FOSS

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FOSS

N E W S L E T T E R

Waves of Systemic Reform

There is activity in America to reform science and mathematics education. Old methods are not congruent with new realities. Passé is the notion that science is a collection of facts about the world and how it works. Science is now understood to be a process of finding out and a system for organizing and reporting discoveries. Science is a way of thinking and working toward understanding of the world in the company of others. More than ever before there is a surge of agreement among educators that elementary science is an active enterprise. FOSS agrees with this vital new view of science education.

Implementing FOSS calls for systemic reform. Whether the system is as modest as a single school, or as grand as a state, implementation of FOSS means reform. The National Science Foundation, in recognition of this fact, has enacted several programs to promote systemic reform. First was the State Systemic Initiatives. The SSIs provided funds to states to design fresh, contemporary approaches to science and mathematics instruction, and to initiate new practices.

Second was the Urban Systemic Initiatives. At this time, nine awards have been made, with a dozen or so additional awards to be made in the future. USIs are intended to stimulate the implementation of new methods and materials that will promote improved science and mathematics performance by the traditionally underserved students in inner-city environments. FOSS holds tremendous promise for implementation in USIs because it upholds all of the reform expectations while at the same time relieving the USI project managers of the need to create appropriate curriculum. However, one major dimension to the USI program

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FOSS in Fort Collins

by Ted Stoeckley

Our science is fun thanks to the efforts of a community of educators in the Poudre R–1 School District in Fort Collins, Colorado. Four years ago a committee of school district and university professors (University of Northern Colorado) began the process of selecting a new science

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Reform continued

still needs to be addressed. If students are learning a new kind of science, how will learning be assessed and reported? Old standardized testing will not be useful in the reform. Assessment will need to be pulled in under the banner of reform as well.

Just ahead is the newest reform program, the Local Systemic Initiatives. LSIs will be administered by Teacher Enhancement Division of NSF. This will be another excellent opportunity for FOSS to play a role in science education reform at the most manageable level—locally. Let your creativity guide the development of a project to advance the cause of science education reform in your area. Project designs might revolve around a large or medium-sized school district, consortia of small districts, a partnership with a college, relationships with informal education agencies, and multitudes of other collaborations that make local sense. Guidelines are available by calling 703-306-1613 and asking for the **Local Systemic Change Through Teacher Enhancement K–8** guidelines. Preliminary proposals are required and due at NSF by January 7, 1995, with full proposals due March 9, 1995. If there is a place in your project design for the FOSS program, or if we can provide input during the development of a project design, call and talk with us.

Ft. Collins continued

program for grades 4–6. Critical selection criteria included hands-on approach, constructivist methodology, careful attention to teacher support, and non-text orientation. We selected FOSS. Now, four years later, FOSS has been successfully implemented in 24 elementary schools, and plans are in progress to add a 3rd grade FOSS component in the near future.

Successful introduction of FOSS into our district was made possible in large part by the Elementary Science Implementation Project, funded by the National Science Foundation. ESI provided the resources to design, develop, evaluate, and disseminate a model staff development program to systematically affect change in science teaching. The project personnel included district trainers (Mike Bilsing and Maggie Carter) and university collaborators (Jay Hackett and Debbie Powell).

During the first year of the project, the staff developed a team of building-level teacher leaders, known as FOSS-ilitators. During the spring of 1991 the teacher leaders completed 30 hours of workshops focused on the FOSS modules, with additional emphasis placed on content background and learning cycle, while creating a science-inquiry environment by modeling cooperative learning and curriculum integration (reading, writing, and math). The final phase of the preparation of the teacher leaders was to design a site staff development plan, the FOSS Implementation Plan (FIP).

The FIP required the participation of every teacher, grades 4–6, and every site administrator in the district. The administrators had to commit staff development time and the site FOSS-ilitators had to prepare their teachers to use FOSS effectively. Over the next two years every teacher received 60 hours of instruction and support, including peer coaching in the classroom. The combination of the FOSS program materials and the staff development provided by the ESI project has transformed the way science is taught in Poudre R–1 School District. Where we once had a textbook, content-based, teacher-directed program, we now have a hands-on, student-oriented, inquiry-driven science program. Both teachers and students are very enthusiastic about science now.

The FOSS-ilitators, now considered experts in their buildings, have ongoing maintenance responsibilities at their schools. They participate in the district-wide FOSS module distribution system by inventorying kits before the kits are returned to the District Materials Center, they introduce new teachers to the FOSS program and approach, and continue to meet during the year to ensure smooth and continuous utilization of the FOSS materials.

The NSF funding is over, but the momentum generated by the project keeps FOSS going well. Eisenhower funds provide the support to keep training activities going, and the new cadre of trainers, elevated from the ranks of the FOSS-ilitators, are expanding the FOSS core curriculum in exciting ways—adding Britannica Science System videodisc technology, integrating GEMS activities with the FOSS modules, and extending the FOSS assessments to develop a districtwide authentic assessment program.

If this sounds like another FOSS success story, it is! And a good thing just keeps getting better.

Editor's note: The Fort Collins implementation program looks like an excellent model for a Local Systemic Initiative proposal to NSF (see Reform article in this newsletter). We can all learn a lot from the pioneering efforts undertaken in Fort Collins.

Ted is a 5th grade teacher at Laurel School and FOSS-ilitator for Poudre R–1 School District in Fort Collins, CO.

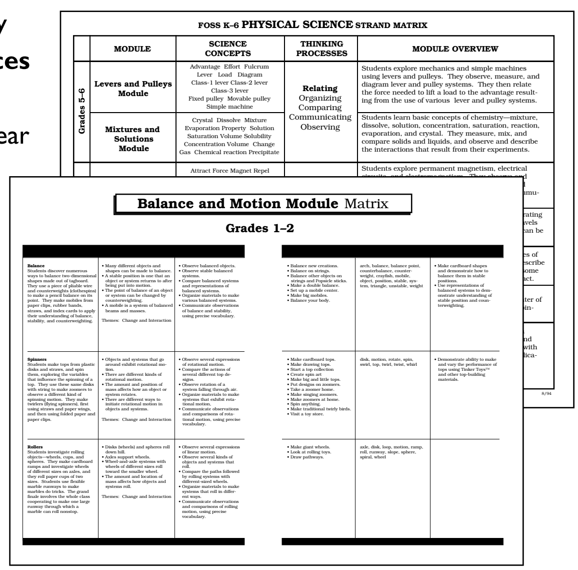
K–2 Revision Complete

Kindergartners in El Cerrito, CA, stage a snail race.

The FOSS staff members were chained to their computers during the months of April, May, and June, so that they could concentrate on revising the eleven modules for grades K–2. The critical commentary from the local school districts and the ten national trial centers where the K–2 materials had been in use for up to two years had to be incorporated into the revision. The student materials were translated into Spanish, and the imbedded assessment items were refined. The FACTs sheets for each module listing complementary literature and video resources were refined and updated. And finally, a teacher-preparation video was developed for each module.

The revised K–2 modules will be available starting in the fall of 1994. Those interested in purchasing revised teacher guides to update their K–2 modules should contact their Britannica sales representative or call the toll-free Britannica number. The materials kits were revised very little, so it is not necessary for current K–2 users to update the materials kits. For a complete list of the significant materials and procedural changes in all of the K–2 modules, write or call the FOSS offices at the Lawrence Hall of Science. Educators who have purchased K–2 kits can call their Britannica rep to retroactively receive their copy of the teacher-prep tape.

FOSS Strand and Module Matrices Available



Need to see FOSS laid out strand by strand? The FOSS **Strand Matrices** is a set of four 1-page documents, each of which shows how students advance year by year throught one of the major strands in the FOSS program: Life Science, Physical Science, Earth Science, and Scientific Reasoning and Technology. Each 1-page matrix suggests a logical sequence of FOSS modules, and describes the major concepts and important thinking processes that come into play at each grade.

Need to see a one-page detailed description of one of the FOSS modules, or all 27 modules for that matter? The **FOSS Module Matrices** includes a 1-page description of each of the 27 FOSS modules. Each matrix is a spread sheet that provides a synopsis of each activity in the module, the major concepts and thinking processes covered, the language and math integration opportunities, assessment activities, and science extension activities. This can be a useful tool for science committees and other curriculum planners and decision makers. For a copy of the **FOSS Strand Matrices** or **FOSS Module Matrices,** write, call, fax, or net the FOSS staff at the Lawrence Hall of Science.

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Where's Kathy?

Kathy Daiker might be a familiar name, particularly if you attended a FOSS workshop in the last four or five years, perused the list of FOSS staff on the back of a module overview, or watched a FOSS teacher preparation video. What you probably don't know is that Kathy has left the FOSS staff at the Lawrence Hall of Science to pursue another goal, a Ph.D. in early childhood education at the University of Alabama in Birmingham.

In 1988 Kathy was a fourth grade teacher at Valhalla School, a FOSS local trial school in the Mt. Diablo Unified School District. Kathy saw immediately what FOSS was all about and made an appointment to introduce herself to the staff and talk about her personal long-range plans to work in curriculum development. For the rest of that year, Kathy distinguished herself by providing insightful comments about the modules she used in her classroom. Clearly, she was a keen student of her own profession as well as a skilled teacher.

When a position as a FOSS developer opened up at the end of the year, it was agreed that Kathy was the one to fill it. During the next five years Kathy was a valuable and enthusiastic member of the team. (At the end of her first month, we couldn't imagine how we ever managed without her.) Her expertise as a classroom teacher, familiarity with programs and methods used in early-childhood education, and willingness to tackle any task were enormous contributions to the success FOSS is experiencing today. Kathy was a central player in Science Update, a teacher enhancement project in Oakland and San Mateo County in the San Francisco Bay Area. She also took leadership in the FOSS K–2 module development, developed assessments for FOSS 3–6 and K–2 modules, produced models for integration of reading, writing, and mathematics in FOSS modules, edited the FOSS newsletter, coordinated the production of the K–2 teacher preparation videos, ran the Bay Area FOSS kit lending library, and conducted numerous leadership institutes nationwide. That's all—I guess we won't miss her much.

In her previous lives, Kathy earned a B.S. in physical education and child development at San Jose State University in California, continued her studies at the College of Notre Dame in Belmont, California, where she earned her Masters in Education, and from there fine-tuned her education with training at the Montessori Teacher Training Center and at St. Mary's College in Moraga, California. She was the owner, director, and a teacher at the American Montessori School before continuing her teaching career in the Mt. Diablo district.

In June Kathy began her course work at the University as she continued to provide training at FOSS Leadership Institutes around the country. We just got our first e-mail message from her; here's an excerpt:

Things are going very well here. It's tough being back in school and trying to conform to the rigors of academia, but I've learned so much already. That part of it is very exciting.

We feel like proud parents around here. Our bright and wonderful child has grown up and gone off to college. The house feels pretty empty at times. We hope secretly that she will get her degree in a week or two and come home to take her place in the family again. But of course she has turned a page in her life and is writing the first few words on the blank sheet. And what a surprise to see her write "...I've learned so much already..." Best wishes, Kathy.

Return to Slovakia

In December of 1993, Linda De Lucchi and Larry Malone traveled to Bratislava, capital of the Slovak Republic, to work with 40 teachers. Using interpreters, we spent four intensive days introducing eight FOSS modules, and then we headed home. EBEC sent over four sets of the modules for pilot testing in selected schools, and that was the extent of our contact with the Slovak teachers.

In April of 1994, we returned to Slovakia, this time to visit schools. The experience was galvanizing. The school buildings are clean, often well supplied with plants, and bustling with enthusiastic educators at all levels. Classrooms, on the other hand, are stark by American standards—few wall decorations or bulletin-board displays, no duplicated work sheets, no electronic teaching aids, and few books and manipulatives. The students sit in traditional rows facing forward, and the teacher teaches, using a chalkboard and whatever few teaching aids she can make or obtain. All of the elementary teachers we met were women. Students write and recite. Consequently, typical upper-grade students are very accomplished at recording information in an organized manner on paper and have excellent verbal reporting skills.

Then came FOSS. The FOSS classrooms that we visited were different. Rows of desks had been replaced with tables for collaborative groups of four. Students worked with FOSS materials and interacted with one another. The noise level went up, and students were out of their seats. The teachers guided the learning from the side. The experience was wonderful because it was at the same time totally unexpected and completely logical. Except for the fact that we couldn't understand the chatter that was going on, we could have been at that moment in a typical classroom in the San Francisco Bay Area. We were observing something universal—something larger than culture, experience, and opportunity. Young people were interacting with materials and each other in anticipated ways, coming to fundamental understandings about their natural world.

The Slovak teachers we met were resourceful, flexible, and eager to incorporate FOSS methods into their instructional practice. When asked if they had previously taught with students in groups, interacting with one another, teachers said no, they had to make a special effort to get appropriate furniture and had to be courageous to allow students the freedom needed to use FOSS. And when we asked if the collaborative-group experience was rewarding, teachers said yes, and volunteered that they now keep their classrooms organized in collaborative groups for all subjects.

With a successful pilot completed, the next step is to explore ways to assemble FOSS kits in Slovakia.

A fourth grade teacher visits with a group of students while they prepare to investigate electromagnetism

Third graders in Bratislava using the Measurement module

Being scientifically literate is more than knowing a set of science facts or having a set of science skills. It includes a way of thinking, a way of seeing, and having a set of values and perspectives. In Tailors' Alley in West Africa, learning the curriculum of tailoring and learning to be a tailor are inseparable: the learning takes place in the context of doing real tailors' work within the community of tailors. Apprentices are surrounded by journeymen and master tailors—from whom they learn their skills and among whom they live—picking up their values and perspectives as well. These values and perspectives are not part of the formal curriculum of tailoring, but they are a central defining feature of the environment and of what the apprentices learn. The novice tailors apprentice themselves into a *community,* and when they succeed in doing so, they possess a point of view as well as a set of skills—both of which define them as tailors (Lave, 1994).

Communities of Practice

Dr. Lawrence F. Lowery

Compare the process by which one becomes a tailor in West Africa, to the process by which one becomes an expert at something in any field of endeavor. You cannot become an expert lawyer, doctor, automobile salesman, teacher, or a wise citizen without meaningful involvement within a particular "community of practice." You cannot become an expert at learning something, such as science, without involvement in a community in which such learning is inherent in what that community does.

The sense people make of what they experience is culturally determined. This holds true for all members of communities of practice and groups of people engaged in common endeavors within their own culture. In each case, the habits and dispositions of community members are culturally defined and have great weight in shaping individual behavior. Even in school, the culture of the classroom shapes what sense students make of what they experience.

The cultural perspective for learning is well grounded anthropologically, but it is relatively new to educational practice. The main idea, that a point of view is a fundamental determinant of cognition and that the community to which one belongs shapes the development of one's point of view, is significant (Geertz, 1983).

In classrooms, the science that students experience is broadly cultural. What is learned by the students extends far beyond the content and procedures of the science that is studied (the curriculum). Whether or not the teacher is explicit about his/her epistemological stance, what the teacher thinks science is shapes the kinds of science environments made available to students and thus the kinds of science understanding that students develop. Recognizing that the teaching of science is done within a cultural setting provides an important perspective to what teachers do when they teach.

The cultural assumptions about science that today's students are acquiring are of great concern to educators (National Commission on Excellence in Education, 1983). Studies show that in most schools the community of practice (the culture of the classroom in action) does not reflect or represent in any way a science community at practice. For decades, textbooks have perpetuated an incorrect point of view—both in terms of what science is and the way by which it is taught and learned. In most classrooms, *doing science* means reading a textbook and following the rules laid down by the teacher; *knowing science* means remembering and applying the correct answer when a question is asked; and *scientific truth* is determined when the answer is ratified by the teacher or the textbook. These ideas do not reflect the nature of science, and repeated experience with this incorrect view has led to several serious consequences.

One consequence is that most students come to accept a passive role in the learning process[1]. Another is that they come to think of science as content that is handed down by experts for them to memorize. Still another is that they come to believe that there is one right way to solve a problem—the way that is shown by the text and that the answers to problems are already known and will be provided[2].

Perhaps the most unfortunate consequence is that many beliefs that today's teachers hold about the nature of science—how to do science and what it means to teach it in school—were acquired when they were students in settings where they were passive and where content was delivered for them to memorize. Through many years of watching, listening, and participating in such practice, most teachers develop an inappropriate point of view concerning science and how it is best taught. The result is that they inculcate an inappropriate point of view to future generations, and the problem is perpetuated (Lampert, 1990, p. 31).

> *"It takes a whole village to educate a child."*
>
> — Ancient African Proverb

Students' primary experience with science—the grounds upon which they build their understanding of the discipline—is their exposure to it in the classroom. If that exposure is not culturally true to the discipline, then the students (and ultimately this country) will be ill prepared to participate in the highly scientific world of the future.

Today, with access to appropriate resources and opportunities to practice teaching science in a different way, some teachers have found that they can change the culture of the classroom—from one in which students are passive and receive information from authorities to one in which the classroom is a dynamic community of learners engaged in the practice of science.

Guided by the goal to create communities of learners in practice within the context of science as a domain, developers of the FOSS curriculum invented and tested activities that were designed to establish the cultural change in the classroom. Often, this was done by making use of small communities of practice (what FOSS calls *collaborative* groups) whose activities reflect the active nature of the scientific enterprise or other selected aspects representative of the science community. For example, some activities provide experiences in which students interact with each other and the science in ways that promote effective scientific thinking. Other activities allow students to exchange ideas and support different interpretations of results. Within this setting the teacher is expected to be a part of the community of practice and not separate from it.

In the research and development phase of the FOSS modules we critically examined whether and how it might be possible to bring the practice of knowing science in school closer to what it means to know science within the community of scholars who practice the discipline. We did this not for the purpose of preparing people to be scientists, but rather to enable people to develop important understandings and capacities that would serve them in many ways. By deliberately altering the roles and responsibilities of the teacher and students in the classroom, we were able to change the meaning of knowing and learning within the school setting. The FOSS Teacher Guide provides ideas for initiating and supporting social interactions appropriate to doing some aspect of science such as conjecturing (e.g., guessing, hypothesizing, predicting) and making scientific arguments in response to conjectures. Through many of FOSS's extensively-tested activities students find patterns, make definitions, reason about their claims, and ultimately defend them. Two examples follow. Both are derived from transcripts taken during the development phase of the activities: *Carbon Printing* from the **Ideas and Inventions Module** and *Stream Tables* from the **Landforms Module.**

[1] Whenever science textbooks include activities, the text is written so that students can "read around" the activities, thus bypassing them altogether, or the activities are structured like a recipe that is to be followed step-by-step. From such experiences students come to believe that ready methods are available to solve all problems, the method for the solution of a given problem must be memorized, and the method will always produce an answer to the problem (Carpenter et al., 1983). The result of this belief is that students (1) seldom attempt to solve problems for which they have no ready procedure to follow, (2) curtail their efforts after only a few minutes of working without success on a problem.

[2] Studies have found that students consider textbook problems to be exercises of little meaning; thus they often come to believe that the topic is not something they can make sense of, but rather that it is something that is arbitrary or at least whose meaningfulness is inaccessible to them and which must thus be memorized without looking for meaning (Lampert, 1990).

Ideas and Inventions Module: Carbon Printing Folio

At one point during the Carbon Printing activity, some students expressed the idea that if their right-hand thumb pattern was of a particular type, then the rest of the patterns on the other fingers of that hand should be of the same type. Other students did not think so. The students agreed that to find out they would have to get pattern samples of all five fingers on their right hands. They divided themselves into two groups—a group that thought the prints would be the same and a group that thought the prints would be different. Each group took samples of themselves and other students in the classroom. When the samples were examined, the group that thought the patterns would be the same abandoned their hypothesis, and the group that thought the patterns would be different were able to provide evidence in support of their idea. But almost immediately, new questions came to mind to the students. One student wanted to know if it was *ever* possible to have all fingers of the same type. Several others wondered if their left-hand patterns would match their right-hand patterns. Another wondered if his toes had prints. Another wondered if her mother had prints like hers. The conjectures were varied and in many cases individualized. All were testable, so students gathered evidence that supported or did not support the idea they had.

Note that in the activity described above, the teacher seems to be invisible. Actually the teacher entered the dialogue from time to time as a knowledgeable participant—a representative of the classroom science community who is not an all-knowing authority but rather one who could ask pointed questions to enable students to arrive at reasonable conclusions. Within a community of learners, this pedagogical practice of deflecting undue authority places the responsibility of scientific conclusions on

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the shoulders of the students. They do not turn to the teacher for answers. They gain confidence that they can derive answers for themselves.

Landforms Module: Stream Tables Folio

The introduction of the use of stream tables began somewhat formally so that students would recognize important procedures in the preparation and use of the apparatus (e.g., there needs to be a container for collecting runoff water and newspapers for sopping up spillage; thought must be given to the preparation of the earth materials and the positioning of the water source, and so on). The apparatus familiarity experience was followed by small groups of learners working independently of other groups but on the same task—running water through the earth material for a certain amount of time and observing the results. There was no prior problem or question to be solved. The experience was open-ended and allowed for the generation of hypotheses. When finished, the different groups were asked to compare and contrast their results. Commonalities and variances in results immediately become apparent. Because students knew they all began with the same set up, variances caused an interesting positive tension that led students to naturally raise questions. Such tensions within and across groups and the discussions that resulted in the resolutions of conflicting ideas made the relevant earth science issues salient and meaningful to the students. In the stream table settings, different students had different ideas regarding what they thought might happen in a situation. The materials were sufficient to provide ways by which students could derive evidence that did or did not support their ideas. On subsequent observations, the students appeared to be intellectually well-prepared (through their prior experiences) and thus entered into more advanced discussions.

Note again that the teacher's role is not one of a "fact teller" but one of a "facilitator." The teacher is visibly active in the management phase of the activity, but she quickly disappears to become free to roam from group to group, engaging as a participant when it is appropriate to do so.

In the preceding examples, the classroom environments were consonant with the idea that science is an ongoing, dynamic discipline of sense making, achieved through the dialectic of conjecture and argumentation. Our early work in developing FOSS found that experiences of these types consistently resulted in the students' coming to grips with some fundamental science notions and that self confidence in problem solving developed. To sense the difference between these experiences and traditional ones, simply compare the same content topics with those in a text-driven program.

For FOSS, the content domains of science (biology, physics, earth science, and so on) provide opportunities for distinctive modes of thought to be used and developed. The modes, which FOSS calls the *Scientific Thinking Processes,* are natural, versatile, and powerful (Lowery, 1990). They underpin the ways by which humans observe and communicate, ways they make order through comparing, grouping, seriating, and classifying, ways they discover cause and effect patterns by seeing relationships between and among objects, ways they infer about what cannot be seen by hypothesizing, predicting, modeling, and experimenting, and ways they apply what they have learned by model building and theorizing. Experience with these thinking processes within a science community of practice moves novices of all cultures toward expertise.

Scientific literacy is a level of expertise of increasing value in the current and future technological age. That expertise will enable individuals to read critically to identify fallacies, to detect bias, to assess risk, and to suggest alternatives. A person who comes to possess such capacities of mind is a scientifically literate person. That person will be empowered to understand better and make effective use of the scientifically information-laden world of the 21st century.

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FOCUS ON CURRICULUM: Physical Science

This is the second article featuring the FOSS program strands. In this issue, the spotlight falls on PHYSICAL SCIENCE. Physical science is the inquiry into the affairs of inanimate matter and the forces that influence matter to change. Implicit in the FOSS investigations of physics is a notion of energy. Students will see the results of energy in action as they investigate rolling systems, sound propagation, electricity, chemical reactions, and mechanical advantage, but this difficult formal concept will remain in the background. As always, the power of the FOSS physical science modules will come from the personal experiences students have with objects and systems. As students observe and ponder interactions, they will integrate the experiences into their evolving understanding of their universe.

The Physical Science Strand Matrix below shows one logical sequence of modules that students might experience as they advance through the grades.

FOSS K–6 PHYSICAL SCIENCE STRAND MATRIX

	MODULE	SCIENCE CONCEPTS	THINKING PROCESSES	MODULE OVERVIEW
Grades 5–6	**Levers and Pulleys Module**	Advantage Effort Fulcrum Lever Load Diagram Class-1 lever Class-2 lever Class-3 lever Fixed pulley Movable pulley Simple machine	**Relating** Organizing Comparing Communicating Observing	Students explore mechanics and simple machines using levers and pulleys. They observe, measure, and diagram lever and pulley systems. They then relate the force needed to lift a load to the advantage resulting from the use of various lever and pulley systems.
	Mixtures and Solutions Module	Crystal Dissolve Mixture Evaporation Property Solution Saturation Volume Solubility Concentration Volume Change Gas Chemical reaction Precipitate		Students learn basic concepts of chemistry—mixture, dissolve, solution, concentration, saturation, reaction, evaporation, and crystal. They measure, mix, and compare solids and liquids, and observe and describe the interactions that result from their experiments.
Grades 3–4	**Magnetism and Electricity Module**	Attract Force Magnet Repel Closed circuit Open Circuit Switch Conductor Electrict circuit Insulator Electromagnet Technology Telegraph Code	**Advanced Organizing** Comparing Communicating Observing	Students explore permanent magnetism, electrical circuits, and electromagnetism. They observe and compare electrical and magnetic phenomena, and organize their observations as graphs. Their accumulated knowledge is applied to make a telegraph.
	Physics of Sound Module	Sound discrimination Code Sound receiver Sound source Vibration Sound Travel Pitch		Students investigate sound as a property of a vibrating object. They observe and compare how sound travels through different media, how the pitch of sound can be altered, and how sound can be amplified.
Grades 1–2	**Solids and Liquids Module**	Change Crystal Dissolve Solution Property Solid Foam Liquid Evaporation Layer Mixture Viscous Transparent Opaque	**Beginning Organizing** Comparing Communicating Observing	Students are introduced to two fundamental states of matter—solid and liquid. They investigate and describe the properties of solids and liquids and discover some things that happen when solids and liquids interact.
	Balance and Motion Module	Balance Balance point Mobile Stability Motion Rotate Disk Wheel Motion Roll Slope Spin Axle Sphere		Students explore stable (balanced) and unstable systems, use counterweighting to manipulate center of gravity, and investigate two classes of motion—spinning, and rolling.
Kindergarten	**Wood Module Paper Module Fabric Module**	Float Sink Wood Change Cut Mixture Sculpture Corrugated Same Different Material Paper Source Tear Fold Absorb Cloth Fiber Pulp Recycle Fabric Sew Thread Yarn Dry Graph Permanent	**Comparing** Communicating Observing	Students observe and describe the properties of a variety of kinds of wood, fabric, and paper, and find out what happens when these materials interact with other materials. Students discover uses and applications for the materials in the real world.

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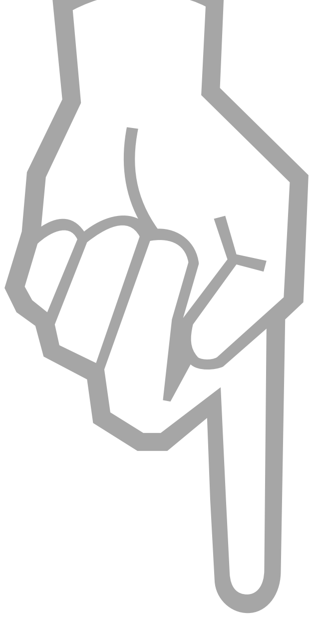


Tips for Physical Science Equipment Management

Equipment Management

Managing equipment for hands-on science can be time consuming. If a teacher has to gather his or her own equipment, chances are there will be no hands-on science. One of the great advantages of using FOSS is that virtually all the equipment needed to teach the activities is in the kits. Even so, it still requires some planning and organization to manage the materials with confidence and efficiency. Here are some ideas to make it easier.

1. One Time Prep.

If you're the first teacher to use a brand new kit, there may be some prep you need to complete before the kit can be used for the first time. After the one-time prep has been completed, keep those pieces of equipment in the kit, so the next teacher will need less prep time. If you get all the grade-level teachers who are going to be using the kit together to do this one time prep, the time required will be much less. In the physical science strand, these are the things you'll need to do for one-time prep:

Paper Module (Grade K)

- ☞ Make a permanent set of Center Instruction Cards (Optional)

Wood Module (Grade K)

- ☞ Mark one set of basswood samples with tiny permanent-ink dots
- ☞ Make a permanent set of Center Instruction Cards (Optional)
- ☞ Copy and laminate three tree posters (Optional)

Fabric Module (Grade K)

- ☞ Make up to four feely boxes
- ☞ Make a permanent set of Center Instruction Cards (Optional)

Balance and Motion Module (Grades 1–2)

- ☞ Punch or cut out die-cut shapes
- ☞ Gather 50–60 pennies
- ☞ Get a large rope to demonstrate knot tying

Solids and Liquids Module (Grades 1–2)

- ☞ Buy liquids and fill 35 bottles
- ☞ Make a permanent set of Center Instruction Cards (Optional)

Physics of Sound Module (Grades 3–4)

- ☞ Make four tin-can telephones
- ☞ Make two Ping-Pong-balls-on-a-string
- ☞ Make two long gongs
- ☞ Make two mini-gut buckets
- ☞ Get ten glass soda bottles
- ☞ Make two FOSS-uleles
- ☞ Make two string beams
- ☞ Put the materials for each mini-activity or learning center in a plastic bag.
- ☞ Make permanent copies of the center duplication masters to include with the materials for each center (optional)

Magnetism and Electricity Module (Grades 3–4)

- ☞ Keep the Teacher Preparation video far away from the magnets
- ☞ Cut and strip hookup wires (20 gauge)
- ☞ Cut and strip electromagnet wires (24 gauge)

Mixtures and Solutions Module (Grades 5–6)

There is no one-time prep

Levers and Pulleys Module (Grades 5–6)

- ☞ Assemble "loads" in clear plastic bottles (or have students do this)
- ☞ Tape over inches on half-meter sticks and recalibrate (or have students do this)
- ☞ Cut rope into 80-cm lengths and use tape to secure loops at each end

2. Repackage Items.

Obtain a supply of zip bags, both large and small. Some equipment items are not prepackaged in the kits (e.g. cups, 1/2-liter containers, wires), and others arrive in plastic bags with twist ties. Transfer these items, (along with the labels from the old bags) to zip bags for more convenient storage.

3. Inventory Small Items.

Three modules have collections of small items that must be cared for: the solid objects in **Solids and Liquids;** the drop objects in **Physics of Sound;** and the mystery objects in **Magnetism and Electricity.** You can make inventory lists and include one in each bag for the students to use at the end of each session to verify the contents of the bag, or you can conduct a "verbal inventory" by calling the names and numbers of the objects as the students return them to the storage bags.

4. Check Notes for Storing.

The *Inventory and Organization* sheet at the back of the teacher guide has a "Storing equipment" section to help you keep the kit materials in tip-top condition.

5. Get Students Involved.

Assign a group of students each week to be responsible for the kit and to keep it clean and organized. When students take ownership of the kit, their respect for materials increases.

What We Hear From The Field

Wood Module.
If wood scraps are splitting when students try to nail them together, try blunting the nail points. Turn the nail head down on a solid surface and whack the point to flatten it a bit. Now the nail will plow through wood rather than wedging through.

Fabric Module.
If you are not familiar with all the fabrics used in the module, make a reference sheet by gluing a small bit of each kind of fabric to a sheet of paper and writing its name underneath. This will require sacrificing one sample of each kind of cloth, but some teachers feel the benefit outweighs the loss.

Balance and Motion Module.
There is a commercial top called Doodle Top on the market. Doodle Tops spin on a felt-tip marker point, leaving a trace wherever they go. They are wonderful additions to the module, providing students with insights into the behaviors of tops.

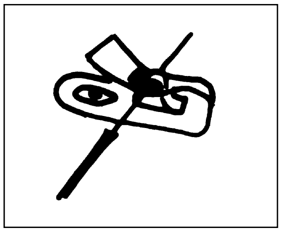
The Twirly Bird cutout used in the Spinners activity can be flown with no paper clip, one paper clip, two paper clips... Let students explore the weighting to discover which configuration works best.

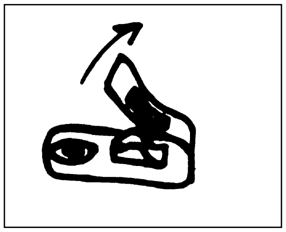
Physics of Sound Module.
Because most of the activities are conducted at centers, with each group working with different materials, it is to everyone's advantage if you can arrange to work in a multipurpose room. Also, if all of the materials for each center are bagged together and stored that way, it will be much easier for the next teacher to prepare. It may be necessary to put the packaged centers in a separate box because of the volume of materials.

Magnetism and Electricity Module.
Cells.
As discussed in the last newsletter, avoid the use of rechargeable cells. They discharge too fast. Alkaline cells are recommended.

Wires.
When preparing the wires, use the stripper tool to cut the lengths described in the teacher guide. One caution is to be careful when stripping the centimeter of insulation from both ends of all of the wires. Adjusting the stripping tool so that it works properly is critical. If the jaws do not close far enough, the insulation will not be cut through. If the jaws close too far, the cutter will bite into the wire, making it impossible to slip the cut insulation off, and scoring the wire so that it might break off after a short period of use. Soon you will get the feel for it and in no time at all you will be an experienced stripper.

Fahnstock clips.
The circuit connections are made with little grippers called Fahnstock clips. To use the clip, you press down on the flange and insert the tip of the wire (just the bare metal—not the insulated part) under the arch that is revealed. In time the clips will lose their grip and the wires will still be loose after the wire tip has been inserted properly. To restore the grip, simply lift up the flange with some authority to bend it into a more upright position. Now the wires will stay firmly in place.





Telegraphs.
Sometimes it is almost impossible to adjust the piece of spring steel to make the telegraph work. When the circuit is closed, the spring steel is drawn over to the electromagnet just fine, but when the circuit is opened, the steel stays stuck to the rivet. If the gap is increased the spring is not attracted over. Frustration!

The cause for this behavior is small amounts of residual magnetism in the piece of steel and the rivet. The north pole of the rivet is attracted to the south pole of the steel. To overcome this problem remove the cell from its holder, turn it around , and reinsert it in the holder. By reversing the direction of flow of electricity in the electromagnet, the polarity of the magnetism in the rivet is reversed. Now the residual magnetism in the rivet and the steel push each other apart. Voila!

Levers and Pulleys Module.
In the last activity students lift a load 10 cm with various pulley systems and observe the distance over which the effort must be applied. The system was designed for smaller pulleys than those supplied in the kits now. Consequently the line indicating the distance over which the effort is applied frequently runs off the cardboard backing. (Those of you who have tried this know what I'm talking about.)

There are a couple of solutions to this problem. If the load is lifted 5 cm instead of 10 cm, the effort will move a shorter distance. Or an extra loop can be made on the end of the rope in a place where the effort line will stay on the cardboard backing. The key is to stay calm, explain the goal, and get the students to problem solve through the activity.

New from the Physical Science Wordsmiths

The search for good books to include as reading resources for your students continues. The annotated list included in this newsletter focuses on books for the FOSS Physical Science strand. Many of the books described here are included in the BSS Reading Resource packages.

KINDERGARTEN

Winter Wood

By David Spohn. Lothrop, Lee & Shepard Books, New York, 1991. Illustrated. **(Wood Module)**

A young boy and his father go out to the winter woods to chop firewood, enjoying the work and the natural world around them.

Paper, Paper Everywhere

By Gail Gibbons. Harcourt Brace Jovanovich, San Diego, 1983. Illustrated. **(Paper Module)**

Briefly discusses and colorfully illustrates where paper comes from, how it is made, and how we use it.

The Goat in the Rug

By Charles L. Blood and Martin Link. Alladin Books/Macmillan, New York, 1976. Illustrated by Nancy Winslow Parker. **(Fabric Module)**

Geraldine, a goat, describes each step as she and her Navajo friend make a rug, from the hair clipping and carding to the dyeing and actual weaving.

Sam Johnson and the Blue Ribbon Quilt

By Shirley Neitzel. Mulberry Books, New York, 1983. Illustrated. **(Fabric Module)**

While mending the awning over the pig pen, Sam discovers that he enjoys sewing the various patches together but meets with scorn and ridicule when he asks his wife if he could join her quilting club.

GRADES 1–2

The Balancing Act: A Counting Song

Lyrics and music collected and edited by Edith Fowke. Clarion Books, New York, 1987. Illustrated by Merle Peek. **(Balance and Motion Module)**

One elephant after another strides onto the high wire until there are ten and the wire threatens to break. Lyrics and music included.

The Balancing Girl

By Berniece Rabe. E.P. Dutton, (A Unicorn Paperback), New York, 1981. Illustrated by Lillian Hoban. **(Balance and Motion Module)**

Despite her physical disability, Margaret's special skill at balancing helps her earn money for the school and the respect of her classmates.

Galimoto

By Karen Lynn Williams. Mulberry Books (A Reading Rainbow book), New York, 1990. Illustrated by Catherine Stock. **(Solids and Liquids Module)**

Galimoto means "car" in Chicewa, the national language of Malawi, Africa. It is also the name for a type of push toy made by children. Walking through his village, a young African boy finds the materials to make his own special galimoto.

GRADES 3–4

How Music Came to the World

Retold by Hal Ober. Houghton Mifflin, New York, 1994. Illustrated by Carol Ober. **(Physics of Sound Module)**

Retells a Mexican legend in which the sky god and the wind god bring music from Sun's house to the Earth.

GRADES 5–6

The Lady Who Put Salt in Her Coffee

By Lucretia Hale. Harcourt Brace Jovanovich, San Diego, 1989. **(Mixtures and Solutions Module)**

Mrs. Peterkin mistakenly puts salt in her coffee, so the entire family becomes involved in the search for ways to make it drinkable again. They visit a chemist, an herbalist, and a wise woman, try some wild experiments, and finally discover a solution.

The Science Book of Machines

By Neil Ardley. Harcourt Brace Jovanovich, New York, 1992. **(Levers and Pulleys Module)**

Simple experiments illustrate basic mechanical principles and applications for them, including levers, pulleys, siphons, and hydraulic jacks.

Third Grade Electricians

by Leigh Agler

"What if we build a house and put in lights and stuff?" My third grade students at Del Rey Elementary in Orinda, CA, had just finished Making Connections from the Magnetism and Electricity Module and were discussing what they could do with their new knowledge. The idea for wiring a house was a spark and the rest of the class exploded with suggestions. So we did it.

The project started with collaborative group members deciding what would go into the house and how those items would be hooked up to the electricity. They had to get their ideas on paper. No work with materials could begin until the designers all agreed on a plan. This was the hard part.

After plans had been approved by the contractor (teacher), work could begin. Each group transformed a shoe box into a room using art supplies, glue, wallpaper scraps, wires, sockets, bulbs, and more. Original plans were modified or scrapped as work progressed. Finished projects included stairs, furniture, interior and exterior light fixtures, TVs, refrigerators (with lights), and ceiling fans. The proposition of a door alarm became an obsession for a couple of groups.

Construction and reconstruction could have gone on for weeks. Eventually, I called for the start of wiring. Because I was conducting this activity with several classes, the basic electrical equipment had to be reused by each class. The students decided they had better add wiring information to their plans. Their plans quickly took on the look of electrician's blueprints. I was kept busy gathering additional wires, cell holders, lights, and motors.

On the final day, each group had time to show off its house. As a grand finale, they assembled their creations into an apartment house, turned off the lights, and invited in "visiting dignitaries" from the office and other classrooms to inspect the illuminating result.

Leigh is a Science Resource teacher at Del Rey School in Orinda, CA.

Ice Breaker

Clorisa Wilson of Amelia Erhart School in Alameda, CA, reported that when she froze water in the graduated cylinders from the **Measurement Module** (as suggested in activity 2 of the **Water Module**), the graduates were damaged—the bottoms were pushed out of some and others were deformed permanently. This has been reported a couple of other times. Usually this doesn't happen. In most cases the water simply expands into the available space at the top of the graduate and freezes without damaging the cylinder. Maybe the damage occurs when the freezer used is particularly cold. If water froze first at the surface (top) of the cylinder, forming an effective plug, as the rest of the volume froze it would expand and deform or break the cylinder. Consider this possibility before you throw your graduated cylinders into the penguin's den.

Feeling the Waters

A teacher called to tell us that he likes to have his students test different kinds of commercial drinking water, as well as the local tap water, for hardness. His students discovered that Evian bottled water was hard and Calistoga water was soft. Can you add to this list?

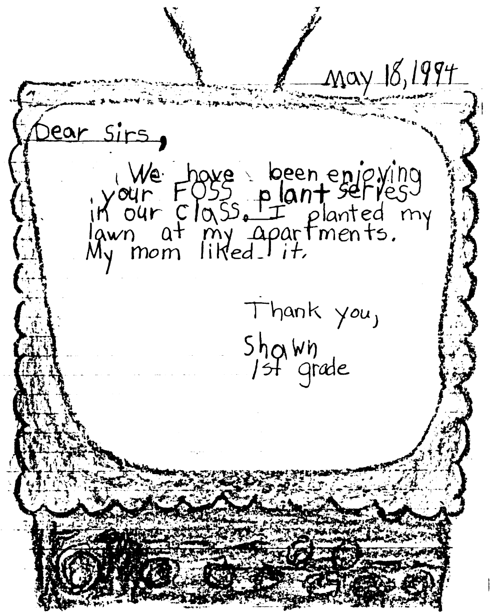
Big Zoomers

Luanne Olson and Lynnanne Warren of Falcon Heights School in St. Paul report that their second graders made zoomers out of margarine-tub lids. Because the lids were larger than the plastic disks in the kits, the students thought longer strings might be in order. Now that's a zoomer! Once the spirit of invention invaded the class, the students had a great time making modified twirlers, making them heavier and trying to find the wing folds that produce the most satisfactory spinning action. Congratulations, Falcon Heights second graders—that's science at its best.

Want to see your name in print? The Spring 1995 issue will focus on the life science modules. Send your ideas for prepping and enriching those modules to FOSS Newsletter, CML/Lawrence Hall of Science, University of California, Berkeley, CA 94720.

Thanks, Pat McCormick from Altamonte Springs, FL, for the following note:

My first-through-fifth-grade emotionally disabled students enjoyed 9 weeks of observing, organizing, and recording with your FOSS New Plants Module. No one was disappointed with the experiences and all learned the valuable lesson of patience. It was appropriate for the variety of ability levels of my special-needs students.



Thank you for the nice note, Shawn, and thanks to your friends Andy, Brenton, Casey, and Lucdwir.

Paraprofessional FOSSilitation

In May, the Roseville Area Schools in Minnesota hosted a networking meeting for paraprofessionals and parent volunteers interested in staffing science materials centers. Focus topics included:

- ❍ How do you keep track of everything?
- ❍ Where is the cheapest source of calcium chloride (and other materials)?
- ❍ How do I keep goldfish alive without killing myself?

If you have similar interests or needs in your school or district, or want to know how to organize such a networking meeting, call Mary Lou Klinkhammer for information at 612-482-8624.

(Editor's note: Roseville is a pioneer FOSS district. FOSS has been in use for four years, and they have developed exemplary implementation, management, and maintenance procedures.)

Living Organisms Update—the West

Four of the FOSS modules require living organisms—**Animals Two by Two**, **Insects**, **Structures of Life**, and **Environments**. Many of the organisms are common and can be obtained from local sources, but sometimes it is necessary to go to a specialist. Britannica has worked with Niles Biological in Sacramento, CA, to ensure quick and accurate delivery of living organisms to customers in the western part of the country. Ted Niles, president of the company, tells us that he is set up to honor the FOSS living-organism coupons, or he can supply individual organisms as needed.

In addition, Ted sells other items that support FOSS. He has a complete line of foods for the various organisms, and a selection of items that support FOSS extensions, such as incubators and fertile chicken eggs, owl pellets, ants, and several different aquatic insects. Contact Niles Biological for a price list of FOSS-related organisms and supplies.

Niles Biological
9298 Elder Creek Road
Sacramento, CA 95829
916-386-2665

Calendar of Events

FOSS Pre-conference Institutes

Britannica will host two-day FOSS introductory institutes just before each of the NSTA Area Conventions in the fall of 1994. Participants will receive a thorough introduction to the program with plenty of time spent doing activities from all four strands and all grade levels K–6. This is an excellent opportunity for a colleague, curriculum coordinator, or principal to get the FOSS message from some of the most knowledgeable FOSS people in the country.

There is no cost, but participants must register to attend. The dates and locations are listed at the right.

To secure your place at the institute of your choice, call, fax, or write

Briana Villarrubia
Manager of Professional Relations
310 South Michigan Avenue
Chicago IL 60604
voice: 1-800-554-9862 ext. 6554
fax: 312-347-7966

October 11–12 (Tuesday and Wednesday)
Sheraton Portland Airport
Portland, Oregon

November 1-2 (Tuesday and Wednesday)
Park Inn International
Minneapolis, Minnesota

December 13-14 (Tuesday and Wednesday)
Las Vegas Hilton
Las Vegas, Nevada

❏ **Yes! I'm interested in attending a FOSS Introductory Institute prior to the NSTA Area convention this fall.**

❏ Portland, Oct. 11-12 ❏ Minneapolis, Nov. 1-2 ❏ Las Vegas, Dec. 13-14

Name ______________________________

School ______________________ District ______________________

Title ______________________________

Address ______________________________

City ____________ State ____________ Zip ____________ Daytime Phone ____________

❏ I did **not** receive this FOSS newsletter in the mail. Please add my name to the mailing list.

About This Newsletter . . .

The intent of the FOSS newsletter is to help FOSS and BSS users develop a network of support across the country. EBEC 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 BSS or would like to submit an article about management, exciting school programs, etc., please send them to FOSS NEWSLETTER, Lawrence Hall of Science, University of California, Berkeley, CA 94720. We'll be waiting to hear from you!

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For information about purchasing FOSS and BSS products or for the phone number of your regional representative, call EBEC Toll Free at: 800.554.9862

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A very special THANK YOU . . . to all the local and national trial teachers who have helped make FOSS such a great success!

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