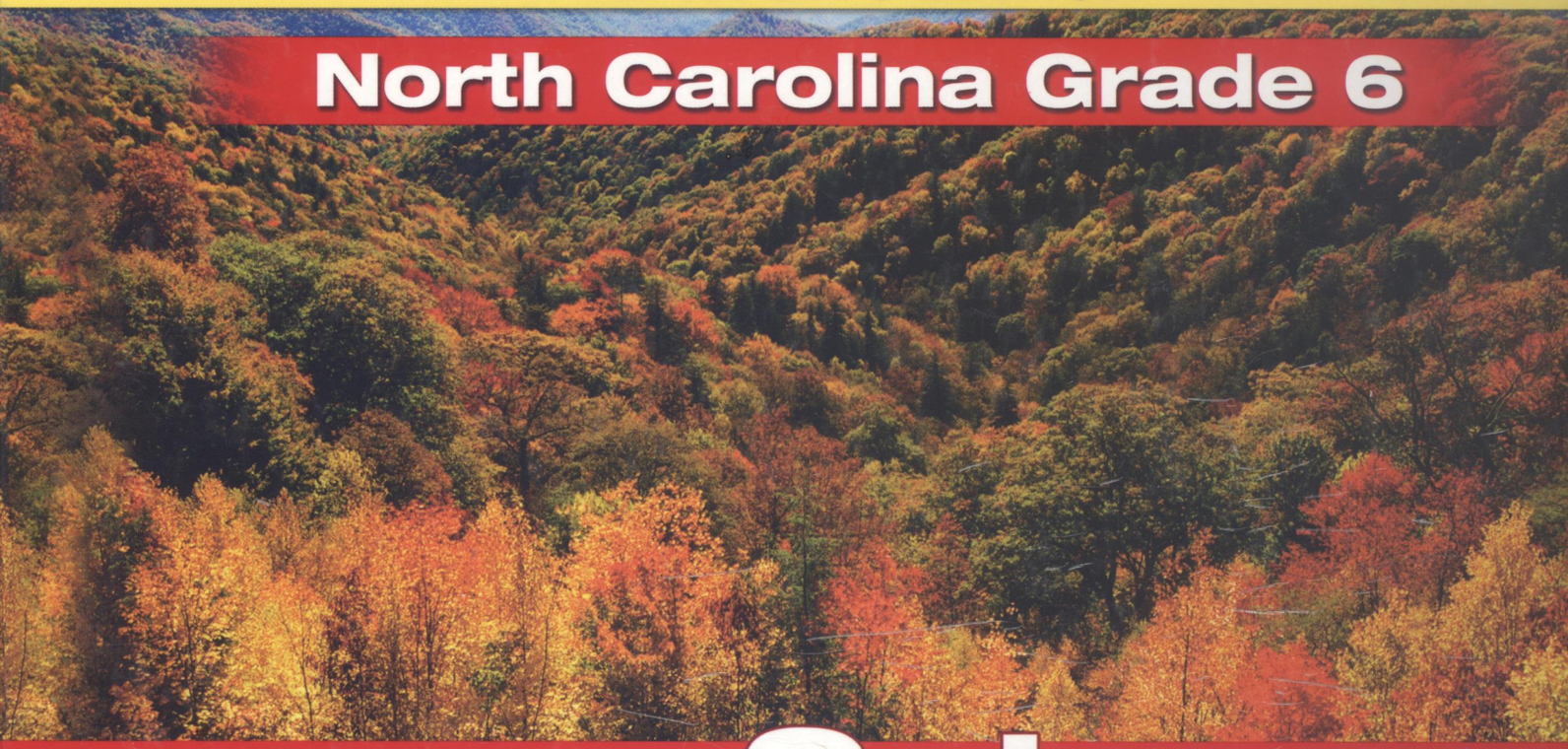
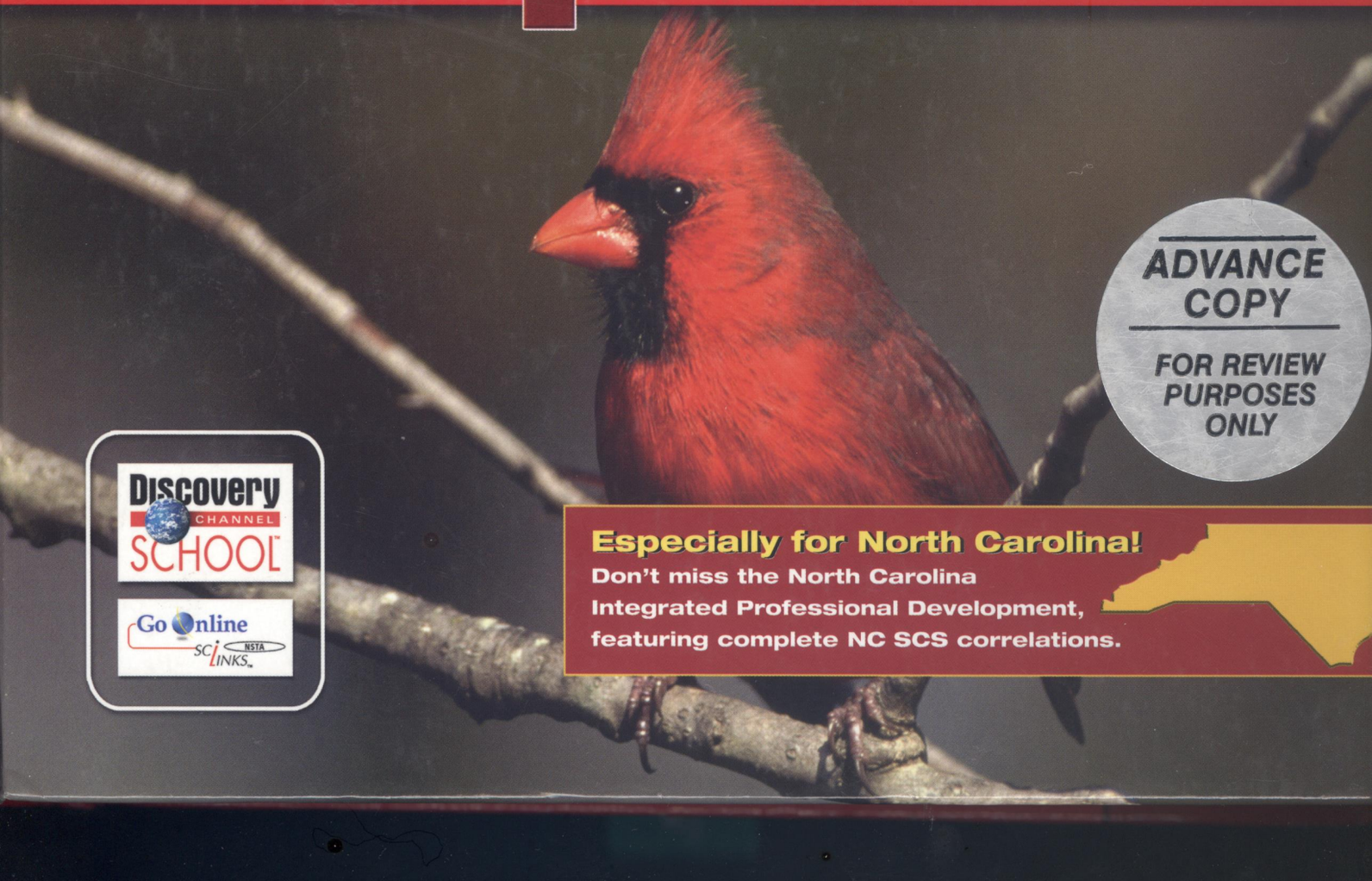
TEACHER'S EDITION

North Carolina Grade 6



PRENTICE HALL Science Explorer



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Discovery CHANNEL SCHOOL

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Especially for North Carolina!

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Section 1

Scientific Inquiry

Reading Preview

Key Concepts

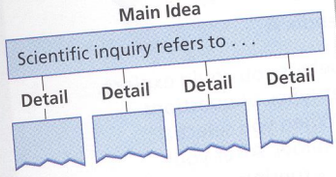
- What is scientific inquiry?
- What makes a hypothesis testable?
- How do scientific theories differ from scientific laws?
- What is scientific literacy and how is it important?

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.



◀ Fresh loaves of bread

Lab zone Discover Activity

What's Happening?

1. Hold a pencil and a sheet of paper at the same distance above the floor.
2. Let go of both objects at the same time. Observe what happens.

Think It Over

Posing Questions Write down three questions you have about your observations. How could you find out the answers?

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 need 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?

Think about the difference between the tw

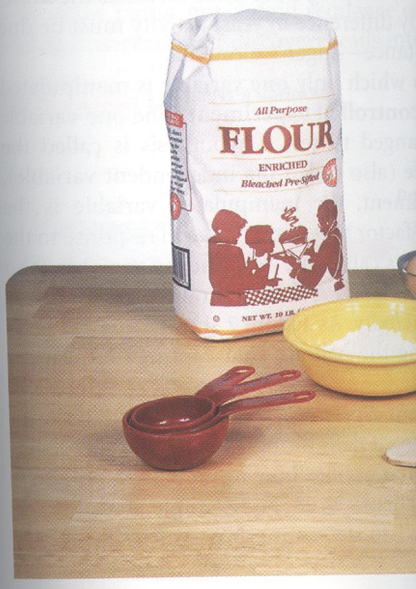
- Why has my TV stopped working?
- What program should I watch on TV?

The first question is a scientific questio answered by making observations and gath example, you could unplug the TV and p outlet and observe whether it begins to wor tion has to do with opinions or values. Sc not answer questions about personal tastes

Developing a Hypothesis How could observation of rising bread dough? "Perhap they have sugar to feed on," you think. In question, you are in fact developing a hypo (plural: *hypotheses*) is a possible explanation tions or answer to a scientific question. In th esis would be that yeast activity increases wh

In science, a hypothesis must be testa researchers must be able to carry out gather evidence that will either suppo hypothesis. Many trials are needed before accepted as true.

Reading Checkpoint What is a hypothesis?



Lab zone Discover Activity

Skills Focus Posing questions

Materials pencil, sheet of paper

Time 10 minutes

Tips Show students that they should hold the sheet of paper flat when they drop it. A sheet dropped flat will fall slowly, because of air resistance. A sheet dropped with an edge down will fall quickly, perhaps as quickly as the pencil

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?

Differentiated Instru

Less Proficient Readers

Answering Questions Select a p from the text, such as *Developing a Hypothesis*. Read the passage aloud students as they follow along in th books. After reading, ask some qu about the passage. If they don't kn the answers, challenge them to fin the answers in the passage. **learni 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 and 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 answer 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.

Reading Checkpoint **What is a hypothesis?**

FIGURE 1
Developing Hypotheses
A hypothesis is one possible way to explain a set of observations. A hypothesis must be testable—scientists must be able to carry out investigations to test the hypothesis.
Developing Hypotheses *Look at the ingredients shown here. Propose another hypotheses that could account for your observations in the bakery.*

Discovery CHANNEL SCHOOL
What Is Science?
Video Preview
▶ Video Field Trip
Video Assessment

Differentiated Instruction

Less Proficient Readers L1
Answering Questions Select a passage from the text, such as *Developing a Hypothesis*. Read the passage aloud to 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**

Gifted and Talented L3
Writing Before students read the section on scientific inquiry, ask them to propose in writing a process of scientific inquiry that they think would work best in finding the answer to a scientific question. After they have read the section, ask them to compare the process they proposed with the process described in the text. **learning modality: logical/mathematical**

Instruct

The Scientific Proce

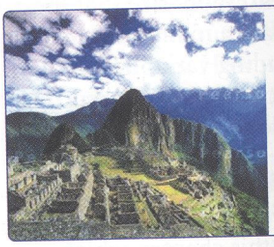
Teach Key Concepts

Diverse Ways of Study

Focus Tell students that scientific i involves many different ways in whi scientists study the natural world.

Teach Have students think about t example of a TV that stopped work responses from students about wha questions they might ask themselve on the observation that the TV doe

Apply Have students assess how ea question might lead to scientific in would involve gathering evidence. **modality: logical/mathematical**



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What Is Science?

Show the Video Field Trip to let st experience the process of scientific Discussion question: **How much r evidence would modern investig about Toms than investigators fr 200 years ago?** *(Toms left clues tha forensic experts could use, includin temperature of the victim, a footpr under the victim's fingernails, cloth the suspect, blood on the victim's h Toms's shirt, and gunpowder Toms*

Independent Practice

All in One **Teaching Resource**

- Guided Reading and Study Wo *Scientific Inquiry*

Student Edition on Audi

Monitor Progress

Answers

Figure 1 Sample answer: Anoth hypothesis is that yeast grows be have chicken eggs to feed on.

Reading Checkpoint A possible explan set of observatio to a scientific question

L2

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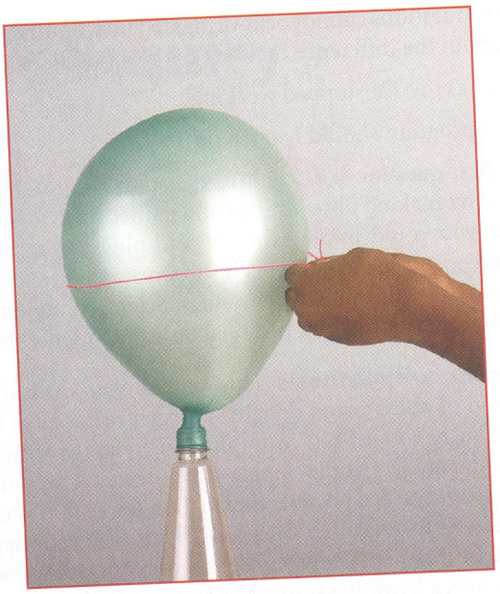
FIGURE 2
Designing an Experiment
A well-designed experiment helps to test a hypothesis.
Designing Experiments *How will the amount of yeast activity be measured in this experiment?*



Designing an Experiment To test your hypothesis, you will need to observe yeast activity in the presence of different substances. Other **variables**, or factors that can change in an experiment, must be exactly the same. Other variables include the amount of yeast, the temperature of the water, and the type of container you use. By keeping all of these variables the same, you will know that any difference in yeast activity must be due to the particular substance—sugar—alone.

An experiment in which only one variable is manipulated at a time is called a **controlled experiment**. The one variable that is purposely changed to test a hypothesis is called the **manipulated variable** (also called the independent variable). In your yeast experiment, the manipulated variable is the amount of sugar. The factor that may change in response to the manipulated variables is called the **responding variable** (also called the dependent variable). The responding variable here is the amount of yeast activity. As Figure 2 shows, you can measure this by measuring the balloon that captures the carbon dioxide gas produced.

One other important aspect of a well-designed experiment is having clear operational definitions. An **operational definition** is a statement that describes how to measure a particular variable or define a particular term. For example, in this experiment you would need to determine how you will measure the balloons.

Yeast Activity		
	Amounts	
Bottle	Sugar	Yeast
A	30 g	15 g
B	5 g	15 g
C	0 g	15 g

Collecting and Interp
experiment, you should
your data. **Data** are the
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organized way to collect

After all the data hav
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Drawing Conclusion
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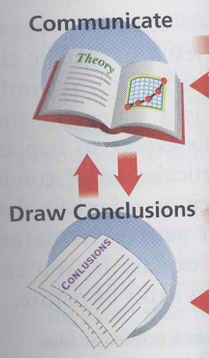
Reading Checkpoint What i



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Yeast Activity in the Presence of Sugar						
	Amounts		Circumference of Balloon (cm)			
Bottle	Sugar	Yeast	10 min	20 min	30 min	40 min
A	30 g	15 g	24	38	45	46
B	5 g	15 g	18	27	33	35
C	0 g	15 g	0	0	0	0

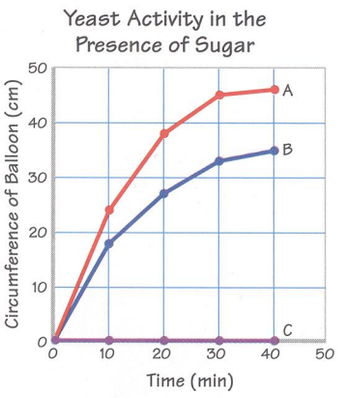

FIGURE 3
Collecting and Interpreting Data
A data table helps you organize the information you collect in an experiment. Graphing the data may reveal any patterns in your data.

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.

Reading Checkpoint **What is a variable?**

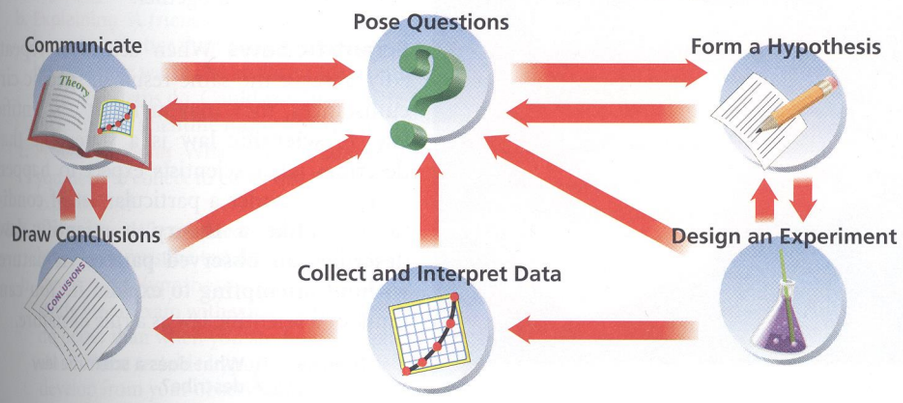

FIGURE 4
Scientific Inquiry
There is no set path that a scientific inquiry must follow. Observations at each stage of the process may lead you to modify your hypothesis or experiment. Conclusions from one experiment often lead to additional questions and experiments.

Use Visuals: Figure 3

The Benefits of a Graph

Focus Tell students that a graph way of organizing data gathered controlled experiment. A graph patterns and trends in the data b data table does.

Teach Ask volunteers to explain measured on the *x*-axis and the graph. Have students look at the the data table that show the circu balloons at specific times. Then, those numbers with the points r the graph. Ask: **What trend do y in the data gathered in the expe** *(Circumference of the balloons in time until beginning to level off a 30 minutes.)* Point out that the d provides the specifics of the data graph provides a visual pattern i

Apply Ask: **Suppose the experi gathered data about balloon cir after 60 minutes. How would th the graph be different?** *(Given t shown by the graph, the lines wou not rise much at all over where th 40 minutes.)* Point out that stude essentially stated another hypoth would have to be tested before it accepted as true. **learning mod logical/mathematical**

All in One **Teaching Resource**
- Transparency P2

Differentiated Instruction

English Learners/Beginning L1
Comprehension: Ask Questions To help students understand the importance of significant figures, distribute a rewritten, simplified version of the subsection *The Scientific Process*. Then ask students questions that can be answered from the rewritten text, such as What is a testable hypothesis? **learning modality: verbal**

English Learners/Intermediate L2
Comprehension: Ask Questions Have students read the simplified subsection you have prepared for the Beginning strategy, and then read the actual text again. Ask whether anything in the text subsection confused students, and help them clarify the meanings. **learning modality: verbal**

Monitor Progress

Oral Presentation Ask student what a controlled experiment is always important to control vari an experiment.

Answers

Figure 2 The amount of yeast a be measured by measuring the s balloon after a certain amount o

Reading Checkpoint A factor that can an experiment