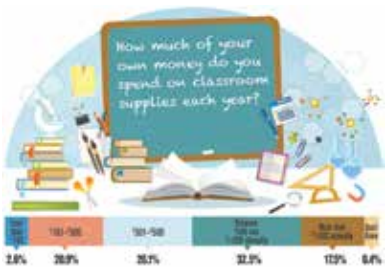

Most Teachers Paying Out of Pocket for School Supplies 6

NSTA Reports
National Science Teachers Association

***The Power of Assessing:* Guiding Powerful Practices** 18

CONTENTS

Summer Jobs for Teachers in National Parks

"I [couldn't] believe I was getting paid for this," says Eric Riemer, fourth- and fifth-grade science teacher at Park City Elementary School in Park City, Kentucky, of his experience this past summer as a National Park Service (NPS) Teacher Ranger Teacher (TRT). Riemer, who was a TRT at Mammoth Cave National Park in Mammoth Cave, Kentucky, maintains that for TRTs, "a day at the office can be really fun!"

K–12 educators serving as TRTs spend 4–6 weeks learning about the resources and educational materials available through the NPS and enhancing their teaching with NPS-based science, technology, engineering, and math (STEM) education resources and the use of primary sources and place-based learning. TRTs also take an online graduate course through the University of Colorado Denver, for which they earn three graduate credits in experiential learning, and receive a $3,000 stipend after completing the program. The graduate credits earned are in experiential learning because "the NPS has cultural resource– and natural resource–based parks, and participating teachers have science and social studies backgrounds. We needed a course that is relevant to both fields," explains Linda Rosenblum, the program's national coordinator.

TRT benefits STEM teachers because "they can develop relationships with parks in their geographic area, learn about educational programs for students, and engage with real-life scientific data," she contends. Teachers and students can do citizen science activities, "gathering data a park can use in an ongoing resource management program" that involves monitoring climate change, wildlife, water quality, weather patterns, and other scientific areas, says Rosenblum.

RANGER TYLER STONE

At Paterson Great Falls National Historical Park in Paterson, New Jersey, students work on a physics activity as part of Batter Up!, an event—developed by TRT Christine Gish and colleagues at Paterson's JFK High School STEM Academy—that incorporates science activities to teach about the Negro Baseball Leagues.

Educators can learn more about the program by visiting the website at *http://teacherrangerteacher.org* and see *www.nps.gov/teachers* for content created by TRTs, according to Rosenblum.

Incorporating *NGSS*

As a TRT, Riemer says he worked "to correlate *NGSS* [*Next Generation Science Standards*] with environmental education programs offered both at [Mammoth Cave] and in schools across the region." He led summer camps for elementary and middle level students at the park. "We did a lot of cool activities and went in the cave almost every day… We did cave surveying using [tools like] inclinometers and compasses to find points in the cave and see how [scientists] map caves," he reports.

"I learned more tools to extend my classroom beyond the four walls," says Riemer, and appreciated "going underground when it was 100 degrees outside and feeling a sense of history, wonder, and curiosity."

See TRT, pg 2

TRT, from pg 1

Hannah VanScotter, grades 6–11 science teacher at Jefferson Montessori Academy in Carlsbad, New Mexico, was a 2018 TRT at Guadalupe Mountains National Park in Salt Flat, Texas. As part of her work there, she created a geology interpretive backpack series that teachers can use "to help students learn about the park within the park," she explains. Each of the three backpacks connects with a different trail and contains "a jump drive with hands-on activities, lesson plans, PowerPoints, and a field guide and geologist tools such as a hand lens," she relates. "Each trail is tied to a different grade level—high school, middle school, and elementary—and an aspect of *NGSS*," she adds.

The Devil's Hall trail, for example, is located along a slot canyon—a narrow canyon formed by the wear of water rushing through rock—and its backpack "teaches how a landscape can change with the effects of water," VanScotter notes. She says she appreciates that as a TRT, she was "able to be creative with the project," and the program "lets you tailor it to your background and discipline," in her case, geology.

Jennifer Taylor, former sixth-grade science teacher at Estes Park Middle School in Estes Park, Colorado, was the first TRT at Estes Park's Rocky Mountain National Park (RMNP) in 2005. Taylor says she "jumped at the chance" because as a new teacher, she "wanted to learn ways to bring project-based learning and place-based learning into the classroom."

Taylor had participated in her school's annual sixth-grade field trip to RMNP, but what she learned as a TRT "helped me make the field trip deeper and more meaningful for my students," she contends. "The students did citizen science–type fieldwork to learn about elk and monitor the impacts elk have on the park, simulating what a resource manager does."

At the end of the field trip, Taylor's students examined "six different plans to manage the park's elk population, and based on what they learned in the field,…[recommended] which one the park should [implement]," she relates. "The experience broadened students' understanding of the importance of our parks and what rangers do. [They learned] rangers help educate people, and they can also do research."

Ron Roskelly, sixth-grade science teacher at Lake City Middle School in Lake City, Tennessee, was a 2018 TRT at Obed Wild and Scenic River in Wartburg, Tennessee. Noting that Tennessee's new science standards, which support *NGSS,* will be implemented this year, Roskelly says activities like working with rangers to identify and cut down invasive tree species, helping children test water for macroinvertebrates, and learning about science careers he wasn't familiar with, such as in hydrology, "let me see the new Tennessee science curriculum in person and get hands-on experience with [it]."

In addition, the TRT online course increased his knowledge of "the history of the parks and how to preserve the area…I'm really going to buy in to [place-based education] this year," he observes.

As a TRT, Roskelly says he built relationships with the Obed community and with rangers. "I can have the rangers I met come to my class," he notes. "I want to do more outdoors and take more field trips to local parks to get students excited about science."

Integrating STEM

Teachers of other subjects also value the program. Christine Gish, special education teacher at John F. Kennedy (JFK) High School's STEM Academy in Paterson, New Jersey, was a 2018 TRT at Paterson Great Falls National Historical Park (NHP). Last year, she relates, "I became involved with a group of students and science teachers working with the NPS on an event called Batter Up! We incorporated anatomy, physiology, engineering, and history in an event to teach students about the Negro Baseball Leagues, [baseball playing], [and] integration of baseball and the Civil Rights Movement." Paterson Great Falls NHP, she adds, includes "Hinchliffe Stadium, one of the few remaining stadiums where Negro League Baseball was played."

In this summer's Batter Up! event, JFK STEM students taught younger students about anatomy and physiology as they batted balls in the batting cage, learning about "muscle movement, muscle memory, and reaction time," says Gish. For the physics portion, the younger students took turns running bases and calculated the velocity of the runs. JFK STEM students had them compare "what the [velocity was when the] average high school baseball player ran to [the velocity of] what players in the major leagues ran," she explains.

Gish hopes to develop Batter Up! into a portable classroom display that teachers and rangers can use. "The TRT program made me want to take this to the next level," she maintains. ●

COMMENTARY: **Sharon Delesbore**

Administrators: Be Intentional 'For All'

By Sharon Delesbore

Sharon Delesbore

As academic institutions strive to create stimulating learning environments where students embrace the "sciences" to become critical thinkers and ecologically productive citizens, more and more employers are recognizing they have an essential role in helping to define qualified employees for the future workforce, but several steps in between need to happen in the educational system to help bring this new cadre of scientific literates to fruition.

School district leaders and campus administrators must take the helm and realize that science instruction must be a priority for a sustainable society. Because science understanding is not assessed as frequently as math and reading—and often left out of funding calculations—its importance has been woefully negated, and our workforce is suffering from lack of qualified science-literate candidates. Even more dismal is the rarity of science-literate candidates from underrepresented populations in the global schema. This is not just about ethnicity or low socioeconomic status, but also about access, now more than ever.

Although I continue to witness our society's wavering commitment to the belief that all students are capable of science learning and pursuing a career in science, technology, engineering, and mathematics (STEM), I also see teachers who want to reach all students regardless of race and seek professional development from organizations such as NSTA to improve their pedagogy. What I do not see is an influx of campus administrators seeking opportunities to develop their capacity in science education to support their teachers.

As educators and humans in general, we tend to focus on and assist in areas in which we are strong, confident, and successful. When math or science is discussed, the common comments are "I was not good at that," or "Those subjects scare me." Many adults believe science and math are difficult subjects and transfer those beliefs to their children at an early age, inadvertently laying the foundation for barriers for their children. Combined with the negative reinforcement of little or poor experiences with science engagement, they are creating a formula for STEM evasion.

We need what I call "Administrators of Advocacy" to join the charge of science for all. This initiative can only happen by changing the mindset around STEM implementation, integration, and involvement. STEM is not just about exposing students to science, technology, engineering, and math. STEM equates to the enhancement of our students' skills when these disciplines are practiced:

Science = Critical Thinking
Technology = Engagement
Engineering = Application
Math = Processing

I hope every teacher strives to help their students acquire these attributes. I believe this goal is attainable if campus administrators don't hide from their own fears of science education.

Administrators of Advocacy can

- **S**upport teachers with funding for supplies and by providing a safe environment to conduct activities.
- **T**ake interest in the science classroom. The constant emphasis on math and reading devalues other subjects. Science can enhance all the learning skills students need to develop. With emphasis on nonfiction reading, writing, problem solving, and critical thinking, along with the use of technology to engage students, a focus on science can increase student achievement.
- **E**mpower teachers to take risks in the classroom. This is vital because opportunities "for all" come with exposure. A science-competent mindset is necessary if we want all students to experience science education. There should be no boundaries to learning based on ethnicity, socioeconomic status, or gender. All children are curious, and it is up to administrators and teachers to keep their inquisitiveness alive.
- **M**onitor for good science instruction. If teachers realize that administrators expect hands-on activities and opportunities for inquiry, then they are more likely to present all students with a rigorous curriculum of fundamental science understanding that will help all of our students excel in academia and the workforce.

So let us as administrators exert ourselves fully to establish opportunities for our teachers to help students strive to excel in science education, once and "for all." ●

Sharon Delesbore, PhD, is a campus administrator at the Ferndell Henry Center for Learning in the Fort Bend Independent School District in Sugar Land, Texas. As an avid science advocate, Delesbore serves as president of the Association for Multicultural Science Education and chair of NSTA's Alliance of Affiliates.

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Speaking Out for Science Education

By Christine Anne Royce, NSTA President (2018–2019)

Christine Anne Royce

"Together, We Advocate for Science Education" is a phrase and a message, and could be a slogan. It also represents my efforts and focus for my year serving NSTA's members as president.

In April 2017, individuals across the nation joined a symbolic movement to March for Science. Science was being attacked; this grassroots effort countered by proclaiming the importance of science in today's world. Knowing the value of science for our future and the need for science education to reach our collective potential, NSTA joined this movement as an official partner in both 2017 and this year.

While by no means was it the first time that science teachers were vocal advocates for our field, this march was the point at which one million people—including science educators—gathered worldwide to declare, "I stand for students, I stand for science." To that, I ask all to add, "Together, we stand for science education."

The need for these collective efforts in some ways is disconcerting, and in other ways, energizing and engaging. While completing some research recently, I found a statement by Morris Meister, an NSTA Past President. His words resonated with me, as they connect to the need for the March for Science and even more vocal advocates to support science and science education.

Meister wrote that "[a] world that is seething with human problems can move in unexpected directions. No one can guarantee a lasting peace. Nor can we be certain that the spirit of science, and the democratic faith with which it is entwined, will assume their rightful places in the affairs of men. Strong and strange forces are at work. They can easily negate the advances which science has made and neutralize further progress. That is why it is more important now than ever before in history that science teachers and teaching scientists speak loud and strong for the contributions they can make to civilized living. Unfortunately, our voice, if it exists at all, has been weak. It has not been heard very often, nor has it been respected. It whispers and sighs. At best, it babbles, because we lack unity."

As educators, we may feel as if our voice is but a whisper among other voices within our school, district, or state. We need to combine our voices into a common message that will allow our concerns to resonate. The individual messages we choose often center around variations of this same point: *Three-dimensional science education is a necessary and needed part of engaging and preparing our students for their future career pathways, whatever they may be.*

Engaging students in science that incorporates the three dimensions models how scientists engage in their careers. This engagement also provides valuable knowledge and practices that extend well beyond the science classroom into the students' futures. Therefore, by combining our efforts and voices, we as a community of science educators will be able to better articulate the accomplishments and needs of our students, the importance of science education as a pathway to future scientific discoveries, and the importance of a three-dimensional approach to teaching that enables students to use real-world strategies. By advocating together, we can speak out for science education.

To add some context to his quote, Meister served as NSTA President from 1946 to 1948. His article, "A Voice for Science Teachers," was published in the October 1946 issue of *The Science Teacher.* Yes, you read that correctly: 1946—more than 70 years ago. The importance of his message was obvious then, and although the problems are different, the strong and strange forces that could negate the advances of science are still present.

Meister concluded his message by dedicating "himself to the basic purposes for which we [NSTA] are organized. Among those is the continued strengthening of the voice of science teachers, so that it will be heard and respected by teachers, by scientists, and by the public." His message remains important today as we approach our 75th anniversary as an organization dedicated to promoting excellence and innovation in science teaching and learning for all.

As we remember our history, I invite each and every one of you to join me, your fellow colleagues, NSTA as an association, and others in advocating for science education by using your teacher's voice to highlight our students' accomplishments and needs, as well as to inform schools, districts, states, and our nation about the importance of science education for our future. I encourage each of you to share how "I Use My Science Teacher's Voice to…" on social media. Don't forget to tag @NSTA and #NSTA18 on Twitter or official_nsta on Facebook and Instagram. ●

Quotable

Science is a method for testing claims about the natural world, not an immutable compendium of absolute truths.

—Stephen Jay Gould, U.S. paleontologist, evolutionary biologist (1941–2002)

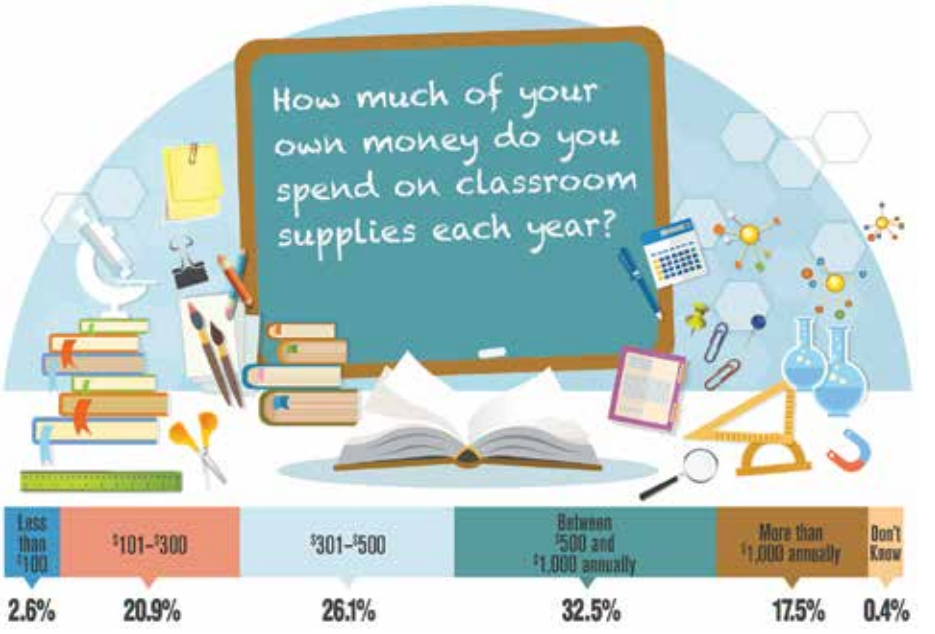
Most Teachers Paying Out of Pocket for School Supplies

As the start of the new school year approached, *NSTA Reports* asked educators about their schools' classroom supply budget and their out-of-pocket spending. In the informal poll, 54% of participants reported their school's typical classroom supply budget was less than $500 annually; 21.8% said it was between $500 and $1,000; 12.8% said it was more than $1,000; and 10.7% didn't know the amount. More than 78% said their classroom supply budget was inadequate. Only 12.8% said their classroom budgets had increased in the last year, while 47% noted budgets had remained the same, and 32.4% said they had decreased. Most (74.6%) *strongly agreed* that "it is imperative that schools find a way to increase classroom supply budgets"; an additional 23% agreed with that statement.

When asked how much of their own money they spend on class supplies each year, 32.5% said they spend between $500 and $1,000, 26.1% spend $301–$500; 20.9% spend $101–$300, and 17.5% spend more than $1,000. Nearly two-thirds of respondents (65.6%) said their classroom budgets do not allow for breakage, upgrades, chemical disposal, annual repairs, and maintenance.

Sharing supplies with other teachers was the most common strategy teachers used to stretch their classroom budgets (37.6%), 29.6% apply for grants, 20% ask students and their families to provide money or supplies, and 12.5% seek donations from businesses or nonprofits.

Teachers are seeing an impact on student learning, as 53.2% *strongly agree* with the statement, "Inadequate classroom budgets harm my students' learning." Another 39% agree.



Here's what teachers are saying about their spending for school supplies:

I figure that I paid about $40,000 of my own money in tuition to become a teacher. Spending a few thousand more to become a better teacher seems worthwhile. I could probably get more funding if I take time out of planning for teaching.—*Educator, High School, Washington*

Sometimes I need last-minute items or perishables, or items I purchase help provide students with opportunities they may otherwise not have had. —*Educator, High School, Michigan*

I know I am getting what I need at the best cost, when I need it.—*Educator, High School, Ohio*

Each year, a few of my students come to school with no school supplies. I have also donated and bought clothes for students in need. Also, a lot of engaging lessons required materials that are not typical school supplies. —*Educator, Elementary, Texas*

[I do it b]ecause my students deserve *real* labs and quality education, and I actually care about their learning. —*Educator, High School, Texas*

[I do it s]o my students have similar experiences to their more affluent peers. We have no budget in Boston. —*Educator, Middle School, Massachusetts*

Our school will only order things once a year (so in February, we have to order everything for the following year...even though we don't know our assigned classes)...With all of the interest in real-world applications, I find myself buying things from the grocery store, the dollar store, and very random places that have just the item I need for a useful lesson.—*Educator, High School, New Jersey*

[I do it b]ecause it is too much hassle to convince all the people up the chain that I need supplies, and [if] that actually happens, it is too late.—*Educator, Middle School, Maryland*

Our lab specialist (in charge of inventory) limits the supplies he distributes to teachers: Even if there is adequate supply, if you are a teacher who uses supplies a lot (paper being the most common example), he will refuse to continue to supply you.—*Educator, High School, New York*

With my performance evaluation based on student achievement, if I need it for instruction, I have to get it. And because it's more fun to do a high-quality activity. —*Educator, Middle School, Michigan*

Not enough [is] budgeted for supplies. Also, the process of having to justify new purchases to administration is sometimes not worth the headache. —*Educator, Middle School, Ohio*

Never mind lab supplies, let's talk about the fact that my classroom does not have a working projector, speakers for audiovisual learning, available seating for all 26 of my students (my lab stools are broken), [or] lab sinks with unclogged drainage systems and drain covers to keep them from getting more clogged.—*Educator, Middle School, Tennessee*

I get $150 from our school's PTSA (if I pay to join)...other than that, I have no school-supplied monies. It is the only way I can adequately support *NGSS* [*Next Generation Science Standards*] in my classroom...I love *NGSS,* but someone should have thought about *how* teachers would ever be able to implement them in a classroom with absolutely no equipment or supplies. —*Educator, Middle School, California*

My learners need books at their level, science supplies for experiments (consumables and not), and general supply items (pencils, notebooks, markers, glue, etc.) that many of my families cannot afford to buy for their learner. —*Educator, Elementary, Maine*

I teach using hands-on activities [because] students are much more engaged. I cannot imagine teaching any other way. I refuse to teach without the supplies that bring the concepts to life. I actively write grants and get donations from processing plants to individuals. —*Educator, High School, Oklahoma*

I have always spent a lot of money on my classroom supplies because I want my students to have what they need. I have retired this year, and I'm sure I will save money!—*Educator, Elementary, West Virginia*

[I do it b]ecause we do not get our instructional funds until three or four months into the year. As a new teacher, there were things that I needed that I could not wait to purchase once funds were available.—*Educator, Middle School, High School, Alabama*

I receive $200 to purchase anything and everything in my class each year from paper clips to paint to replace-

ment safety rugs in front of my door. It would be impossible to do my job without purchasing supplies. —*Educator, Elementary, California*

I do it so that I may take the supplies with me in case I end up moving to a new school or district.—*Educator, Elementary, North Dakota*

I spend the money so my students can have the best learning opportunities that I can give them. Our school does not give teachers *any* supply money. —*Educator, Middle School, Louisiana*

Kids deserve to have access to a hands-on classroom. And honestly, happy kids doing fun experiments and activities are a lot easier to manage. —*Educator, Middle School, California*

Sometimes [I do it] because it is easier, or I am too crunched for time to request a [purchase order] to try out a new idea. Other times it is because I can get something for much cheaper using a vendor not on [the] preapproved list of vendors.—*Educator, High School, Ohio*

It's often so much easier and quicker to just pay for it rather than fill out all the paperwork. I get a lot of last-minute ideas.—*Educator, Middle School, High School, Alabama*

[I do it b]ecause there is limited understanding that for an adequate job in modeling, one needs an initial higher cost, then maintenance costs. —*Educator, High School, Arizona*

I want to provide my students with an engaging, interesting, rigorous learning environment. Sometimes that means changing my classroom plans to better accommodate their needs. If I don't turn in the correct paperwork a month in advance, I can't use my lab funds to purchase materials.—*Educator, High School, Arizona*

Science (STEM [science, technology, engineering, math], in particular) is critical if we're to progress as a society. The only way to do that is to provide hands-on experiences that get kids excited about their future.—*Educator, Middle School, Kansas*

State legislators (Florida) refuse to adequately fund education. It's only about the test scores/dollars ratio. We get good test scores for our money, but are burning out all of the stakeholders in the process.—*Educator, High School, Florida*●

Quotable

The silly question is the first intimation of some totally new development.

—Alfred North Whitehead, British mathematician and philosopher (1861–1947)

[I'm l]earning about machine learning with reinforcement learning through a Research Experience for Teachers at Notre Dame.

—John Gensic, high school teacher, Indiana

From June 14 to July 1, I traveled to Hanoi, Vietnam, to visit the American STEM [Science, Technology, Engineering, and Mathematics] School [with] which I partnered during the [2017–2018] school year. I worked alongside the passionate staff there during their STEM summer camps for ages 5–14. I also hosted two professional development sessions with this school's staff. [My] main objective was to share my STEM approach to teaching STEM and social studies in my fifth-grade classroom in Carnegie, [Pennsylvania]. It turned out that the team there also taught me a ton as well.

—Scott Donnelly, elementary school teacher, Pennsylvania

This summer, my mission has been to work on my professional practices and [grow] my skills. I've spent the day visiting Balboa Park in San Diego [California], taking in the vast museum experiences and exploring. I also traveled to various colleges—including [the University of Nevada, Las Vegas]; Harvard; and MIT—to check out what they offer for science and teaching professionals. I delivered my first professional presentation at [the STEM Forum & Expo, hosted by NSTA], and I know that I will grow more—and the feedback was great!

—Michele Scheuler, middle school teacher, Maryland

I am participating in a Research Experience for Teachers at South Dakota School of Mines and Technology, sponsored by the National Science Foundation. It's a six-week program…focusing on sustainability. My project deals with climate change of the Great Plains.

—Brenda Velasco, elementary school teacher, South Dakota

#Science60 Showcases Summer Learning

Most teachers spend countless hours of their free time on professional learning (PL) experiences to enhance their teaching on behalf of their students, and the summer "break" is no exception. Their time devoted to activities like visiting museums, attending workshops, and reading about the latest in science education often goes unrecognized.

"It is so inspiring to see so many teachers around the country spending their 'free' time working to better their craft," said Megan Doty, NSTA e-learning engagement specialist. "We wanted to make that visible to more people."

To do that, NSTA launched a 60-day initiative, #Science60, inviting science educators to share their summer PL efforts online. As of August 6, more than 400 entries were submitted to the NSTA Learning Center's website for the initiative at *https://learningcenter.nsta.org/science60*, with more posted directly to Twitter using the hashtag #Science60.

"I feel that part of our mission at NSTA is to celebrate teachers for the work they do," said Flavio Mendez, the Learning Center's assistant executive director. "We are now in the planning stages for season two of #Science60, expected to launch this fall."

I participated in week-long professional development on how to apply rocketry basics [to] science curriculum, held at the NASA Wallops Flight Facility in Virginia (the Wallops Rocket Academy for Teachers, WRATs). The week culminated…with the launch of a NASA Terrier-Improved Orion suborbital sounding rocket carrying the students' experiments. The rocket is 36 feet long, and the payload weighs 667 pounds.

—Olukayode Banmeke, high school teacher, Virginia

[I attended the] Hormel Gifted and Talented Education Symposium [in] Austin, Minnesota. This three-day event has 90-minute sessions repeated on each day. So you gain 4.5 hours of experience on a topic spread over three days. There were engaging sessions on engineering instruction, NASA resources, and equity strategies, among other topics.

—John Olson, administrator, Minnesota

I spent five days experiencing the NextGen TIME suite of tools. These resources help educators evaluate and implement instructional materials that are designed for the [*Next Generation Science Standards*] and/or 3-D learning.

—Zoe Evans, administrator, Georgia

NASA: [I attended] a two-day event at the Kennedy Space Center in Titusville, Florida. We toured the center, spoke with scientists who worked on projects that were launching into space, and had VIP viewing of an early-morning SpaceX launch.

—Rachel Hallett-Njuguna, elementary school teacher, Florida

"I am a Teacher-Ranger-Teacher at Hot Springs National Park this summer (2018). As part of the program, I am also taking a three-hour graduate course through University of Colorado [Denver], which is [how] we are guided through our project plan [that] we are working on for the park over the summer.

—Brenda MacKay, elementary school teacher, Arkansas

I have participated in several conferences, learning new and interesting things about Q-computing and quantum mechanics and astrophysics. In addition, I have participated in several NSTA Web Seminars through the NSTA Learning Center.

—Richard Jones, professor, Hawaii

I attended the [Association of Texas Professional Educators'] Annual Summit in Dallas, Texas… [I] networked with teachers from all over the state of Texas and won the 2018 Charles Pickett Educator of the Year Award!

—Richard Embrick, middle school teacher, Texas

Reconnecting with my Earth science hobby, I visited several mines and museums to collect resources for my students in Maryland.

—EllaJay Parfitt, middle school teacher, Maryland

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MONEY 101

The Real Cost of Teacher-Funded Classroom Supplies

By Kelly Kenneally

We've all seen the statistics and heard the stories about the money that teachers shell out of their own paychecks each year to pay for basic classroom supplies.

That latest data from the National Center for Education Statistics (*https://goo.gl/srjZ2z*) reports that 94% of K–12 public school teachers spent their own money on classroom supplies. Among these teachers who spent their own money on classroom supplies without reimbursement, the average amount spent was $479.

NSTA's recent informal member poll (see page 6) had similar findings. Some 26% of NSTA members participating in the poll said that they spend $301 to $500 annually, while 32.4% spend $500 to $1,000.

And it doesn't look like things are getting any better. A full 32% of respondents told NSTA that classroom supply budgets in the past year have decreased, while 47% say their budgets stayed the same. It's a safe assumption that teachers likely will continue to open their wallets because 92% agree that inadequate classroom budgets harm student learning.

But what is the long-term financial impact of this generosity? We already know that teachers are paid significantly less than similarly educated professionals. The Economic Policy Institute reports that in 2015, public school teachers' weekly wages were 17% lower than those of comparable workers—compared with just 1.8% lower in 1994 (*https://goo.gl/SCHGt6*). So teachers are already at a disadvantage when it comes to their financial security.

Then add in the annual cost of using teachers' salaries to pay for lab supplies, paper, pens, and books. But the impact is greater than the cost alone: Just recall math class and those compound interest calculations.

Take, for example, a teacher who spends $500 annually on classroom supplies over a 25-year career. If that teacher instead directed that portion of his or her salary to a retirement account, it would add nearly $27,500 to their nest egg, assuming a 6% rate of return. What about teachers who spend $1,000 annually on classroom supplies? Redirecting that money to their retirement plan would result in nearly $55,000 in additional retirement savings.

We're talking about significant money. *The argument can be made that some teachers work an entire year without pay to cover classroom supplies over the course of their careers.*

So what should teachers do? It's a tough call. Teachers want their students to succeed, but at the same time, educators have to protect their own financial security. I offer a few ideas to consider that can lessen—and hopefully eliminate—the financial impact of classroom budget shortfalls on teachers.

1. **Take the tax credit**. Educators breathed a sigh of relief when the Tax Cuts and Jobs Act passed by Congress late last year left in the tax code the deduction for teachers' out-of-pocket classroom expenses. This tax break, which is claimed directly on Form 1040, allows a single filing teacher to claim $250 spent toward classroom supplies. For married educators, $500 in personal payments for school supplies can be deducted on a joint tax return. So if you're buying supplies, at least take the tax break for your generosity. Save your receipts and read the Educator Expense Deduction (see the website *https://goo.gl/E2S1qP*) information from the Internal Revenue Service to learn the details of eligibility, what is deductible, and how to claim the deduction.
2. **Track spending and spend less**. Keep a log of what you are spending. Odds are you're spending even more than you thought. Regardless of the amount, resolve to spend less. Try to cut spending by 25% next year, then trim that amount by 50% the following year—or whatever amount seems to work for you. The point is to gradually spend less. Ideally, you want to stop using any of your wages to pay for what the schools should be paying for, but that is a hard choice for teachers who care deeply about their students and education. Whatever you cut, put that money directly into a retirement or other savings account. Your future self will thank you.
3. **Find other sources for funding and supplies**. Even if you decrease your spending, chances are your school won't increase your classroom budget. Parents may be unable to purchase additional supplies. Stretch your supply budget with creative thinking. If you're not doing so already, take advantage of Tax-Free shopping days offered in many states. Some retailers offer exclusive discounts to educators to address the chronic problem of teacher-funded class supplies.

   Some educators have big success with "crowdfunding" supplies. Donors Choose, started by a former teacher, has funded more than one million projects, representing a combined $700 million in contributions to schools in all 50 states. Be sure to check with your school administration before pursuing crowdfunding, as some locales have policies and rules about this approach. Corporate donations are an option to explore. Office supply retailers and other companies serving children and education can be

Real Money: $27,432

Year	Beginning Balance	Contribution	Interest	Ending Balance
1	$0	$500	$0	$500
5	$2,187	$500	$131	$2,819
10	$5,746	$500	$345	$6,590
15	$10,508	$500	$630	$11,638
20	$16,880	$500	$1,013	$18,393
25	$25,408	$500	$1,524	**$27,432**

Author's Calculation: Assumes $500 contribution for 25 consecutive years earning 6% interest into a retirement account.

fertile ground for classroom donations. You can find companies that donate to nonprofits and schools through online resources like Fundly (*https://goo.gl/TSJ599*) and the NSTA Calendar (see the website *www.nsta.org/calendar*).

4. **Advocate for increased classroom funding**. From Arizona to West Virginia, teachers seemed to reach their breaking point in the last year, holding rallies at state capitals and walking out of their schools to protest education funding shortfalls and to fight for their salaries and benefits. Teachers weren't shy about posting photos of outdated textbooks and poor classroom conditions. As a result, a few states increased their education budgets and raised teacher salaries. Policymakers are anticipating more pushback from more teachers in more states.

   Certainly, teachers have their own views and preferences on whether to serve as policy change advocates. Teachers have big and little ways to make their concerns heard by policymakers at the local, state, and federal levels: sending letters and e-mails to officials, calling and visiting their offices, or attending school board meetings and legislative rallies. If we learned one thing in 2018, personal stories and direct outreach to legislators from voters really can create change in the classroom.
5. **Reach out to retired teachers**. Every state has a retired educators association (REA) organized with a state office and local districts or chapters. Typically, REA members are retired teachers serving their local communities, including helping to provide resources to schools and children. While each REA is unique, many organize backpack and supply drives, hold food drives to ensure students have adequate nutrition, and find other ways to support teachers still in the classroom. Teachers can contact their state REA to find ways to collaborate. The National Retired Teachers Association—AARP's Educator Community, the national "hub" for the state REAs—lists state REAs at *https://goo.gl/BB5Xa2*.

In the end, teachers are widely applauded and respected for their wholehearted commitment to their students and education, especially when allocating a portion of their salary to ensure students have the necessary supplies to be successful. But it's important for teachers to consider the big picture and calculate the total cost of their classroom supply contributions. For some, contributing to classroom supplies fits in their personal budget. But for many, it negatively impacts the family budget, and that money could help ensure a more secure retirement.

Whatever your decision, make it an informed and conscious decision that takes total cost into consideration. ●

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 coauthored a biennial report on Americans' sentiments regarding retirement.

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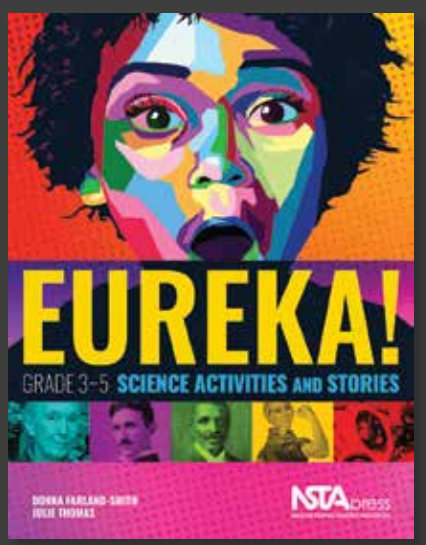
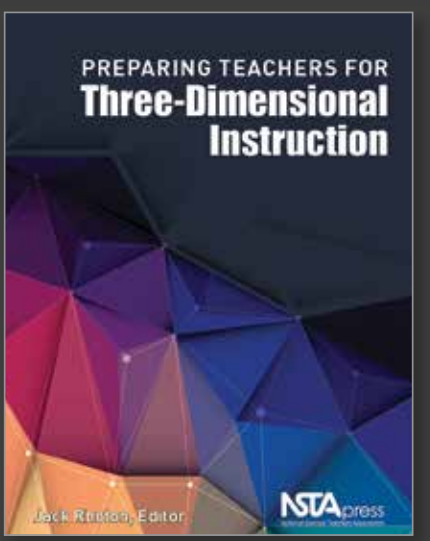


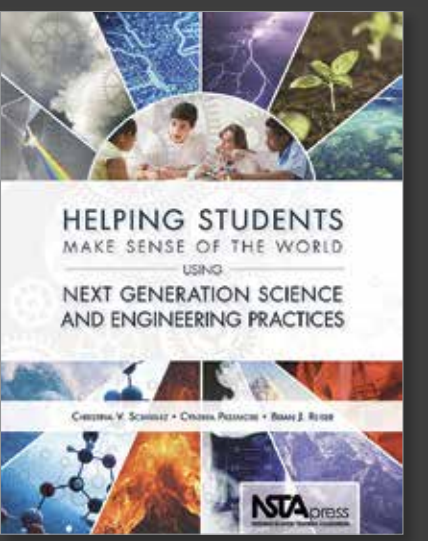
Grades 3–5

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



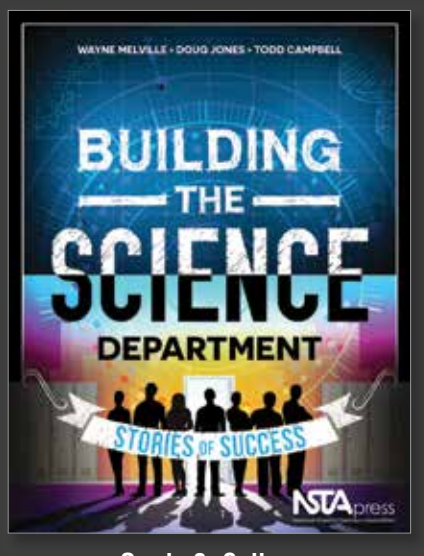
Grades PreK–College

Book: Member Price: $33.56 | Nonmember Price: $41.95
E-book: Member Price: $25.17 | Nonmember Price: $31.46
Book/E-book Set: Member Price: $40.27 | Nonmember Price: $50.34



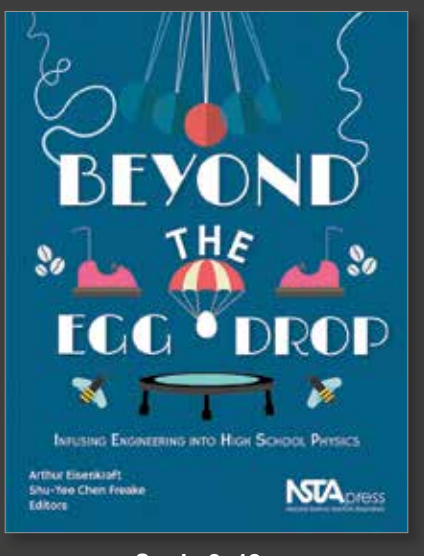
Grade PreK–5

Book: Member Price: $33.56 | Nonmember Price: $41.95
E-book: Member Price: $25.17 | Nonmember Price: $33.46
Book/E-book Set: Member Price: $40.27 | Nonmember Price: $50.34



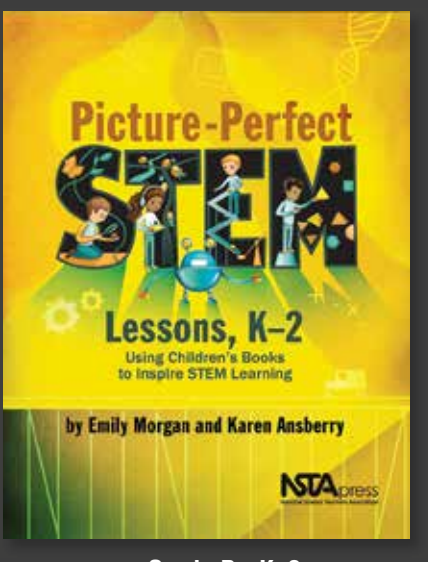
Grade 6–College

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: $53.94



Grade 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



Grade PreK–2

Book: Member Price: $37.56 | Nonmember Price: $46.95
E-book: Member Price: $28.17 | Nonmember Price: $35.21
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NSTA National Science Teachers Association

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies for Science Teachers

Teacher Institute for Evolutionary Science (TIES). M This teacher-run project aims to help middle level educators effectively teach evolution in the classroom. In addition to providing ready-to-use classroom resources on evolution—including monthly webinars, hands-on labs, presentation slides, assessments, and links to websites—the group hosts professional development (PD) workshops for middle level science teachers nationwide. The workshops aim to increase teachers' content knowledge and promote teacher leadership by training participants as presenters, then paying them $250 for every workshop they subsequently conduct. For more information on attending or presenting a workshop, e-mail TIES Director Bertha Vazquez at *bvazquez@centerforinquiry.net,* or visit this website: *www.richarddawkins.net/ties.*

Model Chemical Hygiene Plan for Schools. K12 To prevent injuries (and potential lawsuits) and meet Occupational Safety and Health Administration (OSHA) and related state regulations required for most K–12 schools, a clear, written chemical hygiene plan is needed. At *https://goo.gl/ktgeCz,* educators can access the Laboratory Safety Institute's (LSI) Model Chemical Hygiene Plan for Schools, which covers all of OSHA's required areas, including standard operating procedures, fume hood and emergency equipment, medical consultation, and other topics. The plan can be printed as-is or customized according to school policies and procedures. The plan is free, but LSI asks teachers not to give it away or post it online in a way that anyone can access it.

Purple Plow Puzzlers. E M These hands-on science, technology, engineering, and math (STEM) activities/projects for grades 5–8 develop skills in creativity, critical thinking, and engineering design. Created by the American Farm Bureau, the 16 agriculture–related engineering design projects include Save the Soil, Water Access, Cardboard Tractor, No-Bake Granola Bar, Weather Station, and Miniature Greenhouse. The projects take 1–3 hours to complete to allow students time to follow the steps of the Purple Plow engineering design process: create, test and improve, and share. The activities, which support the *Next Generation Science Standards* (*NGSS*), can be used to supplement classroom curriculum or in after-school programs, camps, and family outreach events. Find them at the website *www.purpleplow.org/puzzlers.*


ANDREAS PRAEFCKE

Brittanica Insights. A A free browser extension developed by the Encyclopaedia Britannica Group can help students and teachers of all ages and levels find accurate, credible content online. Powered by the world's largest semantic general-reference dataset, the extension works with all major browsers to surface information featuring unique relationships and uncommon insights on topics. A search on "climate change," for example, presents both quick facts and a deeper look into coverage of climate change through geologic time and the impact of climate change on rivers, glaciers, and icebergs. Watch an introductory video about the tool at *https://goo.gl/3rJ4tw,* or download a copy at *http://britannica.com/insights.*

GPS-Based STEM Curriculum. M H The U.S. government has developed a new curriculum using Global Positioning System (GPS) concepts and real-world applications to stimulate interest in STEM. Targeted for middle and high school levels, and designed to support the *NGSS* and *Common Core* learning standards, the curriculum features 12 inquiry-based lessons with projects and videos based around four module themes: Earth, space, life, and movement. The lessons, which can be used independently or as part of larger learning units, blend concepts with real-world applications and showcase a spectrum of cool STEM careers. Titles include I'm On My Way! Navigation and GPS; Living Weightless: The Space Station; Baby Is It Cold Outside? Weather Forecasting; and Up, Up, and Away! Aviation Moves Us! Consult *www.gps-stem.com.*

NextGen TIME. K12 A collaboration among education researchers at BSCS Science Learning, Achieve, and the K–12 Alliance at WestEd, NextGen TIME is a suite of PD tools and processes to help K–12 educators evaluate, select, and implement broad scale instructional materials (e.g., large units of study or year-long programs) designed for next generation science. It employs a five-step process (prepare, prescreen, paperscreen, pilot, and plan) and is best suited for use by dedicated, collaborative teams across schools and districts. With the program, teachers and teacher–leaders convene with colleagues to learn how to choose and imple-

See Freebies, pg G2

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

Freebies, from pg G1

ment high-quality materials and/or customize and enact current materials for effective next generation science instruction. At *https://nextgentime.org,* teachers can register for free to access resources like handouts, PowerPoints, and facilitation guides to learn more and see the program in action.

***Racing Extinction* Resources.** H Released by the Oceanic Preservation Society, the documentary *Racing Extinction* highlights the plight of endangered species. The film examines human behaviors, including the international wildlife trade, that contribute to Earth's diminishing biodiversity and to what many scientists refer to as the Sixth Mass Extinction. High school teachers can access lessons and theater-style posters that address the importance of biodiversity on Earth and showcase some of the endangered animal species seen in the film (e.g., frog, elephant, monkey, and tiger). Lessons support *NGSS* and *Common Core State Standards* and incorporate video clips from the film. Titles include Modern Extinction: The Sixth Extinction; Extinction and What We Eat; The Warming Planet; and Working a Turnaround. Go to *https://goo.gl/q5TcHt.*

JOHN AND KAREN HOLLINGSWORTH

Wild Classroom. E Packed with curriculum, hands-on activities, apps, games, and quizzes, this website from World Wildlife Federation (WWF) has everything needed to introduce students in grades 3–5 to wildlife conservation. Students can try the Find Your Inner Animal quiz, play Rhino IQ animal trivia, or learn about dolphins, tigers, or sea turtles and how to protect them with the resources, posters, and hands-on activities in a teacher toolkit. Students can also interact safely with wildlife in their natural environments in immersive apps like WWF Together (about endangered animals) and WWF Free Rivers (about global river ecosystems). Visit *www.wildclassroom.org.*

Vegetable Variety Investigations (Vvi). M H This citizen science program from Cornell University's College of Agriculture and Life Sciences engages students in gardening and science research. Vvi participants interview gardeners about their opinions on vegetable varieties and submit the findings to a nationwide online library of vegetable variety data. Gardeners, researchers, and others use the reported data to preserve knowledge and promote biodiversity for healthy ecosystems, including farms. Participating in Vvi lets students gain experience in science research, data collection, communication, and collaboration.

Vvi is geared for middle and high school levels, but adaptable for other levels. Visit *https://goo.gl/QXQtCm* to access a teacher toolkit with participation guidelines and introductory classroom activities that build understanding of program topics, such as produce characteristics, biodiversity, and interviewing skills.

Creative Educator. E M Seeking ways to foster creativity and engage K–8 students in the curriculum? The lesson plans, digital tools, supporting pedagogical articles, and classroom success stories at Creative Educator (*https://goo.gl/Au3zEw*) make it easy to implement creative educational technology projects in core subjects, including science. The site offers more than 20 creative science projects on a range of topics, including animal behaviors, habitats, the human body, rain forest ecology, conservation, life cycles, physics, and nutrition.

Projects incorporate the use of digital tools to spark learning and enable students to create and share their work. In Animal Riddles (grades 2–3), for example, students conduct online research about an animal, then write a riddle to show what they learned. In Take a Tour of a Biome (grades 4–6), students learn about five biomes as they create a digital travel brochure to share with classmates. And in Fastballs, Free Throws, and Physics (grades 5–8), students make a video showing how physics concepts apply to their favorite sport.

Science GSE Phenomena Data Bank. K12 The Georgia Science Teachers Association has begun a collection of more than 200 science phenomena aligned to the Georgia Standards for Excellence (GSE) in K–12 science that teachers from other locations can use. Each "entry" includes a direct video link to the phenomenon and a brief description about it; Possible Guiding Questions; and Possible Instructional Uses. Teachers can also submit their own phenomena ideas, rate the site's phenomena, and access other resources to learn more about phenomena and their role in 3-D science learning. Refer to *https://goo.gl/jr8crj.*

Girlstart for Educators! K12 Teachers seeking to empower K–12 students—especially girls—in STEM will find hands-on activities, program opportunities, curriculum, a blog, and more to invigorate STEM instruction and inspire students to consider STEM careers at *https://goo.gl/BUX1A3*. View Weekly Activities for an archive of Hands-On Wednesday blog posts with videos of attention-grabbing science demos and activities students can do at home, such as *The Power of Bleach, Candle Seesaw,* and *Floating Paper Clip.*

HUNTERDT

Digital Fabrication in K–12 STEM. K12 Are you a fan of fab labs and makerspaces? If so, check out the SCOPES-DF (Scaling a Community of Practice for Education in STEM through Digital Fabrication) project at *www.scopesdf.org.* This group has produced standards-supported lessons for K–12 audiences using digital fabrication, including 3-D printers and laser cutters. The projects incorporate engineering design and engage students in relevant, applied learning.

High school projects, for example, introduce STEM careers such as Airplane Mechanic, Wearable Device Designer, and Biomedical Engineer. K–12 lessons include Child-Designed Furniture (grades K–3), Make Your Own Cookie Cutter (grades K–6), MP3 Speaker (grades 6–8), and Technical 3-D Modeling (grades 7–12).

AR Moon—Explore Solar System. E With an iPad or iPhone and this app, you can transport students to the Moon to complete astronaut missions. Best suited for elementary audiences, the app uses Augmented Reality (AR) technology to transform your classroom into a moonscape for exploration. Looking through the camera lens, students "walk through" a portal to enter the moonscape, where they can explore the surface and learn to drive a rover to specific locations while controlling the machine's arm to perform tasks. Learn more and download the app at *https://goo.gl/LcwEGx.*

New Visions Science Curricula. H High school science teachers, visit *https://goo.gl/jPxMUU* for thousands of adaptable, teacher–tested instructional materials for your classrooms. Developed by New Visions for Public Schools, the Open Educational Resource collection offers curricular materials across a range of content areas, including full courses exploring the Living Environment and Earth Science and introductory units for chemistry and physics. Other resources help teachers plan more effectively and improve student learning.

Click on Getting Started to access guidelines for Group Learning Routines and find effective reading and writing strategies for Literacy in Science. ●

News Bits

- **The Amgen Foundation awarded Harvard University a $6.5 million grant to develop LabXchange, a free, global online science education platform focusing on biology, to launch in 2019.** H HE

Robert Lue, Harvard professor of the practice of molecular and cellular biology, and his team will build virtual laboratory experiences for students and tools for instructors to create and remix existing instructional content. Noting that many students lack access to laboratories and the preparation to do lab work, Lue says LabXchange will also feature a social media–style community in which students can seek advice, support, collaboration, and mentoring from peers and instructors.

LabXchange invites high school teachers and undergraduate research mentors to provide feedback. High school teachers wishing to collaborate should visit *https://goo.gl/auqovk*. Read more at *https://goo.gl/MWBPXC* and *https://goo.gl/NSmt8a*.

- **Indiana University researchers have invented BioSim, a system that includes wearable 3-D indoor positioning sensors, push toys, and puppets to help first and second graders understand science concepts.** E

Kylie Peppler, who developed the wearable technology with colleagues Joshua Danish and Armin Moczek, says students wear bee puppets on their arms or play with ant-shaped push toys during class and use the insect's perspective to help them grasp the complexity of systems. "Their goal is to collect food as efficiently as possible and communicate with the community to make sure others can also collect food efficiently," explains Peppler.

Students also watch simulations, describe what they see, and offer explanations. Teachers can use the accompanying software to track data and see whether students' classroom behavior matches their answers to questions. Read more at *https://goo.gl/n4PaEb*.

- **Researchers found that students who earned three credits in high school engineering and engineering technology (E&ET) courses were more likely to enroll in science, technology, engineering, and math (STEM) majors in four-year institutions than students who didn't earn the credits.** H HE

In their study, "Choosing STEM College Majors: Exploring the Role of Pre-College Engineering Courses," published in the *Journal of Pre-College Engineering Education Research*, the researchers said the positive, significant association they discovered persisted even after controlling for students' social backgrounds, academic preparation, and attitudes during high school; college choice considerations; and early postsecondary experiences. They concluded that for many students headed to four-year colleges, high school E&ET courses might lead them to choose a STEM college major; high school science and math courses also predict students' STEM major choice in college; women are less likely than men to choose a STEM major in college; and college students' confidence in their high school science and math preparation is key to their decision to major in STEM.

The authors said their results align with adoption of the *Next Generation Science Standards* and advancing the development and expansion of integrated STEM education across school and college settings. Read more at the website *https://goo.gl/kvavYN*. ●

What's New

FROM U.S. GOVERNMENT SOURCES

National Institutes of Health (NIH)

TOXNET H HE

Looking for databases that will challenge high school honors and Advanced Placement (AP) science students? TOXNET, a network of toxicology databases culled from NIH's National Library of Medicine and other sources, contains two resources of particular relevance for high school and college chemistry educators: ChemIDPlus and the Hazardous Substance Data Bank. ChemIDPlus presents basic information about many chemicals, along with links to journal articles and other resources. ChemIDPlus Advanced augments that information with 3-D models of chemical structures that teachers and students can examine (or draw themselves, if desired). Students can also use ChemIDPlus Advanced to conduct chemical similarity searches or view toxicity test results.

The Hazardous Substance Data Bank provides information about the toxicology of potentially hazardous chemicals. Students can use this tool to research information on human exposure, environmental fate, chemical and physical properties, and more. Each section includes a summary and abstracts to peer-reviewed journal articles on the topic. Visit *https://toxnet.nlm.nih.gov.*

U.S. Department of Agriculture (USDA)

Dig In! Nutrition Education Curriculum E M

Involve students in grades 5–6 in growing, harvesting, tasting, and learning about fruits and vegetables through the curriculum Dig In! Standards-Based Nutrition Education From the Ground Up. It contains 10 standards-based, inquiry lessons with student handouts, food safety printables, a school gardening guide, and an at-home guide for parents featuring recipes and tips for encouraging healthy nutrition choices. All materials can be downloaded online; however, schools participating in the National School Lunch Program or other Child Nutrition program may also request a printed copy of the curriculum. See *https://goo.gl/AmXhX3*.

Grow It, Try It, Like It! P

With this garden-themed nutrition education kit, preschool children (ages 3–6) not only learn about fruits and veggies, but also grow and taste them. Each set of lessons focuses on a different fruit or vegetable—peach, strawberry, cantaloupe, spinach, sweet potato, and crookneck squash—and includes kid–friendly hands-on activities, planting activities, nutrition education information, arts and crafts, and songs. The activities can be used in the classroom or shared with families to promote healthy eating habits and encourage cooking and other activities that parents and children can do together. Visit *https://goo.gl/ViQokz*.

U.S. Environmental Protection Agency (EPA)

EnviroAtlas in the Classroom K12 HE

EnviroAtlas, a web-based tool found at *www.epa.gov/enviroatlas,* combines interactive maps, analysis tools, and interpretive information on ecosystem goods and services. The resource empowers K–16 educators and other users to answer their own environmental questions by providing access to map-based environmental data from EPA and its partners and teaching users how to work with the information. Start with the introductory video to learn about EnviroAtlas and its capabilities, then check out the materials in each section for more specific guidance on working with the site's more than 300 interactive maps and supporting articles.

EPA has also developed three interactive learning modules for using EnviroAtlas data in K–16 classrooms. Each module supports the *Next Generation Science Standards* (*NGSS*) and includes outdoor learning activities and the use of hands-on, interactive technology. Exploring Your Watershed (grades K–6, available in both English and Spanish), involves place-based learning and introduces mapping, with students as outside navigators. Connecting Ecosystems and Human Health (grades 4–12) helps learners understand the connections between ecosystem services and human health. Building a Greenway: Case Study (grades 9–college) focuses on teaching students how to be collaborative decision makers in the community.

National Oceanic and Atmospheric Administration (NOAA)

The Ocean Today Videos M

Explore the evolution, biology, beauty, and benefits of corals and coral reefs, as well as the science behind acidification and bleaching, through the videos of NOAA's multimedia exhibit, The Ocean Today. Written for the middle level and suitable for family audiences, each short (about three minutes) video features live footage of a coral reef with commentary from shark researcher and National Aquarium educator Symone Johnson. An embed code makes it easy for teachers to incorporate the clips into multimedia lessons, and the site has links to articles with more information and "Fast Facts" about each video topic. Go to *https://goo.gl/Ck6w8B*.

National Aeronautics and Space Administration (NASA)

Wanted: Citizen Scientists K12 HE

Looking for ways to engage your students in real-world science? Check out NASA's Citizen Science website at *https://goo.gl/yEU92e* to find opportunities for students of all levels, from elementary to adult, to contribute to NASA research. Listed alphabetically and color-coded for ease of identification, the page presents descriptive annotations and links to more than a dozen engaging projects exploring various aspects of the universe, solar system, Sun, and Earth.

Cosmo Quest participants, for example, help analyze more than 15 million images taken by astronauts aboard the International Space Station. Working from computers, students view the images and identify geological features or challenge themselves to find the exact location of the image. In the S'COOL (Students' Cloud Observations On-Line) project, students are "Rovers" (roaming cloud observers) who collect data on cloud type, height, cover, and related conditions to validate satellite data and provide scientists with a more complete picture of clouds in the atmosphere and their role in interactions in various Earth systems.

Experience Mars 2030 K12

This immersive virtual reality simulation lets students explore the Red Planet. Developed collaboratively by Fusion Media Group, Massachusetts Institute of Technology, and NASA—and available free for K–12 classroom and museum educators—the simulation was designed using real data from NASA's Mars missions to deliver an authentic experience based on what is known about Mars today. Players hunt across an accurate Martian landscape for samples, analyze findings under a virtual microscope inside their workstation, and communicate discoveries to NASA and family back on Earth. A desktop version also is available for users without virtual reality hardware. See *http://mars2030-vr.com*.

National Park Service (NPS)

Island of the Blue Dolphins Online Resources K12 HE

In 1960, Scott O'Dell wrote *Island of the Blue Dolphins,* a historical fiction novel for young adults based on the life of a Native American woman who spent 18 years in isolation on San Nicolas Island, one of eight Channel Islands off the southern California coast. The novel remains a favorite reading in many K–college classrooms, and NPS has developed a website for teachers (including science teachers) to enhance its use. The website offers primary and secondary

source materials related to the 19th-century events and people that inspired the novel. For example, the website highlights several natural and cultural resources mentioned in the book (and currently protected in Channel Islands National Park), including images and footage of elephant seals, cormorants, kelp beds, and archaeological sites.

In addition, the site offers writing prompts and classroom lesson plans, adaptable for a range of levels from elementary to university, that provide opportunities for students to reflect on the reading and deepen understanding. Refer to *https://goo.gl/kgDK6T.*

U.S. Department of Energy (DOE)

STEM Careers: Geochemist M H

A geochemist and champion snowboarder? In this short video profile, most appropriate for middle and high school audiences, students meet Alexandra Hakala, a geochemist at the DOE's National Energy Technology Laboratory. The environmental scientist is working to find energy sources in ways that don't harm humans or the environment. Her research focuses on understanding water chemistry and protecting water resources, and it involves lab research, field studies, and data analysis.

Hakala describes what excites her about working in the lab and discusses the varied path (including snowboarding) that led to her science, technology, engineering, and math (STEM) career. Watch the video at the following website: *https://goo.gl/NjZHmy.*

U.S. Census Bureau

Examining Changes to the Environment Through Pictures, Data E M

In this activity for grades 4–6, learners study famous landmarks, such as Times Square and Niagara Falls, to identify human-generated changes in the physical environments across time. In addition to viewing photographs, students analyze population and housing data from the U.S. Census Bureau to reflect on how population changes may contribute to changes in the physical environment. The activity is available in two versions. The educator's version features Teachers Notes (including classroom management tips and extension ideas), standards information, and typical student responses to questions posed during the activity. The printable student version has space to record data and observations. See *https://goo.gl/GGgDs3*.

Emergency Preparedness: Play It Safe! E

In this lesson, upper-elementary students learn how the U.S. Census Bureau supports emergency responders during natural disasters. They then do activities at learning stations to create an emergency preparedness kit, discover the states with the highest threats for hurricanes, and analyze photos to determine which homes are most likely to survive a disaster. See *https://goo.gl/aXX6oo.*

Central Intelligence Agency (CIA)

CIA Kids' Zone K12

The CIA Kids' Zone has lessons, games, and activities for K–12 students to learn about the CIA and potential careers there. At *www.cia.gov/kids-page*, students can take an online tour of the headquarters, then try some puzzles, word activities, and challenges. The Photo Analysis Challenge tests students' visual sense as they look for differences between similar-looking street scenes. Classroom lessons for middle and high school levels (but adaptable for elementary learners) develop students' communication and problem-solving skills. Gathering and Analyzing Information, for example, has students model the Intelligence Cycle, the process CIA employees use to collect and share intelligence data. ●

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

NSTA District Professional Learning Packages

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—Educational Services District Leader

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- **Exploring the *NGSS*:** Give teachers a foundational understanding of the standards and shows them what three-dimensional instruction looks like in classrooms (modeled for each grade and discipline).
- ***NGSS* Administrator Institutes:** Help administrators design professional learning around science standards, assessing current capabilities of teachers, and setting goals for professional learning.
- **Train-the-Trainer Workshops:** Build your team of experts by giving them a powerful tool kit of resources and a solid understanding of the *NGSS*. This workshop uses the interactive e-book *Discover the NGSS: Primer and Unit Planner* to prepare participants to conduct comprehensive teacher training around the new standards.
- **Online Book Study and Discussion Forum:** This series of four web seminars combines asynchronous thought activities with discussions in private forums to give districts a flexible option for *NGSS* training.
- **Or let us tailor a program for your needs.**

For more information, visit *www.nsta.org/district* or email *ngss@nsta.org*.

National Science Teachers Association

In Your Pocket

Editor's Note

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

September 21–29

FirstEnergy STEM Classroom Grants P K12

These grants support classroom projects and professional development initiatives focused on science, technology, engineering, and math (STEM). Those that include the study of electricity are of special interest. PreK–12 educators and youth group leaders in FirstEnergy service areas (in Maryland, New Jersey, Ohio, Pennsylvania, and West Virginia) can apply for grants of up to $1,000. Projects must be completed during the 2018–2019 school year.

Apply by **September 21** at the website *http://goo.gl/MVsFLa*.

The Sparkplug Foundation Grants P K12

These grants go to start-ups and established organizations with new projects in education, music, and community organizing. Grants should spark change and encourage sustainability. Preference is given to "smallish" organizations with small budgets that are less likely to receive corporate, government, or institutional funding. Projects anywhere in the United States or Israel/Palestine are eligible.

Visit *https://goo.gl/cbFGW4* to answer the preliminary application questions by **September 29.** Letters of intent are due on October 3.

September 30

Project Learning Tree GreenWorks! Grants P K12

These grants of up to $1,000 fund environmental service-learning projects that link the classroom with the real world. Previously funded projects have included school gardens, outdoor classrooms, habitat restorations, recycling programs, and energy conservation projects.

Applicants must have attended a Project Learning Tree workshop, and projects must secure at least 50% matched funds and involve at least one community partner. Apply by **September 30** at *www.greenworks.org*.

Green Thumb Challenge Grant K12

The Green Education Foundation awards this $500 grant to an exceptional youth garden program that has demonstrated success and impacted the lives of K–12 students and their surrounding communities. A video chronicling the success of your garden, a digital portfolio, or scanned artwork with descriptions is required to apply. The deadline is **September 30;** see *http://goo.gl/Zetghz*.

October 1

Toshiba America Foundation Science and Math Improvement Grants K12

These grants of up to $1,000 support teachers of grades K–5 with innovative classroom project ideas in science or mathematics. Successful projects often tap into students' natural curiosity, enable them to ask their own scientific questions, and incorporate the expertise of community partners. K–5 requests are due by **October 1.**

The foundation also provides grants for science and math teachers of grades 6–12. For those grades, requests of $5,000 or less are accepted year-round; those for $5,000 or more are due on **November 1** and **May 1.** Visit *www.toshiba.com/taf* for details.

Target Field Trip Grants K12

Target gives these grants to K–12 schools within 100 miles of a Target store. Field trips should connect students' classroom curricula to out-of-school experiences and take place between January and the end of the school year. Grants of up to $700 are available.

Apply by 11:59 p.m. Central Time on **October 1.** Visit *http://goo.gl/jsaFYv*.

Pilcrow Foundation Children's Book Project Program Grants P K12

This program provides a 2-to-1 match for rural public libraries that receive a grant through its Children's Book Project. It also contributes $200–$400 through local sponsors for the purchase of up to $1,200 worth of new hardcover children's books. The foundation provides a list of more than 500 titles to choose from.

Libraries must be located in rural areas, raise $200–$400 through a local sponsor, and have an active children's department and a limited operating budget. Those with budgets of less than $50,000 receive priority, though town libraries with budgets of more than $150,000 may also apply.

Applications must be postmarked by **October 1.** Learn more at *http://goo.gl/DpEh2U*.

Frances R. Dewing Foundation Grants P E M

These grants fund projects or programs focused on early childhood education. Of particular interest are those at new, untried, or unusual educational organizations that aim to introduce new methods for children ages 2–12. Grants range from $1,000 to $20,000.

Programs must be located in the United States and have tax-exempt status. Submit proposals by **October 1;** see *http://goo.gl/iDxXtc*.

Donald Samull Classroom Herb Garden Grant E M

The Herb Society of America offers these grants to public and private school teachers of grades 3–6 with classes of at least 15 students. Ten schools will receive $200 "seed money" grants to establish indoor or outdoor herb gardens. Funds may be used for soil, plant trays, containers, or tools. Apply by **October 1** at *http://goo.gl/YhX1tQ*.

Association of American Educators Classroom Grants P K12

These grants of $500 or less fund a variety of classroom projects and materials, including books, software, calculators, audiovisual equipment, and lab supplies. Full-time educators who haven't received a scholarship or grant from the association in the last two years are eligible. Teachers in Arkansas, Colorado, Idaho, Kansas, Oregon, and Washington compete for state-specific funds and complete a separate application.

Apply by **October 1;** consult *https://goo.gl/eWCd5N*.

Year-Round Grants

Westinghouse Charitable Giving K12 HE

Westinghouse gives grants to nonprofit programs that support K–12 and college/university STEM education, environmental sustainability, or community safety and vitality. STEM programs should enhance the subject matter for students and encourage career interest among youth. Environmental programs should help preserve or protect land, water, air, or biodiversity.

Grantees must be located within 50 miles of Westinghouse sites; see *http://goo.gl/1oV6Ht* for locations. Visit *http://goo.gl/nQxr3l* to submit proposals, which are accepted on a rolling basis. ●

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.

SEE Turtles Costa Rica Leatherback Turtle Volunteer Vacation A

During this conservation trip held by the nonprofit SEE Turtles, participants spend four nights in Costa Rica patrolling nesting beaches, measuring leatherback turtles, collecting eggs and moving them to hatcheries, and working with the turtles once they hatch. During the day, participants can explore the rainforest, help clean up the beach, or simply rest and relax.

This trip will take place on June 9–15, 2019. Proceeds from the trip help save at least 100 hatchlings per participant.

Individuals and groups of up to 12 may apply. Visit *http://goo.gl/vfAiZH* for details.

Announcing Summer PD

Are you holding a summer professional development (PD) program? Want to announce it in the Summer Programs section of NSTA's online calendar at *www.nsta.org/calendar*, and possibly in this column? E-mail the following information to *nstareports@nsta.org:*

- program dates and application deadline,
- location,
- grade levels/positions eligible to attend (i.e., elementary teachers, teachers of grades 7–12, science supervisors, etc.),
- relevant websites, and
- registration fees (if applicable).

All summer PD announcements will be posted on the online calendar. To appear in *NSTA Reports,* a program must meet one of these conditions:

- offer a stipend for all participants;
- offer tuition-free credit to all;
- be offered by/through a nonprofit group, government entity, or university; or
- reimburse all participants for some expenses (such as travel costs),

If your program qualifies for publication in *Reports,* we must receive the information at least two months before the issue in which you want the announcement to appear (remaining issues are October 2018, November 2018, and January 2019 through May 2019). Announcements in the Summer Programs column will be published one time only on a space-available basis and will be edited for style and length.

Get even more visibility for your program by advertising it in NSTA publications. Learn more by visiting *www.nsta.org/exhibitsadv.* ●

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

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Advancing Three-Dimensional Classroom Culture

Cultivating Constructive Partnerships

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#NSTA18

National Science Teachers Association

ASK A MENTOR, **Advice Column**

Time, Technology, and Engagement

How can I teach science when my school only allots 15–20 minutes per day to teach it? This usually comes at the end of the day when students are worn out.

—N., Louisiana

It can be very frustrating to have only tiny chunks of time to teach science. One thing you can try is to block science every 2–3 days. This also gives you extra time for math and English Language Arts (ELA) on most days!

If blocking time won't work, then you have to be very organized to minimize setup time and use demonstrations and lessons that are either quick or lend themselves to being broken into small, separate segments. For instance, you could divide up a hands-on activity involving plants into these parts: filling pots with soil, planting seeds, recording daily observations, collating data, representing data, and creating reports or presenting.

The best solution, in my opinion, is to embed science into math, ELA, and social studies instruction. All subjects benefit from being seen as useful and interconnected. Data manipulation and representations can be done in math, while reading, writing, and presenting projects are all perfectly suited to ELA. Social ramifications, geography, and history can all be incorporated.

The last-period scenario is another concern that requires some extra effort. If you can hype activities and keep them quick, engaging, and hands-on, you may find that students may want to extend their days because we all know how cool science is!

Is there a way to engage those who struggle with chemistry and help them do well?

— M., Utah

When asked to name their hardest class in high school, people often list pre-calculus math, physics, or English Language Arts, but I always answered, "Chemistry"! For most of us, chemistry was taught on a very theoretical level and concentrated on concepts foreign to everyday thinking: enthalpy, stoichiometry, orbitals, and so on.

I believe that the current movement toward using phenomena to teach science, connecting science to big ideas, and learning more about the nature of science is a big step toward making chemistry more accessible and enjoyable for students. Science is more meaningful when we link real-life observations to scientific explanations. So answering a question like "How does soap work?" leads to a terrific discussion about an everyday (we hope!) event and the knowledge we need to explain it. We can even push that explanation further through the questions and investigations that arise from considering a bar of soap.

To make chemistry more engaging, get students to ask the questions and find the phenomena that they want to explore.

How can you check for understanding during a lecture to make sure it is engaging?

—S. Ohio

Although I hated lecturing, I often felt the need to do so, particularly in advanced grades. My advice is to keep

direct instruction short and avoid mindless note-taking. Some things I can suggest

- Have students complete anticipation guides, a reading, or a KWL (Know, Want-to-Know, Learned) chart, or hand-in questions related to the topic.
- Break up the lecture into smaller segments and have them complete an activity between the segments. As a student teacher, my cooperating teacher taught me that a student's attention span in minutes is equal to their grade level!
- Hand out Cloze-format notes (blanks where key words or phrases occur) that the students fill in as the lecture progresses.
- Have students respond to specific "buzzwords" during the lecture to receive a small reward such as stickers or a treat.
- Develop a mantra for the big idea of the lecture that everyone chants at intervals: "Space is really big!" "Everything is made up of atoms!" "Living things need energy!"
- Ask students to hold up small whiteboards or paper with happy, sad, or neutral emojis indicating their understanding. An alternative is holding up a green, yellow, or red card small enough to cup in their hand.
- If the technology is available, use polling software to get responses as you go.

Don't overlook the importance of note-taking! Use a graphic organizer like the Cornell system to help them learn.

I was wondering how other teachers implement technology in the classroom. I think that simulations have the ability to encourage student inquiry, but often their presence seems to distract students from the learning. What are your thoughts?

—K., Wisconsin

Many different kinds of technology are available in addition to laptops and tablets. Smartphone apps, sensors, meters, and cameras can have great impact on learning. Spreadsheet programs, video-editing, photo-manipulation, and desktop publishing all have a place in the science classroom. The big thing to remember is that it is not the technology that is important, but how you use it in science education.

When using any technology, there must be a purpose. With simulations, I also planned a debriefing and a review assignment. Make sure you know what you want the students to learn from the simulation.

I have used technology many ways, including

- graphing lab data using spreadsheets;
- video analysis of moving objects using cell phones;
- measuring the heat of flames, beakers, and boiling water using infrared thermometers;
- using electronic probes to measure distance, velocity, temperature, oxygen, carbon dioxide, light, magnetic fields, and more;
- photographing specimens through a microscope or telescope;
- scripting, filming, and editing public service announcements, mini-documentaries, or science shows;
- creating websites and wikis to highlight and discuss issues;
- creating brochures, pamphlets, and posters;
- programming microprocessors such as Arduino technology to use various electronic sensors; and
- videoconferencing with scientists.

Hope this helps! ●

Check out more advice on diverse topics or ask a question of Gabe Kraljevic from Ask a Mentor at the website www.nsta.org/mentor, *or e-mail* mentor@nsta.org.

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Reno, NV	National Harbor, MD	Charlotte, NC
Oct. 11–13	Nov. 15–17	Nov. 29–Dec. 1

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NSTA National Science Teachers Association

NSTA Area Conferences Kick Off This Fall

Each fall, NSTA's area conferences on science education feature innovation and insight into recent trends in science education. The Reno, Nevada; National Harbor, Maryland; and Charlotte, North Carolina, area conferences will offer hundreds of sessions presented by educators from around the country eager to share their best practices and ideas for sharing their passion for science education. Attendees will be able to expand their content knowledge and connect with other science teachers. More than 100 exhibitors at each event will showcase a range of products, giving attendees a chance to learn about and even try out the newest technology, textbooks, and more.

Reno

From October 11 to 13, science educators will be **Elevating Science: Digging Deeper** in Reno. Selected sessions will follow one of three strands: Developing Persistence: The Power of Experience; Advancing Three-Dimensional Classroom Culture; and Cultivating Constructive Partnerships.

Shah Selbe, founder of Conservify and a National Geographic Explorer and Fellow, will share his experiences developing technological tools to protect and understand the Earth during his keynote address, Wild Technology: Adventures With Open-Source Sensors, Drones, and National Geographic. Featured speakers in Reno also include Kenneth Wesson (Experience: The Brain's Most Powerful Influence), Marianne Dyson (A Woman in Mission Control), Philip Bell (Supporting Equitable 3-D Science Learning Using Assessment, Phenomena, and Community Engagement), and Sarah Reeves Young (How Do You Scale Innovation?). NSTA President Christine Royce will moderate a panel discussion on Children's Literature: Using Phenomena to Uncover Student Questions.

The Reno conference offers two short courses for attendees interested in focusing their experience on Developing Assessments to Advance Three-Dimensional Classroom Culture and Ocean Plastic Pollution: Issues and Solutions.

National Harbor

This area conference, being held November 15–17 in Maryland just outside of Washington, D.C., focuses on **Science Education: A National Priority**, with three strands: Freedom to Become Scientifically Literate, Cultivating Curiosity in the Capital Region, and Monumental Challenge: STEM Equity, Diversity, and Advocacy via *NGSS*. Mireya Mayor will deliver the keynote address, Wild About Science: My Journey From NFL Cheerleader to National Geographic Explorer.

Also featured will be Heidi Schweingruber (Becoming Scientifically Literate: Insights From Research on Learning and Teaching), Ned Tillman (Seven Touches to Enlightenment), and a panel discussion on Advocacy and Equity: Empowering Teachers to Speak Out with Roberto J. Rodríguez; John B. King, Jr.; Laura Casdorph; and Mary M. Thurlow.

A short course, Academic Vocabulary Through Engaging Phenomena, will guide participants through *Next Generation Science Standards* lessons that help engage English language learners and build academic vocabulary through discussion, writing, and reading.

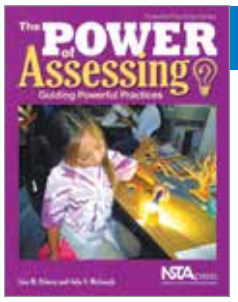
Charlotte

Focusing on **Energize Science: Educate and Engage**, the Charlotte conference will open on November 29 with the keynote address by geothermal scientist and National Geographic Explorer Andrés Ruzo: Scientific Research, Amazonian Conservation, and K–12 Classrooms: A Story of Potential Energy. The conference, which will run through December 1, offers a variety of sessions, including many that follow one of the conference's three strands: Illuminate Literacy Through Science, Amp Up Science Instruction, and High-Voltage Science Strategies Beyond Standards. Featured presenters are Amber Leigh McFarland Kendall (Novel Engineering and Integrated STEM Lessons for Developing Literacy and Problem-Solving Skills), ChaMarra K. Saner (Stepping Outside the Bounds: Character, Creativity, Community, and Culture), and Laura Kloepper (Cultivating Curiosity: Practical Tips to Create High-Voltage Experiences for Students Outside the Classroom Through Community and Scientific Partnerships).

The conference also features three short courses: The IMAGINE-NC Project: Integrating Mathematics and Geology in Eastern North Carolina; Model Rocketry: A Highly Motivational STEM Teaching Tool; and Not the Usual Suspects: Strategies to Cultivate New Community Partnerships.

Early bird registration for members of NSTA or hosting state affiliates costs $190, and advance registration costs $200 (registration deadlines vary by conference). Members of the American Association of Chemistry Teachers, American Association of Physics Teachers, American Chemical Society, American Society for Engineering Education, and National Association of Biology Teachers also receive the discounted rate. Area conference attendees can earn graduate credits by completing required assignments and submitting an NSTA transcript within three weeks of the end of the conference (an additional fee applies).

Visit *www.nsta.org/conferences* for more information on NSTA's area conferences. Don't forget to follow #NSTA18 on Twitter! ●



NSTA PRESS: *The Power of Assessing: Guiding Powerful Practices*

Engaging Students and Teachers in Assessments

Editor's Note

NSTA Press publishes high-quality resources for science educators. This series features just a few of the books recently released. The following excerpt is from The Power of Assessing: Guiding Powerful Practices *by Lisa M. Nyberg and Julie V. McGough, edited for publication here. To download the full text of this chapter, go to* https://bit.ly/2JXDNO7. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

How Do I Build an Assessment Plan Using Backward Mapping?

Working backward helps the teacher monitor progress as students build skills. Starting with a collaborative writing project that organizes the learning is a first step in preparing students to be able to write independently about any animal or topic. Group research and guided writing experiences scaffold learning to help students along the way. Building models helps students understand what they are reading and writing in a purposeful way. Students build confidence in independent writing as they use previously modeled strategies for a variety of topics.

Collaborative Writing

Students learn how to organize thoughts in writing through a collaborative inquiry process that brings their ideas together to create a model writing product. Integrating science and literacy standards engages students, as they want to learn more and communicate their ideas. Collaborative writing lessons help students discover the purpose for organizing information when writing. Working collectively as a group guides students to evaluate information for accuracy and clarity. The teacher is able to formatively assess students throughout the process, making note of students who may need more scaffolding.

Group Research

Small groups engage in online research using National Geographic (*https://bit.ly/1pD9VYG*) and Wildscreen Arkive (*www.arkive.org*) to see photographs and videos of real ocean animals. Students are working on obtaining, evaluating, and communicating information. Visual resources provide context for student groups to discuss, collaborate, and plan their model animal. The teacher guides discussions through small–group focus investigations to help students make sense of the information. Multiple experiences including observations, drawing, and designing a model will help support students as they write about their group's animal.

Independent Writing

Rich and varied experiences provide a scaffolding of tasks to help students gain confidence in writing independently. Students apply research, reading, and writing skills to produce writing on any animal. Students are eager to research new topics as they obtain, evaluate, and communicate what they learn. Students refer to the collaborative writing as a model for their independent writing.

Universal Design for Learning guidelines suggest providing multiple means of engagement for the learner; providing multiple means of representation to present the content; and providing multiple means of action and expression so the students can show what they know (CAST 2011; Nelson 2014).

Gardner's Multiple Intelligences theory suggests that people have very different intellectual strengths. These strengths are very important to how people represent things in their minds and how they express their understanding (*Edutopia* 2009; Armstrong 2009).

Consider the synergy of looking through the lens of multiple intelligences while providing multiple means of action and expression in which students may show what they know in a variety of ways. Imaginative and innovative assessment design helps diverse learners and teachers access understanding. ●

Figure 2.5. Backward Map to Support All Learners

Meeting the needs of a diverse group of learners can be a challenge. The picture above shows a combination class of first and second graders, including students with special needs such as autism and language learning. What questions will you ask to assess what the students know? How will you use this information to plan and scaffold lessons that help all students reach identified learning goals?

How Do I Design Assessments for *All* Learners?

Students need opportunities to show what they know in a variety of ways and at multiple points along the way. Knowing what to look for and how to interpret what you see may guide you to plan new experiences. Questioning, investigating, and assessing help you guide learners and plan experiences that offer *all* learners the opportunity to construct understanding.

Figure 2.1. Backward Mapping

3 Independent Writing: Students apply research, reading, and writing skills to create writing on any animal or topic.

2 Group Research: Students work in groups to research the structure and function of an ocean animal and then design and build a model of the animal. Three-dimensional experiences include collaboration and discussion, video resources, reading, writing, building, and presenting.

1 Collaborative Writing: Students learn how to organize writing through a collaborative inquiry process that brings their ideas together to create a model writing product.

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American Museum of Natural History

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NSTA Virtual Conferences Online Professional Learning

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.

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http://learningcenter.nsta.org/onlinecourses

NSTA National Science Teachers Association

Looking for an opportunity to shape high school science education on a national scale?

The National Science Teachers Association is in search of a veteran high school teacher to serve as the next Field Editor of *The Science Teacher*.

The Field Editor's responsibilities include:

- Identifying essential topics for our high school teacher journal;
- Soliciting articles on these topics from a genuinely diverse mix of engaged educators and columnists; and
- Overseeing the manuscript review process to ensure articles demonstrate good sense, exemplary safety practices, scientific accuracy, classroom usefulness, and alignment with the *Next Generation Science Standards*.

The Field Editor has ultimate responsibility for the journal's content, and therefore must aim high to illustrate best practices while including the everyday activities most likely to achieve our goal of "...excellence and innovation in science teaching and learning for all."

The ideal candidate is a smart, articulate, and effective educator, team player, and communicator who can tap into a network of exemplary secondary level science educators. In particular, the successful candidate must have the following qualifications:

- Experience as a classroom teacher of science (high school);
- A solid science background with a working knowledge of the *Next Generation Science Standards*;
- Insight into enduring objectives and current trends in science education;
- Ability to network in search of suitable content for the journal; and
- Ability to communicate effectively with authors as well as NSTA members, committees, board of directors, and staff.

This is a part-time, three-year appointment, renewable for additional terms. Travel required (two to four trips per year). Stipend and training provided.

To apply, e-mail a concise vita and a letter that specifies related experience and background to the Publisher, Ken Roberts (*kroberts@nsta.org*), by **October 30, 2018.**

BLICK ON FLICKS

Ready Player One: All Hail Pop Culture

By Jacob Clark Blickenstaff

Stephen Spielberg has moved into adapting young-adult fiction with *Ready Player One* (*RPO*), a sci-fi action adventure film based on the 2011 novel of the same title by Ernest Cline. While Spielberg and the stars should not expect Oscar nominations for this film, it does have a ton of fun pop culture references, a nonstop action plot, and ways for science teachers to introduce haptic communication and frames of reference.

RPO is set in 2045, in a dystopian future in which people escape their lives through a virtual world called Ontologically Anthropocentric Sensory Immersive Simulation (OASIS), a massively multiplayer online simulation game. Wade Watts (played by Tye Sheridan) is an orphan who lives in a neighborhood known as The Stacks, where multiple layers of mobile homes are piled atop one another. Players like Wade create an avatar in OASIS that can resemble anything they can imagine, human or not.

Wade's avatar is called Parzival based on one of the Knights of the Round Table in Arthurian legends. Avatars like Parzival interact with one another and with objects in the virtual world, including clothing, cars, and weapons. Parzival/Wade has friends and allies in OASIS whom he eventually meets in real life. Parzival's key ally is Art3mis/Samantha (played by Olivia Cooke).

An avatar can collect or make items of value in OASIS to use or trade with others. If your avatar is "killed," your items are dropped for others to collect, and your in-game money is lost.

Near the start of the film, one of the co-creators of OASIS announces that three keys have been hidden in the game, and the first person to collect all three will receive an "Easter egg" that will give that player control and ownership of OASIS. Easter eggs are hidden features in video games that sometimes confer special powers on the player. One of the first Easter eggs was in the Atari 2600 game, Adventure, which features prominently in solving the puzzle in *RPO*. It shouldn't be a plot spoiler to say that Wade/Parzival finds the keys and the Easter egg with the help of Art3mis/Samantha and his other friends.

The main antagonist in *RPO* is Nolan Sorrento (played by Ben Mendelsohn), head of Innovative Online Industries, or IOI. IOI is a competitor of Gregarious Games, the company that created and runs OASIS. IOI has hundreds of employees searching for the keys and the Easter Egg so that it can take over OASIS and profit from the game.

To make the virtual reality (VR) experience immersive for players, they wear 3-D goggles and interactive clothing, and walk on omnidirectional "treadmills." Folks with little money in the real world have basic rigs that just include goggles and a glove or two. The wealthy have full-body suits that transmit real sensations of touch and temperature to players. Devices that communicate with users through touch are called "haptic" devices.

You probably use haptic tools without knowing it. Haptic controls are also called "touch interfaces" because the device is communicating responses to the user through what the user feels in his or her hands, skin, or muscles. Your students almost certainly have used video game controllers that vibrate in certain game situations, like driving off the road in a car racing game. Your smartphone vibrating in your pocket is another example of haptic communication. Industrial applications include excavation machines that push back on the control stick when the scoop encounters an obstacle. The operator can then "feel" the size of a buried rock and work around it.

For a VR system to be truly convincing, your body should feel the physical sensations appropriate to what you are seeing in the display. Ideally, if you are walking through a virtual desert, your skin should feel warm, or if you open a virtual refrigerator, you should feel something like a handle in your hand, and some cool air in front of you. The body suit, gloves, and treadmill do this for players in *RPO*.

There are some major challenges to VR in dealing with gravity, though. At one point, Parzival and Art3mis visit a dance club in OASIS and end up flying/floating all around the virtual space. The VR experience of this would be tremendously disorienting, though, because Wade's and Samantha's physical bodies are still feeling their weight; the suit has no way to make them feel weightless. Einstein's Equivalence Principle tells us that they would need to be in free fall around the Earth, or in deep space far from any mass to have that floating feeling. (Floating in a tank of water would be close, but not a total simulation.)

The Equivalence Principle says that being in a gravitational field is indistinguishable from being in an accelerated frame of reference. The classic thought experiment is to be inside a box with no windows. A person inside the box would have no way of determining whether they were in that box at rest on the Earth, or in a rocket accelerating at 9.81 m/s^2 in deep space. Similarly, they would have no way of knowing if they were in deep space with no significant gravitational field or in free fall around the Earth.

Science, technology, engineering, and mathematics teachers who want to connect a fun movie to their content could use *Ready Player One* to teach about frames of reference, the Equivalence Principle, and haptic technology.

Jacob Clark Blickenstaff is an independent science education consultant in Seattle, Washington. Read more Blick at http://goo.gl/6CeBzq, *or e-mail him at* jclarkblickenstaff@outlook.com.

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(All dates are deadlines unless otherwise specified.)

September 12—**Session proposals** for the Eighth Annual STEM Forum & Expo in San Francisco, hosted by NSTA; NSTA's 2019 Area Conferences; and the association's 2020 National Conference on Science Education **are now being accepted.** The STEM Forum will be held July 24–26, 2019. The area conferences will take place in Salt Lake City, Utah (October 24–26, 2019); Cincinnati, Ohio (November 14–16, 2019); and Seattle, Washington (December 12–14, 2019). The national conference will be held April 2–5, 2020, in Boston, Massachusetts. For more information on presenting at an NSTA conference or to submit a proposal, visit *www.nsta.org/conferenceproposals.*

September 12—Find out how you can take a leadership position with NSTA and help shape the future of science education during **Leaders for Science Education: Preparing an Application for the NSTA Board and Council**, a free NSTA Web Seminar. Learn about the criteria for each position and strategies for completing an effective application. 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 *https://goo.gl/PRmPR2.*

September 21—It's your last chance to save on registration for **Elevating Science: Digging Deeper, NSTA's Area Conference on Science Education in Reno, Nevada!** The conference takes place October 11–13. Advance registration costs $200 for members of NSTA, Nevada State Science Teachers Association, American Association of Chemistry Teachers (AACT), American Association of Physics Teachers (AAPT), American Chemical Society (ACS), American Society for Engineering Education (ASEE), and National Association of Biology Teachers (NABT). For more information and to register, visit *www.nsta.org/reno.*

October 2—Don't miss the first meeting of **Shifting to the *NGSS*: Professional Book Study!** This online book study features live web seminars and asynchronous discussions focused on NSTA's enhanced e-book, *Discover the* NGSS*: Primer and Unit Planner*. Additional live events will be held on October 9, 16, and 23. Each event will run from 7:15 to 8:45 p.m. ET. Registration for NSTA members costs $63. Participants will receive a certificate of participation from NSTA after each live web seminar (1.5 hours each). For more information or to register, visit *https://goo.gl/PRmPR2.*

October 5—Register by this date to maximize your savings on registration for **Science Education: A National Priority, NSTA's Area Conference on Science Education in National Harbor, Maryland**, November 15–17. Early bird registration for members of NSTA, Maryland Association of Science Teachers, AACT, AAPT, ACS, ASEE, and NABT costs $190. For more information and to register, visit *www.nsta.org/nationalharbor.*

October 19—**Applications for the NSTA Board of Directors and Council** are due by 11:59 p.m. ET. Open positions include President; Division Directors for Coordination and Supervision, High School Level Science Teaching, and College Level Science Teaching; and District Directors for NSTA Districts III, V, IX, XI, XV, and XVII. For eligibility information and to apply, visit *www.nsta.org/nominations,* or e-mail *nominations@nsta.org.*

October 19—Register now for early bird pricing for **Energize Science: Educate and Engage, NSTA's Area Conference on Science Education in Charlotte, North Carolina.** The conference will be held November 29–December 1. Early bird registration for members of NSTA, North Carolina Science Teachers Association, South Carolina Science Council, AACT, AAPT, ACS, ASEE, and NABT costs $190. For more information and to register, visit *www.nsta.org/charlotte.*

October 24—Do you want to receive recognition for your science teaching expertise and win awards to support your efforts? Don't miss **Developing a Competitive Teacher Award Application**, a free NSTA Web Seminar. Gain insight into the NSTA awards application process and learn tips for creating a strong application. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit this website: *https://goo.gl/PRmPR2.*

November 1—Help your fellow middle level educators teach about agriculture by submitting a manuscript on the theme **"Farm to Table (Agriculture, Soil Chemistry, Botany, Animals)"** for the July 2019 issue of ***Science Scope.*** Possible topics include chemical components of soil, factors affecting erosion, plant growth investigations, and field trips. General-interest manuscripts, as well as manuscripts focused on making, technology, practical research, and more, are accepted anytime. Read the call for papers at *https://goo.gl/l6bNbz.*

November 14—Find out how to craft a strong submission for the Shell Science Teaching Award during **Developing a Competitive Application for the Shell Science Teaching Award**, a free NSTA Web Seminar. Learn about the application process and how to showcase your efforts. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *https://goo.gl/PRmPR2.*

November 28—Do you dream about the effect a new science lab could have on your students' learning? Find out how you can win a $20,000 lab makeover for your school during **Developing a Competitive Application for the Shell Science Lab Challenge**, a free NSTA Web Seminar. The challenge recognizes middle and high school science teachers who share how they get the maximum educational benefits for their students using only limited supplies and budgets. The session will run from 6:30 to 8 p.m. ET. For more information on NSTA Web Seminars or to register, visit this website: *https://goo.gl/PRmPR2.* ●

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To apply or nominate an exemplary teacher, visit *www.nsta.org/awards.* All entries must be received by midnight Eastern Time on **December 17.** No fee is required to enter. For more information, contact Amanda Upton, NSTA Awards and Recognition Program liaison, at (703) 312-9217, or e-mail *awards@nsta.org.* ●

Quotable

All our knowledge has its origins in our perceptions.

—Leonardo daVinci, Italian artist and inventor (1452–1519)