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To Teach STEM 9

NSTA Reports
National Science Teachers Association

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Striving for a Zero-Waste School

Taking actions to become a zero-waste school can be "a big pain," says Brian Shmaefsky, professor of biology and environmental science at Lone Star College in Kingwood, Texas. But he adds, "As an environmental scientist, I typically look at waste reduction because of budget concerns…Now [that] we can provide digital [assignments and tests] at school, it has really made a big difference in reducing paper costs. [We've seen a] 95% drop in costs."

While "budget cuts drive zero-waste efforts," he allows, "a cost-cutting mentality [must eventually be] replaced by a sustainability mentality."

In labs, says Shmaefsky, zero waste "gets tricky. Traditional labs use a lot of reagents, animal specimens, and disposables." He advises, "First try to do as much virtually as possible; students get the same effect without chemical and animal waste. With virtual labs, [students] can make an error and not have to start over. [After the virtual lab,] then do an actual lab, and [you'll] have less mistakes made by students."

In his school's chemistry courses, teachers "took a reduction approach [by using] smaller amounts of reagents per class. Or [they substituted] labs [for ones in which] some chemicals are reusable, versus [having] waste disposal. In simple procedures, [you can] reuse reagents," he relates.

Biology teachers found "a vendor that [sold] simple home kits with reusable, safe materials. Students could buy the kits instead of paying a lab fee," Shmaefsky contends. "When students are finished with the kits, as the group project, students could clean them up and donate them to schools that didn't have the materials. [Schools receiving donations] were particularly elementary schools; we gave them instructions to recycle or reuse the kits. Anything that had to be disposed of was environmentally friendly and in small amounts....

"A civic engagement project made our environmental science class very green. We became a recipient of trash; students collected trash and built their own environmental equipment. [For example, instead of throwing soda bottles in the trash,] they made Berlese funnels out of [the] bottles," Shmaefsky recalls.

At P.S. 333 Manhattan School for Children in New York City, K–5 science teacher Shakira Provasoli serves as sustainability coordinator and has spearheaded zero-waste efforts. Last year, when a kindergarten class discovered their classroom couldn't achieve zero waste because of the cafeteria food's packaging, she had the kindergarteners write letters explaining the problem, and sent them to the city's Department of Education's Office of Sustainability. When the city's departments of sanitation and education chose 100 schools to launch a zero-waste pilot program, her school was among them.

At P.S. 333 Manhattan School for Children in New York City, science teacher Shakira Provasoli encourages students to place recyclable materials in the recycle bin.

"It was the first year my school had a lot of resources and people devoted to zero waste," says Provasoli. "It was a lot easier to do because I was not the only one to promote sustainability."

A group of parents found a source of compostable trays to replace plastic foam trays, for example. "A waste disposal service agreed to pick up the composted trays for free if the school weighed [the amount of compost] for

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COMMENTARY: **Jamie Sachs**

Inclusive Education Inspires Good Student Citizenship

By Jamie Sachs

Jamie Sachs

Throughout my career—first as a teacher, then a principal, and now director of education for a nonprofit organization—I've grown to understand the significant impact diverse learning environments have on students. My personal experiences are within the science, technology, engineering, and mathematics (STEM) fields, but the principles of inclusive education can, and should, be applied to all subjects.

As we prepare students for their futures, in college and beyond, we owe it to them to expose them to individuals from a variety of socioeconomic and cultural backgrounds. It is our job as educators not only to teach our students the principles of science, but also to prepare them for the world ahead. And now, perhaps more than ever, we have to ensure our students are in environments that expose them to students of other races, ethnicities, genders, and religions, as well as students with mental and physical challenges. How do we expect young people to respect and understand differing attitudes and opinions later in life if they've never known people from other backgrounds? If we don't expose our students to diverse learning environments, we will perpetuate stereotypes, discriminatory attitudes, and homogenous thinking for generations to come.

I have heard many arguments against inclusive education, and disagreed with them all. Recently, I heard an argument for separating cultural groups within school systems. The idea was that it is logistically simpler for the school system when the majority of students have the same holiday schedule and students would feel more comfortable, and thus more able to learn. I strongly disagree with this notion for a number of reasons, including that research has shown that exposure to individuals with different backgrounds makes us more creative and harder-working—and it actually makes us smarter. By anticipating varying points of view, we change how we approach problems, share concerns, and propose suggestions. By instilling these values in our students and offering opportunities for them to work with others, we can inspire them to be good global citizens and prepare them for success in their professional lives.

I've often heard people advocate for separating children who need specialized attention, the rationale being that students with disabilities will benefit from personalized attention and lesson plans. I cannot argue that some students have disabilities so severe that they need specialized focus or accommodations, but I don't believe students must be 100% separate for 100% of the time. Evidence shows that the negative effects of separating children with disabilities from their peers far outweigh any benefit of smaller classes, and students with disabilities in inclusive classrooms show academic gains in a number of areas, including improved performance on standardized tests, grades, on-task behavior, and motivation to learn, according to the National Center for Education Restructuring and Inclusion.

I think the most compelling way to demonstrate the positive outcomes is to share real-life examples. Across the country, educators are going above and beyond to provide meaningful, rewarding learning opportunities to students of all backgrounds and abilities:

- In Seattle, Delaney Foster, a high school sophomore and FIRST Robotics team member, created Unified Robotics™ (see the website *http://unifiedrobotics.org*) after her learning-challenged sister expressed a shared interest in robotics. Unified Robotics helps bring together students of diverse populations and abilities as teammates and competitors on the field of play. All the students involved in this program, both participants and peer mentors, have undergone a transformation. Foster explains her vision as "creating the norm" in the future, when she and her teammates will be in leadership positions in STEM industries and actively promote neuro-diverse hiring policies and workplace accommodations and adaptations.
- In Texas, students at Coppell High School calling themselves Disruptive Innovation were inspired by their classmates with impaired speech, motor control, vision, and processing challenges to invent Gateways, an interactive training device. Working alongside students with various disabilities opened their eyes to the challenges others face every day. Disruptive Innovation designed their interactive training device to aid cognitive and physical development. Their inclusive education environment taught these students humility and compassion, and motivated them to be successful inventors and engineers.
- The Iowa School for the Deaf is launching a "reverse inclusion" program in which deaf and hard-of-hearing students in mainstreamed settings will start their own teams and invite other students to participate. The North East Regional Academy Deaf and Hard of Hearing Reverse Inclusion Teams are using a STEM Equity Community Innovation Grant from FIRST® (*www.firstinspires.org*).

When we force students with disabilities and those without to remain separate, we're doing a massive disservice to both groups. By providing students the opportunity to work with others, experience their differences, and put their education to work, educators are giving kids valuable life experience that will make them better global citizens. My hope is that educators across the country follow Foster's lead and "create the norm" in their classrooms. ●

Jamie Sachs is the director of education with FIRST®. To learn more about how educators are giving underserved and underrepresented students valuable access to hands-on and collaborative learning opportunities, visit https://goo.gl/CGSi4v.

NSTA Reports

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NSTA National Science Teachers Association

Zero Waste, From pg 1

a month…We went from 12 bags of garbage collected seven years ago to not even one full bag on the first day," she reports. "We're hoping to do this with utensils; we haven't eliminated plastic utensils yet."

Provasoli works with TerraCycle (*https://goo.gl/2xJxCt*), a program offering free national recycling solutions. "They send us a link for shipping labels for sending [food packaging waste] to them. We accumulate points that can be redeemed for money," she explains.

"My school has just adopted a zero-waste cafeteria [policy], and also enhanced classroom recycling," says Lisa Wininger, a science teacher at Plainwell Middle School in Plainwell, Michigan. "In the cafeteria, we took all the trashcans away, and took the dumpsters away; we use recycle bins instead," she explains. Because her school is in an agricultural community, "we recycle food waste for local pig farming. The students wanted to give food to the pigs. We really cut down on the amount of waste that has to go to a landfill: Food waste is down 90%; non-food waste is down by approximately 75%."

Wininger says her students are proud of their efforts to recycle and reuse. "It gives them a new sense of pride in themselves and their abilities, knowing they can make a difference in their community to effect change."

The National Oceanic and Atmospheric Administration's Climate Stewards Education Project (CSEP; see *https://goo.gl/Arl7fs*), "provided the impetus [for my school] to create a zero-waste plan," she relates. CSEP provides educators of elementary through university students with professional development, collaborative tools, and support for their zero-waste programs and connects teachers with a mentor.

"My mentor in Washington, D.C., Dale Glass, gives good ideas on [reducing our] carbon footprint," Wininger observes. CSEP presents free webinars, and "we can network online and give one another suggestions," she notes.

"We have a recycling club at our school, so both the students and I are trying to be zero waste," says Cindy Hopkins, seventh- and eighth-grade science teacher at Kaffie Middle School in Corpus Christi, Texas. "All of our projects must be done with recycled goods…[I tell students that our] bins should be full every day."

Teachers "have to plan for zero waste, have forethought. You have to explain it to students ahead of time. It's a constant thought about what goes into the recycling bin. The teacher has to be careful of what he or she throws out," Hopkins contends.

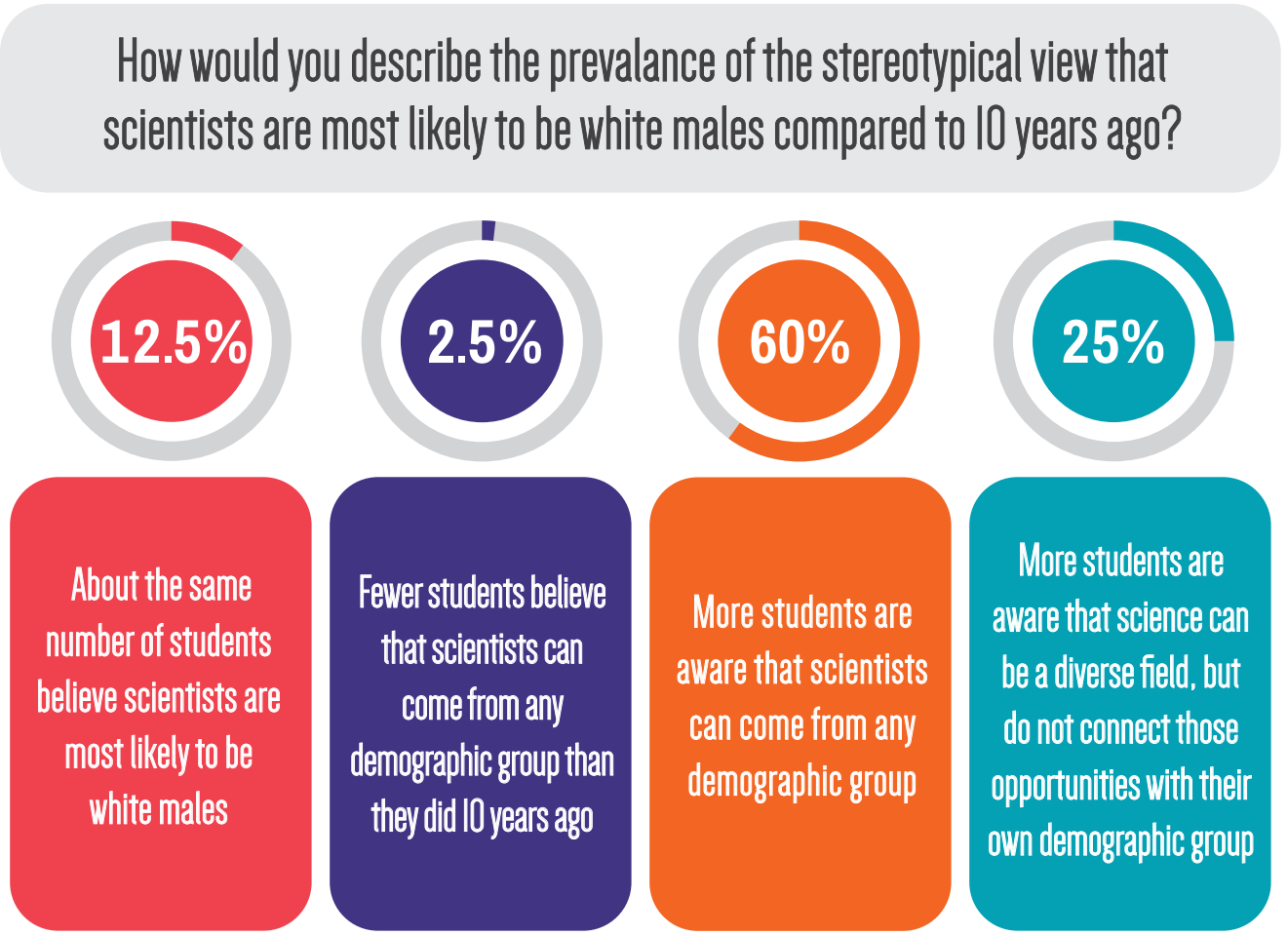
The benefit for students is "if we can do it here, you can do it in your home. It becomes a habit they can do at home," she asserts.

She adds that Communities In Schools of the Coastal Bend, a local nonprofit dropout prevention agency, "holds a recycling contest, and I require all students to participate. They learn so much when they do…This year, we're creating a poster, and one poster from the city will [be chosen to appear] on city dump trucks."

Rebecca Newburn, science and math teacher at Hall Middle School in Larkspur, California, has created a Zero Waste Challenge in which students analyze where they create waste in their lives, then devise a plan and implement it to reduce their waste. Her website for the challenge (*https://goo.gl/22ZzBs*) has suggestions and resources for becoming a zero-waste school or home.

Newburn also was a pilot teacher of KQED Learning's Engineering for Good, a three-week, project-based learning unit for middle school science classrooms that focuses on developing solutions to the negative environmental impact of plastics. In the unit, which supports *Next Generation Science Standards,* students use the engineering design process to define a problem, brainstorm solutions, develop prototypes, and iterate on their designs. As a final project, students produce videos about their solutions. Access the unit at *https://goo.gl/46CcMt.* ●

Scientist Stereotypes Eroding Among Students



Although a small majority of students still hold stereotypical views of scientists, many students have a growing awareness that anyone can be a scientist, according to science educators participating in an informal *NSTA Reports* poll. Fifty-five percent said their students see scientists as most likely to be white males. However, when asked to compare the prevalence of this belief to that of 10 years ago, 60% said more students are aware that scientists can come from any demographic group. But students don't always connect those opportunities with their own demographic group, according to 25% of respondents.

Half of respondents noted that minority and/or female students pursuing advanced or elective science courses in their school or district were underrepresented compared to overall enrollment, while 37.5% said the percentage of minority and/or female students taking these courses correlated to overall enrollment. Only 12.5% said a higher percentage of minority and/or female students take advanced or elective science courses compared to overall enrollment.

More than half (59%) reported their school or district did not offer programs targeted toward increasing the diversity of the students in science programs. Most (82.5%) said they incorporate lessons or use other teaching materials that encourage students of color and/or girls to study science and pursue science careers.

Here's what science teachers are saying about how they encourage students of color and/or girls to study science and pursue science careers:

[We practice] [s]tudent-driven, research-based learning [in which] the dreams of the student are allowed to be explored and achieved.—*Educator, High School, Washington*

All of my lessons are for everyone in every demographic. They should all be able to do all lessons no matter their gender, race, or nationality.—*Educator, Middle School, High School, Minnesota*

[One example is l]earning about Rosalind Franklin.—*Educator, Middle School, Kansas*

Teenage girls still feel pressure to identify as being squeamish about invertebrates and bodily fluids.—*Educator, High School, New York*

I don't really have specific lessons. I am constantly talking about women and people of color in science throughout the year.—*Educator, High School, Minnesota*

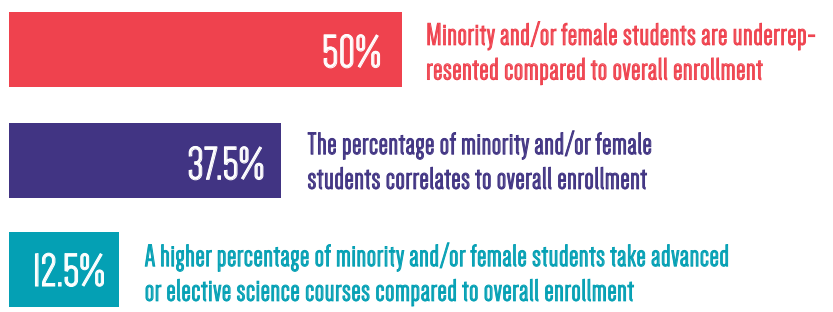
[We expose students to] SciGirls at [third- through fifth-grade] level. —*Educator, Elementary, New York*

[It's] important to consider what we explicitly teach, implicitly teach, and what we teach by omission, particularly when thinking about how to encourage girls to see themselves as scientists. —*Educator, High School, Colorado*

[I] preview instructional materials to [ensure they] show diversity. —*Administrator, High School, Nevada*

I desire to break the gender and racial stereotypes by asking my students often about gender and racial roles. —*Educator, Elementary, Minnesota*

How does the number of minority and/or female students pursuing advanced or elective science courses in your school or district correlate to overall enrollment?



I teach second grade. We have a Super Scientists and Inventors board in the classroom, and each week, I introduce a new person. I have picture cards that [I] put up on the board, along with picture cards with information on the back of them [that I place] in a center for them to write about them and how they impact their lives right now.—*Educator, Elementary, Minnesota*

[I] push all students equally.—*Educator, High School, Minnesota*

We use resource books that include multiple perspectives. We are also trying a biography unit [in which] students of color can read about scientists like themselves.—*Educator, Middle School, Minnesota*

[My class] did a study on women astronauts.—*Educator, Elementary, Oklahoma*

[I use v]aried [resources], e.g., NASA's Modern Figures.—*Educator, Institution of Higher Learning, North Carolina*

All students are treated equally, and an even cross-section [is] invited to attend outside programs.—*Educator, High School, Connecticut*

Women [s]cientists' biographies; science articles; current scientists of color; and especially women of all ethnicities' work is integrated into lessons [and] daily discussions, and related to labs we do.—*Educator, High School, Institution of Higher Learning, Colorado*

[I give] examples of non-white scientists.—*Educator, High School, Tennessee*

[I do v]arious STEM activities both in and outside of the classroom.—*Educator, Florida*

[I use b]ell-ringers on women in science.—*Educator, Elementary, Middle School, High School, Oklahoma*

I always encourage my female students to consider the fields of math and science. We are a predomina[n]tly Native [American] school, so they are exposed to opportunities; however, our school is small and underfunded.—*Educator, High School, Oklahoma*

Science careers are discussed, with a variety of people featured. I don't single out female or male, or minorities.—*Educator, Elementary, Connecticut*

I use myself as [an example of] a minority woman!—*Educator, High School, Oklahoma*

[I hold m]onthly STEM challenges and shar[e] biographies of diverse scientists.—*Educator, Elementary, Georgia*

[I] [c]onnect science to as many of their interests as possible.—*Educator, High School, Wisconsin*

I try to make sure my kids know that scientists are more than just the "Dead White Guys." (I'm white.)—*Educator, Middle School, California*

[I increase awareness t]hrough discussion, classroom resources, projects that increase familiarity of female and minority scientists and their work, and activities that help students identify their own biases in these areas.—*Administrator, Institution of Higher Learning, Arkansas* ●

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National Science Teachers Association

Building Tiny Houses to Teach STEM

After watching HGTV's *Tiny House, Big Living* series, which features homes of 500 square feet or less designed to be eco-friendly, Rita Maultsby, sixth-grade teacher at John Sinnott Elementary School in Milpitas, California, inspired teachers and students there to build a 200-square-foot house as a Project-Based Learning (PBL) science, technology, engineering, and math (STEM) project. "I've done [PBL] for years, and the new teachers said they wanted to do more of it," Maultsby explains, but "PBL can be overwhelming [to teach], and they didn't want to do it by themselves." Her proposal to build the house, and the opportunity it offered to "go deeper into the standards and expand students' critical-thinking skills,…got other teachers on board," she asserts.

High school teachers and students have also built tiny homes. In 2013, Brandon Cohen, former 12th-grade environmental science teacher at High Tech High School in San Diego, California, and his students built a 102-square-foot house. "The design and construction of the tiny house dovetailed with [my curriculum]" because students learned about concepts such as their carbon footprint; energy sources; and "the impact of construction on materials, water, and energy," he explains.

At Waldport High School in Waldport, Oregon, science teacher Melissa Steinman, co-teacher Greg Wood, and students in their Construction class are using grant funds to build a 200-square-foot house. The funds are part of a $384,000 Oregon Department of Education Revitalization Grant written by STEAM (science, technology, engineering, arts, and math) Department staff to develop Waldport's Career and Technical Education program. Steinman says,"When teaching students about design thinking as part of this grant, we didn't want to only teach them one skill. We wanted to teach [them] new habits of mind they could use on the job, [to consider questions like] 'What do you see as problems in the community?'"

Her students created eight proposals and presented them to the student body, who voted for the house to serve as a transitional home for homeless families in the school district. Steinman's students also are building a tiny home shell that will be sold "to meet a community need," she explains.

Building Foundations

Knowing they and their students couldn't build the houses alone, the teachers reached out to community experts. After getting approval from the Milpitas Unified School District for the project, Maultsby enlisted help from the district's director of facilities and modernization; Blach Construction, a local commercial builder and construction manager; and San Jose construction firm Duran & Venables. "[Blach Construction] had a warehouse with different stations for the students, with safety equipment, tools, and supplies. They taught students how to build," she explains. They also funded most of the project, and their staff donated their time to help build the house.

Last summer, Steinman prepared for the project by taking a two-week Tiny House Design/Build class at Yestermorrow Design/Build School. A Yestermorrow architect worked with her class on the blueprints. "We bring in industry experts who have very specialized tools for plumbing and electrical [work], so we only had to buy standard industry tools for this project," she relates.

"I had a general contractor helping during the first semester, when we were creating the shell of the house, and had architects [help with the design]," says Cohen.

Supervising Crews

Starting in October 2016, Maultsby's sixth graders worked with two third-grade and three fifth-grade classes on the project. "We wanted an age span… We wanted to see how third graders progressed with the aid of fifth and sixth graders," she relates. "We wanted to teach them how to collaborate.

"We had about 200 students, so not all of them could build at the same time. We did it in shifts," Maultsby recalls. "We put the students into building companies and had them [assume] the roles of CEO, Marketing Director, and so on. Other teachers and support staff were the clients, and the students had to write proposals and persuasive essays [and create] charts, graphs, and a digital floorplan" for their clients.

With help from community experts, teachers and students at John Sinnott Elementary School in Milpitas, California, built a 200-square-foot house that serves as an extension of the school's classrooms.

Cohen's students prepared for the project by doing a Home Consumption Study analyzing energy and water use and waste production. His Environmental Science course spanned two semesters, so fall semester students worked with the multimedia class to create interpretive signage and videos and design the shell of the house, while spring semester students collaborated with the engineering class to design systems within the house. "This helped students see that life is cross-curricular, especially in professions," he maintains.

Each semester, Cohen supervised 14 teams of three students each. "I tried to avoid 'team products;' students supported [one another] in critical thinking and research," he reports. In the flooring group, for example, each student evaluated the carbon footprint of a different flooring option.

Key to the project's success, says Cohen, is "providing daily expectations and holding students accountable for next steps…[O]nly 6 or 7 students can work under supervision, so an independent product needs to be initiated so that all students are engaged...." His students created blog posts about their work that he could check and that students could use to critique one another.

Steinman's students' "motto to build by is 'Teamwork equals 200 square feet of perfection,'" she observes. "We knew students would be frustrated at times; only three students had ever held a hammer before. The motto has helped students...believe they have something to offer" no matter their experience.

Tiny House, Huge Benefits

Steinman's house will be completed in fall 2017. "Our students are starting to understand what they're capable of. They're recognizing that they don't have the same feeling of accomplishment when they do everything digitally. They're questioning why our culture does some of the things it does, [such as emphasizing] having a large home," she reports.

"This was a truly robust cross-curricular project that mirrors adult life," concludes Cohen. "It showed students that environmental science is part of their life [because] they have to make decisions on how they will live, how they'll use energy, and what products they'll use."

The project "covered standards in many subjects," says Maultsby, and allowed students to see "that perseverance pays off." Her school will use the tiny house "as an extension of the classrooms" for future PBL projects. ●

Videos Enhance Teachers' Grasp of Standards

When states roll out new standards, reaching teachers with appropriate professional development (PD) materials is essential to implementation. In Birmingham, Alabama, Hermanda Cargill-Stanford, science program specialist with Birmingham City Schools, realized many elementary teachers weren't aware of the resources available to them through the district, despite having regular meetings.

"We were having once-a-month meetings with elementary and middle school teachers," Cargill-Stanford recalls. "When I was visiting schools, I found not all teachers [were] getting the information [from the monthly meetings]…many were not even aware of the materials I was sending to the schools. At the same time, I was getting phone calls from teachers and principals asking for help.

"I was averaging 50–60 teachers in a meeting…Those numbers were good for coming to a meeting," she says, but she couldn't help comparing that to the number of teachers in the district. "In my mind, I was wondering, 'What about the ones who are not here?' I had to come up with another way to impact more teachers, to make a difference in those classrooms for those students."

Cargill-Stanford took "ownership" of the fact that information was not reaching all teachers, creating Science on Demand to supplement the in-person meetings. This series of PD videos help Birmingham teachers prepare for the new state standards. "Does this process eliminate [dissemination problems]? No, but more principals are aware; more teachers are aware of what's available. [This was] good timing with the new standards coming along. We were able to start over with these new things at the same time," she asserts.

The first series of videos was an overview of the district resources for elementary and middle level teachers. In the second series, Cargill-Stanford modeled activities, including using the NSTA Press Picture-Perfect Science Lessons book series and the 5E instructional methods. The third video series focused on engineering standards and using the Engineering is Elementary (EiE) format.

"Teachers can watch the videos at their own pace" in faculty meetings, during planning periods, or on the weekend, Cargill-Stanford points out. In the videos, she asks teachers to reflect on how their current practices might relate to a new standard. The format allows teachers to pause the playback and discuss the content with colleagues if they are watching a video during a professional learning community (PLC) meeting. When the video resumes, Cargill-Stanford would give her own "brief answer, and then say, 'Now let's look at the materials' and show a module that would support students mastering that standard. This was one way of getting information out."

Cargill-Stanford released a new Science on Demand video every week during the 2016–17 school year. Some were grade-level specific; others covered a range of levels. "This didn't take the place of embedded PD; they still had full-day or two-day PD [programs]," she explains. "The videos are a way to get PD out on a regular basis, and limited the need for [teachers] to come to PD after school.

"It required a lot of me. I had to create scripts, be in the studio…A video-recording day could go from 8:30 to 2:30. I would try to [record] two to three shows a week," she adds. Recording the videos in advance helped her maintain the schedule she had planned for the year. She would also meet with principals and lead teachers to share the video schedule and "walk them through the district website" to ensure they could access the videos.

"We are going to continue to use these videos. And we're going to another stage: We're going to take [filming] the videos to the classroom and have teachers model [their practices]. We'll stream them live and archive them [for those who can't watch the live stream]," Cargill-Stanford says. "I'm going to train [teachers] on the EiE modules. They're going to take those lessons, and they're going to teach those lessons with their students. It will hopefully make the process more meaningful."

Most Science on Demand videos run 30–40 minutes. Teachers complete a sign-in sheet and a survey that they e-mail to Cargill-Stanford to receive district PD credit. "There's not 100% participation," she admits, "but they are more aware now of the services being provided. They know what resources are available for them, and there are multiple options to share information…We are planning to get data this year on the impact in the classroom."

TSTA Goes *Inside the Science Teachers Studio*

To the north, the Tennessee Science Teachers Association (TSTA) "decided to take the bull by the horns" to help teachers prepare for the state's new science standards, declares Margie Hawkins, sixth-grade science teacher at Winfree Bryant Middle School in Lebanon, Tennessee.

"The new standards we will be implementing [in 2018–19] are based on *The Framework [for K–12 Science Education]*. It's a new way of teaching and learning here in Tennessee," says Hawkins, who also serves on the TSTA board. "We decided as an organization we need to get teachers ready…so they would really embrace them and do well with [the standards]."

TSTA President Linda Jordan, a former science coordinator at the state department of education, proposed an adaptation of the *Inside the Actors Studio* television series format: a live stream of Tennessee science teachers in their classrooms as they discuss the use of particular strategies with students. TSTA partnered with the Oakley STEM [science, technology, engi-

neering, math] Center at Tennessee Tech University to produce the online PD. The first video was recorded in 2015. The live stream interviews are archived on the TSTA website.

"We wanted to focus on the *K–12 Science Framework*," says Jordan. "This is our opportunity to familiarize teachers with the use of practices described in the *Framework* and make science more meaningful for students. The teacher interview serves to familiarize audiences with a particular approach." During the *Inside the Science Teachers Studio* interview, clips of students are shown to illustrate how the particular strategy is implemented in the classroom. "That's enough to hopefully whet teachers' appetites for learning more about the strategy," Jordan adds.

"The videos are short enough for teachers to watch them in a PLC meeting and have time to discuss how it might improve their instruction and how it would look in their classrooms," proclaims Hawkins. "For me to see this new PD format, it's exciting, energizing. It's different from what I've seen done. You can watch the videos as a team and collaborate on how to use these strategies. If you want to know more about these practices, you also have the option to attend a Saturday pop-up."

TSTA is providing one-day "pop-up" conferences, which usually include two or three sessions, to expand on the strategies presented during the *Inside the Science Teachers Studio* web seminars. According to Hawkins, the presenters—often the same teachers who participated in the live stream—"model the class [so attendees can] see how it could work…Because [attendees] have the background from the webinar, [presenters] can go through the setup pretty quickly. They model how it works. [Teachers have said that the] one overriding thing they need is someone to model for them." These pop-ups have been held in eastern and middle Tennessee, with more being planned for the western part of the state. ●

Quotable

I'll believe anything, no matter how wild and ridiculous, if there is evidence for it. The wilder and more ridiculous something is, however, the firmer and more solid the evidence will have to be.

—Isaac Asimov, Russian-born U.S. writer and biochemist (1920–1992)

SAVE THE DATE

NSTA NATIONAL CONFERENCE ON SCIENCE EDUCATION

Atlanta, Georgia | March 15-18, 2018

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Comprehending the Role of Literacy in Science

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National Science Teachers Association

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies page G1

What's New page G3

In Your Pocket page G4

Freebies for Science Teachers

***NGSS* Demystified. K12** This online toolkit is designed for K–12 teachers, administrators, curriculum leads, and others charged with training K–12 educators on the *Next Generation Science Standards* (*NGSS*). Developed by the California Academy of Sciences, the toolkit presents an overview of the *NGSS* along with activities and training videos for teachers that offer an in-depth look at the standards from the basics of performance expectations to an examination of the standards' three key dimensions: science and engineering practices, crosscutting concepts, and disciplinary core ideas. The activities can be used together, combined with other materials, or as stand-alone resources. Learn more at *https://goo.gl/797uw5*.

Science Video Worksheet Guides. K12 Students love to watch popular science videos from favorites like Bill Nye the Science Guy, but how do you help students stay focused and retain content while watching the programs? At StarMaterials.com, K–12 teachers can access video worksheets to accompany more than 200 physical, Earth, and life science videos from series such as Bill Nye, *Magic School Bus,* and *NOVA* Science. Each worksheet includes 15 fill-in-the-blank questions on the video's topic along with thought-provoking statements for students to complete, such as, "Three things I knew that were confirmed in the video…." and "Three things I didn't know, but now know because I watched the video…." Many of the guides include versions with word banks for students who need additional help to complete the task. View the video guide index at *https://goo.gl/RJK7PR*.

JIM1138

STEAM Activities for K–8. E M The Smithsonian and Lenovo have developed science, technology, engineering, art, and math (STEAM) activities that combine the Smithsonian's digital resources and hands-on projects. The projects, which are most appropriate for grades 5–9 but can be adapted for use with older and younger students, address a range of science and art topics and include activities such as drawing a 3-D insect model based on a specimen from the Smithsonian's National Museum of Natural History; creating an art-making robot using batteries, motors, and whimsy; combining circuitry explorations and fabric to create wearable tech; and researching the Wright Brothers' engineering skills and using that knowledge in digital interactives. The projects can be completed in a classroom setting, but also work well in after-school environments. Read the project descriptions and access the project guides and teacher's guides at *https://goo.gl/1w20o5*.

Newton's Second Law of Motion App. H Produced as part of Polyhedron Learning Media's High School Virtual Physics Lab series, this app for iOS uses a laboratory cart and pulley to investigate the relationships between the force applied to an object and the mass and acceleration of the object. In addition to a 3D simulation that produces realistic data, the app includes introductory videos, background theory, experimental procedure, analysis and reporting tools, pre-lab quiz, post-lab questions, and teacher support materials. The app can serve as a replacement for hands-on labs, especially when equipment is unavailable, or as a supplement to a hands-on lab. It also provides an option for students in distance-learning situations. Consult *https://goo.gl/csrt2z*.

Climate Change PBL Unit for Sixth Grade. M Developed by middle level educator Rebecca Newburn, this project-based learning (PBL) unit for sixth graders—Face, Place, Story: The Stories and Science of Climate Change—incorporates the use of interactive science notebooks and involves students in real-world research and solutions. In the unit, students select a region of the world where the human community is being visibly impacted by climate change and analyze a meteorological disaster that occurred there (e.g., hurricanes, sea level rise, etc.) through the lens of climate change. In this way, students learn about climate change's impacts and the need for strategies to mitigate it. The unit's final product is an individual action plan to reduce carbon and a class project addressing climate change that will have a tangible impact on the school or local community. Refer to *https://goo.gl/viwx24*.

See Freebies, pg G2

P: PreK E: Elementary M: Middle H: High HE: Higher Ed A: All K12: K–12

Freebies, From pg G1

Allergies and Scientific Inquiry. M This digital curriculum developed by the Biological Sciences Curriculum Study (BSCS) in collaboration with Dawson Media Group teaches middle level students (grades 5–9) about food allergies through a series of five lessons. In the lessons at *http://allergies.bscs.org*, students assume the role of medical students rotating through an allergy clinic as part of their training. Topics explore what a food allergy is, how to tell if someone has a food allergy, what causes the symptoms of a food allergy, how to manage a food allergy, and how to create a food-allergy management action plan. Each lesson includes an instructor guide as well as student handouts and supplementary materials. (*Note:* Free registration is required to access the curriculum.)

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Ocean Tracks! H HE This program from the Oceans of Data Institute enables high school and college students to work with authentic data sets to study the migration patterns of large marine species and make connections between animal movement patterns and characteristics of the ocean environment. Through five learning modules, students learn to navigate the user-friendly Ocean Tracks! interface (Module 1); measure animal tracks to identify feeding behavior (Module 2); locate areas of high biological activity in the Pacific Ocean (Module 3); find interactions between human activities and marine animals in their hotspots (Module 4); and design a mobile sanctuary to protect marine species based on knowledge acquired in previous modules (Module 5). Watch an introductory video about the project and access the modules at *https://goo.gl/iii65t*.

Totality. K12 Want to witness the 2017 solar eclipse? This educational app from Big Kid Science will tell you when, where, and what you'll see on eclipse day, August 21. The app—available at *https://goo.gl/eH7EqA*—provides navigation tools to help users of all ages find the best route to the path of totality, as well as resources to learn about safe viewing and how eclipses work. In addition, the app has eclipse-related activities for K–12 students and families, such as making a pinhole camera to explore optical principles and view the eclipse on eclipse day (grades 3 and older), creating a work of art based on pinholes in Dynamic Art Activity (all grade levels), or learning tips and tricks to successfully photograph the eclipse using a phone camera, Single Lens Reflex camera, or telescope (grades 5 and older). Activities for older students (grades 8–12) explore how eclipses occur and the principles of shadows.

SciCheck. M H This science-related arm of FactCheck.org, a consumer-advocate website developed at the University of Pennsylvania's Annenberg Public Policy Center, focuses on investigating false and misleading scientific claims made by partisans to influence public policy. Since SciCheck's addition to FactCheck.org (*https://goo.gl/USy158*) in 2015, more than 100 public speeches and other scientific claims and reports have been analyzed for accuracy and posted about on the site. Recent articles include "FactChecking President Trump's Climate Speech," "The Facts on E-cigarettes," "Land Loss in Louisiana," and "Has Autism Prevalence Increased?" Most appropriate for middle and high school levels, the website shows students why it's important for citizens of all ages to be scientifically literate and be able to evaluate claims on their own, and thus make better, more informed decisions for themselves and the planet.

***NGSS* Card Decks.** M H Created for professional development leaders at middle and high school levels, the cards are part of Tool 1 of the Five Tools and Processes, a set of resources developed collaboratively by the American Museum of Natural History, BSCS, and the K–12 Alliance at WestEd to help educators better understand the *Framework* and the *NGSS* and learn how to translate any middle school or high school standards page into instruction and classroom assessment. The *NGSS* Card Decks aid teachers in making their own meaning from an *NGSS* standards page. Manipulating the cards—which are color coded by *NGSS* and formatted to be printed directly onto Avery notecard stock (i.e., one "element" or bullet per card)—allows teachers to more easily map out learning goals for a unit. For more details about the cards and how to use them, along with additional information on the Five Tools and Processes, visit *https://goo.gl/wxI0tI*.

ROGILBERT~COMMONSWIKI

The Sun, the Moon, and Us. M H HE In this hour-long video lecture, Scott McIntosh, director of the National Center for Atmospheric Research's High Altitude Observatory, shares his expertise and excitement about the Great American Solar Eclipse, taking place on August 21. He discusses the Sun and its layers, why we study the Sun, and what we can learn from it—as well as how a total solar eclipse occurs and how viewers can participate in the *Eclipse Megamovie 2017*. While the lecture was recorded for an adult audience, the content is suitable for students ages 12 and up and for astronomy fans of all ages. Visit *https://goo.gl/BWX1gd*.

1, 2, 3, Stay Away Mosquitoes! P E Join Muppet friends Grover, Ernie, the Count, and Rosita as they raise awareness and share critical information about how to prevent mosquito bites in this digital toolkit from SC Johnson

ANDERS BJURNEMARK

and *Sesame Street*. Targeted for early childhood teachers and caregivers, the toolkit contains videos, activity sheets, and tips for parents on how to protect your house and surroundings from mosquitoes. The toolkit, available in both Spanish and English, can be downloaded at *https://goo.gl/IakpFc*.

Career in STEM. P K12 For *NGSS*-supported resources to encourage STEM career exploration for preschool learners to high school graduates, see *http://careerinstem.com*. Early childhood educators can register for the PreK STEM-a-Day Challenge to receive 52 days of hands-on summer STEM activities for young learners, delivered to their inbox. Middle and high school students can select the Search Careers tab to access a video, career information sheet, and an online simulation about numerous STEM careers in Earth and Space Science, Life Science, and Physical Science.

Wow in the World. E A new podcast series about the coolest new stories in science and technology was launched by National Public Radio for students ages 5–12 and their families. Hosted by radio personalities Guy Raz and Mindy Thomas, each episode begins with a series of questions that lead to an explanation about a new scientific discovery or finding, such as "How long would it take to get to the closest star outside our solar system?" or "How did we Homo sapiens come to dominate the planet?" or "How do astronauts poop in space?" Comedy and conversation, along with the voices of real kids, make the news fun and interesting. Listen to it at this website: *www.wowintheworld.com*. ●

What's New

FROM U.S. GOVERNMENT SOURCES

National Institutes of Health (NIH)

GeneEd H

Revisit the National Library of Medicine's GeneEd for new resources (see (*https://geneed.nlm.nih.gov*). Targeted primarily for high school students and teachers, the website offers genetics education resources organized by Topics, Labs, Teacher Resources, Career Information, and Highlights (news). Recent additions to the Topics page include articles, interactive tutorials, and teacher resources for exploring the role of genetics in influencing behavior and identity and for exploring precision medicine and pharmacogenomics. (Precision medicine is a modern approach to health management in which treatment and prevention approaches are identified based on a person's genetic, environmental, and lifestyle factors; similarly, pharmacogenomics, part of precision medicine, examines how genes affect a person's response to drugs.) To access the new materials, click on the Topics tab, go to Top Issues in Genetics, and select the links Genetics, Behavior and Identity, or Precision Medicine.

In addition, the Teacher Resources section has three new guides for teachers and parents of children with genetic conditions such as Down Syndrome, Sickle Cell Disease, and Cystic Fibrosis. The guides were produced by the Genetic Education Materials for School Success (GEMSS) organization, which works to help children with these conditions succeed in school and life. To access the guides, click on Teacher Resources, then Genetic Conditions.

National Science Foundation (NSF)

STEM for All Video Showcase 2017 K12 HE

At *https://goo.gl/GEzfX9,* teachers will find more than 170 videos highlighting science, technology, engineering, and math (STEM) initiatives funded by NSF and other federal agencies. The videos cover topics in science, engineering, computer science, math, computational thinking, standards, and professional development, and they describe initiatives for students of all ages, K–college. Search for videos of interest by keyword, grade level, audience type, or other parameter, such as the "starred" videos recognized as favorites during the online showcase event held in May. Projects as diverse as *Designing Field-Based Learning in the Geosciences, Minds That Build* (i.e., spatial cognition research with blocks), *Constructive Dialog About Climate Change* (a model for professional development), and *Creating Opportunity in an Inclusive STEM Agricultural High School* convey the message that STEM really is for all!

National Park Service (NPS)

Learn NPS A

The NPS has created a department for teachers and learners of all ages. Learn NPS offers a myriad of resources and opportunities for teachers and classrooms. Even if no national parks are located near your school, many online activities and virtual field trips are available. Visit *https://goo.gl/eLOaO1* to search for educational materials and experiences by keyword or by subject (science, math, literacy and language arts, and social studies), grade level (lower elementary through adult), and *Common Core* standard.

Once you've selected an initial search, use additional filters on the left to narrow the results. A keyword search of "virtual field trips," for example, revealed distance learning adventures including two field trips exploring New Mexico's Petrified National Forest and a webquest to learn about Arizona's Sunset Crater Volcano.

National Aeronautics and Space Administration (NASA)

#CassiniInspires A

During nearly two decades, NASA's space probe Cassini has returned thousands of images of Saturn's moons and rings. In September, the Cassini mission will conclude. To celebrate its success, NASA is seeking creative works inspired by Cassini's Mission to Saturn. The creations can be in any medium—writing, sculpture, drama, music, even a recipe—as long as it is in a format that can be shared online.

The contest is open to students ages 13 and older and to educators of any grade level, and selected creations will be shared online and on NASA's social media streams. To participate, ask, "What has Cassini shown us about the worlds of the solar system? In our own world?" and let the ideas flow. For details, visit *https://goo.gl/KWK6L1*.

National Oceanic and Atmospheric Administration (NOAA)

Data in the Classroom M

This program enables students in grades 6–8 to use real-time ocean data to explore current environmental issues and practice problem-solving skills used by scientists. At the website *https://goo.gl/uPS6kI,* teachers can access curriculum modules supporting *Next Generation Science Standards* and guide students through the process of working with real data, moving from teacher-driven activities to student-directed inquiry experiences. The El Nino module, for example, begins with teacher-directed activities instructing students how to read and compare sea surface temperature maps, moves to a guided-inquiry experience applying newly learned data skills to predict an El Nino event, and ends with a student-directed challenge to design a plan to investigate a research question using data. A second module, Sea Level, begins with basic graph interpretation and builds toward activities prompting students to ask questions and develop their own data investigations.

Estuary Education Website K12

NOAA's newly revamped estuary education website offers curriculum and resources to help K–12 educators incorporate estuarine science in the classroom. Estuaries 101 is a series of interdisciplinary learning modules that use estuaries as a basis for exploring Earth system science, life science, and chemistry concepts. The modules bring content to life through a combination of hands-on learning, experiments, fieldwork, and data explorations. In Oil Spill—The Rest of the Story (grades 6–12), for example, students build a watershed model to explore surface runoff, play Water-Quality Limbo to demonstrate their understanding of management practices to keep water clean, and brainstorm ways for the community to limit or prevent nonpoint-source water pollution in the estuaries. In another module, Salinity and Tides in York River (grades 9–12), students investigate how salinity changes with an incoming and outgoing tide; make predictions about the salinity changes at each site based on their observations of the animation; interpret salinity data from monitoring stations along the river; and describe and compare salinity graphs.

The site's System-wide Monitoring Program (SWMP, pronounced "swamp") Graphing Tool enables middle and high school students to work with authentic weather and water-quality data from NOAA to learn more about estuaries. Click on Science and Data for an interactive tutorial describing how to use the tool, as well as SWMP scenarios that students can use to practice data analysis skills and learn more about real weather and events. See *https://goo.gl/KSTW4Z*. ●

In Your Pocket

Editor's Note

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

August 1

American Honda Foundation Grants K12

The foundation awards grants to youth education programs focused on the environment and science, technology, engineering, and math (STEM). 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 K–12 schools, public school districts, and nonprofit organizations that haven't previously received a grant from the foundation can apply by **August 1** at *https://goo.gl/9IckUp.*

Clarence E. Heller Charitable Foundation Grants K12

This foundation supports California-based programs that provide environmental and arts education opportunities for youth. Grants of between $5,000 and $200,000 may be used to help educators and artists improve their teaching skills or enhance environmental or arts education programs. California-based programs that support environmental health and encourage regional planning, prevent harm from environmental hazards, or improve the sustainability in agriculture and food systems in local communities are also encouraged to apply. Visit *https://goo.gl/cmQUpG* to do so by **August 1.**

International Paper Company Foundation Grants P K12

This foundation provides funds for children's education and literacy programs located in communities where the company operates: in Alabama, Arizona, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Kentucky, Louisiana, Maine, Michigan, Minnesota, Mississippi, Nebraska, New Jersey, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Tennessee, Texas, Virginia, Wisconsin, and Washington. Those focused on literacy from birth through third grade are particularly encouraged to apply.

Limited funds are also available for nonprofit organizations working on forest, air, and water issues. See *https://goo.gl/Z6Tn3w* for details; apply by **August 1.**

Spencer Foundation's Small Research Grants P K12 HE

These grants support education research projects with budgets of $50,000 or less. Proposed projects should improve education generally and sometimes fall within these specified areas of inquiry: education and social opportunity; organizational learning; purposes and values of education; teaching, learning, and instructional resources; and the new civics. Most proposals, however, are "field-initiated," in that they support the foundation's general mission but do not fall under one of these specified areas.

To be eligible for these grants, the principal investigator (PI) and co-PIs must have a doctorate degree or equivalent experience in an education research–related profession. Proposals are 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 **August 1** at *https://goo.gl/cWfGpF.*

August 15–31

Open Meadows Foundation Grants K12 HE

Open Meadows funds projects that are led by and benefit women and girls and promote gender, racial, and economic justice. Grants of up to $2,000 are available for projects that

- encourage activism, political change, and empowerment;
- are designed and implemented by women and girls;
- reflect the diversity of the community served by the project;
- encourage the building of community power; and
- have limited financial access to funding.

Small and startup organizations for women and girls are encouraged to apply; organizational budgets should not exceed $75,000. Submit proposals by **August 15;** visit *www.openmeadows.org.*

Duke Energy Foundation Grants K12 HE

The foundation provides grants that promote environmental stewardship in communities where the company operates: in Florida, Indiana, Kentucky, North Carolina, Ohio, and South Carolina. Those that help protect or restore natural resources, particularly water and air; promote environmental education; or support research in emerging energy technologies are encouraged to apply. Visit *https://goo.gl/QnsGH7* to do so by **August 31.**

MAXIMUS Charitable Foundation Grants K12

The foundation awards these grants to nonprofit organizations that provide educational or enrichment programs for disadvantaged or low-income youth. Grants of between $2,500 and $5,000 are available, though larger grants may be awarded to programs with compelling need. Apply by **August 31;** see *https://goo.gl/YEenYF.*

Patagonia Environmental Grants K12

These grants go to small, grassroots activist organizations aimed at preserving and protecting the environment. The company funds work that is action-oriented, builds public involvement and support, and protects local habitat. Grants of between $5,000 and $20,000 are available. Those that are national in scope and not located near a U.S. retail store should apply by **August 31** at *https://goo.gl/nfMISR;* those located near a store should contact it directly for grant information. See *https://goo.gl/VhmCd7* for more details.

September 1

American Chemical Society's Dorothy and Moses Passer Education Fund HE

The American Chemical Society provides up to $1,000 to support continuing education activities for teachers at two- and four-year colleges and universities with no advanced degree programs in the chemical sciences. Grants support activities that directly relate to the recipient's teaching and take him or her off campus. Applicants must be full-time faculty members teaching chemistry or chemistry technology at their college or university. Apply by **September 1;** consult *https://goo.gl/Rzi9m8.*

Charlotte Martin Foundation Grant E M H

This foundation awards grants in two focus areas: increasing opportunities for minority youth and conserving biodiversity in a changing climate. Grants of up to $25,000 support programs that provide educational, stewardship, cultural, or athletic opportunities for students, ages 6–18. Funds are available for projects in Alaska, Idaho, Montana, Oregon, and Washington; preference is given to smaller organizations, particularly in rural areas, that have less access to financial and community resources. Apply by **September 1** at *www.charlottemartin.org.*

Lois Lenski Covey Foundation Bookmobile Grants P E M

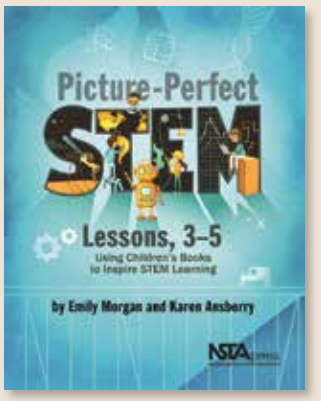
The foundation offers these grants to bookmobile programs that serve economically or socially at-risk children. Grants range from $500 to $3,000 and must be used to purchase books for preK–8 students. Bookmobiles operated by public libraries or nonprofit programs with demonstrated need and limited book budgets are eligible.

Applications must be postmarked by **September 1;** for more information visit *https://goo.gl/6oshRk.* ●

P: PreK E: Elementary M: Middle H: High HE: Higher Ed A: All K12: K–12

I am always looking for quality ideas to improve my curriculum, engagement, and instruction. NSTA books are proven winners.
– NSTA Press Reader Dawn S.

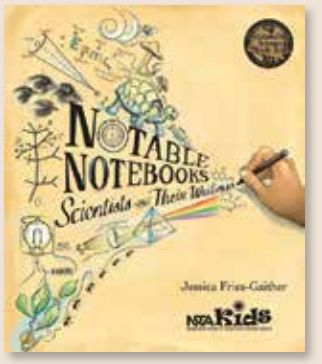
FRESH PICKS FOR SUMMER READING



Picture-Perfect STEM Lessons, 3–5: Using Children's Books to Inspire STEM Learning

Grades 3–5

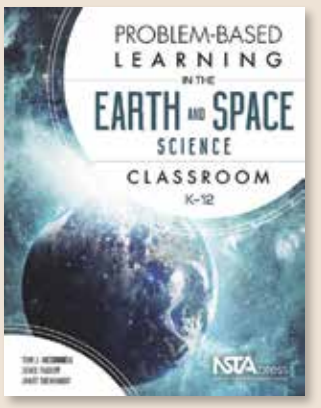
	Member	Nonmember
Book	$35.96	$44.95
E-book	$26.97	$33.71
Book/E-book Set	$43.15	$53.94



Notable Notebooks: Scientists and Their Writings

Grades 3–5

	Member	Nonmember
Book	$10.36	$12.95
E-book	$8.42	$9.71
Book/E-book Set	$13.47	$16.84



Problem-Based Learning in the Earth and Space Science Classroom, K–12

Grades K–12

	Member	Nonmember
Book	$31.96	$39.95
E-book	$23.97	$29.96
Book/E-book Set	$38.35	$47.94

Big Data, Small Devices: Investigating the Natural World Using Real-Time Data

Grades 3–12

	Member	Nonmember
Book	$35.96	$44.95
E-book	$26.97	$33.71
Book/E-book Set	$43.15	$53.94

To place an order or download a free chapter, visit
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NSTA National Science Teachers Association

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‘Wowing’ Students With Radio Astronomy

“We talk about the different arrays, talk about different wavelengths [of light], and different ways to ‘see’ things.”

—Michelle Ferrara

While many astronomy enthusiasts are eagerly awaiting the U.S. solar eclipse on August 21, some educators have been focusing on another aspect of the astronomic spectrum.

The Astronomy in Chile Educator Ambassadors Program (ACEAP, *https://public.nrao.edu/aceap*), has been bringing U.S. formal and informal educators on a tour of the Atacama Large Millimeter-submillimeter Array (ALMA) facility and other astronomy installations since 2015 to share the research they are doing. The educators are then expected to incorporate what they’ve learned into their own curricula and share it with colleagues. ACEAP, supported by the National Science Foundation, is a collaboration among Associated Universities, Inc.; the National Radio Astronomy Observatory; National Optical Astronomy Observatory; and Gemini Observatory.

“After my visit to Chile, I was intrigued by researchers and astronomers—what they studied using those tools…I said, ‘This is something we could adapt for junior high school,’” says David Lockett, a science, technology, engineering, and mathematics (STEM) teacher at Bok Academy in Lake Wales, Florida. He participated in ACEAP in 2016. “We’re studying basics of radio astronomy: Why are radio astronomy images important [and their use compared with visual images]? What part of the radio spectrum can we use for scientific inquiries and discovery? [My students] spent a portion of the year researching astral phenomena, space science…I’m incorporating radio astronomy into existing courses,” including general science, STEM, and engineering classes, he notes.

Lockett launched his students into radio astronomy by studying and interpreting images captured by radio astronomy installations in the United States and Chile. Students “have to understand how to use frequency, why large antennas are important, and that astronomy is important for detecting objects in the universe. Detecting radio signals and the most extreme signals of our galaxy provides regional variations, a celestial reference frame, and access to a global network of radio astronomers,” he continues.

He created opportunities for hands-on learning with the Bok Small Radio Telescope. Using an aluminum television dish, T1 and coaxial cables, and a software defined radio amplifier chain receiver, his students built the simple radio astronomy telescope. “There’s a lot more excitement since they helped build it. They’re more invested. They want to dig deeper…[find out] why it’s so fascinating, what’s the mystique [of astronomy],” he explains. “My students are very research driven… We want to be able to do world-grade research…and have students talk to scientists worldwide.”

DAVID LOCKETT

Bok Academy students study Royal Astronomical Society images of the Circinus Galaxy and compare what the different wavelengths reveal.

Radio Astronomy at Camp

AstroCamp staff in Idyllwild, California, “like to brag [that] kids have the most hands-on experience with telescopes here compared to anywhere in the country,” declares Michelle Ferrara, AstroCamp program director and another 2016 ACEAP ambassador. “It’s really hands-on; they get to operate the telescopes…We ‘wow’ them with astronomy.”

The residential science center hosts school groups on three- or five-day visits to the mountain site, where students participate in teacher-selected labs. The camp serves almost 18,000 students a year; most come from California, Arizona, and Nevada, according to Ferrara. To serve the East Coast, AstroCamp recently opened a second location in Clover, Virginia, near a state park that is a “designated dark zone.”

“When we’re using the telescopes at night in the observatory, one component is we talk about the differences [between] radio astronomy and what we’re doing. With radio astronomy, you get finer details. At ALMA, when the array is spread out [to its maximum span], it is equivalent to a 16-kilometer telescope mirror. That’s why it can get such amazing images and we get so much detail through a lot of math,” she explains.

“We only started doing radio astronomy last year,” Ferrara continues. In the Lights and Laser class, she’s incorporated radio astronomy through discussions of the spectrums of visible and non-visible light. “It depends on the age we’re teaching: We talk about the different arrays, talk about different wavelengths [of light], and different ways to ‘see’ things.” She tells students that telescopes are “comparable to doctors: Different doctors have different specialties.” By using the data collected through different types of telescopes, “we’re piecing all this [information] together to come up with different theories.

“AstroCamp gives kids access to scientists doing real science. Kids think astronomers spend their time looking through telescopes,…but 90% of their time is [spent] looking at a computer.”

During the summer months, AstroCamp hosts camps featuring activities like welding and pottery in addition to physics and astronomy. “We try to foster [their] creative side as well. It’s very important to encourage that other side of the brain. We want them to stay creative while learning hard science,” Ferrara asserts. ●

DISTRICT PROFESSIONAL LEARNING PACKAGES

The National Science Teachers Association (NSTA) meets your teacher professional learning needs around critical science topics, including three-dimensional standards, science and literacy, and argumentation in the classroom.

Long known for high-quality books, NSTA's authors and trusted experts are now delivering these classroom-tested approaches to schools or districts.

Blending on-site and online strategies tailored to your needs, NSTA stimulates sustained change in classroom practice.

Here are a few examples of the professional learning packages NSTA can customize for your district.

NEXT GENERATION SCIENCE STANDARDS (NGSS)

"In my own continued understanding of my work, and to inform the work we are currently doing to implement the NGSS, this workshop has helped me provide a rationale for moving the change forward. It definitely helped my understanding of three-dimensional learning. I appreciated how we continuously went back to all three aspects to gain a further understanding of the entire process."

— Past NGSS Workshop Participant

PICTURE-PERFECT SCIENCE LESSONS

"The *Picture-Perfect Science Lessons* series became a foundation for the district-wide K-5 STEM curriculum building project. This initiative gave an opportunity for students in 54 schools to integrate science, engineering, and literacy in a rigorous and meaningful way. These lessons are an example of Science-Literature integration 'done right'."

— Katya Denisova, PhD, Project Director, SABES at Baltimore City Public Schools, Baltimore, MD

ARGUMENT-DRIVEN INQUIRY

"I have been to many workshops where presenters either danced around a question or failed to answer the question as it was intended completely. What I found most useful was that Victor Sampson addressed every question thoroughly. Just knowing that there are answers to my questions made me feel more confident about implementing the *Argument-Driven Inquiry* strategy in my classroom."

— Past Argument-Driven Inquiry Workshop Participant

NSTA National Science Teachers Association

For more information, contact Kim Stilwell at *kstilwell@nsta.org*.

www.nsta.org/district

NSTA PRESS: *When the Sun Goes Dark*

When the Sun Goes Dark

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 When the Sun Goes Dark, *by Andrew Fraknoi and Dennis Schatz, edited for publication here. To download the full text of this chapter, go to* https://goo.gl/8H8P8Q. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

"Let's talk about why we had to travel so far to see our eclipse," Grandpa said.

He held a Ping-Pong ball between Sammy's head and the bulb that was our Sun. The ball made a dark shadow on only one part of my brother's face.

"This is the same thing that happens on the Earth," Grandpa explained. "The dark eclipse shadow falls only on one small spot on the Earth at a time. You have to be right where the dark spot is to see a total eclipse."

I could see how there was one really dark spot on Sammy's face. Grandpa moved the Ping-Pong ball a little in orbit around Sammy's head, and the dark spot moved across his face. It went from his cheek to one of his ears.

"This is the same thing that happens to an eclipse spot on Earth as the Moon moves in orbit," Grandpa said. "The eclipse shadow moves along a narrow path that can be thousands of miles long before the eclipse is over. On the other hand, the shadow is only about a hundred miles across! You have to be right in that path to see the total eclipse. Anyone outside it will see only a partial eclipse."

I had to think about those numbers. "How big is the Earth?" I asked Grandpa.

We looked it up on the web, and I was surprised. The Earth sure is a big planet! If we put a measuring tape around the Earth's equator, the tape would be almost 40,000 kilometers long, which is about 25,000 miles. So only a small part of the Earth sees a total eclipse.

"So you see that each time there is a total eclipse, only people in the right location can see it," Grandpa said. "That's why people like us travel long distances to be where we can see a total solar eclipse."

I remembered that over dinner, my grandparents told us they had planned this trip a couple of years ago. So I started to wonder how they knew so far in advance when and where on Earth the total eclipse would be visible.

Grandpa turned the lights back on, and we got cozy on the couch.

"How did you know two years ago that this eclipse was going to happen and where you had to fly to see it?" I asked.

"Diana, when I got interested in eclipses, I learned that astronomers can predict them hundreds of years in advance," Grandpa replied. "It surprised me, too. An astronomer on one of our trips explained it to me like this: The movements of the Earth and the Moon may be complicated, but there are regular cycles to how they move. By cycles, we mean things that repeat regularly, like the cycle of the Moon's phases or the cycles of the seasons from winter to summer and back to winter. Scientists have been following the Moon's and the Sun's cycles for many years."

Grandma jumped in. "A good example is the cycle of your birthday. Your birthday falls on the same date every year. But it's not always on the same day of the week, is it?"

Three eclipse paths, each 18 years apart and shifted to eight hours later than the previous eclipse

"My birthday was on a Sunday this year," Sammy said.

"Exactly," Grandma said, smiling at him, "but it wasn't Sunday the year before. Eclipses repeat regularly, too, but where the eclipses are visible on Earth is not the same from one cycle to the next. Still, there is a pattern to them. Now imagine you have a friend whose birthday is February 29. What would that be like?"

I was going to say that there is no February 29; February has only 28 days. But then I remembered about leap years. We had just covered that in school. Every four years, there is a leap year, which means they add a leap day—the 29th of February. But I never thought about somebody actually having that for a birthday.

"Huh," I said. "That means the kid would have a birthday only during leap years. That's kind of weird."

"You see, some cycles take much longer to repeat than others," Grandma said.

"Astronomers discovered that eclipses repeat on an 18-year cycle," Grandpa told us. "So every 18 years, we get eclipses for which the exact lineup of the Earth, Moon, and Sun is the same. But the new cycle's eclipses happen eight hours later than the previous cycle's, so the path will be on a different part of the Earth."

I said, "Wow, that sounds complicated."

And Grandpa replied, "Yes, Diana, nature can be complicated, but isn't it great that people have been able to figure all of this out about eclipses?"

And I had to agree that it was. ●

BLICK ON FLICKS

Everything, Everything

By Jacob Clark Blickenstaff, PhD

This summer will have no shortage of movies based on comic books, and sequels will also abound. I chose to take a break from all of that and see a teen romance based on a young adult novel. *Everything, Everything* is based on the book of the same title by Nicola Yoon, published in 2015. The main character, Maddy, is an 18-year-old girl who never goes outside. She doesn't have a phobia; she believes she has Severe Combined Immunodeficiency (SCID) and would likely die of an infection if she left her house.

Maddy only has contact with her mother (a physician) and her nurse. Her father and brother were killed in a car accident when she was an infant, so she and her mom have been a family of two for a long time. Around the same time as that accident, Maddy had a severe infection, and her mother began to isolate Maddy from the outside world, allegedly due to the SCID diagnosis.

As the movie begins, a new family moves in next door, including Olly, a boy about Maddy's age. Olly and Maddy begin a relationship through texts, e-mail, and signs held up to windows. Her mother does not approve of time spent with Olly, even online. Eventually, Maddy ventures outside, first for a very short time, then on a longer excursion. That outing brings on a medical emergency for Maddy, and a crisis between her and her mother.

SCID

SCID is a real disease in which a genetic defect renders a person's immune system almost entirely ineffective due to a lack of T-cells (more on this later). Without treatment, a child with SCID rarely survives to age two.

The public first became aware of SCID in the 1970s when the story of David Vetter, the "bubble boy," received international attention. David lived his entire 12 years inside a sterile environment to protect him from infections, first at a hospital, then at home. He was treated with a bone marrow transplant from his sister, but though his body did not reject the transplant, he died of an infection not long afterward. Maddy's isolation in *Everything, Everything* seems to be a much milder version of the isolation chamber David lived in.

To understand SCID, it is important to understand some facts about the human immune system. Our bodies are constantly coming into contact with invaders like bacteria, viruses, and fungi. Some are benign (and maybe even helpful), and they constitute our microbiome. Some are definitely problematic and cause diseases. T-cells in our immune system work to identify the invaders, mark the hostile ones, and then render them inactive. T-cells and other essential components of the system are made in our bone marrow,

so problems in the bone marrow often weaken our immune system.

SCID can now be treated with more advanced bone marrow transplants, and some cases are further supported with enzyme replacement therapy or gene therapy. Isolation is no longer used to manage SCID. For more information about the disease, see *https://goo.gl/z8TY3P*.

Reflections

Many shots in the film are from Maddy's bedroom window into Olly's as they text or talk across the gap between their houses. Windows present a challenge for filmmakers because of unwanted reflections. When light passes from one material to another (from air to glass, for example), some fraction of the light is always reflected at each change. With normal glass, most of the light goes through (it is transparent, after all), but a small amount is reflected. (It is also worth noting all waves have this property, so it applies to sound as well as light.)

You've probably noticed this when it is dark outside and the room you are in is well lit. Instead of seeing the outside, you see a reflection of the room. Someone outside looking in will have a clear view of you. If, on the other hand, you are in a darkened room looking out at a bright day, you can see clearly and someone outside would not be able to see you. The scenes in which Maddy and Olly are looking at each other at night had many opportunities for the crew and equipment to be reflected in the windows—and seen by viewers. Even if you don't see the whole film, many examples are clear in the trailers.

Maddy's outing is an adventure outside her house with Olly, and one thing they do is jump off a cliff into the ocean. It is a pretty steep fall, so I decided to calculate her speed when hitting the water. The jump is visible in the trailer, so I paused the video and counted how many Maddy-lengths high the cliff is. It is about five Maddys tall, so as a round number, the cliff is about 10 meters high. That height is the same as the high-dive platform in the Olympics.

Though this problem can be solved using the kinematics equations, it is actually much easier to do so using energy conservation. All the kinetic energy (KE) she has on hitting the water came from the gravitational potential energy (PE) she had at the top of the cliff. Her increase in KE came from her loss of PE.

$$\Delta(mgh) = \Delta\left(\frac{1}{2}mv^2\right)$$

$$mg\Delta h = \left(\frac{1}{2}m\Delta v^2\right)$$

And after playing with some algebra:

$$v = \sqrt{2gh}$$

If I use an approximation for g of $10\,\frac{m}{s^2}$, and 10 meters for the height, the math is pretty simple.

$$v = \sqrt{200}\,\frac{m}{s} = 14\,\frac{m}{s}$$

That means she is hitting the water at about 30 miles per hour, which is part of why diving like that is dangerous. She went in feet-first, which is much safer for a novice than trying to go in head first as Olympic divers do.

Everything, Everything offers a nice break from summer blockbuster action films and gives teachers a chance to discuss the human immune system, the physics of reflections, and free fall. ●

Jacob Clark Blickenstaff is Director of K–12 Engagement at the Pacific Science Center in Seattle. Read more Blick at http://goo.gl/6CeBzq, *or e-mail him at* jclarkblickenstaff@pacsci.org.

MS. MENTOR, **Advice Column**

Finding, and Staying on, Focus

I have some chemistry students who ask, "Why do we have to learn this?" How can I address this other than saying, "You'll need it in college"?

—D., Delaware

Why are we studying this? What good is this?

It's easy to answer student questions like these with "because it will be on the test" or "because it's in the textbook," but this doesn't usually satisfy the student. As you noted, "you'll need this someday" is equally frustrating because information is readily available electronically, and we can't predict what careers and interests students will have in the future.

Some students enjoy science, and their interest is independent of class activities. Others are skeptical and may need to be convinced that a topic is worth learning. Teachers can make science interesting and relevant by sharing their enthusiasm and using thought-provoking investigations or activities, multimedia and visuals, a variety of instructional strategies, cooperative learning, and opportunities for students to use their curiosity and creativity.

As you plan a unit, consider the goal or performance expectation. What content is essential? How can I use a variety of practices to make it interesting? How does the unit connect with or build on what students already know? Does it provide background for future learning? How does it relate to real-life events or other subject areas? How can students personalize this information?

It may help to introduce each unit with essential questions focused on a big idea or theme. During each lesson, revisit the questions, connecting any new content or experiences. If the questions are posted in the classroom or in the students' science notebooks, they serve as a constant reminder of why students are learning about the topic. Eventually, students may create their own questions and learning goals.

I conduct many professional development programs, and I could use some ideas to keep adult participants on-task!

—T., Virginia

As a presenter, it's frustrating to see participants grading papers, texting, or reading the news. But in all fairness to our colleagues, their inattention may stem from experiences with compulsory professional development (PD) sessions that were "sit 'n' git," conducted by drop-in presenters who were unfamiliar with the school's culture, had no teacher input into the content, or held after school, when everyone was tired.

I shared your question with a colleague with whom I have held many PD sessions. We agreed that in addition to well-planned content, it is important to engage the participants with effective strategies they can apply in their classrooms:

- Greet participants as they come in, making a personal connection. Share a summary of your own classroom experiences during the introduction to establish rapport.
- Describe the purpose and goals of the session. Ask participants what they would like to gain from it. Record their responses, and debrief the list at the end.
- Avoid trivial icebreakers, especially if the teachers already know one another. Instead, use bell-ringers, such as responding to a focus question or a brief reading. Refer to their responses during the session.
- Provide an agenda, including scheduled breaks to check e-mails or texts. Start and end the session on time.
- Move around the room and make eye contact.

THINKSTOCK

- Use gallery walks or turn-and-talk for sharing ideas.
- Relax and realize, as an administrator told me, some people aren't happy unless they have something to complain about. One of our workshops was rated low by a participant who said, "I don't like tomato on my sandwich."

I recently took a teaching position, after several years in a different field. I thought I could create a calm, focused atmosphere in my middle school science classes, but some of my students have really annoying and off-task behaviors. How do I deal with this?

—C., Maryland

Though they try to act like adults, most middle schoolers are still basically kids, with high levels of energy and enthusiasm. Most love to participate in activities and readily engage in discussions. They are also physically active, prone to fidget, and aware of how to annoy a teacher to get a response.

To provide focus, set explicit learning goals and performance expectations, describe how each activity contributes to the goals, and provide feedback that will guide students toward the goals.

Regarding a "calm" atmosphere, eventually you'll be able to tell when noise is "noise" and when it's the sound of learning and excitement. Some noise can be controlled by establishing (and practicing) routines and procedures for the beginning and end of class, transitioning between activities, and lab/safety behaviors.

If a behavior is distracting to others or potentially dangerous, you'll need to address it by talking with the student or removing him/her from the activity. Otherwise, can it be ignored? Is it worth making an issue out of? I had a student who would talk to himself as he worked (even answering his own questions!). I asked others if his talking distracted them; they shrugged and said, "It's just his way of thinking." So I asked him to keep his voice low and raise his hand if he had a question for me.

When a student appears to be off-task, ask, "What are you doing or thinking about?" You might discover what appeared to be an off-task behavior was very much on-task for that student. ●

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

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In preparation for back to school, now is the perfect time to review your NSTA membership benefits.

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NSTA National Science Teachers Association

Mark Your Calendar
NSTA Dates to Remember

(All dates are deadlines unless otherwise specified.)

July 12—Does each lesson build upon the prior one when you teach a unit? Explore how a coherent storyline can improve students' learning and learn how to create your own during **How Do I Develop a Storyline for a Unit?** This **free NSTA Web Seminar**, part of a series on implementing three-dimensional science standards, will be held at 6:30–8 p.m. Eastern Time (ET). New users should log in 15 minutes before the scheduled start time for an introduction to NSTA Web Seminars. All participants will receive a certificate of participation and 100 Learning Center activity points for attending and completing the post-program evaluation. An archive and presentation slides will be available at the end of the program. For more information or to register, go to *https://goo.gl/bKCJ9l*.

September 13—Learn more about joining NSTA's leadership and taking a role in shaping science education during **Leaders for Science Education: Preparing an Application for the NSTA Board and Council, a free NSTA Web Seminar.** Applications for NSTA's Board and Council election are due by **October 16.** For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w*.

October 12—The Shell Science Teaching Award recognizes innovative science teachers with a $10,000 award, but you can't win if you don't submit a strong application. Learn how to do so from Gary Koppelman, chair of the Shell Science Teaching Award Judging Panel, during **Developing a Competitive Application for the Shell Science Teaching Award, a free NSTA Web Seminar**. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w*.

October 18—PreK–16 science educators can win up to $10,000 for their outstanding efforts through the NSTA Teacher Awards program. Learn how to craft a strong application during **Developing a Competitive Teacher Award Application, a free NSTA Web Seminar** with Ruth Ruud, chair of the NSTA Teacher Awards and Recognition Committee. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w*.

October 25—Do you teach grades 6–12 science? Does your school need a lab makeover? Don't miss **Developing a Competitive Application for the Shell Science Lab Challenge, a free NSTA Web Seminar**. Learn about the application process and get tips for creating a strong application from Ruth Ruud. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w*. ●

Join the *Science and Children* Team!

Science and Children (*S&C*), NSTA's peer-reviewed journal for elementary teachers, is seeking manuscript reviewers. Reviewers are vital to the journal's production. The review panel evaluates submissions and helps craft them into the articles in each issue.

You need not be an expert writer: Classroom and content expertise are what's needed. Our online manuscript submission and review system allows you to indicate your comfort zone (e.g., assessment, physical science, inquiry skills, etc.), and we will assign you manuscripts accordingly. You can even let us know when you are too busy to do any reviewing.

Being a member of the review panel is a great professional development experience: Not only do you get previews of the articles coming to *S&C*, you help create them! If you are interested in volunteering for this panel, please contact Editor Linda Froschauer at *fro2@mac.com* (include your CV).

JAX PHOTOGRAPHY

Retired National Football League player and former NASA astronaut Leland Melvin recently interviewed national ExploraVision winners Dina Hashash and Lawrence Zhao, seventh graders at Next Generation School in Champaign, Illinois. Their technological innovation, BioKT, is a watch that would use human kinetic and thermoelectric energy to power mobile devices. Learn more at www.exploravision.org.

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Peer Mentors Make a Difference

Having a female peer mentor at pivotal points in the science, technology, engineering, and mathematics (STEM) education pipeline can make a difference in female students continuing to pursue a STEM path.

In April, the *Proceedings of the National Academy of Sciences* (*PNAS*) published a study by researchers at the University of Massachusetts, Amherst, that showed 100% of female engineering students who had female peer mentors remained enrolled in engineering for a second year, while female students who had male mentors or no mentors were more likely to change paths. Researchers concluded, "Female (but not male) mentors protected women's belonging in engineering, self-efficacy, motivation, retention in engineering majors, and post-college engineering aspirations."

Jennifer Lindwall, a doctoral candidate at Portland State University in Oregon, told the *Christian Science Monitor*, "This idea, 'if you can see it, you can be it,' it's a real thing, and I think for somebody who's in a challenging academic program, if you don't see anyone like yourself, whether it's your gender or your race or your socioeconomic status, it's kind of impossible to concretely believe that you can succeed."

Read "Can Female Mentors Patch the Leaky STEM Pipeline?" in the *Christian Science Monitor* at *https://goo.gl/eEsJzW* or the *PNAS* study at *https://goo.gl/1DfPnQ*. ●