www.nsta.org November 2018 Vol. 30 No. 4

JESSICA BOUALAVONG

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National Science Teachers Association

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Helping Students Develop Perseverance

While some people use the terms "perseverance" and "grit" interchangeably, David Upegui, science teacher at Central Falls High School in Central Falls, Rhode Island, has a different view: "I am extremely fortunate to work in Central Falls (the most economically disadvantaged city in Rhode Island), where I teach some of the best students in our country. I have several strategies that I have [used] in the past, and also some potential warnings about the use of the 'grit' concept (perseverance is much better)."

With "100% of students [at my school] receiving free or reduced-price lunch," 80% Latino, and many the children of immigrants, Upegui maintains, "all the students are already 'gritty.' They're survivors. That these students show up [at school] at all is amazing."

Perseverance, however, "is having the faculty to look at academic challenges as a way to grow personally and gain power over the world," says Upegui. In his classes, "students feel science is our language and knowledge…and a tool for empowerment. They understand that science can teach you how to question the world, and you can apply it to all aspects of your life. My students realize it's not about one assignment or one test: It's about tools to help them change the world." Science, he emphasizes to students, "has built into it the ability of changing. Science isn't static."

Helping students persevere is "not training [them] to be managed by others, but to manage others, to be leaders," Upegui asserts. Because many of his students "don't see themselves in college, [they] need to be trained to be problem solvers and better citizens," he says.

DANI RYPKA

Tom Meagher, district STEM education coordinator for Owatonna Public Schools in Owatonna, Minnesota, shows students how to hold a Monarch butterfly before releasing it. "Finding, collecting, feeding, cleaning, and releasing live Monarch butterflies teaches students about scientific observation, collecting samples, recording changes over time, life cycles, and stewardship. Each step requires practice in perseverance," he says.

Upegui shares stories about the successes of former students, many of whom accomplished goals they once thought unimaginable including attending "Harvard, MIT, the Naval Academy." He talks about scientists who overcame obstacles, such as Lynn Margulis, who was honored for her seminal work in endosymbiosis. "She was rejected 18 times until her research was published," Upegui relates. "[I emphasize that] perseverance is something we all can develop: Work hard and work smart."

Because some of his students are skeptical about their potential for success, Upegui says he carefully scaffolds challenging tasks "to help students have small successes first. I make them challenging enough so it's interesting, but simple enough to be doable…

"When students work with [one another], they learn to rely on [one another] in a learning community. The students feel, 'The responsibility to succeed is on all of us.' Purposeful grouping and peer-editing assignments" can bolster that feeling, Upegui explains.

Dave Carlgren, physical science teacher at Renert School in Calgary, Canada, and his colleagues are taking perseverance through collaboration a step further. "Our science department is looking at a new evaluation strategy

See Perseverance, pg 5

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COMMENTARY: **Joyce Gleason**

ET: An Alternative Path to Engineering Careers

By Joyce Gleason

Joyce Gleason

This summer, Congress reauthorized the Carl D. Perkins Career and Technical Education Act, refocusing attention on career and technical education. I believe most in science, technology, engineering, and mathematics (STEM) education want continued support for our students entering technical fields. As a teacher, I have seen talented students struggle as their desire to pursue engineering was dampened by math requirements and the theoretical nature of the discipline. A more hands-on and practical approach could open new pathways to that career. For some students, Engineering Technology (ET) can be that path.

ET is a four-year bachelor's of science (B.S.) degree featuring multiple hands-on experiences and internships, with fewer theoretical courses in a variety of engineering areas. According to the 2017 National Academy of Engineering (NAE) study, *Engineering Technology Education in the United States,* 528 universities offer bachelor's of science degrees in ET. (Nearly twice as many schools offer two-year ET associate degree programs.) Much of the coursework focuses on practical applications of engineering principles.

These programs may not be well known beyond their immediate geographic areas: I personally have met very few STEM teachers who were aware of these programs. However, some programs, such as the one at Purdue University, work to attract ET students from out-of-state. Some ET students enroll in B.S. programs after earning an associate's degree. Others have had military careers, or years of experience in industrial settings in an engineering-related field. Often universities cooperate with nearby industry to provide appropriately-trained individuals for immediate employment.

In 2014, NAE formed a study committee to examine the nature, extent, and value of ET programs. I was the only high school science teacher among the 12 members. Over 18 months, the committee studied government-collected data, sponsored concurrent research on ET education and employment, and held a workshop for interested individuals from academia, business, and industry. The variety in courses and program titles across educational institutions and accrediting bodies, as well as in job titles and duties, were particular challenges in compiling data and drawing conclusions. Four-year graduates are sometimes called "technologists," though many are hired and work as engineers. (Two-year graduates are often considered technicians.)

Four-year ET graduates constituted approximately 17% of all students earning four-year engineering degrees in 2013 (the latest figures for this data at the time of the NAE report). Compared with traditional engineering, students in these programs include higher percentages of African-Americans, Hispanics, and native Americans or Alaskan Natives (10.7% African-American ET graduates vs. 3.8% African-American "traditional" engineering grads; 10.0% Hispanic ET graduates vs. 9.6% "traditional" Hispanic grads; and 0.8% native American or Alaskan Native ET graduates vs. 0.3% "traditional," in 2014). Compared with traditional engineering, women were less well-represented in ET (12.0% of ET graduates were women vs. 19.8% with "traditional" degrees who were women, in 2014).

Often new graduates find employment near the universities offering this degree. While many employers do distinguish ET graduates from those with a "traditional" B.S. in engineering, these grads are valued as highly adept and with substantial practical knowledge. Although the data seems to indicate that engineering technologists command lower average salaries (often by 20% or more) than the average traditional engineering graduates, many four-year ET grads work in positions indistinguishable from those held by traditional engineering graduates and thus are paid accordingly.

Furthermore, the difference in the degree title often fades in significance as ET grads demonstrate their skills and knowledge throughout their careers. As with "traditional" engineers, ET grads often are promoted to middle management, move into sales positions, or find positions outside of engineering in which their skills are valued. ET graduates can expect high levels of successful employment for satisfying careers.

I strongly urge secondary science teachers and counselors to inform their students of ET as an education and career option. In the name of differentiated instruction, these programs could be just the ticket to a STEM career for many more of our students. When parents learn of ET, they, too, may find a satisfying match for their children's capabilities and preferences.

The NAE report can be purchased, read online, or downloaded as a free PDF at *www.nae.edu/169259.aspx.* ●

I wish to thank Greg Pearson, scholar, K–12 Engineering Education and Public Understanding of Engineering, National Academy of Engineering; Christopher Fox, manufacturing engineer and educator; Judith Stevenson, academic advisor (retired), Purdue University; and Tamara Groll, academic advisor/placement coordinator, Purdue University School of Engineering Technology, for their contributions and comments in the preparation of this article.

Joyce M. Gleason is a retired science education consultant. She taught high school biology for 25 years in Norwood, Massachusetts, and has worked as a science curriculum liaison, teacher educator, and director of outreach for the Annenberg/CPB Project (now Learner.org).

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Perseverance, from pg 1

that involves students' individual assessments also counting toward a 'pod' mark involving the individual marks of others. In this way, subcommunities of individuals may form that 'look out' for…one another. They can help other students in their pod study and prepare to do well," he explains.

This idea came about because "we see a disconnect between what's done in school and the way the world is," says Carlgren. Often in the workforce, people "collaborate in support and aren't competitive. We wanted to reflect this in classroom assessment and evaluation."

Beginning this year in fourth- and fifth-grade physical science classes, students have been grouped into pods of four to five students for collaboration. This pod size is "large enough that there's a significant impact of [grade] averaging, but not too large so that students can easily help one another," Carlgren points out.

Grouping is based on teachers' knowledge of students' strengths and weaknesses. "We teach students over multiple years," he notes, so teachers have had sufficient time to familiarize themselves with their students' habits. Other factors in grouping are student communication modes, parental support, past success in science, students' friends, homerooms, and "how often students will see one another during the school day, the more, the better," Carlgren relates. Pods can change during the year, if needed, he adds.

"The pod effect" occurs "before the test or quiz," says Carlgren. High achievers benefit from teaching the material to their peers, while struggling students "will have several students in their pod who can help them and provide different perspectives," he reports.

Carlgren and his colleagues hope the pod arrangement also will discourage bullying. "We're pushing the idea that all students have strengths. The pods allow students to focus on the academic side; we encourage them to help the bully and the bullied," he explains.

So far, students have been "extremely supportive" of the pod concept and of their pod members, says Carlgren. By the end of the school year, the science department hopes to have this strategy incorporated in science classes in grades 4–9. "We hope students will become accustomed to helping others," he observes.

The Power of 'Yet'

Tom Meagher, district STEM (science, technology, engineering, and math) education coordinator for Owatonna Public Schools in Owatonna, Minnesota, works closely with more than 120 teachers to design and implement STEM lessons "grounded in [a] growth mindset [and] perseverance…When you approach learning through problem solving, teamwork, and challenges, there's a whole different mindset: 'We're going to solve this together.'"

When describing strategies for encouraging perseverance, Meagher points to Stanford University psychologist Carol Dweck's work on growth mindset and her TED Talk, The Power of Yet. "When a student says, 'I don't get it,' the teacher responds, 'You don't get it yet. What's our next step?'," he explains. "This provides a path to grow and expand their knowledge. I find it helps with our teachers, too,…to help them grow out of their own comfort zones."

To help students develop perseverance, Meagher discourages teachers from "labeling students according to how they perform on tests. Life's not a race." Developing student perseverance begins with teachers recognizing, for example, that for a kindergartener to successfully do leaf rubbings and find and sort leaves, "fine motor skills are needed. Some students aren't experienced in this, so we need to teach them the fine motor skills, plus [things like] sorting and identification," he maintains.

Often students who are used to getting things right the first time need help developing perseverance, Meagher observes. "They had to learn to change the way they think. [The less-gifted] students were more diligent, more strategic problem solvers." He found pairing the two types helped the advanced students learn perseverance and allowed the less-gifted students to get help with reading.

Meagher also advises, "Don't give students specific roles in groups, like notetaker. Just give them the assignment and say, 'It's up to you to figure it out.' They will determine their roles [naturally]." Educators need only step in "when strong personalities are involved," he suggests.

Rather than presenting challenges to students as things to work on, Meagher suggests teachers present challenges as opportunities for practice. "Students see this as building skill," he explains. ●

STEM Connects Past and Present

Integrating science, technology, engineering, and mathematics (STEM) with social studies can bring new relevancy to the content areas, and incorporating historic sites increases students' engagement even more.

Taking cross-curricular lessons out of school "is a great way to engage kids in science and history," says Janet Sweat, fifth-grade science teacher at Fort White Elementary School in Fort White, Florida. She has been taking students to Ichetucknee Springs State Park in Fort White for several years, first as a seventh- and eighth-grade teacher and now with her fifth-grade students.

Sweat, working with Sam Cole, a park biologist, and Trini Johannesen, a sixth-grade science teacher at Fort White High School, received a Florida Department of Environmental Protection grant to develop a curriculum for the Learning In Florida's Environment (LIFE) program in 2012. "When we created the labs, we thought about what the specific format needed: data gathering, math questions, history, and real-world relevancy, writing portions. We would give them a scenario, real-world problem solving as best we could," she recalls.

Some labs have students assume the role of someone who wants to build in the park; they would have to consider construction sites. "We wanted to get kids to think about their opinions, the where and why, to justify their own thinking. We had 12 labs for the middle school. We'd spend about an hour there and then do analysis at school," says Sweat.

Since the middle and high school was located only a few minutes from Ichetucknee Springs, Sweat says she would take her students there multiple times over several days to conduct the labs. At the park, students collected soil samples, looked for Native American artifacts, and tried to discern natural features from human-made ones. "The land is limestone; it's very porous. The water filters down…Karst [topography] features sinkholes...Students identify sinkholes versus phosphate mines. Water is always a focus [of the labs]… It's very relevant to everyday life," Sweat points out.

She says many of her former students were inspired to protect the natural springs, often returning to remind her of highlights from the labs. "I see that being huge," she says, adding that scores in the district have been on the rise, justifying the program.

Now as a fifth-grade science teacher, Sweat plans to take her four classes of students to Ichetucknee Springs for a full-day experience. "We'll roll in ecology: land features, weathering and erosion, what's [hu-] man made and what's natural. [They] will go on to middle school, where they are still doing the original 12 labs."

JESSICA BOUALAVONG

After learning about the California Gold Rush and geology, third graders from the Town School for Boys in San Francisco try their hands at panning for gold at Columbia Historic State Park.

"It's not classic project-based learning, but it's definitely interdisciplinary," explains Jessica Boualavong, as she describes a third-grade field trip that incorporates geology with social studies. Her students at Town School for Boys in San Francisco, California, learn "a lot about how early California was settled," first by Native Americans, and then through the Gold Rush of the 1800s. The highlight of the year is a trip to Columbia State Historic Park (*https://bit.ly/1CGQS2W*), a California Gold Rush town.

"[Town School students] have been going on this trip for many years; there previously hadn't been a STEM or science component to this unit," Boualavong says. When she joined the school three years ago as the Lower School STEM teacher, she met with the K–4 teachers to try to align some units.

"We were very intentional in mapping science to some things they were doing in some other subjects. In California [it's a] fourth-grade standard to understand California history. Almost every third and fourth grader knows about the Gold Rush," she continues. Noting Town School is a private school, Boualavong says that they are "informed by" the state standards, but had some ability to "rearrange things to fit teacher and student interest."

On the social studies side, students study the history of the Oregon Trail and map out native settlements. In science, they learn about the "geology of the Bay Area. They learn about rocks and minerals and their differences. They learn how to pan for gold and take that skill with them when they go to Columbia and try to pan for gold there," Boualavong says. "It's very immersive, and students look forward to it every year. They're excited that all their different teachers are communicating about it…They start to see more relevance to what they're learning… start to understand, start to learn to identify rock formations. The practical applications make [what they're learning] come alive, make it come out of the textbook for them…It's definitely something they keep with them after third grade."

STEM-ifying Traditions

In Guam, Laura Arndt of Global GreenSTEM has been working with local K–12 teachers to create curriculum that makes STEM relevant to the island's unique history, culture, and natural environment. "Starting with the science concepts and STEM projects targeted for work with particular grade levels, I identify island-specific environmental and cultural issues and traditions to 'Guam-ify' extension lessons," she says.

Through Global GreenSTEM, Arndt had led professional development sessions on Guam in which teachers build simple stringed instruments that become models for their traditional stringed instrument—the belembaotuyan—as part of lessons on vibration, pitch, and volume. She has challenged teachers to adapt the "classic" foil boat engineering design challenge for buoyancy to test models of their traditional flying proas (a type of sailboat). Teachers compared different mixtures of diverse local soils for creating sculptures that included models of their historic latte stones of Latte Stone Park.

A middle school class has taken its garden project beyond the school walls to collaborate with a professor at the University of Guam to design "seed bombs" modeled after traditional sling stones. The professor, who was a guest STEM expert at one of Arndt's professional development sessions, has worked with students to create a mixture of local soil, compost, and banana ash to encase native seeds into "seed sling stones" so they can be shot into inaccessible deforested mountainsides. The goal is to restore natural habitats burned by human-caused wildfires, curb erosion, and reduce sediment deposits on beaches and coral reefs. Making and shooting sling stones adds modern relevancy to a historic tradition while helping to solve an island-specific environmental issue. ●

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TOSHIBA NSTA National Science Teachers Association

A Lesson From Picard: Engage

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

I admit it. I'm in "that" group of sci-fi geeks who call themselves "Trekkies." While we could debate the comparative virtues of the various *Star Trek* series or even *Star Trek* versus *Star Wars*, I want to focus on a key lesson from *Star Trek: The Next Generation (TNG),* which is To Engage!

In every memorable *TNG* episode, Captain Jean Luc Picard considers his potential options to accomplish the mission at hand, then looks toward the camera and commands, "Engage!"

Each and every day when we walk into a classroom, center, museum, or after-school program to work with students in the field of science education, we have a mission to accomplish. Our continuing mission is this: To instill in those students a love of learning while engaging them in the natural, physical, and technological world.

What does it mean "to engage"? If you think for a moment about engagement, you may reflect on educational psychology and learning theories. Engagement in a subject or topic often leads to additional curiosity, and based on a study from the University of California, Davis, we know that when curiosity is piqued, changes in the brain prepare it for learning about the topic (and other information as well).[1] This is nothing that we don't already know as educators.

In the field of education, the idea of student engagement is often discussed in relation to curiosity, interest, passion, or degree of attention. We often strive to engage students, since learning is enhanced when students are more engaged. But this lesson is not only relevant to students: It is also relevant when adults engage in new learning opportunities.

So my mission for each of you is to *"find a way to engage with NSTA in the next week or the next month."* Hopefully, this engagement will lead to continued curiosity, passion, and overall interest in and excitement about our field and our association.

"So exactly how do I engage with NSTA?" might be the next question. Just as in *Star Trek,* we have multiple options to accomplish the mission. To quote Picard, "Every choice we make allows us to manipulate the future." To become engaged, you must choose to do so. First, decide how you will begin! You could

- Pick up a journal and read the call for papers;
- Respond to or write a post for the NSTA Blog;
- Explore how an NSTA Press book can help you enhance your lessons or assessments;
- Attend a virtual conference or web seminar;
- Participate in an online book club;
- Join an e-mail list;
- Go to *https://bit.ly/1rLQUr1 to s*ubscribe to one or more of NSTA's e-newsletters;

- Submit a session proposal (at *https://bit.ly/1cFqzAG*) for an upcoming conference to share your knowledge and expertise with colleagues;
- Attend area conferences, or plan now to join us for the National Conference on Science Education in St. Louis in the spring (see *www.nsta.org/conferences*);
- See what's new on the *NGSS@* NSTA Hub (*https://ngss.nsta.org*) in the area of three-dimensional learning and *Next Generation Science Standards (NGSS)* resources;
- Create an account on the NSTA Learning Center at *https://learningcenter.nsta.org,* and contribute your own resources and read ones submitted by others;
- Follow NSTA on Twitter (@NSTA), Instagram (official_nsta), or Facebook; and
- Participate in the NSTA Tweet Chat (every other Thursday at 9 p.m. Eastern Time) by following #NSTAchat.

These are but a few of the ways you can engage, with NSTA and other educators, through your membership in this association, which helps each of you advocate for science education. Please also watch for additional ways to engage with NSTA and fellow colleagues in the next several months, as NSTA begins launching a new digital engagement strategy. This plan will provide additional strategies for members to connect, communicate, and contribute to the field of science education.

I recall another frequently quoted line from Picard. After discussing options with key people and deciding on a course of action, he says, "Make it so." Therefore, it is your job to determine your best path to *engage* and *make it so!*

(1). Yuhas, D. 2014. Curiosity prepares the brain for better learning. *Scientific American. https://bit.ly/2yyMnit*

Quotable

We each exist for but a short time, and in that time explore but a small part of the whole universe.

—Stephen Hawking, English physicist (1942–2018)

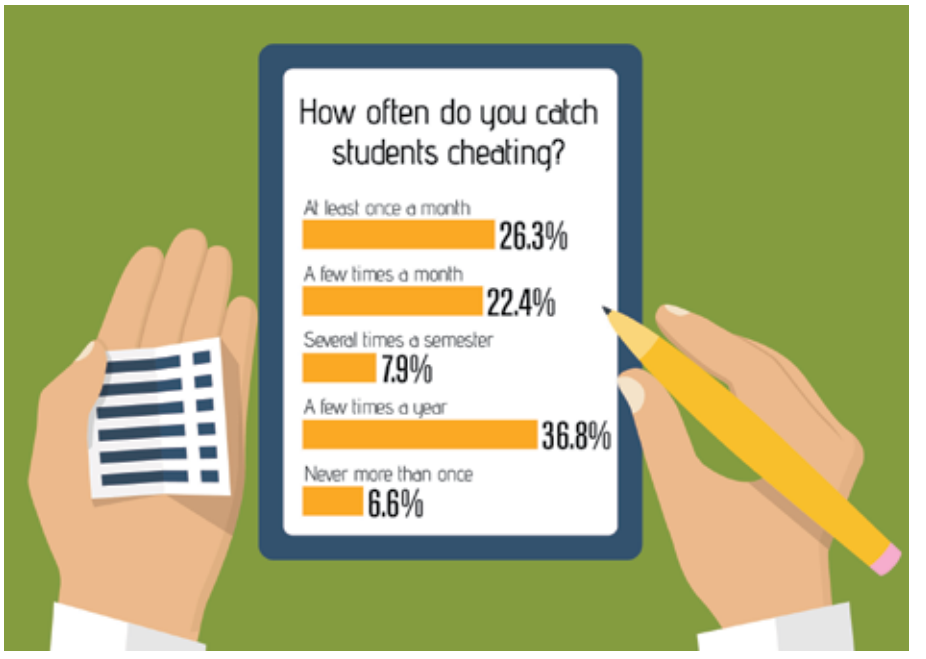
Catching—and Preventing—Cheating

Cheating is not unusual, with 26.3% of respondents in a recent informal *NSTA Reports* poll saying they caught students cheating at least once a month; 22.4% a few times a month; and 36.8% a few times a year. Only 6.6% said they never caught students cheating more than once. Educators said cheating was most commonly discovered when students turned in duplicate papers (67.1%) and when they submitted work containing rote phrases or language that didn't fit the questions asked (64.5%); only 15.8% reported finding cheating through the use of detection software or similar technology.* Teachers also reported catching cheating through observation, such as noticing difference in handwriting, catching students copying papers, and finding "cheat sheets."

Nearly half of educators said they prevent cheating on homework assignments by assigning homework that could not be easily copied (48.6%) and varying assignments and customizing worksheets (45.9%).* To prevent cheating on tests or quizzes, educators most commonly reported making sure students turn in tests/quizzes before leaving class (67.1%); not permitting electronic devices to be used in class (65.8); creating physical obstacles to cheating in class, such as having space between seats or placing temporary visual barriers (47.4%); and customizing tests so that students who copied answers would fail (44.7%).* The most common penalties for cheating included failing grades for the assignment or test and notifying parents/guardians that the student had cheated, with 63.2% reporting taking those actions.* One educator reported assigning students caught cheating "mandatory extra help sessions. It is often a student who has trouble managing time [who] cheats."

More than three-quarters (77.6%) said their schools educate students about various types of cheating. About one-third (31.5%) said parents/guardians typically responded in a "neutral" way when informed a student has cheated, with 39.7% reporting the parents/guardians were supportive of corrective action, and 28.8% reporting parents/guardians either deny the cheating or place blame elsewhere.

**Editor's Note: Multiple responses were accepted for these questions.*



Here's what science educators are saying about how they have discussed the role of failure in the learning process with students:

I tell my kids to fail and fail often, but to make sure they learn from their mistakes.—*Educator, High School, Maryland*

Emphasize to them that a lesser grade because they don't understand something is better than a cheated grade because ultimately, the goal is to learn. Remind them that the material is sequential, so that cheating will start to affect all subsequent grades.—*Educator, High School, California*

I try [to] explain to the students that by missing some of the problems on assignments or quizzes, [it] will help them better understand the information when it comes to taking the test.—*Educator, Middle School, High School, Nebraska*

It's ok[ay] to be wrong (like a hypothesis) or even if you are wrong (as in cheating), learn from it, take the consequence, and move on, having learned a life lesson.—*Educator, High School, New Jersey*

I tell them I'd rather see their wrong answer than the same one I saw for three other periods because at least with their answer, I can gauge how to help them.—*Educator, High School, California*

That is why I make the [homework] score small (20%) and quiz scores small (10%), so they practice and learn. Tests [comprise] 40% [of their grade], and there are usually only two a quarter, so it is a big impact.—*Educator, High School, Minnesota*

Talk about learning from mistakes, opportunity for growth, etc. I also give students the opportunity to retest on content.—*Educator, High School, Ohio*

Failure is a pathway to learning and the opportunity to refine work after it is graded.—*Educator, High School, Tennessee*

Failure is a necessary part of the learning process. Without failure, we cannot understand why our assumption was wrong.—*Administrator, Institution of Higher Learning, Missouri*

[I tell them t]hat it is [okay] to fail. And that as soon as they do take a test or quiz that they fail, I want them to see me immediately so we can work on what they didn't know.—*Educator, High School, Oregon*

[I tell them t]hat failure is part of it, just learn from it [and] don't repeat it.—*Educator, High School, Canada*

Failure at times is expected, part of the learning process, but students should be empowered to seek help, should they need it.—*Administrator, Middle School, Massachusetts*

Educators and parents discuss it often. I think many students see it as a catchphrase at this point, almost like it is a cliché to talk about failure as a good thing.—*Educator, Middle School, New Jersey*

I explain that mistakes are part of learning. It is like taking a person's temperature to see if there is a problem that needs to be taken care of.—*Educator, Middle School, New York*

Failure is an accepted process of learning (as in learning a sport or riding a bike), but it should appear in homework and worksheets so they know the material for quizzes and tests.—*Educator, High School, Connecticut*

[I] have discussed the point is not to have the answer to a particular question, but to be able to use that knowledge of the concept to apply to other situations to solve a problem.—*Educator, High School, California*

Yes, focusing on mindset is a huge part of the work we do in my district.—*Educator, Elementary, Missouri*

Allow retaking of any work, including quizzes up to summative assessment, and encourage them to learn from errors.—*Educator, High School, Missouri*

I talk to them about putting quality time in so that they don't have to cheat.—*Educator, High School, Indiana*

We talk about how the skills they learn in class set a foundation for the upcoming learning.—*Educator, Middle School, California* ●

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NSTA National Science Teachers Association

MULTIVIEW

PULL-OUT SECTION

SCIENCE TEACHERS' GRAB BAG

Inside this Convenient Pull-Out Section you will find:

Freebies for Science Teachers

Realism Virtual Chemistry Labs. M H Check out this collection of "gamified" virtual 3–D chemistry simulations versioned for middle and high school levels. The simulations cover various chemistry topics and support the *Next Generation Science Standards* (*NGSS*). Titles include Rocket Lab (gas-forming reactions), Coffee Cup Calorimeter (thermochemistry), Alkali Metal Lab (periodic trends and exothermic reactions), Titration Lab (acid-base understandings), and Reactions Lab (chemical reactions). Visit *https://realism.io* to learn more and access the materials. (*Note: Free registration is required to access the labs.*)

Augmented Reality (AR) Lessons on Human Body Systems. E M Take your students on a trip inside the human body with AR-enabled resources from Virtuali-Tee. The lessons teach elementary and middle level students about the human body's digestive, circulatory, and skeletal systems and include support materials such as quizzes, challenge questions, and a labeling activity sheet. To use the lessons, teachers download a printable AR tracker and the Virtuali-Tee app. To learn more and access the resources, including a link to the Virtuali-Tee app, go to *https://bit.ly/2EbYAzN*.

STEM Learning With Robots. K12 Using Engage! K12, an interactive learning platform, educators can create and customize their own lesson plans and engage students in science, technology, engineering, and math (STEM) learning with robots. The platform offers a wide range of hands-on activities and digital courses that bring abstract concepts to life with robots. While some of the lessons require an account upgrade to access, others are available free of charge, such as Introduction to Computational Thinking: Investigate ACT and SENSE Cubelets (grades 4–6); Google Expedition—Fly With NASA's Juno Mission to Jupiter (grade 5); and CTE STEM—Automating Toxic Environments (grades 9–12). Explore more free offerings at this website: *http://engagek12.robotlab.com*.


JAKUB HAŁUN

ACS Guidelines and Recommendations for Teaching Middle and High School Chemistry. M H The American Chemical Society (ACS) has updated its guidelines for middle and high school chemistry education. Available at *https://bit.ly/2NtUeUf,* the recently published document identifies core ideas in chemistry that should be addressed in any comprehensive middle or high school curriculum, as well as the best practices for educators to use to teach them. The document also contains detailed recommendations for equipping and maintaining laboratories, staying safe in the laboratory, and storing chemicals.

Imagine If. H This podcast series about climate resiliency is produced by the North American Association for Environmental Education (NAAEE) and National Geographic. The series showcases high school students who are experiencing the real-life impacts of climate change and trying to find solutions in their communities. In each approximately 20-minute podcast, students share their stories, then connect with science experts to get advice on how to tackle their climate challenge.

Recent podcasts have addressed these challenges: How can conservation be reimagined to help Puerto Ricans rebuild in the wake of Hurricane Maria? How can ranching and agriculture continue to grow in the face of future droughts? How can Houston, Texas, residents ensure that Hurricane Harvey recovery solutions align with actual community needs? Listen to the podcasts at *https://imagineif.naaee.org.*

ACT Academy's Smart Library. K12 ACT standardized test makers have developed a "smart library" of online content resources to help K–12 educators align classroom content to learning goals and provide targeted instruction for students. The library contains a database of about 500,000 vetted, high-quality educational videos, games, assessments, homework assignments, and lesson plans. Teachers can assign students ACT Academy homework and quizzes, view the performance and progress of individual students or the entire class, and then receive resources recommended by the Academy library that are tailored for the specific areas of need of individual students or the entire class. Access the library at this website: *https://academy.act.org.*

Evolutionary Genealogy in the Classroom. M H Looking for a fresh approach to teaching evolution in middle and high school classrooms? Consider introducing the topic though evolutionary genealogy, or evogeneao. This "family centered" approach to teaching evolution centers on the premise that

See Freebies, pg G2

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

Freebies, from pg G1

all living things on Earth are cousins. At *https://bit.ly/2QArV8y,* teachers can access resources to learn more about the topic and how to effectively present the concept in the classroom. The resources include explanatory text, an introductory video, a Tree of Life Explorer teaching tool, an evogeneao slideshow, and links to additional evolution materials and websites.

ROB MITCHELL

The Blossoms, the Birds, and the Bees. P E In this lesson plan from Project Dragonfly at Miami University in Oxford, Ohio, young learners (grades preK–2) can grow their understanding of the relationships between plants and pollinators. Through three center-based activities, students discover why hummingbirds, bees, and butterflies choose the flowers they do; model pollinator behavior as they "fly" around the classroom in search of nectar; and use their senses to explore diversity in nature. This lesson plan includes many suggestions for extensions and additions and can be easily be adapted to meet the varying needs of a wide range of students. To access the lesson plan, visit *http://bit.ly/2ydjE3w.*

"How to Incorporate Formative Assessment Into Your Next Generation Science Lesson." K12 Written clearly, and loaded with specific examples, this article from KnowAtom.com reminds K–12 educators about the importance of continuously assessing students during *NGSS*-supported science lessons. The article highlights several ways that teachers can gather meaningful formative feedback as part of science instruction, such as during nonfiction reading assignments, through Socratic dialogues, and by reaching group consensus in discussions in lab planning and investigation and lesson wrap-up. Read the article at *https://bit.ly/2NsRlmp.*

Reading to Learn in Science (RTLS). M The mission of the RTLS project is to increase middle level science content learning by improving students' ability to interpret science texts. At *https://bit.ly/2NuAoYL,* teachers can access a comprehensive collection of resources to help make that happen, including information about the pedagogical basis for emphasizing literacy development in science education, the unique challenges posed by science texts, and effective classroom strategies to use before, during, and after reading instruction to develop and enhance students' disciplinary literacy.

American Nuclear Society (ANS) Education Resources. E M H Nuclear science and technology can be incorporated into almost any STEM lesson plan, including the sciences: biology, chemistry, Earth science, physics, physical science, life science, environmental science, or general science. ANS offers numerous resources (e.g., lessons, fact sheets, and other materials) to explain the many uses of the atom and the vital role of nuclear technology.

For example, more than 20 classroom activities are available for grades 5–12, including titles such as Growing Irradiated Bean Seeds; Making Atoms Visible: Autoradiographs; Half-Life: Licorice; Mouse Trap Reactor; and Fission Demonstration. In addition, the site has downloadable bookmarks featuring positive "Did You Know?" messages about nuclear technology and radiation, such as "Nuclear energy is safe, reliable, and carbon-free" and "Radiation and radioisotopes are used in the medical field to improve our health and save lives!" Find these resources and more at the following website: *https://bit.ly/2PkgJN4.*

ŠARŪNAS BURDULIS FROM USA

An Educator's Guide to the Marine Environment. K12 Developed by the North American Marine Environment Protection Association, this easy-to-use guide introduces K–12 audiences to the marine environment and fosters ocean literacy through lessons exploring themes of Ocean Health, Ocean Acidification, Ocean Exploration, and Marine Industry. Each theme contains three lessons, one each for elementary (K–5), middle (grades 6–8), and high school levels (grades 9–12). For example, in the Ocean Exploration lessons, elementary students conduct a coastal Scavenger Hunt; middle level students Build Your Own Underwater Exploration Vehicle; and high school students study the behavior of Waves and Light in the Ocean.

All of the lessons support the *NGSS* and can be used in both formal and informal settings as either stand-alone content or to supplement lessons in other areas. This guide is available at *https://bit.ly/2yyFRbR.*

ARIS. A Educators can use this open-source game-making program to create location-based games for any part of their curriculum. Students of any age can play the games, but only older students or adults are able to create them. Games can be simple or complex quests.

For example, imagine a science lab in which partners use iPads to complete a scavenger hunt by pointing the camera at certain equipment. Suddenly, their teacher appears on the screen explaining the proper use and function of that equipment and "gives" them that item digitally. Once students have all of the items, they are ready to do an experiment. Visit the website at *https://bit.ly/2xKONcM* for tutorials to learn how to use the program or to join discussion forums for technical support.

Tools for Ambitious Science Teaching. K12 This website provides a vision of ambitious science instruction and what it looks like in elementary, middle level, and high school classrooms. In ambitious teaching, educators deliberately support students of all backgrounds to deeply understand science ideas, participate in the activities of the discipline, and solve authentic problems. The ambitious teaching website features tools, publications, and videos to learn more about the vision and how to become a part of its growing community of practitioners. See *https://ambitiousscienceteaching.org.*

Of particular interest is the How Do I? publication page at the website *http://bit.ly/2OXQ2R8,* which contains a collection of brief papers—i.e., quick reads—on important components of ambitious teaching and classroom practice, such as modeling, use of evidence, making thinking visible, direct instruction, group work, and anchoring events.

National Parks—From Space. M H Take a virtual visit to more than 60 national parks from the vantage of space. Read articles selected from NASA's Earth Observatory website to learn about the parks' unique geology, ecology, and cultural history. Use the resource with middle and high school students to demonstrate the many ways satellite imagery is being used to help us observe geological processes at work, enhance our understandings of interactions at play within various ecosystems, and expand our perspective about the human connection to and cultural importance of national parks and monuments. Refer to this website: *https://bit.ly/2PpnU6u.* ●

News Bits

- **In Missouri's Columbia Public Schools (CPS) district, a science initiative ensures elementary students will participate in or observe 101 science experiments each year.** E

CPS Science 101 focuses on place-based learning, and students are engaging with science through experiences in their own backyards (e.g., local maple trees or shoreline erosion on the Mississippi river), rather than from textbooks about faraway locations. Mike Szydlowski, the district's K–12 science coordinator, says teachers feel pressure to have their students perform well on math and language arts tests, which sometimes leaves science education behind. "With the creation of CPS Science 101," he contends, "teachers are encouraged to make a more conscious effort to teach science often."

Teachers have CPS Science 101 posters for their classrooms with 101 blank beakers on them. Each time students have a science experience, they can color in a beaker on the poster. Learn more at *https://bit.ly/2I52AAv.*

- **The Program for International Student Assessment (PISA) exam to be administered to 15-year-olds in 2021 may include a creativity test designed by ACT, the maker of a major U.S. college admissions exam.** H

The creativity test is still in experimental stages, according to Mario Piacentini, the scientist leading the project from the Organisation for Economic Co-operation and Development (OECD), the Paris-based agency that administers the PISA exam. Questions would fall into four areas, each designed to gauge different types of creativity: scientific problems, written expression, visual expression, and social problems. OECD hopes to present the exam and suggested questions to OECD countries sometime this month.

The public remains skeptical about the concept of a creativity test because of creativity's subjective nature, with comments ranging from "ridiculous" to "far-fetched." Others questioned context (relevance and social problems) and the diversity of students taking the test. One commentator observes, "It is just another test...and it's based on a subject you can't teach." Read more at *https://bit.ly/2QdXXXP.*

- **The Ohio State University received a National Science Foundation grant for a pilot project to design and incorporate engineering-based activities into core high school curricula (e.g., biology, chemistry, and physics) while providing structure for teachers on how to support and offer resources to students interested in science, technology, engineering, and math (STEM).** H HE

Four activities are set for the year, each targeting the first few steps of the engineering design process. The engineering activities are rooted in the *Next Generation Science Standards,* and the project sets expectations for teachers to learn different disciplines of engineering, to help them further engage students with the field.

Researchers will review student feedback and teacher takeaways, as the goal is for teachers to value the experience and adopt activities for their classrooms. The Ohio State University will collaborate with Ohio Northern University and Olathe Northwest High School in Olathe, Kansas. Ohio State will handle data analysis of project results. Read more at *https://bit.ly/2NfWY7x.*

- **The Gaetz Aerospace Institute at Embry-Riddle Aeronautical University is expanding its concurrent enrollment program and will offer STEM courses to high school students in Louisiana and Ohio.** H HE

Gaetz Aerospace Institute's concurrent enrollment program allows students to earn both high school and college credit for successfully completed classes. The program launched in Florida in 2004, expanded to Illinois in 2013, and now has participation from 60 high schools. Available accelerated courses include aeronautical science, unstaffed aircraft systems, meteorology, and engineering. The concurrent enrollment program follows the high school schedule, so students don't have to leave campus to attend courses.

Colleen Conklin, Gaetz Aerospace Institute's executive director, says the program will prepare students with real-life skills and knowledge. "We are working hand-in-hand with government, industries, and local school district partners to guarantee a pipeline of talent for Florida's growing aerospace and aviation industry," she asserts. Read more at *https://bit.ly/2xpqSAS.* ●

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NSTA National Science Teachers Association

In Your Pocket

Editor's Note

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

November 25–30

Knowles Teacher Initiative Teaching Fellowship K12

These five-year fellowships help early-career science and math teachers become master teachers and leaders. Fellows receive stipends, funds for professional development, grants for teaching materials, and leadership and mentoring opportunities during all five years of the fellowship. New teachers with leadership skills and the potential to develop innovative teaching methods make excellent candidates.

Applicants must be entering their first or second year of teaching during the 2019–2020 school year. They also need a degree related to the science or math discipline they intend to teach and a valid state teaching credential, certificate, or license by September 2019.

Apply by **November 25;** see *http://bit.ly/2ysK1Sl.*

SeaWorld & Busch Gardens Conservation Fund Grants K12

These grants go to students, teachers, researchers, and others working at the grassroots level to preserve and protect the environment. Funds are available for conservation education, species research, habitat protection, and animal rescue and rehabilitation. Most grants range between $10,000 and $25,000.

Apply at *https://bit.ly/2xOXrKi* by **November 30** to receive funding for the first two quarters of 2019.

December 1–17

AAPT's Barbara Lotze Scholarships for Future Teachers H HE

The American Association of Physics Teachers (AAPT) offers grants of $2,000 and one-year AAPT student memberships to aspiring high school physics teachers. Undergraduate students enrolled in physics teacher preparation programs at accredited two- or four-year universities or high school seniors admitted to such programs are eligible.

Applicants should show academic promise and be U.S. citizens. Apply online by **December 1** at *https://bit.ly/2cuMyzz.*

ITEEA Prakken Professional Cooperation Award K12

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

Learn more and submit nominations by **December 1** using the nomination form at *https://bit.ly/2CuI0K3.*

Ocean Exploration Trust: Science Communication Fellowship K12 HE

These fellowships allow formal and informal educators to participate in the Nautilus Exploration Program and share their experiences with students and the public. Fellows broadcast their experiences aboard the ship through question-and-answer sessions and live audio commentary on the Nautilus Live website. Fellows bring their experiences back to their classrooms, organizations, and communities in the form of engaging lesson plans and activities.

Fellows participate in a week of training in Rhode Island in March 2019 and sail for one to three weeks between April and September. They're also expected to collaborate with the STEM community for one year after their expedition.

Apply by **December 14** at *http://bit.ly/2A2cX5A.*

Paul DeHart Hurd Award M

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

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

Air Force Association Educator Grants K12

The Air Force Association provides 40 $500 grants each year to promote aerospace education in K–12 classrooms. Projects should include innovative aerospace activities within the prescribed curriculum that significantly influence student learning. One grant per teacher is available, and up to two per school are permitted. Apply by 4 p.m. Pacific Time on **December 15.** Visit *https://bit.ly/2yqZr9V.*

National Gardening Association's Youth Garden Grant P K12

These grants go to schools and nonprofits with planned or existing garden programs that enhance the quality of life for students and their communities. Garden programs must include at least 15 children between the ages of 3 and 18. Twenty winning gardens will receive a $100 gift certificate and $400 worth of gardening tools and supplies. Five will get packages worth $2,100, which include a $1,000 cash prize, a $100 gift certificate, and gardening gear.

Apply by **December 17.** See the website *http://bit.ly/2C7pTIT.*

January 11–February 28

AIAA Foundation Classroom Grants K12

These $250 grants go to K–12 teachers who incorporate innovative aerospace activities in their curricula. Grants can be used for demonstration kits, science supplies, and other resources that will impact at least 25 students. Applicants must first register as American Institute of Aeronautics and Astronautics (AIAA) Educator Associates, at no charge. Apply by **January 11, 2019;** visit the website *https://bit.ly/2xYhh4s* to learn more.

USDA Excellence in Teaching Agriculture Awards P K12

These awards go to state-selected preK–12 "Teachers of the Year" who successfully teach agricultural concepts in their classrooms. Winners receive a $500 honorarium and $1,500 to attend the National Agriculture in the Classroom (AITC) Conference.

Interested applicants must contact their state's AITC program leader, whose signature must appear on the application. See *http://bit.ly/2A2wEua* for details, and apply by **January 15.**

Population Education's World of 7 Billion Contest M H

This contest is part of Population Connection's World of 7 Billion campaign to promote understanding of the ways our world population affects our neighborhoods and global communities. Middle level and high school students can enter 60-second videos illustrating one of these global challenges: preserving biodiversity, sustainable resources use, and protecting human rights. Videos should include content on how population growth affects the selected issue and why it's important, along with at least one sustainable solution.

Free curriculum resources for participating teachers are available, and student winners receive cash prizes of up to $1,000. One cash prize will be awarded in each state. Apply by 5 p.m. Eastern Time on **February 28.** Visit *http://bit.ly/1QL6u1M* to learn more. ●

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

What's New

FROM U.S. GOVERNMENT SOURCES

U.S. Fish and Wildlife Services (FWS)

Conservation Connect E M H

Conservation Connect is a web-based video series for grades 5–9 produced by the FWS. The series aims to inspire a new generation of conservation stewards through virtual field trips around the country introducing students to wildlife species, conservation careers, and technologies used to study and protect wildlife. Each episode runs about 6–8 minutes long and highlights a different conservation topic: efforts to protect endangered species (e.g., American bald eagles, bats, black bears, bog turtles, and Monarchs), electrofishing (a process that biologists use to collect data about fish populations), or working as a wildlife law enforcement officer.

Conservation Connect Live offers an extended version of each episode; these approximately hour-long programs were recorded with a student audience and feature Q&As with wildlife or fisheries biologists who provide insights on their career path and the species they protect. Teachers can access the videos—along with Educational Toolboxes containing lesson plans, activities, and photo galleries for most topics—at *http://conservation-connect.com*.

U.S. Department of Education (ED)

Find What Works Tool K12 HE

Searching for the best evidence and research data on science, math, and reading? Compare research with the Find What Works tool at the website *https://bit.ly/2zx6AYA*. Developed by ED's What Works Clearinghouse, this tool enables educators and other stakeholders to easily access research on programs, products, practices, and policies in K–college education. Select a topic area of interest (e.g., Science, Mathematics, Literacy, Early Childhood, English Learners, Teacher Excellence) to see a list of reviewed items in that category.

For example, 10 science-related items were evaluated, including programs such as Teach for America (grades K–12), Knowledge Is Power Program (grades 5–12), Great Explorations Math and Science Space Science Sequence (grades 4–5), and Technology Enhanced Elementary and Middle School Science (grades 3–4). Each review includes an Evidence Snapshot with infographics highlighting key research findings; an Intervention Report summarizing findings based on a comprehensive search of the literature on the program; and a Review Protocol describing the specific methods used to review the relevant studies. In addition, the Find What Works Video Tour (*https://bit.ly/2OaKQKo*) helps teachers maximize their use of the tool, with tips for sorting and filtering results to delve deeper into specific interventions and studies.

U.S. Department of Energy (DOE)

Girls of Energy! M

Inspire middle level students with the video profiles of outstanding female engineers and scientists working at the DOE to solve today's energy challenges. In each profile, a featured scientist briefly describes her work and shares advice and memories about what sparked her interest in science as a child and what motivates her in her current work. Accompanying classroom activities relate to the scientists' work and reflect a diverse range of energy challenges, such as power sources (e.g., How Can You Make a Plasma Ball and Fusion Physics! A Clean Energy), energy efficiency (e.g., Lead-Free Solder: A Green Solution for the Electronic Age), safety and security (e.g., Top Supercomputers for Safety), and innovative technologies (e.g., How Can You Make a Smartphone Into a Microscope?). Refer to *https://bit.ly/2lTqumy*.

Energy Elf E M

Energy Elf, an educational game from Energy.gov, teaches elementary and middle level students about energy efficiency and how they can help save energy at home. The game—which requires Adobe Flash to play and is available at *https://bit.ly/2OEayX8*—challenges students to make a home more energy efficient and save it from the Power Gobblin' before time runs out. To play, students scroll around the house completing such energy-saving measures as turning off lights, using energy-saving light bulbs, replacing broken windows, programming the thermostat, shutting off the computer, and unplugging a phone charger. As students complete each task, they learn facts about energy conservation at home. The text version of the game (*https://bit.ly/2RvKR9y*) includes energy conservation tips and describes all of the energy-saving tasks students will need to do to complete the game.

U.S. Energy Information Administration

Energy Kids K12

The Energy Kids website is a one-stop source for energy information for K–12 audiences. Organized by section—e.g., What Is Energy?, Energy Sources, Using and Saving Energy, History of Energy, Games and Activities, and For Teachers—the site contains content on almost every aspect of energy education. In addition to articles and fact sheets explaining energy basics, the site has classroom lessons for elementary, middle, and high school levels, as well as a Teacher Guide featuring extension activities that use the website as a resource.

Other notable resources—likely of interest to both teachers and students—are the site's ideas for energy-related Science Fair Experiments and the pictorial glossary of Energy slang, which highlights the "energy" meanings of two dozen common words including face (i.e., the exposed area from which coal is extracted), yellow cake (i.e., another word for uranium oxide, which is eventually processed for use in nuclear power plants), and trip (i.e., to switch off the flow of electricity through a section of electric circuit). Visit the website *www.eia.gov/kids*.

U.S. Department of Agriculture (USDA)

Discover MyPlate: Emergent Readers P E

Available in English, Spanish, and electronic versions, this set of Emergent Readers from the USDA's Team Nutrition helps young children (grades preK–K) build literacy skills while learning about the five food groups and healthy eating. The set contains six books—Fruits, Vegetables, Protein Foods, Grains, Dairy, and A MyPlate Meal—each of which feature sight words for the kindergarten level, such as *the, is, eat, are, I, see, like, has, make, she, can, he, we, was,* and *have*. The electronic version of the set (available in English only) features audio narration that highlights the text as it's read aloud, as well as interactive features that test comprehension and reinforce learning in a fun way (for example, drawing and coloring palettes, colorful characters, and games and mazes). Download the books from this website: *https://bit.ly/2E1rxOI*.

National Institutes of Health (NIH)

2019 National Drug and Alcohol Facts Week M H

Every year, NIH's National Institute of Drug Abuse (NIDA) and National Institute for Alcohol Abuse and Addiction (NIAAA) team up for National Drug and Alcohol Facts Week (NDAFW). This week-long series of educational events—taking place January 22–27, 2019—brings together teens and scientists to share facts and meaningful conversation about substance use and addiction. NDAFW aims to provide middle level and high school students with accurate information and to help counteract myths about drugs and

alcohol spread via the internet, social media, television, movies, music, and friends. Events are held at locations nationwide in schools, health centers, and other community venues. Last year, more than 2,300 events took place worldwide, and even greater participation is expected this year.

The NDAFW website (refer to *https://bit.ly/1PfyPrt*) has resources to help educators plan and promote events, including toolkits, brochures, posters, publications, and the soon-to-be-available 2019 National Drug and Alcohol IQ Challenge, an interactive quiz for students that can be shared on large screens and on mobile devices. The site also provides lessons and classroom activities that explain the effects of drug use on the brain and body, and of drug use on the lives of teens.

In addition, middle and high school teachers can register their classes to participate in National Drugs and Alcohol Chat Day (January 24, 2019, 8 a.m. to 6 p.m. Eastern Time). In this live event, more than 50 NIH scientists and science writers field questions about drugs and alcohol from teens nationwide. Teachers can access transcripts of previous chats to prepare for the event.

National Aeronautics and Space Administration (NASA)

Meteor Showers 101 E M

Shooting star party, anyone? Use this article from NASA's Space Place as a starting point to teach elementary and middle level students about meteors and meteor showers. In simple, straightforward language, the article explains what these space rocks are, how they form, and the best times of the year to view major meteor showers. Visit *https://go.nasa.gov/2pKpT8g.*

So You Want to Go to Mars A

Watch this short video—the first in a video series of the same name—and learn about some of the ways NASA and the International Space Station (ISS) are helping us get to Mars. Appropriate for all ages, the animated episode explains in simple language where we are now, what we've learned so far about keeping astronauts healthy (and equipment operational) in space, and why the ISS is important to deep space exploration. View the video and access links with more information about the ISS at *https://bit.ly/2OLYbIk.*

Spacecraft AR App A

NASA spacecraft travel to far-off destinations in space, but with Spacecraft AR, a mobile app developed by NASA's Jet Propulsion Laboratory and Google, NASA spacecraft come to you! Designed for students, teachers, and space enthusiasts of all ages, the app uses the latest augmented reality (AR) technology to place virtual 3-D models of NASA's robotic space explorers into any environment with a flat surface. Within the app, students swipe to select among NASA missions and choose the spacecraft they would like to see. (Current options include Curiosity, Juno, Cassini, Voyager, and the NASA Deep Space Network dish, with plans to add more spacecraft.)

Once the app detects a flat surface, students simply tap the screen to place the chosen spacecraft into the scene in front of them. Students can then take and share photos of the spacecraft and view in-depth information about each mission. And for those using the app in spaces sufficiently large enough, Spacecraft AR has an option to view the spacecraft at their actual sizes.

The app is available for newer-model Android mobile devices; plans are to add additional device compatibility, including iOS devices. Download the app at *https://go.nasa.gov/2BZn7FE.*

Phenomena Resources From NASA Wavelength K12

The NASA Wavelength team has been creating lists of resources—e.g., K–12 lessons, activities, NASA data, and science articles—that support the *Next Generation Science Standards* (*NGSS*) and relate to science phenomena in the news. Three phenomena-based resource lists have been created so far. Natural Hazard Sequence: Drought to Wildfire (*http://bit.ly/2ydI8d3*) focuses on recent events in southern California as the phenomena to help students support the claim that a change in one of Earth's systems can cause changes to others. Hawaii Hotspot: Resources to Support *NGSS* Phenomena (visit *http://bit.ly/2A7gWhv*) brings together materials relating to the phenomena of the eruption of Hawaii's Mount Kilauea in May 2018. Humanity's Closest Look at the Sun: The Launch of the Parker Solar Probe (see the website at *http://bit.ly/2CEiLES*) presents resources about what can be learned on Earth from the data gathered on the phenomena from a solar probe in space.

U.S. National Archives

Uncle Sam and the American Diet M H

At *https://bit.ly/2Nszmwr,* educators can access primary source documents (historical photographs, posters, letters, legislation, and other materials) and interdisciplinary teaching activities inspired by the National Archives exhibit, What's Cooking Uncle Sam? The online exhibit examines how government activities (food laws, changing manufacturing and farming practices, national school lunch program, and so on) help shape the American Diet.

The accompanying activities, which are interdisciplinary in nature and most appropriate for middle and high school levels, incorporate the use of primary source documents and develop students' analytical skills. In Uncle Sam and the American Diet, for example, middle level students examine two food nutrition guideline posters from the USDA to determine the government's purpose in creating the guidelines and evaluate how the guidelines have changed over time.

National Oceanic and Atmospheric Administration (NOAA)

Understanding Marine Debris K12

Concerned about marine debris and its impact on the health of our oceans and wildlife? NOAA's Office of Marine Debris offers K–12 resources on the topic for both students and teachers. Student resources include puzzles, brainteasers, coloring pages, and other activities that both entertain and inform students about action steps they can take to lessen the impact of marine debris. Highlights of the teacher resources include The Marine Debris Monitoring Toolkit for Educators, which features a citizen science component that involves students in marine debris research outreach, and Turning the Tide on Trash, a three-pronged marine debris curriculum for grades K–12, with activities addressing the Definition, Characteristics, and Sources of Marine Debris (Unit One); The Effects of Marine Debris (Unit Two); and Working Toward Solutions (Unit Three). Access these and other resources at *https://bit.ly/2NtflpG.*

National Park Service (NPS)

Predict Old Faithful Activity E

Though most geysers are unpredictable, Old Faithful in Wyoming's Yellowstone National Park is famous for its regularity. In this interdisciplinary science/math activity, students in grades 3–5 observe Old Faithful erupt via a livestream webcam, recording the eruption's start time, end time, and length in minutes. Then, using the ranger's formula provided on the activity worksheet, students calculate a predicted time for the geyser's next eruption, comparing their predicted time with the ranger's predicted time, which appears on the livestream webcam's web page.

To conclude the activity, students watch the next Old Faithful Geyser eruptions and compare their prediction to the actual time. Visit the website *https://bit.ly/2y8OLND.* ●

Summer Programs

Editor's Note

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

Earthwatch Teach Earth USA Fellowships K12

Earthwatch offers these fellowships to K–12 teachers of any subject area who are passionate about teaching and interested in environmental issues. Led by prominent researchers, fellows will spend one to two weeks on expeditions, collecting data and working to solve environmental challenges. Along the way, teachers gain research skills and content knowledge. This year's expeditions include studying wetlands and traditional agriculture in Mexico City, climate change at the Arctic's edge or its effect on caterpillars in Ecuador and Arizona, and monkeys, parrots, and other wildlife in Costa Rica's forests.

Fellowships cover meals, accommodations, and on-site transportation. Fellows also receive a grant to offset out-of-pocket travel expenses to and from the expedition site. Full and partial fellowships are available.

Teachers must complete and submit an online interest form to determine whether they meet program requirements and make clear what level of funding they're seeking. Those deemed "qualified" are invited to apply by **January 10.** To access the interest form and learn more, consult the website *http://bit.ly/29PCoI0.*

EinsteinPlus Summer Workshop H

This July 7–13 intensive workshop for Canadian and international high school teachers focuses on modern physics, quantum physics, special relativity, and cosmology. Participants will learn about the latest developments in the field from expert researchers, take lab tours, and interact with likeminded individuals from around the world. Session topics include

- innovative teaching strategies suitable for all areas of physics;
- quantum physics: wave-particle duality and the electron double-slit experiment;
- Geographic Positioning Systems (GPS) and relativity;
- dark matter as an application of uniform circular motion; and
- measuring Planck's constant using a simple electronic circuit.

EinsteinPlus will take place at the Perimeter Institute in Waterloo, Ontario, Canada. Those interested in conducting follow-up activities with teachers at home are particularly encouraged to apply (deadline **April 15**). See the website *https://bit.ly/2u52BiD.*

BIOS Six-Day Educator Training Workshop M H

In this workshop offered by the Bermuda Institute of Ocean Sciences (BIOS) June 24–29, 12 teachers, curriculum specialists, administrators, and informal educators will learn how to plan and execute field study courses for their students at BIOS. Participants will explore coral reefs, use Glider technology for ocean study, and visit Whalebone Bay, Cooper's Island, and other attractions to learn how to incorporate them in educational experiences for their students.

Preservice and inservice middle and high school educators may apply by **May 1.** Refer to *https://bit.ly/2yh1ixU.*●

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

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National Science Teachers Association

Teaching About Space Survival

No matter which field of science they teach, science teachers tend to agree that teaching students about survival in space or on planets or exoplanets motivates students to learn.

"I've used it as a hook for a unit about the universe," says Dan Voss, physics teacher at Dallas Center-Grimes High School in Grimes, Iowa. "Space excites students who aren't interested in other science fields," he contends. "[W]e start with what humans need to survive and how that affects the hunt for exoplanets, build off student questions to talk about astronomical tools and solar system formation, then zoom out to the origins of the universe."

Voss first asks students to research another planet and list what humans would need to survive on it. While most mention water, oxygen, and food, "how strong gravity is [on the other planet] is not usually stated," he reports. He then provides a worksheet "that fills in the gaps of what they didn't find. It helps them organize their thoughts and establishes that nowhere in the solar system is perfect, and modifications are needed."

This introduction to the unit is important because "even at the high school level, many students don't realize that the Sun is a star," he relates. In addition, "students forget that the same solids, liquids, and gases on Earth also exist in space. We come from the same place other objects in the solar system come from."

"Our biology classes…start the year with a unit that focuses on going to Mars," says Rachel Tinsley, biology teacher at Battle High School in Columbia, Missouri. "The unit covers photosynthesis, respiration, cycles, properties of water, and characteristics of life. The culminating activity is a town hall meeting [in which] students role play to discuss the issue of 'Should we use taxpayer money to go to Mars?'"

When Tinsley's sophomores learn about photosynthesis, they realize that plants could help humans survive on Mars by providing oxygen, as well as providing food. In keeping with the *Next Generation Science Standards* (*NGSS*), "students use jars to make models of terrariums (containing plants) and aquariums (containing water)," explains Tinsley.

MELISSA SLEEPER

Students in Melissa Sleeper's classes at Gifford Middle School in Vero Beach, Florida, build telescopes as part of a telescope design challenge.

Students also choose and research roles for the town hall meeting, with some choosing to be "Elon Musk, an International Space Station (ISS) astronaut, a mother of six children," or other people, notes Tinsley. Considering their characters and the characters' viewpoints, students determine whether their character would want to go to Mars.

Tinsley then has students form two circles, one inside and one outside. Those in the outside circle listen as those in the inside circle discuss whether to go to Mars "in character," she relates. Her students switch circles so they get a chance to do what their classmates in the other circle did.

The unit concludes with the students writing a position paper on what their answer is to the question of whether taxpayer money should be spent on having humans travel to Mars. "They have to include the carbon and water cycles and photosynthesis," Tinsley points out. "We want them to be able to argue and look at it from different viewpoints, which is a hard skill for high school sophomores."

She contends that photosynthesis and cellular respiration "are not always exciting to teach, but focusing it like this makes it more interesting for teachers. It's a great way to start the year!" She adds, "We show students trailers from [the film] *The Martian*. It's an amazing book!"

Melissa Sleeper's students at Gifford Middle School in Vero Beach, Florida, designed experiments based on *The Martian* and grew potatoes in simulated Martian regolith (a collection of particles of dust, soil, broken rock, and other materials) that she purchased from the Martian Garden (*www.themartiangarden.com*) with funding from her 2017 Shell Science Lab Challenge Regional Competition award. "We had attended a webinar from NASA on the future of living on Mars," she recalls. "The students asked questions and got ideas for their own experiments with the potatoes… [They learned from the webinar that the Martian] atmosphere is too thin to protect against radiation. We had to change habitats to avoid radiation."

"As a NASA Solar System Ambassador, space permeates what I do," Sleeper observes. "We talk about conditions on other planets, how we know [what they are], the tools we use, the food astronauts eat in space. We dry out foods because they have to be lighter on the [ISS because of the weight limit] and reconstitute them with water. We watch [ISS] food preparation [video] clips," she relates.

"We participated in the Genes in Space, Lab in a Box program to solve a simulated foodborne illness outbreak aboard the [ISS] using mini-PCRs [polymerase chain reactions, a laboratory technique used to make multiple copies of a segment of DNA]. They loaned us mini-PCR machines," Sleeper reports.

As participants in the ISS-Above for Schools program (see the website *http://bit.ly/2Cl2bJj*), Sleeper's classroom has an electronic device installed that tracks the ISS. Because of this, "[we] have studied about life aboard the ISS," she explains. "The device allows us to see where the ISS is, when it will be above us, and where to look for it in the sky. A screen tells us who is on station (the crew). Another screen allows us to see what the astronauts see when they look out of the cupola of the ISS. [And] the ISS Above tweets, 'Greetings From Gifford Middle School' to the ISS when it is in range."

Eyes on Exoplanets

"My grade-level partner Lynn Miller and I created a project [using] NASA's Eyes on Exoplanets [app] (*https://go.nasa.gov/2NKFTmi*). Our students must colonize an exoplanet of their choosing based upon the parameters of [the app]. After their initial research, students then create a model of their colony to present to their peers," says Tiffany Ewing, eighth-grade Earth science teacher at Warrensburg Middle School in Warrensburg, Missouri.

Ewing says she and Miller were inspired to update their school's "Planet Project" when they heard Rachel Zimmerman Brachman of NASA's Jet

Propulsion Laboratory speak about NASA's Eyes interactive apps at NSTA's 2015 Area Conference in Kansas City. (NASA's Eyes apps also include Eyes on the Earth and Eyes on the Solar System.) Eyes on Exoplanets is updated daily and features "thousands of exoplanets," Ewing relates. "Exoplanets are new for most students, and [the app] is not like anything they've ever used educationally."

In addition, she and Miller wanted to add "a STEM (science, technology, engineering, and math) portion" to the project, so they chose to have students build models of their colonies using cardboard boxes and recycled materials, she notes.

"We let the students play with the app, then we give them a worksheet to fill out [with information like] the exoplanet's name, its type, its orbital radius, whether it's in a habitable zone or not, whether it's hot or cold, [and how much] time [to] travel from Earth," Ewing explains. "The students calibrate how long it will take to get to that exoplanet…They get excited about something they can travel to in their lifetime."

> ***"We want them to be able to argue and look at it from different viewpoints, which is a hard skill for high school sophomores."***
>
> **—Rachel Tinsley**

Next, the students explore "what to do for food, oxygen, water, waste management, and material for shelter," she continues. Ewing and Miller review life science concepts like ecology and ecosystems and habitat for the eighth graders and show them "how to use the information from the app to choose parameters," Ewing explains. Students typically "get excited [to use the app] because a lot of the *Star Wars* planets, like Kamino, are exoplanets. It ties in the science fiction," she observes.

For the STEM portion, "we turn them loose and let them build," says Ewing. "They have to simulate their colony the best they can, and label things like the water system…and make them as recyclable as possible… They're graded on [their mastery of] the concepts, not necessarily on how artistic they are."

Sometimes Ewing is amazed at the creativity that students display during this project. "One student created his own microorganism on the exoplanet and created a Bloom's Taxonomy for it," she recalls. ●

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NSTA National Science Teachers Association

ASK A MENTOR, **Advice Column**

Staying Current, Working Overseas, Teaching Small Classes

After a number of years working in the science industry, I have now become a teacher. Do you have suggestions for maintaining my skills in both education and science?

—B., Arizona

I like your plan to stay current and active in your former work! I offer a few suggestions:

Watch for professional development (PD) opportunities offered by industry. Many industries and related organizations encourage teachers to keep current and offer workshops, field trips, and other PD. They will often provide high-quality resources. I was fortunate to have attended PD in forestry, hydroelectricity, atomic energy, medical imaging, agriculture, Geographic Information System (GIS), mining, and more! Information about these sessions is usually sent to local schools and distributed to staff.

Attend conferences. Industries hold workshops at local and state conferences, as well as NSTA area and national conferences, which can be real boosts to your teaching.

Volunteer. Many organizations seek teacher volunteers, and summer can be an optimum time. I have served as an education specialist on various boards, learning a tremendous amount along the way. Consider volunteering at zoos, museums, or university faculties to help with their outreach programs, or other opportunities. You don't have to be a tour guide: Volunteer to do something totally unrelated to teaching. I once collected insects for a local nature center.

Become more active in teacher and science organizations. Participating in local, state, and national professional organizations creates opportunities to expand your network and learn cutting-edge ideas. You can simultaneously hone your skills and help your professional communities by joining committees or assuming leadership roles.

Help organize science fairs. You will work with many industry partners who will become resources and connections. Also, the bright, amazing minds of the fair attendees will astound you, further motivating you to remain current!

I have considered teaching internationally. How does it compare to teaching domestically?

—A., Iowa

I commend you for thinking about adventuring into the world! I haven't taught internationally, so I consulted a few friends and colleagues for some advice. Almost everyone found teaching abroad to be an amazing experience filled with many fond memories. One of the easiest options is to apply to teach in an International School (*http://bit.ly/2NBYbpP*).

They also offer this advice for teaching in another country's school system:

- **Check certification and permits.**

Many governments will expedite the process for U.S. teachers wishing to teach in their countries, particularly the English-speaking nations. Even so, start early on the certification and work visa paperwork required by most countries. In Canada, each province has its own certification. While part of the United Kingdom, both Scotland and Northern Ireland require separate certification from Britain and Wales. So do some legwork to ensure you have everything in order. You may want to start at *http://bit.ly/2yw9kmG*.

- **Remember, you're the visitor!**

A close friend who taught in Australia advises, "Keep an open mind, and be willing to look at things in different ways. The way other countries conduct business in their schools might be different from our own experiences in our country. Keeping flexible in your outlook goes a long way to fitting in." One difference—Australian students are on a first-name basis with their teachers.

Many travelers have stories about having said or done something that they thought was innocuous, but was shocking or inappropriate to the locals. Research the customs and norms of the country where you'll be working.

Remember you will be the one with the accent! You may have to slow down, enunciate carefully, and be prepared to repeat yourself. Although you may be a science teacher, being open to teaching English may be an asset.

I will be student teaching in a school with small classes of between 6 and 12 students. I find this to be challenging. Any suggestions or advice?

— M., Kansas

I have taught a few small classes in my career, and I found them to be great opportunities to delve deeply into topics, conduct interesting projects, and become a really cohesive group. I discovered I could monitor and coach students more effectively. The small class size helped me be more of a mentor.

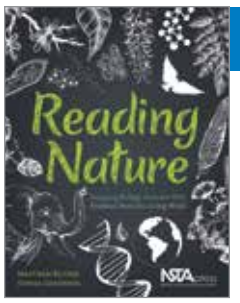
On a practical level, you can perform labs and experiments requiring elaborate or expensive supplies that you couldn't do with a bigger group. Larger projects are easier to manage, and student presentations take less time overall. Coordinating field trips is simpler: I could take smaller classes to places that couldn't accommodate larger numbers. Grading reports is considerably less onerous. With the smaller scale, I was able to try some innovative and new things with fewer headaches.

Surprisingly, we had better conversations and discussions. I thought my larger classes had good discussions, but in the smaller classes, it was easier to coax quieter students to participate. They had nowhere to hide!

Attempt to view your smaller classes as opportunities to try some cool things.

Hope this helps! ●

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



NSTA PRESS: *Reading Nature*

How Evidence-Based Texts Can Address a Need in Biology Education

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 Reading Nature: Engaging Biology Students With Evidence From the Living World, *by Matthew Kloser and Sophia Grathwol, edited for publication here. To download the full text, go to* https://bit.ly/2yCB21c. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

What Is the Structure of the Evidence-Based Texts in This Book?

In the 1960s, Joseph Schwab championed scientific accounts that would present a research problem, important data related to the problem, and conclusions drawn from the data (Olson 2000). In short, he argued for texts that reveal not only scientific facts, but also a justification of these ideas. The texts presented in this book—let's call them evidence-based, or EB, biology texts—overlap in significant ways with historical narratives and adapted primary literature (APL) to provide an opportunity for inquiry into scientific investigations.

As short accounts, the EB texts in this book differ from the in-depth stories found in narratives such as *The Double Helix* (Watson 1968), yet they do recognize the importance of the human and social element of scientific discovery and theory construction. These texts also avoid the formal, authoritative writing of peer-reviewed journal articles found in APL, yet they recognize the importance of supporting claims with empirical data that are made available to the reader. Thus, EB texts are hybrid resources. They combine narrative elements, expository paragraphs, and elements of scientific arguments to provide students with a window into both science ideas and science practices.

Each text is based on one or more peer-reviewed articles from a leading science journal and tied to a life science/biology core idea identified in *A Framework for K–12 Science Education* (*Framework;* NRC 2012). Each EB text has five essential elements:

1. **Section headings are framed as questions, not expository statements.** This format emphasizes that science raises questions and seeks answers rather than functioning in an environment of known facts.
2. **People are central to the texts.** Traditional textbooks assume an actor-free style. Facts and concepts exist mostly detached from human action. But science is a social endeavor involving the interaction of many people. Empirical studies of text comprehension and interest show that students better engage narrative texts in which characters play a seminal role (Armbruster 1991); thus, these texts highlight teams of individuals investigating the world.
3. **The investigations are placed in context.** Science does not occur in a vacuum. Rather, it occurs through the cumulative fits and starts of inquiry based on previous findings and theories. When possible, the EB texts in this book provide context for the studies in question by highlighting existing theoretical convictions and broader implications for the research. Like APL texts, these accounts provide insight into a range of methods—many novel and creative from the perspective of high school students—that help scientists support their claims. Unlike APL, the methods are summarized in a narrative description rather than in a reproducible list of procedures, thus allowing students insight into how one can find answers to scientific inquiries without being overwhelmed by technicalities.
4. **Data support or negate claims in the text.** Perhaps the most seminal element of the texts is the inclusion of empirical data, which is an essential part of providing students with resources that go beyond a "rhetoric of conclusions" and "final-form science." Data is often messy: It paints a picture, but not without interpretation and the probabilistic functions that play a role in supporting one's claims. As observed in interviews with high school students (Kloser 2013), the data provided in these EB texts help students understand claims and how they are justified. For each text, the major claims are supported by one or more data representations that have been adapted in developmentally appropriate ways. The data is not cleaned to the point of deceiving: Some "noise" still remains. The adapted data merely allow students to focus on one idea at a time in forms such as scatter plots, line graphs, and bar graphs. It is important to note that in nearly all cases, statistical significance and error bars have been removed to make these texts more accessible to students who have no statistical background. Teachers may wish to discuss whether differences in lines or bars are different enough to be considered significant, planting seeds for the role that statistics play in supporting claims.
5. **The teacher supplement includes questions and prompts to extend and refine student engagement with the texts.** These texts are not a curriculum and can be used in a number of novel ways to meet the needs of particular classrooms. The texts should not be used like a traditional textbook: as a reading assignment that is followed by end-of-section questions, done individually. Students may read these texts individually at first, but they are organized for the social construction of knowledge across pairs, small groups, and the class as a whole. To increase the level of inquiry, the texts include a series of guiding questions/tasks correlated with numbered sections in the text. They also contain transfer tasks, such as Investigation Design prompts.

What Impact Do These Evidence-Based Texts Have on Student Outcomes?

Quantitative and qualitative data suggest that EB texts have some positive effects on student outcomes. In one experiment (Kloser 2016), 230 high school biology students were randomized into two conditions. Students in one condition were provided with a traditional textbook account of a biology concept, and students in the other condition were provided with an evidence-based text on the same topic. Students read the texts individually and subsequently answered comprehension and application questions, then completed an experimental design task and interest survey. Results indicate that, on average, students reading the EB texts had higher interest levels in the content and were able to transfer the information they read more successfully than those who read the traditional textbook account.

A complementary qualitative study focused on how students engaged the texts and their thought processes when reading the two different accounts that were used in the randomized trial (Kloser 2013). A sample of 24 high school biology students representing a diverse population each read a traditional textbook and an EB account on the same core science idea. Students "thought aloud" as they read, evaluating their experiences with both texts in real time. The study revealed the EB texts to be more interesting and easier to understand because they provided the reader with support for the text's claims. ●

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NSTA National Science Teachers Association

BLICK ON FLICKS

Rampaging Genetics

By Jacob Clark Blickenstaff

The *Rampage* video games appeal to anyone who would build a toy city just to knock it down while pretending to be King Kong or Godzilla. The series spans many years and many platforms, and in 2018, a live-action film became part of the *Rampage* universe.

Dwayne "The Rock" Johnson plays Davis Okoye, a former poacher chaser who rescued an albino gorilla, named him George, and now cares for him at a wild animal park in San Diego, California. Okoye and George have a strong relationship and communicate through sign language and basic gestures. (This seems to be a nod to two real gorillas: Snowflake, an albino gorilla who lived in Spain, and Koko, who was adept at sign language).

A nefarious research lab owned by Energyne is conducting genetic experiments on an orbiting space station, apparently to escape scrutiny the researchers would face on the ground. A rat on the station grows huge and becomes extremely aggressive, attacking and killing all the scientists on board, except Kerry Atkins (played by Marley Shelton). Carrying three canisters of the experimental treatment, she flees the station in an escape pod. Unfortunately, the pod breaks up on re-entry, killing Atkins and dropping the three canisters in San Diego, Wyoming, and Florida.

The San Diego canister lands in George's enclosure, and when he investigates, George is sprayed with some kind of infectious agent. Overnight he roughly doubles in size and becomes very aggressive. Though Okoye tries to calm him down, George escapes the park and begins to rampage across the city.

We soon learn a giant wolf is on the loose in a remote part of Wyoming, where a team of mercenaries is quickly dispatched to kill it. It is some time before we discover what happened to the canister that landed in the Florida Everglades. As you know, if you're familiar with the video game (or might suspect from the title), the three giant monsters converge on Chicago and wreak havoc. Only Okoye and Kate Caldwell (played by Naomie Harris), one of the researchers who worked on the project, can save George and civilization.

This film has a lot of really silly physics, and many of the usual problems with scaling creatures up to giant size that I've addressed before. I won't spend time discussing those issues in this column. Instead, teachers could use this movie to bring up genetic engineering and some recent research in evolutionary biology that students will find exciting, and maybe a bit scary.

In *Rampage*, George, the wolf, and the crocodile all acquire characteristics of other animals through exposure to an infectious agent developed by the Energyne scientists. The scientists explain this was accomplished through "CRISPR," which is a real thing. CRISPR stands for Clustered Regularly Interspaced Short Palindromic Repeats, and refers to a whole category of DNA sequences that occur in bacteria. The CRISPR sequences are bits of virus DNA that are stored in the bacteria to give the bacteria a tool to recognize viruses that have attacked it before and help defend against those viruses.

As the term is used in *Rampage* and in popular science writing, CRISPR refers to the use of those DNA sequences as a tool in gene editing. Very simply, CRISPR enables genetic engineers to move sequences of DNA from one place to another, even from one organism to another, and make the genes that that DNA encodes active in the new site or organism. So if one organism has developed resistance to a particular chemical, that property could be transferred into another organism through CRISPR.

How this works involves much more detail than I can address here, but *Science News for Students* has an explanation at *https://bit.ly/2w47hUT*. In *Rampage*, all three monsters grow very quickly because "fast growth" is copied from another animal. "Aggressive behavior" and "ability to regenerate tissue" are two other properties that were transferred. While all of this was done intentionally by scientists in the movie, evidence exists that similar processes happen in nature, and are key to understanding evolution.

I first learned about "horizontal gene transfer" from an episode of the *Radiolab* podcast (available online at *https://bit.ly/2pJq3Pa* if you would like to listen to it yourself). Before I heard that episode, I believed that traits transferred only from one generation to the next. For example, if a bacterium developed resistance to an antibiotic through random mutation, it could pass that trait on to its offspring. That is known as vertical gene transfer. It turns out that many known instances have occurred of genes moving from viruses to bacteria, bacteria to insects, and very likely, viruses to humans; this is referred to as horizontal transfer.

The most amazing example mentioned in the *Radiolab* podcast is the evolution of the placental barrier between fetus and mother in mammals. That barrier is essential to prevent the mother's body from rejecting the fetus as a foreign "infection," and it appears to be coded by a bit of DNA from a virus that infected a mammal predecessor millions of years ago. For more details about how this works, check out *https://to.pbs.org/2dgcXTh*.

Though *Rampage* has a lot of questionable science in some scenes, life science and biology teachers could use it to spark conversation about genetic engineering, CRISPR, and evolution. ●

Note: Rated PG-13.

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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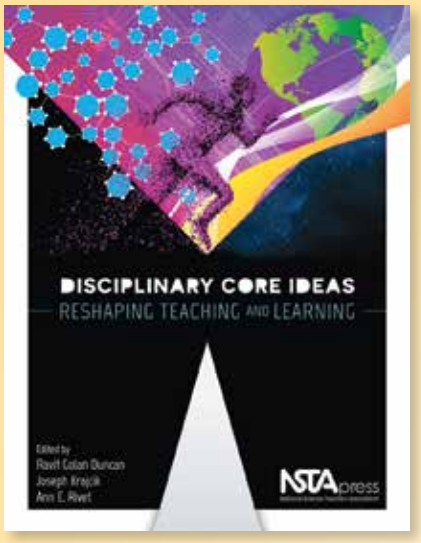

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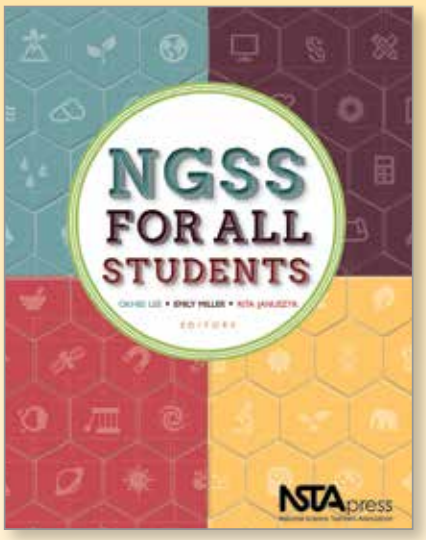

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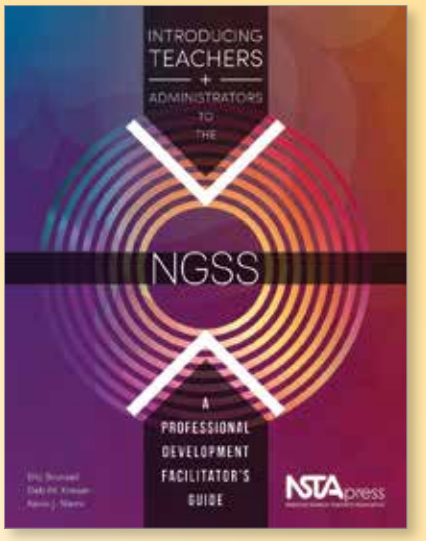

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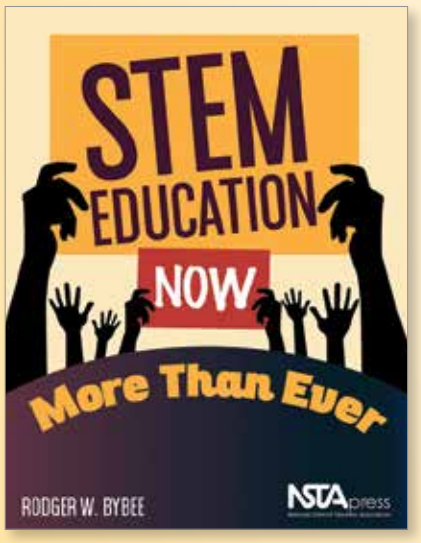

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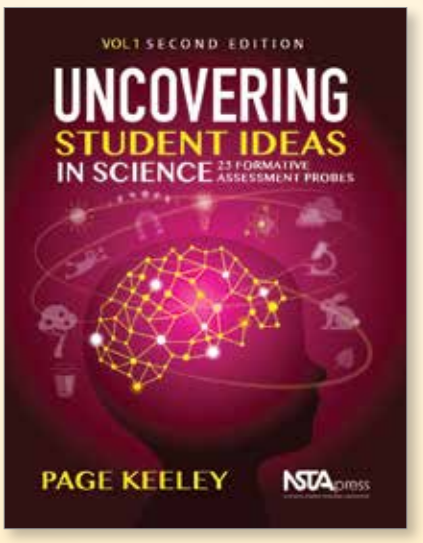

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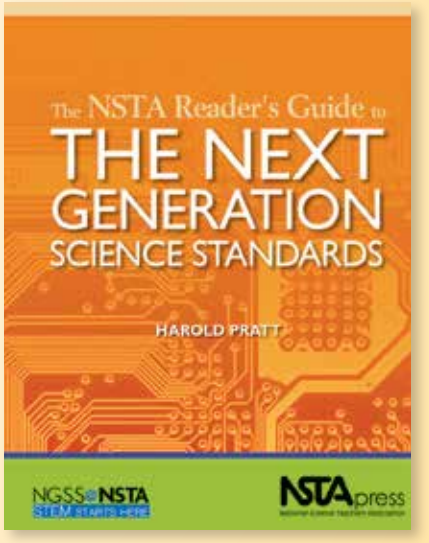

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National Science Teachers Association

(All dates are deadlines unless otherwise specified.)

November 14—Learn 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. Eastern Time (ET). For more information on NSTA Web Seminars or to register, visit *http://bit.ly/2RGhr8N.*

November 15—Science Education: A National Priority, NSTA's Area Conference on Science Education in National Harbor, Maryland, opens today. Registration costs $235 for members of NSTA, Maryland Association of Science Teachers, 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/nationalharbor.*

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 *http://bit.ly/2RGhr8N.*

November 29—Energize Science: Educate and Engage, NSTA's Area Conference on Science Education in Charlotte, North Carolina, opens today**.** The conference will run through December 1. On-site registration for members of NSTA, North Carolina Science Teachers Association, South Carolina Science Council, AACT, AAPT, ACS, ASEE, and NABT costs $235. For more information and to register, visit *www.nsta.org/charlotte.*

December 3—Session proposals for the Eighth Annual STEM Forum & Expo in San Francisco, hosted by NSTA, **are now due!** Proposals for NSTA's 2019 Area Conferences are being accepted through **January 15, 2019,** and for the association's 2020 National Conference on Science Education through **April 15.** The STEM Forum & Expo 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.*

December 17—Applications for the NSTA Teacher Awards and Recognition Program are due by midnight ET today. Visit *www.nsta.org/awards* to apply or nominate an exemplary teacher**.** 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.* ●

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Help Shape NSTA's Future!

Have you ever wanted to take a more active role as an NSTA member, but didn't know where to begin? One option is to join an NSTA Standing Committee, Advisory Board or Panel. These groups of educators support NSTA's mission to promote excellence and innovation in science teaching and learning for all by reviewing manuscripts submitted to NSTA's journals and offering advice on topics ranging from NSTA's international endeavors to issues impacting special needs, urban, and rural science education.

Committees focus on professional development, multicultural/equity concerns, research in science education, grade levels, and more. Advisory Boards address topics like Conferences, *NGSS@*NSTA, Aerospace, Science Safety, Technology, and Retired Members.

Applications for NSTA's Committees and Advisory Boards and Panels are being accepted through **December 3.** Appointees typically serve for three years. For more information or to apply, visit *https://bit.ly/2CPCstI.* ●

Quotable

Students learn what they care about, from people they care about and who, they know, care about them.

—Barbara Harrell Carson, U.S. author