

Organizing Information

Comparing and Contrasting Copy the table about the different types of friction onto a sheet of paper. Then complete it and add a title. (For more on Comparing and Contrasting, see the Skills Handbook.)

Type of Friction	Occurs When	Example
Static	An object is not moving	a. _____?
Sliding	b. _____?	c. _____?
Rolling	d. _____?	e. _____?
Fluid	f. _____?	g. _____?

Reviewing Key Terms

Choose the letter of the best answer.

- When an unbalanced force acts on an object, the force
 - changes the motion of the object.
 - is canceled by another force.
 - does not change the motion of the object.
 - is equal to the weight of the object.
- Air resistance is a type of
 - rolling friction.
 - sliding friction.
 - centripetal force.
 - fluid friction.
- Which of the following is not a projectile?
 - a satellite
 - a thrown ball
 - a ball on the ground
 - a soaring arrow
- The resistance of an object to any change in its motion is called
 - inertia.
 - friction.
 - gravity.
 - weight.
- The product of an object's mass and its velocity is called the object's
 - net force.
 - weight.
 - momentum.
 - gravitation.

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

- Balanced forces are equal forces acting on an object in opposite directions.
- Rolling friction occurs when two solid surfaces slide over each other.
- The greatest velocity a falling object reaches is called its momentum.
- The law of universal gravitation states that the total momentum of objects that interact does not change.
- The force that causes a satellite to orbit Earth is a centripetal force.

Writing in Science

Descriptive Paragraph Suppose you have been asked to design a new amusement park ride. Write a description of how you will design it. Explain the role that friction and gravity will play in the ride's design.



Forces

[Video Preview](#)

[Video Field Trip](#)

[▶ Video Assessment](#)

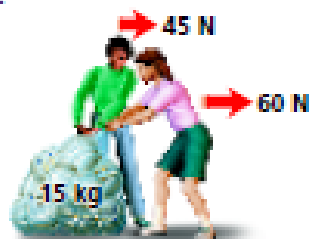
Review and Assessment

Checking Concepts

- Four children pull on the same toy at the same time, yet there is no net force on the toy. How is that possible?
- Why do slippery fluids such as oil reduce sliding friction?
- Will a flat sheet of paper dropped from a height of 2 m accelerate at the same rate as a piece of paper crumpled into a ball? Why or why not?
- Explain how force, mass, and acceleration are related by Newton's second law of motion.
- Suppose you are an astronaut making a space walk outside your space station when your jet pack runs out of fuel. How can you use your empty jet pack to get you back to the station?
- Draw a diagram showing the motion of a satellite around Earth. Label the forces acting on the satellite. Is the satellite accelerating?

Thinking Critically

- Classifying** What kind of friction allows you to walk without slipping?
- Applying Concepts** You are moving fast on a skateboard when your wheel gets stuck in a crack on the sidewalk. Using the term *inertia*, explain what happens.
- Problem Solving** Look at the diagram below of two students pulling a bag of volleyball equipment. The friction force between the bag and the floor is 15 N. What is the net force acting on the bag? What is the acceleration of the bag?



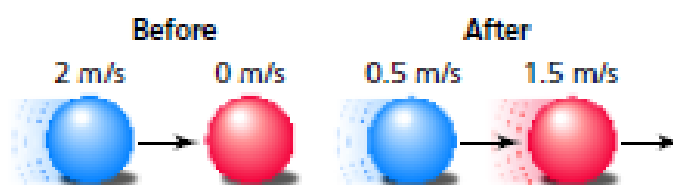
- Relating Cause and Effect** When you drop a golf ball to the pavement, it bounces up. Is a force needed to make it bounce up? If so, what exerts the force?

Math Practice

- Calculating Force** A 7.3-kg bowling ball accelerates at a rate of 3.7 m/s^2 . What force acts on the bowling ball?
- Calculating Momentum** A 240-kg snowmobile travels at 16 m/s. The mass of the driver is 75 kg. What is the momentum of the snowmobile and driver?

Applying Skills

Use the illustration showing a collision between two balls to answer Questions 23–25.



- Calculating** Use the formula for momentum to find the momentum of each ball before and after the collision. Assume the mass of each ball is 0.4 kg.
- Inferring** Find the total momentum before and after collision. Is the law of conservation of momentum satisfied in this collision? Explain.
- Designing Experiments** Design an experiment in which you could show that momentum is not conserved between the balls when friction is strong.

Lab
zone

Chapter Project

Performance Assessment Test your vehicle to make sure it will work on the type of floor in your classroom. Will the vehicle stay within the bounds set by your teacher? Identify all the forces acting on the vehicle. What was the most significant source of friction for your vehicle? List at least three features you included in the design of the vehicle that led to an improvement in its performance. For example, did you give it a smooth shape for low air resistance?