Section 1

Describing and Measuring Motion

Reading Preview

Key Concepts

- When is an object in motion?
- How do scientists measure distance?

Key Terms

- motion
- reference point
- International System of Units
- meter

Target Reading Skill

Using Prior Knowledge Before you read, write what you know about motion in a graphic organizer like the one below. As you read, write what you learn.

What You Know
1. A moving object changes position.
2.

What You Learned
1.
2.

Lab zone Discover Activity

How Fast and How Far?

1. Using a stopwatch, find out how long it takes you to walk 5 meters at a normal pace. Record your time.
2. Now find out how far you can walk in 5 seconds if you walk at a normal pace. Record your distance.
3. Repeat Steps 1 and 2, walking slower than your normal pace. Then repeat Steps 1 and 2 walking faster than your normal pace.

Think It Over

Inferring What is the relationship between the distance you walk, the time it takes you to walk, and your walking speed?

How do you know if you are moving? If you've ever traveled on a train, you know you cannot always tell if you are in motion. Looking at a building outside the window helps you decide. Although the building seems to move past the train, it's you and the train that are moving.

However, sometimes you may see another train that appears to be moving. Is the other train really moving, or is your train moving? How do you tell?

Describing Motion

Deciding if an object is moving isn't as easy as you might think. For example, you are probably sitting in a chair as you read this book. Are you moving? Well, parts of you may be. Your eyes blink and your chest moves up and down. But you would probably say that you are not moving. An object is in **motion** if its distance from another object is changing. Because your distance from your chair is not changing, you are not in motion.

Reference Points To decide if you are moving, you use your chair as a reference point. A **reference point** is a place or object used for comparison to determine if something is in motion. **An object is in motion if it changes position relative to a reference point.**

Objects that we call stationary—such as a tree, a sign, or a building—make good reference points. From the point of view of the train passenger in Figure 1, such objects are not in motion. If the passenger is moving relative to a tree, he can conclude that the train is in motion.

You probably know what happens if your reference point is moving. Have you ever been in a school bus parked next to another bus? Suddenly, you think your bus is moving backward. But, when you look out a window on the other side, you find that your bus isn't moving at all—the other bus is moving forward! Your bus seems to move backward because you used the other bus as a reference point.

Reading Checkpoint What is a reference point?

FIGURE 1
Reference Points
The passenger can use a tree as a reference point to decide if the train is moving. A tree makes a good reference point because it is stationary from the passenger's point of view.
Applying Concepts *Why is it important to choose a stationary object as a reference point?*

FIGURE 2 Relative Motion
Whether or not an object is in motion depends on the reference point.
Comparing and Contrasting *Are the skydivers moving relative to the airplane from which they jumped? Are they moving relative to the ground?*

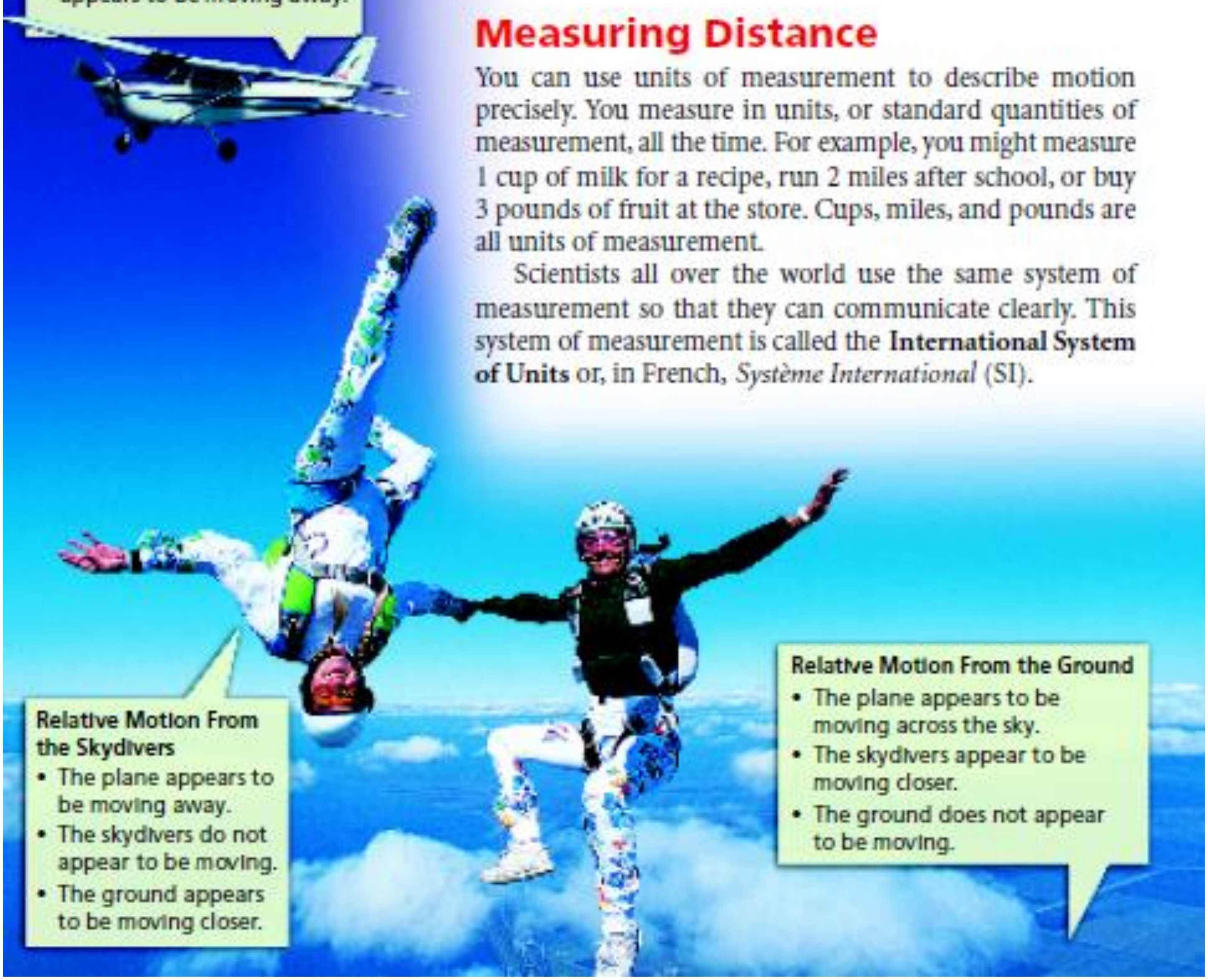
Relative Motion Are you moving as you read this book? The answer to that question depends on your reference point. When your chair is your reference point, you are not moving. But if you choose another reference point, you may be moving.

Suppose you choose the sun as a reference point instead of your chair. If you compare yourself to the sun, you are moving quite rapidly. This is because you and your chair are on Earth, which moves around the sun. Earth moves about 30 kilometers every second. So you, your chair, this book, and everything else on Earth move that quickly as well. Going that fast, you could travel from New York City to Los Angeles in about 2 minutes! Relative to the sun, both you and your chair are in motion. But because you are moving with Earth, you do not seem to be moving.

Measuring Distance

You can use units of measurement to describe motion precisely. You measure in units, or standard quantities of measurement, all the time. For example, you might measure 1 cup of milk for a recipe, run 2 miles after school, or buy 3 pounds of fruit at the store. Cups, miles, and pounds are all units of measurement.

Scientists all over the world use the same system of measurement so that they can communicate clearly. This system of measurement is called the **International System of Units** or, in French, *Système International* (SI).



Scientists use SI units to describe the distance an object moves. When you measure distance, you measure length. The SI unit of length is the meter (m). A meter is a little longer than a yard. An Olympic-size swimming pool is 50 meters long. A football field is about 91 meters long.

The length of an object smaller than a meter often is measured in a unit called the centimeter (cm). The prefix *centi-* means "one hundredth." A centimeter is one hundredth of a meter, so there are 100 centimeters in a meter. The wingspan of the butterfly shown in Figure 3 can be measured in centimeters. For lengths smaller than a centimeter, the millimeter (mm) is used. The prefix *milli-* means "one thousandth," so there are 1,000 millimeters in a meter. Distances too long to be measured in meters often are measured in kilometers (km). The prefix *kilo-* means "one thousand." There are 1,000 meters in a kilometer.

Scientists also use SI units to describe quantities other than length. You can find more information about SI units in the Skills Handbook at the end of this book.

Reading Checkpoint **What system of measurement do scientists use?**

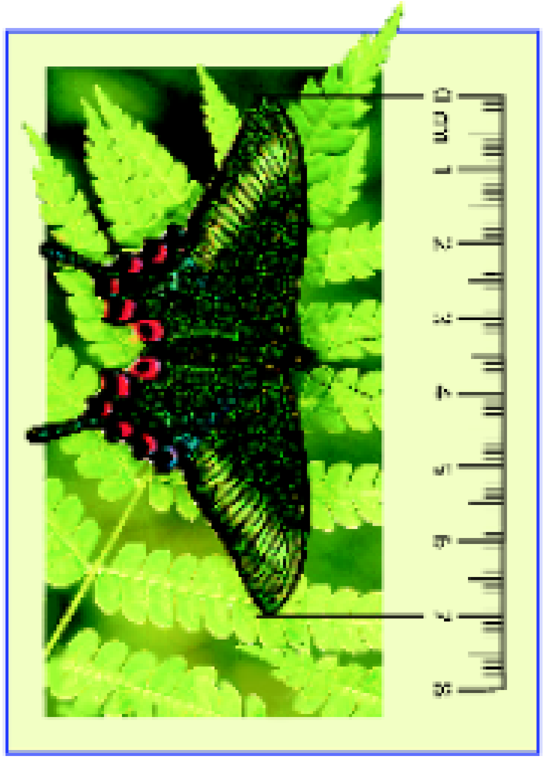


FIGURE 3
Measuring Distance
You can measure distances shorter than 1 meter in centimeters. The wingspan of the butterfly is 7 cm.

Section 1 Assessment

Target Reading Skill

Using Prior Knowledge Review your graphic organizer and revise it based on what you just learned about motion.

Reviewing Key Concepts

1. a. **Reviewing** How do you know if an object is moving?
   b. **Explaining** Why is it important to know if your reference point is moving?
   c. **Applying Concepts** Suppose you are riding in a car. Describe your motion relative to the car, the road, and the sun.
2. a. **Identifying** What is the SI unit for length?
   b. **Defining** How many centimeters are there in a meter? How many meters are there in a kilometer?
   c. **Calculating** This week at swim practice, Jamie swam a total of 1,500 m, while Ellie swam 1.6 km. Convert Ellie's distance to meters. Which swimmer swam the greater distance?

Lab zone At-Home Activity

Roomy Size With the help of a family member, use a ruler to measure the length and width of a room at home to the nearest centimeter. Convert these measurements into meters and then into millimeters.