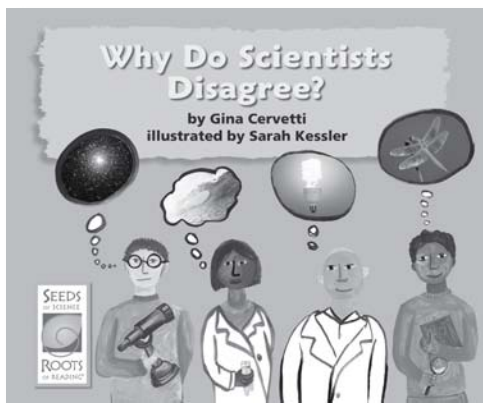


Teaching About the Nature and Practices of Science

with *Why Do Scientists Disagree?*
from *Seeds of Science/Roots of Reading*®



Introduction

This strategy guide introduces an approach for teaching about the nature and practices of science. Learning about the nature of science helps students understand that science is a process for inquiring about the world. Students learn about the scientific enterprise when they read about how scientists pose questions and engage in investigations. This guide includes an introductory section about the nature of science, a general overview of how to teach this strategy with many science texts, and a plan for teaching about the nature of science with the *Seeds of Science/Roots of Reading*® book *Why Do Scientists Disagree?*

Book Summary

Why Do Scientists Disagree? is a book with two distinct but related threads. On the right-hand pages, readers learn about the ways scientists use evidence, make claims, and debate alternative explanations to move the field of science forward. On the left-hand pages, these ideas are exemplified in the story of Galileo and how his observations of the Moon changed people's ideas about light. This book models important ways that scientists communicate and how they use evidence to convince others in the scientific community about the veracity of their explanations.

About This Book

Reading Level

Guided Reading Level*: Q

Key Vocabulary

claim, communicate, disagree, evidence, explanation, scientific community

Text Features

bold print, glossary, illustrations

*Guided Reading Levels based on the text characteristics from Fountas and Pinnell, *Matching Books to Readers*.

Science Background

Scientists ask and investigate questions about how the world works, but they do not always agree on the answers. An important principle of the scientific enterprise is that scientists share their evidence with the scientific community. This allows scientists to evaluate one another's explanations. Scientists may disagree with an explanation in many different ways. For example, they may doubt the reliability of the evidence presented, they may disagree with the interpretation of the evidence, or they may feel that claims made based on the evidence go too far. When scientists disagree, they can propose counterarguments or pursue new investigations to find more evidence to resolve a disagreement. As more and more scientists find evidence in support of a particular explanation, it may gain support within the scientific community. At the same time, sufficiently convincing evidence can challenge even the most well-accepted theories. The constant critical analysis of evidence is one of the hallmarks of the discipline of science.

About the Nature and Practices of Science

Science is a process of continuous inquiry that yields new understandings about the natural world. Learning about the nature of science helps students understand how knowledge is developed by the scientific community. This understanding helps students see that science is not a collection of facts, but rather an ongoing process of discovery. Learning about what scientists do (the practices of science) allows students the opportunity to see valuable habits of mind (such as posing questions and critically evaluating evidence) modeled for them. Discussing how science is conducted encourages students to emulate the practices of scientists when they engage in scientific investigations and may generate student interest in science as a career.

Teaching About the Nature and Practices of Science

The following guidelines can be used to teach about the nature and practices of science with texts that discuss the work of real scientists or those that explore the process of scientific inquiry.

- Select an engaging science book or article that will prompt discussion about the nature and practices of science. Possibilities include biographies of scientists, interviews with scientists, or books featuring scientists who investigate a particular question or problem.
- Introduce the nature and practices of science by explaining that science is a process for learning about the world. Explain that scientists have particular ways of investigating, writing, and talking. Discuss a few examples of what scientists do that might be familiar to your students. On the board or on a class chart, record a list of what scientists do. (See the box on this page for a list of ideas.)
- Highlight one well-illustrated practice from the text and model how to locate and describe an example. You might suggest that students look for key words, such as *investigate*.
- Have students read the text and make notes about what scientists do. You can use the What Scientists Do copymaster included with this guide to support students as they

Practices of Science

- Gather evidence.
- Investigate questions or problems.
- Design new things or make models.
- Make and test models.
- Make comparisons.
- Build on the work of other scientists.
- Work with other scientists.
- Make observations and collect data.
- Use specialized tools.
- Organize and analyze data.
- Use evidence to make claims.
- Make and revise explanations.

locate practices of science in the text. (Not all practices listed on the copymaster will appear in all texts.) Students can use the blank boxes at the bottom of the copymaster to list additional practices they notice while reading.

- After reading, discuss a few of the science practices students read about. As necessary, guide students to generalize about the specific practices discussed in the text. For example, if a student says that a scientist he read about uses a microscope, you can rephrase this as *Scientists use specialized tools to help them investigate*. List these examples on a piece of chart paper.
- Pose questions to prompt further discussion about the nature and practices of science. For example, ask, “How did the scientist gather evidence?” “How did gathering evidence help this scientist answer her question?” “What are some ways that other scientists might gather evidence?”
- Continue adding to the list of what scientists do when students conduct hands-on science investigations, read other books about scientists, or explore the practices of science in other ways. You might find it beneficial to contrast the ways that science is similar to and different from the ways professionals in other fields learn about the world.

Teaching About the Nature and Practices of Science with *Why Do Scientists Disagree?*

Getting Ready

1. Make a copy of the What Scientists Do copymaster for each student.
2. Prepare a large version of the What Scientists Do copymaster on the board or a piece of chart paper.

During Class

1. Explain that science is a way of learning about the natural world and that it is a way of thinking as well. Ask students to think about what they know about what scientists do. (See the box on the previous page for ideas.)
2. Introduce *Why Do Scientists Disagree?* and ask students what they already know about disagreements. Then, ask students to think about how scientists might disagree and how they might communicate their disagreements differently.
3. Show the students the What Scientists Do chart that you prepared before class. Explain that they will be learning more about what scientists do as they read and that you will record what they find out on this chart.
4. Read page 3 of the text together and discuss how the book is structured. Explain that there is information about a scientist named Galileo on the left-hand pages (which are green) and another story about other scientists on the right-hand pages (which are white). Tell students that first they will read the text on the right-hand pages; they will come back later to read the information about Galileo.
5. Have students read just the right-hand pages of the book in a way that is consistent with your classroom routines, giving students as much independence as possible. Remind students to think about what scientists do.
6. After reading the right-hand pages, briefly discuss the main ideas presented to be sure students understood the text. As a class, discuss a few of the practices of science listed on the What Scientists Do chart. For example, ask students where in the book they read about scientists gathering evidence and data. [Page 7.]
7. As students identify examples from the book for each category on the chart, record their examples in the spaces provided. As you complete the chart, discuss each of the identified practices of science.
8. Next, distribute the What Scientists Do student sheets that you prepared before class. Explain that students will now read the left-hand pages about Galileo. Students should complete their student sheets with a partner as they read. Point out that the same categories that were on the class chart are also on their student sheets. Students will try to find new examples that are about Galileo.
9. When student pairs have finished reading and have completed their student sheets, reconvene and share ideas. Refer to both the What Scientists Do class chart and their individual student sheets, and discuss the similarities and differences between the practices of Galileo and present-day scientists.
10. Revisit the idea of disagreement. Ask students to describe how disagreement during Galileo's time led to important discoveries about how the Moon's surface reflects light. Encourage students to think about how this disagreement moved science forward.
11. Reread page 5 of the book and focus students' attention on how scientists participate in the scientific community. Specifically, focus on how both Galileo and other scientists communicated about their evidence with the scientific community. Point out that participating in the scientific community prompts scientists to find more evidence to support their claims, which in turn generates more investigations.

Independent Extension

Have students reread *Why Do Scientists Disagree?* searching for evidence about how the scientific community today is the same as it was in Galileo's time and how it is different. Provide time for students to have a discussion about this topic.

Name _____ Date _____

What Scientists Do

Title of book: _____

What scientists do	Example from the book
Gather evidence and data	
Investigate	
Make explanations	
Work with other scientists	

About Strategy Guides

A six-page strategy guide is available for each *Seeds of Science/Roots of Reading*® student book. These strategies support students in becoming better readers and writers. They help students read science texts with greater understanding, learn and use new vocabulary, and discuss important ideas about the natural world and the nature of science. Many of these strategies can be used with multiple titles in the *Seeds/Roots* series. For more information, as well as for additional instructional resources, visit the *Seeds/Roots* Web site (www.seedsofscience.org/strategyguides.html).

Available Student Books for Grades 3–4

Eighteen engaging student books are now available, each with a corresponding strategy guide. The books are part of the *Seeds of Science/Roots of Reading*® curriculum program described on page 6. Nine *Weather and Water* student books and strategy guides will be available in late 2009.

<i>Digestion and Body Systems</i>	
Strategy	Student Book
Analyzing Part-to-Whole Relationships	<i>Systems</i>
Teaching About the Nature and Practices of Science	<i>Secrets of the Stomach</i>
Teaching Process Description Writing	<i>Voyage of a Cracker</i>
Searching for Information in Science Texts	<i>Handbook of Body Systems</i>
Making Sense of Data in Science Texts	<i>What's the Diagnosis?</i>
<i>Variation and Adaptation</i>	
Strategy	Student Book
Teaching Scientific Comparison Writing	<i>Blue Whales and Buttercups</i>
Using Discourse Circles	<i>The Code</i>
Using Visual Evidence to Make Inferences	<i>Mystery Mouths</i>
Teaching About the Nature and Practices of Science	<i>Evidence from the Past</i>
<i>Light Energy</i>	
Strategy	Student Book
Teaching About Idioms	<i>Can You See in the Dark?</i>
Teaching Summary Writing	<i>The Speed of Light</i>
Teaching About the Nature and Practices of Science	<i>Why Do Scientists Disagree?</i>
Using Discourse Routines with Science Texts	<i>I See What You Mean</i>
Searching for Information in Science Texts	<i>Handbook of Light Interactions</i>
Teaching Scientific Explanation Writing	<i>Light Strikes!</i>
Teaching Vocabulary with Science Texts	<i>Cameras, Eyes, and Glasses</i>
Teaching Concept Mapping	<i>It's All Energy</i>
Interpreting Visual Representations	<i>Sunlight and Showers</i>

Extend Learning with *Seeds of Science/Roots of Reading*®

The strategy featured in this guide is drawn from the *Seeds of Science / Roots of Reading*® curriculum program. *Seeds / Roots* is an innovative, fully integrated science and literacy program.

The program employs a multimodal instructional model called “Do-it, Talk-it, Read-it, Write-it.” This approach provides rich and varied opportunities for students to learn science as they *investigate* through firsthand inquiry, *talk* with others about their investigations, *read* content-rich books, and *write* to record and reflect on their learning.

Take advantage of the natural synergies between science and literacy instruction.

- Improve students’ abilities to read and write in the context of science.
- Excite students with active hands-on investigation.
- Optimize instructional time by addressing goals in two subject areas at the same time.

To learn more about *Seeds of Science / Roots of Reading*® products, pricing, and purchasing information, visit www.deltaeducation.com



Light Energy Science and Literacy Kit



Developed at Lawrence Hall of Science and the Graduate School of Education at the University of California at Berkeley.

Seeds of Science/Roots of Reading® is a collaboration of a science team led by **Jacqueline Barber** and a literacy team led by **P. David Pearson** and **Gina Cervetti**.

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