

Speaking and listening in the science classroom

BY KATHY BIERNAT AND LAURA RILEY

To be literate, you must be able to not only read and write, but also speak and listen. “Literacy practices support learners by enabling them to grapple with ideas, share their thoughts, enrich understand-

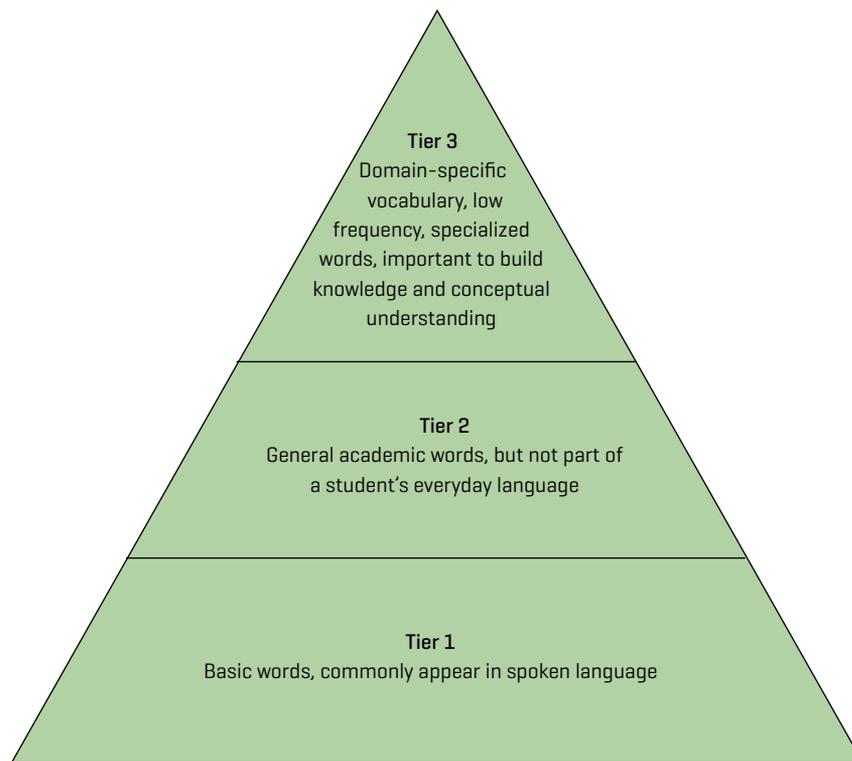
ing, and solve problems” (Krajcik and Sutherland 2010). This column describes numerous literacy practices that can help students master science vocabulary and have in-depth conversations about science topics.

Literacy strategies

One way to provide students practice with Tier 3 (subject related) vocabulary (Figure 1) is to engage students in a quick “bell ringer” activity. Beck, McKeown, and Kucan (2013) classify Tier 3 words as “content-specific vocabulary—the words that are often defined in textbooks or glossaries. These words are important for imparting ideas during lessons and helping build students’ background knowledge.” Give students one minute to work with a partner and write as many words as possible related to a current lesson or experiment. To modify this for English language learners (ELLs) and students with special needs, provide the first letter of lesson words or a picture of the words. As an extension, have students explain a definition of each word on their list.

Another way to help students master Tier 3 vocabulary is by posting a word wall in your classroom (Figure 2). Word walls increase vocabulary retention through repeated daily exposure to Tier 3 terms. Additionally, using semantic maps (Figure 3), or a web

FIGURE 1: Tiered vocabulary



BECK, MCKEOWN, AND KUCAN, 2013

FIGURE 2: Interactive word wall [Jackson et al. 2017]



of words, as a graphic organizer will help students identify important words and see how they fit together. This strategy visually depicts relationships among words and concepts while creating a deeper understanding of the vocabulary. According to Reading Rockets (2014), “The purpose of creating a (semantic) map is to visually display the meaning-based connections between a word or phrase and a set of related words or concepts.” You can even post your student’s work in the classroom as visual support. For more on word walls, see Jackson, Trip, and Cox 2011 and Jackson et al. 2017.

Moreover, students may create a science vocabulary journal where they write and draw important science vocabulary terms. Students can use a graphic organizer, such as a Frayer model, with each word. In a Frayer model (Figure 4), the student analyzes the word and gives a definition, describes the essential

characteristics, and provides examples and nonexamples. (See Online Supplemental Materials for a blank Frayer model.) You can extend this by having the student include a visual representation of the term. Additionally, free vocabulary organizers are avail-

able for download at Freeology (see Resources). Other extended vocabulary activities to use in the classroom include reading nonfiction text such as newspapers and online articles, playing dictionary games, doing word puzzles, using a thesaurus, learning root words, and understanding prefixes and suffixes. More free, vetted strategies and tips can be found at BetterLesson.com (see Resources).

Group discussions and writing prompts

Group discussions are another way to give students a chance to voice their ideas. In a whole-class discussion, the teacher guides the conversation to achieve a specific purpose. However, a successful discussion depends on adherence to several rules. The

FIGURE 3: Semantic maps

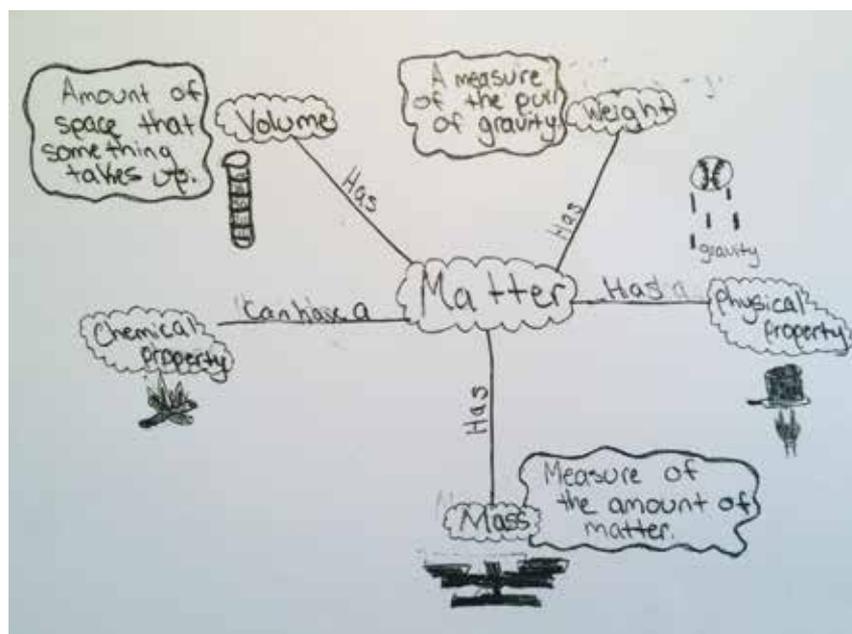
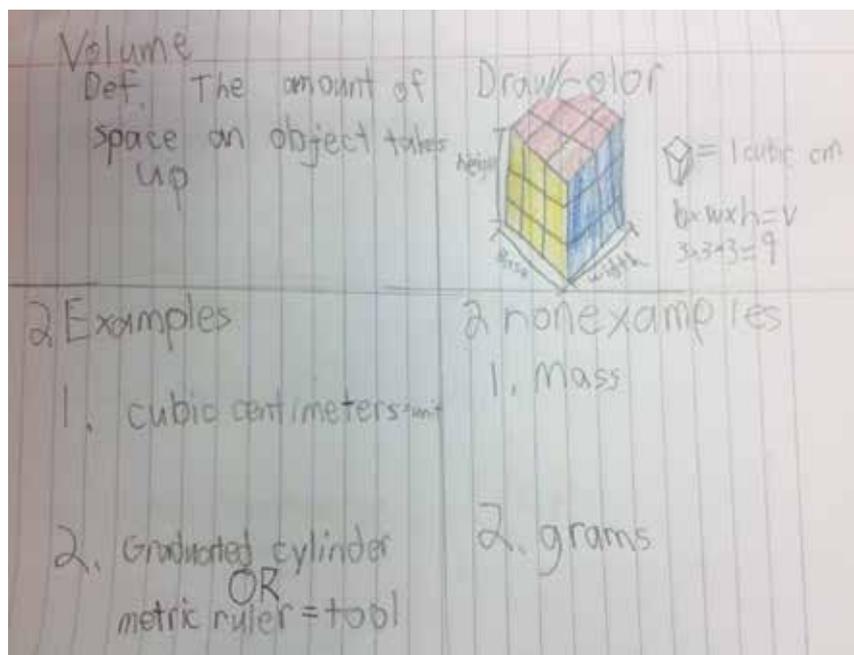


FIGURE 4: Frayer model



Center for Research on Learning and Teaching (see Resources) suggests the following rules to keep conversations respectful and productive:

1. Allow others to speak without interrupting.
2. Only contradict statements when justified.
3. Understand that there are different approaches to solving problems.
4. Don't exaggerate.
5. Have facts to back up your statements.

The teacher must ensure that all students adhere to the rules and have opportunities to participate in discussions. Additionally, the teacher is ultimately responsible for keeping the conversation mov-

ing forward and on task.

What does this look like in the classroom? In a recent classroom discussion about whether or not we should explore Mars, several students began asking questions about black holes. They were following the guidelines for productive discussions in that they were taking turns instead of interrupting each other. However, they did not understand the purpose of the discussion. While seemingly off-topic questions can be interesting and lead to great conversation, the teacher had to redirect the students to the topic at hand by saying, "Let's hold that thought for now. We will be discussing black holes in a few days. Right now, I want to know if you think there is value in humans exploring Mars."

Students may have gotten off task because they wanted to learn

about black holes instead of Mars exploration. Another reason could be that students simply did not have the information they needed to discuss Mars exploration and tried to change the subject. Just as with a formal presentation, students need to be prepared to discuss the topic. This can be done by seeding the discussion in the previous class by saying, "Tomorrow, we will be taking the information we have learned about Mars and rover exploration and talking about whether or not humans should be sent to Mars." This gives students a heads-up about what they should be prepared for and will help them focus on the purpose of the discussion. Then, the next day, the teacher can begin with, "Who can tell me some of the things that the rovers have discovered about Mars?" and follow that with, "Given what we have learned about Mars already, what do you think about the idea of humans exploring Mars? Take five minutes to think about your response, and then we will talk about them as a class."

You can help students focus their comments by writing discussion prompts on the board, such as:

- I think _____ because _____.
- Another way to solve this would be _____.
- In order to solve this problem, I need to know _____.
- I agree with _____; however, _____.

- The findings were significant because _____.
- A source of error was _____ because _____, but next time we could _____.

Prompts give students a place to start their discussions and help them focus and stay on task. Imagine how the group discussion of Mars exploration might have changed if students were given a prompt of, “I think humans should / should not explore Mars because _____.”

Small-group discussions need to follow the same rules as large-group discussions and also must have a clearly defined purpose. Keep in mind that students need to be able to talk to a range of classmates. Students should not be placed into groups only by proximity of their desks. Be sure that they are not always talking to their friends or peers with similar levels of understanding.

Presentations

Give students the opportunity to practice their speaking and listening skills through a formal presentation. In presentation situations, students come prepared to communicate by researching their topic, practicing their presentation, and even bringing in props or visuals. After students gather their research, guide them to create a display board for all to view (Figure 5).

Then give classmates an opportunity to participate in a “gallery walk,” which allows students

FIGURE 5: Display board

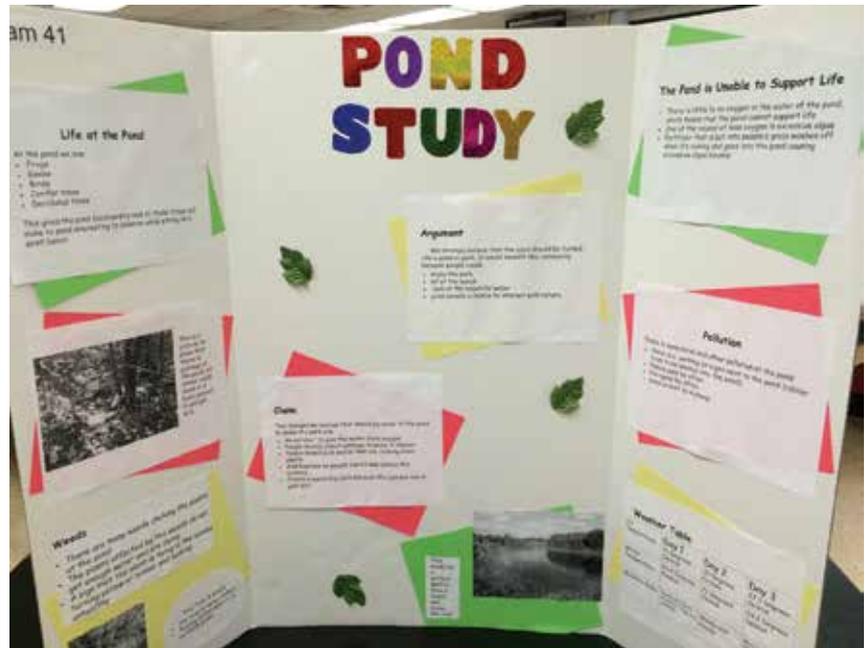


FIGURE 6: Science dialogue example

Circulatory System Dialogue

By Will and Sam [Grade 7]

Scene 2: Red blood cell A and Red blood cell B are trick or treating

B: Where should we go first?

A: How about the lungs?

B: OK! The lungs usually have the best kinds of candy.

A and B: Trick or Treat!

B: Oxygen candy?

A and B: yes!

A: I'm going to have some.

B: Me too. A, You're turning red!

A: So are you!

B: I remember learning this in the bone marrow; if we eat oxygen, we will turn red.

A: Oh yeah!

B: Where next?

A: Let's go to the brain, since we picked up some O, and I need to give some to my grandma. It's sort of like her medicine.

to get up and move around the classroom, read and learn about their peers' projects, and interact and ask questions of each other. Have half of the students stay by their displays and present to their classmates who are walking around, then switch. This helps with time management in a large class where there may not be time for each student to speak to the whole class and is especially effective for middle school kinesthetic learners. Adding a short worksheet with a few questions to answer at each station will encourage listening skills as well. As students view their peer's projects and ask questions, you can assess their work using a rubric specifically designed for your project. *Common Core*-aligned rubrics for presentations can be found at ReadWriteThink.org and Bie.org (see Resources). You may also want to talk with the English/language arts teachers in your building to understand how they assess communication skills in their class because incorporating common language on rubrics decreases confusion for the student.

Another engaging way to practice communication is through the use of science dialogues (Figure 6). These are engaging, short pieces where students read and act out roles of "characters" such as Rocky and Plato discussing plate tectonics, or a science history lesson in a dialogue between Aristotle and Galileo

who are dropping items off the Leaning Tower of Pisa. After students have had initial contact with the vocabulary of the lesson, have them write their own dialogues and perform them for the class. This is an excellent way to let students convey what they have learned, practice their communication skills, and uncover misconceptions.

A good source of presentations that can help build students' listening skills is Temple University's engaging YouTube channel, FunScienceDemos (see Resources). This channel includes a collection of over 15,000 science lessons that are presented by master teachers. The videos cover topics in Earth and space science, physical science, and life science, as well as science practices and engineering.

Learning to speak and listen in science is similar to learning a new language. The language of science must be explicitly taught so that students have the opportunity to practice it through vocabulary, discussions, and presentations. These skills are critical to their understanding, not only of science, but of the world. ●

REFERENCES

- Beck, I., M.G. McKeown, and L. Kucan. 2013. *Bringing words to life, second edition: Robust vocabulary instruction*. New York: Guildford Press.
- Krajcik, J.S., and L.M. Sutherland. 2010. Supporting students in developing literacy in science. *Science* 328 [5977]: 456–9.

- Jackson, J., S. Tripp, and K. Cox. 2011. Interactive word walls: Transforming content vocabulary instruction. *Science Scope* 35 [3]: 45–9.
- Jackson, J., E. Wise, K. Zurbuchen, and N. Gardner. 2017. Teacher's Toolkit: Interactive word walls: Visual scaffolds that transform vocabulary instruction. *Science Scope* 40 [9]: 72–9.
- Reading Rockets. 2014. Connecting word meanings through semantic mapping. www.readingrockets.org/article/connecting-word-meanings-through-semantic-mapping.
- Sprenger, M. 2013. *Vocab rehab: How do I teach vocabulary effectively with limited time?* Alexandria, VA: Association for Supervision and Curriculum Development.

RESOURCES

- Bie.org—www.bie.org/object/document/6_8_presentation_rubric_ccss_aligned
- BetterLesson.com—<https://betterlesson.com>
- Center for Research on Learning and Teaching—www.crlt.umich.edu/examples-discussion-guidelines
- Dialogues for the Science Classroom [free download]—<https://moosemosspress.com/science-promo-download>
- Freeology—<https://freeology.com/tag/vocabulary>
- FunScienceDemos, Temple University—www.youtube.com/user/funsciencedemos/featured
- ReadWriteThink—www.readwritethink.org/classroom-resources/printouts/oral-presentation-rubric-30700.html

ONLINE SUPPLEMENTAL MATERIALS

- Blank Frayer model—www.nsta.org/scope1904

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