nsta Reports
National Science Teaching Association


ISTOCK

Are You Planning for Caregiving Costs? 9

Which Break is More Disruptive for Your Students?

Keeping Students Learning Before Long Breaks 6

CONTENTS

Learning STEM by Building Airplanes

Texas nonprofit Tango Flight builds Van's Aircraft RV-12 airplanes with students at high schools nationwide.

Organizations around the country are helping students and teachers experience the challenges and rewards of building a full-size airplane, allowing students to apply science, technology, engineering, and math (STEM) as well. One organization, Texas nonprofit Tango Flight, builds airplanes with students at high schools nationwide. President and co-founder Dan Weyant, Career and Technical Education (CTE) teacher at East View High School in Georgetown, Texas, says the worldwide "demand for pilots, aerospace engineers, and mechanics" inspired him in 2016 to ask his principal and district superintendent if he could establish a year-long class to build a Van's Aircraft RV-12 two-seat, single-engine, low-wing airplane with students at East View and Georgetown High Schools. Weyant chose the RV-12, which is built from a kit, making it relatively easy to construct compared to other aircraft.

Weyant successfully addressed administrators' concerns, such as liability. "To mitigate liability, Tango Flight owns the planes and manages assets," he explains. When a school or district completes a plane, Tango Flight sells it, and the money goes back to the local program to fund the next plane build.

It costs about $100,000 to start the program, he adds, but "there are many ways to fundraise this; the district doesn't have to pay it all upfront." Aircraft manufacturer Airbus Americas has funded builds, as well as local aviation museums, businesses, and the city government. Local businesses and nearby colleges and universities also provide mentors for the students.

The first Tango Flight class was a partnership among the two schools, Tango Flight, local businesses, and the STEM program Project Lead the Way (PLTW), on which the curriculum was based. Since then, Weyant, university partners, and Airbus Americas have created a college-level Tango Flight curriculum now used by participating high schools. Tango Flight operates in eight schools in Georgetown, Texas; Wichita, Kansas; Mobile, Alabama; Naples, Florida; Manchester, New Hampshire; Atlanta, Georgia; and Yuba City, California.

"We provide curriculum, training [for teachers and mentors], technical support, and instruments," Weyant relates. Some Tango Flight schools have students do internships with local businesses, he notes.

Mike Tinich was a PLTW aerospace engineering teacher at Maize South High School in Wichita, Kansas, when contacts at Wichita State University (WSU) recommended him to funder Airbus Americas to do a Tango Flight build. "We built our first plane while [the Georgetown, Texas, group] built their second one…We had a lot to learn, but we had the benefit of their knowledge from their first build," he recalls.

"We had Airbus engineers work with us as mentors," and WSU Tech, the local technical college, provided "an experienced airframe [plane structure] instructor to help teach

See Airplanes, pg 4

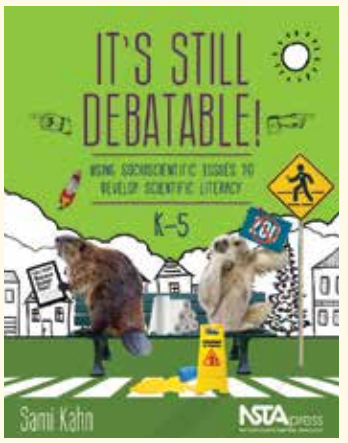
The Pollinators: A Different Kind of Bee Movie PG 16

Grow your knowledge and save!

NSTA Members Get 20% Off NSTA Press Books and E-Books Every Day.

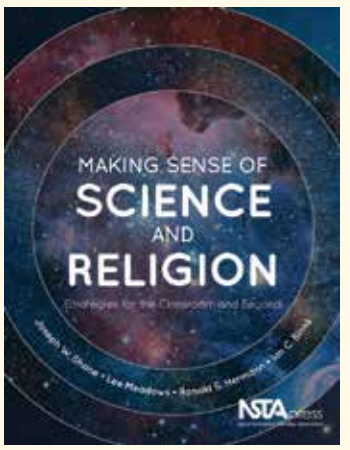
They always have great lessons that are real world applicable. The lessons are tied to literature. This really helps students to see how science can be applied to life without it being boring. – Theresa A.

*Prices subject to change without notice.



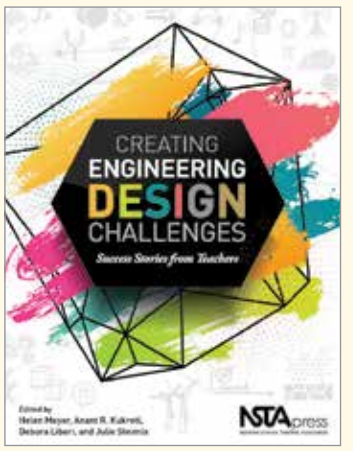
Grades PreK–5

Book: Member Price: $34.36 | Nonmember Price: $42.95
E-book: Member Price: $25.77 | Nonmember Price: $32.21
Book/E-book Set: Member Price: $41.23 | Nonmember Price: $51.54



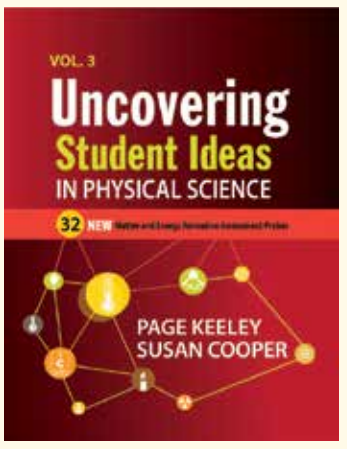
Grade 12

Book: Member Price: $20.76 | Nonmember Price: $25.95
E-book: Member Price: $15.57 | Nonmember Price: $25.95
Book/E-book Set: Member Price: $24.91 | Nonmember Price: $31.14



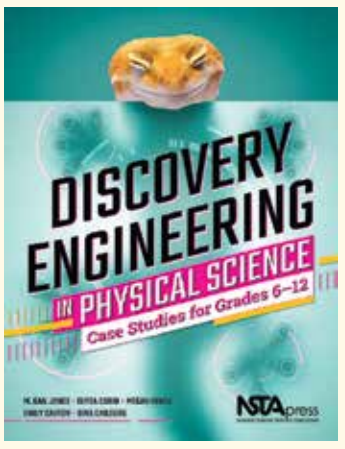
Grades 6–12

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



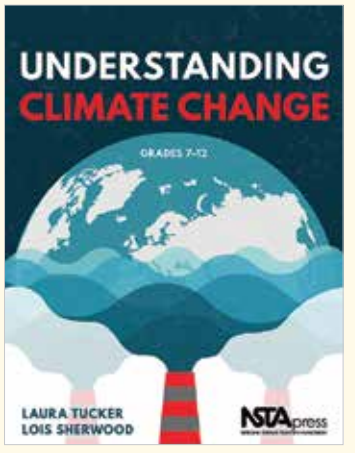
Grades 3–12

Book: Member Price: $30.36 | Nonmember Price: $37.95
E-book: Member Price: $22.77 | Nonmember Price: $28.46
Book/E-book Set: Member Price: $36.43| Nonmember Price: $45.54



Grades 6–12

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



Grades 7–12

Book: Member Price: $25.56 | Nonmember Price: $31.95
E-book: Member Price: $19.17 | Nonmember Price: $23.96
Book/E-book Set: Member Price: $30.67 | Nonmember Price: $38.34

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

nsta Press
National Science Teaching Association

COMMENTARY: **Bill Penuel**

To Promote Equity, Prepare Students for What Science Could Be

By Bill Penuel

JEFF FINKELSTEIN

On a Friday afternoon, at the end of the school week, a group of teens meet to learn about pollution sources in their neighborhood. For them, unpleasant smells and poor air quality are a daily experience, and they are committed to doing something about it. They study air quality reports, read newspaper articles, and learn about what the city is—and is not—doing to improve the quality of the air they breathe. They learn about solutions that local refineries could use to reduce pollution, and make plans to advocate for these solutions within their neighborhoods and to elected officials.

For these students, science and engineering aren't just subjects they encounter in school. Rather, they are an essential part of larger initiatives to promote environmental justice in their communities. As they develop their understanding of the science of pollution, these young people also develop knowledge that will help them speak compellingly to public officials. As they engage in research focused on the priorities of the people in their community, young people embrace engineering design at its best: a set of practices for identifying and solving problems that can help people live better lives together and in good relationship with the planet.

These teens' activities are part of a larger project, funded by the William and Flora Hewlett Foundation, to promote equity in science education across a large urban school district. The project is an initiative of the inquiryHub research-practice partnership, which has been investigating different strategies for promoting inclusive, equitable, student-centered teaching in the district for 13 years. Core partners include Denver Public Schools, the University of Colorado, and community organizations like Project VOYCE (Voices of Youth Creating Equity), which co-designed the program described earlier.

A fundamental strategy of the partnership is to ensure students experience science and engineering instruction in class that is coherent from their point of view, relevant to them personally and to their communities, and in which their ideas matter to the ongoing classroom activity. This kind of science and engineering instruction centers on phenomena that relate to students' interests, and supports engineering design challenges that address community priorities. In supporting this kind of instruction, we seek to prepare students for a science that sometimes is and should *always* be an inclusive culture of building knowledge that supports the thriving and sustainability of human communities.

Creating better experiences for students who face discrimination both in and outside the classroom, and who are not used to having their questions and ideas take center stage in a classroom, is not easy. We have to be willing to live with the recognition that addressing discrimination based on race, gender, sexuality, ability, and language is long-term work, and can't be accomplished in a single class. We also have to focus on aspects of learning that science educators typically don't put front and center: students' interests and identities.

We also have to acknowledge that in many students' communities, science and engineering have caused harm. Science has been used to justify white supremacy and the exclusion of girls, women, and gender nonconforming people from educational and work opportunities. Engineering knowledge has been used to split up neighborhoods with highways in the name of progress and remove mountaintops to bring energy to faraway cities. Equity demands we ask of ourselves, our students, their families, and communities, "What we do want science and engineering to be *for?*"

A science education that works toward justice in communities does not prepare students for how science and engineering are today, but for what they *could be.* The students from Project VOYCE aren't just doing science as it is done today. The ways they are collaborating with one another embody ideals of knowledge-building that aren't always realized in the academic or commercial worlds. The ends they are working toward are only partly represented in science and engineering today.

Megan Bang, a professor of learning sciences at Northwestern University in Evanston, Illinois, who reimagines a science education focused on fostering more ethical relationships among people and the planet, reminds us that science education needs to be focused on helping students imagine new possibilities for living and for science. I believe promoting equity and justice in science education demands it, and our ability to thrive together in a changing climate depends on those new ideas. ●

Bill Penuel is a professor of learning sciences and human development in the Institute of Cognitive Science and School of Education at the University of Colorado Boulder. He is a leader in the inquiryHub research-practice partnership, which has developed a wide range of curriculum materials, assessments, and professional development resources to support equitable implementation of the Next Generation Science Standards, *which are accessible at* https://bit.ly/2QSaIsN.

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.

Airplanes, from pg 1

procedures and inspect the finished product," Tinich reports.

"We were still teaching PLTW during the build, but [Tango Flight] was [the] lab activity. Trying to incorporate both was a challenge," he admits. "Sometimes the plane took precedence because we had to make sure the plane was safe to fly. "

Having enough space to build a plane was a dilemma. "The logistics of doing it in a normal classroom were crazy," Tinich contends. Besides needing room to work, they had "to organize thousands of parts." Fortunately, "in January 2017, [our school] opened a Career and Technical Center, and the new room had a hangar door on it and more space," he adds.

"We made a lot of mistakes during the first year, even working with engineers," Tinich recalls. "But the kids could see adults fail, then move on. [They saw that] failure is an option!"

Students most enjoyed "the opportunity to work with an engineer...It opened their eyes up to opportunities in the aerospace industry," says Tinich. "Building a plane taught them so much more than just the knowledge of why we have to measure twice and cut once. There was a lot of problem-solving [experience] that was invaluable."

Aerospace Enrichment

In the Wings Aerospace Pathways (WAP) program held by Wings Over the Rockies Air & Space Museum in Denver, Colorado, students "build and fly drones; earn [Commercial Drone Pilot Certification];...take concurrent enrollment courses toward an A&P [Airframe and Powerplant (engine system)] certification;...and build the RV-12," says April Lanotte, the museum's director of education. Designed for students in grades 6–12, WAP is an enrichment program for homeschooled students, those in online schools, and students in traditional schools that allow them to be released one day each week to participate.

Middle school students learn skills to prepare them to build a plane as high school students: using tools, soldering, and learning about basic electronics, ham radios, and aviation and space history, for example. "It helps middle school students decide what's next for them," whether they'd like to be pilots, mechanics, or work in another position in the industry, Lanotte maintains.

When choosing students for the build, CTE Coordinator/Instructor David Yuskewich says, "I look for students who are on-task, good at following directions, self-directed, focused, know what tools to use, and are able to lead other students." In WAP's tools and skills classes, "parts of the plane that are not done right have to be scrapped, which costs money and time. I don't accept any less than perfect on the plane," he asserts.

"During the build, the students do 80% of the work. A group of adults come in on Saturdays and do the rest of the work to keep things on track," Yuskewich explains.

Students "wear safety glasses, ear protection, aprons, and gloves, so no one gets hurt," he reports.

"We have a low mentor-to-student ratio so no student works alone," Lanotte adds. "Students must be technically and mentally able to do the work for safety reasons. They take it seriously."

Volunteers who have worked in the industry serve as mentors, including inspectors who can certify the work. "I am an EAA Technical Advisor and inspect the planes. We also have a volunteer who is a technical advisor and serves as 'outside eyes' when inspecting the planes," says Yuskevich.

"We [also] have a team of students who are working on restorations of old planes," reports Lanotte. "These planes won't be flown again, but students are copying and 3-D printing parts that aren't available anymore."

Though WAP's annual tuition is $1,000, "we do have scholarships, so no one is turned away," assures Lanotte. "We work with a local school district with a high [number of low-income students]; they receive 100% funding." Many students, she adds, "earn elective credits" by taking the WAP classes. ●

If a tree falls in the forest and no one is around to hear it, does it make a sound?

Sure does.

NEW! Wireless Sound Sensor
PS-3227

Phenomena-driven inquiry encourages students to think critically and creatively about the world around them. When students use PASCO's line of wireless sensors, they act as real scientists to quantify phenomena in real time, generate graphs, and analyze results. Discover wireless sensors with powerful applications and hundreds of free inquiry labs at pasco.com.

Learn more at **pasco.com • 800-772-8700**

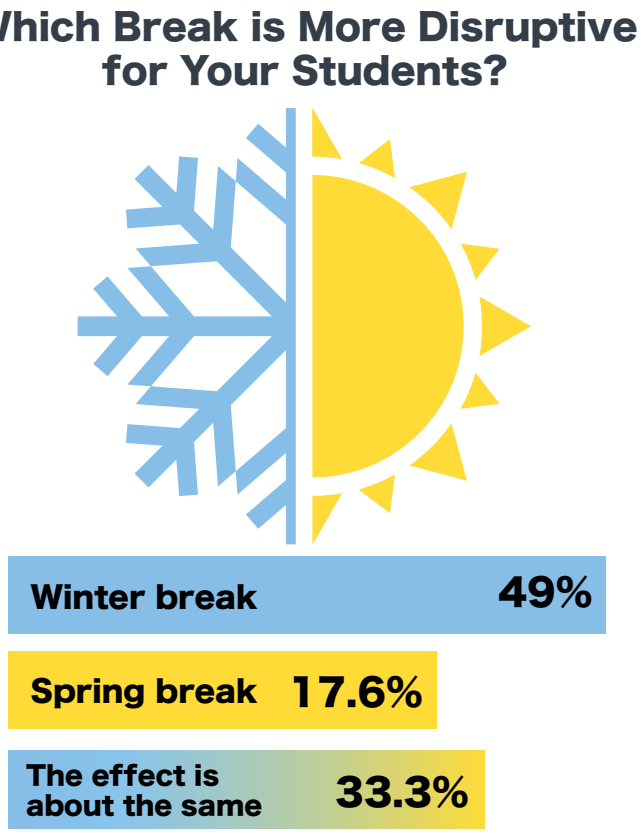
PASCO

Keeping Students Learning Before Long Breaks

As 2019 turned into 2020, *NSTA Reports* asked science educators to share their thoughts on the impact of long breaks on the classroom and their strategies for getting through the last classes before a break started.

The majority, 81.4%, said it is more difficult to keep students on task in the lead-up to a long break, while 8.8% said it was equally difficult before and after a long break. Nearly half (49%) reported the winter break to be more disruptive for their students than spring break, although 33.3% said the two were equally disruptive.

Respondents were divided on trying to cover content during the last class before a break: 54.9% said they try to do so; 45.1% said they do not.



Science educators say they're using these strategies to get through the last class before a long break:

Review/trivia games or challenges. —*Educator, Middle School, Kansas*

Provide choice[s], play science-based games, and allow…students to use the time to catch up on missing work and re-dos.—*Educator, Middle School, Connecticut*

I teach science to K–5. [During] their last class with me before the holiday breaks, I let them do science centers. They get to pick the activity, so they are usually pretty engaged. They are doing science and [the activities] are content, so it really works for me.—*Educator, Elementary, Florida*

Labs, labs, labs. Projects, projects, projects. Hands-on stuff tied to the curriculum to keep them busy and make the time move!—*Educator, Middle School, Vermont*

Lots of hands-on learning activities that are connected to the standards, such as engineering design challenges, problem-based learning activities, etc.—*Educator, Middle School, North Carolina*

Project presentations. Quizzes or game versions of quizzes like Kahoot!—*Educator, Middle School, California*

Summative assessment, things to do when done [with assigned work], extra-credit opportunities for next semester.—*Educator, High School, California*

I try to keep the same routines and procedures and keep the learning activities active.—*Educator, Middle School, Wisconsin*

That's the last day of the semester, so I try to set it up as a time to get [their] final grade, reflect on why they got the grade they earned, and build relationships so that semester two goes even smoother.—*Educator, High School, California*

Pile drive through! However, cover the content a bit simpler and with tiny bits of flexibility.—*Educator, High School, New York*

1. Acknowledge the break is occurring. 2. Share in groups of three (usually ones they have been working with) what their plans are. Three minutes maximum. 3. Report back to class (2–3 minutes). 4. Proceed with relevant, fun hands-on lab.—*Educator, Middle School, Texas*

I'm usually casually dressed, but on the day before a break, I dress the most professional[ly] I can. Suit, heels, the full treatment. I also give them a test. I know, mean, but it keeps them focused. When we come back, we go over the test as a review to get them up to speed.—*Educator, High School, Utah*

Use it as a time to review and introduce a new concept that I am willing to follow up on and revisit in the first class back from break.—*Educator, Institution of Higher Learning, Massachusetts*

Science enrichment activities that support content.—*Educator, Middle School, Maryland*

Switching gears often.—*Educator, Middle School, Pennsylvania*

Hands-on activity; movie with worksheet questions; work catch-up day. —*Educator, Middle School, Virginia*

Content-aligned video or movie with a question-and-answer worksheet… or in-class "game show" on semester topics with winners getting prizes. —*Educator, High School, Nebraska*

Choose an activity that [emphasizes] problem-solving skills or group task that is engaging. Theme may or may not be related to the unit, but the work/activity is not a continuation of the daily content.—*Educator, Middle School, Maine*

Short STEM activity.—*Educator, Elementary, Illinois*

I try to do fun, hands-on activities that are related to my current unit, but are

not going to be a deal breaker for students [who] cannot focus.—*Educator, Middle School, New York*

Bonding with students. Have them talk about what is good about being apart, but also what they are not looking forward to. Not all students want to have the break in their routine and be home for two weeks due to their family situations.—*Educator, Middle School, Colorado*

Do project presentations and cumulative assessments—keeps them focused, since they care about their grades. —*Educator, High School, Minnesota*

Engaging activities with interaction in a group.—*Educator, Elementary, Arizona*

STEM activity [in which] they need to use their hands and their heads! —*Educator, Middle School, Nebraska*

High-engagement-level events; lots of student discourse.—*Administrator, Elementary, Middle School, High School, Kentucky*

Our science department puts on a full day of celebrating science that the whole school participates in. —*Educator, High School, Washington*

Testing is easiest to make up. Otherwise, I try to do things that I can either post digitally or that can be done at home on paper. But I don't really change my plans to account for last-class absences.—*Educator, High School, New York*

I do not cover new content, but I always do something content-related (no assessments)....I try to have an activity to reinforce the current topic, and time for some students to do some make-up work, get extra help, work on a project, etc.—*Educator, High School, South Carolina*

Use a high-interest lesson, but with the expectation that it will function as a review of previously covered concepts.—*Educator, Middle School, Massachusetts*

I do a review competition.—*Educator, High School, Virgin Islands*

Electronic testing.—*Educator, Middle School, Florida*

Keep the same schedule and expectations.—*Educator, Elementary, Washington*

Forced Family Fun: All students in eighth grade must be playing a board game; no electronics; team building. —*Educator, Middle School, Missouri* ●

Quotable

Understand well as I may, my comprehension can only be an infinitesimal fraction of all I want to understand.

—Ada Lovelace, English mathematician (1815–1852)

NSTA Career Center

3 Simple Steps to Find Qualified Science Teaching Professionals

It's really that simple...

The NSTA Career Center is the premier online career resource connecting employer to talented science teaching professionals.

Post your jobs and tap into a concentrated talent pool of professionals at a fraction of the cost of commercial boards.

Visit the NSTA Career Center to learn more
http://careers.nsta.org

nsta
National Science Teaching Association

MONEY 101

Are You Planning for Caregiving Costs?

By Kelly Kenneally

We can plan for many expenses: college for children, retirement, home maintenance, and car repairs. But are you planning for adult caregiving costs? According to AARP, family caregivers can expect to spend nearly 20% of their personal income on out-of-pocket costs related to helping older loved ones. The costs are even higher for those providing long-distance caregiving support (see *http://bit.ly/34CWr8d*).

AARP researchers asked some 2,000 family caregivers to keep a daily record of their expenses. In total, caregivers spent an average of about $7,000 annually in 2016, which translates to more than $7,400 in 2019 dollars. Family caregivers typically are spending this money out of their own pocket. As a result, caregivers say they trim their own budgets—in areas like eating out, vacations, groceries and household supplies, doctor visits and medicine, and their own children's education—to support their caregiving responsibilities.

Caregiving is an increasingly important issue as the U.S. population ages and lives longer. About one in seven adults in the United States—that's 40 million of us—provide some form of unpaid caregiving to an adult, according to a 2018 Pew Research Center analysis (*https://pewrsr.ch/2Q2napu*). On average, U.S. adult caregivers spend almost 90 minutes daily providing unpaid assistance. About 22% of caregivers spend less than 20 minutes a day on such tasks, while 11% spend more than three hours daily supporting a loved one.

Pew also found that more than one in 10 U.S. parents also are caring for an adult—a time and financial double whammy for these multigenerational caregivers.

Caregiving Defined

What exactly is adult caregiving? Typically, it is defined as providing hands-on assistance with daily needs such as dressing, eating, bathing, medical care, providing transportation to appointments, or helping to maintain the home or finances. Caregiving isn't limited to just family. It can be for any adult—a relative, friend, or neighbor—who needs support due to age limitations or cognitive or medical needs.

ISTOCK

Family caregivers provide more than 75% of caregiving support in the United States. The "typical" U.S. caregiver is a 46-year-old woman who works outside the home and spends more than 20 hours per week providing unpaid care to her mother, according to Family Caregiving Alliance (*http://bit.ly/2EEaaB6*). In 2007, the estimated economic value of family caregivers' unpaid contributions was about $375 billion.

Caregiving Impacts

About three out of five caregivers juggle both paid work and caregiving. Among these caregivers, more than half take time off, reduce their hours, or even quit their jobs due to caregiving demands. These changes in employment can continue to impact caregivers' financial life even after their caregiving duties end by harming their chances for promotions, lowering job security, reducing employment benefits, cutting retirement savings, and decreasing Social Security benefits, according to AARP. So working caregivers spend their own money on caregiving, and many have reduced earnings and savings.

When it comes to spending, caregivers report that the largest portion of their caregiving expenses are household-related. For example, some 41% of costs were spent by caregivers helping care recipients with mortgage payments or modifying homes to accommodate mobility and safety. The next largest cost for caregivers is supporting medical needs (25%), followed by personal care expenses (14%), transportation and legal fees (12%), and paid help (8%).

On the savings front, AARP found about 30% of caregivers are dipping into their personal savings to cover these costs, one in six have reduced the money they set aside for retirement, and another 10% have taken out loans.

Given these numbers, it's easy to see caregiving's short- and long-term financial implications for many households.

Supportive Policies

As caregiving demands put increased strains on working families, policy makers are starting to understand the pressure and are taking action.

The federal government does not require private employers to offer paid family leave, but some states have enacted legislation creating mandatory family-leave insurance programs to provide caregivers with paid time off. Four states had government-sponsored family-leave insurance programs in place as of September 2019: California, New Jersey, New York, and Rhode Island. Meanwhile, five states (Maine, Massachusetts, Connecticut, Oregon, and Washington) and the District of Columbia have enacted similar laws that will take effect between 2020 and 2023 (see *http://bit.ly/2PJxKTA*).

The federal government passed the Recognize, Assist, Include, Support, and Engage (RAISE) Family Caregivers Act in January 2018, requiring the U.S. Department of Health and Human Services to create a plan to recognize and support Americans who serve as unpaid caregivers. The resulting RAISE Family Caregiving Advisory Council held its first meeting in 2019, and is seeking public comment on caregiving issues through early February 2020 (see *http://bit.ly/2MgBIkb*). Ultimately, the council will recommend actions to support family caregivers and key priorities, one of which should be addressing financial security and workplace issues.

In the meantime, working families can take action now to best prepare for future caregiving costs so it doesn't throw your current and future budgets off-track.

If you are a caregiver, your chances of financial support are best if you care for a military veteran or for someone eligible for Medicaid. All 50 states and the District of Columbia offer self-directed Medicaid services for long-term care, allowing states to grant waivers that permit qualified individuals to manage their own long-term home-care services. In some states, that can include hiring a family member to provide care. Veterans have four plans they may qualify for: Directed Care, Aid and Attendance, Household Benefits, and Comprehensive Assistance for Family Caregivers. Obviously, all are worth exploring to alleviate the financial burdens (see *http://bit.ly/370U1SF*).

Caregivers also can review long-term care insurance policies that may already be in place. This insurance may cover costs for home health care and personal care services, with some policies extending coverage to spouses or other family caregivers living in the home. It's wise to look at family insurance policies to learn the specifics and take advantage of any of these benefits.

If you're not a caregiver, it's prudent to take time to now assess if you could fall into this role in the future. Have conversations with loved ones to understand their wishes, their finances, and insurance options, as well as your state's laws. Depending on your mutual situations, it may make sense to start saving today for those future costs, just like you would for any other long-term financial obligation. ●

Kelly Kenneally has 25 years of public policy experience including serving in the White House. She has worked for more than 10 years with nonprofit organizations to help improve Americans' financial security.

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

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies for Science Teachers

Willy Wonka Revisited. H Spark conversation in high school classrooms about science, technology, engineering, and math (STEM); economics; and sustainability with this infographic based on the film *Charlie and the Chocolate Factory.* Created at Advanced Technology Services, a manufacturing services company that uses data analytics and other tools to help businesses run more efficiently, the infographic—available at *http://bit.ly/30jrntJ*—revisits Wonka's story and calculates the costs of bringing his world of pure imagination to life today.

Global Warming Three Ways. A Whether film (*http://bit.ly/2QjJHiM*), text (*http://bit.ly/37tZykD*), or comic (*http://bit.ly/2MMjOGw*), these resources created by author and educator Oliver Rosengart provide a foundational understanding of global warming for learners of all ages. The 45-minute film, *World on Fire: The Science,* and the 55-page publication, *Global Warming and Energy Solutions,* each offer a high school–level overview of global warming and related topics. The two resources address matters such as the greenhouse effect, electricity production, fossil fuels (coal, oil, gas), fracking, energy consumption and conservation, and renewable energy.

The third resource—a 23-page comic, *Global Warming: What You Need to Know*—is an illustrated crash course in global warming for all ages. This publication covers only key topics on the subject, such as how much the Earth is warming, why this is happening, some effects of global warming, and the ways we get energy today and how to change that.

IEEE REACH. H The Institute of Electrical and Electronics Engineers Raising Engineering Awareness through the Conduit of History website provides lesson plans, hands-on activities, primary and secondary source documents, and classroom videos that focus on the history of technology and its role in society. Intended for the high school level, the resources can be incorporated in many subjects, including science, history, economics, or language arts. The inquiry units at *https://reach.ieee.org* (e.g., Skyscrapers, Electric Lighting, Early Maritime Navigation, Radio, and Refrigerated Rail Car) are a good place to begin browsing for resources. Each inquiry unit contains several related resources on the topic and includes a guiding question, background information, and supporting questions for teachers.

DAVID ADAM KESS

New Chemicals for Old. H The Laboratory Safety Institute (LSI) is a nonprofit organization providing safety education information for government, industry, and educational laboratories worldwide. LSI's e-book, *New Chemicals for Old,* presents 15 common science experiments in which less hazardous chemicals are substituted for the chemicals traditionally used in them. In promoting these safer chemical substitutions, LSI hopes to encourage high school educators who may have been initially hesitant to conduct the traditional experiments to try the alternatives in their labs. Request a free copy of the book—available until **March 15, 2020**—by sending an e-mail to *molly@labsafety.org.* Mention this listing in the Freebies column in the February 2020 issue of *NSTA Reports.*

Scientific Expedition in CS. M This board game from HughesNet and 4-H teaches computer science (CS) concepts and teamwork while helping students understand how CS can help professionals in any field solve problems and work more efficiently. In the game, students have 20 minutes to work collectively as members of a scientific expedition team whose mission is to collect plants in Colorado and prepare them for input into computers by correctly identifying them by their scientific names. To play, students roll dice and travel the board, answering question cards about computer programming and persevering through obstacles and setbacks encountered. Access the activity materials—downloadable game board, question card printouts, and rules—at *http://bit.ly/2ZLMp3H.*

Innovation and Renewable Energy: A Humanities Module. M This interdisciplinary, standards-based humanities module uses the true story of William Kamkwamba and his windmill to explore renewable energy topics in science, social studies, and language arts. Targeted for grades 6–8, the module combines climate change instruction, literacy skills, geography learning, engineering design skills, and advocacy into a set of cohesive learning experiences over several weeks. The module provides teacher instruc-

See Freebies, pg G2

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

Freebies, from pg G1

tion, links, and student handouts with guiding questions for each activity. Download the module (registration required) at *http://bit.ly/2QCvEUG*.

MUDASIR ZAINUDDIN

CoralRestoration.org. K12 Inspire students to help protect coral reefs with these open-source resources from the Coral Restoration Foundation. Download expert-curated classroom activity packs for K–12 audiences to develop a basic understanding of the organism and the environmental factors, including human impacts, affecting reef health. Themes include "Appetizing Acropora," "Gamete and Greet," "Maritime Slime," and "Anthropogenic Aftermath." Teachers also can access a 16-minute video, *Coral Reef Rescue* (versions for grades K–8, 9–12, and in Spanish), which showcases new developments in improving reef conditions through accelerating coral growth in the lab, creating nurseries in the ocean, and replanting back to the reefs. See *http://bit.ly/2NoJ1Hd*.

STEAM Café. E Science, Technology, Engineering, Arts, and Math (STEAM) Café offers articles, videos, lessons, webinars, forums, and more to empower elementary educators to incorporate 21st-century skills supporting the *Next Generation Science Standards* (*NGSS*) into their STEAM instruction. View videos demonstrating the Question Formulation Technique, read about adding rigor to STEM lessons, discover best practices for managing STEM labs, and access free *NGSS*-supported science textbooks for grades K–5. Teachers can also register to receive STEAM Café updates and freebies, as well as access to their free resource library, at *https://steamcafe.net*.

Doing and Talking Math and Science. K12 Today's STEM instruction puts an emphasis on collaborative "meaning-making," requiring students to attempt explanations, justify their positions, question and challenge one another's ideas, and build new understandings together. These practices are the heart of Doing and Talking Math and Science—Strengthening Reasoning, Strengthening Language, an educational initiative developed at the University of Wisconsin-Madison. The initiative was originally designed to help English Learners develop their language skills through middle level science and math coursework; however, the initiative's resources—including Teaching Guides, Student and Teacher Moves Tool Cards, and Reflection Questions for Strengthening Your Practice—have proven effective at facilitating discussions of complex ideas among all students. The resources provide a framework to guide students as they learn to argue from evidence and create models to explain their developing understandings. Visit *http://bit.ly/2ZLCzPt*.

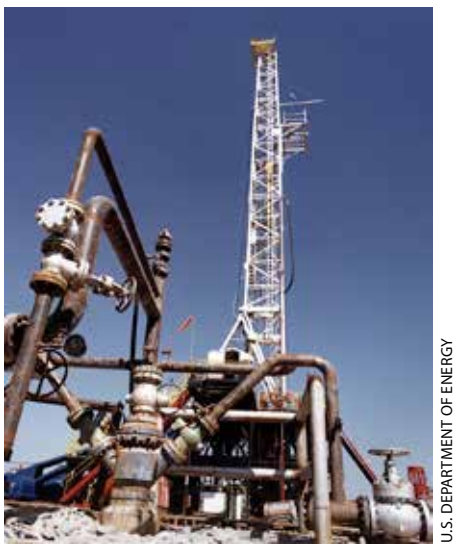
CSA's Space Activities and Experiments. E M Looking for ways to generate student interest in space science and exploration? Check out the educational resources from the Canadian Space Agency (CSA), Canada's version of NASA. Targeted for K–8 students, the resources include quizzes, podcasts, experiments, and activities for the classroom and home to learn what life is like as an astronaut and how to become one. In See Why Astronauts Are Taller in Space, for example, students construct a model of the spine from books (representing vertebrae), sponges (representing discs), and rubber bands (representing the forces of gravity) to visualize gravity's effects on the spine on Earth and what happens in space. In Mission: Astronaut, a multimedia game for grades 3–6, students learn about different aspects of life in space as they complete activities in five missions—training, living in space, robotics, science, and spacecraft. Refer to *http://bit.ly/37o8HuZ*.

STEM Lessons With Snoopy. E The Space Foundation and Peanuts have created a series of Snoopy-themed lesson plans to strengthen K–5 students' skills in STEM. The lessons support the *NGSS* and feature activities such as designing a doghouse lunar lander (The Beagle Has Landed), repairing a hole in a simulated damaged spacesuit (Spacesuit Repair), exploring the fitness requirements of an astronaut (Shape Up, Snoopy), and building/testing a hydroponic germinator (Snoopy Snacks). Publication of the lessons coincides with the release of two Peanuts books from Simon and Schuster: *Shoot for the Moon, Snoopy!* and *Snoopy, First Beagle on the Moon*. The books can be incorporated as part of several lessons to engage students in the excitement of space study and provide background information on lesson topics. See *http://bit.ly/2ZHfjSN*.

Aircraft Carrier: Guardians of the Sea Education Guide. E M This guide for grades 4–8 helps teachers excite students about STEM learning by examining the science and engineering concepts behind technologies found on an aircraft carrier. Designed to accompany *Aircraft Carrier, Guardians of the Sea,* a 3-D film currently playing at various science and aviation museums nationwide, the guide features six open-ended inquiry activities exploring topics such as buoyancy, tensile strength, energy generation, and magnetic forces. Lesson titles include Floating and Sinking; Landing on an Aircraft Carrier; Building the Strongest Wire; Light, Heat, and Sound Waves; Ready for Take Off; and Electromagnets. Refer to *http://bit.ly/37uS2G6*.

Nano4me.org. K12 HE Dedicated to nanotechnology education for all ages (K–college), this website developed by the Nanotechnology Applications and Career Knowledge (NACK) network offers resources on nanotechnology and related topics, including K–12 activities, professional development opportunities, and postsecondary courses and labs. Resource highlights include introductory PowerPoint presentations (for K–12 audiences, and available in both English and Spanish) exploring the history of nanotechnology, how it is practiced, and what it can do, and informal activities for the high school level that can be used to design a Nanotech Academy camp or supplement classroom instruction. Visit *http://nano4me.org/educators* (free registration is required).

Tales of Neuroscience: The Anarchy Aggregates vs. the Brainy Bunch. H HE Produced by BioLegend, a biomedical research and manufacturing company, this comic-style publication targeted for advanced high school to introductory and graduate college levels presents a lighthearted exploration of types of brain cells and their functions. The book includes several neuroscience-themed crossword puzzles, word searches, and coloring pages to reinforce readers' understandings. Download the publication, available in PDF format, at *http://bit.ly/35aMm2x*.



U.S. DEPARTMENT OF ENE

STEM Careers Coalition. M H A new initiative from Discovery Education and business partners (Boeing, Best Buy, Microsoft, American Petroleum Institute, and others) helps address the need for more workers with STEM skills by providing lessons for grades 6–8 and career profiles for grades 9–12 that showcase real-world, cutting-edge applications of STEM in the 21st century. The multimedia lessons cover topics such as 3-D printing, artificial intelligence, and health risks associated with climate change. The career profiles, available in both video and PDF formats, highlight positions such as petroleum drilling engineer, chemist, geologist, environmental health and safety worker, communications specialist, and project manager. Access both at the following website: *https://stemcareerscoalition.org.* ●

News Bits

- **Students at a Florida high school are the first in the world to dissect human-made frogs.** H

At J.W. Mitchell High School in New Port Richey, Florida, students dissect artificial frogs produced by model-manufacturer SynDaver. SynFrog is made to represent a live female frog, including its size and texture and the color of its skin and organs. It also features a realistic reproductive system, complete with eggs. The frogs are made of SynTissue, synthetic wet tissues that mimic the look, feel, and physical properties of real tissue, and are partially funded by People for the Ethical Treatment of Animals (PETA).

SynDaver claims the $150 frogs are safer because they don't expose students to harmful chemicals like formaldehyde, and that they eliminate the moral and ethical concerns of killing live animals to teach anatomy. NSTA President-Elect Beth Allan, a University of Central Oklahoma biology professor, says she hopes the cost will decrease so more schools can afford the frogs. See *http://bit.ly/2Qkksx9* and *http://bit.ly/2SU4KKD*.

- **A program called Girls Take Flight from the Elementary Institute of Science in San Diego, California, seeks to increase the number of female drone pilots.** H

Of the 69,166 Federal Aviation Association (FAA) remote pilot certifications awarded in 2017, women earned only 3,462 of them. To increase that number, Girls Take Flight targets high school sophomores and juniors in the San Diego Unified School District. In addition to training in coding, airport operations, navigation, weather, radio communications, and drone operations, the students participate in field trips, including one that showcased real-life uses of drones at a Boeing facility.

Girls Take Flight aims for each student to attain an FAA remote pilot certificate, and invests hours into honing safety-focused remote flight skills. Executive Director Jim Stone says the biggest challenge to expansion is finding enough qualified female drone pilots who can also instruct, but those numbers are increasing. Read more at *http://bit.ly/36k25hh*.

- **Two math-savvy moms created an app to tackle math anxiety in children.** E

According to an article from TechCrunch (see *https://tcrn.ch/37rn7KQ*), math anxiety stems from the prevalence of accumulated negative math learning experiences by around age six. More than three-quarters (77%) of children with high math anxiety are—when tested—between normal to high achievers on curriculum math tests. Therefore, this anxiety may deter students from entering science, technology, engineering, and math fields when testing otherwise suggests they would perform well in these fields.

To address this problem, the moms' app, called Funexpected, features 11 games in which children tap, cut, slide, grab, and move animated on-screen objects to advance the story, such as by feeding a monkey the correct amount of berries or catching the right type of fish and filling a fish pond. The app runs on a subscription-based model of $5.25 per month or $42.10 per year. ●

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

NATIONAL CONFERENCE ON SCIENCE EDUCATION

EARLYBIRD REGISTRATION IS FEBRUARY 21, 2020

2020

SCIENCE

EXPANDING THE VISION

BOSTON

April 2–5
2020

OVER 1,200 SESSIONS | NETWORK WITH MORE THAN 10,000 EDUCATORS | 350+ EXHIBITORS WITH CUTTING-EDGE RESOURCES | AND MUCH MORE!

REGISTER BEFORE THE EARLYBIRD DEADLINE AND SAVE!

The theme is 20/20 Science: Expanding the Vision. Conference program strands include:

- The Long View: Building a Lifelong Passion for Science
- Learning Science in All Spaces and Places: Near and Far
- Thinking, Acting, and Communicating Like Scientists: A Focus on Disciplinary Literacy
- Aligning the Lenses: Authentic, Three-Dimensional Measurement of Student Learning

For more information, please visit
www.nsta.org/boston

#NSTA20

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.*

February 28

Bayer Fund Grants K12

These grants support projects in one of four areas: science, technology, engineering, and math (STEM) education; food and nutrition; health and wellness; or community development. K–12 STEM programs for underserved youth that occur during the school day are of particular interest. (Those taking place outside of the regular school day should apply for a community development grant instead.) Grantees can use funds for STEM curriculum development, technology, equipment and materials, enrichment programming, or professional development for teachers or school leaders.

Applicants must first request an invitation code at *http://bit.ly/2s2sBJu* and be invited to apply. Nonprofit organizations in St. Louis, northern New Jersey, Pittsburgh, and Berkeley, California, are eligible, as are those within 55 miles of smaller Bayer fund sites (see the list at *http://bit.ly/35ghw8P*). Applications are due by **February 28.**

Canadian Space Agency Junior Astronauts Visits Contest M H

Canadian teachers of grades 6–9 can enter to win a school visit from an astronaut or space expert by completing a class activity in one of the contest's three streams: science and technology, fitness and nutrition, or communications and teamwork. Each activity in these streams reflects the kinds of skills and knowledge required for astronauts. Those who complete more streams earn additional entries.

The Canadian Space Agency will select two organizations per province and territory through a random drawing. Canadian public and private schools and other organizations serving youth in grades 6–9 (grade 6 to secondary 3 in Quebec) are eligible. Visit *http://bit.ly/34IWcbN* to register, and complete your activity by **February 28.**

CAP Award for Excellence in Teaching High School/CEGEP Physics H

This Canadian Association of Physicists (CAP) award recognizes an innovative physics teacher who demonstrates a strong understanding of the subject matter and the ability to motivate and engage students. Nominees should use innovative teaching methods, participate in extracurricular activities related to physics, and mentor students or new teachers in the field.

Awardees receive two free years of CAP teacher membership and a grant that can be used for professional development or to purchase computer software, equipment, or books. Recipients can also participate in a week-long training program at a Canadian research institution.

One award is given in each of five Canadian regions: British Columbia/Yukon, Prairies/Northwest Territories, Ontario, Quebec/Nunavut, and Atlantic Canada. Nominees must be Canadian residents and have taught physics at a Canadian high school or CEGEP for at least five years. Apply by **February 28;** see *http://bit.ly/2Vrjgs1.*

March 1

Toshiba America Foundation Science and Math Improvement Grants M H

These grants support middle and high school science and math teachers with innovative ideas for improving STEM learning in their classrooms. Those using project-based learning with measurable outcomes are eligible. Grant requests of $5,000 or less are due by **March 1;** requests of more than $5,000 are due by **May 1.** Visit *www.toshiba.com/taf* for details.

Arthur Holly Compton Award in Education HE

This award, sponsored by the American Nuclear Society (ANS) to honor physics Nobel Prize–recipient Arthur Holly Compton, recognizes outstanding contributions to nuclear science and engineering education. The honoree will receive $2,000 and an additional $2,000 for his or her academic institution. Nominees need not be ANS members nor work primarily in education.

Submit nominations by **March 1;** visit *http://bit.ly/2F8YAiQ.*

Astronomical Society of the Pacific's Thomas J. Brennan Award H

This Astronomical Society of the Pacific (ASP) award goes to an exceptional high school astronomy teacher in North America who is committed to classroom or planetarium education and training other teachers, or to someone outside the classroom who has enhanced the teaching of high school astronomy. Colleagues, students, and others familiar with the candidate's accomplishments can submit nominations. The honoree will receive $500 and a plaque at the ASP Awards Dinner. Nominations are due by **March 1;** see *http://bit.ly/37y7DFg.*

Biomimicry Institute Youth Design Challenge M H

This challenge asks students to apply biomimicry to a social or environmental issue related to climate change. Working in groups of two to eight, teams study how organisms in nature have adapted to these challenges and design solutions to support a healthier planet. No prior experience with biomimicry is required.

The challenge provides standards-aligned resources and a seven-lesson curriculum module to guide teachers through the process. Middle and high school students with one or two adult coaches affiliated with a school, educational organization, or homeschool are eligible. Register by **March 1;** consult *http://bit.ly/2SfDru7.*

March 4–15

ASHG's DNA Day Essay Contest H

This year's contest, sponsored by the American Society of Human Genetics (ASHG), asks high school students to consider ancestry testing, what they would learn from such tests, and how it would compare and contrast to their cultural heritage. Essays should include at least one citation and demonstrate an understanding of the genetic concepts involved.

The first-place winner receives $1,000 and a $1,000 genetics-materials grant for his or her teacher. Second-place winners get $600; third-place, $400; and 10 honorable mentions, $100 each.

Teachers or administrators may submit up to six student essays from up to three classes after verifying that they are original work. Essays are due by **March 4.** Visit *http://bit.ly/1JdGh9V.*

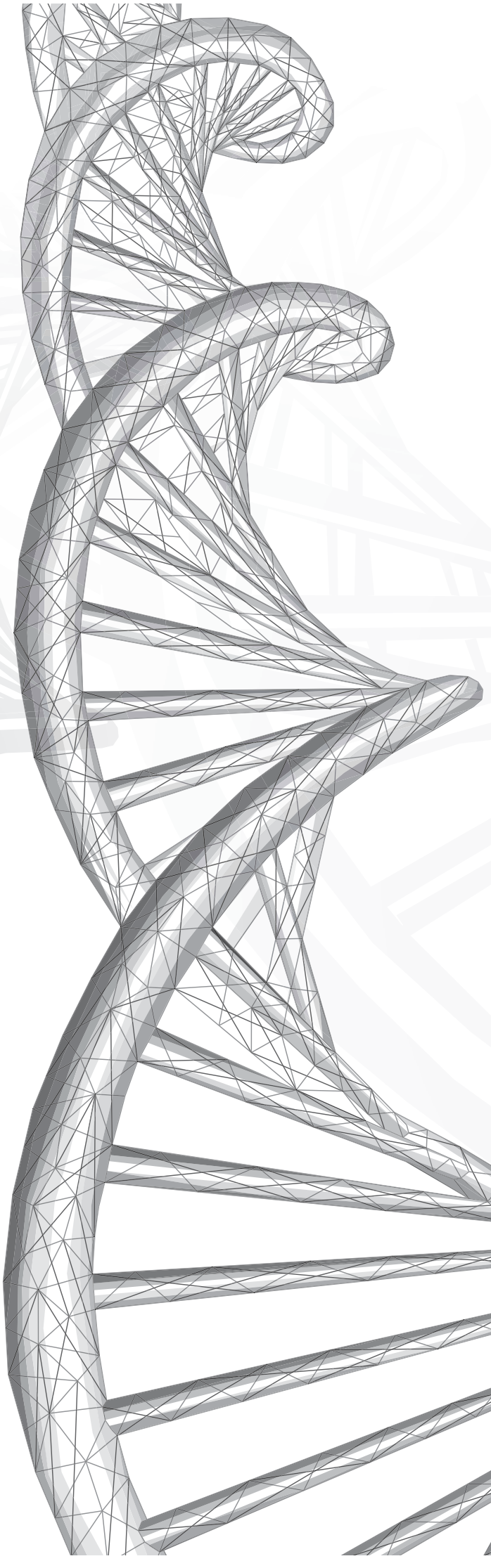
NABT Ecology/Environmental Science Teaching Award M H

This National Association of Biology Teachers (NABT) award goes to a secondary school teacher who has developed an innovative approach to teaching ecology/environmental science and shared their commitment to the environment with the community. The awardee receives a one-year NABT membership, Vernier equipment, and $500 to travel to the NABT Professional Development Conference, where the awardee will receive a plaque to honor their work.

Nominate an outstanding teacher by **March 15.** See *http://bit.ly/37IN48Q.*

NABT Evolution Education Award HE

This year's award goes to an undergraduate educator who promotes accurate understanding of biological evolution. The honoree receives $1,000, a complimentary NABT membership, and a plaque that is presented at the annual NABT conference. Submit nominations by **March 15.** Consult *http://bit.ly/2QUHgCx.* ●



SMARTER SEARCHES, SMARTER YOU.

NSTA Science Supply Guide

Guiding you to an even smarter search **The NSTA Science Supply Guide** is the most connected resource for science educators. With enhanced features and upgraded technology, there's no easier way to source products for your lab or classroom.

Suppliers: Interested in connecting with science educators through our targeted search engine?

Call 1-800-816-6710 or send an inquiry to salesinquiries@multiview.com for more information on staying visible to your customers year round.

nstasciencesupplyguide.com

nsta
National Science Teaching Association

What's New

FROM U.S. GOVERNMENT SOURCES

National Aeronautics and Space Administration (NASA)

Exploring Careers @NASA K12

Discover the many career paths that lead to NASA with this resource at *https://go.nasa.gov/33S0qOG*. K–12 students and teachers can read profiles of NASA interns and employees, explore (virtually) NASA labs and facilities, and learn about available internships, fellowships, and job opportunities. In addition, the site's Career Corner, targeted for grades 5–8, features profiles of women working in STEM positions at NASA, such as microbiologist, astronaut, atmospheric scientist, thermal blanket technician, systems engineer, and software designer.

Library of Congress (LOC)

Today in History: The Brooklyn Bridge M H

Introduce middle and high school students to civil engineering, urban design, patent law, and feats of engineering like the Brooklyn Bridge at *http://bit.ly/2KrBqWH*. You'll find primary source images and text related to the development of the Brooklyn Bridge; the engineer behind its design, John A. Roebling; and the bridge's enduring significance. The page also includes a Learn More section and an audio podcast of the content.

Celebrating the Periodic Table M H

Deepen middle and high school students' understandings about the nature of science—especially the idea that science developments can occur when current understandings are considered in new ways—and help them appreciate the historic accomplishment of Dmitry Mendeleyev's Periodic Table of the Elements with an activity from the Teaching With the Library of Congress blog. The activity asks students to compare Mendeleyev's 1869 periodic table with today's version and consider possible reasons for the differences. The blog post includes guiding questions to ask when comparing the tables and a hands-on extension activity that helps students reflect on what it feels like to develop new scientific understandings. See *http://bit.ly/2MHraek*.

National Oceanic and Atmospheric Administration (NOAA)

What Is a Nor'easter? M H

In the winter, many parts of the United States experience heavy storms called nor'easters. Delve into the science of these storms with SciJinks—NOAA's website about weather, satellite meteorology, and Earth science for middle level and high school educators—at *https://scijinks.gov/noreaster*. Featuring images and weather maps, the article covers how nor'easters form, the difference between nor'easters and hurricanes, when nor'easters are most likely to occur, the kinds of weather nor'easters bring, and what the storms look like as seen from weather satellites.

U.S. Department of Agriculture (USDA)

Food Safety Coloring Book E

This booklet of cartoon coloring pages can familiarize K–5 students with four steps to keep food safe from bacteria that cause foodborne illnesses: clean, separate, cook, and chill. The booklet features reproducible coloring pages highlighting each step, interspersed with food safety facts, tips, and websites for more information. See *http://bit.ly/2trya8f*. ●

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.*

NEH Mesa Verde National Park and Pueblo Indian History Institute K12

In this one-week National Endowment for the Humanities (NEH) Summer Landmarks workshop sponsored by Crow Canyon Archaeological Center in Colorado, K–12 teachers will participate in archaeological excavation and laboratory analyses. During June 14–20 and July 5–11, participants will explore Mesa Verde National Park and the surrounding region—home to humans for more than 13,000 years and the site of some of the world's best archaeological and cultural data. As they explore, participants will seek answers to these questions:

- How do we come to know and appreciate the time depth, people, and activities that comprise the past and shaped our contemporary world?
- Who creates America's history and culture?
- How do Pueblo people balance their cultural identity with ideals of assimilation?

Participants will receive $1,200 stipends, minus meals and housing. Apply by **March 1.** Learn more at *http://bit.ly/35jQAVQ.*

NEH Labor and Landscape: Lowell as 19th-Century Crucible Workshop K12

This NEH workshop takes place in Lowell, Massachusetts, where textile manufacturing and multiple ways of using nature collided in the 19th century. Participants will explore the role of labor and the meaning of landscape for the area's Native Americans, enslaved people, New England farm families, and textile mill workers.

Two six-day sessions are available: June 21–26 and July 12–17. Full- or part-time teachers, librarians, museum educators, and other K–12 school system personnel may apply (**March 1** deadline). Participants receive a $1,200 stipend after completing the program. Visit *http://bit.ly/2FqoQV3.*

NEH Borderlands of Southern Colorado Workshop K12

This NEH workshop explores the multidimensional history of the American Southwest through the intersections of geopolitical, geographic, cultural, ethnic, and religious landscapes. Participants will examine how shifting borders and borderlands in the region impact the community—and the ways in which these issues resonate today.

Stipends of $1,200 and two one-week sessions are available: June 22–28 and June 29–July 5. Full- or part-time teachers, librarians, museum educators, and other K–12 school system personnel may apply (**March 1** deadline). Refer to *http://bit.ly/2tETEyq.*

NEH John Steinbeck: Social Critic and Ecologist Institute E M H

This three-week institute takes participants to the Monterey Peninsula, two hours south of San Francisco, to explore novelist John Steinbeck's writing, ecological vision, and cultural impact. During July 5–25, teachers work with biologists, Steinbeck scholars, and historians to develop new materials and approaches for their classrooms. Participants receive a $2,700 stipend to offset travel, housing, and food costs.

This institute is primarily designed for teachers of grades 4–12, though librarians, museum educators, and other school system personnel may apply (deadline **March 1**). Visit *https://steinbeck.stanford.edu.*

NEH Mapping Nature Across the Americas Seminar K12 HE

This four-week seminar, taking place July 6–August 1 at Chicago's Newberry Library, leads university and college educators through a course of reading, discussion, and research focused on the library's collection of historical maps. (K–12 teachers and school personnel, librarians, and museum educators may also apply.) Participants will explore how maps reveal the complex ways humans have conceived of their place in nature throughout history.

Stipends of $3,300 are provided to offset the cost of attending. Apply by **March 1.** Consult the website at *https://mappingnature2020.com.*

NEH Hoover Dam and the Shaping of the American West Institute K12

This two-week (July 12–24) institute takes middle and high school teachers to Hoover Dam to study the societal consequences—both positive and negative—of its construction. (Educators in full- or part-time positions, other K–12 school personnel, librarians, and museum educators also may attend.) The institute will focus on three central themes: technology, environment, and human communities. Along the way, educators will explore how the Hoover Dam helped develop the American southwest, how its construction reflects broader issues of early 20th-century American society, and what its legacy will mean for future generations.

Stipends of $2,100 are available. Apply by **March 1** at *https://hdsaw.com.*

CEDAM International's Lloyd Bridges Scholarship K12

With this scholarship, one educator can join the Reef Environmental Education Foundation's Fish Survey Trip to the Caribbean island of Dominica to scuba dive, collect data, and participate in daily talks during June 20–27. Afterward, they will return home to share the experience with others and continue working to help protect one of Earth's most fragile ecosystems.

This scholarship is open to certified scuba divers who teach at the elementary or secondary level or work in education programs at aquariums, science centers, or other informal or environmental education venues. The award is based on both merit and financial need, and covers the full cost of the trip, including a meals allowance and up to $1,200 reimbursement for air travel.

Apply by **April 1;** learn more at *http://bit.ly/2GDmILe.*

EinsteinPlus Summer Workshop H

This July 5–11 intensive workshop for Canadian and international high school teachers focuses on modern physics, quantum physics, special relativity, and cosmology. Participants will learn about the latest developments in the field from expert researchers, take lab tours, and interact with likeminded individuals from around the world. Session topics include

- innovative teaching strategies suitable for all areas of physics;
- quantum physics;
- Geographic Positioning Systems and relativity;
- dark matter as an application of uniform circular motion; and
- measuring Planck's constant using a simple electronic circuit.

EinsteinPlus will take place at the Perimeter Institute in Waterloo, Ontario, Canada. Educators interested in conducting follow-up activities with teachers at home are particularly encouraged to apply (deadline **April 10**). See *https://bit.ly/2u52BiD.*

Crow Canyon Archaeology Research Program A

Educators learn excavation techniques while digging alongside archaeologists at the Haynie site, an ancestral Pueblo village located just northeast of Cortez, Colorado. Participants also clean, identify, and analyze artifacts in the archaeology lab; explore nearby Mesa Verde National Park; and hear talks on current topics in Southwestern archaeology. Sessions for new participants will be held on May 31–June 6; June 7–13; August 2–8; and August 9–15. Register at *http://bit.ly/2MbY1XC.* ●

JOIN US

9TH ANNUAL STEM

SCIENCE TECHNOLOGY ENGINEERING MATHEMATICS

Forum & Expo

HOSTED BY NSTA

Louisville, Kentucky

July 22–24, 2020

- Experience hands-on sessions that enhance your ongoing development and improve your STEM knowledge.
- Explore ways to foster integration of research-based methods into the STEM curriculum.
- Network with colleagues and hone your STEM leadership skills.
- Compare project- and research-based activities that tackle issues of real-world relevance.
- Discover the aspirations of students who share their interests in STEM opportunities and careers.
- Check out the hottest tools and resources for STEM educators.
- Get the keys to success in developing partnerships with informal education groups, business, industry, and governmental agencies.

#STEMforum

This dynamic event brings together educators and organizations that are actively implementing STEM programs in their schools or districts.

Come prepared to learn tactics that work, build your professional learning network, connect with effective outreach programs and partnerships, discover new resources, and build a strong curriculum.

nsta
National Science Teaching Association

NSTA PRESS: *Instructional Sequence Matters, Grades 3–5*

Instructional Sequence Matters, Grades 3–5

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 Instructional Sequence Matters, Grades 3–5, *by Patrick Brown, edited for publication here. To download this excerpt, go to* https://bit.ly/2MmSwGz. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Educators—and specifically, teachers—make the difference in science classrooms. If you have embraced the ideas presented so far, you are joining a growing community of science educators who realize that better preparation of students in schools also makes a difference in society. The lessons shared up until this point are preparing you to lead the way to the future for your students and even your colleagues. Now is a time to ask yourself: Are you ready to up the level of the challenge I first proposed in the introduction and spread the word about *explore-before-explain* teaching to other teachers?

Explore-before-explain teachers know something not yet understood by others. To be an effective *explore-before-explain* teacher, you must integrate what you know about instructional activities, content, and learners in a very intricate and organized manner. Scholars have termed the important and specialized type of knowledge necessary for effective teaching *pedagogical content knowledge* (PCK; see Gess-Newsome 1999). PCK symbolizes a powerful type of professional knowledge achieved through the integration of many different domains (i.e., pedagogy, content, and learners). High levels of PCK are imperative for quality teaching and are necessary to ensure that students develop deep science understanding.

If you are wondering why some teachers never become *explore-before-explain* teachers, it is intimately tied to their PCK. I have worked with many well-intentioned teachers whose orientations toward science teaching and knowledge in one or more areas (i.e., content, learners and learning, or pedagogy) hindered their ability to implement 5E (Engage, Explore, Explain, Elaborate, Evaluate) or POE (Predict, Observe, and Explain) instructional sequences. However, by developing their knowledge in these areas and thus gaining higher levels of PCK, they were better able to be *explore-before-explain* teachers. Being acutely aware, motivated, and determined to work to develop research-based professional practice develops teachers' PCK and is crucial to effective teaching.

Working with students and teachers has allowed me to think about best

practices in new and different ways. I have learned quite a bit about teacher knowledge, science teaching, and teacher professional development. In this final chapter, I share some lessons learned so you can pave the way for translating the *Next Generation Science Standards* (*NGSS*; *NGSS* Lead States 2013) into practice not only for your students, but also for your colleagues.

Lesson 1

Focus on Science Phenomena That Students Can Explain From Firsthand Experiences

Keep in mind that excellent, well-designed instruction matters most. Science teaching requires the careful consideration of students' ideas, including misconceptions, and the types of activities that lead toward accurate understanding. When designing 5E and POE lessons, home in on science experiences that allow students to make accurate evidence-based claims. The knowledge that students construct from direct experiences is powerful and long-lasting. Students' experiential learning becomes the foundation of their knowledge. Finding the focus requires us to think deeply about the content, the activities, and our students.

Once foundations are created, all other topics and ideas within the unit of study can be connected to students' experiences. In the process, key associated ideas are tied to students' developing knowledge, while other nonessential topics are cut. Instructional planning around phenomena is considered a "depth versus breadth" approach to teaching, which is all about highlighting in our teaching what we want students to know and remember in the long term to gain higher levels of scientific literacy. Using a depth versus breadth approach keeps instruction focused on big ideas and their relationship to phenomena, and not on science factoids. The result is that students learn and retain the key ideas in science that are important for explaining the world they live in.

Having well-developed content knowledge and a solid understanding of how ideas are connected within a discipline is critical to being an *explore-before-explain* teacher. This requires us to have in-depth content knowledge and to be able to organize knowledge in such a way that all of the desired learning outcomes are directly linked to the phenomena that students explore firsthand. Remember, deeper content knowledge is worth developing and is a critical piece of a teacher's PCK.

Lesson 2

Emphasize an *Explore-Before-Explain* Learning Orientation With Students

Young kids come to school with a natural curiosity about how the world works. However, many students enter classes in which the teacher's focus on covering content supersedes fostering questioning and thinking abilities. Many students are taught science in a traditional way instead of exploring it first for themselves. The pressure that some teachers feel about covering content to make students more academic may be counterproductive; because it may narrow the range of learning activities that kids are willing to consider, it does not encourage the cognitive work they are capable of doing, and it does not prepare them for deeper knowledge-building in the future. Building deep understanding requires treating science learning as a coherent progression over time and across science disciplines.

Explore-before-explain learning requires risk taking and an uninhibited sense of wonder about the world. Students need supportive environments that encourage exploration. Children need to believe that their ideas, in all forms and stages of development, are valued. In this process, students should be encouraged to test hypotheses against evidence; make causal inferences; and use statistics, data, and probability models to explain phenomena. Focusing on valid and reliable means of collecting and interpreting data versus concentrating on whether ideas are "good" or not is a way to highlight the importance of thinking like scientists.

Always remember that *A Framework for K–12 Science Education* (*Framework*; National Research Council 2012) emphasizes the interconnectedness of content, thinking, and doing. The science and engineering practices (SEPs), crosscutting concepts (CCs), and disciplinary core ideas (DCIs) are most effectively intertwined in such a way that one strand alone is best learned in concert with the others, and no one strand is more important than another. Although grappling with data and evidence might be challenging, and although students may need guidance in how to think logically about their experiences, students need to achieve success forming evidence-based claims. Carefully sequencing activities so they lead to the desired outcome is one way to help students form accurate evidence-based claims. Reflection on learning can be a powerful motivator in helping students become learners who are more self-sufficient.

Having a deep understanding of students' intellectual abilities and sequences of instruction also helps teachers assist students in becoming learners who are more self-reliant. Knowledge of learners and pedagogy (e.g., instructional sequence) is foundational to being an *explore-before-explain* teacher and is central to PCK development. ●

ASK A MENTOR, **Advice Column**

Plan to Engage Student Interest, Encourage Risk-Taking in Learning

By Sharon Delesbore

I teach advanced science courses. Many of my students see school as a competition, so they just want the correct answers to study for a good grade. How do I help build student ownership for learning in my science classroom?

–C., Louisiana

Student ownership of learning is a paradigm shift for the teacher as well as the student. We develop this shift by preparing lessons with the end in mind. We must ask ourselves, "What do I want my students to learn from this unit?" As we plan with a conceptual mindset, our instructional strategies and activities must align with this thought process. Instead of fill-in-the-blank notes and worksheets, we plan for students to do more meaningful and creative tasks that will engage them in the content as we facilitate their learning.

Building scientific content knowledge is important, and learning appropriate terminology is crucial, so graphic organizers—such as the Frayer Model in which students write a word's definition, restate it in their own words, draw a picture, then give an example of its usage—makes students responsible for comprehension. We must ask students, "What are you learning?" instead of "What are you doing?" Posting, "What am I learning and how does it apply to me?" in your classroom is a fundamental reminder for educators and students.

As teachers, we must plan opportunities for students to process and apply knowledge, not simply recite or regurgitate information. Yes, science is innately an active subject, but most importantly, science is a way of thinking in which we ask questions, gather information to make informed decisions, and apply our knowledge toward the betterment of our society.

I want my students to take risks when learning, but I am not sure how to start.

—A., Mississippi

We must deliver science content differently by modeling for our students that risk-taking is encouraged in the classroom. You can encourage risk-taking through differentiation. Think about three components that I call the "C.I.A. of Differentiation:" Content, Investigation, and Assessment. As the teacher, you are the "director" of learning. Your mission is to provide a learning environment in which students take an active part in the learning process. This means that you have to make teaching and learning engaging for them, and for you.

Rethink your role as the teacher. You are not expected to know everything; however, you are expected to establish a safe learning environment where mistakes are permitted if students learn from them. Your content knowledge is important, but it can be just as important for you to model the strategies you use when you do not know an answer.

As you guide students toward the information they need, they pose ques-

tions. Allow students to investigate, gathering information that will help them solve problems or validate established theories. Student products or assessments are concrete evidence of the learning that has taken place. Allowing students to demonstrate their knowledge through a choice of blogs, news reports, debates, or posters keeps your classroom creative and relevant. Students feel safe to express themselves without judgment when they have choice.

Bringing the "C.I.A." to your classroom is risky, but worthwhile. With this mindset, you develop skilled, science-conscious scholars willing to question ideas and design answers to help make the world a better place to live.

I'm a first-year high school science teacher seeking desperately the best way to connect with my first-year biology students, who are very smart but are not used to being pushed to comprehend a rigorous curriculum. Any suggestions would be greatly appreciated.

—C., Texas

The 5E model of science instruction is based on the following components: 1) Engage, 2) Explore, 3) Explain, 4) Elaborate, and 5) Evaluate. As you build upon your pedagogy, I suggest you first emphasize the *engage* of the 5E. This component is a good starting point because it helps students learn to ask questions and not assume every answer will be handed to them. This "microwave generation" wants answers now, but if we do not challenge them to ponder the "what ifs" of life, then our students will not develop into young scholars able to innovate and create—making life more effective, efficient, economical, and interesting.

Engaging them with a question or asking them to work in a group to develop a graphic organizer can generate thoughts of what they already know, what they would like to know, and how they know they understand the concept, which also sparks interest and helps students to think in terms of how this applies to them and our world. Engagement leads to exploration that facilitates application. Engaged thoughts should lead students to define specific questions they are curious to answer. Gaining knowledge for themselves will develop their own explanations of phenomena that we, as science teachers, can elaborate on. We can clarify misconceptions, fill gaps of information, and help them evaluate ways to make society better.

I have written a lab about quarks. The problem is there are no *Next Generation Science Standards* (*NGSS*) about quarks. The only standards that refer to the nucleus are about protons and neutrons. How can I align my lab with standards that don't exist?

—G., Illinois

This great question leads to the purpose of performance expectations (What are students to learn?) for states that have adopted *NGSS* and states using their own state science standards. In either case, students have comprehensive assessments. It is important that we, as teachers, follow a trifecta of alignment with 1) performance expectations, 2) instructional delivery, and 3) assessment.

I'm sure you designed a great lab on quarks, but if no performance expectation is written, then I suggest you postpone scheduling the lab. You are charged with preparing your students for successful understanding of the performance expectations. Instructional time is sacred. When your students are assessed, you want them ready.

Focus on that goal by planning backward. Find out when your culminating assessment is scheduled. Then consider your school calendar: When are your formative and summative assessments? When do your terms end? On which days will little instruction happen due to assemblies or school-wide events? Include these dates on your teaching calendar to help map out the time you have to teach all of the significant performance expectations within your designed units of study. Planning is key! ●

Check out more advice on diverse topics or ask a question of Gabe Kraljevic and Sharon Delesbore from Ask a Mentor at https://bit.ly/35LMFS1, *or e-mail* mentor@nsta.org.

BLICK ON FLICKS

The Pollinators: A Different Kind of Bee Movie

By Jacob Clark Blickenstaff

When I was growing up in Northern California in the 1970s, my parents read "back to the land" writings and took them to heart. For about a decade, I lived on what was essentially a small farm. We had chickens for eggs, a cow for milk, and a large garden that produced most of the vegetables we ate in the summer and fall. We also had a hive of bees that pollinated our few fruit trees, but that mostly lived on wild forage. I have clear memories of eating honey right from the comb collected from our own hive. It was pretty cool.

Bees have been getting attention for the last 10–15 years because of significant die-off events that threaten commercial agriculture worldwide. The 2019 documentary *The Pollinators* gives a detailed picture of the commercial bee industry in the United States, and examines the ongoing threats to bees. The filmmakers talked to beekeepers, bee scientists, farmers, and even farm-to-table chefs to get a range of perspectives on the issues. Some of the farmers share innovative techniques they use to be more bee-friendly. The documentary includes suggestions for how individuals can make choices in their daily lives to support both managed and native pollinators.

Importance of Bees

Many of the fruits and vegetables we expect to regularly find in the supermarket rely on insects for pollination. Recall that pollen from a male flower has to get to a female flower to produce a fruit, and that what a botanist defines as a "fruit" includes a lot of produce a dietician would call a "vegetable," including peppers and tomatoes. Bees are so important for the pollination of nut trees like almonds that millions upon millions of bees are trucked to California every year for the short pollination season. Once that season ends, the bees are packed up and moved to other parts of the country to pollinate other crops like apples, cherries, and blueberries. Some beekeepers move their hives more than 20 times each year, following the flowering/pollinating schedules of different crops.

Threats to Bees

Many separate threats to bees have combined in recent years to make it especially hard for both managed and native bees to survive. Farmers have switched to pesticides that are less harmful to people, which is good. Unfortunately, the newer pesticides take

longer to degrade in the environment, so once the pesticide is on a field, it can be toxic to bees for years to come. Other chemicals used on farms are also harmful, including fungicides to control fungus on crops and herbicides to control weeds.

When one kind of crop takes over large areas of land, only a short window of time occurs when that crop produces the nectar and pollen that bees need for food. Managed bees are fed or moved on to another crop, but local native bees have nothing to eat when the crop is not blooming. With little or no food, the hive is severely weakened.

Bee colonies can also become infested with an even smaller insect, the verroa mite, a bee parasite. It attaches to the body of a young pupa or adult bee and sucks out essential nutrients. If several mites attach to one bee, they might kill it outright. The mites also carry viruses harmful to bees, causing even greater damage.

While a healthy colony could probably handle any one of these three threats, two or more could be fatal. A feedback loop exists in which the one problem weakens the colony, making it more susceptible to additional threats.

It is important to note that beekeepers tend managed bees: Colonies can be fed when forage is not available and can be treated for mites; new queens can be introduced to keep a colony going. Native bees and other pollinators can't move away from pesticides or from areas where crops replace seasonal forage, so they are even more susceptible to these hazards.

Potential Solutions

With these threats, it might seem like all is lost for bees, but some new practices are gaining traction in the agriculture industry. First, farmers who have bees pollinating their crops are being more proactive about asking neighbors to postpone pesticide use. This might seem like a small thing, but it can certainly help as a first step.

No field can be used repeatedly without periodic "rest." Some farmers are planting a bee-friendly cover crop that flowers during much of the year. That way, local bees can find food outside of the bloom time for the farmer's main crop.

Another method to limit pesticide use is to try to concentrate the pest insects in one place. Some plants are especially attractive to the pest bugs, so a narrow strip of those "bait" plants can collect a lot of the pests, and the pesticide can be applied in that small area, rather than over the whole field. (This strategy is also much less expensive for the farmer, another big plus.)

We as individual consumers can take several other measures that can support bees and other pollinators:

- Plant a pollinator garden to provide forage for most of the year. Penn State provides some guidance at *https://bit.ly/2T2lOOA*.
- Avoid using pesticides unless absolutely necessary. Consider controlling insect pests in other ways; the Thurston County Public Health & Social Services Environmental Health Department's Grow Smart Grow Safe program offers some tips at *https://bit.ly/37HYLN7*.
- Buy local honey to support local beekeepers.
- Consider purchasing fruits and vegetables that are less than "perfect" so that farmers will have a market for crops that use fewer chemicals in their production.

The Pollinators will give you and your students a deeper understanding of how important bees are to agriculture, and how you can take positive steps to support recovery of bees nationwide. ●

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

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

(All dates are deadlines unless otherwise specified.)

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 26—Start preparing for Citizen Science Month this April! Don't miss the free NSTA Web Seminar, **Citizen Science Month (and Beyond!): Ideas, Tips, and Resources From the SciStarter Team.** Learn about citizen science, free resources, and techniques. Presenters Caroline Nickerson, Darlene Cavalier, and Jill Nugent will also share ideas to inspire your students and community to join the initiative. The session will be held at 7–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/2RGhr8N*.

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. Registration costs $509 for the basic workshop; with the train-the-trainer component and materials, the early bird price is $1,059. For more information or to register, visit *https://bit.ly/2zOlVTx*.

March 18—Take a look at the different ways planets are defined by scientists during **NSTA Science Update: What Is a Planet? How Scientists Classify Pluto and Other Worlds in Our Solar System and Beyond**, a free NSTA Web Seminar. Presenters Alan Stern, Jim Bell, Kirby Runyon, and Philip Metzger will discuss the Geophysical Planet Definition, which is based on intrinsic factors. The session will be held at 7–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/2RGhr8N*.

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 on April 8–11, 2021. For more information on submitting a proposal, visit *http://bit.ly/2uNtbzD*. ●

#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*.

"Improving Elementary Science Programs Through Professional Learning Communities"
Greece Central School District's PreK–12 Science Coordinator Edel Maeder shares her experience launching a district-wide Science Leadership Team to help improve elementary teachers' knowledge of three-dimensional science teaching and learning.
—*Next Gen Navigator* (December 2019, *https://bit.ly/2Yr2PAD*)

"On Being Encouraging"
Editor Becky Stewart shares her own difficulty with encouraging young scientists, as well as her belief that society needs passionate young people in science to find solutions to a myriad of problems. She links to some resources educators can use to inspire students—from stories of young activists campaigning for the environment to a teenage engineer who brought electricity and water to his village.
—*Encouraging Young Scientists* (December 2019, *https://bit.ly/2uFRWNS*)

"Making Sense of Science and Religion: Strategies for Science Teaching"
Lab Out Loud welcomes Joe Shane (Shippensburg University) and Lee Meadows (University of Alabama at Birmingham). Shane and Meadows (in addition to Ronald Hermann and Ian Binn) are co-authors of a new book from NSTA Press called *Making Sense of Science and Religion: Strategies for the Classroom and Beyond*. Written for teachers at all levels, as well as informal science educators, *Making Sense* helps educators prepare for student questions about science and religion so they can confidently facilitate discussions while respecting student beliefs. Shane and Meadows join Lab Out Loud to discuss their new book, describe how they benefit from attending professional conferences, and share some of their strategies for making sense of science and religion in science education.
—*NSTA Express* (January 7, 2020, *https://bit.ly/2NmwiEK*) ●

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

Understanding NOS Key to Student Education

Scientific literacy is essential to comprehending science concepts and applying that knowledge when making decisions about scientifically-based personal and societal issues. NSTA's Board of Directors recently approved an updated position statement on Nature of Science (NOS), derived from the eight science practices in *A Framework for K–12 Science Education,* as well as decades of research.

NSTA makes several declarations in the statement, including these:

- Scientific knowledge is simultaneously reliable and subject to change;
- Creativity is a vital, yet personal, ingredient in the production of scientific knowledge; and
- Subjectivity is an unavoidable aspect of scientific knowledge. Because "science is a human endeavor," it is subject to the functions of individual human thinking and perceptions.

In addition, NSTA offered eight recommendations related to NOS of what students should understand by the time they graduate from high school. These include the following:

- Scientific investigations use a variety of methods;
- Scientific knowledge is open to revision in light of new evidence;
- Science is a human endeavor; and
- Science addresses questions about the natural and material world.

Read the full position statement at *https://bit.ly/35Ozz6t.* ●