How fast am I moving?

CHAPTER **12**

Motion
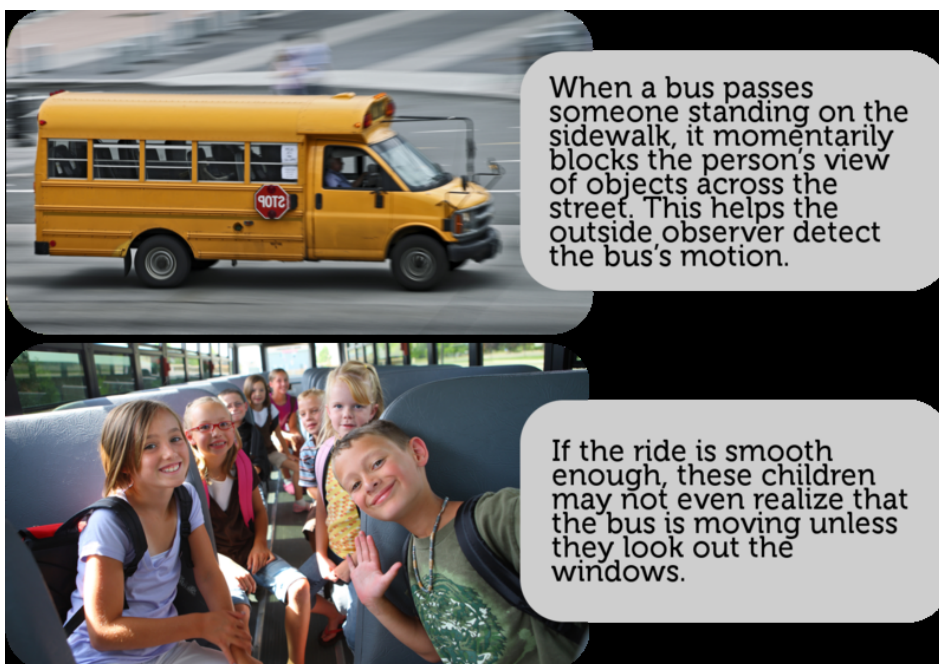
Chapter Outline

12.1 Distance and Direction

Lesson Objectives

- Define motion, and relate it to frame of reference.
- Describe how to measure distance.
- Explain how to represent direction.

Lesson Vocabulary

- distance
- frame of reference
- motion
- vector

Frame of Reference

When a bus passes someone standing on the sidewalk, it momentarily blocks the person's view of objects across the street. This helps the outside observer detect the bus's motion.

If the ride is smooth enough, these children may not even realize that the bus is moving unless they look out the windows.

Distance

Did you ever go to a track meet like the one pictured in **Figure** 12.3? Running events in track include 100-meter sprints and 2000-meter races. Races are named for their distance. **Distance** is the length of the route between two points. The length of the route in a race is the distance between the starting and finishing lines. In a 100-meter sprint, for example, the distance is 100 meters.

Start #1   Finish

#2

Start

20 m

Finish

$$d = \frac{1}{2}(2\pi r)$$

$$dist = 62 m$$
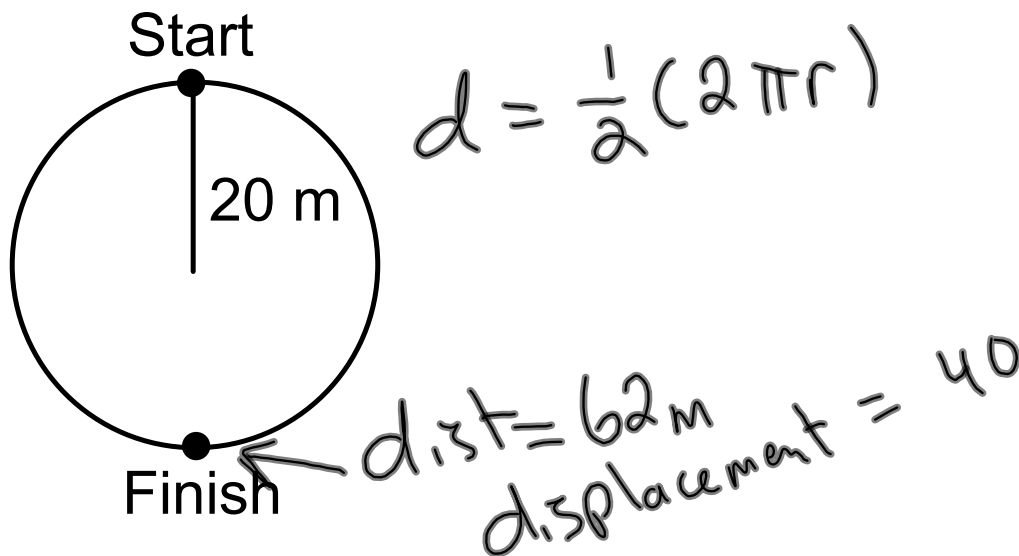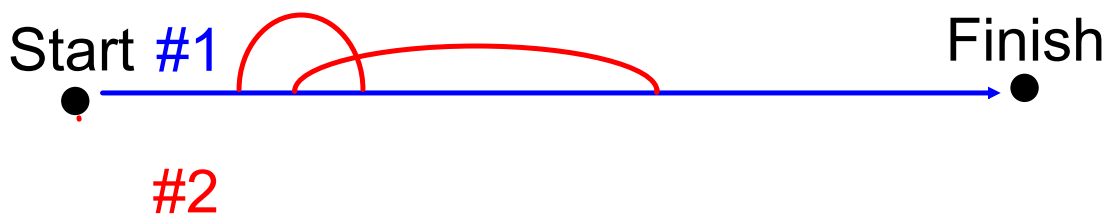
$$displacement = 40$$

Displacement: Change in position (from start to finish)

Distance is an example of a *scalar* quantity. In formulas it is represented as *d*.

Displacement is an example of a *vector* quantity. In formulas it is represented as $\vec{d}$.

$\vec{d}$

A <u>scalar</u> only has magnitude or size. Examples include mass, time, distance, and speed.

A <u>vector</u> has both magnitude (size) and a direction. It is represented by an arrow. The arrow tip shows the direction and size of the arrow the magnitude. Examples include displacement, velocity, acceleration, force, electric and magnetic fields.
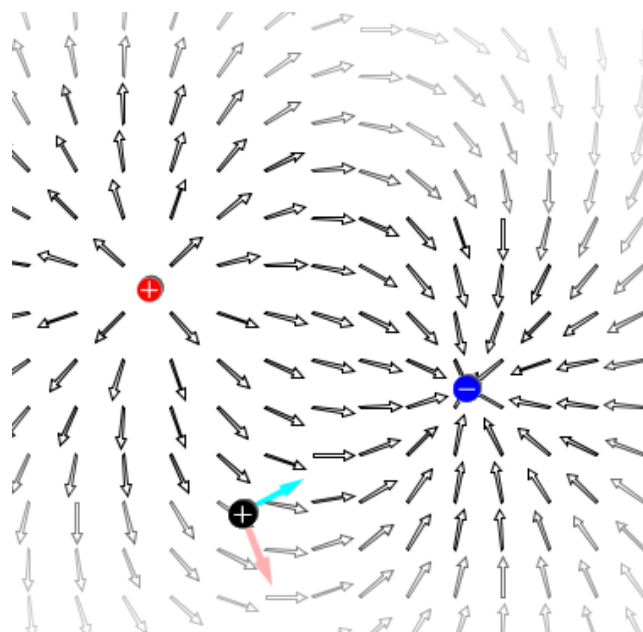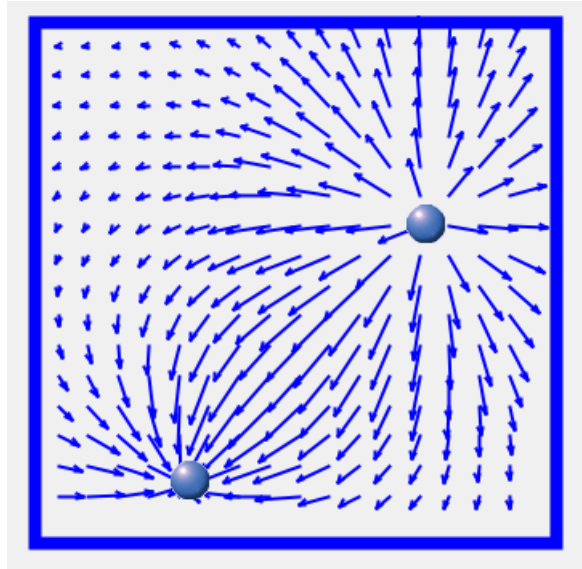
Example Problems

1. A person walks 25 m [E], then turns around and walks 75 m [W].

a) Calculate the total distance traveled.

$$d = 25\,m + 75\,m = \boxed{100\,m}$$

W $\underleftarrow{\qquad\qquad}$ +E

b) Calculate the resulting displacement.

$$\vec{d} = +25_m - 75_m = -50_m\,[East]$$
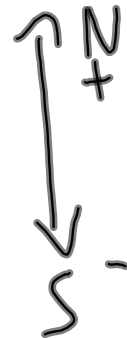
↑East ↑west

or

$50\,m\,[West]$

2. A cat runs 12 m [N], 8 m [S], 22 m [N], and finally 15 m [S].

a) Calculate the total distance traveled.

$$d = 12m + 8m + 22m + 15m$$
$$= \boxed{57m}$$

↑N +

↓ −
S

b) Calculate the resulting displacement.

$$\vec{d} = +12m - 8m + 22m - 15m$$
$$= 11m\ North$$