Methods & Strategies

Ideas and techniques to enhance your science teaching

Connecting Science and Literacy Through Talk

Third graders sit in a literacy circle and talk simple circuits in science class.

By Jeff Winokur, Karen Worth, and Martha Heller-Winokur

"Actually, electricity can jump from wire to wire." Jen, a third-grade student, made this statement after having spent nearly four weeks investigating simple circuits with her class. Her teacher taught the class specific whole-group discussion skills during a literacy block and convened a discussion during science. Because of those efforts, the class was able to engage in a lengthy scientific discussion (more of which we'll hear later), in which Jen felt comfortable sharing her thoughts—and in which her classmates were expected to challenge one another.

Benefits of Talk

Talk is central to how science is practiced and should be considered an important component of elementary science instruction. The National Research Council's report, *Taking Science to School: Learning and Teaching Science in Grades K–8* (NRC 2007) reviewed research on how students learn science and analyzed the past 20 years of standards-based reform efforts. According to the report, "Students who are proficient in science:

1. know, use, and interpret scientific explanations of the natural world;
2. generate and evaluate scientific evidence and explanations;
3. understand the nature and development of scientific knowledge; and
4. participate productively in scientific practices and discourse" (p. 2).

Despite the important roles of debate, argument, and other forms of oral communication in science, *Taking Science to School* notes that discussion tends to be overlooked in the elementary science classroom. Talk is crucial in science classrooms for many reasons, including its use as a vehicle for uncovering reasoning pathways and naive conceptions such as Jen's. Scientists and elementary students alike benefit from talking through their thinking, articulating and defending claims, and debating conclusions—all essential to the process of scientific inquiry. Yet many elementary teachers who teach science do not plan time for whole-class discussions in science. Those who engage their students in hands-on activities often feel that the most important use of the little time available for science should be the direct experience. Although direct experience is crucial to inquiry, students may learn little from the hands-on experiences if they are not given adequate time to make meaning from them. Even where they occur, not all discussions push students to do their own thinking and to interact with one another. Some are not really discussions at all; rather, they are often just a series of teacher–student interactions in which individual students respond to teacher questions and others pay little attention. Yet, in many of these same classrooms, discussion skills are taught explicitly and practiced in literacy as students make meaning of text during interactive read-aloud and literature discussions. As professional developers, we have found it critical to work with teachers so they see the need for this kind of discussion in science and to highlight strategies that help teachers facilitate effective whole-group science discussions.

Mystery Boxes

To illustrate how such discussions can support student science learning, we will drop in on different moments in the discussion in which Jen makes her statement about jumping electricity. The 21 students had constructed simple circuits in a variety of ways. First, students used motors and holiday lights, both of which already have two wires attached, making the wires' connections to each of the battery's terminals relatively obvious for the students. Next, they spent time using one wire, one D-cell battery, and one flashlight bulb to construct circuits. This presented additional challenges for the students because it was not immediately obvious which points on the bulbs and battery were the places, or the critical contact points, that needed to be connected by the wire to complete the circuits. At the time of this discussion, the students in this class have all successfully completed circuits using the materials and have recorded their findings with drawings in their science notebooks.

The teacher plans to introduce a series of "mystery boxes" (cardboard boxes approximately 10 in. × 6 in. × 3 in.) that all look the same from the outside with a wire protruding from two ends of the box. There are two batteries inside each box which may or may not be connected to the protruding wires or to each other. Students must apply their knowledge of complete circuits to determine how the wires and batteries are connected. Before she sends the students off to investigate, the teacher conducts a whole-class discussion, with one box as an example, to encourage students to think about how they will solve these mysteries.

Active Listening

The students sit on a rug in a circle, their science notebooks with them. The class always sits in a circle during discussions in language arts, but the use of this practice, along with science notebooks, is relatively new during science. In language arts, the students discuss books they are reading. They have learned to interact with one another without raising their hands, a practice they have begun to use in the science discussions as well. The teacher has taught—and the students have practiced—other skills such as active listening and respectful wording when disagreeing with a classmate, all of which contribute to productive discussions, such as the following:

"There's no connected battery in this box. It's just one wire going through or two separate wires that aren't touching. So, then how can we figure that out? Jen, you looked earlier like you wanted to say something. Do you have an idea?" (Teacher)

"Well no." (Jen)

"Can we put batteries and a bulb and see if—" (Anita)

"Put them where?" (Teacher)

"We could put a battery—one wire touching one end—and then the other wire touching the bulb and then the bulb touching the battery. And if the bulb lights up that means it's like one long wire coming through both ends of the box." (Anita)

"Why do you think that will work?" (Teacher)

"Because it's going to be a full circuit if it's one long wire." (Anita)

"And if there's one long wire, it can just flow right through the whole wire, come back up, and make a complete circuit." (Eddie)

"Actually, electricity can jump from wire to wire." (Jen)

What has this discussion revealed thus far? We hear Anita and Eddie describing possible ways to address the mystery. This interaction is prompted by the teacher, who is pushing the students to be more precise and to support their claims. We also hear from Jen, who despite her experience with simple circuits, believes that electricity can jump. This is important information for the teacher. Let's return to the

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class's discussion to see what happens.

"Do you have anything in your notes about electricity jumping from wire to wire when we've been lighting bulbs or working with motors?" (Teacher)

"I do." (Dayanne)

(*To all*) "Look in your notebooks because I don't remember that coming up in our conversations. Check your notebooks. Dayanne is saying that she thinks electricity can jump from wire to wire." (Teacher)

"It can jump from wire to wire because at my table, we had four batteries, and one wire wasn't long enough, so we had to take another wire and connect those two wires together to light the bulb up." (Sarah)

"Go ahead, Jorge." (Teacher)

"That's not jumping from wire to wire. You're just holding two wires together to make one long wire." (Jorge)

"I don't understand—" (Sean)

"Look at your diagrams. Were your wires touching?" (Teacher)

"No, they weren't long enough. But they still lit up." (Kristina)

"You have notes in your notebook—everyone should check this because I don't remember this—where you had wires that didn't touch and still lit a bulb?" (Teacher)

"No." (Elena)

"Do you have that in your notebook?" (Teacher)

"My group did the same thing. We tried four batteries, and we knew one wire wouldn't be long enough, so, we connected one end of the wire to another wire. Then we put them on the side, and we'd light a bulb." (Maggie)

"So, you're saying, though, you connected them to make one longer wire?" (Teacher)

Talking to Each Other

Here we see an increase in the number of participants, as often occurs in classrooms in which students have been taught discussion skills, in which discussions happen regularly, and in which students are encouraged to talk about their thinking. We hear students challenging one another, trying to convince not only the teacher but each other about the conditions necessary to complete a circuit. Some do seem to believe that electricity can jump. And the teacher, without furnishing "the answer," is pushing back, challenging students on both sides of the debate to use evidence to support their claims. The students are using words to describe what they did with the materials and referring to their notebooks for evidence. Many students have access to the discussion, a number of ideas are out on the table, and the need for accurate recording has been established. We turn back to the discussion:

"They weren't this far apart. They were really, really close (gestures with fingers)" (Kristina)

"That means they were probably connected." (Eddie)

"No, like if they were really close, it could look like they were connected, but they might not be. And then the electricity could jump from that far apart. Then it could still light up the bulb because they were really close, but it would look like they were connected." (Jen)

(*Many students are talking at once*).

"I'm going to stop again—sorry. I know there are a lot of voices that are trying to get in. But I'm still hearing from Dayanne and Kristina that it *might*—or it *may* have. You have been taking really careful notes. I'm going to push you to prove it to us. Do you have a picture or a recording anywhere—and I'm asking everybody this—of evidence where you didn't have wires connecting that then lit a bulb? Do you have that, Dayanne?" (Teacher)

"No." (Dayanne)

"Kristina?" (Teacher)

"We didn't do it, but I think it could if it was really close." (Jen)

"You think it might. But that's different, right?" (Teacher)

"Then to prove that, all we have to do is test it." (Jen)

The next day, the teacher provided the students with materials to test their idea.

Whole-Class Engagement

Students can benefit from engaging in this whole-class discussion as they listen to others say what they were thinking. As *Taking Science to School* indicates, "Greater engagement can be inferred when more students in the group make substantive contributions to the topic under discussion and their contributions are made in coordination with each other. Engagement also means that students attend to each other, express emotional involvement, and spontaneously reengage with the topic and continue with it over a sustained period of time. Finally, it means that few students are involved in unrelated or off-task activities." (NRC 2007, p. 194)

In this case we know of at least 10 students who are talking. What we cannot see in this transcript is that others, though quiet, seem clearly engaged. They are looking at the person who is talking and searching their notebooks for evidence. The discussion allows those who share Jen's idea to share their thinking without fear of being wrong. The students expect to be challenged to support their claims. They hold each other accountable for the ideas, thinking, and evidence they are sharing. Having had a common experience, they are easily able to respond to one another using evidence from their science notebooks.

Four Basic Steps

These kinds of all-class discussions in which students are engaged in their own science reasoning and thinking are vital to student science learning and represent genuine connections between science and literacy. But these discussions cannot happen on their own—they require willingness to move students to a circle, and they take time from hands-on experience. They also require that teachers make time for explicit teaching—conducted here during a literacy block—of skills such as active listening, engaging in discussion without raising hands, and talking to and with each other rather than just to the teacher. With each skill, the teacher takes the following four basic steps:

1. Assesses students' discussion skills to identify areas of weakness;
2. Designs a mini-lesson to address the weakness (e.g., helping students talk with and listen to each other, not just the teacher);
3. Encourages students to practice that particular skill; and
4. Assesses once more to see if more practice or instruction is required

The benefits are clear. When students are motivated, engaged, and have opportunities to practice and develop discussion skills taught during literacy time, they can deepen their understanding of science concepts. Communication is an important tool for the development of scientific knowledge; group discussions such as the one portrayed in this article are critical to the development of student understanding of concepts and of the nature of scientific inquiry. They not only help students communicate, they help students become proficient in science. ■

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Connecting to the Standards

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

Content Standards

Grades K–4

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry

Standard B: Physical Science

- Light, heat, electricity, and magnetism

Teaching Standards

Standard B: Teachers of science guide and facilitate learning. In doing this, teachers

- Orchestrate discourse among students about scientific ideas.

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

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Reference

National Research Council (NRC). 2007. *Taking science to school: Learning and teaching science in grades K–8.* Washington, DC: National Academies Press.