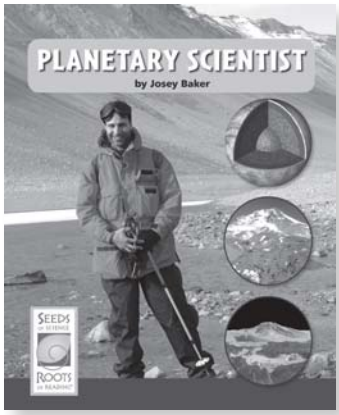
Strategy Guide

Teaching About How Scientists Use Models

with *Planetary Scientist* from *Seeds of Science/Roots of Reading*®



Introduction

This strategy guide introduces an approach for teaching about how scientists use models. The ability to use and interpret models is central to scientific inquiry, especially when scientists investigate things that are not directly observable. This guide includes an introductory section about how scientists use models to learn about the natural world, a general overview of how to teach this strategy with many science texts, and a plan for teaching about how scientists use models with the *Seeds of Science/Roots of Reading*® book *Planetary Scientist*.

Book Summary

Planetary Scientist describes the work of earth scientist Michael Manga. Readers learn how Manga uses innovative methods to study surface features and why these investigations are so important for understanding our Solar System. One of his methods is building models out of common materials in order to answer questions about surface features on distant Solar System objects. Readers learn that Manga's models, like all models, are similar to the real thing in some ways and different from it in other ways. They also learn that a model must be evaluated in terms of how well it explains the phenomena in question. This book depicts important aspects of the nature of science for readers.

About This Book

Reading Level
Guided Reading Level*: R

Key Vocabulary
evaluate, evidence, investigate, model, surface feature

Text Features
bold print, captions, diagrams, glossary, illustrations, labels, photographs

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

Science Background

Planetary scientists study the physical characteristics of planets, moons, and other Solar System objects. One way that planetary scientists gather evidence is from missions to Solar System objects. Another way is by observing similar features on Earth. Still another important part of planetary scientists' work is using models. Scientists use models in a variety of ways to help them understand the Universe. In a scientific model, objects in the real world are represented by other objects, mathematical descriptions, or computer programs. Every model is like the real thing in some ways and different from the real thing in some ways—these differences make models useful for investigating. Models can help scientists communicate their ideas, understand processes, and make predictions. The simplest kind of model is a physical copy of the real thing. A globe, for instance, is a model of Earth. This kind of model is used to help visualize the real object. A model that shows how parts of a system work together is more sophisticated. This kind of model can be very useful for understanding processes and making predictions. By gathering evidence using many different methods, planetary scientists have learned a great deal about the conditions and surface features on other objects in our Solar System.

About Using Models

A model can be an object, diagram, or computer program that represents something that a scientist is studying. Scientists use models in many ways to help them understand the natural world. Models help scientists communicate their ideas, understand processes, and make predictions because models help make something simpler or easier to see. Every model is like the real thing in some ways and different from the real thing in some ways. Different models of the same thing can be useful in different ways. Scientists use models to show their ideas and explain how things work. Models can also help scientists look for patterns.

Teaching About How Scientists Use Models

The following guidelines can be used to teach how scientists use models to investigate.

- Select an appropriate text. Choose a book or article that discusses the work of various scientists. Good examples include books about paleontologists, astronomers, chemists, or other scientists who use models to study something that is difficult to observe directly.
- Tell students that scientists learn about the world by observing, but that they cannot observe everything firsthand. Explain that scientists often use models to collect evidence about objects or processes that they cannot observe firsthand.
- Explain the purpose of using models in science, such as to study things that are too big, too small, too far away, or too dangerous to observe directly. Models are also useful for studying lengthy processes or for explaining ideas that are too complex to explain in words alone.
- Provide students with an example of a model, such as a model car. Ask students to identify ways in which the model is like and unlike the real thing. [The model car has the same shape as the real thing; the model car is much smaller than the real thing.]
- Discuss with students the ways in which different scientists use models. Provide some examples and then have students think of additional examples. Below are some ideas:

  a. Scientists who study ecosystems use models to understand the relationships between different plants and animals.

  b. Scientists who study rivers make models of the rivers to help them understand how the rivers will flow.

  c. Scientists who study chemistry make models of atoms and molecules.

  d. Scientists who study weather use computer models to predict how storms will travel.

- Ask students to preview the text you selected and identify one or more questions that a scientist can investigate. Focus students' attention on the types of models that the scientist uses or could use to answer the question(s).
- Have students read the text and pay careful attention to the parts that explain how the scientist uses (or could use) one or more model. You may wish to have students use the How Scientists Use Models copymaster (included in this guide) to help focus their reading.
- After reading, discuss how scientists used models to understand a topic more deeply. You may also wish to discuss the ways in which the model(s) is accurate or inaccurate and how it could be improved.
- Continue using the strategy as students read other science texts. Find opportunities to read about, use, and compare different types of models and purposes for using models.

Types of Models Scientists Use

- **Physical model:** a physical representation, such as a small version of a large object (e.g., a globe is a model of Earth)
- **Two-dimensional model:** a drawing or diagram of an object or a process (e.g., a diagram of our Solar System)
- **Computer model:** a wide array of representations made using a computer (e.g., an equation or computer animation)

What is the scientist trying to find out?	Describe the model that the scientist used.	How was the model helpful?
how fast lava cooled on Mars (page 10)	pan of wax that is melted and cooled at different temperatures (page 10)	Patterns that form in the wax model look like the patterns in the hardened lava on Mars (page 11).
how the cracks formed on the icy surface of Europa (page12)	flat tray of melted wax, different layers cool at different rates (page 13)	Cracks in the wax look similar to the cracks in Europa's surface (page 15).
how volcanoes work on Earth and on other planets, such as Venus (page 17)	liquid = lava tube = underground tank = lava erupting (page 16)	The liquid can be changed to flow in different ways, just like a real volcano (page 16).
how the inside of a planet changes, how these changes affect the surface (page 18)	big tank of corn syrup (page 18)	The bubbles rise up through the corn syrup the same way that melted rock rises to form a volcano (page 19).

Teaching About How Scientists Use Models with *Planetary Scientist*

Getting Ready

1. Make a copy of the How Scientists Use Models copymaster for each student.
2. Create a large version of the copymaster on the board and label each column. You will fill in the table with students during class; sample student responses are shown above in green.

During Class

1. Show students a simple model, such as a globe. Explain that a globe is a model of Earth. The model is similar to the real Earth but is not exactly like it. Invite students to observe the globe and notice ways in which it is similar to Earth. Then, ask students to identify ways it is different.
2. Explain to students that they will learn about how scientists use models to investigate things that are difficult to observe firsthand—things that are very big, very small, or very far away or that happened long ago. Tell students that a model makes something simpler or easier to understand and helps scientists explain how things work.
3. Introduce *Planetary Scientist*, a book about a scientist who uses models to understand how surface features formed on objects in space.
4. Read the book in a way that is consistent with your classroom routines, giving students as much independence as possible.
5. Distribute the How Scientists Use Models student sheets and point out the class version on the board. Show students how to record information in the table by discussing Manga's model of Mars, as follows:
   - Ask students to reread pages 10–11.
   - Ask, "What was Manga trying to find out?" [How fast lava cooled on Mars, page 10.] Record notes about this (including page numbers) on the table on the board and have students do the same on their student sheets.
   - Ask students to use the information on page 10 to describe the model. Record responses on the board and have students do the same on their student sheets.
   - Lead a brief discussion about the reasons why Manga used a model to investigate the flat areas on Mars. Record this information on the table as well. (Note that responses to this prompt can vary; one suggestion is shown in the table on this page.)
6. Direct students to reread the information about the other three models described in the book, and have students record information about these models on their student sheets. You can do this together as a class or have students work independently. Have several students share their responses with the class.
7. Ask students to discuss with a partner, then share with the class, some reasons why scientists use models.

Independent Extension

There are several questions on page 3 of *Planetary Scientist* that a planetary scientist might investigate. Have students reread these questions, then select one question to discuss with a partner. Have partners brainstorm some ways that a scientist might use a model to investigate this question.

Name _____ Date _____

How Scientists Use Models

Title of book: _____

What is the scientist trying to find out?	Describe the model that the scientist used.	How was the model helpful?

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 4–5

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 *Aquatic Ecosystems* student books and strategy guides will be available in summer 2010.

Planets and Moons	
Strategy	**Student Book**
Connecting Science Words and Everyday Words	*Exploring Planets and Moons*
Using Science Text to Visualize	*Spinning Through Space*
Taking Notes Based on Observations	*Observing the Moon*
Using the Cognates Strategy	*How Big Is Big? How Far Is Far?*
Teaching Scientific Comparison Writing	*Handbook of Planets and Moons*
Using Discourse Circles	*What About Pluto?*
Teaching About How Scientists Use Models	*Planetary Scientist*
Using Anticipation Guides	*Tomato Landers*
Promoting Word Consciousness	*Technology for Exploration*
Chemical Changes	
Strategy	**Student Book**
Teaching Scientific Explanation Writing	*Chemical Reactions Everywhere*
Posing Investigation Questions	*Handbook of Chemical Investigations*
Teaching Text Structure	*What Happens to the Atoms?*
Teaching Procedural Writing	*Bursting Bubbles: The Story of an Improved Investigation*
Promoting Word Consciousness	*Communicating Chemistry*
Models of Matter	
Strategy	**Student Book**
Teaching Summary Writing	*Made of Matter*
Using Roundtable Discussions	*Break It Down: How Scientists Separate Mixtures*
Interpreting Visual Representations	*Phase Change at Extremes*
Teaching About How Scientists Make Inferences	*Science You Can't See*

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**

***Planets and Moons* Science and Literacy Kit**

SEEDS OF SCIENCE / ROOTS OF READING®

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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