Immersing Students in Authentic Research

Innovative after-school programs are providing high-quality science learning experiences for students who need or want more than what their school can provide. For urban middle school students in Chicago, Northwestern University’s Science Club offers “authentic connections to real scientists, Northwestern graduate students who serve as program mentors,” says Michael Kennedy, Science Club creator and director of Science in Society, Northwestern’s office for science outreach and public engagement. “Science skill development and science, technology, engineering, and math (STEM)–related career exposure are central program goals,” he affirms.

“Teachers asked us to help teach their students to think scientifically and analyze data to make evidence-based decisions,” says Kennedy. He and his team developed Science Club in partnership with Chicago Public Schools (CPS) teachers, who helped design the curriculum, and the Boys & Girls Clubs of Chicago.

Science Club members—students in grades 5–8—meet weekly throughout the school year to conduct experiments in a dedicated lab facility at the Pedersen-McCormick Boys & Girls Club. Kennedy spearheaded construction of the lab, with equipment and supplies funded through donations from Northwestern, science supply companies, and a local foundation. Subsequent funding from the National Institutes of Health (NIH) has helped the program grow to 60 students attending weekly, with curricula covering “a wide array of science disciplines with a health theme,” including biomedical engineering, food science, and medicine. “Rigorous evaluation has been another tremendous benefit of NIH funding,” he relates.

“A strong partnership [among] the university, the Boys & Girls Club, and CPS teachers” has been vital to Science Club’s success, says Kennedy. “We have very solid data that the program is a transformative learning environment for kids,” he reports.

“The sense of partnership and reliability was nothing that I had experienced in any interaction with a university research team before,” says Jennifer Koerner, a former middle school science teacher at John T. McCutcheon Elementary School. “The staff and mentors work with struggling populations that wouldn’t normally have access to the amazing resources they have to offer.”

The mentors “help guide our students in their science fair projects. We just had two of our students advance to the CPS citywide science fair,” says Gerard Kovach, science teacher at McCutcheon Elementary School.
Project-Based Inquiry Science™ (PBIS) is a three-year middle school curriculum designed as 13 stand-alone units that fully reflect the science and engineering practices outlined in the Framework and the NGSS.

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Memo to New Teachers: Make Time to Share

Nothing is more frightening than being a novice. For me, the first days of teaching in my own classroom felt like being a new teacher. I had trained for this, and I knew the material and the practices were all fully accredited to launch me correctly, but I harbored a deep doubt that I could actually do it on my own. Would I soar or crash? The first year of teaching is a time of learning and a time of discovery. Just as a science teacher is learning how to teach science students, so too is the new teacher, new to the teaching profession, learning how to teach the students.

The best part of reading anything from NSTA is inspiration. I love reading stories of teachers much like me who have tried something new. When I read the journals, I get a thrill out of imagining that I could try something different and better for my students, too. If you have not read your NSTA journal in a while, find a little time and read just a few articles. And when you do, remember that these writers aren’t experts with long experience; they’re science teachers, sometimes even new science teachers. They tried something a little daring with their students, just like you have, then decided to share what they are doing so it can benefit more students.

Writing is hard work, that’s true. But writing to communicate what we’ve planned and used, and describing the outcome is the very best way to improve our own thinking about our practice. You know that if you try something to someone, you learn it more deeply. That is as true for educators and our teaching practice as it is for our students and Moon phases or food webs. Writing makes you a better writer, better speaker, and a better teacher.

And consider that other matter: professional respect. Being a teacher who publishes in a national journal of science education—that’s good for you, your students, and your school. I personally want to see excellent, dedicated teachers being recognized for their good work!

Getting started is the only really hard part. Read a few articles in your journal: This gives you a solid idea of the types of writing the editor is looking for. Think about something you’ve done that fits what you’ve learned. Or imagine something to try that follows what we collectively know about good science education, and plan something wonderful. Then try it for the good of your own students.

And before you write, be sure to read the journal’s Call for Papers and the Guidelines for Authors. These provide some great advice about how to craft a successful submission, and tell you about the journal’s upcoming themes. There are word limits!

When you have finished your manuscript, you’ll be rightly proud. However, before you submit it, share it with someone you know and trust to give you critical feedback. It never hurts, and you always learn something when you take the time to do this.

Sometimes things that seemed obvious to you won’t be to a reader who wasn’t there. This will make your work better and easier to read for all the folks who will want to follow in your footsteps.

Not long after you have pushed the “send” button on our electronic submission system, an editor will read your hard work. If it fits with the journal, they’ll send it to a set of science teachers for suggestions to make it even better. This happens to every manuscript, and it helps us make every article as strong, safe, and useful as possible.

As journal editors, Linda Froschauer (lindo@me.com, Science and Children), Inez Lifig (izenisci8@aol.com, Science Scope), Steve Metz (smetz@nsta.org, The Science Teacher), and I strive to ensure our publications remain a vital part of science educators’ ongoing professional development.

I hope I’ve convinced you to give writing a try. Even brand-new teachers have much to share with the NSTA community. All of us are working to make science education everywhere better. And you never know if your proudly published journal article will quietly wait at the end of someone else’s imagined runway, lifting the wings of a science teacher just taking off on a great new adventure.

Ann Cutler is the field editor of the Journal of College Science Teaching. She teaches chemistry at the college level near Chicago, Illinois. She can be contacted at acutler@nsta.org.
McCUTCHEON Elementary. “Most of the students in that fair are from more affluent schools, and they have the benefit of their parents being able to help them with their projects. Our two students come from low-income families with limited or no English being spoken at home. The [club] mentors helped push our students to higher levels of research and data collection, analysis, and interpretation so that they [could] compete.”

In 2013, Science Club was one of only two programs honored with the Afterschool STEM Impact Award from the Afterschool Alliance and the Noyce Foundation. “We really loved that Science Club, in addition to offering kids valuable science learning opportunities, provides a platform to improve the teaching and outreach skills of future professional scientists. Science Club commits to intensively training Northwestern graduate students as mentors for the after-school program,” says Melissa Ballard, STEM research associate at the Afterschool Alliance. In addition, the support mentors provide for science fair projects “really helps teachers by freeing up classroom time and allowing students much more individual attention,” she asserts.

At NSTA’s National Conference in Chicago, Kennedy and Ballard will be among the co-presenters of the After-School Science: What’s Possible With Partnerships session on March 14.

**Forming a Science Community**

In Pennsylvania, Science Synergy, a student-run nonprofit based at Harriton High School in Bryn Mawr, brings science activities to inner-city schools in Philadelphia. In 2013, Samantha Davis recruited classmates at Harriton who are also active in extracurricular STEM activities to establish Science Synergy, which works with inner-city schools to develop “a science-loving community like that of Harriton,” says Davis. “The feeling of satisfaction and enlightenment I gain from learning science has inspired me to spread science enthusiasm to other people, especially to those who do not have the same resources and opportunities,” she explains.

The Harriton students contacted Meagan Hopkins-Doerr and Jeremiah White Jr.—program director and president/executive director, respectively—at iPraxis, a Philadelphia-based nonprofit “with a similar mission,” Davis relates. “They connected us to the Philadelphia schools that we have been targeting. Our model is to host Science Club Demo Days at the Philly schools to spread science interest and encourage participants to join the Science Synergy clubs. These clubs prepare students for the Science Synergy Invitational—a fun competition…tailored to the abilities of the middle school competitors.”

“Sam asked to share a proposal to work together,” says Hopkins-Doerr. “We weren’t expecting all that much from a junior in high school..., [but] we were so impressed! Sam gave a great presentation on outreach, including [having] Harriton’s Science Club [hold] science outreach events at Philadelphia schools.”

iPraxis agreed to provide support and some funding for Science Synergy in addition to what Harriton could provide, and they and the Harriton students met with teachers from Northwood Academy Charter School and Cook Wissahickon Elementary School, the K–8 pilot schools, to plan outreach events and after-school clubs that would help students in grades 6–8 prepare for the Science Synergy Invitational. Science Synergy “designed the science competition and the activities for the science club,” says Diane Powers, middle school science teacher at Cook Wissahickon. “Since Science Synergy created the activities [including] the material list and lesson plans [see http://sciencesyn.weakly.com], it made it easier for me to start the first science club at my school.”

The competition took place in June 2014 at the Community College of Philadelphia, with 59 middle school students competing and 35 Harriton students leading events such as Toothpick Egg Drop and Aluminum Foil Towers. “Last year, 29 of our students benefitted from their experience with [the competition],” notes Powers. “Many of last year’s students will participate again, and this year, we have many new sixth and seventh graders who want to join the club.”

“It has been a great addition to things we can offer our schools,” remarks Hopkins-Doerr. “Elementary students [at participating schools] have also been exposed to the chemistry, physics, and other demos during the science outreach.” This year, Science Synergy expanded its reach to two more schools, she reports, adding, “We’re hoping to have 100–120 students in this year’s competition.”

### Appealing to Diverse Interests

The S for Science Club at Nashwaaksis Middle School (NMS) in Fredericton, in Canada’s New Brunswick province, caters to many scientific interests. Students can join an Experiment Group, a Physical Chemistry Research Group, a Robotics Group—each with its own workshops, inquiry-based experiments and research projects, and field trips to places like the Atlantic Cancer Research Institute in Moncton or the Dalhousie University School of Medicine in Nova Scotia. S for Science also offers a Feature Films Group, which has produced four feature-length films with trailers and starring student actors. While the films include science fiction, club director Christopher Abbandonato requires students to research and understand the science behind the fiction.

This diversity has paid off. Since 2011, the club has grown from 25 to 160 students, says Abbandonato, who teaches French immersion math and science at NMS. When he founded the club, he recalls he “went class to class to convince students, ‘You’ll play the role of a scientist and be junior scientists.’ That got a lot of students interested.”

Though managing a large student club might seem daunting, Abbandonato maintains, “If I can organize a really good schedule, it flows very nicely.”

The club is funded by $30 annual membership fees. In addition, Abbandonato does community fundraising activities and writes grant proposals. One grant has paid for a math and science education research assistant from St. Thomas University (STU) in Fredericton “to help out with workshops, publications, and big research projects,” he relates. (Abbandonato also teaches math part-time at STU in the Department of Science and Technology Studies/Mathematics.)

Abbandonato says he has leveraged relationships with universities and other local and international partners to obtain supplies and equipment, “get students involved in university lab settings and expose them to scientists” on field trips, and bring scientists to NMS. S for Science was “the first middle school group to run chemistry lab experiments at the University of New Brunswick,” he reports.

“I let the students know that now is the time to get experience in science and technology because you can get scholarships and studentships if you have experience,” he observes. ●

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We Are NSTA!
By Juliana Texley, NSTA President 2014–15

Have you seen NSTA’s social media dashboard (http://bit.ly/1z8KC4S) lately? It offers a glimpse into lively, ongoing exchanges our fellow NSTA members are having on Facebook, Twitter, the NSTA Learning Center’s Community Forums, and the NSTA blog. Whether seeking help, offering advice, or sharing experiences, all are teachers of science, no matter where they go. A synergy develops when we join together—55,000 of the nation’s finest science teachers—with a strength that cannot be denied.

In NSTA’s new strategic plan (http://bit.ly/1f8T0eB), the first set of goals relate to advocacy. These aren’t political targets, but statements that define the importance of educating everyone we meet about the power of science. Communication is recognized by government, staff, and experienced members also constantly advise on a wide range of projects. Our 18 District Directors are especially valuable in these efforts because they know the states and their special issues. As an NSTA member, you are part of that advocacy team and have constant access to their support.

Another great resource for advocacy is our collection of position statements. These documents aren’t casual remarks, but the result of work by our best thought leaders over many months. Position statements undergo several layers of review before board approval. So when a member or local group encounters a thorny issue—such as safety, evolution, climate change, or special needs—NSTA’s resources are there to support advocacy.

Another, “softer” sort of advocacy occurs when we keep teachers informed. NSTA’s Science Matters network does just that. Last fall, I received an e-mail from a teacher in a very small, rural district that told us, in effect, that the Science Matters blasts were among the only contacts that teacher had with other science education professionals. We’ve set a goal of trying to update the technology we use for this important networking function.

But a careful look at the first section of our Strategic Plan suggests we must go further. In the words of an old song, we must be “Takin’ It to the Streets.” To maximize what we can accomplish in our classrooms and informal institutions, we must remember to teach through example and in conversations outside of our assignments, too—24/7!

Often controversies emerge when we forget to share what we do and why we do it. Does the senior citizen across the street understand the power of “three-dimensional learning” compared with a linear, “back-to-basics” curriculum? Does your school board know the limits of objective tests? How about the NGSS skeptic on the corner: Does she know the document comes not from a federal program, but from the work of great teachers in 26 states? Can you help the parent at the playground select a great trade book for a tot and model how to share it? (For suggestions, check out www.nsta.org/publications/ostb to read NSTA’s Outstanding Science Trade Books for Students K–12 annual lists.) This is all advocacy.

Finally, we advocate for students. In April, a core group of NSTA officers will meet with representatives of a dozen other associations to try to organize a national resource center devoted to “Equity Through STEM.” We know countless local projects demonstrate how a rich STEM education can narrow the achievement gap for underserved groups. The challenge for advocates is to assemble the data, the resources, and the rationale so any district can apply these lessons.

In coffee shops, at parks and social functions, and in commerce, we should emphasize scientific practices as tools to empower progress and build a better future. What issues need advocacy in your own community? How can your fellow members support you? Let us know, through your district director or by contacting me directly at juliana.texley@nsta.org. This is why we are members. This is why we are NSTA!
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FlinnPrep™ helps students experience success in science.
Teachers See Benefit in Student Course Evaluations

In a recent informal poll, NSTA Reports asked science educators if their students evaluate them or their courses and what the impact of these assessments is. Although 86% of respondents reported that students do evaluate their teaching at the end of the course or school year, only 31% indicated that the evaluations affect teachers’ careers at their schools. In addition, 59% reported the evaluations are not required by their schools’ administrations. Nearly all (91%) said they would ask students to complete them if they were not required, with 78% claiming student evaluations are helpful in general. Most (61%) kept the student evaluations for their own use, 36% reported sharing them with school or district administrators as part of the performance review process, and 2% said they shared them with department colleagues.

Here’s what science educators are saying about students’ assessments of them:

I use their responses to further reflect on and edit my curriculum, scope and sequence, and pacing guide.—Educator, Middle School, New York
I’ve started to focus more on areas [in which] I consistently get lower marks (such as posting assignments online/returning assignments quickly).—Educator, High School, North Carolina
Reinforced what I thought was going well; forced me to reflect and change things.—Educator, High School, Wisconsin
I use them to evaluate new lab experiences, activities, and speakers.—Educator, High School, Maryland
I look for big trends within the responses, rather than focusing too specifically on individual comments. Occasionally I also receive great reminders about the hidden world of students, the things they feel or think that they don’t share overtly. These glimpses help me [to be] a better, more compassionate teacher.—Educator, Middle School, California
I look for trends and patterns. A lot of positive feedback about some units make me keep [them] the same, and a lot of negative comments about certain units cause me to change [them].—Educator, Middle School, Massachusetts
I am more mindful of classroom management, which I recognized as an area of growth for me, and [which] my students identified as an area of growth for my instruction and my class.—Educator, Middle School, California
[Surveys] helped me match my impressions with actual data. Occasionally reinforced the need for small changes, as well as supplying a dose of humor.—Educator, High School, Institution of Higher Learning, Arizona
I started the year with a survey, and just did it again mid-year with some additional questions based on the initial survey. I’ve learned that students in my classes prefer individual help time in class over any other method of feedback (comments on tests, homework, rubrics, etc.). I also get a sense of their comfort level with me, other students in the class, and the activities that help them learn best.—Educator, High School, Wisconsin
The student feedback is probably one of the most important tools to me. I teach middle school, and I have found [students] to be very honest and caring. The students help me be a better teacher every year.—Educator, Middle School, Missouri
On rare occasions, I receive a very negative one that leads me to reflect on what I might do differently in the future.—Educator, High School, Kansas
Student evaluations/feedback have caused me to shift the way I’m teaching certain subjects. The feedback has also influenced my class policies.—Educator, High School, Washington
When you notice a commonality about suggestions, it makes you step back and reflect on the validity and implementation of the suggestion.—Educator, High School, California
If I had more time, I could [use] the data more, but the data comes back in a format pretty unusable by individual teachers, but in excellent format for district reporting.—Educator, High School, Georgia

Of Little Use

In my first few years of teaching at a given school, the responses were interesting, but after three years or so, the responses became predictable. By observing the students during the year and paying attention, I knew what the overall responses were going to be.—Educator, High School, Institution of Higher Learning, Arizona
These surveys are optional. My top-achieving students do not complete [them]...usually [the only] students [who] complete the survey [are the ones] receiving below-average grades, and the families want to complain and blame. Better option: student feedback after lessons for what was understood and what still needs clarification.—Educator, Elementary, Georgia
[Evaulations are] anonymous. Sometimes, students can be nasty.—Educator, Institution of Higher Learning, Ontario, Canada

Surveys Beneficial

As a professional educator, it is important to constantly reflect and evaluate instruction, and students are the best ones to help you assess your effectiveness. I say all this when evaluations are not punitive, but are instead meant to help improve instruction.—Educator, High School, Indiana
I can hear their concerns [that] they might not bring to me otherwise.
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They also tend to point out content that wasn’t clear during the semester.—Educator, Institution of Higher Learning, Illinois

I evaluate lessons based on their responses, to improve the following year. It also, most of the time, reinforces my choice of careers and that I am doing my very best, as I expect of them.—Educator, High School, Pennsylvania

The fact that I ask for their input is extremely valuable to the students. They know that I value their input, and because of that, they value what I do. It’s a very symbiotic/mutualistic relationship.—Educator, Middle School, Missouri

It shows students the amount of respect you hold for them and their opinions. It also makes the clear statement that they are vital stakeholders in the education process. It provides a completely different perspective that only they can provide.—Educator, High School, Institution of Higher Learning, Michigan

It’s easy to walk into class and start teaching, but I want to know if students are enjoying the class and feel as though they are learning valuable information and skills. In this age where they can find information online, the classroom learning environment must be more than an information delivery vessel. Students help me gauge the level of interest and are able to share their ideas to improve learning.—Educator, High School, United Arab Emirates

Kids will be honest with you in an anonymous survey. They might be afraid to give you honest feedback [in person] about things they don’t like in your classroom that you would be more than willing to change for them if you were just aware of [them].—Educator, High School, Wisconsin

I find the most useful information comes [when] having students respond freely to broader prompts. I love the quantitative nature of multiple-choice evaluations in theory, but I get the most useful information from these free-form responses.—Educator, Middle School, California

Quotable

Anyone who keeps learning stays young.

—Henry Ford, U.S. industrialist (1863–1947)
Discover Great Ideas, Resources at NSTA’s National Conference

Tens of thousands of science educators will converge on the shores of Lake Michigan for “Chicago: Great Lakes/Great Ideas,” the theme of NSTA’s 2015 National Conference on Science Education, March 12–15. The conference will offer opportunities for teachers in every science discipline and at every career stage to learn from one another, as well as from leading experts. Four themes offer pathways for educators wishing to focus their conference experience on these areas: “Natural Resources, Natural Partnerships”; “Teaching Every Child by Embracing Diversity”; “The Science of Design: Structure and Function”; and “Student Learning—How Do We Know What They Know?”

“We have assembled an incredible program that offers an array of professional development opportunities. Our hope is that you not only get answers to your burning questions, but are also able to walk away from the conference with actionable plans for implementing the great ideas and resources you discover,” says NSTA District XII Director Natacia Campbell, who also served as the conference’s program coordinator.

“The overarching goal was to ensure the conference embodies teachers helping teachers grow professionally, while improving science education for all students. Sessions address the Next Generation Science Standards (NGSS), cross-curricular connections, links between formal and informal education, and teaching diverse students.”

Evolution will be among the great ideas explored near Lake Michigan. Keynote speaker Neil Shubin, Robert R. Bensley Professor of Organismal Biology and Anatomy; associate dean for academic strategy, University of Chicago.

Events like the Elementary Extravaganza allow teachers to network with other educators with similar focus areas and share teaching strategies during the National Conference on Science Education.

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Chicago; and host of the PBS series Your Inner Fish, will trace the organs of the human body over millions of years during his keynote address on March 12. Educators from across the country will present approximately 1,200 sessions, delving into the NGSS; the integration of science, technology, engineering, and mathematics (STEM); the development of science, technology, engineering, and mathematics (STEM); and more.

The conference also features presentations by Liam Heneghan (Beasts at Bedtime: Revealing the Embedded Environmental Curriculum in Classic Children’s Literature), Aída Walqui (Next Generation Science Standards and English Language Learners: The Development of Deep and Generative Practice), Peter Exley (The Power of Play), James Pellegrino (Measuring What Matters: Challenges and Opportunities in Assessing Science Proficiency), Stephen L. Pruitt (The Key to Implementing the NGSS: Teachers!), and Samuel E. Dyson (Connected Learning: Emerging Contexts for Deeper Engagement).

Other featured presentations include the Robert H. Carleton Lecture by Jack Rhoton (Building Capacity in Best Practices for STEM Teaching and Learning), the Mary C. McCurdy Lecture by Okhee Lee (The Next Generation Science Standards: All Standards, All Students), the Paul F. Brandwein Lecture by Curt Meine (Teaching Tomorrow’s Conservation Leaders: Lessons From Aldo Leopold), the American Geophysical Union Lecture by Jim White (Abrupt Climate Change—Past, Present, and Future), and the NSTA / Association for Science Education Honors Lecture by Chris Harrison (Exploring Classroom Assessment in Science—From Research to Classroom Practice).

Maximizing the Experience

“In addition to the sessions, we have planned a number of social gatherings and fun learning field trips. We will be celebrating Pi Day, awarding the great work of teachers, touring informal education at its best, and exploring Chicago’s rich culture,” adds Campbell.

While the educational opportunities are the conference’s primary attraction, attendees also benefit as they develop relationships with fellow science educators. Networking opportunities include events such as the Elementary Extravaganza, Meet Me in the Middle Day, and a chance to meet NSTA chapter and district directors in the exhibit hall on March 13. On March 14, a.k.a. Pi Day, NSTA President Juliana Texley will host a Pi Day Celebration for preservice and new teachers and first-time conference attendees, as well as a Celebration of Einstein’s Birthday for all attendees.

Beyond the conference center, attendees can choose to explore Chicago with a scientific eye during nine educational field trips. Destinations include the FermiLab, to explore neutrino science; the Brookfield Zoo; the Argonne National Laboratory; and the Peggy Notebaert Nature Museum. Educators who can start their conference experience on March 11 will have an opportunity to delve deeply into the NGSS during NSTA’s Professional Development Institutes (PDIs). Three sessions—Moving Standards Into Practice: Five Tools and Processes for Translating the NGSS Into Instructional Sequences and Classroom Assessments; Designing Effective STEM Lessons Incorporating NGSS: What Does It Look Like?; and Leadership for the Next Generation Science Standards’ Practices of Science—will offer one or two days of optional pathway sessions for further exploring the topics. Three one-day work sessions also focus on the NGSS: Developing Next Generation Science Assessments; Promoting Equity and Alignment to the NGSS in Curriculum and With Teaching Using the EQUIP and the EQUALS Rubrics; and Building STEM Capacity With NGSS: Addressing Science and Engineering in the Next Generation Science Standards. PDIs require pre-registration; additional ticket prices apply.

For more information on the 2015 National Conference on Science Education—including a conference preview, session browser, and registration information—visit www.nsta.org/chicago. National conference attendees can earn graduate credit from Framingham State University. For details and a registration form, visit http://bit.ly/1ESgkpO.
There is an “overlap in what is good support for science learning and for dual language learners” that Kimberly Brenneman, PhD, finds really exciting. At the National Institute for Early Education Research (NIEER) in New Brunswick, New Jersey, Brenneman has been studying how learning science content can enhance preschoolers’ English language skills.

“Our goal has been to work with teachers on the pedagogy,” she says. “What we found is that what is good science teaching…is good strategy for engaging dual language learners: linking learning experiences to [students’] prior knowledge.”

With support from a National Science Foundation grant, NIEER has been working with preschool educators in New Jersey who teach high numbers of dual language students and providing professional development (PD) focused on science and math pedagogy, including how to create hands-on learning experiences and incorporate materials students can manipulate. The work has concentrated on developing PD including workshops, coaching protocols, professional learning communities, and more. A lesson on food might focus on how orange juice is made from oranges, with discussion of the process. The next day’s lesson on making applesauce from apples would build on and reinforce the vocabulary from the previous lesson, all within a familiar real-world context.

Brenneman notes they are building on earlier research that showed English Language Learners (ELLs) in the upper grades benefited from learning language in a science context. “Children are learning a rich vocabulary in context with experiences,” she explains. “Preschoolers have no problem with science. They don’t think it’s boring. We take advantage of that,” Brenneman confides. “Our belief is we’ve got really young kids; every child is learning a language; some are learning two. Science experiences are terrific for supporting all kids as language learners.”

In Massachusetts, Jess Gropen, a lead researcher at the Education Development Center, is preparing to launch the first phase of the Literacy and Academic Success for English Learners through Science (LASErS) program in the fall. In its first year, LASErS will focus on preK ELL students in the Hartford Public Schools (HPS) and Capitol Region Education Council (CREC) districts in Connecticut. In Fall 2016, the program will expand to include kindergarten students, then first graders the following year. LASErS is funded by the U.S. Department of Education’s Investing in Innovation Fund (i3).

“The core idea is language is essential to science. We’re trying to make the most of that in a variety of different contexts,” remarks Gropen. LASErS will provide PD to ELL educators and extend students’ science experiences into their homes and communities. In partnership with the Connecticut Science Center, LASErS will host school-based family nights in which families will move through various stations to actively explore science concepts and practices, and talk about it" and develop materials for science activities students can do at home. In addition, families will be encouraged to visit the Connecticut Science Center, particularly during summer capstone events that will tie in with what the students have studied during the school year. “One of the important aspects is we’re focused on helping kids and families have conversations about science in their home languages,” Gropen asserts. “Just having extended conversations…will help
them build conceptual knowledge, help expand [their] language skills.

“Being bilingual should be an asset. We’re trying to help ELLs use that,” he adds. “This is about higher-order literacy skills that support comprehension and reading for understanding, the ability to make sense of discourse, the ability to understand and participate in extended conversations, and the ability ultimately to read or write extended passages.”

Through PD programs for educators in the HPS and CREC districts, LASErS staff will be “building their capacity. By the end of this project, they will be doing their own professional development. We won’t be there, so we want them to be able to sustain this work,” Groppen says. Ultimately, he hopes LASErS will be able to “figure out what we learned and what we need to do to scale [LASErS] to the rest of Connecticut.”

Placing language in context within science also helps older ELL students. Mantas had a student who had relocated to Troy, New York, from Puerto Rico and knew very limited English. Through a combination of technology, support from a Spanish-speaking fellow science teacher, and a willingness to reflect on what worked, Mantas was able to provide a rich experience for this student.

In addition to receiving vocabulary support from the school’s ELL teacher, Mantas’ student used a Spanish-edition textbook and kept a science notebook in his first language. Formative assessments that allowed him to sketch a phenomenon were one way she was able to gauge his progress. “As long as he could explain [the material] in his own way, we took it as he understood and could be successful with it.”

Mantas used web- and software-based translators to provide supplemental materials in Spanish, attended seminars on teaching ELLs, and made “a lot of phone calls to a lot of publishers” seeking appropriate materials. She also learned that some attempts to be proactive had “confused him more” during conversations with the student to assess what techniques were helping him.

“It’s tricky, but when you realize they get it and are successful, it’s incredibly rewarding not just for them, but on the teacher side of it, too,” Mantas declares.

Beverly Kutsunai tackled a different type of ELL challenge when she worked with the Pan Pacific Program at the Punahou School’s Wo International Center in Hawaii. The teenage students from around the Pacific wanted to improve their English language skills, which ranged from upper-elementary to college level. She created a place-based science curriculum for the month-long program, taking advantage of the volcanic islands’ geologic history, geographical features, varied microclimates, and unique ecological relationships.

“Place-based learning has amazing science applications that are real-world links to purposeful learning...Students can observe and gather data with direct experience, [and] organize and share this information to find relationships and investigate the interactions in the systems that surround them. Language and the arts are the communication tools for them to share their ideas and build their understanding,” she states.

“They created daily journals with assignments and reflections...They wrote weekly compositions and created beginning and ending group oral presentations based upon their work. These were the formative and summative assessments. Science was the vehicle to give focus to their purposeful learning of language,” Kutsunai recalls.

“I felt building the learning with direct experiences in a place-based science focus would include the development of the language...to express the learning,” Kutsunai says. “It works well with my primary learners who are learning their first language as young children. I am pleased to say it worked well with the high school learners and their teachers as well!”

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Science on Stage

Acting out science concepts benefits students because “kids enjoy getting up and moving, being that particular concept, expressing it through emotion and movement,” says Judith McDonald, associate professor of science education at Belmont Abbey College in Belmont, North Carolina. In addition, “it engages a part of their brain that helps them recall what they learned,” and “[immerses] them in creative thinking and problem solving,” she maintains.

During visits to K–2 classes in her area, McDonald says she noticed science was not being taught much because many teachers lacked the both content knowledge and the necessary supplies and equipment. Working with colleague Jill Bloede, assistant professor of fine arts, she says she developed some ways to incorporate drama in science lessons “that take little to no materials and use easily acquired stuff.” She has helped elementary methods students and teachers create lessons in which children act out the carbon cycle, the water cycle, or earthquakes, for example.

After the earthquake lesson, a fifth-grade teacher told her that 85% of her students answered a question about earthquakes correctly on a standardized test. “The proof is there for me,” she asserts. “Even just 10 minutes of drama in a science lesson is so effective because every single child can be a part of it and express and share what they’re learning.”

McDonald notes that shy students may need to watch a dramatic activity first before they perform it. “Allow them to watch and encourage them to participate…Don’t force them, [though],” she suggests. “From what I’ve [observed], the kids see how much fun [others are having], and they’ll want to join in, when they’re ready. You’re going to get a much more genuine participation from [those students]; they’ll learn more.”

In a playful approach to chemistry, Rebekah Cordeiro, an Honors/AP Chemistry teacher at Westlake High School in Atlanta, Georgia, creates skits and role play scenarios for her students. She has developed skits based on topics like energy, thermodynamics, phase changes, and gas laws and had students play Red Rover to illustrate the breaking of chemical bonds. “They like to do elementary-style activities like these because it gives them a break and engages them in the topic,” she reports.

One group of students demonstrated the decomposition reaction by role playing the breakup of the pop group Destiny’s Child, for example. Cordeiro has also assigned students to portray various chemical compounds, then determine which compound they could bond with as a “dance partner.” She challenges her AP students to find a chemical/partner to form a precipitate and “stay together forever…kind of like a love story.” Students also have discussed chemical reactions (“divorces”) while pretending to appear on The Jerry Springer Show.

“If it’s a really hard concept, sometimes they need to do it to understand it,” she maintains. “I don’t think there’s a deeper way for students to understand something than when doing role play.”

Wendy Gem says her seventh graders at Pinnacle Classical Academy in Shelby, North Carolina, “are getting exposed to advanced science, things that are still in research,” as part of her integrated science, technology, engineering, and math (STEM) and drama project. “They’re being exposed to the tremendous amount of possibilities [in science] and [the idea] that science is just as interesting as science fiction,” she asserts. One rationale for the project is that “some scientists have said they were inspired by science fiction, and went into [the field] for that reason,” she observes.

Gem’s project theme “revolves around water shortage and contamination in the future...[My students] are looking at technologies that are in research right now and getting ideas they could use in a play or video,” she relates.

One group is researching futuristic fabrics that could be used for costumes; another is studying various types of environments and how plants adapt to them as possibilities for scenery; and another group is exploring lorikefia, a recently discovered phylum of microscopic marine sediment-dwelling animals that can attach themselves to grains of sand, and imagining how they could be weaponized using a blow gun. “These are real organisms they’ve never heard of or seen before,” Gem points out.

While the students are using their imagination to create the piece, Gem emphasizes that all their ideas “have to have that science base behind them.” She adds, “They’ve surprised me: They’re associating colors with water deprivation.” The students are very enthusiastic about the project. “They even want to stay after school to work on it,” she reports.

Using Gestures and Movement

The Wildlife Conservation Society in New York City provides professional development courses for teachers featuring activities combining science and drama. In the Predators: Biology and Conservation course, for example, teacher groups perform mini-dramas showing four critical points in a tiger’s life: courtship, hunting, parental care, and poaching. The actors are silent because “silence allows [teachers] to be dramatic, creative, and outside their comfort zone a bit,” says Amanda Lindell, director of professional development for educators.

“So many teachers have English-Language Learners (ELLs) who struggle with science and language arts. When they don’t have to express themselves in words, it is easier for ELLs to contribute,” Lindell notes. Teachers of special-needs students also find these techniques effective, she points out.

Tips From the Pros

“Make sure the [dramatic] activity demonstrates what you want, from a scientific point of view,” McDonald advises. For teachers new to incorporating drama, she suggests trying out a lesson with colleagues first as a dress rehearsal. She also recommends connecting with fine arts teachers, the staff of children’s theaters, and university students majoring in drama to get ideas and tips.

“Students have to feel that they can be goofy without being scolded,” counsels Cordeiro. “Have a conversation with your administrators, and let them know what will happen in your class” to avoid any misinterpretation of the acting, she suggests.

For students in the audience, “have a worksheet or exit ticket” to ensure they pay attention to “the learning aspect,” says Cordeiro. Follow performances with a quiz or ask students questions about what they watched to ensure retention, she adds. ●
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Freebies for Science Teachers


**Getting the Picture: Our Changing Climate.** The adventures of scientist-photographer James Balog and the Chasing Ice team come to life in this climate science education resource at [www.gettingthepicture.info](http://www.gettingthepicture.info). Targeted for middle and high school students, the interactive, multimedia experience presents the latest developments in climate science through lessons featuring animations, time-lapse videos, and firsthand accounts from research scientists. Lesson topics explore climate science basics, glacial ice, the role of water in climate change, the effects of climate change on plants and animals, the impacts of climate change on people and society, and action steps to address climate change. The site includes a glossary of climate science terms and links for students and educators.

**Museum of Natural History, Virtually.** Want to take students to the Smithsonian Museum of Natural History in Washington, D.C., but find the cost and logistics of the trip impossible? Now you can visit the museum for free without leaving the classroom! At the website [www.mnh.si.edu/panoramas](http://www.mnh.si.edu/panoramas), students can take a room-by-room walking tour of the museum from their desktop computer or mobile device. Browse a list of past exhibits (e.g., Geology, Gems, and Minerals; Fossils; Egyptian Mummies; Bones; African Voices), then navigate to the room of choice by clicking its location on a map or by following blue arrow links on the floor. In the desktop version, camera icons highlight hotspots to click for a close-up view of a particular object or exhibit panel.

**The Ultimate STEM Guide.** You’ll find 239 science, technology, engineering, and mathematics (STEM) links and resources for K–12 students, divided by age and interest, at [http://bit.ly/1CJL7pp](http://bit.ly/1CJL7pp). Compiled by Mastersindatascience.org to generate excitement about STEM everything, especially careers, the website features games and apps, contests, awards, career resources, and opportunities. Highlights include GeoWalk: 3D World Factbook (elementary), an app that piques students’ curiosity about places around the globe; iON Future, a game exploring STEM careers (middle level); and Planet Connect Student Grants (high school), which offers grants of up to $1,000 to implement projects or participate in wildlife and natural resource-themed internships.

**Science Forward.** Produced by Macaulay Honors College and City University of New York Advance, Science Forward offers grants of up to $1,000 to implement projects or participate in wildlife and natural resource-themed internships.

**Endangered Species Day: May 15.** K–12 teachers can find a toolkit and other student-friendly resources to celebrate Endangered Species Day and help spread the message of the importance of protecting endangered animals at [http://bit.ly/1vbpiPn](http://bit.ly/1vbpiPn). In addition to fact sheets with background information about endangered species, teachers can download lesson plans incorporating the use of Endangered Species Playing Cards, as well as an Endangered Species Slideshow (and script) featuring images of animals needing protection. Educators can also watch videos and read articles from teachers describing various ways they have incorporated the teaching of endangered animals into their classrooms.

See Freebies, pg G2
Blaze and the Monster Machines. In Nickelodeon’s new television series, children ages 3–6 follow the adventures of eight-year-old A.J. and his incredible monster truck, Blaze, as they solve challenges and explore STEM concepts. Each action-packed episode is filled with monster trucks, physical humor, and songs highlighting scientific principles such as adhesion, friction, force, trajectory, and magnetism. Blaze encourages viewers to think about how things work and why they work that way, thus helping students to develop critical-thinking skills and understand how engineering and technology can provide solutions to everyday problems. You’ll find videos, a curriculum, and activities at http://at.nick.com/16uKWT5.

Kindle Direct Publishing for Educators (KDP EDU). This resource from Amazon.com helps K–college educators and authors of every age prepare, publish, and promote eTextbooks and other educational content for students to access on a range of devices, including Fire tablets, iPad, iPhone, Android smartphones and tablets, Mac, and PC. (See http://kdp.amazon.com/edu.) Educators can use the Kindle Textbook Creator to turn PDFs of their textbooks and other course materials into Kindle books—complete with features such as flashcards, dictionary lookup, highlighting, and notetaking. Once the book is ready, teachers can upload it to KDP in a few simple steps.

Habitat. Promote ecologically sustainable habits among elementary students (ages 7–12) with this educational app from Elevator Entertainment (see www.habitatgame.com). Using the app, students adopt an endangered animal (i.e., a virtual polar bear) and must keep it happy and healthy. Students earn points through games and by completing real-life “missions,” like recycling or “checking in” at national parks, zoos, and other iconic sites worldwide. In addition to promoting outdoor activities, the game encourages students to reduce their carbon, water, and land use and shows their impact through an ecological footprint calculator. An accompanying Sustainability Learning Guide provides classroom lessons on ecological footprinting, animals and their habitats, alternative energy and renewables, climate science, and more.

Fly to Learn: Aviation Education Resources. Introduce upper-elementary (grades 4–5) and older (grades 6–9) students to STEM topics through the curriculum and resources (e.g., lessons, videos, PowerPoint presentations) at http://bit.ly/1HW1fpp. This program enables students to fly virtual aircraft and learn about energy and forces in the process. Students engage in the engineering process as they modify existing aircraft designs to improve aircraft performance and use math and graphs to predict performance and make informed design decisions.

Elementary Chemistry Experiments. Check out Education World’s kid-friendly chemistry experiments for the elementary level at the website http://bit.ly/1DrzDVX. The experiments—meant to spark interest in chemistry and teach students about scientific methods—require only inexpensive materials and can be done easily in the classroom or at home. Titles include Water Molecules on the Move, Baking Soda and Vinegar Chemical Volcano, and Color Splash.

Journal of Emerging Investigators (JEl). At http://bit.ly/1EYCIkf, an open-access journal publishes original research in the biological and physical sciences written by middle and high school students. jEl enables students, with guidance from a teacher or advisor, to receive feedback on their research and to publish their findings in a peer-reviewed scientific journal. Sample papers include What’s in a Name? Do Labels Influence People’s Liking for Cookies? (middle level) and Does Gaming Improve Cognitive Skills? (high school). The site also has a Featured Scientist tab, where student authors describe their experiences conducting and publishing research.

Common Core and the Arts. The J. Paul Getty Museum and Teaching Channel have produced a video series highlighting innovative strategies that integrate the arts into Common Core State Standards and other subjects. In the video collection, educators from various grade levels, subject areas, and contexts share the creative ways they are using art to help students gain and express understandings. For example, Studying Balance in Art and Science shows how elementary students can learn to make claims about the health of an ecosystem based on observations of a painting. Access the website http://bit.ly/1HAIUjC.

Guidelines for Biosafety in Teaching Labs. Developed for use in undergraduate labs, but also appropriate for use in high school and other lab environments, these guidelines present best practices for safely working with microorganisms in a laboratory setting. The guidelines were developed by the American Society of Microbiology, in conjunction with the Centers for Disease Control and Prevention, in response to serious microbiological contaminations in teaching labs that could have been avoided. In addition, teachers can watch a webinar to help them integrate the recommended and required practices into their teaching laboratories. Find both guidelines and webinar at http://bit.ly/1BKFT1o.

Desmos Graphing Calculator. This online calculator has many uses in science and math settings, from graphing functions, plotting tables of data, and evaluating equations, to exploring transformations and more. Desmos.com is also available as a smartphone app. Read the Desmos blog for tips and ideas for using the calculator in the classroom. See www.desmos.com.

Fruit and Vegetable Fact Sheets. These fact sheets from the University of Nebraska-Lincoln Extension’s Nutrition Education Program provide information about 30 fruits and vegetables. At http://bit.ly/1CXoBHy, each sheet includes an illustration of the fruit or vegetable along with nutrition information, uses, description, varieties, and where the fruit or vegetable was first cultivated. The sheets could be incorporated into K–12 biology, health, or nutrition lessons or shared with students’ families to help promote healthy eating habits.

Bird Quest. This booklet from Cornell Lab of Ornithology’s BirdSleuth program helps K–12 students participate in citizen science bird projects by guiding them through six challenges using resources from eBird. The tasks include getting comfortable with eBird citizen science, using online resources to find your state bird, looking for birds that fit into different groups, practicing bird counting and entering data online, extracting data from eBird about local birds, and taking action to improve bird habitat in your area. See http://bit.ly/1BKFT1o.
According to new analysis, a national grant program designed to recruit top talent into the teaching profession is falling short of this goal. The Teacher Education Assistance for College and Higher Education (TEACH) grant program, established six years ago, awards grants to top students who enroll in high-quality teacher preparation programs and commit to teaching in a low-income school and high-needs field for at least four years. However, if grant recipients leave the profession within four years, can’t find a job in the field, or are terminated, the grant immediately converts to an unsubsidized loan.

Through public records and information obtained via the Freedom for Information Act, nonprofit think-tank Third Way found that since the program’s inception, nearly 40% of students who received these grants have had their grants converted to unsubsidized loans. The Department of Education predicts ultimately three out of four TEACH grants will meet this fate.

In addition, most TEACH grants aren’t awarded to students at top-tier teacher prep programs, as intended. Instead, most go to students at low-performing or for-profit online universities, such as Grand Canyon University and National University—both of which have dominated the funding received since TEACH’s inception. Fifty-eight percent of the nation’s lowest-performing teacher prep programs are using these funds to recruit teachers.

The Obama Administration has proposed that low-performing teacher prep programs be banned from using TEACH grants. And the organization that performed the analysis recommends that the program loosen some of its restrictions on the grant and that the federal government consolidate all of its teacher-specific loan programs into one that would make monthly loan payments for teachers once they start teaching. Read more at the website http://bit.ly/165rJXI.

In a study of 17 schools in four states, the Center for Education Policy found that while added instructional time may help improve academic achievement, more robust teaching and teacher collaboration prove more effective. The study followed low-performing schools required to add time to their school day or school year because of federal funding they received to boost performance. In Oregon, for example, one school added 30 minutes to the school day and three weeks of summer school; another offered after-school enrichment paired with eight extra Saturdays during the school year for those who needed to improve their grades or demonstrate proficiency in reading, writing, and math to graduate. Teachers at these schools also collaborated to develop more accurate assessments of student learning to help provide students with the level of instruction they really needed.

Principals in the study said the added collaboration and instructional focus helped their students, not the extra instructional time. One Oregon principal contends, “When people are looking at improvement for schools, I don’t think that (lengthening the school day or school year) is the central strategy. I think it is a peripheral strategy.”

She continues, “I think the two things that make the most sense to really focus on are the instruction that happens in the classroom during the school day—the quality of that instruction—as well as safety nets for when kids are falling through the cracks.” Learn more at http://bit.ly/1CHIQe6.

A new collaboration between NASA and Microsoft will allow scientists to work on Mars—virtually. Existing software allows scientists to examine Mars on a computer screen, but the images lack the natural sense of depth we use to visually understand spatial relationships. The new software, called OnSight, will employ wearable holographic technology. OnSight uses rover data to create a 3D simulation of the Martian environment, allowing scientists worldwide to explore that environment together when they’re wearing OnSight devices. Learn more at http://1.usa.gov/165PfUx.

An Association of American Colleges and Universities (AAC&U) report finds that most employers give recent college graduates very low ratings in the broad learning and crosscutting skills identified as crucial to long-term success in the workplace. The report summarizes two surveys: one of business and nonprofit leaders and the other of college students, who consistently rate themselves better prepared than employers do. The study found both groups agree on the five most important college outcomes: written and oral communication, teamwork skills, ethical decision making, critical thinking, and the ability to apply knowledge in real-world settings. But only about a quarter of employers found recent college graduates well prepared in these areas.

Most employers (87%) also indicated they would be more likely to hire students who had completed a significant applied learning project before graduation, regardless of their major. In line with this expectation, the AAC&U announced a new Liberal Education and America’s Promise (LEAP) challenge for two- and four-year institutions. The challenge asks colleges to give students the opportunity to experience “signature work,” or projects related to a problem important to the student and to society. This might include a research, creative, or community-based project conducted over the course of at least one semester. Learn more about LEAP by visiting the website http://bit.ly/1Euybpt and about the report at http://bit.ly/1CTXijB.

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National Earth Science Teachers Association
Events at 2015 Chicago NSTA Conference

All NESTA sessions are in the Hyatt Regency McCormick Place, Skyline W375e unless otherwise indicated

Friday, March 13

➢ 8:00 – 9:00 am  Earth Science Rocks! Using Earth Science Activities to Engage Students as Scientists
➢ 9:30 – 10:30 am  NESTA Geology Share-a-Thon
➢ 11:00 am – noon  NESTA Climate, Ocean and Atmosphere Share-a-Thon
➢ 12:30 – 1:30 pm  NESTA Earth System Science Share-a-Thon
➢ 2:00 – 3:00 pm  Harnessing the Power of Earth System Science for Developing Science Practices and Crosscutting Concepts
➢ 2:00 – 3:00 pm  American Geophysical Union Lecture, “Abrupt Climate Change: Past, Present and Future” by Dr. Jim White, University of Colorado, McCormick Place, Skyline W375b
➢ 6:30 – 8:00 pm  Friends of Earth Science Reception (see www.nestanet.org for more info)

Saturday, March 14

➢ 8:00 – 9:00 am  Multimedia Tools and Classroom Resources for Teaching Earth System Science
➢ 9:30 – 10:30 am  Using Data in the Earth and Space Science Classroom to Engage Students as Real Scientists
➢ 12:30 – 1:30 pm  NESTA Space Science Share-a-Thon
➢ 2:00 – 3:00 pm  How Weird Can it Get? Developing Weather and Climate Literacy
➢ 3:30 – 4:30 pm  NESTA Rock and Mineral Raffle
➢ 5:00 – 6:00 pm  NESTA Annual Membership Meeting

National Oceanic and Atmospheric Administration (NOAA)

Ocean Exploration Curriculum
Our ocean’s landscape ranges from tropical underwater volcanoes to the Arctic Ocean floor, and is home to organisms from bioluminescent corals to deep-vent worms. Educators can bring the excitement of ocean science research to middle level and high school students with NOAA’s Learning Ocean Science Through Ocean Exploration: A Curriculum for Grades 6–12 at http://1.usa.gov/18FF6Ph. The lessons in this interdisciplinary, inquiry-based curriculum address topics such as the geologic formations that cut across expeditions (seamounts, ridges and banks, canyons and shelves, and mid-ocean spreading ridges), using models to understand structures and functions, and using scientific data in the classroom to model scientific work and thinking. An accompanying website gives teachers and students a direct connection to the scientists whose work they are modeling in the classroom.

Ocean Science Resources
At http://1.usa.gov/1DkcBjp, teachers can find education resources on ocean science topics, organized by theme. Most appropriate for middle and high school levels, each theme page provides links to content essays (background information), lessons, multimedia activities, career information, and images from associated past research expeditions. For example, the Seamounts (ancient underwater volcanoes) page contains a profile of Tim Shank, a deep-sea biologist who participated in several research missions studying underwater volcanoes. Related classroom lessons include Mapping Deep Sea Features (middle level) in which students create 2D and 3D maps of underwater volcanoes, and Watching in 3D (high school), in which students learn how multibeam sonar uses the properties of sound waves in water to study the topography of the ocean floor.

Other theme pages explore Archaeology, Deep-Sea Corals, Deep-Sea Canyons, Mesophotic Corals, and Vents and Volcanoes. More themes are expected soon: Look for pages on Cold Seeps, the Arctic, and Bioluminescence.

National Institutes of Health (NIH)

Native Voices Website
NIH’s National Library of Medicine has resources to help you teach students about Native American health, medical beliefs, and ties to the environment. The website Native Voices: Native Peoples’ Concepts of Health and Illness (http://1.usa.gov/1Dltr1c), which complements an exhibit of the same name, describes the ways indigenous people work with the environ-
ment to preserve it, show respect for all living things, and harness the power of indigenous plants to help heal disease.

Resources include a timeline of Native history, K–12 lesson plans incorporating exhibit materials, suggested readings, online activities, and news stories relating to Native American health issues. The site has video interviews with health professionals, community leaders, traditional healers, and others working to improve the health of native peoples. Teachers can incorporate these materials into their science, health, and social studies classes.

Library of Congress (LOC)
Understanding the Cosmos e-Book
Have your students ever traced the orbits in Copernicus’ map of the solar system? Zoomed in on Galileo’s drawing of the Moon? Compared different ways of looking at the skies from across 700 years? An interactive LOC e-book makes all this possible.

This new Student Discovery Set, Understanding the Cosmos: Changing Models of the Solar System and the Universe, lets anyone with an iPad explore astronomers’ models of the cosmos as they evolved over several centuries, with images from the LOC’s collections. Interactive tools let students of all ages zoom in for close examination, draw to highlight details, and make notes about what they discover.

Download this e-book for free on iBooks. Learn more at http://1.usa.gov/1L4ZGrf. For a blog post about how a library media specialist used the e-book with fifth graders, see http://1.usa.gov/1CYG3LI.

U.S. Environmental Protection Agency (EPA)
EPA Digital and Print Materials
Looking for an educational, technical, or scientific resource? EPA’s National Service Center for Environmental Publications (http://epa.gov/nscep) offers more than 66,000 digital and 1,500 free print materials. Educators can search the database using the keywords “science education” or “environmental education” to find relevant documents. Click on Materials for the Classroom to access annotated order forms listing materials grouped by grade range (K–3, K–12, Elementary School, Middle School, High School, and General Information for Teachers). Each form has a picture of the item, title, brief description of the item, and the quantity limit that can be ordered.

Materials include posters (e.g., “Pack a Waste Free Lunch” and “Sunwise Sun Safety Tips,” for grades K–12); publications (e.g., Create Less Waste in the First Place [elementary]; Science Fair Fun: Designing Environmental Projects for Students in Grades 6–8 [middle level]; and You Can Make a Difference: Learn About Careers in Waste Management [high school]); and general resources for teachers (e.g., Planet Protectors Club Activity Calendar for Teachers).

National Aeronautics and Space Administration (NASA)
SciJinks Adventures
Meet Theo, a curious kid with a taste for science and hijinks (a.k.a. SciJinks!), and Bill, his serious-minded groundhog and mentor. They are characters in SciJinks Adventures, a web comic series highlighting weather phenomena and featuring a revolving cast of intrepid weather explorers. The latest addition to SciJinks, NOAA and NASA’s kid-friendly weather website for middle level students and teachers, the comic keeps students engaged while providing links to site content.

For example, in the first adventure, Theo builds a robot from recycled materials and brings it to life using energy from lightning. The storyline includes links to content about getting started on a science fair project and facts about how lightning works. Read the comic at http://scijinks.jpl.nasa.gov/comic1.

Field Trip to Mars
Students can explore Mars through NASA’s downloadable virtual field trip (http://quest.nasa.gov/vft), an immersive multimedia application that supports student exploration of areas on Earth identified as analog sites to regions on Mars. Analog sites are those areas that share some common traits with sites on Mars and have been identified based on their significance and importance to NASA. Most appropriate for use with middle and high school students, users navigate around the site selecting various objects and clicking on scientists to learn more about how and why this site was chosen, how it relates to Mars, and why it is of interest.

NASA Apps
“App” up your smartphone, iPad, tablet, or other device, and “amp” up your science knowledge in the process with these apps showcasing the range of activities and projects at NASA. From Deep Space Exploration missions to the solar system to commercial spinoffs resulting from NASA research projects, educators will surely find something of interest here. Many apps can be used in K–12 learning environments.

For example, NASA TV allows students of all ages to share in live events taking place at NASA; elementary students can learn about the process of launching through Kennedy Space Center’s Launch Services Program Activity Book; and middle and high school students can explore lunar to-topography with the Moon Tours app. Access the list, which is organized by topic, at http://1.usa.gov/16f96bU.

U.S. Department of Agriculture (USDA)
Farm to School Efforts Video
In Healthy Habits Take Root—Engaging the Community in Farm to School Efforts, the fifth in a five-part series, Farm to School practitioners nationwide talk about how they engage their entire communities in creating a healthier next generation, and describe who the most unlikely partners—corporations, state departments of agriculture, and other unexpected groups—have turned out to be. The short video aims to inspire educators to get involved in Farm to School efforts, like planting and harvesting school gardens, so that students understand where their food actually comes from. Watch the video at http://bit.ly/1xb0KNB.

U.S. General Services Administration (GSA)
Career Spotlight: Physical Therapists
In this video, three physical therapists from Walter Reed National Military Medical Center share how a love of sports and science can be combined in a physical therapy career. See how the physical therapists work to help injured military personnel. The video was produced by the GSA’s Office of Citizen Services and Innovative Technologies and is available on the kids.gov web portal at http://1.usa.gov/1tUFmqX.

Centers for Disease Control and Prevention (CDC)
Science Ambassador Program
In this program, middle and high school educators collaborate with CDC scientists to develop challenging and innovative public health–based lesson plans. The lessons—available at http://1.usa.gov/1EA4xiu—are produced during a five-day workshop each summer and provide a real-world focus to concepts taught in many biology classrooms. Past lessons include Have You Heard About Immunity (middle level), which uses hands-on activities to teach students how immunizations protect people from vaccine-preventable diseases and why some people are not immunized, and Focus on This: The Biology of ADHD (high school), in which students review and strengthen their understanding of neuron physiology and neurotransmission, and connect these concepts to attention-deficit/hyperactivity disorder (ADHD).●
**ACS Dorothy and Moses Passer Education Fund**
The American Chemical Society (ACS) provides this grant to support continuing education activities for teachers at two- and four-year colleges and universities with no advanced degree programs in the chemical sciences. Grants support activities that directly relate to the recipient’s teaching and take him or her off campus. Applicants must be full-time faculty members at their college or university and members of the ACS Division of Chemical Education. Apply by April 1; consult [http://bit.ly/1E19Q7i](http://bit.ly/1E19Q7i).

**NiSource Charitable Foundation Grants**
The NiSource Charitable Foundation provides these grants to encourage volunteer support and benefit communities in which NiSource employees and customers work and live in Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New York, Ohio, Pennsylvania, Tennessee, Texas, Virginia, West Virginia, Wyoming, and Washington, D.C. Nonprofit organizations with programming in the following areas are eligible: learning and science education, environmental and energy sustainability, community vitality and development, and public safety and human services. Apply by April 1; consult [http://bit.ly/1EZGQxx](http://bit.ly/1EZGQxx).

**NMEA’s Marine Education Award**
This award from the National Marine Educators Association (NMEA) recognizes outstanding work and leadership in marine education at the local, regional, or national level. It can be presented to members or nonmembers of NMEA for current or past accomplishments. Nomination letters should describe the candidate’s leadership and career accomplishments in the field. Award winners receive a one-year NMEA membership and an engraved award. Submit nominations with letters of recommendation by April 1; visit [http://bit.ly/1LAe2QE](http://bit.ly/1LAe2QE).

**ACS-Hach Second Career Teacher Scholarship**
The American Chemical Society (ACS) awards this scholarship to working chemists who want to pursue a master’s degree in education or become certified as a chemistry or science teacher. Awardees receive up to $6,000 for full-time study and up to $3,000 for part-time study. Funds can be used for tuition, books, room and board, and other education-related expenses and may be renewed for up to three years.

Applicants must have a bachelor’s degree or higher in chemistry or a chemistry-related field, at least one year of work experience in a chemistry-related profession, and be a U.S. citizen or permanent resident. Apply by April 1 at [http://bit.ly/Vca6sZ](http://bit.ly/Vca6sZ).

**ACS-Hach High School Chemistry Grant**
The ACS also provides grants of up to $1,500 to high school chemistry teachers who want to enhance the learning in their classrooms, foster student development, and spark interest in the field. Funds can be used for lab equipment and supplies, instructional materials, professional development, field studies, or science outreach events. See [http://bit.ly/10T6LG0](http://bit.ly/10T6LG0). Apply by April 1.

**ACS-Hach Post-Baccalaureate Teacher Scholarship**
The scholarship is awarded to recent graduates and professionals with limited work experience who are interested in becoming secondary chemistry teachers. In addition to being U.S. citi-
Dorothy Stout Professional Development Grants
The National Association of Geoscience Teachers (NAGT) provides these grants for faculty and students at two-year colleges and K–12 teachers who wish to
• participate in Earth science courses or workshops;
• attend a professional scientific or science education meeting;
• participate in Earth science field trips; or
• purchase Earth science materials for classroom use.

The scholarship can be applied to tuition, books, room and board, and other education-related expenses. Candidates must apply online by April 1 at http://bit.ly/1DCSltt.

McCarthey Dressman Student Teaching Scholarships/Mentoring
These one-year scholarships are awarded to preservice educators in their final year of a teacher education program at New Mexico State University; the University of California, Santa Cruz; The University of Texas at Austin; or Stephen F. Austin State University. The scholarship provides $6,000 of financial support and one-on-one mentoring from an exemplary teacher. Full-time students in elementary or secondary education with good academic standing may apply at the website http://bit.ly/19Tcfqc by April 15.

McCarthey Dressman Teacher Development Grants
These grants are available for individuals or small teams of teachers who want to develop and implement groundbreaking K–12 instruction. Projects should incorporate fresh teaching strategies that encourage critical inquiry and allow teachers to observe their effects on students. Recipients reflect and write about their projects and share their results with other teachers.

Grants of $10,000 per year for a maximum of three years are available for licensed K–12 teachers in public or private schools who have the background and experience to implement their projects successfully. Apply by April 15; visit http://bit.ly/1BM6d9J for details.

Westinghouse Charitable Giving
Westinghouse gives grants of up to $5,000 to nonprofit programs supporting science, technology, engineering, and math (STEM) education, environmental sustainability, or community vitality. Within these areas, the company encourages programs that aid the disadvantaged, the young, and those with disabilities. Recipients must be located within 100 miles of Westinghouse sites in Goodyear, Arizona; San Jose, California; Windsor, Connecticut; Burr Ridge and Lake Bluff, Illinois; Rockville, Maryland; Hutchinson and Shoreview, Minnesota; Hematite-Festus, Missouri; Newington and Portsmouth, New Hampshire; Charlotte, North Carolina; Blairsville, Churchhill, Cranberry Township, Madison, New Stanton, and Warrendale, Pennsylvania; Columbia, Rock Hill, and Spartanburg, South Carolina; Dallas and Glen Rose, Texas; Chattanooga and Memphis, Tennessee; Richland and Seattle, Washington; Washington, D.C.; and Ogden, Utah.

Submit proposals by April 15; consult http://bit.ly/MukoVU.

The Snapdragon Book Foundation Grants
Snapdragon provides funds to improve school libraries for disadvantaged children. In a time when many schools are reallocating their funds to technology and audiovisual equipment, Snapdragon wants to ensure that school libraries are still offering children high-quality books. Any school library that serves disadvantaged youth may apply. Grants will be awarded to public, private, and experimental schools.

Grants have ranged from $800 to $20,000. Schools should plan to spend all of the grant money on traditional books. When applying, schools should request the exact amount that the project requires. Though at times Snapdragon may be unable to fulfill the complete request, the foundation can offer a partial grant.

Applications must be submitted by April 18. For more information, go to www.snapdragonbookfoundation.org.
Discoveries in Geosciences Field School. This field-based professional development program allows K–12 teachers to work alongside scientists at an active geological and paleontological research site in Hell Creek, Montana. The program provides 20 teachers with lesson plans, resources, and access to field samples to use in their classrooms after the program, as well as increased confidence in their ability to teach Earth science and evolution.

The field school will be held July 30–August 3 and covers food, scientific equipment, and transportation after teachers arrive in Hell Creek; continuing education credits are also available. Apply by March 22; learn more at http://dfgfieldschool.org.

Library of Congress Summer Teacher Institute for Primary Sources in Science. The institute is open to K–12 teachers and school librarians who want to focus on critical thinking and literacy skills in the sciences, the nature of science, scientific practices, lives of scientists, the historical context of scientific discovery, and the use of primary sources to explore these topics in the classroom. Teachers will develop lessons for their classes with library education specialists and collections experts from the Library of Congress (LOC).


Chesapeake Bay Foundation (CBF) Courses. Spend part of your summer exploring the mountains of Virginia, the rivers of Pennsylvania, and the islands of the Chesapeake Bay in one of CBF’s summer professional learning courses. You will explore schoolyard habitats, land-use issues, and inquiry-based learning techniques for both inside and outside the traditional classroom. This professional development opportunity will give you the tools to build your students’ environmental literacy with a rigorous, interdisciplinary approach.

Participants will take home an array of lessons that can be incorporated into the school curriculum. Courses take place from June through August at locations in Maryland, Pennsylvania, Virginia, and Washington, D.C. Learn more at http://bit.ly/1zdydRc.

Modeling the Molecular World. This workshop, taking place July 6–10 and hosted by the Center for BioMolecular Modeling at the Milwaukee School of Engineering, connects the macroscopic world students live in with the invisible world of molecules. It begins with the basic principles of chemistry and focuses on proteins. Participants will learn how to design protein models that can be built using 3D printing technology and how to lead a Science Olympiad Protein Modeling or a Students Modeling A Research Topic (SMART) team at their school. Apply online at http://bit.ly/1fAv7AF.

Math and Science: Skills and Strategies to Adapt for English Learners Institute. This institute will provide teachers with strategies and activities to support English learners while they simultaneously learn math and science concepts and develop their language skills. Strategies are applicable for newcomer students, students with limited or informal education, bilingual learners, and students with intermediate and advanced proficiencies in English.

The institute takes place August 3–4 at the CAL in Washington, D.C., and is open to ESL and classroom teachers working with preK–8 students. Educators who support these teachers are also welcome; collaborative teaching teams are encouraged. For details, visit http://bit.ly/1zdG1sk.

Sea Camp Summer Internships for Teachers. Texas A&M University at Galveston sponsors internships for school teachers, counselors, 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. Each internship is a week-long adventure and learning experience for interns as they learn alongside campers while acting as chaperones.

Internships are available in marine biology, fishing, coastal photography, biology of the sea turtle, ornithology, and more. After completing the program, interns receive between 7 and 32 continuing education credits. Lodging and meals are provided.

Sea Camps run from June 8 to August 8; dates vary by program. Apply online at http://bit.ly/1fWiTc.
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Immersing Students in Authentic Research

How can teachers give students authentic research experiences? One answer, according to Jeff Goldstein, director of the National Center for Earth and Space Science Education (NCESSE), is the Student Spaceflight Experiments Program (SSEP; see http://ssep.ncesse.org). Launched in 2010 by the NCESSE and NanoRacks, LLC, a company that provides launch services to low-Earth orbit, SSEP was created as a model U.S. science, technology, engineering, and math (STEM) education initiative. The program gives about 300 students—from grades 5–12 to community college and university levels—in participating communities a chance to design and propose real microgravity experiments to fly in low-Earth orbit aboard the International Space Station. “Every community is getting their own real space program,” says Goldstein.

SSEP “grows organically from the Next Generation Science Standards (NGSS),” he contends. “NGSS is really about recognizing that science—and more generally, STEM—is a process,…and it’s more reflective of how scientists and engineers actually [work], as opposed to simply teaching science as a book of content knowledge that students need to know by a particular grade level.”

Communities receive “a real microgravity research mini-laboratory that has real operational constraints on how it’s used,” he maintains. Students can design experiments “across a wide array of science disciplines, whether they’re physical, chemical, or biological systems under study,” Goldstein explains.

“Students are being asked to be real microgravity researchers in every sense of the word,” he asserts. They have to write research proposals in which students must “justify why their research program ought to be chosen;…that’s exactly how professional researchers secure research assets,” he points out. “And once they come up with results, they can convey through poster presentations and oral presentations at conferences what their findings are…They have their own research conference at the Smithsonian National Air and Space Museum.”

Interested communities must “submit a formal implementation plan (describing) what their strategic needs are in STEM education and how this program helps address those needs,” he relates. Another requirement is funding. “We decided to take the precedent-setting step of trying to find a consortium of funders for a community to get them aboard if the community doesn’t have the financial capability to make it happen,” says Goldstein. “Of the 132 community programs we’ve done thus far, [SSEP has found full or partial funding for more than] 100 of them…We have 25 communities that are now on their second, third, fourth, fifth, and even sixth flight opportunity in just four-and-a-half years.”

And teams not selected for flight “still can do their ground truth experiments,…and report out on experiment design and protocol, data and analysis, and results, and hypothesize what they might have seen in a microgravity environment, and why they think that,” Goldstein points out.

SSEP’s flexibility allows it to serve many types of communities. “It could be a single large school; we’ve had a high school and its feeder middle schools; we’ve had a middle school and feeder elementary schools as a community. We’ve had an entire school district at a particular grade level. We’ve had a museum or a science center as the lead, working with a network of master STEM teachers that they had already in place. In the case of American University, they’re leading a consortium of seven [Washington, D.C., metropolitan universities, engaging undergraduates studying to be science teachers,” he reports.

Eric Day serves as community program director for the Washington, D.C., Space Grant University Community. He says SSEP “has strengthened [the undergraduates’] foundations in science and math. Investigating and developing microgravity experiments to fly in low-Earth orbit and be conducted in a weightless environment required lots of reading, research, and lab experiments. But going beyond that, it has given them invaluable real life experience similar to what professional scientists go through…Rarely, if ever, are undergraduate students afforded a research opportunity of this significance. It gives them a real edge when they get to include a program like this on their resumes.”

“When they become K–12 STEM teachers, they can take this incredible experience directly into their classroom and serve as role models and mentors as their own students learn about STEM and participate in SSEP. They have gained a priceless experience that you cannot learn in a classroom lecture,” he concludes.
Since the Oscars were presented on February 22, readers of this column likely know which film was selected for Best Animated Feature. As I write this, however, I only know that The Boxtrolls was one of five films nominated in this category. I think it is worth noting that The Boxtrolls is the only one of the five produced through stop-motion animation, rather than drawing or computer-generated graphics.

Based on a young adult novel, Here Be Monsters (2005) by Alan Snow, the film introduces us to a steampunk-inspired alternate reality populated by “boxtrolls.” Boxtrolls are shy, secretive creatures that live beneath the town of Cheesebridge, sometime in the 19th century. They leave their subterranean homes only after dark, when they scour the town looking for items to re-purpose into fantastic contraptions. When walking, their heads, arms, and legs protrude out of cardboard boxes. When frightened, they pull in all their extremities to hide, looking just like abandoned boxes. Despite their relatively innocent way of making a living and shy nature, their reputation among the people of Cheesebridge is much more sinister.

Archibald Snatcher (voiced by Ben Kingsley) is the exterminator most responsible for spreading the rumor that boxtrolls are bloodthirsty child kidnappers. He uses the disappearance of an infant, the Trubshaw Baby, as a pretense for eliminating the boxtrolls. Snatcher has in fact made a bargain with Lord Portly-Rind, head of the White Hat council that runs the town. If Snatcher can rid the town of boxtrolls, he will be given a White Hat and invited to join the town council.

Snatcher uses all manner of tools to catch boxtrolls, but it takes him nearly 10 years to get close to catching them all. Over this same period, a boxtroll named Fish has been raising a young boy they call Eggs. (Could he be the Trubshaw Baby?) The group’s members take whatever is printed on the side of their boxes as names, so Fish and Eggs are friends with Shoe and Fragile.

The boxtrolls sleep during the day, arranging themselves into a cube-shaped stack to take their rest. As the stack consists of 5 by 5 by 5 (5x5x5) boxtrolls, we know it must contain 125 boxtrolls in the stack. I am almost always surprised just how quickly cubic numbers get bigger. (Doubling each side of a cube makes a cube with eight times the volume and mass, since 2x2x2=8.) The animators don’t seem to be aware of this math, though, as they appear to cap the number of boxtrolls in any one scene at about 50. I leave it as an exercise for the reader to determine how many boxtrolls remain in the 3x3x3 stack we see later in the movie.
I can’t quite tell when the movie is set, though some sources claim 1805 as the period. If that is the creators’ intention, then the film has an anachronism, as corrugated cardboard was not patented in England until the 1850s, and was not widely used until the early 20th century. The incandescent light bulbs and electric toaster are also problematic. However, Snatcher’s steam-powered vehicles are not out of the question for the early 19th century, as the first steam locomotive was successfully tested in 1804. I understand that Here Be Monsters is similarly confusing, as it includes bicycles (which were not invented until the 1880s) and even radio.

Archibald Snatcher longs to be part of the elite White Hat council that runs Cheesebridge, but he suffers an unfortunate allergy to— you guessed it— cheese. Food allergies are a real and potentially deadly problem for millions of people worldwide. Allergic reactions can be thought of as the immune system overreacting to what should be a minor irritant. Proteins are usually the trigger for an allergic reaction, which can include runny nose, watering eyes, skin rash (hives), and swelling or inflammation. If the swelling is significant, and occurs in the throat, breathing can become difficult or even impossible. Repeated exposure to the same allergen usually causes a stronger reaction each time.

In The Boxtrolls, Snatcher’s allergic response to cheese is certainly plausible: His face and lips swell dramatically, and each exposure causes a worse reaction. As part of its Food Allergies: Game On exhibit, the Pacific Science Center has gathered some online resources on global food allergies and recent research at http://bit.ly/1zGbLQK.

I was surprised that the treatment for Snatcher’s swelling shown in the movie is also fairly reasonable: leeches. Historically leeches were used to remove blood as a way to “balance the humors,” which modern science doesn’t support. However, leeches are making a bit of a medical comeback: Doctors are using them to reduce swelling, and to encourage blood flow in skin grafting procedures. If you care to learn more (and see a leech snacking on the presenter’s arm), check out this video at http://bit.ly/1HqZ7ZW.

Science teachers with an interest in steampunk or 19th-century history could use The Boxtrolls to connect with their younger students, and to motivate the imaginative reuse of materials. The film includes some fairly realistic depictions of a food allergy and an opportunity to talk about multiplication and cubic numbers as well.

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.
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Data in Categories: Nominal-Level Data

Data that are in categories without any obvious order or sequence are known as nominal-level data. As an example of nominal-level data, if a student wanted to compare the sleep habits of cats and dogs, the data she or he collected to compare their sleep habits would be at a nominal level.

Nominal data are usually recorded in a table as shown in Table 3.1.

<table>
<thead>
<tr>
<th>Pet</th>
<th>Dogs sleeping</th>
<th>Cats sleeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Avg.</td>
<td>7.4 hours/day</td>
<td>8.2 hours/day</td>
</tr>
</tbody>
</table>

Nominal-level data are often represented in a bar graph. Although in some disciplines pie graphs are used with nominal data, they are much less common in science publications.

When we plot the raw data onto the graph, the graph looks different, and two things are obvious. First, there is an outlier cat who might really be distorting the arithmetic average for the cats overall. Second, even including that outlier cat in the data set doesn’t change something that becomes very clear when looking at the raw data: the data for the cats overlaps that for the dogs quite a lot.

Why is this overlap important? Because scientists draw their conclusions based on the means and the dispersion of the data around the means. A statistical test on this data would probably conclude that there is no statistical difference between the amount of time cats and dogs sleep. This is different from the typical school science conclusion that there is a difference between how much cats and dogs sleep because the means are different. In science, one usually only draws conclusions about means when the dispersion is considered.

So the variable is “type of cup,” which is a nominal-level variable.

Using an 11” × 17” piece of paper, draw a baseline about 10 cm from the bottom of the page. Along the baseline, put three marks to represent the center of the leading edge of each of the three cup types. Label the ticks by type.

Have students place the first cup behind the line centered on the tic and align a ramp system behind the opening in the cup. You might want to have the students describe the controlled variables and list those on the board. Then demonstrate collecting data: Roll the marble down the ruler and into the cup, and mark where the leading edge of the cup stops. Do this several times until you have a cluster of tics.

Once students have been walked through one example of recording tics or had it demonstrated from the front, they can work independently on collecting their own data. They should repeat the activity for all three types of cups.

### Representing the Data

Students do a number of things to interpret the data. First, have them draw a circle that incorporates all, or at least most, of the data tics. Have them place a large dot in the middle of the circle to represent a type of average that approximates a median (or middle) value.

You can introduce the concept of variation and how it exists because of natural differences in populations or because of other variables that weren’t being controlled effectively. You could have the students examine the lips of the cups with a hand lens. Students will often identify that the foam cup lips are smooth, whereas the lip of the foam cup has a bit of texture. Ask the students to speculate about the effect of a smooth edge versus a rough one when sliding across a surface. Often the students’ data will show that the circle for the foam cup is larger than that for the other types, and perhaps this roughness is why.

As the final step in representing the data, have your students take the ruler and place the middle of one end on the center dot in each circle with the other end extending vertically down to the baseline. Have the students trace the ruler’s outline down to the baseline.

If you rotate the figure, it looks more like a traditional bar chart.

So you can see that the students have created, without measuring, counting, numbers, or mathematics, a bar graph representing their data.

### Interpreting the Bar Graph

Usually the data circles for the paper and plastic cups are a slightly different distance from the baseline, and the data circle of the foam cup is usually much farther from the baseline (and is also larger, representing greater variation in the data for that type of cup). Students typically approach interpreting the data by concluding that the different cups traveled different distances. This is consistent with how students are usually taught to interpret bar graphs that represent averaged data.

But is that what scientists would conclude?

Determining which distances are significantly different from one another requires comparing both the distances and the amount of data variation. In this instance, the foam cup traveled a significantly farther distance from the baseline than did the paper or plastic cups. However, because of the amount of overlap of the plastic cup and paper cup data circles, it is more difficult to conclude that the paper and plastic cups traveled different distances. Therefore, a more scientifically correct conclusion would be that the foam cup traveled farther than the paper and plastic cups, but the paper and plastic cups slid more or less the same distance.

By having students do a comparison of the size of the circles and the amount of overlap, they learn the foundations of analysis of variance statistical tests. Drawing a conclusion like this is more scientifically accurate partly because it allows the use of what is called hedging language to indicate how certain they are about what they’ve figured out from their data.
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“Attending an NSTA conference was one of the most influential experiences I have had since becoming a teacher. Attending an NSTA conference should be a requirement for every teacher. I could not wait to get back to my classroom to implement the incredible ideas I had been immersed in at the conference.”

“The experience was absolutely unbelievable. Not only did the experience positively impact me, but it has influenced fellow teachers as well as increased my students’ excitement for science.”

“I am extremely grateful to NSTA for giving me the opportunity to attend one of the greatest professional development opportunities available for elementary science teachers. I grew so much professionally while at the conference, and I implemented many of the strategies I learned at the conference as soon as I returned to my classroom. My students and I have both benefited greatly from this opportunity.”

FOR INFORMATION AND UPDATES, VISIT www.nsta.org/conferences
I like to consider my classroom as a partnership with the students. So this year (my first year), the students were able to choose their own teams for cooperative learning and lab activities. This worked out in some cases, but some teams don’t seem to get much accomplished. They’re often off-task and unfocused. Should I switch to assigning students to teams?

—C., Illinois

Your goal of establishing partnerships with the students is a good one. But as the adult responsible for safety, curriculum, and ensuring an appropriate learning environment, you are the majority partner. (Actually, in terms of safety, you should be a benevolent dictator!)

Questions about cooperative learning groups appear frequently on NSTA e-mail lists and in discussion forums. Questions about group composition and interaction of student personalities frequently arise. Most teachers would agree there is no single “best” way to establish groups.

You could use random assignment. As the students work in these groups, you can observe how combinations of personalities work: who the leaders, the slackers, the thinkers, the doers, the organizers, and the creators are; which students need closer supervision; which combinations of students’ personalities clash; and which students struggle with the activities.

I hesitated to use student-selected groups. Usually, friends wanted to work with friends socially, and I was concerned about the students chosen last or not at all (remembering my own experiences as a non-athlete at recess). I also was concerned students wouldn’t learn how to work with a variety of people. But recognizing the need for students to have a voice in the classroom, I tried a variation in which students could give me a note with the name of one person they would like to work with, without consulting each other. I then structured the groups to try to accommodate their choices, with no guarantees. I had input, too, based on my observations.

Some teachers suggest grouping students by ability. I’m not sure how to determine science “ability”; I suspect teachers use factors such as reading or math test scores, grades, work habits, or behavior. I found that heterogeneous grouping worked best for my classes most of the time.

Once I did put four slackers together. After a while, they realized that they did not have much accomplished, and no one was going to bail them out! And sometimes if I had multiple students intensely interested in one topic, I would have them work together.

Other student variables should be considered. Depending on your students, you may find single-gender groups provide more opportunities for student participation. If your class includes special education students, determine their needs in terms of their Individual Education Plans.

Perhaps the issue is not the structure of the groups, but whether students know how to work cooperatively.

Defining roles is a key component of cooperative learning so the students share responsibility for learning. The roles may vary from task to task: group leader, presenter, data recorder, measurer, equipment manager, liaison (to ask questions of the teacher or other teams), artist, online researcher, questioner, timekeeper, notetaker. Have job descriptions for each role (as checklists or on the bulletin board), and ask students to describe how they and their teammates did their jobs (this could be an exit activity). Rotate the roles to give students a variety of experiences. Be sure each student understands his or her role.

To keep the groups focused and on task, students should understand the expectations for the project or investigation. Share the rubric ahead of time. Monitor the groups as they work, provide feedback, and eavesdrop on their discussions and observe their interactions (this can be a formative assessment).

You may have students who struggle with interpersonal skills. Start with brief and highly structured activities. Model what cooperative behavior “looks like,” and help them understand what type of language is appropriate in their groups. Remember, there are times when cooperative learning is effective, times when large-group instruction is appropriate, and times when you want students working independently.

So if your current strategy is not facilitating student learning, you should change it and discuss your reasons with the students. This provides a great opportunity for action research as you try different configurations or guidelines and note which ones seem to work better for your students.

Our principal just informed us that the science department budget will be decreased for next year. It’s already bare bones, so my colleagues and I are interested in finding other funding sources such as grants. What do we need to know to get started?

—G., Oregon

In a perfect world, schools and teachers would all be funded adequately to provide the highest quality education for our students. As we wait for this to happen, you won’t be the only one looking for external funds to supplement a shrinking budget, and many agencies and organizations are themselves facing reduced resources.

You and your colleagues should discuss your needs and make some decisions as you begin the process. Your needs may include “everything,” so you should prioritize them into categories such as equipment, safety, instructional materials, professional development (including conferences), field trips, technology, and more. Discuss your needs assessment and how meeting those needs will improve student learning. Very few organizations or agencies will write blank checks, so this will help you match your needs with potential funders’ missions.

Differentiate between donations and grants. Donations are straightforward gifts, often very modest, with few strings attached, and often from more local organizations. Grants from large foundations or government agencies usually focus on projects for a particular purpose or audience and have requirements spelled out in a formal contract that must be signed by a school official. These requirements may include periodic progress reports, a formal evaluation component, student learning data, and an itemized budget. They are...
usually competitive. As a grant writer, I found that the larger the grant, the more strings are attached.

Finding potential sources is another challenge.

If your school or district has a grant writer or special projects coordinator, he or she may be able to assist. Check the high school yearbook or sports program to see what local businesses, individuals, or agencies are willing to support schools through donations. Some parents may have ideas, too.

Colleagues on the NSTA e-mail lists have used DonorsChoose.org to post online requests for project funds. You may want to look at the Science category to see how others are framing their requests.

Share resources from the Science Teachers’ Grab Bag from NSTA Reports at your department meetings. This pull-out section includes Freebies for Science Teachers, What’s New from U.S. Government Sources (such as the National Oceanic and Atmospheric Administration, U.S. Geological Survey, and the National Science Foundation), and the In Your Pocket column (with information on grants, awards, fellowships, and competitions). NSTA’s online Science Education Events and Programs calendar (www.nsta.org/calendar) also contains information on grants and other ways for obtaining funding. NSTA conferences usually include sessions on grants, too.

If you decide to seek grant funding, you may have to define and refine your goals and needs to meet the grant description. Few grants will fund “brick-and-mortar” projects (construction or remodeling); basic items that schools/districts should provide, such as classroom furniture or consumables (unless they are part of a more comprehensive project); or items unrelated to student learning.

Depending on the funding source, you may need to describe your needs more comprehensively. For example, say, “We want to include more hands-on learning in science to help students attain the Next Generation Science Standards,” rather than simply stating, “We need microscopes.” The broader statement puts the microscopes into a larger context and can be used in other proposals in a coordinated effort. Too often I’ve seen schools take a patchwork approach to grants, with no focus or master plan. Their projects may even be at cross-purposes and create extra work for teachers. If you align your proposed activities with the school/district/department strategic plan, you’ll have a coordinated rationale for further proposals.

Give yourself enough time to gather data, create a budget, assemble supporting documents (if required), and get the correct signatures on the forms (in some districts, requests must be sent or approved by the central office). Ask someone to proofread the proposal or request, and follow any guidelines on length, formatting, the submission date, and the inclusion of extra materials.

If you receive a donation, be sure to write a thank-you letter (or better yet, have the students write letters), and include photos of how the funds are benefitting your classes.

Above all, don’t be discouraged if some of your proposals are “rejected.” (I have a whole collection of unfunded proposals.) You’ll have a lot of competition, but when your request is funded and your work results in good things for students, it’s a great feeling!

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.

Tap into the incredible network of the National Science Teachers Association with the NSTA Science Supply Guide. Powered by MultiView, the Guide is the premier search tool for science educators. Find the supplies and services you need, within the network of the association you trust.

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www.nstasciencesupplyguide.com / www.nsta.org
March 18—Overwhelmed by the thousands of free resources on The NSTA Learning Center? Find out how to make the most effective use of the site during The NSTA Learning Center: Free Professional Learning Resources for Educators, a free NSTA Web Seminar for K–12 educators unfamiliar with all the Learning Center has to offer. Participants receive a free Sci Pack (an online, interactive learning module valued at $18), a certificate of participation, and 100 Learning Center activity points for attending and completing the post-program evaluation. The session runs at 6:30–8 p.m. Eastern Time (ET). For more information or to register, visit http://bit.ly/Eo1MU.

March 27—It’s your last chance to register as an early bird for NSTA’s STEM Forum & Expo, May 20–23 in Minneapolis, Minnesota. Early bird registration for members costs $175; on-site member registration, $215. For more information and to register, go to www.nsta.org/confreg.

April 15—It’s never too early to delve into science, technology, engineering, and mathematics (STEM)! Educators of young learners (ages three through preschool)—whether they are in a day care setting, Head Start, or public or private prekindergarten programs, or are parents—can learn how to foster children’s conceptual learning and tap into their curiosity about the world during STEM Starts Early: Guidance and Support From the NSTA Early Childhood Science Education Position Statement, a free NSTA Web Seminar. The session runs at 6:30–8 p.m. ET. For more information or to register, visit http://bit.ly/Eo1MU.
NSTA members recently elected Mary Gromko as the association’s 2016–17 president. A science educator from Colorado Springs, Colorado, Gromko has served the association in several capacities, including as a district director, program chair for area conferences, and as a member of the Urban Science Committee. She is also a former president of the Colorado Association of Science Teachers. Gromko taught high school chemistry for 17 years, then worked as a Colorado state science supervisor and a district science coordinator before joining the University of Colorado faculty as a professional development coordinator for science, technology, engineering, and mathematics.

Also elected to the NSTA Board of Directors were Jennifer S. Thompson, Preschool/Elementary Level Director; Kenneth L. Huff, Middle Level Director; Dennis Schatz, Informal Science Director; and Eric Brunsell, Professional Development Director.

In addition, NSTA members in six districts elected directors to represent them on the Council. They are Doug Hodum, District II (Maine, New Hampshire, Vermont); Mary L. Loesing, District IV (New Jersey, New York, and Pennsylvania); Dennis Alan Casey, District VIII (Kentucky, Virginia, and West Virginia); Shannon Hudson, District X (Indiana, Michigan, and Ohio); Jennifer Gutierrez, District XIV (Arizona, Colorado, and Utah); and Camille T. Stegman, District XVI (American Samoa, California, Guam, Hawaii, and Nevada). NSTA Board and Council members serve three-year terms. For more information about NSTA’s leadership, visit www.nsta.org/about.

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