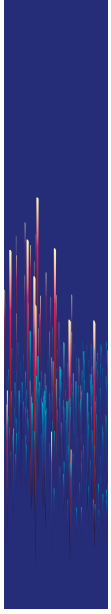

Texts as tools

Engaging students in reading to complement hands-on activities

BY KIRSTEN D. EDWARDS

Learning how to interpret informational texts should start early and continue through school. This work with texts prepares students to read the informational texts they will encounter in their daily lives as adults, such as news articles and medical information. Understanding such texts is necessary for students to be able to make well-informed decisions that affect their personal lives and their communities. The *Common Core State Standards*, ELA (*CCSS ELA*), underscore the importance of this work with informational texts in suggesting that the amount of informational texts students read increases as students progress through the grades (NGAC and CCSSO 2010). The Obtaining, Evaluating, and Communicating Information practice of the *Next Generation Science Standards* (*NGSS*) emphasizes the need for middle school students to be able to read texts, understand diagrams and photographs, synthesize ideas across multiple documents, and evaluate the information in texts (NGSS Lead States 2013). Likewise, the *CCSS ELA* require that middle school students evaluate the argument in a text, determine the purpose of a text, and analyze how the text makes connections across ideas, among other things (NGAC and CCSSO 2010).

When it comes to science reading, however, not all texts are created equal. For this reason, teachers need to carefully review the texts they are using. When choosing texts, teachers should consider three things: level of cohesiveness, distracting details, and the use of diagrams.

Selecting texts

One criterion in science text selection is the cohesiveness of the text (Hall et al. 2015). More cohesive texts have stronger connections between ideas, which help student understanding. A cohesive text will use nouns instead of pronouns in descriptions and contain connecting words, such as "because" and "but." It is the difference between saying, "Plants need sunlight, water, and air. Plants do photosynthesis" and saying, "Plants need sunlight, water, and air in order to do photosynthesis." Notice that the second example is more cohesive, but the sentence's length is longer. Cohesive texts may have higher reading levels because of longer sentences, but will likely be more understandable to students.

Another criterion in text selection is the presence of distracting details (Wang and Adesope 2016). Texts that include details that are unrelated to the main ideas can be distracting and reduce reader comprehension. A tidbit about the real world or a narrative element in a text may be interesting, but it can make the reading harder to understand for some students. Consider a text about photosynthesis that says the following:

> Plants need water, sunlight, and air to do photosynthesis. Sunflowers need 34 inches of water a year and all-day sun to thrive. Photosynthesis is a chemical change that combines carbon dioxide from the air with water to produce glucose.

This text provides interesting information about sunflowers, but this extra information distracts from the main ideas about photosynthesis. This criterion is particularly important to note for struggling readers. When choosing texts, teachers should avoid texts with distracting details.

A third criterion in text selection is the included images. Texts should have clear, labeled images that focus on the main ideas (Ge, Unsworth, and Wang 2017). Such images can improve comprehension. Captions should allow students to make connections between the words and the images. Teachers should select texts with images that convey the main ideas of the text and are captioned.

Texts that meet these guidelines can include excerpts from science textbooks, news articles such as those from *http://newsela.com*, and trade books such as those on the National Science Teachers Association's Outstanding Science Trade Books for Students K–12 list. The following list of reflective questions can be used to evaluate texts:

- Evaluate cohesiveness: Does this text include mostly nouns instead of pronouns? Does the text use connecting words between ideas?
- Evaluate whether the text includes distracting details: Does the text include narrative elements or interesting facts that may distract readers from the main ideas?
- Evaluate whether the images are clear and captioned: Do the images convey the main ideas of the text? Are the images captioned to connect them with the words of the text?

Using texts

Multiple studies have concluded that the more a student knows about a topic, the better he or she will comprehend a reading on that topic (Cervetti and Wright, Forthcoming; Davis, Huang, and Yi 2017). For example, if a student knows a lot about plants, he or she will better comprehend a text about plants than one about birds. Research has also shown that if students enjoy science, then they may find it easier to comprehend science texts (Hall et al. 2015).

To build knowledge and interest, texts should be used as part of other classroom activities, such as investigations and discussions. For example, if a teacher facilitates an investigation about what plants need to grow, students can read a textbook excerpt on photosynthesis as they are analyzing their data. The information from the textbook can then be compared to the results of the investigation.

Additionally, discussions can center on texts. After students read excerpts from the textbook on cellular respiration and photosynthesis, the teacher could lead a class discussion about how the information on plants relates to what students have already learned about animals. They could discuss questions including:

- How do plants move and how is that similar to and different from how animals move?
- How do plants get energy and how is that similar to and different from how animals get energy?
- What evidence from the texts supports your answer?

These and other questions will support students in making sense of the texts and integrating the information in the texts with previous learning.

Supporting comprehension

Science texts differ from texts in other subject areas. They have challenging vocabulary, ideas conveyed in multiple ways, and science-specific expectations for how ideas are supported with evidence (McNamara, Graesser, and Louwerse 2012). Given these differences, students require instruction in making connections across texts, integrating words and images in a text, and making sense of complex vocabulary (Mason, Tornatora, and Pluchino 2015).

Students have difficulty combining information from images

FIGURE 1: A student's completed graphic organizer

	Text 1: A rain forest plant shows its true colors (blue) when in survival mode	Text 2: Photosynthesis
Main Ideas	- Plants make food using photosynthesis. - The peacock begonia has adapted to low levels of light.	- Plants are producers that make their own food.
Evidence	- iridoplasts allow the peacock begonia to collect different wavelengths of light, which makes it appear blue	- with light, $CO_2 + H_2O \rightarrow C_6H_{12}O_6 + O_2$ (glucose)
Similarities	Both texts detail how plants use light to do photosynthesis. The light is energy that is converted into stored energy.	
Differences	-Some plants have different structures for photosynthesis	-All energy used by living things comes from photosynthesis. -Chloroplasts are required for photosynthesis.

and words in a text (Mason, Tornatora, and Pluchino 2015). In science texts, the images often contain information not found in the words, so a reader needs to make sense of the words and images together. Students who do this have better comprehension (Mason, Tornatora, and Pluchino 2015). Teachers can model how to look across the images and the words. While displaying a text, the teacher can read, then look at the images, and then look back at the text. The teacher can discuss her thought process:

- What information do the words provide?
- How is the diagram showing what the words are saying?
- How is the diagram adding to what the words are saying?

The teacher would then repeat the process for the other images.

Students need support in coordinating ideas across multiple texts, because without prompts and specific questions that support them in pulling ideas together, students are unlikely to make these connections (Davis, Huang, and Yi 2017). The teacher should start by having students identify questions that they hope to answer based on the text set. To help students look across the texts, teachers can provide a graphic organizer. It should allow students to record information they learned from each text and compare that information. Students should then be able to draw conclusions to answer their questions and identify what additional information they need to resolve any discrepancies between the texts. Students could then engage in small-group discussions about how they completed the graphic organizer and how they think the texts answer their questions. This activity sequence, including identifying questions, reading two texts, completing the graphic organizer, and having a small-group discussion, could be done in a 45-minute to one-hour lesson. The related homework assignment from the lesson could be for students to find another text that helps answer their remaining questions or resolve discrepancies. The graphic organizer and small group discussion can be used as formative assessments to gauge how students are comprehending and coordinating ideas across texts (see Figure 1 and Online Supplemental Materials). Teachers should listen to students' discussions to see whether they are able to summarize the main ideas in both texts, discuss using precise language how the texts are similar and different, and identify how the texts answer their questions. A rubric can be used to assess students' work on the graphic organizer (see Figure 2).

Students will encounter complex vocabulary in science texts (McNamara, Graesser, and Louwerse 2012). This vocabulary includes both science-specific and polysemous words that have unique meanings in different contexts. An example of a polysemous word is *model*, which is "a representation used to explain" a concept in science; in other contexts, however, it can mean "an

example to follow." Vocabulary instruction that includes active processing of the words within a text—that is, using the vocabulary words for a purpose—can support comprehension of that text (Wright and Cervetti 2017). Active processing could include giving students opportunities to discuss the vocabulary with their peers and represent the vocabulary in pictures.

Research has shown that students with reading disabilities do not have the metacognitive strategies necessary for reading science texts (Botsas 2017). One way to provide metacognitive strategy support for students who need it is to work with the language arts teacher to build on the strategies students are already being exposed to in language arts class. Another method is to have students read together. Students can pause and summarize what they have read, relate the text to their background knowledge, or ask questions. Partner reading gives students an opportunity to talk about a text and practice using strategies with a peer. The teacher can provide support to students with disabilities by giving them sticky notes to record their questions and ideas, and then providing them an opportunity to share their ideas with their peers in pairs or small groups.

Closing thoughts

There is a rich range of science texts, from news articles to trade books, that can and should be used in the science classroom. Reading in science aligns with both the *NGSS* and the *CCSS ELA* for middle school and will prepare students for the texts they

FIGURE 2: Rubric for graphic organizer

	Excellent	Good	Needs improvement
Main ideas	Student provides a precisely stated summary of the main ideas that shows deep understanding of the purpose of the text.	Student provides a summary of the main ideas that shows some understanding of the purpose of the text.	Student provides a statement of some ideas that are not central to the purpose of the text.
Evidence	Student provides a precise statement of all of the evidence that supports the claims in the text.	Student provides a statement of some of the evidence that supports the claims in the text.	Student provides a statement of ideas that do not support the claims in the text.
Similarities	Student provides a thorough and precise summary of the ideas that are common between the texts.	Student provides a summary of some of the ideas that are common between the texts.	Student provides a statement of ideas that may or may not be common between the texts.
Differences	Student provides a thorough and precise summary of the ideas that are different between the texts.	Student provides a summary of some of the ideas that are different between the texts.	Student provides a statement of ideas that may or may not be different between the texts.

will read in adulthood (NGAC and CCSSO 2010; NGSS Lead States 2013). Remembering to choose texts carefully, embed texts within activities, and support students while they read texts will help science teachers be successful in using science texts as tools in their classroom. If you are interested in more information and strategies related to using texts as a complement to hands-on activities, check out the following resources:

- For different purposes that reading can serve in the science classroom: "Chapter 8: Reading and Writing in the Service of Inquiry-Based Science"(Cervetti et al. 2006).
- For more information on selecting and using texts with students: *Reading Science: Practical Strategies for Integrating Instruction* by Altieri (2016)
- For strategies to engage English language learners with texts in science, read "English Learners and the Complex Language of Written Science Texts" by Román, Briceño, and Basaraba (2018). ●

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Wright, T.S., and G.N. Cervetti. 2017. A systematic review of the research on vocabulary instruction that impacts text comprehension. *Reading Research Quarterly* 52 (2): 203–26.

RESOURCES

Article: A rainforest plant shows its true colors (blue) when in survival mode—*https://newsela.com/read/blue-leaves/id/23326*

ONLINE SUPPLEMENTAL MATERIALS

Blank graphic organizer—*www.nsta.org/scope1901*

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