

SECTION 2 What Is a Force?

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is a force?
- How do forces combine?
- What is a balanced force?
- What is an unbalanced force?

National Science Education Standards
PS 2b, PS 2c

What Is a Force?

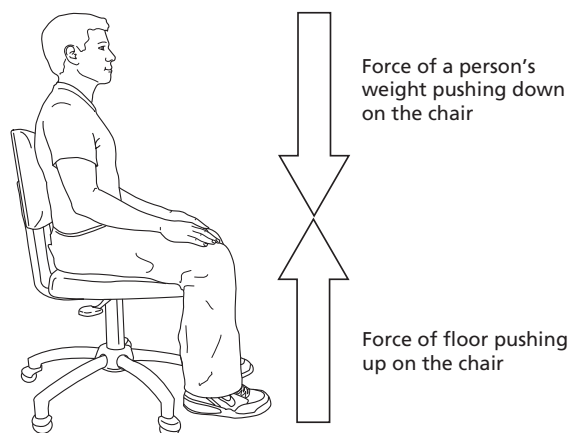
You probably hear people talk about force often. You may hear someone say, “That storm had a lot of force” or “Mrs. Larsen is the force behind the school dance.” But what exactly is a force in science?

In science, a **force** is a push or a pull. All forces have two properties: direction and size. A **newton** (N) is the unit that describes the size of a force. ✓

Forces act on the objects around us in ways that we can see. If you kick a ball, the ball receives a push from you. If you drag your backpack across the floor, the backpack is pulled by you.

Forces also act on objects around us in ways that we cannot see. For example, in the figure below, a student is sitting on a chair. What are the forces acting on the chair?

The student is pushing down on the chair, but the chair does not move. Why? The floor is balancing the force by pushing up on the chair. When the forces on an object are *balanced*, the object does not move.



A person sitting on a chair.

STUDY TIP

Brainstorm As you read, think about objects you see every day. What kinds of forces are affecting them? How do the forces affect them?

READING CHECK

1. **List** What two properties do all forces have?

TAKE A LOOK

2. **Explain** Since the chair is not moving, what kind of forces are acting on it?

SECTION 2 What Is a Force? *continued*

How Do Forces Combine?

As you saw in the previous example, more than one force often acts on an object. When all of the forces acting on an object are added together, you determine the **net force** on the object. An object with a net force more than 0 N acting on it will change its state of motion.

TAKE A LOOK

3. Identify On the figure, draw an arrow showing the direction and size of the net force on the piano. The length of the arrow should represent the size of the force.



FORCES IN THE SAME DIRECTION

Suppose your music teacher asks you and a friend to move a piano, as shown in the figure above. You push the piano from one end and your friend pulls the piano from the other end. You and your friend are applying forces in the same direction. Adding the two forces gives you the size of the net force. The direction of the net force is the same as the direction of the forces.

$$125 \text{ N} + 120 \text{ N} = 245 \text{ N}$$

$$\textit{net force} = 245 \text{ N to the right}$$

FORCES IN DIFFERENT DIRECTIONS



Suppose two dogs are playing tug of war, as shown above. Each dog is exerting a force on the rope. Here, the forces are in opposite directions. Which dog will win the tug of war?

You can find the size of the net force by subtracting the smaller force from the bigger force. The direction of the net force is the same as that of the larger force:

$$120 \text{ N} - 80 \text{ N} = 40 \text{ N}$$

$$\textit{net force} = 40 \text{ N to the right}$$

Critical Thinking

4. Predict What would happen if both dogs pulled the rope with a force of 85 N?

SECTION 2 What Is a Force? *continued***What Happens When Forces Are Balanced or Unbalanced?**

Knowing the net force on an object lets you determine its effect on the motion of the object. Why? The net force tells you whether the forces on the object are balanced or unbalanced.

BALANCED FORCES

When the forces on an object produce a net force of 0 N, the forces are *balanced*. There is no change in the motion of the object. For example, a light hanging from the ceiling does not move. This is because the force of gravity pulls down on the light while the force of the cord pulls upward. ✓



The soccer ball moves because the players exert an unbalanced force on the ball each time they kick it.

UNBALANCED FORCES

When the net force on an object is not 0 N, the forces on the object are *unbalanced*. Unbalanced forces produce a change in motion of an object. Think about a soccer game. Players kick the ball to each other. When a player kicks the ball, the kick is an unbalanced force. It sends the ball in a new direction with a new speed.

An object can continue to move when the unbalanced forces are removed. For example, when it is kicked, a soccer ball receives an unbalanced force. The ball continues to roll on the ground after the ball was kicked until an unbalanced force changes its motion.

READING CHECK

5. Describe What happens to the motion of an object if the net force acting on it is 0 N?

STANDARDS CHECK

PS 2c If more than one force acts on an object along a straight line, then the forces reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.

6. Describe What will happen to an object that has an unbalanced force acting on it?

Section 2 Review

NSES PS 2b, PS 2c

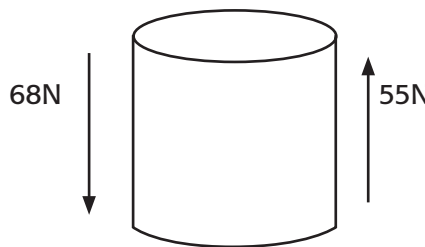
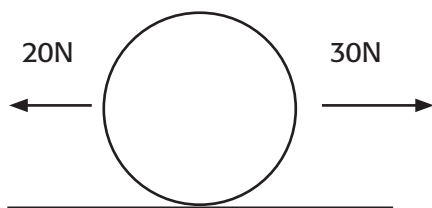
SECTION VOCABULARY

<p>force a push or a pull exerted on an object in order to change the motion of the object; force has size and direction</p>	<p>newton the SI unit for force (symbol, N)</p>
<p>net force the combination of all the forces acting on an object</p>	

1. Explain If there are many forces acting on an object, how can the net force be 0?

2. Apply Concepts Identify three forces acting on a bicycle when you ride it.

3. Calculate Determine the net force on each of the objects shown below. Don't forget to give the direction of the force.



net force = _____ net force = _____

4. Explain How will the net force affect the motion of each object shown above?

5. Describe What is the difference between balanced and unbalanced forces?
