

Newton's First Law

SECTION 2

INERTIA

A hovercraft, such as the one in **Figure 4**, glides along the surface of the water on a cushion of air. A common misconception is that an object on which no force is acting will always be at rest. This situation is not always the case. If the hovercraft shown in **Figure 4** is moving at a constant velocity, then there is no net force acting on it. To see why this is the case, consider how a block will slide on different surfaces.

First, imagine a block on a deep, thick carpet. If you apply a force by pushing the block, the block will begin sliding, but soon after you remove the force, the block will come to rest. Next, imagine pushing the same block across a smooth, waxed floor. When you push with the same force, the block will slide much farther before coming to rest. In fact, a block sliding on a perfectly smooth surface would slide forever in the absence of an applied force.

In the 1630s, Galileo concluded correctly that it is an object's nature to *maintain its state of motion or rest*. Note that an object on which no force is acting is not necessarily at rest; the object could also be moving with a constant velocity. This concept was further developed by Newton in 1687 and has come to be known as **Newton's first law of motion**.

NEWTON'S FIRST LAW

An object at rest remains at rest, and an object in motion continues in motion with constant velocity (that is, constant speed in a straight line) unless the object experiences a net external force.

Inertia is the tendency of an object not to accelerate. Newton's first law is often referred to as the *law of inertia* because it states that in the absence of a net force, a body will preserve its state of motion. In other words, Newton's first law says that *when the net external force on an object is zero, the object's acceleration (or the change in the object's velocity) is zero*.

SECTION OBJECTIVES

- Explain the relationship between the motion of an object and the net external force acting on the object.
- Determine the net external force on an object.
- Calculate the force required to bring an object into equilibrium.



Figure 4

A hovercraft floats on a cushion of air above the water. Air provides less resistance to motion than water does.

inertia

the tendency of an object to resist being moved or, if the object is moving, to resist a change in speed or direction