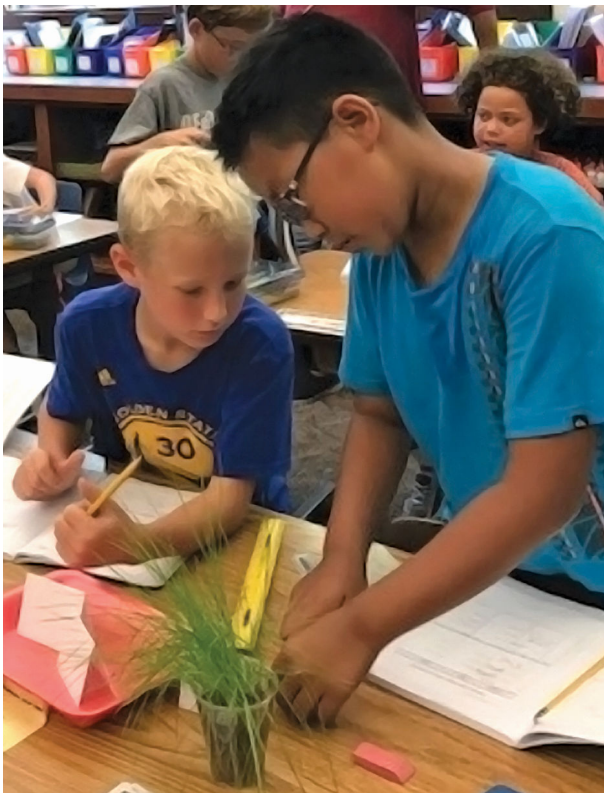
Double the Learning:

Science of Reading Strategies in Elementary Science

In a grade 1 classroom, students consider the question "How can we light our way in the dark?" As part of their lesson, they learn the words *biomimicry*, *engineer*, *mimic*, and *solution* (vocabulary). They read an informational story, first with the class and then with a partner (fluency), as they learn how animals use light, shadows, and reflections to survive. They use evidence from the story to think about and write how animals' bodies help them survive (comprehension).

The first graders, as part of sensemaking in a science and engineering unit, are bolstering reading skills, giving teachers an additional opportunity to meaningfully apply science of reading (SoR) strategies as they incorporate science instruction into their busy school day.

"A whole set of standards is devoted to informational text—and science reading is informational text reading—so it's a great way to merge the two together," Erin Bailey, Ed.D, says of Common Core State Standards in English Language Arts (CCSS-ELA) and inquiry-based science instruction that supports the Next Generation Science Standards* (NGSS) and similar three-dimensional science standards. Bailey, a former classroom teacher and reading specialist with experience in each grade from PreK through 5, is vice president of literacy programs and research with the nonprofit Reading Is Fundamental. In her role, she designs and evaluates literacy programs and has recognized how a thoughtfully developed science curriculum serves as an effective vehicle for teaching literacy, motivating students to read, write, and discuss as they investigate observable real-world phenomena and work to solve puzzling problems.



Credit: Kimberly Fitzpatrick, Abram Lansing Elementary, Cohoes, New York

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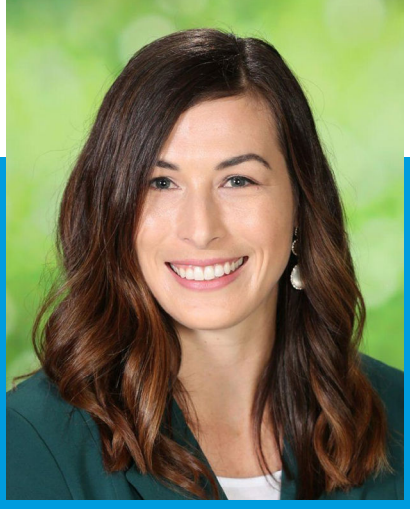

Reading to Learn in Science

Reading provides a unique opportunity to facilitate science learning. Informational text in science instruction gives students a chance to engage in scientific inquiry in multiple forms and, with prompting and support, read text appropriately complex for their grade level.

In developing *A Framework for K–12* Science *Education: Practices, Concepts, and Core Ideas*, the National Research Council of the National Academies recognized the symbiotic relationship between science and reading. It states, “Reading, interpreting, and producing text are fundamental practices of science in particular, and they constitute at least half of engineers’ and scientists’ total working time” (NRC 2012, 74). The science and engineering practice (SEP) of obtaining, evaluating, and communicating information notes that, to advance, scientists and engineers must be able to communicate their findings and designs “clearly and persuasively” (NRC 2012, 53). As such, every science and engineering lesson is, in part, a language lesson that expands students’ vocabulary; exposes them to and builds fluency in reading informational text; and enhances comprehension as they investigate real-world phenomena and solve problems while recording and communicating observations, thoughts, ideas, and models.

The Science of Reading Pillars

The National Reading Panel (NRP 2000) found through extensive research that explicit, systemic, cumulative instruction in five essential pillars is key to children’s reading success. These are the pillars that most agree upon and recognize when referring to the science of reading.

- **Phonemic awareness**—the ability to focus on, and manipulate, phonemes in spoken words
- **Phonics**—understanding letter and sound correspondences and their use to read and spell words
- **Vocabulary**—understanding the meanings of words and how they are used in different contexts
- **Fluency**—reading with speed, accuracy, and expression
- **Comprehension**—understanding what is being read, including making inferences, drawing conclusions, summarizing, questioning, and visualizing

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Of the five SoR pillars, Bailey says vocabulary, fluency, and comprehension offer the greatest impact in teaching literacy skills in conjunction with phenomena-based science education. For the teacher, it’s also important to differentiate between strategies and skills. “Identifying the main idea and key details, that is an example of a reading skill,” she explains. “The way you’re going to teach reading, that’s a strategy.” For example:

- A skill is the ability to describe the main idea and supporting ideas of a piece of text.
- Teaching students to stop and ask themselves questions when they are reading is a metacognitive strategy for comprehending.

“The CCSS are a set of reading skills expectations for each grade level and the science of reading are the research-based strategies for teaching reading,” Bailey explains.

Referring to the grades K–5 *Smithsonian Science for the Classroom*™ curriculum and each unit’s Smithsonian Science Stories reader, Bailey offers strategies for teaching the pillars of vocabulary, fluency, and comprehension in grades K–5 science classes.

Vocabulary. When teachers are using vocabulary from a science curriculum, the words are Tier 3 (domain-specific) words. The vocabulary words for each lesson apply to “Craft and Structure” CCSS ELA-Literacy standards. Grades K–2 students can use word cards that display and illustrate the words and then, with their digital readers, listen to the pronunciation of the words (using the text-to-speech capability) and access the definitions as they explore the lessons. A glossary of key terms can support grades 3–5 students. Bailey also suggests:

- Use the word cards to display the word and its illustration before reading the text.
- When the word comes up in the text, use that opportunity to define it. “That’s a great way to introduce students to context clues,” she says. “If I read the word *biomimicry* in a sentence, students can use the context of the sentence to determine what the word means based on their prior knowledge. This is different from being able to decode, or sound out, the word.”
- After the reading, engage students in word work using research-based strategies for reinforcing vocabulary, such as the Frayer Model, crossword puzzles, and engaging word games.

One word game involves the teacher stating a scenario using the word. If the scenario is an example of the word, the students say the word. If it’s not, they say nothing. “It gives kids opportunities to experience the word in other contexts outside of the text,” Bailey explains. “Kids need around 10 interactions with a word before they can make it their own.”

The Smithsonan Science Stories are carefully calibrated to grade-level appropriate Lexile measurements and are also available in below-grade and Spanish versions.

Fluency. Effective three-dimensional science learning exposes students to multiple CCSS-ELA standards in reading informational text through the lessons, activities, and stories. To build fluency, Bailey recommends literacy strategies for reading informational text in science class:

- Have students listen to the text on their digital readers before they read it themselves.
- Echo reading: Students echo the teacher reading the text.
- Choral reading: The class reads the text together.
- Partner reading: Students read the text with a partner.
- Repeated reading: Students reread the text until they can read it with appropriate rate, accuracy, and expression.

"The repetition makes them more comfortable," Bailey says, "The text becomes easier to read each time."

Comprehension. What's the difference between *assessing* comprehension and *teaching* comprehension? When it comes to comprehension, Bailey says many educators mistake guidelines for monitoring student progress as methods for teaching comprehension skills. She cites two primary research-based strategies that assuredly lead to comprehension after reading an informational text:

- Thinking aloud—With this strategy, teachers provide the inner workings of their brains as the class is encountering the text. This helps students understand the actions they may take to help them understand the text.

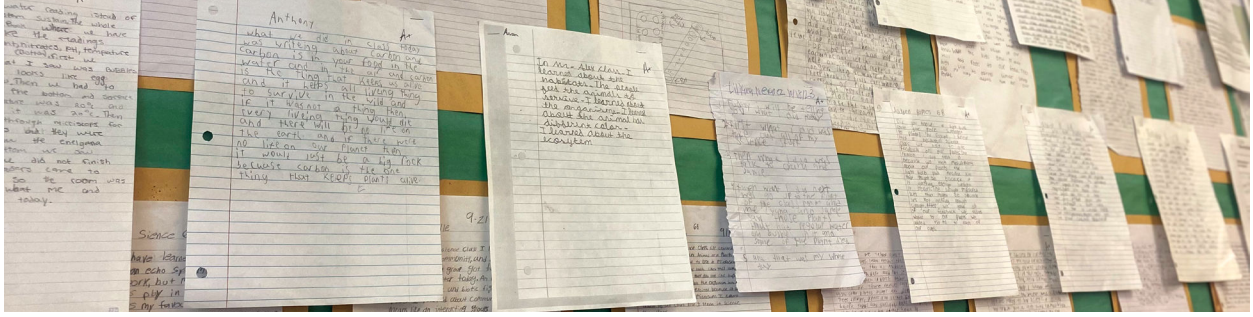
  For example, a grade 2 unit investigating "How can we map land and water on Earth?" introduces the word *symbol*, stating: "Think of symbols that you use that might be on a phone or computer. They have symbols that give you information."

  After reading the above sentences about symbols, the teacher may say, "I see that word *symbol*. I don't know what it means, but I see words in the sentences that a symbol might be on a phone or computer and that symbols give you information. If I look at my phone, I see these little icons

Examples of Literacy in Science Class

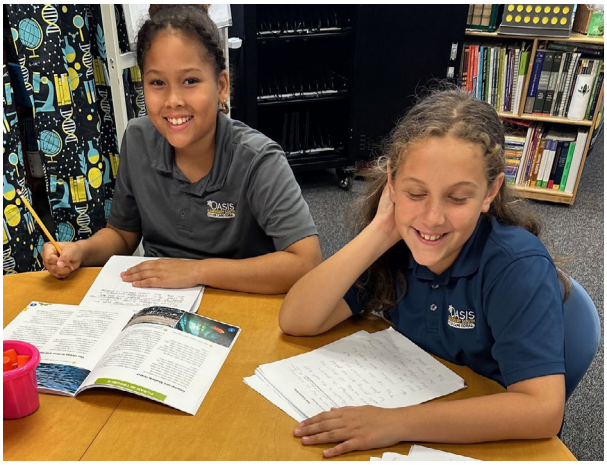
Phenomena/ Problems	Informational Text	Vocabulary	Fluency	Comprehension
Grade 1: How do living things stay safe and grow?	*Survival Stories:* "Protective Parents"	• behavior • chick • survive	The teacher reads the story aloud as students follow along. Student pairs work together to read and become experts in one section.	Students answer guided questions, referring to pictures and captions in their answers. Partners collect and record evidence about animal behaviors.
Grade 3: How do weather and climate affect our lives?	*Raindrops and Rooftops:* "Weather Woman"	• meteorologist • precipitation • radar • weather balloon • weather satellite	The teacher reads the first two pages aloud with students. Student pairs read the story together.	Student pairs read and write about a weather tool: one student reads while the other writes about the tool; then they switch roles.
Grade 5: How can we protect and clean Earth's water?	*Water Works:* "Four Spheres in One"	• atmosphere • biosphere • geosphere • hydrosphere • interaction	Partners read the text together and discuss new vocabulary they encounter.	Students identify specific evidence in the text about one Earth system component's effect on ocean macroplastic pollution and then share their information in a group.

Examples are from the *Smithsonian Science for the Classroom* program.



that give me information. Those must be symbols." The teacher is modeling for students the thought process of how to determine the meaning of the word to better comprehend the text.

- Gradual release of responsibility—This is often called "I do, we do, you do." In this method, the teacher models a strategy for comprehending the text the first time. Then, either as a class or with a partner, the student practices the strategy with the text. Finally, the student practices the strategy on their own. "That's the gradual release," Bailey says. "I'm modeling it for you, we are doing it together, then you are doing it on your own."



Credit: Gena Feury, Oasis Elementary South, Cape Coral, Florida

Final Tips for Leveraging Literacy in Science

Think there's no time for science class while trying to achieve rigorous literacy standards? Remember this: CCSS-ELA standards often overlap with student engagement in the SEPs of obtaining, evaluating, and communicating information and engaging in argument from evidence. As students learn to think and act like scientists and engineers, they read informational text and write to record their questions, predictions, claims, and conclusions.

Look for a strong science curriculum that follows a coherent storyline as it engages students in hands-on investigations of real-world phenomena and problem-solving. In doing so, it should seamlessly integrate informational text, giving teachers the opportunity to facilitate ELA learning and students a chance to engage in scientific inquiry in multiple forms. Vocabulary terms should be central to the core idea and offer multiple, repeated, hands-on experiences with the terms for a richer context of learning. Digital resources should meaningfully enhance science learning as well as support fluency and comprehension of informational text. And students should have myriad opportunities to share their thinking verbally, deepening their understanding of their reading, writing, and hands-on investigations for the unit.

Hands-on sensemaking motivates students to tackle the more complex informational text and delivers relatable reasons to learn, making science and literacy natural partners in education.

References

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How the Smithsonian Science Education Center Supports Literacy through Science Learning and Assessment

The Smithsonian Science Education Center (SSEC) is transforming K–12 education through science in collaboration with communities across the globe. One way to achieve this ambitious objective is by designing science curricula that supports three-dimensional, phenomena- and problems-driven science education that reinforces literacy skills. The grades K–5 Smithsonian Science for the Classroom™ delivers observable phenomena and real-world problems in every lesson, incorporating opportunities for students to drive learning and sensemaking as well as intentional reading with the Smithsonian Science Stories series. A five-year independent study reveals that *Smithsonian Science for the Classroom* lessons paired with high-quality professional learning led to statistically significant gains in students' science achievement and positive gains in students' reading achievement.

Learn more about *Smithsonian Science for the Classroom*: https://smithsonianstc.com/smithsonian-science-for-the-classroom/
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