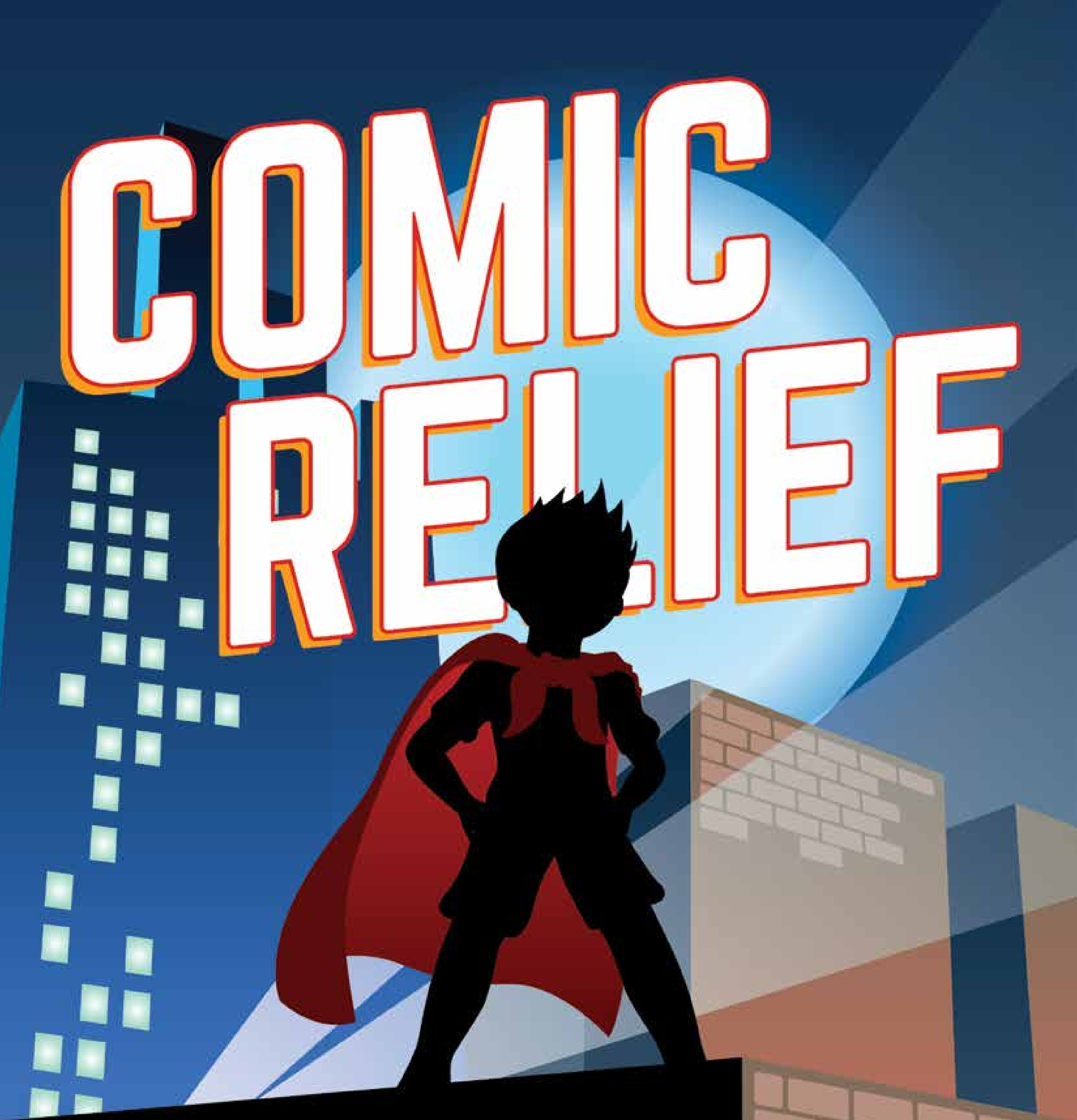
COMIC RELIEF



Using Comics and Illustrated Trade Books to Support Science Learning in First-Year English Language Learners

by Yuliya Ardasheva, Jameson Bowden, Judith Morrison, and Thomas Tretter

In order to strengthen the connections between literacy and science, the *Common Core State Standards* for English language arts (*CCSS ELA*) have clear anchor standards related to science learning that ask students to read informational texts and orchestrate content-specific discussions (NGAC and CCSSO 2010). For example, *CCSS* Reading Anchor #7 states that middle school students should be able to "integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words" (NGAC and CCSSO 2010). This anchor connects strongly to science and engineering practices of the *Next Generation Science Standards* (*NGSS*) that ask students to analyze data presented in various formats. Another *CCSS ELA* standard that directly connects to science is Writing Anchor #8, which states that students should be able to "gather relevant information from multiple print and digital sources … and integrate the information while avoiding plagiarism" (NGAC and CCSSO 2010). Similarly, the National Research Council's (NRC) *Framework for K–12 Science Education*, Practice 8: Obtaining, Evaluating, and Communicating Information, states:

> Any education in science and engineering needs to develop students' ability to read and produce domain-specific text. As such, every science or engineering lesson is in part a language lesson, particularly reading and producing the genres of texts that are intrinsic to science and engineering (NRC 2012, p. 76).

For English language learners (ELLs), the challenge of learning complex science concepts is compounded by their simultaneous learning of English. Because the *NGSS* are cognitively demanding, science teachers with ELLs in their classrooms need effective strategies to incorporate literacy instruction. Experts have promoted the use of comics and illustrated trade books (CTBs) when teaching science to strengthen students' understanding of concepts, practices, and how scientists do science (Cheesman 2006; Donovan and Smolkin 2002; Pappas et al. 2004; Yore 2004). Using CTBs as resources for strengthening students' background knowledge, motivating their questions, or validating their results can support their investigations in science (Cervetti, Pearson, and Barber 2006; Morrison and Young 2008). Further, incorporating CTBs helps students build confidence and independence in accessing complex ideas as they begin by "reading the pictures" (Vardell, Hadaway, and Young 2006, p. 734).

In middle level classrooms, students who struggle with dense texts or have difficulty comprehending academic language involved in science content may do well when reading highly visual CTBs, a format that is part of popular culture, providing students with a familiar frame of reference (Morrison, Bryan, and Chilcoat 2002; Ranker 2007). Indeed, education research has linked the use of CTBs in science classrooms with improvement in both ELL and non-ELL students' science conceptual knowledge, reading comprehension, vocabulary knowledge, and strategy use (Fang and Wei 2010; Morrow et al. 1997; Fang and Wei 2008; Gaskins et al. 1994). There is also evidence to suggest that texts accompanied by visual supports may be particularly beneficial to ELLs with low English proficiency (Liu 2004; Tang 1992).

About our ELL target group

This article focuses on strategies (described in greater detail later in this article) for integrating CTBs—delivered weekly, during Reading Day sessions—to support middle school ELLs' learning of science during their first year in the United States. Reading Day sessions were delivered once a week and lasted for the entire 50-minute period of the class, with students reading CTBs in pairs. Shorter books were read in their entirety during the Reading

FIGURE 1 Stairstep approach to selecting CTBs for the Earth Materials and Systems Unit (adapted from Vardell, Hadaway, and Young 2006)

Stairstep approach	Book titles and references	Disciplinary core ideas	Sampled vocabulary	Scaffolding
One to two lines of text per two-page illustration	Rosinsky, N.M., and J. Matthew. 2006. *Rocks: Hard, soft, smooth, and rough.* Minneapolis, MN: Picture Window Books.	ESS2.A: Earth Materials and Systems ESS3A: Natural Resources	**Science vocabulary*** igneous, sedimentary, metamorphic, melt, form (formation), press (pressure) **General vocabulary** smooth, rough, crack, squeeze, speck, shape	**Increase in science ideas complexity and gradual science-vocabulary buildup**
One to two short paragraphs per one to two illustration pages	Bailey, J., and M. Lilly. 2006. *The rock factory: The story about the rock cycle.* North Mankato, MN: Picture Window Books.	ESS2.A: Earth materials and systems ESS3.A: Natural resources ESS1.C: The history of planet Earth	**Science vocabulary** core, crust, mantle, composition, texture, mineral, sediment, fossil, layer **General vocabulary** red-hot, grainy, swirl, escape, clump, cool, harden	
One page of text opposite a photo or illustration**	Krohn, K.E. 2008. *The Earth-shaking facts about earthquakes with Max Axiom, super scientist.* Mankato, MN: Capstone Press.	ESS2.B: Plate tectonics and large-scale systems ESS3.B: Natural hazards	**Science vocabulary** magma, lava, stratum/strata, transport, deposit, plate tectonics **General vocabulary** rumbling, deadly, shake, destroy, crash, strike record, wave	
	Harbo, C.L. 2008. *The explosive world of volcanoes with Max Axiom, super scientist.* Mankato, MN: Capstone Press.	ESS2.B: Plate tectonics and large-scale systems ESS3.B: Natural hazards	**Science vocabulary** inner core, outer core, intrusive/extrusive rock, lithosphere, convection currents, extinction **General vocabulary** cone-shaped, broad, flat, solid, rise up, come together, boundary, vent	

*Science vocabulary—including some vocabulary that takes specific meaning in science such as melt or form—was taught using direct instruction; general vocabulary including everyday and general academic words was taught in context, as part of prereading activities.

**For comics, this corresponded to about one page of text with each paragraph overlying the corresponding image.

Day, whereas longer books were read over two to three weeks; this applied particularly to the comics, naturally broken down into chapters. (Alternatively, once the Reading Day routines described in the article are established, the CTBs could be read daily during the last 10–15 minutes of the class.)

The students we worked with were enrolled in a specialized school serving students grades 6–11 with limited English skills (a composite score of 2 or less on the district's English proficiency test, with the highest score being 6). Eighty percent of students enrolled in the school were refugees, and 98% were on free- or reduced-lunch programs. However, the same strategies would work well in any integrated classroom that has students (ELLs and non-ELLs) who struggle with dense expository texts or have difficulty comprehending academic language involved in science content (Fang 2008).

Our students used CTBs during a two-month Earth Materials and Systems unit that addressed primarily *NGSS* disciplinary core idea ESS2.A of standard MS-ESS2, Earth's Systems. The strategies in this article, however, can be used to support any type of three-dimensional instruction in the science classroom, as advocated for by the *NGSS*.

Selecting CTBs for the Earth Materials and Systems unit

The CTB selection for the Earth Materials and Systems unit was guided by two principles. The first concerns the selection of individual books appropriate for ELLs.

FIGURE 2 Summary of CTB implementation routines

Step	Strategy	Description
Step 1 Material preparation	Text/graphic organizer alignment	The teacher identifies and marks with a "stop sign"—a numbered, quarter-sized sticker marking logical breaks in the reading focused on a single idea. The number of "stops" identifies the number of identically numbered "passages" on the Summary Writing graphic organizer.
Step 2 "Hook"	Picture Walk	The teacher slowly goes through the book's illustrations while engaging students in discussions of new vocabulary and key science concepts by questioning and eliciting student predictions.
Step 3 Engagement and background knowledge	Read-Aloud	As students follow along, the teacher reads out loud the first part of the book to model expressive reading, provide contextual definitions for new vocabulary, and elaborate on relevant science concepts.* Read-Aloud is also used to model how to identify details and write summaries when students are first introduced to the Paired Reading/Summary Writing routines.
Step 4 Independent CTB reading	Paired Reading/ Summary Writing**	Two students working independently from the teacher and other groups take turns to read and summarize a selection of the text. The students stop at the sticker (STOP), choose important words and phrases to put together the passage summary (SUMMARIZE), and switch roles for the next passage (SWITCH).
Step 5 Assessment	Formative assessment	As students work in pairs on the Paired Reading/Summary Writing activity, the teacher moves around the room to provide assistance and formatively assess student work. At the end of the reading period, the work of one to two pairs is reviewed using a document camera, with the teacher focusing on accuracy of the identified science ideas, vocabulary review, and one to two grammar points at a time.

*In our experience, students with very low English proficiency may benefit from the entire book being read out loud.

**During early stages of our work, we used Paired Reading as a stand-alone strategy but soon realized that our students needed additional scaffolding with identifying key details and producing text summaries. The Summary Writing graphic organizer provided a great scaffold in that respect and became a regular part of the reading routines.

We relied on four criteria recommended by Vardell, Hadaway, and Young (2006):

- *content accessibility*, or books presenting only a few concepts at a time;
- *language accessibility*, or books using clear, simple language and economy of content-specific terms;
- *visual accessibility*, or books with direct text-to-images (side by side) correspondence; and
- *accuracy and organization*, or books with clear layouts and accurate science content.

When selecting grade-appropriate CTBs for integrated or non-ELL classrooms, teachers may use as their guide labels on books or online information provided by book publishers indicating what grades those books are appropriate for.

The second principle—applicable to book selection for ELL, integrated, and non-ELL classrooms—concerns the selection of books as part of a cohesive set on a given topic. This selection was guided by the *stairstep* approach, which involves selecting a set of illustrated books on the same topic with each book in the set being more complex than the last in terms of concept expansion and vocabulary difficulty (Vardell, Hadaway, and Young 2006). (In other words, the first book in the set that students read is the easiest to understand, and the last book in the set is the most challenging.) Figure 1 shows the application of this approach in the Earth Materials and Systems unit, as well as corresponding disciplinary core ideas and key vocabulary linked to each of the selected books (NGSS Lead States 2013).

The goal for this activity is for students to work with their partners to read and summarize passages within a section of a book.

In our work using Paired Reading—with two students reading the same book at the same time, as described in greater detail below—we found a set of books totaling half the number of students in the classroom to be most optimal. Thus, we used one classroom set of 12 books—half the student number in the largest classroom—for each of the selected books. All selected books were purchased through online bookstores with school or charity funds. In researching possible CTBs, we found two helpful resources: the National Science Teachers Association's *Outstanding Science Trade Books for Students K–12* website and Tatalovic's *Resources on the Web: Science Comics and Cartoons* (2010) (see Resources). Teachers who wish to use the Paired Reading strategy but lack the resources to buy several sets of the same books can create one unit set of different books and have students rotate from book to book during times allocated for reading.

Strategies for using CTBs in the science classroom

Two main strategies served to support the inclusion of CTBs in the science unit: Paired Reading (first introduced in 1970 to support children with reading difficulties; Morgan and Gavin 1988) and Summary Writing (adopted from Duran, Gusman, and Shefelbine 2005). Paired Reading is a process in which two students take turns reading and summarizing a selection of text; Summary Writing involves a graphic organizer that assists students in summarizing. The steps involved in the Paired Reading/Summary Writing process—including the preliminary scaffolding and prereading strategies—are summarized in Figure 2 and described below.

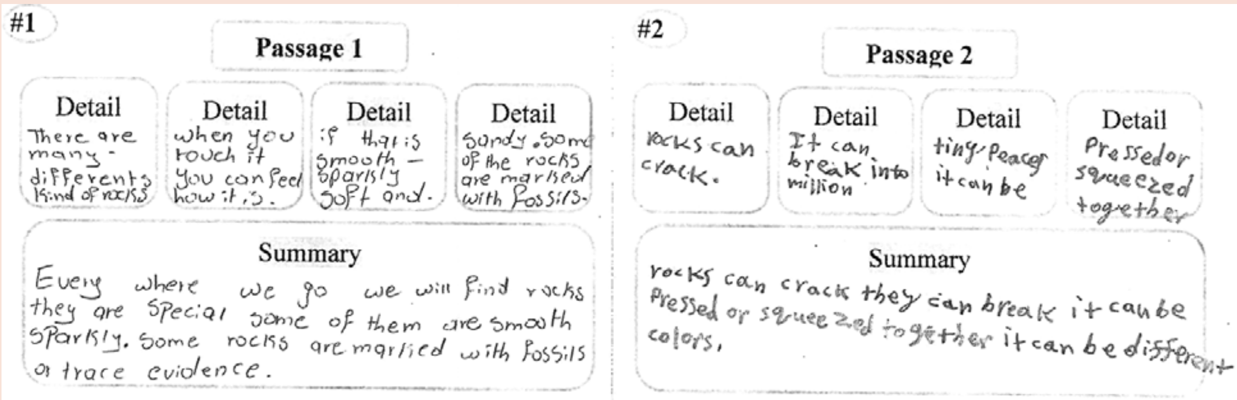
Teacher voice: Paired Reading and Summary Writing

The goal for this activity is for students to work with their partners to read and summarize passages within a section of a book selected for a given Reading Day, with students switching the roles of "Reader" and "Summarizer" from passage to passage.

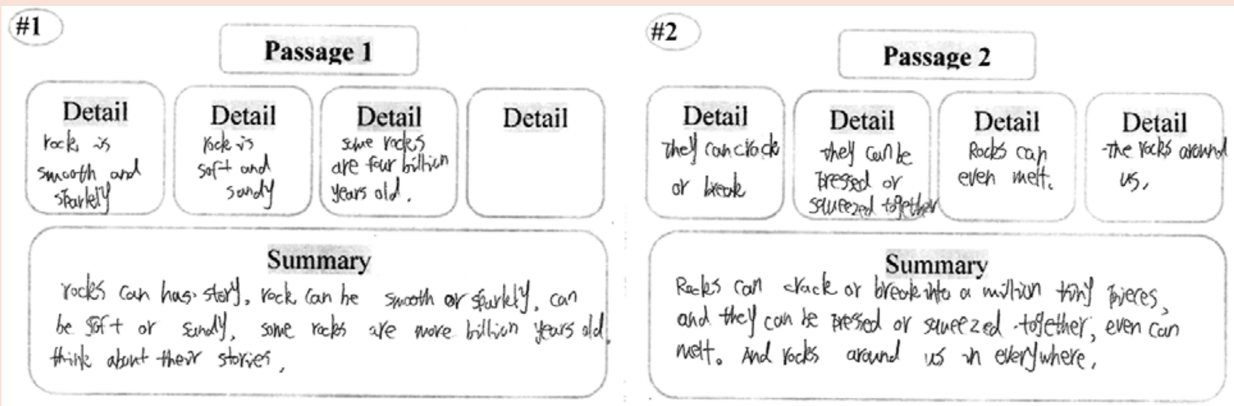
FIGURE 3 Example of a completed Summary Writing graphic organizer

A shows the work of Level 2, or beginning students (most of the written text is adapted from the source text; more advanced). B shows the work of Level 1, or entering students (most of the written text is copied or adapted from the source text; less advanced).

A



B



Students often have difficulty summarizing, even if they are native English speakers. So, we helped the process by following this procedure: First, one student in the pair (the "Reader") reads the passage out loud, using a finger to show the listener exactly where the pair is in the text. Then the pair negotiates and selects three or four key details (words, phrases, or ideas) from the reading. Next, the second partner (the "Summarizer") writes down the selected words in text boxes (called "Details") on the Summary Writing graphic organizer (available with the online version of this article, located at *www.nsta.org/middleschool/connections.aspx*). Finally, the pair restructures what has been written into a larger "Summary" text box. What they write in the large text box is the summary for that passage in two to three sentences. (Figure 3 shows a completed example of the Summary Writing graphic organizer; see Resources for a video demonstrating the process in action.) Having completed these steps, the pair moves to the next passage, with the "Reader" and the "Summarizer" switching roles. After reading all the passages from the selection for the day, students are asked to summarize the selection in its entirety by using sentence starters (e.g., "This reading selection is about…") using their completed "Summary" text boxes. Volunteer students are asked to share their work with the entire class, as described in the assessment section of this article. In

If you work with students with low English proficiency, always remember to preteach key vocabulary and concepts before letting students do independent work.

the case that some student pairs read at a faster rate, teachers may need to have an additional reading or another task ready.

It is important to scaffold up to this step; some suggestions are described below.

Material preparation

Before class, decide how to break up the reading selection for the day into the passages for Paired Reading/Summary Writing. Mark logical breaks in the reading focused on a single idea with round, quarter-sized stickers, each labeled with a number corresponding to the "passage" number on the Summary Writing graphic organizer. It typically takes 5–10 minutes to identify and mark logical breaks in the teacher copy of the book and another 10–15 minutes to mark the passages in the student copies. (Alternatively, to save time, you can ask first-period students to place the stickers for all subsequent classes, showing the marked teacher copy to students to use as a guide. You can also use a document camera to point out the corresponding images and page numbers and read aloud the last line of each passage where the sticker should be placed.) These stickers indicate where students should "Stop" reading to "Summarize" a given passage into the Summary Writing organizer, and, once these steps are completed, "Switch" roles for the next passage. You should also write these directions—"Stop, Summarize, and Switch"—on the board and review them with students each time you do this Paired Reading/Summary Writing activity. The stickers mark transitions in the text as it moves from one concept to another. The stickers also serve as a visual stop sign and help students write each summary by defining a clearly delineated topic.

Modeling

In addition to explaining the routines for the above Paired Reading/Summary Writing activity, second author Jameson Bowden videotaped two students—a male and a female of different backgrounds, both well-liked, strong academic performers—implementing the procedure (see Resources for the narrated video; the link to the Paired Reading video in action showcases the process without the teacher narration). Because Bowden wanted to show the rest of his students that even high-performing students make mistakes, he also included the audio of his redirections and reminders to them as they read to each other: "Stop at the stickers [STOP], choose important words and phrases to put together the passage summary [SUMMARIZE], and switch roles for the next passage [SWITCH]." Bowden shared this three-minute video with his subsequent classes to demonstrate how to follow the procedures; he also replayed this video later, as a refresher, when needed. In addition, for the first two to three weeks of using the Paired Reading/Summary Writing activity, he modeled how to identify details and write the passage summary (first by himself, and then with a student).

If you work with students with low English proficiency, always remember to preteach key vocabulary and concepts before letting students do independent work. The two prereading strategies described below can be useful for preteaching.

Prereading activities

The first strategy, Picture Walk, is a think-aloud activity that uses only a book's illustrations. In this technique, the teacher slowly goes through the relevant section of the book, showing students the succession of illustrations and engaging them in discussions of new vocabulary and key concepts. Ask students a variety of questions about the pictures they are viewing and have them make hypotheses and predictions about what is happening in the text. For example, you may ask, "What do you see in this picture?"; "What clues about … does this picture provide?"; or "How do you think it relates to the title of the book/to what we studied about… /to the experiment we conducted on….?" You can use a document camera to show students the illustrations on an interactive whiteboard. Alternatively, if a document camera or interactive whiteboard is not available, teachers may give the copies of books to students so they can follow the teacher's Picture Walk.

Gestures can help students build visual connections to the content.

Picture Walk can be used instead of a Read-Aloud or before it. A Read-Aloud follows the same principles as Picture Walk, except that teachers read the selection to students out loud, using a document camera so students can follow along. Research indicates that teachers who gesture to visually represent the content they are teaching are more effective than teachers who do not. Gestures can help students build visual connections to the content. For example, during one lesson, Bowden held his hands opposite each other to illustrate the idea that rocks can have opposite qualities (such as smooth or rough); at other times he also had students drag their fingertips lightly over their tabletops and say "smooth" and later, feeling sandpaper, say "rough" (see Resources for a video demonstrating this gesture-association technique).

In addition to gesturing, you can also use enactment. For example, Bowden asked students to physically demonstrate what happens when a snowman melts (as students "fell into the ground," they verbalized their enactment by saying "ooo-waaaahhh"). After this, he led students to make the connection that rocks also melt when exposed to enough heat.

Overall, these techniques give students needed background while building a sense of comfort and familiarity so they can tackle the task of reading on their own.

Assessment

As students work in pairs during the Paired Reading/Summary Writing activity, move around the room to provide assistance and formatively assess student work by identifying challenging vocabulary and misconceptions (e.g., students' asking for help with unfamiliar words, identifying nonessential details, misrepresenting concepts from the book in their summaries). At the end of the reading period, review the work of one to two student pairs to address these issues. You can use a document camera to project student work on an interactive whiteboard and ask students to read their work to the whole class. If this technology is not available, ask one or two pairs to write their final summaries on the board. (To avoid pressuring students who might not want the attention, ask volunteers to share.) This is an opportunity to address student misconceptions regarding identified science ideas, revisit key vocabulary, and focus on one to two grammatical points at a time by inviting the class to discuss the displayed work and compare this work with their own.

Teachers interested in adding summative assessment focused more on student writing may easily adopt the World Class and Instructional Assessment (WIDA) Writing Rubric (see Resources). An example rubric for summative assessment is provided with the online version of this article; this rubric could be used either by the teacher to assess student work or for student peer- or self-assessment, depending on their proficiency. (To facilitate peer-assessment, peer-science and peer-literacy experts could be identified by the teacher or students.) For students who have difficulties in reading and understanding the rubric, the teacher could use a Read-Aloud format to introduce students to the rubric and model how to use it with an example of student summary-writing work.

Impact of incorporating CTBs

In our experience, the positive impacts of these strategies on students' science attitudes and science-vocabulary knowledge are promising (see research results available with the online version of this article), given the nature of student populations including those with low English skills and, often, a lack of prior formal education. However, the strategies described in this article would be beneficial for any students—ELL or non-ELL—who need to improve science attitudes and learn the complex language of science. As such, the ideas described in this article give students experience in the *NGSS* practice of Obtaining, Evaluating, and Communicating Information, while supporting their exposure to the disciplinary core idea of Earth's Materials and Systems and the crosscutting concepts of Cause and Effect, Energy and Matter, and Stability and Change, thus supporting the *NGSS*'s advocated three-dimensional, blended learning. ■

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Resources

National Science Teachers Association's *Outstanding Science Trade Books for Students K–12—www.nsta.org/publications/ostb*

Paired Reading in action, with no teacher narration—*www.youtube.com/watch?v=_eqKyzU4cel*

Reading Aloud, with teacher narration—*www.youtube.com/watch?v=ESUhb2AM3vc#t=30*

Resources on the Web: Science Comics and Cartoons—*www.scienceinschool.org/repository/docs/issue14_web.pdf*

Students modeling Paired Reading, with teacher narration—*www.youtube.com/watch?v=nq4dYpfXa8Y*

WIDA Writing Rubric—*http://bit.ly/GMm7Nr*

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