Mr. Russell's Fourth-Grade Class

Fourth-grade teacher Donald Russell wants to ensure that his students connect the NGSS crosscutting concept related to cause and effect to the core content, while still addressing the CCSS and 4-PS3-1. To accomplish this, he takes his students outside and rolls a tennis ball across the ground. He asks them to notice the motion, or rolling movement, of the ball. The second time he does this, he asks a student to start a stopwatch as the ball begins to roll and stop it when the ball comes to rest. Mr. Russell records the time—5.4 seconds. This time, he tells students that time is a measure of how many seconds go by as the ball moves. Mr. Russell models how to speak the language of science by using the words he wants students to use. Table 2.5 demonstrates Mr. Russell's lesson plan.

Mr. Russell then uses a meter stick to measure the distance the ball travels—7.2 meters—and he marks this on the ground with chalk as he says, "I'm putting marks where the ball started and stopped. If I take my meter stick and measure the distance between my marks, I will know how far the ball traveled." While most of the students don't have a sense of distance in meters, they can conceptualize and actually see this distance marked on the ground. He then asks his students, "If I roll the ball faster, will it take more or less time to travel the same distance, 7.2 meters?"

Using Known and Observed Data to Make a Prediction

To support his students in speaking about content, Mr. Russell introduces them to language frames and explains that they will help start scientific conversation. He says, "I'd like you to talk to your partner using one of three language frames:

1. I predict that the ball will _____.
2. Based on what I know about motion, I think _____.
3. Because of my past experience with motion, I believe _____.

Mr. Russell explains that the language frames are ways for scientists to start a sentence in response to a scientific question, like the one he posed about the ball. He tells them that scientists use the term predict to indicate they are making a good guess based on what they know and what they have experienced in their lives. He adds that the word notice is a way to say that you see or observe something. To help the students use these language frames, Mr. Russell holds up a poster paper with the sentence starters neatly printed on it.

He listens in as Sharon tells her partner, Nick, "I predict that the ball will move farther if Mr. Russell rolls it faster." Nick adds, "Based on what I know about motion—I ride my bike everywhere—I think that if Mr. Russell rolls it faster, it's going to move more meters in a shorter time. That means it will get to the chalk mark quicker." Mr. Russell compliments Sharon, noting that she really seems to understand the term distance. He commends Nick for drawing on his background knowledge and experiences to come to a conclusion, adding that that's exactly what scientists actually do when they are making predictions.

Table 2.5: Fourth-Grade CCSS for Speaking and Listening and Language and NGSS Lesson Plan on Earth and Space Sciences

Crosscutting Concept	Earth's systems
Core Idea	The roles of water in Earth's surface processes
Lesson Purpose	Understand and discuss how the processes of weathering and erosion affect the surface of the Earth
Focus Strategy	Chunking texts to support science reading and using discussion webs to streamline information sharing Thinking aloud to model how to read and think about information in the text
NGSS 4-ESS2-1. Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation. 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	
CCSS • Speaking and Listening standards: SL.4.1. Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly. a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-on rules for discussions and carry out assigned roles. c. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. d. Review the key ideas expressed and explain their own ideas and understanding in light of the discussion. SL.4.2. Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. SL.4.4. Report on a topic or text, tell a story, or recount an experience in an organized manner, using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.	
• Language standards: L.4.1. Demonstrate command of the conventions of standard English grammar and usage when writing or speaking. L.4.3. Use knowledge of language and its conventions when writing, speaking, reading, or listening. L.4.6. Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases, including those that signal precise actions, emotions, or states of being (such as *quizzed*, *whined*, *stammered*) and those that are basic to a particular topic (such as *wildlife*, *conservation*, and *endangered* when discussing animal preservation).	

Source: Adapted from NGA & CCSSO, 2010a, pp. 24, 28, 29, and Achieve, 2013a pp. 23, 26, 32.

Talking Like a Scientist

Every time Mr. Russell asks his students to have a science conversation, he provides them with science talk options using language frames. Over time, if they have ongoing opportunities for practice, Mr. Russell's students will internalize this way of discussing science content, and science talk will become more natural and automatic for them. During the course of the year, he alters the frames to include conditional language (if/then, because, when), adjectives, and adverbs (strongly, increasing) that are common in the language of scientists. A few additional examples he shared include:

- When I look at the data, I notice _____.
- The text states that _____.
- The increasing speed was due to _____.
- When I strongly pulled on the string, the car moved _____.
- If I pull with increasing strength, the car moves _____.

For other suggestions, see the Schools Focused on Science website at http://biochemistry.ucsf.edu/programs/sep/school-programs-schools-focused-on-science.html.

Questions for Discussion or Reflection

1. Did you notice that these students were basing their predictions on facts they were learning from this investigation? They were easily discussing scientific information in a give-and-take manner that indicates their understanding of how to use conversational discourse within a content-based interaction. This occurred because Mr. Russell planned very intentional instruction involving the use of language frames that promoted deepening language exchanges. What other examples of intentional instruction using language frames, or going beyond their use, can you identify that could foster science talk in your classroom?
2. Think about the scientific language you want your students to develop. What kinds of investigations might students conduct with partners so that they have shared experiences around which they may have a science conversation? What would be the science and language purposes of each?
3. Which grade-level NGSS and CCSS does your instruction address?

Students need to engage in conversations while making observations and collecting data. The conversations reflect thinking and provide an opportunity for the teacher to do on-the-spot progress monitoring. Providing students with particular language frames—ones that are relevant to the task at hand—gives them a scaffold on which to hang their thinking. Eventually, an astute teacher can remove the scaffold to allow the students to choose and use their own science language to discuss content. Scaffolds are temporary supports that need to be removed as proficiency builds.