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The World of Physical Science

The Big Idea

Scientific progress is made by asking meaningful questions and conducting careful investigations.

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About the PHOTO

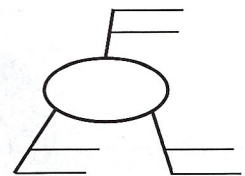
Flippers work great to help penguins move through the water. But could flippers help ships, too? Two scientists have been trying to find out. By using scientific methods, they are asking questions such as, "Would flippers use less energy than propellers do?" As a result of these investigations, ships may have flippers like those of penguins someday!

PRE-READING ACTIVITY

Graphic

Organizer

Spider Map Before you read the chapter, create the graphic organizer entitled "Spider Map" described in the **Study Skills** section of the Appendix. Label the circle "Scientific Models." Create a leg for each type of scientific model. As you read the chapter, fill in the map with details about each type of scientific model.



Exploring Physical Science

You're eating breakfast. You look down and notice that your reflection in your spoon is upside down! You wonder, Why is my reflection upside down even though I'm holding the spoon right side up?

Congratulations! You just completed the first steps toward becoming a scientist. How did you do it? You observed the world around you. Then, you asked questions about your observations. That's what most of science is all about.

That's Science!

Science is a process of gathering knowledge about the natural world. Asking a question is often the first step in the process of gathering knowledge. The world around you is full of amazing things that can lead you to ask questions. The student in **Figure 1** didn't have to look very far to realize that she had some questions to ask.

Reading Check What is often the first step in gathering knowledge? (See the Appendix for answers to Reading Checks.)

Everyday Science

Everyday actions such as timing the microwave popcorn and using the brakes on your bicycle use your knowledge of science. You learned how to do these things by making observations and asking questions. Making observations and asking questions is what science is all about. And because science is all around, you might not be surprised to learn that there are many branches of science. Physical science is the science you will learn about in this book. But physical science is just one of the many different branches of science.

Figure 1 Part of science is asking questions about the world around you.

What You Will Learn

- Explain that science involves asking questions.
- Describe the relationship of matter and energy to physical science.
- Describe the two branches of physical science.
- Identify three areas of science that use physical science.

Vocabulary

science

physical science

READING STRATEGY

Prediction Guide Before reading this section, write the title of each heading in this section. Next, under each heading, write what you think you will learn.

Why can I see a reflection in a spoon?

What causes high and low tides?

Why do I feel pain when I stub my toe?





Figure 2 The cheetah, the fastest land mammal, uses a lot of energy when running full speed. But a successful hunt will supply the energy the cheetah needs to live.

What Is Physical Science?

Physical science is the study of matter and energy. *Matter* is the “stuff” that everything is made of. Even stuff so small that you can’t see it is matter. Your shoes, your pencil, and even the air you breathe are made of matter. And all of this matter has energy. *Energy* is the ability to do work. But energy is easier to describe than to explain. For example, energy is partly responsible for rainbows in the sky. But energy isn’t the rainbow itself. All moving objects have energy of motion, such as the cheetah shown in **Figure 2**.

Food also has energy. When you eat food, the energy in the food is transferred to you. You can use that energy to carry out your daily activities. But energy isn’t always associated with motion or food. All matter, including matter that isn’t moving, has energy. So, because the baseball in **Figure 3** is matter, it has energy even though it is not yet moving.

A Study of Matter and Energy

As you explore physical science, you’ll learn more about matter and energy. And you will see how matter and energy relate to each other. For example, both paper and gold are matter. But why will paper burn, and gold will not? And why is throwing a bowling ball harder than throwing a baseball? How can water turn into steam and back into water? All of the answers to these questions have to do with matter and energy. It is hard to talk about matter without talking about energy. However, sometimes it is useful to focus on one or the other. Physical science is also often divided into two categories: chemistry and physics.

science the knowledge obtained by observing natural events and conditions in order to discover facts and formulate laws or principles that can be verified or tested

physical science the scientific study of nonliving matter

Figure 3 The baseball has energy even before the boy throws it, because it is matter, and all matter has energy.



Branches of Physical Science

Physical science is usually divided into chemistry and physics. But both chemistry and physics can be further broken down into many more specialized areas of study. For example, chemistry includes organic chemistry, which is the study of substances made of carbon. And geophysics, one of the branches of physics, includes the study of the vibrations deep inside the Earth that are caused by earthquakes.

Chemistry—A Matter of Reactions!

Chemistry is the study of all forms of matter, including how matter interacts with other matter. Chemistry looks at the structure and properties of matter. For example, some substances behave one way under high temperature and high pressure. But other substances will behave very differently under the same conditions. The scientist in **Figure 4** is studying the properties of different kinds of materials. He is trying to find materials that have unusual properties, such as the ability to withstand very high heat.

Chemistry is also the study of how substances change. A chemical reaction takes place when one substance reacts with another substance to make a new substance. Chemical reactions are taking place around you all of the time. When your body digests food, a chemical reaction is taking place. Chemical reactions are needed when you take a photo of your best friend, when your parent starts the car engine, and when you turn on a flashlight.

 **Reading Check** What are three things that chemistry studies?

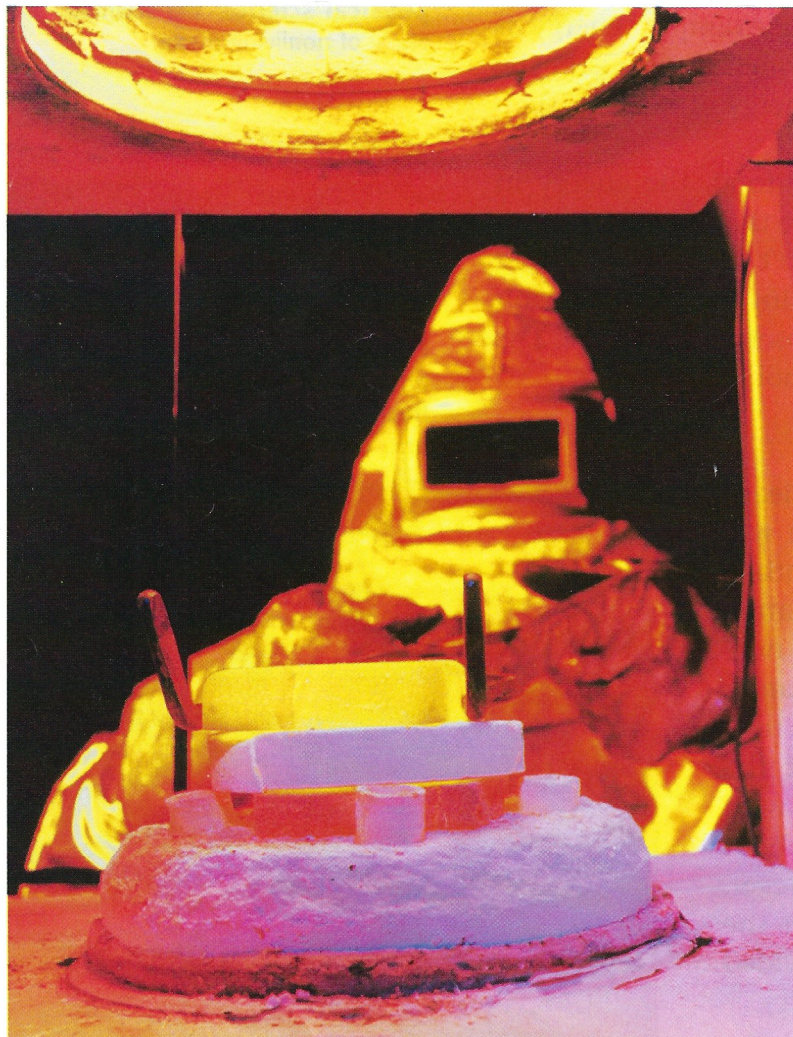


Figure 4 A materials scientist uses his knowledge of chemistry to study the properties of different kinds of substances.



Figure 5 When you study physics, you'll learn how energy causes the motion that makes a roller-coaster ride so exciting.

Physics—A Matter of Energy

Like chemistry, physics deals with matter. But physics looks mostly at energy and the way that energy affects matter. Studying different forms of energy is what studying physics is all about. Energy can make matter do some interesting things. For example, have you ever wondered what keeps a roller coaster, such as the one shown in **Figure 5**, on its tracks? The study of physics will help answer this question.

Motion, force, gravity, electricity, light, and heat are parts of physics. They are also things that you experience in your daily life. For example, if you have ever ridden a bike, you are aware that force causes motion. If you have ever used a compass, you have dealt with the concept of magnetism. Do you know why you see a rainbow after a rainstorm? Or, do you know why shifting gears on your bicycle makes it easier to pedal? You will learn the answers to these questions, as well as many others, as you study physical science.

INTERNET ACTIVITY

For another activity related to this chapter, go to **go.hrw.com** and type in the keyword **HP5WPSW**.

CONNECTION TO Environmental Science

Thermal Pollution Factories are often built along the banks of rivers. The factories use the river water to cool the engines of their machinery. Then, the hot water is poured back into the river. Energy, in the form of heat, is transferred from this water to the river water. The increase in temperature results in the death of many living things. Research how thermal pollution causes fish to die. Also, find out what many factories are doing to prevent thermal pollution. Make a brochure that explains what thermal pollution is and what is being done to prevent it.

ACTIVITY



Figure 6 These meteorologists are risking their lives to gather data about tornadoes.

Physical Science: All Around You

Believe it or not, matter and energy are not just concepts in physical science. What you learn about matter and energy is important for other science classes, too.

Meteorology

The study of Earth's atmosphere, especially in relation to weather and climate, is called *meteorology* (MEET ee uhr AHL uh jee). A *meteorologist* (MEET ee uhr AHL uh jist) is a person who studies the atmosphere. One of the most common careers meteorologists have is weather forecasting. But other meteorologists specialize in and even chase tornadoes! These meteorologists predict where a tornado is likely to form. Then, they drive very close to the site to gather data, as shown in **Figure 6**. By gathering data this way, scientists hope to understand tornadoes better. Meteorologists must have knowledge of physical science. They must understand high and low pressure, motion, and force before they can predict how tornadoes will behave.

Geology

The study of the origin, history, and structure of Earth is called *geology*. Some geologists are geochemists (JEE oh KEM ists). A *geochemist* is a person who specializes in the chemistry of rocks, minerals, and soil. Geochemists, such as the one in **Figure 7**, try to find out what the environment was like when these materials formed and what has happened to the materials since they formed. To understand how rocks and soil have changed over millions of years, a geochemist must have a knowledge of heat, force, and chemistry.


 **Reading Check** What does a geochemist study?

Figure 7 This geochemist takes rock samples from the field. Then, she studies them in her laboratory.



Biology

Students are often surprised that life science and physical science are related. But chemistry and physics explain many things that happen in biology. For example, a chemical reaction explains how animals, such as the cow in **Figure 8**, get energy from food. Sugar, $C_6H_{12}O_6$, which is produced by the plant, reacts with oxygen. As a result, carbon dioxide, water, and energy are produced. This reaction can be shown by the following chemical equation:

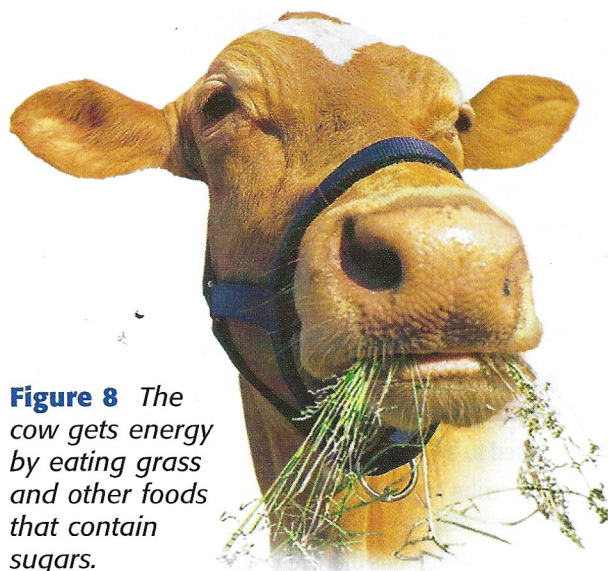


Figure 8 The cow gets energy by eating grass and other foods that contain sugars.

SECTION Review

Summary

- Science is a process of gathering knowledge about the natural world.
- Physical science is the study of matter and energy.
- Physical science is divided into the study of physics and chemistry.
- Chemistry studies the structure and properties of matter and how matter changes.
- Physics looks at energy and the way that energy affects matter.
- A knowledge of physical science is important for many areas of science, such as geology and biology.

Using Key Terms

1. In your own words, write a definition for each of the following terms: *science* and *physical science*.

Understanding Key Ideas

2. Which of the following statements is true?
 - a. Energy is the ability to do work.
 - b. Air is made of matter.
 - c. All matter has energy.
 - d. All of the above
3. What are three areas of science that rely on physical science?
4. What is the difference between chemistry and physics?

Math Skills

5. You want to know which month had the highest percentage of rainy days for your city last year. Your investigation gave the following results: March had 5 days of rain, April had 8 days of rain, and May had 3 days of rain. For each month, what percentage of the month had rainy days? Which month had the highest percentage of rainy days?

Critical Thinking

6. **Applying Concepts** How do you think science is used by a pharmacist? by a firefighter?
7. **Analyzing Ideas** You are building a go-cart and want to know how to make it go as fast as possible. Which branch, or branches, of science would you study? Explain your answer.
8. **Identifying Relationships** Describe three things that you do every day that use your experience with physical science.
9. **Making Inferences** Botany is the study of plants. What role do you think physical science plays in botany?

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Topic: **Scientific Inquiry; Careers in Science**
SciLinks code: **HSM1357; HSM0225**