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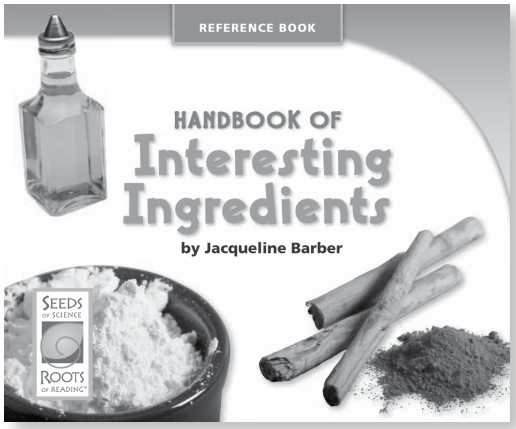
Strategy Guide

Teaching Scientific Explanations

with *Handbook of Interesting Ingredients* from *Seeds of Science/Roots of Reading*®



Introduction

This strategy guide introduces an approach for teaching students to make scientific explanations based on evidence. Making evidence-based explanations about the natural world is the fundamental purpose of science. This guide includes an introductory section about making scientific explanations, a description of how to teach this strategy with many science texts, and a plan for teaching students to make scientific explanations with the *Seeds of Science / Roots of Reading*® book, *Handbook of Interesting Ingredients*.

Book Summary

Handbook of Interesting Ingredients is a reference book that provides information about a range of substances used to make many different mixtures. The book begins with a section that explains how the book is organized. The entry for each ingredient includes information about whether it is a pure substance or a mixture, where the ingredient comes from, the important properties of the ingredient, what the ingredient can be used for, and what happens if the ingredient is added to a mixture. Through the information presented in the book, readers learn that substances can be categorized by their properties, and that ingredients added to mixtures can cause different effects based on those properties.

About This Book

Reading Level

Guided Reading Level*: O

Text Features

book description, table of contents, index, glossary, headings, bulleted lists, about the author, bold print, illustrations, captions

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

Science Background

Our material world is made of countless substances or mixtures of substances. Throughout the history of science, chemists have investigated the substances that make up everything around us, asking questions such as: How can this vast variety of substances be classified? What happens when you mix one substance with another? What makes each substance unique? In order to characterize and identify a substance, scientists carefully examine its properties. The term *property* refers to anything that can be observed and measured about a substance. When analyzing substances, scientists consider both physical properties (such as color, odor, density, freezing point, and melting point) and chemical properties (such as if and how it reacts with other chemicals; if it's an acid, base, or neutral; and how soluble it is). Scientists also analyze the properties of mixtures. Most matter in the world consists of mixtures that are made of two or more substances. Vinegar, corn syrup, egg white, flour, and cinnamon are all examples of mixtures. The properties of a mixture depend on the amount and properties of each of the substances that make up the mixture. Through various techniques, mixtures can always be separated back into their component parts.

About Scientific Explanations

In addition to being an academic discipline, science is a way of communicating. One important way scientists communicate is through constructing scientific explanations. A scientific explanation usually seeks to answer a question. It tells how something in the world works or why something happens. Scientific explanations are always based on evidence. Evidence can come from firsthand experience (such as through observation and investigation) or from reading and carefully weighing the work of others who have conducted investigations themselves. A well-crafted scientific explanation seeks to tie the evidence together in a way that both answers the question at hand and provides reasons for the conclusions that are drawn based on an understanding of relevant scientific principles.

Teaching Students to Make Scientific Explanations

Learning to make explanations from evidence is essential for learning and communicating about science. Many science texts provide an opportunity for students to practice making explanations from evidence. The following guidelines can be used to teach this strategy with any content-rich text.

- Make a class chart that lists prompts, which students can use during discussions. (See the box on this page for ideas.)
- Select a science text that all students will read. Choose a section of the text that presents some information about a natural process or phenomenon (e.g., a passage that describes how clouds form or how an animal gets its food). Develop a question that will elicit an explanation and will require students to consult the text for evidence (e.g., How do clouds form? or How does an octopus get its food?). Write the question on the board.
- After a first reading of the text with students, introduce scientific explanations. Point out that the goal of science is to explain the natural world. Tell students that when scientists make explanations, they use evidence to tell how something works or why something happens.

Prompts for Making Scientific Explanations

- Why do you think that?
- I think this because...
- What is your evidence?
- My evidence is...

- Direct students to reread the section of the text you have selected. Ask students to read with the focus question in mind and to search for evidence that will help them answer this question. The answer to the question will be their explanation about why or how something works in the world.
- Discuss the text and, as a class, try to make an explanation. Let students know that you will be asking for evidence from the book. Point out the class chart on which you have listed the prompts. You may wish to give examples of how to answer the question using the prompts "I think this because…" and "My evidence is…." Be sure to ask, "Why do you think that?" and "What is your evidence?" whenever possible.
- Have students write their explanations (their answers to the question) individually, or as a class, write one together. If your students write their own explanations, use the Making Scientific Explanations copymaster provided with this guide. Be sure that students provide evidence from the text in their responses.
- Repeat this procedure any time the class reads science books. Ask, "Why do you think that?" and "What is your evidence?" during discussions so students gain practice using this language. Once students have practiced making explanations from evidence during a few class discussions, ask them to meet in small groups to discuss a text. Encourage students to use the prompts with each other during their discussions.

Making Scientific Explanations with *Handbook of Interesting Ingredients*

Handbook of Interesting Ingredients provides information about several common ingredients. Students can use the information about each

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ingredient as evidence to make explanations about why they think certain mixtures will have particular properties or behave in particular ways.

Getting Ready

1. Write "What will happen if you mix baking soda and vinegar?" in the space provided on the Making Scientific Explanations copymaster. Make a copy for each student.
2. Make a class chart of prompts that you will use during the discussion of *Handbook of Interesting Ingredients*. (See the box on the previous page for ideas.)

During Class

1. Explain that students will read a book about interesting ingredients. While the book is about interesting ingredients, it is also a book about the way scientists make explanations.
2. Read *Handbook of Interesting Ingredients* in a way that is consistent with your classroom routines, giving students as much independence as possible. Since this is a reference book, it is not necessary to read the text from beginning to end. Students can choose a few sections that interest them to read in more detail.
3. After students become familiar with the content of the book and how it is organized, ask them to read pages 22–23 (the section on oil). Lead a brief discussion about the properties of oil. You might ask students to describe the cooking oil depicted on page 22 and name some of its important properties and uses. Direct students' attention to the chart you made before class and point out that students can use the sentence frames below each question to begin their answers. Provide an example: "Is oil a useful ingredient for cooking?" Ask students to help you compose a sentence that directly answers this question. Write this sentence on the board. [Oil is a useful ingredient for cooking, page 23.]
4. Tell students that when scientists explain things in the world, they use evidence. Evidence is like a clue or a piece of information that helps answer a question. Ask students to provide evidence from the text that supports the statement. Ask, "Why do you think that?" and "What is your evidence?" [Oil keeps food from sticking to the pan, oil helps some ingredients mix well together, page 23.] Record a few pieces of evidence on the board and read the complete explanation aloud.
5. Tell students they are going to learn about two more ingredients. Have them read pages 6–7 and 28–29 (the sections on baking soda and vinegar) and pay particular attention to the sections titled "Important Properties" and "Cause and Effect."
6. Lead a brief discussion about the properties of baking soda and vinegar. You might ask students to describe each of the ingredients based on the pictures and on the properties they read about in the text. Make sure you discuss baking soda's property of creating bubbles when mixed with an acid.
7. Distribute a Making Scientific Explanations student sheet to each student. Read aloud the question written at the top: "What will happen if you mix baking soda and vinegar?" Tell students they will write an explanation to answer this question.
8. Ask students to look back through the text and discuss what they think might happen. When they have made a decision, they should write a sentence in the space provided under "Explanation." Write the sentence starter, "If you mix baking soda and vinegar…" on the board and encourage students to use it to write their explanation.
9. Ask students to write at least two pieces of evidence that support their explanations. (This can be an independent or shared writing activity.) Remind students to begin at least one of the sentences with "I think this because…" or "My evidence is…." [My evidence is that on page 29 it says that vinegar is an acid. On page 7 it says that when baking soda mixes with an acid, it makes gas bubbles.]

Independent Extension

Write the following sentence frame on the board: "When _____ is mixed with water, _____." Ask students to select and read a section in the book on one ingredient (other than water). Students should complete the sentence that you have written on the board for their ingredient, then write evidence from the book that supports their explanation of what happens.

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Name _____ Date _____

Making Scientific Explanations

Question: _____

_____

_____

Explanation: _____

_____

_____

_____

1. _____

_____

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2. _____

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3. _____

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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**).

Student Books for Grades 2–3

Twenty-seven 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.

Soil Habitats	
Strategy	**Student Book**
Using Discourse Routines with Science Texts	*Into the Soil*
Using the Cognates Strategy	*Walk in the Woods*
Connecting Science Words and Everyday Words	*What Are Roots?*
Teaching About the Nature of Science	*Talking with a Habitat Scientist*
Teaching Text Structure	*Handbook of Forest Floor Animals*
Using Text Features	*Earthworms Underground*
Taking Notes Based on Observations	*My Nature Notebook*
Making Sense of Data in Science Texts	*Snail Investigations*
Using Discourse Circles	*Without Soil*
Shoreline Science	
Strategy	**Student Book**
Teaching Vocabulary with Science Texts	*Beach Postcards*
Teaching Concept Mapping	*What Belongs on a Beach?*
Teaching Scientific Explanations	*Gary's Sand Journal*
Interpreting Visual Representations	*What's Stronger? The Forces That Cause Erosion*
Using Text Features	*What Lives on a Sandy Beach?*
Teaching About Multiple Meaning Words	*My Sea Otter Report*
Searching for Information in Science Texts	*Handbook of Sandy Beach Organisms*
Teaching Text Structure	*The Black Tide*
Teaching About the Nature of Science	*Shoreline Scientist*
Designing Mixtures	
Strategy	**Student Book**
Using Discourse Circles	*What If Rain Boots Were Made of Paper?*
Using Anticipation Guides	*Solving Dissolving*
Teaching Scientific Explanations	*Handbook of Interesting Ingredients*
Teaching Text Structure	*Jelly Bean Scientist*
Teaching About the Nature of Science	*Jess Makes Hair Gel*
Gravity and Magnetism	
Strategy	**Student Book**
Interpreting Visual Representations	*Forces*
Making Sense of Data in Science Texts	*What My Sister Taught Me About Magnets*
Using Anticipation Guides	*Gravity Is Everywhere*
Teaching Concept Mapping	*Mystery Forces*

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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.seedsofscience.org**

Soil Habitats **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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