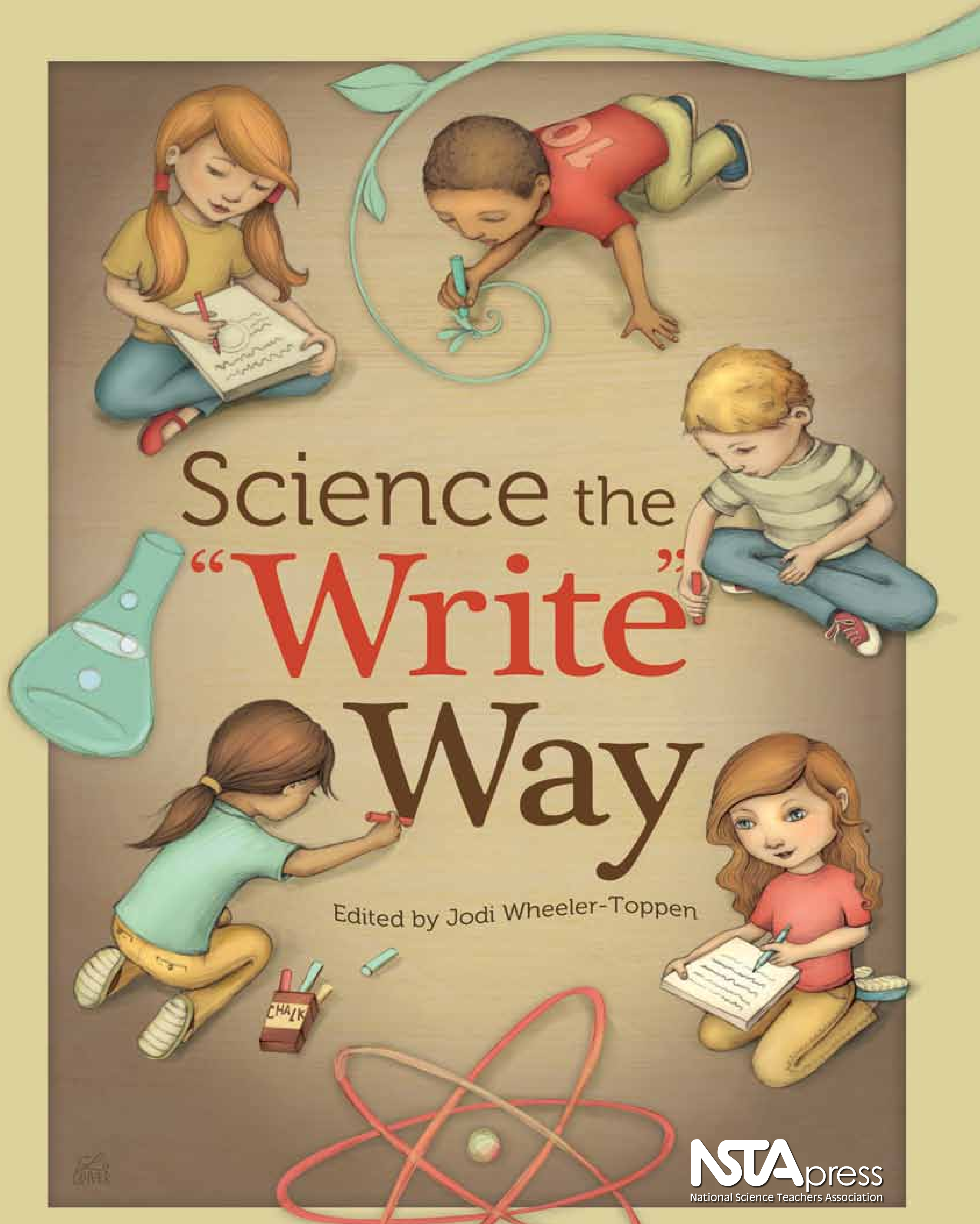
Science the "Write" Way

Edited by Jodi Wheeler-Toppen



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Introduction

As I write this introduction, I am struck by how much this task resembles what we want our students to accomplish when we ask them to write in science class. I sit surrounded by piles of *Science Scope*, *Science and Children*, and research journal articles, as well as pages of scrawled, handwritten notes. Already I have collected, sorted, organized, and reorganized my ideas. As I type them, I will clarify them even further. In short, I am learning as I write.

Why Writing?

There are many reasons to have our students write, but the one that is most powerful for me is simple: Writing helps students learn. While writing, students manipulate and organize their ideas (Langer and Applebee 1987). As they try to explain the concepts they are learning, they may discover gaps in their knowledge (Glynn and Muth 1994). When they use analogies to describe how something new is like something they already know, they link new knowledge to prior knowledge, strengthening both (Rivard 1994). In translating between everyday language and scientific language, they clarify their ideas (Prain 2006). In my classes, I have students write because writing can be a powerful tool for learning.

There are other good reasons to have students put pen to paper (or fingers to keyboard). First, writing is an essential part of the practice of science (Norris and Phillips 2003). Scientists record their findings and interpretations, allowing other scientists to examine their work. This record allows scientists to piece together small ideas, eventually building large theories. Scientists themselves use writing to organize their thoughts and find meaning in their work, reflecting on their own and in communication with peers.

Students' written work also provides a window to their thoughts. Not sure if your students really "get" the molecular nature of matter? Have them write a book that explains the concept to young children (see "Students as Authors," p. 159). You'll spot misconceptions you would never pick up during class discussion. Assessing writing doesn't have to be time consuming. I often have students respond to a question in writing, then quickly scan the answers and sort them into piles based on levels of understanding. This approach lets me know what points need to be addressed and which, if any, students need one-on-one clarification. However, beware of mistaking students' use of science terminology for understanding science material. As Abell points out in "On Writing in Science" (p. 1) students are skilled at throwing around science words to hide their confusion.

Building Basic Skills

You don't have to be trained as an English teacher to integrate writing into your curriculum. However, you may need to practice with students the aspects of their writing that are most important in a science classroom. They may need help learning to put ideas into their own words instead of plagiarizing, or they may require instruction on being specific enough for their readers to understand what they've written. Such skills help students think more deeply about science and enable them to communicate clearly—worthwhile ways to spend class time. Tools for these tasks and more can be found in the second section of this book, "Building Basic Skills."

Writing With English Language Learners

Writing can be an especially important part of the science curriculum for English language learners. Writing not only helps them process the science they are learning, but also gives them needed practice using their new language. Science teachers must ease English language learners into the writing process by integrating it with verbal discussions and drawings to allow ELL students to fully express their thoughts. See the section "Writing With English Language Learners" for more guidance.

The "Write" Way?

What kind of writing should you have your students do? The short answer is that it depends on your goals for the activity. Some teachers want students to replicate reports similar to those found in scientific journals. To generate such lab reports, students need explicit guidance regarding what is expected and how well they are moving toward proficiency (see "Lab Report Blues," p. 111). Learning to write traditional lab reports introduces students to the structure of the formal literature of science. However, the actual practice of science involves many genres of writing, including e-mails, lab notebooks, presentation or seminar notes, and personal writing that helps scientists understand their own research (Yore, Hand, and Prain 2002). In addition, some worry that using formal lab reports as the primary form of writing in science class obscures the underlying thinking involved in developing scientific ideas (Wallace, Hand, and Prain 2004). Resources for both traditional and nontraditional lab reports can be found in the section "Writing in and About Lab Work."

If your goal is to stimulate learning for your students, there are several things to consider (Langer and Applebee 1987). First, think about whether you want students to work on organizing a large breadth of knowledge or if you want them to gain an in-depth view of a smaller subject. They are most likely to learn the ideas directly used in their writing. Second, the more information is manipulated, the better it is understood and remembered. Assignments that help students make new connections include tasks that ask them to reword a text, "translate" an idea into another way of writing, and elaborate and make comparisons (Boscolo and Mason 2001). Finally, keep in mind that if students write about familiar content and they already understand the relationships between the ideas, writing is unlikely to produce new learning.

There are many types of writing that can meet these goals. In part 2 of this book, "Classrooom-Tested Lessons," you'll find examples of different genres of writing that work well in classrooms as well as content-specific activities that you can use right away. You'll notice that these activities require the kinds of thinking described above.

A word on the value of giving students a chance to write for authentic audiences:

Preparing a text for a real person or group, rather than just pretending to do so, is a powerful motivator (Wallace, Hand, and Prain 2004). Students can write for younger children at their school, for visitors to a museum or nature center, for a local newspaper or PTA newsletter, or even for their classmates. For a richer learning experience, students can receive feedback from that targeted group and revise accordingly. Several activities in this book provide suggestions for activities that involve authentic audiences.

Journals and Logs

Many teachers like to have their students collect their thinking and writing in learning logs or journals. When journals are used well, they become an essential part of science class, as integral as the teacher or textbook. Students value their journals because they hold a personal record of learning and ideas. Journals may be primarily focused on investigations, or they may involve reflection on all sources of learning in the science classroom. There are a variety of ways to organize and assess science journals and logs; several systems are described in "Approaches to Science Journals and Logs."

The goal of this book is to provide practical guidance for integrating writing into your classroom. Some articles describe general techniques you can use in any class. Others outline writing activities tailored to a specific topic. Even if you don't teach these topics, you can use such articles as springboards for additional ideas. Whatever science you teach, you'll find strategies and lessons to get you started.

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Chapter 2

Science the "Write" Way:

Nonfiction Writing Activities Help Students Learn Science

By Valarie L. Akerson and Terrell A. Young

Learning to write well is a long process that comes through teacher modeling, instruction, practice, and feedback. Luckily, the writing process can be used to improve science learning, too. Here are a few good writing suggestions that integrate science while helping students develop their informational writing skills.

Science Journals

There is perhaps no better place than a science journal for students to develop informational writing skills. Daily journal prompts are one way to encourage students to write expansively about developing knowledge (see Figure 1 for sample journal prompts).

Figure 1. Sample journal prompts on trees, followed by examples of typical student responses

What do you think is a tree? How is it different from other plants?
I think a tree is wood and leaves. Trees are bigger than plants.

What do you think a tree is made of?
Trees are made of wood and leaves.

What are the parts of the tree? Draw a tree.
Leaves and the wood trunk (Later in the unit they add other parts, such as roots.)

(After we find a tree to "adopt") What is our tree like? What is special about our tree? How do you think our tree might change over time?
Our tree is big. It is special because it is ours! It has big leaves.

Why do you think trees are different shapes? Why do you think their leaves are different?
Because the leaves catch the sun in different ways.

(After several weeks) How does our tree look different? How does it look the same?
The trunk still looks the same. It is getting leaves!

What different shapes of leaves did you find? How can we sort our leaves?
I am putting the big ones together, then putting the spikey ones, and then the skinny ones.

What things can you tell me about a tree now? How do you think it is different from other plants now?
Trees are a kind of plant.

In journals, students make records of what they are doing in investigations—they organize data by creating tables and write observations based on their investigations. They record, via drawing and writing, characteristics of what they observe (e.g., what a pill bug looks like and how it reacts in different settings). In using the journal in this way, students learn that making records of actual observations is something scientists often do and is a useful kind of nonfiction writing.

Beyond recording observations, students can use journals to write inferences based on their observations. For example, if students observe that pill bugs prefer walking on dirt, they could infer that the dirt is similar to the bugs' natural environment—thus making meaning of the observations. Students may find that inferences made from early observations change as they make more observations. This tentativeness in inferences is an intrinsic part of the nature of science, but by making the recordings in their journals, students can track their ideas over time and note any observations that lead to a change in inference.

Observations Versus Inference Charts

Another tool that supports science learning while developing informational writing skills is the observation versus inference chart. We've used this chart successfully to introduce primary students to the distinction between *observation* and *inference*. On the chart, one column is labeled "Observations" and the second is labeled "Inferences." During a class discussion following an exploration, the teacher records student observations under the "Observations" column and then asks students to make inferences about what those observations mean in the "Inferences" column.

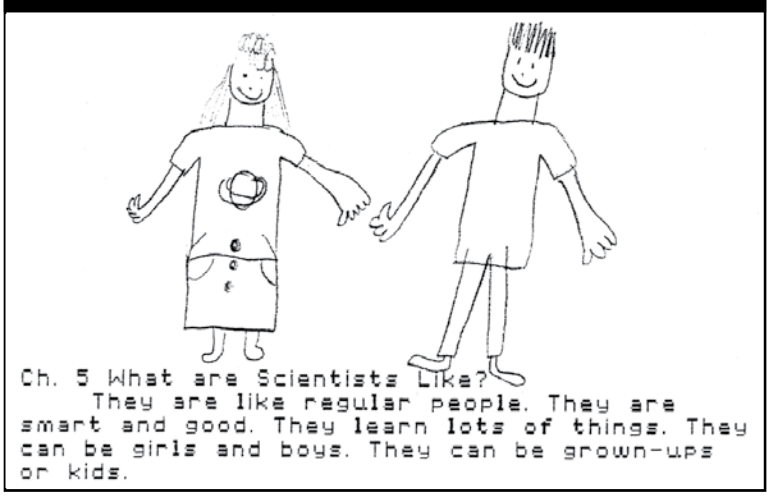
For example, after students have had time to observe snails up close, the teacher would collectively record students' observations (e.g., "The eyestalks move when I touch them") on the chart, then ask students to infer the meaning behind the observation (e.g., "They are trying to move them out of my way—to keep them safe"). The teacher can record the response on the inferences side.

After seeing a few examples, students begin making good distinctions between observations and inferences, and they can be given similar smaller charts in which individual or small groups of students can record observations and inferences about other investigations on their own.

Student-Authored Books

To gain simultaneous insights into a content area, research, and literacy, students can research and write their very own book on a theme such as "A Book about Scientists." Individual students or small groups can research subtopics—"What do scientists do?" "How do I become a scientist?" "What do scientists do in their spare time?"—and write

Figure 2. Sample chapter from a student-authored book called "What Is a Scientist?"



chapters for the book (Figure 2). The chapters usually begin as notes from research or interviews of scientists.

Afterward the book can be published for classroom enjoyment. Publishing a book is another good place to reinforce accuracy in writing in terms of spelling and grammar conventions and the process of writing. Student can edit their drafts—prior notes that they have taken—as they type their chapters on the computer.

After the chapters are compiled, students create a table of contents and a reference list to demonstrate that nonfiction writing must be based on accurate information. Then students can illustrate the chapters with their own drawings.

We keep copies of our student-authored books in free-reading-time tubs, so students can revisit their work, encouraging both recall of information about scientists and the importance of writing informational text.

Custom ABC Books

For younger primary grades, have students collectively create informational text in the form of an alphabetical or counting book. Students not only practice writing and researching content but also learn how to gain information from nonfiction text and group it into categories.

Start by reading examples—such as George Ella Lyon's *A B Cedar: An Alphabet of Trees* (1989), George Shannon's *Tomorrow's Alphabet* (1996), or Kathy Darling's *Amazon ABC* (1996), then choose a content area or have students pick the own content area. Next assign individual students a letter or a number. Each will research information related to that content and write an informational page that relates to their assigned letter or number.

For example, primary students might study organisms, and each child in the class is assigned a letter of the alphabet and selects an organism to study that begins with that letter. The student who gets *L* studies lemurs. That student then writes and illustrates an informational page about the lemur. When all pages are complete, the teacher compiles the book as a class alphabet book. Teachers can also involve their students with similar projects related to nonfiction counting books (see References and Resources). April Pulley Sayre and Jeff Sayre's *One Is a Snail, Ten Is a Crab: A Counting by Feet Book* (2003) is ideal for intermediate students, as readers are required to count, add, and multiply the feet of various creatures. Using *Counting Wildflowers* (McMillan 1986) as a model, a first-grade teacher can take digital pictures of animals on a class field trip to a farm. Students can then record information about what they experienced on the trip.

E-mails to Scientists

Finally, students can pursue science learning by writing e-mails to real scientists. Most appropriate for older elementary students, this activity provides an opportunity for students to compose their own questions about science content. Or, students can interview scientists about how they became scientists and the kinds of work they do. Students can use these e-mail conversations as a basis for a nonfiction report on that scientific specialty. Students can even be required to ask the scientists how they use writing in their work!

Teachers can find contact information for scientist e-mail pals by contacting local universities and science labs. For instance, Indiana University houses a science outreach office in their college of arts and sciences with staff whose purpose is to make contacts between university science faculty and K–12 educators. A similar office is located in Washington State

at the Pacific Northwest National Laboratory's Office of Science Education, which not only arranges for scientists to visit classrooms and interact with students but also provides professional development opportunities for teachers. Teachers can find similar opportunities for contacts with scientists in their own local areas.

Reports and Other Uses

Nonfiction writing can also be used to help students develop understandings of science as inquiry, as students record observations, inferences, and results of investigations, and write formal reports to share with peers. Students can also use writing to design their own investigations, leading to further understanding of investigations as recommended by the *National Science Education Standards* (NRC 1996).

Writings Are Assessments

Incorporating various nonfiction writing activities such as those suggested above not only encourages students to think about science content, but also results in material/work that can help teachers assess student understanding.

For example, observation versus inference charts can be used to capture a picture of what the whole class understands about a given topic. If a student records an observation of an investigation exploring whether pill bugs prefer light or dark environments as "Pill bugs love the dark," the teacher will know that the student is confusing the observation with an inference. The teacher can then ask the student to describe how he or she knows that pill bugs "love the dark." When the student states that it is because pill bugs tend to stay in the dark side of their environment, the teacher can point out to the student that moving to the dark side is the observation and the inference is that they "love the dark."

Similarly, individual journal writings can be used to assess what individual students understand about a science content area. In a unit exploring electrical circuits, students can be asked to respond to a journal prompt of "How do you think electricity works?" several times throughout the unit. Initially the student may respond with something like "Electricity is lightening," whereas later in the unit the student may respond with something like "Electricity makes things work," and finally the student may respond with something like "Electricity works through a complete circle—a circuit." Thus, the teacher can track the development of the student's idea over time, from less informed to more informed views.

Whether supporting content learning, guiding teacher instruction, or furthering the development of students' literacy or science process skills—or all of the above—nonfiction writing opportunities are an essential aspect of science learning from which teachers and students benefit in many ways.

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Chapter 4

14 Writing Strategies

By Thomas Turner and Amy Broemmel

In 1905, a young scientist named Albert Einstein published a three-page paper presenting his theory of relativity. That brief paper was a major step in revolutionizing how physicists throughout the world thought, and it changed the way the world in general thought about science (Penrose 2005). That a relatively small piece of writing could be so important certainly illustrates the significance of writing to science. Good scientists record what they do—their results, procedures and operations, observations, and hypotheses, as well as their problems and questions.

Scientists need to develop their writing skills for a number of reasons:

- Writing down their ideas and describing what they do and find gives scientists, and those who read and depend on their work, a more accurate record from which to attempt to replicate results.
- Written accounts of what scientists observe that are recorded at the time of their observations help scientists remember more accurately and completely.
- Written summaries of scientific work allow scientists to synthesize bodies of work and look at them holistically so that they or other scientists can extend and develop ideas further.
- Written notes about their work allow scientists to reflect on and mentally process what they have observed.
- Written presentations of their work allow scientists to share and publicize their findings, get credit for their work, and, as a result, claim the benefits of their successes.
- Written descriptions of planned work enable scientists to obtain funding to continue their often-expensive work.
- Written summaries of their ideas allow scientists to share the importance of their work with nonscientists.

Why We Need to Teach Writing in Science Classes

Any science teacher who wants his or her students to be engaged in real science is going to engage them in real science writing. Students do not intuitively know how to do such writing, and instruction in scientific writing is not likely to occur in other school subjects. This writing instruction can serve two purposes: It can increase science understanding and engage students in activities that are useful in the assessment process in science itself. Montgomery (2005, p. 28) points out that student writing provides the teacher with "a tangible demonstration of learning and gives students the opportunity to connect their personal experiences to the content." Montgomery goes on to say that well-crafted, thoughtfully planned writing assignments require the student to do a "deep analysis of subject material."

Well-designed science writing assignments essentially have three critical attributes:

1. They provide authentic purposes for writing.
2. They motivate students to want to write and "do" science.
3. They help students plan and structure both their writing and their science activities.

These attributes are inextricably and symbiotically related. They combine to make the writing assignment comprehensible, authentically important, and feasible. Matsumura and his colleagues (2002) found that the cognitive challenge of the writing assignment had a significant effect on the quality of students' final drafts. That is, when students felt that assignments were cognitively challenging and satisfying to complete, they worked more effectively in producing a finished writing product. Writing experiences should help students feel good about their own writing.

Writing in science should begin with clear, imaginative writing purposes and stimuli that are then scaffolded in such a way that students are able to find an organizational structure for their writing. Writing fluency is often enhanced and supported by experiences like brainstorming or free writing.

Writing Assignments That Work in Science Classes

Writing in The American Scientist, Gopen and Swan (1990, p. 550) assert, "The fundamental purpose of scientific discourse is not the mere presentation of information and thought, but rather its actual communication." Of course, much of the public and many scientists would question this idea because they often think that scientific concepts, data, and analysis are extremely complex, difficult, and abstract. However, like Gopen and Swan, we would argue that what matters most in scientific writing is that a majority of the reading audience accurately perceives what the science writer has in mind, and that when science writing improves, it is a sign that the thinking is better. In the interest of promoting such thinking, we would like to offer 14 examples of different kinds of writing assignments that can provide legitimate, purposeful writing practice while promoting solid science learning and review.

1. Writing Hypothetical Letters

Often scientists share their observations and questions, as well as their differences of opinion, by letter or, in today's world, by blogs and e-mail messages. A very simple, yet effective example of a scientific exchange can be seen in the children's book, *Dear Mr. Blueberry,* by Simon James. In this book, James tells a story through an exchange of letters between a little girl named Emily and her teacher, Mr. Blueberry. Read the book aloud and talk about how Emily seeks help, information, and even opinion but is strongly true to her own observations. Students can work collaboratively to create their own hypothetical exchange of letters between themselves and a scientist or teacher. An important lesson of this poignantly sweet book is that a person should believe in the power of evidence even when it contradicts authority. A second lesson is that it is possible to contradict without being disrespectful to authority. In their letters, students can share observations about some theme or topic. If possible, the return letters by the "authorities" or "scientists" can come from older children or parents with science backgrounds. This activity can also be accomplished electronically in collaboration with university students studying to be science teachers.

2. Process Steps Analysis

After observing and/or taking part in a demonstration of a scientific process, the class could discuss what they saw. After talking the observations through, they can analyze and document the sequential steps that they would need to completely replicate the demonstration. In some cases, where it is safe and feasible, students might even have the opportunity to recreate the demonstration following their own written steps.

3. Identifying Critical Attributes

Small groups of students are asked to look at something. This can be an object of any kind or even a plant or an animal. Each group has a different object. They are given the opportunity to make a thorough examination, and identify its critical attributes. Critical attributes are those observable qualities that make the object, plant, or animal unique, allowing it to be distinguished from all others. The groups can then compile a list of what they believe to be the critical attributes of what they have seen. The lists are shared with the whole class, and students attempt to match the correct item with the critical attribute list. If accurate matching is not possible, students are encouraged to revisit and revise their lists.

4. Collaborative Writing of Scientific Stories

The teacher begins by reading (or having the students read) a science-related trade book. Fiction books, such as *How Groundhog's Garden Grew* (Cherry 2003), and nonfiction books, such as *One Tiny Turtle* (Davies 2001), can be used effectively for this activity. After students have become familiar with the story, the teacher starts a discussion focusing on the scientific content or process described in the book. Once the teacher is satisfied that students understand the science of the book, he or she has the class sit in a circle on the floor. Three clipboards with paper are given to students positioned at equal intervals around the circle. Each student holding a clipboard is asked to think about the science described in the book and then write one sentence that describes the first event in the book. They then pass the clipboards to the right. Students are instructed that when they receive a clipboard, they need to read what

has been written up to that point on the paper and then write an additional sentence describing the next event in the scientific process described in the story. Each paper will, in the end, contain a complete retelling of the story in the sequence it occurred. (Three papers are used to provide a means of keeping students actively engaged and to document student understanding of various parts of the content and process.)

5. Chain of Evidence

Because most students have watched many television shows dealing with forensic evidence in criminal investigations, those observation experiences can be used as the basis for writing activities. First the teacher identifies a crime for the team to investigate. Appropriate possibilities include robberies, kidnappings, acts of vandalism, or simple crimes that happen around the school every day. (Avoid scenarios involving violent or graphic crimes.) Begin with a brainstorming session. Have the class create a detailed summary of the chain of evidence leading to the arrest and trial of a suspect in their invented crime. Encourage them to use rich details with leading questions, such as the following: What kind of evidence are we looking for? Where are we likely to find evidence? How do we distinguish evidence related to the crime from what we would normally expect within the crime scene? What are some different ways of reconstructing the crime based on the evidence? What are some possibilities indicated by the evidence?

As an alternative to providing students with only the hypothetical crime, the teacher can also provide a list of "suspects" with a brief introduction to each. Students might then choose a "guilty" suspect and create a well-reasoned written explanation of fictional clues and evidence that could lead to the suspect's arrest. Students then have to learn the difference between being reasonably sure that someone is guilty and having sufficient evidence to bring them to trial, then having enough evidence to convict. Students can assume the roles of judge and jury in response to one another's assembly of evidence, ultimately deciding if the written chain of evidence is sufficient to lead to a trial and subsequent conviction.

6. Accident Report

In this activity, the teacher creates an accident scene by either using photos or actually staging an accident. Examples of cases might include a lunchroom mishap such as spilled trays; a playground incident such as a fall from a piece of equipment, someone being hit by a ball, or a collision between two running students; or a classroom situation such as stacks of papers falling on the floor and getting mixed together. After examining the accident scene and gathering evidence, the investigators are asked to write reports based on their observations. In very small groups, students then read one another's reports, noting inconsistencies or missing details.

7. Label Analysis

The teacher first organizes students into groups and then provides each group with an empty package or label for some product. The products can be foods, medicines, household cleansers, or anything else with a label that lists the ingredients. Each group then writes a description of what they know about the product based on the list of ingredients—in other words, what the contents list tells you and what it doesn't tell you. For example, if something advertised as a juice product has little or no actual fruit juice in it, what does that mean? What does the label tell you about nutrition? What are the risks and benefits of using the product?

8. Technical Directions

The teacher begins by giving students toys or models that require some assembly. Students are then asked to take the role of the marketing staff at the product's manufacturing company. Students must first practice assembling the toy or model, carefully noting the quickest, most efficient steps for assembly. Then they are responsible for writing the directions that will be included on the package. Finally, students attempt to assemble other groups' toys or models using the new directions.

9. Scientific Directions

The teacher organizes the class into small groups and assigns each group a familiar location within a short distance from the school. Each group then discusses the best route to the assigned place and writes directions for getting there using landmarks based on scientific observations taken along the route. For example, the directions could include descriptions of plants, geological formations, or environmental cues. As a follow-up, have students see if they can navigate to a spot using others' directions.

10. Scientific Reporting

After a discussion of the essentials of accurately reporting scientific observations, students are organized into groups. Each group is given a video recording of a scientific experiment and asked to create a detailed list of observations that someone could use to recreate the experiment. The group is allowed to view the video as many times as they like to ensure that their observation list is accurate and complete. (See Resources for recommended video collections.)

11. Proposal Writing

The basic function of a proposal is to describe and pitch to others ideas for projects, papers, and research studies. Proposal writing is an essential activity for many scientists and the skills needed to write proposals should be developed as early as possible. Instead of simply assigning projects and research reports, teachers can provide general parameters for the intended assignment (e.g., research related to rock formation or a project depicting a food chain). Proposal writing activities can begin with a simple brainstorming session for project ideas. The fundamental question is, What do we want to do? After helping generate a list of ideas, the teacher can then lead students through the process of selecting and refining a single idea from the list. The next step is to create a proposal outline. The teacher may choose to have a set of specifications or even provide a simple outline such as the following:

- Title (A proposal…)
- Abstract or summary
- An introduction giving background and explaining the situation
- A statement of the project problem to be solved
- Some suggestion or suggestions about solutions to the problem

- Some explanation of how you will solve the problem
- An outline describing the proposed project outcome
- Step-by-step description of your research methods
- Conclusions

After the outline is created, assign a different group to write a draft for each part. Finally, piece together the proposal, editing each part so that it is consistent with the rest. The combined class effort can then serve as a model for small groups or individual students to develop their own proposals.

12. Pourquois Story Writing

Pourquois stories are fictional explanations of natural phenomena. They are usually based on definitive descriptions of the phenomena themselves. One example is "How the Elephant Got His Long Trunk." A series of logical plot actions are described, connecting the main characters in the story to the creation of the phenomenon. Provide students with a list of natural phenomena and have them create their own pourquois stories for one of these. Stress the importance of including scientific facts in explanations. Examples of appropriate subjects include why magnets attract, why we have tornadoes, why snakes shed their skin, why hens cackle and roosters crow, why owls hoot, how squirrels got their bushy tails, and why volcanoes erupt.

13. Preparing Descriptive Research Through Web Quests

Web quests are designed to be structured inquiry activities in which information is drawn from the internet. Web quests focus the learners' time on using information rather than looking for it and emphasize thinking at the levels of analysis, synthesis, and evaluation. Essentially, students are directed to a sequenced series of specific websites to solve a structured inquiry problem. A number of websites provide examples of Web quests (see Internet Resources). An example of a teacher-created web quest might ask students to determine which simple machines would be most effective in performing a particular multistep task. The web quest would be designed to lead students to a series of websites that present verbal and/or pictorial information about simple machines. Students would use the information to develop a written solution to the problem. Teachers can also train students to develop their own web quests as an alternative means of demonstrating understanding of particular scientific content or processes.

14. News Clip Observations

The teacher shows a short news film clip without sound. The clip may show a natural disasters the effect of weather, destruction brought about by human effort, or another science-related concept. Students then write descriptions of the event based on their observations. After students have completed their descriptions, replay the film clip with sound and ask students to compare the accompanying news commentary to what they wrote.

Final Note

A science class is not complete unless it helps students learn to think like scientists, and writing is an essential part of such thinking. The 14 writing experiences described here for integrating meaningful, interesting writing into science are not intended to be followed to the letter. Rather, they are all adaptable ideas. Neither are they intended to replace traditional science instruction. However, if we want our students to think like scientists, then it is only logical that we should ask them to observe, document, and write like scientists, as well. We believe that these and other thoughtfully structured writing activities can be integrated into science classrooms in a way that addresses curriculum, provides alternative, authentic means of assessing student understanding, and motivates students to become actively involved in the learning process.

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Internet Resources

WebQuest.org
www.webquest.org

Teachnology
www.teach-nology.com/teachers/lesson_plans/computing/web_quests/science

Science Web Quests
www.can-do.com/uci/k12-lessons.html

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