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Learning Early About STEM Careers Through CTE

Career and Technical Education (CTE), long the bastion of U.S. high schools, is becoming more common in middle schools and linked with science, technology, engineering, arts, and math (STEAM) courses. Virginia's Fairfax County Public Schools (FCPS) is one supporter, offering middle level CTE courses in Technology and Engineering Education, Business and Information Technology, and Family and Consumer Sciences. "We're getting [students] engaged at an early age," says Scott Settar, program manager for Technology and Engineering Education and STEAM Integration. "We're rewriting the middle school Business and Information Technology courses with more coding, programming, and networking opportunities," he reports. The CTE courses "focus on the technical application of many career pathways, the design process, and 21st-century skills.

"National research has shown that by grades 5–7, students lose interest in individual [science, technology, engineering, and mathematics] STEM content areas," so students at all grade levels "need to understand why these disciplines are important and relevant" because "upcoming STEM jobs will be in this area," he contends. "The general consensus across the nation is that Technology and Engineering Education and Business and Information Technology are moving toward a STEAM focus, STEAM integration."

In FCPS, "Technology and Engineering Education– and Business and Information Technology–related areas—coding, technology, engineering—[have] almost a K–12 implementation," observes Rachael Domer, FCPS STEAM Resource Teacher and a former CTE middle school Technology and Engineering teacher. "There's a new focus on STEAM at the elementary level, exposing students to coding, engineering, and general problem solving."

KRISTEN FRANKS

Students at Camp Ernst Middle School in Burlington, Kentucky, participate in technology leadership camps. Next year, they can take a CTE course in Digital Literacy for high school credit.

She notes that in FCPS, the seventh-grade technology and engineering education course is now called Engineering, Design, and Modeling, and the eighth-grade course has become Engineering Stimulation and Fabrication. "The idea behind the name change is to have the courses speak for themselves. The previous names were too broad," she observes, adding that these semester-long courses allow students to take two CTE courses each year.

Domer says she talks to teachers of grades 4–6 about CTE course offerings at the high school level so "teachers understand what the end product is" and how familiarity with the engineering design process "will help students in middle school and high school."

"We talk about CTE in general and connected to STEM education and providing relevant experiences for students, engaging them and inspiring them in learning. With [standardized]

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COMMENTARY: **Sean Smith and David Evans**

Teaching About Zika Using Lessons From Ebola

By Sean Smith and David Evans

Sean Smith

David Evans

The growing concern in the United States over the Zika virus recalls last year's Ebola outbreak. Despite being far removed from and having little chance of spreading widely in the United States, the Ebola outbreak was widely misunderstood and feared by U.S. citizens. But it was also a teachable moment that generated a lot of questions among K–12 students. Right now the Zika crisis is much closer to us than Ebola ever was, and the possibility of effects on unborn babies is sure to generate questions and concerns among students, just as Ebola did.

Last winter, a partnership of organizations—led by Horizon Research, Inc., and with support from the National Science Foundation—worked with NSTA to survey a large sample of science teachers nationwide to understand how they addressed Ebola in their classrooms. This article, which focuses solely on the responses from high school science teachers, examines what researchers learned, sheds light on how high school science teachers will likely respond to Zika, and provides recommendations for designing instructional resources that will help students understand the Zika virus and the emerging health crisis. (For detailed findings across grades K–12, go to the preliminary report of results at *http://bit.ly/1TEj9ob.*)

Instructional Time Devoted to Learning About Ebola

The survey found that although Ebola was not a part of their curriculum, three-quarters of high school science teachers devoted some class time to the topic: typically one or two class periods, for a total of approximately an hour. Almost 90% of the life science teachers surveyed addressed the Ebola virus in their classroom.

Almost half of those who did not teach life science (e.g., chemistry and physics teachers) also addressed Ebola with their students. Why? Two-thirds cited student interest as the single most important factor in their decision, and almost 80% reported students first asked about the virus before teachers addressed the topic.

When teachers addressed Ebola, the most frequent mode of instruction was discussion combined with question-and-answer, consistent with the driving force of student interest. Typically, teachers ask questions and students try to answer them. However, study data suggest that this common instructional pattern was reversed. When teachers addressed Ebola, students asked questions and teachers tried to answer them.

The topics addressed by science teachers also provide insight into what students were interested in knowing. The most common topic was explaining what Ebola is. In addition, almost all surveyed teachers said they discussed how the virus is transmitted among humans, and more than three-fourths addressed the likelihood of spread in the United States and how to prevent transmission.

Only about half of science teachers indicated that their knowledge of Ebola encouraged them to address the topic with their students. An even smaller proportion of teachers (about 4 in 10) described their knowledge of how to teach about Ebola as a factor that encouraged them to address the topic. These data suggest that some teachers did not feel comfortable with their knowledge of Ebola, and study data indicate that teachers actively sought information about the virus and disease. Among those who addressed Ebola, two-thirds relied on resources from the websites of health organizations such as the Centers for Disease Control, the National Institutes of Health, and the World Health Organization. To a lesser degree, teachers also used television news programs, newspaper articles, and information from science teacher organizations as resources.

Developing Zika Resources

So what does this survey tell us? The predicted spread of Zika into the United States in the coming months is likely to capture students' interest and to generate questions. Science teachers will respond, hopefully keeping what was learned from teaching about Ebola in mind.

Findings from the Ebola study suggest these four factors should be considered:

Instruction should acknowledge students' interests and concerns and use them as an entry point for discussing Zika. Typically, science teachers must generate interest with a question or problem that engages students. With topics like Ebola and Zika, students come to class with interest and questions, and some of the questions are predictable: What exactly is Zika? What are the symptoms? How likely am I to get it, and if I do, what will happen to me? How does Zika spread, and how do you prevent it from spreading? Teachers can engage students in proposing a means of answering these questions and learning how and where to look for accurate information.

Instruction should be tailored for particular age groups. Some teachers reported avoiding discussing the Ebola virus because of concerns about age appropriateness. Teachers should consider the age and maturity of their students when discussing Zika symptoms and the potential for harm to unborn babies associated with the virus.

Instruction should be based on the most up-to-date scientific information about Zika. As was the case with the most recent Ebola outbreak, the science of Zika is changing rapidly. Large studies are currently under way to understand the link between Zika and microcephaly, as well as other conditions (e.g., Guillain-Barré Syndrome). The science related to other aspects of Zika (e.g., how to control relevant mosquito populations) is also evolving. The sidebar to this commen-

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testing, we've kind of lost this. CTE is moving [back] in that direction," concludes Settar.

STEM Career Pathways

"Middle school—that's where the disconnect happens," says Sunni Stecher, Middle School CTE Consultant for the Sonoma County Office of Education (SCOE) in Santa Rosa, California. With SCOE funds, 13 county schools offer Middle School Career Exploration activities.

Through a partnership of the CTE Foundation and the John Jordan Foundation, SCOE's CTE department offers free Step-Up Classes—"mini CTE classes"—to middle school students, says Stecher. Step-Up Classes are taught by CTE teachers in their regular high school classrooms. "[They] give students experience with fun classes to motivate them to go to high school and get familiar with career pathways," she explains.

"We're trying to focus on high-wage, high-need [subjects] for our area," such as agriculture and manufacturing. Past topics have included Advanced Technology and Manufacturing, Sonoma Specialties (wine and food), Health and Wellness, Agriculture, Construction, and Green Services, which covers solar and geothermal energy, green technology, agriculture, and alternative fuels.

"The teachers love teaching those classes; they love the exuberance of middle school students. The students are very engaged," Stecher reports. In course evaluations, 95% of students rate the classes highly, and "the teachers come back every year," she relates.

SCOE also helps organize a Construction Expo, a free event for middle and high school students staged by the North Coast Builders Exchange, a not-for-profit association serving the construction industry in the California North Coast area. "The kids get to use equipment, do hands-on welding...We get a huge response," she reports.

Programs like these can be key to attracting students to STEM careers. "Districts need to build career exploration activities into their infrastructure, devote time to it in school," she contends.

Preparing for High School

"I teach technology courses for middle school and feel passionate about preparing students for CTE," says Kristen Franks, technology teacher at Camp Ernst Middle School in Burlington, Kentucky. "I will be teaching a high school–credit class (Digital Literacy) next year to eighth graders. The course is a prerequisite for many career pathways that our sister high school offers. As a former high school teacher, I understand the importance of CTE classes and am driven to support our students at the middle school level. There are so many opportunities in high school, and it is crucial for students to get a head start."

Students in the Digital Literacy course "can go into programming, computer science, digital design, or web development. It's amazing what opportunities will be available to them," Franks maintains.

Having CTE at the middle level is important because in high school, CTE courses often "conflict with student schedules, which can include dual enrollment, AP courses, internships, band, and choir. It's a struggle to get [students] to complete a pathway," Franks allows. "Hook them early...[so they can] take advanced CTE classes before they leave high school," she advises.

"The disconnect between middle and high school can't be like that anymore…We're all on the same team," she asserts. She advises middle school CTE teachers to tell high school CTE teachers, "you want to prepare kids for their schools…Having these relationships will change everything."

Franks notes one obstacle for middle school teachers who want to teach high school CTE courses is that their certification "ends with eighth grade, so they're not certified to teach a high school-level CTE course...It's sad that a certification is holding them back. It's holding the kids back," she asserts. "Hopefully this will change as they see the successes in middle school." ●

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tary includes links to organizations that provide current, authoritative information about Zika.

Zika, like Ebola, can provide a context for discussions of how knowledge in science is generated and about the dynamic nature of scientific knowledge. During the Ebola outbreak, a concurrent epidemic of misinformation occurred. Science teachers can use such opportunities to stress the importance of examining the evidence for claims. In addition, scientific knowledge in general is too often portrayed as static. Given that knowledge about Zika is growing rapidly, examining what we do and do not know about the virus and what we are trying to learn will provide an opportunity for students to understand the science practice of constructing explanations.

Science teachers would benefit from vetted resources addressing the Zika crisis. Teachers have had numerous discussions and shared many resources on Ebola via NSTA's Learning Center discussion forums (*http://learningcenter.nsta.org/discuss*) and members-only e-mail lists (*http://bit.ly/1Wfo7IF*), and similar discussions have begun on Zika. NSTA will share resources as they become available and point teachers to key resources.

Resources on Zika

- Centers for Disease Control and Prevention: *www.cdc.gov/zika*
- The American Medical Association: *http://bit.ly/20b7Jcj*
- World Health Organization: *www.who.int/topics/zika/en*
- U.S. Food and Drug Administration: *http://1.usa.gov/1oFRTsn*

Connecting Zika to the *Next Generation Science Standards*

The Zika public health crisis offers a great opportunity for teachers to engage students in science discourse emphasizing scientific practices and content. One way could be to focus student investigations on the potential link between Zika and microcephaly in exposed fetuses. Exploration of this question could support student understanding of the middle school core idea, MS-LS1.B: Growth and Development of Organisms, and the MS-LS1-5 performance expectation to construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Constructing arguments about and possible explanations of the probable mechanism by which the Zika virus affects brain development would engage students in authentic science questions and demonstrate the rapidly changing nature of scientific knowledge related to Zika. This could be extended by studying ecosystems and the reproduction of mosquitos. Since we know that mosquitos are a major factor in spreading Zika, student research and exploration could focus on ways to reduce the population of mosquitoes. Student solutions, many using engineering design, might include draining ponds and pools, creating a system of nets, spraying pesticides, exploring genetic modification, and a host of other solutions. Life science standards at the middle school level, including LS2.A: Interdependent Relationships in Ecosystems and ETS1.B: Developing Possible Solutions, make a great connection. ●

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Sean Smith is the president of Horizon Research, Inc. David Evans is executive director of the National Science Teachers Association.

To Do or Not To Do: Rewarding Good Behavior

A recent informal *NSTA Reports* poll found science educators varied in their views of rewards-based behavior management programs. While some educators reported them useful, several noted they worried that extrinsic motivation was replacing intrinsic motivation and would lead to more problems later. More than half of respondents (53%) said their school does not have a school-wide reward system for behavior, although 62% said they do reward students' positive behaviors in their classrooms.

Thirty-three percent said they only reward positive behaviors that exceed expectations of good behavior. Eleven percent reported rewarding students who work positively with others, and 10% said they did so for students who stayed on task. Twenty-four percent said they rewarded other behaviors than those listed including "all of the above;" good behavior in the cafeteria, halls, and at recess; attendance at tutoring sessions; being respectful; and "everything." One respondent reported rewarding "whatever behavior needs reinforcing. [It] varies depending on [the] maturity level of [the] class and individual student."

Preferred rewards were tickets or coupons that can be saved and redeemed for special privileges (47%) and small treats (31%). A majority of respondents (80%) said they only gave rewards when they thought it was appropriate, not every time students exhibit good behavior.

Forty percent said they had tried a reward system but discontinued it. Their reasons for stopping included student disinterest, requests from administrators or school policy, cost, time, and general ineffectiveness.

Here's what science educators are saying about rewards-based behavior management systems:

Allows for positive attention for those attention-seeking students who strive to gain attention one way or another.—*Educator, High School, Mississippi*

By concentrating on positive behavior, the whole classroom atmosphere changed for the better.—*Educator, Middle School, Florida*

Can be helpful. Can be one more thing to manage.—*Educator, High School, Florida*

Counterproductive. I teach high school, and students who are used to that don't always transition well to a learning focus.—*Educator, High School, California*

Depends on the school and if the negative outcomes for extrinsic rewards are outweighed by the positive changes in students attitudes/behaviors. —*Educator, Elementary, California*

Doesn't make students good people. Doesn't work because it never gets to the root of behavior.—*Administrator, High School, Missouri*

Doesn't meet scientific research on reward systems. Dweck's research supports Montessori pedagogy [in which] no rewards are given. Children develop intrinsic motivation to learn. —*Educator, Middle School, South Carolina*

Extrinsic motivators only work as long as the rewards keep coming. Intrinsic motivation should be taught. —*Educator, High School, New York*

Focusing on positive behavior is more effective than on negative behavior. —*Educator, Middle School, Hawaii*

Good for K–6, but 7–12 students should know better.—*Educator, Middle School, Massachusetts*

Some students take it as [a] growing step; others do not care and make no effort to improve.—*Educator, High School, Ecuador*

I always believe in rewarding any positive behavior! I do not accommodate... negative behavior. I randomly reward good behavior because it is the behavior I desire. I guess it is a process that I picked up from psychology class in college. It has helped create an awesome environment in school and out of school.—*Educator, Middle School, Tennessee*

I am not a proponent of using rewards to reward behavior that should be naturally occurring. I feel that this will only encourage students to behave appropriately just for the rewards and not really for the behavior.—*Educator, Middle School, Pennsylvania*

I am not convinced that rewards yield the internal motivation we are looking for in our students, but they sure can make kids like a teacher more. —*Educator, Middle School, California*

I believe in the power of positive peer pressure and thus reward class behavior, not individual behavior.—*Educator, Middle School, Georgia*

I dislike classroom economies, so the school-wide program was a tough sell for me, but it works...I always give specific feedback with the "ticket." —*Educator, Elementary, Missouri*

If you are having management issues and you see students making an effort to change their behavior, then it can be a useful tool.—*Educator, High School, California*

I don't like them because you can never truly be fair in rewarding behavior. Kids are different and must be awarded differently based on their effort and ability to truly account for their actions. —*Educator, High School, Illinois*

I believe it must be school-wide and be based on standard criteria that all students are taught throughout the school year.—*Educator, Middle School, Florida*

I don't use it, unless it becomes necessary. Sometimes you have classes that just "don't get it." When you exhaust all other options, and you have certain students taking away learning time from others on a regular basis, you might have to pull out the reward system...I work in a really tough school. Many of my students come from poverty and really crappy "family" lives. Sometimes the "rewards" they get at school are the only positivity they will get all day. What's the harm in that?—*Educator, Elementary, California*

I have a classroom reward system, and it works well to keep students in younger grades behaving appropriately. They have to work as a class to

earn 100 points, and then get to go to the prize box for erasers, pencils, slap bracelets, etc.—*Educator, Elementary, Middle School, North Carolina*

I have read the results on rewards and am careful not to use it for academics. I believe students appreciate being noticed in a positive way.—*Educator, Middle School, Pennsylvania*

I make a big deal when someone completes a job to the best of [his or her] ability and shows great attitude. We give them a high thumbs-up, and we do various chants or high-fives. —*Educator, Elementary, Missouri*

I see no harm in using rewards in a classroom to motivate students to practice appropriate behavior. I consider my paycheck to be [a] reward. —*Educator, Middle School, Florida*

I think it's a good idea, but...I don't know if I have enough time/mental space to institute a system consistently and effectively. I already have so much to manage!—*Educator, High School, Maine*

I truly believe that the reward is in doing the right thing and behaving in the correct manner. The reward will appear in the form of better grades and better relationships with peers. Verbal praise and encouragement will go a long way, especially with younger students.—*Educator, High School, Florida*

It helps me keep order in my classroom, but it gets old quickly. I wish I could just get the kids to do what they need to do without it.—*Educator, High School, Michigan*

It is more effective than punishment. —*Educator, Middle School, California*

It's not effective in our [urban] culture. It leads to jealousy, teasing, bullying, and theft among the students. —*Educator, Elementary, Missouri*

Mixed feelings. Can be beneficial, especially for kindergarteners. We still keep focus on internal motivation and putting supports in place so the vast majority of students can succeed without the need for incentives.—*Educator, Elementary, Missouri*

Rewards-based behavior management is common in the behavior [management] world of psychology. I work at [an] alt[ernative] high school where we deal with a lot of behavioral issues. —*Educator, High School, Idaho* ●

Quotable

We gain our ends only with the laws of nature; we control her only by understanding her laws.

—Jacob Bronowski (1908–1974), British biologist, mathematician, and author

Teaching the Science of Aging


GRALAND COUNTRY DAY SCHOOL

Seventh graders from Graland Country Day School in Denver, Colorado, play croquet with seniors as part of an interdisciplinary unit and service project on Alzheimer's disease and aging.

> ***"It is important for science students to learn about aging and diseases associated with aging because they are more likely to be affected by [them] than in generations past."***
>
> **— Laura Stiles**

"I think it is important for science students to learn about aging and diseases associated with aging because they are more likely to be affected by [them] than in generations past. As we are living longer, there is a larger part of the population that will experience age-related diseases," says Laura Stiles, science teacher at Wakefield High School in Raleigh, North Carolina.

"Our current students will be the researchers, doctors, and caretakers of the affected individuals. We need to do what we can to prepare for their future careers and family obligations. Even if my students aren't going to study science in college, it is still important to me that they are science literate so they can make informed decisions in terms of things like health care and [when] voting," she contends.

Stiles co-authored a lesson plan, The Aging Brain: A Lesson on Alzheimer's Disease (available at the website *http://1.usa.gov/1SgrGOV*), as part of her participation in the Centers for Disease Control's Science Ambassador Workshop, an annual professional development workshop for middle and high school teachers.

"[W]e had a variety of lesson topics and had to select one. Part of the reason for me selecting the topic of Alzheimer's was that I didn't know much about it, and it was a way to learn while I created a new unit for students; there wasn't much available for high school students at that point."

While teaching seventh-grade life science in the Ladue School District in St. Louis, Missouri, Elizabeth Petersen—currently STEM [science, technology, engineering, and mathematics] Teacher Quality Initiative Facilitator for the Institute For School Partnerships at Washington University in St. Louis—taught her students about progeria, a rare, progressive genetic disorder that causes children to age rapidly.

"We were in the genetics unit, and the students got to pick a disease to research. Progeria was one of the diseases that was always the one that made kids go 'whoa.' They were astonished about it, and many wanted to know more after the students' presentations," she recalls.

Progeria was on the list of topics because "in grad school, I took a class on the science of aging, and there learned about progeria and did a major paper on it. I will never forget how interesting it was to learn about something I had never heard about, and of course, transferred that interest to the seventh graders.

"Now it fits in nicely with *NGSS* [*Next Generation Science Standards*] with growth and development, so I would probably put progeria along with several other disorders in growth and development in the elaboration phase of the 5E learning cycle," she explains.

Mark Gatlin, science teacher at Graland Country Day School in Denver, Colorado, developed an interdisciplinary curriculum on Alzheimer's disease. The unit, which involves science, math, art, and writing, is part of Graland's annual intergenerational service learning project in which seventh graders also meet regularly with residents of Sunrise Senior Living in Denver.

During the first week, "we focus on brain research. The students learn about the basic functions of the brain and [related] vocabulary," says Gatlin. Students use information from Inside the Brain: Alzheimer's Brain Tour, a section on the Alzheimer's Association's website (refer to this web page: *http://bit.ly/1SfS9Jj*), to study the brain and learn about the causes and treatments of Alzheimer's, he notes.

Gatlin and former student Anna Newman, who continued to study the disease in high school and college, created a list of more than 30 inquiry topics and questions about Alzheimer's and a disease that mimics it, Chronic Traumatic Encephalopathy. During the unit's second week, groups of seventh graders choose three of these topics/questions to explore and research. In week three, students give presentations to their classmates based on their research.

The unit concludes with an Alzheimer's Night during which students display the art they created and biographies they wrote about an elder in their lives to their families and the community. The event features guest speakers like Huntington Potter, director of Alzheimer's research at the University of Colorado Anschutz Medical Campus. "Because the students have learned so much about Alzheimer's, [Potter's technical description of the disease and research] is accessible to them, and students can ask him questions [and understand his answers]," says Gatlin.

Andrew Petto, senior lecturer in anatomy and physiology, teaches about the human life cycle, including aging, in a course for general-education undergraduates at the University of Wisconsin–Milwaukee. "I emphasize that aging is part of the normal life cycle, not a disease or disorder," he relates. "I emphasize that as people go through life, they take on different roles in society…, and that [loss of] physical strength, agility, and quickness can often be made up for by experience."

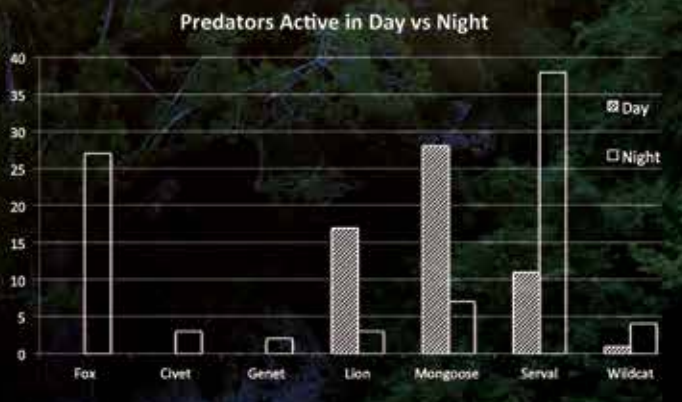
Petto uses what he terms "a biocultural approach: Humans exist only in social groups and contribute to [them] by serving in biological and social roles." Grandmothering, for example, "makes humans successful [because it] relieves a mother's burdens so she can help acquire more food resources or share knowledge, [which is beneficial from] an evolution perspective."

The course concludes with a trip to a cemetery. As they collect data on age there, students are surprised to learn there are 90- and 100-year-olds buried there. They learn that "the oldest people today are not living longer, [there] are just more of them living to old age," he points out. "I elicit misconceptions [like this one] and try to address them." ●

Teach Science with *Citizen* Science

New Web-based tools enable students to use trail camera photos of animals from Gorongosa National Park to ask ecological questions, form hypotheses, filter datasets, and make evidence-based claims.

WildCam Gorongosa



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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

The Mystery of Matter. This six-part PBS science series explores the human story behind the Periodic Table of the Elements and introduces some of history's extraordinary scientists. Viewers will meet Joseph Priestley and Antoine Lavoisier, whose discovery of oxygen—and radical interpretation of it—led to the modern science of chemistry; Humphry Davy, who made electricity a new tool in the search for elements; Dmitri Mendeleev, whose Periodic Table brought order to the growing number of elements; Marie Curie, whose groundbreaking research on radioactivity opened a window into the atom; Harry Moseley, whose investigation of atomic numbers redefined the Periodic Table; and Glenn Seaborg, who discovered plutonium.

At *The Mystery of Matter* website, educators can find resources to explore the series content in high school chemistry classrooms (click on For Teachers), including a Teacher's Guide that supports the *Next Generation Science Standards* (*NGSS*) and the National Science Education Standards, video clips from the series, and supplementary videos that address key chemical concepts and show chemistry at work in social and historical context. Refer to *www.mysteryofmatter.net*.

Life in a Nest. High-definition bird cams and four engaging activities from The Cornell Lab of Ornithology's BirdSleuth program are just what you need to hook K–12 students on science learning and the study of birds. Through the activities—Introducing Nesting Birds, From Nestling to Fledgling, Create a Field Guide to Local Birds, and Investigating Our Habitat—students learn about the different stages of a bird's life; explore bird habitats and map their own; and practice tracking bird behaviors and recording the data. Download the activities (registration is required) at *http://bit.ly/1qlA2Zm*.


JORDIFERRER

Maker Ed's Resource Library. Maker education—a movement focused on empowering students through learning activities that incorporate creativity and student-centered design and result in novel digital or physical creations—engages students of all ages, K–college, and helps prepare them for successful careers. At this website, teachers can access a host of resources to encourage the "makers" in their classrooms, including activities and tutorials designed for movement "newbies," research that demonstrates the impact of the maker education movement, and tours and descriptions of successful makerspaces. Go to *http://makered.org/resources*.

Discovering Farmland. Give high school students a first-hand look into agriculture, and teach them about critical issues in the industry, such as sustainability, the science behind farming, and entrepreneurship, with these lesson plans, activities, and videos from the U.S. Farmers and Ranchers Alliance and Discovery Education. The lessons support the *NGSS*, and the videos showcase real farms and the people who work on them, bringing the topic to life for students. Titles include Farming as an Industry, Educated Consumers, Challenges in Farming and Ranching, Professional Careers in Farming and Ranching, and Modern Farmers and Ranchers: Breaking Down Stereotypes. Refer to *http://bit.ly/207I7wX*.

Flipside Science. These media-rich video units from the California Academy of Sciences engage middle level students in discussions about critical environmental topics like food, water, and energy, empowering them to make a difference for the planet. Each video unit contains a combination of animations, infographics, and interviews with experts conducted by teens, along with supplementary activities and further readings for the classroom. Teachers can use the units to spark peer-to-peer dialogue and help students develop solutions-oriented thinking around environmental issues. Unit titles include Our Hungry Planet: Food for a Growing Population and Fresh Solutions: Water Use and Conservation. Learn more at *http://bit.ly/1SuZNj4*.

Engineering Inclusive Teaching Faculty Professional Development. This webinar series helps busy engineering educators engage all college learners in the field, but especially diverse women and underrepresented minority men. Learn anew or refresh your memory on the best practices for creating inclusive teaching environments, with guidance from social science experts and master engineering educators. The webinars

See Freebies, pg G2

Freebies, from pg G1

address topics such as unintended bias in engineering education; dealing with incivility or conflict in the classroom; active learning "live" and online; and a model for creating inclusive teaching environments. Visit *www.wskc.org/eit*.

***Common Core* Interactive Assessment Grid.** This tool is presented in the form of an Excel spreadsheet with all U.S. *Common Core State Standards* for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects, as well as Mathematics. Teachers can plug students' names into the grid and manipulate the data on it to examine students' progress or needs within various standards. Using the filters in different combinations will help teachers develop a deeper understanding of the *Common Core* and their students' strengths and needs. Explore the grid and how to use it at *http://bit.ly/22MQmUd*.

Gravitational Waves 101. This handy guide to gravitational waves and their ripple effects on our understanding of the cosmos was produced by the Perimeter Institute, a Canadian research hub dedicated to theoretical physics. The site offers a primer on gravitational waves: what they are, how they were found, and why they could lead to profound new understandings of our universe. Share the site with high school physics students to generate interest in the discoveries and to help inspire the next generation of researchers. Consult *http://bit.ly/1UBcZGL*.

CHEMSTEM. Check out the chemistry videos for students in grades 9–12 at *www.chemstem.com*. The website presents videos on many basic chemistry topics (such as atomic structure, isotopes, ions, nomenclature, chemical reactions, balancing equations, and gas laws and pressure), as well as videos with chemistry problems for students to solve (problem-solving videos are indicated by a plus sign [+]). Use the site for students' (or your own) self-guided, blended learning, studying, and review.

HENRIK ABELSSON

Dental Health Lessons. Kool Smiles, a national dental care provider for underserved children and families, offers a series of dental health lesson plans for preschool and elementary classrooms. The lessons—available for grades K–1, 2–3, and 4–5—can help students understand the link between food and candy and oral health issues like cavities and toothaches. The materials include printable activity sheets, experiments, and games. Download the lessons (registration is required) at *http://bit.ly/1SABxJU*.

Mass Extinctions: Lessons From the Past. In this eBook published by Howard Hughes Medical Institute BioInteractive, students examine the evidence and causes of mass extinctions and what they reveal about how humans are affecting the planet. Appropriate for high school and introductory college students, and available for iPad, Mac, and iPhone devices, the book explores the topic of mass extinctions through a combination of interactive graphics, animations, and videos. Learn more and download the book at *http://apple.co/1V9kXp4*.

Project-Based Engineering Lessons. The Instructables Workshop for Young Engineers offers a collection of project-based lessons for students in grades 5–9 that explore basic principles of physics and structural and mechanical engineering. Project-based learning is designed to promote investigation, critical thinking, and hands-on subject matter and allow students to control the direction and pace of their learning. Teachers can access video instructions for student model-building projects of many kinds that meet these criteria, including Slingshot Rockets, Rubber-band Helicopters, Extending Grabbers, Tornado Tower, Marble Roller Coaster, Simple Sail Car, and Truss Bridges. The projects can be used in after-school learning environments or in the classroom as enrichment activities. Check them out at *http://bit.ly/21Uo30y*.

Phenomena for *NGSS*. Phenomena—those "ewwwww, weird, oh man!!" science demos and other activities commonly shared in many science classrooms—can spark science interest and student curiosity, but they are not always academically productive. At the Phenomena for *NGSS* website, teachers can learn how to choose phenomena that anchor science units and engage students meaningfully in the science and engineering practices of the *NGSS*. When phenomena are used effectively, as a student digs deep into the phenomenon, he or she uncovers the core science understandings themselves rather than "learning about" these understandings. The website also includes a gallery of interesting phenomena and their descriptions. See *http://bit.ly/1oCgezn*.

U.S. AIR FORCE PHOTO BY EDWARD ASPERA JR.

WeatherSchool @ AAAS. This series of modules was developed by researchers at the American Association for the Advancement of Science to help middle level students explore how different factors—time of the year, location, or elevation—work together to produce the day-to-day weather of a local community as well as the overall climate for the specific region of the world where it's located. Each module contains a guided activity to illustrate a concept or weather pattern, an open-ended Try It activity to deepen understanding, Quiz Yourself questions to check student understanding, and Expand Your Knowledge links to learn more. Consult *http://weatherschool.aaas.org*.

Research Matters. Current science education research has vital implications for the classroom, but research journals and articles aren't always accessible to teachers. NSTA, in collaboration with the Alliance of Affiliates, is working to change that!

Each year, NSTA selects the best research from journals including *Journal of Research on Science Teaching, Journal of Science Teacher Education, Contemporary Issues in Technology Education,* and *Science Educator* for its Research Worth Reading list. A new podcast, Research Matters—hosted by the University of Missouri and co-produced by the National Association for Research in Science Teaching and NSTA—features conversations with researchers whose work was selected for Research Worth Reading. Authors discuss the significance of their work and how it applies to teachers' work in classrooms. Included with each podcast is a collection of resources for teachers interested in learning more and exploring how to apply these findings to their teaching.

The first two podcasts can be found at *http://bit.ly/1qEvdKM*. In Episode 1, Jennifer Hope and Joe Polman discuss their study of engaging students in creating science news stories and how this helped students cross the actual or perceived lines that divide students' home, school, social, and personal worlds.

In Episode 2, Kelly Ryu and Marcia Linn describe the use of dynamic visualizations and the impacts of generating versus reading scientific explanations on students' understanding of energy transformation during photosynthesis.●

News Bits

- **Teachers looking to present difficult science concepts simply will have a new tool this fall: textbooks with funny, easy-to-follow illustrations from web comic XKCD creator and former NASA roboticist Randall Munroe.**

The high school chemistry, biology, and physics textbooks, published by Houghton Mifflin Harcourt, will feature Munroe's signature stick-figure drawings with straightforward explanations of math and science concepts—many of which originally appeared in his book *Thing Explainer: Complicated Stuff in Simple Words,* which uses line drawings and the thousand most common words in the English language to explain things like nuclear reactors or the periodic table. The textbooks, to be released this summer, will also feature new comics, including one on how plant and animal life returns to an area devastated by fire, according to the *New York Times.*

Read more at *Quartz* (see the website *http://bit.ly/1VmI4MZ*) or the *New York Times* (*http://nyti.ms/1TvQ52i*).

- **Thanks to a grant from the Oklahoma State Department of Education, 80 teachers in northeastern Oklahoma will participate in a new mentorship program that provides training, content-specific instruction, observations, and workshops for new math and science teachers.**

Twenty mentors and 60 novice teachers will take part, and all will receive stipends. According to Xan Black, program director for the Oklahoma Innovation Institute's Tulsa Regional STEM Alliance, the goal is to help make new teachers more effective in the classroom and to retain them in the profession. In addition, she says, the program will provide a collection of resources for math and science teachers at every level and a framework for what kind of training works best for Oklahoma teachers.

"To me, the really exciting thing is the collaboration [among] all these partners to go after this grant," Black told *Tulsa World.* The group includes teachers from both public and private schools in urban, suburban, and rural areas of the state; the STEM Alliance, of which Black is part; the University of Tulsa; and various individual and nonprofit organizations. The $1.58 million Math and Science Partnership grant will be awarded over three years, giving program staff time to determine what is most effective for the participating teachers. The first mentor workshop will take place this summer. Read more at *http://bit.ly/1qoOEXQ.*

- **Are mealworms the answer to the plastic bag pollution problem? Some U.S. middle school students in Okinawa, Japan, think so.**

Eighth graders at Lester Middle School, a Department of Defense Education Activity school at Camp Lester in Okinawa, used mealworms to biodegrade plastic shopping bags after reading about similar efforts at Harvard and Beihang Universities with plastic foam. In those studies, the mealworms successfully biodegraded the plastic foam, and the fecal product of their munching was nontoxic.

"We thought, 'Why don't we try using plastic grocery bags instead,'" Lexus Haight, a student in Maryanne Tirinnanzi's science class, which conducted the experiment, told *Stars and Stripes.*

Haight and her classmates were right: The mealworms in their experiment broke down the petroleum-based polyethylene plastic shopping bags, and the fecal byproduct was also nontoxic.

The students hope their research will be used by schools, industry, and restaurants to reduce plastic bag pollution. They plan to submit their findings to Harvard University's *Journal of Emerging Investigators,* which publishes student work. See *http://1.usa.gov/1RVjfse.* ●

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NSTA National Science Teachers Association

What's New

FROM U.S. GOVERNMENT SOURCES

National Institutes of Health (NIH)

Healthy Vision Month

May is Healthy Vision Month. NIH's National Eye Institute (NEI) offers resources like eye-related posters, activity books, infographics, and fact sheets that teachers can use to promote eye health in elementary and middle level classrooms. Use the materials to conduct activities such as inviting a local eye care professional to your class to discuss the importance of eye health and safety; watching selections from NEI's Ask-a-Scientist video series (at the website *http://bit.ly/1RE0hjp*), which addresses topics such as color blindness and the science behind optical illusions; or creating an "Eye Spy" scavenger hunt/webquest that challenges students to find answers to vision and eye health–related questions. Refer to *https://nei.nih.gov/HVM*.

National Park Service (NPS)

WebRangers Website

The WebRangers website, found at *www.nps.gov/webrangers*, provides a safe environment for K–8 students to explore the environment, stewardship, and U.S. history. At the site, students can build a customized ranger station and participate in more than 50 interdisciplinary online activities supporting national learning standards.

Activities include Arctic Artifacts, in which students examine artifacts from an archaeologist's perspective, asking questions and using archaeological tools such as metric weights and measures to discover the historical past of arctic people. In Fire Story, students learn about the behavior of fire, including what ingredients are needed to start a fire (i.e., fuel, oxygen, and heat) and how environmental conditions such as fuel, weather, and slope affect the behavior of fire. In Rock Around the Park, students create a timeline to depict erosion over time and learn about the erosion processes of natural arches and canyons and various rock formations, such as mesas, buttes, and spires.

A teacher's guide explains how each activity correlates to standards in science, math, geography, language arts, history, and social science, providing elementary and middle level teachers with numerous options for incorporating the activities in classroom learning. See *http://1.usa.gov/1Sne551*.

National Science Foundation (NSF)

New Science of Innovation Videos

NSF and NBC Learn debuted six new videos in the Science of Innovation series. From 3D bioprinting that could generate heart tissue to origami-inspired structures built for space exploration, the videos highlight how innovation can turn fundamental science and engineering ideas into significant societal and economic impacts.

Most appropriate for middle and high school classrooms, the videos showcase trailblazing scientists and engineers and their inventions; their stories can inspire the next generation of inventors and promote an interest in science, technology, engineering, and mathematics careers. Visit the website at *http://1.usa.gov/1Ul1eUA*.

National Aeronautics and Space Administration (NASA)

African American Astronauts

This two-page fact sheet lists astronauts of African descent, providing short biographic profiles including their education history, mission(s), and hours flown in space. Share it to generate interest in space exploration and to encourage all students to pursue careers in space science. Refer to *http://go.nasa.gov/1q3qFgv*.

Elementary Robotics Activity

NASA uses robotic explorers to collect information about places where humans cannot travel. In I Want to Hold Your Hand, a classroom activity for students in grades 3–5, students build and test a robotic-like hand to discover how data can be collected from robotic technology. The lesson plan includes Background Information for Teachers, Concluding Questions, Extension Ideas, and an Answer Key. In addition, teachers can access a video of Robonaut2, a robot collaboratively built by NASA and General Motors that demonstrates hand dexterity. Visit *http://go.nasa.gov/1SdJJzj*.

U.S. Environmental Protection Agency (EPA)

Carl Gets Some Rest

This coloring and activity book teaches preK–2 students about transportation alternatives to using "Carl" the car, such as bikes, buses, trains, and skateboards, and the potential benefits for humans and the environment from using them. The book concludes with a parent page that discusses other ways to reduce the use of cars, such as carpooling and trip-chaining (doing several errands at one time rather than taking multiple trips). Consult *http://1.usa.gov/22FvCxC*.

U.S. Department of Agriculture (USDA)

SuperTracker Nutrition Lesson Plans

The USDA's Center for Nutrition Policy and Promotion, in conjunction with Team Nutrition, has developed SuperTracker, an interactive online nutrition tool and curriculum for high school students. SuperTracker helps teens think critically about food and physical activity choices. Students can get personalized recommendations for what and how much to eat and optimal amounts of physical activity; track foods and physical activity from a database of about 8,000 foods and 900 physical activities; set nutrition and fitness goals; and measure and share progress on social media.

The curriculum provides four standalone lessons to help students get comfortable using the SuperTracker tool: Track Your Snack, Three-Day Food Record, Build Healthy Meals, and What's Your Plan? Each lesson includes preparation steps, learning objectives, teaching instructions, and a handout for students to reflect on what they have learned.

Learn more at the SuperTracker website: *http://1.usa.gov/1pV9ONn*.

U.S. Patent and Trademark Office (USPTO)

Trademark Education and Outreach Website

Channel your students' "inner inventor," and help them develop engineering design skills with resources from USPTO's Education and Outreach website. At *http://1.usa.gov/1Mb8Mqz*, teachers can access activities, videos, links, and information organized by grade level to help K–12 students learn about intellectual property and how to protect it.

For example, elementary students can complete the *Trademark Activity Book*, which presents information about patents and trademarks through games, puzzles, quizzes, and fun facts. Middle level students can explore the patent process through the video *Extraordinary Innovations* and its accompanying guide, while high school students can learn about careers in the field through the video A *Day in the Life of a Patent Examiner.*

Teachers of all levels will appreciate the illustrated inventor cards, which highlight and recognize patent holders from diverse backgrounds and demographics. ●

In Your Pocket

Editor's Note

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

May 25–June 3

ASM's Living in a Material World Grants

The ASM Materials Education Foundation provides these grants to help K–12 teachers bring the world of materials science into their classrooms. Funds should help teachers bring awareness to the field and the role of materials scientists in society.

Twenty $500 grants are available. Applicants can contact local ASM members to help them develop innovative projects. Apply by **May 25;** see *http://bit.ly/1fAPQ2R.*

Duke Energy Foundation Grants

The foundation provides grants to support science, technology, engineering, and math (STEM) and early childhood literacy in communities where the company operates: in Florida, Indiana, Kentucky, North Carolina, Ohio, and South Carolina. Grants are available for nonprofit programs that build STEM knowledge and critical reading skills in schools, prepare STEM teachers, and provide students with out-of-school STEM opportunities. For the next deadline, the focus is on programs with community impact and cultural enrichment. Apply online by **May 31** at *http://bit.ly/18Y6mTF.*

SPIE Education Outreach Grants

SPIE, the international society for optics and photonics, provides these grants for optics- and photonics-related education outreach projects. Schools, youth clubs, universities, science centers, optics centers, industry associations, and optical societies are eligible for grants of up to $5,000. Projects are judged by their potential to impact students and increase optics and photonics awareness. Apply by **May 31;** consult *http://spie.org/x36692.xml.*

NEA Foundation Student Achievement Grants

The National Education Association (NEA) Foundation provides these grants to support NEA members at public schools and universities working to improve academic achievement and encourage critical thinking and problem solving in any subject area. Grants of $2,000 and $5,000 are awarded to programs that stimulate inquiry, critical reflection, and self-directed learning.

Some funds may be used to support professional development, but most should pay for student materials or educational experiences. PreK–12 public school teachers, public education support professionals, and faculty and staff in public institutions of higher education with NEA memberships are eligible. Education support professionals are especially encouraged to apply. Apply by **June 1** at *http://bit.ly/Xo4n8W.*

Escalante–Gradillas Prize for Best in Education

This $20,000 prize goes to one outstanding K–12 teacher whose efforts have helped students achieve remarkable academic success despite the challenges they face. Nominees should work in the United States and demonstrate a commitment to learning, discipline, character building, and high expectations for his or her students.

The winner will receive $10,000, as will his or her school. Nominate an outstanding teacher by **June 1** online at *http://bit.ly/1CFrBuu.*

NEA Foundation Learning and Leadership Grants

The foundation also provides funds for individual teachers and support professionals or groups of them through its Learning and Leadership program. Individual grants support participation in professional development programs, summer institutes, conferences, or action research. Grants to groups fund study groups, lesson study, action research, or mentoring experiences for faculty and staff.

Individuals receive $2,000 grants; groups get $5,000 grants. PreK–12 public school teachers, public education support professionals, and faculty and staff in public institutions of higher education who are NEA members are eligible. Education support professionals are especially encouraged to apply.

Apply by **June 1;** see the website *http://bit.ly/XMe5xB.*

National Weather Association's Sol Hirsch Educational Grants

The association awards these grants of up to $750 to help K–12 teachers improve meteorology education. Funds can be used to purchase scientific equipment; start school or community outreach programs; enhance or expand existing programs; or attend accredited courses, workshops, or conferences. Teachers, program directors, school district supervisors, or other individuals or groups seeking to improve meteorology education for K–12 students are eligible. Apply by **June 3;** see *http://bit.ly/14yMEPw.*

June 15–July 15

NAGT Outstanding Teaching Assistant Awards

This National Association of Geoscience Teachers (NAGT) award honors 30 outstanding teaching assistants (TAs) in geoscience education. Winners receive a one-year NAGT membership, which includes a subscription to the *Journal of Geoscience Education* and the *In The Trenches* quarterly magazine.

Both graduate and undergraduate TAs are eligible. Awardees must be nominated by the department chair or faculty member that coordinates TAs.

Submit your nominations by **June 15** at *http://bit.ly/10WLGZO.*

Mitsubishi Electric America Foundation's Grants for Youth With Disabilities

The foundation provides funds for innovative projects that help youth with disabilities develop the leadership and employment skills they need to succeed—particularly in STEM careers and environmental fields. Grants range from $10,000 to $75,000 for one to three years. Preference is given to projects that involve Mitsubishi Electric employee volunteers or their communities in Cypress, Garden Grove, and San Diego, California; Vernon Hills, Illinois; Northville, Michigan; Mason, Ohio; Maysville, Kentucky; Suwannee, Georgia; Cambridge, Massachusetts; Warrendale, Pennsylvania; Memphis, Tennessee; and Arlington, Virginia.

Submit a concept paper by **June 15** and a full proposal by July 1. Refer to *http://bit.ly/1eDT0l2.*

Presidential Awards for Excellence in Science, Mathematics, and Engineering Mentoring

The White House established this award to recognize people or organizations demonstrating excellence in mentoring members of underrepresented groups in STEM education and the workforce. Both individuals and organizations in public or private, formal or informal settings are eligible. Nominees must have five years of demonstrated mentoring experience and be U.S. citizens or permanent residents. Organizations must be located in the United States.

Sixteen winners will receive $10,000, a presidential certificate, and an invitation to the awards ceremony in Washington, D.C. Nominate yourself or a colleague by **June 17.** Visit the website *http://1.usa.gov/1MGOrcr.*

Pathways Within Roads to Reading Initiative

This initiative provides new books for circulation and story time in underserved communities. Public and private schools and their libraries,

nonprofit organizations, after-school programs, community centers, daycare centers, and licensed in-home daycare facilities are eligible; preference is given to those that provide remedial reading instruction and have been operating for at least six months.

Visit *http://bit.ly/1Y3QnMX* for details. E-mail applications by **June 30** to *bookdonations@pwirtr.org*.

ASM's Kishor M. Kulkarni Distinguished High School Teacher Award

ASM International, the professional society for materials scientists and engineers, provides this award to recognize the accomplishments of a U.S. high school science teacher who has made a significant and sustained impact on precollege students. The honoree will receive a $2,000 cash grant and up to $500 in travel costs to attend the ASM Awards Dinner.

ASM members can nominate colleagues for these awards. Suggested candidates include past recipients of ASM Foundation K–12 Teacher Grants and graduates of the ASM Materials Teachers Camp program. Submit nominations by **June 30** to the website *http://bit.ly/1fXOyJL*.

RBC Foundation's After-School Grants

These grants support nonprofit programs that provide structured and supervised after-school activities for K–12 students. Programs should aim to improve academic achievement; encourage relationships among home, school, and community; and assist at-risk or underserved communities. Those demonstrating a commitment to diversity and inclusion and have broad community support are preferred.

Programs with a minimum operating budget of $100,000 and an established relationship with an RBC Wealth Management employee or board member are eligible. Programs in the Minneapolis/St. Paul area can apply by **June 30;** those outside that area can apply by **July 15.** Visit the website *http://bit.ly/1EPY0kI*.

American Legion Child Welfare Foundation Grants

The foundation accepts proposals from nonprofit organizations that contribute to the mental, emotional, physical, and spiritual welfare of children through new or established programs designed to benefit youth. Grants are awarded for one year and must have the potential of helping American children in a large geographic area (more than one state). Apply by **July 15** at *http://bit.ly/HjcVTF*.

United States-Japan Foundation Educational Grants

The foundation awards grants to projects that promote stronger ties between Americans and Japanese, foster mutual knowledge and education, deepen understanding, create effective channels of communication, and address common concerns in an increasingly interdependent world.

The foundation welcomes Letters of Inquiry anytime during the year, but no later than **July 15** for the fall grant cycle. For more information, consult *www.us-jf.org*.

Apply Year-Round

The Awesome Foundation Grant

The Awesome Foundation provides $1,000 grants to projects that bring communities together. Awesome projects are defined as sparking "an instant of joy and delight and inspir[ing] a long-term hope for a more awesome future."

Anyone can apply, and requests are reviewed monthly by chapter location. For more information, refer to the website: *http://bit.ly/1dn0mKX*. ●

Summer Programs

Editor's Note

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

Haw River Herpetology Curriculum Workshop. In this free workshop from the Herp Project, a National Science Foundation–funded program promoting herpetological fieldwork for youth, participants learn how to run a formal or informal field ecology program. Meals, lodging, curriculum materials, and a copy of the Turtle Box Collection will all be provided. The workshop takes place June 10–12 at Haw River State Park in North Carolina and is limited to 24 participants. Apply at the website *http://bit.ly/1pKmN3T.*

Teacher Research Academy: Computational Modeling and Simulation. The Teacher Research Academy offers programs for middle and high school teachers and community college faculty at Lawrence Livermore National Laboratory (LLNL) in Livermore, California. This program will teach participants how to use NetLogo, a free open-source simulation software used to create computer models in science, technology, engineering, and mathematics classrooms. Level I (June 20–24) will introduce the concepts behind computer modeling and simulation and its real-world applications. Level II (June 27–July 1) will expand teachers' knowledge of programming with NetLogo.

Level III (July 25–29) is for teachers who have completed Levels I and II the previous summer. Teachers are encouraged to bring along two students to learn how to use NetLogo and how to teach other students to do so. Level IV is for those who have completed Level III the previous summer and will present their capstone project at the LLNL Summer Research Symposium.

Graduate credits are available. Learn more at *http://1.usa.gov/1QnubMN.*

Lunar Workshop for Educators. This free workshop for science teachers of grades 6–9 explores the latest discoveries in lunar science. Participants work with Lunar Reconnaissance Orbiter (LRO) scientists to explore the LRO facilities and learn how to incorporate LRO data into activities and lessons that help address common misconceptions in their classrooms. The LRO team will also follow up with participants during the school year to keep them abreast of new results and activities and to monitor their progress.

Inservice and preservice teachers may apply for this workshop, taking place June 27–July 1 at NASA's Goddard Space Flight Center in Greenbelt, Maryland. Participants receive a certificate and a letter of completion for 36 hours of instruction. Maryland teachers also get continuing professional education credits. Learn more at *http://go.nasa.gov/1UIwvBb.*

Introduction to Aquaponics Teacher Workshop. This workshop introduces K–8 teachers to aquaponics, the cultivation of plants and aquatic animals in a recirculating environment. Over two-and-a-half days at the Herring Gut Learning Center in Port Clyde, Maine, teachers will use the facility's small-scale greenhouse and hatchery and learn how to integrate aquaponics in the classroom through hands-on lessons and experiments. Teachers also receive curriculum materials and an aquaponics kit, including a tank, filter, pumps, planting materials, and a manual, for their classroom.

Two sessions are available: June 28–30 and July 12–14. Register by **June 28** at *http://bit.ly/23jbiiD.*

Teacher Research Academy: Fusion and Astrophysics. In this academy, Level I (July 6–8) introduces teachers to astrophysics, atomic physics, and fusion research, as well as the basic tools used in these fields, such as spectroscopy. Level II (July 11–15) provides more advanced instruction in astrophysical studies, gravitational physics, and general relativity. Level III (July 25–29) prepares teachers to work on a practicing research team in the field. At Level IV, they participate in an eight-week mentored research internship and present the results of their work at the LLNL Summer Research Symposium.

Attendees may earn graduate credits for the academy. Register online at *http://1.usa.gov/1pKhuRS.*

Teacher Research Academy: 3D Print & Design. This academy is designed for middle and high school teachers and community college faculty who want to incorporate modeling, design, and 3D printing into their classes or student clubs. Level I (July 6–8) teaches participants how to design and print everyday objects from their own computational models and provides an overview of the field of advanced manufacturing. Register online at the website *http://1.usa.gov/1MSAgMm.*

All Things Marine, a Summer Hands-On Experience. The Huntsman Marine Science Centre in St. Andrews, New Brunswick, offers teachers, families, and friends (age 10 and older) the opportunity to explore the Bay of Fundy and the diversity of life it supports. Participants collect and observe what they catch to explore the biodiversity of the area and learn about history, biology, and art in the process. The program is offered twice: July 6–8 and August 17–20. Learn more at *http://bit.ly/25wmaf4.*

NSTA 2016 Summer Institute: Implementing *Next Generation Science Standards*. This one-day institute is designed to help science teachers and administrators learn more about the *Next Generation Science Standards* and how best to incorporate them in the classroom and school settings. Sessions will be available by grade band and by content. This year's institute takes place on July 15 at the University of Reno in Nevada. Register online at *http://bit.ly/1SwZlRb.*

BioBuilder Professional Development Workshops. The BioBuilder Educational Foundation offers three-day workshops to help biology teachers incorporate engineering in their classrooms, labs, or science clubs. Participants leave the workshop with ready-to-teach lesson plans and 45 professional development points. Workshops will be held July 26–28 at Rockefeller University in New York City; Northwestern University in Evanston, Illinois; and Missouri University of Science & Technology in Rolla. During August 2–4, an additional workshop will take place at the Massachusetts Institute of Technology.

High school biology teachers, college instructors, and science club leaders may apply. Preregistration for all workshops is required; scholarships are available. For more details, visit *http://biobuilder.org/workshops.*

DREAM2Explore Workshop for Educators. This NASA workshop for grades 6–9 preservice and inservice science teachers focuses on lunar and planetary science, exploration, and how our understanding of these things changes as we gain new data from NASA missions. During July 11–15, teachers learn how to address common misconceptions about the Moon through hands-on activities and lessons. Participants also work with data and scientists from NASA's Goddard Space Flight Center in Greenbelt, Maryland.

Maryland teachers receive professional development credits from the state, and all participants get certificates of participation and letters of completion, along with the ability to "check out" meteorite samples during the school year. The DREAM2 Education Team follows up with teachers throughout the year and beyond. See the website *http://go.nasa.gov/1olTsM9.* ●

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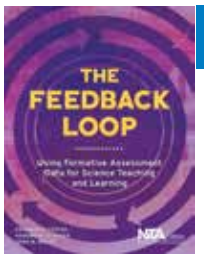

NSTA PRESS: *The Feedback Loop*

Chapter 1: Overview of the Feedback Loop

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 Feedback Loop, *by Erin Marie Furtak, Howard M. Glasser, and Zora M. Wolfe, edited for publication here. To download the full text of this chapter, go to* http://bit.ly/22rLpwp. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Our framework for interpreting data is inspired by the methods researchers and professional assessment developers have been using for years to design approaches for determining what students know and are able to do. Assessment developers never think just about the data they are collecting; instead, they develop assessments as part of a coherent process in which they consider what they want to assess, how they will assess it, what format the data will come in, and how they will interpret the data. There have been a number of ways that these processes have been described; for example, the National Research Council has an assessment triangle (Pellegrino, Chudowsky, and Glaser 2001), the Stanford Education Research Laboratory has an assessment square (Ayala et al. 2002; Ruiz-Primo et al. 2001), and the Berkeley Educational Assessment Research group has the BEAR assessment system (Wilson 2005).

No matter what you call them or what shape they're in, these systems have four elements in common. To start, they build on some form of the question "What is the goal?" Rather than just looking at data, these frameworks focus on assessing something specific. For a classroom teacher, the goal should be the guiding principle underlying what you are asking students to do. If students are doing a lab, what is the reason for it?

FIGURE 1.1 The Feedback Loop

Are you interested in them coming to know a particular science concept, or are you interested in seeing the kinds of science practices in which they engage? If you ask students to take measurements of water quality, such as pH levels and concentrations of dissolved substances in a local stream, is there a science practice goal, such as Obtaining, Evaluating, and Communicating Information, or are you more interested in supporting their learning of the crosscutting concept of Energy and Matter: Flows, Cycles, and Conservation?

This first step—being cognizant of the *goal,* or what you want to explore about your students' learning or your teaching—is the cornerstone of the Feedback Loop. Policymakers have dedicated a lot of time to working out what these goals are in the form of state or district standards, or more recently, the *Next Generation Science Standards* (*NGSS*; *NGSS* Lead States 2013). At the same time, you might have other goals that interest you about your own teaching that you wish to explore or strengthen, such as creating learning environments in which more students are able to participate in scientific argumentation or supporting students from diverse linguistic backgrounds in engaging in the language of science (e.g., Zembal-Saul, McNeill, and Hershberger 2012).

The second common element is considering the answer to the question "How will I know if students have met the goal?" This leads to considering what we call the tool, or the activity, protocol, or other "thing" you use to guide you in finding out what students know and are able to do. We use the term *tool* in the sense of an instrument that is used for a particular function, such as a meter stick to measure length or a spectrophotometer to measure wavelengths of light. In this case, we use a *tool* to find out what students know. In the Feedback Loop, the tools are the common instruments teachers might use to collect data about student learning, such as worksheets, classroom assessments, and quizzes, as well as an observation protocol used to write down student ideas overheard from small groups or even a tablet or smartphone used to record a lesson. It can also be something that is not written down or handed out, but that you plan to use to get students to share their ideas, such as a really good, open-ended question asked as students engage in a laboratory investigation. The important feature is that they should be aligned with the goal you intend to assess.

The third element of the Feedback Loop is *data*. Data are all the bits of information that can indicate what students know and that are yielded by the tools we use or create in our classrooms. Data might be students' written responses to worksheets or classroom assessments, a teacher's written notes about student ideas shared in a whole-class conversation or small-group work, or the students' verbal responses to that open-ended question. Although data might seem very formal and official, they can also be unrecorded and ephemeral, such as the looks on students' faces when the teacher asks a particular question or a tally of student responses on a sticky note to track participation.

The last—and arguably most important—element of the assessment development framework has to do with how you make sense of the data. Since these elements are connected, the process of making sense of the data is interwoven with your goals and the tools used. We call this process making *inferences* about what students know; that is, you're taking multiple pieces of data and trying to determine what they tell you about the goals. When you think about it, it's very similar to a scientist's reasoning. The individual pieces of information themselves don't necessarily make a whole lot of sense unless we consider why we collected them (goal) and what instruments we used to collect the data (tools). But if we consider them together, we can piece together an argument about what the data might mean.

What is important about highlighting these elements is that they should all be in sync with one another, and it is difficult to think about one element separately from the rest. We do not intend to suggest that the components should always be considered in a stepwise fashion; indeed, teachers often simply receive standardized test score data and must make sense of it. However, reflecting on the data along with the other three elements, rather than as individual pieces in isolation, empowers you to take ownership of what was being assessed in the first place, the nature of the tool that was used, and the inferences you can make from the data in hand.

After making inferences about what students know, the last step is to determine the implications for your teaching and supporting student learning relative to your learning goal. What have you learned about what students know and are able to do relative to the goal? If students have not yet met the goal, what subsequent activities might you engage them in to help them move closer to it?

We bring all of these elements together in the Feedback Loop. We represent them this way because thinking about one element in isolation misses the bigger context in which they are situated. For example, we find it impossible to think about data without thinking about why it was collected and the tool used to do so. Similarly, we find it difficult to make inferences about the implications any set of data might have about teaching and learning without considering why and how the data were collected. ●

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NSTA National Science Teachers Association

MS. MENTOR, **Advice Column**

Apprehensive About Teaching Science; Advice for a New Principal?

I'm nervous about teaching science. It was not my favorite subject in high school, and I took only the required courses in college. My elementary math-science methods course included science inquiry, but I had very few opportunities to do science activities during student teaching. Now that I'm on my own in a first-grade classroom, I'm not sure where to start.

—C., Washington

Many elementary teachers share your apprehension. Sometimes it may be due to a lack of background in science content or processes. A school's focus on reading and math may limit science (and social studies) to only a few minutes per week. I'm glad to see that you are thinking about providing time and opportunities for science investigations.

For starters, look at the science curriculum. What are the goals for first grade? Focus on content and activities related to them. Ask other teachers in your school what they do and if they're willing to share. Collaborating with your peers on science lessons can be a powerful form of professional development. Could your school provide time or resources for these collaborations?

If you have to design or choose your own science activities, take a deep breath and jump in with a simple activity…and another…and another. After each, reflect on what went well and what could be improved. Even something as simple as growing seeds or examining rocks can be interesting for students.

NSTA's *Science and Children* journal is a good source of lesson ideas each month (and you can search the back issues by topic). You could also provide opportunities for informal activities such as a collection of science-related books available for instruction, independent reading, or picture-looking; learning centers with a science theme and objects for students to explore (such as bones, butterfly larvae, shells, or rocks), materials they can manipulate and build with, or a classroom garden or aquarium; and incorporating science practices into math activities, including measuring and graphing.

The internet has resources to fill the holes in your content knowledge. Find out what kind of science or nature seminars or programs are offered at local museums, science centers, or libraries. These are usually informative, enjoyable, and may provide continuing education hours and opportunities to network.

Participating in a professional learning community through social media offers a timely way to get ideas and information. NSTA has e-mail lists and discussion forums related to elementary teachers, new teachers, and general science. Science teachers use many hashtags on Twitter, including #NSTA and #scichat. In these resources, you'll find colleagues eager to offer information, suggestions, and resources.

You might think, "What if I try an activity or investigation that goes wrong? What do I do?" You certainly need to

be prepared and organized, but if you don't try an activity or investigation until or unless you're sure it will be perfect, you're missing opportunities for you and your students to explore, learn, and reflect. Give yourself permission to make mistakes (and learn from them).

Our new principal doesn't seem to understand what it's like to be a science teacher. What can we do to "educate" him on what we do?

–L., Massachusetts

I posed your question to a colleague who is a middle school principal. In sharing some good insights and suggestions, he described how as a new principal, he had to get up to speed on English as a Second Language and Special Education requirements. He noted that teachers in other departments such as science, art, physical education, or music also had situations that were outside his teaching background.

It's hard for non-science educators to understand what science teachers do unless they've walked in our shoes. They may not be aware of the science teacher's responsibility for lab safety and security in storage areas. Sometimes principals see how organized you are and don't realize how much time and effort is behind the organization. My colleague suggested it might be helpful for your principal to see your challenges in a setting that is informative and non-threatening for him and non-evaluative for you.

Ask your principal to observe lab classes (bell to bell, not just a brief walkthrough). When you meet later, you can describe what students learn from lab activities with examples of student work, the amount of time it takes to set up and put away the materials and read a report from each student, the safety and cooperative learning procedures you taught students, and the fact that the students could not have done the activity in a "regular" classroom. Give him a guided tour of your storage areas, emphasizing the necessary safety and security.

Ask your principal to observe your formative assessments, including how students use science notebooks to organize materials and reflect on their learning. If your students are involved in projects, it would be helpful for him to observe these activities. Share a copy of the *Next Generation Science Standards* or your state's science standards.

All teachers use planning time for writing lessons and evaluating assignments. But your principal should be aware of the additional demands on your planning time. Keep a log of the amount of time spent setting up lab activities, ordering supplies, organizing and maintaining the storage areas, repairing or servicing equipment, and complying with local and state regulations. Show him the inventory of equipment and materials and the Safety Data Sheets you have to keep up to date. Also share the safety acknowledgement form you send home with every student.

Invite your principal to come to a department or team meeting to discuss any concerns. Frame your suggestions in terms of what is better or safer for the students rather than what is easier or more convenient for the teachers. For example, describe the hazards (and possible liability) of scheduling non-science classes in lab classrooms. If you think that homeroom or study hall students would interfere with your lab setups, suggest that you could take on a different duty. If you ask for more planning time, emphasize that it would be used for these additional responsibilities.

By being a professional colleague focused on student learning and safety, you may help your principal become the science department's best advocate. ●

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 TV

MythBusters—The End

By Jacob Clark Blickenstaff, PhD

I've written about *MythBusters* before (*http://bit.ly/1qoy3Uw*) during the series' 14-year run on Discovery Channel, which has announced the series' cancellation. I've given both praise and constructive criticism in the past, noting that co-hosts Jamie Hyneman and Adam Savage have done a great service to make science popular, but missed many opportunities to make the show more useful to science teachers.

I know teachers have been using the series in class, not the least of which for the explosions *MythBusters* can do that a teacher could never do safely in the classroom. Quite a few episodes could be used to illustrate isolation of variables because Savage, Hyneman, and co-hosts Grant Imahara, Kari Byron, and Tory Belleci were careful about controlling their experiments to only change one variable at a time. I also appreciate one of Savage's catchphrases: "The difference between science and messing around is writing things down."

In later seasons, they introduced more content that teachers could connect to classroom experiences and revisited demonstrations that fans thought they had gotten wrong in their initial treatment. Some episodes also included brief inserts that resembled a science notebook in which multiple data runs could be displayed, or rough force diagrams included. The writers began to include International (SI) units like Joules in addition to miles per hour and pounds of force.

For this column, I'll look at a couple of items in the "Grand Finale" episode, which included two major explosions and a rocket sled sendoff for Buster. ("Buster" is the crash-test dummy that took 14 years of abuse in the series. It has been dropped from great heights onto concrete and into the water, shot from a cannon, and launched by a cannon ball chained to its leg, and had clothing blown off of it innumerable times.) I'll return to the explosions, but will start by examining Buster's last ride.

They send Buster out with a bang by putting it on a rocket sled and smashing it into a concrete block wall. Imahara, Byron, and Belleci used the same New Mexico rocket sled facility in an earlier season to slice a car in half with a metal wedge. This time, Savage and Hyneman pose Buster as a superhero and see what happens when a supersonic crash test dummy hits a wall. They provide these numbers: The sled will be pushed by 10 rocket motors, each with 5,600 pounds of thrust, for a total of 56,000 pounds. The track is 1,000 feet long.

They later mention that Buster was going 780 miles per hour when it hit the wall, and the collision represented five million Joules of energy. (Minor issue here, they give the force and distance numbers in British units; the energy number in SI.) We have enough information here to do some interesting calculations, once we convert all the British units into SI.

Note that I am making rough conversions, as I have no information about the accuracy of the data provided. Please treat this as a "back-of-the-envelope calculation." I also use the physics definition of "work," a measure of the energy added to a system by applying a force. In this case, the rockets apply a force over a distance, and that adds kinetic energy to the sled.

The amount 56,000 lbs. is about 225,000 Newtons of thrust, and 1,000 feet is about 300 meters. With these two numbers, we can calculate the work done by the rocket motors on Buster and the rocket sled.

$$W = Fd$$

$$W = 225{,}000N \; x \; 300m = 67.5 \; million \; Joules$$

If all of that energy went into the kinetic energy of the sled, it would be moving at about 950 meters per second at the end of the track, or more than 2.5 times the speed of sound.

$$KE = \frac{1}{2}mv^2$$

$$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2(67.5 \; million \; J)}{150kg}} = 950\frac{m}{s}$$

I noted that the *MythBusters* report a speed of 780 mph, or about 350 meters per second, so where did all of that extra work go? The railroad track the sled went down has some friction, but more importantly, it takes work to push something through the air. The faster you go, the more wind resistance there is, so instead of getting to 950 m/s, the sled and Buster only made it to about 350 m/s. Another way of looking at the energy efficiency of this demonstration is that the rockets did more than 67 million Joules of work, but Buster only ended up with 5 million Joules of kinetic energy. That's about 7% efficiency.

This final episode included two very grand explosions. The first, of an old recreational vehicle (RV), is notable for the super high-speed camera they used to record it. Typically, their high-speed cameras shoot 10,000 frames per second, while this time they have one that records 50,000 frames per second, providing some neat details.

First, the inside of the RV lights up, as though someone turned on bright orange lights inside. Next, we see a shockwave propagating out as a distortion of the scene behind the RV. The force of the explosion temporarily compresses the air enough to change the speed of light in the air, bending it from the normal path. The compression is very short-lived, though, so the lensing effect travels out in a dome shape from the center of the explosion.

I am sorry that we'll have no more new episodes of *MythBusters* to look forward to, but past episodes feature many, many hours of cool demonstrations that teachers can use to illustrate isolation of variables and iterative design, or to share demonstrations too dangerous for the classroom. ●

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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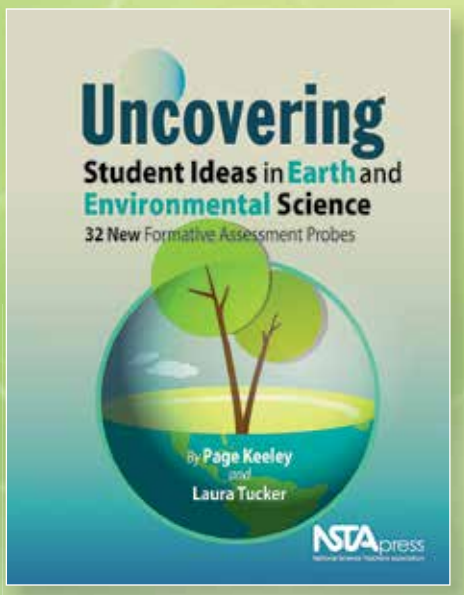

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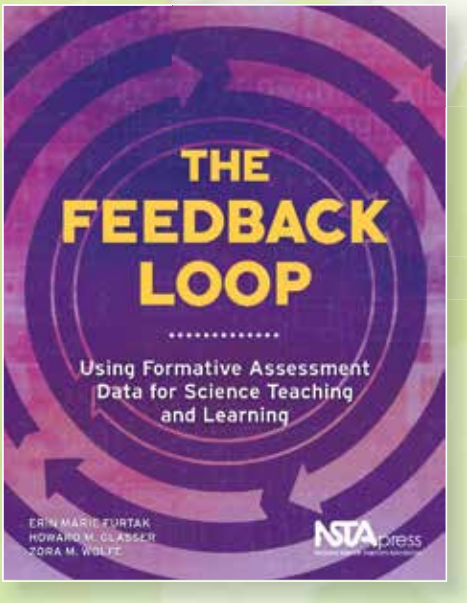

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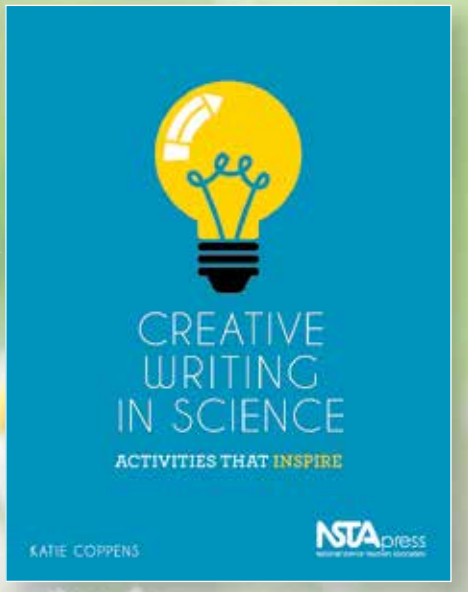

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#NSTA16 Recap

Whether you couldn't attend the 2016 National Conference on Science Education or want to revisit a few of the highlights, check out these online resources:

- You can watch attendee interviews, peer in to the exhibit hall, and catch highlights of Grand Hank's keynote speech, as well as NSTA's own Ted Willard showing off his juggling skills during a discussion of phenomena and the *Next Generation Science Standards* (*NGSS*) on NSTA's YouTube channel at *http://bit.ly/1Mw69zF.*

- NSTA members and staff shared their experiences on the NSTA Blog (*http://nstacommunities.org/blog*) and in photos in the Facebook album (*http://bit.ly/1XxAMVN*).

- Attendee Becky McKinney shared some of her favorite resources compiled at the conference on her blog, *NGSS* Made Me Do It, at *http://bit.ly/1XxATkc.*

- The *NSTA Conference Daily* shared memorable moments, such as Bill Nye's Planetary Society Lecture, If the Dinosaurs Had a Space Program, and featured upcoming key events to help attendees plan their conference schedules. Check out the archive at *http://bit.ly/1p13SRv.* ●