Describing Motion

Position and Motion

**Before You Read**

What do you think? Read the two statements below and decide whether you agree or disagree with them. Place an A in the Before column if you agree with the statement or a D if you disagree. After you’ve read this lesson, reread the statements to see if you have changed your mind.

<table>
<thead>
<tr>
<th>Before</th>
<th>Statement</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Displacement is the distance an object moves along a path.</td>
<td></td>
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<tr>
<td>2.</td>
<td>The description of an object’s position depends on the reference point.</td>
<td></td>
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</table>

**Read to Learn**

### Describing Position

How would you describe where you are right now? You might say that you are sitting one meter to the left of your friend. You might explain that you are at home, which is two houses north of your school.

What do these descriptions have in common? Each states your location relative to a certain point. This point is called the reference point. A reference point is the starting point you choose to describe the location, or position, of an object. The reference point in the first example is your friend. In the second example, it is your school. These descriptions specify your location relative to a certain point. You compared your location to reference points, your friend and your school.

Each description of your location also includes your distance and direction from the reference point. Describing your location in this way defines your position. In the first example, the distance is one meter. The direction is to the left, and the reference point is your friend. In the second example, the distance is two houses. The direction is north, and the reference point is your school. A position is an object’s distance in a certain direction from a reference point. A complete description of your position includes a distance, a direction, and a reference point.

**Key Concepts**

- How does the description of an object’s position depend on a reference point?
- How can you describe the position of an object in two dimensions?
- What is the difference between distance and displacement?

**Study Coach**

Create an Outline As you read, make an outline to summarize the information in the lesson. Use the main headings in the lesson as the main headings in your outline. Use your outline to review the lesson.

**Academic Vocabulary**

specify (verb) to indicate or identify

**Reading Check**

1. Name two ways you could describe your position right now.

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Reading Essentials

Describing Motion
Using a Reference Point to Describe Position

Suppose you are planning a family picnic at the park shown below. How would you describe the position of the picnic table you reserved? First, choose a reference point that is easy to find. In this park, a statue is a good choice. Next, describe the direction of the table from the reference point. The direction is toward the slide. Finally, suppose the table is about 10 m from the statue. You would say that the position of the table is about 10 m from the statue, toward the slide.

Changing the Reference Point

Look again at the drawing of the park. Suppose you choose the drinking fountain as the reference point instead of the statue. Now the direction of the table is toward the dead tree. The distance from the drinking fountain to the table is about 12 m. You can tell your family that the table is about 12 m from the drinking fountain toward the dead tree. The table did not change position. Your description of its position and the reference point are different.

The Reference Direction

Sometimes direction is described using the words positive or negative. The reference direction is the positive (+) direction. The opposite direction is the negative (−) direction. Suppose east is the reference direction in the diagram below. The museum’s entrance is 80 m east of a bus stop. The library is 40 m west of the bus stop. You could say that the museum is +80 m from the bus stop and the library is −40 m from the bus stop. Using the words positive or negative to describe direction can be useful for explaining changes in an object’s position.
Describing Position in Two Dimensions

Sometimes you need to use more than one reference direction to describe an object’s position. When you describe position using two directions, you are using two dimensions.

Reference Directions in Two Dimensions

The figure below is a map of a city. It shows positions in two dimensions. To describe a position on the map, you might choose north and east or south and west as the reference directions.

Sometimes north, south, east, and west are not the most useful reference directions. Imagine that you are looking at a skyscraper. You might describe a certain window as “up” and “to the left.”

Locating a Position in Two Dimensions

Suppose you want to locate your classmate’s home on the map above. To find a position in two dimensions, first choose a reference point. You could choose your home as a reference point. Next, give specific reference directions. In this case, you would use south and east. Then, determine the distance along each reference direction. On the map, your classmate’s home is one block south and four blocks east of your home.

Describing Changes in Position

Sometimes you need to describe how an object’s position changes. Suppose a boat is floating on a lake. How do you know whether the boat has moved throughout the day? You know this when its position changes relative to, or compared to, something else. Motion is the process of changing position.

5. Apply What are two other examples of directions you could use besides north, south, east, and west?

6. Describe If the library is the reference point, how would you describe the position of your home in two dimensions?

7. Summarize How can you describe the position of an object in two dimensions?
Motion Relative to a Reference Point

In the figure below, is the man in motion? Use the fishing pole as the reference point. The positions of the man and the pole do not change relative to each other. This means the man does not move relative to the pole. When the buoy is the reference point, the man’s distance from the buoy changes. The man is in motion relative to the buoy.

Distance and Displacement

Suppose a baseball player runs the bases. Distance is the length of the path the player runs. It is shown below by the arrows with dashed lines. He runs 90 ft to get to first base. When he gets to second base, he has run 90 ft + 90 ft = 180 ft.

Displacement is the difference between the initial (first) position and the final position of an object. Displacement is shown below by the arrows with solid lines. The initial position is home plate. At first base, the player's distance and displacement are the same. He has run a distance of 90 ft and he is 90 ft from home plate, where he started.

At second base, distance and displacement are different. Look at the middle drawing. The player has run a distance of 180 ft, but his displacement is 127 ft from home plate.

In the drawing on the far right below, the player has circled the bases. He has run a distance of 360 ft (90 ft × 4), but his displacement is 0 ft. His starting position and ending position are the same—home plate.

Distance depends on the path taken. Only the starting and ending positions matter in displacement. Notice that distance and displacement are equal only if the motion is in one direction.
Mini Glossary

displacement: the difference between the initial (first) position and the final position of an object

motion: the process of changing position

position: an object’s distance in a certain direction from a reference point

reference point: the starting point you choose to describe the location, or position, of an object

1. Review the terms and their definitions in the Mini Glossary. Write a sentence identifying three things you need to include in a description of any object’s position. Then choose an object in the room. Write another sentence describing the position of the object.

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2. In the diagram below, the theater is your reference point. Your reference direction is east. The mall is located +2 blocks from the theater. The park is located –3 blocks from the theater. In the diagram, circle the locations of the mall and park and label them.

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3. How did your outline of this lesson help you understand position and motion?

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