What Is Science?

You are eating soup and you see your reflection in the spoon. It is upside down. You wonder, “Why is my reflection upside down in a spoon, but not in a mirror?” Asking questions like this one is the first step in doing science. Science is a process of collecting information about the world. Much of the time, the first step in collecting information is asking a question.

You may not realize it, but you use science every day. When you use the brakes on your bicycle to slow down, you use your knowledge of science. You learned how hard you should apply the brakes by making observations. Making observations, asking questions, and trying to find the answers is what science is all about.
What Is Physical Science?

Science is divided into many branches, or parts. Three major branches of science are Earth science, life science, and physical science. Physical science is the study of matter and energy.

Matter is the “stuff” that everything is made of. Your shoes, your pencil, and the air you breathe are made of matter. Energy is the ability to do work. Matter and energy are related because all matter has energy.

Sometimes, you can see or feel energy, such as light or heat. Sometimes, you can tell that an object has energy because it is moving.

All matter contains energy, even if you cannot see or feel the energy. For example, food contains energy. When you eat the food, you get energy from the food. You can use the energy to do all of your daily activities.

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

Why will paper burn, and gold will not? Why is throwing a bowling ball harder than throwing a baseball? How does water turn into steam? The answers to these questions have to do with matter and energy. As you study more about physical science, you will learn more about matter and energy. You will see how matter and energy are related to each other.
What Are the Branches of Physical Science?

Physical science is divided into two main branches: chemistry and physics. Both chemistry and physics can be divided into even smaller areas of study. For example, a smaller branch of chemistry is solid-state chemistry. *Solid-state chemistry* is the study of the reactions and behavior of solid materials. Another example is geophysics, a smaller branch of physics. *Geophysics* is the study of movements deep in the Earth.

**CHEMISTRY**

*Chemistry* is the study of the structure and properties of matter. The structure and properties of a substance determine how it interacts with other matter. For example, sugar dissolves in water. A diamond has a different structure and properties, so it doesn’t dissolve in water.

The structure and properties of matter also affect how it behaves under different conditions. For example, water is a liquid at room temperature. If the temperature decreases, the water may become solid. However, honey has a different structure and properties. It will become solid at a different temperature than water.

Chemistry also includes the study of how matter changes. Substances can change during chemical reactions. A *chemical reaction* happens when one substance interacts with another substance to form a new substance. Chemical reactions are happening all the time. When your body digests food, a chemical reaction is taking place. Chemical reactions are what make flashlights work. They also allow car engines to run.

**READING CHECK**

4. **Identify** What are the two main branches of physical science?

5. **Explain** Why don’t all substances behave the same way under the same conditions?
PHYSICS

The second area of physical science is physics. Like chemistry, physics has to do with matter. Physics is the study of how energy affects matter. The study of physics can help you understand how a roller coaster works and what keeps it on its tracks.

You can tell that a roller coaster has energy. When you study physics, you will learn what makes the roller coaster ride so exciting.

Why does a ball roll down a hill? Why doesn’t a brick roll down the same hill? How does a parachute let someone jump out of an airplane without getting hurt? How can a compass tell you which way is north? Physics can help you answer questions like these.

Motion, force, gravity, electricity, light, and heat are parts of physics. They are also things that you experience in your everyday life. For example, when you ride a bike, you are dealing with force and motion. If you fall off the bike, you are affected by gravity.

How Do Other Branches of Science Use Physical Science?

You learn about matter and energy when you study physical science. However, matter and energy are important in other branches of science, too. Many kinds of scientists use ideas from physical science in their work.
METEOROLOGY

The study of Earth’s atmosphere, weather, and climate is called meteorology. Scientists who study meteorology are called meteorologists. You may have seen meteorologists on the news, forecasting the weather. Other meteorologists study severe weather, such as hurricanes and tornadoes. They may be able to predict where severe weather will form so they can warn people.

Before they can predict the weather, meteorologists need to understand pressure, motion, and force. These are ideas that you will study in physical science.

GEOLOGY

The study of the history, structure, and formation of Earth is called geology. One kind of geologist is a geochemist. A geochemist is a person who studies the chemistry of rocks, minerals, and soil. Geochemists also need to know about heat and force to understand how parts of Earth formed and how they have changed.

BIOLOGY

Believe it or not, life science and physical science are related. Chemistry and physics can explain many things that happen in biology. For example, a chemical reaction explains how animals get energy from food.

Plants make sugar. Animals eat plants and breathe in oxygen. In animals, the sugar reacts with the oxygen to make carbon dioxide, water, and energy. You will learn about this and other chemical reactions when you study physical science.
Section 1 Review

SECTION VOCABULARY

**physical science** the scientific study of nonliving matter

**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

1. **Identify**  What are three main branches of science?

2. **Define**  What are matter and energy? How are they related?

3. **Infer**  A scientist is studying the forces that act on a hockey puck. What branch of physical science is the scientist probably using? Explain your answer.

4. **Explain**  Why does a meteorologist need to understand physics?

5. **Apply Ideas**  You are building a go-cart. You want to know how you can make it go as fast as it can. Explain how you can use both chemistry and physics to help you build your go-cart.

6. **Explain**  Why does a biologist need to understand chemistry?
8. Answers include: eye protection in the lab area, heating safety near hot plates

Review
1. °C and K
2. All measurements use the same units, so it is easy to compare measurements. Units are based on the number 10, so it is easy to convert between units.
3. Multiply its length, width, and height together.
4. | Type of measurement | Examples of units used for this measurement |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Length</td>
<td>meter, centimeter</td>
</tr>
<tr>
<td>Area</td>
<td>square centimeter, square meter</td>
</tr>
<tr>
<td>Mass</td>
<td>kilogram, gram</td>
</tr>
<tr>
<td>Volume</td>
<td>cubic centimeter, milliliter</td>
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</tbody>
</table>
5. 2 g/cm³
6. Follow teacher's directions; follow written directions; do not take shortcuts.

Chapter 3 The World of Physical Science

SECTION 1 EXPLORING PHYSICAL SCIENCE
1. asking questions
2. light, heat
3. It is made of matter, and all matter has energy.
4. chemistry, physics
5. They have different structures and properties.
6. Chemistry deals with the properties and structure of matter; physics deals with the interactions of matter and energy.
7. the study of the atmosphere, weather, and climate
8. They need to understand the chemistry of rocks; they need to understand how heat and force affect the Earth.

Review
1. physical science, life science, Earth science
2. Matter is what everything is made of. Energy is the ability to do work. They are related because all matter has energy.
3. Physics; physics deals with forces and the interactions between matter and energy.
4. A meteorologist needs to know about pressure, motion, and force to understand weather. These topics are all part of physics.
5. Studying physics will help you learn about motion and the forces that act on the go-cart. Studying chemistry will help you learn about the properties of the different materials you can use to make the go-cart.
6. Many biological processes are driven by chemical reactions.

SECTION 2 SCIENTIFIC METHODS
1. ways in which scientists answer questions and solve problems
2. drawing conclusions
3. scientists who build things based on scientific knowledge
4. as flippers
5. a possible explanation or answer to a question
6. The statement lists the expected result of the experiment if the prediction is true. One need only compare the actual result with the statement to learn whether the hypothesis is correct.
7. more, the same
8. the factor that changes in a controlled experiment
9. foils, or flipperlike paddles
10. distance and weather
11. the flapping rate of the flippers
12. pieces of information collected during experiments
13. to interpret what the data mean
14. 1.7 flaps per second
15. *Proteus* was 17% more efficient.
16. Their results supported their hypothesis.
17. Write a paper; give a talk; create a Web site.

Review
1. **Steps in scientific methods**
   - Ask questions.
   - Form a hypothesis.
   - Make observations.
   - Test the hypothesis.
   - Analyze results.
   - Draw conclusions.
2. guess, explanation
3. 0.95 flaps per minute
4. an experiment in which only one factor changes at a time