nsta Reports
National Science Teaching Association

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Teaching the Science of Honeybees

Most students know "honeybees are important pollinators that provide some of the foods they like to eat. Additionally, students may also recall hearing news stories about honeybees not doing well or even dying off. [O]thers are…terrified of anything that has a stinger…Bringing an observation hive into the classroom where students can see the real-time activities and life cycle of honeybees can provide a significant life-changing learning experience for them," asserts Phil Kahler, a science teacher at Tualatin Valley Academy in Hillsboro, Oregon, who once had a beekeeping program at his school.

"[S]tudents will learn to appreciate the work [bees do] to store pollen, make honey, and raise their young. If students can make a personal connection to honeybees, they will begin to understand them and will be more likely to do what they can to protect these and other pollinators," Kahler maintains.

Beekeeping fits in "with many units I teach in my Advanced Placement Biology curriculum," such as "animal behavior, ecology, and conservation," says Jamie Holbrook of Saint Mary's Hall in San Antonio, Texas. Beekeeping "gives students an opportunity to connect with nature that they wouldn't get otherwise, an experience that might influence [their] future decisions [such as] voting on [environmental] policies."

"All bees aren't equal; they serve different purposes within their hive and the environment. This appreciation of differences translates to other animals as well as to plants, [helping students] develop a greater respect for all living things," maintains Beth Guzzetta, Lucius and Marie Gordon Chair in Science at Allendale Columbia School in Rochester, New York, who started an apiary with her seventh-grade life science students in 2018.

BETH GUZZETTA

Middle school students at Allendale Columbia School in Rochester, New York, prepare their honeybee colony for the winter.

"Honeybees aren't aggressive, not like yellow jackets are. [Studying them] gave students a different perspective on bees," observes Jacqueline Cappiano, a science teacher at Amity Regional High School in Woodbridge, Connecticut.

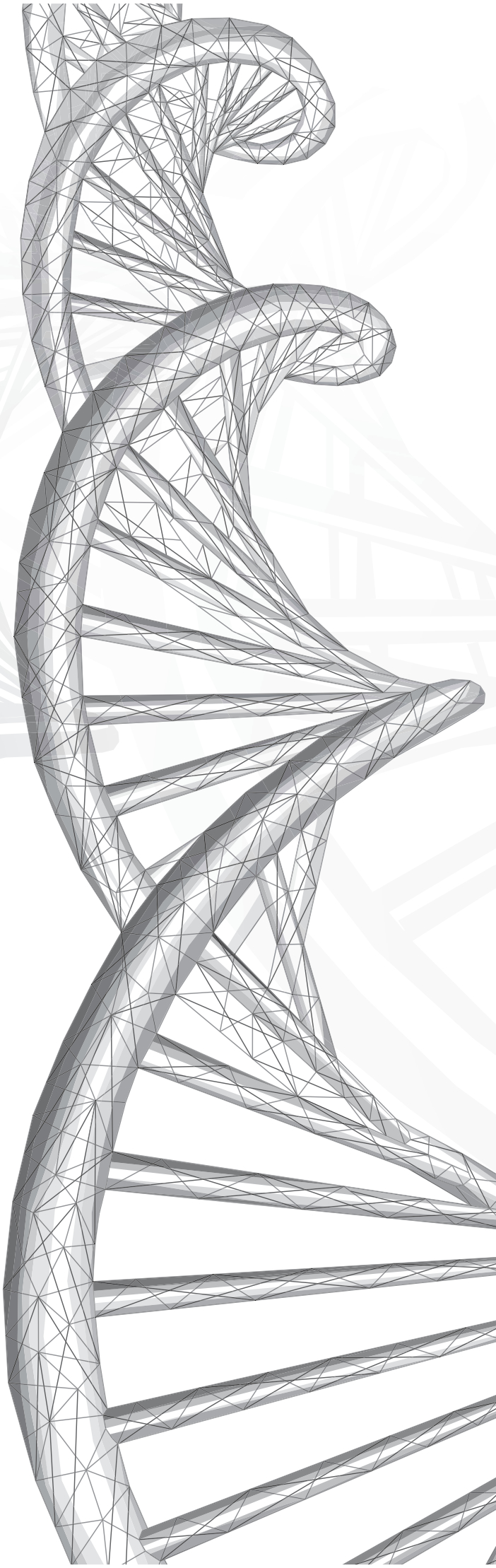
Cappiano, English teacher Sean Malloy, and a social studies colleague helped establish their school's beekeeping program, which is part of the curriculum for an alternative program within the school for students who need more individualized learning. In this program, "we take a nontraditional approach to teaching [and wanted to have] a program that would be special for [these students]. Our school psychologist, Linda Descesare, is a beekeeper and encouraged us," Cappiano relates.

"The students were really enthusiastic," Malloy recalls. "They developed a proposal [explaining] why beekeeping is important, how the program would be run, the risks versus the benefits… They [presented their proposal to the school superintendent and the principal], and it was approved" for funding.

"There have been numerous benefits to our students," says Malloy, including "team building, problem solving, and fulfillment via activities that fall outside expectations of the traditional classroom setting, as we have maintained four hives on the roof of our school." Plans call for the hives to be moved from the roof to inside the school because "we want to make the apiary part of the school community and have more students be able to see it," says Malloy.

Guzzetta's seventh graders planned and designed a pollinator garden with help from a local beekeeper and nursery. "They even give tours and teach the elementary students about the importance of honeybees, our garden, and other pollinators," she relates,

See Honeybees, pg 4



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COMMENTARY: **Jo Anne Vasquez, Michael Comer, and Jen Gutierrez**

Transforming to a Successful STEM School

By Jo Anne Vasquez, Michael Comer, and Jen Gutierrez

Jo Anne Vasquez

Michael Comer

Jen Guttierez

Creating a successful culture of science, technology, engineering, and mathematics (STEM) teaching and learning in any school requires commitment from the various educational partners to a common goal: a unified vision of what students need to achieve success, regardless of how success is defined beyond the classroom. Research described in *STEM Integration in K–12 Education*, a joint report from the National Academy of Engineering and the Board on Science Education, is clear and supports the proverb "It takes a village to raise a child."

Many individuals and factors within and without a school building influence the daily life of the school's "ecosystem," leading us to wonder how more holistic STEM education experiences could support all students. Can learning experiences in the school engage and enrich the community in which it exists? W.F. Killip Elementary School in Flagstaff, Arizona, took a systematic approach to implementing STEM teaching and learning, transforming itself into a successful STEM school, and in the process, found willing community partners eager to participate.

In 2005, Killip Elementary School was labeled an underperforming school, as measured by the school accountability system of No Child Left Behind. Principal Joe Gutierrez and his team analyzed the data to uncover what improvements could be made to address these deficiencies. They discovered a need to better align the curricula, instruction, assessments, and interventions with the Arizona College and Career Ready Standards and the *Next Generation Science Standards*. According to Gutierrez, "The standards provided our students with an expected level of academic knowledge and skills, but what was missing was the application of that knowledge to the real world." By 2008, they had raised and have since maintained student performance levels to a "Performing Plus" benchmark, in part by including real-world applications in the classroom learning experiences. The Killip leadership team implemented a cycle of continuous improvement to monitor and evaluate the processes used to determine the effectiveness of their practices.

To maintain such a large-scale, systemic change, a sustained implementation plan is critical. Consider these four elements as you make transitions in your learning environments.

- Assessment and Data

Without a reliable assessment and data collection system, it is difficult to balance STEM integration with the core standards in English language arts and mathematics. Administrators and teachers frequently reviewed student testing data and used those analyses to identify students at risk of falling behind earlier and followed up with targeted interventions more quickly to keep them on a positive learning trajectory.

- Common Planning Time for Teachers

Weekly collaborative planning time is crucial to implement STEM education successfully. The school community worked together and changed how they used their planning time. Each team member is assigned tasks to prepare and share prior to the meeting, facilitating group discussions and collaboration.

- Continuous Improvement Cycle

A culture of continuous improvement encourages teachers to reflect on their instructional goals and the effectiveness of each integrated unit. Before starting a unit, teachers review it, and if necessary, modify it to reflect changes in scope or relevancy. After each unit, the teachers review its execution and make adaptations based on its success and student engagement for the next time.

- Incorporating Community Collaboration

STEM-related community partnerships give students access to experts who model employable skills. These skills then are nurtured within the integrated STEM units. Building sustainable partnerships with community businesses and organizations promotes the success of the STEM units to the community and demonstrates how the education system operates, creating a culture of community collaboration.

Educational transformation of this magnitude requires a three- to five-year plan that includes activities that embed STEM into the school's culture and climate. Instructional resources need to align with proven professional learning support at all levels. Community and business partnerships allow students to discover the relevance of what they are learning and how it applies in different work and career paths. They make the learning come alive for the students.

Evaluating the plan, the framework, the process, the instructional units, the teaching, and the students' achievement is critical. This cycle of continuous monitoring and adjusting of the instruction based on the evaluations and feedback from all team members works to ensure success.

Gutierrez has said if she had to describe all these efforts in one word, "it would be perseverance." ●

Jo Anne Vasquez has served as NSTA President. She is a science and STEM education author, consultant, and professional learning provider with Rocks to Rainbows, LLC. Michael Comer is the director of science K–12 at Savvas Learning Company. Jen Gutierrez is a K–12 STEM education specialist and serves as NSTA Division Director of Professional Learning.

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

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

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

Honeybees, from pg 1

and they acquired "engineering skills" when they built a stand for the hive.

Holbrook says she asks her AP Biology students to "build a website [for] a beekeeping business [located] anywhere in the world…They are business owners selling a product from the hive," such as honey or beeswax.

Starting an Apiary

"When starting out, I highly recommend recruiting a volunteer beekeeper who will commit to working with you and your class over several seasons until you feel comfortable running things yourself. Read lots of books and watch online videos. Talk with other beekeepers, or take a beekeeping class… Seek out a nature center or museum in your area that has an observation hive," Kahler recommends.

In addition, The Honeybee Conservancy has lesson plans on honeybees at *http://bit.ly/2wzz2Jx*. The NSTA Kids book *Next Time You See a Bee* by Emily Morgan could be used with elementary students (see *http://bit.ly/2TGdPFI*).

Starting an apiary can cost anywhere from $1,500 to $3,000, the amount Holbrook estimates she spent, most of which she obtained from donations. "Bee suits are expensive," she notes, costing about $120 each. She began the program with two nuclear hives that hold five frames each—half the number of a regular hive body. "I recommend having two hives because if one fails, you'll still have the other," she says.

"Our beekeeper volunteers his time and has brought us supplies to use, such as a smoker, and [other] equipment," Guzzetta relates.

"When people [in your area] decide to give up beekeeping, they'll be selling or donating supplies and equipment. Look online," Malloy suggests.

Teachers should also anticipate ongoing expenses for replacing supplies, suits, and equipment—and sometimes, the colony itself. "We lost all our hives one time. It taught students about perseverance because we learned to troubleshoot what went wrong," Cappiano recalls.

"To ensure their survival, before the weather turns cold in the fall, you will want to move the colony to a full-sized hive box in your backyard, where they will remain until spring," Kahler urges.

When working with bees, safety is paramount, and several teachers say their schools have developed a safety protocol. "Our school's attorney created a liability waiver [because] students may not know if they have an allergy to bee stings," recalls Holbrook. She checks students three times after they have donned bee suits to make sure they're thoroughly covered and keeps epinephrine injectors and allergy relief medication on hand. Her school's maintenance staff found a remote spot for the hives, and "built a fence, a gated area to keep students" who aren't in her class out, she adds.

"I teach students how to behave [around bees] and why bees react [in certain ways]," Guzzetta explains. "We use smoke to calm the bees" when opening the hive during certain times of the year, which also allows "us to install traps for hive beetles and treat for varroa mites [which threaten the hive]. It also allows us to remove honey from the hive without causing a lot of stress to the bees," she reports.

Sometimes the students need calming. Holbrook recalls two students who feared bees and were claustrophobic. "They helped everyone else get suited up and walked outside, but not close to the hives…They didn't feel left out, and were able to do the class projects."

"I never force a student [to get close to the hive], but the students are curious, and in the end, [those who are afraid usually] want to get close to the hive and observe the bees," says Guzzetta.

"Modeling by students who are proficient and competent with bees" helps students who are afraid because "they see the other students are safe," Malloy maintains.

Though Malloy and his social studies colleague "knew nothing about beekeeping to start, we learned so much by being open-minded and unafraid. If you commit yourself to learning, you can make it work," he concludes. ●

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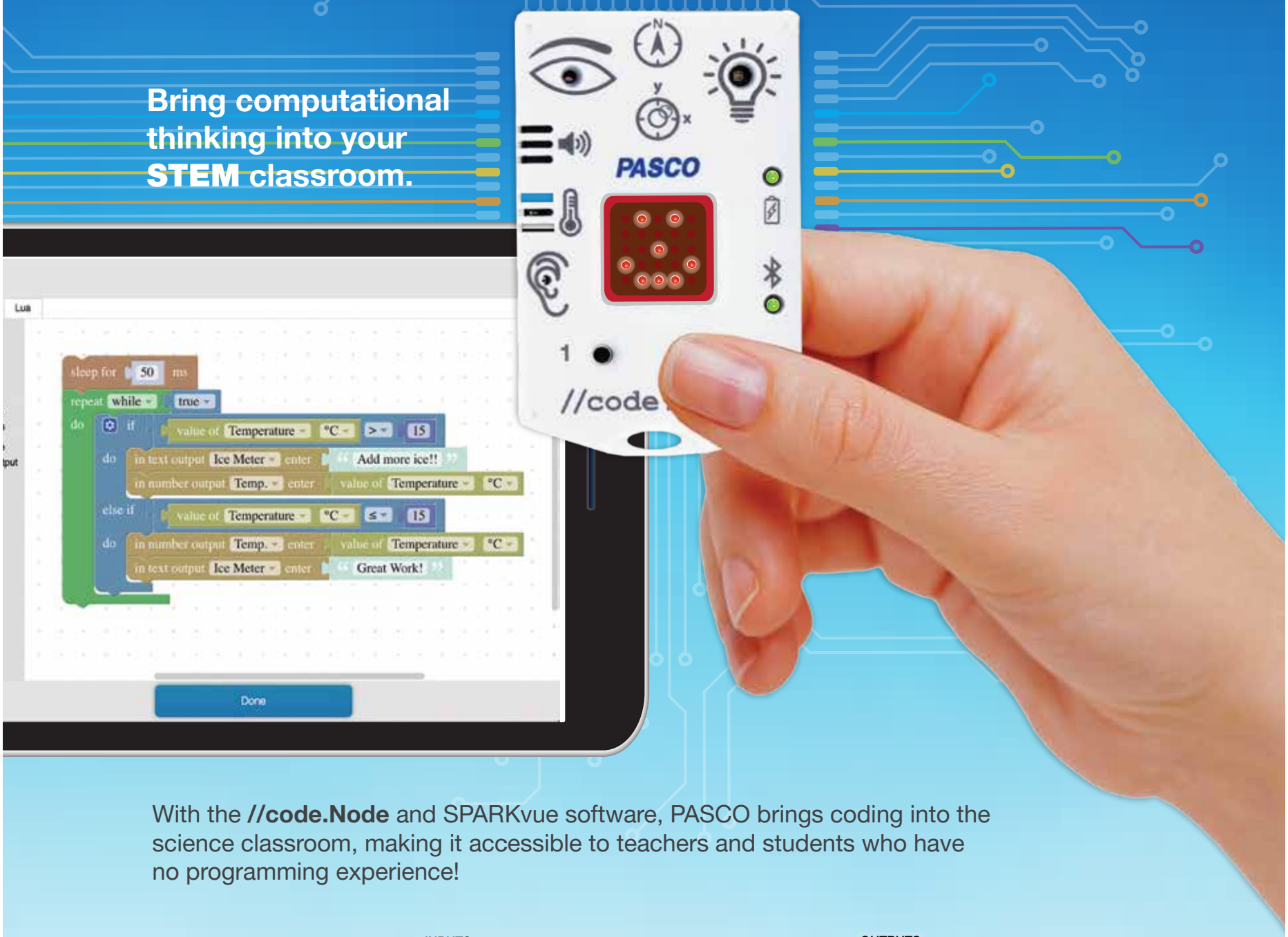

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Life Skills, Literacy, and STEM

Afterschool programs around the country have discovered that students benefit when programs combine science, technology, engineering, and math (STEM) and English language arts (ELA) content with opportunities for students to develop life skills. For example, Brave Hearts, a national nonprofit organization that promotes leadership, literacy, and STEM for young women (*www.braveheartleaders.org*), was founded to help girls "understand how to advocate for themselves" to "make a difference in their homes, schools, and communities," says CEO Jennifer Boykins. Eventually, "it became apparent that an important anchor was missing,…the inclusion of STEM" in the Brave Hearts curriculum, so girls could learn about STEM careers and opportunities, Boykins contends.

Working with Hampton City (Virginia) Schools, "we created a...curriculum that included practical applications for [STEM] through [the Flying Classroom program," Boykins relates. The Flying Classroom, a K–12 STEM curriculum (*https://bit.ly/395d1Qw*), was created by Barrington Irving, a Guinness World Record holder as the youngest person and first African American pilot to fly solo around the world. "It was through those integrated experiences in leadership, literacy, and STEM [that] we began to see the girls soar and thrive," Boykins maintains.

When she was principal of Forrest Elementary School in the Hampton City Schools (HCS) district, Kelli Cedo heard Boykins speak at a conference and was inspired to bring Brave Hearts to her school. Later, when Cedo became the HCS ELA curriculum, instruction, and assessment lead, "we worked with the community to expand the program to middle school girls. The expansion continued through collaboration with the HCS Out of School Time program coordinator," she says, who obtained a Department of Education 21st-Century Community Learning Centers grant that helped Brave Hearts expand to five HCS middle schools.

Expansion beyond ELA has enabled the infusion of "STEM-based activities, presenters, and field trips," notes Cedo. "The curriculum has all of that embedded."

Students at Tarrant Middle School in Hampton, Virginia, observe magnetic fields under the direction of National Institute of Aerospace graduate student Cecilia Mulvaney.

Betsy McAllister, HCS STEM teacher specialist and National Institute of Aerospace (NIA) educator in residence, has connected Brave Hearts girls with female employees from NIA, the American Institute of Aeronautics and Astronautics, and NASA Langley Research Center, who lead them in STEM activities. "It's important to give girls [opportunities to interact with] individual females in STEM that they can relate to," she maintains. A recent lesson on magnetic fields, for example, "was tied into navigation because one of the women [teaching it] is a pilot," she relates.

Adding to STEM

In Petri-dish Science, an afterschool STEAM (STEM plus arts) program in Cupertino, California, "we work on science and engineering challenges, but incorporate literacy, storytelling, arts, and public speaking in our curriculum," says Pragya Bhatnagar, educator and Petri-dish Science's founder. Her lessons, which support *Next Generation Science Standards* (*NGSS*), feature "hands-on, integrated stories and games and design challenges," she relates.

For example, Bhatnagar continues, "I bring in Force, Motion, and Gravity as characters [in a story], with Friction as the enemy—at first. The story gets kids to think about these concepts, then I do hands-on activities with them." The stories often "get kids laughing," she adds, and help them "remember the concepts better."

While Petri-dish Science serves grades K–5, "I work with mostly first to third graders…[Those grades seem to be] the sweet spot for hands-on activities," she points out, noting these activities frequently incorporate the arts. "The materials are everyday [items], which students use to create models," she explains. Drawing and designing are integrated.

Students build devices, and "we do a lot of testing, make a game out of it sometimes," Bhatnagar relates. For example, "when we are building sampling devices for drilling into soil on the Moon, we also talk about NASA missions…[In one game,] we test a sampling device via a relay race [in which the goal is to] capture small [plastic foam] balls," she explains. The goal in her lessons, she says, is to explore "real-world phenomena, apply what is learned to solve a real-world problem."

Lessons always include an opportunity for students "to tell their stories [to their classmates]. Students feel proud of what they've accomplished," and gain experience with public speaking, Bhatnagar observes. And she tells children, "It's okay to talk about success or failure; we will learn from both. It's important to share information and data like scientists and engineers do."

For more details on Petri-dish Science, see *www.petridish-science.org*. ●

Quotable

Reach for the stars. Although you will never touch them, if you reach hard enough, you will find that you get a little star dust on you in the process.

—Norman Borlaug, American agricultural scientist and humanitarian (1914–2009)

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STEM Career Expos Expose Potential Paths

Sixty-three percent of respondents to a recent informal *NSTA Reports* poll said their schools don't hold career expos focused on science, technology, engineering, and mathematics (STEM), but 63% reported that their schools strive to include STEM in general career fairs. One respondent noted a dual benefit, as a STEM career fair "exposes students to different STEM careers they may not have known existed. It allows the school to create community connections to be used in the future."

Division Street Elementary School in Saratoga Springs, New York, adds the arts to STEM, holding a STEAM Career Fair for more than 10 years. According to Principal Greer E. Miller, the fair features four presentations per K–5 grade; each presentation includes a discussion or demonstration and time for students to ask questions.

"The theory goes, by the time they leave elementary school, they will have been introduced to at least 24 careers in STEAM," explains Miller. Volunteer presenters are either family members of students or community members. "When we first started the STEAM Career Fair several years ago, a staff member knew someone who designed water parks. The person still comes every year, even though he does not have any affiliation with the school."

The Greater Capital Region STEAM Exposition (GCRSE) in Albany, New York, has incorporated career education with a high school STEAM competition for five years. The three-part event opens with high school students presenting interdisciplinary STEAM projects to judges and attendees, followed by a networking lunch.

"This provides the high school students with an opportunity to meet… (other like-minded high school students from all over the Capital Region of New York State) and with individuals at the next level (college) who can provide guidance as to how to continue with their interest in STEM fields," explains Michele C. Famoso, physics teacher and STEM Club Advisor at Albany's Colonie Central High School and GCRSE coordinator. The event wraps up with a Discovery Fair during which the high school students display their projects, and groups such as robotics clubs, technology companies, environmental groups, and colleges and universities "have demonstrations and hands-on activities for the public to participate in," she continues. "Our goal here is to excite, motivate, and encourage students at all levels to learn about STEM and STEAM, and to pursue STEM careers…whatever that may be. Who knows what a career in STEM will look like in the next 20 years?

"We have the full continuum," Famoso adds. "We have the hands-on, interactive, fun exhibits that you might see at other STEM Expos, but we also get our students involved, all the way from preK through grade 12, and college students and programs, too (even graduate students come and show off what they are doing)."

There are many challenges to planning a successful event. "Planning this annual event is a full-time job, and I already have one," she says. The first year, she worked closely with Principal Tom Kachadurian, who organizes a district "character building" event, Raiderfest, at the school. GCRSE and Raiderfest are held on the same day, and many participants attend both events. "As the event has grown, so has my team. We now have a GCRSE Planning Committee from all over the Capital Region…It is still a lot of work, but it is so worth it."

The STEM Summit has been bringing schools and area businesses together in Fredericksburg, Virginia, for nine years. "We're pulling from three [different] counties," says Dianne Clowes, instructional technology resource teacher at Courtland High School and Spotsylvania Career and Technical Center in Spotsylvania County, Virginia. "We get [representatives from the] Civil Air Patrol, Dahlgren [Naval] Surface Warfare Center, FIRST Robotics, GEICO, [and others,] all showcasing the STEM jobs available. They demonstrate equipment and show how they use STEM in their careers."

Clowes said they have received good feedback and drew between 700 and 800 participants in 2019. "It's nice to be partnered with the Chamber of Commerce. They're always working with businesses, which makes an easy relationship for us." Local students also showcase projects they're doing in school.

REIDAR HAHN, CREATIVE SERVICES AT FERMI LABS

The STEM Career Expo at the Fermi National Accelerator Laboratory in Illinois is a chance for students to meet with STEM professionals and learn about a variety of potential career paths.

Discovering Opportunities

The "big intention" of the Ohio Department of Natural Resources (ODNR) Division of Wildlife's Student Wildlife Research Symposium is to "not only encourage kids to go into research, but to encourage them to stay involved in the field," says Jen Dennison, wildlife education coordinator.

The symposium offers an opportunity for high school students to share their research with other students and professionals. The symposium includes "five slots for paper presentations, but we take as many posters as we can," Dennison explains. "We have 30–40 students presenting their research; there's usually 3–4 kids working on each presentation…Students have told us they like the non-competitive aspect."

The symposium attracts 75–100 attendees, including staff from ODNR's fish management, wildlife management, and law enforcement divisions who visit the poster presentations and join the students for a networking lunch. ODNR staff also bring equipment such as shock boats, live bear traps, and robotic decoy animals. "We also invite colleges and universities to come and…talk about study paths. There's a lot of casual interaction. Kids walk up and ask a question one-on-one," she says.

"The intention has always been to pull more kids into the field. By giving [students] opportunities to show what they've been doing, they're more likely to stick" with the field, Dennison says.

The Fermi National Accelerator Laboratory in Illinois hosts a STEM Career Expo that drew nearly 1,000 participants last year, according to Susan Dahl, education program leader at the lab. "We have 150 or more STEM professionals" from Fermi as well as other labs, small businesses, large corporations, and government agencies, Dahl explains. Students and their families visit exhibitors arranged by the type of career they represent. The expo typically has professionals representing more than 80 engineering careers, 10–15 math or technology careers, and about 25 science careers. Five panel discussions offer additional insight into various career paths.

"We started with two schools [in 2007]…The idea was 'Why should the schools do [separate events]?'," Dahl recalls. "It's become really popular. We attract a lot of local people and have expanded into the Chicagoland area."

She says students learn about careers and some even ask about internships. "We even had a student [who attended one of the] earlier years of expo who found out about a career [who is] now in that career and on our panel.

"Thirteen years ago, people didn't think about STEM as much as now. The public and educators can come here to learn more and be inspired," Dahl asserts. ●

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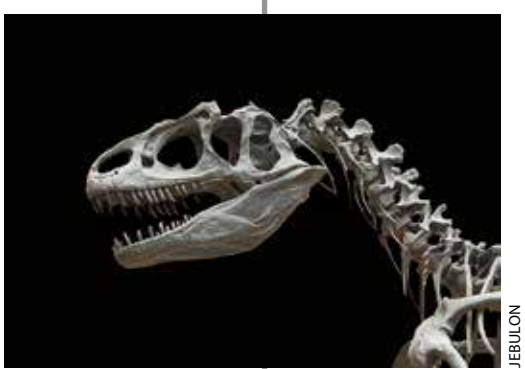
inquiryHub Biology. H This open-access, digital biology curriculum supports three-dimensional learning and the *Next Generation Science Standards* (*NGSS*). Targeted for the high school level, the yearlong course features three units: Evolution, Genetics and Heredity, and Ecosystems. Each unit is organized around a sequence of coherent lessons—a storyline—that involves students in asking and investigating questions relating to an anchoring phenomena or design challenge. Students use science and engineering practices to determine the Disciplinary Core Ideas and crosscutting concepts needed to make sense of and explain phenomena and solve challenges.

The units examine biological concepts through phenomena such as antibiotic resistance and a bird population that evolved to become bold (Unit One, Evolution); Duchenne Muscular dystrophy and gene editing (Unit Two, Genetics and Heredity); and how trees can mitigate climate change and population changes among large animals on the Serengeti (Unit Three, Ecosystems). At *http://bit.ly/2Tw2EAF,* teachers can access materials for each unit, including teacher's guides, slides, student activity sheets (available in English and Spanish), assessments, and other resources to facilitate classroom implementation.

Stanford Science Penpals. M H Connect students in grades 6–12 across the United States with science mentors from Stanford University in California for a year of scientific correspondence. In the program, university scientists are matched with a participating classroom at the beginning of each school year to exchange letters monthly during the academic year (September to June). The mentors aim to share their love of science with students, be a resource to answer students' science questions, and expose students to new and diverse scientific careers. To read a blog featuring some of the science mentors and find participation details, visit *http://bit.ly/39OhM1N.*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EarthDate. M H HE This weekly public service radio program (and podcast) is dedicated to engaging listeners of all ages—including teachers and students from middle to college levels—in Earth science topics. Produced by the Bureau of Economic Geology at the University of Texas at Austin and hosted by geologist Scott Tinker, the program presents two-minute episodes highlighting interesting insights on a broad array of Earth science topics from water to climate, earthquakes to volcanoes, and dinosaurs to early humans. Supplementary materials, including a peer-reviewed background summary and a list of references for more information about the topic, accompany each episode.

Teachers can incorporate the program podcasts and materials into lessons to invigorate their Earth science and other science instruction. Visit *www.EarthDate.org* to learn more and search the collection of 150 available episodes.

UCI CaSTL Physical Science Lesson Plans. E Excite elementary students about physical science with this collection of 28 *NGSS* lessons developed by master teacher Terry Shanahan of the University of California, Irvine's Chemistry at the Space-Time Limit (CaSTL) Center. Appropriate for both classroom and afterschool settings and presented in a 5E (Engage, Explore, Explain, Evaluate, Extend/Elaborate) lesson format, the teacher-tested lessons provide descriptions of roles of the teacher and students in each activity, along with classroom management tips and student handouts required for implementation. Lesson highlights include titles such as Alien Invasion, Forces Push and Pull, Glow in the Dark Slime, Gravity of the Situation, Surface Tension, and What Do Magnets Attract? To access these and other hands-on activities, visit *http://bit.ly/2xeA8L2.*

One Hundred Years of "Progress." K12 HE Since 1973, safety education expert and Laboratory Safety Institute founder Jim Kaufman has been collecting anecdotal accounts of lab accidents. The collection now includes descriptions of more than 5,000 accidents that have occurred when laboratory safety rules were broken and proper lab safety procedures not followed. One Hundred Years of "Progress"—one of several laboratory safety education resources available from *www.labsafety.org*—is a compilation of descriptions of major lab accidents from the past 100 years. The electronic publication was developed as a reminder to K–12 educators and other laboratory professionals of the need for continued vigilance and understanding of laboratory safety practices.

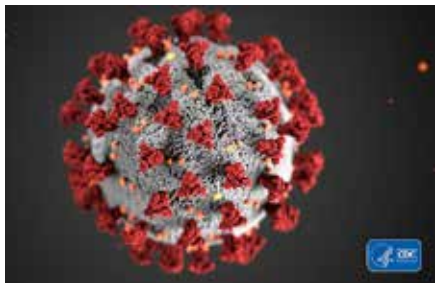
Request a free copy by e-mailing *molly@labsafety.org* and mentioning this listing from the April 2020 issue of *NSTA Reports.* The publication will be available upon request until **May 15.**

See Freebies, pg G2

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

Freebies, from pg G1

OpenSciEd Instructional Units: Middle Grades. M OpenSciEd—a national education initiative developed by a consortium of curriculum developers to address the demand for high-quality, open educational resource instructional materials in science for the middle level—has released units for grades six, seven, and eight as part of its ongoing effort to develop a full-course, three-year, open-source science program for the middle grades. The units support three-dimensional learning and the *NGSS* and have been designated high-quality instructional materials through an external evaluation by an Achieve, Inc., Science Peer Review Panel. Available to middle level educators across the United States, the units address the following topics: Weather and Water Cycling (grade six); Matter Cycling and Photosynthesis (grade seven); and Forces at a Distance (grade eight). To find out more about the initiative's timeline and access all available units, visit *www.openscied.org.*



CDC

Analyzing Data: Coronavirus. H Tackle a timely subject, the coronavirus outbreak, and provide high school students valuable practice in analyzing authentic data with two ready-to-teach lessons from DataClassroom.com. In each activity (Spread of 2019-nCoV Within China and Spread of the Virus Outside of China), students use the datasets provided to answer a series of questions relating to the spread of the virus. Learn more and find the activities at *http://bit.ly/3aBez5Q.* (*Note: Free registration is required to access the datasets.*)

PD Course: Early Childhood STEM. P E Check out this professional development course, Early Childhood STEM (Science, Technology, Engineering, and Math): Building the Foundation, for insights and actionable tips about engineering with students in grades preK–K. Developed by the Museum of Science, Boston's Engineering is Elementary curriculum program, the self-directed, monthlong e-mail course contains four lessons: STEM 101: The Basics; Social and Emotional Learning: Engineering Empathy; Engineering Foundational Skills; and How Young Children Engineer. The lessons show educators what STEM looks like in early childhood, how kids learn it, and how young students benefit from STEM learning. For more information or to register for the course, visit *http://bit.ly/2TzqCes.* Teachers who successfully complete all four lessons receive a certificate for course participation.

Navigating Nuclear: Energizing Our World. M H Developed jointly by the American Nuclear Society and Discovery Education, this standards-supported curriculum program (with versions for middle and high school levels) explores the many applications of nuclear science and their impact on energy, healthcare, food, and the environment. The curriculum features digital lesson plans, STEM project starters, career profiles, and additional resources about the nuclear science industry. Highlights from the high school materials include Decoding Decay, a digital lesson in which students use the periodic table as a tool to predict a nuclide's properties, and the related Decay Detectives: Art Forgery or Masterpiece?, a STEM project starter in which students apply what they've learned about radiocarbon dating to explain how the process can be used to help detect art forgeries. Highlights from the middle level curriculum include activities such as From Atoms to Electricity, a STEM project starter in which students demonstrate their knowledge of nuclear energy by creating a model of a nuclear power plant and explaining the energy transformation in different parts of a nuclear reactor.

In addition to curriculum activities, students from both levels can learn about many dynamic jobs in the nuclear industry through career profiles and a virtual tour of a nuclear generating station. Access these resources at *http://navigatingnuclear.com.*

NASA

Meteor Terminology poster. K12 Comet. Asteroid. Fireball. Meteor. Metorite, Meteroid. These terms and many others are highlighted and defined on this striking poster produced by the American Meteor Astronomy Society. The purpose of the poster is twofold: to inform K–12 educators and the general public of the true meanings of many commonly misused astronomical terms, and to generate interest in the expanding field of meteor astronomy. In addition to the poster, which is available to download and print in 10 languages (English, Italian, German, Spanish, French, Dutch, Brazilian Portuguese, Latvian, Croatian, and Farsi), teachers can access an online glossary of additional meteor-related terms. You'll find both resources at *http://bit.ly/32ZZBUo.*

PETER KASPER

California Academy of Sciences High School Lesson Plans. H Browse the Academy's curated collection of more than 25 science lesson plans for grades 9–12, many of which include connections to the *NGSS.* The lessons address topics in biology, chemistry, environmental science, and other fields and reflect varied types of learning experiences from computer-based data analyses to hands-on role plays and more. In addition to including the digital files necessary to complete an activity in the classroom, the lessons include links to related lessons for further learning. Lesson highlights include Carbon Cycle Role-Play; Mapping Mockingbirds; Our Hungry Planet: Design Thinking Challenge; and Photosynthesis Seen from Space. Visit *http://bit.ly/3aB1oSr.*

Save Our Seas. K12 The North American Marine Environment Protection Association (NAMEPA) has a variety of resources to engage K–12 students, teachers, families, and marine professionals in the effort to save our seas. The resources—including curriculum guides, flyers, and handouts—teach students (and others) about marine environments, marine pollution and how to prevent it, and the maritime industry. Find these resources and more at *https://namepa.net/education.* (Free registration is required to download the materials.)

I Notice, I Wonder, It Reminds Me Of. E M Use this simple routine to lead students in grades 3–8 to good inquiry questions. Developed through the Lawrence Hall of Science's Better Environmental Education Teaching, Learning, and Expertise Sharing project, the standards-based technique helps students develop a mindset of curiosity and provides language tools to directly engage with the natural world. To begin, students make "I notice..." statements about a natural object, such as a leaf, aloud with a partner, then share some of their observations with the group. They do the same with "I wonder..." questions and with "It reminds me of..." connections. The simple routine, applicable to any object in nature, helps students move from seeing nature as a "green blur" to being careful observers. To download an instructor's guide and watch a short video of the technique in action, visit *http://bit.ly/3b8X3XL.* ●

News Bits

- **Researchers found learning in a green school building positively affects elementary students.** E

Professors in University of Missouri's College of Education and architectural studies department partnered with the Columbia, Missouri, school district for their study, published in *Environmental Education Research*. Roughly half of the 37 participating fifth graders were taught in a green school building; the other half in a neighboring trailer classroom. Both classes had similar curricular activities.

When students were asked to draw a picture reflecting how their school building affected the ecosystem, students in the green building showed a more positive relationship between the building and the environment. Researchers also found that green buildings help students make environmental connections when learning concepts. Learn more at *http://bit.ly/2QhynU6*.

- **A tornado-damaged area of Baker University Wetlands in Baldwin City, Kansas, is now a research site.** HE

The university has designated the area damaged by the EF-4 grade tornado last May as a natural disturbance research site. Tornado damage is unusual at the university, making it harder to study. Biology professor Scott Kimball says, "This is a wonderful and rare learning opportunity for our students to learn about the effects of nature on a habitat impacted by a natural event."

Students will gain hands-on experience measuring and analyzing the forest's response to disaster; communicate research results with both the scientific community and the general public; and develop interpretive public displays explaining the role of disturbance in natural systems, the role of riparian forests in the landscape, and the importance of science in understanding the natural world. Read more at the website *https://prn.to/2U8IGek*.

- **Modern teacher professional development is focusing more on science, technology, engineering, art, and math (STEAM).** HE

Gwynne Rife, chair of advanced professional programs at University of Findlay in Ohio, says teachers don't need help with technology; they need help with using technology for instruction. Findlay's online master's program in STEAM education covers differentiated instruction, inquiry-based science, robotics, coding, artificial intelligence, makerspaces, and more. Preservice teachers also learn new, more holistic methods of assessment (e.g., having students create digital stories and infographics to demonstrate learning), and ways to use technology to develop students' soft skills, such as problem solving, communication, creativity, and collaboration.

Still, Rife says, "Staying on top of changing technologies and leveraging them to deliver the best instruction to students is a challenge."

At Buena Vista University in Storm Lake, Iowa, master's candidates in STEAM education are challenged to embrace change, says Lucas DeWitt, an assistant professor of education. Candidates are designing lessons in which students and teachers collaborate to analyze different perspectives and decipher fact from fiction using online information.

DeWitt contends that teachers will need to learn how to reimagine school through digital content. Learn more at *http://bit.ly/38SDzUL*. ●

What's New

FROM U.S. GOVERNMENT SOURCES

U.S. Fish and Wildlife Service (FWS)

Eggs! K12

K–12 audiences can celebrate birds and their eggs' distinctive characteristics with this science-rich photo essay from the National Wildlife Refuge System. Featuring striking wildlife photography and accompanying text, the essay explains some of the reasons for eggs' distinctive characteristics, such as why some eggs are colored and others are white and why some eggs are oval and others pear-shaped. The essay also tells why some birds lay one egg and others a clutch of eggs. Read the essay at *https://go.usa.gov/xpJ8u*.

National Aeronautics and Space Administration (NASA)

Go With the Flow E M

Go With the Flow, an educational game from NASA's Space Place, teaches students about ocean currents and how they work. Targeted for grades 3–6, the game challenges players to adjust ocean currents so they can maneuver their submarine and find a key to unlock a treasure chest. Game rules reinforce how real ocean currents work (e.g., salt makes water heavier, so it sinks; heat makes water lighter, so it rises), so students deepen their understandings about ocean currents as they play. The game's web page also includes informational text about currents, as well as an animation of major ocean currents flowing around the globe. Play the game at *https://go.nasa.gov/2PZoKJt*.

Earth-Now App M H

NASA's Earth-Now app visualizes real-time global data from Earth science satellites, including surface air temperature, carbon dioxide conditions, gravity anomalies, and ozone levels over Antarctica. The three-dimensional app offers an instant glimpse of the planet's vital signs and provides numerous opportunities for users—including middle level and high school students and teachers—to work with authentic data and learn to read and interpret climate data maps. The app is available for both Apple (*https://apple.co/2v6jn41*) and Android (*http://bit.ly/331brgU*) platforms.

Wetlands: Applied Research STEM Unit H

In this comprehensive curriculum unit developed through NASA's Climate Change Research Initiative, students in grades 9–12 study the wetlands as scientists do. Through a combination of laboratory investigations and fieldwork, students learn about the importance of the saltmarsh ecosystem and evaluate the impact of human behaviors on it. The unit gives students opportunities to participate in authentic science research and data analyses through the use of GLOBE, My NASA Data, and other NASA educational resources, content, and platforms. Access the unit's complete teaching guide—which features lesson plans, a pre- and post-assessment, and links to the NASA resources used in the unit—at *https://go.nasa.gov/2vH36D7*.

National Oceanic and Atmospheric Administration (NOAA)

"Trends in Our Changing Climate" Poster K12 HE

This poster produced by NOAA's Climate Program Office features red and blue arrows alongside brief text to provide a snapshot overview of current climate change indicators. The resource was developed to support K–college educators and other stakeholders in understanding climate science and in interpreting content from NOAA's climate reports and resources, such as the Fourth National Climate Assessment (*http://bit.ly/3cN2IU0*) and Climate.gov's Global Climate Dashboard (*http://bit.ly/2TBzaRN*). Request a poster by e-mailing *education@noaa.gov*.

Teaching Climate K12 HE

NOAA's Climate.gov offers an assortment of research-backed teaching resources to help K–college educators (and the public) deepen their understanding of climate science and share their knowledge in the classroom and community. The resources available at *www.climate.gov/teaching* include classroom activities, curriculum materials, multimedia resources, and professional development opportunities for formal and informal educators. Of particular interest are case study examples highlighted on the website. These diverse programming models provide support and inspiration for teachers interested in establishing successful student-driven initiatives to help solve climate issues in their communities.

Nature's Notebook K12

Produced as part of NOAA's Planet Stewards webinar series, this hour-long webinar at *http://bit.ly/2IxJvrR* introduces the topic of phenology—i.e., the study of the recurring life cycle events in plants and animals—and how to use it as a K–12 teaching tool and as a lens to the natural world. The webinar guides viewers in recording nature observations through Nature's Notebook (*http://bit.ly/39JwOGo*), a *Next Generation Science Standards*–supported citizen science plant and animal phenology observation program from the USA National Phenology Network (*www.usanpn.org*). The webinar also discusses how to implement a long-term monitoring program at your school and explains how participation in such programs leads to a better understanding of climate change.

STEM-Focused Giveaways K12

Looking for STEM-focused giveaways to share with your organization or at an upcoming outreach event? If given a three-week turnaround time, NOAA SciJinks, NASA Space Place, and the GOES-R programs will provide free stickers, bookmarks, temporary tattoos, or other educational materials for your event. The materials can be used to generate excitement about STEM topics and inspire K–12 educators and their audiences to engage in STEM pursuits. To request the resources, complete a Materials Request Form at *http://bit.ly/2TCOTQR* and provide pertinent details about the event (e.g., organization name, event date, event type, intended audience, expected number of attendees, mailing address, and so on).

U.S. Geological Survey (USGS)

Powell150 Website K12

In May 1869, American explorer/scientist John Wesley Powell and a crew of 10 traveled the Green and Colorado Rivers, a 95-day journey that resulted in some of the earliest known maps, data, topographic measurements, geology research, and reporting on local Native American cultures in the region. Today, the area remains an important site for science study and investigation of the geology and ecology of rivers. Powell150, an outreach website (*https://on.doi.gov/39E96LA*) created by the USGS to commemorate the historic scientific expedition, has a collection of maps, images, and other primary source documents to help K–12 students understand the trip's significance. The site also includes lessons and activities for students to learn more about Powell and explore river science concepts in the classroom.

Centers for Disease Control and Prevention (CDC)

Understanding E-Cigarettes and Their Risks K12 HE

This resource at *http://bit.ly/39G0SSW* informs readers about e-cigarettes and their risks for children, teens, and young adults. The website covers

what e-cigarettes are, how they work, their negative health effects, and federal regulations regarding their use. In addition, educators can access fact sheets and infographics to download and display in K–12 schools and other community venues.

U.S. Environmental Protection Agency (EPA)

Service-Learning Education Beyond the Classroom K12 HE

Need inspiration to encourage civic responsibility among students? Browse this online booklet from the EPA to learn about environmentally themed service-learning projects conducted with students at every level, K–college. The publication highlights successful projects relating to solid waste management, including projects for reducing household hazardous waste, student-led recycling programs, and school composting efforts. Although published in 2002, the booklet at *http://bit.ly/38E9Oar* serves as a good starting point to spark ideas and discussion about the types of service-learning projects that can be successfully conducted with students and partners in community schools, businesses, and neighborhood associations.

U.S. Department of Agriculture (USDA)

Plant It, Grow It, Eat It! Healthy Habits Take Root E M

School gardens can help increase elementary and middle level students' awareness of where foods come from and promote a preference for fruits and vegetables. Find tips on starting your own school garden and read descriptions of successful garden programs at U.S. schools in the article "Plant It, Grow It, Eat It! Healthy Habits Take Root." Available in PDF format, the article at *http://bit.ly/38JAXc5* was produced by the USDA's Team Nutrition program and appeared in the program's *Team Nutrition Popular Events Idea Booklet*.

A-Maze-ing Light Investigation E M

What do plants need to grow? Do they seek out what they need? Students in grades five and six can explore answers to these and other garden-based questions in A-Maze-ing Light, a simple investigation from *Dig In!,* the program curriculum from the USDA's Team Nutrition program. In the activity, students design and build a cardboard maze for a bean plant to grow in and observe what happens when the plant receives limited or minimal sunlight. As students complete their investigations, they practice many processes used in science and elsewhere, such as engineering design, asking questions, making predictions, collecting data, recording observations, analyzing data, and communicating results. Refer to *http://bit.ly/2WjVu4o.*

National Institutes of Health (NIH)

Life and Death of a Neuron E M H

Part of NIH's National Institute of Neurological Disorders and Stroke's Brain Basics series, this brochure at the website *http://bit.ly/2TZ6lO9* provides an introduction to neurons, the brain's information messengers. It discusses neurogenesis (the birth of neurons), neurons' migration to the place in the brain where they will do their work, differentiation into different types of cells, and the death of neurons in healthy brains and in disease. The material is designed to be used at the middle level, but teachers have adapted it for upper-elementary and high school students.

Genes at Work in the Brain E M H

This brochure in the Brain Basics series introduces students to genes, how they work in the brain, and how genomic research is helping lead to new therapies for neurological disorders. The material is designed to be used at the middle level, but teachers have adapted it for upper-elementary and high school students. Access the brochure at *http://bit.ly/2UelfAv.*

Library of Congress (LOC)

Innovators and Inventions in History M

For generations, innovators have used their imaginations to create new products to improve our daily lives. But how can historical examples be used to spark innovation for inventors today? A recent post in the Teaching with the LOC blog describes an activity that does just that. In the lesson at *http://bit.ly/38Hg9l8,* which is best suited for middle level learners, students use three primary sources (e.g., a historical newspaper advertisement, a diagram of the telegraph, and a personal letter) to compare and contrast three inventors and their inventions in history: Leo Wahl and a new barbering tool; Samuel F.B. Morse and the telegraph; and Benjamin Franklin and bifocal lenses. The post includes questions for teachers to ask students as they work through the activity, as well as a link to a Primary Source Analysis Tool, on which students can record their responses.

Tuskegee Airmen and the Engineering Design Process K12

The Tuskegee airmen broke barriers by becoming the first African American military fighter and bomber pilots in the U.S. Armed Forces during World War II. The men trained as pilots, mechanics, air traffic controllers, parachute riggers, navigators, and electrical system specialists at Moton Field in Tuskegee, Alabama. American photographer Toni Frissell captured images of the men, highlighting wartime conditions of the period. "Celebrating the Tuskegee Airmen," a recent blog post in Teaching With the LOC, shows K–12 teachers how the photographer's primary source images can be used to explore the engineering design process with students and introduce the Tuskegee Airmen at the same time. See *http://bit.ly/2vYPpzt.* ●

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

In Your Pocket

Editor's Note

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

April 22–30

National Film Board of Canada Education's Ocean School Contest K12

Teachers and their students can enter to win three Oculus Go Virtual Reality headsets, a 360-degree camera, and a day with the Ocean School team. To enter, students must create a response to one of the following questions:

- How can we contribute to healthy habitats?
- What actions can we take to protect marine ecosystems? or
- How can we ensure the sustainable use of our marine resources?

Entries should demonstrate a deep understanding of the problem at hand and provide an innovative, inspiring solution. This might include organizing a shore cleanup or interviewing members of the community to share differing perspectives on the issue.

Classes or small groups at any level in Canada can enter by **April 22** at *http://bit.ly/3cI8ZQO.*

Recycle Rally Competition K12

Schools can win cash prizes of between $500 and $50,000 by logging their recycling efforts online. Those registering with the Universal League report recycling via bag count; those that choose the Challenge League report by weight. Schools can compare their counts to others around the country. Register your school online at *http://bit.ly/2TW3KV8* and submit your stats by **April 28.**

Siemens and Discovery Possibility Grant Sweepstakes K12

This $10,000 grant will help one Title I school "fab" its science, technology, engineering, and math (STEM) lab. Funds can be used to refurbish an existing lab or buy science, technology, engineering, and math (STEM) equipment, supplies, and technology. K–12 teachers can enter their school in the contest, and parents, teachers, and community members can vote for it daily until **April 28.**

Visit *http://bit.ly/2tGLTVB* to enter and vote for your school. STEM activities that accompany the contest are also available for elementary, middle, and high school levels.

Roberta Williams Biology Laboratory Teaching Initiative Grant HE

The Association for Biology Laboratory Education (ABLE) provides these grants to help teachers develop investigative lab activities at the university and college level. This can include designing new labs, improving existing ones, or creating multimedia tools.

Projects that are innovative, adaptable, and inquiry-based receive priority. Recipients will present their work at an ABLE conference workshop within two years of receiving the grant.

Faculty, staff, or graduate students who are currently teaching life science at two- and four-year postsecondary institutions are eligible. Apply by **April 30** at *http://bit.ly/2xcJgQi.*

The Lawrence Foundation Grants P K12

Public schools, libraries, and nonprofit organizations that support the environment, human services, and other causes may apply for these grants. Both program and operating funds are available; the average amount ranges from $5,000 to $10,000. Apply by **April 30.** See *http://bit.ly/2XuD0w5.*

The Safeway Foundation's Grants K12

These grants fund K–12 schools and nonprofit organizations in the following areas: education, supporting diversity and inclusion, environmental issues, and health and nutrition, among others. Grants of $5,000 to $10,000 are available. Applications are accepted year-round from organizations located near Safeway stores; to determine whether your community qualifies, see *http://local.safeway.com.*

The next application review takes place on **April 30.** For more information, visit *http://safewayfoundation.org.*

Voya Unsung Heroes Grants K12

Each year, Voya Financial provides $2,000 grants to 50 educators with innovative project ideas that will positively influence their students. At least one grant is awarded in each of the 50 states. The top three winners will receive additional prizes of $25,000 (first place), $10,000 (second place), and $5,000 (third place).

Full-time teachers, principals, paraprofessionals, and classified staff at accredited K–12 schools are eligible. Apply by **April 30** at the website *https://go.voya.com/2UcEsRw.*

May 1–11

Kinder Morgan Foundation Education Grants K12

These grants of between $5,000 and $20,000 go to education programs for at least 500 underserved youth in communities where Kinder Morgan operates. K–12 public and private schools and nonprofit organizations with arts education or academic programs, including tutoring, in the United States and Canada are eligible.

Locations must be within 30 miles of Kinder Morgan sites in Birmingham, Alabama; Phoenix, Arizona; Tucson, Arizona; Concord, California; Carson, California; Colorado Springs, Colorado; Lakewood, Colorado; Tampa, Florida; Alpharetta, Georgia; Downers Grove, Illinois; Chicago, Illinois; Shreveport, Louisiana; Port Sulphur, Louisiana; Harvey, Louisiana; Williston, North Dakota; Port Newark, New Jersey; Tulsa, Oklahoma; Midland, Texas; Pasadena, Texas; Houston, Texas; El Paso, Texas; Norfolk, Virginia; and Vancouver, Washington. Apply by **May 1** at *http://bit.ly/2k4lS1q.*

National Green Week/ Green in Action Award K12

Each year, the Green Education Foundation (GEF) encourages schools to highlight sustainability for one week in February, March, or April as part of its National Green Week initiative. The foundation provides five-day, standards-based lesson sets; activities; and readings; and holds contests focused on various green themes, such as the "Green Thumb Challenge," the "Waste Reduction Challenge," or "I Ride Green." Schools can participate for the entire week or for just one day, or use just one lesson from the curriculum. Afterward, participants submit a survey and can nominate themselves for a Green in Action Award of $250.

To participate, teachers must become GEF members (at no charge), choose a timeframe in which to participate, and select their green theme at *http://bit.ly/2Iv11Nn.* Applications for the Green in Action Award are due by **May 10.**

Dreyfus Foundation Educational Grants K12

The Max and Victoria Dreyfus Foundation provides grants of between $1,000 and $20,000 to community-based nonprofit programs in the United States. Schools; museums; educational and skills training programs; environmental and wildlife protection activities; cultural and performing arts programs; and programs for youth, seniors, and persons with disabilities may apply.

The foundation must receive mailed letters of request by **May 11.** (Online submissions will not be accepted.) Learn more at the following website: *www.mvdreyfusfoundation.org.* ●

NSTA Career Center

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nsta
National Science Teaching Association

Summer Programs

Editor's Note

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

FDA Professional Development (PD) Program in Food Science M H

This weeklong Food and Drug Administration (FDA) workshop introduces middle and high school teachers to the *Science and Our Food Supply* curriculum. Participants explore the farm-to-table process, hear food safety and nutrition presentations from experts, and visit FDA labs and agricultural facilities. In the fall, they implement the *Science and Our Food Supply* curriculum in their classes and conduct a workshop for other local teachers, for which an honorarium and materials are provided.

This year's workshop will take place July 12–18 in Washington, D.C. Certified middle or high school science, health, or family and consumer science teachers with at least three consecutive, full-time years of teaching experience may apply. Air travel, lodging, and meals will be provided. Apply by **April 24;** see *http://bit.ly/38EpMky.*

Center for Learning With Nature's Engineering Inspired by Nature Program E M H

This free online synchronous course is designed to help educators use nature-inspired innovation to enrich their STEM teaching. The course is based on the free *Engineering Inspired by Nature* curricula and supports *Next Generation Science Standards* (*NGSS*). Register by **May 10** at *http://bit.ly/2Isd9hZ.* Teachers will indicate their availability on the registration form.

ASM Materials Camps for Teachers M H HE

Sponsored by ASM, the professional society for materials scientists and engineers, this weeklong, hands-on lab experience shows teachers how to use applied engineering techniques in their classes and make core science and math principles more engaging for their students. In doing so, they work with metals, ceramics, polymers, and composites.

Camps are offered at no charge and are geared toward middle and high school science teachers, though preservice science, art, and math teachers and community college instructors also may apply. Teachers can complete the program as residential participants or commuters. The camps provide continuing education or graduate credits. Apply online at *http://bit.ly/2EhIuBu.*

GEEO Teacher Travel Programs K12 HE

The Global Exploration for Educators Organization (GEEO) sponsors programs to help teachers study abroad at a discounted rate. Programs range from 5 to 23 days and take place in Armenia/Georgia; the Balkans; the Baltics; Bangkok and Hanoi; Bhutan; Budapest and Bulgaria; Camino de Santiago; Central Europe; Egypt; Ethiopia; Galapagos; Greece; India and Nepal; Ireland; Japan; Jordan; Maldives; Morocco; Multi-Stan; Peru; Southern Africa; and Vietnam and Cambodia.

GEEO programs are open to K–12 teachers and university faculty, school administrators, and retired educators. Participants can earn graduate and professional development credit. Apply by **June 1.** See *www.geeo.org.*

Explore Before Explain: A Practical, Fun Approach Toward *NGSS* E

This course for upper-elementary teachers introduces a new way to sequence instruction that promotes enduring understanding. Teachers learn how small shifts in the way they arrange activities can help students better construct knowledge as they prepare for the revised *NGSS*-based Colorado Science Standards.

The course will take place June 15–16 at the Denver Museum of Nature and Science. Register by **June 14** at *http://bit.ly/3aI1Gad.*

Lawrence Livermore National Laboratory PD Workshops M H HE

The Teacher Research Academy at Lawrence Livermore National Laboratory in Livermore, California, offers PD programs for middle and high school teachers and community college faculty. Teachers participate in a continuum of standards-based instruction, progressing from novice to mastery, while experiencing the application of real-world science in an environment most teachers seldom get to explore. Choose from these offerings:

- Technical Writing for Science Class, June 15–16;
- Modeling for Science and Math, June 15–19;
- Bioscience, June 8–12;
- Fusion and Astrophysics, June 17–19 and June 22–26; and
- 3-D Print and Design, July 8–10 and July 13–17.

Continuing education and graduate credits are available. Register at *http://bit.ly/2WqznGa.*

QUEST 2020 UnleadED—What Is in Our Drinking Water? M H

The Flint water crisis focused national attention on lead in drinking water, and many New Jersey municipalities have similar water-quality issues. This Princeton University–based institute will consider the geographic distribution of lead levels in drinking water to help educators understand the structural and environmental factors involved. Teachers will work with an interdisciplinary research team to explore these issues, including a sociologist, geologist, biologist, and an education policy scholar. They'll also collect water samples in their school communities.

This free institute takes place July 7–9 at Princeton and is open to teachers in grades 6–12. Apply at *http://bit.ly/2TAbbCG.*

QUEST 2020: Our Changing Weather E M

QUEST institutes enhance teachers' knowledge of science and math through lab experiments and field experiences supporting the *NGSS.* Current researchers and teachers co-teach the institutes. During the Our Changing Weather institute, teachers will explore air pressure, temperature, seasons, the greenhouse effect, and other factors that relate to both typical weather and extreme weather events, as well as how climate change may affect weather patterns.

This institute takes place July 6–9 at Princeton University. Teachers in grades 3–8 in all content areas may apply. Visit *http://bit.ly/2TAbbCG.*

Summer Institute for Climate Change Education K12

The institute gives educators hands-on experience with climate change activities and using phenomena-based learning to ignite students' curiosity. This year's institute, taking place July 22–24 at Hamline University in St. Paul, Minnesota, provides a special strand for Minnesota teachers focused on new state science standards. Twenty hours of continuing education and graduate credits are available. See *http://bit.ly/2vUTtAL.*

Summer Modeling Workshops M H HE

The American Modeling Teachers Association (AMTA) hosts two- to three-week modeling workshops for middle, high school, and university or college STEM educators. The modeling method was designed to correct some of the flaws of lecture-based STEM teaching, in which knowledge can be fragmented, students tend to be passive, and naïve beliefs of the physical world persist. Participants receive a full set of course materials and work through modeling activities as they practice guided inquiry and cooperative learning.

The AMTA hosts these workshops in locations nationwide. First-time participants receive a reduced rate. Refer to *http://bit.ly/2IDsLz7.* ●

NATIONAL CONFERENCE ON SCIENCE EDUCATION

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ASK A MENTOR, **Advice Column**

Strategies for Enhancing Science Learning and Teaching

By Sharon Delesbore

I love science fair, but is it still practical?

—R., Texas

Science fair provides our students the opportunity to apply scientific processes to problems or questions that interest them. Students performing science is the greatest achievement for teachers of science education. With that understanding, science fairs are practical and relevant.

The basis of science, in my opinion, is a way of thinking in which scientists seek answers to questions by taking inventory of the world that we live in and defining issues that concern our human existence. The methodical approach is to first define that issue or problem. Second, we conduct background research to gain more knowledge of the issue. Based upon the background information, we can suggest a possible solution, or hypothesis, to be tested. The results of those tests can lead us to determine if the hypothesis was confirmed or refuted, or if additional testing is needed.

We can also discuss how to improve the testing process to increase the experiment's validity. If students do not have opportunities like science fairs to use scientific practices, then we are not preparing a generation of science-conscious thinkers and problem-solvers. Just like students cannot grow dendrites by completing worksheets, you cannot help them develop into scientists if they sit at a desk all day following cookie-cutter activities with preset questions that fail to stimulate their creativity or inspire thoughts to make the world a better place.

February is designated as Black History Month. Why is this the only time that black inventors and scientists are recognized?

—T., Alabama

It is important to expose students to the many significant accomplishments that black scientists and inventors have contributed to the world. I don't know of any performance expectations or state standards that specifically state, "Expose students to multicultural scientists and inventors within the curriculum of science education," but cultural relevance has come to the forefront of engaging students to increase academic success. Students become more engaged in their learning when they recognize themselves in the concepts they're studying. For example, a lesson in computer science class may become more interesting to students of color when they learn that a black female was one of the inventors behind animated GIF technology. Lisa Gelobter played an integral part in the creation of Shockwave Flash, which helped popularize web animation.

Pique the interest of black male students with a discussion of Philip Emeagwali, who was inspired to rethink computer processing while studying bees. In 1989, he invented the world's first supercomputer able to perform 3.1 billion calculations per second. Known as "the Black Bill Gates of Africa," he ignited a revolution in technology. Check out "14 Black Inventors You Probably Didn't Know About" on Thinkgrowth.org at *http://bit.ly/2uxx23S* for more examples. Educators should take the opportunity to incorporate multicultural acknowledgement in their curriculum, integrating them in lessons throughout the school year because Black History is American History.

As I continue to teach my science class, I often wonder throughout my unit if the students are really grasping the concepts. How do I know my students are getting it?

—D., New York

This question should be at the root of every teacher's planning. Being a reflective practitioner is important in our profession. Developing curriculum and lessons do not matter if our students do not understand the concepts we teach.

Because thinking and learning occur within the minds of our students and we are not mind readers, we need to first take the opportunity to get to know our students. By building relationships with students, the teacher can begin to notice students' nonverbal cues to determine if they are struggling or understanding a concept. More concrete ways of checking for understanding (CFU) include, but are not limited to, the use of exit tickets, a thumbs-up/thumbs-down signal, red card/green card indicator, or a quick write to explain their thinking.

What really can help a teacher be certain their students get the concept is providing opportunities for them to apply the knowledge. When a student can tackle a task designed to demonstrate their knowledge and skills, they get it. When students can explain what they are doing, they get it. More excitingly, when a student can teach another student a scientific procedure, they get it. As a teacher, it is important that you do not view CFU only one way. Allow students to give you feedback as well. Their thoughts, questions, and comments provide not only a means to check their understanding, but also to review your instructional practice.

Professional development can be boring at times, but I don't really think my colleagues would be receptive to what I say since I teach science.

—R., Wisconsin

Please know that you are a valuable resource to your colleagues. We need more science teachers to put themselves out there and help provide quality professional development for their schools. Teachers need exposure to the science in everyday life. We benefit from learning from our peers, just as our students are motivated and build their confidence when they learn from one another.

You may reduce your peers' resistance to trying new things in their classrooms because of the mutual respect for the work "we do in the trenches every day." Working with different teachers in different content areas provide a platform to discuss and share literacy strategies and the importance of nonfiction reading and writing for everyone's discipline. Besides, science is fun. Demonstrating how we keep students engaged and excited about learning can inspire others.

An open dialogue about your needs as a professional is important, too. Your colleagues may have a similar need as well. If we do not participate in our pedagogical growth, we leave our development in the hands of others who can only speculate on how we can help our students grow academically, socially, and emotionally. ●

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

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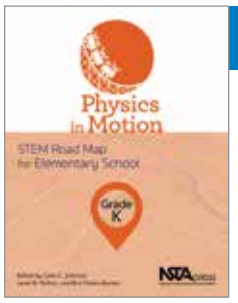


NSTA PRESS: *Physics in Motion, STEM Road Map for Elemetary School*

Strategies Used in the *STEM Road Map Curriculum Series*

By Erin Peters-Burton, Carla C. Johnson, Toni A. Sondergeld, and Tamara J. Moore

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 Physics in Motion, STEM Road Map for Elementary School, *edited by Carla C. Johnson, Janet B. Walton, and Erin Peters-Burton, edited for publication here. To download this excerpt, go to* http://bit.ly/38mY4cf. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Project- and Problem-Based Learning

Each module in the *STEM Road Map Curriculum Series* uses project-based learning or problem-based learning to drive the instruction. Project-based learning begins with a driving question to guide student teams in addressing a contextualized local or community problem or issue. The outcome of project-based instruction is a product conceptualized, designed, and tested through a series of scaffolded learning experiences (Blumenfeld et al. 1991; Krajcik and Blumenfeld 2006). Problem-based learning is often grounded in a fictitious scenario, challenge, or problem (Barell 2006; Lambros 2004). On the first day of instruction within the unit, student teams receive the context of the problem. Teams work through a series of activities and use open-ended research to develop their potential solution to the problem or challenge, which need not be a tangible product (Johnson 2003).

Engineering Design Process

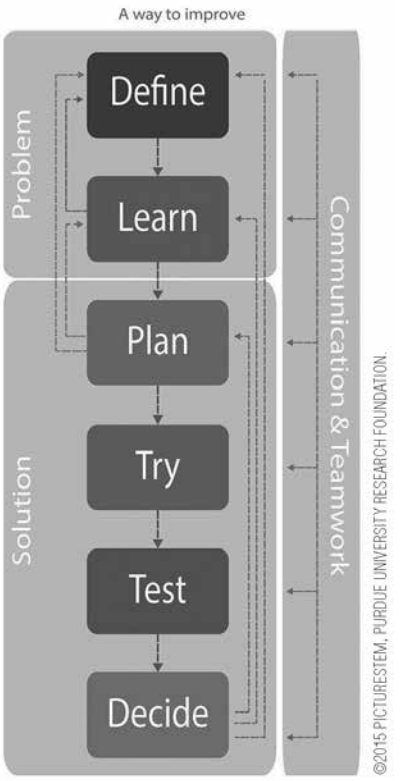
The *STEM Road Map Curriculum Series* uses engineering design to facilitate integrated STEM within the modules. The engineering design process (EDP, Figure 2.1) highlights two major aspects of engineering design—problem scoping and solution generation—and six specific components of working toward a design: define the problem, learn about the problem, plan a solution, try the solution, test the solution, decide whether the solution is good enough. As the arrows in the figure indicate, the order in which the components of engineering design are addressed depends on what becomes needed as designers progress through the EDP. Designers must communicate and work in teams throughout the process. The EDP is iterative, meaning that components of the process can be repeated as needed until the design is good enough to present as a potential solution to the problem.

Problem scoping is the process of gathering and analyzing information to deeply understand the engineering design problem. It includes defining the problem and learning about the problem. Defining the problem includes identifying the problem, the client, and the end user of the design. The client is the person (or people) who hired the designers to do the work, and the end user is the person (or people) who will use the final design. The designers must also identify the criteria and the constraints of the problem. The criteria are the things the client wants from the solution, and the constraints are the things that limit the possible solutions. The designers must spend significant time learning about the problem, which can include activities such as these:

- Reading informational texts and researching relevant concepts or contexts;
- Identifying and learning about needed mathematical and scientific skills, knowledge, and tools;
- Learning about things done previously to solve similar problems; and
- Experimenting with possible materials that could be used in the design

Problem scoping also allows designers to consider how to measure the success of the design in addressing specific criteria and staying within the constraints over multiple iterations of solution generation.

Figure 2.1. Engineering Design Process



Solution generation includes planning a solution, trying the solution, testing the solution, and deciding whether the solution is good enough. Planning the solution includes generating many design ideas that address the criteria and meet the constraints. The designers must consider what was learned during problem scoping. Design plans include clear communication of design ideas through media such as notebooks, blueprints, schematics, or storyboards. They also include details about the design, such as measurements, materials, colors, costs of materials, instructions for how things fit together, and sets of directions. Making the decision about which design idea to move forward involves considering the trade-offs of each design idea.

Once a clear design plan is in place, the designers must try the solution. Trying the solution includes developing a prototype (a testable model) based on the plan. The prototype might be something physical or a process to accomplish a goal. This component requires that the designers consider the risk involved in implementing the design. The prototype must be tested. Testing the solution includes conducting fair tests that verify whether the solution is good enough to meet the client's and end user's needs and wants. Data must be collected about the test results, and these data should be used to make evidence-based decisions regarding the design choices made in the plan. Here, the designers must again consider the criteria and constraints for the problem.

The designers must justify or reject design decisions based on the background research gathered while learning about the problem and on the evidence gathered during the testing of the solution. The designers must now decide whether to present the current solution to the client as a possibility or to do more iterations of design on the solution. If they decide that improvements need to be made to the solution, the designers must decide if more needs to be understood about the problem, client, or end user; if another design idea should be tried; or if more planning needs to be conducted on the same design. One way or another, more work needs to be done.

Throughout the process of designing a solution to meet a client's needs and wants, designers work in teams and must communicate to one another, the client, and likely the end user. Teamwork is important in engineering design because multiple perspectives and differing skills and knowledge are valuable when working to solve problems. Communication is key to the success of the designed solution. Designers must communicate their ideas clearly using many different representations, such as text in an engineering notebook, diagrams, flowcharts, technical briefs, or memos to the client. ●

BLICK ON FLICKS

Science Podcasts in the Classroom

By Jacob Clark Blickenstaff

Podcasts have exploded in popularity over the last decade. Where once only a few radio shows posted podcast versions of their content, the catalog of available podcasts in 2020 reaches into the thousands. I suspect most podcast listeners are adults, and the majority of the content available is certainly targeted to adult audiences, but some good shows exist that teachers could use while teaching science to middle and high school students.

Ways to Engage

Many have written about how to use podcasts in the classroom. Elementary teachers might read Ashley Marquez' blog post at *http://bit.ly/2TQKRTL*. As with movies, I do not recommend playing a full-length podcast in class, as that could require a full class period or part of several periods. A podcast could be assigned as homework, similar to a reading assignment, with students completing questions either as part of the homework, or in class as part of a discussion. Be sure all students have a way to play the podcast at home: a computer, tablet, or smartphone will be needed.

If you use a podcast during class time, a short segment could introduce a new topic or get students engaged in discussing a controversial topic. In the specific podcasts I will mention later, the podcast format is good for interdisciplinary treatment of subjects, as the presenters' narratives very often blend the disciplines of science with history, literature, and economics. Some literacy specialists see benefit in having students read along with the text of a podcast. For more about this application, check out *http://bit.ly/2Q11uuA*.

You could consider having students create their own podcasts as a way to demonstrate their understanding of a topic, perhaps even as a group project.

I've a few suggestions for podcasts with interesting science content:

Undiscovered is a spin-off from *Science Friday,* a great NPR series. Hosts Ella Feder and Annie Minhoff explored unfamiliar stories from the history of science for three seasons. Though they are not creating new episodes, the available episodes cover an amazing range of subjects, from human interactions with robots, to the controversy over the extinction of the dinosaurs, to how whales and dolphins became popular enough to be protected in the 1970s and 80s.

The Naked Scientists generally has a panel of experts on the topic of the episode and a fun identification question running through each episode. The level is appropriate for middle schoolers

(and the title will likely appeal to some middle school students). Broadcast on radio continuously since the mid-2000s, this series offers many podcast episodes. The website is organized by broad subject area, so you can locate a biology or physics topic more easily. Since the show is based in the United Kingdom, U.S. students might find the accents of some guests difficult to understand, but I'm sure others will be intrigued by a series from another country.

Hidden Brain, an NPR podcast hosted by Shankar Vedantam, focuses on psychology, and often the intersection of psychology and economics. I appreciate how *Hidden Brain* often makes connections between psychology and literature in unexpected ways. For example, a recent episode on how people respond to warnings used the Greek myth of Cassandra to illustrate what kinds of warnings are more likely to be heard, understood, and acted upon. Finally, Vedantam usually has practical tips for using the results of psychology research to improve your own life.

If you're looking for some great informal professional development for yourself, listen to a few episodes of the NSTA podcast ***Lab Out Loud***. Dale Basler and Brian Bartel are two awesome science teachers who enjoy talking to folks about teaching science. Some episodes focus on the work of a scientist, while others are more about science pedagogy. (And yes, I was their guest a year or two ago.)

Caution

Podcasts have no official ratings as movies do, so it can be difficult to determine if a podcast includes strong language. Also, podcast versions of radio shows sometimes remove the "beep" that obscures profanity. The "beeped" version typically appears on their website.

Quality control varies widely. I generally listen to podcasts from respected radio sources like the BBC, NPR, or large radio stations like WNYC-FM. Independent podcasts can be good, but are not supported by research teams and fact checkers in the same way the larger ones are.

Insufficient Facts is an interesting case. It is hosted by three PhD students who discuss a variety of topics related to a theme in each episode. I like that the hosts are two women and one man, and their conversation shows that they enjoy discussing interesting science, which can be good for students to hear.

Unfortunately, the hosts are all life science grad students, and they don't stick to topics they're familiar with. I listened to their episode "Space," and I like that they touched on ways *Star Trek* features real science, pointing out that Spock's green blood is similar to the green blood of horseshoe crabs (as I did in my column on the *Star Trek* reboot at *http://bit.ly/3aH1ic0*). When addressing physics and astronomy, though, they were careless in their language, using the terms *solar system, galaxy,* and *universe* essentially interchangeably. I worry that students could be confused about the distinction between our galaxy, which has 100 million stars or so, and the universe, which is composed of billions of galaxies.

Teachers looking to engage reluctant readers could consider using a podcast or two to bring the sounds of science into the classroom. ●

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

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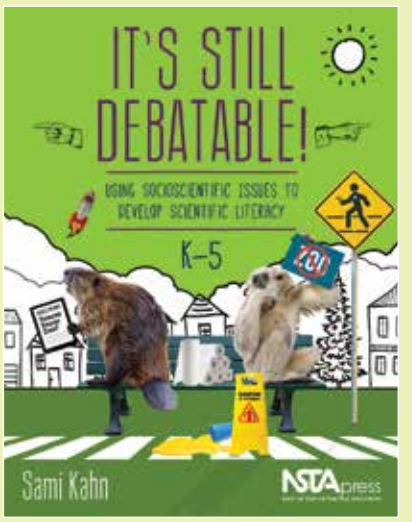

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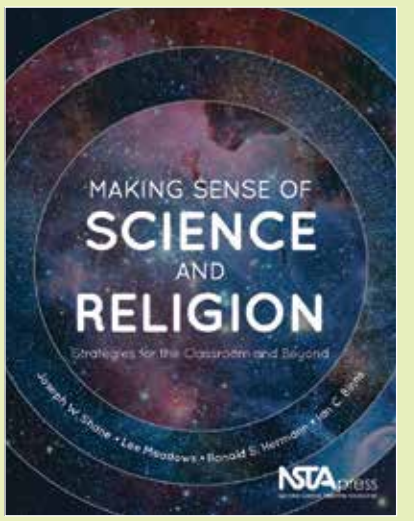

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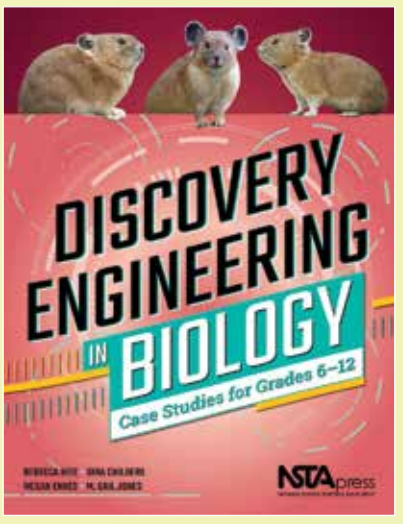

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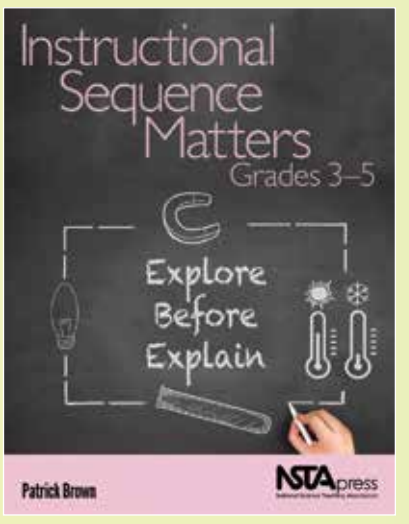

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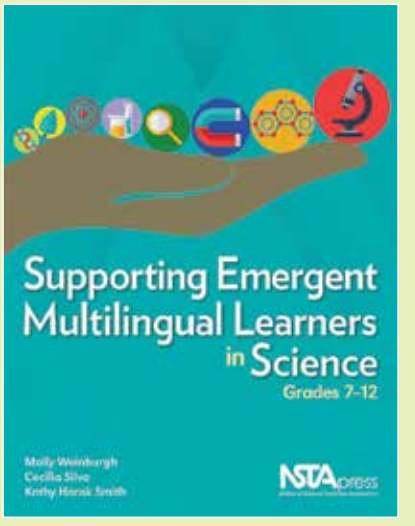

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(All dates are deadlines unless otherwise specified.)

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

April 21—Join the first session of **Shifting to the *NGSS*: Professional Book Study for Elementary School Teachers** live **web seminars** today! Improve your understanding of the *Next Generation Science Standards* (*NGSS*) during four sessions focusing on the enhanced e-book, *Discover the NGSS: Primer and Unit Planner.* Tricia Shelton and Jessica Holman will lead the sessions. Registration costs $63 for NSTA members. Seminars will be held at 7:15–8:45 p.m. ET. Additional dates are April 28 and May 5 and 12. Participants will receive a certificate from NSTA after each live web seminar (1.5 hours per web seminar) as evidence of their attendance and participation. For more information or to register, visit *http://bit.ly/2POSUPM*.

April 29—Mark the 30th anniversary of the Hubble Telescope! During a **free web seminar, NSTA Science Update: Hubble's 30th Anniversary,** Max Mutchler, science data analyst at the Space Telescope Science Institute, will share highlights of the Hubble mission, including some behind-the-scenes insight on how these amazing Hubble images are created. The session will be held at 7–8 p.m. ET. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/2RGhr8N*.

May 5—Don't miss the start of this two-day **Picture-Perfect Workshop,** as authors Karen Ansberry and Emily Morgan delve into using picture books to teach elementary science, technology, engineering, and math (STEM). Attendees will receive *Picture-Perfect STEM Lessons, K–2*; *Picture-Perfect STEM Lessons, 3–5;* and *Even More Picture-Perfect Science Lessons.* The workshop will take place at 8:30 a.m.–3:30 p.m. at the Arizona Science Center in Phoenix, Arizona. Earlybird registration by **April 14** costs $449 for the basic workshop; with the train-the-trainer component and materials, the earlybird price is $999. For more information or to register, visit *https://bit.ly/2zOlVTx*.

June 18—Join authors Karen Ansberry and Emily Morgan for this two-day **Picture-Perfect Workshop** as they share strategies for using picture books to teach elementary STEM. Attendees also will receive *Even More Picture-Perfect Science Lessons; Picture-Perfect STEM Lessons, K–2*; and *Picture-Perfect STEM Lessons, 3–5*. The workshop will take place at 8:30 a.m.–3:30 p.m. at the Fulton County North Learning Center in Atlanta, Georgia. Earlybird registration by **May 28** costs $449 for the basic workshop; with the train-the-trainer component and materials, the earlybird price is $999. For more information or to register, visit *https://bit.ly/2zOlVTx*.

July 22—Join your STEM colleagues at the Kentucky International Convention Center for the start of the **Ninth Annual STEM Forum & Expo** hosted by NSTA! You'll experience three days of professional learning, with many sessions aligned with one of six strands: Lower Elementary/Early Childhood; Upper-Elementary; Middle Level; High School; Building STEM Ecosystems: Community Partnerships; and Postsecondary. Earlybird registration by May 8 costs $210 for NSTA members. Graduate credit is available for an additional fee. For more information or to register, visit *www.nsta.org/stemforum*. ●

#ICYMI

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

"Coronavirus Meets…Physics? Making a Biological Topic Fit Into a Physics World"
As science teachers, particularly those working to make learning relevant to student experiences, engaging them in phenomena that have meaning in their own lives enables them to contextualize the learning: What better way to drive student interest than by drawing from current news headlines? Read how high school teacher Stephanie Duke enacted the NSTA lesson plan focused on the coronavirus and helped her students become better critical consumers of information.
—*NSTA Express* (March 3, 2020, *https://bit.ly/2NmwiEK*)

"Going Green? Check Out the Green Ribbon Schools Program"
Is your school a green school? Is it doing amazing work in reducing environmental impacts, improving the health and wellness of students and faculty, and providing an effective environmental and sustainability education to students? Then you should apply for the Green Ribbon Schools Awards program; read more about it in this NSTA Blog post from the Campaign for Environmental Literacy.
—*NSTA Express* (February 25, 2020, *https://bit.ly/2NmwiEK*)

"'A Lot of My Research Involves Poo' and Other Stories From the Field With Cassandra Raby #ScientistOutLoud"
Joining the Lab Out Loud podcast this week is Cassandra Raby, PhD, a research fellow at Leeds University Business School who is studying diversity and inclusion in the workplace. Raby has studied behavior and disease transmission in Namibian wild baboons, summarizing her work as, "a lot of my research involves poo." Raby joins co-hosts Brian Bartel and Dale Basler to discuss collecting (and transporting) feces, what we can learn from studying disease transmission and social behavior in baboons, and how her field research experience has helped her succeed in her current research.
—*NSTA Express* (March 10, 2020, *https://bit.ly/2NmwiEK*)

"New NSTA Position Statement on STEM Education Teaching and Learning"
Help your students see the connection between the content they are studying and its application of STEM content in authentic and relevant ways with the newly approved NSTA position statement on STEM Education Teaching and Learning.
—*STEM Classroom* (March 2020, *http://bit.ly/2He0lev*)

"Making Students' Thinking Visible Through Discussion"
Fourth-grade science teacher Dana McCusker and Marissa Miller, assistant director of science at Mastery Charter Schools, share how they get students to make their thinking visible through discussion.
—*Next Gen Navigator* (February 2020, *https://bit.ly/2Yr2PAD*) ●

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2020 NSTA Board and Council Elected

NSTA members recently elected Eric Pyle, professor in the Department of Geology and Environmental Science at James Madison University in Harrisonburg, Virginia, to serve as the association's 2021–2022 president. Pyle will begin serving his three-year term in June as president-elect.

As he prepares for his new role, Pyle says he will be making "opportunities to reflect on how we can grow and expand our membership reach, particularly ways to collaborate with other science organizations. We need to help frame what meaningful collaboration for the best science education looks like at this time when science in general is under assault."

Also elected to serve on the board are Alicia Conerly as Multicultural/Equity in Science Education Division Director, Donna Governor as Preservice Teacher Preparation Division Director, and Cynthia D. Crockett as Research in Science Education Division Director.

NSTA members also elected six district directors to serve on the council. They are Susan Meabh Kelly, District I (Connecticut, Massachusetts, and Rhode Island); Michelle Ellis, District VI (North Carolina, South Carolina, and Tennessee); Jacob Hayward, District VII (Arkansas, Louisiana, and Mississippi); Brian Klaft, District XII (Illinois, Iowa, and Wisconsin); Terry White, District XIII (New Mexico, Oklahoma, and Texas); and Marilyn Webster, District XVIII (Canada). ●