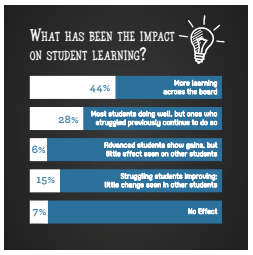


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# Studying Science at the Zoo

Schools around the country are partnering with their local zoos to establish "zoo schools," or classrooms at the zoo that enable teachers to incorporate zoo resources into their lessons. At Brevard Zoo in Melbourne, Florida, for example, Zoo School "immerses students in hands-on discovery and interactive learning through both animal encounters and environmental programming," says Zoo School Coordinator Dawn Hurley. "We've lost our appreciation for nature, its value to our quality of life, and the need to foster an informed sense of stewardship, especially in this age of ever-increasing technology. With Zoo School, the walls of the traditional classroom have been expanded to offer those opportunities in a safe and structured environment."

*Fifth graders construct oyster mats for the Indian River Lagoon Oyster Restoration Project as part of activities in Zoo School at Brevard Zoo in Melbourne, Florida.*

In 1996, fifth graders from Melbourne's Sherwood Elementary School began coming to Brevard Zoo for an "integrated, thematic approach to science, mathematics, social studies, and language arts," says Hurley. Sherwood teachers and other educators from Brevard Public Schools partnered with the zoo's education staff to develop an interdisciplinary, science-based "Zooriculum" that supports state standards and *Common Core State Standards,* she explains.

In 2000, Brevard Zoo received a $500,000 grant from the Eckerd Family Foundation to build three permanent classrooms on-site: a cave, a tree house, and a house that resembles the homes of the state's original settlers. The classrooms "are on zoo property, but off the zoo path" so visitors are unlikely to drop in and distract students from learning, Hurley points out.

Since then, fifth graders from two other Brevard County schools—Cambridge Elementary and Dr. W.J. Creel Elementary—have joined the program, and each school spends six weeks at Zoo School. The schools are on-site at separate times, and "we schedule them all before spring break and [Florida State Assessment] testing so that all can benefit from what they've learned at the zoo," says Hurley.

Three Zoo School Instructors work with the classroom teachers to teach thematic lessons covering topics like general animal care, habitats, adaptations and behavior, and Florida fossil history. "An extensive conservation program…involves students in activities like oyster reef restoration, mangrove planting and fostering, and sea turtle education. Students also learn from the zoo's animal keeper staff, who regularly [discuss]…specific animal needs, diets, and behaviors and inform students about their individual career paths," Hurley relates. "The goal is to encourage students to develop an interest in science while cultivating a stronger sense of community involvement and environmental stewardship."

Teachers have remarked that "attendance spikes during Zoo School, reinforcing student interest in the program and subsequent experiential learning in a new environment," and

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COMMENTARY: **Amanda Lindell and Andrea Drewes**

# Evaluation in Informal Environments

By Amanda Lindell and Andrea Drewes

*Amanda Lindell*

*Andrea Drewes*

The data-driven assessment and evaluation culture present in K–12 education also influences informal educators. The question of whether a pressing need exists for evaluation in informal settings is a hot topic in informal education communities. Calls for all educators to demonstrate standards-based effects through valid and reliable measures have become the norm inside as well as outside the traditional classroom. However, the difficulties in showcasing learning outcomes are compounded in informal environments due to the diverse nature of these settings.

Though obstacles are wide-ranging and numerous, many forward strides are being taken. The number of organizations specializing in informal education evaluation has skyrocketed as the demand has grown. These groups' strength lies not only in the concentration of talent and effort, but also in the ability to share instruments among programs and institutions to create larger data sets to better inform the field. By working alongside an evaluation firm, informal educators learn techniques they can implement after the evaluators leave, increasing their organizations' evaluation capacity.

Numerous leading institutions like the Exploratorium, the Shedd Aquarium, the American Museum of Natural History, and the Wildlife Conservation Society (WCS) are supporting evaluation positions, or even entire departments, within their education departments. These commitments are a response to investment needed from both within institutions and from outside funders, school leaders, and other partners. These departments ensure a continuity of evaluation efforts, allowing institutions to measure outcomes such as standards-based learning goals as well as goals tied to the institution's mission. This type of evaluation allows organizations to meet the educational needs of grant funders as well as those of school groups and other visiting participants.

An example of how these goals are merging is in the development of the Survey of Educator Attitudes on Science (SEAS) by WCS with Hezel Associates, an educational evaluation group. SEAS measures change in attitudes on five areas—value of science, trust in science, value of teaching and learning science, self-efficacy in teaching science, and conservation attitudes. Through a year-long process, informal educators at WCS and partners from Hezel Associates reviewed existing instruments, wrote (and rewrote) survey statements, organized them into the scales, pilot-tested items, performed factor and reliability analyses, and re-tested items. Data was collected over two and a half years from all multi-day WCS professional development events. The result is a statistically reliable way to evaluate our impact across our programming, and greater evaluation capacity within the department.

Other organizations also have been involved with collaborative efforts to share developed instruments across multiple formal and informal settings. STELAR (STEM Research and Learning Center; *http://stelar.edc.org*) and Center for Advancement of Informal Science Education (CAISE; *www.informalscience.org*) are two such groups. Both websites offer evaluation resources and shared surveys covering educational programming, exhibit evaluation, podcasts, films, and more in almost every setting imaginable.

These repositories are an important step in moving evaluation forward in informal environments. We may never get to the level of standardized evaluations that formal environments have, but publishing instruments widely are a step in the right direction. However, these instruments need to be adopted and data shared to better determine the collective impact of the field.

Even with these bright spots, there is still much room for growth in evaluation within informal settings. The largest need we see is the continuity of evaluation efforts over time. Evaluation in informal education is all too often tied to specific projects. Once funding runs out, evaluation stops, the report is written, and everyone goes back to their "regular programming." Project-specific evaluation is important, but for the long term, a wider focus is needed to answer the big questions in our field about meaningful science learning in out-of-school environments.

Evaluation dissemination also is an opportunity for growth in informal settings. Many reports written each year are simply put on a shelf and rarely examined. STELAR and CAISE seek to change this phenomenon, but more informal science institutions need to encourage the sharing of evaluation efforts and findings. Conferences are a great way to meet colleagues from across the nation and world and provide inspiring stories and experiences to take back to our home institutions. With time for reflection on these new ideas and methods, educators can easily build them into a more effective practice.

Despite the challenges, evaluation within informal science settings will allow the field to be more reflective on our pedagogical practice and will assist with meeting our learners' educational needs. Additionally, by formalizing and sharing the results of our efforts, we will be able to highlight the unique and extremely valuable learning that occurs in out-of-school science settings. The path may be slow, but will certainly be fruitful! ●

*Amanda Lindell is director of professional development for educators at the Wildlife Conservation Society (WCS). She has worked as a coordinator of professional development at WCS and as a high school biology teacher in the Bronx, New York.*

*Andrea Drewes is a doctoral candidate at the University of Delaware. Her research interests include climate change education in the middle school classroom and informal science learning in out-of-school settings. She has worked as a coordinator for professional development for educators at WCS/Bronx Zoo and as a middle school science teacher.*

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students have said it was "the best time in their life…ever," she reports.

## Unique Course Offerings

Located at the North Carolina Zoological Park in Asheboro, North Carolina, Asheboro High School (AHS) Zoo School gives students "a unique opportunity because we're able to offer classes here like zoology, agricultural science, and forensics. These classes are only offered at Zoo School," not at AHS's main campus, says science teacher Brooke Davis, the program's lead teacher. "I can teach about primates and ecosystems because the zoo is set up as a teaching resource,…[making it easy] to incorporate environmental science and ecology" in lessons, she maintains.

Students accepted into this science-based program take their science, math, social studies, agriculture, and for some, English classes, at the zoo; some students take one or two classes on the main campus, then finish the school day at the zoo. Though Zoo School can accommodate as many as 150 students, "our school building is a modular unit with a small but cozy, family-like atmosphere that students enjoy," Davis explains.

"The zoo gave us a little piece of land to rent at a low cost," she relates. "We have an outdoor classroom area and access to a lake" and a community garden. Students can work with the zoo's horticulture staff in greenhouses. "The horticulture class is helping the zoo grow its annuals. They get to see the horticulture industry in action," she observes.

Students "do a lot of project-based learning and regularly make presentations to the community, zoo staff, and to parents on Parent Night," as well as to notables like the state's governor, says Davis. Class sizes are smaller than those on the main campus—20 to 25 students—which makes it easier for "hands-on, project-based learning" to occur, she points out.

In the zoology class, for example, "students do most of the teaching. They do projects and present their findings," Davis notes. On Amphibian Awareness Day, "students are in charge of activities that day. They meet with zookeepers in advance to plan the day." In addition, "we have a wildlife rehabilitation center here. Students can eventually be certified in wildlife rehabilitation," she reports.

In the forensics class, "we create a mini-murder mystery for students to solve," she relates. Students observe the behaviors of zoo visitors at various locations "and use that as an example of witness statements," she explains. The class "incorporates something else besides animals [because] we want everybody to be included. We don't have a sole purpose of training zookeepers; we cover all kinds of careers."

Because Zoo School students must traverse the zoo grounds daily and interact with visitors, students accepted into the program "have to be willing to think outside the box, be comfortable with project-based learning and have the ability to work independently and in groups. They have to be mature enough to walk around the zoo by themselves and explain their projects to visitors. They need to be able to handle the freedom they have without teachers having to hold their hands," Davis emphasizes. Though Zoo School courses are rigorous, "we don't just choose students for the program based on grades; we look at discipline and attendance as well. They have to be reliable and trustworthy," she maintains. "The zoo expects the kids to be actively working on projects, not just strolling around."

Zoo School students welcome and benefit from these opportunities. "Our kids really want to be involved…Kids you'd never think would want to be in the public eye" have blossomed and thrived in the program, Davis observes. "Sometimes a traditional classroom is not enough for kids. They want to be in a different environment."

## A Zoo Magnet Program

For more than 25 years, Richmond Heights Middle School in Miami, Florida, has offered its Science Zoo Magnet Program at Zoo Miami. "We are a Title I neighborhood school that offers a magnet program, and the program has given us a chance to increase student enrollment from students outside of our boundary," says Zoology Magnet Lead Teacher Tamara Monroe. "We focus on animal conservation efforts and learning about exotic animals and zoo careers."

Sixth graders study animal classification, taxonomy, habitats, and behavior and create ethograms, quantitative descriptions of an animal's normal behavior. "They develop a general knowledge of different animals and learn to differentiate among animals within a species," says Monroe. Seventh graders focus on amphibians and reptiles, marine mammals, animal conservation, and laws protecting animals, while eighth graders concentrate on primates, birds, and animals' anatomy and physiology.

On their daily zoo visits, students "do research and talk with experts in the field of animal science about their conservation projects and share personal experiences and stories," Monroe relates. "It's bringing their books to life…Students can learn about science, then go outside and really learn and explore science."

In addition to their studies at Zoo Miami, students take "expeditions" to venues such as Miami's Monkey Jungle wildlife park, the Marjory Stoneman Douglas Biscayne Nature Center in Key Biscayne, and Everglades National Park—or even as far away as the National Zoo in Washington, D.C. "We wanted students to see how the exhibits and animals there compared with [those at] Zoo Miami, and compare the Washington climate with Miami's, which determines why some animals [can't be housed at some locations], as well as the design layout of other zoos," Monroe explains.

The program expands students' horizons. "Sixth graders all start out saying they want to be veterinarians…[After being in the program,] they have a broader interest in science careers, [not just limited to] veterinarian and zookeeper. It gives them a lot of options," she observes. In addition, students develop "a love and compassion for animals."

They also benefit academically. "Students tend to do better in English language arts and math because the teachers are able to integrate the zoo magnet curriculum into other subjects…They can work with topics that students are already interested in, and still teach their content," Monroe contends.

After leaving Richmond Heights, "students have told us that in high school, they tend to do extremely well in biology because they had three years of it in middle school. They tend to excel in science [in general] in high school," she reports. ●

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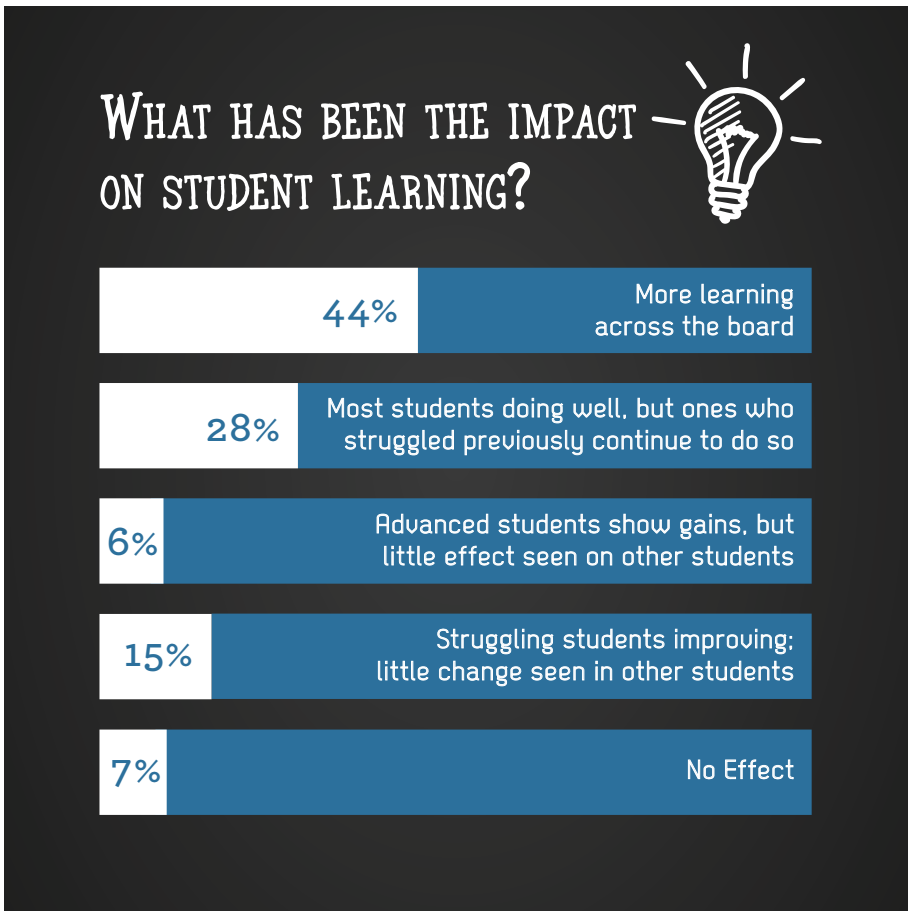
# Considering Differences in Differentiation




*NSTA Reports* recently asked science educators to share their experiences with differentiating in the classroom. Most respondents indicated they differentiate lessons, with 20% reporting they do so about half the time, 33% differentiate "often," and 18% said they always differentiate. Eight percent reported they "rarely" differentiate, and 1% said they never do. Educators in the last two groups cited the difficulty of differentiation and a lack of time to create a variety of materials, as well as some students' immature behavior, as reasons why they do not differentiate. One respondent stated, "Differentiation is a mostly meaningless buzzword; no research backs it up…I teach well rather than worrying about meeting some new fad that will soon be over."

The most common strategies used by educators who do differentiate include varying the amount of teacher scaffolding/guidance (85%), using cooperative learning (84%), using small-group instruction (70%), giving students options for the type of activity to complete (57%), and giving tiered assignments with varying levels of complexity (51%). (Respondents could select all strategies that applied.)

Educators reported the impact on students has varied, with 44% saying more learning has occurred for all students; 28% reporting most students are doing well, but those who struggled previously continue to do so; 15% seeing improvement among struggling students but little change in other students; 6% noting their advanced students show gains, but they see little effect on other students; and 7% reporting they have seen no effect on student learning. More than half of educators (53%) said the response from school administrators has been positive, while 1% reported having a negative response from administrators.

## Here's what science educators say they consider when differentiating instruction:

Am I still asking students to rise to a challenge rather than just simplifying the information until students pass the assessment?—*Educator, Middle School, Illinois*

Cognitive, behavioral, and achievement level of the students.—*Educator, Elementary, Middle School, High School, Washington*

Differentiating for content, process, product, and sometimes environment.—*Educator, Elementary, Middle School, New York*

Do not give higher-achieving students more work, but assignments at a higher level of thinking.—*Educator, Middle School, Pennsylvania*

Having options to present for each lesson. You also have to be mindful of the class size.—*Educator, High School, Maryland*

How much time I will have to create, implement, and work with each child as needed.—*Educator, High School, Texas*

How to engage all learners so that they are advancing and not being held back or moving on without proper understanding.—*Educator, High School, California*

I keep assignments the same and tier expectations, otherwise my lower[-level] kids get lower and lower every year.—*Educator, Elementary, Connecticut*

In my class, behavior. I struggle to create groups that are academically and emotionally conducive for learning. My higher[-level] group tends to mess around, fight, [and so on], which creates a tough dynamic.—*Educator, Elementary, California*

Making the most impactful changes that will help the kids, but not kill the teachers with extra work to do. —*Educator, Middle School, Colorado*

Pre-assessing to see the student readiness.—*Educator, High School, Pennsylvania*

Student's willingness or ability to do the project. Some of my students don't speak English, but can do science very well if hands-on.—*Educator, Elementary, Nebraska*

Think about each student as an individual: [W]hat does that one child need? Then build groups of students whose needs are either similar, so you can pinpoint your instruction, or build mixed-ability groups so that students can all benefit from helping [one another].—*Educator, High School, Kentucky*

To provide the content to be learned in a variety of forms: written, oral, visual (drawings/tables), and when needed, acting it out.—*Educator, High School, Rhode Island*

What are the basics you want all students to know? And for those that already know that, how can students apply the basic knowledge?—*Educator, Middle School, Nebraska*

When I differentiate my instruction to meet diverse needs, it is important not to sacrifice the rigor of the content. Differentiated doesn't mean that mastery is sacrificed; it means that the methodology is different, allowing for more diverse learning strategies and multiple ways to show mastery. —*Educator, High School, California*

### Support Needed

Although I have some [educational technology] support, it is not every day because of shared need (other students in other classes). I wish there were more support staff available.—*Educator, Middle School, Maine*

More feedback and more professional development [PD].—*Educator, Middle School, Michigan*

Emotional support. Training on techniques and strategies. Recognition of efforts.—*Educator, High School, Texas*

I ask other teachers for lesson or differentiation ideas, but rarely ask administrators. Literacy coach and school librarian have helped with multilevel texts for research or content. —*Educator, Middle School, Illinois*

My boss would like to see differentiation in my room. She would try to do or provide anything I asked. I have had a short [two-hour] PD on it. So I really need more ideas.—*Educator, Middle School, North Carolina*

I feel that I do not get support from my administrators. Most of the time, I think they don't really know what goes on in my daily lessons.—*Educator, Middle School, Pennsylvania*

I wish we had more technology and other means for instruction [instead of] textbooks.—*Educator, Elementary, California*

I wish we had smaller class sizes to facilitate the differentiation.—*Educator, High School, California*

I wish we had time to network strategies with other teachers.—*Educator, Elementary, Middle School, High School, Washington*

If I ask a question, my administrators will answer and give strategies. Text resources of suggested strategies were provided at the beginning of the year. I wish I had more curriculum resources.—*Educator, High School, Illinois*

It would be nice to have learning walks to see differentiation in action.—*Educator, High School, Maryland*

More collaboration time with other teachers.—*Educator, Middle School, Florida*

More informational reading at varied levels, ideas on how to differentiate, modeling lessons.—*Educator, Elementary, Indiana*

They actually told me last year to save the labs for after they learn the material. Do the labs at the end of the unit as a reward! *Teach* to the standards! Don't do the packets; use the *book*!...I thought about leaving my school, but didn't. I just ignored them the best I could and "jumped through the hoops" and kept doing what I know students need: *hands-on learning in science!*—*Educator, Middle School, High School, Institution of Higher Learning, Nebraska*

PD on how to scaffold or differentiate.—*Educator, High School, New Jersey*

They provide inservice speakers, but little real time to plan. Often classes aren't as heterogeneous as they claim since they put too many [students with individual education plans or gifted indivudual education plans] in one period.—*Educator, Middle School, Pennsylvania*

They want it, but do not support it. We have no prep hour this year, so I wish I had that time.—*Educator, High School, Michigan*

[I] wish I had an assistant available when instruction is provided for my lower-level learners.—*Educator, Middle School, Tennessee* ●



## Quotable

***A good question is, of course, the key by which infinite answers can be educed.***

—Isaac Asimov, Russian-born U.S. writer and biochemist

# Using Drones to Enhance STEM Learning

Science, technology, engineering, and mathematics (STEM) educators often use technology to capture their students' interest, and drone aircraft are proving to be no exception. Whether being used to reinforce concepts taught in the classroom, learn new skills, or explore future applications, educators across the country are incorporating drones into their curricula.

At the Liberty Science Center, drones are being used to reinforce concepts such as Earth and Weather, and Force and Motion, taught in class as part of a hybrid learning program involving the center and Jersey City Public Schools in New Jersey.

"The point of the program is to provide students an opportunity to explore concepts learned in school by complementing their lessons with inquiry-based and hands-on activities at the Liberty Science Center," explains Deepa Shah, the center's specialized program coordinator. "With the hybrid program, the main goal is to help teachers understand and use hands-on, inquiry-based activities to complement content in their classes. With the implementation of drones, we're helping students understand applications of the content.

"Both fourth- and fifth-grade students from [Public School] 30 are working on the Force and Motion unit," Shah continues. "Since drones fly with the use of a variety of forces, students get the opportunity to experiment with the merger of forces that keep drones flying. Third graders, who are working on a unit on Earth and weather, are learning how we could potentially use drones to better understand the geological and meteorological features around us. For that particular cohort, we're teaching them how to use drones to explore weather phenomena and geological events using the camera and video system aboard the drones."

Jason Diodati incorporates drones into his Engineering 1 and 2 courses at Templeton High School in Templeton, California. "I'm teaching electronics, programming, mechanical engineering, and leadership and responsibility. They have to take drones after school and on weekends to film events to make videos we give to people in the community," he explains. His students research different drone types, from agile racing drones to specialized filming drones, to decide what components they need to incorporate into their own designs based on the tasks the drones will do.

"My classes are not focused on drones. All of the engineering classes focus on the Maker Movement, and they all have to do projects. Some kids choose drones, but they have also built 3D printers, 3D routers, robots, and much more," Diodati says. "My students spent two months building [their drone] before getting it to fly. The kids are building them from scratch…I think we're hitting almost all of the [*Next Generation Science Standards*]. It's all experimenting, and the kids have to document everything…They probably crash [the racing drone] every other day, so they have to repair it almost every day."

Diodati also teaches a STEM Outreach class, which uses drones during demonstrations at community events. He says drones have increased student interest in his classes, noting, "I've been here for four years. When I first arrived, there was one engineering class with 22 kids. Now there are four different classes with about 200 kids—that's out of less than 800 kids in the school!"

Jennifer Handler, STEM teacher at Talley Middle School in Wilmington, Delaware, challenges her eighth graders to use their drones to set off a sensor on landing pads they build themselves. Over a few weeks, her students learn about computer programming and circuitry as they design and build their landing pads using Arduino electronics and flex sensors.

"It's a huge impact, a hot topic right now," she says. "Most students walk away saying, 'I want a drone, I want an Arduino, I want to learn more.' It's a nice compliment to the course."

She maintains the course has had a positive impact on students' learning. "Students know about lift and drag a lot more. [The terms] thrust, lift, drag have meaning for them. They're really paying attention more, even to the wind outside. I expect an uptick in students' grades, especially when it comes to math and physics," Handler explains, adding that next year she will "focus on 3D printing different blades. I'd like them to experiment with different blade types and drag. We're pushing it to the limit, pushing our eighth graders to high school [levels]."

In Broward County, Florida, James Nance has made drones part of the pre-engineering curricula for seventh and eighth graders at Ramblewood Middle School, where he chairs the science department. "Kids are used to doing something on the computer and seeing it on the screen. Using drones brings their programming to life," he contends. "This is a mesh between computers and STEM. My courses, Introduction to Technology and Pre-engineering, do a lot more of the electrical engineering and programming than the local high school does. Our goal is to work within our zones to prepare students for an engineering pathway and give students exposure to electrical engineering early."

Drones allow him to "hit the nature of science standard, the engineering design standard. I can really apply some math standards in there, too," Nance asserts. "They have to understand how drones respond to commands. In order to be successful, they have to test each command. If you program a drone to go forward one second, it's going to have variations on all three dimensions; it's the complexity of it as a flying object. You reinforce the engineering process with the level of complexity. If you're flying, you're [making] corrections without thinking about it. If they're programming, students have to think about the result of all these corrections as the drone goes through the course.

"This is my first year with drones and my sixth year teaching. Overall student engagement is up with hands-on programming. My core principle is student engagement. If they're excited about being there,…we're going to get more productive students…The point of our pre-engineering program across our school is to get students engaged," he says.

> ***"Using drones brings their programming to life."***
>
> **—James Nance**

Nance hopes to see that student engagement spread across Broward County—and perhaps the region and beyond—through a virtual drone racing league. "We would have a standardized drone course layout, and schools could post racing scores on the internet. That's my big idea using mini drones…In my county, we may only have three or four likeminded teachers. It would be great if we could compare our students' performance to other counties and states through the internet," he says.

Nance's mind hasn't always been on racing, though. "I've been flying and building drones for three and a half years…One of my early thoughts was, 'Wouldn't it be great to have students use these to collect data for research projects?'"

A little more than 10 miles away, drones are being used to do just that at South Plantation High School. Gustavo Junco's students learned to fly drones during an agriscience course and an unmanned aircraft systems course sponsored by Embry-Riddle Aeronautical University, and as part of the school's drone club activities. They now use their new skills to help monitor laurel wilt as part of a research program at Florida International University.

"They've been using dogs to monitor laurel wilt in avocado groves," Junco explains. "We're using drones to replicate what dogs [do] on a larger scale." His students fly drones with mounted cameras over the avocado groves, mapping them for comparison to the Normalized Difference Vegetative Index to identify stressed plants. "There's a big push toward using drones for field mapping. [They'll be used to] start giving growers fertilizer prescriptions, let them know how much water to use. One study estimates 80% of future (commercial) drone use will be in agriculture," Junco contends.

In addition to agricultural uses, Junco's students program drones to navigate obstacle courses autonomously. "They've built two drones from parts, learning about electricity, circuitry, amps, and voltage" as well as coding in Java Script and Python along the way.

"Drones get kids excited about science and math…It's another way to get kids involved in growing crops and the science behind them. It's a way to discuss farming. Engineers are going to be our future farmers," he adds. ●

# Learning STEM Through EPICS Experiences

Project-based learning was hardly new when Purdue University launched its Engineering Projects in Community Service (EPICS) program 20 years ago this spring. But EPICS incorporated a community aspect when "not many STEM [science, technology, engineering, and mathematics] programs gear[ed] projects toward the community," says Charese Williams, EPICS K–12 coordinator at Purdue. "The idea is for them to better their community [while learning STEM]. That service learning piece sets EPICS apart.

"At the university level, the idea was to be of service to the community while using engineering skills," Williams continues. "Because the program was working so well, so successfully at the university level, former EPICS students from Purdue University developed the idea to offer it to younger students." Although some expressed initial concern that middle and high school students would not have the necessary skills, Williams says there was immediate success when EPICS K–12 launched a decade ago.

The EPICS K–12 curriculum was designed in modules to guide students through the process of identifying a need in the community and a nonprofit organization to work with as the students create a product to meet that need.

"The entire curriculum is based on the design cycle. We deal with five phases, or modules. At the end of each phase, students are tested to make sure they understood that phase…The first module is determining who the [nonprofit] partner will be. We tell schools to start small, start in the school. The idea is once students select a project, they have immediate buy-in. If students make suggestions or determine who[m] they want to service, then it goes well."

At the all-girls residential Foxcroft School in Middleburg, Virginia, Maria Evans has taught EPICS for five years. "The curriculum is really comprehensive if done as a full year, but I pick and choose pieces to implement" because of teaching the class as an elective on a semester basis, she explains. Her students have completed about 20 projects, include building sensory trails for therapeutic riding programs and a handicapped-accessible produce sorting station for a work training program.

"Culturally, we expect men to be engineers; we don't expect [women] to be [them] as often. [In EPICS,] they're doing projects they may have never imagined themselves doing before. It lets them see potential they didn't see before," contends Evans. "They're not just putting in volunteer hours. This is kind of a perfect blend for girls and how they learn. They overcome their fear of engineering…We start class with [a discussion of] what kind of volunteering [that] they do. From that list, we look at agencies that match [their interests], and reach out to those agencies. Students handle it all; I coach them through it."

Evans' students take the lead as they visit potential partner organizations, talk to CEOs about their needs, then determine requirements such as the project budget, materials, and schedule, as well as any applicable regulations.

"This class is kind of amazing in the amount of confidence they gain with a set of skills they never had exposure to. They're in the shop, and when they walk out of there, they aren't afraid of anything," she continues. "It really changes what they think they're capable of. Students who end up in [EPICS]

are not necessarily the strongest [in science and engineering]…They have to present and defend [their designs]. What I saw this fall were industry-level presentations. They knew what they were doing, why, [and] who they were doing it for, and they had a detailed design to support it. It's a different level of motivation. By the time they leave class, they have a different skill set in an adult arena: They know how to interact with adults on a professional level…They become a cohesive unit and leave with a much better understanding of diplomacy and sharing of responsibility."

Dan Zavaleta, EPICS program instructor at Desert Vista High School in Phoenix, Arizona, was introduced to EPICS in 2013. With EPICS, students learn "engineering is not just about what they are going to do, but [also] what they are going to do for others," he asserts. "It shows them… they can be a responsible person in the community."

Zavaleta had used project-based learning in the past, but found the EPICS curriculum to be a "natural fit" at Desert Vista that provided "a curriculum based on why we need to get involved in the community.

"The big thing about EPICS is kids get to see this is their idea…They take ownership of it, and once they take ownership, they're going to complete the task," he notes, adding that the students take pride in their work and aren't afraid to talk about it.

After his students worked with foreign language teachers to create Spanish-language instructions for a water filtration system they designed and built for a community in Mexico, Zavaleta started thinking about how to expand the program to include other subjects. He is now working with Desert Vista's business teachers to include marketing in future student projects.

## EPICS Resources

The EPICS curriculum is free to educators who register online at the website *http://bit.ly/1Mc5cqj*. Basic members can access an overview of the curricula and participate in the online EPICS community. Professional members have full access to the curricula and are expected to complete EPICS training, either in person at Purdue or virtually. (Both membership levels are free, although a fee is charged for attending the training on the Purdue campus.)

Although the name EPICS K–12 includes the elementary level, the available curricula are for the middle and high school levels, including in-school and after-school variations. According to Williams, the EPICS staff has discussed expanding the curriculum to the elementary level, perhaps focusing on learning about the engineering process. "We believe it will be difficult for elementary students to produce projects that will be deliverable," she says. "Although we have found some fifth graders can do the sixth-grade/middle school curriculum."

With more than 100 middle and high schools in 17 states and Washington, D.C., participating in EPICS K–12 and 26 university programs, Williams says they are working to develop "hubs" of schools located within a geographic area that would provide immediate feedback and support to one another. She says in the best case scenario, each hub would include a university that could show the middle and high school students they could pursue engineering throughout their education and beyond. ●

# Get Your Hands On Science

## DID YOU KNOW?

### STEM is Everywhere at NSTA

STEM is designing our future and opening doors to strategic thinking and lucrative careers. NSTA has an abundance of STEM resources from award-winning NSTA Press books, virtual conferences, resources in the NSTA Learning Center, journal articles, STEM-specific sessions at our conferences, and a STEM Forum & Expo held this July in Denver, plus much more! Also, on most all of these resources, you can use your member discount on purchases!

*www.nsta.org/membership*

NSTA National Science Teachers Association

PULL-OUT SECTION

# SCIENCE TEACHERS' GRAB BAG

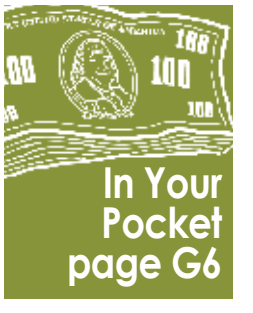
**Inside this Convenient Pull-Out Section you will find:**



Freebies page G1


News Bits page G3


What's New page G5


In Your Pocket page G6


Summer Programs page G8


## Freebies for Science Teachers

**JV InvenTeam Resources.** Looking to enhance science, technology, engineering, and mathematics (STEM)–based education for students in grades 7–10? Resources from Lemelson-MIT's Junior Varsity (JV) InvenTeam program can help. In Electronic Textiles, an activity guide, students explore creative applications of circuitry, including light-up paper designs and wearable electronic textiles, discovering firsthand how inventors solve problems along the way. In Shoe Soles, another activity guide, students learn about biomechanics and biomimicry as they make shoe soles and develop skills in sketching and design, making molds, and creating models and prototypes. Access the guides at *http://bit.ly/1QyBtNH* (registration required).

In addition, an Inventor Archive presents an annotated list of noteworthy inventors and inventions in the fields of medicine and healthcare, consumer products, energy and the environment, transportation, and computing and telecommunications. Share the list in the classroom to spark discussion about the history of invention and the idea that we all are potential inventors. See *http://bit.ly/1LbFGXl.*

**Shelf Life!** Dive into the American Museum of Natural History's collection of more than 33 million artifacts and specimens through this monthly series of original videos. Most appropriate for use in middle and high school classrooms, each video features museum scientists explaining an interesting topic relating to the museum's collection. Topics include how to transport a giant squid specimen, why salamander embryos allow green algae into their egg cases, where to find the best early carnivorous dinosaur fossils, and many others. Watch the videos at *http://bit.ly/21RGS6j.*


YOSEMITE

**SARE Resources.** Sustainable Agriculture Research and Education (SARE), an organization focused on spreading innovation to and improving the profitability of American agriculture through research and education, has compiled a web page of online resources for K–12 educators. Highlights include the publication *Sustainable Agriculture Resources and Programs for K–12 Youth,* updated in 2015, which lists more than 50 sustainable agriculture-oriented programs and curricula for students nationwide; and the Sustainable Agriculture Learning Modules for High School Agriculture, created by the University of Nebraska-Lincoln, which show students what sustainability within agriculture actually looks like through videos of farming operations across Nebraska. In the videos, local high school students interview farmers about what their operation does, how and why they manage it as they do, what makes the operation sustainable, and what can be done to make it more sustainable.

Another curriculum for high school students, *Toward a Sustainable Agriculture,* addresses the environmental, economic, and social impacts of agriculture. The six-module curriculum provides a critical analysis of agricultural and food systems and helps students understand new concepts through hands-on examples. Find these resources and more at *http://bit.ly/1RNWhjk.*

**EarthScope.** This project focuses on deep geoscientific exploration of the North American continent and Earth. Scientists collect and analyze data from seismic waves, crustal movements, Earth's magnetic field, rock and soil samples, and images obtained from aircraft and satellites to help people better understand the materials Earth is made of and how it works, particularly its recurring earthquakes and active volcanoes. Teachers will find animations, video lectures, articles, project data, and other resources to incorporate the project discoveries in middle and high school classrooms and enhance Earth science instruction. Consult the website *http://bit.ly/1OWGcDi.*

**Beta Blasters!** This retro arcade-style game offers a fun way to help high school biology students understand the health benefits of carotenoids, a group of plant chemicals responsible for the colors of many fruits and vegetables that also play an important role in human health. Players must battle Emperor Oxide and the Free Radicals, who are trying to harm the DNA inside the cell nucleus, which would lead to an unhealthy body. As Captain Blake C. Trispora, players use a beta carotene–powered vitamin A blaster and the help of carotenoid allies (e.g., lutein, astaxanthin, phytofluene, lycopene, and alpha carotene) to defeat the emperor. As they

See Freebies, pg G2

Freebies, from pg G1

do when they are in the human body, the cartenoid allies work better when they work together. Learn more and play the game at *http://bit.ly/21f62cT.*

**Geniverse.** Web-based software from The Concord Consortium brings genetics to life with game-like challenges and an engaging narrative. Targeted for high school biology students, but adaptable for use with middle level and college students, the software lets students explore heredity and genetics by breeding and studying virtual dragons. Interactive models, powered by real genes, enable students to conduct simulated experiments, generate realistic and meaningful genetic data, and earn star ratings for efficient experimentation. Geniversity, an accompanying website for educators, offers teacher guides, lesson plans, student handouts, technical tips, and discussion forums to support the use of the software in the classroom. See *http://bit.ly/1R1iHR8* (registration is required).

**UDesign™ Science Facilities Layout Planner.** Flinn Scientific's new tool helps teachers plan and design a customized laboratory space. UDesign offers several pre-planned layouts as well as an option to customize it to specific room dimensions. Teachers can drag and drop furniture and equipment icons to create the desired layout and floor plan. An "Item Summary" feature provides a list of the selected furniture and equipment shown in the floor plan along with cost information to help establish and manage the budget. Refer to *http://bit.ly/1Rvc6J6.*

**BloomBoard.** In this online community, educators of all levels can learn, share, and discuss the best teaching ideas to solve everyday classroom challenges and improve their practice. The site offers teacher-curated collections of resources on various topics from content-oriented groupings in numerous subjects (including science/STEM) to collections on pedagogies, classroom management, and more. Teachers must register (at no charge) to search the collections. After registering, the site shows you collections based on your selected interests. In addition, registered teachers can like, recommend, share, and discuss the collections' content, making the community a truly interactive professional development experience. Consult *http://bit.ly/21TrJRY.*

DOUGLAS P PERKINS

**Earth Day 2016: Procession of the Species.** One way to honor the Earth is to organize a "Procession of the Species," an inclusive type of community event that helps us celebrate our connection to nature and to one another. An article from Teaching Tolerance offers suggestions for schools interested in organizing a Procession of the Species in their own communities. Ideas include designing the event to involve a diversity of ages, identities, and abilities; encouraging celebration through various artistic mediums, such as music, dance, and 2D and 3D art; and serving as an example of sustainable practices by emphasizing the use of recycled, natural, and donated materials for art project construction. Learn more at *http://bit.ly/1X5aWrL.*

**Real Disney Theme Park Science.** This site's videos, slideshows, and games—appropriate for upper elementary and middle level students—explore how science is used to create theme park attractions at Disney. The resources are organized by topics such as gravity, energy, trajectory, magnetism, and electricity. See the website *http://bit.ly/1R1Rfmm.*

**Thomas Edison's Secret Lab.** In this STEM–based animation series for children ages 5–9, Thomas Edison (brought back to virtual life as a hologram) guides a group of students—the Secret Lab Kids—on science- and humor-filled adventures across time and space. Edison "comes to life" to encourage the children in various explorations in physical science, life science, Earth science, space science, and other disciplines. "The Secret Lab" also transforms into a virtual reality environment, transporting the crew to various locations, including the International Space Station, a "fantastic voyage" within the human body, and meetings with visionaries Isaac Newton and Galileo. Watch two sample episodes—"No Volts for Von Bolt" and "The Eagle Has Landed"—at *http://bit.ly/1QZYtHB,* then visit the series website (*http://edisonsecretlab.com*) to access additional episode clips, music videos, printable activities, and games to spark student interest in science.

THESUPERMAT

**Activity of the Month, Grades 3–5.** With spring in full swing, now is the time to try activities from the Elementary Science Program, It's Science Time archives! Organized by season, the simple activities can spark an investigative spirit among students. Celebrate spring rains with a Puddle Science investigation, or make a rain gauge (Rain Studies) to collect data in your location. Next, celebrate summer with a Photo Safari, or search for the sights, sounds, smells, tastes, and textures of the season through the Five Senses of Summer. In fall, explore October Changes or Leaf Activities; by winter, you and your students will be ready to stay inside for a little Kitchen Chemistry. Many of the activities listed in each season can be done at any time of year, so get started investigating at *http://bit.ly/1ROj6Dn.*

**Ohio Resource Center.** K–12 science educators can access a searchable database of vetted resources that can be sorted by grade level, topic, resource type, and more. Several resource collections are grouped by theme, including the New Teacher Survival Guide, containing resources to help novice teachers set up and maintain a science classroom; Science Bookshelf, offering guidance for preK–5 teachers about using science trade books in the classroom; and Science Window, which helps teachers of all levels stay current with science issues, practices, news, and discoveries. Visit *http://bit.ly/1TJ45qr.*

**Digital Notebook Documents.** Sixth-grade science educator and digital notebook fan Nick Mitchell believes teachers should share more of what they do in the classroom. On his blog, The Scientific Teacher, Mitchell discusses using digital notebooks in his middle level classroom, and provides digital documents for units on scientific inquiry, ecology, chemistry, and geology. For each unit, the documents include lessons, homework assignments, and assessments, along with a digital study guide with an overview of the unit standards and many learning resources. See *http://bit.ly/1R0ulvx.*

**InTeGrate.** This collaborative initiative focuses on interdisciplinary teaching about the Earth for a sustainable future at the college level. Represented by a cross-section of faculty from higher education institutions, and sponsored by leading science organizations, the program has created course modules to help develop an Earth-literate citizenry and workforce that can address environmental and resource issues facing our society. Selected modules include Soils, Systems, and Society; Map Your Hazards! Assessing Hazards, Vulnerability, and Risk; and Humans' Dependence on Earth's Mineral Resources. In addition to course modules, the program offers workshops and webinars to incorporate the teaching of sustainability into your courses. Refer to the website *http://bit.ly/1nuOLzc.* ●

# News Bits

- **New PBS programs help kid engineers worldwide connect and share ideas for solving global engineering challenges.**

PBS' Design Squad Global website allows children ages 8–13 to share their solutions for issues like water conservation, play videos and games, and participate in contests to experience the fun in engineering and understand its connection to everyday life. The site provides resources and lesson plans to help teachers incorporate these activities in the classroom.

This summer, PBS will launch the Design Squad Global Clubs initiative to directly connect children ages 10–13 with out-of-school engineering programs worldwide. During 10 sessions, teams from different countries will learn about one another and their communities, choose an issue they face, engineer solutions for it, and provide feedback on these ideas. The program has been piloted in 14 countries so far, including the United States, Botswana, Swaziland, and South Africa.

Both programs accompany PBS' *Design Squad* series, in which high school teams compete to design engineering solutions for real companies. Check out the new website and club initiative at *http://pbskids.org/designsquad* or learn more at *http://bit.ly/24B707O.*

- **High-achieving high school students in New York have another reason to pursue science, technology, engineering, and math (STEM) careers: The state's STEM Incentive Program will award scholarships to the top 10% of students in each graduating class who want to major and work in STEM fields in New York for at least five years after graduation.**

The program will provide a full tuition scholarship to State University of New York or City University of New York schools for four years, unless the program of study requires five.

"The STEM Incentive awards not only give this state's top high school students access to a first-rate education, but it ensures that they and their talents remain in New York to help build our burgeoning high-tech economy," says New York Governor Andrew Cuomo. Eligible students must be attending or recently graduated from a New York State high school. Learn more at *http://bit.ly/1WUTeqJ.*

- **What can schools do when they can't provide full-time, in-house mentoring to teachers? A handful of start-ups and nonprofit organizations are offering virtual mentoring.**

*Slate* reports one, EdConnective, pairs teachers with a virtual instructional coach who analyzes videos of the participant's teaching and provides feedback, action plans, and follow-up help through twice-weekly webchats for one to six months. Results are shared only with the teacher, a key feature of these programs. "My coach was almost like a fairy godmother," says Valerie Amer, a veteran third-grade math teacher at Olney Elementary, a Philadelphia public school that uses EdConnective. "I could try new things in class and talk about it with her, without worrying that she was reporting back to [my principal]."

"I always ask my staff if anyone's interested. It's opt-in," says Michael Roth, Olney Elementary's principal. "My mantra is that I want my teachers to go from good to great."

Another such organization, the New Teacher Project, offers virtual coaching sessions through Bloom Board, an application that allows mentors to insert time-stamped questions and comments on mentees' teaching videos, and allows mentees to respond digitally. Read more about these programs at *http://slate.me/218adHk.* ●

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# — Forum & Expo —

## HOSTED BY NSTA

Denver, CO

July 27–29, 2016

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NSTA National Science Teachers Association

# What's New

FROM U.S. GOVERNMENT SOURCES

## Library of Congress (LOC)

### Science Webcasts

Check out the LOC's new selection of webcasts at the following website: *http://1.usa.gov/1OUZw3X*. The webcasts were created at the LOC's National Book Festival in September 2015, which featured many book talks and presentations.

Among the science-themed presenters were astronaut Buzz Aldrin, author Andrea Wulf, biologist Edward O. Wilson, and weather broadcaster Al Roker. The webcasts, which are appropriate for middle and high school level audiences, offer insight about topics such as Earth science, biology, weather, astronomy, and climate change.

To access the webcasts, visit the site and click on the Science and Technology link in the left column.

## National Aeronautics and Space Administration (NASA)

### Soda Bottle Rocket Activities

Harness the expertise of NASA space scientists with activities from NASA's Rockets Educator Guide. Targeted for students in grades 4–12, the activities introduce students and teachers to rocketry through the processes of building a soda bottle rocket and launcher from everyday items and "off the shelf" hardware and wood. Students then use the model and launcher to explore Newton's Laws of Motion and engineering design, as well as how air pressure and water power the rocket.

Choose from Water Rocket Construction, available at the website *http://go.nasa.gov/1QmKSq9*, and Water Rocket Launcher, available at *http://go.nasa.gov/24C8Vcm*.

## National Oceanic and Atmospheric Administration (NOAA)

### Expedition Videos

In Summer 2015, the NOAA research vessel Okeanos Explorer studied largely unknown deep-sea ecosystems around Hawaii as part of the Hohonu Moana: Exploring the Deep Waters off Hawai'i expedition. Scientists investigated waters in and around Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands, Johnston Atoll in the Pacific Remote Islands Marine National Monument, and various seamounts throughout the region. Share the expedition's discoveries with middle and high school students through highlight videos and images from each leg of the expedition. In the videos—found at *http://1.usa.gov/1ORlg0t*—the expedition scientists offer commentary on what is seen on screen, providing students with both a firsthand glimpse of an unexplored deep-sea ocean habitat and real-world insight into what it is like to be an ocean researcher.

## National Science Foundation (NSF)

### Nanotechnology: Super Small Science

Each short video in this six-part series created by NSF and NBC Learn presents an example of how nanotechnology—the science of manipulating atoms and molecules thousands of times smaller than the width of a human hair—can be used as the building blocks of future technology. For example, students learn how scientists are using nanotechnology to capture energy from the Sun, increase the power of smaller microchips and computers, build structures that are lightweight and resilient, and more. Read a press release about the series and access the videos at *http://1.usa.gov/1L73TxY*.

## U.S. Environmental Protection Agency (EPA)

### Think Green Infographic

At *http://1.usa.gov/1UEewKA*, teachers can access a colorful infographic that encourages tweens and teens to "think green." Through simple, thought-provoking questions—Do You Really Need It?, How "Green" Is It?, Can You Reuse It?, and Can You Buy It Used?—the graphic provides tips and action steps middle and high school students can take to reduce their impact on the environment and promote conservation. It's a good reminder for Earth Day (April 22) and every day!

## Kids.gov

### STEM Career Video: Nutritionist

A career in the food field can go beyond the kitchen. In the latest career video from Kids.gov, you'll meet Sasha Bard, a registered dietician and nutritionist from the U.S. Department of Agriculture, and learn the ins and outs of being a nutritionist. Bard describes a day in her life on the job promoting healthy eating and choices for all Americans, shares an app to help students maintain a healthy diet, and offers advice for students interested in pursuing a career in the field. Watch the video at the website *http://1.usa.gov/1X24RMK*.

## U.S. Department of Agriculture (USDA)

### Hand Hygiene Resources

Compiled by USDA's national Team Nutrition program, this website offers a collection of hand hygiene posters and resources produced by various state health initiatives across the country. While all of the resources address the topic of hand hygiene, each is unique and presents the content in different ways. For example, the collection includes posters with large illustrations of the steps of proper handwashing technique, stickers and signs with handwashing reminders (appropriate for use in classrooms and child care centers), posters featuring facts and figures about handwashing practices, and more. Several of the posters are available in multiple languages. Refer to *http://1.usa.gov/1TgHrFn*.

## U.S. Department of Energy (DOE)

### STEM Resources for K–12 Educators

At *http://1.usa.gov/1Ru0SVh*, teachers can access a database of science, technology, engineering, and mathematics (STEM) resources for K–12 classrooms. Compiled by the DOE's Office of Science Workforce Development for Teachers and Scientists, the resources include vetted labs, activities, videos, and articles from leading science and education organizations, such as the National Renewable Energy Laboratory, Thomas Jefferson National Accelerator Facility, PBS Education Foundation, and others. Search for resources by grade level, STEM discipline, or resource type.

Selected activities from each grade level include Pinwheels, for grades K–2, in which students learn about wind energy, what devices use it, and how wind creates movement; Magnets and Electromagnets, for grades 3–5, in which students make and test electromagnets using size D batteries and a length of wire; Making Stuff Activity Guide, for grades 6–8, in which students conduct experiments exploring the characteristics of materials like strength, electric conductivity, magnetism, and viscosity; and Radiation Makes House Calls, for grades 9–12, in which students demonstrate that some household items are radioactive. ●

# In Your Pocket

## Editor's Note

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

## April 22–30

### AFCEA STEM Teachers Scholarships

In partnership with NSTA, the Armed Forces Communications and Electronics Association (AFCEA) awards these scholarships to students pursuing a graduate degree, credential, or licensure to teach science, technology, engineering, or math (STEM) at the middle or high school level. Awards of between $2,500 and $5,000 are available.

Graduate-level applicants should be majoring in secondary education at an accredited U.S. college or university, have a minimum GPA of 3.5, and be enrolled in at least two semester-equivalent classes. Credential or licensure applicants must have a bachelor's or master's degree in a STEM field. All applicants must be U.S. citizens. Apply by **April 22** at *http://bit.ly/VnfEWU.*

### Collaboration Nation Video Contest

The contest recognizes schools or districts with successful collaborative educational technology projects. One $50,000 grand prize and three $15,000 monthly prizes will be given to the winners to help enhance their existing projects. Submit a nomination and short video chronicling your collaboration and how the project has impacted teaching and learning in your school or district by **April 30.** Refer to *http://bit.ly/1NPbzQB.*

### Patagonia Environmental Grants

These grants go to small, grassroots activist organizations aimed at preserving and protecting the environment. The company funds work that is action-oriented, builds public involvement and support, and protects local habitat. Grants of up to $12,000 are available. Apply by **April 30** at the website *http://bit.ly/JHFtFU.*

### SeaWorld Environmental Excellence Awards

These awards recognize students, teachers, researchers, and other individuals working at the grassroots level to protect and preserve wildlife. The organization funds work in four major areas: conservation education, species research, habitat protection, and animal rescue and rehabilitation. Applicants create a log-in and submit materials by **April 30;** consult *http://bit.ly/1FvfiQe.*

### The Lawrence Foundation Grants

The foundation provides grants to organizations that support education, the environment, human services, and other causes. Nonprofit organizations, public schools, and libraries may apply. Both program and operating grants are available. The average grant amount ranges from $1,000 to $5,000. Apply by **April 30;** see *http://bit.ly/18mrVSH.*

### Voya Unsung Heroes Grants

Each year, Voya Financial selects 100 educators with innovative project ideas to receive $2,000 toward their classroom projects. Projects should be creative and positively influence 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, or classified staff at accredited K–12 schools are eligible. Apply at *http://go.voya.com/1BqvPpA* by **April 30.**

## May 1–4

### Presidential Awards for Excellence in Mathematics and Science Teaching

This year, the White House recognizes outstanding K–6 math, science, and computer science teachers who serve as models for their colleagues, inspire their communities, and are helping to improve education in their field. More than 100 teachers in each of the 50 states; Washington, D.C.; Puerto Rico; the U.S. territories; and Department of Defense Education Activity schools will receive a certificate signed by the President; a paid trip for two to the awards ceremony in Washington, D.C.; and a $10,000 award from the National Science Foundation.

U.S. citizens or permanent residents with at least five years of teaching experience in K–12 schools are eligible. Apply by **May 1.** See *www.paemst.org.*

### American Honda Foundation Grants

The American Honda Foundation (AHF) awards grants to youth education programs focused on STEM and the environment. Grants of between $20,000 and $75,000 are available. Programs should be imaginative, creative, youthful, forward-thinking, scientific, humanistic, or innovative. Public and private elementary and secondary schools, public school districts, and nonprofit organizations that have previously received AHF grants may apply again by **May 1** at *http://bit.ly/OnjIiB.*

### Carski Foundation Distinguished Undergraduate Teaching Award

The American Society for Microbiology (ASM) presents this award for outstanding teaching of the subject to undergraduate students. Nominees must be currently teaching at a recognized college or university and have at least 10 years of college teaching experience, with a focus on microbiology for the last five years. The winner will receive a $2,500 cash prize, a commemorative piece, and travel to the ASM General Meeting, where he or she will deliver the Carski Award lecture.

Self-nominations are not accepted. Nominate a colleague by **May 1** at *http://bit.ly/1dsn8RT.*

### Mountaineers Foundation Community Conservation Education Grants

The foundation promotes the study of the mountains, forests, and streams of the Pacific Northwest, and contributes to preserving its natural beauty and ecological integrity. Funds for these grants are limited to no more than $5,000 and are meant to support modest, short-term projects related to conservation education and consistent with the foundation's vision and mission. Apply by **May 1.** See *http://bit.ly/1G35YTW.*

### Butler-Cooley Excellence in Teaching Award

The Turnaround Management Association (TMA) presents this award to teachers who have demonstrated their capacity to change the outcome of students' lives and the communities in which they teach. Two teachers will receive $5,000 cash prizes and up to $1,000 for travel, lodging, and meals while on-site at The Annual, TMA's annual conference, which takes place November 2–4 at Disney's Yacht Club Resort in Lake Buena Vista, Florida.

Active K–12 teachers at an accredited public or private school with at least five years of teaching experience may apply. Entries must be e-mailed by **May 2.** See *http://bit.ly/15qnrUV.*

### National Green Week/Green in Action Award

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 standards-based lesson sets, activities, readings, and contests focused on various green themes. Schools can participate for the entire week, for just one day, or use just one lesson from the curriculum. Afterward, participants complete a survey and can nominate their programs or projects for a $250 Green in Action Award.

To participate in National Green Week 2016, teachers register as GEF

members (at no charge), choose a timeframe in which to participate, and select their green theme at the website *http://bit.ly/1GoqDFv.* Apply for the Green in Action Award by **May 2.**

### A. Harry Passow Classroom Teacher Scholarship

The National Association for Gifted Children (NAGC) provides this scholarship to two K–12 teachers who have demonstrated excellence in teaching this population and are committed to furthering their own teaching skills. The funds are meant to reimburse or defray the costs of continuing education for these teachers. Nominees must teach gifted students in some capacity and have been an NAGC member for at least one year. Awardees will receive half of the scholarship at the NAGC convention in November 2016 and the remainder after they have written an article for NAGC's *Teaching for High Potential* magazine and submitted their transcripts.

Nominate yourself or a colleague by **May 4;** visit *http://bit.ly/1QTIL0w.*

## May 10–17

### Dreyfus Foundation Educational Grants

The Max and Victoria Dreyfus Foundation gives 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 the handicapped may apply. Proof of 501(c)(3) status is required. Applications must be postmarked by **May 10;** consult *http://bit.ly/1KtIP3J.*

### Lois Lenski Covey Foundation Library Grants

The foundation offers these grants to help libraries and other organizations serving economically or socially at-risk children buy books. Grants range from $500 to $3,000 and must be used to purchase books for preK–8 students. School libraries at schools where 65% or more of the student population qualifies for free or reduced-price lunch, bookmobile programs, and nontraditional libraries with 501(c)(3) status that have operated for at least three years are eligible.

Applications must be postmarked by **May 13;** visit *http://bit.ly/16ktYB1.*

### Award for Excellence in Polymer Education by High School, Middle School Teachers

This award, presented by POLYED, recognizes excellence in polymer education at the middle and high school level. The winner receives $1,000 and an all-expenses-paid trip to the NSTA National Conference on Science Education, where he or she will interact with a Polymer Ambassador. Apply by **May 15** at *http://bit.ly/U0pubO.*

### Google Science Fair

This global online science and engineering competition encourages individuals and teams of students ages 13–18 to change the world through scientific inquiry and problem solving. One grand-prize winner will receive $50,000 in scholarship funding, which will be split evenly among recipients if the winning entry is submitted by a team. Several $15,000 scholarships are available for runners-up, and one Inspiring Educator will receive a $5,000 grant and $5,000 for LEGO Education products.

Entries are due by **May 17.** Visit *http://bit.ly/1QnorCK.* ●

# Summer Programs

**Editor's Note**

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

**A Dairy for Every Classroom.** This course is for middle school, high school, and career and technical education teachers seeking to incorporate dairy agriculture in their classrooms. The course allows participants to focus on projects of their choosing while learning from experts. Teachers attend a residential intensive session at Vermont Technical College July 12–14, then work independently on their projects at their homes. They return for a curriculum retreat at Shelburne Farms in Shelburne, Vermont, September 30–October 1. Teachers develop a culminating project due in December.

Scholarships and graduate credits are available. Apply by **April 25** at *http://bit.ly/1ScHVLt.*

**Shelburne Farms: Project Seasons for Young Learners.** This workshop for early childhood educators takes place July 11–14 at Shelburne Farms in Shelburne, Vermont. Participants will explore ways to enhance their curriculum with sustainability in mind and help students make connections between the natural and agricultural worlds.

Scholarships and graduate credits are available. Submit a scholarship application by **April 29** before registering online at *http://bit.ly/1Qo3eqV.*

**Smithsonian Science Education Academies for Teachers (SSEATs).** These programs aim to bridge the gap between formal and informal science education. Each course combines science content and pedagogy with behind-the-scenes experiences at the Smithsonian and other research facilities in Washington, D.C. Three SSEATs will be held: Biodiversity (June 19–24), Energy's Innovations and Implications (July 10–15), and Earth's History and Global Change (July 17–22). Participants will interact with scientists, curators, and museum educators and learn pedagogical techniques to deliver the content in their classrooms.

K–12 teachers can register online at *http://s.si.edu/1RAQ4Vi* by **April 30.**

**STEM Think Tank and Conference.** The Center for STEM Education for Girls will host this event July 13–15 at the Harpeth Hall School in Nashville, Tennessee. The conference aims to promote new connections and conversations about STEM among K–12 teachers, university faculty and staff, informal educators, and industry members. Those who teach or work with girls and young women in a STEM field are encouraged to attend. Register online by **May 31** at *http://bit.ly/12WpWNx.*

**Sea Camp Summer Internships for Teachers.** Texas A&M University at Galveston sponsors week-long internships for teachers and administrators in conjunction with its Sea Camp program, a residential summer camp for students ages 10–18 who are interested in marine biology and science, and its Talented and Gifted Program, for high-ability students ages 14–18. No teaching is involved; interns learn along with their campers while acting as chaperones. Internships are available in marine biology, fishing, marine engineering, and biology of the sea turtle, among others.

Interns can earn 7 to 30 continuing education credits. Lodging and meals are provided. Dates vary by program. Apply online at *http://bit.ly/1fAViTc.*

**Advanced Placement (AP) Summer Institutes.** These institutes are open to those teaching an AP course for the first time, those with limited experience with AP courses, or teachers who are adapting or revising an existing course. Sessions will provide instruction on methodology, curriculum, assignments, exams, and teaching strategies in the AP classroom.

Three institutes will take place at Fitchburg State University in Massachusetts during July 11–15; July 18–22; and July 25–29. On-campus housing and graduate credits and professional development points are available. Apply at *http://bit.ly/1UujXfk* for Weeks 1 and 2 by **June 20** and Week 3 by **July 5.**

**NEWBio Bioenergy and Bioproducts Workshops.** These week-long programs are for science and technology educators who want to learn and teach about bioproducts and bioenergy systems under development or currently in use in the United States. Inservice and preservice teachers and extension coordinators in grades 6–16 may apply. Programs will be held at Penn State University June 20–24 and at West Virginia University July 11–15.

Scholarships, materials, food, transportation, and travel funds are available. See *http://bit.ly/1OUpEMi.*

**Teacher Research Academy: Biotechnology Research.** The Teacher Research Academy offers programs for middle and high school teachers and community college faculty at Lawrence Livermore National Laboratory (LLNL) in Livermore, California. Participants engage in a continuum of standards-based instruction and progress from novice to mastery through four levels of instruction.

The Biotechnology Research Academy prepares teachers to conduct biotechnology research with their students. Level I (June 20–22) introduces them to the field and its basic tools, such as DNA extraction, gel electrophoresis, and DNA fingerprinting. Level II (June 27–July 1) provides the skills and knowledge teachers need to meet California Content Standards for evolution, genetics, and immunology. Level III (July 25–29) prepares teachers to work on a practicing research team. At Level IV, teachers can participate in an eight-week mentored research internship and present the results of their work at the LLNL Summer Research Symposium.

Graduate credits are available. Register online at *http://1.usa.gov/1KYwfur.*

**Technical Writing for Science Class.** The LLNL offers this course to help K–12 science teachers meet *Common Core State Standards* for technical communication. Participants will learn how to incorporate real-world instructions, descriptions, abstracts, notes, science posters, and more into the classroom. Courses will take place June 23–24 and July 18–19 in Livermore, California. Register online at *http://1.usa.gov/1pbU8iE.* ●

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MINNESOTA

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EXPLORING MOUNTAINS:
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The View from the Summit: Celebrating Science for All

The View from All Angles: Connecting Three-Dimensional Science Instruction

Training Camp: Strengthening Fundamentals in Elementary Education

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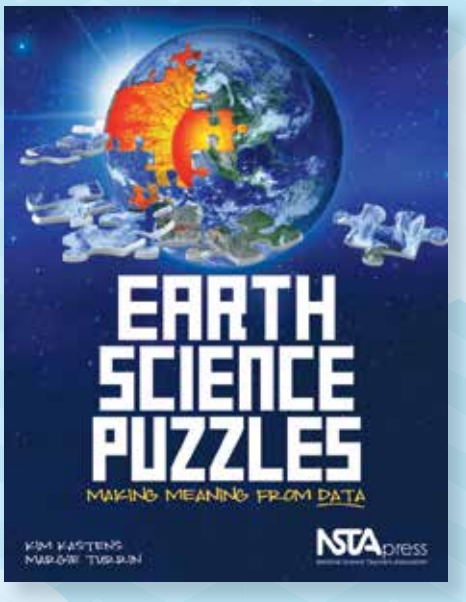
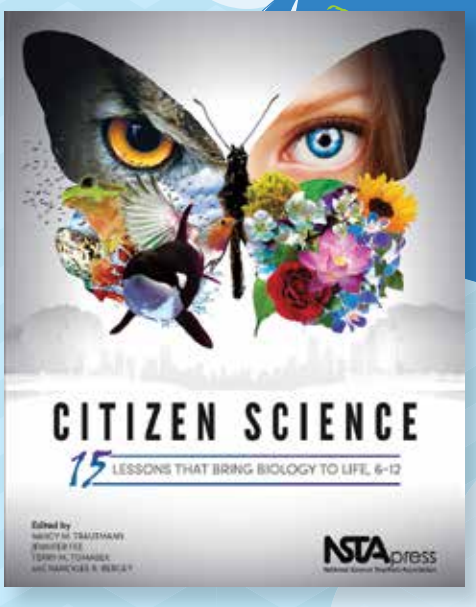
NSTA National Science Teachers Association

# Dig Into **Earth Day** Resources **From NSTA**



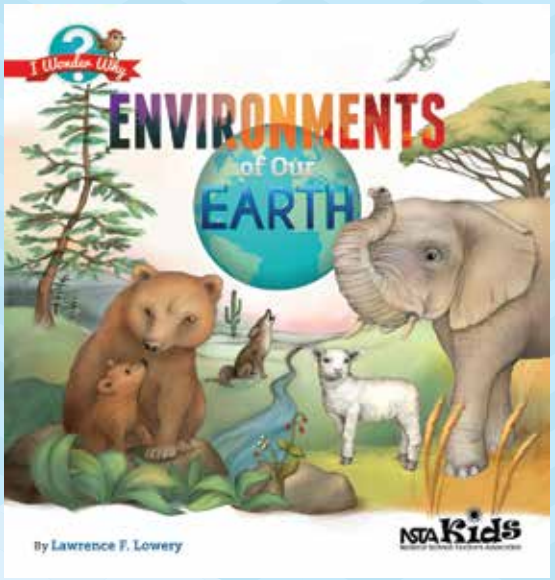

**Grades 8–12**

**Book: Member Price: $22.36** | Nonmember Price: $27.95
**E-book: Member Price: $16.77** | Nonmember Price: $20.96
**Book/E-book Set: Member Price: $26.83** | Nonmember Price: $33.54




**Grades 6–12**

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




**Grades K–6**

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NSTA National Science Teachers Association

MS. MENTOR, **Advice Column**

# Teaching on the Record, Addressing Misconceptions

My mentor wants to video my middle school science class. I'm not having specific problems with students, and I think my lessons are good, but this still makes me nervous. Why would she want to do this?

*—G., Minnesota*

Actually, your mentor may be doing you a favor by introducing you to a meaningful professional development activity. You can reflect on a lesson without watching a video of it, but sometimes memories are selective. If we remember a few students misbehaving or being confused, we may see the entire lesson as a failure. Or we may overlook the quiet students and later assume that everyone was engaged and participating. We may mistake a lack of questions as a sign that students understood the lesson.

You and your mentor should check whether recording a lesson for the purpose of teacher development is acceptable in your school and with your teachers' organization, the video is meant for your eyes only, and it is not an evaluative tool for you or for students. Based on your mentor's guidance, you may also want to inform students that they will be part of the video, but it will not be shared with anyone else.

My preservice science methods class had a video component. (This was in the days of VHS equipment, before cell phones or handheld cameras!) A classmate recorded the video, then we would critique ourselves. We shared the videos and our reflections with the professors, too. It was a win-win situation: We gained experience making a video as well as critiquing our own. I learned that I used many "aahs" and "ums," which I chalked up to being nervous, but I needed to be aware of this vocal tic. I focused more often on one side of the classroom, and most of my questions were at the factual level, two things I needed to address during student teaching. I decided I needed to be more mobile and circulate more.

I offer some suggestions from my own experiences on both sides of the camera:

First, view it from your perspective. Consider your voice level and tone, eye contact, gestures, speech patterns, appearance, and vocabulary. Don't be too hard on yourself at this point, unless you see something that would interfere with student learning or the lesson's structure.

Second, consider the video from a student's perspective. Was there a lot of down time at the beginning or end of the class period? How did the transitions between activities work? Did some students not participate? Were students beyond your gaze off-task? Could students hear and see what they needed to? Did any distractions occur that interfered with the lesson (e.g., announcements via speakers, noise from the outside), and how did you deal with them to keep students focused? Did you recognize students who had their hands up? If you monitored group work, did all groups get some attention? How did you handle groups who needed more attention? Did some students get more attention than others, and if so, why?

Third, watch the video again and reflect on effective practices you used. Were students aware of the lesson's goal? How well did the activities align with your curriculum? Did you pose questions on a variety of levels? Did students use safe lab procedures? How did you incorporate wait time? What evidence shows that students worked effectively in their groups? What strategies did you use to get all students engaged in the lesson? What formative assessments did you use, and what did you learn from them? What kind of feedback did you give students? Did the lesson turn out the way you thought it would? What might you do differently?

Another thought is to share the video with the class for their input, explaining that you are using it to become a better teacher. What do they see that you may have missed?

My upper-elementary students have had very little formal science instruction. I'm finding that they have a lot of "knowledge" that consists of misconceptions, half-truths, and opinions. I'm looking for suggestions on how to deal with these misconceptions.

*–P., Minnesota*

Along with their notebooks and pencils, students often bring misconceptions to science class. It's hard to tell how students get these muddled ideas.

If learning involves building on our current understanding, then finding out what students know, don't know, or think they know is important when beginning a unit. A written pretest might help, but students may have memorized some facts or definitions without really understanding a concept.

I recommend Page Keeley's book series, *Uncovering Student Ideas in Science*. The "probes" in these books are brief activities that help identify students' preconceptions or misconceptions about a topic. Each probe has a summary of the topic, a detailed description of what can be learned from the students' responses, teaching suggestions, and a list of resources. The probes are in the form of questions or activities that could also serve as engaging activities at the beginning of a unit. The series has several volumes, each with 25+ probes covering a wide variety of topics. (If you want to preview these probes, NSTA's elementary journal *Science and Children* publishes one in each issue.)

Simply asking students to discuss or write about what they know can be eye-opening. I would ask my seventh graders to make a list of 10 animals. Without looking at their lists, I predicted that most, if not all, of the animals would be vertebrates, and most of those would be mammals. When we debriefed on why they mentioned so many mammals, their immediate response was the misconception that mammals were the most common kind of animal. When we researched that fact, they were shocked to discover that hundreds of thousands of invertebrate species exist. We then had a lively discussion of why we overlook invertebrates, as an introduction to the unit.

Simply telling students their ideas are wrong won't help them learn the correct ones. The article "From Misconceptions to Conceptual Change" in the April 2011 issue of *The Science Teacher* (*TST*) provides insights into how students develop misconceptions and how teachers can help students change their thinking. The sentence that stood out for me was "…the brain files new data by making connections to existing information. If this new information does not fit the learner's established pattern of thinking, it is refashioned to fit the existing pattern." So misconceptions can actually become stronger and more resistant to change if all we do is present correct facts.

So what can a teacher do to help students grasp new information that corrects rather than reinforces misconceptions? "Active Learning Strategies: The Top 10" in the same *TST* issue has some suggestions. The strategies don't require special materials or hours of professional development (e.g., using discrepant events to awaken curiosity, using concept maps, writing to learn). One important one was "demystify diagrams." Some diagrams actually contribute to students' misconceptions. Textbooks often show diagrams of the circulatory system with the veins colored blue. Another strategy is using vocabulary correctly.

It may take a while for students to have their "aha" moments, but it is exciting to see the "light bulbs turn on" in their heads! ●

*To maintain anonymity when requested, some letters to Ms. Mentor are signed with a pseudonym. We regret any coincidental resemblance to other educators when a pseudonym is used. Check out more of Ms. Mentor's advice on diverse topics or ask a question at* www.nsta.org/msmentor.

# Interdisciplinary Project Spans Three States

Middle school teachers and students from three states collaborated online last fall to create science and social studies lessons, units, and projects on the theme "How the Earth Affects People and How People Affect the Earth" as part of the COW (California, Ohio, and Wisconsin) project.

Superintendents Devin Vodicka of California's Vista Unified School District (VUSD), Matthew Miller of Ohio's Mentor Public Schools District, and Patricia F. Deklotz of Wisconsin's Kettle Moraine School District were introduced at a meeting of Digital Promise's League of Innovative Schools, a national network of leaders who are leveraging technology to improve student outcomes. They discussed a collaboration that would be "interdisciplinary and competency-based, feature blended learning, and allow for student voices," says Vodicka.

"One of us said, 'Let's do this together.' All three states have similar standards and can use Google applications for education [to collaborate online]," says Vodicka. The superintendents decided middle schools should be involved because students at that level "have some content knowledge, but don't have the complications of earning high school credits," he explains.

When locating partners for COW, Vodicka was connected with the team from the U.S. Department of Education's #GoOpen campaign to encourage states, school districts, and educators to use openly licensed educational resources (OER). "If we tried to use proprietary resources purchased by only one district, the students couldn't collaborate," he observes. "We were compelled to make use of OER…[and] were intrigued to see how OER would [foster] innovative collaboration."

With OER, the teachers were "freed from using a single textbook: That was so liberating," says Erin English, VUSD's director of online and blended learning, who helped coordinate the COW project for the three districts. "We have kids with textbooks as old as they are…We owe it to our students to keep content relevant."

DEBBIE GIESMAN

*For her COW project, a student at Roosevelt Middle School in Oceanside, California, made a model to show how natural disasters can impact the land and humans.*

## Making the Idea Work

The superintendents chose schools for the project. After hearing from several interested principals, Vodicka chose Elise Ochenduszko of Roosevelt Middle School in Oceanside, California. She selected science teacher Jessica Janes and seventh-grade social science teacher Stephanie Daoust to participate.

To prepare the teachers, Ochenduszko says she arranged for professional development sessions on "teaching students how to use the internet wisely,…creating and curating online educational resources in a way that is strategic and focused," and on using technology, including Google hangouts, which enabled teachers and students to "meet" and communicate. "I had to push my teachers to think bigger, give them the permission to create, be creative, push the boundaries, and take the risks to try things they wouldn't normally try," she contends.

Seven teachers from the three states met in Ohio last August. "We came up with a guiding question that was broad enough to apply to both subjects and include [science, social studies, and literacy] standards," says science teacher Jayne Miller of Mentor Public Schools in Mentor, Ohio. Afterward, teachers collaborated online to develop lesson plans and units.

"We used *Next Generation Science Standards* for Earth science and *Common Core State Standards* in social studies and language arts as targets for topic groups," says Mike Steger, science teacher at Kettle Moraine Middle School in Dousman, Wisconsin. "[W]e told students to choose a few targets, explain how [they would] meet those targets, and gave them [the chance to do] lots of personalization."

"The students had to choose three tag words for their topic to help students find others with the same interest and topic without [having to read entire research proposals]. If the topic was erosion, for example, then the tag words could be erosion, prevention, and Lake Erie," Miller explains.

Because students chose collaborators based on topics, not all students worked with peers from another state, but many did. "COW took the school walls down and let students glimpse the lives of other people, students, outside experts, and teachers," Steger remarks.

Though COW was exciting for teachers and students, teachers faced some challenges. "We had to teach students to vet online resources for reliability," says Janes. "We had to teach many of them how to send an e-mail. We had to show them it's not a text message: You need to present yourself as a professional."

Different time zones posed issues. "We had to get students to have patience and not give up when a person in another time zone didn't answer right away," Miller observes.

## Experiencing Success

"The teachers e-mailed [one another weekly] with updates, had a Google Drive folder to share resources, and held occasional Google hangouts," Janes relates. "This helped with accountability for ourselves, staying on time and on track, as well as providing a way to get good ideas and resources."

The California teachers told students their projects could not be "posters, papers, essays, or tri-fold boards. That opened the doors to creativity," Janes maintains. As a result, students produced models, art projects, computer applications, podcasts, simulations, games, stop-motion animations, and other projects involving higher-level thinking.

Science topics ranged from "landslides to glaciers to pollution to toxic waste," Steger recalls. Students working on a nuclear energy project who were interested in climate change "wrote to university professors, business leaders, [representatives from] wildlife organizations…[who responded] with great enthusiasm, [heightening] the students' engagement and curiosity," he relates. Another student explored "the local interstate highway system that was all built on a glacial till; he rolled some science into it."

"The students exceeded their own expectations," says Ochenduszko. During her school's exhibition night, "hundreds of people came, and parents were pleased...[that] their children were learning valuable 21st-century skills."

COW's lessons and units will eventually be available free to all on Amazon.com. And the amount of content will keep increasing: A second cohort of COW—dubbed "2COW"—is in the works, says Vodicka. ●

BLICK ON TV

# Seeing the Future in *Minority Report*

By Jacob Clark Blickenstaff

Way back in 2002, the film *Minority Report* was released, with some big-name talent: Steven Spielberg directed, and Tom Cruise and Colin Farrell had leading roles. Set in 2054 in the Washington, D.C., area, the plot revolved around three "pre-cognitives," Agatha and her twin brothers Arthur and Dash, who were able to see into the future and predict murders soon to be committed. A police division called Pre-Crime was created to arrest the almost-murderer, and he or she would be "haloed" or placed into a kind of suspended animation.

Usually all three would agree on the prediction, but occasionally only one would see the murder, resulting in a "minority report." The film recounts how one officer brought down the pre-crime program over a scandal around minority reports. At the end, the three pre-cogs were relocated to a remote cabin, where it was hoped they would not be tormented by visions of murders.

In September, the *Minority Report* television series debuted. Again set in Washington, D.C., the story begins about a decade after the events in the film. Police officer Lara Vega (played by Meagan Good) and her boss, Will Blake (played by Wilmer Valderrama), wish they had the kind of information pre-cogs provided. All the haloed people have been freed, though they suffer after-effects of the suspended animation. Vega and Blake have high-tech tools like vision-enhancing contact lenses and computer technology to recreate crime scenes in real time.

While Agatha seems content to live in isolation, Arthur and Dash have returned to the D.C. area. Arthur is there to use his premonitions to make money, and Dash to try to prevent deaths he sees in his visions. After several failed attempts to rescue people, Dash contacts Vega for help. Following leads related to the death of a woman who fell from a high-rise apartment building, they uncover a plot to attack a political rally with a biological weapon.

Biology teachers could use plot points in the pilot episode to discuss extinctions and viruses, and connect to the film.

A former Pre-Crime prisoner, Rutledge, is plotting to deliver a deadly virus to a large crowd gathered for a political rally, and to assassinate the man he blames for his Pre-Crime conviction. How will Rutledge deliver the virus? With pigeons. It turns out that Rutledge is a pigeon fancier, and he has birds he controls via a brain connection.

I'll grant that by 2065, there might be a way to communicate telepathically with birds. But why choose passenger pigeons, which went extinct in the early 20th century and would have to be re-created? I suspect the writers intended to use *homing* pigeons, which are not extinct, and are very good at returning to a known location. Scientists have been trying to understand this ability for decades. Hypotheses include magnetic navigation, use of scent clues, the position of the Sun in

the sky, and even low-frequency sound. No clear consensus has been reached, and some argue that homing pigeons use a combination of techniques.

In Dash's vision, people are bleeding, vomiting, and dying minutes after exposure to the virus. Even allowing for filmmakers' usual creative liberties, this is a bit much. Viruses cause deadly diseases, but the time from infection to symptoms is days or weeks. A virus needs time to invade host cells, take over the cell's reproductive machinery, and create copies of itself. In addition, even the most deadly viruses do not have 100% mortality rates. The kind of reactions in Dash's vision look more like a chemical agent. Gasses like chlorine and sarin can cause injury or even death in minutes, and have similar symptoms.

An interesting line is spoken near the end of the episode, when Arthur mentions that mosquitoes are extinct. With the recent Zika virus outbreak, mosquitoes have gotten a lot of attention. Some have wondered why we don't try to eradicate them. A National Public Radio piece asked scientists "Would It Be a Bad Thing to Wipe Out a Species...If It's a Mosquito? (see *http://n.pr/1L67Djn*), and found some agreed that eliminating a single species of mosquito might be okay, but trying to kill all of them could have dangerous consequences. Mosquito larvae are food for fish and other insects, and many mosquito species pollinate flowers and food crops.

Folks who enjoyed the film *Minority Report* may be disappointed, but topics in the television series can certainly be used to spark some interesting conversations. I also appreciate that the cast was fairly diverse, with an African American woman in the lead role, and a Hispanic man as her lieutenant. ●

*Note:* Minority Report's *status for next season is unclear at this time. The film* Minority Report *is rated PG-13.*

*Jacob Clark Blickenstaff is the program director for Washington State Leadership and Assistance for Science Education Reform at the Pacific Science Center in Seattle. Read more Blick at* http://bit.ly/amBgvm, *or e-mail him at* jclarkblickenstaff@pacsci.org.



## Quotable

***Be less curious about people and more curious about ideas.***

—Marie Curie, Polish-French chemist and physicist (1867–1934)


**NSTA PRESS:** NGSS *for All Students*

# Charges of the *NGSS* Diversity and Equity Team

**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* NGSS for All Students, *edited by Rita Januszyk, Okhee Lee, and Emily Miller, edited for publication here. To download the full text of this chapter, go to* http://bit.ly/1QSixVW. *NSTA Press publications are available online through the NSTA Science Store at* www.nsta.org/store.

Beginning with *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (NRC 2012), and continuing through the *Next Generation Science Standards* (*NGSS* Lead States 2013), the science learning of diverse student groups is part of our national discourse. The *NGSS* from its inception ensured that concerns of diverse student groups were addressed. Of the 41 *NGSS* writing team members, a smaller group of those individuals representing diverse student groups was brought together to form the Diversity and Equity Team. The team was given the task of ensuring that diverse student groups' interests were incorporated into the *NGSS* planning, writing, rewriting, revising, adding, subtracting, and visualizing.

With feedback from key state partners and two rounds of public comments, the *NGSS* writers went through an iterative process of revising and refining the standards based on that feedback. The team made adjustments accordingly and completed four significant tasks: (1) Appendix D "All Standards, All Students": Making the *Next Generation Science Standards* Accessible to All Students; (2) bias reviews of the standards; (3) inclusion of the diversity and equity topic in the appendixes; and (4) seven case studies.

## APPENDIX D

Appendix D is designed as a reference tool for classroom teachers, school and district administrators, and state policy makers. The appendix presents current issues around equity of science education for diverse student groups.

### The *NGSS* Offer Both Opportunities and Challenges for All Students

Consideration of learning opportunities and challenges are particularly important for student groups that have traditionally been underserved in science classrooms. In the *NGSS*, the rigor of disciplinary core ideas is intertwined with science and engineering practices (the "doing" part of science) and crosscutting concepts (bridging ideas that encompass multiple science disciplines). This three-dimensional learning defined by the *Framework* and embodied by the *NGSS* promises to be an opportunity for

students to explain natural phenomena, solve design problems, and develop lasting scientific knowledge about how scientists and engineers really do science and engineering in their careers. Additionally, the *NGSS* provide connections to the *Common Core State Standards*, and the overlap between science and engineering practices with English language arts (ELA) and mathematics practices allow for reinforcement across subject areas.

### The Context of Science Learning Matters

Appendix D identifies the context of science learning in terms of student demographics, science achievement, and education policy. The student population in our nation is becoming more diverse racially and linguistically, and more students are living in poverty. Meanwhile science achievement gaps among demographic groups persist, according to the *National Assessment of Educational Progress* (National Center for Education Statistics 2011). Unanswered questions remain. If current trends in student demographics continue, what will happen to science achievement? What will it take to close the gaps? In education policy, No Child Left Behind (NCLB 2001) defines accountability for reading and math, but not for science. The fact that science is not part of annual yearly progress has major implications.

### Bias Reviews of the *NGSS*

In the development of the *NGSS*, the team reviewed the standards for bias. From the early stages of standards development, writers were alerted to potential bias possibilities. For example, a clarification statement in a performance expectation that included an example of baking cookies to describe the molecular nature of a gas might bias a student who never experienced baking cookies in her or his family life. Examples in clarification statements were carefully selected to avoid such bias.

The team reviewed the standards for consistency of language to ensure that (1) the language used in performance expectations was consistent as the concept built across grade bands, and (2) language used in science and engineering practices and crosscutting concepts was consistent within a grade band and across grade bands. The team also reviewed the standards for clarity of language, while being mindful that as performance expectations translated into assessments, clarity was important for understanding the intent of the *NGSS* writers and not being confusing to diverse student groups. Therefore, suggestions were made to use accessible language.

Finally, the bias review included recommendations directly impacting diverse student groups. Where appropriate, the team suggested real-world problems or reference to local contexts that are motivating to students in poverty, and low-cost materials for students in urban or rural schools. The team also suggested references to familiar objects or tools for English language learners (ELLs) as they can more effectively demonstrate their knowledge with such references.

## Diversity and Equity Topic in Appendixes

*NGSS Volume 2: Appendixes* (*NGSS* Lead States 2013) is the companion volume, consisting of Appendixes A through M. Many of the appendixes address diversity and equity connections and stay with the theme that the *NGSS* are for all students. The inclusion of the diversity and equity topic in the appendixes is described below.

- Appendix F: Science and Engineering Practices states that science classroom discourse is vital to three-dimensional learning and presents both language demands and language learning opportunities. This is particularly true for ELLs, speakers of nonstandard English, and students with Individualized Education Programs (IEPs) who have language processing difficulties: "When supported appropriately, these students are capable of learning science through their emerging language and of comprehending and carrying out sophisticated language functions (e.g., arguing from evidence, providing explanations, developing models using less-than-perfect English)" (*NGSS* Lead States 2013).
- Appendix G: Crosscutting Concepts emphasizes that connections through crosscutting concepts promote a more complete understanding of science for students who may have traditionally been relegated to basic-level classes.
- Appendix H: Understanding the Scientific Enterprise: The Nature of Science emphasizes contributions to science and engineering by individuals and teams of men and women from diverse cultures.
- Appendix I: Engineering Design has a section called Engineering Design in Relation to Student Diversity. The *NGSS* elevate engineering as integral to science, a marked shift from previous standards. Engineering design is at the same level as scientific inquiry in the *NGSS*. Engineering permeates modern life and is important for career and college readiness. Participating in engineering problems or designing solutions creates relevance and motivation to students who otherwise might not be engaged.
- Appendix J: Science, Technology, Society, and the Environment highlights that the home/community connection to science is important for academic success of diverse groups of students who have "funds of knowledge" from their home and community contexts that can provide a bridge to science learning in the classroom (Gonzalez, Moll, and Amanti 2005).

## Conclusion

Looking at the quotes at the beginning of this chapter, we hopefully will be moving from "We have lower expectations for minority students in poverty" and "It's so depressing" to "We have a unique opportunity to get it right" and "All students can learn, and it begins with me." State and local organizations formulating policy and acting as agents of change can turn the pessimism into optimism.

The vision of the *Framework* and the *NGSS* to include the needs of diverse student groups to ensure access and achievement is commendable. The challenges and opportunities for diverse student groups in meeting the *NGSS* are illustrated in the case studies as students are engaged in meaning making, science discourse, and explanation of natural phenomena and solution of design problems, which will lead them to the goal of career and college readiness. Appendix D and the case studies can inform discussions around addressing diversity and equity in science education. ●

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*(All dates are deadlines unless otherwise specified.)*

**April 13**—What is the role of a watershed, and how can you identify a healthy one? Learn how to answer these questions and more, and discover some hands-on investigations to conduct with your students during **Global Precipitation Measurement Mission: Watersheds, a free NSTA Web Seminar**. The session will run from 6:30 to 8 p.m. Eastern Time (ET). Participants receive a certificate of participation and 100 Learning Center activity points after completing the post-program evaluation. An archive and presentation slides will be available when the program concludes. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.*

**April 15—Session proposals** for the **2017 NSTA National Conference on Science Education** are now due. The conference will be held March 30–April 2, 2017, in Los Angeles, California. For more information or to submit your session proposal, go to *http://bit.ly/1wI4iQg.*

**May 5**—Explore the types of weather, how weather is monitored by satellites, and opportunities to have your students participate in weather data collection during **Global Precipitation Measurement Mission: Weather, a free NSTA Web Seminar**. The session will run from 6:30 to 8 p.m. ET. Participants receive a certificate of participation and 100 Learning Center activity points after completing the post-program evaluation. An archive and presentation slides will be available after the program ends. For more information on NSTA Web Seminars or to register, visit *http://bit.ly/1Iwpg4w.*

**May 13**—It's your last chance to take advantage of early bird discounts on your registration for NSTA's **2016 STEM Forum and Expo** in Denver, Colorado, July 27–29. Derek Muller, creator of the science You Tube channel Veritasium, will present the keynote address on July 27. For more information or to register, visit *http://bit.ly/1ppHD9d.*

**July 15**—Don't miss NSTA's **Summer Institute, Implementing *Next Generation Science Standards***, at the University of Nevada in Reno. *NGSS* experts will lead sessions designed to help attendees better understand what *NGSS* looks like in the classroom at different grade levels and content areas. Registration opens April 10. For more information or to register online, go to *http://bit.ly/1QF7boT.* ●



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# Bacterium a Potential Advance in Plastic Recycling

MICHAL MAÑAS

With plastics piling up in landfills and swirling in massive patches in oceans, scientists have been searching for ways to decompose the durable materials. Researchers in Japan believe they've found a bacterial candidate for the job at a bottle-recycling facility.

According to the article published in the journal *Science*, the team discovered *Ideonella sakaiensis* 201-F6 while screening "natural microbial communities exposed to" the durable plastic polyethylene terephthalate, or PET. The bacteria break down PET using two enzymes that convert it into "environmentally benign monomers, terephthalic acid and ethylene glycol." The bacterium joins strains of fungus and polystyrene foam-eating mealworms as potential natural recyclers of plastic compounds.

Read the abstract online at *http://bit.ly/24VoHPD*. ●