SECTION 1

Displacement and Velocity

SECTION OBJECTIVES

- **Describe motion in terms of frame of reference, displacement, time, and velocity.**
- **Calculate the displacement of an object traveling at a known velocity for a specific time interval.**
- **Construct and interpret graphs of position versus time.**

MOTION

Motion happens all around us. Every day, we see objects such as cars, people, and soccer balls move in different directions with different speeds. We are so familiar with the idea of motion that it requires a special effort to analyze motion as a physicist does.

One-dimensional motion is the simplest form of motion

One way to simplify the concept of motion is to consider only the kinds of motion that take place in one direction. An example of this one-dimensional motion is the motion of a commuter train on a straight track, as in **Figure 1.**

In this one-dimensional motion, the train can move either forward or backward along the tracks. It cannot move left and right or up and down. This chapter deals only with one-dimensional motion. In later chapters, you will learn how to describe more complicated motions such as the motion of thrown baseballs and other projectiles.

frame of reference

a system for specifying the precise location of objects in space and time

Motion takes place over time and depends upon the frame of reference

It seems simple to describe the motion of the train. As the train in **Figure 1** begins its route, it is at the first station. Later, it will be at another station farther down the tracks. But Earth is spinning on its axis, so the train, stations, and the tracks are also moving around the axis. At the same time, Earth is moving around the sun. The sun and the rest of the solar system are moving through our galaxy. This galaxy is traveling through space as well.

When faced with a complex situation like this, physicists break it down into simpler parts. One key approach is to choose a **frame of reference** against which you can measure changes in position. In the case of the train, any of the stations along its route could serve as a convenient frame of reference. When you select a reference frame, note that it remains fixed for the problem in question and has an origin, or starting point, from which the motion is measured.

Figure 1
The motion of a commuter train traveling along a straight route is an example of one-dimensional motion. Each train can move only forward and backward along the track.