

This article originally appeared in the November 2013 issue of *Book Links* magazine.



Earlier this year, the National Research Council released the much-anticipated Next Generation Science Standards. Educators in 26 states collaborated with a team of 41 writers to develop the standards. The authors emphasize that science understanding is key to making our way in the world. Whether we are making decisions about our health care, attempting to understand current events, or learning to perform new jobs, science knowledge plays an important role in our ability to succeed.

These standards differ from those in the past in significant ways. Traditionally, science standards have focused on core content related to the physical, life, and earth sciences. The new standards, though, include an additional set of core ideas categorized as “engineering, technology and applications of science.” In the National Research Council’s document outlining the standards, *A Framework for K–12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, the difference between the work of scientists and engineers is explained. The major goal of scientists is to develop or further develop current theories that “can explain bodies of data and predict outcomes of further investigations.” An example of this is detailed in Sandra Markle’s *The Case of the Vanishing Golden Frogs: A Scientific Mystery*. A biologist discovered a large number of dead frogs in Panama and engaged in research with other scientists to determine the cause and discover a cure. Engineers use their knowledge of science, math, and engineering design to solve problems that “arise from a specific human need or desire.” An excellent illustration of engineers at work is Marc Aronson’s *Trapped: How the World Rescued 33 Miners from 2,000 Feet below the Chilean Desert*, which recounts how engineers designed and implemented ways to save the workers trapped below the earth. This feat required an understanding of geology, mathematical computing, and the design of powerful drills.

Another important shift in the Next Generation Science Standards is the adoption of the term *practices* instead of *scientific method* or *skills* to describe the work of both scientists and engineers. The standards’ authors believe that traditional implementation of the scientific method in classrooms has only focused on a narrow set of lockstep procedures—ask a question, conduct background research, construct and test a hypothesis, analyze data, and draw a conclusion. As a result,

other practices, such as modeling, critiquing, and communicating, have been marginalized, and the iterative process of practice has not been established. The practices of scientists and engineers, requiring coordination of skill and knowledge, can be categorized into three spheres of activities: investigating, evaluating, and developing explanations and solutions. Each sphere of activity requires a multitude of other skills, such as asking questions, using mathematical and computational thinking, observing, arguing, collaborating, imagining, modeling, and more. As scientists and engineers engage in practice, they continuously apply content knowledge, and the use of twenty-first-century technology is an integral component of their work as well.

Although the authors of the standards emphasize the need for science and engineering education to be hands-on, reading nonfiction books for youth about the work of these professionals can greatly enrich learning. The titles in the bibliography below create vivid pictures of the day-to-day practices of scientists and engineers as well as the larger purpose of their work.

For nearly 15 years, the excellent *Scientists in the Field* series has opened windows for readers onto the real-world practices of scientists and engineers in fields such as oceanography, biology, and genetics. The books are filled with large, high-quality color photographs and, as needed, additional features to scaffold for understanding. Several notable titles from the series are included below, including Sy Montgomery’s *The Quest for the Tree Kangaroo: An Expedition to the Cloud Forest of New Guinea*, which was listed as a fourth-grade exemplar informational text in “Appendix B” of the Common Core State Standards.

In addition to titles from the *Scientists in the Field* series, the following bibliography also emphasizes the work of Sally M. Walker, who is the author of dozens of carefully researched nonfiction books for youth. Walker has found a particular niche in writing about how the work of archaeologists and forensic anthropologists contributes to what we understand about historical people, places, and things.

When students read trade books like those listed below, a real-world picture of what they have been studying in the classroom emerges. This cohesive and coherent vision of science and engineering at work reinforces the purpose of learning.

Scientists and Engineers at Work

Bomb: *The Race to Build—and Steal—the World’s Most Dangerous Weapon*. By Steve Sheinkin. 2012. 272p. illus. Roaring Brook/Flash Point, \$19.99 (9781596434875); e-book, \$49.99 (9781596438613). 623.4. Gr. 7–10.

This multi-award-winning title offers a fast-paced, thrilling narrative about the Manhattan Project. Sheinkin details how

Oppenheimer strategically recruited scientists with varying areas of expertise to work at the Los Alamos laboratory on plans for an atomic bomb. Only through collective thinking, critiquing, and continuous trial and error were the teams able to pursue completion of this—and other—daunting tasks.

The Case of the Vanishing Golden Frogs: A Scientific Mystery. By Sandra Markle. 2011. 48p. illus. Millbrook, lib. ed., \$29.27 (9780761351085); e-book, \$21.95 (9780761379836). 597.8. Gr. 4–6.

In this title from veteran science writer Markle, clear text and sharp photographs introduce Project Golden Frog. In 1996, biologist Karen Lips noticed a significant drop in the population of Panamanian golden frogs, and she determined to discover the cause of their deaths. In 1998, scientists from around the world gathered in Panama to analyze the problem and critique possible solutions.

Citizen Scientists: Be a Part of Scientific Discovery from Your Own Backyard. By Loree Griffin Burns. Illus. by Ellen Harasimowicz. 2012. 80p. Holt, \$19.99 (9780805090628); paper, \$12.99 (9780805095173); e-book, \$9.26 (9781466809161). 590.72. Gr. 3–6.

Citizen science is the study of the world by the people who live in it. In this attractive title, Burns introduces readers to children and adults, scientists and nonscientists, who study nature in an effort to learn more and save particular species of animals.

The Elephant Scientist. By Caitlin O’Connell and Donna M. Jackson. Illus. by Caitlin O’Connell and Timothy Rodwell. 2011. 80p. Houghton, \$17.99 (9780547053448); e-book, \$17.99 (9780547574011). 599.67. Gr. 6–9.

While working with local Namibians to solve the problem of elephants destroying their crops, O’Connell, an American scientist, observed elephants stopping and purposefully leaning forward on their front feet. This *Scientists in the Field* title details how O’Connell and her colleagues employed the use of technology to discover how elephants can recognize callers and receive important messages through the ground.

The Hive Detectives: Chronicle of a Honey Bee Catastrophe. By Loree Griffin Burns. Illus. by Ellen Harasimowicz. 2010. 80p. Houghton, \$18.99 (9780547152318); paper, \$8.99 (9780544003262); e-book, \$8.99 (9780547488127). 638. Gr. 6–10.

In 2006, a beekeeper discovered that his hives were completely empty; 20 million bees had disappeared. Other beekeepers had the same story to tell. This *Scientists in the Field* title describes how scientists joined with the beekeepers to investigate what has come to be called colony collapse disorder (CCD).

Invincible Microbe: Tuberculosis and the Never-Ending Search for a Cure. By Jim Murphy and Alison Blank. 2012. 160p. illus. Clarion, \$18.99 (9780618535743); e-book, \$18.99 (9780547822686). 616.9. Gr. 6–10.

In their introduction, the authors reveal that by 1850, it is believed that 75 to 90 percent of earth’s human population had TB. After detailing a history of TB and failed attempts to find a cause and cure, Murphy and Blank move into a historical narrative of the cooperation between physicians, microbiologists, pathologists, sanitarium workers, public-health-care workers, policymakers, and many others to find a cure. The current existence of a new drug-resistant TB makes the lessons learned from the past all the more relevant today.

The Many Faces of George Washington: Remaking a Presidential Icon. By Carla Killough McClafferty. 2011. 120p. illus. Carolrhoda, lib. ed., \$20.95 (9780761356080); e-book, \$15.71 (9780761371571). 973.4. Gr. 7–9.

In pursuit of life-size representations of Washington at the ages of 19, 45, and 57, a team of historians, scientists, engineers, and artists shared and applied their expertise. In alternating chapters, McClafferty describes the life of the first U.S. president at particular ages and then the work of this team to create accurate representations.

The Mighty Mars Rovers: The Incredible Adventures of Spirit and Opportunity. By Elizabeth Rusch. 2012. 80p. illus. Houghton, \$18.99 (9780547478814); e-book, \$18.99 (9780547822808). 523.43. Gr. 5–8.

In 2003, two rovers were sent to Mars to discover if water had ever existed there. Their miraculous landing and six-year journey is a spectacular achievement. What surfaces repeatedly in this excellent *Scientists in the Field* title is the consistent need for scientists and engineers to imagine, build models, and engage in simulation.

Quest for the Tree Kangaroo: An Expedition to the Cloud Forest of New Guinea. By Sy Montgomery. Illus. by Nic Bishop. 2006. 80p. Houghton, \$18 (9780618496419); paper, \$8.99 (9780547248929); e-book, \$14.99 (9780544115644). Gr. 5–8.

Montgomery and Bishop’s award-winning entry in the *Scientists in the Field* series follows researchers on a grueling expedition in Papua New Guinea to track the rare Matschie’s tree kangaroo. Montgomery gives an unusually strong, visceral sense of the work and cooperation fieldwork entails and the scope and uniqueness of this particular mission. As usual, Bishop’s color photographs are exemplary and extend the excitement in stunning close-ups of creatures and of the team at work.

Secrets of a Civil War Submarine: Solving the Mysteries of the *H. L. Hunley*. By Sally M. Walker. 2005. 64p. illus. Carolrhoda, \$18.95 (9781575058306). 973.7. Gr. 7–10.

During the Civil War, the *H. L. Hunley* was the first submarine to successfully sink an enemy ship. However, the submarine failed to return. In 1995, under the supervision of underwater archaeologists, a team of divers discovered the *Hunley* buried three feet under the ocean floor. Engineers created a sling that would carry the *Hunley* to the surface, and conservators created a fresh-water-tank environment to avoid oxidization and further deterioration of the submarine and its contents. Then, a crew of archaeologists, conservators, geologists, anthropologists, and historians worked together to reveal its secrets. Walker describes the careful work of this group, the technology they used, and the discoveries they made as a result.

Stronger than Steel: Spider Silk DNA and the Quest for Better Bulletproof Vests, Sutures, and Parachute Rope. By Bridget Heos. Illus. by Andy Comins. 2013. 80p. Houghton, \$18.99 (9780547681269). 595.4. Gr. 7–10.

This first *Scientists in the Field* book about genetics introduces readers to Randy Lewis and his colleagues, all of whom have been researching the golden orb weaver spider. Lewis and his team have genetically implanted golden orb DNA into a goat, and the result is goat's milk containing proteins that can be spun into a durable silk strong enough to hold a plane back when it lands on an aircraft carrier. With captivating prose, Heos pulls readers into the world of these geneticists, who are working diligently to make the unimaginable possible.

The Tapir Scientist: Saving South America's Largest Mammal. By Sy Montgomery. Illus. by Nic Bishop. 2013. 80p. Houghton, \$18.99 (9780547815480). 599.66. Gr. 5–8.

The latest project of the award-winning dynamic duo of Montgomery and Bishop takes the reader to Brazil's Pantanal, the world's largest wetlands, where field scientist Patricia Medici leads a talented team in search of the relatively unsung tapir. This contribution to the *Scientists in the Field* series seamlessly blends Montgomery's typically polished narrative and Bishop's illuminating photography to spotlight the gentle tapir and those field scientists whose lives are committed to conserving animal species.

Their Skeletons Speak: Kennewick Man and the Paleoamerican World. By Sally M. Walker and Douglas W. Owsley. 2012. 136p. illus. Carolrhoda, lib. ed., \$22.95 (9780761374572); e-book, \$34.60 (9781467700016). 970.01. Gr. 6–9.

After a skeleton was discovered in the Columbia River, a diverse team, including a coroner, an archaeologist-paleontologist, a radiologist, a young artist, and many others, worked

to help this prehistoric human tell his story. Throughout, the authors emphasize how technological advances continue to reveal more to scientists as they revisit studies of Paleoamerican skeletons.

Tracking Trash: Flotsam, Jetsam, and the Science of Ocean Motion. By Loree Griffin Burns. 2007. 64p. illus. Houghton, \$18 (9780618581313); paper, \$8.99 (9780547328607); e-book, \$14.99 (9780544106628). 551.46. Gr. 7–10.

Oceanographer Curtis Ebbesmeyer has spent years tracking debris that has fallen off cargo ships—Nike sneakers, rubber ducks, hockey gloves, and more. With the help of beachcombers, ship captains, and other scientists, Ebbesmeyer has documented the astounding journeys of particular items and used the data to map ocean currents. In this *Scientists in the Field* title, Burns takes readers to points around the globe where debris has been found or even accumulated, including the Eastern Garbage Patch, an island of trash twice the size of Texas that has gathered in the northeastern Pacific.

Trapped: How the World Rescued 33 Miners from 2,000 Feet below the Chilean Desert. By Marc Aronson. 2011. 144p. illus. Atheneum, \$16.99 (9781416913979); e-book, \$11.76 (9781442439818). 363.11. Gr. 4–8.

How do you rescue 33 trapped miners from 2,000 feet below the Chilean desert? In a gripping narrative, Aronson details how an extensive group of mine owners, geologists, expert drillers, and engineers arrived from all over the world to work together and save the miners. Although the miners' location was discovered in 17 days, they would not escape their shelter for nearly two more months. Through collective expertise and the power of twenty-first-century technology, the men were finally returned to the surface of the earth and their families.

Written in Bone: Buried Lives of Jamestown and Colonial Maryland. By Sally M. Walker. 2009. 144p. illus. Carolrhoda, \$22.95 (9780822571353); e-book, \$34.60 (9780761381075). 614. Gr. 7–11.

Walker's text focuses on how archaeologists, forensic anthropologists, and other scientists, with the help of technology, work together to tell the stories of excavated skeletons from seventeenth-century colonial America: what people ate, how they worked, and where they fell in the social class structure. The engaging text provides insight into the importance of science in helping to uncover new information about the past.

Sunday Cummins is the author of *Close Reading of Informational Texts: Assessment-Driven Instruction in Grades 3–8* (2013).

Common Core Connections: Scientists at Work

The following are suggestions for implementing the Common Core State Standards with recommended books about scientists and engineers at work. Log on to booklistonline.com/commoncore for an extended version of this article. You can find more information about the standards at www.corestandards.org.

In the Classroom: Encourage students to try nonfiction during independent reading by giving an enthusiastic book talk about Loree Griffin Burns' *Tracking Trash: Flotsam, Jetsam, and the Science of Ocean Motion*. Next, present a display of the following texts, which have a similar theme, and suggest students choose from this text set for independent reading: *Citizen Scientists: Be a Part of Scientific Discovery from Your Own Backyard* and *The Hive Detectives: Chronicle of a Honey Bee Catastrophe*, both by Loree Griffin Burns; *The Case of the Vanishing Golden Frogs: A Scientific Mystery*, by Sandra Markle; and *The Elephant Scientist*, by Caitlin O'Connell and Donna M. Jackson. Finally, in a class discussion, have students present two or more overlapping concepts and terms from the titles they chose.

Common Core Connections

- **CCSS.ELA-Literacy.RI.5.2.** Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.
- **CCSS.ELA-Literacy.RI.5.9.** Integrate information from several texts on the same topic in order to write or speak about the subject knowledgeably.

In the Classroom: Ask students to write in response to the following text-dependent questions as a way to deepen their understanding of the authors' central ideas and the practice of scientists and engineers.

- In Sandra Markle's *The Case of the Vanishing Golden Frogs: A Scientific Mystery*, how did communication between members of the scientific community play a vital role in saving this frog?
- Using evidence from Sally M. Walker's *Written in Bone: Buried Lives of Jamestown and Colonial Maryland* and *Their Skeletons Speak: Kennewick Man and the Paleoamerican World*, coauthored by Douglas W. Owsley, describe the authors' point of view regarding ethical treatment of human remains. Analyze how she conveys this view and whether she is effective in her presentation of this view.
- After reading Elizabeth Rusch's *The Mighty Mars Rovers: The Incredible*

Adventures of Spirit and Opportunity, describe how the scientists' and engineers' use of specific skills and knowledge contributed to the success of this project.

Common Core Connections

- **CCSS.ELA-Literacy.RI.7.1.** Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
- **CCSS.ELA-Literacy.RI.7.3.** Analyze the interaction between individuals, events, and ideas in a text; provide an objective summary of the text.
- **CCSS.ELA-Literacy.RI.7.6.** Determine an author's point of view or purpose in a text and analyze how the author distinguishes his or her position from that of others.

In the Classroom: Model close reading of page 55 from Elizabeth Rusch's *The Mighty Mars Rovers: The Incredible Adventures of Spirit and Opportunity* to reveal how scientists and engineers engage in problem solving as part of their practice. On this one page of text, the author clearly illustrates the tenacity of the team members and how their iterative practice involved asking questions, imagining, designing, building, simulating, and reimagining. Because of the cohesive nature of this excerpt, it is not necessary for the students to be familiar with the entire text to understand this one page.

Begin by reading aloud page 55, which describes how the team worked tirelessly to get the rover *Opportunity* unstuck from the soft sand on Mars. Then project page 55, using a document camera or similar device. Post and pose the following questions: What is the author's central idea on this page? What details in this excerpt of text support that central idea? Ask students to discuss these questions in groups of three and then share their thinking. Listen to ensure that students are making specific references to the text, and prompt them to do so as needed. During the conversation, take notes on a piece of chart paper divided into two columns with the headings "Central Idea" and "Key Details."

Common Core Connections

- **CCSS.ELA-Literacy.RI.4.2.** Determine the main idea of a text and explain how it is supported by key details; summarize the text.
- **CCSS.ELA-Literacy.SL.4.1.** Engage effectively in a range of collaborative discussions with diverse partners on grade 4 topics and texts, building on others' ideas and expressing their own clearly.

Common Core Connections: Scientists at Work

In the Classroom: Introduce the Scientists in the Field series as resources to help students understand the real-world practice of scientists. State that the authors and publisher of these books have carefully chosen images to support or extend the text. Present a copy of Loree Griffin Burns' *The Hive Detectives: Chronicle of a Honey Bee Catastrophe* and turn to pages 24 and 25. Show the photographs and captions on these pages to the students. (This can be done with a document camera or by holding up the book for all students to view.)

Post the following questions for students to consider: What do you notice? How do these photographs help us understand the work of bee scientists? As students answer the first question, coach them to use words emphasized by the Next Generation Science Standards, such as *investigating, evaluating, observing, imagining, developing explanations, and creating solutions*. To create a visual reminder of how students have used these words, write their responses on one piece of chart paper. Assign small groups to look through other titles in the Scientists in the Field series, to choose particular photographs and captions or other features, and to discuss together what these features reveal about the work of scientists.

Common Core Connections

- **CCSS.ELA-Literacy.RI.6.1.** Cite textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text. (In this case, the text is the images or features students view and discuss.)
- **CCSS.ELA-Literacy.RI.6.7.** Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

In the Classroom: Over the course of several lessons, read aloud Marc Aronson's *Trapped: How the World Rescued 33 Miners from 2,000 Feet below the Chilean Desert*. As you read, engage the students in conversation and/or shared and independent writing activities in response to the following questions (posted for students to view): How do the engineers and other professionals solve problems that arise from a specific human need? What is essential to their success in solving these problems? During the discussions, prompt students to use specific details from the text to support their comments. Following are suggestions for stopping points to allow for discussion and writing in response to the passages read aloud: chapter 6, "August 10–21: Drilling Blind"; chapter 8, "Camp Hope"; chapter 11, "The Race Down"; and chapter 12, "Phoenix Rising."

Common Core Connections

- **CCSS.ELA-Literacy.RI.6.2.** Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.
- **CCSS.ELA-Literacy.RI.6.3.** Analyze in detail how a key individual, event, or idea is introduced, illustrated, and elaborated in a text (e.g., through examples or anecdotes).
- **CCSS.ELA-Literacy.W.6.2.** Write informative/explanatory texts to examine a topic and convey ideas, concepts and information through the selection, organization, and analysis of relevant content.

In the Classroom: Read aloud pages 3 to 6 in the first chapter of *Invincible Microbe: Tuberculosis and the Never-Ending Search for a Cure*, by Jim Murphy and Alison Blank. Then, post in full view the following short excerpt from pages 4 to 5:

M. tuberculosis is a slender, elegantly curved rod, so small that 25,000 of them laid end to end would measure only one inch. They grow much more slowly than other bacteria and are bound up in a fatty, waxlike protective wrapping. When observed through a microscope, they look more harmless and beautiful than deadly.

State that the authors have carefully chosen words to describe *M. tuberculosis* in order to contrast its appearance with its impact. Ask students to name the words or phrases used to describe *M. tuberculosis* and write their responses on a piece of chart paper. The list might include "slender," "elegantly curved," "so small," "grow . . . slowly," "protective wrapping," "look more harmless and beautiful," "deadly." Ask the students to notice how Murphy has chosen words that normally have positive connotations, such as *slender* and *elegantly*, but he ends with the word *deadly*. Pose the question: "How does Murphy's choice of words impact the reader's understanding of TB?" Write students' comments on chart paper as a reference for independent thinking.

As a follow-up, ask partners or individuals to think about and then write a response to the authors' choice of words in this excerpt from pages 5 to 6:

"Once inside a human body, the *M. tuberculosis* bacterium usually finds a comfortable home in the lungs. But these germs have the remarkable ability to establish themselves in other parts of the body as well. They can survive in and infect the large and small intestines, the lymph nodes, the skin, bones, and joints, the brain, the eyes, the inner ear. . . . In fact, there is almost no organ or tissue in the human body that is immune to this germ."

Coach the students to notice how Murphy has chosen words and phrases to describe TB that convey the strength and pervasiveness of this microorganism, such as "finds a comfortable home," "remarkable ability to establish themselves," "can survive in and infect," and "almost no organ or tissue in the human body that is immune to this germ."

Common Core Connections

- **CCSS.ELA-Literacy.RI.8.2.** Determine a central idea of a text and analyze its development over the course of the text, including its relationship to supporting ideas; provide an objective summary of the text.
- **CCSS.ELA-Literacy.RI.8.4.** Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the impact of specific word choices on meaning and tone, including analogies or allusions to other texts.
- **CCSS.ELA-Literacy.RI.8.5.** Analyze in detail the structure of a specific paragraph in a text, including the role of particular sentences in developing and refining a key concept.