

SECTION 1

Changes in Motion

SECTION OBJECTIVES

- Describe how force affects the motion of an object.
- Interpret and construct free-body diagrams.

force

an action exerted on an object which may change the object's state of rest or motion

FORCE

You exert a **force** on a ball when you throw or kick the ball, and you exert a force on a chair when you sit in the chair. Forces describe the interactions between an object and its environment.

Forces can cause accelerations

In many situations, a force exerted on an object can change the object's velocity with respect to time. Some examples of these situations are shown in **Figure 1**. A force can cause a stationary object to move, as when you throw a ball. Force also causes moving objects to stop, as when you catch a ball. A force can also cause a moving object to change direction, such as when a baseball collides with a bat and flies off in another direction. Notice that in each of these cases, the force is responsible for a change in velocity with respect to time—an acceleration.



(a)



(b)



(c)

Figure 1

Force can cause objects to (a) start moving, (b) stop moving, and/or (c) change direction.

The SI unit of force is the newton

The SI unit of force is the newton, named after Sir Isaac Newton (1642–1727), whose work contributed much to the modern understanding of force and motion. The newton (N) is defined as the amount of force that, when acting on a 1 kg mass, produces an acceleration of 1 m/s^2 . Therefore, $1 \text{ N} = 1 \text{ kg} \times 1 \text{ m/s}^2$.

The weight of an object is a measure of the magnitude of the gravitational force exerted on the object. It is the result of the interaction of an object's mass with the gravitational field of another object, such as Earth. Many of the