D id you know that Arizona is the only state in which it is illegal to transport live crayfish of any kind? That tidbit of information becomes pretty important if you’re a teacher in Scottsdale, Arizona, who is using the FOSS Structures of Life Module. But when Janey Kaufmann, K–12 Science Coordinator in the Scottsdale Unified School District, and resource managers from the Arizona Game and Fish Department (AGFD) put their heads together, a solution to the crayfish problem was soon in the works.

Crayfish are not found naturally in Arizona, so they are deemed invasive. Invasive species are nonnative plants and animals that cause or may cause harm to a state’s economy, human health, or environment. Some animals and plants that were introduced from beyond Arizona’s borders are not considered invasive as they provide economic benefits or cause no harm to human health or the environment. But crayfish fit the definition because they eat just about anything and everything in typical freshwater environments. Many native species can fall prey to crayfish voraciousness. Over time crayfish can transform a diverse aquatic environment.
Crayfish in Arizona continued

into an environment that is home to only crayfish. Hence, the ban on importing live crayfish into most areas of Arizona was put into place.

This ban took effect in 2001, just about the time many Arizona school districts had invested in science programs, such as FOSS, that use crayfish in their life science investigations. According to Janey, in an article in Arizona Wildlife Views, “We felt like our hands were tied. Without the crayfish, this part of our curriculum meant nothing.”

The crayfish problem needed to be resolved. Janey and Richard Pacheco (FOSS Sales Manager for Arizona) met with Eric Proctor and Jeff Sorensen from the Arizona Game and Fish Department (AGFD) to discuss the issue. After Janey presented the education case, the group worked out a compromise. Scottsdale Unified School District developed a responsible-use plan, and AGFD agreed to issue a Wildlife Holding Permit that allowed the district to buy, import, receive, hold, and transport live crayfish in Arizona. The responsible-use plan outlined protocols for handling live crayfish and specific procedures for crayfish care. It included a list of the people responsible for transporting, caring for, and feeding the crayfish and details about crayfish disposal to ensure that they would not be released into Arizona’s lakes and rivers. The district could get the crayfish from various sources, including biological supply companies, persons with scientific collecting permits, individuals identified by the school district who had valid Arizona fishing licenses, or AGFD staff. The plan was approved by AGFD, and the school district was issued the permit to use live crayfish in their classrooms. The Scottsdale plan is now used as a template for other districts. You can view the template at http://www.azgfd.gov/eservices/special_licenses/wildlife_holding.shtml.

Part of the responsible-use plan included education for both teachers and students about invasive organisms. Cathy Jansen and Kelly Plowman, Scottsdale USD teachers, were enlisted by AGFD to provide the training. They developed a lesson called The Trouble with Crayfish to introduce students to crayfish issues through a simulation of what can happen when crayfish are introduced into a local Arizona stream. The lesson includes modeling crayfish behavior and analyzing data and graphs to determine the impact of nonnative crayfish on native fish populations and aquatic ecosystems. Students are challenged to brainstorm solutions and develop a management plan to address the problem. The Trouble with Crayfish complements the FOSS Structures of Life Module and is used at grade 4. You can find the lesson as part of the Focus: Wild Arizona program at http://www.azgfd.gov/i_e/ee/lessons/crayfish/crayfish.shtml.

The most interesting part of the teacher training on this new lesson was a field trip to an ecosystem where crayfish had been introduced. The first field experience occurred in late August 2006. Six teachers from the Phoenix area, including Janey Kaufmann, joined AGFD staff at the Seven Springs area near Cave Creek in southern Arizona. Their goal was to experience firsthand the destruction that crayfish can cause to an ecosystem. They captured, counted, measured, and sexed the crayfish and recorded data about the condition of the stream habitat. At the end of the experience, they enjoyed a crayfish boil. The remaining crayfish were transferred to the Arcadia Critter Farm, an animal care facility for the Scottsdale district. Here the crayfish would be managed.

It’s hard to imagine the FOSS Structures of Life Module without students interacting with crayfish.
according to the responsible-use plan implemented by the district.

But the fun wasn’t over. In October 2006, nearly 20 teachers and AGFD staff returned to Cave Creek for another round of crayfish field study. But the crayfish study was interrupted. Only minutes after they arrived at Seven Springs, a downpour began. Many experienced their first flash flood. Everyone was safe, except for the crayfish and other flora and fauna that washed down the creek bed to who-knows-where. But the crayfish investigation was not a total loss. Some of the staff and other volunteers had arrived the day before and had trapped six crayfish. These six crayfish were the focus of discussion for the participants huddled together under improvised canopies stretched between vehicles.

For many, the flash flood was a chance-of-a-lifetime experience. They safely watched as the flood tore apart riverbanks and road crossings and swept away vegetation. Fire had recently devastated the Cave Creek Complex, so the effects of fire on soil erosion and flooding was glaringly apparent. The group may not have captured crayfish that day, but they did experience other wonders of nature—the flash flood, a great blue heron soaring overhead, caterpillars, raccoon tracks, and a red-spotted toad. No one left disappointed.

The FOSS crayfish investigations in the Structures of Life Module in Scottsdale have become even richer with the addition of The Trouble with Crayfish lesson and the teachers’ experiences in the field. For her efforts, Janey Kaufmann was awarded a certificate of achievement by the Arizona Game and Fish Department for her “leadership and dedication for making the ‘crayfish problem’ a successful collaboration between school districts and the department.” Our congratulations to Janey!

Reference

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There is tension in U.S. elementary science education. The tension is created by the disconnect between learning expectations described in standards and the reality of what can be effectively taught in classrooms. With limited time allotted to science, this leaves teachers and curriculum planners in a quandary: do we make decisions based on quantity or quality? Or, in other words, do we value coverage or depth of engagement?

First, a couple of comments on standards. I favor standards. They have the potential to give structure, coherence, and focus to K–12 science instruction and to provide concise descriptions of the core scientific knowledge and thinking abilities we expect of our students throughout their academic careers. In practice, however, many state standards fail to fulfill these functions. They miss the mark in two areas: 1) they are too broad in scope, and 2) the cognitive load implied by many standards is inappropriately high for the corresponding grade. This latter is frequently justified as rigor. In reality, it is a misrepresentation of good science for children.

Back to the tension between coverage and depth. If a school responds to the call for comprehensive coverage of standards, in all likelihood science instruction will move from topic to topic rapidly, surveying large amounts of content briefly. This approach necessarily results in presenting science as a descriptive subject, emphasizing the learning of facts. This kind of science teaching has been characterized as teaching answers to science questions rather than teaching science that answers questions. The bits of memorized knowledge tend to be unconnected conceptually, producing what has been referred to as inert knowledge.

If, on the other hand, the school decides to pursue science in depth, instruction dwells much longer on each topic, allowing time for experimentation, discourse, and reflection in the interest of durable concept development. Conceptual learning involves orders of thinking beyond memorization:

- comparison, logical analysis, inference, and modeling. As a result, the march across the content terrain slows down. At the end of the year the curriculum will not, in all probability, have embraced the full extent of the standards.
- How should we deal with these divergent clarion calls? Which should command our attention? At this time we know quite a bit about teaching science to elementary school children. From carefully crafted surveys and rigorous research evidence we know that students are more motivated to learn, perform better on achievement tests, and are more likely to continue science studies when they are involved in coherent active-learning curricula. And from informal observation of students in classrooms and anecdotal reports from experienced active-science teachers, we know that students love to learn science by doing science, and teachers relish the culture of inquiry that develops in the classroom.

In FOSS our position is clear: teach less in order to teach more. Teaching less means choosing fewer topics for students to study; teaching more means doing science investigations, writing about science, engaging in scientific discourse, and creating a culture of inquiry. We dedicate our undivided attention to science engagement that involves the whole child in meaningful encounters with objects, organisms, systems, and principles that constitute and govern the natural world. Without the least hint of regret we continue to promote a philosophy and instructional design that we know is right for students.

If we are to transform science education in this country to value conceptual learning, we need to advocate for a new vision of standards and assessment. It seems unlikely that we will move away from comprehensive science standards anytime soon. We will continue to prescribe too much. A change that could be implemented more easily would be to accept that students could receive an excellent science education by studying a subset of the standards in greater depth. This would allow local districts to decide which standards best meet the needs of their students and focus on those. By declaring in advance what will be taught, the state could tailor the district’s assessment on those concepts. This approach would require a revised set of criteria for achievement, one that deemphasizes comprehensive coverage of all of the standards and values deeper understanding of fewer standards, as well as knowledge of the particular characteristics of the scientific enterprise and the habits of mind that pervade scientific inquiry.

Larry Malone is co-director of the FOSS Project at the Lawrence Hall of Science.
FOSS is in the process of evaluating the multimedia component of the nine middle school courses (Electronics, Weather and Water, Diversity of Life, Populations and Ecosystems, Human Brain and Senses, Force and Motion, Planetary Science, Earth History, and Chemical Interactions). Some of you probably were contacted this past spring about completing an online survey. The survey was e-mailed to teachers and FOSS professional developers who have been working with the middle school FOSS courses. Approximately 700 participants completed the survey, which focused on how the multimedia component of FOSS is being used in classrooms and workshops.

There are four main areas that are being examined in the multimedia survey. The first area is the school environment. The FOSS team is interested in the number of students using the multimedia, types of schools and classrooms, and how the classrooms are set up. Certain types of classrooms may be more conducive for using the FOSS multimedia. There are also different teaching styles and classroom environments that are of interest.

The second area involves looking at the technology teachers have in their schools. The FOSS team is interested in how many students per computer, what kind of technology the school has, where students generally use computers, if the students have access to the Internet, etc. FOSS wants to better understand the realities of science classroom technology in order to improve access to the multimedia. It is expected that in some schools the multimedia will be presented more as a demonstration because there are not enough computers in the classroom for students to access the multimedia. Other classrooms have multiple computer stations in their classrooms or even class sets of laptops. Other schools make computer labs available.

The third area involves examining FOSS multimedia on a general level. The FOSS team is interested in what courses teachers are using and how they are using the multimedia. The team is also interested in general impressions of the multimedia, whether teachers are following the teacher guide recommendations for using the multimedia, whether they received professional development on the FOSS multimedia, and whether they like the general format of the system.

The final area FOSS is examining is the specific multimedia components within each course. Teachers gave us feedback about whether they are using specific sites and rated how much these particular sites affect student learning. They also gave us feedback about the usability and the help features for each course.

Another aspect of this study involved surveying FOSS professional developers on whether they include the multimedia component when doing a workshop. The FOSS team is interested in what experiences teachers have with the multimedia during a FOSS middle school workshop. Is there a link between teachers who use the FOSS multimedia and those who have it as part of their professional development?

By collecting this data, the FOSS staff will have a better understanding of how teachers use the multimedia component of FOSS. This information then can be used to improve professional development, teacher guides, and the multimedia itself in future versions. In addition, the FOSS team is interested in whether teachers feel the multimedia enhances student learning.

Currently the data from this study is being analyzed and the results should be known in the next few months. If you have any further questions, feel free to contact me at fossresearch@berkeley.edu.

Thank you to all of the teachers and FOSS professional developers who participated! We greatly appreciate all your feedback. 🌟

Dr. Rebecca Deutscher is a Research Associate Specialist at the Lawrence Hall of Science. She is currently evaluating the multimedia component of the FOSS middle school curriculum.

FOSS Middle School Multimedia Available Online
As noted in the Fall 2006 issue of the FOSS Newsletter, the multimedia for each of the nine FOSS Middle School courses is available to registered teachers with passwords on FOSSweb.com. After registering, teachers can share their usernames and passwords with students. (For this reason, be sure to create a unique username and password for this site; do not use usernames and passwords that you use for other sites, such as personal email or online banking.) Students may then use their teacher's username and password to access this site. For privacy reasons, students under the age of 18 cannot register for their own passwords, but they may use the ones given to their teachers. The FOSS staff appreciates your cooperation in not having students register with their own login information.
During the Earth History workshop at Grand Canyon in the summer of 2006, six of the participants represented schools in Stark County, Ohio. The group included Nancy BakerCazan, professional development specialist in science and technology at the Stark County Educational Service Center; Todd Alkire and Laura Heckathorn, teachers at North Canton Middle School; Terrie Baumgartner, teacher at Tuslaw Middle School; and B.J. Arnold and Joseph Chermansky, doctoral fellows in the GK–12 program at Kent State University.

I was excited to meet the Ohio group, since a few weeks after the Earth History workshop, I was packing up my California life and moving it to Avon Lake, Ohio, where I would continue my work as a member of the FOSS team. Stark County is located south of Cleveland and about 80 miles southeast of Avon Lake. It was good to know that there would be nearby FOSS folks to connect with in Ohio (the schools in Avon Lake also use FOSS). And after getting to know the Ohio group during our time at Grand Canyon, I knew these were people I wanted to know better. Over the past school year, here’s what I’ve found out.

The S A M M Center
The FOSS implementation for middle school in Stark County began four years ago with assistance from the S A M M Program (Science And Math on the Move), based in Massillon, Ohio. The S A M M Program was instituted in 1996 as a collaborative between educational institutions in Stark County. Representatives from the partner organizations helped develop the original proposal, selected the original equipment, and continue to advise ongoing activities. The current program is administered by the science supervisor of the Stark County Educational Service Center (ESC) and supported by the local districts.
FOSS Implementation Experiences in Stark County

The Minerva School District in Minerva, Ohio, was the very first district in Stark County to embrace FOSS. The principal of Minerva Middle School invited Dave Miller from the SAMM Center to co-teach lessons with the teachers for two weeks. The teachers were impressed, and FOSS was adopted.

The Minerva School District is small, consisting of two elementary schools, the middle school, and a high school. There isn’t much teacher turnover in the district. The two teachers at the middle school who started with FOSS taught 8th grade and could be described as traditional teachers who had been with the district for quite a while. They started their implementation with the FOSS Earth History Course. As Nancy described their experience, it was an “epiphany for them.” They loved the FOSS materials and the results they saw with their students. The younger teachers in the school soon embraced the FOSS program, too, because of what they saw happening in these other classrooms.

Northwest Local Schools in Canal Fulton, Ohio, was the last district to join the FOSS implementation in Stark County. One of the teachers in the middle school had created his own science kits in the past. The kits were stacked from floor to ceiling in his classroom. It was a bit more difficult to convince him of the merits of adopting FOSS. The SAMM Center staff worked with him and another teacher from the school, providing the training needed to get them started with FOSS. Now this teacher is one of their greatest FOSS advocates. He has vigorously embraced the Dotcars™ from the Force and Motion Course and assists with breeding milkweed bugs for the Populations and Ecosystems Course. Everyone is on board with FOSS at Northwest Middle School.

The big similarity between the Minerva and Northwest schools experience with FOSS is that both districts have low teacher turnover. That allows for greater stability in the FOSS implementation and opportunities for teachers to become involved with the SAMM Center and projects such as breeding milkweed bugs.
Several groups provided initial funding for the initiative, including:
- Stark County Schools
- Stark Education Partnership
- The Timken Foundation
- Paul and Carol David Foundation
- The Diebold Foundation
- Martha Holden Jennings Foundation
- The Hoover Foundation
- Copco, Inc.
- Spectronic Instruments, Inc.
- Silk Foundation

The SAMM Center is the only program of this nature in the nation; it was modeled on similar programs at Purdue University in Indiana and Juniata College, Pennsylvania. The SAMM Center provides scientific equipment, such as microcentrifuges, soil test kits, probes, HR microscopes, incubators, gas chromatographs, pH meters, water test kits, portable planetariums, and more. The Center staff also maintains and delivers live organisms, including those needed for the FOSS middle school life science courses.

Training is provided to teachers who can then borrow the equipment. The equipment is reserved via an online registration system and delivered when needed by the equipment specialist via the SAMM van. A system has also been set up that allows for co-teaching with SAMM Center staff and follow-up support to the classroom teacher.

After three years of grant funding, the participating schools now support the SAMM program financially. The National Science Foundation has awarded several grants to the Stark County Educational Service Center to provide professional development through the SAMM Program.

The SAMM collaborative includes 17 county school districts, the Stark County Educational Service Center, and other institutions, including:
- Ashland University
- Canton Crime Lab
- Canton Joint Engineering Council (CJEC)
- Kent State University—Main Campus and Stark Campus
- Malone College
- Mount Union College
- Stark State College of Technology
- Walsh University

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**Funding for Professional Development**

Several grants and awards have supported professional development through the SAMM Center since its origins. Some of these grants have ended, but the importance of professional development is apparent in the county. Presently, the school districts provide financial support for the FOSS Forum and other professional development opportunities. Some of the other grants that have supported professional development are described here.

**SATURN**

SATURN (Science and Technology for Understanding, Research and Networking) is a local systemic initiative for grades 7–12 that builds on the SAMM project as well as two other NSF-funded projects, SEEDS (Science Education Enhancing the Development of Skills) and GRASSROOTS. These two projects were five-year programs focusing on improving the teaching of elementary science in Stark County. Funding for the five-year SATURN project began in 1999 and came from NSF and matching funds from local foundations, including Timken, Hoover, Herbert W. Hoover, Deuble, and the Stark Community Foundations.

The goal of the SATURN project was to train teachers to develop and implement a quality, standards-based program that would promote science literacy for all and increase student achievement. The SATURN objectives were to:

1. Develop a clearly articulated and sequenced science curriculum, grades 7-12, based on national science education standards and Ohio proficiency standards.
2. Identify and implement exemplary instructional materials that reflect national science education standards.
3. Create a leadership team in every district to facilitate the localization of the curriculum, development of the scope and sequence, selection of instructional materials, and facilitate the year-long SATURN Study Group.
4. Educate all middle school and high school science teachers in coursework related to national science education standards, pedagogical and content knowledge of specific instructional materials, use of authentic assessments, and application of high performance technology (totaling 130 contact hours).
5. Increase student achievement in science as measured by the current 9th and 12th grade Ohio Proficiency Tests and the new Ohio High School Graduation Qualifying Exam (10th grade).

SATURN involved every school district in Stark County, Ohio and all 44 buildings at the middle school and high school.
levels. The SATURN project was a collaborative effort of the Stark County Educational Service Center, the Stark County School District, The Education Enhancement Partnership (a local school/business foundation), the Canton Joint Engineering Council (CJEC), local colleges and universities, and local private foundations. The SATURN project relied heavily on teacher leaders to direct the project with extensive collaboration and co-teaching with college/university professors and other professionals from business and industry.

Results of the SATURN initiative can be inferred from Stark County school district test scores. While the Ohio state average gain in 9th grade science proficiency was 29% over the life of the SATURN grant, Stark’s county-wide gain was 33%. Individual districts showed gains ranging from 22% to 44% in Stark County. At the 10th grade, the county-wide average over the course of testing was 34% compared to a statewide average of 29%. Individual districts showed gains between 24% to 53%.1

Math/Science Partnership
The Stark County Math and Science Partnership (MSP) Program is a partnership of the Stark County ESC with all 17 school districts, colleges, universities, business, and industry. It was funded by a $7.5 million grant from the National Science Foundation. The grant focuses on the improvement of student achievement and the reduction of achievement gaps in math and science at the middle and high school levels. The five-year grant was awarded in 2002 and will be extended for the 2007–2008 school year.

Partners in the MSP include Malone College, Stark State College of Technology, Kent State Stark Campus, Mt. Union College, Walsh University, approximately 60 professors from area colleges and universities, over 50 area businesses and industries in Stark County, and the Stark Education Partnership. Programs include Masters Degree programs for teachers through Malone College and Kent State University to improve middle school teacher content knowledge in math and science and a math and science teacher leadership program. The Stark County grant will carryover grant funds into the 2007–2008 school year to continue some of the programs and to continue the data collection.

SMART Board Initiative
SMART Board interactive whiteboard technology was implemented through the SAMM Center beginning with the 2005–2006 school year through a grant from the Timken Foundation. Twenty-four SMART Boards and data projectors were awarded the first year which focused on implementation in math classrooms.

Continued on page 10
movement of teachers in and out of a school or school system. These teachers had a more difficult time being convinced that the FOSS program was making a positive impact on student learning since they weren’t around long enough to observe the outcomes. The FOSS Forums provided an opportunity for these teachers to interact with other teachers who were achieving success with FOSS in the classroom. The experience challenged them to continue to use the FOSS program and implement the suggestions offered during the Forum.

Observations, Reflections, and Objectives
During a recent conversation with Nancy BakerCazan, we chatted about the following observations and reflections.

- Because of the FOSS forums, teachers stick with the program. Even naysayers will admit the students love it.
- The SAMM Center staff still gets pressure from others who don’t understand the process. They question where the indicators are that need to be covered and how the program fits into their needs to cover the standards.
- It takes about three years for teachers to get to be comfortable with FOSS and other inquiry-based science before they begin seeing connections between their local environment and other subjects of study.
- Students move from school district to school district fairly regularly, but with the standardized use of FOSS in county schools, students don’t have to start over each time they move to a new school.

Nancy would like to do some research into other aspects of science implementation and professional development.

Teachers at a recent FOSS Forum hear how SMART Boards can be used to project images for investigations such as those found in the Earth History or Weather and Water Courses.

Teachers were encouraged to write grants for the second year, since science applications of the SMART Board technology differ from those used in math classrooms. SMART Boards made their way into math and science classrooms during the 2006–2007 school year. Training in the use of SMART Boards was provided by local teacher leaders and the SAMM Center staff through the math/science grant.

GK-12 Grant
An NSF Graduate Teaching Fellows in K-12 Education (GK-12) Program grant also supported the SAMM Center and FOSS beginning in 2005. As described on the NSF website (http://www.nsf/gk12.org/), the GK-12 program “supports fellowships and training for graduate students in science, technology, engineering, and mathematics (STEM). Through interactions with teachers and students in K-12 schools, graduate fellows can improve communication and teaching skills while enriching STEM content and instruction for their K-12 partners.” The SAMM Center partners with the Departments of Geography and Geology at Kent State University on a project called North East Ohio Geoscience Education Outreach an inquiry-based approach to Earth Systems Science, otherwise known as the NEOGEO project.

Through the enhancement of existing educational partnerships between Kent State and the Stark County Educational Services Center, the goal of the NEOGEO project is to enrich middle and high school Earth Science education by introducing educators and students to inquiry-based earth science and geospatial technology. The goal of the NEOGEO team is to work with 40 middle and high school science teachers per year and their approximately 5,000 students.

Ten GK-12 fellows are collaborating with middle and high school teachers in Stark County. Fellows help implement inquiry-based science, such as FOSS, and the associated understanding of Earth system processes. They develop inquiry-based curriculum modules based on analysis of the local environment using field methods and on-line geospatial databases. BJ Arnold, one of the fellows who attended the Earth History workshop at Grand Canyon last summer, has worked on starting a rock garden at a Stark County middle school, as well as led field trips for teachers in the Cuyahoga River National Park area. These content specialists, such as BJ, were a big influence on the successful implementation of inquiry-based materials, such as the FOSS Earth History Course, in Stark County schools. You can find out more about the NEOGEO project at their website, http://neogeo.kent.edu/.
development in Stark County. The SATURN grant and the Math/Science Partnership provided an opportunity to work with Nancy Love's data analysis\(^2\) and TERC. The team used the data-analysis tool with teacher coaches across the county. Each August, teachers come together to analyze their testing data. Nancy noted that they can't correlate the improvements in science test scores mentioned earlier in this article with FOSS, but there is a steady increase in math and science across the board. She has considered several possibilities for the increase:

- There might be an effect from teachers working together in collegial teaching.
- Attitude change in teachers and students may be reflected in the scores.
- Previously there was competition between teachers and schools regarding their science programs, so they didn't share what was working in their classrooms. With the inception of the FOSS Forums, teachers now talk to each other across the board and share their successes. So, could some of the test score increases be because of FOSS? Is the FOSS curriculum stimulating the sharing?

A variety of other thoughts and possibilities came up during our discussion, including:

- The use of field methods and on-line geospatial databases to enhance the FOSS program.
- Can attitude be correlated to the amount of professional development? Nancy proposes that the more professional development hours over 80 hours the better the attitude of students towards science. Fewer than 80 hours seems to have no effect on student attitude.
- How do we address teacher turnover and the orientation and training of new teachers?
- Does the implementation of the Math/Science Partnership and GK-12 cause connections with the universities that can influence the training of new teachers? One approach they have tried is to have the SAMM center provide three days of intensive professional development, two days back to back and one later in the school year. The new teachers are paired with master teachers, allowing the master teachers to pass on their experience with pitfalls and successes. This approach honors the master teachers' expertise and provides valuable connections for the fledgling teachers.

**Conclusions**

It's been a year since the Earth History workshop and my first interactions with the crew from Stark County. I have probably just grazed the surface of what's going on in the county regarding FOSS and its implementation in the county's middle schools. The energy and dedication of professionals like Nancy, BJ, Laura, Todd, Terrie, and others is impressive. With the beginning of the new school year, we hope to continue our collaboration and be able to use this expertise to help the implementation of FOSS for middle school in other school districts.

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The Weather Report for June 24–30, 2007: Everybody Talks about It...
By Larry Malone

When you watch the TV weather report this evening, take a close look at the graphic weather being waved across the screen by the station’s meteorologist. Pretty impressive stuff. But think past the clever animations to consider the information presented and the science that generated it. The handsome graphics represent some of the most complex, dynamic natural processes on the planet. Observing and understanding those processes is the realm of a host of governmental agencies, institutions of higher education, communication networks, and private enterprises. Weather is a big deal, especially in Norman, Oklahoma, known by many weather scientists as the meteorological capital of the world.

On Sunday, June 24, a small group of FOSS developers and middle-school science educators from around the country converged at the appointed hotel in Norman, Oklahoma. Terry Shaw, FOSS author/developer and professional development coordinator, described the high points of the FOSS Weather and Water Institute. The coming week promised to be a whirlwind of activities, featuring a complete training on the use of the FOSS Weather and Water Course, copiously enriched with presentations, tours, and field trips related to the research, acquisition, processing, and dissemination of weather.

Monday: 22°C (72°F); Relative humidity 75%; Partly cloudy; Chance of thunderstorm 50%

The host institution for the Institute was the National Weather Center, a unique confederation of federal, state, and University of Oklahoma organizations that work together to advance the understanding of weather and improve the instrumentation and information systems that yield timely, reliable forecasts. The Center, a brand-new, state-of-the-art facility, provided a high-tech classroom for the week, access to many scientists, and the continuous support of Andrea Melvin, the Outreach Coordinator for the Oklahoma Climate Survey. The circumstances couldn’t be better for an institute on weather.

We settled into our 5th floor classroom, and Terry led us through the first investigation in the Weather and Water Course. What is Weather? We saw an introductory video featuring some examples of severe weather, used that to define weather, and then took a mini-field trip to the grounds of the Center to measure weather variables: temperature, wind speed and direction, humidity, and barometric pressure. Back in the classroom we started our science notebooks, recording the weather data as our first entry. It all seemed to add up to a perfect Oklahoma summer day.

Dr. Kevin Kloesel, Associate Dean of the College of Atmospheric and Geographic Sciences at the University of Oklahoma, offered his welcome, and primed the group with a riveting introductory talk on the field of meteorology and the art and science of weather forecasting. After lunch, we again applied ourselves to the curriculum, becoming familiar with Earth’s atmosphere, particularly the troposphere—the shallow portion extending from the surface up some 10–18 kilometers. This is the place where weather happens.

About 4:00 p.m. we were preparing to start the third investigation, Seasons and Sun. That’s when we heard a tremendous explosion, followed by a short, insistent rumbling and thumping. After a brief moment of confusion, the automated emergency warning system started up with flashing strobe lights, sirens, and a voice urging us to evacuate the building. In moments the stairways delivered the denizens of the center to the first-level foyer, where we all congregated. A rumor, soon confirmed, ran through the crowd that lightning had struck the communication tower on the Center and the ground close by. The fire department arrived within minutes. The fire marshal was unhappy to see that the building had not been evacuated and ordered the Center directors to move everyone out immediately. The meteorologists resisted, pointing out that the safest place to be during a thunderstorm is in a protected building, like the National Weather Center. After a few tense interchanges, the building was evacuated for a minute or two, and then everyone was allowed back inside. Everyone’s needs were accommodated. At that point we adjourned for the day, confident that we had started the institute with a bang.

As it turns out, this was the first time the Center had been struck by lightning. And we were there to experience the strike and see how the emergency procedure played out. We felt honored that the Center arranged this signature weather event for our benefit, but it was really not necessary. We could have had an excellent weather experience without being hit by lightning.

Tuesday: 21°C (70°F); Relative humidity 72%; Cloudy; Chance of thunderstorm 80%

It rained hard last night. There was widespread flooding south of Norman. We resumed our curriculum work with Investigation 3, Seasons and Sun, in the morning, and Investigation 4, Heat Transfer, after lunch. Mid-afternoon we broke away from our academics to hear from Andrea about the Oklahoma Mesonet Survey, a model statewide remote monitoring system that sends continuous weather data from around the state to a central computer. Then a tour of a number of facilities housed in the Center, starting on the roof with a number of instrument installations. Here Dr. Bill Beasley, an authority on lightning, showed an experimental device that reads static electricity buildup, and discussed its potential as a lightning prediction tool.
He also launched into an impromptu discussion of lightning rods and how they work. He debunked the frequently advanced notion that lightning rods are designed to repel strikes, acting as a kind of shield. Quite the contrary, the rod actually produces static streamers that act as discharge attractors. When lightning does strike, the charge is directed to ground, where it dissipates without causing damage to the structure.

The tour continued to the regional National Weather Service Forecast Office. Here a handful of meteorologists monitor huge quantities of data and animated weather patterns on banks of monitors to keep a finger on the pulse of the regional and national weather. While we were there, a forest fire in South Lake Tahoe, California, had just exploded into a catastrophe, sweeping through thousands of acres of forest, and incinerating scores of homes. One of the monitors clearly showed a mass of unusually warm air flowing off the Pacific, across central California, and into the Tahoe area. This was the driving force behind the intensity of the conflagration, which blew the fire out of control. The monitor also showed a counterclockwise flow of cold air starting to invade the warm air mass. We speculated that if the developing pattern continued, the cold air might overpower the warm air and provide the firefighters with more favorable weather. This is what did happen. During the next two days the fire was brought under control, and a couple of days after that it was contained.

The next stop was the National Severe Storms Laboratory. Here in another data fortress, meteorologists were poring over information looking for the telltale indicators of severe weather brewing. It might be an intense region of thunderstorms with the potential to develop tornadoes, a cyclonic disturbance over the central Atlantic that might develop into a hurricane, or, like in California, wind and moisture conditions that signal a fire alert. This is totally serious science coupled with a tremendous wealth of experience and a measure of intuition. The consequences of their determinations have huge societal impact.

From there it was on to lighter business, a weather balloon launch. Twice every day, rain or shine, weather balloons are launched simultaneously at hundreds of locations around the world. In Norman the times are 6:00 a.m. and 6:00 p.m. A small instrument cluster, called a radiosonde, is tethered to a 1.5-meter balloon filled with helium or hydrogen. For the hour or so following the launch, radiosondes the world over transmit temperature, pressure, humidity, and wind data back to their home bases. These data are then forwarded to the National Weather Service for redistribution to all the forecast stations. These data form one set of anchor points for the weather forecast you and I will hear on the radio and TV tonight. And, shortly after the balloon went up, the rain came down.

**Wednesday: 27°C (82°F); Relative humidity 100%; Cloudy; Chance of thunderstorm 80%**

In the morning we heard about an experimental urban weather monitoring system, the Micronet. Local weather conditions in the artificial city canyons with their altered surfaces and human activities can be significantly different from the surrounding areas. A network of small, durable monitoring devices has the potential to provide specific meteorological information for urban health, safety, security, zoning, and a host of other purposes. After this interesting excursion, we returned to the curriculum and tackled Investigation 5, Convection, and in the afternoon we dove into Investigation 6, Water in the Air. This important topic filled the rest of the day.

I had to leave Wednesday evening, so I didn't have firsthand experience with the rest of the Institute. But I heard from Terry that...it rained. Oklahoma had a record June for rain. The ground was saturated. Additional precipitation remained on the surface and headed for lower ground, leading to flooding. But the Institute continued.

**Thursday: 25°C (78°F); Relative humidity 100%; Cloudy; Chance of thunderstorm 60%**

Thursday was spent on Investigations 7 and 8, The Water Planet, and Air Pressure and Wind. For scientific enrichment the group heard a presentation by Andrew Reader on the mix of atmospheric ingredients that leads to severe weather, and in the afternoon they heard a panel discussion on the coming advances in data-acquisition technologies, particularly radar-based instrumentation, and the advances in forecasting the panelists foresee when these technologies come online.

On Friday Terry completed the Institute with Investigation 9, Weather and Climate. To put a cap on the week, Andrea demonstrated a piece of weather visualization software, Rick Smith from the National Weather Service discussed severe weather and storm spotting, and Derik Arndt painted the largest, most pressing picture with a presentation on climate change.

That evening Terry and his wife Skye entertained the participants with a farewell dinner party. The participants graciously presented Terry with thank-you presents, a nice bottle of wine, a hibiscus, and a pond plant for the yard. They say, everyone talks about the weather, but no one does anything about it. Well, Terry has started doing something about it...he’s introducing plants into his yard that are appropriate for the weather. ☀️
This issue’s Wordsmiths features books various publishers have sent to FOSS staff to review and consider for inclusion in the FOSS resource database. If you have found a book that you think other FOSS users should know about, please send the reference to foss@berkeley.edu, including author, title, ISBN, and a short annotation.

**New from the Wordsmiths**

**Hey There, Stink Bug!**

( **Life Science Strand** )
Ant lions, skipper caterpillars, and even dung beetles make appearances in this book, which is a collection of poems that focuses on the insect world. It includes a number of poetic forms, including haiku and clerihew. A brief annotation is included with each poem, providing some interesting background information for the readers, young and old alike. Glossary included.

**101 Things Everyone Should Know About Science**

101 Things Everyone Should Know About Science uses a question-and-answer format to entice the reader into learning more about key concepts in biology, chemistry, physics, earth, and general science. This book is perfect for anyone interested in gaining a better understanding of how science impacts everyday life. Some questions include “Why do you see lightning before you hear thunder?” “What keeps the planets orbiting around the sun?” “Why do we put salt on roads when they are icy?”

You can review all of the resources recommended for FOSS modules and courses in the online resource database, [http://lhsfoss.org/fossweb/teachers/resources/index.html](http://lhsfoss.org/fossweb/teachers/resources/index.html).
**FOSS Institutes**

Delta Education will host one-day FOSS Institutes in conjunction with the three 2007 NSTA Area Conferences on Science Education. These institutes are held on the Wednesday before each conference and are designed for leadership educators—lead teachers, administrators, curriculum coordinators, professional developers, and university instructors.

This fall, the elementary institute will be for educators from districts that have implemented FOSS for at least a year and it will focus on using formative assessment to improve teaching and learning. The focus will be on new assessment tools and strategies designed specifically for FOSS modules grades 3-6.

The Middle School Institute will focus on the science content and instructional pedagogies in the new **Chemical Interactions Course** for grades 7 and 8. This institute is designed for education leaders who are now or will soon be implementing this course.

There is no charge for the Institutes, but they are by invitation only. Times and locations are listed in the FOSS Professional Development calendar. To request an invitation and secure your spot at one of these institutes, please call, write, fax, or email:

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Phone: 1.800.258.1302 ext. 503  
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Check the FOSSweb.com Calendar for FOSS Institutes at the Fall 2007 NSTA area conferences.

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**NSTA 2007 FALL AREA CONFERENCES**

- Detroit, MI      Oct 18–20, 2007
- Denver, CO      Nov 8–10, 2007
- Birmingham, AL  Dec 6–8, 2007

**FOSS WORKSHOPS IN THE NSTA PROGRAM**

**THURSDAY (10/1; 11/8; 12/6)**

- 8:30–10:30   Force and Motion Fundamentals for Middle School
- 11:30–1:00   FOSS Assessment—Valuing Academic Progress in Grades 3–6
- 2:00–4:30   FOSS Chemical Interactions for Middle School Students

**FRIDAY (10/19; 11/9; 12/7)**

- 8:00–11:00   Using Science Notebooks with FOSS Modules K–6
- 11:30–1:00   FOSS Assessment—Valuing Academic Progress in Grades 3–6 (same as workshop on Thursday)
- 2:00–4:30   Using Science Notebooks Featuring FOSS Middle School

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).

**New Products Featured at FOSS Workshops**

**FOSS Science Notebooks**
Grades K-6
Save time and money with consumable FOSS Science Notebooks. Investigation Duplication Masters from the FOSS Teacher Guide are all in one place with additional blank pages where students can record, organize, and interpret their observations.

**FOSS Science Notebook Folio**
Grades K-6
Engaging in active science is one part experience and two parts making sense of the experience. The science notebook helps students with the sense-making part. Notebooks provide two major benefits to students who are engaged in scientific inquiry, documentation, and cognitive engagement. The FOSS Science Notebook folio offers instructions and strategies for teachers to implement science notebooks in the FOSS curriculum.

**ALSO AVAILABLE**

**FOSS at Home Folio**
Grades K-6
Get parents involved with hands-on science at home! This folio offers a variety of ideas for involving families in science investigations to connect teachers, students, and parents in an exciting way.

Contact Delta Education to find out more about these great new FOSS products!
800.258.1302  
www.deltaeducation.com

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If you would like to be added to the mailing list to receive this newsletter, send your name and address to:

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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 Internet with FOSS. Send your contributions to:

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The deadline for submissions to the next issue is December 15, 2007. We’re waiting to hear from you.

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For More Information
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See you at the NSTA Area Conferences this fall!