The San Francisco Bay Area is considered one of the top regions in the world for STEM education and careers. It hosts prestigious universities like UC Berkeley and Stanford, an extensive array of science museums and institutions, and Silicon Valley, which “has the highest proportion of tech jobs of any region in the country—more than four times the national average” (Kotkin, 2012).

Yet, a disturbing paradox presented itself in science education in the Bay Area. Despite the region’s abundance of STEM-related jobs and resources, science instruction in Bay Area public schools is only now beginning to squeak its way back into the elementary classroom.

The lackluster state of elementary science education became a focal point of discussion when the directors of two of the Bay Area’s top science education institutions—Elizabeth Stage from the Lawrence Hall of Science and Dennis Bartels from the Exploratorium, together with Mark St. John from Inverness Research—joined forces to tackle the issue. It was 2006 and science education was languishing on the vine. The effects of high-stakes testing in reading and math were taking their toll, pushing out any time in the class schedule for science. At the same time, a report had just been published in Science that found that students’ early interest and exposure to science in the middle and younger grades was a stronger predictor than any other factor of how likely they were to graduate college with a bachelor’s degree in science (Tai, Liu, Maltese, & Fan, 2006). Yet, a study commissioned by the Gordon and Betty Moore Foundation in 2007 and conducted by the Lawrence Hall of Science found that most elementary school teachers (80%) spent only 60 minutes or less per week on science, and 16% spent no time at all on science (Dorph, Goldstein, Lee, Lepori, Schneider, & Vankatesan, 2007). These two studies suggested a bleak future for STEM education in the Bay Area. Little or no exposure to science at the elementary level meant Bay Area students were far less likely to graduate from college with a bachelor’s degree in science. The Gordon and Betty Moore Foundation called on the science community and other foundations to come together to address the urgent need for improving science education in the Bay Area. Ideas were debated and a question was posed: What if science institutions and foundations collaborated to support local school districts? The result was the Bay Area Partnership for Science Education (BaySci), a formal partnership between the Lawrence Hall of Science, the Exploratorium, and Inverness Research. Its

Continued on page 2
BaySci continued

mission was to strengthen inquiry-based science instruction in the Bay Area.

The BaySci partners believed that a window of opportunity to bring back elementary science was now open. It was an adoption year for California, and FOSS was on the list of state-approved science curricula. There was complete consensus among the science leaders and program funders that FOSS was the only high-quality inquiry-based science curriculum on the list. The question was how to ensure that all K–5 teachers had access to the materials and adequate training to implement FOSS successfully in the classroom. The answer: the unit of change would have to be at the district-level.

Bay Area districts were clearly interested. As a result of two public forums on the need to improve elementary science education, there were 40 school districts that expressed interest in joining the partnership. The S.D. Bechtel, Jr. Foundation and the Noyce Foundation committed financial support, however, there were not enough resources to serve all 40 of the interested districts. The next step was to determine which of these districts would be the best fit for the BaySci partnership.

The founders wanted districts that would become a showcase for science and thereby encourage other districts to enact their own reform efforts. According to Craig Strang, the BaySci Co-Principal Investigator, a district had to show they were ready. He notes, “It didn’t matter if they were starting at ground zero or already moving forward. The point was to support continued improvement.” Reflecting on the process, Craig says, “There was no question or hesitancy that to participate you had to be a FOSS district. FOSS was the only curriculum that met the readiness criteria.” Research by Inverness supported BaySci’s strong stance on adopting the FOSS Program. National Science Foundation (NSF) systemic initiatives showed that it was critical to have a high quality curriculum in order to improve science education. There was general agreement among educators that a textbook-based curriculum would make it too difficult to achieve the goal of science education reform.

After three months of interviews and gathering data on the districts, the BaySci team agreed that the decisions would be based on three criteria. The first was readiness, which meant not only adopting the FOSS Program, but also having an infrastructure or plans to develop an infrastructure to support implementation. The other two were intent and potential. The district had to demonstrate their intention to make science among their highest priorities at all levels—from the superintendent to the classroom. There also had to be potential to benefit. A district had to demonstrate a certain level of administrative stability and the capacity for improvement.

Five districts that met these criteria were selected, Novato, Petaluma, Newark, Palo Alto, and Emery. The superintendents from each of these districts pledged their commitment to participate in BaySci events and to support district-wide reform. Of the five districts, three had previously been using the FOSS Program for science and were already planning to adopt FOSS again. The other two had no experience with FOSS or any type of science education reform, and they had no science coordinators. Nevertheless, they made strong cases to enter into the BaySci partnership.

The goal of the partnership was to increase the likelihood that every student would encounter high quality science instruction and have engaging opportunities to learn science. To reach this goal, the BaySci partners focused on desired outcomes—the improvement of infrastructure, the building of teacher capacity, and improving science learning (see the BaySci Theory of Action diagram). For the first three years, BaySci focused on building district-level capacity to implement FOSS and on providing professional development for teachers and teacher leaders. Top-level district leaders participated in leadership seminars and planning sessions and received technical assistance to help them prioritize high quality science instruction and build leadership capacity.

By 2011, the efforts were paying off. Districts had developed functioning materials management systems and demonstrated increased leadership support for science teaching and learning. One of the districts that had started from ground zero, now had a science coordinator, a materials replenishment...
system, ongoing professional development for teachers, principal support, and a district funded teacher leadership committee that met periodically throughout the year.

Teachers from all the districts participated in workshops improving their capacity to implement FOSS modules effectively and to integrate science with literacy and English language development strategies. Inverness Research found that the BaySci teachers taught science more often and delivered higher quality lessons than would be found in the typical California elementary classroom. According to the BaySci Evaluation Report (2011), using the FOSS program in a steady and consistent manner helped create a foundation of high quality instruction. The report concluded that BaySci provides an upward pressure on science teaching that has resulted in improved instruction overall and better instruction than the national or state average.

Of course, there isn’t always clear sailing. On the contrary, BaySci has worked with districts through an era of great turmoil. In addition to the constraints of No Child Left Behind accountability, state budget cuts and district administrator turnover have churned the waters, making reform efforts even more difficult. According to Vanessa Lujan, BaySci’s project director, one of the biggest challenges is maintaining leadership capacity. Due to budget cuts and position consolidations, all of the BaySci districts experienced changes in their science leadership teams. Vanessa explains,

Within the first three years of the project, every person had turned over at least once and in some cases twice (superintendents, assistant superintendents, science coordinators), with the exception of one district that still has the same superintendent. Turnover affects momentum, continuity, and capacity; you spend a lot of time developing leaders in science reform and then they leave. If one leaves that’s ok, but when two or more leave at the same time, the history of learning is disrupted, and it affects the program.

To address the problem, BaySci focuses on making sure the leadership teams remain a part of the districts’ infrastructure by including teachers and principals, as well as district administrators, and by encouraging districts to craft vision statements and implement action plans for their district’s elementary science program. Experience with districts has shown that there is a simultaneous need to cultivate teacher leaders and to provide opportunities for those teacher leaders to engage in leadership activities.

Both Craig and Vanessa agree that the commitment to providing high-quality science instruction for all students must be district-wide, from the top to deep into classrooms. “It can’t just be science coordinators, or resource teachers, or teachers going to workshops; that’s not enough,” insists Craig, adding,

Inverness Research evaluations found that most of the systematic initiatives have consisted of large-scale professional development for every teacher with the assumption that they will change their practice. However, the research shows that if the change is not supported, if there isn’t an infrastructure, or a shared vision of what it looks like in the classroom, at the school site, and district-wide, then it won’t happen.

It is the focus on district capacity that has the most effect on changing teachers’ practice.

Vanessa also highlights inter-district sharing as a powerful way to help build capacity and effect change.

In BaySci, teachers are able to share with other teachers in workshops, and teachers and administrators learn from other districts during the leadership seminars. We’ve seen how the work of one district can influence others. For example, we had districts share about using science as the context for their district writing assessments and now other districts are following suit. Even though districts differ, they learn from each other.

BaySci has learned a lot about what it takes for a district to support district-wide FOSS implementation. These elements are included in the BaySci District Capacity Framework, a tool designed by Inverness to help districts monitor their progress in developing the capacities and policies necessary to sustain a standards-based elementary science education program. (See Appendix D of BaySci Evaluation Report, 2011) One of the key elements is creating, communicating, and building consensus around a vision of what good science instruction looks like for each district. It has proven to be effective in helping districts prioritize science learning and building a school culture that supports science education. Craig points out the importance of this approach. Every child has the right to learn science. That was it. Now five years later, districts are saying, ‘Science should be taught daily.’ The way a district goes about supporting the former vision is radically different than the actions they would take with the later vision. Craig notes,

We have found that being clear on the vision is really important to prevent the possibility that there is a lot activity but no consensus on what you want to achieve. Teachers will teach science differently if it is a
core subject versus teaching a little science during the year. People might think a vision statement is rhetoric or not worthwhile, but it can be a very powerful tool if you are using it as a basis for systemic reform. It has made a difference in a lot of districts. People have been both surprised and inspired during the process.

In addition to helping shape the local infrastructure through its work with school districts, BaySci also supports high-quality teaching and learning of science by bringing important issues to the forefront in community forums and through two other programs: Science Champions Network; and the Science-rich Education Institution (SREI) Learning Community. The BaySci Science Champions are individual educators from districts all around the Bay Area dedicated to improving their science instruction by participating in summer institutes and follow-up workshops at the Exploratorium. The SREI Learning Community consists of representatives from museums and other science educational institutions around the Bay Area and the state that meet periodically to share their expertise and collaborate on ways to support teaching and learning of the Next Generation Science Standards (NGSS).

The BaySci District Network continues to expand with the inclusion of Oakland, Alameda, Orinda, Santa Clara, and San Mateo/Foster City in the Bay Area, the Sonoma County Office of Education, and Santa Barbara USD in Southern California. It’s a different era now, with districts focusing on implementing new standards from the Common Core State Standards (CCSS) and planning for the implementation of the NGSS. These changes pose both challenges and exciting opportunities. BaySci districts are in an advantageous position to share ideas and resources within the network as they grapple with issues such as new approaches for integrating subject areas, providing high-quality professional science learning for teachers, and communicating their vision statements and action plans to stakeholders.

Each district varies in its approach to NGSS implementation. Most are continuing to use the FOSS California Program and are focusing professional learning on expanding the opportunities for students to engage in the practices and use the crosscutting concepts to deepen understanding of the big ideas in science. Some districts are using FOSS as the context for addressing the CCSS for ELA. Academic discussions, writing in science notebooks, and close reading are examples of some of the ways teachers are using literacy strategies to address both Common Core and NGSS. At Oakland USD, the science and ELA departments are working together to converge FOSS and ELA into seamless units of instruction. A cohort of their dual immersion schools is currently developing comprehensive units based on the content of FOSS modules using connections to social studies, literature, and the arts to address both content standards and academic language development in both Spanish and English.

Three of the districts new to BaySci opted to begin implementing FOSS Third Edition and are using the program as a resource for transitioning to NGSS and for addressing the CCSS for ELA. In a time when districts are scrambling to find curricula that address the new standards or are calling on teachers to develop new comprehensive lessons, teachers using FOSS Third Edition find it makes their work much easier when they’re using a science curriculum that incorporates the practices and crosscutting concepts, as well as literacy and language development.

Regardless of their approach and despite the inevitable storms that lay ahead, the BaySci districts are clearly turning the tide of STEM education in the Bay Area with their commitment and dedication to making sure science is a part of every child’s elementary education. Having accomplished that goal, BaySci is now working to replicate this model approach in other districts in the state. The focus now is to continue moving forward, building capacity in both teaching and learning in the classroom and in improving the infrastructures that support the new national vision for science.


References
In Santa Barbara, California, BaySci is supporting the district’s effort to implement a vision and plan for an integrated and rigorous approach to science instruction. The goal of SBUSD’s science initiative is to reverse the trend of the No Child Left Behind era when elementary science was not a priority. Most teachers were teaching science less than one hour a week or not at all. The curriculum was textbook based and there was no plan for replenishing materials.

To address the problem, a leadership team headed by Associate Superintendent Robin Sawaske put together a plan for improving science instruction by providing professional development for teachers using their existing curriculum. But as teachers became more reflective in their practices, it soon became apparent that the materials they had were not adequately engaging students or providing the desired level of rigor.

In 2010, Holly Gil and Bridget Lewin were hired to help coordinate the district’s science initiative. They began by providing workshops and hands-on materials for teachers to strengthen their science program. Holly took the district’s list of ideas and turned it into a comprehensive strategic plan that could be presented to funders, supporters, and other stakeholders.

The BaySci/FOSS Connection
That spring 2010, Holly attended a BaySci presentation at NSTA and knew right away that the systematic approach outlined in the BaySci theory of action was exactly what Santa Barbara needed. The BaySci directors were encouraged by Santa Barbara’s plan and saw the opportunity to expand the BaySci model beyond the Bay Area. Thanks to a grant from the Wharton Foundation, funding was provided to support the partnership with BaySci. But the first thing Santa Barbara had to change was their science curriculum. Enter Emilio Handall, who at the time was the principal of McKinley Elementary School (Emilio is now the Assistant Superintendent and is leading the district through systemic reform in science education). Emilio had a vision and the support from his staff to make McKinley a science-centered school. He sent teachers to the Lawrence Hall of Science to find out about FOSS Third Edition. Bridget recalls that the teachers from McKinley were relieved to find that FOSS had what they had been striving to create all along— inquiry-based hands-on lessons that articulated K–5. She adds, “While observing FOSS taught in the classroom teachers said they saw something magical.”

The plan for McKinley had taken hold, and teachers began to pilot FOSS Third Edition school-wide. With the support of FOSS staff and WestEd’s K–12 Alliance, McKinley teachers were soon implementing FOSS at a high level.

Thanks to the passage of a parcel tax in 2012, SBUSD was able to begin purchasing FOSS Third Edition for the rest of the elementary schools in the district. According to Bridget, using FOSS gives teachers the “cognitive Velcro” they need to be able to identify and understand when and where to engage students in the NGSS practices. Teachers find that the notebooking component gives them a way to intersect with the common core ELA standards and the English Language Development (ELD) opportunities are authentic and robust throughout the modules. Bridget explains,

“Teachers appreciate the high level of engagement and academic language FOSS provides. We see students engaged in science and writing more. Students who weren’t doing well are now excelling. Students with special needs or disciplinary problems go right to it and are able to access it. It builds their self-confidence.”

The science leadership team members agree that without FOSS it would have been much more difficult to realize their science initiative.

SBUSD is following the “Go slow, but go” approach to NGSS transition. Holly and Bridget decided to start FOSS implementation with the modules that aligned best with their recent foundational science content trainings. (Physical Science for grades 1, 3, and 5; Earth Science for grades K–2, 4, and 6.) In 2013, teachers were given one module to implement to allow sufficient time to be trained, to try out the investigations, and collaborate with other teachers. In 2014, teachers will receive their second module in either Life Science (K–1, 3), Physical Science (2 and 4), or Earth Science for 5th. In 2015, all grades will receive their third module. Reflecting on the process, Holly and Bridget agree that it would not have been possible to roll out everything in one year.

District Reform
SBUSD teamed up with BaySci because of its district-wide approach. The leadership team needed to move beyond focusing on individual teachers and broaden the scope to implementing a more comprehensive plan for the district. Fortunately, the groundwork was laid for that to happen—a strategic plan and a leadership team. Holly emphasizes the importance of having a “vertical slice structure” to keep the leadership team cohesive. She explains, “There have been changes in superintendent, assistant superintendents, and principals, but enough people are invested and involved to keep the plan moving forward.

BaySci involvement has helped SBUSD look more closely at the structures that support high-quality instruction in general. Bridget explains, “We see the science initiative as one in the same with Common Core implementation. It would have been easy to forget about science but now everyone sees science as part of Common Core implementation; it’s part of how we are changing how we teach. We are in a better position as a district to move forward with NGSS.”
Have you had the opportunity to look through a FOSS Third Edition Teacher Toolkit yet? If so, you may have seen the ladybug icon in the margin or language such as “use the outdoor learning door” or “grab the outdoor teaching supplies.” If you dig a little deeper into the Teacher Resources component, you may have seen the Taking FOSS Outdoors chapter. FOSS has always gone to the schoolyard for certain modules. How could anyone possibly teach Air and Weather without going outside to feel the temperature, to fly a kite to observe the wind, or to make the anemometer work? But now, in the FOSS Third Edition, teachers are prompted to head to their outdoor gathering spot regularly. Each Third Edition module has students going to the schoolyard at least once, and most of them have students going outside once for each investigation. All of this work grew out of Boston. Let’s travel back in time and see how FOSS was inspired to start taking children to the schoolyard on a regular basis.

In 1995, Mayor Thomas M. Menino deemed Boston schoolyards “a barren wasteland of cracked asphalt” and formed a task force to remedy the situation. He recommended a five-year initiative and formed a public-private partnership between a group of private funders—the Boston Schoolyard Funders Collaborative, the City of Boston, and the Boston Public Schools (BPS)—who together began the work of “transforming Boston’s schoolyards into active centers for recreation, learning, and community use.”

Eighteen years later, in 2013, the Boston Schoolyard Initiative (BSI) had completed a project on every feasible elementary and K–8 schoolyard throughout the city of Boston. Their work is the envy of other urban school districts across the country. Collectively, more than $20 million was invested into projects that were envisioned and accomplished with thoughtful participation of teams of parents, teachers, principals, students, neighbors, landscape architects, city and school officials, funders, and other partners committed to creating outdoor spaces to learn and connect to the natural world.

The idea of using schoolyards for learning was a goal of the task force from the beginning, but it took time to understand how to accomplish it. Within a few years it became clear that simply creating a green space was not enough to support teachers to teach outside, and that these spaces weren’t really designed for teaching. In 2004, BSI began piloting a new concept of an urban outdoor classroom designed to more
directly support outdoor teaching. The BSI education team engaged BPS teachers and leadership in the district’s science and literacy departments to determine the approach that would best support the curricula that educators needed to teach. Although the schoolyard designs have evolved over the years and vary from site to site, many include natural habitats, weather stations (including thermometers and wind vanes) permanently installed on armature structures, along with installations rarely found in schoolyards, such as pulleys and a variety of metals for testing magnetic properties and conductivity. Fencing defines these areas, keeps plants safe from recess activity, and also provides the teacher with a sense of security while giving students the freedom to roam. All of the outdoor classrooms contain defined seating areas for one or two classes, but they also include some of the comforts of indoor classrooms, such as white boards and chalk boards. As a direct result of incorporating the urban outdoor classrooms into 32 schoolyards, more educators were taking students outside for learning on a regular basis.

BSI provided spaces conducive to outdoor learning but also worked closely with the BPS science and ELA departments, and with teacher leaders within those content areas, to develop techniques for outdoor teaching, as well as curriculum support materials. The University of Chicago report (see “New Study Finds Outdoor Science Lessons Benefit Students and Teachers” in this issue) demonstrates that the Science in the Schoolyard™ professional development impacted teachers’ practice dramatically. More than 850 Boston educators have been trained to teach outside, and professional development tools were created to support them. For example, BPS teacher leaders were videotaped using effective outdoor teaching strategies and practices outside. The project also created Science in the Schoolyard guides to support each of the elementary science modules that BPS teaches. The guides determine when teachers should go outside in the flow of what they already need to teach and explain the activities. Essentially students apply the indoor concepts to another setting, the schoolyard, and involve real-world applications. The FOSS program has enthusiastically endorsed these guides, one for each of the 12 FOSS modules taught in Boston. The guides can be found on www.FOSSweb.com (under the Teaching Resources, Taking FOSS Outdoors section for Second Edition modules).

The Science in the Schoolyard two-day professional development workshops included information about how to manage a class of 25 students with one adult in an urban schoolyard. Teaching outside demands different teaching strategies to help students learn quickly that the outdoor area that they’re normally encouraged to run and play in requires different behaviors when they go outside for science. Teachers appreciated the simple tried-and-true techniques to improve behavior such as going outside through a different door than the recess door. During each workshop teachers participated in a wide variety of outdoor activities that they could do with students. Modeled within each activity were behavior management strategies and simple tools that teachers could make or buy. Many teachers loved the simple satchels made out of zip bags and string for hands-free exploration. Others loved the cardboard-binderclip-clipboards with an extra-large rubber band at the base to keep papers from blowing around.

All of this work—the videos, the workshops, and the guides—inspired the FOSS development team to integrate outdoor investigations into the FOSS Third Edition. Now every Third Edition module has at least one outdoor part, and most modules contain one outdoor part per investigation. This means that the work started in Boston, by BSI in conjunction with BPS teachers, reaches far beyond the city limits. If FOSS Third Edition users teach our program the way we’ve designed it, students across the country will be going to the schoolyard for science a minimum of 9–14 times annually.

BSI forged a critical link between sometimes difficult to connect organizations. It was a vital partnership between education innovators, city government, and funders that lasted over 18 years. BSI garnered and nurtured the trust and buy-in of the leadership and educators of one of the largest school districts in the country. Mayor Menino’s tenure loosely parallels the trajectory of this project, and he was there from concept to completion. The book, Learn, Play, Continues on page 8
Grow: The Boston Schoolyard Initiative Story, showcases some of the most important achievements of this project:
- 88 schoolyard renovations
- 32 outdoor classrooms constructed
- 30,000 school children reached annually
- 850 teachers engaged in professional development
- 25 acres of asphalt greened
- 100 garden beds created
- 200 trees planted
- 75 play structures installed
- 130 acres reclaimed for learning and play

Most schoolyards across the country aren’t as lovely as Boston’s. Many are barren asphalt. And still, most FOSS outdoor activities can be done in all schoolyards even if they are primarily asphalt or monocultures of grass. Sometimes life can be found in the cracks of the asphalt or along the fences where weeds have hidden from the lawn mower. FOSS believes strongly that taking students outside, no matter what the schoolyard looks like, will impact students’ science understanding and, more importantly, their well being. Of course, being in spaces designed to support outdoor learning will better benefit students, and BSI has many resources on the www.schoolyards.org website to help improve outdoor spaces on small or large budgets.

If you have FOSS Third Edition using your schoolyard for learning will be easier. The outdoor parts are built into the program and the Taking FOSS Outdoors chapter is right in your teacher resources book. If you’re a FOSS Second Edition user, you can use the 12 Science in the Schoolyard Guides to describe where to go outside within each of the 12 modules. The Taking FOSS Outdoors chapter is available to everyone on FOSSweb.com and describes how to manage space, time, materials, and students outdoors. Many of the techniques for improving behavior management came directly out of the experiences of BPS educators. One such guideline is, “students always carry a tool to the outdoor site,” even when it would be easier for you to carry everything. This reminds students that they are heading out for science, not recess. Some very outdoorsy teachers have said that this one technique has made teaching and learning outside much more effective and enjoyable.

In December 2013, the Boston Schoolyard Initiative celebrated the accomplishment of having achieved its founding mission. As the Boston Schoolyard Funders Collaborative ceases their involvement, others are stepping up to carry on the program. John McDonough, Interim Superintendent of the Boston Public Schools, said the district is committed to continue support for outdoor education and recreation, including maintenance of schoolyards and professional development opportunities for teachers. “We are proud that Boston schoolyards have emerged as extensions of the school learning environment,” said Mr. McDonough. Our teachers have embraced the innovative training and resources that enable them to bring the curriculum outdoors in ways that are meaningful to urban students.” A Schoolyard Leadership Committee has been established bringing together representatives from both the academic and facilities departments in connection with Green Schools efforts in BPS, and Science in the Schoolyard professional development courses will continue to be taught by SSY teacher leaders through the Boston Science Department.

The roots of this program extend far beyond the city limits of Boston. The www.schoolyards.org website will be maintained for years and has tremendous resources for schoolyard project development, teaching tools, and teaching support. Plus, now that the lessons learned from BSI are embedded in FOSS Third Edition, the ideals of the program can be carried on by individual teachers.

A major part of the success in Boston is because the BSI education team listened very carefully to teachers. They asked teachers what they had the time to do, what they already had to teach, what they needed to feel confident enough to take students outside, and what was needed in the physical space to motivate

Otis Elementary School in East Boston before schoolyard renovation

Otis Elementary School in East Boston after schoolyard renovation
them to take kids out regularly. Boston listened to teachers and FOSS listened to Boston. In the fall of 2014, in select schools in Chicago Public Schools, in small cities like Portland, Maine, across many districts in eastern Iowa, in ten GEMS-Net districts in Rhode Island, and in many other pockets across the country, students will start going to the schoolyard on a regular basis as part of their FOSS experience.

New Study Finds Outdoor Science Lessons Benefit Students and Teachers

By Kristin Metz, Education Consultant

“BPS has a strong commitment to high-quality science instruction. The resources provided by BSI’s Science in the Schoolyard program have helped BPS teachers actively engage students in ‘doing science,’ helping them develop good observation skills, make predictions, talk about science with each other, and connect science concepts to their everyday lives. With BSI, BPS science teachers have proudly led the way in using outdoor teaching to support rigorous science learning.”

— Pam Pelletier
Senior Program Director
Science Department
Boston Public Schools

In a new University of Chicago study, LaForce and Bancroft (2014) found that elementary science teachers in Boston Public Schools (BPS) are taking science outdoors across the district, benefiting students and science instruction overall. The study looked at the extent to which the Boston Schoolyard Initiative’s Science in the Schoolyard (SSY) program is being implemented in BPS schools and the corresponding outcomes for student learning and science teaching in the district. It centered around four questions:

1) To what extent are science teachers in BPS incorporating outdoor science lessons?

2) How does outdoor science instruction affect student learning?

3) How does outdoor science instruction affect science teaching in the district?

4) How has the Schoolyard™ program affected science teaching in BPS?

In brief, the study found:

1) Of the 100 elementary teachers from 55 schools who participated in the study, 70% reported incorporating outdoor science lessons in their spring 2013 classes.

2) The benefits of outdoor lessons for students included: higher levels of interest in science; better science communication skills (including science vocabulary and student to student science talk); higher rates of identifying connections between lessons; and greater risk-taking, independence, and curiosity.

3) Teachers who took lessons outdoors were significantly more likely to engage in several specific practices identified by the science department as indicators of high quality science instruction. These include: supporting science talk in their classes; structuring lessons to allow students to work at their own level; and asking students to make observations in science.

4) Teachers who had participated in SSY professional development were significantly more likely to incorporate outdoor science lessons in their classes and to do so with greater frequency than teachers who had not had SSY training.

5) Teachers who had participated in SSY professional development also demonstrated a greater commitment to outdoor science and had greater confidence in their ability to take science outdoors. Of those with SSY training, 92% said their “science teaching skills had improved inside and outside of the classroom” as a result of the training.

Measuring the impact of a program like SSY in a large urban district is challenging. “In large-scale innovations, particularly in districts with a lot of other challenges, it’s often difficult for programs to show strong and direct effects,” Melanie LaForce, lead evaluator explained. “I think it’s particularly difficult to find effects with programs that are implemented diversely across a district where there are also many other variables (different student populations, economic variability, etc.) that come into play. So, considering the rigor of our methods and the nature of the SSY program, I think it’s very encouraging to see some effects.”

About the Survey

To evaluate the impact of SSY, researchers looked at science instruction across BPS not just at the SSY program. They made every attempt to ensure that the collected data represented the full spectrum of science teachers in the district. The final data

Continued on page 10
New Study continued

represent science specialists and classroom teachers, teachers with and without SSY training, and classroom observations in classes, which did and did not include outdoor lessons in nearly equal numbers.

All 200 K–5 science teachers in the district were surveyed. Of the 97 who responded, approximately half were science specialists (47%) and half were classroom teachers serving as their students “primary science teacher” (51%). Survey respondents included teachers who had had no SSY training (41%) as well as teachers who had taken SSY courses (59%).

Of the eight schools that were randomly selected for data collection, none declined to participate. At these schools, evaluators collected qualitative data through in-depth interviews with selected teachers and the school principal, teacher and student focus groups, and classroom observations. Six of the eight schools had an outdoor classroom, and five had a science specialist who had participated in SSY training. Seven of the 15 classroom lessons observed included an outdoor component.

One thousand students (grades 3–5) were surveyed resulting in 800 useable surveys, half of which were from schools with an outdoor classroom and/or SSY trained science teacher and half of which had neither.

To overcome social desirability and confirmation biases, LaForce, lead evaluator, said, “we worked hard to create instruments where teachers didn’t just answer what they thought they should answer, or answer questions that they knew were linked to their experience with the SSY program.” For example, using the first science class they taught each week, teachers were asked to respond to a wide array of questions about the teaching practices they use. In separate sections about classes held indoors and outdoors, teachers were asked questions such as the following: “How often did you ask students to discuss lesson content and activities with each other?” and “How often did you ask students to articulate what they are doing in a science investigation and why they are doing it?” In other sections of the survey, teachers were asked to describe the behaviors their students (in the first class of the week) had engaged in, with reference to both indoor and outdoor classes. For example,

- How many of your students discussed lesson content and activities with each other?
- How many of your students articulated what they were doing in a science investigation and why they were doing it?

**Extent of Outdoor Science Teaching in BPS**

Of the teachers who reported incorporating outdoor science lessons in the spring of 2013, 83% reported going out multiple times. Teachers reported using outdoor lessons to support all 18 elementary science units, in schools across the city, independent of number of years teaching. Correspondingly, of the 800 students surveyed in grades 3–5, only 26% said they never go outside for science.

**Increased Interest in Science**

Students who had science lessons outdoors showed significantly higher interest in science than those who didn’t have outdoor lessons. They were significantly more likely to agree that learning science was fun, and that they wanted to learn more science; and were significantly more likely to report that they do science activities at home “even when I don’t have to.” They were also more likely to agree that they could do well in science even if a new science topic was hard.

In addition, the study found, outdoor lessons may help students become independent learners. Teachers who take science lessons outdoors were significantly more likely than teachers who didn’t go out, to report that their students ask questions stemming from their own curiosity. The more often teachers went out for science, the higher the number of students they reported asking such questions.

Teachers who took science lessons outdoors more frequently also reported higher numbers of students connecting concepts from one lesson to another.

**Increased Science Talk**

Students who reported having outdoor science lessons also reported significantly higher frequencies of using science words—both with peers and their teacher—and ranked their own listening skills during science significantly higher than students who didn’t go out.
Students reported feeling that they were freer to talk to each other outdoors, “I like doing science outside because you’re allowed to talk about your experiments to your partners.”

Teachers concurred, reporting that when they are outdoors, students talk more to each other about science, and use science vocabulary more. One teacher explained:

*My third grade class, they’re learning about the water cycle and it’s hard for them, it’s abstract concepts, really technical language [...] and getting them to use the vocabulary was hard, you know, precipitation, condensation, evaporation—they all sound very similar. But I took them to the outdoor classroom recently and we looked for signs of the water cycle outside so they could see exactly where it happens and would happen. [...] I’m noticing them using the vocabulary correctly and in context since we went outside.*

**Impact of Outdoor Instruction on Science Teaching in General**

The BPS Science Department has developed guidelines for the classroom practices that serve as indicators of high quality science instruction. Teachers who took students outdoors were significantly more likely to engage in three of the teaching practices identified in the guidelines compared to teachers who didn’t.

- Structuring activities to allow students to work at their own level.
- Promoting science talk (for example, 50% of teachers taking science outdoors said they “always revisit vocabulary learned in a previous lesson”, compared to 29% for teachers who didn’t teach outdoors).
- Asking students to make observations in science.

Students who reported going outside for science also reported conducting investigations at higher rates and were 10% more likely than students who didn’t go out, to say they “always” make observations in science.

**The Role of SSY**

The study highlights the importance of professional development in general and the Science in the Schoolyard program in particular. Teachers who had participated in SSY trainings were significantly more likely than teachers who hadn’t to take students outdoors for science, even when controlling for years of teaching, presence of an outdoor classroom, number and length of science classes, other outdoor PD, and fidelity of kit use.

Teachers with SSY training were more confident in their ability to teach outdoors. For instance, they were significantly more likely to agree that they had the content knowledge to implement outdoor lessons, and the ability to handle the unpredictability of teaching outdoors. They were also more committed to the goals of outdoor teaching, and more likely to report that outdoor teaching supported English language learners and students with special needs. Ninety two percent of teachers rating the SSY trainings agreed that their “science teaching skills had improved both inside and outside of the classroom” as a result of SSY.

**Throughout SSY’s history all professional development has been designed by BPS science teacher leaders in conjunction with BSI staff. These teacher leaders, continue to provide leadership and training through the BPS Science Department. They bring a deep understanding of how outdoor instruction increases student interest in science, improves science proficiency, and leads to high-quality science instruction. Their understanding and skill will grow and develop (along with teachers in schools across the district) as they continue to build on the foundation laid by BSI. To learn more about BSI, or to read the evaluation in full, visit www.schoolyards.org.*  

**Reference**


Kristin Metz is an Education Consultant helping schools and districts build the in-house capacity to support outdoor teaching and learning. She was the Director of Education for the Boston Schoolyard Initiative from 2000–13. She can be reached at www.linkedin.com/in/kristinmetz or at kristinmetz@outlook.com.
Transitioning to NGSS with FOSS
By Brian Campbell, FOSS Curriculum Developer, The Lawrence Hall of Science

With educators in many states looking at the Next Generation Science Standards (NGSS), teachers are asking questions about how they should modify their instruction. Teachers do not often have the option of purchasing new materials but are tasked with using what they currently have available. Fortunately, leaders in many states that are transitioning to NGSS do not expect full NGSS implementation for several years, meaning districts and teachers can focus on smaller, more purposeful incremental changes rather than tackling NGSS all at once.

Next Generation Standards
The NGSS do not provide a roadmap for instruction, but rather describe a set of performance expectations, and Framework Boxes, as well as connections to Common Core State Standards. The NGSS are described thus,

The performance expectations are written in a way that expresses the concept and skills to be performed but still leaves curricular and instructional decisions to states, districts, school and teachers. The performance expectations do not dictate curriculum; rather, they are coherently developed to allow flexibility in the instruction of the standards” (NGSS Executive Summary, p. 2, June 2013).

Each standard statement incorporates all three of the domains of science knowledge and skill described in the Framework for K–12 Science Education: 1) science and engineering practices (SEP); 2) disciplinary core ideas (DCI); and 3) crosscutting concepts (CC). Each of the three domains is promoted as having critical importance in the science learning experience of students. The standards are statements of the complex scientific knowledge that students will be expected to communicate as a result of their science learning experience.

We see two major challenges arising from the above. First, the challenge for students to acquire substantial knowledge of the three dimensional standards is no small task. Second, a mechanism for engaging in an assessment process that will efficiently and accurately expose students’ knowledge is at this time unknown.

So what’s a classroom teacher to do? Clearly the industry has some work to do before the NGSS marching orders are pronounced. What is the interim strategy for transition to the NGSS vision?

What to Do in the Interim
An interim strategy depends on a number of variables that teachers may or may not have control over, such as when new materials can be purchased, the timeframe for full implementation, and amount and timing of professional development. However, there are some appropriate actions that teachers can take to begin this process.

1. Study the NGSS for your grade level. While it is important for teachers to be familiar with them, it is equally important for teachers to not be overwhelmed. The standards ask a lot of students and teachers, and the transition to them should be purposeful and manageable by teachers. Plan to continue using your current science curriculum, paying particular attention to a reinvigorated treatment of the science and engineering practices. This will prove to be very useful for getting a sense for the NGSS vision. The Framework provides more information on the three dimensions.

2. Read the appendices for NGSS. Appendix F provides specific indicators for the science and engineering practices for K–2 and 3–5. These are particularly useful for planning opportunities using FOSS to help students develop these abilities. Appendix G provides similar guidance for the crosscutting concepts. Appendix I discusses engineering at each grade band. These documents are a good starting point for teachers.

3. Analyze what you are doing already. Teachers using FOSS already engage students in many of the science practices. While some fine-tuning of some practices might be needed, other practices, such as models, constructing explanations, and engaging in argumentation, may require some exploration on the teacher’s part.

4. Introduce small purposeful changes in instruction. When beginning to transition, science and engineering practices are a good place to start.

By looking through the steps in a FOSS Teacher Guide or FOSS Investigations Guide, an area of focus can be identified, such as collecting and analyzing data. Teachers should consider what will best support students in a deeper engagement with data. Initially, teachers might have one area of focus to keep the lesson length manageable and the focus should change from lesson to lesson building toward a natural incorporation of the revised instructional methods into their standard practice.

Once teachers understand the crosscutting concepts, these can be woven into existing FOSS investigations. Concepts such as cause and effect and patterns are good starting points. They do not require additional materials and can be done with just about any current FOSS content.

Disciplinary Core Ideas
DCIs are more challenging to address if you are unable to get new resources or receive additional training. And students might be assessed on existing state science standards. Fortunately, many states have an NGSS implementation timeline that outlines when full implementation is expected. During this time, the adoption of materials is included, which will provide teachers with curriculum that addresses all three dimensions of the NGSS.

Current FOSS users in districts where resources are limited should become familiar with the three dimensions of the NGSS and initially look for opportunities to enhance science and engineering practices. Some teachers might focus their transition energy for an entire year on SEPs and the following year on CCs. The important idea is that teachers are making purposeful and reasonable instructional enhancements as they transition toward NGSS.
Observations . . . by Larry

The FOSS Vision

By Larry Malone, FOSS Co-director

FOSS happened rather by accident. As many people know, Linda De Lucchi and I spent the late 1970s and early ‘80s developing, manufacturing, promoting, and disseminating a special education science program, Science Activities for the Visually Impaired and Science Enrichment for Learners With Physical Handicaps (SAVI/SELPH). Then one day we had an outlandish and presumptuous notion. We envisioned a grand transformation in our little special education science program. “We can reinvent this program to be a regular science program for all students learning in integrated classrooms!”

We proposed the Full Option Science System (FOSS) to the National Science Foundation and, in 1989, received funding. At that time we envisioned a science curriculum that would be enjoyable, logical, and intuitive for teachers, and stimulating, provocative, and informative for students. Pursuing this vision was informed by research in cognitive science, learning theory, and critical study of effective practice. The modular design of the FOSS program allowed users to select topics that aligned with district or state learning objectives, or simply resonated with their perception of sound and reasonable science instruction. The original design of the FOSS program was somewhat eclectic in scope and sequence, but was at the same time sufficiently comprehensive in terms of coverage. The original FOSS curriculum—the first edition—was unencumbered by externally imposed organizational structure. There were no national standards nor any consistently coherent state or local standards. FOSS was designed to provide real and meaningful student experiences with important scientific ideas and to nurture developmentally appropriate knowledge of the objects, organisms, systems in, and principles governing, the natural world.

The FOSS Revision
That was then . . . but FOSS has evolved. Now the Third Edition of the Full Option Science System is a fully realized 21st century science program with authentic connection to the Next Generation Science Standards (NGSS). The FOSS science curriculum is a comprehensive science program, featuring instructional guidance, student equipment, student reading materials, multiple digital resources and online activities, and an embedded assessment system. FOSS has always utilized an inquiry approach to teaching and learning, but the Framework for K–12 Science Education, on which the NGSS are based, has provided a new way for the FOSS developers to think about and communicate the FOSS message. The FOSS philosophy has always taken very seriously the teaching of good, comprehensive, accurate, science content using the methods of inquiry to advance that science knowledge. But the Framework has allowed us to articulate our mission in a more coherent manner using the vocabulary established by the authors of the Framework. The FOSS instructional design now strives to:

a) Communicate the disciplinary core ideas (content) of science, while
b) Guiding and encouraging students to engage in or exercise the scientific and engineering practices (inquiry methods) to develop knowledge of the disciplinary core ideas, and
c) Help students apprehend the crosscutting concepts (themes that unite core ideas, overarching concepts) that connect the learning experiences within a discipline and bridge meaningfully across disciplines as students gain more and more knowledge of the natural world.

The NGSS describe the knowledge and skills we expect our students to be able to demonstrate after completing their science instruction experience. The expectations are demanding, and include no small measure of ability to communicate scientific knowledge. The ability to communicate complex ideas assumes that students have had a significant amount of experience and practice building coherent explanations, defending claims, and organizing reasoned arguments in the context of their science curriculum. This is where scientific inquiry encounters language arts. FOSS draws on both CCSS for language arts and research data regarding the productive use of student science notebooks. FOSS developers now realize that the most effective science program must seamlessly integrate science instruction goals and language arts skills. This was certainly not part of the original FOSS vision, but central in the FOSS revision. Science is one of the most engaging and productive arenas for introducing and exercising language arts skills: vocabulary, nonfiction (informational) reading, cause-and-effect relationships, and on and on.

FOSS Third Edition is crafted with a structured, yet flexible, teaching philosophy that embraces the much heralded STEM—21st century—skills: collaborative teamwork, critical thinking, and problem solving. The FOSS curriculum design promotes a classroom culture that allows both teachers and students to assume prominent roles in the management of the learning experience.

Now, surveying the horizon . . . is this the final and forever edition of FOSS? Well, no, as usual, now that we have crafted all the answers, they once again changed the questions. And now, the FOSS staff is engaged in a process of tweaking and contouring FOSS Third Edition to make the FOSS Next Generation Edition with the connections to the three dimensions of NGSS much more explicit to the user.
In past installments of the “FOSS Assessment Corner,” I’ve provided an overview of the FOSS Assessment System (FOSS Newsletter, Fall 2013), a more detailed description of embedded and benchmark assessments, and a peek at FOSSmap, the computer program FOSS users can access to have students take assessments online and for teachers to run a number of reports that can help guide instruction as well as differentiate student learning needs (FOSS Newsletter, Spring 2014). In this issue I’ll talk about some of the criteria we use to design items and describe student progress levels based on assessment responses.

**FOSS Assessment Corner: Why Code Rather than Score?**

By Kathy Long, FOSS Assessment Coordinator, The Lawrence Hall of Science

All of the benchmark assessments for the FOSS Third Edition have the same basic item types. They usually include 8–10 multiple-choice items (mark the one best answer), multiple-answer items (mark all that apply), and short answer items. In addition, there are two to three open response items for which students need to write answers.

There are three levels of items on the tests. Level I items examine the pieces of knowledge students are acquiring and their command of academic vocabulary. Level II items look at how students are beginning to connect pieces of knowledge in order to demonstrate emerging conceptual understandings. Level III items require students to apply the science knowledge and practices that they have learned to answer questions or solve problems presented in new contexts.

The benchmark assessments are constructed to provide information about students’ conceptual progress rather than simply show mastery over minimum competencies. This is an important distinction. There is a wide range of item difficulties included on the benchmark assessments. You should not expect most of your students to get 100% on the test. If this were the case, you wouldn’t get much information about where students still need to work on understanding. Because of this design, you will need to adjust your evaluation criteria if you are going to use the benchmark assessments as a tool for giving grades. (See more about grades in a later question.)

**Why Code Rather than Score?**

Items on the benchmark assessments are coded, rather than scored. A coding guide, along with an answer sheet, is provided for each item in the Assessment chapter. We code rather than score in an effort to identify the level of the understanding exposed by a student’s response rather than simply noting whether the answer was wrong or right, or adding up points for correct answers. Coding provides information about the quality (depth and flexibility) of learning, rather than the number of correct answers.

There are four levels of codes (see the Progress Level Chart). By describing these levels we are providing information to teachers and students about the complexity of the thinking students are able to demonstrate and what they need to do to improve their responses (and therefore their understanding).

You may also have noticed that some of the item codes range from 0–2, others from 0–3, and still others from 0–4. The range of the codes for each question depends on the level of complexity of the question. For example, if the question is a Level II question (medium in complexity and requiring students to connect pieces of information), then the highest code possible for that question is

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic (4)</td>
<td>Students have a strong conceptual understanding of the content. They are able to apply their knowledge of science concepts to explain new situations. They are working on generalizing what they have learned in class to apply to real-world situations.</td>
</tr>
<tr>
<td>Conceptual (3) [Minimum goal for all students]</td>
<td>Students have a strong understanding of basic facts required to construct grade-appropriate understanding of content. They are working on putting appropriate pieces of knowledge together to develop deeper understandings. To get to the next level (strategic), students need to master the relationships between pieces of knowledge to develop more complex explanations and to transfer learning from the classroom to new, real-world situations.</td>
</tr>
<tr>
<td>Recognition (2)</td>
<td>Students are developing a deeper understanding of scientific vocabulary to describe their observations and ideas. They are building a network of basic facts related to the module topic. To get to the next level (conceptual), students need to continue to construct pieces of knowledge related to the topic and begin putting those pieces together to form a more complex understanding of phenomena.</td>
</tr>
<tr>
<td>Notions (1)</td>
<td>Students may use a few science words and recall simple facts about the topic, but their performance on assessments shows relatively little understanding of the module topics. To get to the next level (recognition), students need to develop and incorporate more scientific vocabulary into their communications, and construct more pieces of knowledge that can be linked together to help explain phenomena.</td>
</tr>
</tbody>
</table>

PROGRESS LEVEL CHART FOR THE FOSS ASSESSMENT SYSTEM

CODING PROVIDES INFORMATION ABOUT THE QUALITY OF LEARNING, RATHER THAN THE NUMBER OF CORRECT ANSWERS.
FOSSweb 2.0

If you haven’t created a new account on FOSSweb 2.0, now is the time! Archive.FOSSweb.com was retired in July 2014. All users should now be using the new FOSSweb.com

Register for the FOSSweb 2.0 at: http://www.fossweb.com/getting-started

Once you create your account on FOSSweb 2.0, you’ll need an access code to unlock teacher resources for your specific module. For the FOSS Third Edition, you will find the access code pasted on the inside cover of your Investigations Guide. Third Edition modules are modules purchased after August 2011 and have a “3rd Edition” logo on the front cover. For the FOSS Second Edition, you can sign up for the access codes online at http://www.fossweb.com/access-codes or use the access codes in this newsletter.

Improved FOSSweb. 2.0 Video Servers and Site Performance

FOSSweb is an integral component of the FOSS curriculum, and we are always working on improving the site for our users! Several exciting updates have been rolled out on FOSSweb in the past few months.

In spring 2014, a new video server was added to FOSSweb to provide a significant improvement in the video playback. Streaming videos in the current FOSS editions and teacher prep videos across all FOSS editions will have faster video performance with video resolution automatically optimized for your location’s bandwidth.

It should be noted that the new video server will not be able to resolve issues some districts experience due to local bandwidth and infrastructure. There have been noted instances where bandwidth at the local level can be impacted by the number of teachers/students trying to access Internet content. Bandwidth and any firewall issues are still issues that may need resolution from district or school IT staff.

In addition to the video updates, FOSS and School Specialty have been working on a project to improve FOSSweb overall performance. The performance upgrades have required extensive behind-the-scenes architecture changes. We hope that your classroom experience with FOSSweb will be much smoother with these new improvements!

Should you encounter any issues with FOSSweb, don’t hesitate to contact support@fossweb.com! Our technical team is here to help and is always looking for ways to improve the site.

Permanent Access Codes:
FOSS K–6 2nd Edition Access Code AME2EL3656
FOSS Middle School 1st Edition Access Code AMEIM6950
FOSS CA Edition (K–5) Access Code AMEICA1284
NYC K–8 Access Code NYCEI9833

FOSSweb Help
Account Questions/Help Logging In:
School Specialty Online Support loginhelp@schoolspecialty.com Phone: 800.513.2465, 7:30 am–5:00 pm CT

General FOSSweb Technical Questions:
FOSSweb Tech Support support@fossweb.com Phone: 510.643.6997, 9:30 am–5:30 pm PT

Access Code Questions
Delta Customer Support customerservice@delta-edu.com Phone: 800.258.1302, 8:00 am–5:00 pm ET
Shipping this fall to schools near you: **Weather and Water Course, Second Edition**! The FOSS Middle School Project released this course in August 2014, completing the NGSS-aligned **FOSS Earth Science Strand for Middle School**. The recommended course sequence is:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>8th</td>
<td>Planetary Science, Second Edition</td>
</tr>
<tr>
<td>7th</td>
<td>Earth History, Second Edition</td>
</tr>
<tr>
<td>6th</td>
<td>Weather and Water, Second Edition</td>
</tr>
</tbody>
</table>

Within this sequence, there is flexibility. As an example, if your school or district chooses to focus on the crosscutting concept of energy at 7th grade, you might choose to place the **Weather and Water Course, Second Edition** at 7th grade and move the **Earth History Course, Second Edition** to 6th grade. The FOSS curriculum developers and sales representatives are always happy to talk with you about your school or district situation to figure out the best arrangement to meet your needs.

For existing **Weather and Water Course** users, it will be a smooth conversion to update your program. And for those looking for a new resource to connect with the National Research Council’s *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (2012) and the Next Generation Science Standards (NGSS) performance expectations, this course will meet your needs.

Here is a glimpse of the major components of **Weather and Water, Second Edition**.

- The course consists of ten investigations that engage students in collecting weather data and learning about physical processes that determine the weather and climate, including energy transfer and phase change. The investigations have been reorganized and expanded to better explore global climate factors, ocean currents, and climate change.
- In Investigations 1–3, students begin to collect weather data and learn about the properties of air to explain phenomena in the atmosphere. They connect these ideas to explain the weather phenomenon of wind.
- In Investigations 4–6, students explore energy transfer through convection, radiation, and conduction. This helps them understand the Sun’s differential heating of earth materials, including the atmosphere, and how that affects wind.
- In Investigation 5, students compare weather data from different locations on Earth, and differentiate for the first time between weather and climate. They learn that different locations on Earth receive different amounts of solar radiation depending in part on the season and explore how this affects climate.
- In Investigation 7, the focus shifts from air flow to the effects of water in the air. Students explore humidity, phase changes (condensation and evaporation), and energy transfers associated with these changes.
- In Investigation 8, students pull together all the physical science concepts they’ve learned in the course to explain weather. They interpret radiosonde data and weather maps to prepare and deliver a TV-style weather report.
- Investigation 9 focuses on water resources on Earth. Students explore human water use, the water cycle, and ocean currents. They investigate ocean currents as factors that affect climate.
- In Investigation 10, students refine the distinction between weather and climate and are introduced to the concept of climate change. They explore the relationship between greenhouse gases and global average temperature, and consider implications of climate change. Students consider human activities that contribute to greenhouse gas concentration, and those that may mitigate greenhouse gas production and reduce the impact of climate change.

Some of the revised pedagogical features in the **Weather and Water Course** include:

- Science notebooking embedded in the revised course, including focus questions and data processing (sensemaking) practices;
- Assessment aligned with the FOSS K–6 assessment system based on findings from the NSF-funded ASK research;
- FOSSmap, providing online formative assessments and diagnostic reports;
- Updated **FOSS Science Resources**, used with literacy strategies that reflect Common Core State Standards for English Language Arts;
New and improved multimedia features embedded in each investigation;

Homework suggestions for each part; and

Teaching strategies that support content, practices, and crosscutting concepts as described in the Next Generation Science Standards.

Science and Engineering in the Earth Science Strand
The science and engineering practices are embedded in the FOSS Middle School Second Edition courses. Here is one example of how a complex concept—the fluid movement of air and its relationship to weather—is developed with models throughout the Weather and Water Course.

Developing and Using Models to understand air flow in weather

Investigation 3, Part 1: Students develop a particle model (microscopic-scale model) for air pressure to explain phenomena they observed during an air pressure activity.

Investigation 3, Part 2: Students apply the particle model with a wind map (large-scale model) to predict and explain air flow patterns over large areas of differing air pressures.

Investigation 4, Part 1: Students apply the particle model to solutions of different densities to understand motion of fluids (liquids).

Investigation 4, Part 3: Students apply the particle model to air of different temperatures (and densities) to understand motion of fluids (gases).

Investigation 6, Part 1: Students consider energy transfers at the particle level to understand how the atmosphere, which is made of air, is heated.

Investigation 6, Part 2: Students apply their understanding of energy transfers at the particle level as a model to explain large-scale movement of air masses in the form of local winds.

Investigation 6, Part 3: Students apply their understanding of energy transfers at the particle level (microscopic-scale model) combined with an understanding of heating and cooling on a global scale (large-scale model) to explain large-scale movement of air masses in the form of global winds.

Notice how, in the example above, various content ideas are threaded together to build toward the more complex phenomena that students tackle in the later investigations. Students are provided with opportunities to learn the physical science and earth science core ideas in the context of the FOSS investigations along the way. Also notice how the practice of developing and using models is employed as scaffolding for students’ development of these core ideas as they progress through the course.

FOSS Connections to NGSS
Teaching the new FOSS Middle School courses will address the learning expectations for the disciplinary core ideas, crosscutting concepts, and scientific and engineering practices described in NRC’s Framework and the NGSS. For each revised course, we provide a connections document that is posted on FOSSweb (www.FOSSweb.com) under the “Module Information” for the course. See this document for a more complete look at how each science and engineering practice is supported in the Weather and Water Course.

What Is Next for FOSS Middle School?
With FOSS Middle School Second Edition courses, FOSS now has grade-level recommendations. Some FOSS courses serve as the foundation for later courses. For example, in the Life Science Strand, the Diversity of Life Course helps students explore the characteristics of life and basic classification of living things, which lay the groundwork for content developed in the 7th- and 8th-grade Life Science courses. Similarly, in the Physical Science Strand, the Motion and Forces Course is closely aligned with the skills in the Common Core State Standards for Mathematics at 6th grade, and develops content that students will expand on in the 7th- and 8th-grade courses. As an alternative, districts could choose to teach Life Science in one year, Earth Science in another, and Physical Science in the last middle school year.

Not all of the revised courses will be available immediately. From a school/district adoption standpoint, this can be seen as a good thing. It’s not necessarily advantageous to change all your curriculum materials at the same time. This may overwhelm your teachers. FOSS recommends introducing one to two courses per grade level per year, using the materials that are available at the time. This will also give teachers time to work closely with the NGSS as they proceed and understand how the new FOSS curriculum supports their classroom work. The Delta sales representatives work very closely with FOSS Middle School Program development team at the Lawrence Hall of Science to design a rollout plan that works for your district and school.


FOSS Newsletter, Fall 2014, No. 44
Blasting Off with FOSS!

By Joanna Totino, FOSS Elementary Specialist & Director of Bay Area Science Project

"Every step was the right thing I needed to lead me to feeling like a scientist … having access to real scientific tools and the location to be able to do those things, the guidance of scientist, and the support of my fellow teachers really pushed me to do new things … and be a scientist … it's self-affirming.”

— 5th-grade teacher

"The field research with teachers injected new energy into me and provided me with a refreshing and different kind of excitement about science. Working with the teachers also made me realize better my own strengths, and that even [my own] small scientific questions that we are patiently working to answer are important.”

— Graduate student

FOSS has deep roots in the Oakland Unified School District (OUSD) and the FOSS team at LHS has cultivated many FOSS champions and expert teachers in OUSD classrooms over the years. Collaborative Approach to Learning: Building Language And Science Teaching (CAL:BLAST), an innovative project that recently completed its third and final year, was able to use the expertise of OUSD teachers with FOSS as a base to expand their science content knowledge and field research experience.

CAL:BLAST, a professional development collaboration between OUSD, the Lawrence Hall of Science, and UC Berkeley, had two main goals. First, it was important to increase teachers' science content knowledge as well as their interest and confidence in science through a series of field research experiences that were guided by graduate student scientists. Second, it was essential to advance science content area language strategies and instruction designed to develop both academic language and content understanding for all students, with a particular focus on English learners (EL). The program worked with teachers to incorporate content and academic language strategies in the existing district-adopted FOSS curriculum.

The CAL:BLAST team comprised the Director of Bay Area Science Project, Coordinators from Berkeley Natural History Museums, Graduate Student Scientists from UC Berkeley, Bay Area Writing Project Teacher Consultant, District Science Coach, Evaluators from the Research Group at the Lawrence Hall of Science, and approximately 35 third–fifth grade teachers from fifteen Oakland schools. CAL:BLAST was funded by the California Department of Education, Improving Teacher Quality (ITQ) Grant Program. UC Berkeley graduate students were directly partnered with OUSD teachers.

The FOSS curriculum was integrated throughout the CAL:BLAST project. During the course of the project, the UC Berkeley graduate students were familiarized with FOSS so they would be better prepared to support the teachers with the specific FOSS modules that the teachers were using in their classrooms.

Throughout the three years of the program, teachers received professional development in science content with a focus on California biodiversity. During each of the three one-week summer institutes, the teachers had a multiday field research experience at one of the University of California field stations. Each of these stations is the site of current research and offered the opportunity to focus a locally diverse ecosystem.

The field research experiences were the centerpiece of the summer institute. A graduate student scientist supported each group of eight teachers. Teachers were given an authentic research experience that was self-generated by asking questions. Teachers designed, and executed their research project and shared their results with the group.

By partnering UC Berkeley graduate students with Oakland teachers, a reciprocal learning environment was fostered that empowered both groups. The UC Berkeley graduate students taught the teachers science content and field research techniques. The teachers had the expertise with teaching skills and strategies, which they taught to the graduate students, who were able to implement these new skills in their teaching assistant positions at UC Berkeley. CAL:BLAST was structured to create a synergistic space whereby each group experienced being an "expert" and a “learner” and the outcome was a new learning, appreciation and team building. Being the “expert” created pride and empowerment and being the “learner” created humility and excitement of learning, and by experiencing both roles, an understanding was developed that experts in one situation can be learners and that learners in one context can be experts in another. This is an important lesson for anyone engaged in the teaching field.
Delta Education will host two one-day FOSS Institutes before the National NSTA Conference in Chicago, Illinois (March 11, 2015). These Institutes, one for K–6 and one for middle school, will be for educators from districts that have implemented FOSS or are planning to implement FOSS. The Institutes will focus on FOSS Next Generation, K–6 FOSS Third Edition, and the revision of selected FOSS Middle School Courses. These Institutes are designed for experienced FOSS educators—lead teachers, administrators, curriculum coordinators, professional developers, and university methods instructors.

These Institutes are free, but you must register in advance to attend.

To secure your spot at an Institute, please contact:
Jenn Reid at Delta Education
800.258.1302 x3667
jenn.reid@schoolspecialty.com

NSTA 2014 FALL AREA CONFERENCES

K–8 Commercial Workshop Schedule
Richmond, VA  October 16–18, 2014
Orlando, FL  November 6–8, 2014
Long Beach, CA  December 4–6, 2014

Thursday (10/16, 11/6, 12/4)
8:00–9:15  Engineering Design in the FOSS Next Generation Program
10:00–11:15  Scientific Practices: What Does Argumentation Look Like in an Elementary Classroom?
12:00–1:15  Crosscutting Concepts: What Do They Look Like in an Elementary Classroom?
2:00–3:15  Floods, Heat Waves, and Hurricanes: Analyzing Evidence for a Changing Climate using FOSS
4:00–5:15  Evidence for Plate Movement with FOSS Earth History for Middle School

California 2014 STEM Symposium
San Diego, September 21–23, 2014

Monday, September 22, 2014
1:25–2:25  Engineering in Elementary Science: Designing with FOSS

For more information about the workshops on this page, regional institutes for elementary and middle school programs offered throughout the country, and other professional development opportunities, visit the FOSS Professional Development calendar. http://www.FOSSweb.com/pd-event-calendar

Sign Up to Receive the FOSS Newsletter
To receive the FOSS Newsletter electronically, sign-up at www.deltaeducation.com/science/foss/newsletter.aspx. You can also view both the recent and previous issues of the FOSS Newsletter, as well as archived articles, at http://www.FOSSweb.com/newsletter.

If you’d like to be added to the mailing list to receive this newsletter by mail, please send your name and address to:
Gregory Bayer, gregory.bayer@schoolspecialty.com

http://www.facebook.com/FOSSscience  http://twitter.com/FOSSscience
The complete FOSS Middle School Second Edition Earth Science Strand is now available!

Every FOSS Middle School Second Edition Course includes:

- Embedded science notebooking, including focus questions and data processing (sensemaking) practices.
- Updated FOSS Science Resources, used with literacy strategies that reflect Common Core State Standards for English Language Arts.
- New and improved multimedia features embedded in each investigation.
- Teaching strategies that support content, practices, and crosscutting concepts as described in the Next Generation Science Standards.

Contact your FOSS Regional Sales Manager for more information!