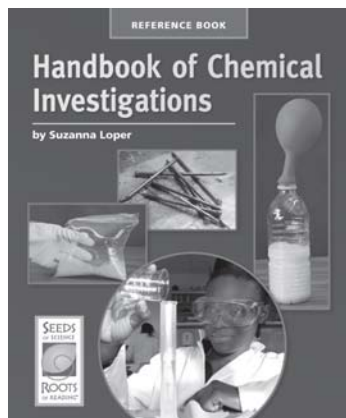


Posing Investigation Questions

with *Handbook of Chemical Investigations*
from *Seeds of Science/Roots of Reading*[®]



Introduction

This strategy guide introduces an approach for teaching students about how to pose a question that they can answer with a classroom science investigation. In science, asking questions is the foundation for learning about the natural world, and posing questions that can be investigated is an important part of scientists' work. This guide includes an introductory section about posing investigation questions, a general overview of how to teach this strategy with many science texts, and a plan for teaching students to pose their own investigation questions with the *Seeds of Science/Roots of Reading*[®] book *Handbook of Chemical Investigations*.

Book Summary

Handbook of Chemical Investigations is a reference book that helps readers learn how to plan, conduct, and make sense of scientific investigations with common substances. The book includes sections on safety, common safe substances to investigate, making observations, variables to change, and hints for choosing questions to investigate. Information about atoms and molecules, chemical formulas, and the periodic table of elements is also included. Along with considerations for designing a scientific investigation, this reference book also has information readers can use to make sense of the chemical reactions they observe, sample data from simple investigations, and tips on figuring out what is happening in a chemical reaction.

About This Book

Reading Level

Guided Reading Level*: T

Key Vocabulary

chemical reaction, investigation, measurement, observation, product, reactant

Text Features

bold print, bulleted lists, diagrams, glossary, headings, index, labels, photographs, subheadings, table of contents, tables

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

Science Background

Chemists conduct investigations to study matter and the changes it undergoes during chemical reactions. During a chemical reaction, substances change to form new substances. The substances present at the beginning of the reaction are called the reactants, and the substances present after the reaction are called the products. For example, when baking soda and vinegar are mixed, they react to form three new substances: carbon dioxide, water, and a substance called sodium acetate. When investigating a chemical reaction, things you might observe include a color change, a temperature change, or production of a gas. A variable is something that can be changed in an investigation. Variables that might affect a chemical reaction include the temperature of the reactants and the amounts of the reactants. Experiments are investigations where two or more situations are compared, with only one changed variable between each situation. When conducting investigations of chemical reactions, safety procedures should be followed, including using only safe substances, using only containers and measuring tools that are not used for eating or drinking, and avoiding eye and skin contact with irritating substances.

About Posing Investigation Questions

Scientists ask many different types of questions, but some questions are more suitable for firsthand investigation than others. Posing an investigation question involves multiple steps, including asking a question, making predictions, planning the investigation, and observing what happens. Understanding how to come up with a question to guide scientific investigation is an important inquiry skill. When students are taught how to pose their own investigation questions, they can better understand the ways in which scientists explore the natural world and generate new knowledge. Learning about posing investigation questions also helps students understand the nature and practices of scientific investigation.

Teaching About Posing Investigation Questions

The following guidelines can be used to teach students how to pose an investigation question related to the content in many science texts.

- Select a text about a science topic that students could potentially investigate in the classroom. Topics could include plant growth, magnets, simple chemical reactions, phase change, or rocks and minerals. Texts about particular scientific investigations can also be used for this purpose, but it is not necessary that the text specifically mention investigations.
- Create a chart on the board listing guidelines for developing investigation questions. See the box on this page for ideas.
- Explain to the class that scientists ask questions to learn about the natural world and that investigations always begin with asking questions.
- Have students read the text you selected. Tell students that as they read they should think about questions they are curious about that they would like to investigate.
- After students read the text, briefly discuss the main ideas. Then, ask students to share some questions they thought of during reading. Record these questions on the board.

Guidelines for Investigation Questions

1. The question will help you learn new information about a topic of interest.
 2. The question can be answered by an investigation that takes about one class period.
 3. The question cannot be answered just by looking it up in a book.
 4. The materials needed are easy to get, inexpensive, or already in the classroom.
 5. The investigation is safe.
- Explain that coming up with a question that can be investigated can be challenging, even for scientists. Tell students that the class will think about the questions they have generated and work to make them investigable.
 - Select one of the student-generated questions that does not require too many revisions to make it an investigable question. Circle this question on the board.
 - Read over the Guidelines for Investigation Questions and let students know that by checking their questions against these guidelines, students can revise their questions to make them more suitable for investigation.
 - Reread the guidelines one by one and determine if the question you selected meets the guidelines or if it requires some revision. Ask the class for input as you use the guidelines to revise the question.
 - Let the class know that they will complete this same process with questions of their choice. Arrange students into pairs or small groups so they can discuss their questions.
 - Explain that students should agree upon one question to discuss. Say that they may think of new questions, or they may draw from the questions on the board. Give students time to select a question.
 - Once groups choose their questions, have groups check them against each of the guidelines and revise them as needed.
 - Ask students to share their revised questions. Confirm that the questions meet the guidelines. Discuss how students could investigate these questions. If possible, give students a chance to carry out these investigations.

Teaching About Posing Investigation Questions with *Handbook of Chemical Investigations*

Getting Ready

Make a copy of the Posing an Investigation Question copymaster for each student.

During Class

1. Tell students that *Handbook of Chemical Investigations* is a book that contains information about how to conduct a scientific investigation. Explain that since this is a reference book, it does not need to be read from beginning to end. Explain that students will read parts of the book today and think about questions they have about chemical reactions.
2. Point out the table of contents, headings, and index and explain that these features are often included in reference books. Give students a few minutes to browse the text and become familiar with how it is organized.
3. Direct students to read page 4 and discuss what a chemical reaction is. [When substances change to form new substances.]
4. Tell the class that they will think of questions about chemical reactions that could be answered in a classroom investigation. Explain that they will not actually conduct their investigations today, but they will think about questions in the way that scientists do.
5. Have students read page 5 and discuss the many ways the book could be used. Ask students to identify the pages on which they might find information related to posing questions. [Pages 26–27.]
6. Read pages 26–27 as a class. Briefly discuss the three types of questions. Highlight examples of investigable questions included on these pages. Tell students to keep these different types of questions in mind as they read additional sections of the text.
7. Invite students to read pages 10–25 in a way that is consistent with your classroom routines, giving students as much independence as possible. Remind students to think about questions they have as they read.
8. After reading, ask students to share some questions they have about chemical reactions. Record several ideas on the board. Distribute the Posing an Investigation Question student sheets and instruct students to record a possible investigation question at the top.
9. Remind students that not all questions are possible to investigate in the classroom. For example, “Why” questions are sometimes difficult to investigate; they can be better answered by consulting a book, rather than through an investigation.
10. Introduce the Guidelines for Investigation Questions on the student sheets. Read and briefly discuss each guideline together.
11. Choose one question from the board and demonstrate how to apply the guidelines. As a class, read the guidelines one by one, and determine if the question meets each guideline. If the question does not meet the guidelines, discuss how to revise the question so it could be investigated in the classroom.
12. Have students revisit the questions they wrote and invite them to apply the guidelines to their questions by checking the box under “YES” or “NO” next to each guideline. Then, invite students to work in pairs or small groups to rewrite their questions.
13. After students revise their questions, have them share their questions with the class. Have a whole-class discussion about how students might investigate their questions in the classroom. At another time, if possible, use *Handbook of Chemical Investigations* to help design a simple investigation to answer students’ questions.

Independent Extension

Have students reread the information about one of the investigations described in *Handbook of Chemical Investigations* and examine the corresponding data table. (These can be found on pages 15, 19, and 21.) Have students discuss the data table with a partner and describe the results of the investigation.

Name _____ Date _____

Posing an Investigation Question

Title of Book: _____

Possible investigation question:

Guidelines for Investigation Questions

	YES	NO
1. The question will help you learn new information about a topic of interest.		
2. The question can be answered by an investigation that takes about one class period.		
3. The question cannot be answered just by looking it up in a book.		
4. The materials needed are easy to get, inexpensive, or already in the classroom.		
5. The investigation is safe.		

Revised question:

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.

<i>Chemical Changes</i>	
Strategy	Student Book
Teaching Scientific Explanation Writing	<i>Chemical Reactions Everywhere</i>
Posing Investigation Questions	<i>Handbook of Chemical Investigations</i>
Teaching Text Structure	<i>What Happens to the Atoms?</i>
Teaching Procedural Writing	<i>Bursting Bubbles: The Story of an Improved Investigation</i>
Promoting Word Consciousness	<i>Communicating Chemistry</i>
<i>Models of Matter</i>	
Strategy	Student Book
Teaching Summary Writing	<i>Made of Matter</i>
Using Roundtable Discussions	<i>Break It Down: How Scientists Separate Mixtures</i>
Interpreting Visual Representations	<i>Phase Change at Extremes</i>
Teaching About How Scientists Make Inferences	<i>Science You Can't See</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.seedsofscience.org



Chemical Changes 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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