

INVESTIGATE



Observing Air Resistance

HANDS-ON ACTIVITY

1. Obtain two identical sheets of paper. Crumple one sheet into a ball.
2. Hold the crumpled sheet of paper in one hand and the uncrumpled sheet in the other hand. Extend your arms straight out in front of you at shoulder height.
3. Release both sheets of paper at the same time and observe them fall.

THINK ABOUT-IT: Both sheets of paper are identical, yet one fell faster than the other. Why do you think this happened?



Objective

Explain how air resistance affects moving objects.

Key Terms

air resistance: force that opposes the movement of an object in air

terminal velocity: speed at which air resistance and gravity acting on a falling object are equal

vacuum: empty space

Falling Objects The force that opposes the downward motion of objects falling through Earth's atmosphere is called **air resistance**. Air resistance is not the same for all objects. The greater the surface area of an object, the greater the air resistance. Suppose, for example, an oak leaf and an acorn fall from a tree. The leaf flutters slowly to the ground, whereas the acorn drops straight down. As each object falls, air pushes up against the surfaces of the objects. The leaf has a greater surface area than the acorn. As a result, air pushes with more force against the leaf than it does against the acorn. The leaf is slowed more than the acorn, so the acorn hits the ground first.

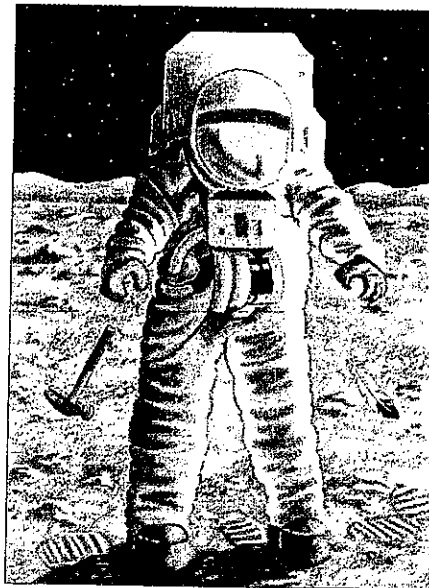
▶ **PREDICT:** Which falling object will hit the ground first, a marble or a feather?

Terminal Velocity When an object is dropped from a high place, gravity pulls the object toward Earth. As it falls, gravity causes the object to accelerate. Its velocity and air resistance increase at

steady rates. At some point, the upward force of resistance becomes equal to the downward pull of gravity. At this point, the object reaches **terminal velocity**. It stops accelerating and velocity remains the same for the rest of downward trip.

▶ **DESCRIBE:** What happens to an object's velocity as it falls?

Free Fall A **vacuum** is empty space. If a bowling ball and a sheet of paper were dropped from the same height in a vacuum, they would hit the ground at the same time. Because there is no air in a vacuum, there is no air resistance to slow the objects as they fall.

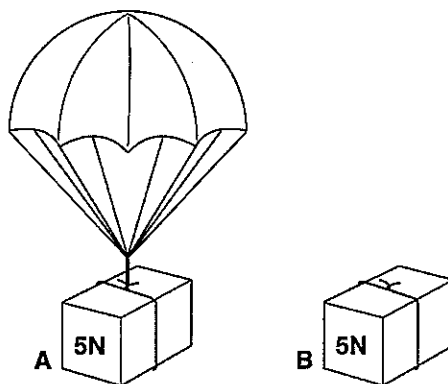


▲ **Figure 12-21** When on the Moon's surface, an astronaut dropped a hammer and a feather to test the idea of free fall.

12-6 What is air resistance?

Lesson Review

Use the diagram below to answer the following questions.



1. Which object has more air resistance? Explain your answer. _____

2. Which object will hit the ground first? _____
3. When these objects reach their terminal velocity, how will the upward force of air resistance compare to the downward pull of gravity? _____

4. When will these objects have a velocity of zero? _____

5. What condition would have to exist for these two objects to hit the ground at the same time? _____

6. What will happen to each object's acceleration as it falls? _____

Skill Challenge

Skill: researching

Use reference materials to find out at what rate an object accelerates as it falls toward Earth. Write the results of your research below.

