The Language of Science in the Reading and Writing of Student Scientists

By Carol Donovan and Julianne Coleman

A group of second- and third-grade teachers meet after one of a series of workshops on interdisciplinary planning. Consider their conversation:

Angela: Wow, I like that idea of a language of science. I know we talk about what we are doing during science activities, and we read about the topic and write in our notebooks, but I hadn't ever really thought about the language we used being somehow different or special.

Violet: I thought that was interesting, too. I understand how to plan the lessons using the *NGSS* standards, but what writing fits in? Are science journals enough? Can we just have the students write what they observed after each lesson?

Tony: That's what I do, but in the workshop I heard the presenter say "genres of science" and the importance of explanation and argumentation to science, but I'm not sure I know what that means for elementary students other than what we keep in our journals and how we talk about the experiences and experiments. Is this what the *Common Core* means by informational/explanatory writing?

Rona: I'd like to know more about that,

TABLE 1

Genres of science writing for elementary grades.

SCIENCE GENRE	PURPOSE/LANGUAGE FEATURES/STRUCTURE	SCIENCE TOPIC EXAMPLE
Information Report	Provides information by giving facts about the general class of a topic, including attributes and characteristic events in timeless present tense	**Bean Plant Growth** Observed phenomenon such as recording the daily observations of bean plant growth over three weeks—descriptions of the way the seeds look and change (not the lifecycle)
Procedures	Tells how to do, make, or create something in timeless present tense so that anyone could follow in the same manner, often created in sections with materials and numerated steps	**How to Make a Mentos Geyser** Instructions including materials and procedure for how to make a geyser using a 2-liter soda bottle and a package of Mentos candy
Explanation	Describes how something happens or how something works with a focus on the process of how and why rather than factual descriptions of the topic in timeless present tense; includes conditions, procedures, effects, and cause	**How Earthquakes Happen** The how of earthquakes is explained by giving the cause of plate shift and its effect on Earth's crust.

too. I have the students keep science journals for recording and describing investigations and activities and then explaining what happened as a result. They do okay with writing down facts and what we did, but they have trouble explaining the science, and I am not sure how to help them get better.

As seen in this discussion, the convergence of the *Next Generation Science Standards* emphasis on the discipline specific uses of reading, writing, and speaking about science, and the *Common Core State Standards* emphasis on discipline-specific language arts has moved curriculum development into an exciting era of interdisciplinary planning. The language of science, which emphasizes reasoning about the causes and conditions of scientific phenomenon and use of visuals to convey information, can be difficult for young readers and writers without a lot of teacher scaffolding (Pappas and Varelas 2009). It is important that teachers understand these linguistic requirements to support students' writing and reading of the many genres of science. However, as seen in the above discussion, teachers may need additional resources in this area. This article serves as an introduction to the different genres used in the work of doing science. We offer information about each and examples of how they differ in purpose and language features across several topics so teachers can do more to support their young scientists' reasoning as they read, write, and talk about scientific phenomena.

GENRES OF SCIENCE

Scientists use language in many ways during their work. These uses of language have typical features that are consistent and serve specific purposes (Derewianka and Jones 2012). Typical science genres—information report, explanation, procedures and arguments—can be included in the work of children doing science and are found in trade books written on science topics for this age group (Coleman, Bradley, and Donovan 2012). Table 1 provides an overview of each genre to give teachers more information. A similar table could be constructed with students as a tool for teachers to support learning and use of each genre during science activities that include opportunities to discuss writing procedures, explanations, recounts of experience, and arguments about findings. Teachers can create an anchor chart (Figure 1) with their students that records information about the genre, its purpose in science, times they have used the genre during science, and books that include models of the genre.

FIGURE 1

Sample anchor chart (see NSTA Connection).

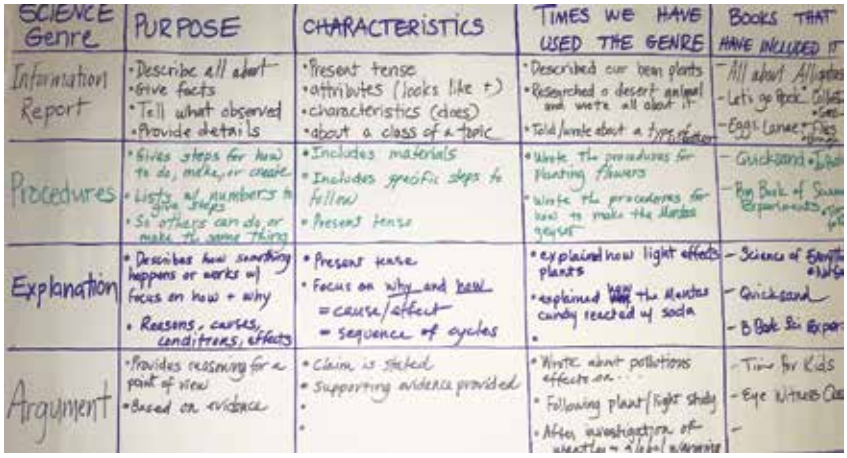
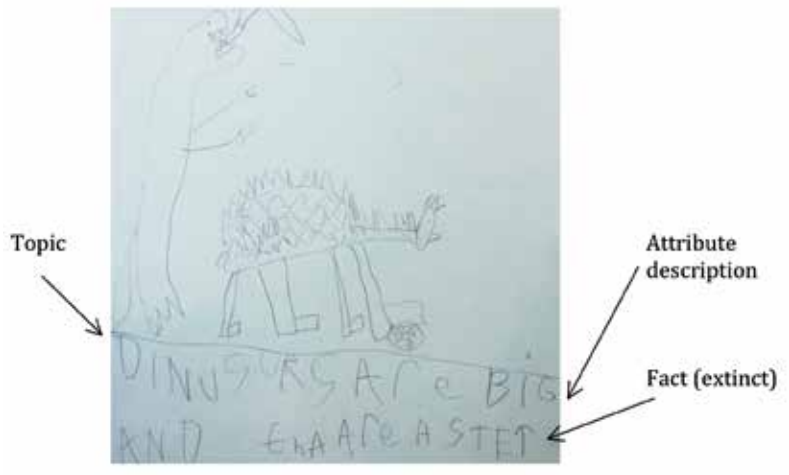


FIGURE 2

A kindergartner's information report.



Drawing on the work of Derewianka and Jones (2012), we have included for each genre the purpose for its use, basic structural elements, and the specific features of language that make them unique. We then provide examples of how that genre might be used within a particular science topic.

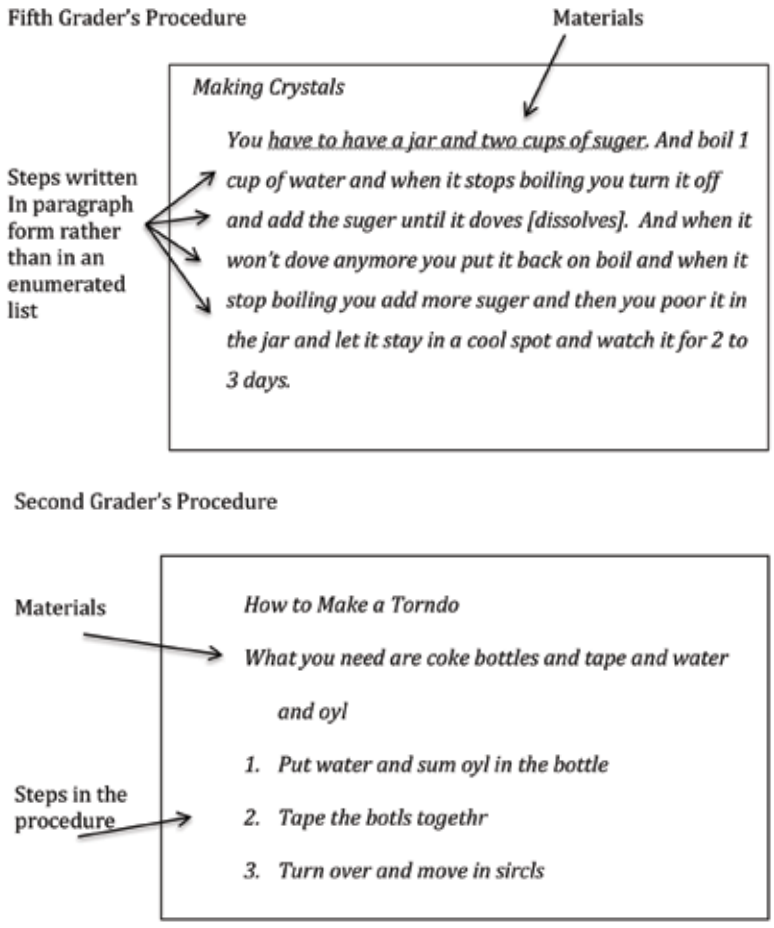
INFORMATION REPORT GENRE

Reporting general information is a large part of a scientists' work, as they must keep detailed descriptions of specimens, places, results, and so on. The information report is the type of text that is created for this purpose. The *Bean Plant Growth* example in Table 1 is one way in which teachers who include this activity (during a study of growth and development (LS1.B) and engage in the practice of obtaining, evaluating, and communicating information by planting bean seeds) can include information reports in the same way that scientists do. When students describe any aspect of a topic under study focusing on the attributes and characteristics, they are using the information report genre. Children often write all about pieces for topics about which they have background knowledge by providing descriptions of what the animal or object looks like (attributes) and what it is used for or eats and how it lives (characteristic events).

Examples of this genre are abundant in informational trade books written for children. Even young children are able to write information reports using genre-specific language. A kindergartner wrote the text in Figure 2, p. 63. He uses language for reporting information in his simple text. Even though reporting about dinosaurs, he uses timeless present to assert, "They are extinct." A teacher knowledgeable about the genre can now scaffold the student to add additional descriptors of the attributes (size, color, shape) and characteristics (function). For example, she can prompt for attributes by asking the kindergartner, "How big are they? Can you compare it to something the same size? I see you made points on its back. What are those called? What are they for?" And she can prompt for characteristics by probing with questions such as, "What do scientists know about what this dinosaur ate? How does it move?"

FIGURE 3

Examples of procedural texts.

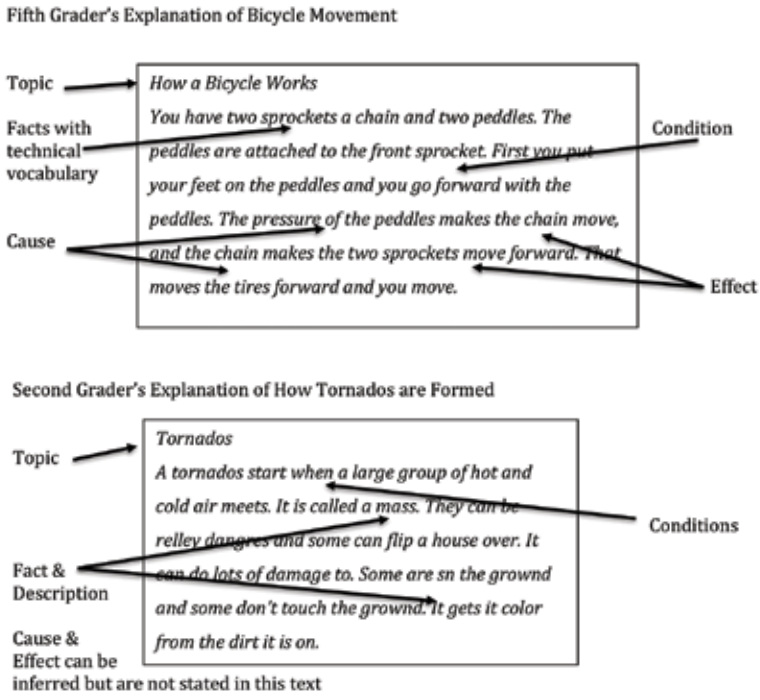


PROCEDURE GENRE

The procedure provides the steps for how to do or make something. In science classrooms, the procedures for investigations are a typical context for this genre. The *How to Make a Mentos Geyser* example in Table 1 is one example of a procedure that may be used in science class to plan and carry out investigations when studying chemical reactions (PS1.B). When students record the materials to be used and steps to be followed for a science project, they are creating a procedural text. Found in science activity books, textbooks, and trade books written for children such as *Time for Kids Big Book of Science Experiments: A Step-by-Step Guide* (Editors for Time for Kids 2011), procedural texts are an important part of science work. Writ-

FIGURE 4

Children's written explanation texts.



ten for others to follow, procedures use present tense, typically list the materials needed, and then provide the steps in the order they must be completed. They may be accompanied with information that tells what should be expected at each step. The use of visuals is common, and children need to learn to read and create visuals as well as text in science (Coleman et al. 2012; Donovan and Smolkin 2011).

Children across the elementary grades can write procedures. See Figure 3 for two student examples. The fifth grader includes language necessary to provide the steps for making crystals in present tense with action verbs, even though it does not use the typical format of providing a list of materials followed by an enumerated list of steps. The second grader also knows the basic features of a procedural text. She used present tense, action verbs, technical vocabulary (e.g., *dissolve*), and the features of a materials list and numbered list of steps. A teacher knowledgeable of the genre could scaffold both students' writing of procedures by starting where they are and working to add more detail in the steps with accurate information. Spelling can always be attended to before the writing is to be read by a public audience.

EXPLANATION GENRE

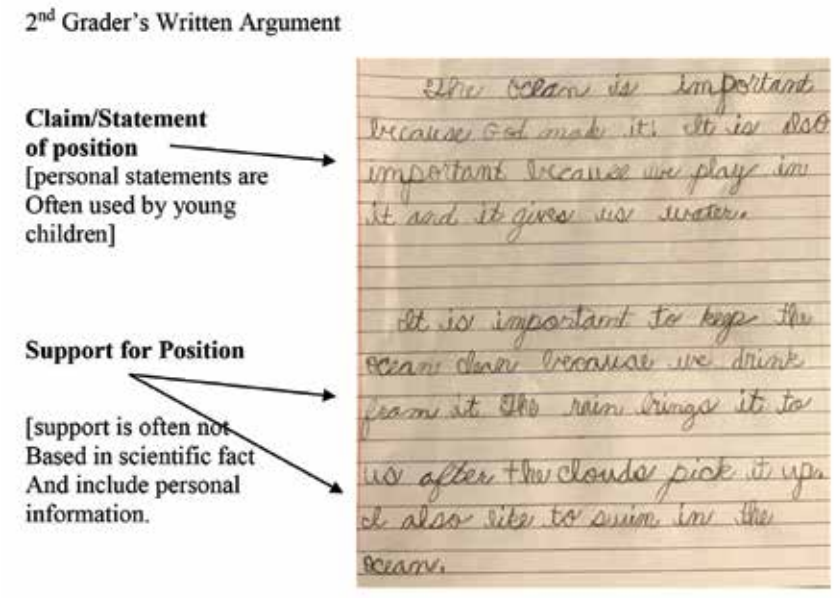
The explanation is an important science and engineering practice to describe why a phenomenon happens, such as tornadoes or lightning, or how something works such as electricity or doorknobs. The typical structure of the written explanation is to state the phenomenon to be explained, "Lightning happens when…" followed by description of the sequence and/or cause of the phenomenon. Explanatory texts include the conditions of the phenomenon (when, if), effects of the conditions (then the air…), and in many cases the causal aspects of how things work or happen (makes, creates, leads to, forces) in sequence of how the phenomenon unfolds.

Learning to reason through explanations of phenomena—how and why—is the heart of science and thus reading, writing, and talk during science activity is always leading to the understanding of concepts and ability to provide an explanation. Explanations of scientific phenomenon written for children can be found embedded in texts such as *Inside Tornadoes* (Carson 2010) and *The Visual Dictionary of Everyday Things* (Brown and Hussey 1991) that include sections of description as well as explanations.

We all know that young children want to know why and how about everything in their world. They seek explanations in their very early questions "Why is the sky blue? How do birds fly?" and on and on. With modeling and background knowledge, children begin to approximate explanatory accounts of phenomenon. Figure 4 presents written explanations of bicycle movement by a fifth grader and tornado formation by a second grader. Each text includes the basic features of explanation, including the statement of the phenomenon. The fifth grader's statement doubles as the title: *How a Bicycle Works*. The second grader's is in the first part of the opening sentence: "A tornado starts…." Both continue with a sequential order of the events that unfold. Each is written in present tense and includes conditions and effects. The fourth grader's text also includes elements of cause of the phenomenon. Teachers can scaffold students' learning about explanation by modeling them during science activities using the language that clearly defines con-

FIGURE 5

Children's argument writing and included features.



ditions, effects, and causal aspects of the phenomenon under study. Information books include embedded explanations that can be used as models for writing explanations.

ARGUMENT GENRE

Using data to support a position is very important to the endeavor of science, and children can be introduced to the argument genre in elementary school (Froschauer 2009). Written in present tense, arguments begin with a claim and then provide support for that claim, sometimes using persuasive language to convince readers of the position taken. Informational trade books on some topics may embed an argument including a call to action. Topics such as rain forests may include an argument for halting deforestation; books on weather may broach the subject of climate change; books about the ocean may include an argument to ban plastic bags to keep sea turtles safe.

The written argument in Figure 5, provided by a second grader, provides an example of emerging ability to take a position and support it using evidence from experiences and background knowledge. Much can be done by teachers to support argumentation in elementary science by modeling and providing written models.

PLANNING FOR THE INCLUSION OF SCIENCE GENRES

Doing science requires the use of language for specific purposes. Find ways to include these genres by considering when they are naturally occurring in your science curriculum. We suggest teachers do the following:

- Model use of different science genres during the science work in the classrooms. Explain, describe, and so on, and ask children to do the same.
- Immerse children in opportunities to explore information books that support learning about science and opportunities to write all of the genres.
- Provide children opportunities to explore and read related information books that include a variety of genres and the accompanying visual representations.
- Know which genres are presented in the text and plan places to model and support children's knowledge of science genres and visuals.

The curriculum demands are great for children and teachers, and we rely on teachers to know content and language requirements across disciplines. If children are to think and reason like scientists, it is essential that teachers know about the different genres used in science and how they differ in purpose and features to best support their young scientists' reasoning as they read, write, and talk about scientific phenomena. ●

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Download the anchor chart from Figure 1 at *www.nsta.org/SC0818*.

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