www.nsta.org
January 2020 Vol. 31 No. 5


INTREPID MUSEUM

Retired Aircraft Carriers
Become STEM Museums 9

nsta Reports
National Science Teaching Association

Making the Most of
Industry Partnerships 10

CONTENTS

Inspiring Young Geoscientists With Fossils


JASMINE ESSINGTON

Troy J. Simpson's students at Glenn Raymond School in Watseka, Illinois, use a limestone slab with brachiopods and trilobite fossils to make claims of past geologic environments.

"I have an extensive fossil collection that we use in my eighth-grade science classes. We use it in our investigations of Earth history, in particular the Midwest," reports Troy Simpson of Glenn Raymond School in Watseka, Illinois. He says he uses fossils "not only for investigating how life evolves and develops, but [also] for paleoenvironmental changes, simulated geologic strata interpretation, piecing together the geologic history of our region. I believe…getting the specimens in the hands of the students…helps make it more relevant to them…Even if you have [only] a few samples, it can impact students' learning.

"I like to use larger specimens that show fossils in their environmental and geological context. This helps with the student interpretation of the geologic past," Simpson observes. "The Midwest used to be an ocean and a tropical forest; we have evidence of this.

"My mission is [this]: We need more geoscientists," Simpson asserts. "Unfortunately, geoscience [has] become a fossil science in and of itself. It is a vicious cycle [in which] fewer students are introduced to it at the K–12 level, thus fewer college students go into it, then numbers drop, and programs become downsized. Looking down the road, we will need those geoscientists to help with investigations on Earth and on other celestial bodies as well."

DeLacy Humbert, a science teacher at Capital High School in Helena, Montana, would agree. She acquired funding from science-based grants that allowed her to create a high school class on paleontology. "Everyone loves dinosaurs, but after third or fourth grade, [the enthusiasm] dies down. That's a detriment to STEM [science, technology, engineering, and math because] dinosaurs are a 'gateway science drug,'" she explains. "I saw the need. In paleontology units in Earth science class, the students loved it."

Humbert says she "dreamed of this class for years. It took two years to get everything ready and propose it" to all of the department heads and the principal, then to the school board. She had to create her own curriculum and resources because "nothing between [the] elementary [level] and [the] college [level] existed."

Humbert first taught the class in the 2018–2019 school year. "We had 30 students and a waiting list. There were a few less students this year, but we still had a waiting list," she notes.

After the first year, Humbert tweaked the course. "Last year, we did a pigeon dissection before lunch. It was gross, and pigeons are expensive," she admits. This year, she is using rotisserie chickens, which are much less expensive. "Bone structure is important," she maintains.

Humbert also leads a summer camp that features a dinosaur dig. To prepare the students, she shared fossils from her

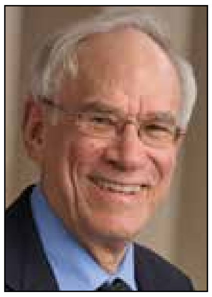
See Fossils, pg 4

2020's Outstanding Science Trade and STEM Books PG 14

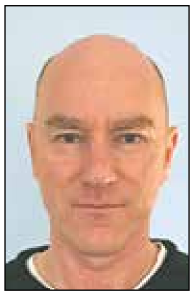
COMMENTARY: **Frederick Grinnell and Simon Dalley**

How to Make Science Fairs More Effective

By Frederick Grinnell and Simon Dalley



Frederick Grinnell



Simon Dalley

When NSTA first adopted guidelines for science competitions in 1999, two of the important questions addressed were whether competitions should be voluntary or required, and whether the emphasis should be on the learning experience or the competition. Our recent research concerning students' high school science fair experiences has important implications for both of these questions.

Several years ago, we began a systematic and ongoing study of high school science fairs using anonymous voluntary surveys that included a combination of quantitative and qualitative (open-ended text) questions about students' experiences. In 2015–2016, we surveyed a group of high school students who had competed in the Dallas Regional Science and Engineering Fair (DRSEF). Since 2017, we have been surveying national groups of high school students who use the Scienteer online science fair management system. In 2015, we also began surveying post–high school students on biomedical education trajectories; i.e., undergraduates doing summer research, biomedical graduate students, and medical students at University of Texas Southwestern Medical Center.

High school and post–high school students overwhelmingly (4:1) oppose the idea of being required to compete in a science fair. Students shared that view regardless of whether they had been required to do so or not. Not only did students dislike being required to compete, but also negative consequences were tangible. When asked the question *Did your science fair experience increase your interest in the sciences or engineering?*, students who had chosen to participate in science fair reported a more positive impact of science fair compared to students who said they were required to compete. Indeed, 10% of the students who said they were not interested in a career in the sciences or engineering and who were required to compete said they made up their data or copied their science fair projects from someone else. Based on our findings, we predict that if school districts were able to encourage and incentivize students to participate voluntarily in high school science fairs—rather than requiring participation—outcomes would improve.

Regarding whether the learning experience or competition should be emphasized, our findings suggest that this distinction might depend on whether science fairs are competitive or noncompetitive. When asked about competitive science fairs, the most common negative student comments mentioned not liking to compete and not enjoying doing so, while the most common positive comment was that competition motivated them to do their best. On the other hand, when we asked students about noncompetitive science fairs, the focus on competition disappeared; the most common negative comments were about having no enjoyment and no time, and the top positive comments were about getting an introduction to the scientific process and a general learning experience. High school students were mostly opposed to the idea of required science fair even if noncompetitive, but almost 50% of the students in the post-high school group indicated that they would favor such a requirement.

We suggest that developing noncompetitive science fairs would be one way to increase student focus on learning instead of winning. In a noncompetitive (i.e., standards-based) science fair, judges assess student progress toward mastery of the different practices of science, such as those practices emphasized by the *Next Generation Science Standards*. This approach would be consistent with goal orientation theory; i.e., the value of mastery orientation (competition with oneself with emphasis on understanding and improving skills and knowledge) compared to performance orientation (competing with others with emphasis on demonstrating high ability and grades). Ironically, at the time science fair began in New York City around 1930 as a derivative of after-school science clubs, students were engaged in both competitive and noncompetitive activities centered on the use of science toys. After World War II, the focus of science fair increasingly became competitive.

The National Research Council's *A Framework for K–12 Science Education* describes two aims for science, technology, engineering, and mathematics education, one oriented to science for everyone and the other relating to science for future scientists and engineers. Maybe we need two kinds of science fairs to achieve this dual emphasis: competitive science fairs for the scientists and engineers of the future and noncompetitive science fairs to help educate all students about science and engineering. ●

The research described in this commentary has been published in the open access journal PLOS ONE *in 2017 and 2018 and the bioRxiv preprint server in 2019.*

Frederick Grinnell, PhD, is the Robert McLemore Professor of Medical Science at the University of Texas Southwestern Medical Center. He has a longstanding interest in the nature of science and is author of The Scientific Attitude *(second edition, 1992) and* Everyday Practice of Science *(2009).*

Simon Dalley, PhD, is a senior lecturer in physics at Southern Methodist University and was president of DRSEF from 2006 to 2016.

nsta Reports
National Science Teaching Association

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

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

Are you interested in submitting a Commentary for consideration for *NSTA Reports?* E-mail Lynn Petrinjak at *lpetrinjak@nsta.org* for more information.

Fossils, from pg 1

collection and revealed their age, then had the students identify them. "It takes a while for them to identify [the fossils]. They need practice," she contends.

The dig was challenging, she says, because "I have to teach [students] how to excavate and prospect. Prospecting is hard because the terrain isn't easy. [There's the] dangers of falls, snakes, and wild cows." Students' parents had to sign waivers and provide health insurance, she notes.

Last summer, she and her students found a couple of dinosaurs. "I teach them how to prepare the fossils so they will be able to do internships at university labs," she reports.

Michael Baldwin, IB Biology and IB Chemistry teacher at Brent International School in the Philippines, has his students do several activities to learn about fossils. For one, he says, "I find diagrams of articulated fossil vertebrates from different time periods, project them onto a surface, and draw and cut out the bones on card stock as close to actual size as possible. I then mix the 'bones' in a plastic bag, and I have students try to reconstruct the animal. From their reconstruction, you can have them draw what they think the animal looked like; you can give them real index fossils along with their skeleton so that they have to try [to] identify when the animal lived. They can look for evidence of what the animal ate and how it moved, etc. You can also have students use similar puzzles to compare homologous structures, etc."

In another activity, says Baldwin, "Students can look at photos of fossil leaves and count stomata to compare to living plants to investigate possible levels of carbon dioxide in a discussion of the effects of carbon dioxide concentration and global warming on plants. Is there evidence that there was a high level of carbon dioxide as indicated by the number of plant stomata on similar species of plants from the Eocine [epoch]?" He has also "had students do experiments to test different hypotheses about the function of gastroliths [rocks held inside a gastrointestinal tract] in plesiosaurs."


SARAH ERDMAN

A student in Sarah Erdman's class at FB Meekins Cooperative Preschool in Vienna, Virginia, examines fossils on the science table.

Teaching about the fossil record and how it's changed over time gives her eighth graders "a piece of evidence to show how species changed over time," and helps them construct a scientific explanation using geological rock strata, says Tanya Gordon, Earth science teacher at West Junior High School in Boise, Idaho. "My colleague and I have students do an activity to address that as part of a quarter performance task."

Sue Meggers, middle school science instructor at Interstate 35 School in Truro, Iowa, points out that fossils are not only evidence of life, but also "evidence of nutrients, especially in typical marine deposits (limestone, potash, and phosphorus are mined from marine deposits and used as nutrient supplements or pH balancers in soils). And there's an economic connection to fossils; for example, limestone is used in building."

All of the teachers agree that letting students do their own fossil identification is essential to three-dimensional learning. "I brief them first, then give them the resources to do it, but they have to figure it out," Meggers maintains.

Even young children can benefit from exploring fossils, says Sarah Erdman, lead teacher at FB Meekins Cooperative Preschool in Vienna, Virginia, whose collection includes "some mud tracks, fossils plus the environment they're in, which helps students connect with what fossils are." She adds, "We've been lucky to have people bring in their personal collections—for example, a paleontologist who visited my class…With students this age, we expose them to what we learn [from fossils] and who does the finding, [which is someone's] job. [We tell students,] 'That's so-and-so's mom who also [finds and studies fossils].'" At age three, children become aware of gender roles, "so it's great to counteract that [by saying,] 'This is an everybody thing.'"

Finding, Handling, and Storing Fossils

Simpson connects with local quarry managers who help him find fossils. He also gets them from contacts from the National Earth Science Teachers Association and the Geological Society of America. And he takes his students to accessible outcrops and parks where collecting is permissible to gather rocks and fossils: "My students and I can go on-site and learn on the spot [about] the geology of the area and its fossils," he relates.

In her rural area, "we live on Devonian to Pennsylvanian bedrock, so we collect fossils in our gravel," reports Meggers. "My students don't think of their environment as very cool or unique. Then they discover that their driveway has fossils. It blows their minds!"

"I was very fortunate to receive some lovely fossils from a member of our local rock club," says Marteen Nolan, science teacher at Crocker High School in Crocker, Missouri. Among them was a fossil bed that intrigued students in her advanced geology class, so they contacted a University of Missouri-Columbia geology professor for assistance in identifying the fossils. "The students were able to determine that what they had thought was a [dinosaur] bone was in fact a different type of mud, and the fossil bed was likely from an ancient oyster bed that had been washed inland by a hurricane. It was such a great authentic scientific inquiry experience for them," Nolan relates.

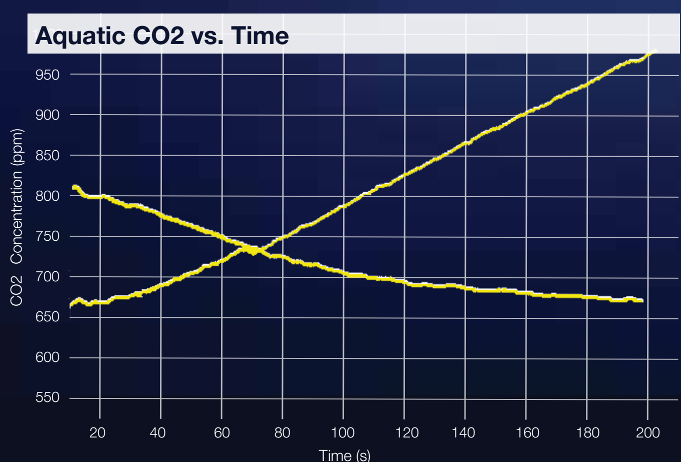
"Our state mining trade industry does a summer workshop," she notes. "If mining takes place in your state, check with a mining agency" about fossil donations, she advises. Nolan also offers some safety precautions: "Obsidian glass is a volcanic glass with sharp edges…Don't bring in asbestos! Gypsum can have it, too, so don't let students hold it."

One consideration for teachers is fossil storage. "Storage depends on how rare the fossil is and its condition. Some fossils can only be looked at. Thing is though, if you use them, then eventually they may be broken," Baldwin cautions.

"I'm encouraging students to touch all of the fossils except carbon films because they're so fragile," says Gordon, who has found carbon films with impressions of fish fossils. She suggests that experienced teachers share their fossil collections with new teachers. "It would be beneficial for new teachers to have a way to build a collection… Foster that new enthusiasm for teaching with the ability to share things hands-on with students." ●

DIVE DEEPER
INTO MARINE BIOLOGY
WITH LIVE DATA

Observe fluctuations in carbon dioxide anytime, anywhere, including underwater, with our latest **Wireless CO_2 Sensor + Dissolved CO_2 Waterproof Sleeve.**



Get Your CO_2 Sensor and Dissolved CO_2 Waterproof Sleeve!

Get all this for FREE:

- SPARKvue software*
- Lab Experiments
- Sample Bottle

Wireless CO_2 Sensor
PS-3208 $195

Dissolved CO_2 Waterproof Sleeve
PS-3545 5 for $20

Investigate photosynthesis, respiration, and water quality all with this **one powerful device**.

At PASCO we understand how busy classtime can be. That's why our sensors make room for science by shaving time off the data collection process.

Effortlessly sync with smartphones, tablets, computers, and Chromebooks™, and the device is ready to record. Our products quickly produce live data, which cuts prep time, so you can focus on teaching.

SPARKvue

Windows Mac® and iOS Android™ chrome™

NOTE: Do not submerge the CO_2 Sensor without a Waterproof Sleeve. It is not recommended that the sensor be submerged past the Waterproof Sleeve.

*SPARKvue software is free for iOS, Android™, and Chrome™. For Mac® and Windows®, see website for pricing.

10101 Foothills Blvd. Roseville, CA 95747 • 800-772-8700 • **www.pasco.com/CO2**

PASCO

Taking Time to Refresh and Recharge

Making time to take care of yourself can help mitigate the toll of high-stress jobs. *NSTA Reports* recently asked science educators to share how they take care of themselves. Seventy-eight percent of respondents said they make time to focus on their personal/emotional needs. Although 22% reported not knowing how much time they devote to self-care, 38% reported spending an hour a day, and 31% said two hours a week.

Spending time with family/friends was the most common self-care practice, cited by 76% of participants. About half said they read for pleasure, exercise, and engage in other hobbies. (Respondents could select multiple choices.) Other strategies mentioned included gardening, getting massages, spending time with pets, watching TV, and having a drink.

Half of respondents said work commitments interrupt their plans about half the time; 24% said that seldom happens, and 25% reported it happens "pretty much all the time." Slightly more than half (59%) reported limiting what time of day they respond to parent e-mails and post grades. One middle school educator declared, "I recently deleted my school e-mail app from my phone because checking e-mail in the evening was literally ruining family time."

Here's what educators are saying about the most personally taxing aspects of teaching:

The constant press of grading, especially lab reports. I want to give my students quality feedback on their work, and that's very time-consuming. I just don't bring work home. It's possible to keep up (maybe be just a little slow in grading) if I use my planning time well and avoid chatting or surfing the web. It's more important to be able to go home with an empty backpack. *—Educator, High School, California*

Taking care of kids is hard! It requires so much energy, especially for teachers who are more introverted. I do my best to take time for myself, but I coach three [groups] and often don't feel like I have the time.*—Educator, Middle School, Colorado*

The mental and emotional toll. It is very easy to bring work home with you from a mental and emotional standpoint even if you actually leave the physical work at school.*—Educator, High School, Utah*

Paperwork (**IEP,** 504, referrals, etc.); I save those to do when I'm lying on the couch at home. Creating lesson plans; I try to plan and work with other science teachers so I'm not relying solely on myself.*—Educator, Middle School, Missouri*

The spiritual, psychological, and emotional aspects are taxing on me. I work at a private independent school, and the single counselor is not sufficient for [more than] 1,000 students. I need therapy support myself to deal with the deep troubles my students bring [to class], and to endure the abuses [by] the administration [of] faculty. *—Educator, High School, Florida*

Lack of motivation from most students and lack of support from administration. They would rather staff be in school than use the sick days or personal leave time, saying we need to be in the classroom setting an example that we need to be here.*—Educator, High School, Kansas*

Professional Learning Teams are the most taxing because due to retention [issues], I'm always working with new team members. It takes them time to "learn the ropes" and time for me to help them navigate the system and curriculum.*—Educator, High School, North Carolina*

Dealing with people of any age; after the school day is over and everyone [is] gone, I avoid people for a few hours. Then I can get back to work.*—Educator, High School, Idaho*

Overwhelming and increasing workload added on to teacher duties. I have recently learned about an approach toward my work of being happy with something that is good enough versus perfect. It is called "satisficing"…After years of always trying to perfect my craft, this "satisfying" mindset gives me permission to take care of myself.*—Educator, Middle School, Nevada*

Dealing with the trauma many of my students have suffered. Parents often take my time and ask for copious amounts of advice. I haven't found a solution yet.*—Educator, Elementary, Utah*

Behavior management and phone calls to parents. I minimize the effect [by] only calling a few parents every week, which only adds to my stress because it leaves so many uncalled. Also lesson planning, because our planning sessions are often taken up by duties or frustrating technology issues. This causes me to stress dream about my students and my prep for teaching them. I deal with this by taking a break on Saturdays, and then doing more planning on Sunday, usually.*—Educator, Middle School, Virginia*

Planning and documenting student growth are the most taxing. I find it helpful to set a time frame after school at work to get this done.*—Educator, Middle School, Texas*

Keeping up with the grading, planning, contacting parents, prepping for labs, collaborating—11 years in and I still never have enough time in the day to get [everything] done! It's definitely all on me; I am never satisfied with a lesson; I am always changing and trying new ideas with my students. *—Educator, Middle School, New York*

Overloaded teaching requirements with no support. I am teacher, lab manager, purchaser, custodian, course and curriculum developer, guidance counselor, and more.*—Educator, Institution of Higher Learning, Idaho*

Contacting parents and disciplining students are the most toxic to me. I try to minimize the effects by taking time to blow off steam, but there is never enough time to take.*—Educator, Elementary, Middle School, Illinois*

I feel like I have more standards than I have instructional time to cover them. As a result, I seem to be rushing the children all the time. They never have time to really digest what I am teaching. At the end of the day, I actually feel breathless due the stress of trying to rush everything all day long. *—Educator, Elementary, South Carolina*

Comply[**ing**] **with** all the administrative tasks—lesson plans, plans for tutorials, plans for remediation or re-teaching, collecting and analyzing data, staying after school too often, etc. Not much way to minimize. Trying to not stay after school and maximize the free time as much as possible. *—Educator, Elementary, Texas*

Grading; I prioritize which assignments help me assess what my students have learned and look closely at those.*—Educator, Middle School, Utah*

Planning and preparing; reflecting upon the lessons. I minimize the effect by not taking anything personally. *—Educator, Administrator, Middle School, New York*

The most personally taxing aspect is how intense the student population is, with their fighting [one another] as well as teachers, attitude issues, and need for negative behavior.*—Educator, Elementary, New York*

Dealing with student behaviors is a growing problem because of the lack of parent support. I limit the amount of time outside school that I will spend dealing with these negative behaviors.*—Educator, Elementary, Ohio*

The general attitude of entitlement the kids seem to have, and I just try to remember that they're just kids. *—Educator, Middle School, Massachusetts*

So many high expectations; so little time to plan/prepare for meeting them.*—Educator, Elementary, Missouri*

Having 130+ students and wanting to give thoughtful feedback, [so] I spend a lot of time grading. I am still working on it: Group projects help, as well as presentations, and with written tests, a combination of quick-to-grade multiple-choice and short answer/essay [questions].*—Educator, High School, Institution of Higher Learning, Ohio*

Any written communication required—evaluations of students, report card comments, e-mails documenting IEP compliance, etc. There is no way to minimize it. I just work until it is done, and if that's well after bedtime, so be it. It's part of the job expectations. *—Educator, High School, Maryland*

Planning and grading. To try and minimize the time spent doing these tasks for too long, I will count nonessential assignments as completion grades from time to time (maybe two or three per quarter). I will also spend my own money on Teachers Pay Teachers to purchase pre-made assignments and activities.*—Educator, Middle School, Ohio* ●

Quotable

Intelligence is the ability to adapt to change.

—Stephen Hawking, English physicist (1942–2018)

Retired Aircraft Carriers Become STEM Museums

Five retired aircraft carriers, including the U.S.S. *Yorktown, Intrepid,* and *Hornet*, have found new life as museums.

The *Yorktown* "provides a backdrop, a launching point for discussions" that put science in context, contends Hannah Giddens, science program coordinator at Patriots Point Naval and Maritime Museum in Mount Pleasant, South Carolina. "A lot of what we do is married to history." Teachers can participate in summer professional development programs and bring students on field trips that align with the state's education standards and "marry [our] history and science program with a literacy component," she continues. "Everything we do…really focuses on careers here and social and soft skills. Those are the core values. This ship literally didn't float without teamwork!"

Although they offer "programming at various levels…our fifth-grade program has the widest reach currently. When originally developing programs, we determined that the fifth-grade level was the best grade level to focus our resources in the development of both history and science curriculum. However, we always have been able to modify the program to other grade levels," Giddens notes. For students visiting the *Yorktown,* "the shipboard component is not lecture-based; it's hands on…We're all scientists. We all ask questions."

Reinforcing that idea, Patriot's Point is working with Erik Sotka, PhD, of the Grice Marine Lab for the College of Charleston on a citizen science project—the Lowcountry Algal Monitoring Program for Students (LAMPS, *https://bit.ly/38tlQ7B*)—in which teachers and their students help observe and quantify invasive algae on mudflats.

Tracy Lyles, a science teacher at James Island Charter High School in Charleston, uses LAMPS with her International Baccalaureate (IB) classes. "The ecology component for IB requires students to be able to estimate population numbers using quadrats and transects. The LAMPS data allows us to practice these skills in class so we can then use them in the field.

INTREPID MUSEUM

Students look closely at a Gruman Tracer aircraft aboard the Intrepid *Museum as a museum educator explains a folded wing mechanism.*

"Having these resources so readily available has made it possible for my students to learn 'real-world' techniques for doing science. It also gives them insight to processes happening in our local marshes that they would otherwise not be aware of. I also find that they remember information more easily if it relates to something they already know about, like our salt marshes," she observes.

Patriot's Point has been hosting "educator science cafes" since 2014, which Giddens calls intimate opportunities for educators to meet with representatives of the local science community to discuss topics such as deep-sea ecosystems.

In New York City, Jennifer Elliott, senior museum educator of School and Teacher Programs at the *Intrepid* Sea, Air, & Space Museum (see the website *www.intrepidmuseum.org*), says most visitors "think of us as a military history or straight military museum. We frame it as a science museum that explores the intersection of history and innovation," noting that when the ship entered service during World War II, it was "the best of the best, premiere in the world, but now it's outdated. We show how fast technology moves."

The *Intrepid* Museum offers "content-heavy" professional development (PD) programs that coincide with teacher development days in New York City, as well as summer PD programs open to educators nationwide. The PD topics range from using oral history in English language arts to the engineering design process, using the aircraft carrier as "a living example… of technologies created to solve specific problems not found on the ship."

Elliott estimates 14,000–15,000 K–12 students visit the *Intrepid* Museum as part of school groups, participating in history programs that analyze documents and other artifacts, aviator programs exploring flight, and space programs that include the ship's role in recovering astronauts after their return to Earth during the Space Race.

The engineering program not only delves into how the ship stays afloat, but also how the methods used to launch aircraft from the flight deck evolved over the ship's service. "During World War II, the ship would turn to the wind to help planes take off, an example of [how they used the] environment to begin to generate airflow and lift before planes began moving. Later it was outfitted with a catapult system [that could] slingshot planes from the flight deck, from 0 to 150 miles per hour in about 2 seconds."

The nature of the museum—much of it outdoors and listed on the National Historic Registry—leads to some accessibility challenges, and adverse weather can close the flight deck. The museum uses technology, virtual experiences, and alternate ways of engagement to make the ship accessible to all.

Through Skype in the Classroom, team members lead virtual field trips for classes as far away as Australia and Venezuela. "Team members walk around, show different artifacts, and do small demos," she explains.

"We're not a traditional museum. [Being on a ship] makes you think in different ways about what a museum is and what it can be," Elliott says.

Linda Uhrenholt, STEM specialist at the U.S.S. *Hornet* Sea, Air, & Space Museum (*www.uss-hornet.org*) in Alameda, California, says most of the education programs have a science, technology, engineering, and mathematics (STEM) focus. "For instance: Step Into History. As students tour, there are stops along the way where such inventions like communication tools, the microwave, radar, ultrasound, the atomic bomb, penicillin, and plasma are discussed."

Hands-on activities range from teams stacking cups without using their hands in conjunction with learning about the importance of teamwork on the carrier to building a mangonel before visiting the ship's Catapult Room to "learn the physics that enabled the *Hornet* to launch aircraft from the deck with enough velocity to launch from the ship," Uhrenholt adds.

"At the moment, our programs require a physical visit to the aircraft carrier; however, we have been working on virtual programs with the help of The Center for Interactive Learning and Collaboration," says Uhrenholt. "Many of the STEM activities that our students physically onboard explore are being duplicated to reach students, libraries, and even assisted living facilities via virtual field-trip experiences." ●

Making the Most of Industry Partnerships

While it is fairly common for science, technology, engineering, and math (STEM) companies to offer a teacher workshop, externship, or classroom resources or a program for students, some companies provide all that and more. For example, the Amgen Foundation of Thousand Oaks, California, has the Amgen Biotech Experience (ABE; *http://bit.ly/2sjH3jO*), offering high school teachers training, curricula, resources, networking opportunities, and research-grade equipment. "We want to train and equip science teachers to run labs in their own classrooms to reach every student taking biology or biotechnology courses," says Amgen Foundation Vice President Scott Heimlich. "Our model partners with universities and other science education organizations to train biology teachers [and give] them confidence and skills" to teach the material. ABE has reached nearly 800,000 students worldwide.

Students at Broadalbin-Perth Middle School in Broadalbin, New York, examine a model wind turbine in a wind tunnel with Veronica Barner, an engineer at General Electric Renewable Energy in Schenectady, New York.

With ABE, "the teacher gets the professional development to learn the labs and can reach out to a community of practice, a network, to get support" long after the training, he points out.

ABE's professional development (PD) programs vary in content depending on local teachers' needs and experience. "Some might focus on isolating DNA or cloning a gene, while others might focus on the full genetic engineering sequence," Heimlich explains. Afterward, teachers can sign up to borrow research-grade lab equipment.

Though ABE is open to all types of schools, "we emphasize reaching schools of greatest need, like Title I schools," says Heimlich. The ABE-Massachusetts program, offered through Harvard University's Life Sciences Outreach Program, enables teachers at schools in low-income areas to take students to Harvard "and do the labs there," Heimlich notes.

While ABE focuses on high school, "it is open to teachers at other levels who deem it appropriate and a value-add for their students. We engage regular, honors, and Advanced Placement science teachers," Heimlich reports. "Some educators [are at] the community college level, some teach gifted middle level students, and the labs have even been used to teach special education students."

Soon more teachers will have access to Amgen's resources. The Amgen Foundation has a partnership with Harvard launching this month called LabXchange, a free online community for educators. On LabXchange.org, "the [ABE] labs [will be] virtual," Heimlich explains. "Teachers can assign students to do them virtually, to give them practice with the labs, then have students do the real thing…LabXchange can also be used without [the ABE equipment]."

Renewable Energy

"I have worked with General Electric for several years,…when they ran a regional KidWind competition, provided training and materials to teachers, and came into our school to work with students," says Jim Brown, grades 5/6 STEM teacher at Sand Creek Middle School in Albany, New York. In the Kid Wind Challenge (*www.kidwind.org*), a worldwide competition, student teams in grades 4–12 design, construct, and test small-scale wind turbines and solar structures. General Electric (GE) Renewable Energy sponsors the KidWind Challenge in upstate New York.

"GE provided mentors for teachers," Brown continues, and students on his KidWind teams have toured GE Renewable Energy's Remote Operations Center, "which controls and monitors all of GE's wind turbines in the Northern Hemisphere." The experience was valuable because the students were exposed to "good careers" in renewable energy and were able to share their experience with classmates, he notes. Brown used his experiences with GE and KidWind to help his school district create their current fifth-grade STEM course. "Now every student in our district gets to learn about renewable energy," he reports.

"KidWind is an amazing way of engaging young children in STEM and renewables," remarks GE Wind Fleet Strategy Leader Veronica Barner, who worked with Brown. The challenge, she adds, gives students a chance to interact with industry professionals.

At GE's Wind Energy Workshop, 30 teachers receive science kits and curriculum, hear from GE staff about aspects of wind energy, and do activities like building a wind turbine. "Every teacher [leaves] with a contact/mentor—a GE engineer—to help them throughout the school year," Barner reports.

GE has also assisted students in programs like Junior Achievement and Girl Scouts and Boy Scouts. "Randomly, we get teachers and principals who want GE speakers," Barner says.

Help With Science, Math

Eastman in Kingsport, Tennessee, partners with East Tennessee State University's Center of Excellence in Mathematics and Science Education (ETSU CEMSE) to enhance science and math education. Eastman provides two graduate-level summer PD programs, ScienceElites and MathElites (see *http://bit.ly/2rpOaqT*), to science and math teachers in its home communities. MathElites "helps teachers feel more comfortable with the foundations of math," says Education Manager Tanya Foreman. ETSU CEMSE faculty teach the course, for which elementary and middle school teachers can earn graduate credit. They also receive a stipend from their school district and $700 from Eastman for math manipulatives.

ScienceElites is designed for elementary teachers because "that's where the biggest gap is," Foreman notes. "We try to close that gap and teach them the foundational concepts [of the physical sciences]…We give them experiments they can do with inexpensive materials, and a lot of modeling examples," she relates.

"Our program is based on Tennessee state science standards," Foreman asserts. The course is taught by ETSU CEMSE science educators and Eastman scientists. Teachers get to spend a day at Eastman touring the labs and interacting with other scientists.

ScienceElites and MathElites have benefited more than 40,000 students, and "we have trained more than 800 teachers," she points out. "Teachers say they feel like they did at the start of their careers again."

Eastman scientists also visit classrooms as part of Eastman's GEM 4STEAM (Growing Educational Mentors for Science, Technology, Engineering, Arts, and Mathematics) program. Engineers volunteer to go to schools, do presentations, and mentor teachers, says Foreman.

Eastman also offers programs for STEM students. Eastman team members mentor high school students in the FIRST Robotics Competition; the company also provides monetary support to several FIRST teams.

"It's a workforce development issue: [W]e have to do everything we can to help promote [STEM] in order to produce the next crop of scientists and engineers," Foreman adds. ●

NSTA Online Course Providers

NSTA partners with professional development providers that offer their online learning opportunities on a continuing basis. These institutions offer short courses as well as degree-granting programs to assist the teacher of science.

American Museum of Natural History

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

Montana State University – Bozeman

Take online graduate credit and non-credit courses for professional development, or work toward one of five 12-credit online graduate certificates (Life Science, Physics, Chemistry, Elementary Science and Earth Science) or an online Master's of Science in Science Education.

California University of Pennsylvania

Designed for elementary and middle level teachers, Cal U's online Master's degree focuses on teaching inquiry across the STEM disciplines. Each course in the 30-credit program also develops your teacher leadership skills so you can take your career to the next level.

University of Maryland

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

- **High quality interactive content for K–12 science teachers**
- **Earn graduate credits and advanced degrees**
- **Affordable and user-friendly**
- **Moderated by world-renowned faculty**
- **Gain knowledge specific to your area of instruction**

https://www.nsta.org/course-providers

nsta
National Science Teaching Association

P U L L - O U T   S E C T I O N

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

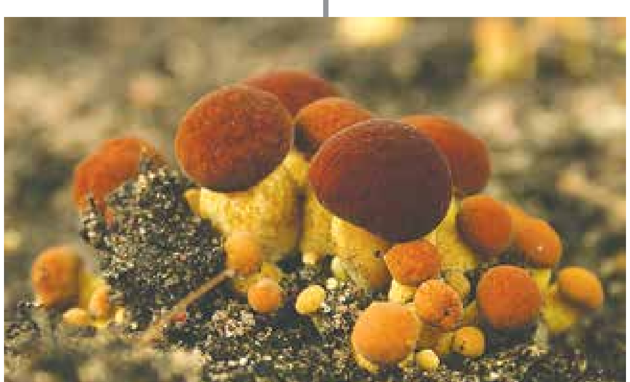
Freebies for Science Teachers

Chemistry Shorts. **M H** These short (less than 10 minutes each) chemistry-centric films produced by the Camille and Henry Dreyfus Foundation and Theorem Studios showcase recent innovations in chemistry and include accompanying lesson plans to bring the science research directly to middle and high school classrooms. *Under the Skin* describes the work of Stanford University professor Zhenan Bao and her research team, who are using the principles of molecular chemistry to develop "electronic skin," a new material that, like human skin, is stretchable, conductive, and self-healing. In the accompanying lesson (for the high school level), students conduct strength tests on various crafting materials, then combine the materials in different ways to create a new material (i.e., a molecule) that exhibits properties of each contributing part.

Rewriting Life discusses the history of genome editing and introduces the concepts behind the CRISPR technology. In the accompanying lesson, designed for both middle and high school levels, students apply what they learned from the movie to model various processes to edit DNA using repositionable notes and student handouts and following specific instructions. Access these resources at *http://bit.ly/2P2zTrB*.

Teaching Today to Save Tomorrow. **H** This Creative Commons course has everything high school educators need to teach a comprehensive, four-week unit on climate change. Written by instructional designer Malanka Riabokin of Zofostro Science and funded by BeInteractive—a nonprofit group that helps everyday citizens produce impactful projects that make a difference—the downloadable resource includes weekly itineraries exploring themes such as "A Glowing Earth" (geologic timeline), "Your Carbon Footprint," "The Earth's Future Climate," and "Four Ways You Change the World." Within each topic, teachers can access lecture-based PowerPoint presentations, student handouts, and rubrics for each activity. The unit also includes supplementary materials (e.g., syllabus, teacher's manual) along with instructions for a student project, the Green Home Design Assignment. Refer to *www.beinteractivehq.org/climatecourse*.

What's in Your Backyard? **K12** In this citizen science soil collection program sponsored by the University of Oklahoma, participants—including K–12 students and teachers—contribute to authentic biomedical research by collecting soil samples and submitting them to university scientists for analysis. The scientists are using the data gathered from the samples to help develop new drug-like molecules from fungi identified in the soil. Visit *https://whatsinyourbackyard.org* for participation details and additional resources, such as a curriculum guide for grades 4–12, fungi facts, and a look at the processes involved in analyzing a soil sample at a university.



PRZYKUTA

Bond Breaker Classroom Edition. **M H** Middle and high school students can delve into the worlds of atoms, molecules, and chemistry research with this chemistry-themed puzzle game developed by the Center for Chemistry at the Space Time Limit (CaSTL) and TestTube games (see the website *http://bit.ly/2RoJOe8*). The game combines rigorous science learning with gameplay, allowing students to manipulate protons, molecules, laser light, and more to solve challenging levels in a nanoscale world. The game can be played online or downloaded as an app for iOS and Android devices.

In addition, lesson plans that guide teachers in using the game as a classroom teaching tool are available at *http://bit.ly/35RkGAF*. Lesson plans support the *Next Generation Science Standards* (*NGSS*) and cover topics such as chemical reactions, thermal energy and change of state, and Van der Waals forces (for the middle level) and thermal energy transfer, atomic and molecular interactions, and attractive and repulsive forces (for the high school level).

Journey 2050. **M H** A multilevel farm simulation game and program focus on this question: How will we sustainably feed nearly 10 billion people by the year 2050? Targeted for grades 7–12, the simulation helps students learn to balance economic and social factors involved in sustainably feeding an increasing world population. The game is designed to complement learning standards in agriculture education classes and science, technology, engineering, and math (STEM); social studies; and geography programs. In addition, teachers can register at no charge to access lesson plans, videos, and other resources to deepen students' understanding of the influence of agriculture in our communities

See Freebies, pg G2

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

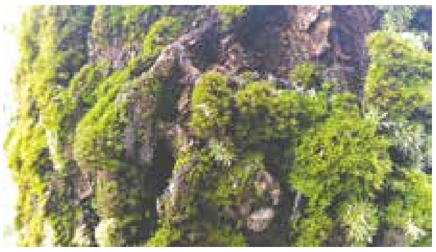
Freebies, from pg G1

and introduce new careers in the field. See *www.journey2050.com*.

We Are Urban Geoscientists. M H Introduce middle and high school students to careers in geoscience and environmental science with this short video from Temple University's Department of Earth and Environmental Science. Featuring interviews with students, professors, and others involved in geoscience-related projects within the university, the video reveals the interdisciplinary nature of a major in Environmental Science and the diversity of potential careers stemming from it. Students will hear from GIS (geographic information systems) mapping specialists, geologists, hydrology technicians, environmental researchers, and consultants while discovering facts and statistics about geoscience-related careers in the United States, including salary information and employment projections. Watch the video at *http://bit.ly/35NZMT1*.

NGS Navigators Podcast Series. K12 Seeking high-quality professional development to guide your implementation of the *NGSS?* Check out NGS Navigators (*www.ngsnavigators.com*), a weekly podcast series hosted by veteran science educator and *NGSS* guru Margaret O'Sullivan. This series features interviews with key science education researchers, writers, teachers, and scientists weighing in on impactful *NGSS*-related topics, such as Teaching for Social Justice, Five Practices for Orchestrating Task-Based Discussion, and Forming a Productive *NGSS* Professional Learning Community. Each approximately 30-minute podcast is accompanied by a web page with an episode summary, highlights, notable quotes, and links for further learning.

The Algae Academy. K12 This learning module introduces K–12 audiences to the fundamentals of algae growth and how algae can be used as a solution for global dilemmas. Through the module's lessons, students will grow algae, develop experiments, measure growth, analyze data, and make connections on how algae production pos-



VIJAYANRAJAPURAM

itively impacts the global environment. The five-day curriculum fulfills the human impact education component in the *NGSS,* which requires students be able to apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

The kit includes daily lesson plans, live algae to grow in the classroom, and educator training and support. The curriculum is versioned for grades 2–3, 4–8, and 9–12. After completing the curriculum, educators can continue to receive free algae and consumables to teach the Algae Academy lessons each year. Resister for the Spring 2020 session at *http://bit.ly/2P75ybs*.

Little Bins for Little Hands. P E On this science-themed website and online store for educators are free science experiments, projects, and STEM ideas to try with students ages 3–9. Grouped by theme and subject (e.g., holiday, edible science, physics, chemistry, weather, space, ocean, STEM, and more), the experiments can spark interest in science and encourage experimenting, tinkering, building, observing, exploring, problem solving, and creating. For example, visitors can find recipes for various slimes, doughs, and sands; explore weather concepts through activities such as Shaving Cream Rain Clouds and Water Cycle Discovery Bottles; or learn about space science by sculpting an edible Moon cycle or whipping up a batch of Fizzy Moon Rocks. See *http://bit.ly/2Y38ytG*.

American Physical Society Outreach Guide. K12 HE This online guide was developed to help K–college physics educators and other physics enthusiasts design and implement successful physics outreach programs in their schools or communities. The guide has information on topics such as the types of outreach programs, ways to work with schools and other audiences, safety issues, and public relations tactics to help advance the outreach effort. Links to information about popular physics demonstrations for outreach events, as well as contact information for physics experts willing to assist colleagues in developing a new outreach program, are included. Refer to *http://bit.ly/2rHoshc*.

Engineering for Good. M Developed by PBS Learning Media and KQED Teach, this three-week, project-based learning unit for middle level science classrooms focuses on developing solutions for negative impacts of plastics on the environment. The unit supports the *NGSS* and promotes the engineering design process as students define a problem, brainstorm solutions, develop prototypes, and iterate on their designs. The project culminates with students producing videos about their solutions to share with the community. In addition to lesson plans and videos, the unit instructs teachers on how to create digital media artifacts such as digital stories and data visualizations. Access the unit at *http://bit.ly/2rJuiPf*.

National Geographic's Water Cycle Resources. E M H At this National Geographic Resource Library website (*http://bit.ly/2Y8z84p*), teachers will find a collection of vetted resources to deepen students' understanding about condensation, precipitation, and weather patterns that are affected by, and a part of, the water cycle. Most appropriate for grades 5–12, the standards-supported resources include encyclopedic entries on various topics (e.g., Earth, types of precipitation, air, hydrosphere, and clouds), infographics (e.g., Urban Water Cycle), and classroom activities using interactive computational models exploring water's movement above and below ground (e.g., Availability of Fresh Water; Using Groundwater Wisely).

The Dinosaur Database. K12 Built with PaleoDB, a scientific database assembled by hundreds of paleontologists over the past two decades, this searchable resource features a rich set of dinosaur names, pictures, and facts. Dinosaur enthusiasts of all ages—including K–12 students and teachers—can search for dinosaurs

SEBASTIAN BERGMANN FROM SIEGBURG, GERMANY

by region, time period, or name. The site also features an interactive globe of ancient Earth, and students can select a period of time between 0 and 750 million years ago to view the Earth as it appeared at that time. Visit *https://dinosaurpictures.org*.

K–12 Food Education Standards. K12 The first-ever nationwide recommendations for food education for K–12 students are available at the website *http://bit.ly/34GZWeF.* The standards were developed in collaboration with chefs, nutrition and education experts, and faculty from the University of Chicago, Columbia University, the U.S. Department of Agriculture, and Chicago Public Schools. The standards provide detailed guidelines for curriculum development, instruction, and assessment of food education in classrooms. Each standard is divided into measurable competencies by grade-level bands (K–2, 3–5, 6–8 and 9–12) and is tied to a library of sample lesson plans for reference and inspiration.

Rebound: Beating Concussions. E M An interactive e-book and app teaches students in grades 4–6 about sports, concussions, and brain health. Available at *http://bit.ly/2P78hSg,* and suitable for both iOS and Android devices, the digital publication is unique not only for its age-appropriate, interactive approach to learning about concussion safety, but also because the content's reading level can be adjusted to reflect the user's reading ability. This feature makes the resource as useful for language arts instruction as it is for teaching science. ●

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

News Bits

- **Many educators don't use research to enhance their teaching, and those who do most frequently access research from blogs, news articles, journal articles, and professional conferences. A**

Researchers from the Jefferson Education Exchange, a nonprofit supported by the University of Virginia's Curry School of Education and Human Development, surveyed 1,334 educators from all 50 states and the District of Columbia. Their findings show that educators prefer research that they can act on and that is relevant to their work. Teachers' views on whether education research is timely, easy to find, understandable, or transferrable to their practice fell in the 4.5 to 4.9 range on a 1 to 7 scale. In an additional, smaller study, only 16% of teachers reported using research to inform their instruction.

Research–practice partnerships are on the rise to address this gap. Read the report at *http://bit.ly/JEXEDVoice*.

- **An Ohio high school is one of the first high schools in the nation to have a virtual dissection table for biology classes. H**

Ursuline High School in Youngstown purchased the technology, called Anatomage, which incorporates different biological dissections into one piece. For example, students can study various animals, MRI scans, and the human body. It allows students to see the human body up close and gives them a multidimensional view. When students open any type of image on the table, it labels everything down to a specific blood vessel and where it starts.

The new equipment lets students interact with every picture through special touch pens. One student said it made him look forward to biology class because it was different from reading and note-taking. "It makes the whole experience more exciting, and you want to learn more; you're more eager," he said. Read more at the website *http://bit.ly/2Of26wq*.

- **California State University plans to require a fourth year of high school math, or a quantitative reasoning class, for freshman admissions. H HE**

Civil rights organizations, education groups, and state leaders voiced concern against the controversial change, saying that it would make it harder for black, Latino, and low-income students to attend the 23-campus university. Opponents also contend that the university has not provided sufficient evidence showing the change is necessary to improve student achievement. Others say many high schools don't have enough teachers to offer the courses that would be required under the proposal.

However, outgoing Chancellor Timothy White maintains that the nature of work in the future will require more quantitative reasoning, coming from classes such as computer science or personal finance. "We want underserved students to be competitive in the future of work," he asserts. "There are numerous safety valves in this proposal to ensure it is not going to be hurtful to a single student. We need to have the courage to give the support to these young men and women to be competitive in the workplace of tomorrow." Read more at this website: *http://bit.ly/35wrWSc*. ●

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

NSTA School Partner Program

Each Partner School receives these benefits:

- **NSTA membership** for all teachers in the school building
- **One free conference registration** for a teacher/administrator to a STEM Forum or an NSTA Conference
- **Recognition** as an NSTA Partner School
- **One print journal** for the school building and e-journals for every teacher/member in the school
- **One hard copy of *NSTA Reports*** (newspaper) with e-Reports for every teacher/member in the school
- **Access to Learning Center Forums**, including collections of *NGSS* and STEM resources differentiated by grades
- **An initial one-on-one conversation** with NSTA to determine which products and services can best support school-wide professional learning goals
- **Participation in three virtual conferences** per year, exploring critical topics for STEM and *NGSS* integration
- **Access** to a national *NGSS* and STEM listserv and 16 other listservs

In addition, each teacher gets discounts on

NSTA conferences and workshops

NSTA Press books

Enhanced e-books

For more information please visit
www.nsta.org/schoolmembership

Contact us:
schoolmembership@nsta.org

nsta
National Science Teaching Association

In Your Pocket

Editor's Note

Visit https://bit.ly/2ZlRIp5 *to learn about more grants, awards, fellowships, and competitions.*

January 20–31

Bostitch Creativity in the Classroom Grant K12
These $250 grants will be presented to two K–12 teachers who have lesson plans encouraging creativity. Lessons should be original, impactful, and foster creative thinking, expression, and individuality.

Submit a Google Doc with your lesson plan and an application by **January 20** to *http://bit.ly/2DWZ2jw.*

Lawrence Scadden Teacher of the Year Award in Science Education for Students With Disabilities K12
This award recognizes excellence in science teaching to students with disabilities. The honoree receives $1,000 for travel expenses to attend the NSTA Conference on Science Education and be recognized at the Science-Abled Breakfast. K–12 science, general education, or special education teachers with at least five years of teaching experience may apply by **January 20** at *www.sesd.info/scadden.htm.*

Edward C. Roy, Jr., Award for Excellence in K–8 Earth Science Teaching E M
This American Geosciences Institute award goes to a K–8 Earth science teacher who is a leader and innovator in the field. The awardee receives a plaque, $2,500, and a $1,000 grant to attend the NSTA national conference.

Full-time K–8 teachers in the United States or Key Stages 1–3 teachers in the United Kingdom who teach Earth science are eligible. Apply by **January 22** at *http://bit.ly/37W4v6U.*

Melinda Gray Ardia Environmental Foundation Grants K12
These grants help educators develop and test environmental curricula that integrate field activities with classroom teaching. Proposed projects should incorporate basic ecological principles and encourage students to be informed decision makers and environmental problem-solvers.

Grants are available for organizations worldwide. Applicants should submit a pre-proposal by **January 25.** Selected organizations will then be invited to submit full proposals. See *http://bit.ly/1lZdoPJ.*

Five Star and Urban Waters Restoration Grants A
These grants go to projects that promote community stewardship of natural resources and enhance local water quality, watersheds, and the species and habitats they support. Projects should have measurable outcomes and include community partners, along with an education or outreach component.

Grants range from $20,000 to $50,000. Apply by **January 30;** refer to *http://bit.ly/2U0taAh.*

Fund for Teachers Grants P K12
These grants support self-designed professional development (PD) experiences for teachers anywhere in the world. The fund provides $5,000 for individuals and up to $10,000 for teams. PreK–12 teachers, curriculum specialists or heads, special education coordinators, media specialists, and librarians who have at least three years of teaching experience and spend 50% of their time directly teaching students are eligible.

Application instructions vary by state; check eligibility and apply online by **January 30** at *www.fundforteachers.org.*

Captain Planet Foundation Project Learning Garden K–5 Grant E
Recipients are provided with hands-on training, curriculum aligned to national standards, lesson kits filled with supplies, a fully-equipped garden cooking cart, and a summer garden management intern. All Project Learning Garden lessons encourage inquiry-based learning, provide hands-on experiential learning, and guide the teacher toward the *Next Generation Science Standards.* Apply by **January 31;** see *http://bit.ly/2rVfJI8.*

February 1–28

NSCF National STEM Scholar Program M
This National Stem Cell Foundation (NSCF) program supports middle school science teachers and their students. Ten teachers will connect with thought leaders in science, technology, engineering, and math (STEM) education; learn new approaches; and develop a Challenge Project for their classrooms. Each receives a tablet and funding for their projects and an all-expenses-paid trip to the 2021 NSTA National Conference in Chicago.

The program takes place May 31–June 6 at Western Kentucky University (WKU) in Bowling Green. WKU faculty will provide mentoring throughout the year, and NSCF will provide funding and materials.

Teachers with two years of experience who teach science classes the majority of the day in grades 6, 7, or 8 are eligible. Apply online by **February 1** at *http://bit.ly/2rHKq3s.*

Air Force Junior ROTC Grant H
The Air Force Association offers these $250 grants to promote aerospace education in classrooms and Junior ROTC units. Funds can be used for aerospace-related items, such as books, materials, or field trips to an aerospace museum, Air Force base, or other aerospace facility.

Classrooms and units can apply every other academic year. Apply by **February 10;** see *http://bit.ly/2xTheX4.*

Vernier Engineering Contest M H HE
This $5,500 award goes to one middle, high school, or college educator who uses Vernier sensors to introduce engineering concepts and practices. The award includes $1,000 in cash, $3,000 in Vernier technology, and $1,500 to attend either the STEM Forum & Expo, hosted by NSTA, or the American Society for Engineering Education Conference.

Applicants will be judged based on their use of innovative ideas, the engineering concepts being taught, and the ease of replicating their projects. Current engineering, science, or STEM teachers are eligible. Submit a video showcasing your entry and the online application by **February 15** at *http://bit.ly/1DNqCZ3.*

SPIE Education Outreach Grants A
SPIE, the international society for optics and photonics, provides grants for 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. Those with the potential to impact students and increase optics and photonics awareness are preferred.

Apply by **February 28.** Consult *http://bit.ly/2RoiKsr.*

March 30

RALLY for STEM Fellowship at Ohio University HE
This fellowship provides full funding for the university's one-year STEM Education master's degree. Fellows receive free tuition and a $14,000 stipend while in the program. After they complete it, they also receive PD and an $11,000 stipend each year for four years if they teach in a high-needs school.

Applicants should have an undergraduate degree in a STEM field and a desire to teach middle or high school science or mathematics, but not already be a certified teacher. Apply by **March 30** at *http://bit.ly/360MP8A.* ●

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

What's New

FROM U.S. GOVERNMENT SOURCES

National Oceanic and Atmospheric Administration (NOAA)

Ocean and Coastal Acidification Module H

This learning module for grades 9–12 from NOAA's Data in the Classroom program explores ocean and coastal acidification through authentic research questions and scaled data interactions using near real-time data from NOAA. Through the module activities, which progress from guided teacher experiences to student-led inquiries and data analysis, students explore the relationships among carbon dioxide, ocean pH, and aragonite saturation state and learn to predict whether ocean conditions can support the growth and survival of marine life, now and in the future. The module materials include information on how the module activities support three-dimensional learning as indicated in the *Next Generation Science Standards,* a teacher's guide, and a set of downloadable student activity sheets. Refer to *http://bit.ly/2DDbbc8*.

Okeanos Explorer: Education Materials M H

Bring the excitement of ocean exploration and scientific research to students in grades 6–12 with materials based on the discoveries of NOAA's ship *Okeanos Explorer.* Developed by educators from NOAA's Office of Ocean Exploration and Research, the resources provide hands-on, standards-based lessons that foster understanding of the Ocean Literacy Essential Principles and Fundamental Concepts, and teacher training to successfully implement the lessons in the classroom. *Volume 1: Why Do We Explore?* contains background information for teachers and 15 student-centered activities focused on understanding the reasons for ocean exploration. *Volume 2: How Do We Explore?* expands on the first volume's activities to introduce students to modern exploration tools used aboard a research ship, including telepresence, multibeam sonar, water column investigations, and underwater robots. Find these and other resources, including career profiles of more than 30 scientists working in ocean exploration, at *http://bit.ly/33L33kJ*.

U.S. Fish and Wildlife Service (FWS)

Wildlife Artifact Lending Library K12 HE

FWS's National Wildlife Property Repository sponsors a donation program allowing K–college educators to borrow wildlife artifacts donated to or confiscated by the U.S. government, such as items made from (or suspected of being made from) endangered animals and plants. The items—which may include artifacts such as a sea turtle shell, fur pelt, reptile skin, and ivory bracelet—can be used to enhance instruction on wildlife conservation topics and scientific research. For more details or to make a request, visit *http://bit.ly/2P1Ne3H*.

Salmon in the Classroom K12

With this curriculum from the FWS Pacific Region's Fish and Aquatic Conservation offices, K–12 students in the Pacific Northwest can get a "fisheye" view of the salmon lifecycle by observing the transformation of eggs to salmon up close in school classrooms or libraries. The program brings aquaria with cold-water, native fish eggs nearly ready to hatch into the classroom. Throughout the process, which typically occurs in about 50–75 days, students complete salmonid-themed lessons, learning about the species' habitat, life cycle, anatomy, history, and environmental impacts. The project culminates with the release of the hatchery-raised salmon to the watershed. Learn more and access program materials, such as a curriculum guide and Tank Care Guidelines, at *http://bit.ly/37UUzup*.

U.S. Department of Energy (DOE)

Energy Education Resources K12 HE

The DOE's Education Resources web page (*http://bit.ly/37zvOE0*) has materials to engage K–college learners in energy topics from renewable energy to innovative careers in the field. For example, high school and college audiences can learn about renewable energy sources and energy efficiency through the video series Energy 101, while younger students can explore energy topics through activity books. Educators will find energy-themed publications and classroom activities created by the National Energy Education Development Project, and materials and activities relating to the DOE's Solar Decathlon Design Challenge.

Library of Congress (LOC)

Engineering Design and Thomas Edison M H

The blog Teaching With the Library of Congress provides ideas for and activities on using primary source documents in K–12 classrooms. At *http://bit.ly/2Rj4VOL,* Amara Alexander, elementary educator and 2019–20 Albert Einstein Distinguished Educator Fellow at the LOC, shares an activity using Thomas Edison's invention of the phonograph to introduce the engineering design process. Targeted for middle and high school levels, but adaptable for all ages, the activity teaches students how to analyze a primary source photograph using the LOC's Observe-Reflect-Question analysis tool. The blog post includes discussion questions and links to another lesson plan about Edison and his inventions.

National Aeronautics and Space Administration (NASA)

STEM Outreach for Families K12

Developed by NASA Jet Propulsion Laboratory educators, these science, technology, engineering, and math activities can spark science conversation and learning among K–12 students and families. Best for outreach events, but adaptable for classroom use, the activities address topics from integrating science and the arts (e.g., Art and the Cosmic Connection, Space Science Musical) and engineering design challenges (e.g., Ring Wing Glider, Water Filtration Challenge) to exploring scientific models and data (e.g., Precipitation Towers: Modeling Weather Data; Modeling an Asteroid) and computer programming applications (e.g., Explore Mars With Scratch). Access lesson plans, including targeted grade level, procedures, background information, and standards connections, at *https://go.nasa.gov/35uExpa*.

Tour the Electromagnetic Spectrum M H

This multimedia resource introduces electromagnetic waves, their behaviors, and how scientists visualize these data. Most appropriate for middle and high school levels, and found at *https://science.nasa.gov/ems,* the resource uses online videos, a book (in PDF format), a hands-on activity, a pictorial diagram, and examples of NASA science to provide a comprehensive description of each region of the electromagnetic spectrum.

U.S. National Archives and Records Administration

What's Cooking, Uncle Sam? M H

This interactive e-book features video, audio, and content based on a past exhibit at the National Archives exploring the government's role in the American diet throughout history. From the Revolutionary War to the late 1900s, the letters, photographs, pamphlets, posters, films, and radio programs from the exhibit echo many of our current concerns about government's role in the health and safety of our food supply. The e-book—available for various iOS devices as well as for PCs and Macs—includes slideshows, audio/video with captioning, and links to records citations from the National Archives. Share the publication with middle and high school audiences to give students opportunities to analyze primary source documents and develop their own understandings about the changing relationships between food and government in both science and history. See *http://bit.ly/35Pm8mY*. ●

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

Summer Programs

Editor's Note

Visit https://bit.ly/2ZlRIp5 to learn about other summer professional development opportunities.

Smithsonian's Teacher Innovator Institute M

This free summer program at the National Air and Space Museum in Washington, D.C., helps middle school teachers connect informal science, technology, engineering, and math (STEM) education with authentic learning. Working with museum educators and content experts, teachers develop projects for their classrooms that incorporate museum learning. Participants will attend the institute in person for two weeks each summer, two years consecutively. This year's institute takes place July 6–17.

Thirty teacher-innovators will receive lodging, food, and travel to the institute, along with the program materials. Individuals or teams of middle school science, technology, engineering, arts, and math (STEAM) teachers with project ideas and an interest in informal education techniques are encouraged to attend. Apply by **February 1;** visit *https://s.si.edu/2OI6EeS.*

National WWII Museum Seminar: From Liberation to V-J Day, Exploring the End of WWII M H

Designed for middle school and high school teachers, this July 20–24 seminar covers topics related to the history of World War II using a curriculum built on primary source materials. Participants will have access to noted WWII scholars, as well as hands-on experiences and virtual resources they can incorporate into classroom instruction. Teachers of subjects other than social studies may apply, but should explain how they plan to incorporate WWII themes into their curriculum. Participants will receive free lodging, a travel stipend, seminar materials, and most meals free of charge.

Apply by **February 7.** See the website *http://bit.ly/2YhYoWi.*

McDonald Observatory Workshops K12

McDonald Observatory, located in the Davis Mountains of west Texas, hosts four summer workshops focused on astronomy. Participants discuss current astronomy research, practice basic astronomy skills, tour the facility's telescopes, and conduct nighttime observations with experts. This year's workshops include

- Mysteries of the Universe, Dark Matter, Galaxies, and More (grades 8–12; June 10–12);
- Explore Our Solar System (grades K–8; July 22–24);
- Explore Our Solar System for UTeach Students and Alumni (grades K–8; July 27–29); and
- Explore Our Milky Way and Beyond (grades 8–12; August 6–8).

Continuing education credits are available. Apply by **February 7** online at *http://bit.ly/2TtjRrD.*

EARTH Workshop K12

Education and Research: Testing Hypotheses (EARTH) workshops bring teachers, scientists, and engineers together to develop effective methods for using near-real-time data from ocean observatories in the classroom. The Mercy College Center for STEM Education will host this year's workshop during August 3–7 in Dobbs Ferry, New York. Participants are required to try out an EARTH lesson in their classroom after the workshop and submit a feedback rubric based on their experience.

Apply by **February 21;** visit the website *http://bit.ly/2R8hEUB.*

AEOP Research Experiences for STEM Educators and Teachers M H

The Army Educational Outreach Program (AEOP) provides this summer research opportunity at participating Army laboratories. Teachers work online with Army and Department of Defense scientists and engineers, with a subset selected for on-site research. When the program ends, teachers translate this experience into enhanced curricula and learning for their students.

Upper middle and high school teachers of STEM-related subjects or career technical education are eligible. Apply by **March 1** at *http://bit.ly/2Y7Lyts.*

Idaho STEM Action Center i-STEM Institutes K12

These four-day institutes provide professional development for Idaho teachers. Participants attend a strand of their choice, hear from keynote speakers, and network with their peers. Each strand focuses on hands-on, project-based learning on topics of local interest. Everyone receives a kit of instructional materials to implement what they learn. Workshops will be held at these locations:

- June 15–18: College of Southern Idaho
- June 15–18: Lewis-Clark State College
- June 16–19: Idaho State University
- June 22–25: College of Eastern Idaho
- June 22–25: North Idaho College
- June 23–26: College of Western Idaho

Teachers can apply for funding by **March 2** at *http://bit.ly/2OHUuTb.*

AMS Project Atmosphere Workshop K12

The American Meteorological Society (AMS) offers this hybrid workshop for K–12 teachers who teach science courses with atmospheric content and their supervisors. Participants learn the latest technologies for sensing, analyzing, and forecasting weather and how to incorporate them in the classroom.

Before the on-site workshop, participants complete online learning modules. Then from July 26 to August 1, they participate in lectures, tutorials, hands-on lab exercises, field trips, and seminars led by U.S. National Weather Service (NWS) and National Oceanic and Atmospheric Administration (NOAA) personnel at the NWS Training Center in Kansas City, Missouri. Participants receive graduate credit, a $300 stipend, lodging, travel funds, tuition, instructional materials, and $200 for food and incidentals. Afterward, they must conduct at least one training session for teachers in their home regions, supported by AMS.

Apply by **March 27** at the website *http://bit.ly/2OyBgPY.*

AMS Project Ocean Workshop M H

This hybrid AMS workshop is for precollege teachers who teach oceanography content. Participants learn the physical foundations of oceanography, explore how to employ these concepts in the classroom, and prepare workshops for teachers in their home regions.

Participants complete online learning modules before they attend the workshop in Chestertown, Maryland, July 12–18, where they'll learn from U.S. Naval Academy faculty and NOAA scientists. After the workshop, they will conduct at least two training sessions for precollege teachers in their home regions, supported by AMS.

Graduate credits, a $100 stipend, lodging, meals, travel funds, tuition, and instructional materials are available. Apply by **March 27;** see the website *http://bit.ly/2cQO2Gz.*

Educator Workshop at BIOS M H

This five-day (June 23–27) workshop offers 12 educators the opportunity to plan a field study course for their students at the Bermuda Institute of Ocean Sciences (BIOS). Participants explore coral reefs, use Glider technology for ocean study, and visit Whalebone Bay, Cooper's Island, and other attractions.

Preservice and inservice middle and high school teachers, curriculum specialists, administrators, and informal educators may apply by **April 1.** Refer to *https://bit.ly/2yh1ixU.* ●

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

2020's Outstanding Science Trade and STEM Books

The best nonfiction books not only impart information, but also can inspire readers to consider new ideas and ways to approach problems. Each year, NSTA and the Children's Book Council (CBC) convene a panel of educators to compile the Outstanding Science Trade Books for Students (OSTB) and the Best STEM Books lists of books published that year. NSTA recently released the OSTB and Best STEM Books lists, featuring books that present accurate information in engaging ways to educate and inspire young readers. For details on the OSTB books and to peruse lists from prior years, visit *www.nsta.org/ostb*. The Best STEM Books list can be downloaded at *https://bit.ly/355GlFi*.

OSTB

All in a Drop: How Antony Van Leeuwenhoek Discovered an Invisible World, by Lori Alexander, illustrated by Vivien Mildenberger

Amazing Evolution: The Journey of Life, by Anna Claybourne, illustrated by Wesley Robins

Anna & Samia: The True Story of Saving a Black Rhino, by Paul Meisel

Beyond Words: What Elephants and Whales Think and Feel, written and illustrated by Carl Safina

A Book About Whales, by Andrea Antinori

The Butterfly House, by Katy Flint, illustrated by Alice Pattullo

A Computer Called Katherine: How Katherine Johnson Helped Put America on the Moon, by Suzanne Slade, illustrated by Veronica Miller Jamison

Counting the Stars, The Story of Katherine Johnson, NASA Mathematician, by Lesa Cline-Ransome, illustrated by Raúl Colón

Darwin: An Exceptional Voyage, by Fabien Grolleau, illustrated by Jérémie Royer

Dreaming in Code, Ada Byron Lovelace, Computer Pioneer, by Emily Arnold McCully

Electric War: Edison, Tesla, Westinghouse, and the Race to Light the World, by Mike Winchell

Evelyn, the Adventurous Entomologist: The True Story of a World-Traveling Bug Hunter, by Christine Evans, illustrated by Yasmin Imamura

Exemplary Evidence: Scientists and Their Data, by Jessica Fries-Gaither, illustrated by Linda Olliver

Fanatical About Frogs, by Owen Davey

The Frog Book, by Steve Jenkins and Robin Page

Hawking, by Jim Ottaviani, illustrated by Leland Myrick

Hedy Lamarr's Double Life, Hollywood Legend and Brilliant Inventor, by Laurie Wallmark, illustrated by Katy Wu

Hummingbird, by Nicola Davies, illustrated by Jane Ray

Instructions Not Included: How a Team of Women Coded the Future, by Tami Lewis Brown and Debbie Loren Dunn, illustrated by Chelsea Beck

Into the Deep Sea: An Exploration of Our Oceans, by Wolfgang Dreyer, illustrated by Annika Siems

Look Up with Me, Neil deGrasse Tyson: A Life Among the Stars, by Jennifer Berne, illustrated by Lorraine Nam, introduction by Neil deGrasse Tyson

Mario and the Hole in the Sky: How a Chemist Saved Our Planet, by Elizabeth Rusch, illustrated by Teresa Martinez

Migration: Incredible Animal Journeys, by Mike Unwin, illustrated by Jenni Desmond

Moth: An Evolution Story, by Isabel Thomas, illustrated by Daniel Egnéus

Nine Months, by Miranda Paul, illustrated by Jason Chin

Nose Knows: Wild Ways Animals Smell the World, by Emmanuelle Figueras, illustrated by Claire de Gastold

Not a Butterfly Alphabet Book, by Jerry Pallotta, illustrated by Shennen Bersani

Now You Know What You Eat, written and illustrated by Valorie Fisher

One Iguana, Two Iguanas: A Story of Accident, Natural Selection, and Evolution, by Sneed B. Collard III

Overview: A New Way of Seeing Earth, Young Explorer Edition, by Benjamin Grant with Sandra Markle

Paper World Planet, written and illustrated by Bomboland

The Poison Eaters: Fighting Danger and Fraud in Our Food and Drugs, by Gail Jarrow

Pollen: Darwin's 130-Year Prediction, by Darcy Pattison, illustrated by Peter Willis

Secret Engineer: How Emily Roebling Built the Brooklyn Bridge, written and illustrated by Rachel Dougherty

Titanosaur: Discovering the World's Largest Dinosaur, by Jose Luis Carballido and Diego Pol, illustrated by Florencia Gigena

Undaunted: The Wild Life of Biruté Mary Galdikas and Her Fearless Quest to Save Orangutans, by Anita Silvey

Unseen Worlds, by Helene Rajcak and Damien Laverdunt

What Miss Mitchell Saw, by Hayley Barrett, illustrated by Diana Sudyka

Wilderness: Earth's Amazing Habitats, by Mia Cassany, illustrated by Marcos Navarro

Woolly Monkey Mysteries: The Quest to Save a Rain Forest Species, by Sandra Markle

The Wonders of Nature, by Ben Hoare

Best STEM Books

All in a Drop: How Antony van Leeuwenhoek Discovered an Invisible World, by Lori Alexander, illustrated by Vivien Mildenberger

Born Just Right, by Jordan Reeves and Jen Lee Reeves

Buzzing with Questions: The Inquisitive Mind of Charles Henry Turner, by Janice N. Harrington, illustrated by Theodore Taylor III

A Computer Called Katherine: How Katherine Johnson Helped Put America on the Moon, by Suzanne Slade, illustrated by Veronica Miller Jamison

The Crayon Man: The True Story of the Invention of Crayola Crayons, by Natascha Biebow, illustrated by Steven Salerno

A Dream of Flight: Alberto Santos-Dumont's Race Around the Eiffel Tower, by Rob Polivka and Jef Polivka

The Electric War: Edison, Tesla, Westinghouse and the Race to Light the World, by Mike Winchell

Elon Musk: A Mission to Save the World, by Anna Crowley Redding

The First Dinosaur: How Science Solved the Greatest Mystery on Earth, by Ian Lendler, illustrated by C. M. Butzer

From an Idea to LEGO: The Building Bricks Behind the World's Largest Toy Company, by Lowey Bundy Sichol, illustrated by C. S. Jennings

Full of Beans: Henry Ford Grows a Car, by Peggy Thomas, illustrated by Edwin Fotheringham

Guitar Genius: How Les Paul Engineered the Solid Body Electric Guitar and Rocked the World, by Kim Tomsic, illustrated by Brett Helquist

The House That Cleaned Itself: The True Story of Frances Gabe's (Mostly) Marvelous Invention, by Laura Dershewitz and Susan Romberg, illustrated by Meghann Rader

How to Become an Accidental Genius, by Elizabeth MacLeod and Frieda Wishinsky, illustrated by Jenn Playford

Instructions Not Included: How a Team of Women Coded the Future, by Tami Lewis Brown and Debbie Loren Dunn, illustrated by Chelsea Beck

Karl's New Beak: 3-D Printing Builds a Bird a Better Life, by Lela Nargi, illustrated by Harriet Popham

Prairie Boy, Frank Lloyd Wright Turns the Heartland into a Home, by Barb Rosenstock, illustrated by Christopher Silas Neal

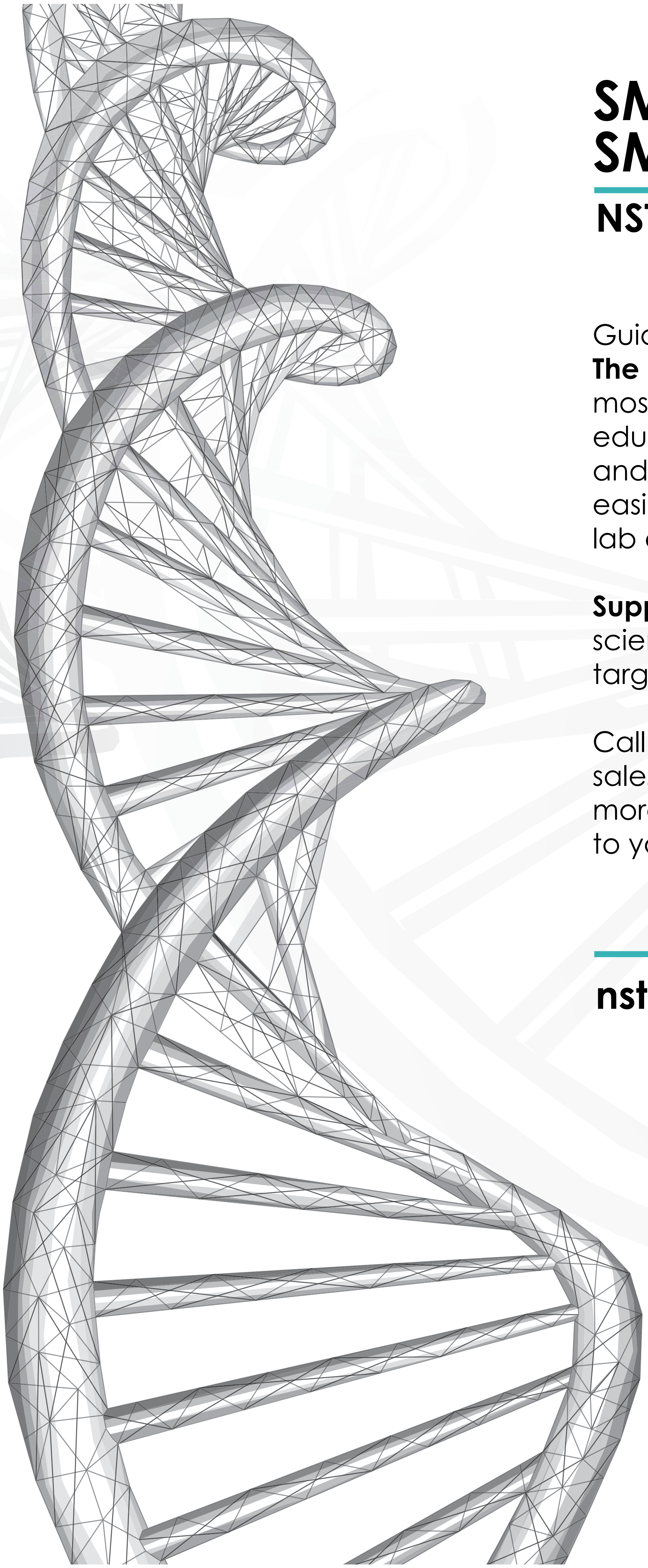
Samuel Morse, That's Who! The Story of the Telegraph and Morse Code, by Tracy Nelson Maurer, illustrated by El Primo Ramón

Save the Crash-test Dummies, by Jennifer Swanson, illustrated by TeMika Grooms

Saving the Tasmanian Devil: How Science Is Helping the World's Largest Marsupial Carnivore Survive, by Dorothy Hinshaw Patent

Secret Engineer: How Emily Roebling Built the Brooklyn Bridge, written and illustrated by Rachel Dougherty

Titan and the Wild Boars: The True Cave Rescue of the Thai Soccer Team, by Susan Hood and Pathana Sornhiran, illustrated by Dow Phumiruk ●



BLICK ON FLICKS

Aurora and Elements in *Frozen II*

By Jacob Clark Blickenstaff, PhD

With two kids younger than age 10 in my house, you can bet that *Frozen II*'s release date has been circled on the calendar for some time. I have to say I like the sequel better than the original. The stars from the first film reprise their roles: Kristen Bell as Anna, Idina Menzel as Elsa, Josh Gad as Olaf, and Jonathan Groff as Kristoff. We return to Arendelle six years after the events of *Frozen* to find Elsa is restless. She hears a voice on the wind calling her to travel north and find a land her father told stories about when Elsa and Anna were children. Of course Elsa cannot go on this adventure alone, Anna won't be left behind, and Kristoff, Sven, and Olaf provide transportation (and comic relief).

With a little difficulty, the group finds four elemental standing stones marking the border of an enchanted forest. Each stone bears a symbol for one of the elements: earth, air, fire, and water; the cooperation of the elemental spirits enchants the forest. I won't reveal any big spoilers here: Elsa learns from each of the four elementals how to better control her powers, and that leads her to a transformation. All in all, the roles for both Elsa and Anna are more powerful this time around, and that's great for all the kids who will be planning costumes for Halloween 2020.

Elementary students will certainly be excited about the movie, but I'm betting some middle and high school students will check it out, since 2013's fourth graders are now in high school. Physical science teachers can use scenes to discuss the Earth's aurora, atomic theory, and the phases of water. Environmental science teachers could address the water cycle and humans' impact on the environment.

Aurora

We know that Arendelle is a northern realm, based on the weather and the geography. It seems to be modeled on Norway or Sweden. The Northern Lights, or Aurora Borealis, are a common phenomenon in regions 10 to 20 degrees from the North Pole. The same phenomenon in the southern hemisphere is known as the Aurora Australis or Southern Lights. The aurora's glow is caused by charged particles from the Sun interacting with the Earth's magnetic field, but the details of the mechanism are still being explored. The aurorae can be seen far from the poles at times when the Sun's geomagnetic activity is high. Some of the most spectacular images of aurorae that I have seen have been taken by astronauts on the International Space Station.

The Elements

Elsa encounters the spirits of air, fire, water, and earth in the enchanted forest. These four elements have been called the classical elements, and in western European history, were precursors to our modern understanding of the chemical elements of the periodic table. Now it is easy to consider the classical elements a bit silly, but the idea that just a few basic building blocks could be combined in various ways to make a wide range of materials is a powerful one.

In Aristotle's classical model, the relative amount of each element in an object could explain its properties: Wood contains more air and water than metal does, so wood floats. Scientific work in the 17th, 18th, and 19th centuries led to the periodic table with about 100 elements, each with distinct chemical properties. We now know that elements like carbon and hydrogen are made up of smaller components: protons, neutrons, and electrons. Though the pieces are smaller, we still understand that combining just a few ingredients can lead to a huge diversity of materials.

Environmental Science

In *Frozen II,* we learn that Elsa's and Anna's father was present at a meeting between the people of Arendelle and the people of the forest, the Northuldra. The Arendellians had built a dam, claiming it would give the Northuldra a regular water supply. We learn that in fact, the dam upset the ecosystem of the Northuldra and was harming the environment. Elsa and Anna must decide how to restore the environment of the Northuldra and recognize that their solution could cause problems for Arendelle.

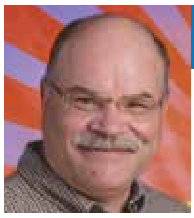
I think this relatively simple story could help elementary students understand how human projects that seem purely good (building a dam to prevent flooding and create a steady water supply) can have unintended consequences. It is powerful to see that doing the right thing for the environment can have negative impacts on humans in the short term, even if the long-term benefits are clear.

As in the first film, some of the best lines belong to Olaf, though here he has become an Arendellian encyclopedia, spouting facts without context. He also enjoys the kind of gross humor that will appeal to lots of kids: informing us that turtles breathe through their butts (true, for some turtles) and that wombats poop in squares (definitely true.) He also shares that water has memory (not true) and that it has passed through several creatures before you drink it (likely true). This last one, along with all the phases of water depicted in the movie, could be a fun way to talk about the water cycle with elementary students, and also call attention to the need to take care of the fresh water we have. Someone upstream has nearly always used the water already, and someone downstream will use it in the future. It makes sense to keep pollution out of the water when you're using it so that it will be clean for others to use.

Frozen II will give teachers opportunities to talk about physical and environmental science topics at the elementary and middle school levels.

Note: Frozen II *is rated PG for action/peril and some thematic elements.*

Jacob Clark Blickenstaff is a learning designer with AVID, based in Seattle, Washington. Read more Blick at http://bit.ly/2S2wH2L, *or e-mail him at* jclarkblickenstaff@outlook.com.



ASK A MENTOR, **Advice Column**

Stars, Scores, Small Budgets, and Significance

By Gabe Kraljevic

I was planning a lesson for fifth grade about constellations. If you have any ideas, I would love to hear them.

—B., Illinois

Students often develop the misconception that constellations are two-dimensional. It's like looking at a road map and never understanding that the land has a three-dimensional topography. I would stress that the stars in a constellation are almost all at different distances from Earth. Your students can research their own constellations to make three-dimensional models that when viewed from the right direction, form the shape we know. The American Museum of Natural History has some related activities at *http://bit.ly/346dKi0*.

Students should make some night observations of stars, the Moon, and planets. You can download many online maps for each month of the year. Have students learn the prominent constellations and how to use "finder stars." Have your students construct *planispheres*—simple paper-and-card stock dial maps that you rotate to the correct time and date for observation. Many are available online, such as this one from *Sky & Telescope* at *http://bit.ly/2po0Q0f*.

Why not make the lesson cross-curricular? The sky map we follow reflects Greek culture from two-and-a-half millennia ago. The names and stories of the constellations will interest students as they ponder why there is a *harp* (Lyra) and a *winged horse* (Pegasus) in the sky, and who was *Perseus*? Give them a star map without lines or names. Ask them to make up their own constellations and stories. I bet that they will see cell phones, anime characters, and pop stars.

If a student receives a bad test score, how do you interpret it? Would you allow the student to retake a modified version of the test?

—B., Ohio

A poor score on a test can be interpreted many ways.

Knowing your students and developing an assessment practice in your classroom that gives you and your students constant feedback on performance is essential to successful teaching. A quick look at your gradebook should easily identify a poor test score as an anomaly or a fair assessment.

If it is an anomaly, you should consider if the student was ill or missed some work. Do you know if events outside school could be a factor? Are things like test anxiety and organizational difficulties possible concerns? Did the student simply need more time?

Reflect on your role: Were the questions unexpected or confusing? Was the test poorly scheduled? Was there ample time to prepare? Did you give adequate feedback on returned work?

Students need to learn how to prepare for and take a test. Give them simple tips like bypassing difficult questions until later and pacing themselves, and that erasing is a waste of time: They should simply strike through passages they changed (you may want to have extra copies of the test or blank paper available). Suggest how to organize themselves and plan their study time. Encourage rewriting notes, and anticipating questions.

I would certainly allow the student a second attempt. Don't just give another date and general encouragement to study more. Arrange for some remedial work or one-on-one time. Informing the parents can shed light on the issue and will allow them to support their child's preparation. Consider having the student only retake missed questions or modifying the format.

What advice would you give to first-year teachers who want to give life to their lessons, yet have a budget that is small or non-existent?

—J., Iowa

STEVE BUISSINNE FROM PIXABAY

I always had living things in my classrooms: Just by going to a park or garden, you can find sow bugs (pill bugs), lady beetles, earthworms, and more.

Seeds are easy to acquire, and a single package of say, tomato seeds, can go a long way. You can request donations of equipment such as tubs, aquarium supplies, soil, and sand in your school newsletter or website, or in communications to students' families. Consider asking for old cell phones that can be repurposed as cameras for observations. I often would get dissection specimens of fish, oysters, clams, and even crabs and lobsters by going to the local grocery store and explaining how I could use any of the creatures that died in their fresh seafood section! They would freeze them, and I would pick them up.

Many, many, many shoestring budget lessons are out there that don't need fancy equipment. My classes would make planispheres—"sky maps" of constellations that you dial to the correct date. You can download one for free, then all you need are paper, glue, and card stock (I repurposed file folders instead of card stock). A bit of searching on the topics you teach will net you many cheap-to-make items like this that become little projects in themselves.

Bring in classroom speakers! Many organizations have free travelling shows and experts who will come to your classroom. Check out the websites of nature centers, hospitals, zoos, parks, societies, and universities. Staff from a bird rehabilitation center in my city would bring owls into the classroom! Free!

How do you explain to your students that what you're teaching is important even if it has no obvious real-world application?

—B., Ohio

I'm sure every teacher has heard this refrain!

I found that students question what we teach when it is dull and repetitive. So trying different strategies may work.

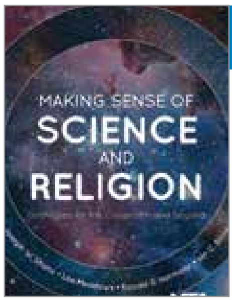
You can appeal to them on a philosophical level: Explain to them that most of us don't know what may be personally useful in the future.

The history of science is full of discoveries that were ahead of their time. It took time and the right people to reveal the importance or usefulness of that knowledge. Classic stories you can relate to your students: Michael Faraday and electromagnetism; Wilhelm Röntgen and X-rays; Alexander Fleming and penicillin; and many more.

My favorite is about Christian Doppler, who in 1847, studied and determined why sound coming toward you is higher pitched than when it moves away from you (think race cars). Twenty years later, astronomers discovered that the light followed the "Doppler Effect," and they could identify stars moving away or toward our solar system. In 1929, Edwin Hubble's observations of galaxies indicated that they were all moving away from one another at ever-increasing velocity. This finding is the basis for the "Big Bang" theory, part of our current model of the universe. From Doppler's curiosity about how train whistles change pitch, we now have the current theory of the cosmos!

As a last resort, you can always just say the people who write curriculum felt it was important to understand. They can always complain to the government.

Check out more advice on diverse topics or ask a question of Gabe Kraljevic and Sharon Delesbore from Ask a Mentor *at* http://bit.ly/2FpGb1u, *or e-mail* mentor@nsta.org.



NSTA PRESS: *Making Sense of Science and Religion*

Distinguishing Science and Religion Via the Nature of Science

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 Making Sense of Science and Religion, *by Joseph W. Shane, Lee Meadows, Ronald S. Hermann, and Ian C. Binns, edited for publication here. To download this excerpt, go to* https://bit.ly/2s9D2yi. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Before reviewing the various aspects of the nature of science (NOS), we need to ask a broader question: Namely, what is science? As science teachers, you may not ask yourself this question very often. But it is important because this understanding is a key part of addressing science-religion interactions, and basic misunderstandings about NOS are often central to the distrust in science and scientists that is expressed by people of faith.

One particularly concise definition states that science is "the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." (National Academy of Sciences and Institute of Medicine 2008, p. 10) This definition includes key characteristics that distinguish science from other ways of knowing: empirical evidence, testable explanations and predictions, and natural phenomena. An additional characteristic is that science involves a scientific community. This reinforces the notion that scientific research is ultimately collaborative, reproducible, and subject to expert peer review. Each of these characteristics is an essential part of the development and acceptance of scientific knowledge.

With this general understanding, let's move to NOS, which is in essence "the epistemology of science, science as a way of knowing, or the values and beliefs inherent to scientific knowledge and its development." (Lederman 2007, p. 833) While there are many lists outlining aspects of NOS, the following characteristics are commonly cited:

- *Science requires empirical evidence.* This one is straightforward. In order for something to be accepted as scientific, there must be evidence based on observable, verifiable data. No scientific explanations are considered without empirical evidence. It is important to note that empirical evidence can be both quantitative and qualitative descriptions of the natural world.
- *Science is tentative.* Scientific knowledge is not absolute, meaning it is subject to change. This happens when either new evidence is discovered or new ways are discovered to evaluate existing evidence. This

process may not always be quick, but over time when new instrumentation or new evidence comes to light, scientific explanations can, and will, change.

- *Science is subjective.* This suggests that scientists' backgrounds influence what they investigate, what they observe, and how they interpret evidence. To be a detached observer in a purely objective sense is simply not possible, even though many people think that is how science works.
- *Science is creative.* Scientists use creativity and imagination throughout the scientific process. This includes developing research questions, designing investigations, and formulating explanations of their findings.
- *Science is influenced by social and cultural values.* What scientists and scientific communities value guides questions that scientists ask, influences ways scientists conduct research, and potentially advances or impedes scientific progress.
- *Scientific knowledge comes from both observations and inferences.* "Seeing is believing" is a common idiom and implies that if you cannot directly see something, then it is not real. In reality, however, scientists cannot artificially separate observations from their inferred explanations and provisional hypotheses.
- *Scientific theories and laws are distinct, but equally important, aspects of science.* Theories are not merely hunches or guesses, but rather they are the overarching frameworks based on overwhelming evidence that guide inquiry within a scientific discipline. Theories explain and predict observed phenomena. Laws, on the other hand, are the most basic descriptions of observed phenomena that apply across all disciplines. In science, theories do not grow up and become laws. Atomic theory and the law of conservation of energy (i.e., the first law of thermodynamics) are straightforward examples.

Ultimately, NOS makes it a quintessentially human endeavor, and this is what makes science so fascinating, especially when compared to other domains where the human dimension is perhaps more obviously central, like economics, politics, and yes, religion. Individual scientists bring a finite amount of knowledge and cultural experience to bear in order to explain evidence derived from experiments, observations of nature, and artifacts from the past. Provisional hypotheses are creative, subjective assertions that are typically consistent with the currently accepted theoretical framework. Hypotheses must be tested against further evidence. Inquiries must be repeated and subjected to review by qualified experts via peer-reviewed publications and conference presentations.

If sufficient evidence accumulates within the global scientific community, previously accepted ideas are discarded, often reluctantly. On occasion, entire underlying theoretical frameworks are altered so as to change how we perceive the natural world. These internal checks and balances are imperfect to be sure (plenty of examples of fraud exist), but the success and impact of the collective, global scientific endeavor are undeniable and unmatched.

In our view, this basic understanding of science goes a long way toward addressing misunderstandings that the public frequently has about science. The common dismissive statement that evolution is "just a theory" falls flat, as does the claim that scientists are "biased." The inherently tentative nature of science is not a weakness, but rather a self-correcting historical reality and a strength of science that separates it from other ways of knowing about the world. Scientists rarely speak with absolute certainty, but this is not evidence of anxious doubt or irreconcilable gaps in scientific knowledge. The measured tones of science merely suggest that there is always more to know. ●

Mark Your Calendar

NSTA Dates to Remember

(All dates are deadlines unless otherwise specified.)

January 28—Join the first session of **Science and Engineering Practices: Professional Book Study for K–12 Teachers** live **web seminars** today! The online book study, focusing on *Helping Students Make Sense of the World Using Next Generation Science and Engineering Practices,* will be led by Jessica Holman, Kate Soriano, and Tricia Shelton. Registration costs $63 for NSTA members. Seminars will be held at 7:15–8:45 p.m. Eastern Time (ET). Additional dates are February 4, 11, and 18. Participants will receive a certificate from NSTA after each live web seminar (1.5 hours per web seminar) as evidence of their attendance and participation. For more information or to register, visit *https://bit.ly/35I3xcJ*.

February 21—Register today to maximize your savings on registration for the **NSTA National Conference on Science Education**, 20/20 Science: Expanding the Vision, happening April 2–5 in Boston, Massachusetts. Visit *www.nsta.org/boston* for more information and to register.

February 27—Don't miss this two-day **Picture-Perfect workshop,** as authors Karen Ansberry and Emily Morgan delve into using picture books to teach elementary science, technology, engineering, and math (STEM). Attendees also will receive *Even More Picture-Perfect Science Lessons; Picture-Perfect STEM Lessons, K–2*; and *Picture-Perfect STEM Lessons, 3–5*. The workshop will take place at 8:30 a.m.–3:30 p.m. at the Denver Museum of Nature and Science in Denver, Colorado. Early bird registration by **January 16** costs $449 for the basic workshop; with the train-the-trainer component and materials, the early bird price is $999. For more information or to register, visit *https://bit.ly/2zOlVTx*.

April 1—The **Assessing Three-Dimensional Learning Workshop** in Boston, Massachusetts, will empower you with a set of tools that can be used to evaluate and improve existing assessment tasks, as well as analyze student artifacts using a student work analysis protocol. Registration includes *The NSTA Quick Reference Guide to the* NGSS, *K–12*. Early bird registration (by **February 21**) for the workshop costs $500 for NSTA members; combined early bird member registration for the workshop and the **NSTA National Conference on Science Education** costs $600. For more information or to register, visit *https://bit.ly/2XTi6rc*.

April 15—Session proposals for the **NSTA 2021 Chicago National Conference on Science Education** must be submitted by 11:59 p.m. ET today. The conference will be held April 8–11, 2021. For more information on submitting a proposal, visit *https://bit.ly/2s4Awco*. ●

#ICYMI

In case you missed it, check out a few highlights from NSTA's e-newsletters. Catch up on all the latest e-newsletters at *https://bit.ly/2X5iuEQ*.

"Ensuring All Elementary Students Have Access to Science Learning"
A solid foundation in science at the elementary level gives students a better grasp of science at the secondary level and beyond. Council of State Science Supervisors' (CSSS) Supporting Elementary Science Committee Co-Chairs Amber McCulloch and Kathy Renfrew discuss the importance of high-quality elementary science education for all students and share ideas to support effective science learning in the elementary grades.

"Bring STEM Practices Into the Secondary Classroom"
Juan-Carlos Aguilar, Anne Petersen, and Megan Schrauben discuss their efforts as members of the CSSS STEM+ Committee to determine current practices in science, technology, engineering, and math (STEM) education throughout the United States and provide educators with instructional best practices to help them prepare students for higher education and the workforce.
—*Next Gen Navigator* (November 2019, *https://bit.ly/2Yr2PAD*)

"Identifying and Implementing Science Instructional Materials in Middle School"
Identifying and implementing science instructional materials that equitably engage students in active learning of science concepts, practices, sensemaking, problem solving, and decision making can be overwhelming for schools. This NSTA Blog post has great suggestions for middle level teachers and administrators from the Council of State Science Supervisors.
—*The STEM Classroom* (December 2019, *https://bit.ly/2PA4qxt*)

"Join the STEM Teacher Leadership Network!"
The National Science Foundation–funded STEM Teacher Leadership Network invites teacher leaders, aspiring teacher leaders, researchers, and administrators interested in teacher leadership to join, interact, and connect with this new virtual learning community and collegial network. The free membership provides access to networking tools, resources, and events throughout the year that will help members explore topics related to STEM teacher leadership. Members share their paths, challenges, strategies, opportunities, events, and resources with one another.
—*NSTA Express* (December 3, 2019, *https://bit.ly/2K9R5M0*) ●

Index of Advertisers

National Science Teaching Association
1840 Wilson Boulevard
Arlington, Virginia 22201

NON-PROFIT ORG.
U.S. Postage Paid
CAPITOL HEIGHTS, MD
PERMIT NO. 953

Vote for Your NSTA Representatives!

It's time to cast your votes for the NSTA Board and Council! Ballots were e-mailed in December, and voting ends on **February 10, 2020!**

The candidates for NSTA President are Eric J. Pyle, professor in the Department of Geology and Environmental Science at James Madison University in Harrisonburg, Virginia, and Craig Gabler, retired secondary science teacher and science education consultant with Horizons Educational Consulting in Centralia, Washington.

NSTA members also will vote for the Multicultural/Equity in Science Education Division Director (candidates Leena Bakshi and Alicia Conerly), Preservice Teacher Preparation Division Director (Donna Governor and William Veal), and the Research in Science Education Division Director (Cynthia D. Crockett and Heather Burns Page).

Six district directors also will be elected. The candidates are

- District I (Connecticut, Massachusetts, and Rhode Island) Susan Meabh Kelly and John A. Labriola
- District VI (North Carolina, South Carolina, and Tennessee) Melissa Collins and Michelle Ellis
- District VII (Arkansas, Louisiana, and Mississippi) Jacob Hayward and Rochelle Darville
- District XII (Illinois, Iowa, and Wisconsin) Brian Klaft
- District XIII (New Mexico, Oklahoma, and Texas) Lisa Brown and Terry White
- District XVIII (Canada) Chuck Cohen and Marilyn Webster

Visit *www.nsta.org/nominations* to read the candidates' biographies and position statements. If you haven't received your ballot or have a question about the NSTA Board and Council, contact Amanda Upton, senior manager for nominations, at *aupton@nsta.org*. ●