Informal STEM Centers Partner With Teachers

When searching for resources to enhance students’ learning of science, technology, engineering, and mathematics (STEM), teachers often turn to community informal STEM education centers. These venues provide professional development (PD), classroom and multimedia materials, and a variety of other services for teachers and students. For example, the staff of The Franklin Institute in Philadelphia, Pennsylvania, “hope that teachers think of us as their partner in STEM learning,” says Karen Elinich, director of Science Content & Learning Technologies.

“We believe strongly that science learning follows direct, hands-on encounters with scientific phenomena. Throughout our museum, visitors find opportunities to engage directly with basic scientific principles. We want all students to have an opportunity to visit our museum for those experiences, so we offer a variety of ways to help teachers manage field trips,” says Elinich.

Free events like Educators’ Night Out give teachers the opportunity “to visit the exhibits without students so that they can focus on the experience and plan how to connect a field trip with classroom learning. We also provide Educator Guides for our exhibits that outline those curricular connections [and] teacher workshops to offer strategies to maximize the impact of a field trip experience,” she explains.

Besides help with planning field trips, the Franklin Institute offers professional development programs that provide “more in-depth learning experiences for inservice K–12 educators. Over a number of weeks, small cohorts of teachers dive deeply into a science content area to develop both their own content knowledge as well as strategies for engaging students with the topic,” Elinich relates. “Over the years, thousands of teachers have participated in our programs, many of whom return whenever a new program is offered.”

Alignment with science standards is paramount at the Franklin Institute. “Since the release of the National Science Education Standards in 1996, all of The Franklin Institute’s resources and programs for teachers have been presented in context with the national standards. Everything that we offer has the potential to support standards-based achievement,” she contends.

When asked about alignment with the Next Generation Science Standards (NGSS), Elinich responds, “The 2013–2014 school year is a time of transition for us. The state of Pennsylvania is currently focused on implementation of the Common Core for math and language arts and has not yet announced a timeline for adopting the [NGSS]. Nevertheless, we are preparing ourselves for the likely transition in...
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Collaborative Efforts to Put the ‘E’ Back in STEM

By Heather Johnson and Michelle Cotterman

Schools across the country are revamping their focus on science, technology, engineering, and math (STEM). New magnet and charter schools targeting science, technology, and math open each year. Yet in many of these efforts, the “E” in STEM is often hard to find. This missing “E” has frequently been the most underdeveloped component of STEM teaching and learning. However, with the release of the Next Generation Science Standards (NGSS), it is clear engineering education will need to play a more prominent role in K–12 science classrooms.

This creates a dilemma, as a second missing “E” is all too often in engineering education: “expertise.” Most K–12 science teachers or college of education faculty do not have engineering backgrounds. Only a few have been exposed to engineering practices in their science coursework or teacher training. If the typical science teacher is ill equipped to support engineering education, how will we strengthen the “E” in STEM? The challenge—and potential solution—is to create synergistic partnerships leveraging different forms of expertise to enhance K–12 student engagement.

Collaborative ‘E’ Effort

Imagine the potential of a university–school partnership uniting three stakeholder groups: undergraduate engineering students, preservice secondary teachers, and middle school inservice teachers. For such a collaboration to work, partners need to bond around a common goal, such as crafting a unit of study in which students explore engineering design in a meaningful way. What could happen if these stakeholders pooled their expertise?

Engineering students are applying science concepts to engineering design challenges. Since many K–12 students are not exposed to engineers or engineering in their STEM courses, engineering students provide authenticity and content expertise in the design of an engineering challenge.

Preservice secondary science teachers have limited experience with engineering design, but they do bring expertise in science content areas. They are developing pedagogical expertise and are excited to engage in the professional work of unit planning and implementation in real classroom contexts.

Middle school inservice teachers have extensive pedagogical expertise and access to students. Because they are aware of the need to include engineering in their science lessons, they are often willing to open their classroom in exchange for opportunities to develop their own engineering content knowledge.

One institution launched just such an effort…with sky-high results.

Effective ‘E’ Collaboration

Annually, engineering students in the Aerospace Club in Vanderbilt University’s mechanical engineering department compete in NASA’s University Student Launch Initiative (USLI). Educational outreach introducing K–12 students to engineering is required. With little pedagogical expertise, their challenge was figuring out how to talk about and engage students in engineering design. They reached out to science teachers for support.

The result was a multi–lesson project-based outreach unit that engaged urban middle school students in iterative cycles of the engineering design process applying science concepts while building water-bottle rockets. Each lesson explored different grade-level-appropriate aspects of physical science. This design challenge was inspired by the club’s own research, developed by the preservice teachers, and collectively implemented in the inservice teachers’ classrooms as engineers, teachers, and students worked side by side.

The Aerospace Club members experienced an authentic apprenticeship in a vital area of professional service. The preservice teachers gained an urban practicum experience, a common planning experience, and exposure to engineering design principles. The inservice teachers and their students improved their knowledge of the engineering design process and experienced excitement for engineering. One teacher noted, “I already know that I can build on this experience in future lessons in ways that will make science more meaningful.” The “E” had found its way into the science classroom!

More importantly, the teachers now had the confidence to pursue other engineering design projects. The collaboration also received the NASA USLI Educational Engagement Award.

Engineering practices are notably absent in K–12 science classrooms. This does not need to be the case. This project-based rocketry unit involved the collaborative efforts of a university’s aerospace club, school of education, and local school district teachers. It provided pedagogical support to the club’s outreach while enriching the STEM experience of science teachers and middle school students. It effectively met the specific needs of diverse participants and demonstrated how schools can partner with university engineering and education departments to create immersive STEM experiences. With the emphasis of engineering content in the NGSS, efforts like this could enhance the knowledge, practices, confidence, and excitement of K–12 science teachers incorporating engineering content in the science classroom.

Heather Johnson is an assistant professor of the practice of science education at Vanderbilt University in Nashville, Tennessee. Her work focuses on supporting science teachers as they interpret and implement new content, including engineering, and practices outlined in the NGSS.

Michelle Cotterman is a former high school teacher and current doctoral student in math and science education at Vanderbilt University. In addition to support for teachers, her research investigates disciplinary practice with middle school students.
In the near future by beginning to align existing materials and programs with the new framework so that we will be ready to serve teachers when the implementation begins.” Visit www.fsis.edu for more information.

From STEM to ‘STE[+]aM’
Across the country, educators are establishing arts-based informal STEM learning centers like The Mosaic Arts Center (MAC) in Avondale, Arizona (in the Phoenix metropolitan area). In addition to its STEM, arts, reading, and language arts afterschool enrichment program for students, the MAC offers classes to help teachers explore ways to incorporate art into STEM curriculum. Teacher seminars cover such topics as Flipped Classrooms and What Is STEM (STEM Is Not a Four-Letter Word). The MAC also offers TED Talks that are open to both teachers and the community.

“Imagine a classroom where students know they are in a place to be creative. At the MAC, collaboration is a natural occurrence, and invention is inevitable. We have a network of people who are some of the best in the area in education and the arts coming together to lend their talent to ‘STE[+]aM,’ adding the arts to STEM,” says Marty Wesolowski, the MAC’s president. He co-founded the MAC with Ellen George and Kerry Mitchell; all are employed with the Maricopa County Community College District (MCCCD) and bring the knowledge and experience from their work in that school district to the programs at the MAC.

“We work with math and science instructors to develop curriculum that is aligned with the class so as not to be out of step with the progress of the grade level,” Wesolowski explains. “We focus on the research, development, execution, and presentation of a project, to allow the Common Core skills to be commonplace at the MAC.” To further this effort, the MAC has “partnered with other ‘STE[+]aM’ organizations at University of California at San Diego and the MCCCD,” he notes.

The center is “fully equipped with art supplies and tools, a high-speed internet computer lab, and a full multimedia, 300-square-foot stage [that is] accessible to persons with disabilities,” he emphasizes. “Our open classroom environment is designed to be modified to host many different events” related to “Arduino Robotics, dance, plays, [and] Maker Space [and more].”

While providing classes and events to promote creativity and problem-solving skills, the MAC’s staff also focuses on developing students’ communication and teamwork skills to prepare them for the workforce. “We are providing services for Maricopa Workforce Development [to provide education and employment training to area youth] and also have established a mentor/intern program with Estrella Mountain Community College,” says Wesolowski. Learn more at www.mosaicartscenter.org

Blending Science and Play
Some informal education centers are developing new ways to look at teaching and learning. One of them, the New York Hall of Science’s Sara Lee Schupf Family Center for Play, Science, and Technology Learning (SciPlay), researches and explores students’ understanding of and engagement in STEM by harnessing the potential of play for learning. New York City teachers bring their students to SciPlay to try out play-based learning environments, and SciPlay staff collect data on students’ engagement with the activities they do. This data informs the development of educational games and kits. “We include play in everything we do, and we use play to motivate the learning of science,” says Project Manager/Curriculum Designer Laura Rodriguez-Costacamps.

One of SciPlay’s grant-funded research and development projects is SciGames. For this project, middle school students learn about energy and force and motion as they slide down a sliding board equipped with light sensors and other digital technologies that enable them to make predictions, experiment with different variables, and run trials. When completed, SciGames will consist of three science games, associated digital apps, and a portable kit with equipment that can be used in most playgrounds. The kit will allow teachers to “harness the power of play on the playground to inspire students to continue scientific investigation in the classroom,” says Rodriguez-Costacamps.

In GeniGames, another SciPlay project, urban high school students use the Concord Consortium’s created software to breed fictitious drakes and solve genetic problems in a virtual world. GeniGames researchers are studying what aspects of the game “interest students and motivate them to learn about genetics,” she explains, adding, “We want to make sure everyone is having fun as they learn. We are interested in discovering what engages and motivates students underrepresented in the sciences.”

SciPlay is working with the New York State Department of Education to align the games to both local and Common Core State Standards. Regarding the NGSS, Rodriguez-Costacamps remarks, “While not citing them specifically, the play [occurring in SciGames and GeniGames] really focuses on the NGSS practices, those crosscutting concepts.” For example, as part of SciGames, students can write about and use a graphing tool to express trends and patterns in relationships that they’re noticing while on the playground, she explains.

In addition, SciPlay offers PD events for teachers that help them understand “how to best use the technology with their students” and “focus on getting teachers to use the apps and technology to deepen their understanding of the science content they’ll be teaching,” she relates.

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Stanford Students Create Boot Camp for Bioengineering

A small group of California high school students experienced the bioengineering design process firsthand last summer during the Bioengineering Boot Camp at Stanford University in Stanford, California.

“The idea for the program sprouted in the summer of my sophomore year... I realized with a friend, Rachel, who was working a debate summer camp, that nothing like a bioengineering camp exists,” recalls Stephanie Young, a Stanford undergraduate. She says she wanted to “give [high school students] a camp that goes beyond what they would get from learning biology or interning at a medical school. We wanted to show them what bioengineering (building something about biology) is really about. The idea is really to get students involved in the bioengineering process and to let them experience it for themselves.”

For six weeks, high school students attended lectures presented by Stanford researchers and professors and worked with six undergraduate and graduate student mentors. “The goal of the camp is to give students exposure to bioengineering and to feed the pipeline for a field that’s growing fast and showing enormous potential. Most importantly, the students learn how to solve problems,” asserts Young. “Bioengineering is all about creating new, innovative solutions. So we asked them to do exactly that.”

She explains, “We came up with real-world challenges that we thought would interest the students and be well scoped for the six weeks of camp. The camp organizers (Ken Xiong, Jacqueline Young, Midori Greenwood-Goodwin, Sasha Denisin, and me) came up with the original problem statements and tweaked them to fit the scope of the camp. We also had students submit their own problem statements before the camp started and added those to the pool of problem statements.”

Students were grouped according to their interest in the problem statements, and then began to devise solutions. “They [were] free to come up with any solution that can solve the need. We wanted them to create a prototype, not just an idea. [We] provided mentors and resources in the Stanford Product Realization Lab for them to build their prototypes,” says Young.

One problem students tackled was increasing surgical safety by creating a way to monitor the location of medical instruments in the operating room, to prevent tools from being left in the patient. “One group tackled the problem by coding a mobile application that allows medical instruments to be detected electronically (on the phone) using a NFC (near field communication) chip,” explains Young. “NFC chips are incredibly cheap (in the cents) and thus dispensable. The team managed to create a real working prototype [wrote code for the project] to demonstrate.”

Denisin, a National Science Foundation graduate research fellow at Stanford, says the boot camp’s curriculum was designed “to engage students in engineering design projects with...”
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real-world motivations and applications...Recruiting aspiring scientists and engineers starts at the high school level (and earlier) as students form their identities and discover their academic passions.” She notes the camp covered several topics, including biomedical imaging, optogenetic control of neuron function, Food and Drug Administration regulations, synthetic biology, biomedical ethics, metabolic engineering, and DNA sequencing and synthesis.

“Students were learning the quantitative approach to engineering device design. They learned that defining a problem in a concise ‘need statement’ is very important to creating a solution [that] will best satisfy the demands of the user. We guided students through structured brainstorming and taught them methods to select ideas based on how each solution addresses user criteria, rather than subjective factors,” Denisin continues.

“[Students] got a taste of the bioengineering field, and learned that they can practice engineering design thinking to create interesting solutions to the problems around them.” She proclaims, “I was very impressed by the students’ commitment and enthusiasm! I learned just as much from them as they did from me. We lowered barriers students may have felt to being an engineer by letting them practice the ‘engineer lifestyle’ for six weeks of their summer!”

“I’m a strong believer that creative solutions can come from anybody with any type of resources,” says Young. “Going through this process showed the students that they, too, are qualified to think of solutions to bioengineering problems and that they have the resources at hand to prototype some of their ideas.

“We received good feedback from the students on the performance of the bioengineering camp,” adds Young, who hopes to secure funding to continue the Bioengineering Boot Camp at Stanford. “I think this is a great program [that] would have enormous contributions outside the Silicon Valley...We’d love to see it replicated at other universities.”
Colleagues Key to Teaching Outside Certification Area

NSTA Reports recently asked educators about their experiences teaching outside their subject areas. While some passionately asserted this should never happen, others reported using science content to teach English language arts or mathematics. The practice appears fairly widespread, with more than 80% of participants reporting they had been asked to teach outside of their certification area at some point during their career; 49% currently do so. Only 16% reported receiving any professional development (PD) to help them prepare for the new content.

While teaching out of their subject area, only 14% said they taught only one course; 41% reported teaching more than one subject, including non-science subjects; and 44% said they taught more than one course, but the courses were all in science.

Networking was the most commonly cited method of preparation (by 94%), while attending PD sessions provided by the school or district was mentioned by only a quarter of participants (respondents could select more than one answer). When asked what they considered essential to successfully teach outside their certification areas, teachers frequently noted networking, finding a mentor, and self-directed learning were key to success.

Here’s what science educators are saying about teaching outside their certification area:

1. An outstanding curriculum; 2. Help from the department when needed; 3. Chances to attend workshops and training.—Educator, Elementary, Middle School, Texas

A connection to teachers who regularly teach the subject.—Educator, High School, New York

A firm knowledge of what is expected by administrators, appropriate supplies in working condition, flexibility.—Educator, High School, New Jersey

I don’t mind teaching a course that is in my subject area. My license area is biology and general science. However, this year I am teaching three science courses that I never taught before: health, astronomy, and environmental studies. If they wanted me to teach these, they should have let me know over the summer, so I could prepare lessons and familiarize myself with the content…There is no equipment at all for the courses, which makes it harder. I have no curriculum. No one has told me what topics to cover, so I am basically winging it because there is no textbook for the course to at least follow… I think all teachers should be trained to teach all courses in their area, just in case. There should be a book of lesson plans ready for any teacher who may have to teach outside of certification.—Educator, High School, New York

A good textbook and lots of hours researching materials to use. A good mentor is very handy, too.—Educator, High School, Pennsylvania

A solid curriculum as well as a “crash course” as a reminder of what we may have learned 10+ years ago, or never took a course in.—Educator, High School, Illinois

Advance notice would be nice, not finding out the week school starts, like I did.—Educator, High School, Louisiana

Aspire to work it out, perspire to attend trainings and seminars, inspire young minds.—Educator, Institution of Higher Learning, Tarlac City, Philippines

Assistance from colleagues is extremely important; PD opportunities such as seminars and short courses would also be beneficial.—Educator, Middle School, Minnesota

Being able to work with other teachers of the subject at other schools and share presentation, lab, and assessment materials.—Educator, High School, New York

Examples of excellent classes and materials. Access to resources used by other teachers.—Educator, High School, Illinois

Extra prep/plan time; help with lesson materials; ideas for lessons.—Educator, Middle School, Oregon

Find someone in their department to network with. Check the NSTA files. Find a buddy teacher.—Educator, High School, Rhode Island

Flexibility, and great friends.—Administrator, Middle School, Massachusetts

I was asked to teach language arts. I just used science as the focus of my writing and research lessons.—Administrator, Middle School, Florida

Lesson plans, time reading/doing practice problems, teacher copy of textbook, previously used materials (at least to have a base to start on); time, time, time.—Educator, High School, Ohio

Lots of networking, extra prep time at home, and the use of multiple sources for topics less comfortable with (sometimes a different textbook says something in a better way).—Educator, High School, Massachusetts
Methods in running and keeping a safe lab. Proper lab equipment. Well-developed curriculum.—Educator, High School, Institution of Higher Learning, Michigan

More money to put their certification on the line. Also, when teaching underprivileged and challenged students, pay differential is a necessity.—Educator, High School, Louisiana

More time to prep and less sleep or admin support for online coursework and prep.—Educator, Middle School, High School, Virginia

Need to be flexible. Need to have a course outline. Need to have access to materials essential to the course.—Educator, High School, New York

Notification that you’ll be teaching outside of your certification area at least three months ahead of time. That way, you can look for materials, strategies, etc., before having to teach the class. You will need as many ancillaries that you can find help.—Educator, High School, Pennsylvania

Paint with broad strokes, go for teaching strategies that work with all subjects, and take what you use in science and see what translates, especially in terms of problem-/project-based learning, and scientific process reasoning. It can be applied to thought methods for other subjects. I taught social studies, and treated it as social science.—Educator, Middle School, New Jersey

Pre-written lab activities and demonstrations. I've found I can learn, understand, and teach the content, but struggle with identifying/creating engaging and beneficial lab activities and demonstrations. Having labs/activities for major topics is very valuable.—Educator, High School, Institution of Higher Learning, Maryland

The online courses I took and help from colleagues were key.—Educator, High School, Oregon

Using inquiry-based instructional strategies is useful regardless [of] the content area.—Educator, Middle School, High School, Montana

More Thoughts

Science teachers should not be expected to teach outside their certification areas. I fought it and won about two weeks ago. My state [department] of education supported me when a new principal assigned me to teach elementary school. I am certified in general science and other sciences, grades 7 through 12.—Educator, Elementary, Middle School, Connecticut

Revise your resume to get in a school that will allow you to teach science!—Educator, Elementary, Middle School, High School, Taiwan

Science teachers are already math, history, and language arts teachers, so it wasn’t too much of a jump to teach any of those subjects.—Educator, High School, New Jersey

People outside of science classrooms need to understand that teachers of secondary science are pretty specialized in the content that we teach. Asking an Earth science teacher to teach physical science is like asking an English teacher to teach history. It’s the same language and probably has some overlap, but the teacher’s mastery of the content is not guaranteed. The level of passion that a teacher brings to his/her subject is very important and often overlooked.—Educator, Middle School, Minnesota

Science teachers need to teach science—not history, English, social studies, etc.—Educator, High School, Institution of Higher Learning, Texas

Willingness—We shouldn’t expect kids to learn things that challenge them if we can’t do the same ourselves.—Educator, High School, Kentucky

A bigger concern is non-science certifications teaching science!!!!—Educator, Institution of Higher Learning, South Dakota

Ohio does not allow you to teach outside your area. Therefore, all new hires must have a comprehensive license. Unfortunately, that means a mile wide and an inch deep.—Educator, High School, Ohio

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Dancing With Future STEM Stars

When “Science Guy” and Planetary Society CEO Bill Nye joined the cast of TV’s Dancing With the Stars this fall, his appearance drew attention to the intersection of science, technology, engineering, and math (STEM) and the art of dance. Many scientists have commented on this connection. For example, John Bohannon, the biologist and writer who runs the annual Dance Your PhD contest, observed in his TED Talk Dance vs. PowerPoint, a Modest Proposal (see http://bit.ly/18CDb9z), “If you’re trying to give someone (e.g., photosynthesis, protein synthesis, phases of the Moon), and ask your students to imagine (and demonstrate) how they might role play the items going through that process. The movements and rhythm of students going through that process could be the dance,” Flammer contends.

“‘[If you’re trying to give someone (e.g., drama or dance or song), but not remember the science process] was supposed to represent! I would suggest that after the presentation, teachers query their students as to what each element of the dance (or other activity) represented, and have a class discussion of those representations, and even (perhaps) how it could have been improved,” he advises.

Bohannon’s contention is supported by many science teachers. “Teachers should make every attempt to incorporate any medium that makes topics more engaging, and encourages students to get involved based on their existing talents, strengths, and interests. In fact, the more dramatic and offbeat the experience, and the more senses that are stimulated, the more likely it will be remembered,” suggests Larry Flammer, a retired teacher from San Jose, California.

“The main problem is that students might remember the drama (or dance or song), but not remember the science that the [performance] was supposed to represent! I would suggest that after the presentation, teachers query their students as to what each element of the dance (or other activity) represented, and have a class discussion of those representations, and even (perhaps) how it could have been improved,” he advises.
new routes toward understanding the subjects they study.” (View a summary of their presentation at http://bit.ly/tbQPMp.)

Chesmel says she and Wunsch brainstormed “ways to incorporate all types of performing arts in my chemistry class. The movement part (I don’t call it ‘dance,’ as some kids will get turned off immediately) came as a way to make vocabulary more fun and meaningful.”

When asked about how she assessed her students’ chemistry-related movement, she responds, “Much of the work was not graded but had a peer review. We played ‘vocabulary charades’; feedback was instant: ‘Could others guess the word?’ Students would ‘perform,’ and others would state what they felt was the message of the performance. We would compare the ideas of the viewers with those of the presenters.”

Teachers have incorporated dance into the life sciences. “It’s basic, but I have my students do the Mitosis Ballet, either as a group or individually (they create their own),” says Carly Barnett, seventh- and eighth-grade science teacher at Laurel Ridge Middle School in Sherwood, Oregon. “For the group dance, students act as parts of the organelles. It’s always dramatic when the chromosome pairs split, and at the end, with the nuclear membrane splits. We use the Star Wars theme music as I call out the difference phases,” she explains. Besides the music, the only other supplies she needs are “string for spindle fibers” and “excited students,” she notes.

“The idea to have my students dance (originated) back when I first started teaching and I had many ELD [English Language Development] students who needed help visualizing mitosis. I had seen another class visually show an atom, and I just thought how fun it would be to show mitosis through movement. Last year, I Googled ‘mitosis dance,’ and found loads of examples. The examples helped my students understand what we were going to attempt in class,” Barnett observes.

When combining dance and science, the choice of music is critical to keeping students motivated. “When I was in the classroom, I was known as the ‘singing biology teacher,’ and used camp songs that all my students could sing,” says Cindy Moss, who taught science for 20 years and now serves as director of Global STEM Initiatives for Discovery Education. “We had choreography for most of the songs, ranging from simple motions to whole-class movement. Sometimes I would give them a motion for the key terms or chorus, and they would create the rest. Sometimes I created the choreography, or students would volunteer to do it for the class.

“I taught in high-poverty situations, and it really engaged my students,” she asserts.

**Partnering With the Pros**

Some teachers enlist the help of a choreographer or other dance professional. “Many years ago, I had a dance instructor come in to work with my classes after receiving a grant for arts in the classroom,” recalls Kimberly Bradshaw, science teacher at Penfield High School in Penfield, New York. “We picked a topic and choreographed a dance. Our topic was ecology, and we danced the flow of energy from Sun to carnivores (reducing the number of participants at each stage).

“I was way out of my comfort zone,” she confesses, “but the kids I run into from the class (10+ years ago) still comment about dancing in biology.”

After attending Elizabeth Johnson’s and Laura Grabel’s Science Choreography workshop at a biology teachers conference two years ago, Chris Willems says he “was instantly hooked.” Willems, a science educator at Metropolitan Business Academy in New Haven, Connecticut, partnered with stem cell biologist, dancer, and Wesleyan University biology professor Grabel and Johnson, a dancer, choreographer, and Arizona State University educator. “Their expert melding of physical movement and science (with a welcoming, nonthreatening approach) is absolutely incredible,” he maintains.

The partners created the Pluripotency Dance, an interactive, multimedia performance piece exploring stem cells and the ethical implications of stem cell research. Working with Willems’ high school students, they studied the stages of human development, from fertilization and blastocyst through quickening, viability, and birth. Willems believes his students greatly benefitted from the experience. “My students get to move their bodies a lot more. We look at our work from more angles than before. Simply put, our classroom is more joyous and memorable.”

He points teachers to the toolbox page of the Science Choreography website (http://sciencechoreography.wesleyan.edu/toolbox). It features classroom activities and teaching modules developed by choreographer, performer, and educator Liz Lerman and artists at the Liz Lerman Dance Exchange.

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**In fact, the more dramatic and offbeat the experience, and the more senses that are stimulated, the more likely it will be remembered.”**

—Larry Flammer

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Linking Science and Literacy

By Bill Badders, NSTA 2013–2014 President

Teachers of science at all grade levels are faced with the task of teaching inquiry-based, content-rich science and at the same time meeting the goals of the English Language Arts Standards and the Common Core Standards in Reading. Connecting science and literacy and finding the time in a typical school day to do so can be a challenging endeavor for many educators. Elementary teachers often find it difficult to find the time in the school day to teach science because of the emphasis on the reading curriculum. Middle and high school science teachers must address students’ ability to read, write, and communicate what they know and understand.

But what if there was a way to examine this problem by thinking differently about how to connect the two curricular areas? What if we considered a teaching strategy that integrated the two curricula? How would it work?

During my teaching career with the Cleveland Metropolitan School District, we piloted a program capitalizing on the connections between science and literacy. The goal was to increase the opportunities for student achievement in both reading and science. All reading and writing activities were designed to be done in the context of teaching science and used content–rich nonfiction texts. Over a three-year period, students in third, fourth, and fifth grades involved in this science program scored statistically significantly higher on the Ohio State Reading Assessments than did students who were not in the program. It was a “Eureka” moment for both the teachers and the district. Students could have great experiences in science and read better!

Students cannot learn everything simply from inquiry-based experiences. They must be able to read and comprehend nonfiction and informational text to better understand the science concepts they are studying. They must be able to communicate and use evidence to present information both formally and informally. They must be able to write descriptions and give scientifically based explanations. They must understand technical writing. They must use scientific vocabulary to explain something or answer questions. They must use, organize, and represent data. And they must be able to summarize their ideas, build on others’ ideas, and present information accurately.

So where are the connections between science and literacy? Let’s look at a partial list of the goals we often see in a school district’s reading/writing courses of study: making inferences; communicating information orally; posing questions; making predictions; writing explanations; comparing and contrasting; drawing conclusions; accessing and applying prior knowledge; making explanations from evidence; summarizing, organizing, and representing data; determining cause and effect; learning and using vocabulary; using features of informational text; making connections; locating information in texts; writing to communicate information; and discussing words and their meanings. But wait: Aren’t these the same goals we see appearing in the science course of study? It is clear a common thread runs through both reading and science outcomes, creating a connection and a reason to integrate the two curricula.

Since many goals are the same, where are the opportunities for a teacher of science to incorporate reading and writing into inquiry-based science instruction? Some possibilities include, but are not limited to, searching and gathering information in nonfiction texts, making sense of data in scientific texts, taking notes, teaching concept mapping, and working with vocabulary. Teachers can focus on developing students’ skills in procedural and descriptive writing, scientific comprehension writing, development of explanations writing, and information summary writing.

Using nonfiction and informational text can also be the vehicle for teachers to address the teaching of text features that are needed not only in science, but also across disciplines. Understanding how one uses a table of contents, an index, a glossary, diagrams, illustrations, captions, tables, bulleted lists, headings/subheadings, and special type characteristics, such as bold, are critical strategies for improving reading comprehension.

I am sure other examples exist of successful programs and initiatives teachers and school districts around the country are using. I welcome the opportunity to hear about them. Please share your ideas with me at bbadders@nsta.org.
eCYBERMISSION is a free web-based science, technology, engineering, and math (STEM) competition for students in grades 6-9 that promotes self-discovery and enables all participants to recognize the real life applications of these disciplines. Using either scientific practices or the engineering design process, students are grouped in teams of 3 or 4 and propose a solution to a real problem in their communities—to compete for state, regional, and national awards.

Students compete to win up to $8,000 (maturity value) in U.S. Savings Bonds.

For more information, visit www.ecybermission.com or call 1-866-GO-CYBER (462-9237).

Administered by NSTA National Science Teachers Association

DEADLINE JANUARY 15, 2014
A career in aquatic animal medicine was first introduced to me by my 10th grade science teacher, Mr. Hargis. He inspired my love of the ocean and all of its inhabitants, as well as an appreciation of its fragility. Each time I release a manatee or sea turtle back to its natural habitat, he’s played a role in that animal’s care without ever having seen it!”

Dr. Lara Croft, Veterinarian, SeaWorld

At SeaWorld and Busch Gardens, we’re reminded daily of the importance and influence of teachers. The animals we rescue, the people we educate, and the species we save benefit from the influence teachers had on our lives. We’re dedicated to sharing our passion and helping you educate your students to protect the world we share. We invite you to visit our new website for free resources created just for teachers.

SeaWorld.com/teachers

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WHAT AWAITS YOU IN BOSTON

• A wide range of Science, Technology, Engineering, and Math (STEM), Next Generation Science Standards (NGSS), and Common Core sessions
• 2,000 sessions, workshops, field trips, and short courses for K–16 educators
• Content development and ready-to-use teaching techniques
• Exhibit Hall featuring new products and giveaways from more than 400 exhibitors
• NSTA Science Store with 100s of professional development books; attendees receive a 20% discount
• And much more!

PROFESSIONAL DEVELOPMENT STRANDS

• Science and Literacy: A Symbiotic Relationship
• Teaching Elementary Science with Confidence!
• Leading from the Classroom
• Engineering and Science: Technological Partners

For updates and information, visit www.nsta.org/boston
IBN Online Science Fair. A new web platform from the science nonprofit Informed by Nature (IBN) allows students and teachers in grades 7–12 to upload, share, and store science fair projects online. To encourage participation and reach underserved populations lacking access to local science-themed competitions, IBN will hold an annual virtual science fair competition with educational prizes for winners. In addition to sharing experiments, students can interact with peers through comments and by voting for favorite entries. Learn more at http://bit.ly/173qMZq.

Physics With Portals. High school science educator Cameron Pittman likes teaching physics with video games. At http://physicswithportals.com, he shares his experiences using the 3D puzzle game Portal 2 to help students learn about the physical world. His posted lesson plans allow students to build their own experiments, which they then use to collect data. Titles include Terminal Velocity; Building an Oscillator; Gravity; Man on the Moon! (grades 9–12); Getting Faster as You Fall; and Conservation of Momentum.


STEM-Works. K–12 teachers, mentors, volunteers, and others passionate about inspiring students to pursue science, technology, engineering, and math (STEM) fields will appreciate www.stem-works.com. Content is organized into high-interest subjects such as Crime Scene Investigation, Extreme Weather, Medical Innovations, Robotics, Space, The Animal Kingdom, Under the Sea, Video Games, and Wind Energy. Within each subject, users can access related articles, educational events, advocacy opportunities, activities, and interviews with STEM professionals (Cool Jobs). Click on Locations for an interactive map highlighting STEM-related destinations and related organizations around the country.

Sesame Street STEM. Preschoolers (and the adults in their lives) have a new digital destination: http://sesamestreet.org/STEM. Elmo and his Muppet friends help young scientists learn age-appropriate information about everyday science topics like Experiments, Sinking or Floating, Measurement, Properties of Matter, Engineering, and Force and Motion. The content is presented through short video clips and online games; an educators guide and a parent newsletter for each topic reinforce STEM learning in the classroom and at home.

My Science Box. K–college teachers will find high-quality, classroom-tested hands-on science lessons at My Science Box (http://bit.ly/1G4knUS). This site offers individual lessons for various grade levels as well as “curriculum boxes,” or units, for middle level and high school students. The resources address ecology, watersheds, plate tectonics, geology, genetics, and physiology. Each “box” contains everything needed to teach the unit: lesson plans, assessments, field trip planning materials, resources, and even Sub Plans with independent activities like webquests.

EcoMUVE. A new curriculum research project from the Harvard Graduate School of Education uses immersive virtual environments to teach middle level students about ecosystems and causal patterns. The two-week modules Ponds (Module 1) and Forests (Module 2) have the look and feel of a video game, and their multi-user virtual environments (MUVEs) re-create authentic ecological settings within which students explore and collect information. Students work individually at computers and collaborate in teams within the virtual world. Register to access EcoMUVE at http://ecomuve.gse.harvard.edu/JoinEcoMUVE2.php.
GLOBE Environmental Science Resources. Broden students’ perspective and understanding of our environment through student–scientist activities from the Global Learning and Observation to Benefit the Environment (GLOBE) program. GLOBE provides opportunities for elementary to high school students to collect environmental data in five areas of scientific investigation—Atmosphere, Earth as a System, Hydrology, Land Cover/Biology, and Soils—and share that data with the worldwide scientific community. Students must follow required data collection protocols for their data to be valid, providing them with valuable real-world experience in what it means to be a scientist. To learn more, visit www.globe.gov/home.

“Feathered Friends” Activities. These resources from Pennington Wild Birds and the Cornell Lab of Ornithology will keep the science content flying high year round in elementary classrooms! The materials at http://bit.ly/16HEC7 provide a wealth of bird information, including facts about bird biology, behavior, and identification. A combination of simple activities, cool facts, kid-friendly bird book recommendations, and links can help students discover the pleasures of wild bird feeding and bird-watching and ignite an interest in citizen science.

K-12 Soil Science. The Soil Science Society of America (SSSA) offers lessons, activities, and other resources at www.soils4teachers.org. The vetted materials are culled from SSSA and other Earth science education organizations; a hyperlinked lesson matrix puts all the resources conveniently in one place. Students will appreciate the Ask a Scientist feature, where they can post questions about soil and receive a response within 48 hours, while teachers will enjoy the opportunity to invite a certified professional soil scientist to visit the classroom (click on Contact Us).

Biodiversity Game. In M-EOL, a new app from Encyclopedia of Life, middle and high school students are explorers, discovering different plant and animal species by traveling around the world. Players can increase their knowledge about each species through descriptions, images, distribution information, and conservation status from the Encyclopedia of Life website (http://eol.org). Explore how organisms in each game collection are related to one another by browsing a dynamic, interactive graph. M-EOL is available on iTunes (http://bit.ly/1fRorBN) and Google Play (http://bit.ly/GzKzZT).

Science Video Podcasts. Teachers will find a library of 920 video podcasts (and growing) for K–12 students at www.mcsdpodcast.net. Produced by Muscogee County School District in Columbus, Georgia, through Department of Defense Education Activity Grants, the podcasts address core subjects. Selections from the science collections include Force Using a Soccer Ball and Weather Instruments (elementary); The Rock Cycle and Differences Between Animal and Plant Cells (middle level); and Waves and Evidence of Evolution (high school). The podcasts can be used for homework assistance, classroom explanations, “bell ringers,” and other activities.

National STEM Centre. Based in the United Kingdom, this science education website at www.nationalstemcentre.org.uk has an e-library of more than 7,000 digital resources for STEM educators. The site features a mix of instructional materials for K–college students (ages 5–19), including quizzes, fact sheets, lesson plans, videos and animations, and career advice. The site also offers news articles and opportunities for teachers to connect with an international community of STEM education enthusiasts.

Exoplanets Resource Guide. This annotated guide highlights written, web, and audiovisual resources for teaching high school and college students about exoplanets, a rapidly changing branch of astronomy focusing on planets that orbit other stars. Resources include video and audio files of lectures and interviews with leading scientists in the field; phone and tablet apps; a citizen-science website; and books and articles. Published by the NASA Astrophysics Education and Outreach Forum and the Astronomical Society of the Pacific, the guide is available at http://bit.ly/191mxQk.

Educade. For lesson plans incorporating today’s technologies—apps, games, and other innovations—into instruction, visit www.educade.org. The website offers hundreds of ready-to-use lesson plans in core subjects, each of which is aligned to Common Core State Standards for English language arts, math, and science. Science highlights include Classify Wildlife in Your Community with Project NOAH (elementary), Construct a School Wide Scale Solar System With Scale of the Universe (middle level), and Conservation of Momentum with Portal 2 (high school).

Perfect Picnic. The Partnership for Food Safety Education’s app at http://bit.ly/1k1vuGw offers a fun way to teach students in grades 3–5 how to prevent food poisoning. In the game, students must build the best picnic park in town. But nothing spoils a picnic like harmful bacteria on dirty hands, in food left sitting out, and in undercooked meat! Park operations go awry when basic food safety practices are ignored. The educators guide reinforces the message with a food safety quiz and a “Ten Least Wanted Pathogens” poster.

LearnBIG. A community-based website for learners from preK to college contains more than 14,000 digital educational resources, including apps, videos, games, and courses. At www.learnbig.com, visitors can search for resources by parameters to meet specific needs (e.g., subject, grade, format, standard) or by Career Path (e.g., web developer, software engineer, infrastructure technologies, etc.). LearnBIG offers a unique way for middle and high school students to learn about the skills needed in various fields and start developing them. Educators who join the community can comment on the resources as well as add their own to the site.

Fraction Calculator Plus. Help elementary and middle level students get comfortable with fractions! This app features an innovative three-keypad layout to enter fractions and a large, easy-to-read display that shows fractions the way you write them. Students will find the app useful for checking homework: The answers to the problems are written in the simplest form, and the decimal equivalents are included. The app is available for iPad and iPhone (http://bit.ly/1fXE94h), Android (http://bit.ly/YqCk5b), and Amazon’s Kindle Fire (http://amzn.to/14YMDUh).

Rethinking School Lunch Guide. This revised publication from the Center for Ecoliteracy explains the rationale for reforming school food programs and provides a planning framework for change. The document at http://bit.ly/d6SAIp discusses 10 key areas to consider when reforming school food programs: teaching and learning; food and health; wellness policy; the dining experience; procurement; finances; facilities; waste management; professional development; and marketing and communications. The goal is to teach nutrition, improve school food, support sustainable food systems, and help individuals make connections among food, health, culture, and the environment.
The National Science Foundation has awarded a $20 million grant to develop a new Science and Technology Center: the Center for Integrated Quantum Materials. This Harvard-led center will not only provide avenues for exploring the unique behaviors of quantum materials, but will also encourage underrepresented students to pursue science and engineering careers.

The center’s affiliated network of colleges is designed to attract students from diverse backgrounds and give them opportunities for scholarship and leadership in the field. Participating schools will include women’s colleges Mount Holyoke and Wellesley; Gallaudet University, a liberal arts school for the deaf; the Massachusetts Institute of Technology in Boston; Howard University in Washington, D.C.; and several community colleges around the country. Learn more at http://1.usa.gov/1dQUOV5.

A new U.S. Department of Education study found that middle and high school math teachers from Teach for America (TFA) and The New Teacher Project (TNTP) Teaching Fellows Program are just as effective—in some cases, more so—than other math teachers at the same schools. The study provides new evidence for policymakers and education officials concerned with staffing schools in high-poverty areas.

TFA and TNTP programs attempt to address the gap in staffing high-poverty schools by providing high-achieving college graduates with no formal training in education the opportunity to teach. Participants receive five to seven weeks of full-time training and are often assigned to teach hard-to-staff subjects and in high-poverty areas. However, critics of these programs often contend that teachers from these programs are less well prepared, and therefore, less effective than those who take the traditional path to teaching.

This study—the first large-scale, random assignment study of these programs—suggests that TFA and TNTP teachers are indeed effective and that these programs can provide promising options for high-needs schools. Read more at http://bit.ly/1bUbkpl.

Want to know who received the Nobel Prize in Chemistry in 1931? Check out the QR-coded poster published recently in the Journal of Chemical Education. In his article, author Vasco D.B. Bonifácio provides QR-coded information for the winners of the Nobel Prize in Chemistry from 1901 to 2011. QR codes are two-dimensional barcodes that can be scanned with a camera-equipped mobile device or tablet to provide instant access to a website. Bonifácio’s QR codes are arranged in a format that resembles the periodic table and lists the Nobel Prize winners and their accomplishments chronologically. This mobile learning tool can help engage students and introduce them to the world’s most prestigious prize in chemistry. Check out the poster with your own mobile device at http://bit.ly/1eSnFvo.

The U.S. military could learn a thing or two from the common squid, according to researchers at the University of California at Irvine (UCI). A recent study found that Loliginidae—also known as pencil squid or your everyday calamari—have a structural protein in their skin called reflectin that might come in handy for covert operations.

Reflectin helps the squid change color and reflect light, and in this study, UCI scientists used it to make thin, optically active films that mimic the squid’s skin. With the right chemical stimuli, these films will disappear and reappear when visualized with an infrared camera.

“Our approach is simple and compatible with a wide array of surfaces, potentially allowing many simple objects to acquire camouflage capabilities,” says Alon Gorodetsky, assistant professor of chemical engineering and materials science at UCI. The team’s findings have applications in infrared stealth camouflage, energy-efficient reflective coatings, and biologically inspired optics—all of which might benefit the U.S. military. “Our long-term goal is to create fabrics that can dynamically alter their texture and color to adapt to their environments,” Gorodetsky adds. “Basically, we’re seeking to make shape-shifting clothing—the stuff of science fiction—a reality.” Learn more about the team’s findings at http://bit.ly/16CxWcP.

Green Your School: Save Energy, Save Money

Engage Students in Real World STEM Learning

- Teacher professional development
- Curriculum kits aligned with education standards
- GreenSchools! investigations
- Grants for student-led action projects

www.plt.org/teachenergy
Federal Emergency Management Association (FEMA)
Youth Emergency Preparedness Materials
Embedded with real-world connections, FEMA’s Be a Hero youth emergency preparedness curriculum and website (http://1.usa.gov/1755dYm) teach students in grades 1–12 what to do before, during, and after an emergency while fostering critical 21st-century skills such as problem solving, teamwork, creativity, leadership, and communication. The curriculum is available for four grade levels (grades 1–2, 3–5, 6–8, and 9–12) and offers three inquiry-driven, project-based, differentiated learning activities aligned to core subject standards at each level. For example, early elementary students learn about various types of emergencies and how to prepare for them, while upper-elementary students work individually and in teams to research emergencies that can impact communities locally and nationally. Middle level students develop a graphic novel to show their understanding of emergency preparedness. And high school students engage in discussions, multimedia research, surveys, and interviews to develop their own communication campaigns aimed at raising awareness and motivating others to be prepared for emergencies.

In addition to the curriculum activities, students can play two online games, Disaster Master and Build a Kit, to reinforce learning and test their know-how about a wide range of emergencies and what constitutes a perfect emergency kit.

National Institutes of Health (NIH)
National Drug Facts Week
National Drug Facts Week will take place January 27–February 2, 2014. This annual event from NIH’s National Institute on Drug Abuse (NIDA) raises awareness among teens about the dangers of drug abuse through community-based events around the country. At these events, held at schools, hospitals, sports clubs, and other community venues, students learn about the science behind illicit drug use, prescription drug abuse, and use of alcohol and tobacco from addiction scientists and other health experts. Teachers can access a toolkit to help plan an event in their community at http://drugfactsweek.drugabuse.gov/planyourevent.php (free registration is required). The kit includes information about how to create an event, publicize it, find an expert, and obtain scientific information on drugs. In addition, NIDA will provide the booklet Drugs: Shatter the Myths (http://drugfactsweek.drugabuse.gov/booklet.php) and the 2014 National Drug IQ Challenge (http://drugfactsweek.drugabuse.gov/iqchallenge.php), a quiz teens and adults can take to test their knowledge about drugs.

Drug Facts Chat Day, scheduled for January 28, 2014, from 8 a.m. to 6 p.m. Eastern Time, offers another opportunity for teens and educators to learn about drug abuse prevention. At this live web event, NIDA scientists answer students’ questions about drugs, such as these:
- Why do some people get addicted to drugs and others don’t?
- What should you do if your friend wants to try drugs?

To register for the event and read transcripts from previous years, visit http://drugfactsweek.drugabuse.gov/planyourevent.php (free registration is required).
Cell Biology Resources
NIH’s National Institute of General Medical Sciences (NIGMS) offers resources for middle level and high school biology teachers to enhance instruction and spark interest in careers in biomedicine. “Seeing Cells,” a poster, presents colorful cell images alongside some basic facts about cells and links for more information. Order a print copy, or download it at http://1.usa.gov/1fLslyQ.

In addition, the NIGMS digital publication Inside Life Science contains numerous high-interest articles on cell biology topics appropriate for use with middle and high school students. The articles, available at http://1.usa.gov/1bzwGFN, show how basic biomedical research—from the history of the field to the cutting-edge work scientists are doing today—becomes the foundation for advances in disease diagnosis, treatment, and prevention.

U.S. Environmental Protection Agency (EPA) Climate Change Lesson Plans
The EPA has seven new lesson plans about climate change developed specifically for middle school students. The lesson plans and related activities are tailored to meet national science learning standards, and most can be completed in one 45- to 60-minute class period. Topics address the difference between weather and climate, the sources of greenhouse gas emissions, the carbon cycle, sea level rise, and the impact of climate change on coral reefs. Access a lesson matrix at http://1.usa.gov/Gb9eNN.

In addition, the website http://epa.gov/climatestudents offers climate change information for students that can be used in the classroom or to support independent study. For example, students can explore their personal impact on the planet by calculating emissions use; take a Climate Change Expedition to learn about the evidence of climate change in different parts of the world; and get involved in citizen science events to track the effects of global climate change on the natural world.

National Aeronautics and Space Administration (NASA)
Space Station Educator Resource Guide
The International Space Station Learning, Achieving, Believing, and Succeeding Educator Resource Guide contains eight guided educational learning activities. It highlights the international collaboration involved in building and operating the space station and provides an overview of space station construction and assembly. The eight activities cover topics relating to science, technology, engineering, and mathematics. All lessons are aligned with national education standards.

The guide also includes student sheets, lesson plan instructions, background information, answer keys, and a certificate of completion to award to students after completing the activities. Access the guide at http://1.usa.gov/1hnsB8h.

ScienceCasts Video Series
ScienceCasts, NASA’s new video series, offers middle and high school educators and the public a fast and fun way to learn about scientific discoveries and facts about Earth, the solar system, and beyond. Found at http://1.usa.gov/law6AM, the videos were produced by an astrophysicist and a team of agency narrators and videographers. The format is designed to increase understanding of the world of science through simple, clear presentations.

Want to see the latest ScienceCasts on YouTube? Visit http://bit.ly/1a2YDUn.

National Oceanic and Atmospheric Administration (NOAA)
Ocean Literacy Resources
This area of the education resources website provides links to NOAA resources that explore the physical and chemical properties of the ocean and its adjacent ecosystems to advance ocean literacy. Consult http://1.usa.gov/19kwewM.

U.S. Department of Agriculture (USDA)
Food System Education Booklet
For the Good of the People, a 32-page booklet from the USDA’s Natural Resources Conservation Service, is filled with fun facts about farmers and ranchers. Written for fifth graders, the book describes where food comes from, how it is produced, and the benefits of conservation. Read it at http://1.usa.gov/1g0Ap1P.

Clean Water Resource Packet
With colorful drawings and cartoon characters like Major Mulcher, the materials in the Hometown Clean Water Tour packet get students excited about keeping local waters clean and clear. Produced by USDA’s Natural Resources Conservation Service, and targeted for the elementary level, the packet includes classroom activities, a 10-question water quiz, and puzzles and games. Access the packet at http://1.usa.gov/18pw0Bz.

National Science Foundation (NSF) An Interactive Tour of the Cell
Although the cell is the smallest unit of life, it is by no means simple. Take the tour with your students at http://1.usa.gov/17586IC.

U.S. Department of Homeland Security (DHS) Online Security Education Resources
Whether you need a game for a middle school classroom activity, a video to share with parents in your community, or an article to use in your workplace newsletter, K–12 teachers can find it here: http://1.usa.gov/15O8EIM.

U.S. Geological Survey (USGS) Teaching About and Using Coordinate Systems
Teaching about coordinate systems is an excellent means of integrating geography and mathematics, incorporating fieldwork, and paving the way for understanding the Global Positioning System (GPS) and Geographic Information System (GIS) in education. Learn more at http://on.doi.gov/GBet05.

National Park Service (NPS)
New NPS curriculum-based lesson plans draw from the spectacular natural landscapes and authentic places preserved in America’s national parks. You’ll find them at http://1.usa.gov/173gnMd.
Editor’s Note
Visit www.nsta.org/publications/calendar to learn about more grants, awards, fellowships, and competitions.

Reading Is the Way Up Literacy Grants Program
This program awards grants to educators in K–12 schools in California, Georgia, Nevada, New York, and Tennessee. Funds can be used to purchase books, videos, CDs, DVDs, computer software and hardware, and other resources to support literacy. Full-time teachers, librarians, school media specialists, and administrators are eligible to apply for grants of up to $500.

Funds must be expended by December 31 and projects completed by the end of the 2013–2014 school year. Apply by November 30; see http://bit.ly/1az72jh.

NSTA and DuPont Pioneer Excellence in Agricultural Science Education Award
Sponsored by DuPont Pioneer and NSTA, the award recognizes excellence and innovation in agricultural science education. One winning teacher will receive a $5,000 grant for his or her classroom, paid travel to the NSTA National Conference on Science Education, mentorship from a DuPont Pioneer scientist, classroom resources, and access to one of the company’s product plants or research facilities.

K–12 teachers who implement agricultural science in their classrooms are eligible; applicants must include a 20-minute video of the teacher and students participating in an agricultural science activity, a two-page description of the activity portrayed, a curriculum vitae, and three letters of recommendation. Apply by November 30; visit http://bit.ly/10e81Z.

AAPT High School Physics Teacher Grant
The American Association of Physics Teachers (AAPT) provides funds for teachers who want to experiment with and improve their teaching practices. The best proposals will result in better teaching practice, heightened student understanding and interest, increased enrollment, and innovative teaching. High school teachers with an AAPT membership may apply for grants of between $100 and $500. Up to $200 in travel expenses is also available for awardees who present a paper on their project at the national AAPT meeting.

Maley/FTEE Technology and Engineering Teacher Scholarship
The Foundation for Technology and Engineering Educators (FTEE) provides $1,000 scholarships to help teachers improve outcomes in their classrooms. Technology and engineering teachers at any grade level who are beginning or continuing graduate study and are International Technology and Engineering Educators Association (ITEEA) members may apply. Applications are due December 1; see http://bit.ly/TXsDxJ.

Greer/FTEE Grant for Technology and Engineering Educators
The foundation also provides $1,000 grants to help teachers and supervisors in technology and engineering education (grades 6–12) attend the ITEEA Annual Conference. Applicants must be ITEEA members, have already registered to attend the conference, and not have attended more than three previous conferences. Apply by December 1; refer to http://bit.ly/OxTtX.

2014–2015 Albert Einstein Distinguished Educator Fellowship
The Einstein Fellowship program gives current science, technology, engineering, and mathematics (STEM) teachers in K–12 public and private schools the opportunity to work in public policy. Fellows spend 11 months in Washington, D.C., working in a federal agency or U.S. Congressional office to help bridge the gap between our legislative and executive branches and the STEM education community. Applicants must be U.S. citizens and have at least five years of full-time teaching experience in a STEM discipline. They should also be currently employed and able to obtain a leave of absence to participate for the full 11 months.
Fellows receive a $6,000 monthly stipend and a $1,000 monthly cost of living allowance, along with reimbursement for moving expenses and professional travel. Apply online at www.trianglecoalition.org/einstein-fellows by December 4.

Space Foundation Teacher Liaisons
The Space Foundation invites preK–20 educators who teach about space to apply for its Teacher Liaisons program. School administrators and public, private, and homeschool teachers are eligible. Participants receive training and resources to further integrate space in their classrooms and serve as links between the Space Foundation and their respective schools and districts. Liaisons often work with other space organizations as well, such as NASA. Once selected, they remain active in the program as long as they continue to meet its requirements．

Youth Garden Grants
Schools or youth programs planning to garden in 2014 with at least 15 children between the ages of three and eight are eligible for these National Gardening Association awards. Twenty groups will receive a $500 gift certificate to the Gardening With Kids online store, along with tools, plant starts, and seeds for their gardens. Winners are selected based on the demonstrated relationship between the garden program and education related to the environment, health and nutrition issues, character education, and entrepreneurship in the United States. Apply by December 6; visit http://bit.ly/18e1WbX.

United States-Japan Foundation Educational Grants
The foundation promotes stronger ties between Americans and Japanese and provides grants for projects that support mutual understanding, create effective communication channels, and address common concerns. Of particular interest are precollege teachers who wish to study topics related to the United States-Japan relationship. Interested teachers should submit letters of inquiry by December 15; refer to www.usjf.org.

Distinguished Fulbright Awards in Teaching Program
This program provides opportunities for distinguished primary and secondary teachers, guidance counselors, curriculum specialists, curriculum...
Gustav Ohaus Award
The award is presented to a teacher with innovative ideas for improving science teaching at the primary, secondary, or college level. This can include ideas for curriculum design, teaching strategies, administrative or organizational patterns, or the use of labs. The winner will receive $1,500, a paid trip to the 2014 NSTA National Conference on Science Education, and a personalized Gustav Ohaus Award. The recipient’s school will also receive a plaque and an Ohaus product valued at up to $1,000.

Applications are due by December 16; visit http://bit.ly/173CptV.

Celebrate Urban Birds Mini-Grants
The Cornell Lab of Ornithology provides mini-grants to help U.S. educators, organizations, and youth hold neighborhood birding events. Winners are awarded $100–$500 to host events featuring birds, community service, art, and greening and to collect data for the Celebrate Urban Bird program; however, all applicants will receive materials and training to support their events. No prior birding experience is necessary, and communities with underserved groups are particularly encouraged to apply. Visit http://celebrateurbanbirds.org; apply by December 15.

Project Orange Thumb Grants
Project Orange Thumb funds new garden projects sponsored by public schools, youth groups, and other nonprofit community groups in the United States and Canada. Projects should include horticultural education, community involvement, neighborhood beautification, and sustainable agriculture. Ten groups will receive $5,000 in cash and tools to support their projects; one group will win a complete garden makeover. Apply online at http://bit.ly/19NyfM2 by December 31.

World of 7 Billion Contest
This contest is part of Population Connection’s World of 7 Billion campaign, which promotes understanding of the ways our world population of 7 billion affects our neighborhoods and global communities. High school students can enter short videos illustrating the connection between world population and one of these topics: climate change, global poverty, or water sustainability. Free curriculum resources for teachers are available, and student winners in each of the three topic areas will receive cash prizes of up to $1,000. Get resources and submit videos online at www.worldof7billion.org by February 21.
Summer Programs

Rocky Mountain Field Camp. The Geological Society of America (GSA) hosts field camps that allow K–12 teachers to explore geology firsthand and incorporate these field experiences in the classroom. This field camp for K–12 inservice and preservice teachers will take place June 21–26. Participants will study the geology of central Colorado firsthand and collect mineral, rock, and fossil samples to learn about more summertime professional development opportunities.

Illinois Basin Field Camp. The GSA will host this four-day field camp at the Illinois Basin in LaSalle County, Illinois, June 15–19. Participants will explore the geological gems of the basin, tour the Viper Coal Mine and the iconic Silurian reef at Thornton Quarry, and collect frac sand, limestone, shale, dolostone, and other samples along the way.

Preservice teachers may attend this field camp. For more information, visit www.geoventures.org, or e-mail Davida Buehler at dbuehler@geosociety.org. Apply by January 10.

GeoVentures: Explore Australia. During this 12-day (June 14–26) trip sponsored by the GSA, teachers will explore the Sydney Basin and see some of the oldest caves and volcanoes on Earth. They will snorkel the Great Barrier Reef, explore the Blue Mountains, and gain experience using new field tools, such as EarthCaching.

An eight-day extension will take teachers to Southern Australia, and teachers can explore the geology, birdlife, kangaroos, and other wildlife in South Wales in a June 26–July 3 trip.

Spouses, partners, and children may join these trips, all of which involve some hiking. For more information, visit www.geoventures.org, or e-mail Gary Lewis at glewis@geosociety.org. Register by January 10.

GeoVentures: Explore Dynamic Iceland. The GSA also offers a trip to Iceland July 27–August 7. Participating K–12 teachers will explore a wide range of geologic phenomena and discuss the intersection of active Earth systems, science, and human culture. No prior knowledge of geosciences is required.

Apply by January 28. See www.geoventures.org, or e-mail Gary Lewis at glewis@geosociety.org for details.

Project Dragonfly’s Earth Expeditions. This program provides university courses and field experiences that link teachers with scientists, naturalists, and conservationists worldwide.

Teachers can participate in inquiry and action research projects in Africa, Asia, Australia, and the Americas. Back in the classroom, teachers continue work on their projects and engage their students and colleagues in their efforts.

Earth Expeditions are open to preK–12 teachers, administrators, and university faculty, as well as educators and naturalists from nonschool settings. Graduate credit is available.

Applications are due on January 28. Learn more at www.EarthExpeditions.org.

Mammoth Cave Field Camp. K–12 teachers will explore the world’s longest cave during this GSA field camp taking place July 14–19. Participants will map surface and cave features, do a karst hydrology research project, and collect and interpret data at Mammoth and Crumps Caves.

Opportunities to collect sedimentary rocks and fossils abound.

Teachers should expect to hike several miles of rough, uneven terrain daily. Visit www.geoventures.org for more information, or e-mail Davida Buehler at dbuehler@geosociety.org. Register by February 10.

ECO Classroom Program. Sponsored by the Northrop Grumman Foundation and Conservation International (CI), this program provides teachers with resources and learning opportunities in environmental science. Participants will spend two weeks at CI’s Tropical Ecology and Assessment Monitoring (TEAM) network site in Costa Rica in July. Teachers will gain experience in the data collection protocols used at TEAM sites and use camera traps, satellite imaging data, and other advanced field technologies to collect data.

Sixteen middle and high school biology, ecology, and environmental science teachers will be selected for the program. Interested teachers must form a team of four from the same or a neighboring school district; teams can be composed of teachers at various levels, though each teacher must be from a different school. Special consideration will be given to teachers in underserved communities. Apply by March 31; visit http://bit.ly/16VJTV0 for details.

GeoVentures: Explore Hawaiian Volcanoes. The GSA invites teachers to join this seven-day field trip to the Big Island of Hawaii. During August 6–13, teachers will learn about plate tectonics, hot spot volcanism, and the geologic features and hazards associated with living on an active volcano. They will also learn how best to share these geologic concepts with their students.

The trip is designed for K–12 Earth science and geology teachers with little or no Earth science background. Teachers’ family members may also attend. Visit www.geoventures.org for more information, or e-mail Gary Lewis at glewis@geosociety.org. Registration is open until May 15, or the class fills—whichever occurs first. ●
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Our middle school teams are encouraged to make interdisciplinary connections. I have some ideas for integrating physical science topics with language arts and mathematics, but we’re struggling with social studies connections. I was considering having students do presentations or pamphlets on inventors, but do you have any other ideas?

—Casey, Montgomery, Alabama

Inventions and inventors could be an interesting topic for students. If your learning goals focus on students’ finding and summarizing information, then the presentations of biographies could be appropriate. However, I hope in the context of science, technology, engineering, and mathematics (STEM) education and the engineering focus of the Next Generation Science Standards, you’ll want students to also understand and have experiences with the processes of inventing and innovating, perhaps addressing the topic “How do we invent inventors?”

I observed a social studies teacher introducing a unit on the Industrial Revolution. He framed the unit around two questions: Why do we invent or innovate? How do some inventions and innovations change society? At the start of the lesson, he demonstrated Morse code and had students tap out messages. They then discussed communication inventions of the 19th century (such as the telegraph and telephone) and compared them with modern communication vehicles such as cell phones and texting, with which the students readily identified. He also asked, “Imagine that the light bulb had never been invented. How would our world be different today?” The conversations in this classroom were amazing, as students were hooked on the topic.

This set the stage for a unit he had designed to show how the Industrial Revolution changed America from an agricultural to an industrial economy, from a rural to an urban society, and to a nation with even more immigrants. As I thought about this unit, I could see ways to integrate the topic with science and engineering topics.

Rather than a stand-alone activity on inventions, perhaps you could use inventions and innovations as an overarching theme or big idea for a series of units in physical science. Topics such as mechanical forces and simple machines, motion, electricity and magnetism, light, and sound waves could be investigated in the context of inventions. Students could build things in class, dismantle items to see how they work, design solutions to problems, and work with robotics and other electronics.

As a culminating project, students could become inventors themselves by finding a problem, designing and testing an invention to solve the problem, and “selling” their invention to others. This would take more planning than having students write reports, but NSTA publications have featured many articles about young classroom inventors and “invention conventions.” I’ve created a resource collection with articles from NSTA journals and NSTA Reports on inventions and inventors (see http://tinyurl.com/1blBoGW).

In addition, the NSTA website has information on national initiatives such as the Toshiba/NSTA Exploration Vision Awards science competition (http://bit.ly/GHFLvy). The NSTA website also contains a calendar of Science Education Events and Programs (http://bit.ly/1b1BD4R) with projects that may be of interest. NSTA and SciStarter (www.scistarter.com) are partnering to connect teachers and their students to opportunities to collaborate with scientists on cutting-edge research projects and informal science activities.

Our parents’ association is giving each teacher a mini-grant. This is only my second year teaching at the elementary level, so I still need lots of stuff for my classroom. I’d like to spend the funds on science-related materials. Any suggestions on what I should buy?

—Darin, Savannah, Georgia

Although it’s tempting to use the funds for classroom supplies or posters and decorations, I’m glad you’re thinking about science! Some basic materials can go a long way in providing opportunities for young students to explore and investigate.

First, look at your school’s science curriculum for your grade level and your lesson plans from last year. Were there activities you couldn’t do because you didn’t have the materials? Refer to the Next Generation Science Standards (NGSS) for elementary students, and consider how the performance expectations (and the practices, core ideas, and crosscutting concepts they were developed from) could be addressed through student investigations. Materials for these activities could be a good start for your shopping list.

Next, consider safety. Do you have protective eyewear and other basic safety equipment? Did you use science kits last year? You may need to replenish the consumable materials this year. Perhaps you and your colleagues could pool your mini-grants for larger-ticket items to share among your classrooms.

I have several colleagues who were elementary science specialists. Based on what I saw in their classrooms, you could begin to develop an inventory of simple materials for a variety of activities such as building blocks in different sizes and shapes; magnets; hand lenses; calculators; metric rulers and plastic measuring cups; easy-to-read thermometers; and science-related books at a variety of reading levels. (Read this post online for a more complete list.)

Consider what you might need for student projects: materials for investigating plant growth in a classroom garden (even a window ledge can be a garden) such as small pots, plants, potting soil, a grow light; binoculars and field guides; science notebooks for student journaling, sketching, and recording data; and a small aquarium.

If you have access to tablets, their cameras can be turned into microscopes, or you could purchase apps that relate to your learning goals or enhance student creativity. Students could use a digital camera to document and share their activities.

Storage space is a concern in many classrooms. You could include containers for storing materials or trays and small boxes to organize materials for the lab groups.

Browse through the articles in NSTA’s peer-reviewed journal Science & Children for more activities (and what you would need) that fit with your learning goals and students’ interests.

During the school year, share what you and your students are doing with
the materials with members of the parents’ organization. They’ll appreciate seeing pictures or videos of students at work. You could also ask students to write thank-you notes or create presentations explaining what they’re learning in science as a result of the organization’s gift.

Once you’ve used these funds, start a list for next year!

Do you have advice on assessments that would be helpful for sharing with my mentee, a new teacher?

—Shirley, Lexington, Kentucky

Assessing student learning can (and should) include more than final tests. The process has components before, during, and at the end of the unit of instruction. You might find my archived posts with questions on assessments helpful:

Assessment at the beginning of a unit—finding out what students know (or don’t know)
- What do students already know? (http://bit.ly/noP6Cw)

Assessment during the unit—helping students monitor their own learning, in addition to formative assessments (http://bit.ly/VK5dY2)

Assessment at the end of a unit—going beyond multiple-choice questions
- Using essay questions (http://bit.ly/1eUaolQ)
- Rubrics (http://bit.ly/1bDITS)

And giving students meaningful feedback (http://bit.ly/19bXe1l) is another component of assessment.

Above all, I’d emphasize to your mentee that assessment is more than acquiring numbers to average into a grade. Using a variety of assessment strategies can help both the students and the teacher determine to what extent the learning goals are being met.

Check out more of Ms. Mentor’s advice on diverse topics or ask a question at www.nsta.org/msmentor.

Quotable

“If you can’t explain it simply, you don’t understand it well enough.”

—Albert Einstein, theoretical physicist (1879–1955)
Inspiring ELLs With STEM

For students learning English, subjects like science, technology, engineering, and mathematics (STEM) may not seem like a priority because “[w]e haven’t made it really appealing yet,” says Kathy Wright, principal and chief learning officer of Hughes STEM High School in Cincinnati, Ohio. She points out that on television programs with lots of STEM content, “there may be one Spanish-speaking person, one African American person. We don’t have marketing of STEM to kids [where] it needs to be…We take something and put it in Spanish or another language, and we think we’ve marketed to them, but…there’s nothing magical about that. We’ve created access to information by taking a message that may not resonate, that people may not find value in until we make it culturally relevant.”

Instead, the science education community needs “to think about how to access minority students, [English language learners (ELLs)] included,” and show these students they are not “marginalized” from careers in the STEM fields and that resources are available to help them pursue STEM careers, adds Wright, who serves as NSTA’s Multicultural/Equity in Science Education Division Director. “I haven’t seen a lot of significant research in the last year or so [that shows] what’s going on with ELLs is different from what’s going on with minority students…It’s the same story we have known for a long time: the power of role models, the availability of these people to come in to school and mentor so students can see they are not very different from them.”

Educators also need to think about the complex roles many ELLs may have within their families. She says, “I find a lot of young people translating for the whole family. When parents come in,…we have to rely on students to be learners and translators, to be the resource for the family. We’re talking about 15- to 16-years-old [students] traversing two different worlds.”

One way Hughes STEM High School addresses that concern is through technology: “We’re using ‘T’ pretty heavily, [looking at] what tech can we put into the hands of ELL students. We use iPod Touches and iPads with lots and lots of apps loaded for the special use of ELL students and software to work on fluency. It’s not about delivering the curriculum in English and forcing them to translate,” explains Wright. “We gave iPods to some ELLs to use in class so they don’t have to wait for a teacher to come to them. It has cut down on that barrier for kids. It hasn’t truly solved it, but it has helped.”

The Next Generation Science Standards (NGSS) will also make a difference for ELLs and other students with diverse needs, Wright asserts. “The new standards are exciting in general. The Framework really set the stage for integration of content and skills and created a thoughtful continuum to tell kids [the] story of science, STEM…The strategies, support, and connections you can make to frame this all out are helpful for all students, not just ELLs…As long as we are culturally responsive to the different backgrounds from which students come to school, and we’re not thinking we [can] just translate information to another language, there’s work to be done creating access points to establishment in STEM.”

Okhee Lee, a professor in the Steinhardt School of Culture, Education, and Human Development at New York University, served on the NGSS writing team in the group tasked with addressing equity issues for seven groups: ELLs,
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Since I saw the first trailer for Gravity, I've been waiting for the chance to see it on the big screen. I decided to shoot for the Moon and see it in IMAX 3D on opening day for the full effect. In the end, it was worth the wait, and the film contains much for science teachers to take advantage of.

Gravity follows two astronauts, Dr. Ryan Stone (Sandra Bullock) and Lieutenant Matt Kowalski (George Clooney), who become separated from the Space Shuttle Orbiter during an Extra-Vehicular Activity (EVA) after debris from other satellites collides with the orbiter. Their spacesuits have a limited supply of breathable air, and there is no chance of rescue coming from Earth. The next hour and 20 minutes show us the ingenuity, perseverance, and strength of Stone and Kowalski as they try to save themselves. (No spoilers here.) I commend Alphonse Cuaron, the film's writer/director, for creating a story with a female scientist in the lead role. Dr. Stone is almost always referred to with her full title, and though she is the much less-experienced astronaut, her strength and intelligence are important in the end.

To get some perspective on the authenticity of Gravity's EVA usage, I interviewed George "Pinky" Nelson, a retired shuttle astronaut I know from my work as a science educator. Pinky is one of only six people who flew the Manned Maneuvering Unit (MMU) in space. In Gravity, we see Kowalski flying a very similar device, though NASA retired the actual MMUs from use following the Challenger disaster. You can see footage of Pinky flying the MMU in The Dream Is Alive (1985), a documentary about two shuttle flights in the 1980s, available on YouTube (http://bit.ly/1cwpqNX).

In my interview, Pinky described his training on the MMU simulator, which included scenarios much like that depicted in the film: An astronaut on a tethered spacewalk has become detached from the shuttle, and with the MMU, another astronaut would go out and rescue him/her. One of the main difficulties is doing this with the very limited supply of propellant aboard the MMU. The way Kowalski flies his MMU in the movie would exhaust the propellant very quickly, as he is constantly speeding up, slowing down, rotating, and changing direction. As we know from Newton's laws of motion, any of those actions require a force, and the MMU used compressed gas to provide that force. Pinky learned to fly the MMU conservatively, only using the gas when really needed, and not making unnecessary turns or rotations.

Kowalski seems to have forgotten those lessons. As Pinky and I watched the previews, he noted that no matter how motivated an astronaut might be by his or her situation, gripping anything while wearing the spacesuit gloves would be really difficult. He described it being like working while wearing boxing gloves, since the suit contains many layers of material, and the pressure inside makes it the material fairly stiff.

Accuracy was compromised in some of Gravity's scenes to make the story flow at a reasonable pace, and the reason why Kowalski flies the way he does is one example. It wouldn't be very exciting to watch a real MMU flight in a feature film because it's not very fast, and it involves mostly straight-line motion. I also understand why three objects that should be very far apart—the Hubble Space Telescope, the International Space Station (ISS), and a Chinese space station—are placed close together. It makes the whole plot of an astronaut going from one to the other without an orbiter plausible. Let's examine some of the details.

While in orbit, the shuttle and astronauts travel about 17,000 miles per hour (28,000 kilometers per hour, to use more appropriate scientific units). This takes them around the planet in about 90 minutes, with 45 minutes of daylight and 45 minutes of darkness. The ISS orbits 200–250 miles (320–400 km) above Earth, and would generally be toward the low end of this range when the orbiter was making a rendezvous. To make the servicing of the Hubble Space Telescope a plausible opening scene, Gravity's writers moved everything up to 600 km above Earth. I had been wondering where the 372 miles noted in the trailer came from. Now I know: 600 km = 372 miles. Still, that is unusually high for the shuttle orbiter, and much higher than where the ISS is actually placed.

I don't recommend using the flight simulator on http://gravitymovie.warnerbros.com because the physics are pretty terrible. To move at constant speed in this simulator, you have to keep your thrusters on continuously, and as soon as you stop firing thrusters, you begin to slow down. These properties would be acceptable for a simulation of an environment with significant and constant friction opposing your motion. This movie simulator is set above the atmosphere, so almost no friction should occur, nothing opposing your motion.

Another issue I have with the simulator is that when you are coasting (using no thrusters), if you turn to look in a new direction, you move in that direction. Turning to look should not change the direction of your motion; you should continue in a straight line.

Despite any shortcomings in details and with the online simulator, I think Gravity is the most scientifically accurate space film in a very long time. The filmmakers have attended to the fact that sound does not travel from one place to another without a medium to carry it, so mostly what we hear are sounds inside Stone's suit. When in orbit, an object's inertia is very evident, because very little friction exists to slow down a moving object. We often see Stone and Kowalski careening through space, bouncing off things because they cannot control their motion. Images of Earth from space and the various satellites are breathtakingly good and true to life. Careful observers will see a hurricane, and may recognize several locations on the globe, like the "boot" of Italy and the Nile River.

Gravity is a visually stunning film with enough true-to-life physics to keep a high school science teacher happy. The depiction of Dr. Stone as a female astronaut/scientist with strengths and skills is a move in the right direction.

Note: Gravity is rated PG-13 for intense perilous sequences, some disturbing images, and brief strong language.
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Holding an Electronic Science Fair

Last January, members of NSTA’s general science e-mail list received this message: “I was wondering if anybody would like to judge our science fair here at Nicholas Orem Middle School. This year’s science fair will be electronic, so you do not have to come to the school at all.”

The message came from Justin Leonard, seventh- and eighth-grade science special education teacher and science department chair at Nicholas Orem Middle School in Hyattsville, Maryland. Leonard, who is also a member of NSTA’s Special Needs Advisory Board, immediately received responses from educators across the country. He ultimately recruited 43 judges, most of them teachers; a few were scientists who also do science education outreach. “I wasn’t expecting that many…A lot of them wanted to see how an e-science fair was done,” he reports. “They were all really receptive to the idea.”

Leonard says he and the other science teachers participating in the fair agreed that “since we are an iPad school (each student has their own iPad during the academic day), and we were looking to do something different, we decided to integrate the iPads into the science fair process.” All of the students employed “the traditional process” of developing a science fair project, but they used PowerPoint and the iPad’s Keynote presentation app, which is similar to PowerPoint and allowed them to integrate their photos and videos into their presentation, he explains. The projects were “all student-based…They chose their own demonstrations and PowerPoints,” says Leonard. (View some of their projects at http://bit.ly/15S79IM.)

In addition, the students taught the teachers about some of the features of Keynote and PowerPoint, says Leonard. “This showed [the teachers] that their students could achieve more and do more” than what they had previously thought.

He provided the students with a template “that allowed them to be more creative, [with] open-ended questions about what to put on [each] slide…It allowed them to fully express themselves,” he contends. In addition, the students seemed to enjoy the hands-on aspects of using the iPad “to capture their data and procedures,” he observes. “Some students even videotaped how they set up their project” and edited the video so that it presented key clips from the process, he explains, adding, “They were excited to videotape themselves and to show their work to people who actually work in science fields.”

Why an E-Fair?

“The advantages to conducting an e-science fair are an increase in organization for the students, better technology skills, and we can get a broader judge base,” says Leonard.

“The benefits for students with disabilities participating in the e-science fair are tremendous,” he asserts. “At our school, we pair up a student with a disability with a non-disabled peer, and they work alongside each other, while learning social interaction skills and teamwork. Then the students gain valuable note-taking and organization skills with preparing their journals. When it comes time to prepare their presentation, the students are guided through the process, and they are able to share their projects.”

Virtual fairs are also very environmentally friendly. “Our fair definitely
cut down on paper consumption and paper waste...It cut down on a lot of the traditional concerns, such as greenhouse gas emissions, because all of the judges did not have to converge on the school. And we didn’t have to store 150 backboards that students didn’t want to keep,” he points out.

“One of the challenges we faced was that plagiarism was in just about all of the projects. We dealt with this issue by enabling some features on the iPad to prevent the students from going onto the internet and cutting and pasting information into their presentations,” he explains. In addition, Leonard and his colleagues were able to have their students work on their science fair projects in class because Nicholas Orem is a Title I school. “If they took their iPads home, we would have faced more problems,” he admits.

Presentations and Judging
After students presented their work to their classes, each teacher chose five students to compete in the e-science fair. “We had three special ed/regular ed pairs who advanced from the class presentation round to the school-wide competition. They were pretty excited to have judges across the country see their projects, [to get] that kind of recognition,” Leonard observes. He created a Google site for the fair, and students uploaded their presentations to that site.

Each judge was assigned five student presentations and given three weeks to evaluate them. The judging round “allowed the judges to ask students questions” and vice versa, and gave both sides time to receive the answers, explains Leonard.

“I really wasn’t sure what to expect when I initially offered to help judge, but being very curious about the process of virtual versus traditional, I was eager to find out,” says Betty Jo Moore, science teacher at Wiley Middle School in Winston-Salem, North Carolina. “Instead of the usual display of triptych boards, I was sent a series of digital presentations that essentially captured the same information. I enjoyed the virtual displays as much as the traditional displays and found it interesting as to how the students presented their findings. The only thing that [was] very different was that there were no ‘hands-on’ materials from the science fair displays to look through or look at, [such as] test tubes, physical displays related to the project, [and so on].”

Leonard gave the judges a rubric and advised against simply comparing one presentation to another. “As an educator, I would hope that I always evaluate a student’s work as the work of the individual instead of looking for comparison to another student,” agrees Moore. “When Justin told us how to judge the projects, he did want us to look at every project individually from a science perspective. To me, this indicated that he wanted the scientific process followed within each project: a clear statement of the problem, a clearly defined plan for obtaining a solution, variables recognized and defined, data to support their conclusions, proper citations. Additionally, we were looking at the content of their science presentations, not the pizazz of the presentation,” she explains.

“Essentially, it was the same type of information that I would give judges in a traditional science fair. It told us about the scoring rubric, the requirements set forth to all students, and the expectations of our judging,” she notes. “Justin really had this whole event down to a science. He made the entire event look very easy,” she maintains.

The fair concluded with a family science, technology, engineering, and math night, when parents could see the students’ presentations. Leonard describes the event as “well-attended…the biggest parents night at my school,” with about 60 parents attending. Typically, only about 15 parents come to such events, he notes.

He quotes parents as saying, “I never thought my kid could do this!” In addition, “the students had a high degree of ownership of their projects,” he contends.

The e-science fair made it easy for the students who won at the school level to prepare their entries for the county’s science fair, says Leonard. “It was easy to print out their slides…Everything was all done; the edits were all done. All they had to do was just print out their slides and organize them for the county fair.”

Advice to Teachers, Judges
Leonard offers this advice to teachers wishing to hold a virtual science fair:

- Be organized: “Have due dates and deadlines set for students and judges.”
- Have your students use both a print and online science notebook to plan their presentations. “I built the template for the presentations from their notebooks,” he explains. He also checked the notebooks to make sure students were completing their work on time.
- Send notes to parents explaining what a virtual science fair is and what the students will be required to do. About “15 or 16 parents had questions about their roles and the requirements,” he notes.

Moore has some recommendations for would-be judges: “I would strongly suggest a period of uninterrupted time to effectively review all projects. When I judged, I did so at home after school hours. I closed my office door to limit my distractions and interruptions. I would also recommend evaluating each project immediately upon review.”

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Chapter 8: Correlation

The Pearson Correlation Coefficient

The correlation coefficient is a statistic that illustrates the existence of a linear relationship between two variables. It also expresses the strength of the relationship. For example, you might ask this question: Are higher teacher salaries linked to higher academic achievement scores among students in a school district?

Table 8.1 Interpretations of Correlations

<table>
<thead>
<tr>
<th>Correlation</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000 to 0.200</td>
<td>Very Weak</td>
</tr>
<tr>
<td>0.201 to 0.400</td>
<td>Weak</td>
</tr>
<tr>
<td>0.401 to 0.600</td>
<td>Moderate</td>
</tr>
<tr>
<td>0.601 to 0.800</td>
<td>Strong</td>
</tr>
<tr>
<td>0.801 to 1.000</td>
<td>Very Strong</td>
</tr>
</tbody>
</table>

Note: Numerical values can be plus or minus.

The numerical values of a correlation coefficient range between –1.00 and +1.00. The higher the numerical value is, the stronger the relationship between the two variables (see Table 8.1). If the coefficient has a positive sign, the relationship is positive: If one value is high, the other value is high. Conversely, if the coefficient is negative, the relationship is negative: If one value is high, the other value is low. For example, when a correlation coefficient is positive, if x is high, so is y. You would expect that a person who scores high on an algebra aptitude test would also obtain high grades in algebra. The correlation is also positive when a low value for x corresponds to a low value for y.

Conversely, if a correlation is negative, high scores on x are associated with low scores on y.

As an example, let’s look at the relationship between the SAT math scores and the trigonometry grades of 10th, 11th, and 12th graders. Table 8.2 shows these students’ SAT mathematics scores and trigonometry grades. To determine the correlation coefficient, we will calculate the Pearson correlation coefficient for this set of scores.

Table 8.2 SAT Math Scores and Trigonometry Achievement Scores

<table>
<thead>
<tr>
<th>Name</th>
<th>SAT Score</th>
<th>Trigonometry Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forrest</td>
<td>740</td>
<td>95</td>
</tr>
<tr>
<td>Jamal</td>
<td>680</td>
<td>90</td>
</tr>
<tr>
<td>Alexandra</td>
<td>660</td>
<td>90</td>
</tr>
<tr>
<td>Lauren</td>
<td>550</td>
<td>86</td>
</tr>
<tr>
<td>Sabrina</td>
<td>500</td>
<td>80</td>
</tr>
<tr>
<td>Roberto</td>
<td>480</td>
<td>80</td>
</tr>
<tr>
<td>Chang</td>
<td>500</td>
<td>75</td>
</tr>
<tr>
<td>Jane</td>
<td>470</td>
<td>75</td>
</tr>
<tr>
<td>Rick</td>
<td>480</td>
<td>70</td>
</tr>
<tr>
<td>Pete</td>
<td>400</td>
<td>65</td>
</tr>
</tbody>
</table>

The Pearson correlation coefficient, sometimes called the Pearson product-moment correlation, is a measure of the linear relationship between the paired values of two variables (x and y). The equation takes into account each paired value and uses the mean, standard deviation, and z-score formulas in its computation (see Equation 8.1)

Equation 8.1

\[ r = \frac{\sum (x - \bar{x})(y - \bar{y})}{(n-1)S_x S_y} \]

In this equation, \((x - \bar{x})\) is the deviation of the x variable from the mean, \((y - \bar{y})\) is the deviation of the y variable from the mean, \(S_x\) is the sample standard deviation for the x variable, \(S_y\) is the sample standard deviation for the y variable, and n represents the number of pairs of scores. To simplify this equation, we will represent r as the average value of the products of paired z-scores. This formula is found in Equation 8.2

Equation 8.2

\[ r = \frac{\sum z_x z_y}{n-1} \]
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November 20—Educators can learn how to incorporate concepts from the Common Core Standards for Mathematics and the NGSS into their curricula during Heat, Temperature, and Energy: MESSENGER—Cooling With Sunshades, a free NSTA Web Seminar. The session includes an overview of the Cooling with Sunshades student activity. The session runs at 6:30–8 p.m. Eastern Time. For more information or to register, visit http://bit.ly/Eo1MU.

November 30—It’s your last chance to submit an application for the NSTA Teacher Awards for outstanding educators. Award categories include inquiry-based science teaching, biotechnology educators, new teachers, and more. For more information on the 2014 NSTA Teacher Awards program, visit www.nsta.org/awards.

December 3—Explore the relationship between humans and the Earth in the context of the NGSS during NGSS Core Ideas: Earth and Human Activity, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. Eastern Time. For more information or to register, visit http://bit.ly/Eo1MU.

December 4—Learn how to combine Common Core Standards for Mathematics and science concepts during Geometry: Space Math Problems—Solar Storms, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. Eastern Time and will be repeated on March 26. For more information or to register, visit http://bit.ly/Eo1MU.

December 5—Explore why extreme temperature differences exist between Earth and other planets, and learn about NASA’s MAVEN mission during Temperature and Earth Climate: Modeling Hot and Cold Planets, a free NSTA Web Seminar. Learn how to use models to build understanding of the relationships among variables contributing to a planet’s temperature. The session runs at 6:30–8 p.m. Eastern Time. For more information or to register, visit http://bit.ly/Eo1MU.

December 10—How does space travel affect an astronaut’s physiology, and what can be done to prevent those changes? High school teachers can explore how NASA mitigates these effects during Skeletal System: Human Physiology in Space, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. Eastern Time and will repeat on March 4. For more information or to register, visit http://bit.ly/Eo1MU.

December 12—Discover how “Science Runs Through It”—where “it” is everything—at the 2013 NSTA Area Conference on Science Education in Denver, Colorado. The conference focuses on three strands—PreK–8 Science: A Playground for Literacy and Mathematics; Engineering the Engineering: Connecting the Why to the How; and Exploring STEM: Inside and Out—with sessions for all levels. The conference runs through noon on December 14. For more information and to register, visit www.nsta.org/denver.

December 17—Creating and tracking a professional development plan can be a daunting task, but the NSTA Learning Center’s professional tools can help you manage and document your professional learning activities. Learn how during Give Yourself Credit: Planning Your Professional Learning Activities, a free NSTA Web Seminar. The session will be held at 6:30–8 p.m. Eastern Time. For more information or to register, go to http://bit.ly/Eo1MU.

December 18—Learn how to use authentic NASA data from the Kepler Mission to engage your students during Algebraic Equations: Transit Tracks—Finding Habitable Planets, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. Eastern Time. For more information or to register, visit http://bit.ly/Eo1MU.

December 19—See how other educators have introduced Newton’s Laws of Motion, and explore three lessons that dispel common misconceptions and foster real-world understanding, while addressing components of the NGSS, during Newton’s Laws of Motion: Lunar Nautics, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. Eastern Time. For more information or to register, visit http://bit.ly/Eo1MU.

December 20—Applications for the 2013–2014 Shell Science Lab Challenge are due! Describe your science teaching philosophy, your school’s current laboratory facilities and resources and why they might be classified as “limited,” and your innovative use of them. For more information or to apply, visit www.nsta.org/shellsciencelab.

January 7, 2014—Make sure common errors don’t derail your Toshiba/NSTA ExploraVision team’s hard work by attending the free NSTA Seminar, How To Avoid Disqualification in ExploraVision. ExploraVision Ambassadors will share their experiences and strategies for preparing projects for submission. The session will at 6:30–8 p.m. Eastern Time. For more details or to register, see http://bit.ly/Eo1MU.

January 8—Find out how to guide your students through the NASA Balloon Aerodynamics Challenge during Engineering Design: Forces and Motion—Balloon Aerodynamics Challenge, a free NSTA Web Seminar. This activity incorporates national science, technology, and mathematics learning standards, as students use the engineering design process to design, build, and test a mechanism with the goal of achieving neutral buoyancy. The session runs at 6:30–8 p.m. Eastern Time and will repeat on February 12. For more information or to register, visit http://bit.ly/Eo1MU.
Evidence of Extrasolar Water Orbits White Dwarf

Scientists in the United Kingdom found evidence of water in debris orbiting a white dwarf star (GD61) outside our solar system, indicating an asteroid with a mass of 26% water may have existed. As reported in *Science* online in October, the researchers “have identified a circumstellar disk that resulted from the destruction of a water-rich and rocky extrasolar minor planet” using observations from the Hubble Space Telescope and the large Keck telescope in Hawaii.

The researchers identified water as the most likely source of oxygen in the atmosphere around the star after eliminating possibilities such as carbon dioxide. This evidence of water on rocky asteroids could indicate the system may have once included the necessary elements for the formation of a planet capable of sustaining life.


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**Quotable**

* Becoming a critical explorer, a creative teacher, or a thoughtful citizen all require a willingness to forgo the comfort of certainty and engage with the discomfort of ambiguity and uncertainty.
  —Eleanor Duckworth, Canadian educational theorist, cognitive psychologist, and constructivist educator

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