Changing VELOCITY

SPEED

In science there are many terms that can be used to describe motion. The **speed** of an object describes the distance an object travels in a certain period of time. Average speed is calculated by dividing the total distance traveled by the total time. The formula for average speed is speed = distance ÷ time.

$$s = \frac{d}{t}$$

EXAMPLE 1

A toy car moves 50 cm in 5 seconds. What is the average speed of the car?

t = 5 sec

0 cm — 50 cm

$$s = \frac{d}{t} \qquad s = \frac{50\ cm}{5\ sec} = 10 cm/sec$$

VELOCITY

The speed of an object describes how fast an object is moving, but it does not give any information about the direction the object is moving. The **velocity** of an object describes how its position, or displacement, changes over time. Velocity describes the *speed* of an object as well as the *direction* the object travels. An arrow can be used to represent the velocity of an object. A larger arrow represents greater velocity.

EXAMPLE 2

A cyclist travels west at 10 km/hr on her bicycle. Describe the speed and the velocity of the cyclist.

Speed = 10 km/hr

Speed = 10 km/hr
Velocity = 10 km/hr west

ACCELERATION

During the Explore activity, you determined that a force is needed to change the speed or direction of an object. In science, any change in velocity (speed or direction) is called an **acceleration**. There are three types of acceleration:

- increasing speed
- decreasing speed
- changing direction

Based on the Explore investigations, we learned that forces are needed to change the velocity (speed or direction) of an object. This means that all accelerations are caused by forces.

According to Newton's first law of motion, an object will remain at rest until a force causes it to start moving. A moving object will continue to move at the same speed and in the same direction until a force changes its motion. Another way to state Newton's first law of motion is that forces cause *changes* in motion, or accelerations.

TYPES OF FORCES

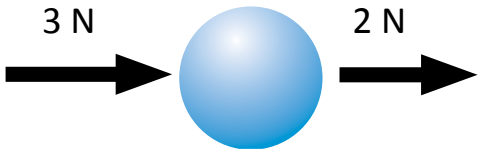
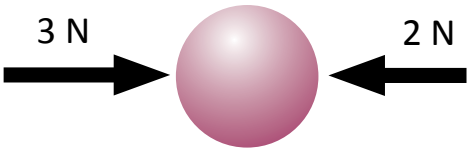
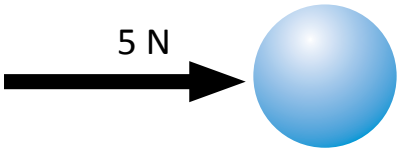
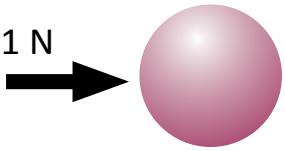
What kinds of forces act on objects? There are many forces that can affect the motion of an object. For example, the force of gravity is always pulling downward on an object toward the center of Earth. Friction is another force that affects the motion of objects. The force of friction is always acting in the direction opposite of the direction of motion. Friction causes moving objects to slow down and eventually stop.

The force of gravity pulls objects toward Earth.

The force of friction is always in the opposite direction of the motion of the object.

NET FORCE

When we talk about a force acting on an object, we are usually describing **net force**. The net force is the total of all the forces acting on an object. The forces acting on an object can be used to calculate the net force.

If forces are acting in the same direction, the forces can be added together.	If forces are acting in opposite directions, the forces are subtracted.
	
Net Force	Net Force
	

BALANCED FORCES

If the forces acting on an object cancel out, the net force is zero. These forces are called **balanced forces**. When the forces acting on an object are balanced, there is no change in motion because there is no net force. The object is not speeding up, slowing down, or changing direction.

EXAMPLE 3

A 5 N force is applied to a wood block resting on a table. The force of friction applies 5 N of force to the block in the opposite direction.

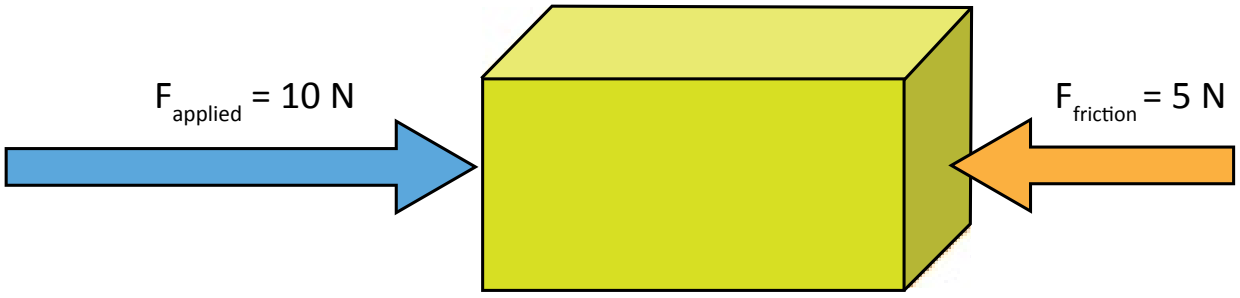
What is the net force acting on this block? Do the forces change the motion of this block?

UNBALANCED FORCES

If the forces acting on an object do not cancel out, a net force is applied to the object. These forces are called **unbalanced forces**. When the forces acting on an object are unbalanced, there is a net force that always results in a change in motion, or an acceleration. While a net force is applied, the object is speeding up, slowing down, or changing direction.

EXAMPLE 4

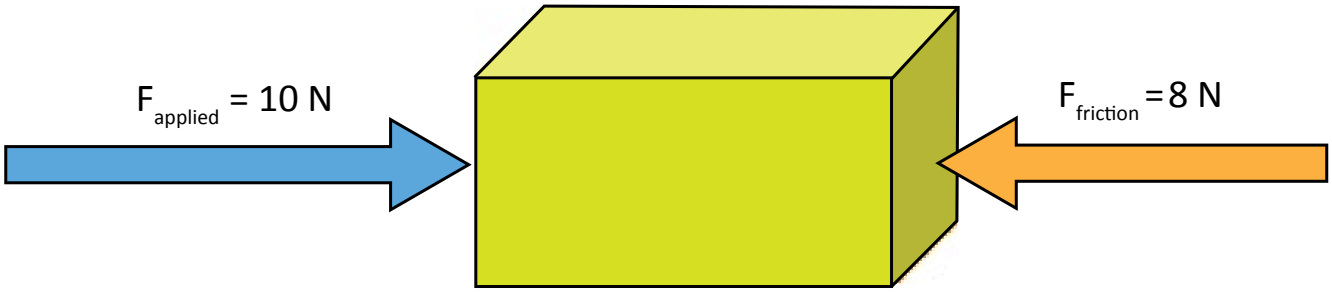
A 10 N force is applied to a wood block resting on a table. The force of friction applies 5 N of force to the block in the opposite direction.



What is the net force acting on this block? How do the forces change the motion of this block?

EXAMPLE 5

A 10 N force is applied to a wood block resting on a floor with carpet. The force of friction applies 8 N of force to the block in the opposite direction.



What is the net force acting on this block? How do the forces change the motion of this block?

How does the net force in Example 4 compare with the net force in Example 5?

How does the motion of the block in Example 4 compare with the motion of the block in Example 5?

Page intentionally left blank.