Reading Preview

**Key Concepts**
- What is scientific inquiry?
- What makes a hypothesis testable?
- How do scientific theories differ from scientific laws?
- What is scientific literacy and how is it important?

**Key Terms**
- scientific inquiry
- hypothesis
- variable
- controlled experiment
- manipulated variable
- responding variable
- operational definition
- data
- communicating
- scientific theory
- scientific law
- scientific literacy

Target Reading Skill

**Identifying Main Ideas** As you read about scientific inquiry, write the main ideas in a graphic organizer like the one below. Then write several supporting details that further explain the main idea.

<table>
<thead>
<tr>
<th>Main Idea</th>
<th>Detail</th>
<th>Detail</th>
<th>Detail</th>
<th>Detail</th>
</tr>
</thead>
</table>

Mmmmm. The wonderful smell of freshly baked bread is making you hungry. Golden brown loaves of bread are stacked on the bakery shelves. After you finish eating a delicious, fluffy roll, you ask the baker how he makes a roll with such a light texture.

The baker tells you that the special ingredient is yeast. Yeasts are tiny single-celled organisms that feed on substances in the dough and release carbon dioxide gas as waste. Bubbles of carbon dioxide gas trapped in the dough make it rise and give bread and rolls their light texture.

Living creatures in the dough! Just what do they eat, you wonder. Is it the salt, or is it the sugar in the dough?

**The Scientific Process**

Your thinking and questioning is the start of the scientific inquiry process. Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence they gather. If you have ever tried to figure out why your TV has stopped working, then you have used scientific inquiry. Similarly, you could use scientific inquiry to find out whether yeast needs sugar or salt to make dough rise.

**Posing Questions** Scientific inquiry often begins with a question about an observation. In the case of the dough, your question might be: How does the presence of sugar affect the activity of yeast?

*Fresh loaves of bread*

**Expected Outcome** Students will observe that the pencil falls quickly to the floor, while the paper floats down more slowly.

**Think It Over** Sample answer: What causes objects to drop when let go? Why did the paper float to the floor? Would the paper drop at the same rate as the pencil if the paper were crumpled first?

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**Differentiated Instruction**

**Less Proficient Readers**

**Answering Questions** Select a passage from the text, such as *Developing a Hypothesis*. Read the passage aloud to the students as they follow along in their books. After reading, ask some questions about the passage. If they don’t know the answers, challenge them to find the answers in the passage.

**Learning Modality:** Verbal
Some questions cannot be investigated by scientific inquiry. Think about the difference between the two questions below.

- Why has my TV stopped working?
- What program should I watch on TV?

The first question is a scientific question because it can be answered by making observations and gathering evidence. For example, you could unplug the TV and plug it into another outlet to observe whether it begins to work. The second question has to do with opinions or values. Scientific inquiry cannot answer questions about personal tastes or judgments.

Developing a Hypothesis How could you explain your observation of rising bread dough? "Perhaps yeasts grow best if they have sugar to feed on," you think. In trying to answer the question, you are in fact developing a hypothesis. A hypothesis (plural: hypotheses) is a possible explanation for a set of observations or answers to a scientific question. In this case, your hypothesis would be that yeast activity increases when sugar is present.

In science, a hypothesis must be testable. This means that researchers must be able to carry out investigations and gather evidence that will either support or disprove the hypothesis. Many trials are needed before a hypothesis can be accepted as true.

![What is a hypothesis?](Image)

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**Instruct**

**The Scientific Process**

**Teach Key Concepts**

**Diverse Ways of Study**

**Focus** Tell students that scientific inquiry involves many different ways in which scientists study the natural world.

**Teach** Have students think about the example of a TV that stopped working. Ask what other responses from students about what questions they might ask themselves based on the observation that the TV does not work.

**Apply** Have students assess how each question might lead to scientific inquiry. What would involve gathering evidence?

**Modality:** logical/mathematical

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**What Is Science?**

Show the Video Field Trip to let students experience the process of scientific inquiry. Discussion question: How much more evidence would modern investigators have about Toms than investigators from 200 years ago? (Toms left clues that forensic experts could use, including the temperature of the victim, a footprint under the victim’s fingernails, clothes the suspect, blood on the victim’s hand, Toms’s shirt, and gunpowder Toms’s hands.)

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**Independent Practice**

- Guided Reading and Study Work Scientific Inquiry

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**Monitor Progress**

**Answers**

**Figure 1** Sample answer: Another hypothesis is that yeast grows best if they have sugar to feed on.

**Modality:** logical/mathematical
FIGURE 2
Designing an Experiment
A well-designed experiment helps to test a hypothesis.

**Designing Experiments** How will the amount of yeast activity be measured in this experiment?

<table>
<thead>
<tr>
<th>Yeast Activity</th>
<th>Amounts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle</td>
<td>Sugar</td>
</tr>
<tr>
<td>A</td>
<td>30 g</td>
</tr>
<tr>
<td>B</td>
<td>5 g</td>
</tr>
<tr>
<td>C</td>
<td>0 g</td>
</tr>
</tbody>
</table>

**Collecting and Interpreting**
Before you perform an experiment, you should collect and test data. You can record data through observation, calculation, or data collection. After all the data have been collected, you can then interpret the data. One useful tool for interpreting data is a graph. Graphs can reveal patterns and trends in the data.

**Drawing Conclusion**
Once you have collected and interpreted your data, you have learned from an experiment. You can then ask yourself: Did your hypothesis work? How well did it work? A result that is different from the data you predicted during the experiment is an unexpected result. After reviewing the results, you can compare your data with your original hypothesis. If the results match your hypothesis, your original hypothesis is supported. If the results do not match your hypothesis, your original hypothesis is not supported.

As you can see, there are many paths, not just one, to drawing conclusions. Some paths may be more comfortable or convenient than others. The path you follow will often depend on your personal interests or needs.

**Differential English Learning**
Comprehension of significant figures Simplified version: Scientific Process Questions that can help you rewrite this text, such as: What is your hypothesis?
Collecting and Interpreting Data  Before you begin your experiment, you should create a data table in which to record your data. Data are the facts, figures, and other evidence gathered through observations. A data table provides you with an organized way to collect and record your observations.

After all the data have been collected, they need to be interpreted. One useful tool that can help you interpret data is a graph. Graphs can reveal patterns or trends in data.

Drawing Conclusions A conclusion is a summary of what you have learned from an experiment. In drawing your conclusion, you should ask yourself whether the data support the hypothesis. You also need to consider whether anything happened during the experiment that might have affected the results. After reviewing your data, you decide that the evidence supports your original hypothesis. You conclude that yeast activity increases when sugar is present.

As you can see in Figure 4, scientific inquiry is a process with many paths, not a rigid sequence of steps. Often, a surprising observation or discovery leads into a new inquiry.

Use Visuals: Figure 3  The Benefits of a Graph

Focus Tell students that a graph is a powerful way of organizing data gathered from a controlled experiment. A graph can reveal patterns and trends in the data better than a data table does.

Teach Ask volunteers to explain how the data are measured on the x-axis and the y-axis of the graph. Have students look at the data table that shows the circumference of balloons at specific times. Then, ask those numbers with the points not on the graph. Ask: What trend do you see in the data gathered in the experiment? (Circumference of the balloons increases over time until beginning to level off after about 30 minutes.) Point out that the data supports the scientific inquiry you have done and that the graph provides a visual pattern for the results.

Apply Ask: Suppose the experiment gathered data about balloon circumference after 60 minutes. How would the graph be different? (Given the information shown by the graph, the lines would not rise much at all over where the data is measured.) Point out that students would have to be tested before it is accepted as true.

Monitor Progress

Oral Presentation Ask students what a controlled experiment is and what it is always important to control variables during an experiment.

Answers

Figure 2 The amount of yeast activity can be measured by measuring the circumference of a balloon after a certain amount of time.

A factor that can affect the amount of yeast activity is...