TEXTBOOK CHAPTER

Preparing to Read

Physical Science

Informational Text Focus

Structure and Purpose of a Textbook The pages of a textbook are filled with useful information, but you have to know how to find it. Here are some of the features that will help you find your way through a textbook:

- **Table of Contents** This list appears at the front of the book and shows the book's structure and the major topics covered.
- **Headings** These words in large bold type signal key topics of a section; subheadings divide text into more specific topics.
- **Diagrams** Diagrams such as graphs, charts, and outlines visually present an idea or concept.
- **Captions** Text that is placed beneath an illustration, photo, or diagram helps to explain the image's significance.
- **Text Styles** Boldface text and italicized text draw your attention to key ideas and terms.

Into Action The headings in a textbook can help when you take notes. As you read the chapter in *Physical Science,* write each main heading on a separate notecard. Take notes about the most important ideas under each heading.

I. What Are Scientific Methods?	II. Asking a Question	III. Forming a Hypothesis
• ways scientists solve problems • use steps	• observations lead to questions • example—Czarnowski and Triantafyllou	

Writing Focus

Preparing for **Constructed Response**

Textbooks often use examples to help clarify information. As you read the textbook chapter that follows, record the examples you find in your *Reader/Writer Notebook*.

Reader/Writer Notebook

Use your **RWN** to complete the activities for this selection.

Vocabulary

observation (ahb zuhr VAY shuhn) *n.*: act of noticing. *Scientists can learn about glaciers from careful observation of their movements.*

hypothesis (hy PAHTH uh sihs) *n.*: possible explanation or answer. *Once a scientist has developed a hypothesis to answer a scientific question, he or she has to test the hypothesis.*

necessarily (nehs uh SAIR uh lee) *adv.*: unavoidably; in every case. *Conclusions based on only one experiment are not necessarily reliable or true.*

Language Coach

Prefixes A thesis is an idea or theory. Which word on the list above contains the word *thesis*? What prefix is added to *thesis*? How does that prefix alter the meaning of the word?

Learn It Online

Do pictures help you learn? Try the *PowerNotes* version of this lesson on:

go.hrw.com L8-109 Go

Selection Resources

Collection 1 Resources, on-level practice and assessment, p. 31

PowerNotes, interactive lesson presentation with activities

Teacher One Stop™, on-level lesson plans and all print resources

Holt Audio Library

Holt Audio Library: Selections and Summaries in Spanish

The Holt Reader, p. 40

The Holt Reader, Adapted Version, p. 36

Holt Audio Tutor Holt English Language Development, systematic instruction and scaffolded content

Supporting Instruction in Six Languages

Holt English Language Development

Resources for Teaching Advanced Students, lesson plans

Preteach

Introducing Vocabulary

Read aloud the Vocabulary words and sample sentences. Then, have students respond to the following prompts.

1. Make an observation about life in a classroom.
2. Form a hypothesis about students who do well in school.
3. Discuss an assumption about teenagers that is not necessarily true.

Language Coach

Use **Language Coach** to help English-language learners acquire word-attack skills. ***Answer:*** *hypotheses*

Remind students that suffixes also affect the meanings of words. Point out the Vocabulary words *observation* and *necessarily*. Explain that –ion and –ily are suffixes.

Informational Text Focus

As you read and discuss the selection with students, have them note the different text features.

Writing Focus

Have students record examples that help clarify information in their **Reader/Writer Notebooks.** Students can use their notes to complete the Writing Focus activity.

Learn It Online

The **PowerNotes** presentation for this lesson includes a short video that introduces the selection. The video is also available on the online version of this page. Preview at **go.hrw.com**.

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Direct Teach

Guided Practice

Model and Apply

- Point out that the table of contents on these pages gives an overview of all the topics in the book. The chapters are titled, The World of Physical Science, The Properties of Matter, States of Matter, and Elements, Compounds, and Mixtures.
- Model for students how to use the table of contents to find specific information quickly and easily. For example, if students wanted to learn more about the differences between gases and liquids, they would look at the headings to find the specific information they need. Tell students that Chapter 3, Section 1 provides information about the three states of matter.
- **Think-Pair-Share** Group students into pairs to discuss why a table of contents is useful. What are the limitations of a table of contents? Have student pairs read the text under the other two subheadings and fill in the remaining bullets under this column. (See p. T28.)

TEXTBOOK CHAPTER

Read with a Purpose
Read to learn about scientific methods and how and why scientists use them.



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Safety First! xxvi

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A **Informational Focus** **Structure and Purpose** Where is the topic of Scientific Methods covered?

Selection Readability	
Easily Accessible **Accessible** Challenging	selection provides background information; chronological order; accessible theme
Lexile	**890**

Selection Summary

Scientists conduct inquiries using the scientific method, which involves the following steps: state the problem; gather information; form a hypothesis; perform experiments; record and analyze data; reach a conclusion; and repeat the process.



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LabBook Skills Practice A Sugar Cube Race! 706
Skills Practice Making Butter 707
Model Making Unpolluting Water 708

B

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B **Informational Focus** **Structure and Purpose** What does this table of contents tell you about the structure of this textbook?

Think About/Talk About

Read with a Purpose Have students read the Read with a Purpose statement. Remind students that chapter titles or headings often contain main ideas. Point out that the title of Chapter 1 appears in large, blue type. Ask students to identify the main idea of the chapter.

Comprehension

A Informational Focus

Possible response: *Scientific Methods is covered in Chapter 1, Section 2.*

B Informational Focus

Possible response: *The book is structured in units. Each unit contains chapters that are divided into sections.*

? Extend the Discussion

Finding Details Where should readers look to learn about safety in science? ***Possible response:*** *Chapter 1, Section 4, on page 24*

Speculating What is the purpose of the Table of Contents? ***Possible response:*** *The purpose is to list the book's content and tell what page begins each chapter, article, or element of the book.*

Differentiating Instruction

English-Language Learners

To help students read "Physical Science," model the reading skill of identifying structural elements.

- Tell students that when reading a textbook, they should isolate each text feature. Help students scan the table of contents to identify the structural elements.
- Have students identify the different chapter titles. Then, call attention to the sections of each chapter. Tell students that these are the basic concepts in the textbook.

Advanced Learners

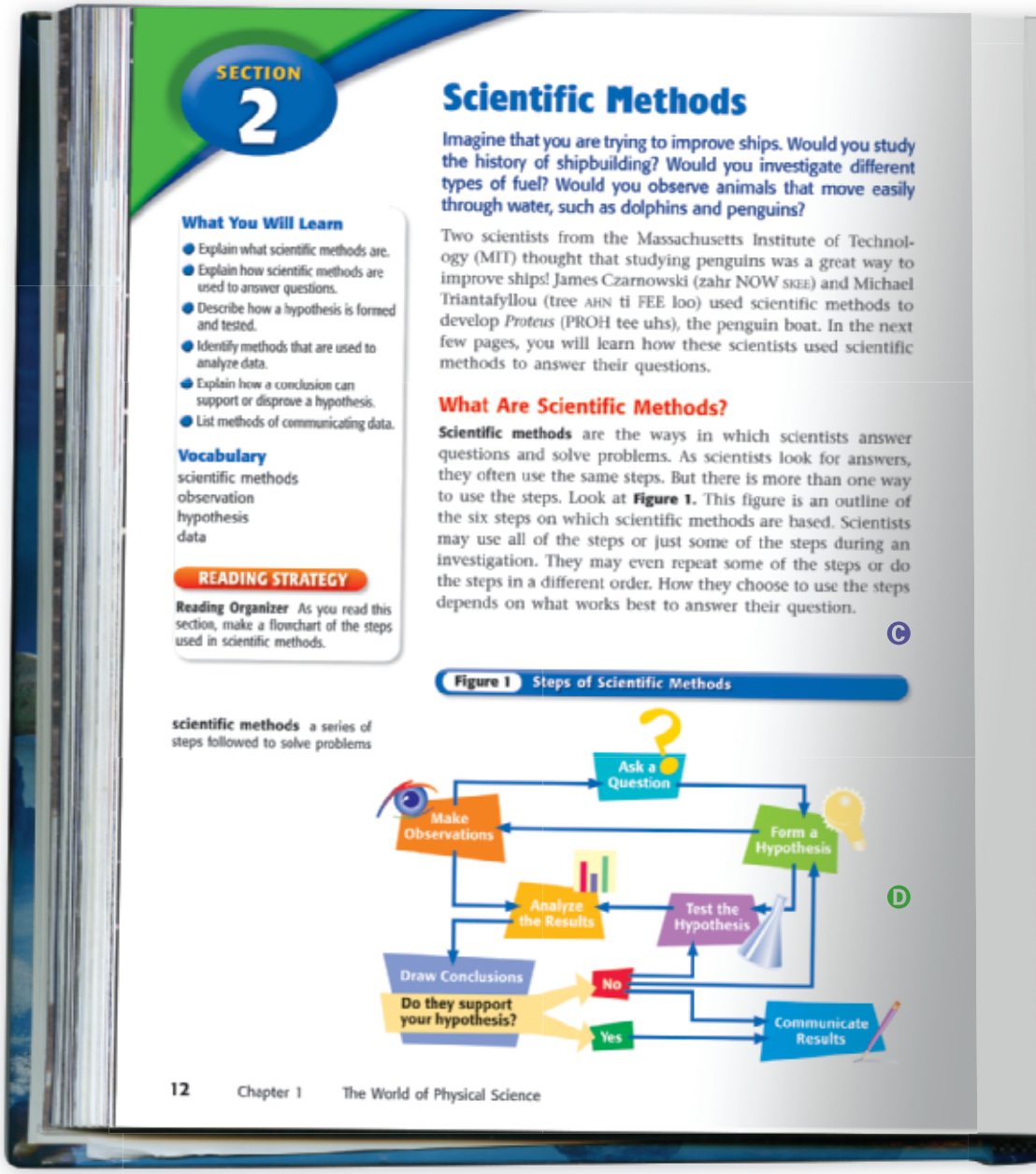
Acceleration Provide students with copies of a section or chapter from a grade-level science textbook. Make sure that all headings, diagrams, captions, and text styles have been removed from the passage.

- Challenge students to mark the selection to show where and how these elements should be introduced to make the selection accessible for readers.
- Ask students to share and explain their choices.

Guided Practice

Model and Apply

- Help students identify the key concept from the first paragraph. Point out that the first paragraph includes an example to illustrate the idea of the key concept. The example introduces two scientists trying to improve the design of ships.
- Point out that the two scientists study penguins to improve shipbuilding techniques. Explain to students that the chapter will illustrate how the scientists use the scientific method to integrate their research of penguins into shipbuilding.
- **Turn-and-Talk** As students read, have student groups discuss their responses to the following questions: What do the scientists develop? What methods do they use? ***Possible responses:*** *The scientists develop a penguin boat called* Proteus *to improve ships; they use scientific methods to build an efficient ship.*



SECTION 2

Scientific Methods

Imagine that you are trying to improve ships. Would you study the history of shipbuilding? Would you investigate different types of fuel? Would you observe animals that move easily through water, such as dolphins and penguins?

Two scientists from the Massachusetts Institute of Technology (MIT) thought that studying penguins was a great way to improve ships! James Czarnowski (zahr NOW SKEE) and Michael Triantafyllou (tree AHN ti FEE loo) used scientific methods to develop *Proteus* (PROH tee uhs), the penguin boat. In the next few pages, you will learn how these scientists used scientific methods to answer their questions.

What You Will Learn

- Explain what scientific methods are.
- Explain how scientific methods are used to answer questions.
- Describe how a hypothesis is formed and tested.
- Identify methods that are used to analyze data.
- Explain how a conclusion can support or disprove a hypothesis.
- List methods of communicating data.

Vocabulary

scientific methods
observation
hypothesis
data

READING STRATEGY

Reading Organizer As you read this section, make a flowchart of the steps used in scientific methods.

What Are Scientific Methods?

Scientific methods are the ways in which scientists answer questions and solve problems. As scientists look for answers, they often use the same steps. But there is more than one way to use the steps. Look at **Figure 1.** This figure is an outline of the six steps on which scientific methods are based. Scientists may use all of the steps or just some of the steps during an investigation. They may even repeat some of the steps or do the steps in a different order. How they choose to use the steps depends on what works best to answer their question.

C

Figure 1 Steps of Scientific Methods

scientific methods a series of steps followed to solve problems

D

12 Chapter 1 The World of Physical Science

C **Read and Discuss** What have we learned about scientific methods?

D **Informational Focus** **Structure and Purpose** What is the purpose of this diagram?

Developing Oral Fluency

- Point out that unfamiliar names and vocabulary words are often followed by phonetic pronunciations.
- Explain that these notations are provided to help readers pronounce these words.
- Tell students that they should scan the text to locate these pronunciations and practice reading them aloud several times before reading the passage.
- Model for students how to use the notations to pronounce *Czarnowski*, *Triantafyllou*, *Proteus*, *propulsion*, and *efficiency*. Tell students that *Czarnowski* has three syllables. The middle syllable is in capital letters. This tells the reader to emphasize or stress that syllable when he or she speaks.
- Then, read the introduction aloud, having students echo your reading of each sentence.

Paired activity Have student pairs take turns reading the section titled "A Real-World Question" aloud.



Asking a Question

Asking a question helps focus the purpose of an investigation. Scientists often ask a question after making many observations. **Observation** is any use of the senses to gather information. Noting that the sky is blue or that a cotton ball feels soft is an observation. Measurements are observations that are made with tools, such as the ones shown in **Figure 2.** Keep in mind that observations can be made (and should be accurately recorded) at any point during an investigation. E

Reading Check **What is the purpose of asking questions?** *(See the Appendix for answers to Reading Checks.)*

A Real-World Question

Czarnowski and Triantafyllou, shown in **Figure 3,** are engineers, scientists who put scientific knowledge to practical use. Czarnowski was a graduate student at the Massachusetts Institute of Technology. He and Triantafyllou, his professor, worked together to observe boat propulsion (proh PUHL shuhn) systems. Then, they investigated how to make these systems work better. A propulsion system is what makes a boat move. Most boats have propellers to move them through the water.

Czarnowski and Triantafyllou studied the efficiency (e FISH uhn see) of boat propulsion systems. *Efficiency* compares energy output (the energy used to move the boat forward) with energy input (the energy supplied by the boat's engine). From their observations, Czarnowski and Triantafyllou learned that boat propellers are not very efficient.

Figure 2 *Stopwatches and rulers are among the many tools used to make observations.*

observation the process of obtaining information by using the senses

Figure 3 *James Czarnowski (left) and Michael Triantafyllou (right) made observations about how boats work in order to develop* Proteus.

Section 2 Scientific Methods 13

E **Read and Discuss** What do "asking a question" and "observation" have to do with scientific methods?

Vocabulary **observation** (ahb zuhr VAY shuhn) *n.*: act of noticing.

Think About/Talk About

Comprehension

C Read and Discuss

Possible response: *Scientific methods are a series of steps scientists use to solve problems and answer questions.*

D Informational Focus

Possible response: *The diagram clarifies the steps of scientific methods and gives possible sequences.*

E Read and Discuss

Possible response: *Often, scientists will ask a question after making many observations. This question helps focus the scientific investigation.*

Extend the Discussion

Speculating Why do you think there are different ways of performing the steps of the scientific method?
Possible response: *The steps will vary depending on the question or problem that scientists are exploring.*

Making Connections How do the images on the page connect with the text? ***Possible response:*** *They illustrate information from the text.*

Differentiating Instruction

Readers Gaining Proficiency

Point out the word *technology* in the text. Explain that this word contains the Greek root *logos* meaning "word." Tell students that the suffix *–logy* is added to many English words to indicate "the science, doctrine, or theory of." Explain that *technology* is "the science or study of the practical or industrial arts, applied sciences, and so on." Have student pairs use their knowledge of the Greek root and the English suffix to develop definitions for the following words. Have students check their responses using dictionaries.

- biology [*science that deals with the life processes of living organisms*]
- geology [*science dealing with the physical nature and history of the Earth*]
- radiology [*science dealing with x-rays and other forms of radiant energy*]
- theology [*study of religious doctrines and divinity*]

Guided Practice

Model and Apply

- Provide students with copies of the Informational Text Focus graphic organizer for "Physical Science." (See **Collection 1 Resources**.)
- Model for students how to take notes about the key concepts by looking for these topics in the introductory paragraph, under the main headings, and under each of the subheadings.
- Tell students that the introductory paragraph under the *Forming a Hypothesis* main heading explains what a hypothesis is.

III. Forming a Hypothesis

- possible explanation or answer to question; testable
- propulsion system modeled after penguins more efficient
- predictions usually made in if-then statements

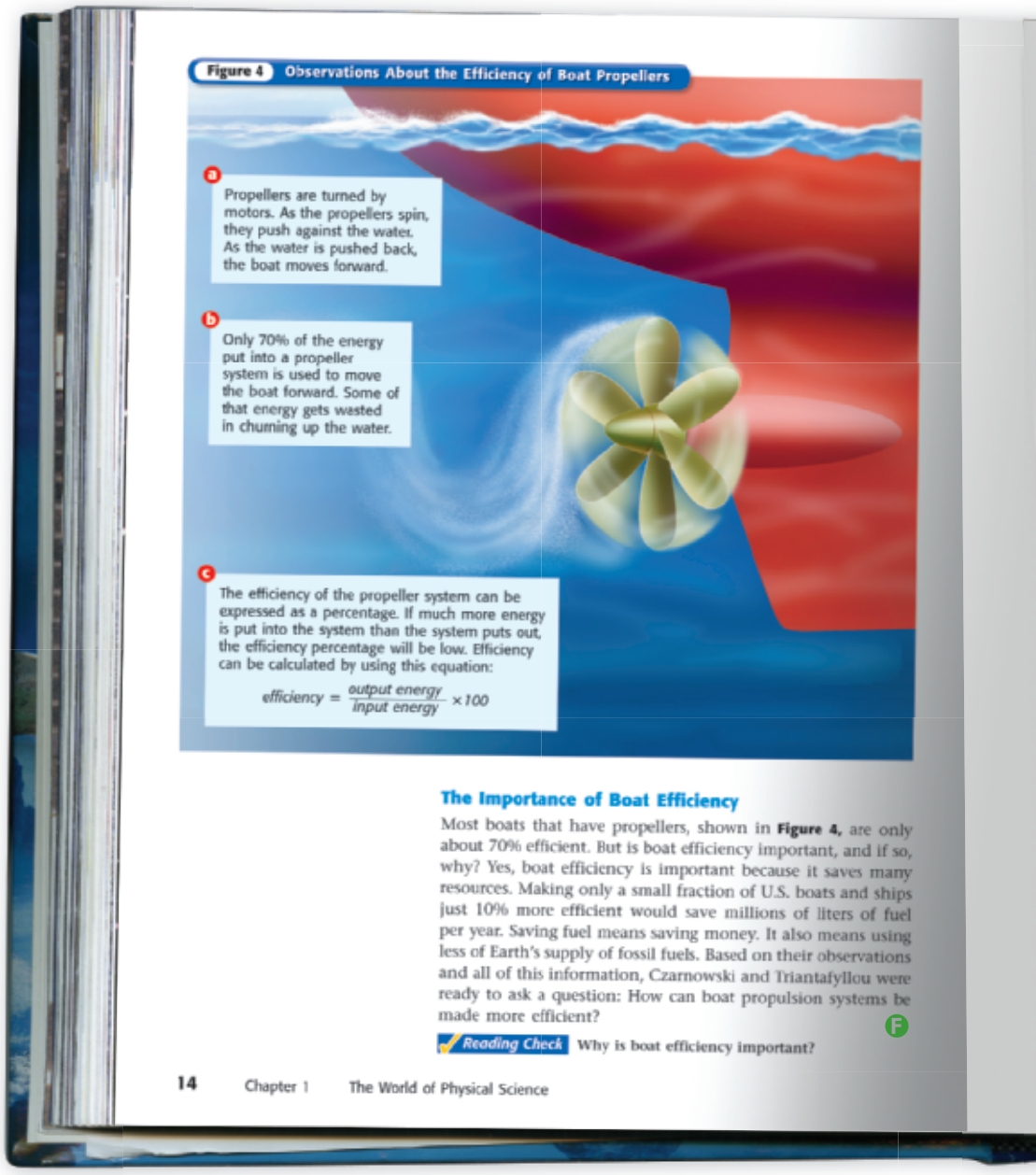


Figure 4 Observations About the Efficiency of Boat Propellers

a Propellers are turned by motors. As the propellers spin, they push against the water. As the water is pushed back, the boat moves forward.

b Only 70% of the energy put into a propeller system is used to move the boat forward. Some of that energy gets wasted in churning up the water.

c The efficiency of the propeller system can be expressed as a percentage. If much more energy is put into the system than the system puts out, the efficiency percentage will be low. Efficiency can be calculated by using this equation:

$$\text{efficiency} = \frac{\text{output energy}}{\text{input energy}} \times 100$$

The Importance of Boat Efficiency

Most boats that have propellers, shown in **Figure 4,** are only about 70% efficient. But is boat efficiency important, and if so, why? Yes, boat efficiency is important because it saves many resources. Making only a small fraction of U.S. boats and ships just 10% more efficient would save millions of liters of fuel per year. Saving fuel means saving money. It also means using less of Earth's supply of fossil fuels. Based on their observations and all of this information, Czarnowski and Triantafyllou were ready to ask a question: How can boat propulsion systems be made more efficient? F

Reading Check Why is boat efficiency important?

14 Chapter 1 The World of Physical Science

F **Informational Focus** **Structure and Purpose** What purpose do the labels next to Figure 4 serve?

Reaching Reluctant Readers

- Point out to students that scientists are often people who like to ask questions and solve problems about the way the world works.
- Organize students into small groups. Provide each group with a variety of objects to observe such as a flower, a cotton ball, and a mechanical toy.
- Have each group elect a student to record observations on a group chart. Then, have students make observations for as many of the five senses as possible.
- Students should then select one observation with which to work.
- Tell students to turn the observation into a question. For example, if students observe that the cotton ball is soft, they might ask: Why is the cotton ball soft?
- Remind students to turn their questions into testable hypotheses. For example, students might hypothesize that cottons balls are soft due to the structure of the fibers. Have students conduct research and/or experiments to respond to their hypotheses.

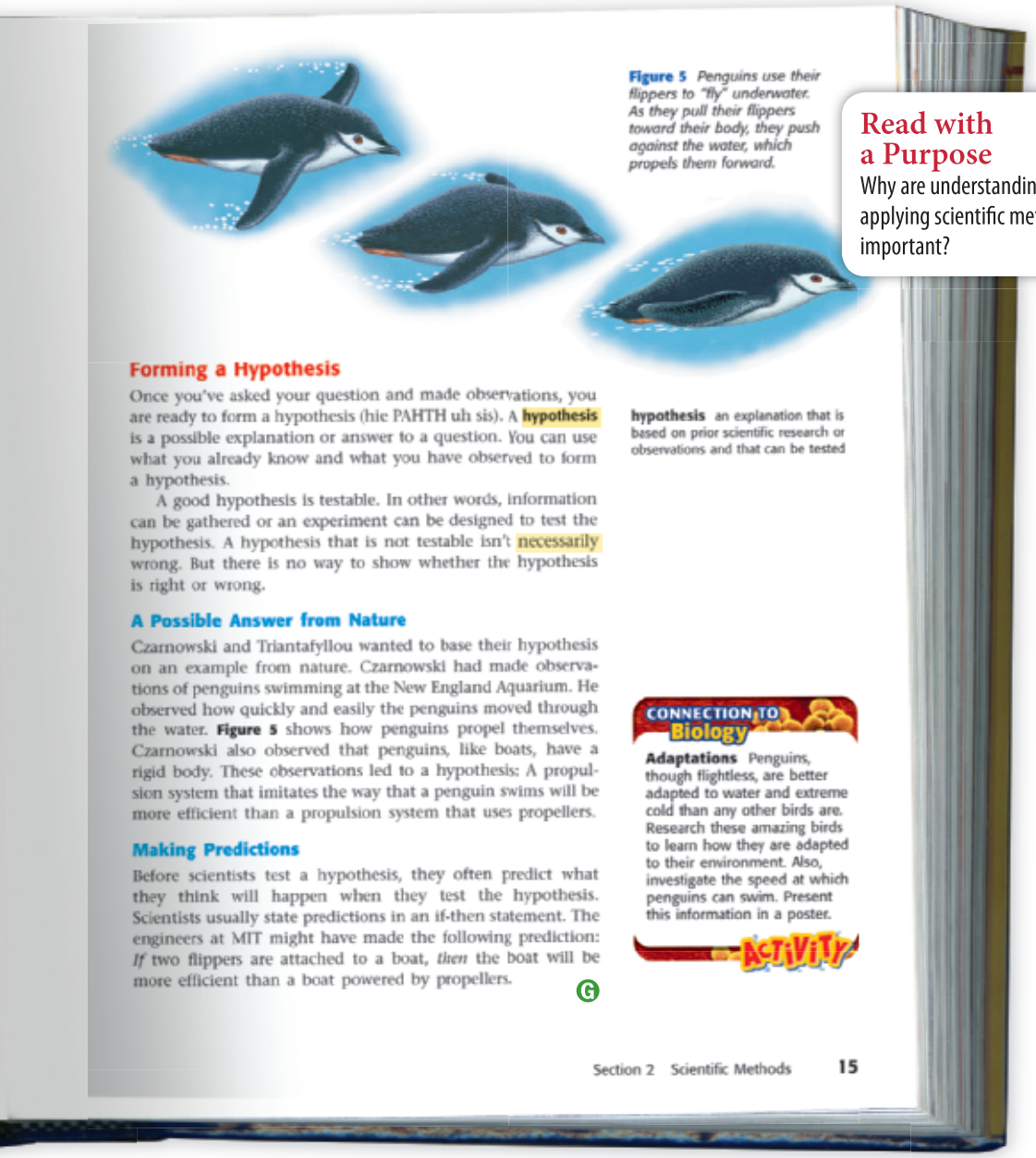


Figure 5 *Penguins use their flippers to "fly" underwater. As they pull their flippers toward their body, they push against the water, which propels them forward.*

Forming a Hypothesis

Once you've asked your question and made observations, you are ready to form a hypothesis (hie PAHTH uh sis). A **hypothesis** is a possible explanation or answer to a question. You can use what you already know and what you have observed to form a hypothesis.

A good hypothesis is testable. In other words, information can be gathered or an experiment can be designed to test the hypothesis. A hypothesis that is not testable isn't necessarily wrong. But there is no way to show whether the hypothesis is right or wrong.

hypothesis an explanation that is based on prior scientific research or observations and that can be tested

A Possible Answer from Nature

Czarnowski and Triantafyllou wanted to base their hypothesis on an example from nature. Czarnowski had made observations of penguins swimming at the New England Aquarium. He observed how quickly and easily the penguins moved through the water. **Figure 5** shows how penguins propel themselves. Czarnowski also observed that penguins, like boats, have a rigid body. These observations led to a hypothesis: A propulsion system that imitates the way that a penguin swims will be more efficient than a propulsion system that uses propellers.

Making Predictions

Before scientists test a hypothesis, they often predict what they think will happen when they test the hypothesis. Scientists usually state predictions in an if-then statement. The engineers at MIT might have made the following prediction: *If* two flippers are attached to a boat, *then* the boat will be more efficient than a boat powered by propellers. G

CONNECTION TO Biology

Adaptations Penguins, though flightless, are better adapted to water and extreme cold than any other birds are. Research these amazing birds to learn how they are adapted to their environment. Also, investigate the speed at which penguins can swim. Present this information in a poster.

ACTIVITY

Section 2 Scientific Methods 15

Read with a Purpose
Why are understanding and applying scientific methods important?

G **Informational Focus** **Structure and Purpose** What are the headings and subheadings on this page? What information do those heads reveal?

Vocabulary **hypothesis** (hy PAHTH uh sihs) *n.:* possible explanation or answer. **necessarily** (nehs uh SAIR uh lee) *adv.:* unavoidably; in every case.

Differentiating Instruction

Visual/Spatial Learners

- Have students compare and contrast the illustrations of the penguins with that of *Proteus*.
- Have students make a list of similarities between the two, and another list of the differences. Guide students in a class discussion about the similarities and differences.
- Record students' observations on the board.

Possible responses: *similarities—both have flippers, both propel themselves across distances; differences—penguins swim underwater,* Proteus *moves on top of the water; penguins have flippers on the sides of their bodies,* Proteus's *flipper paddles are positioned at the rear of the boat; penguins' bodies are completely streamlined,* Proteus's *form is not.*

Think About/Talk About

Comprehension

G Informational Focus

Possible response: *The labels give information about how propellers function.*

F Informational Focus

Possible response: *Heading—Forming a Hypothesis; Subheadings—A Possible Answer from Nature, Making Predictions. These heads reveal the thought process behind how the scientists form their hypothesis.*

? Extend the Discussion

Evaluating Text Features How do the figures on these two pages relate to each other? ***Possible response:*** *Figure 5 shows how a penguin propels itself through water. Figure 4 shows how propellers move boats through water.*

Drawing Conclusions The scientists turn to nature to test their hypothesis. What is the connection between the scientists' hypothesis and nature? ***Possible response:*** *One of the scientists had observed how quickly and efficiently penguins propel themselves through the water even though they have rigid, boatlike, bodies.*

Check for Understanding

Use the Read with a Purpose follow up question to assess students' understanding. ***Possible response:*** *It provides a means of understanding the natural world through careful investigation.*

Review

Independent Practice

Answers and Explanations

1. **A** *This feature is used to locate where information is in a text.*
2. **C** *Most diagrams contain captions that give additional information.*
3. **C** *Vocabulary words and references to figures appear in boldface type.*
4. **C** Unavoidably *is a synonym for* necessarily.
5. **D** A hypothesis *is a possible explanation for a question that precedes an investigation or an experiment.*
6. **A** *Scientists use their five senses to make observations.*

Writing Focus

Possible response: *Graphics and captions are often the most helpful aspects of a textbook because they clarify and reinforce important concepts.*

What Do You Think Now?

Have students identify the goals of Czarnowski and Triantafyllou and how science helped them solve a problem. Have students discuss other issues that can be solved through science.

Assess

Collection 1 Resources, Selection Test

ThinkCentral Online Assessment, Selection Test

Teacher One Stop™, editable Selection Test

Reteach

ThinkCentral Online Remediation

TEXTBOOK CHAPTER

Applying Your Skills

Physical Science

Practicing the Standards

Informational Text and Vocabulary

1. Which question can you answer by reading the **table of contents** for *Physical Science*?
   - **A** Where will I find information about organizing scientific data?
   - **B** What is the scientific definition of *efficiency*?
   - **C** How is the design of the *Proteus* different from the design of other boats?
   - **D** What is the difference between controlled and variable parameters?

2. Which of the following text features helps explain the parts and significance of a **diagram**?
   - **A** Headings
   - **B** Italics
   - **C** Captions
   - **D** Table of contents

3. What kinds of details appear in **boldface** type in *Physical Science*?
   - **A** Main ideas and chapter summaries
   - **B** Names of scientists and inventors
   - **C** Vocabulary words and references to figures
   - **D** Diagram labels and key questions

4. *Necessarily* means —
   - **A** Uncertainly
   - **B** Unfriendly
   - **C** Unavoidably
   - **D** Unimportant

5. If you make a *hypothesis,* you —
   - **A** avoid a dangerous situation
   - **B** analyze the results of an experiment
   - **C** solve one problem but create another
   - **D** come up with a possible explanation

6. What do you need to make an *observation*?
   - **A** Your senses
   - **B** Your imagination
   - **C** Your encyclopedia
   - **D** Your beliefs

Writing Focus — Constructed Response

What features of the textbook excerpt did you find most useful in helping you understand the concepts being explained? Give reasons for your response.

What Do You Think Now?

How do scientific methods help us use science to fulfill our wishes?

SKILLS FOCUS pp. 116–117

Informational Skills
- Analyze the structure and purpose of a textbook.
- Understand the structure and purpose of a newspaper article.

Vocabulary Skills
- Demonstrate knowledge of literal meanings of words and their usage

Writing Skills
- Write to explain