Yokomi Science and Technology Magnet Elementary: FOSS as an Instructional Model in Fresno, California

Jerry D. Valadez, Ed.D., K-12 Science Coordinator, Fresno Unified School District, California

One by one reports emerge that underscore our nation’s failure to find or invent ways to close the achievement gap in mathematics, science, and technology (NSF, 2004). This gap between the achievement of historically underrepresented populations and other groups must be closed aggressively, comprehensively, realistically, and affordably. The Yokomi Science and Technology Magnet Elementary School is an innovative and effective solution to this gap created by the Fresno Unified School District. Fresno is located near the heart of California’s San Joaquin Valley and, according to the 2000 Census, is one of the largest, fastest growing, and most diverse cities in the state of California. Fresno’s population of more than 450,000 people makes it California’s sixth largest city. The city of Fresno’s population is ranked first in the nation in poverty (Brookings Institute, 2005), and Fresno County’s most significant workforce issue is a chronic unemployment rate that ranges from 10–16%. The Fresno County Grand Jury recently released a report (Report #1, 2005) on economic development, education and workforce issues. It cited the need for additional educational opportunities for youth to acquire technological literacy and experience in applied technology fields. This is also consistent with the recent report issued by 15 of the most prominent U.S. business organizations, called “Tapping America’s Potential: The Education for Innovation Initiative.” The report calls for the need to maintain this

Continued on page 2
country’s competitiveness in the 21st century by doubling the number of science, technology, mathematics, and engineering graduates with bachelor’s degrees by 2015.

The Yokomi Science and Technology Magnet School opened as a new K–6 campus with 644 students in August 2005. The student population is very diverse: 68% Hispanic, 12% African-American, 12% Asian, and 8% white. Gender distribution is 48% female and 52% male. More than 70% of the students come from homes where English is not the primary language spoken, and 48% of the students are identified as English learners.

Funded through a U.S. Department of Education Magnet grant, Yokomi’s instructional design is based on the ideal of preparing students for work in the 21st century by increasing the opportunities for students to learn about, experience, and use information technologies that enhance the learning of science content and the acquisition of workplace skills. Yokomi Science and Technology Magnet provides students the opportunity to learn from the extensive use of technology in classrooms, libraries, and science laboratories built and equipped specifically for elementary students. The instructional program provides an exceptional learning environment that engages students in inquiry-based activities, which develops conceptual learning throughout the curriculum. The curricular emphasis is on science and the integration of technology as a tool for acquiring and demonstrating knowledge. Every classroom is equipped with a SMART Board, laptop computer, projector, AlphaSmart system, wireless microphone, document cameras, and a mobile wireless laptop cart. A school-wide video conferencing system is also available. Technology has become an integral part of the curriculum and is used as a vehicle for cooperative learning, science content instruction, and literacy connections through science.

The core curriculum for Yokomi’s science magnet program is the Full Option Science System (FOSS) developed by the Lawrence Hall of Science, University of California at Berkeley. Fresno Unified has used FOSS since 1993, and many of the teachers have received ongoing training on the modules. The daily science-based literacy instruction provides students with both FOSS and Harcourt Science programs. Students engage in science instructional materials and text every day. The time spent on science learning varies with each grade level, from 70 minutes daily at grades K–3 to 120 minutes daily for grades 4–6. Students go to a specially designed elementary science lab every day for half of their science instruction. In addition to science lab time, every Yokomi student has science-based literacy instruction for 45–60 minutes daily. Techniques and practices of sound language arts instruction are enhanced through embedded literacy strategies found in the FOSS and Harcourt curriculums. The skills essential for all students to internalize and apply scientific concepts and practices, including knowledge of academic language and good reading comprehension, is enhanced by the use of the selected materials and effective strategies. The frequency and spiraling design in which science academic words are introduced and reinforced throughout the FOSS science program also enhances the acquisition of technical vocabulary.

Academic language development is further supported through expository and informational text from Harcourt Science and the inquiry-based investigations, embedded assessments, and teacher resource materials provided in each FOSS module. Every student creates a science fair project twice a year that is based on one of the FOSS modules they have experienced. The student projects are then displayed at a special exhibition for parents. The first event held was focused on physical science using FOSS modules, such as Solar Energy, Magnetism and Electricity, Solids and Liquids, and Balance and Motion. It was very successful, with over 500 parents and community members attending.

The school’s commitment of instructional time to science inquiry is quite exceptional and considered high risk by some in this era of accountability. The risk the school’s leadership and district is taking with Yokomi is based on sound research that points to evidence that explicit instruction in both academic language and reading in the context of inquiry-based science learning is effective in improving student achievement in literacy. Other studies show that certain practices can also improve student achievement in literacy when embedded in the natural context of inquiry-based science.

Yokomi continued

instruction. Based on these findings, it is evident that Yokomi English-learner students will develop significant vocabulary knowledge and conceptual understanding in science if they use the English language to solve real problems and will, therefore, learn the language. Researchers also find that English-learner students frequently do not have access to all of the courses other students do, are placed in less demanding academic tracks, or are taught by less-experienced science teachers. This will not be the case with Yokomi students. High expectations for students and a strong commitment by Yokomi Principal Steve Gonzalez to provide needed support and professional development for every Yokomi teacher is the reality. Every teacher has been provided 15–20 hours of paid training time per month and will also participate in a 40-hour intensive science content institute during summer 2006. Yokomi has also developed partnerships with the Central Valley Mathematics and Science Partnership (MSP) and the California Science Project to strengthen the professional development program by providing science content and literacy expertise.

The district and community vision for Yokomi is based on decades-long work for improving science education in Fresno and the Central Valley. A series of mathematics and science initiatives funded by the National Science Foundation, the Department of Education, and the State of California over the years have identified the need and developed the capacity for enhancing science education in Fresno. Success in the past has created high expectations by the community to support teachers and students in these efforts. As a result, Yokomi students and teachers are encouraged to develop mentoring relationships with local scientists, engineers, medical professionals, and local political leaders. Partnerships with the San Joaquin River Parkway, Fresno Community Hospital, California State University Fresno, and the University of California, San Francisco, will provide opportunities to explore science and medicine and give students at Yokomi Science and Technology Magnet School a head start on their future.

KATHY MARTINEZ, A TEACHER AT YOKOMI, INTRODUCES AN INVESTIGATION FROM THE FOSS AIR AND WEATHER MODULE.

For more information about the Yokomi School, contact:

Jerry D. Valadez, Ed.D.
Coordinator—Science and After School Programs
Science and After School Education Center
3132 E. Fairmont, Building 5
Fresno, CA 93726
Phone: 559.248.7181
jdvalad@fresno.k12.ca.us

Kathy Martinez, a teacher at Yokomi, introduces an investigation from the FOSS Air and Weather Module.
Newport-Mesa USD in southern California had a problem, as many districts do—how to train their teachers to be effective FOSSilitators. When they first adopted FOSS in the early '90s, they had one-day trainings for the teachers. However, because they were grouped by grade level (i.e., K–2, 3–4, and 5–6), each teacher only received a half day of training on the kits they were teaching. The trainers felt that these trainings did not meet all the teachers’ needs. They wanted to give their teachers and the students of the district something more—a summer institute. Under the direction of Scott Dukes, a high school physics teacher, the three trainers, Pat Holmberg (K–2), Maggie Ostler (3–4), and Bob Kelly (5–6), developed Newport-Mesa USD’s Summer Science Institute. Through the institute, teachers get hands-on FOSS training and apply their new skills and knowledge in the classroom full of students looking for summer enrichment. The original staff has come and gone, but the institute has enjoyed 14 years of success.

The institute begins with three Saturdays in June, before school is out for the summer. These include two days of training on the FOSS modules and extension activities. One of the days is a field trip related to the strand (Life Science, Earth Science, or Physical Science). For example, if the institute’s emphasis is on earth science, the teachers might explore different geological sites in the county by Jay Yett, a geologist at Orange Coast College.

Once school adjourns for the summer, teachers begin their training on Monday morning and prepare their classrooms with a teaching partner in the afternoon. Tuesday is when the real fun begins!

It’s 8:00 a.m., and it appears to be the first day of school, but it’s June! Students arrive with their parents and excitedly look at lists to find out their room and teacher assignments. At 8:30, they say goodbye to their parents and begin their day by creating a graph or doing a “sponge” activity. They start their first investigation and record their findings in their science notebooks. Math lab is held every week. Students return home at 12:00 noon, and the teachers grab lunch to bring to their afternoon training session. These sessions include further training on the kits, math lab directions, science standards, etc. The schedule continues through Friday. The Tuesday through Friday school week continues for another two weeks. Then everyone heads off for summer vacation.

For further information, please contact: Marcy Encinas, Math/Science Coordinator, Newport-Mesa Unified School District, 714.424.7570.
We received the following letter from Mary Humphrey, describing the art-related extensions she uses with her second-graders when she teaches the FOSS Insects Module.

Dear Sue,
I have taught second-grade FOSS for the past five years. Each year I get more excited about teaching the Insects Module. I thought your FOSS readers would benefit from these ideas.

The scooter bugs are made from small foam containers from fast-food restaurants. A hole, the size of a tennis ball, is cut into the bottom of the container. The container is decorated to look like an insect. When you put a tennis ball in the hole, you are ready for the scooter race.

In order to have the race, all of the students line up at a starting line in the gym. I count: one, two, three, SCOOT! The hooting, laughter, and fun begin. The fastest bug scooted over four meters. The class records the distance each scooter bug travels. We then discuss and interpret the results.

Another fun project came about because of our study of ants. Students learned about the different jobs each ant has: worker, soldier, undertaker, etc. During language arts, students drew a picture of an ant doing an occupation in today’s society. The ant had to be dressed appropriately and have six legs.

One year, as a culminating activity, students studied photographs of insects and drew at least five insects on white paper. They cut around their insects and glued a small piece of cardboard on the back of each insect to give it a 3D effect. Then, on a large sheet of paper, students drew the environment for their insects. Some of the habitats were on land, some in water, and some in the air. They then glued the insects into the environments.

Sincerely,
Mary Humphrey
St. Jerome Parish School
Oconomowoc, WI 53066
Grade 2
Assessing Science Knowledge (The ASK Project)

By Kathy Long and Larry Malone, FOSS Developers
Lawrence Hall of Science, University of California, Berkeley

Assessing Science Knowledge (ASK) is a project based at the Lawrence Hall of Science that was funded by the National Science Foundation in the summer of 2003. The purpose of the project is to design an assessment system for grade 3–6 FOSS modules that produces valid and reliable evidence of science achievement in an active-learning science environment. The article “Inside the Black Box” (Black & Wiliam, 1998) set the stage for ASK. Paul Black and Dylan Wiliam make a very convincing argument in the article that formative assessment practices are an important part of enhancing learning. It is not enough to do activities and to have discussions; you need additional information about how the students are interpreting those activities and discussions. Students can be further involved in the process through self-assessment practices. When students take on more responsibility for their own learning and teachers understand better how students are building the complex relationships involved in learning, it can only be a recipe for success.

ASK Goals

Two goals guide the work of the ASK Project:

1. **Classroom assessment practices.** Develop daily classroom assessment strategies and practices that lead to greater student achievement and enhance instructional practices.

2. **Accountability.** Develop assessments with the technical quality needed to provide accountability information to schools and districts. (In essence, the goal is to provide a measure closely aligned with the curriculum that could be used in conjunction with standardized test scores—usually disconnected from the curriculum—to measure student progress and evaluate program effectiveness.)
ASK is designing two kinds of assessments: embedded (formative) and benchmark (which can be used for formative or for summative purposes).

**Embedded assessments** are incorporated seamlessly into instruction. Their purpose is to provide diagnostic information about student learning to both teachers and students as teaching and learning are happening. (They are not used for grading purposes.) Embedded assessments generally involve teacher observation (watching students’ inquiry practices during investigation activities), looking at written work in science notebooks, and having students engage in self-reflection.

**Benchmark assessments** assess students’ accumulated knowledge and understanding of the science covered by a module. These assessments include a *Survey* before beginning instruction, *I-Checks* after each investigation, and a *Posttest* after the module is completed. Schools and districts can eventually use these assessments for accountability purposes (or for giving grades), but the most beneficial use that we have seen so far in the project is the use of I-Checks (short for “I check my own work”) as a tool for student self-reflection. When used for formative purposes, teachers score the I-Checks to look for student progress, but they do not put scores on the students’ papers. Instead, the papers are handed back to students and, as

Continued on page 8

The ASK Project is restructuring the FOSS assessment system to provide teachers with tools for understanding the progression of learning taking place in the classroom as instruction occurs. It is designed to enhance the dialogue between teachers and each student to increase science understanding for all students.

**ASK Design**

In order to produce valid and reliable evidence of learning, the ASK Project follows the guidelines described in the National Research Council Report, *Knowing What Students Know: The Science and Design of Educational Assessment* (NRC, 2001). The report discusses three aspects of assessment design that must be carefully linked: cognition, observation, and interpretation (see *Assessment Triangle* diagram).

National Standards and Benchmarks suggest learning outcomes for contemporary science education and thus inform the big picture for thinking about models of student learning (the cognition corner of the *Assessment Triangle*). Standards and Benchmarks are a good place to start, but further work is often needed to understand the finer-grained, incremental learning that must occur in order to acquire the knowledge described in a standard or benchmark.

Our specific module work begins with a review of the learning goals and objectives of the module. This leads to precisely defining our expectations for student learning outcomes, which we call **key concepts**—that is, what we want students to know and be able to do after completing the module. Once the key concepts for a module are identified, they are analyzed in terms of their conceptual complexity. We extract the sub-concept chunks, the pieces of knowledge that students must know and put together in relationships in order to build the bigger ideas. These are laid out in a matrix called a **construct map**. A construct map for a module generally has two to four key concepts followed by a description of the smaller pieces (called **constructs**) that need to be developed in order to fully understand the key concept.

Assessment items (the observation corner of the *Assessment Triangle*) are developed to elicit evidence of student learning related to the constructs and key concepts in a given module.

A sample construct map.
the class discusses the answers to the questions, students ponder their own answers and think about how they might improve them (if needed). This process encourages students to take more responsibility for their own learning, to ask questions to help clarify their thinking, and to understand more about what is required to write good explanations. Some classes have even taken this a step further. Students have been engaged in the project as research partners, and now they not only critique their own answers, but they also critique the questions and point out flaws in the ways questions are being asked that may have led them to give a wrong answer. That is definitely higher-level thinking!

Interpreting the assessment data (the third corner of the Assessment Triangle) ties the evidence gained from the observations back to the cognition corner. Scores are run through a rigorous statistics program (quantitative analysis) and then combined with a qualitative analysis to determine whether the items are eliciting the information we were looking for about student learning. The quantitative statistics indicate when an item should be red flagged, but it’s the qualitative analysis that generally allows us to describe and consider what to do about a problem with an item.

The statistical analyses also allow us to look at student achievement in relation to the constructs (based on the items students were able to answer). Both quantitative and qualitative statistics help us complete the final piece of the assessment program we call progress maps. Progress maps will detail by module a number of levels of student achievement and will describe what students are capable of doing independently at a particular level and what they still find challenging.

Lessons Learned

You may find yourself asking, “Why do we need to do all of this assessment?” We think there are several reasons. First, when students are engaged in active learning, it is impossible to interview every student every day to find out what they understand and where they need help. ASK assessments give teachers additional insight into each student’s thinking. Second, when teachers have class discussions with students, they generally call on three or four students, and if they give the right answers, then the teacher assumes everyone else is at the same place. This often is not the case we found as we began to use more formative assessments. Third, if teachers find that students are not giving correct answers, they tend to ask more questions that lead students to the right answers. It’s good teaching to scaffold students’ learning when they are not able to do so independently, but it does not ensure that students will be able to answer independently the next time they are asked. Assessments help to fill in the missing information.

The next question you might ask is, “How can I know what my students know if they are not good writers?” This was a question that was asked the first year of the project. An interesting shift occurred in the second year of the project. Teachers decided to look at this from a different perspective—students need to be good writers in any subject they study. So the question changed to, “How can we help our students be better writers?” We collectively decided that looking for progress was the more important factor. If you have a student who is only capable of responding with one relevant word, then that’s where it starts. Each time students write they try to add a few more words, gradually shaping the kinds of answers that provide detailed explanations and good reasons (evidence) for those explanations. That’s what we’re looking for.

We collectively also discovered that writing can be used as a learning tool. When you have to write, you must gather your thoughts around the topic. As you write, you find that there are things you can communicate about the topic, but you also discover that there are pieces of information that you still need in order to complete your explanation. Students can then ask more focused questions to continue to build their understandings of the science they are studying.

When we decided to incorporate the benchmark assessments into the project, we worried that teachers and students would feel like they were being tested to death. We thought we might be adding more stress to the already stressful atmosphere that seems to have invaded schools in the past few years. Surprisingly, we found this not to be the case. In fact, exactly the opposite is happening in many classrooms. The classroom culture is changing. Tests are viewed as another part of the learning, but the key is that students are checking their own work and thinking hard about their own learning. They are now viewing the tests as another way to build their knowledge.

This revelation suggests a new teaching/learning paradigm, one in which the distinction between instruction and assessment is eroding. The separation between opportunities to learn (lessons, projects, practice, etc.) and demonstration of learning (tests, papers, homework scores, etc.) is proving to be a detriment to student achievement. When students and teachers understand that assessment results are shared intellectual property, they are transformed from judgments into valued information for planning corrective measures. In this open-access learning environment students understand assessment as an opportunity to discover
what they don’t know, share that flawed understanding with their teacher and peers, and together forge a plan for fixing the deficit. Students become unselfconscious, imaginative learners, and teachers are efficient, thorough facilitators of learning. The line between instruction and assessment is blurred now; by the end of the project the line may very well be absent.

Finally, we would like to acknowledge all of the people who are helping to shape the ASK Project. The most important are the teachers and the students in classrooms at nine different centers who are testing all of the materials and giving us a lot of detailed feedback. No matter how many “experts” look at assessment items, you never know if they are really going to work until students start answering the questions. We appreciate all the extra time that teachers are putting into the project to give us feedback and suggestions for making the system viable. We have curriculum developers, science educators, outside evaluators, and graduate students spending hours scoring, analyzing the data, revising the items and re-conceiving the whole system each year. Our thanks to all who are involved and helping to make this a successful project. 😊

For more information about the ASK Project, contact:

Kathy Long, FOSS Assessment Coordinator
e-mail: klong@berkeley.edu
or
Larry Malone, FOSS Co-Director
e-mail: lmalone@berkeley.edu
Lawrence Hall of Science, University of California
Berkeley, CA 94720, phone: 510.642.8941

For more information about an upcoming ASK workshop, see page 15 of this newsletter.

References


It all started innocently enough. Mrs. H had ordered crayfish for the FOSS Structures of Life Module. She was planning for her third-grade class. I was going to use them after her. I had already extended my Structures of Life Module to include raising silkworms and hatching chicks, as well as growing beans hydroponically. But I had not used crayfish before. When Mrs. H was through, I inherited her crayfish.

She had been following the directions in the FOSS teacher guide for the care of these crustaceans, and I received them in the shallow tub with the half pots. She had fed them in a separate container each day, returning them to their big tub and cleaning the feeding container. This seemed like a lot of trouble to me. During my youth, my family would gather 20–40 large crayfish from a river near our home in California, cook them, and enjoy eating them in the same way as large shrimp. I also remembered that we would dive three to four meters into the river to grab the tasty critters. So why couldn’t we keep them in an aquarium? Thus the adventure started.

I set up a ten-gallon tank and placed the crayfish in it. I also remembered that the creatures in the river were scavengers, so I decided to feed them something much less messy than cat food. I switched their diet to shrimp pellets and fish food. They did very well.

When the next school year started, I took them to my room and added them to the menagerie that I had already. The other third-grade teachers were curious about the set-up. One crayfish had died, so I had four left—one male and three females. We were all happy to have crayfish on hand and not to have to order them.

Then came the big surprise. The females came “in berry!” In other words, they laid eggs, hundreds of them. We set up another tank and separated them into two groups. We recorded the dates that we first saw the eggs and waited anxiously for them to hatch. The eggs are carried under the mother’s tail, and once the eggs hatch, the babies continue to stay there for several days. They are very small when they hatch and nearly transparent, so we had difficulty telling the baby crayfish from the eggs. It wasn’t long before we had hundreds of tiny crayfish swimming in the tanks and getting sucked into the aquarium filter.

The mortality rate was very high. We occasionally saw them attack each other. Many just disappeared. We set up more tanks, and soon four of our third-grade classrooms had at least one tank. Two of us had three tanks with crayfish. Few of the crayfish grew to more than 4 or 5 cm. Some would grow rapidly and attack the smaller crayfish. We started giving the crayfish away to other schools, rather than set up dozens of tanks.

My class decided to incorporate a growth experiment by separating the babies. Each student kept one baby crayfish on his or her desk in a clear cup, documented its molting, and measured its growth over several weeks. They would feed the crayfish shrimp pellets and clean their water every other day. These babies were only about 4 mm in length when we started. If one died, they recorded that on their index card, got another baby, and started again. Students also made a Kid Pix® slide show with pictures of their baby (taken with an Intel® microscope), its mother, and diagrams of body parts.

Near the beginning of this experiment, the local newspaper published an article about a man in Nevada that had switched from raising cattle to raising freshwater lobsters (Australian crayfish). I shared the article with my class, and they had a lot of questions. We made a list of the questions and sent them with a letter to the lobster farmer. He responded by sending us a brochure about the lobsters and explaining that he fed them fish food and dried peas. We decided to extend our experiment by investigating which food types caused the most growth. What we found surprised us. Although there was little difference in growth between the two groups, there were no deaths with the peas. This caused us to wonder how many deaths were due to food source instead of sibling rivalry. The students learned, and so did the teachers.

Inquiry goes on. We continue to learn from the offspring of those original crayfish. Occasionally, one manages to escape a tank and is found dehydrated down the hall or crawling out from behind a bookcase. We have shared our extra crayfish, as well as our experience in raising them, with other schools. It has truly been a great learning experience for both students and teachers.

For more information about this article, contact Tena Brown at Thrownetena@aol.com.
making them engaging and exciting reading choices. (Diversity of Life and Populations and Ecosystems)


This issue of the Wordsmiths includes several new titles that support the FOSS Life Science strand.

You can find more FOSS reading resources, as well as software and video resources, at http://lhsfoss.org/fossweb/teachers/resources/index.html.

If you would like to recommend books or other resources to our FOSS users, you can submit your suggestions to http://www.fossweb.com/scripts/usersubmit.html.

You should plan to include all of the information you see in the Wordsmiths listings (e.g., title, author, ISBN, publisher, date published, and a short description). We are particularly interested in books published in Spanish and other languages that are appropriate to FOSS modules.

**Animal Kingdom Classification Series**


The books in this new series feature beautiful eye-popping photographs and diagrams along with descriptions of reproductive behavior, communities, movement, and the variety of ecosystems where different animals live. An incredible variety of animal life is highlighted by interesting information in each book.

Continued on page 12
Sheila Dunston, my friend and colleague, passed away suddenly in August 2005. She died far too young, but she left a legacy of individual accomplishment and systemic reform.

Sheila Dunston and I began our work together counting gram cubes in the basement of our school district's administration building. It was one of her first days as the Science Professional Developer for Community School District 16 in Bedford Stuyvesant, Brooklyn. I know she was wondering what counting measurement cubes in a dungeon-like cellar to refurbish science kits had to do with helping teachers, but she did not let on. The next day, she was front and center, loading and unloading FOSS boxes from a 20-foot rented truck, but she did not complain. She just changed her shoes, rolled up her sleeves, and did what needed to be done. That was Sheila.

Sheila spent thousands of hours with teachers across New York City, at conferences, in school in-service workshops, and in classrooms. She just wanted teachers to love science and become better science teachers. On a few occasions Sheila even ventured into the wilds to do field work with teachers. Mind you, hiking was not Sheila’s favorite activity—she was a city gal. So when we led teachers on a team-building hike in the Pocono Mountains, and came to a dashing creek that had to be crossed, she paused. Later she confided that she was terrified. Her commitment, however, proved greater than her impulse to retreat. She fought back her fear and trepidation, took off her shoes, and pulled herself across the creek on a log, gripping with hands and feet like an octopus. She did not recognize limits for herself or for those she touched. She led by example...with or without shoes.

Sheila Dunston and I worked together in one of the poorest districts in New York City with an entirely minority population. Many demanded much of our students, but expected little. Not Sheila. She believed that “our kids” could learn anything and fought for them relentlessly. Sheila knew that science education was about learning how the world works, but she also saw it as a vehicle for helping children become thinkers and actors in their world. As a result, Sheila helped countless children and teachers push their limits and discover their potential. She was fiercely committed to the children and teachers of her community and exemplified “teacher” in the broadest terms.

Sheila was a master teacher, a pioneer in the development and implementation of FOSS, a tireless science staff developer, and a reliable, insightful colleague. We will all miss her, but we will continue to be inspired by the memory of her zeal and dedication to science education.
We experience the three basic forms of matter—solid, liquid, and gas—every day as we go about our lives. But scientists have described other forms of matter that are unusual, to say the least. In January 2004 scientists produced a new form of matter. They call the new form “fermionic condensates.”

Most of us know the properties of ordinary solids, liquids, and gases. We learned those in elementary school. Solids resist changing shape and have a constant volume. Liquids flow, they’re hard to compress, and their shape can change to fit any container. Gases are compressible; they can change shape and volume.

Before the creation of fermionic condensates, two other forms of matter were identified: plasma and Bose-Einstein condensate, or BEC. Plasma is gaslike and composed of atoms that have been ripped apart into ions and electrons. The Sun is made of plasma. Plasmas are usually very hot and need to be stored in magnetic bottles.

Bose-Einstein condensates (BECs) were discovered in 1995. They exist when scientists chill particles called bosons to very low temperatures. The cold bosons join together to form a superparticle that is more like a wave than an ordinary speck of matter. BECs are very fragile. Light travels through them very slowly.

Fermionic condensates are also cold (hence the name “condensate”). Deborah Jin, a physicist at the National Institute of Standards and Technology (NIST) at the University of Colorado, created the new form by cooling a cloud of 500,000 potassium-40 atoms to less than a millionth of a degree above absolute zero. Fermionic condensates probably flow without viscosity, but that’s about all that scientists know about their properties. Fermionic condensates are so new that scientists have not discovered all of their properties.

BECs and fermionic condensates are probably related, although they are made of different particles. Scientists describe the bosons in BECs as sociable. That is, they like to get together. Fermions, the particles in fermionic condensates, are antisocial. But Jin and her group found a way around their antisocial behavior. They came up with a “Cupid”—a magnetic field that caused loner fermions to pair up and then pair up with other pairs.

Why is the new form of matter important? It’s related to superconductivity. The new form of matter might allow the production of superconductors to produce cheaper, cleaner electricity and the construction of levitating trains and ultra-fast computers. It may even play a role in the establishment of a permanent base on the Moon.

With fermionic condensates, six forms of matter have now been identified. But that number is still being debated by physicists. Some suggest that liquid crystals, glass, ferromagnets, and other forms might still be added to the list. They’re not sure that BECs and fermionic condensates belong on the list with solids, liquids, and gases. The debate continues.

To find out more about fermionic condensates and BECs, check out the following references.

http://science.nasa.gov/headlines/y2004/12feb_fermi.htm
http://jilawww.colorado.edu/%7Ejin/introduction.html

Bosons and Fermions

Bosons are sociable; they like to get together in the same quantum state. Fermions are antisocial and can’t gather together in the same quantum state.
Are you interested in attending a **FOSS Earth History Course** workshop for middle school teachers at the South Rim of Grand Canyon in Arizona?

We are setting the stage for another week-long **FOSS Earth History Course** workshop for 30 middle school teachers in cooperation with the National Park Service. The dates are June 25–July 1, 2006.

The week's activities will include:
- Hikes along the Rim Trail, down the South Kaibab Trail to Cedar Ridge, and along the Hermit Trail
- In-depth exploration of the **FOSS Earth History Course** with FOSS developers from the Lawrence Hall of Science
- Presentations by NPS staff and other Grand Canyon experts
- An evening at the IMAX theater in Tusayan
- A tour into the Painted Desert with stops at a petrified forest, dinosaur tracks, and more
- A sunset picnic at Shoshone Point (weather permitting)

We will spend three or four hours a day working with the **FOSS Earth History Course** materials. Each participant will receive an **Earth History** Teacher Guide, **Earth History** Resources book, **Earth History** Lab Notebook, and an **Earth History** CD-ROM. Housing will be at the Yavapai Lodge. See the online registration form for more details. Participants are responsible for the workshop fees, as well as travel, room, and most meals.

If you are interested in attending this workshop, go to the online FOSS Professional Development Calendar [http://www.fossweb.com/news/calendar.php](http://www.fossweb.com/news/calendar.php) and download the following forms in pdf format from the calendar entry.

- Registration Form
- Health Information Form
- Release and Indemnity Agreement

Deadline for registration and submittal of the $225 registration fee is April 21, 2006. Housing fees are due by May 15, 2006. All fees are payable to Delta Education. For more information, contact Sue Jagoda at skjagoda@berkeley.edu.

**Update: Populations and Ecosystems for Middle School Workshop, Summer 2006**

Planning for a **Populations and Ecosystems Course** workshop in Puerto Rico is still in the preliminary stages. The FOSS staff from Lawrence Hall of Science is working with the University of Puerto Rico to finalize plans. The workshop is scheduled for July 10–14, 2006. The workshops will be held at the University of Puerto Rico, Mayagüez.

Science leadership educators from universities or districts responsible for implementing the **FOSS Populations and Ecosystems Course** for middle school and middle school teachers using or planning to use the course in their classrooms are encouraged to apply.

Accommodations will be in the university dorms. Transportation on the island and most meals will be provided. Participants will be responsible for their own travel to and from San Juan, Puerto Rico, and some meals. Group size is limited to 30 participants. Total cost per participant is yet to be determined.

For more details, contact Teri Dannenberg at the Lawrence Hall of Science, phone 510.642.8941, e-mail teridann@berkeley.edu.
**FOSS Institutes**

Delta Education hosts one-day FOSS Institutes in conjunction with the National NSTA Conference. There is a K–6 Informational Institute and a Middle School Informational Institute that take place on the Wednesday (April 5, 2006) before the conference. These Institutes are designed for all educators—lead teachers, administrators, curriculum coordinators, professional developers, and university methods instructors.

The K–6 Institute provides an introduction to the elementary school program by focusing on several modules from the different grade levels. FOSS developers and/or experienced FOSS professional developers are there to lead each workshop and provide program updates and introduce new components.

The Middle School Institute provides an introduction to the program by focusing on a few of the eight courses currently available. FOSS development staff and experienced teachers lead the Middle School Institutes.

Delta also offers an advanced-level two-day FOSS Institute prior to the National NSTA Conference. The Research Into Practice Institute is presented by Dr. Lawrence Lowery and is reserved for individuals who have at least three years experience teaching or using FOSS. This institute involves advanced study and application of research findings. Attendance is limited. The advanced-level institute will take place on Tuesday and Wednesday, April 4 and 5. There is no charge for any of the institutes, but participants must register in advance to attend. To register for any of these exciting FOSS Institutes, please call, write, fax, or e-mail:

Pam Frisoni  
Delta Education  
80 Northwest Boulevard  
Nashua, NH 03063  
pfrisoni@delta-edu.com

Phone: 1.800.258.1302 ext. 503  
Fax: 603.579.3504

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**Calendar of Events**

### FOSS Institutes

#### Delta Education

- One-day FOSS Institutes in conjunction with the National NSTA Conference.
- K–6 Informational Institute on Wednesday, April 5, 2006.
- Middle School Informational Institute on Wednesday, April 5, 2006.

#### K–6 Institute

- Provides an introduction to the elementary school program.
- Focuses on several modules from different grade levels.
- Led by FOSS developers and/or experienced FOSS professional developers.

#### Middle School Institute

- Provides an introduction to the program.
- Focuses on a few of the eight courses currently available.
- Led by FOSS development staff and experienced teachers.

#### Advanced-Level Institute

- Research Into Practice Institute presented by Dr. Lawrence Lowery.
- Reserved for individuals with at least three years experience teaching or using FOSS.
- Involves advanced study and application of research findings.
- Limited attendance.

### FOSS Institutes Contact Information

Pam Frisoni  
Delta Education  
80 Northwest Boulevard  
Nashua, NH 03063  
pfrisoni@delta-edu.com

Phone: 1.800.258.1302 ext. 503  
Fax: 603.579.3504

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**NSTA NATIONAL CONFERENCE**

- **April 6–9, 2006**  
  - Anaheim, CA

**PRE-CONFERENCE INSTITUTES**

**Tuesday–Wednesday**

- 9:00–4:30 Research Into Practice for educators with advanced FOSS experience

**Wednesday**

- 8:30–4:00 K–6 Institute
- 8:30–4:30 Middle School Institute

**FOSS WORKSHOPS IN THE NSTA PROGRAM**

**Thursday**

- 8:00–11:00 Explore to Understand with FOSS Middle School Weather and Water Course
- 1:00–2:30 FOSS Forum: Issues in Kit-Based Science

**Friday**

- 8:00–11:00 Using Science Notebooks Featuring FOSS
- 1:00–3:00 A New Accountability: Valuing Academic Progress (ASK)

**Saturday**

- 8:00–11:00 Integrating Math and Science with the Force and Motion Course for Middle School
- 1:00–3:00 Breeding Larkeys in the FOSS Middle School Populations and Ecosystems Course

### Other Professional Development Opportunities

- **June 25–July 1, 2006**
  - FOSS Earth History Workshop at Grand Canyon
  - See page 14 of this newsletter for more information.

- **July 10–14, 2006**
  - FOSS Populations and Ecosystems Workshop in Puerto Rico
  - See page 14 of this newsletter for more information.

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For more calendar events, visit FOSSweb at [http://www.fossweb.com/news/calendar.php](http://www.fossweb.com/news/calendar.php). If you would like to be added to the mailing list to receive this newsletter, send your name and address to:

Gary Standafer  
Delta Education  
80 Northwest Boulevard  
Nashua, NH 03063  
gstandafer@delta-edu.com

Phone: 603.579.3487

For more details about these workshops and other upcoming events, visit the online FOSS Professional Development Calendar at [http://www.fossweb.com/news/calendar.php](http://www.fossweb.com/news/calendar.php).
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:

Sue Jagoda, Editor
skjagoda@berkeley.edu
FOSS Newsletter
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

The deadline for submissions to the next issue is June 12, 2006. We’re waiting to hear from you.

Delta FOSS Sales and Marketing Division
800.258.1302
603.889.8899
fax 603.579.3504
Tom Gueting
Vice President Sales & Marketing
tguentling@delta-edu.com
Gary Standifer
Director of Field Marketing
gstandifer@delta-edu.com
Pam Frisoni
Institute Coordinator
pfrisoni@delta-edu.com

FOSS Regional Sales Managers
All Regional Managers have toll-free voice mail at 800.338.5270
Rick Brost
IL, IN, WI
847.838.9689
rbrost@delta-edu.com
Darin Christianson
IA, MN, MO
608.437.7141
dcristianson@delt-edu.com
Bill Corbett
ID, MT, ND, NE, SD, WY
800.338.5270 ext. 541
bcorbett@delt-edu.com
Tom Custer
DC, MD, VA, WV
410.531.2380
tcuster@delt-edu.com
Jane DeGory
West NY, East OH, PA
412.257.0730
jdegory@delt-edu.com
Emile Farris
MI, West OH
513.791.2783
efarris@delt-edu.com

Miguel Gil
So. TX
210.509.9545
mgil@delt-edu.com
Knansie Beth Griffing
CT, MA, ME, NH, East NY, RI, VT
603.315.1220
kgriffing@delt-edu.com
Verne Isbell
AR, LA, OK, No. TX
817.379.2013
visbell@delt-edu.com
Comer Johnson
AK, No. CA, HI, OR, WA
530.672.1233
cjohnson@delt-edu.com
Steve Jones
FL, So. GA, NC, SC
904.599.9084
sjones@delt-edu.com
Adrienne Maughan
AL, No. GA, KY, MS, TN
205.594.1854
amaughan@delt-edu.com
Laura Meliberg
CO, KS, NM, UT
720.981.5991
lmelberg@delt-edu.com
Chika Onyeani
DE, NJ, NY City
908.851.2251
conyeani@delt-edu.com
Maggie Ostler
So. CA (L.A., Orange, Riverside, and San Bernardino counties)
949.653.0324
mostler@delt-edu.com
Richard Pacheco
AZ, So. CA
480.961.0901
rpacheco@delt-edu.com

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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.deltaeducation.com/foss

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
e-mail: foss@berkeley.edu
Internet: www.fossweb.com
lhsfoss.org

See you at the NSTA National Conference in Anaheim, April 2006!