Chapter Preview

Improving Comprehension

Graphic Organizers are important visual tools that can help you organize information and improve your reading comprehension. The Graphic Organizer below is called a *comparison table*. Instructions for creating other types of Graphic Organizers are located in the **Study Skills** section of the Appendix.

How to Make a Comparison Table

1. Draw a table like the one shown below. Draw as many columns and rows as you want to draw.

2. In the top row, write the topics that you want to compare.

3. In the left column, write the general characteristics that you want to compare. As you read the chapter, fill in the characteristics for each topic in the appropriate boxes.

	Solid	**Liquid**	**Gas**	**Plasma**
Definite volume	yes	yes	no	no
Definite shape	yes	no	no	no
Possible changes of state	melting, sublimation	freezing, evaporation	condensation	

When to Use a Comparison Table

A comparison table is useful when you want to compare the characteristics of two or more topics in science. Organizing information in a table helps you compare several topics at one time. In a table, all topics are described in terms of the same list of characteristics, which helps you make a thorough comparison. As you read, look for topics whose characteristics you may want to compare in a table.

You Try It!

This Reading Strategy can also be used within the chapter that you are about to read. Practice making your own *comparison table* as directed in the Reading Strategies for Section **1** and Section **2**. Record your work in your **Science Journal.**

Section 1
Four States of Matter

Key Concept Each state of matter has a characteristic way in which its particles interact.

What You Will Learn
- All matter is made of particles that are in constant motion.
- Each state of matter depends on the motion of its particles.
- In solids, particles can only vibrate; in liquids, particles can collide with and move past one another; in gases, particles are free to move independently, colliding frequently.
- In plasmas, particles move independently and are broken apart.

Why It Matters
Understanding the states of matter will help you understand natural processes in the world around you.

You get home from school and decide to make yourself a snack. There are some leftovers in the refrigerator from your dinner last night. So, you heat some up in the microwave oven. As the food heats up, you begin to smell the food. You're also thirsty, so you put some ice in a glass—*clink!*—and fill the glass with water. You take a big gulp—*ahhh!*

Matter: Moving Particles

The scene described above has examples of the three most familiar states of matter. Those states of matter are solid, liquid, and gas. The **states of matter** are the physical forms of a substance. The states of matter depend on the motion of particles.

Matter is made up of very tiny particles called *atoms* and *molecules* (MAHL i KYOOLZ). Atoms and molecules are in constant motion and are always bumping into each other. The motion of particles is different for each state of matter. The way that the particles interact with each other also helps determine the state of the matter. **Figure 1** describes three states of matter—solid, liquid, and gas—in terms of the motion and attraction of the particles.

Figure 1 Models of a Solid, a Liquid, and a Gas

Particles of a solid have a strong attraction between them. The particles are closely locked in position and can only vibrate.

Particles of a liquid are more loosely connected than those of a solid and can collide with and move past one another.

Particles of a gas move fast enough so that they overcome the attractions between them. The particles move independently and collide frequently.

Standards Check In terms of particles, how does each state of matter differ from the others?

Solids

Imagine dropping a marble into a bottle. Would anything happen to the shape or size of the marble? Would the shape or size of the marble change if you put it in a larger bottle?

A marble keeps its original shape and volume no matter where it is placed because it is a solid. A **solid** is the state of matter that has a definite shape and volume.

The particles of a substance in a solid state are very close together. They have a strong attraction between them. The particles in a solid move, but they do not move fast enough to overcome the attraction between them. Therefore, each particle is closely locked in position and can only vibrate in place.

Liquids

What do you think would change about orange juice if you poured the juice from a can into a glass? Would the volume of juice be different? Would the taste of the juice change?

The only thing that would change when the juice is poured into the glass is the shape of the juice. The shape changes because juice is a liquid. **Liquid** is the state of matter that has a definite volume but takes the shape of its container. The particles in liquids move fast enough to overcome some of the attractions between them. The particles collide with and slide past each other. But the particles remain close together.

Because the juice is a liquid, its volume stays the same whether you pour the juice into a large container or into a small one. **Figure 2** shows the same volume of liquid in two different containers.

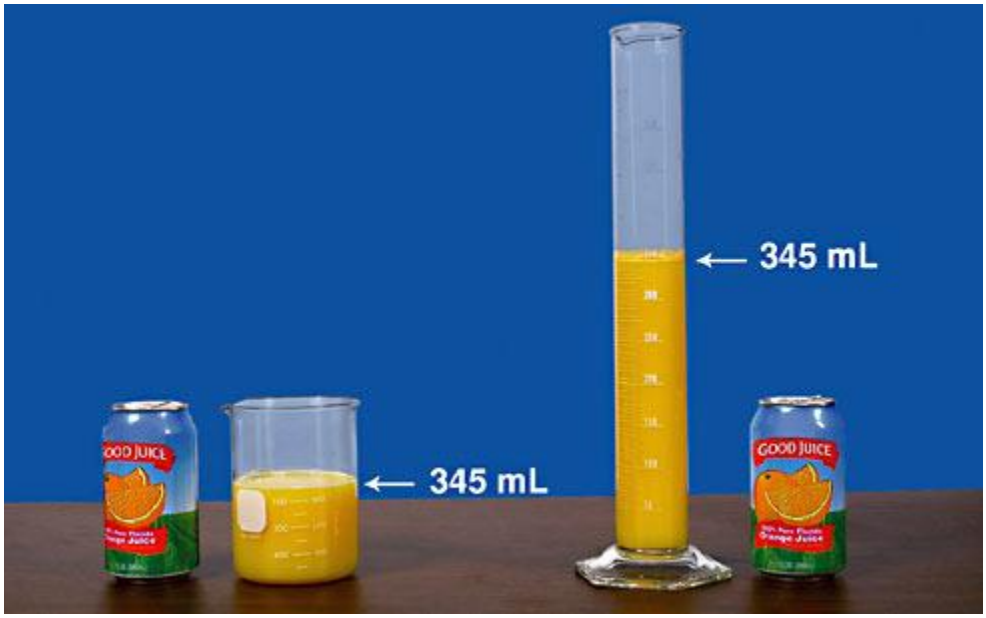

Figure 2 Although their shapes are different, the beaker and the graduated cylinder each contain 345 mL of juice.

Standards Check What are a liquid's particles able to do that a solid's particles cannot?

Gases

Would you believe that one tank of helium can fill several hundred balloons? How is this possible? After all, the tank is only as big as about five filled balloons.

Helium is a gas. **Gas** is a state of matter that has no definite volume or shape. The particles of a gas have little attraction between them. The particles move about freely and collide randomly with each other.

Because gas particles move about freely, the amount of empty space between them can change. Look at **Figure 3.** The particles of helium in the balloons are farther apart than the particles of helium in the tank.

As helium particles fill the balloon, they spread apart. The greater amount of empty space between the particles makes the volume of the gas larger.

Figure 3 Many balloons can be filled from one tank of helium because the particles of helium gas in a balloon are far apart.

Standards Check Describe the motion of particles of a gas.

Plasmas

The sun and other stars are made of the most common state of matter in the universe, called plasma. **Plasma** is the state of matter that does not have a definite shape or volume and whose particles have broken apart. More than 99% of the matter in the universe is plasma.

Plasmas have some properties that are quite different from the properties of gases. Plasmas conduct electric current, but gases do not. Electric and magnetic fields affect plasmas but do not affect gases. In fact, strong magnetic fields are sometimes used to contain very hot plasmas that would destroy a solid container.

Here on Earth, natural plasmas are found in lightning and fire. Plasma sometimes forms during storms on Earth by the electrical energy in lightning, as shown in **Figure 4.** Artificial plasmas, found in fluorescent lights and plasma balls, are created by passing electric charges through gases.

Figure 4 One place that plasma forms is in the electric discharge of a lightning bolt. A lightning bolt is made of plasma.

Section Summary

- Particles of matter are in constant motion. The states of matter depend on the motion of particles.
- A solid has a definite shape and volume. A liquid has a definite volume but not a definite shape.
- A gas does not have a definite volume or shape. Plasma, a fourth state of matter, does not have a definite shape or volume, and its particles are broken apart.