Multisensory Strategies for Science Vocabulary

By Sandra Husty and Julie Jackson

Support learning about properties of matter for ELL—and all—students with these techniques.

Seeing, touching, smelling, hearing, learning! We observed that our ELL students achieved a deeper understanding of the properties of matter, as well as enhanced vocabulary development, when they were guided through inquiry-based, multisensory explorations that repeatedly exposed them to words and definitions in context. We describe our experiences using the following strategies with a group of third-grade students who are classified as English Language Learners, but it is our belief that all students benefit when science content vocabulary instruction includes a sustained, context embedded, and multisensory approach.

Mystery Canisters

Our exploration of the states and properties of matter begins with a "mystery canister" activity that is a concrete way to introduce students to the idea that matter exists in different states. First, we explain that matter is anything that takes up space and that it occurs in different forms that we can observe with our senses. Then, we divide the students into groups of three to four to begin their matter exploration. Students' task is to sort a set of 35 mm black film canisters containing various unknown objects into three categories based on properties they observe. Groups may shake, rattle, and roll the canisters, but they may not open them as they work to determine their three classifications. We encourage students to write down as many properties they can for each canister. For example, if a canister contains an item that slides from side to side, students note this property along with the fact that the object makes a thud sound when it hits the inside of the canister.

Students usually group items into three categories: canisters that rattle, canisters that "slosh," and canisters that are silent. After group sharing, the students open the canisters and discover what is actually inside. The canisters contain a variety of solids, liquids, and gases (e.g., a marble, a cotton ball, air, a whiff of perfume, water, and colored water). Students are amazed at what they find or don't find. Typically the biggest and loudest reaction from the students is from the cotton ball—they predicted that the container was empty. Another surprise from the students is from the whiff of perfume. Again, most students predicted that the canister did not contain anything.

At this point, the teacher introduces explicit matter-related vocabulary terms with a PowerPoint slideshow. The show presented pictures of solid, liquid, and gas items along with the scientific definitions for *solid*, *liquid*, and *gas* (Solid: A form of matter that takes up a specific amount of space and has a definite shape; Liquid: A form of matter that has volume that stays the same but can change shape (i.e., one cup of water always occupies one cup of space in any container); Gas: A form of matter that does not have a definite shape or a definite volume.) Afterward, student groups label three circles on poster paper as *solid*, *liquid*, and *gas* and then place their canisters into these categories.

Windowpanes

Another effective strategy for developing vocabulary is a visual strategy called a *windowpane* (Pike 1994). A windowpane is a graphic organizer similar to an actual windowpane with equally divided sections that is typically used to introduce new vocabulary, organize information with key points, or describe a process. It may be used throughout a unit of study or as a summative assessment. In our case, we use the windowpane strategy to organize key concepts and reaffirm students' knowledge.

Students are given a piece of paper divided into eight squares and asked to write the vocabulary words *matter*, *solid*, *liquid*, and *gas* in four of the squares. Next, students draw their own pictorial representation of what each word means to them before writing their own definition (Figure 1, p. 34). Students may write "has a definite shape" for a solid and draw a cube, write "liquids can change shape" and draw a picture of water, and write "gas can be everywhere" and draw a picture of a floating balloon. Next, the teacher encourages students to discuss and view one another's pictorial representations and definitions. This ongoing collaborative process supports student adjustments and creates a better product.

Throughout our matter unit, students revise their windowpanes to clarify and support their understanding of the topic and add new vocabulary to the remaining panes. The students' windowpanes are posted in a common area for everyone to see. Being able to see all of the students' work ensures repeated exposure to the content vocabulary.

Hardness Scale

Another activity to deepen students' understanding of matter—in this case solids—is to compare and contrast the physical properties of matter. *Hardness* is the property of matter that describes the resistance of a solid to being scratched by another substance.

To begin, various solids are placed in front of the students and the teacher asks them to classify each object as a solid, liquid, or a gas. "What phase of matter is an eraser? A bar magnet? A stick? A rock? A crayon?" Of course, after the previous film canister classification and window pane activities, all students will respond that each item is a solid.

The teacher then asks more questions. "Are these all the same? How are they different?" Students are encouraged to handle each item for about five minutes and discuss any property differences they may observe. Students often state the obvious use of each object; however, the teacher guides students to discuss each item's properties. Are there differences between these solids? Press your finger into the eraser. Can you do the same to the bar magnet?

Next, the teacher prepares a hardness scale by placing a six-foot strip of blue masking tape on the floor. One end of the tape is labeled "soft" and the other end

"hard." The students are divided into small groups and each group is given an iron nail and asked to perform a scratch test on each item to determine if it is hard or soft. Student groups are asked to come to a consensus about each item and then place it on the blue line. This activity creates a relative hardness scale. Each group explains the rationale behind their placement decisions and the whole class discusses the differences in the physical property of "hardness" in solids.

Bag-and-Tag Word Wall

Many elementary classrooms have word walls displaying vocabulary students have learned in class. To support vocabulary development in science, we created an interactive science word wall—the bag-and-tag word wall—that combines the use of semantic maps (Masters, Mori, and Mori 1993) and kit inventory techniques (Amaral, Garrison, and Duron-Flores 2006). Semantic maps are graphic organizers that help students identify important ideas and how those ideas fit together. They visually showcase relationships and may also be referred to as a web or concept map. Kit inventory techniques emphasize vocabulary development, oral language practice, and revealing prior knowledge about the topic.

A bag-and-tag word wall is a way to present vocabulary to students while providing an ongoing visual representation that can also be touched and felt. The word wall includes a visual representation of the word (in a bag) and a vocabulary label (a tag) to accompany it. Vocabulary definitions are optional.

Students enjoy making contributions to bag-and-tag word walls. They can supply the items to be bagged, create the tags, and suggest relevant connections. This method for teaching science vocabulary supports students across ability levels because all students are given an opportunity to personally interact with the objects on display. Seeing, touching, smelling, and hearing items creates a deeper understanding of science vocabulary words.

Putting It All Together

Combining the various vocabulary techniques in one unit of learning is not hard to do and can be useful in fostering student understanding. We combine the use of windowpanes and bag-and-tag word wall in our exploration of liquids. First prepare sealed, clear plastic containers of the following liquids: tap water, colored water, corn syrup, cooking oil, liquid detergent, liquid dish soap, and fabric softener. Allow student groups time to observe the different liquids. Encourage them to find out as much as they can about the liquids in the containers without removing the caps. After students have conducted free exploration of the liquids, the teacher asks guided questions (e.g., "How are the liquids different?" "Do all of the liquids move the same?" and "What happens when you shake the bottles?") to support understanding of the key terms and phrases: *bubbly, translucent, has color, transparent, foamy,* and *viscous*.

Student groups have discussions about their observation of the different liquids, then the teacher bags and tags the liquids to explicitly teach vocabulary by matching each liquid to its appropriate description (Figure 2). The teacher pours the tap water from the container into a zipper-top plastic bag, seals the bag and attaches a *transparent* tag (label). The "transparent" bag and tag are then added to the word wall. Students simultaneously complete a "properties of liquids" windowpane. To do this, students draw a container holding a transparent liquid, write their own definition of *transparent* (e.g., "see-through"), and describe its characteristics in a square. Next, the teacher bags and tags the next liquid, and students again draw a picture, write their own definition, and list appropriate characteristics in a windowpane square. The teacher bags and tags all the liquid samples while the students follow along, completing their windowpane.

Once students complete their properties of liquids windowpane, the teacher shows a PowerPoint slideshow illustrating each of the liquids in the activity. Slides include a liquid term, a picture of an example, and a scientific definition. For example, the slide for *transparent* shows a picture of a bottle with a transpar-

Figure 1.

Windowpane example.

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ent liquid in it (e.g., distilled vinegar). The definition "things that are clear and that you can see through are called *transparent*" accompanies the picture.

Students then confer with one another to check for accuracy in their windowpane, making changes to the windowpanes as needed. The teacher creates different student pairs to provide further opportunities for students to collaborate and correctly define and exhibit on their window pane what *transparent* means. Ultimately, the properties of liquids word wall includes all bagged and tagged liquid items and the students' completed liquid windowpanes with their illustrations, descriptions, and definitions. This provides multiple exposures to words and meanings.

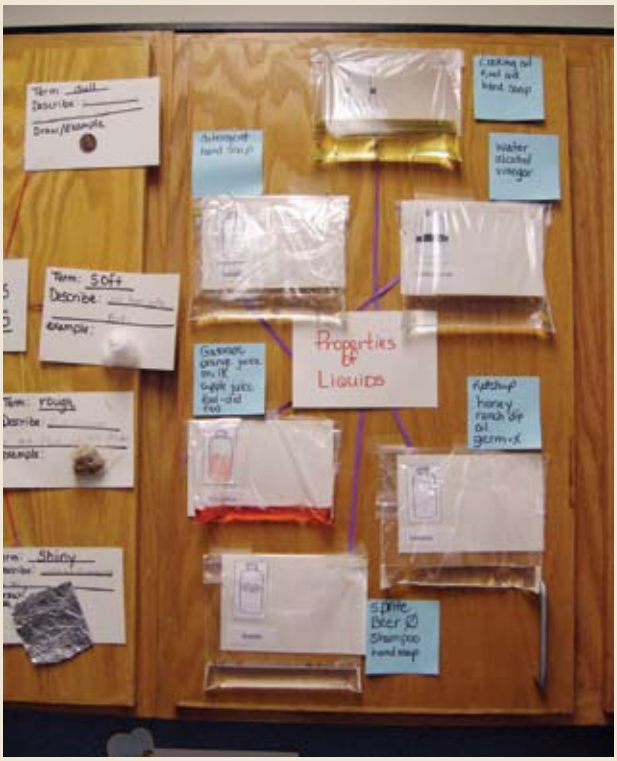
Assessment and Connections

Windowpanes offer useful opportunities for authentic assessment of students' understanding of scientific concepts and vocabulary throughout a unit. They can be used as ongoing formative assessments as well as culminating summative assessments. When used as a formative assessment, the teacher constantly monitors students' understanding of scientific vocabulary by observing individual windowpane elements. Do sketches properly represent scientific concepts? Are sketches properly labeled? The teacher can also use the windowpane activity as a measure of their own teaching and make lesson adjustments to ensure all students understand. Completed windowpanes display scientific vocabulary and conceptual understanding.

Setting up your classroom so students can informally see, hear, touch, manipulate, name, and discuss the differences in the properties of matter and its related vocabulary supports science learning for all students. Throughout the school year, students are touching, testing, naming, and discussing the items placed around our classroom. With the implementation of inquiry-based exploratory science that incorporates windowpanes and the bag-and-tag word wall, each student has a personal and ongoing connection, as well as a deepened understanding, of the properties of matter. ■

Figure 2.

Bag-and-tag word wall display.



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Connecting to the Standards

This article addresses the following *National Science Education Standards* (NRC 1996):

Science Teaching Standards

Standard A

Teachers of science plan an inquiry-based science program for their students.

Standard B

Teachers of science guide and facilitate learning.

Standard D

Teachers of science design and manage learning environments that provide students with the time, space, and resources needed for learning science.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press.