of the SMCs from Palo Alto and Antioch, California, found themselves sitting side-by-side, having never met before. This spurred on an effort to search out other SMCs in the San Francisco Bay area. This effort blossomed into regional meetings held to share strategies, meet with vendors, and set up consortiums. Last fall, the Highline and Seattle SMCs hosted a two-day Nuts-and-Bolts conference that brought together science materials center staff from Washington, California, and the Einstein Project in Wisconsin.

The Association of Science Materials Centers is a network of people with expertise in supplying kit-based instructional materials to schools and who share a passion for systemic reform. ASMC’s purpose is to bring together materials and resources that serve people responsible for the delivery of instructional materials in science. The vision of the ASMC is to create opportunities for science materials centers to share information on best practices, help new centers get off the ground, and develop partnerships with other centers, vendors, and foundations. Opportunities are publicized in a members newsletter, a listserv, and at annual meetings at the national NSTA conferences. Professional development is provided for educators, administrators, and instructional materials staff at their Next Steps institutes. Next Steps ’01 is scheduled for this October in South Carolina.

The groups that gathered in May 2001 in Vancouver represented a wide variety of experience. The number of schools served by the centers ranged from 77 in the Seattle Public Schools (which translates to 2,560 kits) to six in the Linn-Benton ESD (36 kits). The Highline materials center has been going strong for 34 years, while the Battelle SRC in Kennewick is celebrating

Continued on page 6

Congratulations, Anne!

Congratulations to Anne Kennedy for receiving the Ackerley Corporate Giving/Pacific Science Center Outstanding Teacher Award for Elementary Science Education. Recipients of this award are selected by the Pacific Science Center’s (Seattle, Washington) education staff. Anne, Director of the Science and Math Education Resource Center at Educational Service District 112, has been instrumental in leading the development of highly effective science education programs in southwest Washington through encouraging elementary science teachers to use hands-on science in their classroom (e.g., FOSS). She has assisted rural districts in improving their science curriculum and has developed a program that is a model for school districts and educational service districts throughout Washington. Anne has worked with the Pacific Science Center on teacher education programming and has served as a faculty member of Strategic Planning Institutes implementing science education reform in Washington state.

As part of her award, Anne’s name has been added to the national honor roll of the Association of Science-Technology Centers in Washington, D.C.

The FOSS staff congratulates Anne on her award and her continuing efforts to support hands-on science in the classroom!
their first year of operation. One center may have streamlined their inventory process and another researched barcoding—together their individual efforts amount to a wealth of expertise.

Presentations at the conference included talks on the role of science specialists, a model project for organizing volunteers to stock inventory kits, an explanation of the FOSS revisions, and an open discussion of operating concerns, such as support books, staffing, and handling oversized items. One of the exciting outcomes of the meeting was the concept of forming cooperatives to purchase materials at a discounted bulk price. Although district requirements, services offered, and experience varied, together they shared a similar vision—that of providing appropriate materials to the students and enabling the teachers to do what they do best, that is, teach. These are the key ingredients to any science program.

For more information on future Nuts-and-Bolts and Next Steps conferences, check out the ASMC website at http://www.cos.clemson.edu/aoppub/ASMC. The host of this year’s Northwest Mini Nuts and Bolts conference, ESD 112 in Vancouver, has an excellent website at http://www.smerc.org.

---

Science Materials continued

Notes from the Field...

Weighing Activity

This great idea for an extension to the FOSS Measurement Module was posted on the FOSSWEB bulletin board (at www.fossweb.com) in October 1999 by Roxanna Rickly. It has also been suggested as an extension to the Food and Nutrition Module.

“I have my students bring in pop cans or snack food wrappers. We check the labels for the amount of sugar and fat. The students then weigh the given amount of sugar and place it in a snack-size zip bag. They can weigh Crisco for the fat or, to keep things a little cleaner, we substituted white playdough. The snack wrapper and snack bag of sugar and fat are hot-glued onto index stock and then hung in the hallway. As a class we tabulated the amounts of sugar and fat for the different snacks and graphed them on the computer using a spreadsheet program.”

Adopt a Wheat Field

This website suggestion came from Cindy Garwick, a first grade teacher at Bluemont Elementary School in Manhattan, Kansas.

Go to http://www.oznet.ksu.edu/wheatpage and click on Kids Corner (right side of screen), and then go to Adopt a Wheat Field.

Kansas State University agronomist Jim Shroyer picked a spot in a wheat field north of Manhattan, Kansas, to show the cycle of wheat from field preparation in August to bread the following July. The photos are great! Go to “Wheat Watch” in the Kids Corner to click on dates to move through the photos you want students to view. At the primary level the text is informational for the teacher, but students love the photos (as you can see from the photo below).

This website is the perfect way to incorporate technology with the planting of a wheat seed in a straw activity found in the FOSS New Plants Module. Students can compare their wheat growth with what occurs in the fields of Kansas.”

You can communicate with Cindy at Bluemont Elementary School
714 Bluemont
Manhattan, Kansas 66502
E-mail: cindyg@manhattan.k12.ks.us
Phone: 785-587-2030

---

First-grade students from Bluemont Elementary School in Manhattan, Kansas, go online for a “Wheat Watch.”
Spring Scales!

This letter from Oklahoma City came via e-mail to Larry Malone regarding the spring scales used in the FOSS Levers and Pulleys Module.

Dear Foss:
I am teaching in a summer science academy that brings together master teachers, potential teachers, and students in grades 2–8. The curriculum that we are using is the FOSS Levers and Pulleys Module. As master teachers, we taught the unit to the potential teachers prior to the students arriving at the academy. As our potential teachers explored the use of the spring scales, they reached a dilemma!

Our question to FOSS is: Why do you have to use a spring scale right side up? Why can’t it be used upside down?

We discovered that the spring scale measured 2.4 N with the load right side up. Hanging the load on it upside down and reading the scale, gives you 2.9 N so that you do not need to add the .5 N when reading it. If you “zero it out” with the weight upside down, then you get 2.4 N and have to add the .5 N, giving you a 2.9 N reading just like you get right side up. We have puzzled over the workings of the spring scale for 2 weeks! Can you satisfy our questions for us? Thanks for your help!

Betsy Mabry

Larry wrote:
Hi Betsy…
OK, here’s the deal. When you hold the scale in the usual manner, by the bail (loop) at the top, the only mass pulling on the scale spring is the mass of the hook. By zeroing the scale to compensate for the mass of the book, you are ready to go. Any additional force applied to the hook (a mass responding to the acceleration of gravity, a person yanking on it, a magnet attracting it, etc.) will stretch the spring. The amount of stretch is a measure of the force. Let’s say you put a 500-g mass on the scale. The scale will register 5 N. However, if you hang the scale-and-500-g-mass system on a second scale, the second scale will read 5.5 N. This is because the total force pulling on your hand is the sum of the mass on the hook plus the mass of the scale. So, when you attach the bail to a lever arm and pull down on the book to measure the force acting on the lever, you read the scale and add the 0.5 N that represents the force contributed by the mass of the scale to determine the total force pulling downward.

When you pull upward in the usual way, you are supporting the mass of the scale... it is not contributing to the force acting on the spring.

Always look at the lever where the force is being applied. What is pulling on it at that point? If the mass of the scale is pulling, add in 0.5 N to account for its mass.

And why do we always use the scale right side up? Because it is easier to read.

Good luck and congratulations on using Levers and Pulleys.

Have you encountered Sparky the pony yet? He’s in the maib section of one of the pulley investigations (revised version).

Regards,
Larry

Betsy replied:
Larry,
Thanks so much for your prompt reply!
What you wrote were observations that we had made, but it was fun to include FOSS comments. I never realized that a spring scale would be as intriguing as it has been for us! The interest was piqued by two of our “potential teachers” who are working with the academy and who are 2001 high school graduates. As far as Sparky is concerned, we are using a “real-world” Oklahoma application instead!

Construction of a dome on our State Capitol has begun. Today a massive structural beam is being raised in Oklahoma City. We challenged our students to construct a pulley system that would raise a poster board dome to the top of the second floor “capitol roof” in the Commons Area at NWOSU where our academy is taking place. The kids had a wonderful time working together to make it happen!

After the “Efforts in Pulley Systems” tomorrow, we will guide them toward the ultimate “Survivor Challenges” using levers and pulleys.

Thanks again for your help.
Betsy Mabry
Over the last two years I have been deeply embroiled in a struggle over the content of the Massachusetts Mathematics and Science and Technology/Engineering Curriculum Frameworks. Much of the debate has centered on the role of inquiry in mathematics and science instruction.

Two things have become clear to me. First, although many people are using the term inquiry, we don’t all mean the same thing. Second, people bring different values about the goals of education to the discussion. Clarifying what we mean by inquiry and its role in what we value about learning is essential if we are to shed any light on what should be happening in classrooms.

Although much of the recent discussions about improving mathematics and science education has revolved around the term “inquiry,” there is still a great deal of confusion about what it means. A point of agreement is that all inquiry involves asking questions and framing explanations. Over the years, I have witnessed more than a few discussions that evaluated science curriculum and instruction based on the degree to which they were perceived as being inquiry-based. These discussions turned on the extent to which questions and investigative methods were generated by students or teachers.

This is not a trivial question, but it glosses over a number of prior questions which, if explored thoughtfully, could provide useful direction to teachers. A good place to start, I think, is to ask the following questions.

What do we know about the process by which people learn? How do scientists and mathematicians go about asking and answering questions or solving problems? What are the skills that people need to engage in scientific inquiry and mathematical reasoning? What habits of mind support these modes of thinking? What pedagogical strategies support these notions of learning and thinking?

However, before we can sort out these dimensions of inquiry, we need to set aside two ideas that tend to confuse the discussion. The first such notion is that there can be “pure inquiry.” In designing instructional experiences, we need to make decisions about the relative degrees of students’ self-direction and teacher direction in relation to nature of the particular subject matter, levels of student cognitive development, and available time and resources.
Second, we need to be clear that although the urge to inquire is a fundamental human trait, we are always inquiring about something. We want students to learn how to inquire, so that they develop more nuanced understandings about the world that are grounded in reason and evidence.

Teacher professional development should help bring some clarity to these questions in order to guide what happens in classrooms. Unless teachers develop some passion for why inquiry is important, not much will change. Teachers need to engage in inquiry themselves and then reflect on the question of inquiry and how to implement the practice in their classrooms.

There are a number of implicit values that are the foundation upon which to build our work. I place a high value on scientific thinking and mathematical reasoning as a way to make sense of both the physical and social realms. This is related to the notion that reason and logic, systematic testing and altering of explanations in the light of evidence, and openness to peer critique are superior to simple intuition or prejudice as a way of knowing.

As educators we are faced with the challenge of preparing students to live in a world we cannot yet imagine. This implies that learning how to learn and how to make sense of and interpret information in the natural and social spheres is our most important challenge. Since knowledge and understanding inform the questions we are able to ask, we also want children to gain as much conceptual knowledge as is reasonable and age appropriate. I also believe that the only chance we have of addressing issues of inequality, poverty, prejudice, and environmental degradation is for students to internalize the habits of mind and skills associated with inquiry. They need to learn how to utilize them to make sense of and interpret information and to make decisions. If, as educators, we can do this in a context that places value on respect and dignity for all people, we will have done our jobs.

What Are the Characteristics of Inquiry?

I propose that we need to think of inquiry as having five distinct, yet interdependent, dimensions.

- As a description of the cognitive processes by which people make sense of patterns and relationships in the natural and social world. This is a biologically-determined, but socially-mediated process. That is, it is based on how the brain works and how people interact with one another in the social world.
- As the processes of investigation, problem solving, and verification that are the essential core of mathematics and science.
- As a set of skills or abilities that we want students to develop in order to be effective thinkers and problem solvers.
- As a description of the “habits of mind,” attitudes, and behaviors related to learning and knowledge that we value. Many of these are part of the ways of thinking and problem solving that are part of the enterprises of natural science, mathematics, and social science.
- As a description of the instructional practices that build upon the four categories above.

The significance of these distinctions can be clarified by a simple example. Measurement is an essential aspect of mathematics and science. We can teach students how to use a graduated cylinder to measure volume in a step-by-step fashion. However, unless our teaching is informed by an understanding of how children develop images of three-dimensional space and notions of standard unit or how they come to understand measurement as an iterative process, they will soon forget the skill. Unless students understand the process of inquiry they cannot make judgment about when it is appropriate to measure or how to use measurement as part of a logical explanation. Finally, unless they develop not only the skills to measure with precision and accuracy, but value it as well, our teaching will ultimately prove useless. Teachers will need to develop different strategies to address skills, processes, and habits of mind.

Continued on page 10
Dimensions of Inquiry continued

What do we know about how people learn?

Inquiry Builds Upon Innate Cognitive Processes

Learning is an active process in which people identify new patterns and relationships in the natural and social worlds. The ability to decipher patterns grows out of innate human cognitive capacities, and it develops in a fairly predictable order. These biologically-based capacities need nurturing and a rich experiential base in order to develop full expression in thought and behavior. Effective teaching for particular educational goals makes full use of and exercises these cognitive capacities through planned, developmental, structured instructional experiences. It builds upon children’s questions and natural curiosity, as well as seizes upon teachable moments and opportunities for independent learning. These cognitive capacities are the substructure upon which all thinking, attitudes, and behavior are constructed. For the purposes of understanding, organizing, and responding to teaching and learning experiences, the following fundamental cognitive processes can be considered.

- **Observing**
  Children observe the world through their senses, including looking, touching, tasting, smelling, and listening.
- **Communicating**
  Humans are by nature social animals with the unique ability to communicate through invented language and symbols. The development of knowledge, skills, and understanding is, therefore, inextricably linked to social interaction and communication.
- **Comparing**
  This process builds upon observations and deals with similarities and differences in both qualities and quantities and between the known and the unknown. Frequently comparing objects leads to finer observation.

- **Organizing**
  Human brains have the capacity to bring order to observations and comparisons by “putting objects or phenomenon together on the basis of a logical rationale,” including seriating, sequencing, grouping, and classifying.
- **Relating**
  Seeing relationships involves understanding interactions, dependencies, and cause-and-effect.
- **Inferring**
  This process involves our ability to draw logical conclusions from events, phenomenon, or ideas that may be remote in time and place based on orderly reasoning from evidence or premises.
- **Applying**
  This is the process by which humans bring all other processes together to tie knowledge, relationships, and inferences together into a comprehensive framework or theory or to apply these in a new or novel situation.

An awareness of these cognitive capacities and their developmental trajectory should guide instructional design and questioning strategies.

Inquiry Builds Upon Prior Knowledge

Current research indicates that children arrive in school with fairly well-developed mental schema, ideas, and values about how the natural and social world works. Conceptions are formed through the construction of complex webs of interconnections among neurons in the brain. These ideas or conceptions serve as filters, constraints, and springboards for all school-based learning. Research has demonstrated how resilient and powerful these conceptions can be. Learners will often hold onto preconceptions or intuitive ideas even in the light of new evidence or teaching.

There are two implications for acquiring new knowledge. First, we know that new information is interpreted through existing mental schema. Second, we know that contradictory or discrepant information only alters existing schema when those contradictions are realized and resolved on a conscious level (reflection). People often hold simultaneous but contradictory conceptions; however, the ideas with the more “hard-wired” interconnections are most often used to interpret new information. Third, although knowledge consists of constructions in an individual brain, the process by which information is processed is socially mediated. Therefore the social context for learning exerts powerful influence on what is learned and how learning takes place.

How do scientists and mathematicians go about asking and answering questions or solving problems?

Inquiry Models the Processes Used by Scientists and Mathematicians

Over the course of conscious human existence we have generated an enormous body of knowledge that has sought to bring some order to the natural world. Essentially, this order-seeking is a uniquely human endeavor in which we look for patterns to make sense of the world around us. The formal enterprises of mathematics and science have developed systems of reasoning and logic, rules of evidence, and means of verification and revision. Our educational goal is for students to learn, practice, and adopt these modes of investigation in their everyday existence.

- **Questions and Conjectures**
  Scientists and mathematicians ask questions and make conjectures that are answerable based on evidence. (This is distinct from questions that can only be answered based on personal feelings or faith.)
- **Observation and Tools**
  Scientists and mathematicians use technology to extend their senses, manipulate data, and to improve the accuracy of observations.
- **Evidence and Explanation**
  Scientists and mathematicians develop explanations using observations (evidence) and what they already know about the world.
• **Reasoning and Proof**
Scientists and mathematicians offer explanations and proofs that are based on reasoning that is logically consistent.

• **Communication and Critique**
Scientists and mathematicians make their explanations public so that investigations are subject to replication and verification.

• **Revision and Change**
Scientists and mathematicians consider alternate explanations and revise their explanations in the light of new evidence.

*Inquiry is Enriched by Rich Conceptual Knowledge*

In discussions about learning, inquiry is often discussed as a separate entity from content knowledge. However, research that compares how novices and experts in particular disciplines approach solving problems has highlighted the importance of conceptual understanding in framing how individuals make observations and incorporate those observations into new understandings. Experts notice more features and nuances of a phenomenon or situation than novices do. Their conceptual understandings make it possible for them to make connections among what may seem like disparate phenomenon to novices.

In addition, experts monitor their own learning (meta cognition) so that they can check for what they may not know or what requires additional information. Being an expert is not innate. Novices can learn to be experts. Being an expert in one field does not imply expertise in another. An expert in microbiology may behave as a novice in another area of inquiry such as astrophysics or piano playing. However, experts’ habit of first seeking to develop an understanding of a problem and search for patterns tends to differentiate them from novices whose knowledge tends not to be organized around big ideas. Inquiry, therefore, is contextualized within specific areas of knowledge.

What are the skills that people need to engage in scientific inquiry and mathematical reasoning?

*Scientific Inquiry Skills*

Our natural abilities are quite distinct from the extent to which we exercise them. Being physically able to throw a baseball is rather different from throwing a strike, much less throwing strikes consistently. Being able to observe and see patterns does not mean that we have the repertoire of experience and practice to do so with care, refinement, or routine. There are, therefore, skills that must be practiced in order to become an effective learner. From an instructional point of view, it is not only critical to be aware of the cognitive process available to children, but also to organize engaging experiences for students to practice these skills in a variety of meaningful and engaging contexts. Below is a non-exhaustive list of some of these processes drawn from science education, but which have application to other subject areas.

- Identifying questions that can be answered through scientific investigations;
- Systematic, careful, or refined observing;
- Sorting on the basis of single or multiple properties;
- Communicating through written expression (pictures, words, sentences, paragraphs, reports, etc.);
- Graphing (concrete, pictographs, histograms, bar, pie, Cartesian, etc.);
- Constructing and using data tables and charts;
- Measuring with a variety of tools and units;
- Using various types of scales (temperature, hardness, etc.);
- Identifying variables;
- Predicting;
- Using the tools of scientific investigation to gather data and extend the senses;
- Interpreting and organizing data;
- Designing and conducting scientific investigations;
- Making predictions on the basis of evidence;
- Constructing logical arguments on the basis of evidence;
- Locating information from a variety of sources;
- Working effectively as a team member;
- Following directions.

*Continued on page 12*
What habits of mind support scientific and mathematical modes of thinking?

Habits of Mind

Research indicates that direct teaching of science process skills or mathematical procedures without conceptual understanding does not result in effective learning. However, even if children are taught to apply the methodologies of scientific and mathematical inquiry in a school context, they may not ultimately assimilate these ways of thinking, problem solving, or verifying into more generalized thinking and attitudinal patterns. Neither our biologically determined capacities nor the socially mediated skills needed to exercise them necessarily mean that students will, in fact, think or behave, for example, as a scientist or mathematician. For students to be effective problem solvers or critical thinkers they need to adopt and assimilate the values, attitudes, and ways of thinking associated with the scientific inquiry and mathematical investigation. This requires instructional direction and focus. Most importantly, it means that students need regular opportunities to apply these skills and process in personally meaningful contexts. Listed below are some of these “habits of mind.”

- **Curiosity**: A willingness to ask questions about the natural or social world; wonder;
- **Open-mindedness**: A willingness to change ideas in the face of new contradictory evidence; valuing both skepticism and theory; valuing and practicing collaboration with others in the process of experimentation and the creation of knowledge;
- **Respect for Evidence**: A desire for accuracy and precision in observation and measurement; valuing and practicing the use of data, evidence, and reason in the construction of explanations; valuing and practicing accuracy and precision in explanation;
- **Persistence**: A willingness to persist and take risks to find answers and ask new questions in the face of ambiguity, challenge, and contradictory evidence; and
- **A sense of stewardship and care**: A sense of responsibility for the well-being of others and the environment.

What pedagogical strategies support these notions of learning and thinking?

Effective teaching based on inquiry in all the facets discussed above is not simple or easy. It requires deep conceptual knowledge on the part of teachers who have access to high quality curriculum materials that are thoughtfully developed across at least a K–12 continuum. It requires subject specific knowledge about how particular conceptions typically develop, as well as what confusions may arise. It requires a great deal of continual planning and constant assessment and reframing of instruction. It requires a supportive social context for students and teachers. It requires ongoing, honest collaboration among teachers, administrators, and parents. It requires time!

We can note some general features of inquiry-based teaching.

**Inquiry-Based Teaching**

- Focuses on learning with understanding.
- Is rooted in students’ knowledge.
- Is guided by student curiosity and questions.
- Engages students in active learning.
- Identifies, builds upon, and, when necessary, consciously challenges students’ existing ideas and preconceptions.
- Provides opportunities for learning that build upon students’ interests, questions, curiosity, and existing knowledge.
- Engages students in self-conscious sense making, self-assessment, and reflection.
- Engages students in applying knowledge, skills, and understanding.
- Engages students in learning activities that require collaboration in order to reach and verify conclusions.
- Engages students in critical questioning.
- Engages students in using evidence to reach and verify conclusions.
- Engages students in communicating tentative thinking, as well as ideas about which they are more confident.
- Self-consciously establishes goals in the areas of significant content knowledge, skills of inquiry, and modes of thinking and behaving consistent with inquiry.
- Creates a positive social context that supports inquiry.
- Uses ongoing assessment to improve instruction and meet the diverse needs of children.
Why should we care about inquiry?

Finally, inquiry-based teaching is rooted in a belief that inquiry matters in children’s lives and in our own. One of my most vivid enduring memories as a child recalls a bus ride home subsequent to the arrest of Adolph Eichmann for his role in the extermination of Jews in Nazi concentration camps. Although I was only about 7 or 8 years old, I was keenly aware of the events as well as my minority status in my community. I don’t quite remember the context that prompted the conversation, but I heard one of my classmates, sitting behind me on the bus say, “He should have killed six million more.” Two things stand out for me in this memory. The first, is that I did not yet have the courage to speak up. I regret this even to this day. Second, is the deeply troubling recurrence of unexamined prejudices. For me, inquiry is about helping to build a community of inquirers in which speaking up is not only safe, but encouraged and where attitudes, values, and beliefs are able to be challenged in the light of evidence. Each of us will have to find our own set of motivations, but I believe that our efforts need to be driven by a passion for personal and social values.

References


*The Biological Basis of Thinking and Learning*, Lawrence Lowery, University of California, 1998.


Sometimes you need a third eye to penetrate dense subjects and see them clearly. That current ran through the week-long FOSS middle school workshop on the campus of Northeastern University in Boston the second week in July. The main attraction was the Human Brain and Senses Course. Susan Brady, Linda De Lucchi, and Larry Malone had the luxury of almost enough time to thoroughly present the course to an enthusiastic assemblage of middle school educators from around the country.

The primary goals of the workshop were to prepare the participants to teach the course confidently and to act as Human Brain and Senses staff developers. The secondary goal was to look beneath the surface—any surface—to explore deep truths.

Last fall at an NSTA convention we mentioned the idea of a Human Brain and Senses workshop to Marilyn Decker and Pam Pelletier of the Center for the Enhancement of Science and Mathematics Education program (CESAME). They discussed how great it would be to hold the workshop on their campus. They were particularly excited because they are affiliated with the CenSSIS (Center for Subsurface Sensing and Imaging Systems) engineering center on their campus and saw an opportunity to bring the CenSSIS expertise into the workshop plan.

CenSSIS has a number of high-powered engineering research centers as members, including the optics lab on the Northeastern Campus, Woods Hole Oceanographic Institution, and Massachusetts General Hospital. Each of these engineering groups was engaged in looking below the surface of something to find out what’s going on. Marilyn and Pam immediately made the connection between the diverse interests of the CenSSIS groups and the challenges of studying the brain’s structures and functions without disturbing its integrity. Their enthusiasm was enough to convince us that Boston was the place for the workshop. We started planning.

The results are history now. The workshop started on Sunday afternoon with a get-acquainted reception and dinner at the Boston Museum of Science. After introductions, we steered the group to the human body wing, where we explored brain physiology, optical illusions, reaction time, depth perception, etc. A fine supper and a show in the IMAX theater about Ernest Shackleton’s Antarctic adventure wrapped up the first day.
Monday and Tuesday we tackled the course, covering the first six investigations. We also had a short stint in the computer lab to become familiar with the CD-ROM and a quick tour of one of the laser research labs on campus. We saw exploratory systems for looking under Earth’s surface for land mines and some emerging technologies for 3-D imaging of human joints and microscopic imaging of the cell interiors. Amazing stuff—the third eye in action.

Wednesday we took a trip to Woods Hole to see some emerging technologies for imaging the sea floor. We visited the prototype of the latest ROV (remotely operated vehicle) called ABE, short for autonomous benthic explorer. What makes ABE the cutting-edge imager is that it is unmanned and untethered—it is able to go anywhere in the ocean and work for as long as it is needed.

Thursday afternoon we took the T (Boston’s underground transit) to Mass General Hospital, one of the largest and most important medical research hospitals in the country (14,000 employees). Our host, George Chen, took us behind the scene to see the proton knife. This experimental tumor killer uses a proton beam to destroy cancer cells by damaging their DNA or producing a flood of free radicals that do the job. The heart of the knife is a modest cyclotron connected to a mammoth beam-aiming system, all of which weighs in at some untold number of tons. All this technology is designed to deliver a high dose of energy at a precise location without any damage at all to surrounding tissue. A considerable breakthrough.

Friday we wrapped up the course and parted company, somewhat brainier and quite a bit more sensitive to the tools used to study our amazing brain and senses. 🧠.
The Various Dusts in FOSS Kits

If FOSS kits are well-used, there should be no concern for dust on the outside of the boxes, but it is the “dust” (also called fine particulates) inside the boxes that has our attention once more. There have been some questions about possible health issues surrounding the diatomaceous earth and powdered clay in some FOSS kits. Diatomaceous earth was once used in the stream tables that are part of the Landforms Module and is still used in small quantities in the Mixtures and Solutions Module. Powdered clay replaced diatomaceous earth in the stream tables where it is now used in small quantities mixed with fine-grained sand.

Our current information was that there are no health concerns associated with the use of these materials in the classroom. To update our information, the FOSS staff contacted Christine Parks, a researcher at the National Institute for Environmental Health Sciences in Research Triangle Park, North Carolina. She, in turn, connected us with Dr. David Goldsmith, an associate research professor at the Department of Environmental & Occupational Health at George Washington University in Washington, D.C. His primary research involves cancer prevention, pesticides, and risk assessment for airborne silica dust. Dr. Goldsmith happened to be in the Berkeley area and generously agreed to spend some time with us at LHS to answer our questions about these materials.

Dr. Goldsmith’s research on silicosis and the materials that contribute to it has focused mainly on occupational hazards. Certain occupations, such as mining, sand-blasting, sculpting, road construction, and silica-rock processing, place workers at risk because of the great exposure to airborne silica. These occupations are sometimes called the “dusty trades.” In these occupations workers are exposed to large amounts of dust over long periods of time. Good ventilation and devices such as air filters, respirators, breathing masks, safety goggles, and protective clothing can reduce the exposure and lessen the risk.

If silica, such as that found in diatomaceous earth and clay, is an occupational health hazard, is it safe to use in the classroom?

According to Dr. Goldsmith, the methods and techniques in which these materials are used in FOSS essentially eliminate any hazard. In FOSS investigations,

• Exposure time to silica-containing materials is limited.
• The quantity of silica-containing materials is limited.
• If used according to instructions, the silica-containing materials are mixed with water. There should be no dust, as the silica bonds with the water.

NOTE: Some powdered clays and some forms of diatomaceous earth contain a higher percentage of silica. For example, calcined, or cooked, diatomaceous earth contains more crystalline silica. Natural diatomaceous earth (that is, uncalcined) is called amorphous. It has much less crystalline silica. Certain types of clay contain more silica than others. And when clay pottery is fired (i.e., calcined), more crystalline silica is formed.

The powdered clay and diatomaceous earth used in various FOSS modules have been specifically chosen so as to have as little crystalline silica as possible. Labeling on bags and bottles in the kits will provide information on hazards and use.

There are other provisions you can make to eliminate flying dust in the classroom. These are:

• In the Landforms Module, the earth material, consisting of sand and powdered clay, should be mixed in a closed zip bag. Water should be added to the earth material in the bag to cut down on flying dust.
• Contact lens wearers should remove their lenses before mixing the material. Use safety glasses for further protection. (Note: If the material is mixed in a closed bag as described earlier, there should be little or no dust to worry about.) Airborne silica dust particles may get lodged behind the lens and irritate corneas. If eye contact occurs, immediately flush the open eye with.
lukewarm, gently flowing water for at least 10 minutes. If irritation continues, obtain medical attention.

- Some students may experience mild, temporary skin irritation when handling the stream table earth material, especially if humidity is particularly low in your area. If this is a concern, make sure students use the wooden blocks supplied in the kit to manipulate the material in the stream table. Before handling the material, it also helps to wash hands and apply a skin location. Dry skin is more susceptible to irritation. If irritation occurs, rinse the irritated area with plenty of clear water.

- To clean up, do not dry-sweep powdered clay or diatomaceous earth. Whenever possible, sweep up the material when damp or spray with water before you sweep to cut down on the amount of airborne dust. Have students conduct their investigations over old newspapers that can then be rolled up and tossed, containing any dust spills.

By following the guidelines above and those included in the FOSS teacher guide, you should have no problems with the use of these materials in your classroom.

**Resources**

Dr. Goldsmith has agreed to be a continuing resource for further questions you might have about silica and its health hazards.

**David F. Goldsmith, MSPH, PhD**

Associate Research Professor

Department of Environmental & Occupational Health

George Washington University

2300 K Street NW, Suite 201

Washington, DC 20037

Tel: 202-994-1734; fax 202-994-0011

email: eohdfg@gwumc.edu


**Materials Safety Data Sheets (MSDS) Online**

There are a variety of websites where you can download MSDS for substances you might have in the classroom. Before doing so, make sure you have as much product information as possible, as MSDS may vary from one manufacturer to another and from one version of a substance to another (e.g., calcined versus amorphous diatomaceous earth). Some sites to browse include:

- Vermont SIRI MSDS collection: [http://hazard.com/msds2/](http://hazard.com/msds2/)
- Cornell University MSDS Search: [http://msds.pdc.cornell.edu/msdssrch.asp](http://msds.pdc.cornell.edu/msdssrch.asp)

---

**More Ways to Keep Science Safe**

**Vermiculite**

Vermiculite has recently made the news as a potential health hazard. The vermiculite that has caused concern comes from a specific source, Libby, MT. The Libby vermiculite contains a higher percentage of asbestos. This is the only vermiculite source that we know of that has this problem and is NOT the vermiculite supplied by Delta Education. As a result, FOSS vermiculite is not a potential health hazard. Vermiculite is used in the FOSS *New Plants Module* for grades 1 and 2.

**Owl Pellets**

A May 31, 2001, report in the Saint Paul Pioneer Press described an outbreak of salmonella that was probably caused by owl pellets from a captive owl. Students dissected the owl pellets during a science club meeting on a cafeteria table that was later cleaned with water, but not disinfected. It is also reported that students did not wash their hands after handling the owl pellets. Within a few days, many students exhibited flu-like symptoms. After some detective work, the symptoms were attributed to salmonella.

Owl pellet dissection is now part of the FOSS *Human Body Module*. By taking appropriate precautions, there should never be any problem with disease associated with this activity. These precautions include:

- Purchase owl pellets from Delta Education or another science supply company that specializes in owl pellets. These owl pellets are sanitized chemically to eliminate any chance for disease.
- Make sure students wash their hands with soap after working with owl pellets.
- As an extra precaution, provide students with masks and latex gloves. (Note: Be sure students aren’t allergic to latex before providing them with gloves.)
Health Research: Inquiry in Action!

Paracelsus was a 16th century physician who was the first to realize that a chemical can be safe at a low dose but poisonous, or toxic, at a higher dose. He came up with this hypothesis: The dose of a chemical determines the type and severity of the body’s response to it.

Paracelsus (1493-1541) was born in Einsiedeln, Switzerland in 1493, one year after Columbus’s first voyage to the New World. Paracelsus was a member of an illustrious group that included Nicholas Copernicus, Martin Luther, Leonardo da Vinci, and many others associated with the shattering of medieval thought and the birth of the modern world. The scientific debates of the late sixteenth century were centered more frequently on the innovations of Paracelsus than they were on Copernicus’s theory of a heliocentric system.

Paracelsus laid the groundwork for scientists, like Dr. Goldsmith, in the study of environmental health issues. Environmental health specialists continue to conduct inquiries into possible health risks from different materials that may be part of our daily lives, whether at work, in our homes, schools, and places of commerce, or within the environment in which we live and maintain our existence.

Environmental health scientists employ the same techniques that students are introduced to in FOSS modules. They ask questions such as “How much of a certain chemical (e.g., silica) is in the air, water, soil, sediments, or organisms?” Or “How much exposure do people have to chemicals when they breathe air, drink water and milk, garden, build highways, etc., and when does this exposure become a health hazard?” They gather information to help answer the question by reading about research that other scientists have done and about techniques and instruments that other scientists have used to study the chemical. They form testable hypotheses, i.e., those that can be answered with the available techniques and instruments. They may have to develop new techniques and instruments to explore a hypothesis. They can use methods that have been used before or validate or prove that their new methods work. They conduct controlled experiments and report their results, describing their methods and their conclusions based on evidence and assumptions they collect and make.

These were the methods Dr. Goldsmith employed in his studies of silicosis and agricultural cancer prevention for farm-workers and farmers in California’s Central Valley. His research now focuses on the science and epidemiology for the Occupational Safety & Health Administration’s (OSHA) new national silica dust standard and a new study of pesticide exposure and the risk of ovarian cancer. These are the types of concerns that your students may address in their future careers as scientists and lives as well-informed citizens. These are the methods of inquiry which they learn as they are involved with FOSS modules and courses.

Resources
Office of Environmental Health Hazard Assessment (OEHHA) Website
http://www.oehha.org/education/risk/

This website for teachers and students includes a tutorial on how OEHHA scientists study possible hazardous substances plus links to information about common art supply hazards and other educational resources.

Paracelsus: Five Hundred Years: Three American Exhibits

If you’d like to learn more about Paracelsus, visit this website from the National Institute of Health. This is an online version of an exhibit held at three sites in 1993 and 1994 (the National Library of Medicine, Bethesda, MD; Hahnemann University, Philadelphia, PA; and Washington University, St. Louis, MO).
Mapping the Grand Canyon


John Wesley Powell’s trip as students discover in the Landforms Science Stories and in the Earth History course was made when the only way to map a place was to go there. This investigation was known as a survey. This website describes how today the U.S. Geological Survey produces its popular topographic maps by using remote photography and computers.

Lunar Atlases

http://www.lpi.usra.edu/research/la_home.html

The Lunar and Planetary Institute website includes two lunar atlases, the Lunar Orbiter Atlas of the Moon and the Consolidated Lunar Atlas. Students can search through both atlases for photographs of craters to compare to their efforts with the cratering investigation in the Planetary Science Course.

Phases of the Moon

http://lunar.arc.nasa.gov/science/exp2.html

A Shockwave presentation from the NASA Ames Research Center (ARC) demonstrates how the Earth/Sun/Moon system operates to create Moon phases. Students can compare this demonstration to the simulation on the FOSS Planetary Science CD-ROM.

Clastic Depositional Environments

http://www.science.ubc.ca/~eoswr/clastic/clastic.html

The Geological Science department at the University of British Columbia provides students with more information about the types of environments in which different sedimentary rocks have their origin. By clicking on a word on the image or one of the words below, you will be shown examples of rocks typical of that environment. This is a good extension to the FOSS Earth History Course.

Scientists in Action!


This U.S. Geological Survey website includes news about careers in the natural sciences—from mapping the planets to sampling the ocean floor, from protecting wildlife to forecasting volcanic eruptions.

Online Connections for FOSS Modules

This issue’s list of online connections focuses on some of the topics covered in the FOSS Middle School courses. If you or your students have encountered any websites you’d like to share, send the URL and an annotation to Sue Jagoda at skjagoda@uclink4.berkeley.edu. Look for more online resources at http://www.fossweb.com.
New from the Wordsmiths

Footprints on the Moon

In this well-illustrated book, you’ll look at our fascination with the Moon, spotlighting Project Apollo. It includes many captioned photographs of the Moon and those who have explored it. This is a good resource for students who get interested in the Moon after reading the story about water on the Moon in FOSS Water Science Stories. (Water, Planetary Science)

The Icky Bug Alphabet Book

Once you get past the title of this colorful book, you’ll be introduced to the characteristics and activities of insects and other crawly creatures from A to Z, beginning with ants and ending with zebra butterflies. After you read the book with your students, you might discuss whether the word “icky” applies to all insects and crawly creatures. (Animals Two By Two, Insects)

Books for Younger Learners

At Home in the Rainforest

From the tops of the tropical trees to the forest floor, this colorful book shows the interrelationships of plants and animals which thrive at each level of an Amazonian rainforest. (Animals Two By Two, Insects, Structures of Life)
Books for Older Lifelong Learners

Air Apparent: How Meteorologists Learned to Map, Predict, and Dramatize Weather
Traces the scientific debates that try to unravel the enigma of storms and global change, explains strategies for forecasting severe weather, and efforts to detect and control air pollution. If you’re fascinated with the Weather Channel, this may be the book for you. (Air and Weather, Solar Energy)

The Eternal Frontier: An Ecological History of North American and Its Peoples
An account of North America from the end of the dinosaurs to the current ecological crisis. The author, a world-renowned paleontologist, traces the rebirth of plants, animals, climate, and landforms after the mass extinctions 65 million years ago when the North American continent was devastated by the impact of a celestial object. (Earth History, Environments)

Braving the Elements: The Stormy History of American Weather
Americans are fascinated with weather, and North America is a land of extreme weather. This book contains stories from over the centuries about hurricanes, droughts, blizzards, dust bowls, and other extreme weather that has affected our land. The author offers the history of how weather has changed Americans and shaped the nation. (Air and Weather, Solar Energy)

In the News

What Killed the Iceman?
Two recent reports provided new information about what may have caused the death of the Iceman. The story of the Iceman is introduced in FOSS Human Body Science Stories as part of the Human Body Module. In September 1991 a German couple hiking in the Alps discovered his body poking out of the snow. Since then many scientists have tried to unravel the evidence to find out how the Iceman ended up buried in the snow, how he died, how old he was, what he looked like, and more.

A report in Discover magazine in June 2001 described the analysis of his intestinal contents. Klaus Oeggl, a paleoethnobotanist at the University of Innsbruck in Austria found pollen from the hop hornbeam tree in the contents. This tree flowers in the spring and lives only at low altitudes. The pollen grains were intact. Pollen degrades rapidly when exposed to the air, so Oeggl suggests that the Iceman must have died in spring or early summer. Skin analysis also supports this idea since it appears that the body must have lain in a pool of water for several weeks before it was frozen.

A July 16, 2001, article in several newspapers relates how an X ray revealed a flint arrowhead in the left side of the Iceman’s chest. He probably suffered for a few hours after being shot and eventually died of internal bleeding and possibly paralysis.

You might encourage your students to find updated research and ideas about the Iceman. As one scientist suggests with this new evidence, “The story needs to be rewritten.”

Life: A Natural History of the First Four Billion Years of Life on Earth
One of the world’s leading paleontologists relates his own adventures in the field as he creates vivid descriptions of creatures who emerged and disappeared over the vast march of geologic time. Includes bibliography and index. (Earth History, Diversity of Life)
Opportunity for FOSS Teachers to Learn Science Content

Are you a teacher currently using FOSS materials in our classroom? If so, a new project in teacher professional development may be seeking your input.

Over the next four years, the National Teachers Enhancement Network (NTEN) will be developing and piloting 12 Internet-delivered “short courses” (1 graduate credit each) focusing on the science concepts that underlie kit-based curricula. NTEN is looking for teachers, experienced with FOSS, to serve on development teams or to participate as students in the pilot versions of these courses.

Located at Montana State University—Bozeman and funded by the National Science Foundation, NTEN has provided professional development in the form of science content courses for high school and middle school teachers since 1993. An NTEN course is highly structured, involves close communication with the instructor and fellow participants, and carries regular MSU credit. Because it is delivered nationwide by computer-mediated conferencing, a participant may access the course at any time during the day from a computer at home or work.

Working in consultation with the developers of FOSS, STC, and Insights, NTEN is now working on a new four-year project to create similar resources in support of elementary school teachers. The project is now recruiting in-service elementary teachers for two challenging and rewarding roles.

1. Teachers with extensive FOSS experience may apply for the opportunity to participate on development teams, working with university science and science education faculty and educational technologists and helping to create individual course modules. This role will involve extensive interaction with the other team members, as well as travel and compensation.

2. Teachers who have been using FOSS kits for at least two years may request to join an initial class of students for the pilot version of an NTEN short course. These participants will take the course free of charge (tuition and materials) and will provide the developers with detailed feedback to help guide the course revision and improvement process.

To express your interest in these opportunities, or for further information, please contact George Tuthill (406-994-6177, tuthill@physics.montana.edu) or Kim Obbink (406-994-6550, kobbink@montana.edu).

To learn more about NTEN, please visit http://btc.montana.edu/nten.

Answers to Solar Observations
page 7, FOSS Newsletter, Spring 2001, Number 17
You can see the original “Solar Observations” article online at http://www.lbs.berkeley.edu/FOSS/Foss17.SolarObservations or download the entire PDF version of the newsletter at http://www.lhs.berkeley.edu/FOSS/Foss17.SolarObservations.

- The two Shadow Trackers were created on March 30, 1999. The top Shadow Tracker was aligned to true north, i.e., toward the north pole of rotation. The lower Shadow Tracker was aligned with magnetic north, i.e., the north towards which the needle points in a compass. These two “norths” can vary as much as several degrees. Magnetic north does not remain constant. You might have noticed a symbol on topographic maps referring to magnetic declination. This symbol tells how much difference there is between true and magnetic north. This information is useful when you are trying to find your way with a map and compass, i.e., orienteering. For more information about magnetic declination, check out these websites.


- The photo of the Sunstones at Lawrence Hall of Science was taken during one of the equinoxes, either spring or fall (we don’t know for sure). An equinox is when night and day are of equal length in all parts of the Earth. The word equinox comes from a Latin word meaning “equal night.” At this time the Sun appears to rise and set directly over the Equator. It sets due west. For more information, check out the NASA website http://www-istp.gsfc.nasa.gov/stargaze/Season.html.

- The shadow tracings at the bottom of page 7 probably don’t provide enough information for an accurate answer. Was the person whose shadow was being traced facing toward their shadow or away? If they were facing their shadow, the sun was at their back. So the longer shadow was taken during early morning hours when the sun was lower in the sky. The shorter shadow was drawn later in the day when the sun was almost overhead. If the shadows were drawn in the morning and the person was facing their shadow, they were facing to the west. Would the shadow have looked the same if they had been facing away from it? That’s something to try out. (Some clues from the photographer: The person was facing their shadow in the morning.)
### FOSS Institutes and Workshops

FOSS and Delta Education host institutes and workshops in conjunction with the National Science Teachers Association’s (NSTA) Area and National conventions. On each Wednesday prior to the conference, FOSS staff and consultants present one-day introductory institutes for both the K–6 and Middle School programs. During the conference, the staff presents half-day FOSS Middle School Short Courses and 75-minute K–8 workshops featuring various program components and grade levels. These institutes and workshops are designed for all educators—teachers and administrators—who are interested in finding out more about FOSS, learning the research and development behind the program, and networking with other FOSS users. Most of the time is spent working with the different program components, conducting investigations, and engaging in inquiry.

During the summer Delta hosts Implementation/Leadership Institutes. These meetings are designed for educators who have adopted FOSS and are into their implementation process. Some time is spent working with the FOSS materials, but a greater proportion of time is spent delving into issues of management, teacher preparation, materials maintenance, and a host of other subjects.

Most Institutes are led by FOSS development staff. There is no charge, but participants must register in advance to attend. You are responsible for your own travel and lodging expenses. Times and locations are listed in the calendar. To secure your spot at the Institute of your choice, call, write, fax, or e-mail:

Pam Frisoni  
Delta Education, Inc.  
80 Northwest Boulevard  
Nashua, NH 03063  
pfrisoni@delta-edu.com  
Phone: 1.800.258.1302 ext. 503  
Fax: 603.579.3504

#### NSTA Fall Area Conventions
- **October 25–27** Salt Lake City, UT  
- **November 8–10** Columbus, OH  
- **December 6–8** Memphis, TN

#### FOSS K–6 and Middle School Introductory Institutes (at NSTA)
- **October 24** Salt Lake City Marriott Downtown  
- **November 7** Hyatt Regency, Columbus  
- **December 5** The Peabody, Memphis

#### FOSS Middle School Short Courses (at NSTA convention center)
- **Thursdays (10/25; 11/8; 12/6)**  
  - 8:00–11:15 FOSS Human Brain and Senses Introduction  
  - 1:00–4:15 FOSS Electronics Introduction

#### FOSS K–8 Workshops (at NSTA convention center)
- **Fridays (10/26; 11/9; 12/7)**  
  - 8:00–9:15 FOSS Assessment for Grades 1–6  
  - 10:00–11:15 FOSS Middle School: Earth History Overview  
  - 12:00–1:15 FOSS Middle School: Planetary Science Overview  
  - 2:00–3:15 FOSS for Grades 1–2: An Overview featuring Air and Weather  
  - 4:00–5:15 FOSS for Grades 3–6: An Overview featuring Physical Science Investigations

#### NMSA Annual Conference (National Middle School Association)
- **November 1–3** Washington, DC

#### FOSS Middle School Introductory Institute
- **October 31** Location TBA

#### NSTA National Convention
- **March 27–30** San Diego, CA

#### FOSS K–6 Introductory Institute  
**FOSS Middle School Introductory Institute**  
**FOSS Advanced Institute: Research into Practice** (by invitation only)  
- **Tuesday, March 26**

---

To register for any of the Institutes, please provide the following information:

<table>
<thead>
<tr>
<th>Yes! I’m interested in attending a FOSS Introductory Institute.</th>
<th>Yes! I’m interested in attending a FOSS Implementation/Leadership Institute.</th>
<th>Yes! I’m interested in attending a FOSS Middle School Institute.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Please send me registration information for the [Institute name, date, location].</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School</td>
<td>District</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Address</td>
<td>E-mail</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>State</td>
<td>Zip</td>
</tr>
</tbody>
</table>

I did not receive this newsletter in the mail. Please add my name to the FOSS mailing list.
About This Newsletter . . .

The intent of the FOSS Newsletter is to help FOSS users develop a network of support across the country. Delta Education and LHS will work together to bring you news two times per year, including articles regarding the latest development of modules, tips about management from teachers and administrators, ways to make connections with other teachers and districts, extensions and reading materials to add to modules you are already using, and informative articles about good educational practices.

So, we need your help. If you have a tip that enhances the teaching of FOSS or would like to submit an article (with photos) about exciting activities or school programs, management, implementation projects, etc., please send them in. We would also like to hear from your students, whether they have questions about the content, projects they have done, photos or other images they have created, or insights into how they use the World Wide Web with FOSS. Send your contributions to:

FOSS Newsletter
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

The deadline for submissions to the next issue is January 11, 2002. We’re waiting to hear from you.

Delta FOSS Sales and Marketing Division
800.258.1302
603.889.8899
fax 603.579.3504

Tom Guetling
Vice President Sales & Marketing
tguetling@delta-edu.com

Pam Frisoni
Marketing Communications Coordinator
pfrisoni@delta-edu.com

Dana Koch
Director of Sales
dkoch@delta-edu.com

Karen Stevens
Marketing Manager
kstevens@delta-edu.com

Dave Vissoe
Director of Marketing
dvissoe@delta-edu.com

FOSS Regional Sales Managers
All Regional Managers have toll-free voice mail at 800.258.1302

Bill Corbett
Nashua, NH
603.579.3541
bcorbett@delta-edu.com

Harold Edwards
Pleasantville, NJ
609.646.0478
Hedeo@delta-edu.com

Verne Isbell
Keller, TX
817.379.2013
FOSSK8@aol.com

Comer Johnson
Folsom, CA
916.983.1702
FOSSK8@aol.com

Steve Jones
Hobe Sound, FL
561.546.9587
dsjones@aol.com

David Kavlick
Medina, OH
330.722.2875
davkav@aol.com

Adrienne Maughan
Loveland, OH
513.936.8074
FOSSRepAM@aol.com

Tom Pence
Osweego, IL
630.215.3017
TApence7228@aol.com

Gary Seymour
McHenry, IL
773.973.7590
Seymourdelta@aol.com

Dean Taylor
Flagstaff, AZ
928.527.5717
MRFOSS@aol.com

For More Information

For information about purchasing FOSS or for the phone number of your regional representative, call Delta Education, toll free at 800.258.1302 or log on to www.delta-education.com

For information about the development of the FOSS program, contact:

Larry Malone or
Linda De Lucchi
FOSS Program
Lawrence Hall of Science
University of California
Berkeley, CA 94720
voice: 510.642.8941
FAX: 510.642.7387
Internet: lmalone@uclink4.berkeley.edu

Printed on recycled paper

FOSS Newsletter Online
Would you like to receive the FOSS Newsletter electronically? Please send an e-mail to kstevens@delta-edu.com to start receiving this newsletter via e-mail. Include your name, title, school, and e-mail address. An archive of FOSS Newsletters is available online at www.lhs.berkeley.edu/FOSS/FOSS.Archives.html.

Please remove my name from the mailing list.