

# Chapter 5

## Measuring Matter

A powerful stream of air blows up through the floor in the special flying room in the picture. The stream pushes the people up in the air and holds them there. Although you cannot see air, it is made of matter.



## Introducing the Chapter

Matter can be described in many different ways. You might describe some matter by its color or its length. In the activity below, you will learn another way matter can be described. In this chapter, you will learn about the tiny bits that make up matter. You also will learn different ways you can measure matter.

### DISCOVER!

#### Describing Air

One way you can describe air is that it takes up space. You can show that air takes up space by pouring air from one plastic cup to another.

Fill a large plastic container with enough water so that you can hold a cup completely underwater. Hold one plastic cup under the water to fill it with water. Carefully turn the cup upside-down underwater so that the water stays in the cup.

Hold the second cup upside-down above the water. Keeping the cup upside-down, slowly push it into the water until it is under the water. What is inside the cup?

Move the cups next to each other. Now raise the cup filled with water slightly higher than the cup filled with air. Now pour the air from one cup to the other.

#### Talk About It

1. What happened to the water in the cup when you poured air into it?
2. What can you tell about air from what you observed?



# 1 What Is Matter?

## LESSON GOALS

You will learn

- two properties of objects made of matter.
- three states of matter.

**mass** (mas), the amount of material that an object has in it.

**volume** (vol/yəm), the amount of space that matter takes up.

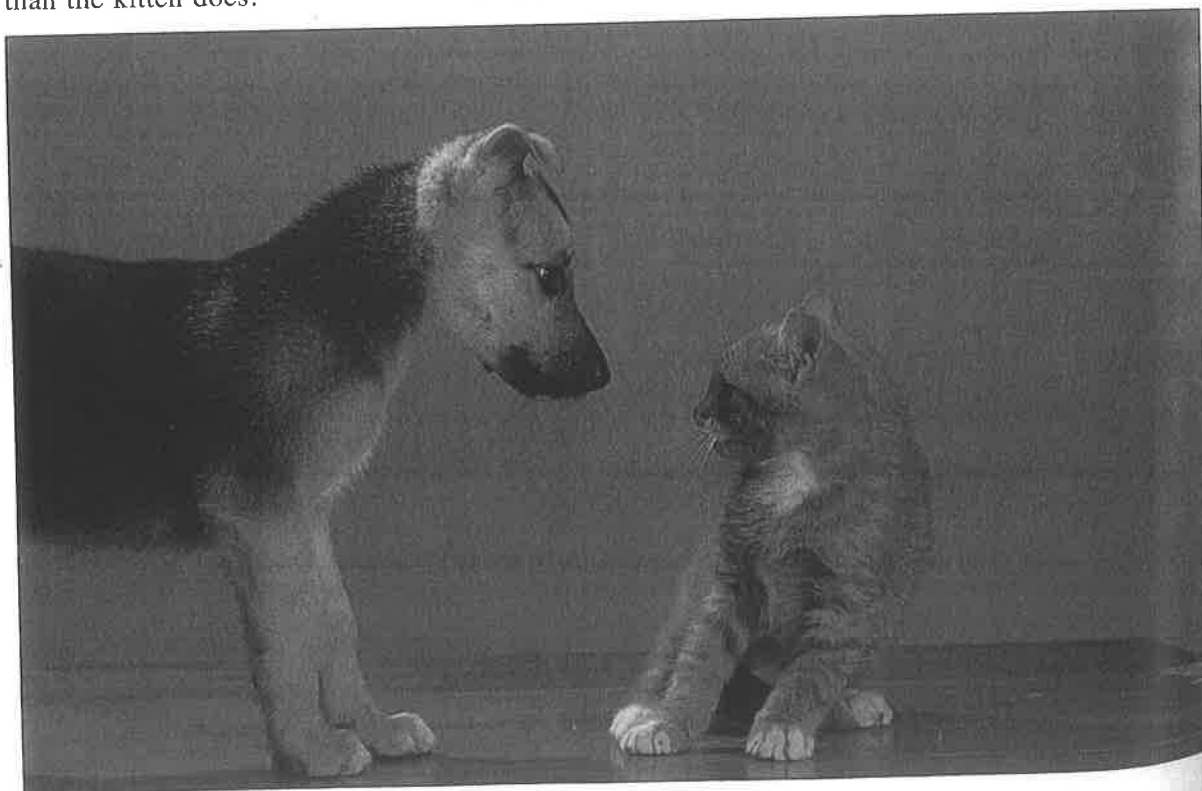
The puppy has a larger volume and more mass than the kitten does.

Read the title of this lesson. Do you think a word has been left out? Someone might have asked you, “What is *the* matter?” In that question, the word *matter* means “problem.” In science, *matter* means something else. This book is made of matter. You are made of matter. Water and food are made of matter. Even the air around you is made of matter.

## Mass That Takes Up Space

Anything that takes up space is made of matter. The puppy and kitten in the picture take up space. The glass and the milk on the next page take up space. What takes up space inside the balloons? **Volume** is the amount of space matter takes up. Does the puppy or the kitten have a larger volume?

Anything that has **mass** is made of matter. Mass measures the amount of material an object has in it. The puppy has more mass than the kitten does.



### Three States of Matter

You can tell the differences among many kinds of matter. For example, you know if you are drinking milk or tomato juice. They have different colors, for one thing. The color that milk has is a property of milk. A property is something about matter that can be observed and tells you what the matter is like. Another property of milk is that it is a liquid at room temperature. What are some other properties of milk?

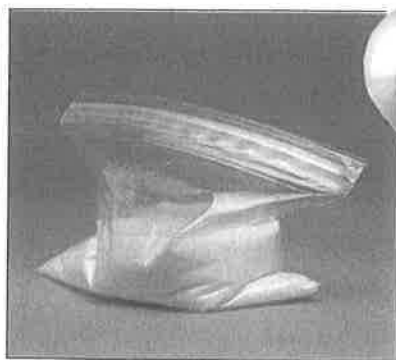
The state—or form—that matter has is an important property. Liquid, solid, and gas are three states of matter. You can tell if matter is a solid, liquid, or gas by what its shape and volume are like.

A solid has a certain shape and volume of its own. The glass in the picture is a solid. What are some solids in your classroom?

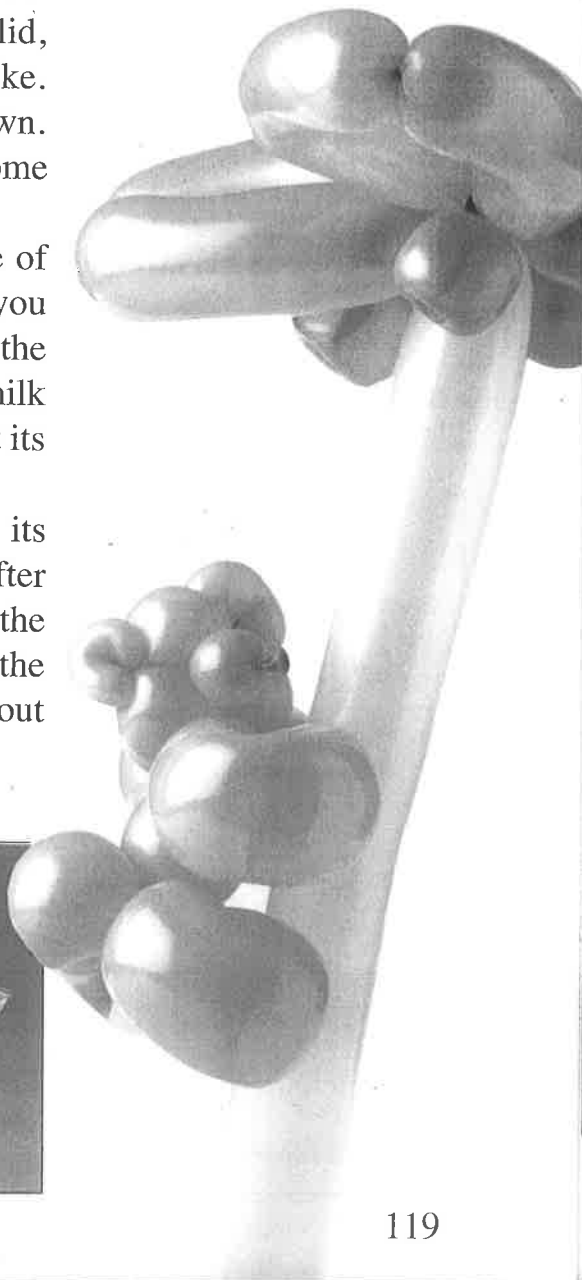
A liquid has a certain volume but has no shape of its own. A liquid can change shape. How could you change the shape of the milk in the glass in the picture? The plastic bag in the picture holds the milk from the glass. The milk's volume is the same, but its shape changed.

A gas does not have a shape or a volume of its own. Air is made up of different kinds of gases. After you put air in balloons like the ones in the picture, the air takes the shape of the balloon. When you let the air out of a balloon, the gases in the air spread out around you and take up more space.

The milk's volume is the same in both containers.



The air inside the balloons has the same shape and volume as the balloons.



## SCIENCE IN YOUR LIFE

When you sweat, a change in a state of matter takes place. The water in the sweat is a liquid. Heat changes this liquid to water vapor. This change in state from a liquid to a gas cools your body.

Matter changes from one state to another when its temperature changes beyond a certain point. If you freeze a liquid, it becomes a solid. If you boil a liquid, it becomes a gas. The bubbles in the picture of the boiling water are gas escaping from the water. The gas is water vapor. What is water called when it is a solid?

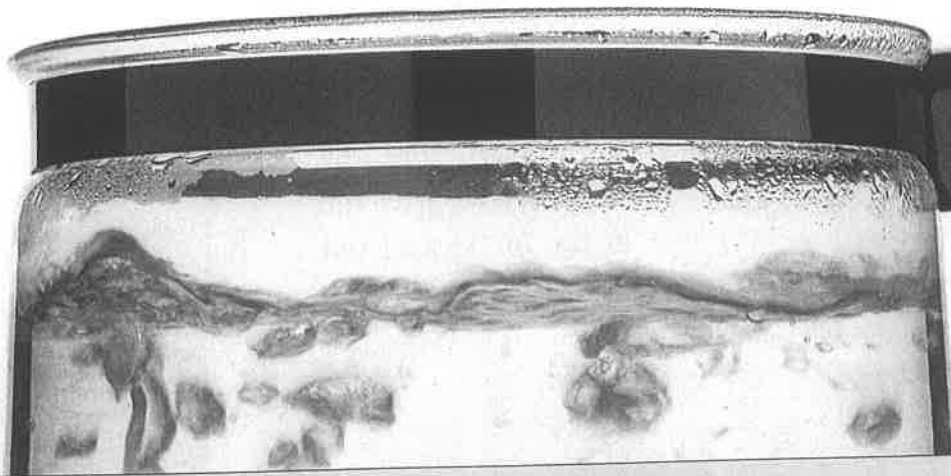
The states of matter are physical properties of matter. A change in the state of matter is a physical change. This kind of change does not change the kind of matter. Ice and water vapor are still water. They are just in different forms.

### Lesson Review

1. What is matter?
2. How are the properties of the three states of matter different?
3. **Challenge!** What would happen if you added four large rocks to an aquarium filled with water? Explain your answer.

Study on your own, pages 384–385.

Bubbles of water vapor in boiling water



EARTH SCIENCE

FIND OUT  
ON YOUR OWN

CONNECTION

Use an encyclopedia or other books in the library to find out about the different states of matter in Halley's Comet. What kind of change takes place as the comet moves toward the sun?