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GRAB BAG
Pull-Out Section!

Meeting the Demand for Future STEM Teachers

The University of Virginia (U.Va.) made headlines in August when it announced its new five-year, undergraduate dual-degree program that will allow students to earn a bachelor's degree in engineering and a master's degree in teaching, along with a license and endorsement in chemistry, physics, or math. U.Va. joins other universities around the country in offering these programs to meet the demand for science, technology, engineering, and math (STEM) teachers.

"The impetus [for U.Va's new program] is the *Next Generation Science Standards* (*NGSS*)," says Jennifer Chiu, assistant professor in the university's Curry School of Education. The new standards "place a lot of emphasis on engineering, but most science teachers have a background in science, not engineering. [The dual degree provides] an opportunity to encourage those with an engineering background to become science teachers and to incorporate engineering into science classrooms," she explains.

The dual degree also was created "out of student interest," says Chiu. Advisors have reported that engineering students have expressed interest in teaching, with many "suggesting a possible career pathway [of using] their engineering degree for the benefit of society," she relates.

Students who complete the program "come out with an engineering bachelor's degree and can work in industry, and are certified to teach in multiple content areas in Virginia." They earn endorsements in physics, chemistry, and math because engineering degrees require a lot of basic foundation courses in those subjects; "biology and Earth science endorsements involve courses not as prevalent in the engineering major," she explains.

U.Va. is offering scholarships to students who apply for the program. Ten $10,000 scholarships were awarded this semester, and "five or six" that will "fully fund the students for the master's portion" are expected to be awarded next year, according to Chiu. "We're trying hard to get people through [the program]," she adds.

COURTESY OF HOFSTRA UNIVERSITY

Third graders in Hofstra University's STEM Studio ponder how to display the data generated from their pre-exercise/post-exercise pulse rate experiment.

The university also offers experiences to support students in becoming practicing teachers. "Field placements provide opportunities to teach peers science and engineering in methods courses, and weekly student teacher seminars present strategies and solutions to engage students in ways that reflect the practices of the *NGSS,*" she notes.

Recruiting Engineering Students

Last winter, Philadelphia's Drexel University launched DragonsTeach, a new program that gives STEM majors the opportunity to minor in STEM edu-

See Degree Programs, pg 4

Uniting Scientists, Educators to Share Knowledge pg 22

New study confirms that *Project-Based Inquiry Science*™ has a positive effect on how <u>all</u> students learn science

The study is the first to examine use by middle-school teachers and students of science curriculum aligned with the new *Framework for K-12 Science Education* and ***Next Generation Science Standards (NGSS).***

An NSF-funded SRI study revealed that middle-school students taught using *Project-Based Inquiry Science*™ *(PBIS)* curriculum materials scored significantly higher on post-unit tests than students in traditional science curriculum classrooms.

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COMMENTARY: **Lynne Cherry**

Teaching Climate Change With Stories of Success

By Lynne Cherry

Lynne Cherry

Science teachers often find teaching about climate change challenging; when they discuss the dire consequences of rising CO_2, students have a propensity to shut down. The common belief has been that if people understood climate change science, they would want to do something about it. But years of speaking to students about environmental issues made it clear to me that messages of gloom and doom elicit reactions of fear, demoralization, and hopelessness. However, when I shared inspiring stories about youth actions to, for example, preserve land or clean up rivers, it allowed young people to hear the bad news because they understood they had the power to change things. Positive, solutions-oriented stories motivated students to try to make a difference. And social science research confirms the importance of a positive approach.

"Motivated avoidance" is the tendency of people to avoid learning about troubling issues and seemingly intractable problems. The 2012 study, "On the Perpetuation of Ignorance: System Dependence, System Justification, and the Motivated Avoidance of Sociopolitical Information," published in the *Journal of Personality and Social Psychology*, showed people are motivated to avoid learning more about problems that they think they can't do anything about. People become blind to facts when confronted with disturbing scientific information. A study by the Yale Project on Climate Change (2014) corroborated this, showing that alarmist images were the least likely to motivate viewers to action.

These studies make it clear that social science must be considered when teaching about climate change; they show that environmental education and information itself does not motivate people to act. In fact, depressing environmental information delivered without the counterbalance of solutions can be counterproductive, turning some people into climate "ostriches" who bury their heads in the sand. The appeal of "ostriches" and "deniers" is that they say what people wish to be true and psychologically wish to hear—unless an alternative scenario espousing action is presented.

Realizing the power of success stories to provide inspiration and role models for young people, photojournalist Gary Braasch and I founded the nonprofit Young Voices on Climate Change. Our Young Voices for the Planet (YVFP) films showcase youth reducing $C0_2$ emissions through many creative win-win scenarios, engaging local governments, businesses, and school administrators and helping their peers develop confidence in themselves as agents of change in the world. We champion and publicize these inspirational, authentic, and positive youth-led models of social action, filling an important niche in climate education.

In teaching about climate change, it is essential to begin teaching about troubling issues with hope and inspiration. Youth success stories need to precede the teaching of climate science and other wrenching environmental issues. Stories of youth "taking the reins" provides a wonderful engagement point for teachers wanting to help students who are interested in becoming agents of change and helping to protect the planet. These relevant stories also act as a lens through which to teach climate science.

Some of the youth documented in the YVFP films include 12-year-old Alec, who erects Sea Level Awareness posts along coastal California, speaks to Congress, and advocates for putting a price on carbon; Team Marine, who helped pass bans on plastic bags; 11-year-old Olivia, who raised $200,000 to clean oiled birds after the BP spill and advocates for renewable energy; and high school students who created a healthy school lunch through their school garden and local community partners.

The most recent YVFP film, *Save Tomorrow*, documents the motivational power of the other YVFP films. After watching the YVFP films, nine-year-old Alice founded a "Save Tomorrow" club that helped solarize her school and town and save a forest. Once they realized they, too, had power, Save Tomorrow has become unstoppable. As Olivia states, "If they can do that, then so can I."

Youth action can act as an antidote to the fear surrounding climate change. By making the teaching of climate change hopeful and relevant, students can absorb the science that is essential that they learn, as they will inherit a warmer world and will bear the brunt of climate disruption. Studies show the importance of beginning any teaching about the science of climate change with stories of hope, empowerment, and solutions. Your students are no different from the youth in the YVFP films and can become exemplars of hope and empowerment, as well as how we all can, and must, make a difference. ●

Lynne Cherry is the author and illustrator of 30 award-winning children's books including best-sellers The Great Kapok Tree *and* A River Ran Wild. *She is also the producer/director of the Young Voices for the Planet film series: short films that champion youth solutions to the climate crisis. These films are used by institutions such as National Geographic, PBS, National Wildlife Federation, and the United Nations Foundation. Cherry emphasizes the importance of sharing hopeful messages as a way to educate people and help motivate them to take positive action regarding climate change. She has received science-writing fellowships and has been awarded a Metcalf Fellowship and the Brandwein Medal. View and learn more about the films at* YoungVoicesonClimateChange.com.

NSTA Reports

National Science Teachers Association
1840 Wilson Boulevard
Arlington, Virginia 22201-3092
703-243-7100
nstareports@nsta.org

Lynn Petrinjak ..... *Managing Editor*
Debra Shapiro ..... *Associate Editor*
Will Thomas, Jr. ..... *Art Director*
Production Staff ..... Jack Parker
Catherine Lorrain
Kenneth Roberts .. *Asst. Exec. Dir. for Periodicals*
David Beacom ..... *Publisher*
David L. Evans ..... *Executive Director*
Advertising
Jason Sheldrake ..... *Director*
jsheldrake@nsta.org
703-312-9273

Degree Programs, from pg 1

cation and obtain secondary teaching certification along with their STEM degree. DragonsTeach is a collaborative effort of the College of Arts and Sciences, the College of Engineering, and the School of Education, and is supported by a $1.45 million grant from the National Math and Science Initiative. Eligible students include chemistry, biology, physics, mathematics, and engineering majors.

DragonsTeach arose, in part, from Drexel's desire to improve the quality of STEM education in the Philadelphia region, as well as its commitment to become the most civically engaged university in the country. "As a result of the university-wide emphasis on community and education," says Jason Silverman, DragonsTeach co-director, "a lot of our STEM students are interested in K–12 work, and through DragonsTeach, these students are able to provide meaningful STEM lessons and experiences to Philadelphia students while learning about a career in education."

DragonsTeach is a partner of the nationally acclaimed UTeach program established by the University of Texas at Austin. "DragonsTeach is unique because it offers an opportunity to recruit engineering students into teaching," says Jessica Ward, DragonsTeach director of operations. "Historically, UTeach has had difficulty recruiting engineers," she reports.

> ***"Even [if] you haven't been a science star in high school, you can be a good STEM teacher."***
>
> **— Dave Burghardt**

Additionally, because Drexel is a five-year, co-op institution, "[t]his means that while students are completing their undergraduate degrees, they can also complete up to 18 months of work experience," she explains, "so we are recruiting students who are already career-oriented."

As an incentive beyond additional career options, Dragons Teach provides a stipend to students who earn a B or better in the two introductory recruitment courses: Inquiry Approaches to Teaching and Inquiry-Based Lesson Design. In these courses, DragonsTeach students teach lessons in elementary and middle schools, and "the younger students' energy and interest in the STEM activities ultimately excite our DragonsTeach students about teaching," Ward says.

The first two courses help students "know sooner rather than later if teaching is right for [them]," she notes. And after taking them, "even if you don't want to teach, a lot of the skills learned are applicable to any career," she contends.

For example, if a student opts for graduate school, he or she will find "the 5E model is good for a teaching assistant job in any major," she points out. DragonsTeach courses foster communication and leadership skills; co-teaching prepares students "to work in a team environment"; and designing lessons increases creativity and shows students "how to get someone interested in the material you're trying to convey," she asserts.

DragonsTeach students teach high school students in subsequent courses, such as Knowing and Learning in Science and Mathematics, in which "students begin to delve into the *NGSS,*" Ward relates.

Focusing on Engineering Design

Twenty years ago, Dave Burghardt, engineering professor at Hofstra University in Hempstead, New York, co-created a STEM master's degree program with "children's engineering and engineering design at its heart," he explains. Elementary teachers in the program develop the "knowledge, skills, and attitudes essential for using informed engineering design as a pedagogical strategy in K–12 STEM education," according to the program's description. The goal is "design-based activity," says Burghardt.

With that degree program in mind, Burghardt decided to create "an accessible bachelor's degree in STEM as a co-major for elementary education majors." The degree would not require a lot of math courses; it just required "basic algebra, logic, and [an] understanding of math systems, along with introductory, non-major courses in chemistry, biology, and astronomy, and lots of hands-on learning," he asserts, noting that most bachelor's degree programs for elementary education majors only require one math and one science course. The degree would feature two STEM capstone courses to provide a broad understanding of the scientific and mathematical foundations of the natural and human-made worlds.

Best of all, every course except the two capstone courses already were being taught at Hofstra. "It was an effective way to use existing resources and can be replicated easily at other schools," he maintains. "The capstone courses make it unique."

Burghardt's creation, the "BA in STEM, always has engineering design at heart because it enhances a lot of kids' creativity," he contends. The degree features "children's engineering as a part of elementary educators' portfolio to make science and math more interesting in the classroom. And it does—we have research supporting that," he declares.

Students earning the degree "have a broad background in all subjects, but also a strong STEM background," he explains. He tells students, "It's very accessible, and you'll be able to enjoy [teaching the material] and impart that to your students. Kids sense when their teacher likes the subject matter…Even [if] you haven't been a science star in high school, you can be a good STEM teacher."

The degree makes students more marketable because "superintendents are looking for people with this background," he reports, noting that the degree "is totally consistent with the *NGSS* because of its focus on engineering design. It makes it easier to teach to the *NGSS.*" ●

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Cities Reward STEM Learning Digitally

As part of the Cities of Learning (COL) program, students in Chicago, Pittsburgh, Dallas, and Washington, D.C., can choose from a range of experiences to extend their learning—including science, technology, engineering, and math (STEM)–related ones—in their city, and "earn digital badges to show what they've learned," says Nichole Pinkard, director and associate professor of the School of Design in the College of Computing and Digital Media at Chicago's DePaul University and founder of the Digital Youth Network, which supports organizations, educators, and researchers in learning best practices to help youth develop skills. With COL, says Pinkard, "we were not trying to do new programs; [instead, we thought,] 'Let's make visible what already exists in a city and have a way to look up all the learning opportunities for kids in one place...It takes a lot of time and energy for parents to find [out-of-school activities]. We wanted to make it easier for families to help children sustain engagement in an area of interest."

Each COL is run by local public-private partnerships and receives national support from the John D. and Catherine T. MacArthur Foundation, the Digital Youth Network, and the Connected Learning Alliance. Chicago's COL grew out of the city's 2013 Chicago Summer of Learning in which more than 100 youth-serving organizations participated. The program now runs year-round in Chicago "because learning takes place year-round," Pinkard maintains. After Chicago's success, "other cities heard about it and wanted to do it" and received MacArthur Foundation funding to launch their own COLs, she notes.

Earning digital badges is a key element. "Digital badging is relevant as an indicator of who a child is. It's like a footprint of how someone became who they are. You can use that to help a child plan for the future," Pinkard remarks. Because they chronicle a student's accomplishments, badges can lead to deeper learning opportunities when children show them to teachers, and some school districts recognize them as well. Digital badges also serve as a permanent record that can help students attain internships, college admission, and jobs.


CHICAGO BOTANIC GARDEN

Students from Chicago-area public schools conduct a plant investigation as part of the Science First summer program at the Chicago Botanic Garden.

Each city offers a range of STEM-related badges that students can earn online or as part of face-to-face activities held by participating schools and organizations. For example, Chicago students can earn the STEM Explorer badge by completing a self-paced, STEM-focused curriculum consisting of a series of videos, educational games, and exercises. In Dallas, a student can strive for Citizen Science Level 2 by contributing observations and data to a citizen science project. The COL website (*http://citiesoflearning.org*) "stays current on [activity and badge] availability," Pinkard notes, and "parents will get an e-mail saying your child earned this badge; now here are other opportunities for [him or her]."

COL "makes opportunities and access points more available to kids, regardless of their economic circumstances," and "allows us to look for patterns, such as where we need to add resources, for example. Then we can fine-tune the learning opportunities," she explains. "Teachers have been given way too many expectations; [COL] provides a window into what kids are already interested in, [making it] easier for teachers to customize what they do. They know [students'] work is being assessed" in the program," she points out.

From Badges to Career

The Chicago Botanic Garden's Science Career Continuum offers a pathway of programs, internships, and mentoring for middle school students through college. The continuum begins with the Garden's Science First and College First programs that annually recruit up to 60 middle school and high school students from Chicago Public Schools. Since 2013, these students have been "automatically part of Chicago City of Learning (CCOL)," says Amaris Alanis Ribeiro, manager of the Garden's Secondary Education Programs.

Science First's middle school students spend four weeks in a free, nature-based science enrichment program featuring hands-on activities in environmental science, ecology, and botany. They can earn Discover Nature and Discover Science badges for their participation. "We want to help urban youth be comfortable in the natural environment," says Ribeiro.

The Discover Science badge "helps identify who is interested in science and will pursue it as a career," she maintains. "Badges are...a way for them to identify with a community, not just recognition of skills and presentations. For underrepresented students, it gives them confidence that they can do science."

All Science First students are invited to return for the Garden's College First paid internship and college preparation program, in which they can earn Explore Nature and Explore Science badges. "Explore Nature begins with the concept that 'nature is cool.' Then students take it to another level and change their behavior, exploring what they can do to help the environment," explains Ribeiro. Those pursuing Explore Science "build their curiosity and observation skills" and "come up with their own independent project ideas," she notes.

Students applying for both programs have an advantage if they have already earned related CCOL badges, Ribeiro points out. "They can share their badges as part of the online application."

Robotics Camp Badges

Supported by Carnegie Mellon University (CMU), Pittsburgh's Girls of Steel Robotics is a FIRST (For Inspiration and Recognition of Science and Technology) Robotics Competition team for high school girls. Last summer, Girls of Steel partnered with Pittsburgh COL to hold two robotics camps that allowed middle school participants and the Girls of Steel team members who mentored them to earn badges: Programming Your Future With Robotics and FIRST LEGO League Skills Camp, which was also open to boys. Theresa Richards, Girls of Steel mentor and FIRST Robotics program coordinator at CMU, says she wanted to partner with COL "to learn about the digital badging process while doing it."

Badges were awarded not just for design, programming, and research, but also for 21st-century "dispositions," such as teamwork and collaboration, says Richards. "When I asked which badges they wanted to earn, most of the kids said, 'All of them,'" she recalls.

Richards says she assessed student learning through "pre- and post-surveys, photos of students doing activities, student feedback," and observations from the high school mentors, who earned mentoring badges. "Just because they don't get grades [in out-of-school programs] doesn't mean they're not learning. That's what the badges can document: They're definitely learning. We want kids to be proud of that."●

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Learning STEM by Designing Space to Play

Children learn through play, but allowing them to design a play space creates engaging learning opportunities that can integrate science, technology, engineering, and math (STEM), as well as art, social studies, and English language arts (ELA).

For Laura Watson, a fifth- and sixth-grade math and science teacher at Carthage Middle School in Carthage, Missouri, an e-mail from her district's superintendent soliciting ideas for a new playground led to an opportunity for her fifth graders last year.

Working with Amy Collier, who teaches fifth- and sixth-grade ELA and social studies, Watson assigned her students the task of designing a play space for a new school under construction. "We went over math and did a lot of geometry, a lot of measurement…I had a playground expert come to my classroom…[Students] had to include one of each type of simple machine," Watson says. "They took measurements to get an idea of how big swings are. Some took ownership…[and] went to playgrounds [near their homes] to take measurements of equipment we didn't have. Students made scale drawings of aerial views."

"We did a lot of reading material in small groups," adds Collier. "There was a lot of reading and research to help with the building of their projects…As best as we could, we tried to integrate it all together. [There was a] persuasive writing piece to convince the superintendent to pick their playground; students produced a 'commercial' video to promote their playgrounds as well."

"We covered so much more math," asserts Watson. "Those projects took it to the next level, the real-world application of math [geometry and measurement]. The whole idea incorporated everything into hands-on problem solving with teachers there to help…We all became problem-solvers together. In our classrooms, performance drastically improved for all students," she contends.

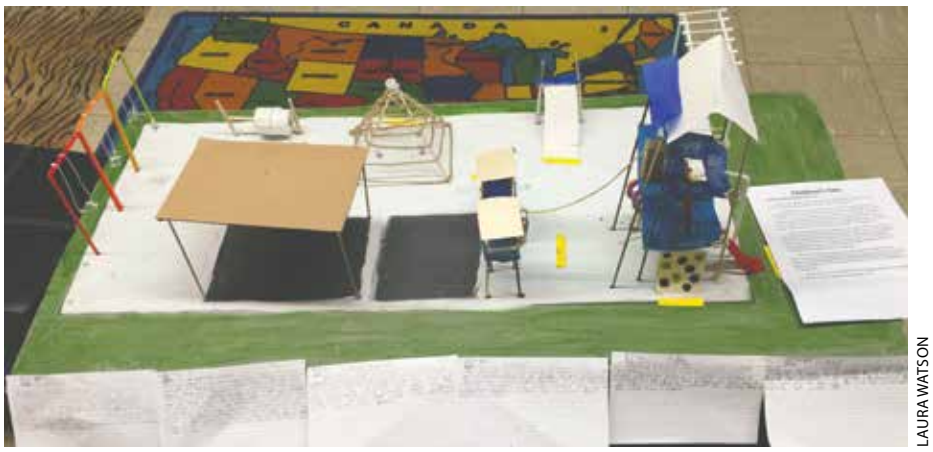
Although the playground has been built, Watson and Collier plan to repeat the project with their new fifth graders and extend the experience by designing storm shelters with the students who looped into sixth grade with them.

"It was very rewarding. We could see just how far we as teachers could go and just how far [the students] could take…their projects," declares Collier.

The Trust for Public Land (TPL) in New York City has been redesigning play spaces with student input for nearly 20 years, according to Mary Alice Lee, director of TPL's New York City Playgrounds Program.

"It's a three-month participatory design process. We come in once a week for three months and talk about existing conditions…We survey the whole school," Lee explains. TPL asks students to consider the budget, available space, and—since TPL focuses on creating play spaces in underserved areas and the area will be open to the public after school hours—what amenities the neighborhood needs.

"As part of the survey, we talk about democratic practices. When measuring, we talk about the differences between a meter and a yard," she continues. TPL staff members also discuss topics like solar orientation, the water cycle, and plant life with students.



LAURA WATSON

Fifth graders in Carthage, Missouri, created scale models of playgrounds they designed for a new school being built.

"After the playground opens, an [TPL] environmental educator works in conjunction with science, art teachers, anyone who wants to work with what they're studying," Lee states. "They talk about insect identification; sometimes they co-teach." She adds, "The specific lessons are up to the teachers at the schools; during the process, we check in with them regarding any connections to what they're doing in the classroom…We also have lesson plans for bringing students out to garden."

Lee said construction of the new play spaces usually takes about 18 months, including the design process. The playgrounds are funded through a public-private partnership with the New York City departments of education and environmental protection as well as fundraising efforts by TPL. "We do geographic information systems mapping analysis to determine which areas need play space," she says. "Sometimes schools have heard of us and come to us. We work with them if they meet our criteria."

The criteria include being located in a low- to moderate-income neighborhood with a large population of those younger than age 18, and access to safe recreational space. TPL offices in Newark, New Jersey; Philadelphia, Pennsylvania; and San Francisco, California, do similar projects.

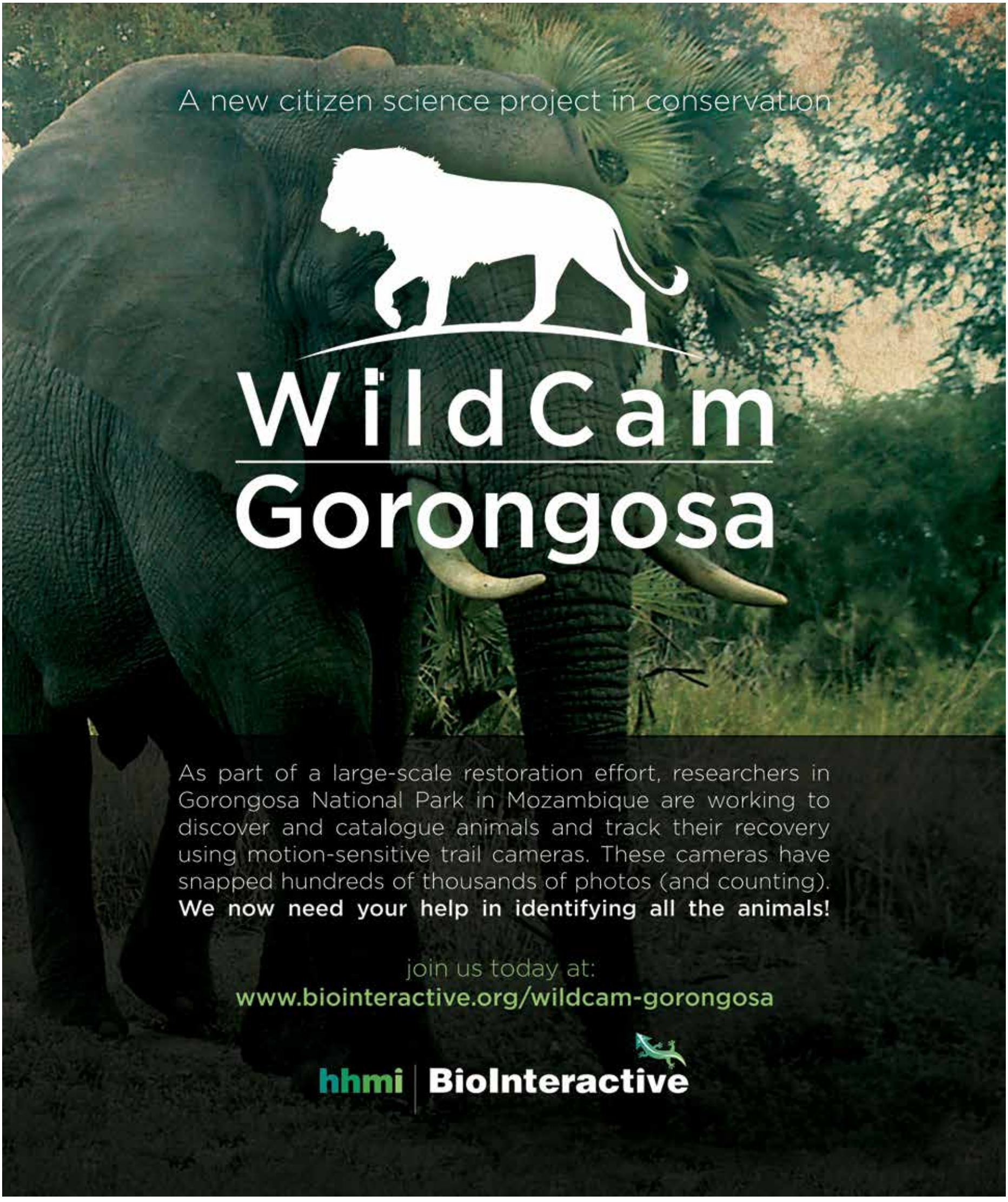
Blending Art and Science

When Ann Arbor (Michigan) Public Schools decided to transform an existing K–5 elementary school to a K–8 STEAM (science, technology, engineering, arts, and mathematics) school, major renovations to the building began. The district also wanted to incorporate a new playscape.

The school's art teacher, Rachel Van Dyke, "saw [an] opportunity, and took it on as a year-long project that involved all grade levels," recalls Joan Fitzgibbon, principal of A2 STEAM at Northside. "Students looked at the difference between a playscape and a playground…she had students start [by] visualizing and drawing their dream playscape, then they had to draw a functional playscape," Fitzgibbon says.

Van Dyke regularly checked the school-wide project board in the teachers' lounge to see what content area teachers were covering. "We would try to tap into that," she says. When first graders were learning about heat conductivity in science, Van Dyke had them design shelters while considering whether they would release heat or make an area hotter. While fifth graders were studying kinetic and potential energy, she asked them to design safe running paths on the steep hill where the play space would be.

When it was time to create scale models, Van Dyke says each class decided which elements they considered most important, then designed the model around them. Students presented their models at a school community forum, and attendees voted on the various elements. Two climbing areas and a slide that received the most votes are being built for the school's playscape. ●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Turning Teachers Into Teacher-Leaders

Erin Lawrence says she applied for the Kenan Fellows Program for Curriculum and Leadership Development because she "wanted to be with a network of people who want to challenge themselves, all with the students in mind." Lawrence is one of 354 North Carolina teachers who have completed the program, which provides a year-long fellowship in partnership with university researchers and industry experts to aspiring teacher-leaders of science, technology, engineering, and math (STEM) and serves as a national model for teacher retention. "It has changed how I approach teaching," declares Lawrence, who teaches Earth and environmental science at Apex Friendship High School in Apex, North Carolina.

Founded in 2000 by the Kenan Institute for Engineering, Technology, and Science at North Carolina State University (NCSU), the Kenan Fellows Program aims "to improve STEM education in [the state] by identifying high-performing teachers and increasing their capacity for leadership through customized professional development (PD)," says Elaine Franklin, the program's director. The fellowship includes a three- to five-week summer research experience with a mentor in a local workplace and 80 hours of rigorous PD.

Originally an effort to increase the number of STEM teachers in the Research Triangle region, the program has expanded to 54 of North Carolina's 100 counties. "We hope to expand and provide equitable opportunities across the state," Franklin relates. The program is funded primarily through federal and corporate foundation grants, the Kenan Institute, a small state appropriation, and private donations, she explains.

Admission, which is open to K–12 teachers with at least three years in the classroom, is highly competitive. "We look for teachers who have shown leadership potential or aspire to it," says Franklin. "Do they belong to professional organizations? Have they obtained grants? Do they serve on a school leadership team? Do they present sessions at education conferences?"

She continues, "We have more great teachers applying than fellowships: We receive three to five times as many applications." Candidates submit an essay and two letters of recommendation, including one from their principal, and are interviewed by Kenan Fellows staff "and someone from the research project, ideally the mentor," she explains.

When matching candidates to internships, "we try to have the internship in the teacher's home community or county, if possible. A lot of industries want to draw from the area their workers come from…They want to build a relationship with the community through a connection with the schools. Students learn there are jobs inside those walls for them if they take the right career path," Franklin relates.

After the internship, fellows create lesson plans based on their experiences, some of which are available online at *http://kenanfellows.org,* with more to be posted, according to Franklin. "We also require fellows to [speak about their experiences] to at least 40 other teachers so they can benefit as well," she notes.

"We do try to keep track of fellows [after the fellowship ends]. Once a fellow, always a fellow," she maintains. "The Kenan Fellows Network continually helps fellows connect with other opportunities. We get requests for teacher-leaders to help with [PD] or review materials. We have a bank of superb teachers to draw from.

"Fellows often learn how to engage with legislators and inform them about issues related to education policy. This comes from the work we do on leadership and advocacy…how to contact legislators, have a good conversation, and get folks to listen to you. Fellows may have more opportunities to voice their ideas about policy than other teachers might have," Franklin contends.

AMNERIS SOLANO, KENAN FELLOWS PROGRAM

Kenan Fellow Ilana Livstrom interned in the vineyards at the Duplin Winery in Duplin County, North Carolina.

Learning in the Workplace

Lawrence, who taught sixth-grade science during her fellowship, worked with scientists at the pharmaceutical company Biogen in Durham to develop lesson plans about biopharmaceutical research, development, and manufacturing processes. "My favorite part was getting gowned up and testing water samples," she recalls. "It was great to have people take time to show you what they do and explain why. You're not just a teacher visiting: You're part of the company."

She says her biggest challenge was making "it clear to sixth graders, to give them a real-world example of 'why should I learn this?' I wanted to bring the chemistry curriculum to life for them."

Lawrence created a curriculum called Should This Little Drug Go to Market? that teaches students how to use physical and chemical properties to test the safety of a mock drug (a flavored drink mix). "I learned new vocabulary to share with students. They loved seeing the videos and photographs of my experience [at Biogen]."

She arranged for her students to visit Biogen, conduct tests in the company's Community Lab, and talk with employees. "Some students became interested in careers as biochemists or engineers, [while others learned,] 'I could work for a science company in another capacity besides science,'" she relates. She also brought colleagues to Biogen for tours and on-site PD.

Lawrence created trading cards featuring Biogen scientists and descriptions of their work. Using the cards, "the kids take on the personalities and roles of the scientists," she explains. Biogen has duplicated the cards and gives them to other visiting teachers.

During his fellowship, Mark Townley, AP Environmental Science (APES) and Earth science teacher at Holly Springs High School in Holly Springs, North Carolina, worked with Heike Sederoff, assistant professor of plant and microbial biology at NCSU, on Biofuels for Jets, a project that could lead to small scale production of algae in the classroom from which students could extract and convert oil to run a small engine. The project explored "the connection between the biosphere and alternative energy and energy sources" and "fit between two major concepts I was trying to teach. It helped me fill a need, especially for the energy portion of the APES exam," he explains.

Though he studied biology in college, that was 15 years ago, he notes. "I learned quite a bit while I was working in the labs. It was a totally different world," he relates.

His challenge involved "how to bring it to a classroom using limited equipment and make it accessible to any teacher at any price point." He aligned the biofuels concept to four different science classes—Earth science, biology, chemistry, and APES—and wrote a lesson for each. He has since worked with other Kenan Fellows to present talks "on bridging curricular islands [by seeing] how subjects connect," he reports.

"The Kenan Fellows program treats a teacher as a working professional in the scientific field. The network and cohort of fellows that year were tre-

mendous," he declares, noting that he remains in touch with them. Sederoff continues to provide resources, and one of Townley's students did an independent study at her lab. The student "presented her findings at an undergraduate symposium at the university," he adds.

When she taught middle school science last year, Cindy Bullard partnered with Keith Schimmel and his team at North Carolina Agricultural and Technical State University's CREST Bioenergy Center, who are developing technology to make biofuels a more viable source of renewable energy. "I visited many labs and was exposed to a lot of different research," she recalls.

Among the lesson plans she created is one on "renewable versus nonrenewable energy…Students do a research activity culminating in a presentation showing the pros and cons of both types of energy resources. [They] learn there is no one best solution…It's eye-opening for them," she observes.

In addition to allowing her to borrow equipment to show her students, Schimmel evaluated her students' work. "My students said, 'A real scientist looked at my stuff!' This interaction helped them stay engaged," she contends.

She praises the program's Professional Advancement Institutes. "We spent a week at the North Carolina Center for the Advancement of Teaching and heard amazing speakers on current research-based methodologies…Because we spent so much time together, it helped build relationships."

'A State Treasure'

The program "opens doors," Bullard maintains. She is currently a North Carolina Science Leadership Association fellow and serves on the North Carolina Science Teachers Association's board.

Calling the program "a state treasure," Townley says it "gave me the confidence to take on a leadership role beyond my school and county, and gave me resources to create a community model in Holly Springs with best practices that could be shared throughout the state."

Lawrence believes she might have left teaching if not for the support she received from the Kenan Fellows Network. "It inspires you to keep going… That's the good thing of it." ●

Quotable

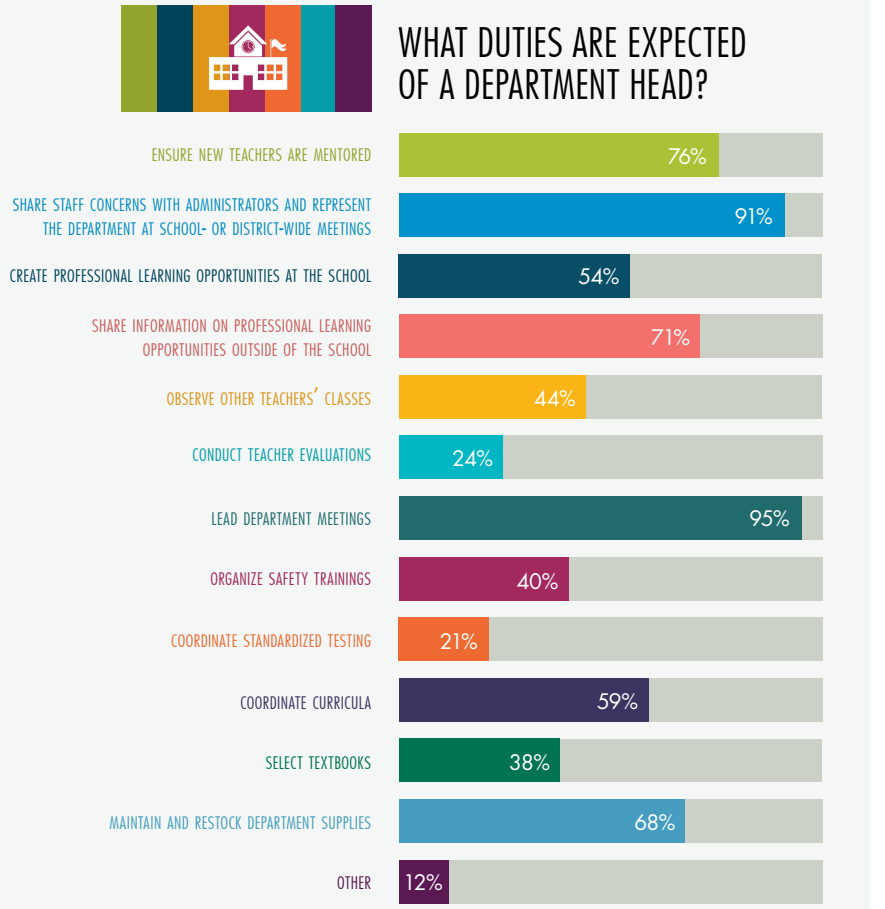
Inventing is the mixing of brains and materials. The more brains you use, the less materials you need.

—Charles F. Kettering, U.S. scientist and engineer (1876–1958)

Examining the Role of Department Head

NSTA Reports recently polled science educators to learn how many worked at schools with department heads or similar positions. Unsurprisingly, 91% of respondents said their schools had department heads. Most (87%) reported that department heads are chosen by the administration, and seniority is a consideration in the selection process 40% of the time.

Eighty-seven percent said they value the department heads' contributions, and more than two-thirds had served in that role. Of those, 90% said they would do so again. More than 75% of educators who had not been department heads said they would be willing to assume the role Among the most common duties of the department heads were leading department meetings (95%), sharing staff concerns with administrators and representing the department at school- or district-wide meetings (91%), ensuring new teachers are mentored (76%), and disseminating information on professional learning opportunities outside of the school (71%). Additional duties noted by respondents included serving as a lead on accreditation committees, coordinating budgets for all science classes, coordinating teacher schedules and room assignments, reviewing lesson plans, managing the school science fair, mediating staff conflicts, and finding coverage for absent faculty.



Here's what science educators are saying about department heads:

Someone has to do the job. It gets a small stipend, not nearly enough for the extra work.—*Educator, High School, Georgia*

I have worked in schools with and without department heads. In the ones with [department] heads, there was more consistency and more com-

munication [among] teachers, and the students benefitted from that. Department heads ensure that teachers all use the same assessments, so there's no "easy teacher" or "hard teacher." Also, they make sure all teachers, even long-time veterans, are using the latest technologies and teaching methods. —*Educator, Elementary, New Jersey*

If [a department] head were more administrative, materials and ordering would be more efficient and economical. If [the school has] a [science, technology, engineering, and mathematics] department, coordination…could happen.—*Educator, Middle School, Maine*

If the department head has time to stay current with professional opportunities and can lobby for monies to attend them, it is helpful.—*Educator, High School, Kansas*

If they have time set aside to prep and supply [a] lab. [It] would be good to have a voice that [we] need time to set up [and] clean up and [conduct] safety checks.—*Educator, Middle School, High School, Saskatchewan, Canada*

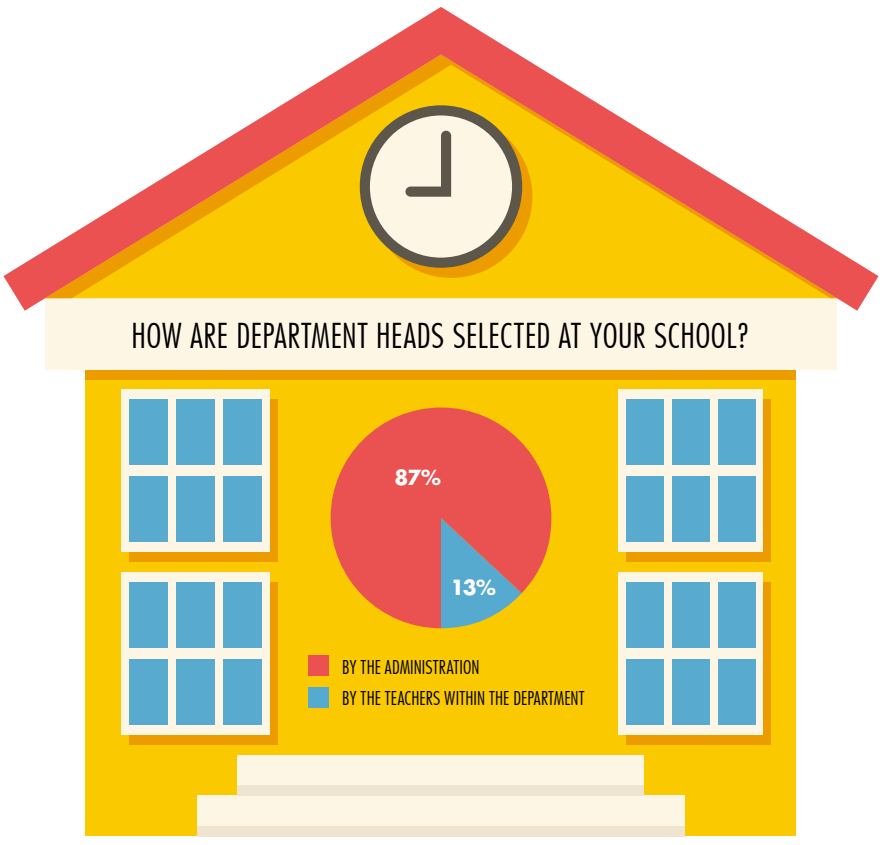
It would be pretty chaotic if the [department head] wasn't coordinating curriculum and the ordering of supplies and creating [an] agenda. —*Educator, Middle School, Institution of Higher Learning, Connecticut*

So that we have a direction and can discuss controversial issues (interpersonal-staff/societal) with a focus. —*Educator, Middle School, High School, Michigan*

Someone needs to have a clear mind and handle all the paperwork for ordering and budgets and keeping track of equipment. More importantly, someone needs to push the vision of [the *Next Generation Science Standards*], even when others are uncomfortable. —*Educator, High School, California*

I'm going into my second year at a new school at which I am the first science [department] chair that the school has had. I hope that I am contributing to forming a sense of community and a functional working environment, and starting to look at our program in a broader sense.—*Educator, Elementary, Middle School, New Jersey*

It gives a leader, a sounding board, [and] a go-to/liaison, and it forces someone to order supplies.—*Educator, High School, Michigan*



It helps the science team collaborate and work toward common goals within the school. Also, it helps delegate tasks from the [administration] down to the individual level.—*Educator, High School, New York*

It is a new concept for our school. We in science have had a department head for 10 years, but other departments at school have pleaded for someone to be assigned that role. As of this summer, all departments have heads now. It gives us a point person for handling department business and one spokesperson to represent our united efforts on curriculum and other department activities.—*Educator, Elementary, Middle School, High School, Maryland*

It provides a leader in the department, someone who can help manage the budget, materials, and direction. They have no authority over teachers in the department, and we can equally take turns in the role. It's a nice opportunity to get your feet wet in a leadership position without having lots of extra responsibilities. We work well as a team of science teachers, and the department chair simply acts as the liaison between the administration and the department.—*Educator, Middle School, Illinois*

Because it is good to have a person who is not as official as principal but still experienced [enough] to get help [and] advice.—*Educator, High School, Indiana*

[Department heads] provide leadership and guidance. Often science departments share space and supplies and need a point person who can provide the glue to keep everyone working together and on the same page. —*Educator, Middle School, South Dakota*

[A department head provides an] overview of everything to pull everything into place.—*Educator, High School, United Kingdom*

We have a voice with our teaching and learning department.—*Educator, Middle School, South Africa*

Work is better coordinated.—*Educator, Middle School, High School, Cameroon*

We are a big school (3,000) with a big department (22 teachers) and need coordination.—*Educator, High School, Illinois*

It puts someone in charge of coordinating the program, knowing what's going on in all the areas of the department, and aligning the curriculum. —*Educator, Middle School, Tennessee*

We do not have a department head/chair, and there is a schism in our department…When we have meetings, people sit on sides, and ideas brought to the table are often ridiculed or scorned. As a group, we do not have equal goals for our department. Having a head who makes those goals known and helps pilot a path toward attaining them would absolutely be a step in the right direction.—*Educator, High School, New York*

Not Always Valued

We have a small school; not too sure if it is really necessary.—*Educator, Middle School, Missouri*

In our school, it's just the person who serves as the messenger of bad news from admin[istration].—*Educator, High School, Pennsylvania*

It's just bureaucracy; no value added except I don't have to go to as many meetings if the department head goes to them instead.—*Educator, High School, Minnesota*

District-level science department head…does not provide value, only rudimentary lists that any teacher with Education 101 training could create. If the job description involved taking feedback from teachers and applying it to improve overall science curriculum in our schools, then yes, a department head could be of value.—*Educator, Elementary, Florida*

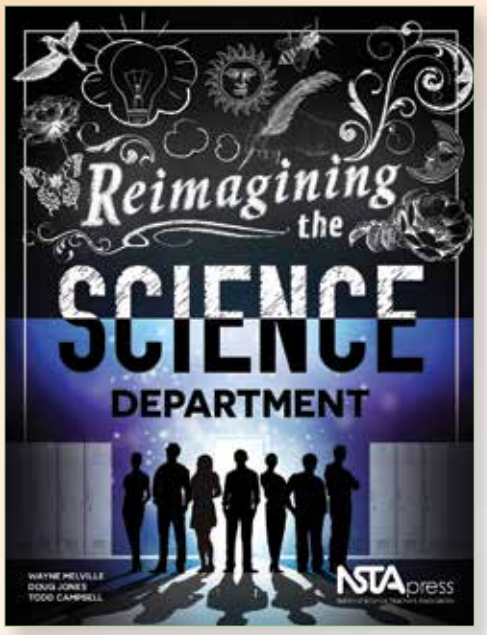
My department chair is a teacher who has little experience compared to most of the department, does not have a good grasp on the content, and does not have good management skills. Therefore, she is not respected by the department. —*Educator, High School, Alabama*

Our department head has been the head for almost 20 years and takes the position for granted. The newer teachers do not respect her as she seems to be unwilling to mentor and share the load of the more difficult-to-handle classes. She will only have one prep this year, while all others in the department have three.—*Educator, High School, Colorado*

Science [department] leadership should be shared. Best practices in teaching science place emphasis on sharing ideas and collaboration. Having a [department] head implies top-down working groups.—*Educator, Elementary, Ohio*

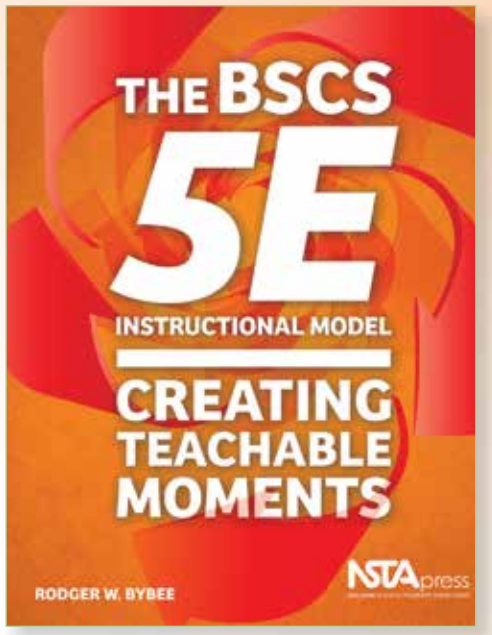
She is useless as a mentor and does not listen to anyone's concerns [and] does not share information from administration.—*Educator, High School, California* ●

LEAF THROUGH THESE NEW BOOKS



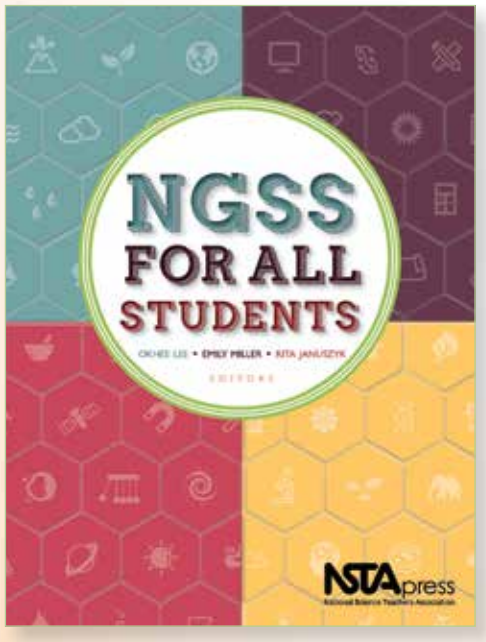
Grades K–12

Book: Member Price: $23.96 | Nonmember Price: $29.95
E-book: Member Price: $19.47 | Nonmember Price: $22.46
Book/E-book Set: Member Price: $31.15 | Nonmember Price: $38.94



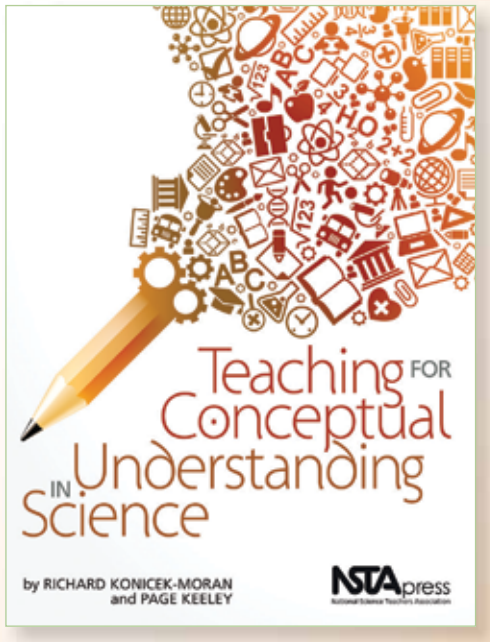
Grades K–12

Book: Member Price: $25.56 | Nonmember Price: $31.95
E-book: Member Price: $20.77 | Nonmember Price: $23.96
Book/E-book Set: Member Price: $33.23 | Nonmember Price: $41.54



Grades K–12

Book: Member Price: $27.96 | Nonmember Price: $34.95
E-book: Member Price: $22.72 | Nonmember Price: $26.21
Book/E-book Set: Member Price: $36.35 | Nonmember Price: $45.44



Grades K–12

Book: Member Price: $27.16 | Nonmember Price: $33.95
E-book: Member Price: $22.07 | Nonmember Price: $25.46
Book/E-book Set: Member Price: $35.31 | Nonmember Price: $44.14

To place an order or download a free chapter, visit
www.nsta.org/store

NSTA National Science Teachers Association

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies for Science Teachers

In the* NGSS *Classroom With Kristin Mayer. These eight videos introduce science teachers to important strategies based on the *Framework for K–12 Science Education* and the *Next Generation Science Standards (NGSS)*. The collection highlights the major shifts in science instruction, explores the new role of the teacher, and demonstrates new instructional strategies in the high school classroom. The videos show what "*NGSS* looks like in the classroom" and provide related lesson plans. NSTA led the project with funding from Disney; video and lesson development was led by the CREATE for STEM Institute at Michigan State University, in partnership with the Concord Consortium and the University of Michigan. Learn more and access the videos at *http://ngss.nsta.org/ngss-videos.aspx.*

Bears of the World: Interactive Range Map. Bear Trust International's interactive world map shows students and educators in grades 9–12 where eight different species of wild bears live. The map includes photos, facts, and lesson plans for American and Asiatic black bears, brown bears, giant pandas, polar bears, sloth bears, and sun bears. Students can use the resources to develop skills in interpreting and analyzing data, answering questions like these: Which bear species has the widest range? Is this bear species declining, increasing, or stable? Find the map at *http://beartrust.org/bear-basics.*

News Literacy Model Curriculum in Science. A collection of science lessons for students in grades 7–12 teaches news literacy through science. In the News Literacy project, professional journalists teamed with educators affiliated with NSTA, the National Council for the Social Studies, the National Council of Teachers of English, and the National Council of Teachers of Mathematics to create a curriculum that develops critical-thinking skills so students can better analyze the reliability of news and information in core subjects and apply these skills in everyday problem-solving. Refer to *http://bit.ly/1KQkXWE.*

BISWARUP GANGULY

EDC Earth Science. For teachers seeking materials supporting the *NGSS,* this activity-driven high school course is aligned with the National Research Council's *Framework for K–12 Science Education.* In four sample activities from the curriculum, students analyze climate data, study patterns in surface currents, learn about the Peru Current phenomenon, and examine issues surrounding water shortages in U.S. communities. Each activity is set in a real-world context, involves the use of authentic data, and is designed to build critical data-using skills. See *http://bit.ly/1IfshF7.*

The Science Game: Electromagnetism. Unleash your inner Einstein! This app lets high school students learn about electromagnetism by doing—on their tablet! In the app, students explore electromagnetism concepts through challenges involving magnets, dynamos, motors, and more. As they play, helpful hints and guides explain phenomena such as electric currents and fields and how things like microphones, televisions, and electric bells work. Students can reinforce science understanding through quiz questions and probes (i.e., mini-games) that review the concepts and can keep students engaged. An applications section shows examples of how electromagnetism theories are used in real life. The app is available for both iOS and Android platforms at *www.mazalearn.com.*

Citizen Science With *SciGirls*. Teachers can access activities for grades 5–8 that involve students in real scientific research. Designed as an accompaniment to the PBS Kids television series *SciGirls* (which focuses on citizen science this season), students can create a food web to model an ecosystem (All Tangled Up); observe and identify neighborhood birds (Bird Is the Word); explore cloud characteristics (Cloud Clues); create a field guide (Out and About); look for phenomenal phenology in the community (Season Seeking), and identify frog calls (Wetland Band). Visit *http://bit.ly/1NMWylX.*

In addition, an online game, Rule the Roost, encourages students to participate in monthly citizen science challenges, creating and sub-

See Freebies, pg G2

Freebies, from pg G1

mitting their own creations as part of the game. Students have created homemade boats, animal sketches, cloud observations, and more. Consult *http://to.pbs.org/1UxD9VT.*

LinkEngineering. A new website from the National Academy of Engineering helps preK–12 educators implement engineering education in classrooms and out-of-school settings. With videos, interviews with engineering and education professionals, lessons, links to professional development, and opportunities to connect with fellow engineering education enthusiasts, the website provides teachers with models of engineering instruction in educational settings as well as background information on engineering and engineering design. Visit *www.linkengineering.org.*

Theories of Everything, Mapped. *Quanta* magazine's recent interactive map of fundamental physics is a resource for high school and AP Physics students. Built by interactive developer Emily Fuhrman, the map provides concise descriptions of highly complex theories relating to quantum gravity (including general relativity and quantum mechanics), dark matter, black holes, and other physics topics, along with proposed solutions to each question. Users can learn more about each theory by exploring the links to dozens of related articles and videos and cast votes for the solutions or ideas they believe to be most elegant or promising. Access *http://bit.ly/1hhoIsy.*

DIY Lake Science. Let young scientists investigate lakes and other freshwater ecosystems at home or school, or anywhere they go! Produced by University of California, Berkeley's Lawrence Hall of Science with National Science Foundation funding, and targeted for upper-elementary and middle level students, this app presents 12 hands-on indoor and outdoor "field adventures" using everyday items; videos; and a simulation exploring how lakes change. Sample activities include making a viewscope to look for underwater plants and animals, and crafting a Secchi disc to measure

WING-CHI POON

water clarity. The app is available for iPhones and iPads, iOS 7 and above. See *http://bit.ly/1LJqik9.*

How-to Guide for Schoolyard Habitats. Learn how to create and maintain a successful and sustainable wildlife garden on school grounds with this online guide from the National Wildlife Federation. Divided into seven sections, the guide walks educators of all ages through the entire process of creating a schoolyard habitat and provides K–12 lesson plans. Teachers will find information about the benefits of having a wildlife garden on campus, gardening basics, tips for choosing an appropriate outdoor learning site, guidance for ensuring continued success at the space, and more. Refer to *http://bit.ly/1JsufWN.*

Essential Lens: Analyzing Photographs Across the Curriculum. This multidisciplinary professional development resource for middle and high school teachers from the Annenberg Foundation explores photography's role in documenting history, change, and hidden worlds. Through videos, curated photograph collections, background information, and thematic classroom lessons, teachers (and their students) analyze photographs to understand the different ways images can impact our lives and views of the world. Climate change, environmental issues, microbiology, Earth and space science, and history are among the subjects investigated through the photograph collections. Visit *http://bit.ly/1La2foP.*

InterestID. This tool from NextLesson.org can encourage differentiated instruction in the classroom by helping teachers discover students' interests and providing standards-supported lessons on topics students love. Through the online tool, students share favorite interests within categories such as sports, books, movies, food, music, and gadgets. Teachers view a results summary displaying the top categories, most popular interests within those categories, and recommended lessons from NextLesson based on student interests. Teachers can view summaries for individual students or classes as a whole, and track changes over time. Check it out at *http://bit.ly/1MVrgZm.* (Free teacher registration is required.)

The American Association of Physics Teachers ComPADRE Digital Library. This network of resource collections supports physics and astronomy education at all levels. The collections are organized by user group and course (e.g., K–12 Physics, Faculty Resources, and Higher Education Resources) and contain many resources within each category. For example, the Open Source Physics collection offers tips, activities, and curriculum for using computer models and simulations in physics. The Interactive Video Vignette collection presents short, online tutorials exploring introductory concepts like projectile motion, Newton's Laws of Motion, centripetal force, and electric charges—ideal for use in flipped classrooms or as online assignments. Refer to *www.compadre.org/index.cfm?.*

MARTIN DAVIS

Progressive City Planners. In this interdisciplinary science and social studies lesson, middle level students create imaginary cities, deciding where to place amenities such as parks and libraries, and deal with drawbacks such as environmental hazards. Then students compare their imaginary cities to the real world, where resources and hazards often aren't distributed fairly and certain areas and populations suffer disproportionately from environmental burdens. The lesson promotes discussion about the issue of environmental racism and empowers students by having them propose solutions. Access *http://bit.ly/1La2q3u.*

MakerBot's Thingiverse. In this thriving design community for discovering, making, and sharing 3D printable things, educators of all levels are encouraged to get on a 3D modeling program or 3D scanner and create, construct, and innovate! Build something, then upload the file to Thingiverse and tell the community about it. The Thingiverse community has uploaded more than 100,000 3D models. See *www.thingiverse.com.*

Space Girls Space Women. A new app for iOS and Android devices produced by the European Space Agency and Sipa Press features "the stories of girls and women passionate about space, all around the world." Designed as part of a multimedia component to a traveling museum exhibition of the same name, the app allows users to create their own Space Girls profile and test their knowledge of space. The app also includes video profiles and interviews with a variety of women studying and working in space science and technology, making it a tool to inspire middle and high school students and others to pursue careers in the science, technology, engineering, and mathematics (STEM) fields. Download the app and learn more at *http://bit.ly/1h5DbI7.*

The Radix Endeavor. Motivate middle and high school students and supplement STEM learning with this massively multiplayer online game. In The Radix Endeavor, students enter the fictional world of Ysola ruled by evil, science-hoarding overlords, the Obfuscati. Students encounter Ysola's citizenry and embark on various STEM quests, such as finding a cure for a deadly disease or using math to reinforce weak buildings, while avoiding the Obfuscati. Access the game at *www.radixendeavor.org.* ●

News Bits

- **Want to improve your students' critical-thinking skills during labs? Ask them to make decisions about the data they collect.**

So say physicists at Stanford University and the University of British Columbia (UBC), who followed first-year students in a UBC introductory physics lab during a multi-year study. The researchers observed students learning through a conventional "cookbook" approach to physics experiments, then modified the experiments so that students were asked to make their own decisions about the data they collected, such as how to improve its quality or how to test it against the textbook result.

The team found that students' data—and their understanding of the physics concepts at work—improved when they were asked to make their own decisions. Students were 12 times more likely to find ways to improve their data than their counterparts in traditional instruction. And they were still employing these critical-thinking skills a year later in another physics course. See *http://stanford.io/1LL0GR3*.

- **To spark academic classroom discussions, try an Edcamp "unconference." In this free-form model of professional development, participants develop the content and volunteer to lead sessions themselves at the outset, then attend sessions as their interests dictate. Several educators who have attended unconferences are trying them with their students.**

Jason Seliskar, a fourth-grade teacher for the Covina-Valley Unified School District in California, tried this model when his class got sidetracked by a conversation about study habits. Realizing his students had good advice for their classmates, he showed them a video of the model and asked them which topics they wanted to present. The result was 15 20-minute sessions on topics like how to study on the weekends and how to succeed in math.

Lively conversations ensued, says Seliskar. He also found the model helped improve his students' communication, collaboration, creativity, and critical-thinking skills.

Seliskar now chooses a subject area, such as science, and has students present topics of their choice. He recommends teachers adopting this model consider elements like where these conversations will occur, how to determine who will attend which session, how long sessions should be, and how much direction to give students. See *http://bit.ly/1ii2Fmb*.

- **One classroom for grades K–5? That's the new model for one Charlottesville, Virginia, school.**

This year, students at Agnor-Hurt Elementary moved into a new classroom space designed to promote flexibility and collaboration and support multi-age learning. "[The multiage environment] actually creates a better flexibility for the students and the teachers because typically, we'll have about 10% of our kids operating on grade levels above," says Michele Castner, Agnor-Hurt's principal. "So rather than them being limited to just being in a room with their same-age peers, they actually can easily move up in that setting." The school has already had success with its current multi-age learning programs.

According to the school's website on multi-age learning, this kind of environment allows students to learn at a more individualized pace and form stronger relationships with their teachers. It also helps them become mentors for one another. See *http://bit.ly/1Jzn39b*. ●

What's New

FROM U.S. GOVERNMENT SOURCES

National Park Service (NPS)

National Park Fair

The NPS celebrates its centennial in 2016. Inspire students and families to discover America's national parks by hosting a national park fair at school. In this lesson, written by classroom teacher and park ranger Kristen Bergren, students research a national park and create a visitor center display with souvenir items to share with classmates. The lesson is written for third grade but can be adapted for all grades. Refer to *http://1.usa.gov/1Juaj5Y.*

U.S. Department of Energy (DOE)

Sustainability in Bioenergy: A Nation Connected

This informative documentary highlights ongoing efforts in communities nationwide to develop, produce, and provide bioenergy. From farmers and families in the Midwest to researchers and business owners on the coasts, the video provides firsthand views and personal stories describing bioenergy-related projects and how they work to create new jobs and lessen humans' impact on the environment. Share the video with middle and high school students; it provides a new look at many careers in the energy industry. Watch it at this website: *http://bit.ly/1ibYAjh.*

National Aeronautics and Space Administration (NASA)

Eyes on the Earth

This software shows real NASA satellite data from Earth-orbiting missions that monitor everything from carbon dioxide and carbon monoxide to sea level elevation to changes in Earth's gravity over time due to precipitation and glacial melting. You can even see computer models of the spacecraft that collected the data.

Don't have computers in your classroom? The Earth Now app (for iPhones or Androids; search for Earth Now in the app store) has the same data as Eyes on the Earth. See *http://eyes.nasa.gov.*

Sun Science

Each month, NASA solar scientists and education experts join middle level and high school educators online to discuss Sun science topics and share educational resources and experiences. The community is passionate about solar science, and members have forged a strong bond; however, they would love to have more educators and scientists join the group! All that's required is the desire to learn about Sun science (heliophysics) and how to bring it to student audiences. To learn more about the group, watch their video at *http://bit.ly/1Kw95ZW* or contact Andi Nelson at *anelsonsmd@gmail.com.*

STEM on Station

Celebrate the year-long mission to the International Space Station (ISS) at *http://1.usa.gov/1PHAK9R.* This website helps K–12 educators bring space into the classroom with lesson plans, videos, and more. For example, students and teachers of every level can take the European Space Agency's online tour of the ISS; watch a video about a day in the life aboard the ISS; learn and share the ISS Benefits for Humanity with students; and check in with the Space to Ground web series, which features a short wrap-up of the week's activities aboard the ISS every Friday.

The lesson plans are most appropriate for middle and high school levels. Of particular interest is the *ISS L.A.B.S. Educator Resource Guide,* which contains a collection of activities for students in grades 5–8 in which they assume the roles of a scientist, engineer, or astronaut to explore the different aspects involved in building and operating the ISS. High school students will appreciate the lessons in the *Science in a Box Educator Guide,* which ask them to model the behaviors of ISS astronauts and conduct experiments in a glovebox, a device that provides a sealed laboratory setting. Astronauts (and in this case, students) place their hands inside glove inserts to operate the experiment in the box.

Bureau of Land Management (BLM)

Habitats and Wildlife

This middle level teaching guide helps students understand why habitat conservation is important, how changes to habitats' health affect wildlife, and how the BLM monitors and promotes healthy habitats. Four activities offer students speaking, research, and teaching roles as they progress through the unit. Afterward, students design an experiment based on their research of Western wildlife and habitats in the previous activities. The unit can also be adapted for high school and upper-elementary levels. Download a copy at *http://on.doi.gov/1Iw2Gru.*

U.S. Fish and Wildlife Service (FWS)

Monarch Curriculum Webinars

Learn about monarch resources and curriculum through two FWS web seminars. Targeted for both formal and nonformal educators in K–12 and other settings, the introductory seminar covers the basics of the monarch life cycle and migration, threats facing the species, and ways to help the monarchs. The second, Monarchs in the Classroom, presents ideas for both elementary and secondary levels that use monarchs as a basis for the units of study in life cycles, migration, ecology, systematics, and conservation. Watch both at *http://1.usa.gov/1UmqDZs.*

National Oceanic and Atmospheric Administration (NOAA)

Diving Deeper

Commissioned in 2008, NOAA Ship *Okeanos Explorer* is the only U.S. federal ship with the sole assignment to systematically explore our largely unknown ocean for the purposes of discovery and the advancement of knowledge. In a lesson for grades 6–12, students learn how to access exploration observations, images, and other data collected through remotely operated vehicle dives during *Okeanos Explorer* missions. The lesson contains the Diving Deeper student worksheet, background information, learning procedure, assessment ideas, additional resources, and connections to the *Next Generation Science Standards* and Ocean Literacy Essential Principles and Fundamental Concepts. See *http://1.usa.gov/1hNfh4S.*

U.S. Environmental Protection Agency (EPA)

Faces of EPA Video Series

Students may not always know about the many and diverse careers available in the environmental field. Now middle and high school students can meet EPA's staff and learn about possible careers through the video series *Faces*

of EPA. Each two- to three-minute video spotlights a different EPA employee. Students will meet special agents, ocean explorers, former members of the military, and many others, all of whom discuss their career paths and passion for their work and the environment. Watch them at *http://bit.ly/1Kw4l6z*.

Library of Congress (LOC)

Thomas Jefferson's Vegetable Market Chart

Even in the early 1800s, recording and analyzing data was an informative and useful practice. Teachers can access Thomas Jefferson's Vegetable Market Record from 1801, along with ideas for incorporating this primary source into middle and high school science, math, and social studies lessons. Suggestions include creating a vegetable market chart to track, as Jefferson did, seasonal availability of produce in your location, and comparing your findings to his, and brainstorming factors that have contributed to the transformation of American eating habits since the early 19th century. Consult *http://1.usa.gov/1MXdBAM*.

Federal Bureau of Investigation (FBI)

FBI Kids Page

With age-appropriate (and interest-grabbing) games, stories, and interactives for grades K–12, the FBI Kids Page is *the* place to learn about the agency and what it does. About the FBI, an interactive for elementary students, tells the history of the agency and describes some of the jobs there, including special agents, language specialists, fingerprint experts, and computer specialists; students can try their hands at cracking codes like an FBI cryptanalyst and record their results on the Special Agent fitness test. Middle and high school students can follow a case from start to finish in the interactive How We Investigate, learning about various units in the FBI Lab along the way, or see what it's like to be a special agent in the interactive A Day in the Life. Visit *http://1.usa.gov/1Iy3nRd*.

National Institutes of Health (NIH)

ToxInvaders

What happens when a gaming expert has a knack for chemistry and environmental health science? An app for middle level students that explores chemical structures, chemicals that help our environment, and the health effects of toxic chemicals! In ToxInvaders, a new game from NIH's National Library of Medicine, students eliminate toxic chemicals in a "Space Invaders" meets *Jeopardy* environment.

Players use launchers to destroy toxic chemicals as they fall from the sky, earning points for every chemical structure hit. But don't let a roaming toxic element land on the launcher, or you'll automatically lose the game. If a good element lands on the launcher, that's okay: This earns shields to protect you from falling toxic elements. To advance to the next level, players must answer questions about the chemicals in the just-completed level. Questions range from identifying chemical formulas to determining the potential health effects of exposure to the chemical. Play ToxInvaders at *http://apple.co/1FHuaP7*.

U.S. Department of Agriculture (USDA)

Farm and Garden Produce Safety Resources

Introducing a one-stop shop for resources on farm and garden produce safety for preschools and schools. The resources are culled from leading nutrition and school gardening programs nationwide. For example, teachers can access videos, fact sheets, and Power Points on produce safety from the Institute of Child Nutrition; learn the Farm to School Network's best practices for using produce from school gardens; and find online food safety training for child-care professionals and food service staff developed by the University of Massachusetts and University of New Hampshire. See *http://1.usa.gov/1NHYpco*.

Centers for Disease Control (CDC)

Color Me Safe

Meet the Safes, the stars of a new CDC safety coloring and activity book for grades preK–1. Students read (and color) along with the Safes, who promote safety at home and on the road by activities such as installing smoke alarms and using child safety seats. Teachers can integrate the book into early childhood reading lessons and share copies with parents and children at health and safety events. Available in both English and Spanish, the book can be found at *http://1.usa.gov/1cuncjK*.

U.S. Department of Education (ED)

First Look: Second Grade

Findings From the Second-Grade Rounds of the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11, a recent report from ED's National Center for Education Statistics, examines the overall second-grade achievement of students who attended kindergarten for the first time in the 2010–11 school year and were in second grade in the 2012–13 school year using data from the Early Childhood Longitudinal Study, Kindergarten Class of 2010–11. Science, mathematics, and reading assessment scores in the fall and spring of second grade are shown, both overall and by selected child and family characteristics. Download the study at *http://1.usa.gov/1X8etYg*. ●

In Your Pocket

Editor's Note

Visit* www.nsta.org/calendar *to learn about more grants, awards, fellowships, and competitions.

October 30–31

State Farm Company Education Grants

State Farm provides grants of $5,000 or more to promote educational excellence and help K–12 students reach their fullest potential both inside and outside the classroom. Funds are available in three areas: teacher development, service learning, and education reform/system improvement. Schools, educational institutions, and nonprofit organizations are eligible. Apply by **October 30.** Visit *http://bit.ly/1wOsAat.*

Whole Kids Foundation School Garden Grants

In partnership with FoodCorps, the Whole Kids Foundation provides $2,000 grants to support new or existing edible gardens on school grounds. Applicants must have the support of a specific partner organization in the community, such as a nonprofit, farm, local business, Whole Foods store, or garden club. K–12 public schools, nonprofit private or charter schools, and nonprofit organizations working in concert with K–12 schools may apply by **October 31 at 5 p.m. Central Time** (CT); see *http://bit.ly/1pqsP7E.*

November 1

American Honda Foundation Grants

The American Honda Foundation awards grants to youth education programs focused on science, technology, engineering, and math (STEM) and the environment. Grants of between $20,000 and $75,000 are available. Programs should be imaginative, creative, youthful, forward-thinking, scientific, humanistic, or innovative. Public and private elementary and secondary schools, public school districts, and nonprofit organizations with 501(c)(3) status may apply by **November 1** at *http://bit.ly/OnjIiB.*

American Radio Relay League Education and Technology Grants

The American Radio Relay League (ARRL) offers two types of grants for teachers who currently use or want to use amateur radio in their classrooms. School Station Grants provide $1,500 worth of equipment to those who plan to use amateur radio as part of an enrichment or in-class project; Progress Grants of $500 go to teachers who already use amateur radio in the classroom and want to purchase license manuals, instructional guides, and other supplies or to do station upkeep and maintenance. Grantees must seek funding from their local communities to help sustain their programs.

Teachers in U.S. schools may apply by **November 1.** Consult *www.arrl.org/etp-grants.*

Knowles Science Teaching Foundation (KSTF) Teaching Fellowships

These five-year fellowships help early-career science and math teachers become master teachers and leaders. KSTF Fellows receive stipends, funding for professional development, grants for teaching materials, and leadership and mentoring opportunities for the duration of the program. Educators with the potential to develop exemplary teaching methods and leadership skills, as well as the content knowledge needed for teaching, are excellent candidates.

Applicants should have earned a degree related to the science or math discipline they intended to teach and have obtained a valid state teaching credential, certificate, or license by September 2016. They must also be entering their first or second year of teaching during the 2016–2017 school year. Apply by **November 1;** for more details, see *www.kstf.org/fellowships.*

James Bryant Conant Award in High School Chemistry Teaching

The American Chemical Society (ACS) and Thermo Fisher Scientific give this award to one outstanding high school chemistry teacher in the United States or the U.S. territories. Nominees should demonstrate quality of teaching, the ability to challenge and inspire students, extracurricular work that helps stimulate their interest in the field, and a willingness to stay current. The winner will receive $5,000, an ACS certificate, and up to $2,500 in travel expenses to attend the meeting at which the award is presented. Nominations are due by **November 1;** see *http://bit.ly/15geLhb.*

ACS Award for Achievement in Research for the Teaching and Learning of Chemistry

Sponsored by the ACS and Pearson Education, this international award recognizes an individual's contribution to experimental research that has increased our understanding of chemical pedagogy and improved the teaching and learning of chemistry. The winner will receive $5,000, a certificate from ACS, and up to $2,500 for travel expenses to attend the meeting at which the award is presented. Submit nominations by **November 1;** see *http://bit.ly/1aMfOO8.*

ACS Award for Encouraging Disadvantaged Students Into Careers in the Chemical Sciences

This ACS award, sponsored by the Henry Dreyfus Foundation, recognizes an individual who encourages students that are underrepresented in the profession to pursue careers in engineering or the chemical sciences. The recipient may work in academia, industry, government, or any other professional setting in the United States. He or she will receive $5,000, an ACS certificate, and up to $1,500 for travel expenses to accept the award. The Henry Dreyfus Foundation will also provide a grant of $10,000 to an academic institution of the winner's choosing to help it better meet the award's objectives.

Submit nominations by **November 1.** Learn more at *http://bit.ly/19Ko8uF.*

ACS Award for Research at an Undergraduate Institution

Sponsored by the Research Corporation for Science Advancement, this ACS award honors a chemistry faculty member whose research with undergraduates has significantly contributed to the field and to the development of his or her students. The awardee will receive $5,000, a certificate, and up to $1,500 for travel expenses to the meeting at which the award is presented. Research Corporation will also provide a $5,000 grant to the recipient's institution.

Nominees must be tenured faculty members at a predominantly undergraduate institution that does not have a doctoral program in chemistry. Nominations are due **November 1;** see *http://bit.ly/1IzeAks.*

George C. Pimentel Award in Chemical Education

ACS, Cengage Learning, and friends and colleagues of George and Jeanne Pimentel present this award to recognize outstanding contributions to chemical education. This can include training professional chemists, integrating chemistry into the educational system, and disseminating reliable information about the field to prospective chemists, students in other fields, members of the profession, and the general public. The activities recognized by this award may be in the fields of teaching (at any

level), administration, research, writing, or public enlightenment.

The winner will receive $5,000, a certificate from ACS, and $2,500 for travel expenses to accept the award. Submit nominations by **November 1** at *http://bit.ly/16KnvN1*.

The Lawrence Foundation Grants

The Lawrence Foundation provides grants to organizations that support education, the environment, human services, and other causes. Nonprofit organizations, public schools, and libraries may apply. Both program and operating grants are available. Grant amounts range from $1,000 to $100,000.

Apply by **November 1.** Learn more at *http://bit.ly/18mrVSH*.

November 3–24

Spencer Foundation's Areas of Inquiry Small Grants

The Spencer Foundation offers these $50,000 grants to support research in the following areas: education and social opportunity; organizational learning; purposes and values of education; and teaching, learning, and instructional resources. The principal investigator (PI) and co-PIs applying for a grant must have a doctoral degree or equivalent experience in an education research–related profession. The PI must also be affiliated with a college, university, research facility, school district, or cultural institution that is willing to serve as the fiscal agent if a grant is awarded.

Proposals will be accepted from the United States and abroad but must be written in English and propose a grant amount in U.S. dollars. Apply online by **4 p.m. CT on November 3** at *http://bit.ly/1Mf6zZO*.

Fulbright Distinguished Awards in Teaching Program

This program provides opportunities for educators to study abroad at a university, observe classes, or complete a project pertaining to their field of inquiry for three to six months. Applicants propose an inquiry project of their own design that will enhance both their learning and their teaching back home. Participants must

- be U.S. citizens who are fluent in English;
- be employed full-time at an accredited school in the United States or a U.S. territory;
- hold a master's degree or be enrolled in a master's degree program at the time of application;
- be in at least their fifth year of full-time teaching;
- spend at least 50% of their time interacting with students; and
- have a proven track record of professional development activities and leadership.

Opportunities for the 2016–2017 school year will take teachers to Botswana, Chile, Finland, India, Israel, Mexico, Morocco, the Netherlands, New Zealand, the Palestinian Territories, Singapore, South Korea, Taiwan, the United Kingdom, and Vietnam. Apply by **11:59 p.m. CT on November 4;** visit *http://bit.ly/1EZzfU6*.

Improving Students' Understanding of Geometry Grants

The National Council of Teachers of Mathematics (NCTM) provides these grants to help teachers develop activities that will allow their students to better understand and appreciate an aspect of geometry that is consistent with accepted standards. Proposed projects should also include applications of geometry to nature, art, literature, music, or some other relevant subject area.

Current NCTM teachers of grades preK–8 are eligible. Postmark proposals by **November 6.** Learn more at *http://bit.ly/1N4uEml*.

Dreyfus Foundation Educational Grants

The Max and Victoria Dreyfus Foundation gives grants of between $1,000 and $20,000 to community-based nonprofit programs located in the United States. Schools; educational and skills training programs; environmental and wildlife protection activities; museums; cultural and performing arts programs; and programs for youth, seniors, and the handicapped are eligible. Applications must be postmarked by **November 10;** refer to *http://bit.ly/1KtIP3J*.

Kinder Morgan Foundation Education Grants

These grants of $1,000 to $5,000 are awarded to educational programs for K–12 youth in the United States and Canada in communities where Kinder Morgan operates. Nonprofits and public and private schools with academic programs, including tutoring; environmental education programs that work with local schools and meet curriculum standards; or arts education programs are eligible. Local, state, provincial, and regional educational institutions; libraries; and programs providing ongoing support, such as Junior Achievement, may apply.

The next deadline is **November 10.** For more information, go to *http://bit.ly/1tNMKLr*.

Canadian Association of Physicists (CAP) Medal for Excellence in Undergraduate Teaching

CAP presents this award to faculty members who have comprehensive knowledge of their subject areas, an exceptional ability to communicate that knowledge, and a proven record of high-achieving students in physics. Nominees must be members of a CAP-approved professional science society and have spent half of their teaching career in Canada or made a prominent contribution to the teaching of physics there.

CAP members can nominate outstanding faculty members until **November 15.** See *http://bit.ly/1UnqswO*.

Air Force Association Educator Grants

The Air Force Association provides these $250 grants to promote aerospace education in elementary and secondary classrooms. Projects should include innovative aerospace activities within the prescribed curriculum that significantly influence student learning. Apply by **November 18.** Visit *http://bit.ly/1PGZnTU*.

Verizon Innovative App Challenge

Eligible middle school and high school students in the United States will work with a faculty adviser in teams of five to seven and develop an original concept for a mobile app that incorporates STEM principles and content and addresses a societal or community problem. No app building experience is necessary to enter. Eight "Best in Nation" winners will be awarded a $20,000 cash grant for their school, and students on the winning teams will receive Samsung Galaxy Tabs and be invited to present their developed apps in person at the National Technology Student Association's conference.

Register by **November 24.** For more information, consult *http://bit.ly/1FAac4R*.

Apply Year-Round

The Pollination Project's Grants

With the belief that "anyone can change the world," this organization provides seed grants of $1,000 to start-up projects that spark social change and promote compassion around the world. Projects in the early stages of development with a clear target audience are preferred. Funds can be used for infrastructure, outreach, supplies, travel, printing, websites, promotional fees, or other things that help establish the project.

Grants are awarded every day. Apply online at *https://thepollinationproject.org*.

ARRL Victor C. Clark Youth Incentive Program

This program provides mini-grants to groups that promote high school–age (or younger) students' participation in amateur radio. High school radio clubs, youth groups, and general-interest clubs with programs for youth are eligible. Grants of up to $1,000 may be used for equipment, training materials, and local service projects; preference is given to those with matched funding. Learn more at *http://bit.ly/1LFyP4N*. ●

Summer Programs

Editor's Note

Visit www.nsta.org/calendar to learn about other summer professional development opportunities.

Miami University's Earth Expeditions from Project Dragonfly. Earth Expeditions pairs university courses with field experiences that allow teachers to engage in inquiry and action research projects at conservation hot spots around the world. Participating educators build relationships with scientists, naturalists, and conservationists in Africa, Asia, Australia, and the Americas. After they return home, they continue work on these projects in their schools and communities.

Earth Expeditions are open to all preK–12 teachers, administrators, and university faculty, as well as educators, naturalists, and other professionals from non-school settings. Courses are for stand-alone graduate credit or can be applied toward a master's degree. Apply by **January 28, 2016;** for more details, see *www.EarthExpeditions.org.*

National Park Service Teacher-Ranger-Teacher Program. This program provides an opportunity for teachers to spend the summer learning in one of the nation's National Parks. Most teacher-ranger-teachers, or TRTs, spend their time participating in park education projects, learning about park resources, and developing lesson plans for their classrooms—though the tasks assigned will depend on the teacher's interests and the park's particular needs. TRT program dates vary by park, but typically last four to eight weeks. Housing is available in some parks.

TRTs are enrolled in an online graduate course from the University of Colorado, Denver, for which they earn three graduate credits; the National Park Service pays tuition for the course. (TRTs may request a transcript from the university that reflects the earned credits.) After completing the course, TRTs receive a stipend to help cover travel or living expenses incurred while participating in the program.

Visit *www.teacherrangerteacher.org* for a list of program contacts by region, and contact the specific National Park you are interested in for its application materials. Application dates vary by park; some are due by **January 31,** while others have spring deadlines.●

NPS PHOTO

The National Park Service's Teacher-Ranger-Teacher Program lets teachers spend their summer learning in a U.S. National Park. These teachers inventoried and monitored plants in Acadia National Park in Maine.

The NSTA Learning Center

High quality interactive content for K–12 science teachers

Earn graduate credits and advanced degrees

Affordable and user-friendly

Moderated by world-renowned faculty

Gain knowledge exclusive to your area of instruction

American Museum of Natural History

Seminars on science, six-week online graduate courses in the life, Earth, and physical sciences, incorporate the museum's resources plus interaction with scientists and educators. CEUs and graduate credits.

Montana State University - Bozeman

Online graduate credit courses for K–12 science teachers through National Teachers Enhancement Network, as well as online offerings for Masters of Science in Science Education. NSTA member discount.

University of Maryland

Designed for science teachers, the Master of Chemical and Life Sciences is a 30-credit, online, interdisciplinary master's degree offering concentrations in biology and chemistry.

Wildlife Conservation Society

Free Teacher Webinar & Student Webcast Series. Learn real-world science through WCS research and experts. Receive training to introduce core science concepts to your students. Connect your students with science experts through interactive, TV-style webcast programs. Monthly webinars and webcasts begin September 2015. Visit *wcs.org/teacherpd* for more information.

NSTA Virtual Conferences

A day-long series of live web sessions delivered via an interactive distance-learning tool. Each conference features content and/or pedagogy from experts in a particular topic. Participants can log on from anywhere with an internet connection and interact with presenters and educators from across the country.

http://learningcenter.nsta.org/onlinecourses

National Science Teachers Association

MS. MENTOR, **Advice Column**

Science Vocabulary: See It, Say It; A Graphic Organizer for Writing

How do you make vocabulary terms meaningful for students? I'm talking about really getting them to understand how the word or words are used in context. I feel students often just copy down a definition and never truly grasp how it relates to the topic at hand.

—S., Missouri

Science students at all grade levels struggle with the vocabulary. They are SLLs—Science Language Learners. Textbooks and websites are full of specialized words that challenge our students. Some are technical and relate specifically to science (e.g., photosynthesis, thermodynamics, plate tectonics), while others have meanings in science that differ from common usage (e.g., theory, hypothesis, matter). Even the graphics in books and websites go beyond being decorative to include the language of science in tables, diagrams, graphs, captions, sidebars, and footnotes.

Sometimes we assume students understand a word, only to discover on an assessment that they are confused. For example, my middle school students often interchanged the words *medium* and *median,* and they didn't realize that *media* was the plural of *medium*. No wonder the room was sometimes full of puzzled looks.

Teachers can use many strategies to help students with vocabulary, most of which involve reading and writing and focus on definitions. Common strategies include graphic organizers (such as the Frayer Model), word walls, student-created flash cards with definitions and pictures, vocabulary games, and notebook exercises.

As you mentioned, students need to go beyond writing definitions to recognizing and using the words in context. Before reading, students are often given a list of words to define. I wonder what would happen if students looked at the text first to see the context in which the words were used. Can they use any context cues to figure out a definition before resorting to the glossary? (They may need some guidance on using cues. This could be an interesting action research topic.)

I had success with showing students how knowing common affixes and root/base words can help in determining what a word means. For example, when my students first encountered the word *photosynthesis,* I pointed out that *photo-* means *light,* and we brainstormed other words that started with *photo* and had something to do with light (photograph, photocopies, photojournalism). They had a page in their notebooks for these "word parts."

In my experience, for students to understand and use new words, they also need to hear and say them. Sometimes what students wrote had little in common spelling-wise with the actual word. They could recognize the word in written material and match it to a definition, but many had difficulty pronouncing the word, generating the word in oral conversations, or using it in their writing.

I shared my dilemma with an elementary-level colleague. He suggested that for more complex or unfamiliar words, have the students repeat the words several times aloud, emphasizing the syllables by clapping out each one: *met-a-mor-pho-sis*. I tried this with my middle and high school classes, and it did help them with pronunciation and spelling. (Be prepared for some initial eye-rolling with secondary students, so explain why you are asking them to do this.)

An article from the July/August 2013 issue of the *Journal of College Science Teaching* (*JCST*), "On the Road to Science Literacy: Building Confidence and Competency in Technical Language Through Choral Repetition," shared an intriguing study on the effects of choral repetition on science learning in college science classes. They went further than my action research and did a more formal study of the strategy.

In addition to the quantitative findings, the authors include perceptual feedback from the students. Among other findings, students reported that the strategy helped them remember the terms, it was a cue that the term was important, and it was something that would apply to other courses: "You are not as afraid to use the big words when you understand them better," and "the words or phrases that we repeated in class pop out more when you read it than if you never heard the word before…you would probably just gloss over it." This simple strategy

requires no professional development or materials.

I'd be interested in hearing from you about any strategies you find useful!

When I ask students to write about a topic, most try to submit a collection of copy-and-paste paragraphs. I'm looking for strategies to help students create original writing.

—H., Georgia

Before the internet, when students were assigned to write about a topic, they went to the library, found the topic in an encyclopedia, and copied enough words to meet the length criteria. Fast-forward to today's world of online searching, Wikipedia, and electronic copy and paste, and you have updated the situation.

In the old days, as students copied by hand, they at least had to look at the words. I recently watched a biology student completing a vocabulary activity on cells. Using his laptop, he copied and pasted a definition of nucleus—as the center of an atom composed of protons and neutrons!

Synthesizing information from several sources is a useful process. But it might not be an intuitive one for students. When I was teaching middle school, each student created a report on an endangered animal. Even though I told the students I wanted to see their own writing, I still had many copy-and-paste versions. It was clear that students needed some guidance and examples of how to gather and use information from several sources.

Although my colleagues at the high school level swore by index cards and outlines for preparing reports, I knew these would be hard for many seventh graders. My classes included special education students, so I asked the special education teacher if she had any suggestions for helping students organize information and use what they find.

My colleague introduced me to the idea of using a "matrix" to help break down the task and provide a graphic organizer for the information. We worked together to design a template, realizing that what was helpful for special-needs students would be helpful for all.

Writing Matrix

	Source #1	Source #2	Source #3	Source #4
Physical description (size, color, etc.)				
Habitat				
How it reproduces and cares for its young				
What it eats				
Enemies				
Who it's related to				
Why is it endangered?				
Interesting information				

It was a simple document with a table. The column headers were blank to allow students to identify the sources they used (the librarian helped explain how to document the sources). The row labels were for characteristics of the animal. We brainstormed these labels in class. Most classes came up with the same ones, but it gave students some input into the document. If they didn't think of it, I suggested a row for "interesting facts." (Above is an example of a matrix; feel free to copy and adapt it!)

As students found information, they filled in a column for each source. They had questions and concerns: *What if a source doesn't have information for a box?* (Write "N/A"; it shows the value of multiple sources.) *I can't fit everything into the box.* (The size of the square means just summarize the facts, not a lot of writing.) It was another teachable moment when students realized that some sources had different information.

The effectiveness of this strategy became apparent when they started to write. This time, they looked at each row to summarize and elaborate on the topic. For students who weren't sure how to start, I suggested opening with an interesting fact, writing one or two paragraphs for each row, and concluding with another interesting fact. It was an "aha" moment for students as they saw their original writing emerge. We did the writing in class, which took a few class periods. My colleague and I decided it was worth it when we saw the results.

One year, two students showed me how they took the matrix idea and used it to organize their own notes on arthropods. The column headings were classes of arthropods, and the row labels were characteristics, such as number of legs. I asked them to explain why they found this more helpful than an outline or text paragraphs. They said that it was really easy to see how the classes of arthropods were similar and how they were different—quite an observation! I also used this strategy with high school students, and the use of matrix organizers morphed into my dissertation topic.

Both parts of the process—notetaking and writing—can be done electronically. The final document could be a written report, presentation slides, a foldable, or infographic.

Once I encountered a former student at a social event in our community. We reminisced about school, and he said that he still had his endangered animal report and read it to his kids!●

To maintain anonymity when requested, some letters to Ms. Mentor are signed with a pseudonym. We regret any coincidental resemblance to other educators when a pseudonym is used. Check out more of Ms. Mentor's advice on diverse topics or ask a question at www.nsta.org/msmentor.

BLICK ON FLICKS

Pacific Rim: Big 'Bots Battle Beasts

by Jacob Clark Blickenstaff, PhD

As the season of blockbusters winds down, I'm looking back a couple of years into the archives at *Pacific Rim*, an alien invasion story directed by Guillermo del Toro, the director of *Pan's Labyrinth* (2006), *Hellboy* (2004), and *Mimic* (1996). We enter this story several years into the Kaiju War, humankind's fight against giant monsters that emerge from a rift in the middle of the Pacific Ocean and attack population centers around the Ring of Fire. (It should come as no surprise to regular readers of my column that the first city attacked was San Francisco, and the Golden Gate Bridge was the first landmark destroyed.)

Human engineers have developed "Jaegers" to fight the Kaiju, since traditional weapons were ineffective. Jaegers are giant robots that have a humanoid form (a head, two arms, and two legs) controlled by a pair of pilots who are mentally connected to each other and to the robot. The idea is that the psychic energy needed to control the robot is too much for one person to handle. The two pilots are temporarily fully aware of each other's brains during the pairing, or "drift." Many of the pilot teams are relatives: sibling pairs, or parent and child. Battles between Kaiju and Jaegers typically happen in the ocean just offshore from major cities, or among the high-rise buildings just on shore.

In the initial scene, we see brothers Raleigh and Yancy Becket piloting the *Gipsy Danger* in a fight against a Kaiju. In the battle, Yancy is killed, but Raleigh survives to defeat the Kaiju and bring *Gipsy Danger* back to shore heavily damaged. Raleigh then leaves the Jaeger program and seeks work elsewhere. Despite this near defeat, the Jaegers are generally effective against Kaiju, and the pilots are global heroes.

The story then jumps five years ahead to a time when the Kaiju are arriving more frequently and appearing larger each time. Jaegers are less and less effective, so the world leaders are collaborating to build a wall around the Ring of Fire to keep the Kaiju out. Since political leaders believe the wall will work, the Jaeger program is being shut down despite dire warnings from the military commander Stacker Pentacost (played by Idris Elba). All the remaining Jaegers are on their way to Hong Kong to be mothballed until a Kaiju easily breaches the wall near Sydney, and Jaeger *Striker Eureka* saves the city.

Pentacost searches for Raleigh Becket and finds him working on the construction of the global wall in Alaska. With some difficulty, Pentacost convinces Becket to rejoin the Jaegers for a last attempt to close the rift where Kaiju arrive on Earth. Becket needs a co-pilot who is drift-compatible, and the best match for him is a young woman, Mako Mori. Pentacost initially

does not want to allow them to pilot the rebuilt *Gipsy Danger*, but in the end, agrees. Further summary will give away too much of the plot, but you can guess that major battles occur between Jaegers and Kaiju, and ultimately, humanity will be saved, opening the door for a planned 2017 sequel.

This film has received attention for its cool visuals of giant robots fighting huge reptile-like creatures and for recalling the monster films of the 1960s and 70s, as well as for its depiction of a competent female. Mako Mori is an unusual character in a science fiction blockbuster: She is very competent at her job, succeeds despite major opposition, and is never objectified or outfitted in sexy costumes. Her main relationship with Becket is one of respectful colleagues. It is hard to find movies that present female characters like this, and particularly difficult in the action/sci-fi genres.

What can science teachers take away from *Pacific Rim* to use in their classes? Last month, I wrote about *Ant Man*, and making things small. In contrast, Kaiju are absolutely gigantic, which presents another set of biological problems. I've previously written about strength and mass scaling problems, but this time, I'd like to consider nerve signals.

Nerve impulses carry information from extremities to our brains so that we can make decisions about where our limbs are, how they should move, and what kind of environment we are in (temperature, pressure, wind, etc.). Human nerve impulses move pretty fast: up to about 100 m/s, sending signals from our feet to our brains in just a couple of hundredths of a second.

Kaiju are huge, some more than 100 meters long (according to the *Pacific Rim* Wiki: *http://bit.ly/1KCNJf6*). That would mean that if a Kaiju stepped on a spike, it would take one second for its brain to find out, and another second for it to detach its foot from the spike. This poses a real problem because much can happen in a second.

The solution is not a second brain, as presented in the movie, though, and it is a longstanding misconception that dinosaurs had two brains (*http://bit.ly/1Fww1SO*). What happens in most creatures with a spinal cord is that some signal processing and reactions are completed in the spinal cord, and our brains get involved only when a decision needs to be made. This dramatically reduces the distance, and therefore, time required to respond to a stimulus.

A scene involving a pregnant Kaiju inspired me to look up the distinction between oviparous and viviparous reptiles, because I was surprised to see an umbilical cord on the fetal Kaiju. It turns out that the filmmakers got that right, if Kaiju are basically viviparous reptiles. Students might recognize the prefix "ovi" meaning "egg" in the term oviparous. Most reptiles lay eggs and leave their young to hatch and make their way in the world; these are the oviparous reptiles. A few snakes and quite a few lizards give birth to live young (like the vast majority of mammals) and so are called viviparous. All viviparous fetuses must get nutrients from their mother, and so an umbilical cord makes that connection. My mammalian prejudice initially led me to think that a reptile wouldn't have an umbilical cord, but I was wrong.

Science teachers can use *Pacific Rim* to introduce some interesting neurobiology and show students an example of a giant viviparous reptile, as well as recognize an unusually powerful female character in Mako Mori.●

Note: This film is rated PG-13 for sequences of intense sci-fi action and violence throughout, and brief language.

Jacob Clark Blickenstaff is the program director for Washington State Leadership and Assistance for Science Education Reform at the Pacific Science Center in Seattle. Read more Blick at http://bit.ly/amBgvm, *or e-mail him at* jclarkblickenstaff@pacsci.org.

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*"**The experience was absolutely unbelievable.** Not only did the experience positively impact me, but it has influenced fellow teachers as well as **increased my students' excitement for science.**"*

*"I am extremely grateful to NSTA for giving me the opportunity to attend one of the greatest professional development opportunities available for elementary science teachers. **I grew so much** professionally while at the conference, and I **implemented many of the strategies** I learned at the conference as soon as I returned to my classroom. My students and I have both **benefited greatly** from this opportunity."*

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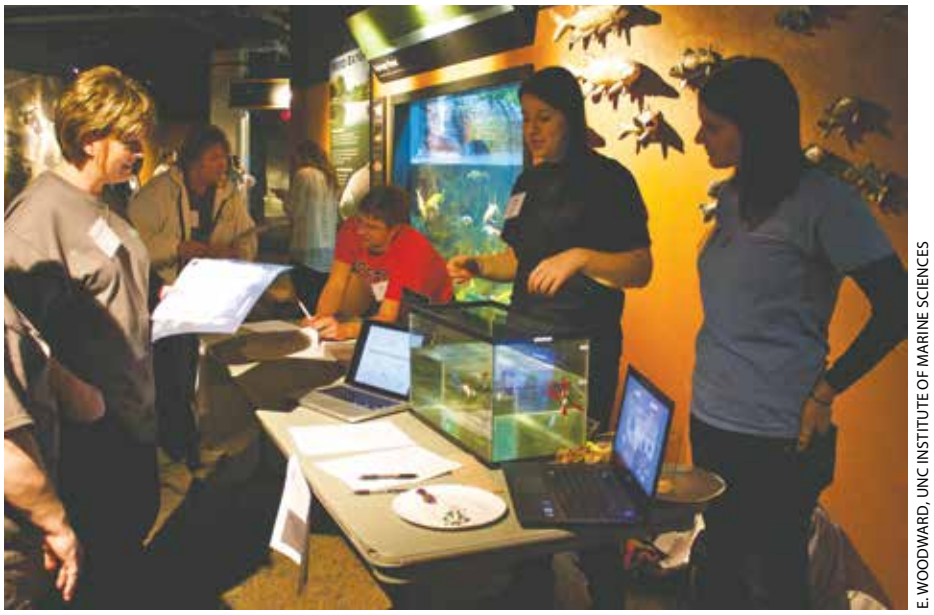
Uniting Scientists, Educators to Share Knowledge

Scientists may know their work inside and out, but many of them struggle to share that knowledge outside the lab. Science educators need to know both pedagogy and content, but may not know what resources are available in their area. Events that bring scientists and educators together can benefit both—enhancing scientists' ability to communicate effectively and expanding educators' content knowledge and other resources.

Along the North Carolina coast, institutions like the University of North Carolina at Chapel Hill, Duke University, North Carolina State University, National Oceanic and Atmospheric Administration's Beaufort Lab, the North Carolina Maritime Museum, and the North Carolina Coastal Reserve carry out a variety of research, especially in marine science. "There's so much science in this area, but there was a gap… it wasn't getting into the classroom," says Ethan Theuerkauf of The Scientific Research and Education Network (SciREN). Theuerkauf and Justin Ridge, executive directors of SciREN, formulated the idea for SciREN at a Research Educator Exchange Forum (REEF) hosted by the Centers for Ocean Sciences Education Excellence (COSEE) and North Carolina Sea Grant. During the REEF, K–12 educators, informal educators, and scientists worked in small groups to develop a "product"—typically a scientist-led class visit to a museum or a field trip.

"Our product ended up being an event [during which] we pulled researchers from around North Carolina and invited teachers for an evening at an aquarium," recalls Ridge. "Both Ethan and I have moms that are teachers, so we're familiar with how resource-limited teachers are. [We considered] how scientists could share their neat tools and materials with teachers and enrich the whole classroom experience."



E. WOODWARD, UNC INSTITUTE OF MARINE SCIENCES

At SciREN, scientists share lesson plans, such as this one on the physical environment of phytoplankton, with educators from around North Carolina.

SciREN's free networking events feature scientists sharing lesson plans and activities they've developed with assistance from teachers to ensure they address standards and match curricular needs. "It's one of the big things we do. We help researchers translate their science for the classroom," emphasizes Ridge. "When the research is presented at SciREN, it is classroom-ready down to the curriculum and standards. [Educators] could do them the next day if they wanted to. We wanted to make sure what teachers received from the workshop was usable." What's more, because the educators receive the lessons from the researchers themselves, "if they have questions, they know who they can ask about it."

The first SciREN event in 2013 focused on marine science. Since then, two more SciREN events have occurred at the North Carolina Aquarium at Pine Knoll Shores. In Raleigh, North Carolina, a new SciREN event launched in 2014 and included researchers in science, technology, engineering, and mathematics (STEM) from the Research Triangle area. "We had the whole gamut of STEM fields," asserts Theuerkauf. To date, SciREN workshops have connected around 300 researchers with more than 600 educators.

Scientists and educators maintain their connections beyond the SciREN events as well. Theuerkauf says, "There have been dozens of interactions after workshops," ranging from classroom visits to presentations at summer camps. Researchers are also using teacher feedback to "tweak" their lesson plans, he adds.

To facilitate those interactions, SciREN hosts a portal on its website (*www.thesciren.org*) that includes lesson plans from the networking events and communications between educators and researchers. "We really want everyone who's interested to be a part of the network," says Theuerkauf, noting that they don't limit access strictly to attendees, but allow other educators to register as well. "All the content is there; you just don't have that face-to-face connection."

Theuerkauf and Ridge are currently pursuing their doctorates in coastal geology, but hope to see SciREN continue to expand. To that end, they obtained nonprofit status for the organization this summer and established a board of directors. "We'd like to see the SciREN network spread to other

places rich with scientific research," Theuerkauf continues. "There are a lot of logistics, but one of the things that inspired us was how excited everyone was. We weren't 100% sure people would share our enthusiasm for science outreach, but after three years of workshops, we continue to be amazed at the passion of both the educators and the researchers."

In South Carolina, a REEF event led to a Night at the Museum in Columbia in 2012. Marine and environmental scientists from the University of South Carolina shared their research with educators at the South Carolina State Museum. "A focus of COSEE training was to help researchers communicate what they do in a way that teachers can understand, then understand the needs of teachers who might be interested but don't know they could have a researcher come to their classroom," explains Colette Dryden, elementary science coordinator for Richland County School District in Columbia.

For Night at the Museum, "There were participants from across the state," she recollects. "I knew people who came from more than one-and-a-half to two hours away. Researchers had live specimens, [conducted] demonstrations. They talked about ways to bring research into the classroom, doing teacher-student research projects or [having] teachers work with professors."

Dryden says the open house–style event allowed educators to meet a greater variety of researchers as they circulated from table to table. Most of the researchers were relatively early in their careers (less than 10 years). She says the school district, university, and museum hope to be able to hold a similar event in the future.

The Clarke County School District in Georgia incorporated a day on the University of Georgia (UGA) campus as part of its redesigned support system for new math and science teachers. Science and math teachers in their first through third years of teaching worked with a veteran teacher coach who provided support throughout the school day and met monthly with district science and math coaches, according to Amy Peacock, K–12 science content coach for the school district in Athens, Georgia. Before their day on the UGA campus in December 2013, the middle and high school teachers were surveyed on the topics they wanted to learn about.

"They went all over campus to have interactions with scientists," Peacock says. "We were really trying to talk in-depth about what scientists really do, what engineers really do. This was to help [them] with their content knowledge and to make connections back to the classroom. They networked with people who could come to their classrooms, possibly to co-teach, talk with students, or borrow equipment. [The teachers] made connections and had stronger connections with content and with science."

She says the teachers appreciated the chance to network, and some gained new perspectives on themselves. One teacher shared that although she had always wanted to be a science teacher, she hadn't had the opportunity to take "a lot of science classes." After her day at the UGA campus, she stated, "Today, I see myself as a scientist."

Peacock says the district is currently working on the logistics for another day on the UGA campus. "It's something we would like to try to continue, not just with only new teachers, but [also] for all of our teachers to have these experiences…It worked for us to [hold the event] on the [university's] reading day [so that] professors were not teaching classes." ●

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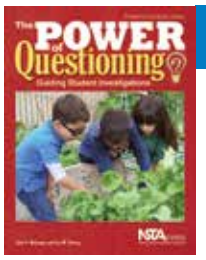

NSTA PRESS: *The Power of Questioning: Guiding Student Investigations*

Building a Questioning Environment

Editor's Note

NSTA Press publishes high-quality resources for science educators. This series features just a few of the books recently released. The following excerpt is from The Power of Questioning: Guiding Student Investigations *by Julie V. McGough and Lisa M. Nyberg, edited for publication here. To download the full text of this chapter, go to* http://bit.ly/1Q3F9nF. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

How Do I Build a Collaborative Learning Community to Support Questioning?

The physical learning space may be indoors or outdoors, real or virtual. The physical learning space in the classroom includes the investigation station. An investigation station is an organized learning space complete with resources and tools to invite students into a world of discovery. The investigation station includes resources such as a nonfiction library, vocabulary resources, and an observation area. The investigation station also includes instruments such as observation tools, data collection tools, and writing supplies.

The cognitive environment is carefully established as the teacher sets expectations for respectful interactions and dynamic discussions. Active listening plays a key role in modeling a learning community ready to engage in questioning. During discussions, the teacher models expectations as he or she looks at the speaker, leans forward, encourages the speaker with nonverbal signals (head nods, animated facial expressions), and asks purposeful questions.

Establish the cognitive learning environment to demonstrate value for children's ideas by asking, "What do you think? How do you know that? Tell me about your work or idea." Engage students in questioning, and value each child's contributions as you model a sense of wonder and exploration.

You should also create an environment where mistakes play an expected and accepted part of the learning process. Actively model lifelong learning skills, including making mistakes. Finally, build on authentic and relevant connections as students learn to understand the importance of asking questions and engaging in dynamic discussions.

Table 2.1. Setting Expectations for Dynamic Discussions

Seating Room Arrangement	Respect for Self and Others	Nonverbal Communication Signals	Possible Types of Interaction
• Sitting in a circle • Small group discussions at tables • All students facing forward • Assigned seating vs. choice seating	• One person talks at a time • Everyone listens • Participants are respectful of each other's learning • Participants support each other • Dynamic community environment	• Raising hand to speak • *C* on forehead to signal making a connection • Holding two fingers up to signal quiet • Thumbs up to agree • Thumbs down to disagree	• Asking clarifying questions • "I agree because …" • "I disagree because …" • "I have a connection to what ___ said." • "I understand what ___ said but I also think …"

Teacher Metacognition

Students learn how to interact in a discussion through modeling, teacher think-alouds, and sentence frames.

Modeling: A teacher may say something like, "Michael, that is an excellent question. I don't know the answer. We need to do some more research. I think I know of a book in the library that might help us."

Teacher think-aloud: "I think we may need to find some resources to help us understand the parts inside this bird of paradise stem and how it works. Lukas, please bring the tablet from the investigation station."

Sentence frames: Sample dialogue posted on charts may be helpful when students begin learning the skills of questioning. The charts can be taken down as the students build confidence and become more skilled in academic discourse.

"I agree with _____ because _____."

"I disagree with _____ because I was thinking _____."

A collaborative learning community includes setting expectations for dynamic discussions (Table 2.1). Think about the arrangement of students during discussions and how students interact. For example, students may sit on the floor in a circle, at desks, or at tables. Sitting in a circle on the floor offers students the opportunity to see each person as he or she speaks and encourages group participation. When desks are arranged in groups, consider strategies to focus student attention if student chairs do not face the speaker.

Expecting students to respect others helps students to listen and take turns speaking so that all students have an equal opportunity to participate. Signals may be used to help students communicate that they have connections or want to ask questions while another child speaks. For example, students may place their hands in the shape of the letter C to signal that they have connections to share. Using a nonverbal signal allows the teacher to acknowledge the child and give him or her an opportunity to speak next.

Unfortunately, there may not be time to hear every connection. The teacher may say, "Hold on to your thought. We will share more connections this afternoon." Or "I love that so many of you have made connections! To make sure everyone gets to share their ideas, please write your connection on a sticky note and place it on the chart. We will look forward to reading each other's ideas."●

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NSTA National Science Teachers Association

(All dates are deadlines unless otherwise specified.)

October 21—It takes more than great teaching to earn a coveted award. Find out how you can win up to $10,000 by showcasing the outstanding teaching you already do during **Developing a Competitive Teacher Award Application, a free NSTA Web Seminar**. Diana Wiig, NSTA Teacher Awards and Recognition Committee chair, will discuss the application process for 2014–15, sharing insights into completing applications and tips for strengthening submissions for a chance to win prize money, materials, and equipment for your classroom! NSTA Teacher Awards recognize preK–16 science educators in the United States and Canada. More information about the NSTA Teacher Awards program is available at *www.nsta.org/awards*. For more details about NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.* The session runs at 6:30–8 p.m. Eastern Time (ET).

October 22–24—NSTA's three-day **Area Conference**—themed **"Science and Literacy: Creating Connections!"**—opens in **Reno,** Nevada. Attendees can follow one of three strands—Bundling the *Next Generation Science Standards* (*NGSS*) and the *Common Core State Standards; NGSS:* Connecting Standards to Practice; and Creatively Engineering Future Resources—to focus their professional learning or select individual sessions that best meet their needs. On-site member registration costs $225. For more information or to register online, visit *www.nsta.org/reno*.

October 27—With more than 4,000 resources, finding what you need in the NSTA Learning Center may seem daunting to the uninitiated. K–12 educators can explore the Learning Center in depth during **NSTA Learning Center: Free Professional Learning Resources for Educators, a free NSTA Web Seminar.** The session runs at 6:30–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.*

November 12–14—The **NSTA Area Conference in Philadelphia** explores **"Revolutionary Science"** at the Pennsylvania Convention Center. Three strands—Revolutionizing Engineering for the Future, Integrating Literacy Strategies to Revolutionize PreK–12 Science Instruction, and Technology: Teaching Revolutionary Science in the Digital Age—allow attendees to focus on specific areas of interest. NSTA members must register by **October 16** to receive the $190 advance rate. On-site registration costs $225. For more information or to register, visit *www.nsta.org/philadelphia*.

November 17—Learn how free tools on the NSTA Learning Center help you create, curate, and share your most valuable online learning resources during **Creating and Sharing Collections in the NSTA Learning Center, a free NSTA Web Seminar.** The session runs at 6:30–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.*

November 18—The first step to winning a lab makeover for your school is discovering the keys to **Developing a Competitive Application for the Shell Science Lab Challenge** during this **free NSTA Web Seminar**. The Shell Science Lab Challenge recognizes middle and high school science teachers (grades 6–12) in the United States and Canada who develop replicable approaches to science lab instruction using limited school and laboratory resources. Participants will learn how they can craft their best entry from presenter Ruth Ruud, judging chair for the Shell Science Lab Challenge. The session runs at 6:30–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.*

December 3–5—"**Raising the Stakes in Science,"** the **NSTA Area Conference** in **Kansas City,** Missouri, gives educators an opportunity to hone their practice, content knowledge, and more. Three strands help attendees focus their experience: The Art and Craftsmanship of Teaching, Combining Science With Agriculture, and Achieving Success with the *NGSS*. NSTA members must register by **October 26** to receive the $180 earlybird rate. On-site registration costs $225. For more information or to register, visit *www.nsta.org/kansascity*. ●

Are you aware of all the advantages you get as an NSTA member? We will be featuring some of the regular benefits NSTA members enjoy, as well as special offers for our members from other organizations, in this space. For more information on NSTA membership, visit *www.nsta.org/membership.*

- **NSTA Conferences.** NSTA conferences offer a concentrated professional learning experience for science educators at every career stage and across grade levels. Whether you're a formal or informal educator, you'll have a chance to learn from innovative teachers, hear from leaders in the field, and be inspired by colleagues striving to improve their practice.

NSTA area conferences will be held in Reno, Nevada; Philadelphia, Pennsylvania; and Kansas City, Missouri, this fall. NSTA members save $90 on their on-site registration for area conferences, compared to non-members. The NSTA National Conference on Science Education will open in Nashville, Tennessee, on March 31, 2016. As a NSTA member, you can save up to $145 compared to regular non-member registration when you register by **February 5, 2016.** ●

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The program features 19 educator awards—including the Robert H. Carleton Award for National Leadership in the Field of Science Education (NSTA's highest honor), NSTA Distinguished Informal Science Education Award, Faraday Science Communicator Award, Sylvia Shugrue Award for Elementary School Teachers, and the Robert E. Yager Excellence in Teaching Award. The Angela Award honors one female student in grades 5–8.

NSTA updated the online application process to include an option to nominate educators for all awards. When a teacher is nominated by someone else, NSTA notifies them by e-mail and encourages them to complete the application.

The NSTA Awards and Recognition Program is sponsored in part by Bio-Rad, DuPont/Pioneer, Northrop Grumman Foundation, PASCO, Sea World Parks and Entertainment, Tru Green, Shell, and Vernier Software & Technology. All entries must be received by **11:59 p.m. Eastern Time on November 30,** except entries for the Shell Science Teaching Award, which are due on **November 18.** No fee is required to enter. For more information on the NSTA Awards and Recognition Program, to submit an application, or to nominate an educator, go to *www.nsta.org/awards.* ●