

4

How Are Mass and Density Measured?

LESSON GOALS

You will learn

- how to measure mass.
- how to measure density.

kilogram (kil'ə gram), a unit for measuring mass.

gram (gram), 1/1,000 of a kilogram.

milligram (mil'ə gram), 1/1,000 of a gram.

Have you ever had a bar of soap that sank when you dropped it in water? Have you ever had a bar of soap that floated in water? You can measure the property that causes the soap to float or sink by measuring the soap's mass and volume.

Measuring Mass

A unit for measuring mass is the **kilogram**. The girl in the picture has a mass of 30 kilograms. A smaller unit is the **gram**. The mass of the small paper clip in the picture is about 1 gram. A kilogram has 1,000 grams. Some medicines are measured in even smaller units called **milligrams**. In Lesson 3, you learned that the prefix *milli-* means 1/1,000. A milligram is 1/1,000 of a gram.



A mass of 1 gram

A mass of
30 kilograms

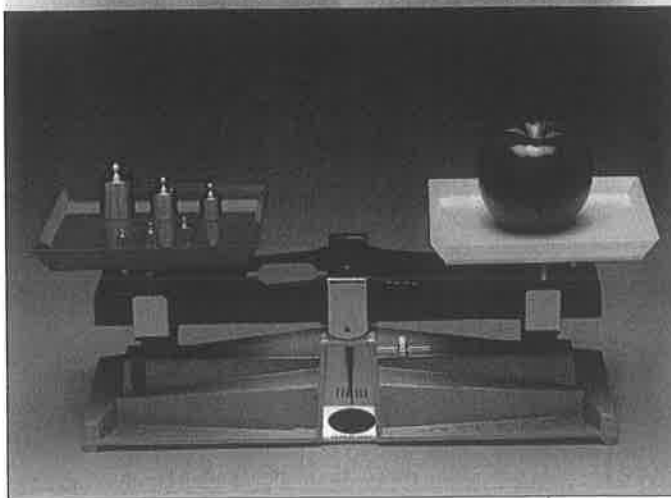
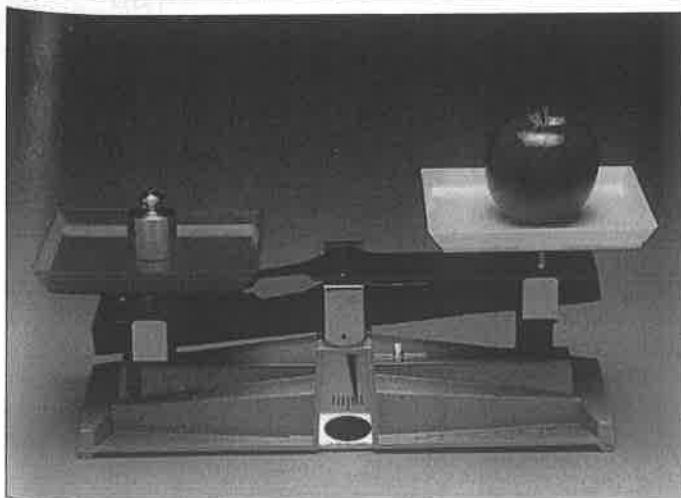
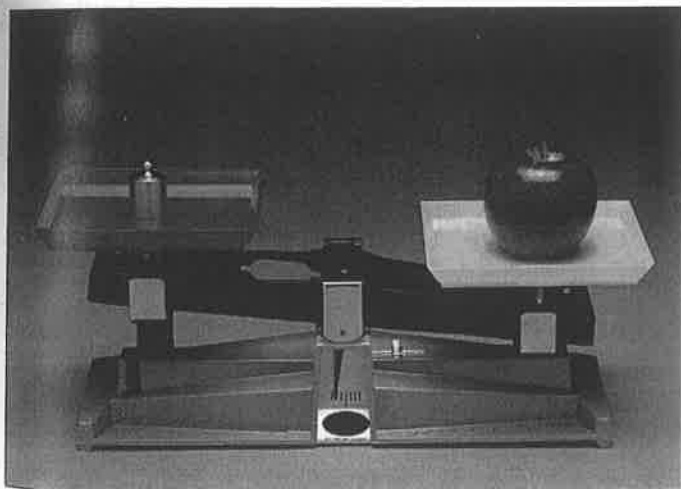


You can use a tool called a balance to measure mass. To find the mass of an object, you balance it with objects whose masses you know. The girl in the picture is measuring the mass of an apple. Notice what happens to the top left balance when an object has less mass than the apple. The apple drops lower.

When the object has more mass than the apple, the apple rises. Does the object in the bottom left picture have more or less mass than the apple?

Notice in the bottom right picture that the pans are even when the objects and the apple have the same mass. The pans look balanced, and an arrow on the lines in the middle of the balance points straight down. When the girl adds together the masses of these objects, she will know the mass of the apple.

Measuring the mass of an apple



density (den/sə tē), how much mass is in a certain volume of matter.

Measuring Density

Find the three liquids in the picture. The top liquid is rubbing alcohol that has been colored blue. The middle liquid is vegetable oil. The bottom liquid is water that has been colored red. These liquids float or sink because each has a different density.

Density is how much mass is in a certain volume of matter. Each liquid in the picture has the same volume—or takes up the same amount of space. What is the volume of each liquid? However, each liquid has a different mass—or amount of matter—in that space. The water has more matter in it than the same volume of oil does. The water has a greater density than the oil does. The oil has more matter in it than the same volume of alcohol does. Which of the three liquids has the greatest density? Which of the three liquids has the least density?

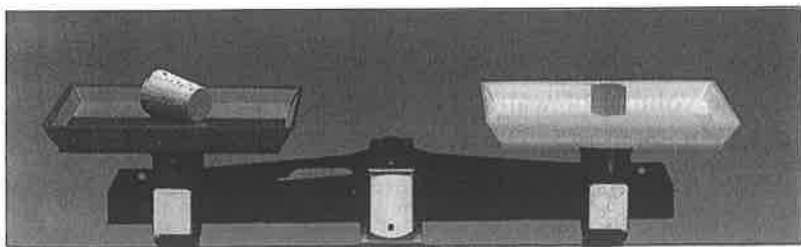
Density is another property of matter that you can measure. A unit for density uses both a unit used for measuring mass and a unit used for measuring volume. For example, 1 cubic centimeter of water has a mass of 1 gram. Water's density is 1 gram per cubic centimeter.



Each liquid has a different density.

You can easily compare the density of one kind of matter with another kind of matter if you have the same volume of each object. If you measure the mass of 1 cubic centimeter of wood, you will find that it has a mass of a little less than 1 gram. If you measure the mass of 1 cubic centimeter of salt, you will find that it has a mass of about 2 grams. Does the wood or the salt have a greater density?

You also can easily compare the density of one kind of matter with another kind of matter if you have the same mass of each object. Notice in the picture that the cork and the wood balance. They balance because they both have a mass of 1 gram. Which of the two objects has the greater density? The wood has the greater density because it has the same amount of matter in a much smaller volume.



SCIENCE IN YOUR LIFE

If a solid object has a greater density than water has, it will sink in water. If an object has a lower density than water has, it will float. Most people can float. Their density is slightly less than the density of water.

The cork on the left has the same mass as the wood on the right.

Lesson Review

1. What tool can you use to measure mass?
2. What two measurements do you need to measure density?
3. **Challenge!** Imagine you have a kilogram of feathers and a kilogram of lead. Which has more mass? Explain your answer.

Study on your own, pages 384–385.

Look up the Greek inventor Archimedes in an encyclopedia. Find out how and why he measured the density of his king's crown. What did he find out? Write a paragraph telling what you learn.

PHYSICAL SCIENCE

FIND OUT
ON YOUR OWN