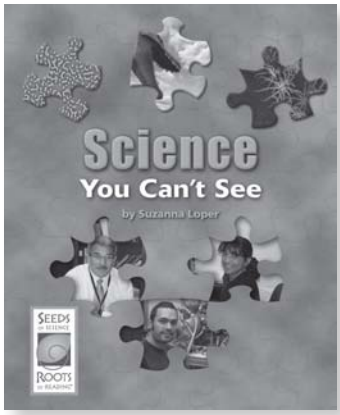
Strategy Guide

Teaching About How Scientists Make Inferences

with *Science You Can't See* from *Seeds of Science/Roots of Reading*®



Introduction

This strategy guide introduces an approach for teaching about how scientists use evidence to make inferences. The ability to gather and evaluate evidence 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 evidence to make inferences, a general overview of how to use this strategy with many science texts, and a plan for teaching how scientists gather evidence to make inferences with the *Seeds of Science/Roots of Reading*® book *Science You Can't See*.

Book Summary

Science You Can't See introduces readers to the work of three scientists who study phenomena that cannot be observed directly. Karen Chin studies dinosaurs using fossilized remains. Edward Saade investigates the depth of the ocean floor using sound waves. Farid El Gabaly makes images of magnetic atoms using an electron microscope. Each of these three scientists must make inferences to answer their questions. Their inferences are based on evidence that they collect during their investigations. Readers learn that scientists gather and interpret evidence and draw conclusions based on this evidence.

About This Book

Reading Level
Guided Reading Level*: R

Key Vocabulary
accurate, evaluate, evidence, inference, observation

Text Features
bold print, captions, diagrams, glossary, headings, illustrations, labels, maps, photographs, table of contents

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

Science Background

Some scientists investigate things that they cannot observe directly. For example, scientists cannot see dinosaurs, the bottom of the ocean, or atoms and molecules. Still, scientists want to know more about these things, so they gather evidence about them in other ways. For example, they make observations of fossil dinosaur droppings or measure the amount of time it takes sound to travel to the bottom of the ocean. Although atoms and molecules are too small to see, scientists use very powerful microscopes to gather evidence about them. Once scientists have gathered evidence, they use it to make inferences about the things they are investigating. For example, when scientists figure out what is in a fossil dinosaur dropping, they can then make inferences about what the dinosaur ate when it was alive. They are not observing the dinosaur eating—they are using evidence to make an inference. Similarly, by measuring the amount of time it takes for sound to travel to the ocean floor, scientists are able to make inferences about how deep the ocean is and what the ocean floor is like. Over time, scientists gather more evidence and become more and more sure of the inferences they have made.

About Making Inferences

Scientists answer questions by gathering and evaluating evidence. One way scientists gather evidence is through firsthand observation; however, sometimes scientists ask questions about things that are not immediately observable. For example, scientists cannot directly observe an extinct organism or the surface of a faraway planet. In these instances, scientists use inferential reasoning to figure out answers to their questions based on evidence gathered through observations and from information that they or other scientists have already discovered about the topic. Scientists understand that inferences are always subject to revision as new evidence becomes available or new ways of thinking emerge. Understanding that observations are based only on what one can detect firsthand can help students learn how scientists make inferences. Distinguishing between observations and inferences can help students better understand how scientists use evidence to answer questions.

Teaching About How Scientists Make Inferences

The following guidelines can be used to teach how scientists make inferences based on observations.

- Select an appropriate text. Choose a book or an article that discusses the work of various scientists. Good examples include books about paleontologists, astronomers, chemists, or other scientists who rely on evidence to make inferences.
- Tell students that scientists learn about the world by observing, but that they cannot always observe everything firsthand. Explain that scientists often use evidence to make inferences about something they are studying. Explain that an inference is like a good guess based on evidence.
- Provide students with a short list of observations that can be used to make an inference. For example: *A boy comes inside wearing a coat. The boy is holding an umbrella. His shoes are wet.* Ask students to make an inference based on these observations. [It is raining outside.] Discuss the differences between what can be directly observed and inferences that can be made from these observations. [The coat, the umbrella, the wet shoes. It is raining.]
- Have students practice making observations and inferences. Invite them to observe a photograph or an object and share the observations they make. List their observations first, then ask students to make inferences based on their observations. Some examples include the following:

  a. Observation: An apple has a missing chunk. Inference: Someone took a bite of the apple.

  b. Observation: A girl is dressed in shorts and a jersey and is holding a basketball. Inference: The girl is on a basketball team.

  c. Observation: There are shoe-shaped footprints in the mud. Inference: A person has been here.

  d. Observation: There are pieces of eggshell in a nest. Inference: A bird hatched from the egg.

- Ask students to preview the text you have selected and identify one or more questions that a scientist can investigate. Focus students' attention on sources of evidence that the scientist might use to answer the question(s).
- Have students read the text and pay careful attention to the parts that explain how the scientist gathers evidence. You may wish to have students use the Evidence and Inferences copymaster, included in this guide, to help focus their reading.
- Discuss different types of evidence with students. Guide students in listing some ways that the scientists gather evidence to inform their inferences. Discuss what inferences the scientists make based on the evidence. Encourage students to summarize the reasoning that the scientists used to make their inferences.
- Continue using the strategy as students read other science texts. Remind students to look closely at observable evidence as they read and investigate in science. Find opportunities to discuss the distinction between observations and inferences and discuss what inferences scientists make using evidence.

What question is the scientist investigating?	What evidence does the scientist use?	What inferences does the scientist make?
How and what did dinosaurs eat?	fossil dinosaur droppings	the dinosaur was a *T. rex* it ate smaller dinosaurs and crushed bones as it ate
How deep is the ocean floor in different places?	bouncing sound waves computer model of ocean temperature	how deep the ocean is in different places where fish live in the ocean
What patterns do magnetic atoms form in very, very small pieces of metal?	images made by electrons bouncing off the atoms	magnetic cobalt atoms can clump together in groups

Teaching About How Scientists Make Inferences with *Science You Can't See*

Getting Ready

1. Make a copy of the Evidence and Inferences copymaster for each student.
2. Create a blank chart on the board, using the model on this page. Sample responses are shown in green; you will fill these in with students during class.

During Class

1. Briefly explain the difference between observations and inferences. Explain that an observation is something that can be perceived with one or more of the five senses (sight, sound, smell, taste, and touch). Tell students that an inference is something a scientist thinks is true, based on observations or evidence.
2. Introduce *Science You Can't See* and ask students to turn to page 4. Focus their attention on the photograph. Ask students what the scientist might be observing. [The ant is black; the ant is on a leaf.] Then ask what inference they might make based on this observation or on evidence. [The ant is looking for food.]
3. Explain to students that they will learn about how scientists use evidence to answer questions. Tell students that the scientists in the book investigate things they cannot observe directly, so they rely on other kinds of evidence to make inferences.
4. Invite students to read the book in a way that is consistent with your classroom routines, giving students as much independence as possible.
5. Distribute the Evidence and Inferences student sheets and direct students' attention to the chart on the board. Ask students to identify the questions that each of the three scientists investigated. Record these questions on the chart and have students do the same on their student sheets.
6. Explain that students will revisit the book, focusing on the evidence that each scientist gathered in order to make inferences to answer their questions.
7. Model recording information about the first scientist's evidence and inferences. Ask students to reread pages 7–8 and identify the evidence that Karen Chin used to investigate her question. [Fossil dinosaur droppings.] Record this on the chart and have students do the same on their student sheets.
8. Have students reread page 9 and discuss what inferences Karen Chin made based on the evidence. Record these as well.
9. Instruct students to reread the remainder of the book and record on their student sheets the evidence and inferences that the other two scientists used.
10. After students gather information from the book, have a discussion about how each scientist used evidence to make inferences. As students share, record their ideas on the chart. Focus on why each scientist had to make inferences. [They could not directly observe something that would answer their questions.]

Independent Extension

Ask students to turn to pages 22–23 of *Science You Can't See* and think of some of the ways that scientists could gather evidence about stars, planets, and galaxies that are too far away to observe directly. Invite students to discuss their ideas with a partner and compare how they were similar to or different from those of the three scientists in the book.

Name _____ **Date** _____

Evidence and Inferences

Title of Book: _____

What question is the scientist investigating?	What evidence does the scientist use?	What inferences does the scientist make?

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

Nine engaging student books are now available from *Models of Matter* and *Chemical Changes*, each with a corresponding strategy guide. The books are part of the *Seeds of Science/Roots of Reading*® curriculum program described on page 6. Eighteen student books from the remaining grade 4–5 units (*Planets and Moons* and *Aquatic Ecosystems*) are currently in development and will be available in spring and summer 2010.

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.deltaeducation.com**

***Models of Matter* 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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