Shell Education

Think It, Show It Science

Strategies for Demonstrating Knowledge

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Table of Contents

Acknowledgements 4

Foreword 5

Introduction 6

Chapter 1: Given That I Know 11

Chapter 2: Writing to Demonstrate Learning: "How" and "Why" Explanations. 15

Chapter 3: Writing to Record Learning 33

Chapter 4: Writing to Further Learning 65

Chapter 5: Scientific Vocabulary. 99

Appendix A: References Cited 109

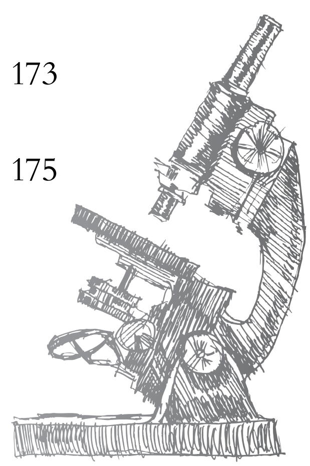
Appendix B: Mentor Texts. 110

Appendix C: Student Resources 124

Appendix D: Rubrics. 167

Appendix E: Recommended Literature. 173

Appendix F: Contents of Digital Resource CD 175



Introduction

Many schools presently face a curricular dilemma not unlike that of a friend of mine in a school in Colorado. At her school, the decision had been made to focus primarily on reading and writing during the first half of the year in advance of the state's yearly assessments. Since her class of third graders, many of whom were below benchmark, would not be tested in science that academic year, it was rationalized that for the sake of the school's literacy scores, the students would best be served by postponing any science instruction until after the tests were administered. Unfortunately, the test results that year indicated that a portion of her students were still falling below benchmark. The question was then raised: Now what should be done? Should they do away with science completely for the remainder of the year in order to put another reading intervention period into the schedule in an effort to get the kids to benchmark?

This predicament, or a version thereof, is not unique to my friend's school. In many elementary schools (both with higher- and lower-functioning students), the importance of science as an integral and vital part of all students' educational landscape is being contested—contested not for pedagogical reasons but solely and understandably as a reaction to the pressure of state and federal mandated tests and their highly competitive publicized scores. As a result, science, like art, music, and to a large measure, physical education, is systematically being sidelined in the curriculum and in some cases completely eliminated in order to devote as much time as possible to a multitude of reading and writing interventions—this in an age when, as expressed in Appendix A of the *Next Generation Science Standards*, "Given the importance of science and engineering in the 21st century, students require a sense of contextual understanding with regard to scientific knowledge, how it is acquired and applied, and how science is connected through a series of concepts that help further our understanding of the world around us" (2013, 1).

Reading and writing are, of course, absolutely critical skills. For all practical purposes in today's global, informational, and technologically driven world, literacy is nothing less than an economic life skill, and as such, students' progress with it should be monitored regularly. All students need to be able to read with discerning comprehension and use written communication with precision and clarity. What is missing from the science versus exclusive literacy instruction argument, in the view of many educators, is that science, in and of itself, presents students with incredibly engaging content in which both reading and writing instruction can be integrated not only to support science instruction but also to augment the acquisition of 21st century literacy skills.

Indeed the *Common Core State Standards* emphasizes that "Literacy standards…are predicated on teachers of ELA, history/social studies, science, and technical subjects using their content area expertise to help students meet the particular challenges of reading, writing, speaking, listening, and language in their respective fields" (2010, 3).

In fact, the *Common Core State Standards* specifically addresses these literacy skills with their *Reading Standards for Informational Text*:

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- Determine the main ideas of a text; recount the key details and explain how they support the main idea.
- Describe the relationship between a series of historical events, scientific ideas or concepts, or steps in technical procedures in a text, using language that pertains to time, sequence, and cause and effect.
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (2010, 14).

In the same way, writing can be infused into the science classroom. After a lesson in which mill worms are observed by third graders, a follow-up writing lesson might be an observation-notes paragraph. Included in a life science unit can be written pieces in which students compare and contrast plant and animal cells. A scientific conclusion provides a perfect way to bring closure to an experiment in a fifth-grade science class that involves and records all the steps of the scientific method and does so with a strong literacy link. Structured and authentic reading and writing tasks such as these are decisive in helping students make sense of and remember what they are learning in science. Within the context of an inquiry-based, activity-geared science classroom, reading and writing tasks function as co-conspirators in the acquisition of both science principles and concepts and the skills and processes of literacy. This curricular merger is clearly delineated in the *Next Generation Science Standards:*

> "Engagement in any of the scientific and engineering practices involves both scientific sense-making and language use. Students engage in these practices for the scientific sense-making process, as they transition from their inexperienced conceptions of the world to more scientifically-based conceptions. Engagement in these practices is also language intensive and requires students to participate in classroom science discourse. Students must read, write, and visually represent as they develop their models and explanations. They speak and listen as they present their ideas or engage in reasoned argumentation with others to refine their ideas and reach shared conclusions" (2013, 2).

Think It, Show It Science: Strategies for Demonstrating Knowledge has a single purpose: to give teachers a series of practical and clear-cut materials and strategies on how to integrate discipline-specific writing instruction and student discussion into their science curriculum. In the book, I have steered clear of any lengthy discussions about methods of science instruction. Although they will be referred to, you won't, for example, find an examination of inquiry-based instruction or the scientific method. As a science teacher, you likely already know this material. If you do not, there are many fine texts available

Chapter 2

Writing to Demonstrate Learning: "How" and "Why" Explanations

Science is the exploration and explanation of our physical world. For students, nothing is more exciting than the continual and deepening understanding of the "how" and "why" of things all around them that grow out of inherent curiosity and inquiry. In our science classrooms, writing to support and demonstrate these understandings is made up of "how" and "why" explanations. Unlike multiple-choice questions and single word or phrase fill-in-the-blanks assessment items, "how" and "why" explanations allow students to demonstrate a more comprehensive understanding of science.

"How" Explanations

How does a seed first sprout?

By explaining how something proceeds in scientific terms (either in a time sequence, as procedural steps, or as an order of events), students come to more fully understand scientific processes.

"Why" Explanations

Why does your heart rate increase when you exercise?

Being able to explain why something occurs helps students comprehend the links and the relationships (causes and effects) among phenomena in science.

How do you go about teaching this specific type of writing in your classroom?

Before I discuss the specific methods and student materials I use, I would like to present, in general terms, three instructional principles that I believe are needed to support the greatest growth in writing:

The purpose of the task you are having students work on is made clear to them.

It is important to talk to students about how scientists work. I refer to students as scientists-in-the-making and explain that we wear our aprons and eye goggles during experiments because, along with protecting our clothes and our eyes, that's what scientists do in their laboratories. In the same way, we role-play as scientists when we write and record our thinking and learning as scientists do, and in the discussions we have as a result of the writing that is done.

The distinct characteristics of the type of writing being produced are made understandable for students by means of an abundance of written models, teacher demonstrations, and student feedback.

Writing experts agree that writing instruction is not simply assigning and grading. Rather, writing instruction is derived from models (mentor texts), explanations, and targeted student feedback. Students need to read and to be exposed to numerous examples of the type of writing we are expecting them to master. They need to have their written efforts scored or evaluated and be provided with feedback in alignment with the characteristics of the specific genre or type of writing they are doing. In addition, they need to see us write. Our strongest instruction is when we, the teachers, model for the student the process of composition (Tompkins 2012; Moore-Hart 2010; National Writing Project and Nagin 2006).

Finally, specific strategies for the type of writing being learned are practiced frequently and in a variety of contexts throughout the year to help students develop a degree of independence with them.

As supported repeatedly by research, new skills must be repetitively practiced over time for students to reach a level of proficiency with them. For students to become independent, competent, and confident writers, they need many opportunities in many different contexts, to practice the writing skills they are being taught (Wray et al. 2000).

To help students become familiar with the language and structure of explanation paragraphs, start with model paragraphs on familiar topics and then analyze them as a class.

Paragraph 1

<u>Getting to school five days a week involves many steps. How I get myself ready is pretty much the same every morning.</u> First, I hear my mom or dad yell that it is time for me to get up. When I have stayed up too late the night before, they sometimes have to yell a couple of times to wake me. I then yawn, stretch my arms, throw the bedcovers off, and get out of bed. After that, I put on my clothes, brush my hair, and head downstairs to the kitchen where my mother has my breakfast ready. I quickly pour some milk on my cereal and wolf it down. Finally, I brush my teeth, grab my backpack, and head out.

Paragraph 2

Missing your school bus in the morning is definitely not a good idea. The reasons are simple. If you miss the bus, you will have to walk back to your house and tell your mother. Since she is busy trying to get herself ready for work, chances are she is going to be upset with you because now she has to drive you to school. As a result of having to drive you to school, she is probably going to be late for her job, and consequently, you are in for a long lecture. Finally, when you do arrive at school you are in such a bad mood because of the lecture you received from your mother that you probably wouldn't be any fun to be around with for most of the morning.

Model It!

Use the think-aloud and action steps below to model analyzing the language and structure of explanatory paragraphs for your students.

Looking only at the first two sentences in paragraph 1, do we know what is going to be explained? (*How one individual gets ready for school.*) How about in paragraph 2? (*Why missing the bus is not a good idea.*) These sentences are the topic sentences that we have talked about in language arts.

Let's underline the topic sentences in each paragraph. Another option is to have students color-code these as opposed to underlining, circling, and boxing: topic sentences, green; sequence words, yellow; cause-and-effect word, red.

What transition words, *first*, *then*, *after that*, and *finally*, can we find in the first paragraph? In science, we are going to learn that these transition words are called *sequence* or order words. They help scientists organize their writing in the correct sequence of scientific steps or events.

Add-a-Characteristic Poem

A simple, yet highly effective pattern that students can use when researching and thinking about the characteristics of a certain concept in science content is called an *Add-a-Characteristic* poem. This type of activity helps as they are learning to read and locate relevant information. *Add-a-Characteristic* poems simply start with *A* or *An* as the first line, and the noun being described is added as the second line. Each successive line repeats the previous line and adds a characteristic, hence, an *Add-a-Characteristic* poem. This type of poem can be used to describe living and nonliving things, natural phenomena such hurricanes, volcanic eruptions, or eclipses, and much more.

One way this was enacted in the classroom was by using animals as the subjects of the poem. Students were provided an *Add-a-Characteristic Planning Sheet* (Figure 4.3). On their planning sheets, students included the name of their animal and recorded their research as they studied them.

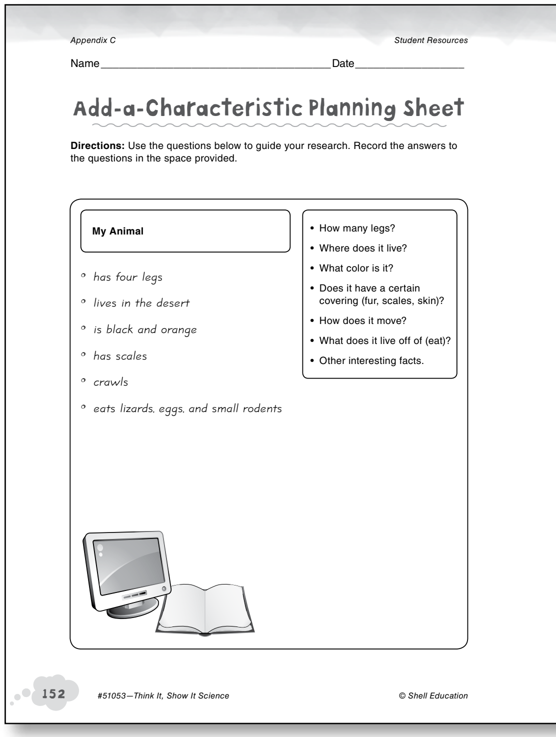
- How many legs?
- Where does it live?
- What color is it?
- Does it have a certain covering (fur, scales, skin)?
- How does it move?
- What does it live off of (eat)?
- Other interesting facts

Students filled out the sheet with a bulleted jot list.

- has four legs
- lives in the desert
- is black and orange
- has scales
- crawls
- eats lizards, eggs, and small rodents

Using the information from their planning sheet, students then composed their poems. Finally, students had an opportunity to take their poems to other classrooms and, without giving away their last line, have other students guess what animal each student had researched.

Figure 4.3 Sample Add-a-Characteristic Planning Sheet



Appendix C Student Resources

Name______________________________Date_______________

Add-a-Characteristic Planning Sheet

Directions: Use the questions below to guide your research. Record the answers to the questions in the space provided.

My Animal

- has four legs
- lives in the desert
- is black and orange
- has scales
- crawls
- eats lizards, eggs, and small rodents

- How many legs?
- Where does it live?
- What color is it?
- Does it have a certain covering (fur, scales, skin)?
- How does it move?
- What does it live off of (eat)?
- Other interesting facts.

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Here is a student's poem, probably best read aloud to get a feel for its poetic nature with the repetition.

Add-A-Characteristic Poem Student Sample

An

An animal

A desert animal

A desert, four-legged animal

A desert, four-legged, an animal with scales

A desert, four-legged, an animal with scales, that crawls

A desert, four-legged, an animal with scales, that crawls, and eats lizards, eggs, and other small rodents

(*a gila monster*)

Here is a student sample using an obsidian rock:

Sample Student Add-A-Characteristic Poem

A

A rock

A black rock

A black, shiny rock

A black, shiny rock that contains the minerals hematite and feldspar

A black, shiny rock that contains the minerals hematite and feldspar and was formed by heat and pressure

A black, shiny rock that contains the minerals hematite and feldspar and was formed by heat and pressure and can be found near volcanoes

What kind of rock am I?

(*an obsidian rock*)

Creatively bringing science writing into the writing class and making the most of the writing process helps students learn more about their science content, and also supports their growth as writers. It helps them gain greater skill, control, and independence with their writing. Along with feeling more successful, it deepens students' understanding of the processes and functions of writing. They sense that they are becoming real scientific writers. Part of this emerging awareness of our "real writers" is their understanding of the different purposes and types of writing.

Writing Purposes and Different Types of Writing

To help students understand the different purposes and types of writing that are important in science, I start by having them close their eyes to imagine their "dream car."

> *If you had all the money you would ever need, what car would you have in your driveway?*

When they have fully visualized all of its details and are totally enthralled by their imagined dream car, I say:

> *Now, drop the engine out. So what do you have now?*

Plant and Animal Cells

The mentor text below is annotated to support you during instruction. The student version of this text is provided on the Digital Resource CD (mentortext5.pdf)

The basic unit of life is the cell, and all living things are made up of cells [**topic**]. Although they are similar in many ways, there are, however, important differences between plant and animal cells [**subjects; topic sentence**]. To begin with, both plant and animal cells have a nucleus that contains the cell's genetic material [**1st similarity**]. Also [**transition word**], both animal and plant cells are filled with cytoplasm [**2nd similarity**]. Cytoplasm is a clear, gel-like substance that suspends and holds in place the organelles that float within the cell. In addition [**transition words**], plant and animal cells are alike [**word used to compare**] because both have a cell membrane that surrounds the cell [**3rd similarity**]. The cell membrane allows the movement of substances in and out of the cell.

One of the biggest differences between [**words used to compare**] plant and animal cells is that the plant cell has a cell wall, unlike [**word used to compare**] the animal cell, which does not [**1st difference**]. The plant's cell wall protects the cell and gives it a regular shape. Another difference is that animal cells have small and numerous vacuoles in contrast to [**word used to compare**] the plant cell, which has only one large vacuole [**2nd difference**]. The plant's one large central vacuole takes up nearly 90 percent of the cell's mass. Finally [**transition word**], under a microscope, the plant cell reveals a definite shape, unlike [**word used to compare**] the animal cell, whose shape varies greatly [**3rd difference**].

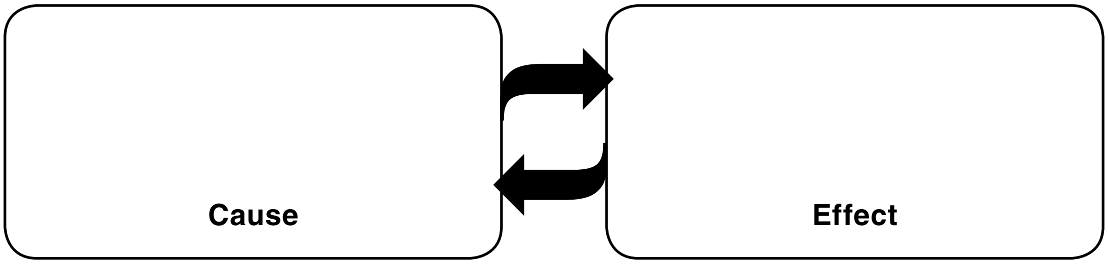
Mentor Text: Comparative Text

Demonstrating subjects, topic, topic sentence(s), transition words, similarities and differences between subjects, and words used to compare

Name: ______________________________ Date: ________________

Cause-and-Effect Sentences 1

Directions: Write a cause and an effect. Then, write sentences to describe how the cause and effect are related.



1. ____

____

____

____

(cause first sentence)

Put a box around your cause-and-effect word(s).

2. ____

____

____

____

(effect first sentence)

Put a box around your cause-and-effect word(s).

Cause-and-Effect Words:
(something happening as a result of something else)

- because
- a reason for this
- so
- when
- as a result
- since
- consequently
- if
- due to

