CAMERON MACINTOSH, CBC

NSTA Reports
National Science Teachers Association

MILTON HERSHEY SCHOOL

Ask a Mentor: Starting
Clubs, Creating Tests, Surviving the First Year 20

Strategies for Engaging
Students in STEM 6

CONTENTS

Educating Students About Veterinary Science

Veterinary schools at universities around the country are offering programs for students interested in veterinary medicine and informing them about careers in the field. Oregon State University's (OSU) Summer Veterinary Experience, for example, lets academically talented high school students from underrepresented populations "see the diversity of experiences you can have as a veterinarian; [there are] more options than just private practice," says Tess Collins, admissions coordinator for OSU's College of Veterinary Medicine. "Veterinarians are dentists, surgeons, anesthesiologists," and students participating in the six-day program learn about "the complexity and variety of veterinary research," she relates. "It's a more immersive experience than what they have in school, typically."

The program also provides a way for students to experience "what being a veterinary student [at OSU's Corvallis campus] would be like," Collins explains. In its first year, 10 Oregon students participated; last year, 24 students—including several from outside Oregon—were chosen from nearly 100 applicants. "Most students have pretty good grades and are motivated to do well in science courses," she adds.

"We want the program to be hands-on and have a small-group feel," Collins observes. Veterinary student mentors choose the program's activities, which this year included doing electrocardiograms and physical examinations on dogs, she explains.

PHOTO COURTESY OF OSU COLLEGE OF VETERINARY MEDICINE

Oregon State University's Summer Veterinary Experience informs academically talented high school students from underrepresented populations about diverse career options in veterinary medicine.

The students spend three to four days conducting lab research with OSU's biomedical research staff, exploring "intense topics, such as the immune responses of cheetah and elk, feline injection site sarcomas, and examining the genotypes of litters of mice and determining [those of] the parents using [polymerase chain reaction]," says Collins. They also practice 21st-century skills such as "how to work together, communicate, and make presentations."

To ascertain the program's success, Collins says she does "an e-mail check-in every year, and typically those who respond [comprise] about half of the group." A recent check-in showed "100% were pursuing undergraduate education; 90% were still interested in veterinary medicine; and the rest were still science-minded," she reports.

Strong Student Interest

Purdue University's week-long summer residential Junior and Senior Boiler Vet Camps draw about 500 applicants for the two camps, including students from outside Indiana and from Europe,

Veterinary Science, pg 4

CONTEXT MAKES SCIENCE MORE ACCESSIBLE PG 14

JOIN US

ATLANTA

MARCH 15–18 2018

Science State of Mind

NSTA NATIONAL CONFERENCE

Over **1,200** sessions

Network with more than **10,000** educators

350+ Exhibitors with cutting-edge resources

And much more!

REGISTER EARLY AND SAVE

EARLY BIRD DEADLINE
FEBRUARY 9, 2018

CONFERENCE STRANDS

Focusing On Evidence of 3-D Learning

Imagining Science as the Foundation for STEM

Reflecting on Access for All Students

Comprehending the Role of Literacy in Science

Learn more and register
www.nsta.org/atlanta

#NSTA18

NSTA National Science Teachers Association

COMMENTARY: **Patricia D. Morrell**

What Is Educational Research? Why Should You Care?

By Patricia D. Morrell

Patricia D. Morrell

You're credentialed. You keep abreast of scientific updates. You watched the solar eclipse. You know about the new dinosaur species found this summer in Alberta, Canada. You are aware of the *Next Generation Science Standards* (*NGSS*) and what 3-D instruction means. You know STEM stands for science, technology, engineering, and mathematics. You look forward to attending professional development conferences and share-a-thons and continue to add new teaching ideas to your collections. You're an excellent, enthusiastic teacher. But when was the last time you read a research journal in science education or science teacher education? Why should you? And what is that, anyway?

When I started my career as a classroom teacher, it was easy for people to understand what I did (or so they thought!). But when I moved to higher education and became a School of Education faculty member, things got murkier. *You do what? You teach people how to teach? You study what? What is there to study in education? You study subjects: How do you study education? Why would you study education? We all know how to teach, right? What else is there to know?*

I used to think the same thing. When I was a high school teacher and had my first student teacher, I remember her telling me her college class had discussed how to cut down on pre-lab time in the classroom. Intrigued, I inquired about this technique. Have the students read the lab for homework! Gosh, why hadn't I ever thought of that? I probably smirked and rolled my eyes while trying to be supportive and wondering when was the last time her professor had been near high school students. Those people in their "ivory towers" know nothing about life "in the trenches."

I am now one of those people in the "ivory tower," except I'm not—or rather it's not. These days, strong ties exist between higher education and community schools. In my university, all School of Education faculty have close connections with the "real world." We visit classrooms regularly, engaging with our student teachers and field-experience students and interacting with their cooperating teachers—and of course, with classroom students. We work with graduate students who share their stories and questions and keep us grounded in the changing dynamics of today's classrooms. And we do educational research.

As educational researchers, we examine all aspects of teaching and learning, formal and informal, from the classroom through different levels of organizations. We try to identify what shapes educational outcomes and what can be done to maximize those outcomes. Depending on individual interests, researchers might look at teachers, students, classroom interactions, integration of technology, or professional learning communities. We try to understand why things happen, or how things happen, or what would be the result if…We consider what works and what doesn't, and identify the necessary components to succeed.

In a sense, we build on what classroom teachers do every day. We take those nagging questions you have at the end of the day and try to answer them by examining many classrooms in different contexts with changing variables. What we find is meant to inform you in your daily activities with your students, colleagues, administrators, parents, and community members.

Just as science is a discipline, science education is a discipline. Educational research has its own methodologies, literature base, and rules. And it seeks to improve the field. I think now is an exceptional time to be in education at any level. With all the advances in neuroscience and neuroeducation, we are learning how brains actually learn! With the implementation of the new standards, we have the opportunity to explore different ways of teaching: to connect the *what* with the *why* and the *how*. And STEM is a common acronym, making linkages for our students so much easier.

We all know and use our "bag of tricks." Inside the bag are all the individual teaching resources that help make our jobs easier. Well, I think of educational research as the bag itself. It is the foundation that holds everything together. It is the what, why, and how of our profession.

NSTA has several affiliate organizations whose main mission is to conduct educational research. The Association for Science Teacher Education (ASTE) is one; the National Association for Research in Science Teaching (NARST) is another. Take advantage of what educational research has to offer you. Besides filling up your bag, keep your bag strong, weaving in the latest results from studies in the field. Keep abreast not only of curricular and discipline-specific updates, but also the findings and improvements being made to the art of teaching itself. Read a research journal every once in a while! ●

Patricia D. Morrell is the ASTE liaison to NSTA's Alliance of Affiliates. She is also ASTE's president-elect, a professor of education at the University of Portland, and director of the University of Portland STEM Education and Outreach Center.

NSTA Reports

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

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

© 2017 National Science Teachers Association

K–16 teachers only may reproduce NSTA Reports' *contents for classroom or noncommercial, professional-development use only. This does not include display or promotional use. For all other permission to photocopy or use material electronically, please contact the Copyright Clearance Center (CCC) (*www.copyright.com; *978-750-8400). Please access* www.nsta.org/permissions *for further information about NSTA's rights and permissions policies.*
Although advertisers work hard to follow strict safety procedures, guidelines are constantly evolving. It is important to note that all ad images are simulations, not actual experiments—any safety lapses are extremely unlikely to endanger the participants, who are models rather than actual teachers and students. Therefore, NSTA assumes no responsibility for nor guarantees the accuracy of safety information presented in ads.

Veterinary Science, from pg 1

according to Jim Weisman, Clinical Associate Professor in Purdue's College of Veterinary Medicine and director of the camps. "We take about half from Indiana and half from outside Indiana," he reports. Of a cohort of students who participated two years ago, "nearly 90% were interested in veterinary medicine as a career path," he recalls.

Eighth and ninth graders can attend Junior Boiler Vet Camp, which presents "a broad overview of areas of veterinary medicine and lots of hands-on activities," Weisman observes. Activities include dissecting a cow's, dog's or horse's heart; watching a veterinary pathologist perform a necropsy; practicing hands-on skills and techniques used by food animal veterinarians and veterinary technicians, such as administering oral medication; and working with School of Veterinary Medicine faculty on a real medical case, determining the appropriate treatment, and giving a presentation about it "as if they were doctors" to their families, he explains.

High school sophomores, juniors, and seniors qualify for Senior Boiler Vet Camp, "a more focused experience on the dog model, [in which] camp dogs get medical attention, and students learn what a small animal veterinarian does," Weisman relates. Student groups are assigned a dog, then learn about its behavior and training; see how to do a physical exam—then do one on their dog; study parasites and examine their dog for them; and hear about spaying or castration of a dog, then do the procedure on a cadaver dog.

"We want to expose [students] to options in STEM [science, technology, engineering, and math] fields, even if they decide not to become a veterinarian," he maintains. "We build upon what we hope they're learning in science in school."

Using Animal Artifacts

University of California, Davis's School of Veterinary Medicine's Veterinary Medicine Extension takes a different approach with its Animal Ambassadors science education outreach program for grades 3–5. Instead of live animals; hands-on materials like rubber foot molds, plaster tooth casts, and imitation animal coats are used in classrooms and informal education venues, eliminating the need to bring live animals to schools or for students to travel to places with live animals.

"We use artifacts to provide a longer intervention over multiple weeks that is very inquiry-based and allows students to explore the animal kingdom in depth," says Martin Smith, cooperative extension specialist. He notes that students in urban areas "don't see many animals, but they can learn about them and about veterinary science through an artifact-based program."

Plaster tooth casts, for example, can show students "the size and shape of teeth and what they do" for herbivores, omnivores, and carnivores, Smith explains. "As an extension activity, students can make animal masks showing the teeth of different animals and wear them in a skit. This reinforces concepts and brings in the arts and other subjects," he contends.

The curriculum also delves into "non-vocal indications" of animals' emotions and behavior, such as "showing or not showing their teeth," Smith relates. In a game, students match pictures of animals displaying various emotional states with the correct emotion: A smiling dog is actually an angry dog, for example. "Students describe what the animal is trying to communicate and why," which has important implications for students' safety, he explains. "We try to go beyond the activity and have real-world connections for authentic learning."

After participating, students' drawings of Self-Animal Perceptions showed "the program improved students' relationships with animals," Smith reports, and "students use more vocabulary and make more observations" after exposure to the curriculum. Because group activities emphasize "skills such as teamwork and communication, students' [abilities in these areas] improve," he maintains. And "in elementary classrooms, students asked a lot about veterinary school." ●

search
SMARTER

Finding products and services has never been easier for science educators. NSTA's Science Supply Guide gives you access to the data you need to make well-informed purchasing decisions, and it's easily accessible no matter whatsv device you're using, from your laptop to your smartphone. The future of product sourcing is here.

Try it today at **nstasciencesupplyguide.com**

NSTA National Science Teachers Association

MULTIVIEW

WildCam Lab

Investigate ecological questions by exploring trail camera data using an interactive map. Filter and download data to perform analyses and test hypotheses. As an educator, you can set up private classrooms and invite your students to join. Curate data sets or let your students explore on their own. Guided activities and supporting educational resources are also available.

WildCam Gorongosa

hhmi | BioInteractive

lab.wildcamgorongosa.org

Strategies for Engaging Students in STEM

How can teachers get students interested in studying science, technology, engineering, and math (STEM)? "Whether you teach in a *Next Generation Science Standards* (*NGSS*) state or not, the Science and Engineering Practices (SEPs) are powerful because they [show] what a child is thinking and doing. When students develop a model, [for example], they're not just seeing it and being lectured about it," they're actively engaged in sensemaking, says Jen Gutierrez, director of NSTA's District XIV and a member of the *NGSS* writing team.

When she initially taught fourth graders about the solar system, Gutierrez recalls, "I only showed it to them. That was not as effective [as when I had them] act out the solar system. Then it started having meaning for them…Giving students an opportunity to figure things out for themselves allowed them to make connections; they weren't just taking notes."

Citing the NSTA Press book series for elementary students, Picture-Perfect STEM, she notes that "students also connect with books and stories. They ask themselves, 'What does it have to do with me?' Stories invite people in."

When teaching young children, "preface questions with 'what,' not 'why.' For little kids, 'why' is very frightening. 'What' is what [they] see, what they think, what they wonder about," she contends. "The 'whats' will lead to the 'whys.'"

"What I really love about science and the *NGSS* is [their] focus on phenomena. These are great ways to engage students: [presenting them] with interesting things that make them ask questions and have a curious desire to solve," says Jessica Holman, special education teacher at Boone County High School in Florence, Kentucky. "A lot of engagement comes out of a relationship and an understanding 'Why?'…[W]hen you know the kids you are working with, you can get a handle on the things that may engage them.

MILTON HERSHEY SCHOOL

Middle division students at Milton Hershey School in Hershey, Pennsylvania, observe earthworms under microscopes while recording their findings on iPads with Jaunine Fouché, science curriculum supervisor and director of STEAM initiatives.

"One of the things that I do for my students near the first few days of school is to give [them] multiple intelligence surveys," Holman relates. "This is a great way for me to get a handle on the different learning styles that are in my classroom and allows me to reflect on the way that I will present information."

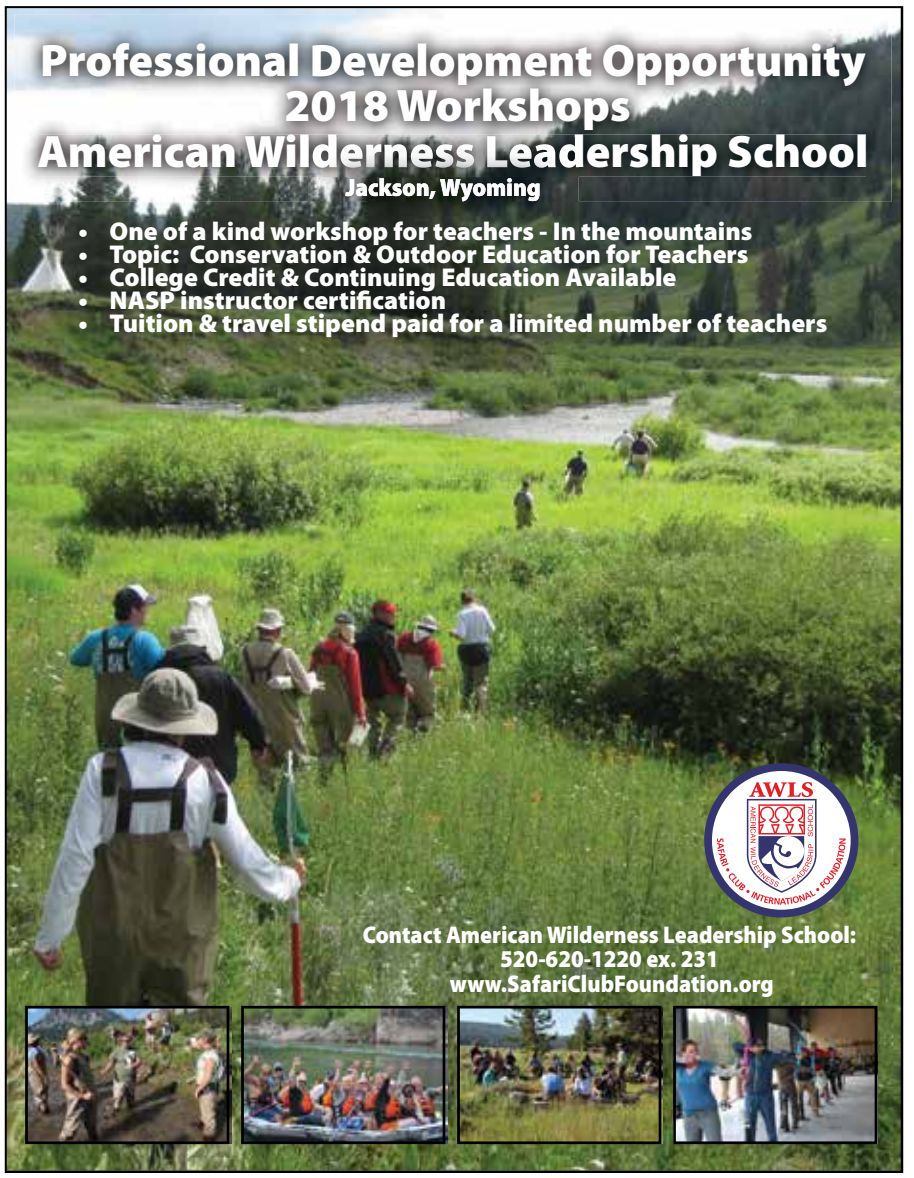
She continues, "The second thing I mentioned was the 'Why?' Our students want to know why they should care about what they are learning." To answer that question, she recommends doing "transitional surveys that ask students what they want to do after school. What are they interested in? Where do they see themselves?"

For Ana Appel, associate director of Lower School Science at Ascend Public Charter Schools in Brooklyn, New York, "the biggest part [of engaging students] is the choice, the student agency factor…Instead of being told what to design, inventors choose."

Appel, who presented Rubric First: Engineers Start With Contracts Before Making Blueprints at NSTA's 2017 National Conference on Science Education, advises, "Use the engineering design cycle. At the beginning, we introduce the problem and the rubric and let [students] discuss it in a group. That's the contract, like an engineer has. The rubric tells [them] how to work together, how to give feedback, and how to present to [one another]."

Self-assessment is key. "Monitoring their own work creates high-level engagement. When the end goal is clear for students, they become engaged in the project itself," she asserts. And "when teachers give [students] feedback along the way, students know where they stand and know they can improve," which also engages them, she contends.

"Science is often presented as 'you have to have the right answer.' This strips the interest out of the STEM fields. We've put it back in," asserts Jaunine Fouché, science curriculum supervisor and director of STEAM [STEM plus arts] initiatives at Milton Hershey School in Hershey, Pennsylvania, a private, residential school that provides cost-free education to K–12 students from low-income backgrounds. "When we do design thinking projects, failure is expected as part of the process, [but we] support students as they confront failure so that they productively engage it, rather than become frustrated by it," she maintains.



To inspire student creativity, the school has a "student-run business model [called] STEAM Project Market" in which "students produce a product and have a pipeline to help with research and development," says Fouché. "We partner students with local entrepreneurs and work with students to bring their products to the market."

Students can create their products "in conjunction with a class, or separately" as an independent learning project, she explains. Products include "produce we grow on our campus, or products that are engineered and developed through design thinking projects. All products are sold through the student- run Project Market, which in turn, generates business-related opportunities that authentically connect …to many of our career technical education pathways," she adds.

"Authentic experiences make our curriculum unique, allowing students to [pursue] their ideas and realize success, or deal with and learn from failure," Fouché contends.

Putting Strategies Into Practice

Some teachers are creating projects designed around successful strategies. Marisa Castronova-Wos and Cheryl Zanone, seventh-grade science teachers at Robert R. Lazar Middle School in Montville, New Jersey, say they "use phenomena to transition our students into engineering tasks. In [STEM PALS], a cross-collaborative project, we share our advisory groups of middle school students with Jessica Palombi's and Meg Garcia's classes at Intervale Elementary School in Parsippany, New Jersey. Small groups (teams) of our students compete and collaborate with small groups of elementary students in engineering design challenges. We [use] Google Hangouts as a vehicle for these [challenges]," they explain.

Funded by a $10,000 Frederick L. Hipp grant from the New Jersey Education Association in 2016 and a 2017 continuation grant award, STEM PALS creates what the teachers call "21st-century [digital] pen pals," pairing middle school mentors with elementary school mentees for weekly real-time activities.

"The energy in the room is palpable," the teachers assert. "The elementary students want the middle school students to see what they're doing and comment on it," while the older students "enjoy being helpers."

During the Packing Peanuts Challenge, in which students used glycerol to create biodegradable packaging material to prevent damage to holiday ornaments during shipping, the schools mailed packages containing the ornaments to one another, "and we opened them on camera together," the teachers relate. "The students were so excited when ornaments arrived intact, and when they didn't, it generated more questions [the students wanted to answer]…[They] really saw the relevance of what they were doing."

Other educators are helping to prepare teachers to use effective strategies. Jodye Selco, a professor in the Center for Excellence in Mathematics and Science Teaching at California State Polytechnic University in Pomona, California, and Juanita Chan, science lead for the Rialto Unified School District in Rialto, California, say they "have been writing 'Common Labs' for K–5…that address *NGSS* [Performance Expectations]." These Project-Based Learning units "include reading, writing, speaking, listening, mathematics, and the science [and] make all of these [subjects] more applicable to the task at hand," they contend.

"We tried hard to include engineering in every one of the tasks," say Selco and Chan. "We tried to model [three-dimensional] learning for teachers. [SEPs] shouldn't be a 'check off; we've done this' thing…We purposefully tried to ensure [that] students are figuring out how to test things."

Teachers who piloted the units "said they enjoyed [them] and students loved [the activities]; they were very engaged and excited to do science and wanted to do more," Selco and Chan report. ●

Educational Innovations, Inc.®

See What's New!

Stackable spinners!


PHY-255

PHY-270

new

Double Hand Spinners

Do fidget spinners really teach anything? You bet they do! Our Double Hand Spinners offer more teachable physics—at such a reasonable price—than almost anything we've seen. Start by using a single spinner to discuss all three of Newton's Laws. Then attach the spinners together and observe how their contra-rotational motion can cancel out angular momentum. Go even further and add the six neodymium magnets (included) to the spinners' arms to open up an exciting new area of exploration involving magnetic forces—both attraction and repulsion. Your students will be riveted by this memorable, unique demonstration. Includes two spinners, a connector, six neodymium ring magnets, and lesson. See it in action on our website. Colors and styles may vary.

PHY-255	Single Hand Spinner	$6.95
PHY-270	Double Hand Spinners	$16.95
M-187	25 Neodymium Ring Magnets	$19.95

new

Exit: Escape Room Kits

2017 Award Winner

These unique games are a thrilling way to encourage critical thinking and collaboration among your students! Players must use their team spirit, creativity, and powers of deduction to crack codes, solve puzzles, collect objects, and earn their freedom bit by bit. Modeled after the increasingly popular "Escape Rooms" around the country, in which players join forces to solve a series of puzzles using clues, hints, and strategy to escape from a locked room. Ages 12+. 1-6 players. 1-2 hours. See our website for more details on each kit.

PUZ-400	Exit: The Abandoned Cabin	$14.95
PUZ-405	Exit: The Secret Lab	$14.95
PUZ-410	Exit: The Pharaoh's Tomb	$14.95

www.TeacherSource.com

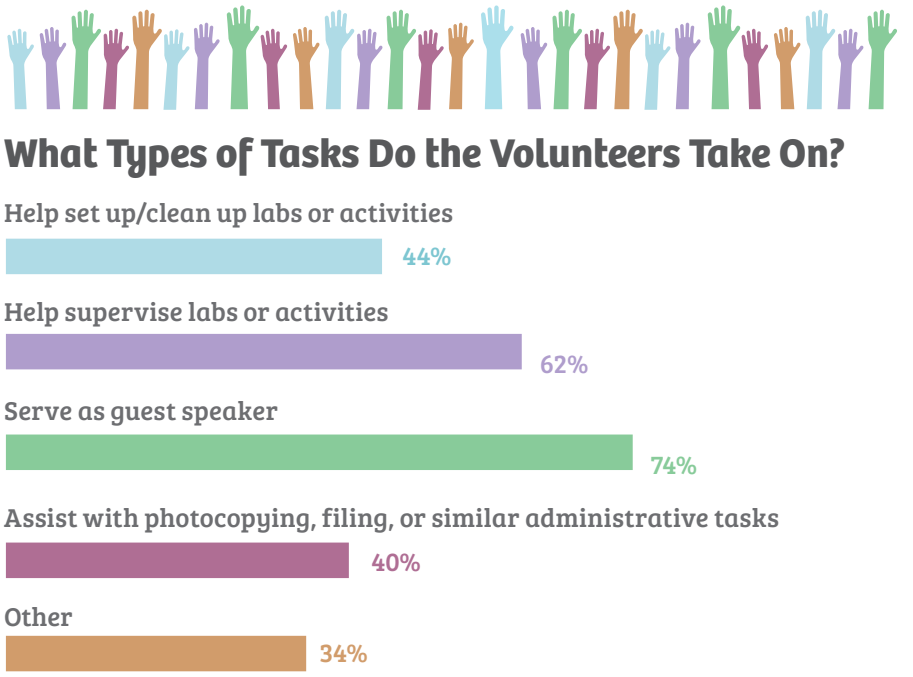
Call 203-74-TEACH (83224) or order 24 hours a day online!

Science Educators Share Views on Parent Volunteers

NSTA Reports recently asked science educators if they use parent or guardian volunteers in their classroom. Sixty-three percent reported that their schools typically recruit parent volunteers and that they recruit parent volunteers specifically for their classrooms. A parent volunteer's most common role was guest speaker (74%), with 62% helping to supervise labs or activities, and 44% helping to set up/clean up labs or activities (respondents were allowed to choose multiple answers to this question). Other roles for parent volunteers included acting as mentors, chaperoning field trips, listening to students read, helping with specific skills groups, and helping to supervise club activities and sports.

E-mailing or sending notes home with specific one-time requests was the most common way to recruit volunteers (59%), and 53% used a sign-up list at Back-to-School Night or similar events with specific requests for either one-time or recurring tasks (respondents were allowed to choose multiple answers to this question). Educators said they used parent volunteers to "get more done and be better prepared," because they can "offer expertise in relevant areas" or "ensure safety and mentor teams through the design process." One educator noted, "I find they appreciate and support what I do for the children so much more if they get a chance to see it firsthand." Others have struggled with finding parents able or willing to volunteer and have found parents in the classroom to be a distraction or even aggressive.

Only 25% of respondents said they believe parent involvement has increased over the last five years.



Here's what science educators are saying about having parent volunteers in the classroom:

[I have m]any less volunteers now than a few years ago.—*Educator, Elementary, Oregon*

I find it harder to recruit.—*Educator, Elementary, New York*

Even with the most stringent background checks, liability of placing an untrained adult in a classroom can be a worry.—*Educator, Middle School, Tennessee*

It is harder for parents to volunteer during the school day [because] usually both parents work. But we have several parents who have blocked out a small part of their day (if their job allows) to come in and volunteer.—*Educator, Elementary, Washington*

Parents need to work, or middle school child does not want them there. —*Educator, Middle School, Texas*

[Use of parent volunteers] hasn't [increased] in the division I teach in, I think probably because in middle school, we are trying to get the students to work independently and having parents around could hinder that behavior.—*Educator, Middle School, Michigan*

I have become more project/lab oriented, and therefore, look for additional assistance in my classroom. —*Educator, Middle School, New Jersey*

Parents mostly work or have full-time commitments. Often they are not available during the school-day hours.—*Educator, Elementary, South Carolina*

People are busy working. The economy in California makes it very difficult for middle-class people to get by without working overtime or extra jobs.—*Educator, High School, California*

I like that the dads are highly involved in our school and often [volunteer in] my class.—*Educator, Elementary, Colorado*

I think [the frequency of volunteering] has stayed the same. Our parents have the same time commitments that they had five years ago, so it is usually the same adults at most events.—*Educator, Elementary, Illinois*

The Kavli Institute for Theoretical Physics at UC Santa Barbara will host its annual Teachers' Conference

MATTER OF MEMORY

How are memories stored in matter?

Saturday, February 17, 2018

Join high school physics teachers from across the U.S. for a stimulating full-day conference.

For further information, please visit our website:

www.kitp.ucsb.edu/outreach/teachers

Many of our parents don't speak fluent English and work long and/or late hours.—*Educator, Middle School, Iowa*

Because I have specifically taken an active role to recruit and increase parent presence in my classroom, [volunteering has increased].—*Educator, Middle School, Idaho*

Parents are busier than ever, and schools don't always make a point of inviting them in.—*Educator, Middle School, Pennsylvania*

In our school, it seems to come and go in waves. Currently, we are in a less engaged period.—*Educator, Elementary, Washington*

I think more teachers see the value in having the parents/guardians in the classroom.—*Educator, Middle School, Missouri*

[Volunteering has increased b]ecause I am asking them more!—*Educator, High School, Connecticut*

Teachers in our middle school have talked about the fact that parents in our district do a lot of volunteering and donating to our elementary schools, and we see a big drop-off in parent involvement with the school at the middle school level.—*Educator, Middle School, Massachusetts*

At the high school level, [interest in volunteering] is only strong in athletics...that is all.—*Educator, High School, North Carolina*

Schools are making efforts to be more of an "open community" as competition from charter schools, online schools, [and so on has increased].—*Educator, Middle School, Wisconsin*

If anything, it has declined. I know my site has a hard time getting parents to help. When they do, it's often the same families who volunteer each year.—*Educator, Middle School, California*

[In] my population—inner city—parents are trying to survive, and do not typical[ly] have experience or interest in science teaching.—*Educator, Elementary, Middle School, Ohio*

I have seen a decrease at our school, and I think it is because of the turnover rate in administration.—*Educator, Middle School, Texas* ●

LEARNING UNBOUND

Empower your students and unleash their curiosity for science and discovery.

Vernier introduces Go Direct™ sensors. Wireless or USB—the versatility is built into these affordable sensors, so you have the flexibility to choose. All Go Direct sensors connect directly to student computers, Chromebooks, or mobile devices, so there's no interface needed. That's freedom, versatility, and boundless opportunity.

Learn more at www.vernier.com/unbound

Teaching with Vernier

NEW Go Direct® Sensors | FREE Graphical Analysis™4 App | Electronic Versions of Lab Books | All Backed by Our Stellar Service

Quotable

Failure has to be an option....No important endeavor that required innovation was done without risk.

—James Cameron, Canadian filmmaker

MONEY 101

403(b) + 401(k) + 457 ≠ An Algebra Equation

By Kelly Kenneally

So many terms are associated with saving money for retirement: terms like 401(k), 403(b), 457, defined benefit, and defined contribution. In combination, they read almost like an algebra equation or word problem, but actually these terms play a big role in your financial security in retirement. But what do they all mean, and which terms are relevant to you and your money?

If you work in a public school, you probably hear about a "**defined benefit**" (**DB**) **pension** frequently. A DB pension is a retirement plan that an employee and his or her employer regularly contribute to. The contributions are pooled together and invested by professional money managers. At retirement, an employee with a DB pension receives retirement income each month, and that "defined" amount is based on a formula. Pensions are available to most public sector workers, and some private companies still offer pensions because they are considered a powerful tool for recruiting and retaining workers.

One of the DB pension's major benefits is that the money lasts through retirement. Also, many DB pensions have regular cost-of-living adjustment increases, and the burden of money management is done.

It's important for public school teachers to stay informed about their pension plan. Most are well-managed and in a strong financial condition, but a few states face challenges.

The National Association of State Retirement Administrators (NASRA, *www.nasra.org*) offers in-depth information on public pension plans. Nationally, NASRA finds that the typical annual DB pension payout for a public sector worker like a teacher is about $25,000.

For many, that amount of annual pension income may not be sufficient to cover living expenses. In most states, educators also contribute to Social Security, which can supplement pension income. Public school teachers without Social Security typically have higher pension incomes.

Research shows that public and private sector workers who will receive Social Security in retirement are wise to delay taking benefits as long as possible. The later the Social Security claim, the higher the monthly benefit. The Boston College Center for Retirement Research (CRR) offers understandable research and guides (*https://goo.gl/Wq3gdr*) on this issue. In fact, CRR estimates that if you would receive a Social Security benefit of $1,000 a month at age 62, a delay would mean receiving $1,333 at 66 or as much as $1,760 at 70.

So what about all the "algebraic" terms: 401(k), 403(b), and 457? These are all types of "**defined contribution**" (DC) retirement accounts, and the names refer to the section of the tax code that outlines them.

A main difference among these accounts is the type of employer that can offer them. A **401(k)** plan can be offered by for-profit companies, while **403(b)** and **457** accounts can be available to employees of tax-exempt organizations like schools, hospitals, or religious groups. You can check with your human resources or benefits staff to learn precisely which DC plan may be available to you.

With a DC account, the employee decides how much to contribute, and the employer puts that money into an individual account through a payroll deduction. The employee also selects how to invest the money from a menu of investment options offered by the employer. When employees retire, they decide how to spend down the balance. Depending on the investments, the account balance can fluctuate dramatically in conjunction with the stock market.

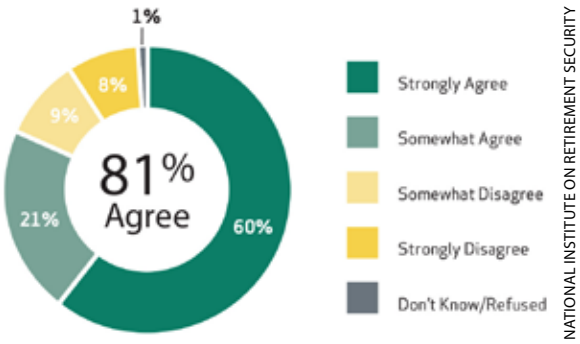
Originally, DC accounts were intended to allow workers to save additional money to supplement pension income, and this holds true for most public sector employees like education professionals. But in the private sector, however, many companies have moved away from pensions or only offer DC accounts, if they offer a retirement plan at all. This has made the task of preparing for retirement more complex and expensive for private sector employees. Regardless of the type of DC plan offered to you, the earlier you begin saving, the larger your DC nest egg likely will be at retirement, thanks to the power of compound interest.

One area to focus on regarding DC plans is related to high or less-than-transparent fees. DC account fees have been often discussed lately, and *The New York Times* recently published a series of articles focused on teacher DC plan fees. Their reporting indicated that 403(b) accounts "are not subject to the more stringent federal rules and consumer protections that apply to 401(k) plans." States are examining this issue, and one example of action is legislation in Connecticut requiring all 403(b) retirement plan providers to disclose fees and compensation to state and municipal workers. States like California have been recognized for helping teachers understand their DC accounts and fees with online tools like 403bCompare (*https://goo.gl/GVSs4q*).

So just as monitoring a DB pension plan is important if you have one, it's equally important for educators to understand if you're eligible for Social Security and any DC savings options available to you. The devil is in the details, and those small details can have a big impact on how much money you'll have available when you decide to retire.

Figure 32: **81 percent of Americans support pensions for public school teachers given their lower salaries.**

Please tell me whether you (agree/disagree): Public school teachers deserve pensions to compensate for lower pay.



NATIONAL INSTITUTE ON RETIREMENT SECURITY

And one more area you should monitor with regard to DB and DC plans for public sector education professionals—a few states are considering eliminating DB pensions for public school teachers and only offering DC accounts, a trend that is happening in the private sector and contributing to the national retirement savings shortfall.

Kentucky's governor, for example, is expected to introduce legislation to eliminate teacher pensions. Active and retired teachers are mobilizing to oppose the measure. In West Virginia, the teacher pension plan was closed, and teachers were moved into DC accounts. The state eventually re-opened the pension when West Virginia teachers found their DC accounts had insufficient funds when teachers reached retirement age. In fact, the American public strongly supports teacher pensions as a way to compensate for low teacher salaries, according to polling from the National Institute on Retirement Security. (See Figure.)

Clearly, the teacher retirement equation is dynamic and different for everyone. But with early and regular attention, it's a solvable equation. ●

Kelly Kenneally has 25 years of public policy experience including serving in the White House, and she has worked for more than 10 years with retirement organizations to help improve retirement prospects for Americans. She has co-authored a biennial report on Americans' sentiments regarding retirement.


“This online master’s in biology program was perfect for me. It opened up opportunities and also moved me on the pay scale.”
Curtis Reese, Graduate
Online Biology, MS ▸ University of Nebraska at Kearney
• Lab and Field Experiences
• Master’s of Science Program
• Low Student to Faculty Ratio
Application deadline for spring semester is October 15.
online.nebraska.edu
University of Nebraska Online
KEARNEY | LINCOLN | OMAHA | MEDICAL CENTER

NSTA
CAREER CENTER
FIND QUALIFIED SCIENCE TEACHING PROFESSIONALS

POST.
INTERVIEW.
HIRE.

IT'S REALLY THAT SIMPLE...

The NSTA Career Center is the premier online career resource connecting employers 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 and newspapers!

Visit the *NSTA Career Center* to learn more

http://careers.nsta.org

NSTA National Science Teachers Association

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies for Science Teachers

STEM Spotlight: Argumentation, Critique, and Other Discursive STEM Practices. K12 Developed by the Community for Advancing Discovery Research in Education, this collection of materials spotlights K–12 science, technology, engineering, and math (STEM) resources—including curriculum units, professional development, articles, books, and papers—that support argumentation, critique, and discourse in the classroom, and in research and development. The resources are useful for practitioners and administrators at every level from elementary to high school. Learn more at *http://goo.gl/mwT5tC*.

Sustainable Agriculture Lessons. H This set of five lessons from the American Farm Bureau Foundation explores the social, economic, environmental, and production components of sustainable farming and ranching in the 21st century. Targeted for high school students, the lessons teach key terms relating to sustainable agriculture and agricultural history; explore business concepts of farming and how agriculture contributes to local, national, and global economies; describe how farmers care for the environment; highlight the four major categories of agriculture use (food, fiber, fuel, and shelter) and biological and technological advancements impacting agriculture production; and demonstrate the role agriculture plays in society. Each lesson includes a downloadable PDF, a PowerPoint, and an online learning component with videos and extra resources. Visit *http://goo.gl/jvoUb3*.

Research Quest. M Created by the Natural History Museum of Utah, these virtual research investigations engage students in grades 6–8 in authentic science and foster their critical-thinking and collaboration skills. The investigations—What Dinosaur Did These Bones Come From? What Happened at the Cleveland-Lloyd Dinosaur Quarry? and What Physical Feature Helped a Dinosaur Survive?—support the *Next Generation Science Standards* (*NGSS*) and incorporate the use of 3D models of dinosaur bones and short videos with museum scientists to help students analyze fossils, evaluate evidence, and develop arguments explaining the possible causes for the dinosaurs' death. Each investigation includes a teacher's guide, reference materials, and assessments; free registration is required to access the materials at *http://researchquest.org*.

NINJATACOSHELL

ClimateSim. H HE A web-based climate change simulator for advanced high school and undergraduate students can be used as a virtual lab in physics and environmental science courses. The app allows users to model scenarios of greenhouse gas emissions in the current century and simulates the first-order response of the Earth system. Instructors can use ClimateSim to illustrate climate change concepts, demonstrate dynamic relationships among climate variables, and assign simulation-based exercises for enhanced learning. The app is also useful for teachers interested in developing a better understanding of climate science basics. Consult *http://goo.gl/nDSMPT*.

Physicscentral.org. E M Packed with research, experiments, images, and resources for K–8 audiences that highlight physics and physics applications in our everyday lives, this American Physical Society outreach website more than delivers on its motto, "learn how your world works." Click on the Ask and Experiment tab to access hands-on investigations exploring the Coriolis effect (Wheels and Whirlwinds), the structure of metals (Paper Clip Heat), static electricity (Hovering Snowflake Designs), momentum (Office Chair Physics), and other topics. In Explore the Science, teachers will find resources focused on current research in physics and physicists' interesting lives; for example, check out more than a dozen physics demos conducted by scientists aboard the International Space Station (Science Off the Sphere), or learn about the human side of science through interviews with physicists describing their work and lives (People in Physics). Visit *www.physicscentral.org*.

Lessons from Smithsonian Museum Day Live! E M This annual celebration of curiosity hosted by *Smithsonian* magazine brings together K–8 students and adults to create and invent as they visit participating museums and complete activities. The 2017 Museum Day Live!

See Freebies, pg G2

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

Freebies, from pg G1

(which occurred on September 23) featured three interactive lessons developed using Microsoft's Minecraft: Educator Edition software to spark creativity and student collaboration. Now available at *http://goo.gl/NZiApg*, the lessons include The Museum Idea (primary [ages 5–8], intermediate [ages 9–12], and middle [ages 12–15] levels), in which students design a 3D model of a museum exhibit and collaborate with classmates to combine exhibits and build a museum in Minecraft; and The Universe: An Introduction (intermediate and middle levels), in which students research the conditions that allow Earth to support life, design and build a sustainable habitat for humans on Mars or another planet, and work in groups to create a representation of that planet in Minecraft. The third lesson—Building Up, Breaking Down (primary and intermediate levels)—challenges students to research an important building in the community and recreate that building in Minecraft, trying to match the building materials used in construction to blocks available in Minecraft.

Medicines and Me. H Developed at the University of Rochester Medical Center's Life Sciences Learning Center, these lessons for high school students present information about over-the-counter medicine safety. Available at *http://goo.gl/JKNqxL*, the hands-on lessons are appropriate for use in life science, biology, health, and consumer science classes. Each lesson features a teacher's guide with answer key, student handouts, and lesson extensions. Titles include Choosing and Using Medicine Safely, in which students analyze mini-cases and Drug Fact labels to determine which over-the-counter medicines patients should use and how to use them safely; A Case of Unintentional Overdose, in which students conduct simulated laboratory tests to determine that a young patient's symptoms are due to liver damage; and Cold, Flu, or Allergy?, in which students conduct a simulated flu test and use product labels to choose appropriate medicines for patients with the flu, common cold, or allergies.

ESO/NASA/JPL-CALTECH/S. KRAUS

Star Chart app. M H Star Chart, an Augmented Reality (AR) astronomy application for iPads and iPhones, is a point-and-view app! Simply point your AR-enabled device at the sky, and Star Chart tells you exactly what you are looking at. Targeted for middle and high school educators and astronomy buffs of all ages, the app uses Global Positioning System technology, an accurate 3D simulation of the visible universe, and technical "wizardry" to calculate (in real time) the current location of every star, planet, and moon visible from Earth, day and night. Tap on anything in the sky to learn facts about what you are looking at, or view an illustrated overlay of 88 constellations (as envisioned by 15th-century astronomer Johann Hevelius).

Additional features enable users to view the sky beneath the horizon, so the Sun can be "seen" even at night. Teachers can easily incorporate the app into astronomy or space units: Have students use the app at home to learn more about stargazing and the nighttime sky, or use it at school to remind students that space is still there, even when it's light outside. Consult *http://goo.gl/BNfzGN*.

***On Duck Pond*–Teacher's Guide.** E Introduce K–2 students to life in a pond habitat with the discussion questions and standards-based, interdisciplinary activities in this resource from Cornell Lab of Ornithology's BirdSleuth Program. Create a Marsh Mural highlighting animals that live at the pond; draw the pond habitat at different times of the year in Shifting Seasons; or learn about life cycles by recording each stage in The Life of Duck. Other activities challenge students to make Bird Comparisons of different birds found near a pond; explore the features that make webbed feet so special in Waddle and Wade; and experiment with paper clips and water to learn about surface tension and mimic Water Skimmers at the pond. The website offers additional content to supplement the printable guide, including images, videos, and student worksheets. Refer to *http://goo.gl/WWxgQk*.

Grades of Green. E M Educators can access more than 40 activities and projects at *www.gradesofgreen.org* to inspire environmental stewardship and involve K–8 students in a hands-on way in protecting the environment. Projects involve improving air quality (No Idle Zone), conserving energy (Energy Audit), reducing waste (Trash-Free Lunch Challenge), limiting water consumption (School-Wide Water Reduction), eliminating toxins (Green Cleaning Supplies), or emphasizing ways that promote a healthy planet Earth (Meatless Meals). Participating schools earn badges for each green project completed; schools completing five or more projects earn a Grades of Green Certification. (*Note: Free registration is required to access the projects.*)

ANDREW DUNN

Science Careers Series Podcasts. E M Introduce elementary and middle level students to new career possibilities as they listen to scientists from the North Carolina Museum of Natural Sciences talk about their careers in the life sciences. Developed by the Walking Classroom, an educational program for grades 3–8 that promotes exercise without sacrificing instructional time through approximately 20-minute "walk along with" podcasts; each podcast highlights a different field of research and includes a classroom lesson plan with resources for further learning. Used in or out of the classroom, the series introduces students to careers in paleontology (Paul Brinkman), mammalogy (Benjamin Hess, Stephanie Schuttler), citizen science (Chris Goforth), entomology (Jason Cryan, Colin Brammer), microbial ecology (Julia Stevens), and other fields. Listen at *http://goo.gl/1Z8VsE*.

Where Are the Small Worlds? M This game-style exploration of our solar system uses real NASA data and the relative motion of objects in the solar system. Developed for NASA by Arizona State University, the game enables students in grades 6–8 to explore our solar system from the perspective of the Sun and collect data on small worlds. Learners observe the motion of different worlds to determine their location in the solar system, then launch probes to search these small worlds to find the hidden caches and collect astrocoins. By doing so, students develop understandings about the use and limitations of a solar system model as well as insight into the relationship between relative speed versus distance of the object in the solar system.

Where Are the Small Worlds? supports the *NGSS* and *Common Core* learning standards and is appropriate for use in both formal and informal learning settings. Access the game and accompanying educator resources, such as lesson plans and documents with specific connections to learning standards, at *http://goo.gl/bvbjVC*.

Using Science Anchor Phenomena Effectively. E M KnowAtom.com's online publication introduces K–8 educators to science phenomena and their relationship to the *NGSS*. The publication answers several questions regarding phenomena: What are phenomena? How do we choose phenomena appropriately? How can we implement phenomena within actual lesson and unit flow? What is the connection between phenomena and standardized testing? (*Note: Free registration at* http://goo.gl/VmxppZ *is required to download the book.*) ●

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

News Bits

- **An eight-year-old girl who was bullied for her passion about bugs has co-authored a study published in *Annals of the Entomological Society of America*.** E

Sophia Spencer's mom Nicole contacted the Entomological Society of Canada (ESC) for advice on encouraging her daughter's interest in entomology. The ESC tweeted her request with the hashtag #BugsR4Girls, inviting entomologists to connect with Sophia, and garnering media attention and reaching an audience of approximately one million people. Responses with expressions of support and offers of entomology research tools and books arrived.

The success of this effort was analyzed in a study co-authored by Sophia and published in a special edition of ESC's journal on science communication. She wrote, "[I]t felt good to have so many people support me, and it was cool to see other girls and grown-ups studying bugs. It made me feel like I could do it too." Read more at *http://goo.gl/fcfvcy*.

- **Following years of declining enrollment, Hidden Oaks Elementary School in Boynton Beach, Florida, is piloting Palm Beach County's first K–8 school.** E M

The school admitted 70 sixth graders as it struggles to fill even two-thirds of its seats because of competition from charter schools and schools of choice offering K–8 options. The school will add one grade per year for the next three years.

More than 20 of the nation's largest urban districts have adopted the K–8 model. For many parents, the idea of middle school is a scary notion. Hidden Oaks' principal, Sari Myers, observes, "I think there's a feeling of security that staying here gives."

Researchers have been unable to prove the model's superiority, however, despite studies in Milwaukee, Baltimore, Philadelphia, New York, and Miami showing sixth, seventh, and eighth graders in K–8 settings perform better on standardized tests and have fewer disciplinary issues. A review of these studies showed that researchers "did not control for school size, socioeconomic factors, and other variables, so results could be attributed to reasons other than grade configurations." Read more at *http://goo.gl/FZ4dDV*.

- **The University of Akron (UA) received a $450,000 National Science Foundation grant for its "Zip to Industry" program, in which researchers will study how job shadowing impacts student retention in science, technology, engineering, and math (STEM); students' perceptions and knowledge of STEM careers; and their motivations for STEM careers during their freshman year.** HE

Zip to Industry will identify 50 incoming students with weak connections to STEM careers and give them paid job-shadowing experiences following UA STEM students in co-ops/internships with local and regional employers.

Research team member Deanna Dunn says job shadowing is regarded as a powerful learning experience that affects persistence toward a career goal. Students will get "a glimpse of real-world work…[that will] help them gain a better understanding of what skills are needed to succeed," she relates. If successful, Zip to Industry may be replicated at other schools. Read more at *http://goo.gl/ckUDWU*. ●

Make the Switch: **Modular Circuits**

Untangle your circuits

Get it right the first time
- Easy to understand
- Easy to wire

Students build circuits that look like their circuit diagrams.

Clips for electrical connections

Wirelessly measure current and voltage

PASCO

10101 Foothills Blvd.,
Roseville, CA 95747
877.373.0300

Make the Switch: **pasco.com/circuits**

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

What's New

FROM U.S. GOVERNMENT SOURCES

U.S. Fish and Wildlife Service (FWS)

The Compass to Nature E M

The Prairie Wetlands Learning Center, part of the FWS National Wildlife Refuge System in Fergus Falls, Minnesota, has produced *The Compass to Nature: Teaching in the Outdoor Classroom,* a booklet for K–8 teachers and parents highlighting an innovative approach to outdoor learning. The four points of the compass to nature—place, phenology, naturalists, and journals, unified by the sense of wonder—provide direction for educators to help students develop a caring relationship with the environment. The booklet describes each point of the compass and has activity suggestions for each point. The booklet also contains a list of Top 10 Field Activities such as aquatic labs, discovery hikes, outdoor alphabet, and sketching. See *http://goo.gl/QDpkKn*.

Conservation Connect Live! E M H

This web-based video series connects students ages 10–15 with the outdoors and conservation careers. Each six- to eight-minute episode features a conversation with a wildlife specialist and footage of a species. The webcasts take place the third Thursday of every month at 2 p.m. Eastern Time. While students watch, they can chat directly with the presenters via the Livestream platform. Questions for presenters can be submitted via chat room on the Livestream video player or e-mailed to *broadcast@fws.gov.* (For chat room instructions, see *http://goo.gl/UG51qs*).

Episodes are archived along with accompanying lesson plans. Teachers can use the episodes to supplement existing environmental education curriculum or to spark interest in citizen science and science, technology, engineering, and math (STEM) careers. Upcoming webcasts are Without a Paddlefish (January 18, 2018), Bald Eagles Are Back (February 15), The Sturgeon General (March 15), and Freshwater Mussels (April 19). Visit *http://goo.gl/PeZnCh*.

National Oceanic and Atmospheric Administration (NOAA)

Humpback Whale Activity Book E M

A publication from NOAA's Hawaiian Islands Humpback Whale National Marine Sanctuary offers a fun way for elementary and middle level students to learn basic information about humpback whale behavior and biology. Students can match whale flukes, search for terms relating to whale behaviors, complete a migration maze from Alaskan to Hawaiian waters, go whale watching (on paper), take a Humpback Quiz, and more. Download the book at *http://goo.gl/dHVxcW*.

Long-Term Reef Monitoring Lesson M H

Developed by NOAA's Flower Garden Banks National Marine Sanctuary, this lesson introduces students in grades 6–12 to the difficulties of data collection in an underwater environment and challenges them to identify changes over time in reef habitats. Students practice observation skills by finding the differences between slightly altered images, then apply those skills to analyzing actual monitoring images from all three parts of the sanctuary. Once changes are identified, students can conduct more research to try to determine what might have caused the changes. Refer to *http://goo.gl/9J1aJN*.

Fish Fun! E

Fish feeding adaptations are the focus of this 5E (Engage, Explore, Explain, Elaborate, and Evaluate) lesson for grades 3–5. Students use various household implements to simulate feeding techniques of fish species found on the coral reefs of Flower Garden Banks National Marine Sanctuary. They learn to identify how and what fish eat and where they eat, based on their adaptations. Find the lesson, which includes teacher information and student worksheets and answer keys, at *http://goo.gl/a1tjRC*.

U.S. Department of Agriculture (USDA)

School Gardens: Using Gardens to Grow Healthy Habits in Cafeterias, Classrooms, and Communities K12

Produced by the USDA's Farm to School program for K–12 audiences, this document presents practical information about the health and educational benefits of school gardens. Peppered with tips from schools nationwide with successful garden programs, the document discusses how to find space for gardens in any location or climate and offers suggestions for using garden bounty in the cafeteria. Information about food safety in the garden and about funding, staffing, and maintaining a garden program is included. See *http://goo.gl/VqFnAt*.

National Aeronautics and Space Administration (NASA)

Space Weather Action Center M

Most students have never pondered weather in space, much less considered that space weather—solar storms, solar wind, auroras, solar flares, and other conditions—affects us on Earth. With NASA's Space Weather Action Center (SWAC), you can teach students about these phenomena and watch the Sun's weather activity from the classroom. Most appropriate for middle level students, this interdisciplinary, computer-based activity teaches students about space weather as they learn how to track the development and progress of solar storms in near-real time using NASA data.

See *http://sunearthday.nasa.gov/swac* for resources to set up a SWAC in the classroom. By following the basic steps in the Instructional Guide, your class will be able to access, analyze, and record NASA satellite and observatory data. From there, students can use online resources—e.g., informational flip charts and guided data collection sheets—to transform their data into real space weather action reports.

"What Is the Aurora?" E M

The aurora borealis and aurora australis—often called the northern lights and southern lights—are common occurrences at high northern and southern latitudes. But what are they, and what causes them? A downloadable poster at *http://goo.gl/0bSIH* includes a lesson plan for grades 5–8. The poster has photos and explanatory graphics, along with information about the history of auroras and their cultural significance. The lesson challenges students to analyze data to identify the range of latitude with the highest probability of seeing an aurora and choose a location to visit to view them.

Ask a Scientist K12

K–12 teachers and students can find answers or someone who can help at NASA's Ask a Scientist portal (*http://goo.gl/5PaEZf*). Broken into different areas of expertise—Astrobiology, Astronomy, Astrophysics, Geology, Lunar Science, Physics, Solar and Heliospheric Observatory, and Space Science—this series of pages has answers to frequently asked questions and more. In addition to question archives and "how-to submit" information on each page, many pages include resources and images to help students learn more about the topic.

U.S. Geological Survey (USGS)

Water Education Posters E M

Check out a collection of downloadable water education posters from the USGS and South Atlantic Water Science Center. The cartoon-style posters address nine water-related topics: coastal hazards, watersheds, hazardous waste, wetlands, water use, wastewater, navigation, groundwater, and water quality. Each poster features an illustration on the front and related hands-on activities on the back.

The collection has color versions for elementary (grades 3–5) and middle levels (grades 6–8), along with black-and-white versions that K–5 students can color. See *http://goo.gl/5Th2Rg*.

National Institutes of Health (NIH)

Medical Imaging App H HE

Understanding Medical Scans, an app from the National Institute of Biomedical Imaging and Bioengineering (NIBIB), shows what to expect during a medical scan and how scans can help with both diagnosis and treatment. With question-based navigation, images, and videos, the app makes medical imaging information easily available anywhere, including the classroom. High school educators can use the app in anatomy and physiology or biology classes to teach about five different imaging technologies (PET, CT, MRI, Ultrasound, and X-ray) and how they work. The app also has updates on NIBIB-funded imaging research, such as efforts to design child-friendly MRI tools and decrease radiation. With versions for Apple and Android products, the app is available at *http://goo.gl/ezV6q5*.

Findings Magazine H

High school students can meet diverse scientists who do cutting-edge research and lead interesting lives via *Findings,* the National Institute of General Medical Sciences' magazine for budding biologists. *Findings* also includes research highlights, puzzles and activities, and online extras. For example, the latest issue profiles molecular biologist Rebecca Heald, who envisions 50-pound frogs—and characterizes the developmental factors that control body size in animals—and cell biologist Enrique De La Cruz, who teases out how a super-strong cellular fiber called actin can break so easily. Research highlights describe a virtual reality program designed to relieve pain from burns; the promise of gene therapy for glaucoma; what researchers know—and don't know—about how general anesthetics work; and more.

Visit *http://goo.gl/oNSGwu* to request a single print copy of the issue; classroom sets (30 copies) are available only to educators. Previous issues of *Findings* may be read online.

National Drug and Alcohol Facts Week M H

Every year, NIH's National Institute of Drug Abuse and National Institute for Alcohol Abuse and Addiction team up for National Drug and Alcohol Facts Week (NDAFW). This series of educational events taking place January 22–28 connects teens and scientists to share facts and meaningful conversation about substance use and addiction. The event provides middle level and high school students with accurate information to help counteract myths about drugs and alcohol. Events occur at locations nationwide in schools, health centers, and other community venues. Last year, more than 2,100 events took place nationally and in 17 countries.

Access the NDAFW website (*http://goo.gl/OZJAgh*) for educator resources for planning and promoting events, including toolkits, brochures, posters, publications, and the soon-to-be-available 2018 National Drug and Alcohol IQ Challenge, an interactive quiz for students that can be shared on large screens and on mobile devices. The site also provides lessons and classroom activities that explain the effects of drug use on the brain and body. In addition, middle and high school teachers can register their classes to participate in the National Drugs and Alcohol Chat Day (held on January 22 from 8 a.m. to 6 p.m. Eastern Time). In this live event, more than 50 NIH scientists and science writers field questions about drugs and alcohol from teens. Teachers can access transcripts of previous chats to prepare for the event. ●

Share Your Ideas!

NSTA's CONFERENCES ON SCIENCE EDUCATION

Have an idea for an inspiring presentation or workshop on science education? Submit a session proposal today for...

7th Annual STEM Forum & Expo, *hosted by NSTA*
Philadelphia, PA..... July 11–13, 2018
Proposal Deadline: 12/4/2017

2018 Area Conferences
Reno, NV ..... October 11–13
Gaylord Nat'l Harbor, MD ..... November 15–17
Charlotte, NC ..... November 29–December 1
Proposal Deadline: 1/16/2018

2019 National Conference
St. Louis, MO ..... April 11–14
Proposal Deadline: 4/16/2018

To submit a proposal, visit
www.nsta.org/conferenceproposals

NSTA National Science Teachers Association

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

In Your Pocket

Editor's Note

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

November 24–30

Space Foundation's Teacher Liaison Program A

The Space Foundation invites educators who teach about space to serve as Teacher Liaisons. Those chosen receive training and resources to further integrate space in their classrooms and connect the foundation to their respective schools and districts. Liaisons also work with other space organizations, such as NASA, and get complimentary registration for and special recognition during the foundation's annual Space Symposium. Once selected, Teacher Liaisons remain active in the program as long as they meet its requirements.

Public, private, and homeschool teachers; school administrators; and informal educators in preK–20 settings are eligible. Liaisons tend to be Master Teachers who want to inspire the next generation of science, technology, engineering, and mathematics (STEM) students, but educators in any discipline who integrate space education into their curriculum may apply. Apply by **November 24;** visit the website at *http://goo.gl/HiBsPq*.

Knowles Teacher Initiative Teaching Fellowship K12

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

Applicants must be entering their first or second year of teaching during the 2018–2019 school year and have obtained a degree related to the science or math discipline they intend to teach and a valid state teaching credential, certificate, or license by September 2018. Apply by **November 26;** see *www.kstf.org/fellowships*.

Reading Is the Way Up Literacy Grants K12

City National Bank awards these grants to support literacy and financial literacy projects at public and private elementary, middle, and high schools in California, Nevada, New York, Tennessee, and Georgia. Grants provide up to $500 for recipients to create, augment, or expand literacy projects that are judged to be creative and engaging and that help improve student achievement. Awards can be used for books, videos, CDs, DVDs, computer software or hardware, or in other ways as long as the recipient shows that the project supports literacy or financial literacy and fosters creativity and critical thinking.

Applicants from the same school may apply individually or as part of a team. Each team may receive up to $1,500. Any full-time teacher, librarian, or administrator at schools in the 16 counties where City National operates may apply, though the principal or administrator must approve the project. Apply online by **November 30** at *http://goo.gl/ypuepG*.

December 1

ITEEA Prakken Professional Cooperation Award K12

The International Technology and Engineering Educators Association (ITEEA) presents this award to an individual who, through teaching, research, or professional service, has promoted the field of technology and engineering education in collaboration with other disciplines, such as science, engineering, math, and management. Nominees can be from inside or outside the field of technology and engineering education and need not be ITEEA members.

Visit *http://goo.gl/Q42oLs* for details. Submit nominations by **December 1;** access the nomination form at *http://goo.gl/227ePp*.

ITEEA's Teacher Excellence Award K12

This award goes to technology and engineering teachers in each grade band in every state who have made significant contributions to the field and to their students' success. Awardees in each state receive a one-year ITEEA membership, a plaque, and a discounted rate for and recognition at the ITEEA Annual Conference.

ITEEA members who incorporate technology and engineering in their curriculum and have been teaching for at least three years are eligible. Nominate yourself or a colleague by **December 1;** see *http://goo.gl/xRtuvt*.

AAPT's Barbara Lotze Scholarships for Future Teachers H HE

The American Association of Physics Teachers (AAPT) provides grants of $2,000 and one-year AAPT student memberships for aspiring high school physics teachers. Undergraduate students enrolled in physics teacher preparation programs at accredited two- or four-year universities, or high school seniors admitted to such programs, are eligible. Applicants should show academic promise and be U.S. citizens. Apply online by **December 1** at *http://goo.gl/pfcvF4*.

Wyland National Art Challenge K12

This competition asks students in grades K–4, 5–8, and 9–12 to submit classroom murals that celebrate conservation and promote the health of our oceans, lakes, rivers, streams, and wetlands. The winning class in each category will receive $1,000 for art supplies. At least five students in each class must also submit a drawing or painting to the individual art contest; the winner in each grade earns a $50 gift certificate for art supplies, and one high school junior or senior will also get a $1,500 scholarship to attend an accredited four-year college or university. Students can also enter the individual photo contest for a chance to win a new camera or a college scholarship.

See *http://goo.gl/WZ3xpG* to submit class and individual entries by **December 1**.

FTEE Undergraduate Scholarship HE

The Foundation for Technology and Engineering Educators (FTEE) provides this $1,000 scholarship to an undergraduate student majoring in technology and engineering education teacher preparation. Applicants must be enrolled full-time, be ITEEA members (membership fee can be sent with the scholarship application); and not be a senior when they apply.

Postmark applications by **December 1.** See *http://goo.gl/VTtdGY*.

Maley/FTEE Scholarship for Technology and Engineering Teacher Professional Development A

FTEE provides these $1,000 scholarships to technology and engineering teachers at any grade level who are beginning or continuing graduate study. Applicants must be ITEEA members and provide plans for graduate study and action research, along with documentation of their acceptance to a graduate program. Postmark applications by **December 1;** see *http://goo.gl/me9hV5*.

Safer Brand School Garden Grant K12

This $500 grant goes to one K–12 school wishing to develop or maintain a fruit, berry, vegetable, flower, or hydroponic garden to bring classmates together and promote better health. Applicants submit a 50- to 300-word essay describing their garden and how it will benefit students, along with photos of the

garden location. Apply by **December 1.** Visit *http://goo.gl/vaVwYS.*

December 15–31

NAGT Outstanding Teaching Assistant Awards HE

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

Both graduate and undergraduate TAs are eligible. Awardees must be nominated by the department chair or faculty member who coordinates TAs. Submit nominations by **December 15** at *http://goo.gl/Li3jKi.*

Paul DeHart Hurd Award M

The National Middle Level Science Teachers Association (NMLSTA), an NSTA Affiliate, offers this $1,000 award to a middle school science teacher who has demonstrated leadership in sharing his or her skills and ideas with others. The awardee receives a cash prize, a one-year NMLSTA membership, and a plaque. The award will be presented the following calendar year at the NMLSTA Share-a-Thon, held during NSTA's National Convention.

Applicants must be NMLSTA members and full-time middle school science teachers with at least three years of teaching experience. Entries must be postmarked by **December 15.** Consult *http://goo.gl/hv8t4Z.*

The Follett Challenge K12

This challenge rewards top-notch educators in the United States and Canada who teach 21st-century skills. Entrants create a three- to five-minute video that showcases how their programs teach critical thinking, communication, creativity, and collaboration in innovative ways. A panel of education thought leaders and the public will vote on the best entries. One grand-prize winner will receive $60,000 worth of Follett School Solution products and services; three semifinalists—one elementary, one middle, and one high school—will win $30,000; and 10 People's Choice winners will receive $8,000.

Teachers, technology specialists, administrators, librarians, and media specialists at K–12 schools are eligible. Submit entries by **December 15.** Refer to *www.follettchallenge.com.*

Air Force Association Educator Grants K12

The Air Force Association provides these $500 grants to promote aerospace education in K–12 classrooms. Projects should include innovative aerospace activities within the prescribed curriculum that significantly influence student learning. A limit of one grant per teacher, and up to two per school, are available. Apply by **December 15.** Visit *http://goo.gl/BdrsrL.*

NSHSS Educational Conference Registration Grants H

These $1,000 grants help high school teachers and counselors attend educational conferences. Funds can be used for conference registration, travel, and accommodations. Those working at public or private schools in the United States or abroad who have registered with the National Society of High School Scholars as an "Educator" are eligible.

Register online by **December 15** at *http://goo.gl/GhgKq5.*

United States-Japan Foundation Pre-College Education Grants K12

These grants support K–12 projects that help American and Japanese students learn about each other's society, culture, and country and work together on common concerns. The foundation welcomes Letters of Inquiry anytime, but no later than **December 15** for the spring grant cycle. Consult *http://goo.gl/HprQHo.*

Katie's Krops Start a Garden Grants E M H

These grants help youth ages 9–16 start a vegetable garden in their community and donate their harvest to people in need. All types of gardens are eligible, from urban container gardens to school or neighborhood vegetable gardens. Grantees decide what kind of garden to grow and where to donate their harvest.

Those chosen receive gardening supplies, a gift card for a local garden center, growing manuals, and support from Katie's Krops, but should be committed to maintaining their garden season after season. Grants to attend Katie's Krops Camp and scholarships are also available. Postmark applications by **December 31.** Visit the website *http://goo.gl/6CpKmb.* ●

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

Summer Programs

Editor's Note

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

NOAA Teacher at Sea Program A

This program sends preK–college teachers, museum and aquarium educators, and adult education teachers to sea aboard National Oceanic and Atmospheric Administration (NOAA) research and survey ships. Participants conduct fisheries research, oceanographic research, or hydrographic surveys, guided by NOAA scientists. Following their voyages—which range from one week to one month—teachers bring the research and knowledge they've gained back to their classrooms.

Though most educators sail over the summer, trips are available year-round. Applications are due by **November 30.** For more details, visit *http://teacheratsea.noaa.gov.*

MSSEF Teaching Science Through the Inquiry Process M H

The Massachusetts State Science & Engineering Fair (MSSEF) offers this hands-on course to help educators better integrate inquiry into their current teaching practices and curricula. Participants bring existing labs or activities and make them more inquiry-based. The program takes place July 30–August 3 and November 3 in Massachusetts (location to be determined).

Three graduate credits and scholarships are available. Teams of teachers and those in high-needs or underperforming schools receive priority. Apply for a scholarship by **March 1** and register by **July 15** at *http://goo.gl/EY682A.*

MSSEF Project-Based Classroom Science E M H

This hands-on course helps educators develop project-based units for targeted science concepts and introduces them to guiding students working on independent research projects. Teachers will design project-based science activities that connect to Massachusetts state standards. The program takes place August 6–9 and November 3, with an additional 10 hours online. The course will be held in Massachusetts (location to be determined).

Two graduate credits and scholarships are available. Teams of teachers and those working in high-needs or underperforming schools will receive priority. Apply for scholarships by **March 1** and register for the course by **July 15** at *http://goo.gl/x7BUja.*

MSSEF Guiding Research and Innovation Projects by Students E M H

This course provides best practices for teachers who are guiding students doing independent student research for science fairs and who want to build district-based support for them. Teachers will learn how to help students explore their own curiosities about the world while developing the 21st-century life skills science fairs require. The program takes place August 9–10 in Massachusetts (location to be determined).

One graduate credit and scholarships are available. Teams of teachers and those working in high-needs or underperforming schools receive priority. Apply for a scholarship by **March 1** and register for the course by **August 1** at *http://goo.gl/sjFhtX.* ●

Energize Your Classroom

Free Workshop for Middle and High School Teachers !

Learn how to facilitate low cost, simple labs and experiments using everyday materials.

Physical Science | Chemistry | Engineering | Industrial Technology

For more information: asmfoundation.org
800.336.5152 ext. 5533

MATERIALS CAMP®
ASM MATERIALS EDUCATION FOUNDATION

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

We're thankful for science teachers!

NSTA books are so concise that they will assist me as I continue to integrate the Standards into my courses. Students benefit when teachers are using well-defined objectives for their courses.

– NSTA Press Reader Jane K.

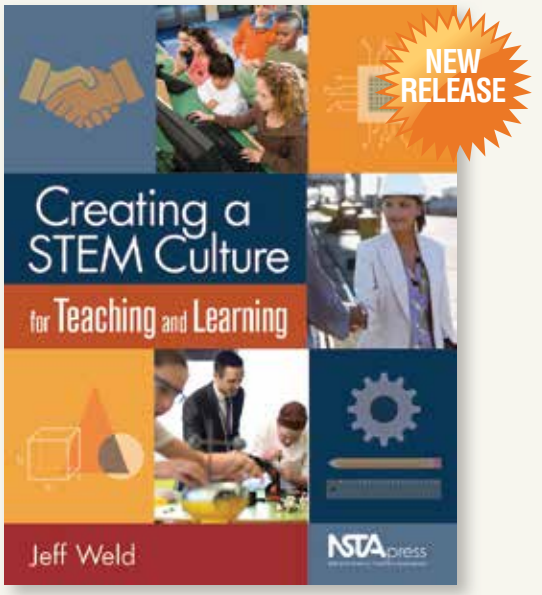
SAVE $15

on purchases of $75 or more with promo code **NOV17** between November 1–30, 2017

Offer valid only on orders placed of NSTA Press books and NSTA Kids books to U.S. addresses. May not be combined with any other offer.

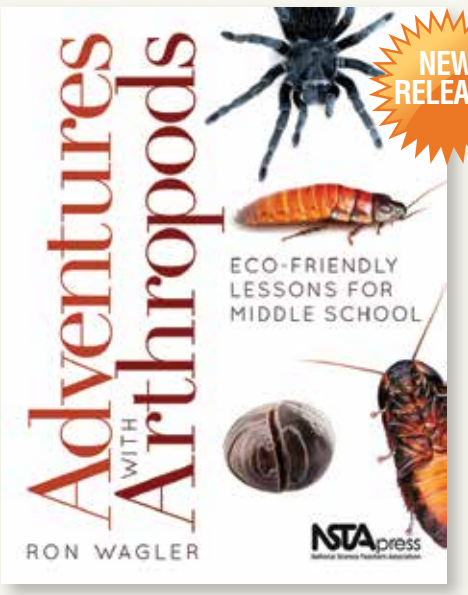
Grades 3–5

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 K–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 6–8

Book: Member Price: $18.36 | Nonmember Price: $22.95
E-book: Member Price: $13.77 | Nonmember Price: $17.21
Book/E-book Set: Member Price: $22.03 | Nonmember Price: $27.54

Grades 9–12

Book: Member Price: $35.96 | Nonmember Price: $44.95
E-book: Member Price: $26.97 | Nonmember Price: $33.71
Book/E-book Set: Member Price: $43.15 | Nonmember Price: $53.96

To place an order or download a free chapter, visit

www.nsta.org/store

NSTA National Science Teachers Association

Context Makes Science More Accessible

By David Crowther, NSTA President 2017–18

The U.S. population is changing rapidly as it grows. The subset population who are English Language Learners (ELLs) is increasing in classrooms across the nation. According to the National Center for Educational Statistics (NCES 2017), 4.6 million ELLs accounted for 9.4% of the total K–12 student population in the United States in the 2014–2015 school year. This is a sustained increase from the 2004–2005 school year, when 4.3 million ELLs comprised 9.1% of the entire K–12 student population (NCES 2017).

Research is burgeoning with ways to aid students in academic achievement, as well as to prepare and educate teachers on how to best work with growing diversity. Language plays a significant role in learning math and science, yet using scientific language is the principal barrier to conceptual understanding for ELLs. The language of science is highly complex and requires, in many settings, precise understanding of a specialized vocabulary to carry out common scientific tasks. Most general vocabulary research focused on second language acquisition recommends that teachers use a Direct Instruction (DI) approach and advocates frontloading the majority of technical words to provide students with the vocabulary before most content instruction (Short, Vogt, and Echevarria 2011; Guided Language Acquisition Design 2008).

However, some science, technology, engineering, and mathematics (STEM) researchers have been advocating for a different approach to developing academic vocabulary for some time: not just for ELL students, but for *all* students. Since the 1960s, they have pushed for science to be taught through an inquiry approach, changing from a "frontloading" behaviorist method to a constructivist "contextualized" approach to teaching academic vocabulary.

This "contextualization" in science education capitalizes on discourse in learning science. Scientific discourse is basically "sensemaking" of phenomena. *The Framework for K–12 Science Education* (2011) describes this as a natural process for students in both formal and informal education. However, the *Framework* notes, "Many students from lower socioeconomic strata enter formal schooling with smaller academic vocabularies," and the discourse patterns commonly used in most U.S. schools are often found in middle and upper socioeconomic status (SES) homes. The *Framework* further elaborates that for diverse students in lower SES and high ELL populations, "traditional classroom practices function as a gatekeeper, barring them because their community's sensemaking practices may not be acknowledged," and that "language and discourse patterns vary across culturally diverse groups." The *Framework* also states the "importance of accepting, even encouraging, students' classroom use of informal or native language and family modes of interaction."

Scientific discourse is essential in developing both content and academic language. In 2013, Okhee Lee, Helen Quinn, and Guadalupe Valdés argued, "The classroom culture of discourse must be developed and supported. Teachers need to ensure that all voices are respected, even as the process reveals limitations of a model or explanation, or 'flawed' use of language. For all students, the emphasis should

Enhanced E-books
SIMULATIONS • ASSESSMENTS • VIDEOS

Whether you're learning science content for the first time or you just need a refresher, NSTA's highly interactive and engaging Enhanced E-books are full of dynamic features that enable you to learn science content and pedagogy. Simulations, animations, and video bring content to life, while embedded review questions and special notes help underscore the most crucial points of knowledge.

Member Price $23.96
Non-member Price: $29.95

Discover the ultimate professional learning experience:
www.nsta.org/ebooks

NSTA eBooks+
National Science Teachers Association

be on making meaning, on hearing and understanding the contributions of others, and on communicating their own ideas in a common effort to build understanding of the phenomenon or to design solutions of the system being investigated and discussed."

When students experience phenomena first, then construct knowledge using their own words to describe the phenomena, they do so within their own cultural context using words accessible to them. Students then participate in class activities that emphasize the Science and Engineering Practices (Asking questions; Constructing explanations; Engaging in argument from evidence; and Obtaining, evaluating, and communicating information) that lead to developing language. When children are engaged in discourse—be it student to student or teacher to student—teachers can model and scaffold scientific discourse that better describes the phenomena through a natural process. The emphasis is not on providing explicit vocabulary instruction, but rather on using experiences to help develop discourse that explains the phenomenon.

The WIDA Consortium, which includes 39 U.S. state education agencies, has developed some great strategies to help improve scientific discourse in K–12 classrooms. Researchers funded by the National Science Foundation developed two sets of discourse strategies: Teacher to Student and Student to Student. Teacher to Student strategies include ways to help students clarify their thoughts, make their ideas public, emphasize an idea, listen carefully and react to others, deepen their reasoning, and apply their own thinking to other ideas. Student to Student strategies include how to clarify someone else's ideas, restate or summarize another's ideas, compare ideas, build on someone else's idea, question or challenge an idea, and state and explain an idea.

NSTA is helping to disseminate these strategies by including sessions presented by WIDA at our area and national conferences. For more details about these strategies and how they can be implemented into the classroom, download the January 2017 issue of WIDA's *STEM Discourse: Strengthening Reasoning, Strengthening Language* newsletter at *https://goo.gl/CcJMjU*. ●

Everything **teachers** need for **science labs** on one convenient website.

CYNMAR®
an Emersive Learning Company
www.cynmar.com
1-800-223-3517

Quotable

Creativity is so delicate a flower that praise tends to make it bloom, while discouragement often nips it in the bud. Any of us put out more and better ideas if our efforts are truly appreciated.

—Alex Faickney Osborn, U.S. advertising executive (1888–1966)

BLICK ON FLICKS

Leap–ing Into Science

By Jacob Clark Blickenstaff, PhD

The late 19th century was a busy time in science and engineering in Europe. Physicists were developing an understanding of electricity and magnetism, *The Origin of Species* was transforming biology, and railroads were making transportation of people and materials easier than ever. In Paris in the 1880s, Gustav Eiffel created two monuments that remain icons to this day: the Statue of Liberty and the Eiffel Tower. These two works provide a backdrop for action in the animated film *Leap!* (2016), starring Elle Fanning and featuring Mel Brooks.

The story focuses on a young orphan, Felicie, who dreams of dancing while she cleans the rural orphanage that is her home in Brittany. Felicie's best friend Victor is a tinkerer and inventor. Together they escape from the orphanage (using an early prototype flying machine) and make their way to Paris: Felicie to find a ballet school, and Victor to become an engineer.

Felicie stumbles upon a former ballerina, Odette, and convinces her to be her mentor—and through some trickery, manages to get into a weeks-long tryout for the role of Clara in the *Nutcracker.* Meanwhile, Victor finds a way to get an apprenticeship in Gustav Eiffel's workshop, where he (Victor) completes menial tasks with another young apprentice. Through hours of hard work in and out of the dance studio, Felicie becomes a skilled ballerina, but it is her passion for dance that wins the day in the final round of the audition. While Victor never seems to have any direct interaction with Eiffel, he is able to build a successful flying machine, which he uses to save Felicie in the end.

I am a bit frustrated by the stereotypical gender roles in the movie: The girl dreams of dancing ballet, and the boy of building machines. Perhaps this film should be followed by watching *Billy Elliot* (2000) and the *Ghostbusters* reboot (2016) to provide alternative role models.

Although *Leap!* is not up to the standard of some other animated films I've reviewed, it offers opportunities for teachers to connect to

NSTA AREA CONFERENCE ON SCIENCE EDUCATION

JOIN US IN

NEW ORLEANS

LOUISIANA

NOVEMBER 30–DECEMBER 2, 2017

CELEBRATE SCIENCE: INSPIRE, INTEGRATE, INNOVATE

INSPIRE OUR YOUNG LEARNERS

INTEGRATE SCIENCE EDUCATION FOR ALL

INNOVATE SCIENCE EDUCATION FOR TOMORROW

FOR MORE INFORMATION AND UPDATES, VISIT WWW.NSTA.ORG/NEW ORLEANS

#NSTA17

NSTA National Science Teachers Association

the physics of dance, chemistry, and engineering design.

Impulse in Dance

In the beginning, Felicie has passion and energy in her dancing, but little control. She can jump, and turn, and slide, but tends to land heavily, and is inconsistent in her routines. Odette gives her a challenge, but provides almost no guidance: Jump up and ring a bell hanging from a tree, then land in the puddle below without making a splash. Felicie can easily leap high enough to touch the bell, but her landings cause big splashes. After many unsuccessful attempts, she realizes that landing on her toes and slowly putting her heels down will prevent the splash. This technique slows down the interaction between her foot and the ground, and spreads the force out over more time. This demonstrates the relationship between impulse and changes in momentum: By increasing the time, she decreases the force on her foot.

$$F\Delta t = \Delta(mv)$$

The right side of the equation stays constant (the change in her momentum), so if Δt gets larger, F must get smaller.

Green (With Envy?)

The Statue of Liberty was built in France and provided to the United States as a gift. The torch and right hand were completed in 1876, and used to help drum up support for the whole project. The full statue was completed in Paris in 1884 and shipped to the United States in 1885. Why should we care about dates?

The outer skin of Lady Liberty is copper, and you might think that when we see the statue in the movie, it should be the reddish brown of a copper penny. That would be true if the copper skin was new, but the arm and the head were completed years before the rest of the statue. Long exposure to air causes copper to oxidize, and the particular compound that forms a patina on copper is copper(II) carbonate hydroxide, commonly called copper carbonate. The blue-green color of the Statue of Liberty is the layer of copper(II) carbonate hydroxide that covers the whole surface. The patina helps prevent further weathering, as it is insoluble in water and resistant to acids.

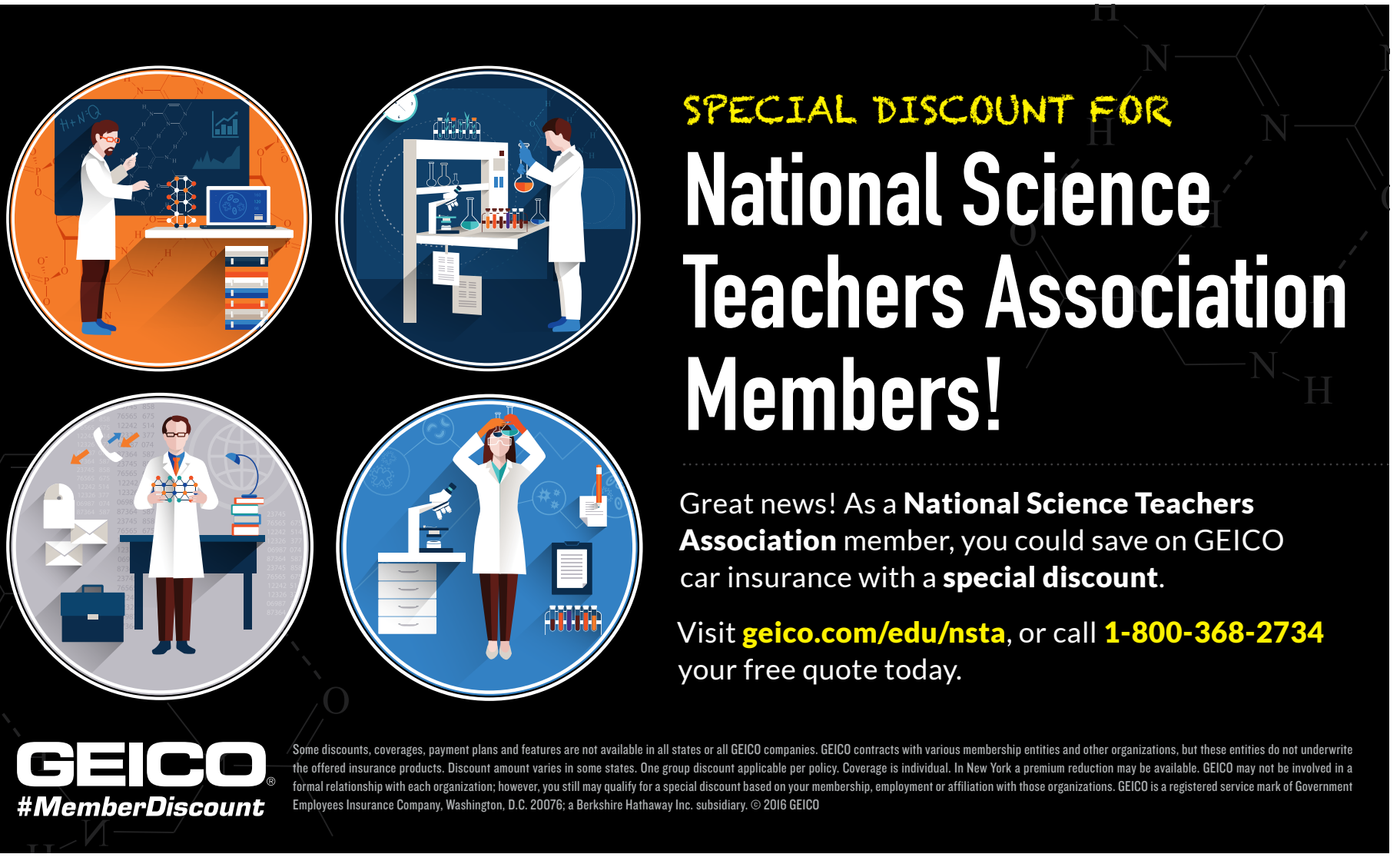
A further side note on dates: In the film, we also see the Eiffel Tower under construction, but the Tower and Statue of Liberty were not under construction in Paris at the same time. Lady Liberty had moved on to New York in 1885, and construction on the Eiffel Tower did not begin until 1887. The approximate state of completion we see in the movie corresponds to about 1888. I guess Eiffel only had so many hours in the day to work on major monuments, and couldn't do both at once, despite what we see in *Leap!*

Design Challenge

Early plans for the Statue of Liberty called for a stone core to hold up the metal outer shell. Eiffel recognized how massive that stone tower would be, and that a foundation to hold that up would be a real problem. He revised the plans and made Lady Liberty an early "curtain wall" construction. The statue's outer shell is hung on a metal framework; it does not carry the load of the statue above. This contrasts with earlier methods used in cathedrals and castles in which the walls hold up the whole building. Steel-lattice curtain-wall construction is how virtually all high-rise buildings are designed even today.

Teachers who want to engage younger students in a discussion of engineering, chemistry, or physics could use scenes from *Leap!* to get kids excited and engaged.

Jacob Clark Blickenstaff is a senior program officer for Washington STEM in Seattle. Read more Blick at http://goo.gl/6CeBzq, *or e-mail him at* jacob@washingtonstem.org.



NSTA District Professional Learning Packages

The National Science Teachers Association (NSTA) inspires teachers with innovative instructional strategies while reaching beyond traditionally designed workshops. NSTA's authors and expert trainers are available throughout the year to bring these classroom-tested approaches to your school or district.

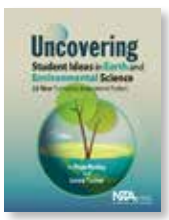
Partner with NSTA to take professional learning days to the next level. Using a blended approach, NSTA combines a face-to-face component with additional online opportunities to extend learning. Implementing this approach promotes sustained change in classroom practice. NSTA offers tailored packages of books and workshops on popular topics—for schools, districts, or states!

- Keynote Presentations
- One- and Two-Day Workshops
- Train-the-Trainer Opportunities
- Online Options: Web Seminars, Virtual Conferences, Book Studies, and more

Authors of the books below are available throughout the year to bring these classroom-tested approaches to your school or district. For more information on professional learning opportunities and grant partnerships, please contact Kim Stilwell at 703-312-9247 or *kstilwell@nsta.org*.

Connect science and literacy in the elementary classroom with the popular *Picture-Perfect Science* teaching style.

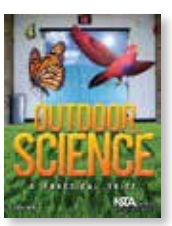
Take a deep-dive into three-dimensional instruction and science standards.



Capture the vision behind the *Uncovering Student Ideas* books and learn everything you need to know about using formative assessment probes.

Get training on the innovative approach to lab instruction that forms the core of the *Argument-Driven Inquiry* series.

Harness the natural curiosity of elementary students with the powerful practices of questioning, investigation, and assessment.



Introduce your colleagues to the concepts of *Outdoor Science*. Learn how to create outdoor learning spaces with little extra effort or resources.

NSTA
DISTRICT PROFESSIONAL LEARNING PACKAGES

Learn more about NSTA's District Professional Learning Packages at ***www.nsta.org/district.***
©2017 NSTA Tel: 703-312-9247

Upcoming Training Opportunities

Picture-Perfect STEMposiums

San Bernardino, CA
November 1–2

Learn more at
www.nsta.org/district/pps.aspx

Discover the NGSS Train-the-Trainer Workshops

Milwaukee, WI
November 10–11

New Orleans, LA
December 1–2

Learn more at
www.nsta.org/conferences

NGSS Administrators Institute

Los Angeles, CA
November 15

Monterey, CA
November 17

Learn more at
www.nsta.org/conferences/ngss4.aspx

Picture-Perfect Science Online Course

Winter Course Dates:
Wednesdays at 7:00 p.m.
January 31–March 7

Learn more at
www.nsta.org/district/pps.aspx

"I left the workshop having a deeper understanding and confidence in using the practices and cross-cutting concepts. I am excited to further dive into the NGSS."

Past NGSS Summer Institute Participant, Naperville, IL

NSTA PRESS: *Eureka! Grade 3–5 Science Activities and Stories*

Scientists and Engineers Are Imaginative

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 Eureka! Grade 3–5 Science Activities and Stories, *by Donna Farland-Smith and Julie Thomas, edited for publication here. To download the full text of this chapter, go to* https://goo.gl/QYKG9Q. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Lesson: Starlight—Light From the Sun

Description

Students will learn about how scientist Annie Jump Cannon observed variations in the brightness of stars and explored behaviors of light from the Sun.

Objectives

Students will consider how the character trait of being imaginative helped Annie Jump Cannon develop a classification system for stars and explore the nature of reflected light.

- Before starting the lesson, students will make a two-dimensional (2D) foldable model of their place in the solar system.
- As a class, students will make a model to show the position of Earth and the solar system within the Milky Way galaxy.
- Students will hear the story *Annie Jump Cannon, Astronomer* by Carole Gerber and discuss how it relates to the word *imaginative*.
- Students will explore the behaviors and benefits of luminous and reflected light.

Overview

In this lesson, students learn how Annie Jump Cannon invented a model for classifying stars based on the stars' temperatures and shared her classification system with others in her science community. This challenged the way people thought about female astronomers. Through the featured book, students learn that men and women from all backgrounds choose careers as scientists and engineers. The character trait *imaginative* references Cannon's meticulous and creative attempts to organize the starlight behaviors she observed. Students also share ideas about women being scientists. In the hands-on exploration, students explore the nature of reflected light.

Materials

You will need a supply of 9 in. × 14 in. or 8.5 in. × 11 in. colored paper in seven colors, enough for one color set for each student, and one copy of *Annie Jump Cannon, Astronomer*, by Carole Gerber. Each group of students will need one rock, a cup of water, a piece of aluminum foil, a piece of white paper, and a small plastic bag. Each student will need a set of colored papers, a glue stick, his or her science notebook, a flashlight, safety glasses or goggles, and a small acrylic mirror (e.g., 3 in. × 5 in.). *Note: Acrylic mirrors minimize the safety risks of glass mirrors.*

Safety Notes

(1) Personal protective equipment should be worn during the setup, hands-on, and takedown segments of the activity. (2) Immediately wipe up spilled water: It creates a slip-and-fall hazard. (3) Wash hands with soap and water upon completing this activity.

Setting the Context

Engage

Ask students whether they have wondered how humans fit in the universe; that is, where we are relative to galaxies, the universe, and the solar system. Ask, "Which is larger, a galaxy, the universe, or a solar system?" Help students build a model of the universe so they appreciate how they actually fit into it.

1. Before class, prepare the colored paper sets for students, planning for all students to create their stacks in the same color sequence. Leave the sheets of the first color of paper whole. For each subsequent color, cut the sheet to be 1 in. shorter and 1 in. narrower than for the previous color.
2. Provide each student with one set of precut colored paper and a glue stick. Have students stack the paper sheets by descending size and glue them.
3. Help students label their models. Have them label the bottommost paper "Universe" (the outermost location in the universe model) and the topmost paper "Home" (the innermost location in the universe model). Involve students in a conversation about which colors in this model represent the Milky Way galaxy, the solar system, Earth, North America, the United States, and their state. Prompt students with questions about relative size; for example, "If the universe is the biggest, what fits inside it?" It is sometimes easier to begin with the home city and expand outward.
4. Prompt students to connect their models to the classification of the stars by asking, "Where would the stars be found?" and "How might scientists find out the temperature of a star?" Guide the discussion to the idea that collecting data about space is challenging because stars are far away.

Making Sense

Explore

Begin by holding a discussion about rainbows to help students recall their knowledge of refraction—the bending and separating of light into a spectrum of colors. Although refraction is not the lesson focus, this discussion will help students connect the lesson to Annie Jump Cannon's interest in and research about stars. Initiate the discussion by asking, "When do we see rainbows?" "What are the colors of the rainbow?" and "What causes rainbows?"

Extend the discussion to students' experience of light from the Sun and other stars. Ask, "What do we know about the light that comes from the Sun, which is one of the largest stars in our galaxy?" Encourage students to share personal experiences and observations of the nature of light from the Sun (e.g., what sunlight feels like on their skin, that sunlight passes through clouds and windows, and that blocking sunlight produces shadows). Then, inform students that they will conduct an exploration of how the Sun's light behaves when it strikes various objects. The steps of the exploration are as follows:

1. Organize students into table groups and provide each group with a rock, a cup of water, a piece of aluminum foil, a piece of white paper, and a small plastic bag. Each student will need a flashlight. Invite students to examine each item and predict what will happen when they shine a flashlight on it. Encourage students to think of the flashlight as the Sun. Guide their thinking by asking, "What will happen to the light when it hits this object?" "Where will the light go?" and "Will the light rays pass through, be blocked, or be reflected?" Have students record their predictions in their science notebooks; encourage them to create a chart so they can record both their predictions and their test results. Then, allow some time for students to use their flashlights to test their predictions.
2. Have students work in pairs. Provide each pair with a flashlight and a small acrylic mirror. Begin with the guiding question, "What happens when the Sun's light reflects off a mirror?" Prompt students to think of their flashlight as the Sun, and invite them to work together to observe what happens when they shine their flashlight on the mirror. They should easily observe a reflected light beam if they lay the flashlight on the table and shine it into a mirror held perpendicular to the table so that some of the light spills onto the table. Once they recognize the line of reflected light, ask, "How can you change the line of reflected light?" Challenge students to record their data by creating three diagrams in their science notebooks. Each diagram should include an arrow to show the direction of the reflected (outgoing) light. ●

ASK A MENTOR, **Advice Column**

Starting Clubs, Creating Tests, Surviving the First Year

Wow, do I have big shoes to fill! Mary Bigelow is stepping down as NSTA's original Ms. Mentor after years of advising teachers across the globe. She has demonstrated a noteworthy commitment to helping the science teaching community with thoughtful, sage advice on a vast array of topics. And now I'm taking over. Wow!

As I started writing my initial blog posts, I was reminded of my first day of teaching. The science department head (and my former biology teacher!) put his arm around my shoulders and said, "Now that you're here, you'll really learn how to teach." In my guided tour of the inner workings of the school, he pointed out everyone's filing cabinets in the science prep area. "In here, you'll find everything you need: tests, labs, assignments, diagrams, notes. If you can't find something, just ask! We're here to help."

I immediately felt a sense of community as I embarked on my career. From this initial exchange, I took up the torch and committed myself to sharing, mentoring, running workshops for, and supporting my colleagues in any way I can.

Now that I have retired, writing an advice column feels like a natural progression in my journey as a science educator. I just hope that I can reach the standard set by Mary and provide you with advice that will be helpful on your own journey in our teaching community.

Kindest regards, and…just ask! I'm here to help.

—Gabe Kraljevic

I would like to contribute to the extracurricular activities in my school, but I'm not sure what I can do. Do you have any suggestions?

—T., Pennsylvania

Some of my most rewarding teaching experiences often centered on extracurricular science clubs. A club's appeal (for the teacher and students) is that it is not a formal class with the burden of marked assignments, reports, and so on. In general, you will get a natural grouping of people who at least are interested in the same thing. It is also a place where students who don't want to participate don't have to.

Clubs can have specific goals: robotics; high-altitude ballooning; science fairs. Others can be more open-ended and allow the students to choose their directions, such as Science Olympics or Enquiring Minds, for example.

I think the trick to a successful club is to pick something you are truly interested in. Second, don't feel that you have to be the expert! Let the students have a say and help run things. I ran robotics clubs for years, and when students asked me how to do something, I would say, "I don't know, I've never built a robot before! Where do you think we can go to find out?" Use the club as a shared learning experience in which students will see you as a learner and can feel that they can make significant contributions. A club is also a low-risk environment for making mistakes during the learning process.

I'm starting to plan some formal assessments, but because it's my first time, I'm not exactly sure if I'm creating a test correctly. Do you have any advice?

—L., Nebraska

The notion of a fair test is an important tenet in science, and we strive to teach our students how to develop unbiased data collection for the purpose of making sound conclusions about phenomena. This should also extend to the science teacher: developing fair, unbiased assessments that allow you to make a sound conclusion about what your students have learned. I offer just a few ideas on formal assessments that I have used and a few suggestions to help you along:

- Try to build some success for all your students. Work from easy to hard questions.
- Fill-in-the-blanks—Place the blank at the end of the sentence.
- Multiple Choice: Avoid "None of the above" or "All of the above."
- Assessments should not be a punishment. This includes "snap" quizzes.
- Don't surprise students with questions completely different from what they have seen before. (I can discuss exceptions to this in another blog post.)
- Don't try to trick students with double negatives, complicated wording, etc.
- Set one copy of a test aside to take notes on how the test went: mistakes, ambiguous wording, etc. Fix mistakes as soon as possible, or you'll forget. Record how long it took for the first, median, and the last tests to be handed in, and adjust the length accordingly.

CAMERON MACINTOSH, CBC

Students prepare to launch a high-altitude balloon with a science payload.

I'm a new teacher, and I can't believe how ragged I feel: I seem to be just barely ahead of the class. I have lessons that are not working as planned, and I feel like I'm just running around nonstop. Please help!

—W., Virginia

Your feelings are probably no surprise to anyone in the first months of teaching: This job is tough! You may often feel you have two types of lessons: those that bomb, and those that bomb *big*!

Here are some survival tips:

- Colleagues: They have done it before; they know the school; they know the students. Develop good relationships, and don't be afraid to ask for help. Discuss procedures and protocols that "everyone knows," but aren't written down. Talk to your colleagues about grading and the time you can expect to spend on it and other tasks.
- Calendar/Daybook: Use it faithfully. Don't be surprised by deadlines and meetings.
- Transitions: Moving from one activity to another in class is when breakdowns can occur. Take time to plan how you will distribute materials. Plan your student groups.
- Cleanup: Don't do all the cleanup yourself! Allow time, and enlist your students' help. Don't let them leave until the room is ready for the next class. (Stand at the door and point, "That beaker is not where it should be;" "Those paper towels need to be in the garbage.")
- Venting: Talk to someone when you have a bad day. Find a confidant and have a rant, then don't dwell on it.

Check out more advice from Ask a Mentor on diverse topics or ask a question at www.nsta.org/mentor.

#onlyatNSTA

#onlyatNSTA can you boost your career and have a positive impact on science education at the national level by serving on a standing committee, advisory board, or panel.

We need your views and your expertise.
Apply by December 4, 2017.

Visit this link for details:
www.nsta.org/about/governance/standingcommittees.aspx

Share your #onlyatNSTA moments with us on Twitter @NSTA

Learn about all your membership benefits
at *www.nsta.org/membership*

NSTA National Science Teachers Association

The NSTA Learning Center

High quality interactive content for K–12 science teachers

Earn graduate credits and advanced degrees

Affordable and user-friendly

Moderated by world-renowned faculty

Gain knowledge specific to your area of instruction

American Museum of Natural History

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

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.

Montana State University – Bozeman

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

University of Nebraska

Four campuses, 100+ online programs including Biology, MS; Science for Educators Specialization, MAS; and Science/Math Education, MS Ed. Experience the same rigor, faculty, and support you expect from a leading university. Learn more: online.nebraska.edu

Unity College

Unity College offers an online Master's in Professional Science (MS), providing the training and credentials to advance in your career path. Students choose from two concentrations: Sustainability Science and Sustainable Natural Resource Management. Teachers earn CEUs for undergraduate and graduate courses.

NSTA Virtual Conferences

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

http://learningcenter.nsta.org/onlinecourses

National Science Teachers Association

(All dates are deadlines unless otherwise specified.)

November 16—Discover new ways to spice up science, technology, engineering, and mathematics (STEM) lessons by **Contextualizing STEM in the Science of Food, a free NSTA Web Seminar.** Follow food's journey from the farm through processing to the market and the various effects of STEM along the way. The session will run from 6:30 to 8 p.m. Eastern Time (ET). For more information on NSTA Web Seminars or to register, visit *http://goo.gl/J9oapc.* This seminar is underwritten by the National Agriculture in the Classroom Organization and the National Center for Agricultural Literacy.

December 1—NSTA's peer-reviewed journal for high school science teachers, ***The Science Teacher*** (*TST*), is accepting manuscripts that explore teaching strategies and classroom activities to develop critical-thinking skills, an important ability for all students. In addition, the journal accepts articles unrelated to a theme at any time. For more information on writing for *TST,* issue themes, and more, go to *https://goo.gl/u6JTM6*. For help preparing a manuscript, see an annotated sample manuscript at *https://goo.gl/EwzlLG*.

December 1—The do-it-yourself initiative inherent in the Maker Movement offers myriad avenues to science teachers trying to incorporate engineering and design processes into the classroom. Share your best practices for including engineering challenges, 3D printing, coding, or other technology—as well as how to get funding, organize supplies, and manage these activities—with the August 2018 issue of ***Science Scope,*** NSTA's peer-reviewed journal for middle school science teachers. General-interest manuscripts, commentaries, and column submissions may be submitted at any time. Read the call for papers and access submission guidelines at *https://goo.gl/l6bNbz*.

December 4—Today's the final day to **submit a proposal for the Seventh Annual STEM Forum & Expo,** hosted by NSTA. The forum will be held in Philadelphia on July 11–13, 2018. To submit a proposal, visit *www.nsta.org/conferenceproposals*.

January 16, 2018—Don't miss this deadline to **submit a proposal** for one or more of **NSTA's 2018 Area Conferences** in Reno, Nevada; Charlotte, North Carolina; and the Gaylord National Harbor, Maryland. These conferences take place October 11–13 (Reno), November 15–17 (Gaylord National Harbor), and November 29–December 1 (Charlotte). To submit a proposal, visit *www.nsta.org/conferenceproposals*.

February 1—Submit your manuscript sharing how you teach your middle school students core ideas about the history of Earth—as well as its materials and systems, plate tectonics, and more—for consideration for the September 2018 issue of ***Science Scope*** by today. General-interest manuscripts, commentaries, and column submissions may be submitted at any time. Read the call for papers and access submission guidelines at *https://goo.gl/l6bNbz*.

February 9—Plan ahead for the **2018 NSTA National Conference on Science Education!** Register early to receive the lowest rate. NSTA and Georgia Science Teachers Association members who register by this date pay only $285 for the conference, taking place March 15–18 in Atlanta, Georgia. For more information or to register, visit *www.nsta.org/atlanta*.

March 1—How do you teach middle school students to become reflective thinkers who can understand new information and connect it to different ideas? Share your strategies with your fellow educators by submitting your manuscript for the October 2018 issue of ***Science Scope*** by today. General-interest manuscripts, commentaries, and column submissions may be submitted at any time. Read the call for papers and access submission guidelines at *https://goo.gl/l6bNbz*.

April 1—Share your best strategies for applying Newton's Third Law, constructing investigations into the factors affecting electric and magnetic forces, and more related to "**Motion and Stability: Forces and Interactions"** for the November/December 2018 issue of ***Science Scope*** by today. General-interest manuscripts, commentaries, and column submissions may be submitted at any time. Read the call for papers and access submission guidelines at *https://goo.gl/l6bNbz*.

April 16—Today's the final day to submit a proposal for the **2019 NSTA National Conference in St. Louis** (April 11–14). To submit a proposal, visit *www.nsta.org/conferenceproposals*. ●

Index of Advertisers

National Science Teachers Association
1840 Wilson Boulevard
Arlington, Virginia 22201

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

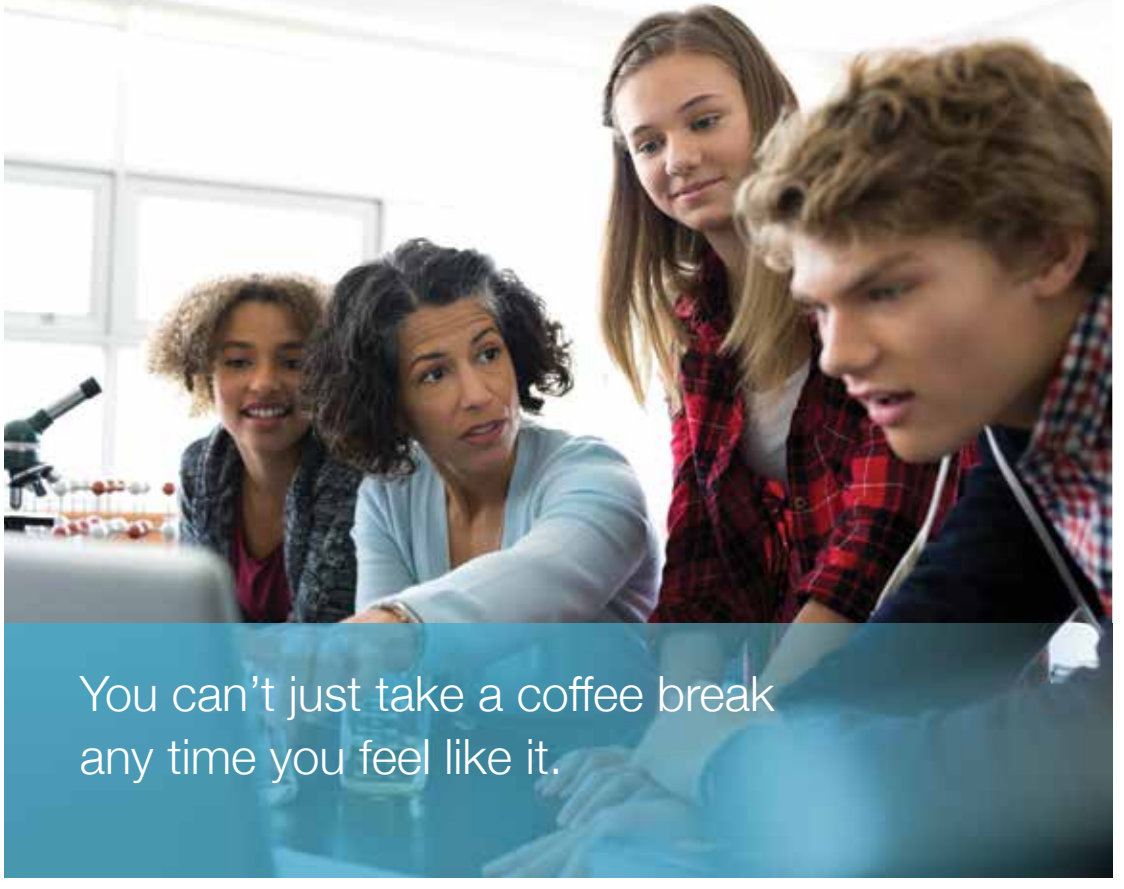
NSTA Awards Seek Exceptional Science Educators

From informal to elementary, NSTA has been recognizing teachers who make a difference in science education for more than four decades. The annual NSTA Awards and Recognition Program presents 18 educator awards and one student award.

NSTA awards include the Faraday Science Communicator Award, Maitland P. Simmons Memorial Award for New Teachers, Ron Mardigian Memorial Biotechnology Explorer Award, Robert E. Yager Exemplary Teaching Award, Robert H. Carleton Award, Sylvia Shugrue Award for Elementary School Teachers, and the Wendell G. Mohling Outstanding Aerospace Educator Award. Entries will be judged by a panel of professional science educators. Recipients will be honored at a black-tie dinner during the 2018 NSTA National Conference on Science Education in Atlanta, Georgia.

All entries must be received by 11:59 p.m. Eastern Standard Time on **December 15.** Visit *www.nsta.org/awards* for more information or to apply online. No fees are required for award entries.

NSTA awards are sponsored in part by Bio-Rad, DuPont/Pioneer, Northrop Grumman Foundation, Sea World Parks and Entertainment, Shell, and Vernier Software & Technology. ●



Carolina.
Right there with you.

It can be exhausting to have to be "on" so much of the time. You have to know what's happening with each of your students, give them the information and support they need, guide their learning, answer their questions. It's hard. But it's what you do, who you are. And remember - Carolina is always here to do the same for you.

Learn more about our commitment at
www.carolina.com/withyou

CAROLINA®
www.carolina.com