UNIT 8

Forces and Motion

FLORIDA BIG IDEA 13

Forces and Changes in Motion

A surfer seems to have found the perfect wave.

I Wonder Why

Why does a surfer need to wax the board before riding the waves? *Turn the page to find out.*

Here's Why

The hard shell of a surf board is smooth and slippery. By waxing the board, the surfer creates bumps, giving the feet something to hold on to.

Essential Questions and Florida Benchmarks

Science Notebook

Before you begin each lesson, write your thoughts about the Essential Question.

P.13.1 Identify familiar forces that cause objects to move.... **SC.5.P.13.2** ... the greater the force applied to it, the greater the change in motion of a given object. **SC.5.P.13.3** ... the more mass an object has, the less effect a given force will have on the object's motion. **SC.5.P.13.4** ... when a force is applied to an object but it does not move, ... another opposing force is being applied ... so that the forces are balanced.

LESSON 1

ESSENTIAL **QUESTION**

What Are Forces?

Engage Your Brain

As you read the lesson, figure out the answer to the following question. Write the answer here.

What forces are acting on this cyclist? Are all the forces balanced?

ACTIVE **READING**

Lesson Vocabulary

List the terms. As you learn about each one, make notes in the Interactive Glossary.

Cause and Effect

Some ideas in this lesson are connected by a cause-and-effect relationship. Why something happens is a cause. What happens as a result of something else is an effect. Active readers look for effects by asking themselves, What happened? They look for causes by asking, Why did it happen?

PUSHING and Pulling

You pull on a door to open it. You lift up a backpack. You push on the pedals of a bike to go faster. What is the relationship between force and motion?

ACTIVE READING As you read this page, underline the effects a force can have on an object.

The horse and the road it is on both exert a force on the cart.

▶ Draw an arrow that shows the direction of the force applied to the cart by the horse.

Changes in motion all have one thing in common. They require a **force**, which is a push or a pull. Forces can cause an object at rest to move. They can cause a moving object to speed up, slow down, change direction, or stop. Forces can also change an object's shape.

Forces are measured with a spring scale in units called newtons (N). The larger the force, the greater the change it can cause to the motion of an object. Smaller forces cause smaller changes. Sometimes more than one force can act together in a way that does not cause a change in motion.

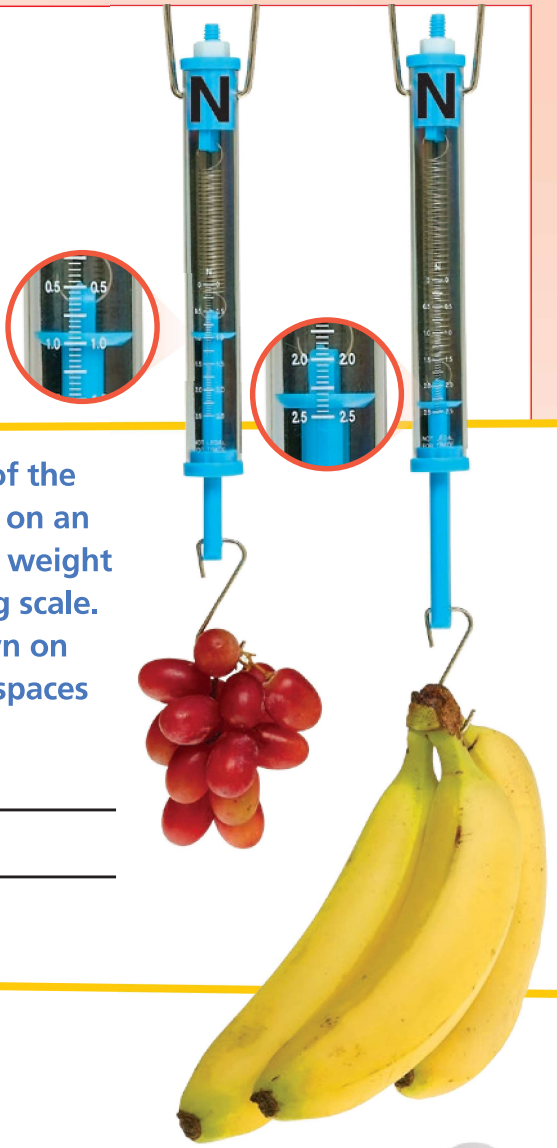
When the rowers pull back on the oars, the oars push against the water.

The water pushes back against the oars. This force causes the boat to move.

▶ Weight is a measure of the force that gravity exerts on an object. You can measure weight in newtons with a spring scale. Record the weight shown on each spring scale in the spaces below.

_____

_____



When the ball hits the floor, the force of the floor makes the ball stop and change its direction of movement. When the ball hits the player's hand, the same thing happens.

TWO COMMON Forces

What do the skydivers and some of the flower petals have in common? They are both falling! What causes this?

ACTIVE **READING** As you read these pages, circle the sentence that describes a force that causes things to slow down.

▶ Draw an arrow showing the direction of the gravitational force between Earth and the falling flower petals.

Gravity

Gravity is a force of attraction between two objects. The size of this force increases as the mass of the objects increases. It decreases as the distance between the objects increases. Gravity acts on objects even if they are not touching.

Large objects such as Earth cause smaller objects, such as the skydivers, to accelerate quickly. We expect to see things fall toward Earth. However, the force of attraction is the same on both objects. If you place two objects with the same mass in outer space, they will move toward one another. If one object is "above" the other, the bottom object will appear to "fall up" as the other "falls down"!

Friction changes the energy of motion into thermal energy. When you use sandpaper to smooth wood, you can feel the temperature rise.

Friction

Is it easier to ride your bike on a smooth road or on a muddy trail? Why?

Friction is a force that opposes motion. Friction acts between two objects that are touching, such as the bike tires and the road. Friction can also exist between air and a moving object. This is called air resistance. The skydivers use air resistance to adjust their positions in the air. Their parachutes use this force to slow down their fall.

It is easy to slide across smooth ice because it doesn't have much friction. Pulling something across rough sandpaper is a lot harder because there is lots of friction.

An air hockey table blows air upward. This layer of air reduces the surface friction, so the pieces move quickly.

▶ In the pictures on this page, circle the places where there is friction between two objects. In the small boxes, write *Inc* if the object is designed to increase friction and *Dec* if the object is designed to decrease friction.

The tires on this bike are designed to keep the rider from slipping. You have to pedal harder on a rough surface to overcome the force of friction.

BALANCED or Unbalanced?

The tug-of-war teams are both applying forces. So why isn't anyone moving?

ACTIVE **READING** Draw a circle around a sentence that explains why objects don't always move when a force is applied.

When you sit on a chair, the force of gravity pulls you down. The chair pushes you up. You stay in one place because the forces on you are balanced. **Balanced forces** are forces on an object that are equal in size and opposite in direction. They cancel each other out.

The tug-of-war teams in the picture don't move because the forces are balanced. Friction keeps them from sliding. They won't move until one side exerts a larger force. Then, the forces are no longer balanced. **Unbalanced forces** are forces that cause a change in motion. A force must also overcome the force of friction before an object will move.

When a plane flies at a constant velocity, all the forces on the plane are balanced. If they weren't, the plane would speed up, slow down, or gain or lose altitude.

The push on the first domino was a(n) _____ force that caused it to fall into the next domino. As each domino fell, it transferred the force to the next domino.

The force exerted on this domino by the falling dominoes is balanced by the force of the box. Because the forces are _____ , the domino doesn't fall.

▶ Are there any forces acting on the dominoes that have fallen? If so, are they balanced or unbalanced? How do you know?

_____

_____

_____

_____

The forces on the dominoes are _____ when they are standing upright. When a falling domino hits them, the forces become _____ and they fall.

PULL (or Push) Harder!

Would you expect a bunt in baseball to go out of the park? Why or why not?

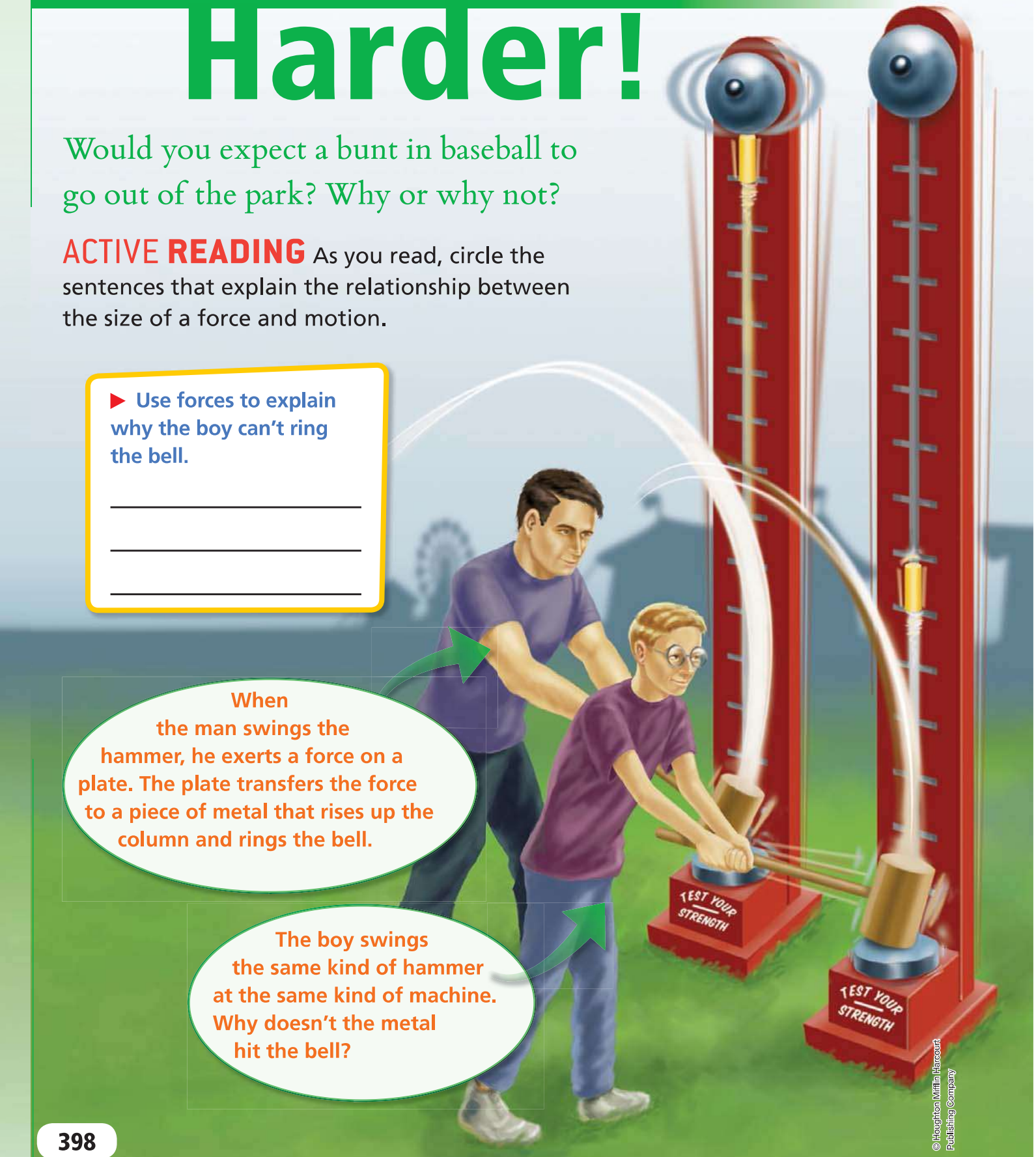
ACTIVE **READING** As you read, circle the sentences that explain the relationship between the size of a force and motion.

▶ Use forces to explain why the boy can't ring the bell.

_____

_____

_____



If you want to make the bowling ball knock all the pins, you will have to hit them with a lot of force. The greater the force you apply to the ball, the more force it can transfer to the pins. A large force will cause a large change in motion. A small force will cause a small change in motion. The bowling ball's force comes from the mechanical energy you give it when you swing it back and then forward in your hand. This motion changes the ball's velocity. After the ball leaves your hand, its velocity continues to change. A change in an object's velocity is called acceleration. The ball may hit and apply a force to just a few pins, causing them to accelerate in many directions. But if you're lucky, these pins will knock other pins and you will get a strike!

DO THE **MATH**

Display Data in a Graph

Use the data in the table to make a graph that shows the relationship between the force applied to an object and its acceleration.

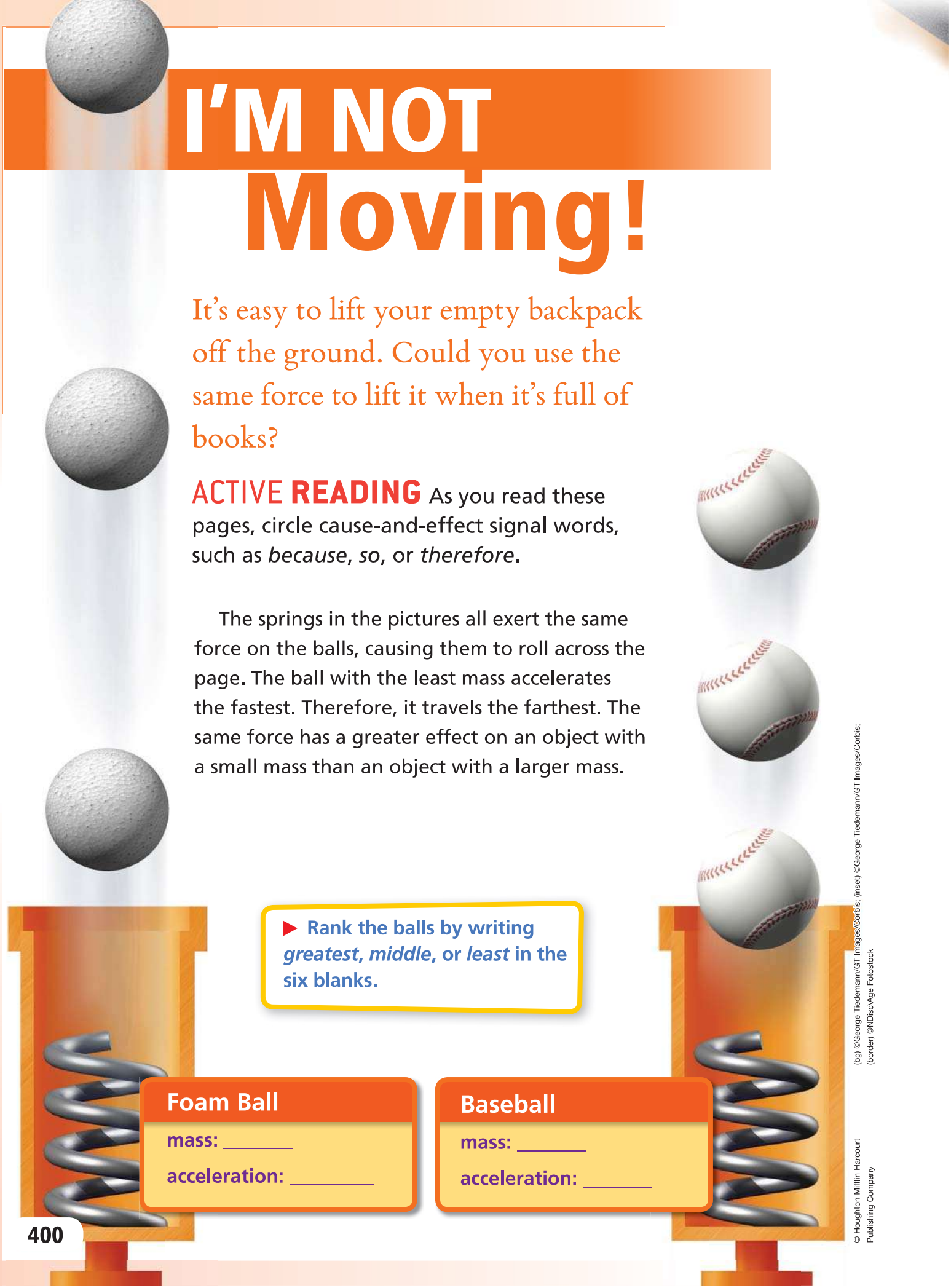
Force (N)	Acceleration (m/sec^2)
1	0.5
2	1.0
5	2.5
8	4.0
10	5.0

I'M NOT Moving!

It's easy to lift your empty backpack off the ground. Could you use the same force to lift it when it's full of books?

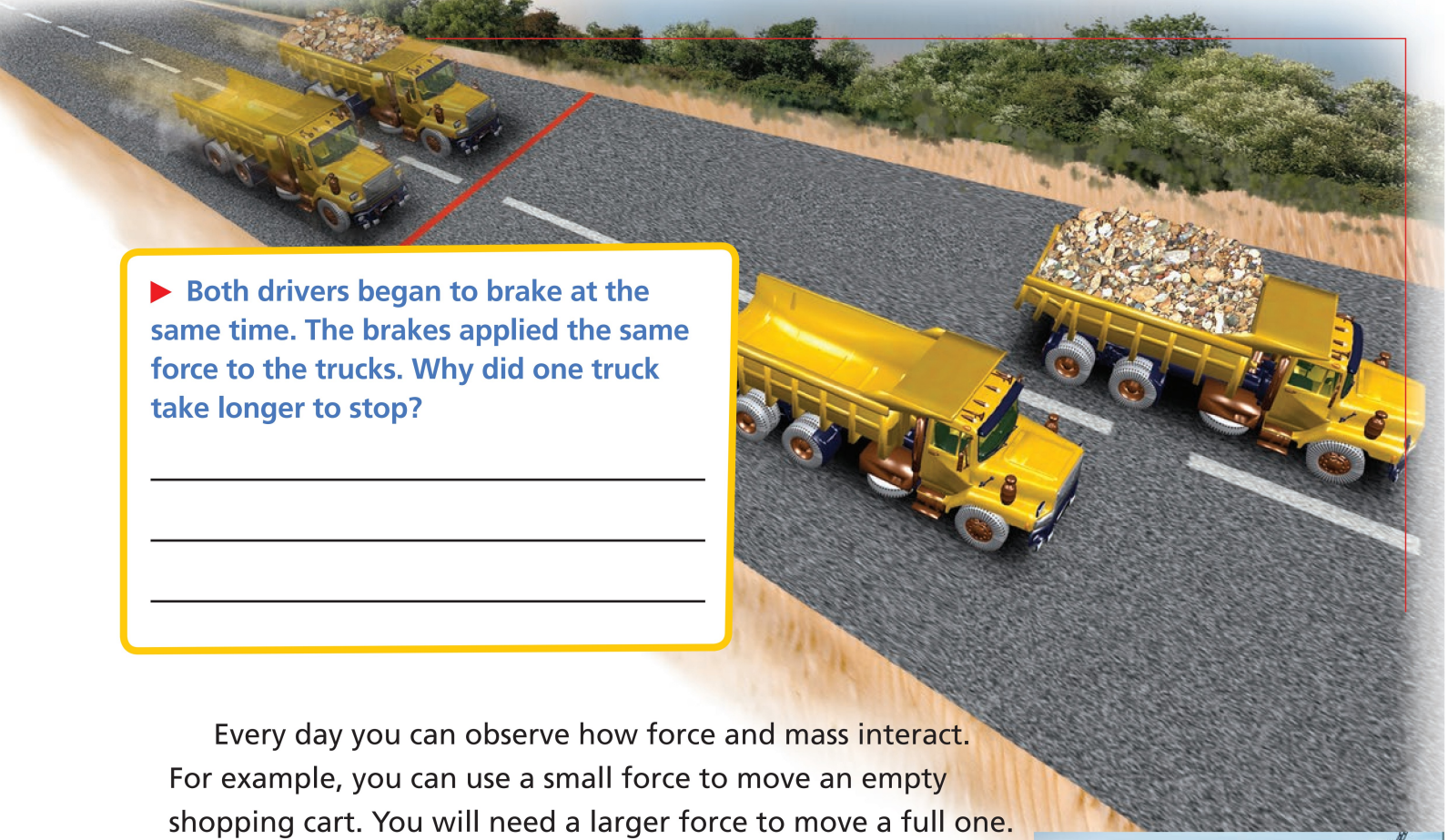
ACTIVE READING As you read these pages, circle cause-and-effect signal words, such as *because*, *so*, or *therefore*.

The springs in the pictures all exert the same force on the balls, causing them to roll across the page. The ball with the least mass accelerates the fastest. Therefore, it travels the farthest. The same force has a greater effect on an object with a small mass than an object with a larger mass.



▶ **Rank the balls by writing *greatest*, *middle*, or *least* in the six blanks.**

Foam Ball	Baseball
mass: _____	mass: _____
acceleration: _____	acceleration: _____



▶ **Both drivers began to brake at the same time. The brakes applied the same force to the trucks. Why did one truck take longer to stop?**

_____

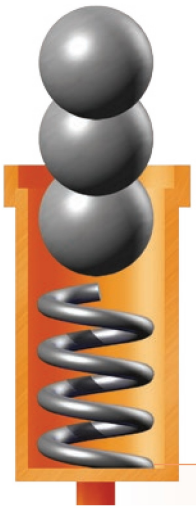
_____

_____

Every day you can observe how force and mass interact. For example, you can use a small force to move an empty shopping cart. You will need a larger force to move a full one. With a small force, you can push a young child on a swing. Applying the same force may not help you push an adult.

Look back at the ball and spring examples. Suppose you now want to make the balls travel faster and farther. You will need to use a larger force. Remember that the greater the force, the greater the change it can cause. A larger spring will apply a greater force on the balls. So, this will increase their acceleration and distance traveled.

An object's acceleration depends on the object's mass and the force applied to it. If you want to slide a heavy box across the floor faster, you have two options. You could take some items out of the box, which decreases its mass. Or you could have a friend help you, which increases the force you apply.



Steel Ball

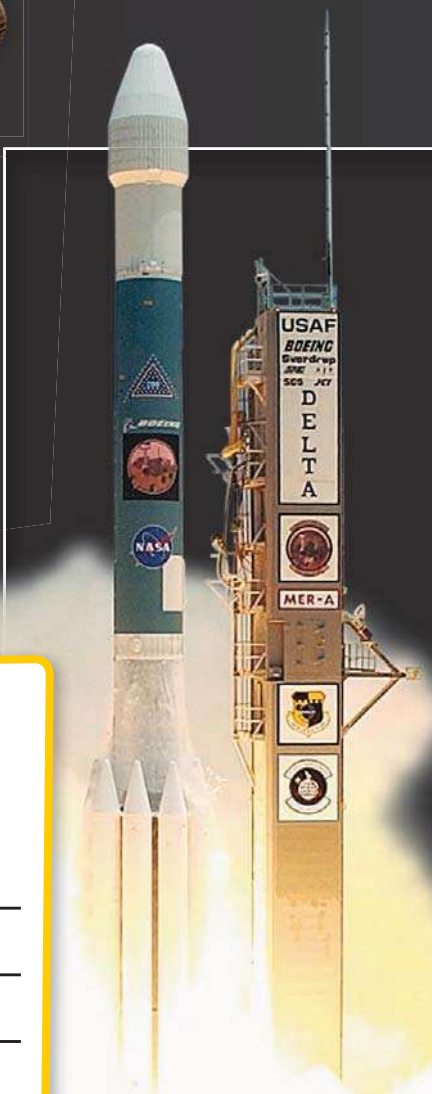
mass: _____

acceleration: _____

How did I get to Mars?

LET'S GO to Mars!

How did an understanding of forces help to send a rover to Mars and safely land it there?



1 The first force you need is an unbalanced force to oppose Earth's gravity. A huge booster rocket produces nearly 900,000 N of force that accelerates the rocket upward.

▶ **What forces act on the rocket while it's at rest on Earth's surface? Are they balanced or unbalanced?**

_____

_____

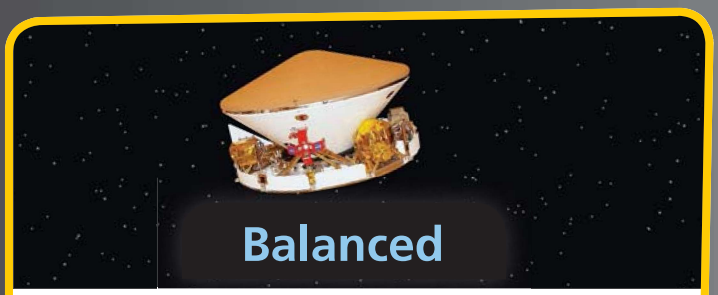
_____

_____

_____

2 After the booster rocket falls away, smaller rockets in the second stage fire. The rockets change the direction of the vehicle's motion and put it in orbit around Earth.

3 The third-stage rocket firing produces enough force to reach "escape velocity." Earth's gravity can no longer pull it back down. We're on our way!



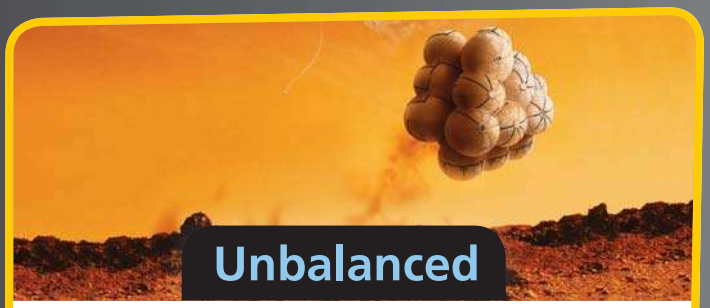
Balanced

▶ At what points during the Rover's trip to Mars are the forces on it balanced?

_____

_____

_____



Unbalanced

▶ What unbalanced forces are acting on the Rover as it lands on Mars?

_____

_____

_____

_____

Gravity

▶ Use forces to explain why the Rover required a parachute and "air bags."

_____

_____

_____

During much of the time it takes the spacecraft to travel to Mars, it travels at a constant velocity. The forces acting on the spacecraft are balanced, so its motion does not change.

Tiny rockets occasionally fire to keep the spacecraft on course. During these times, the forces are unbalanced.

As the spacecraft approaches Mars, gravitational attraction begins to accelerate it toward the surface. Like a person jumping from a plane, the Rover detaches from the spacecraft. Parachutes open to slow its fall. Then a big ball inflates around the Rover. When the Rover hits the surface of Mars, it bounces around until it comes safely to rest.

Mars Rover air bag testing

Sum It Up »

Change the part of the summary in blue to make it correct.

1. Forces are pushes and pulls that increase the speed of objects.

2. Gravity is the force of attraction between a planet and another object.

3. An object moving through the air slows down because it is affected by the force of gravity.

4. When balanced forces act on an object, the object falls.

5. In order for an object to change its speed or direction, someone has to push it.

Brain Check

LESSON 1

Name _____

Vocabulary Review

1 A foreign-language teacher placed words from other languages into the following sentences. For each sentence, write the English word that means the same as the foreign word. Then use the circled letters to complete the riddle.

1.  **Italian**

   A push is an example of a forza. Another example is a pull.

   _ ◯ _ ◯ _
   11 3

2.  **French**

   The force of attraction between Earth and objects on its surface is pesanteur.

   _ ◯ _ _ _ _ _
   8

3.  **Russian**

   The force between two moving objects that are touching is Трение.

   ◯ _ _ _ _ _ ◯ _
   4 7

4.  **German**

   Two forces that are equal in size but opposite in direction are ausgeglichene Kräfte.

   _ _ _ _ _ ◯ _ _ _ _ ◯ _ _ ◯
   10 5 9

5.  **Portuguese**

   Two forces that are not equal in size are Forças desequilibradas.

   ◯ _ _ _ _ _ _ _ _ _ _ _ _ _ ◯ _
   2 6

6.  **Chinese**

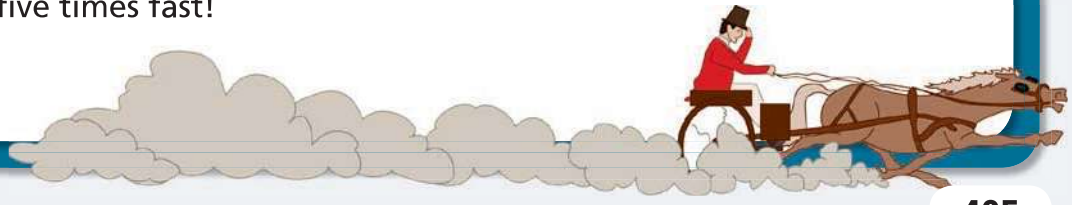
   A 彈簧秤 is a tool that can be used to measure the size of a force.

   ◯ _ _ _ _ _ ◯ _ _ _ ◯
   1 12 13

Riddle: What conclusion did the student draw?

The _o_r_e (1 2 3) of the _o_c_ (4 5 6) is the h_____e (7 8 9), of ____ur____ (10 11 12 13).

Try saying that five times fast!



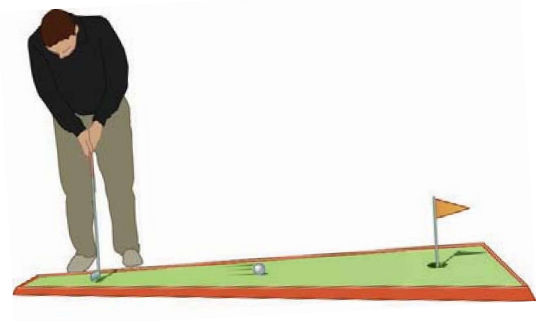
Apply Concepts

2 Draw pictures of two activities that you might do. In the first, draw a pushing force. In the second, draw a pulling force.

pushing force

pulling force

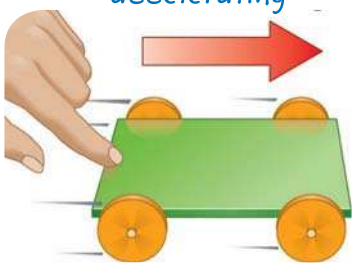
3 The golfer applied a force when he hit the ball. Describe at least two forces acting on the ball as it rolls. Draw arrows to show the forces.



4 Two students are using a catapult to try and hit a target. The catapult has only one setting. The first time they tried, they used Rock B. Which of the remaining rocks is likely to come closer to the target? Why?

5 Use the words *balanced* and *unbalanced* as you name and describe the forces acting in each of these pictures.

a. accelerating



b.

c.

6 Draw what will happen to a ball that you throw straight up into the air. Explain why this happens.

7 Explain why it is easy to slip on a floor that is wet.

8 Look at the drawings to the right. Mary measured the distance each ball traveled. Draw lines to match the ball with the distance it traveled.

Explain why each ball traveled a different distance.

_____

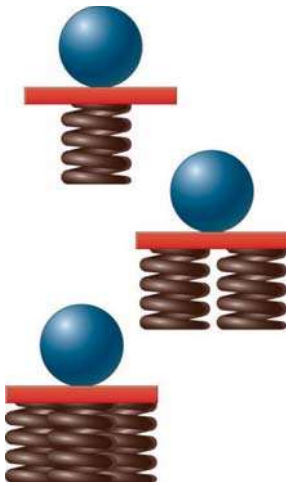
_____

_____

25 cm

15 cm

20 cm



9 Give an example of each of the following.

a. A force is applied but nothing happens.

_____

b. A force causes an object to change shape.

_____

c. A force causes an object to change position.

_____

d. A force causes an object to stop moving.

_____

10 Circle the object(s) whose velocities are not changing. Draw an up arrow next to the object(s) whose speeds are increasing. Draw a down arrow next to the object(s) whose speeds are decreasing.

A car travels 35 miles per hour around a bend in the road.

A car comes to a stop when a traffic light turns red.

A race car accelerates when a race begins.

A car is driving 45 miles per hour down a straight road.

Take It Home! See ***ScienceSaurus***® for more information about force and motion.

SC.5.N.1.5 Recognize and explain that authentic scientific investigation frequently does not parallel the steps of "the scientific method."

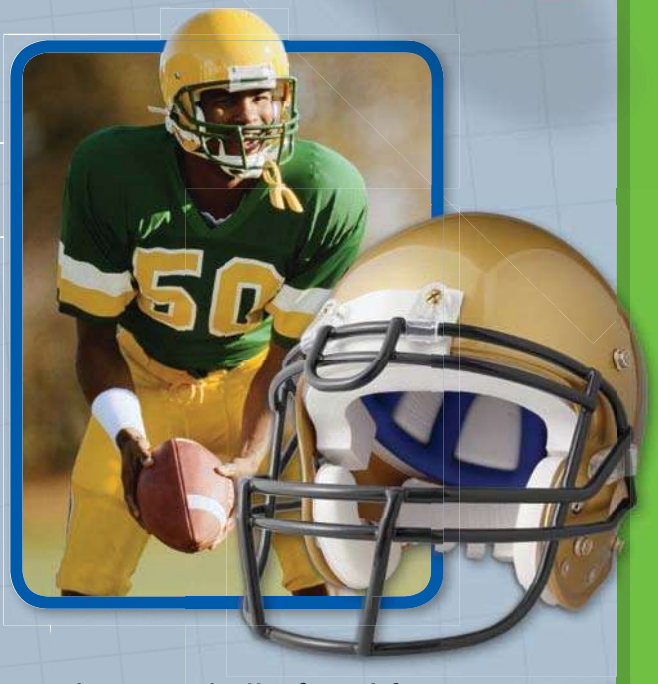
S.T.E.M.

ENGINEERING & TECHNOLOGY

Football Safety Gear

Football is a rough sport. In order to protect players from injury, designers have developed protective gear.

The first helmets were custom made out of leather by horse harness makers. Later, ear holes and padding were added. These helmets had little padding and no face guards.



Hard plastic shells, fitted foam linings, and metal facemasks now make helmets more protective. Some helmets even contain sensors that transmit signals to warn if a player's head has been hit hard enough to cause a serious injury.

CRITICAL THINKING

How do modern materials make it possible to build a better helmet than one made of just leather?

When engineers develop new materials, it can spark new and improved designs of all sorts of familiar objects.

Choose two pieces of safety gear from your favorite sport or activity. Draw each piece of gear. Do research to find out what material makes up each piece. Label the materials. Explain how one material's properties made it a good design choice.

List three features of this bicycle helmet. Draw arrows to the features that are for safety. Circle the features that are for comfort.

Design It:
Balloon Racer

Have you ever inflated a balloon, then released it? If so, you've observed jet propulsion.

The blast of air that shot out of the balloon's nozzle produced an opposite and equal reaction. This opposite reaction causes the balloon to fly off in the opposite direction of the escaping air.

Now, it's time to apply your understanding of forces to the design of a balloon car racer.

What to Do:

1. Find out about jet propulsion and how it is used by racing cars.
2. Find out what materials are available to build a balloon racer. List the materials.
3. Based upon your research and available materials, make a diagram of the design for your balloon car racer.
4. Build your design.
5. Think about how you will test your design's speed. What additional tools and materials will you need to test it? Speed is calculated using the formula $s = d/t$.
6. Measure the distance traveled and the time the racer took to travel the distance. Calculate the model's speed.
7. Continue improving or redesigning and testing your racer until you are satisfied with the final product.
8. Compare its performance in a classroom race with balloon racers designed by other students.
9. Keep a record of your work in your Science Notebook.

Name _____

ESSENTIAL **QUESTION**

How Do Forces Affect Motion?

Materials

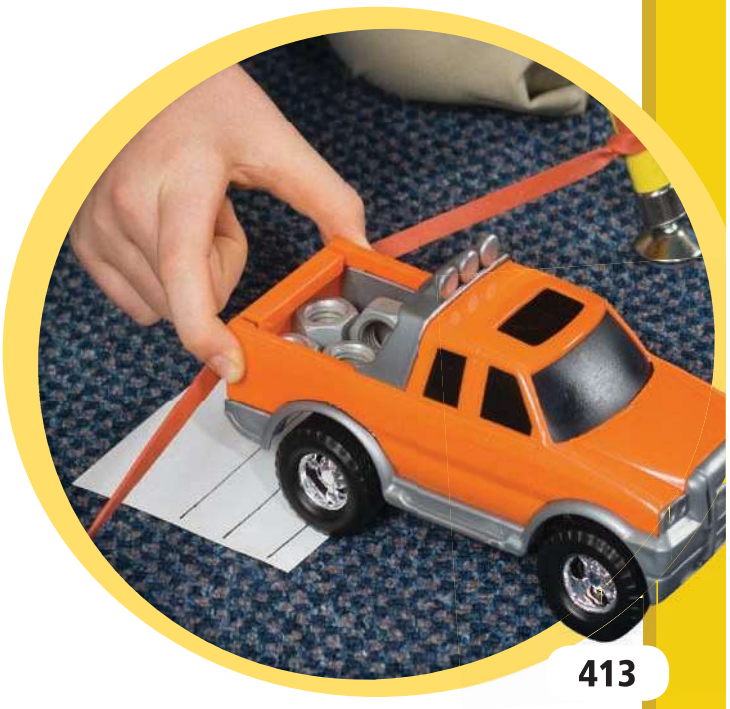
- safety goggles
- giant rubber band
- chair
- tape
- ruler
- toy truck
- meterstick
- metal bolts

EXPLORE

What can you do to make a toy truck move faster or travel farther?

Before You Begin—Preview the Steps

1. **CAUTION:** wear goggles. Cut a rubber band in half, and tie the ends around the legs of a chair.
2. Place a piece of tape on the floor. Mark lines that are 1 cm, 2 cm, and 5 cm behind the rubber band.
3. Place a toy truck against the rubber band. Pull the truck back to the 1-cm mark, and release it. Measure the distance the truck travels, and record the data. Repeat this step two more times.
4. Repeat Step 3 using the 3-cm and 5-cm marks.
5. Place four bolts in the toy truck. Launch the truck from the 3-cm mark, and record the distance it travels. Repeat this step two more times.
6. Add four more bolts to the truck. Repeat Step 5.



Set a Purpose

What will you learn from this experiment?

State Your Hypothesis

Write your hypothesis, or testable statement.

Think About the Procedure

Why do you use a rubber band to start the cars, rather than your hand?

Why do you add bolts to the truck?

Name _____

Record Your Data

In the table below, record the data you gathered.

How Forces Affect Motion									
Part 1	Distance rubber band was streched								
	1 cm			3 cm			5 cm		
Distance traveled (cm)									
Part ii: Rubber band streched to 3 cm									
	Empty Car			Car with 4 bolts			Car with 8 bolts		
Distance traveled (cm) Trial 1									
Distance traveled (cm) Trial 2									
Distance traveled (cm) Trial 3									

Draw Conclusions

Each time you changed a variable and launched the truck, you ran three trials. Calculate the average distance traveled by the truck in each experimental setting.

Experimental settings	Average distance traveled (cm)
Rubber band at 1 cm	
Rubber band at 3 cm	
Rubber band at 5 cm	

Experimental settings	Average distance traveled (cm)
truck with 0 bolts	
truck with 4 bolts	
truck with 8 bolts	

Draw two bar graphs to display your data.

Claims • Evidence • Reasoning

1. Interpret your data. Write a claim about how an object's mass is related to its change in motion when acted on by a force.

2. Cite evidence that supports your claim and explain why the evidence supports the claim.

3. Write a claim about how the size of the force applied to an object affects its motion.

4. Cite evidence that supports your claim and explain why the evidence supports the claim.

5. Why is it important to repeat an experiment several times or to have several people perform the same experiment? Explain your reasoning.

Name _____

ESSENTIAL **QUESTION**

What are Balanced and Unbalanced Forces?

Materials

- spring scale
- 3 wood blocks with hooks
- sandpaper
- waxed paper
- oil

EXPLORE

Think about an object that is not moving. What do you need to do to make it move? Does the mass of the object make a difference?

Before You Begin—Preview the Steps

1. Use the spring scale to lift a block. Observe and record the force needed to overcome the force of gravity.
2. Repeat Step 1 with two blocks and then again with three blocks.
3. Place one block on its side on a piece of sandpaper. Attach the spring scale, and pull it gently. Record the scale reading just as the block begins to move. Repeat this measurement two more times.
4. Repeat Step 3 with the block on other surfaces, such as waxed paper and waxed paper that has been coated with vegetable oil.

Set a Purpose

What will you learn from this experiment?

_____

_____

Think About the Procedure

What forces are acting on the blocks when they are sitting on the table?

_____

_____

Why will you pull the block across several different surfaces?

_____

_____

Name _____

Record Your Data

Record your measurements in this table.

Forces Investigation	
Action	**Force(N)**
Lift one block	
Lift two blocks	
Lift three blocks	
Pull block on sandpaper	
Pull block on waxed paper	
Pull block on oiled paper	

Draw Conclusions

What is required to start an object moving?

_____

_____

_____

Claims • Evidence • Reasoning

1. The block below is being pulled to the right. Draw arrows to show the forces acting on the object. Label each arrow.

2. At what points during this activity were the forces on the block balanced? Draw the block, and show the forces as arrows.

3. Write a claim about how an object's mass is related to the upward force needed to overcome the pull of gravity. Cite evidence to support your claim.

4. Write a claim about why the blocks required a different force to begin moving on the three different surfaces. Cite evidence to support your claim.

10 THINGS TO KNOW ABOUT Safety Engineers

1. A safety engineer helps design and test devices to make them safer.
2. Safety engineers make changes to designs to avoid possible dangers.
3. I'm a crash test dummy. Some safety engineers use me as a model.
4. Safety engineers can make machines, such as cars, safer to use.
5. Safety engineers make cars safer with inventions such as seat belts and air bags.
6. Some safety engineers focus on stopping specific dangers, such as fires.
7. Safety engineers help society have fewer injuries and illnesses.
8. Some keep germs from spreading into our food and making us sick.
9. They may focus on protecting workers from getting hurt on the job.
10. To do their jobs, safety engineers need to study physics, chemistry, math, and human behavior.

(bl) ©Tim Wright/CORBIS; (tl) ©Garry Gay/Alamy

Now You Be the Engineer!

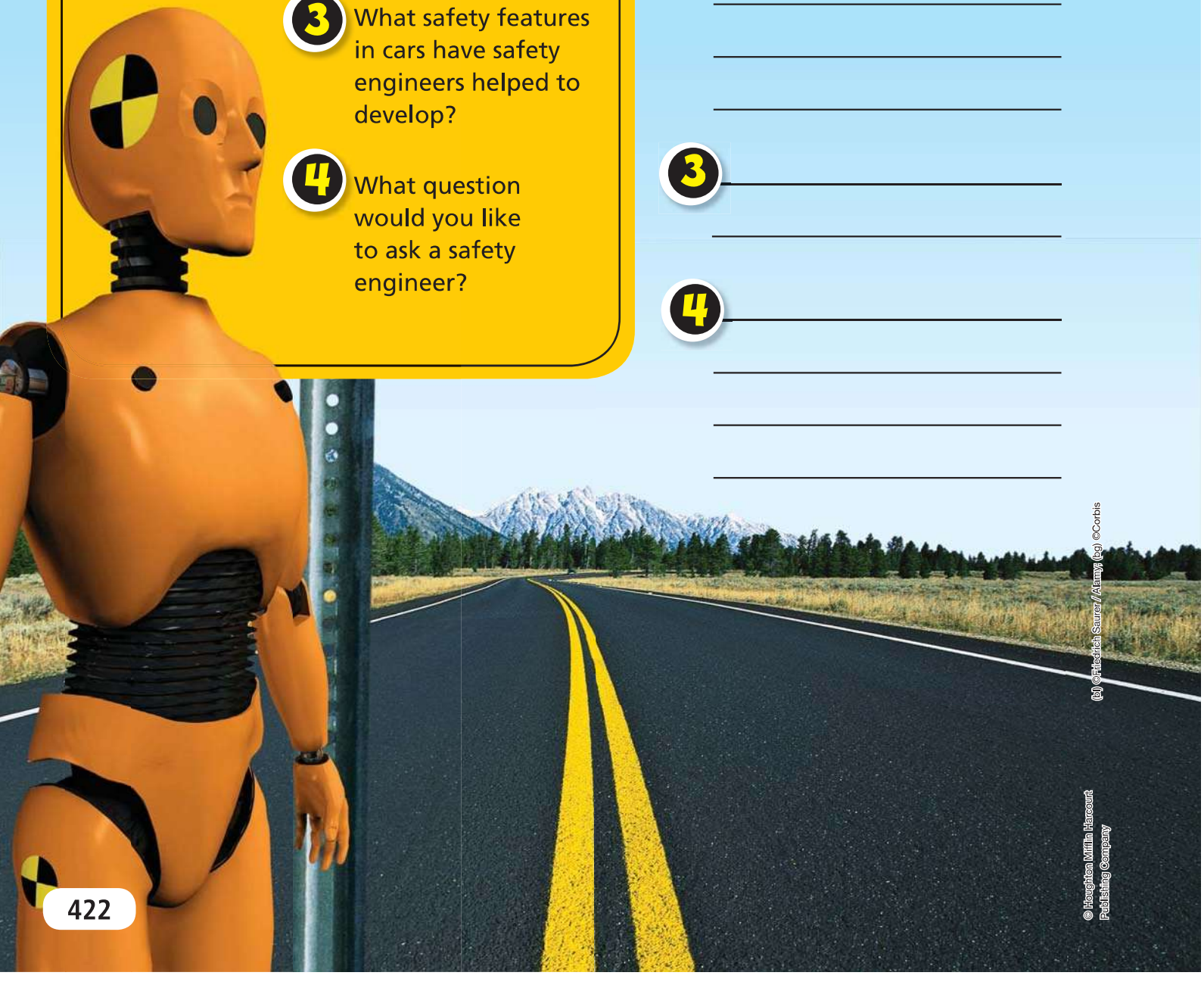
1. What do you think is the best thing about being a safety engineer?
2. How do safety engineers help society?
3. What safety features in cars have safety engineers helped to develop?
4. What question would you like to ask a safety engineer?

1 _____

2 _____

3 _____

4 _____



UNIT 8

Benchmark Review

Name _____

Vocabulary Review

Use the terms in the box to complete the sentences.

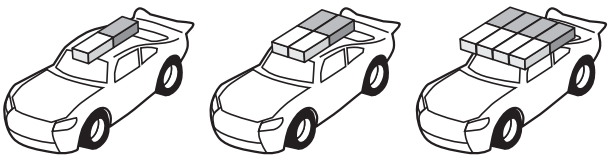
balanced forces
force
friction
gravity
unbalanced forces

1. Forces that cause a change in motion are _____.
2. A force of attraction between two objects, even if they are not touching, is _____.
3. A push or a pull, which causes movement or change in an object's movement or shape, is a(n) _____.
4. Forces on an object that are equal in size and opposite in direction are _____.
5. A force that opposes motion and acts between two objects that are touching is _____.

Science Concepts

Fill in the letter of the choice that best answers the question.

6. Suri places magnets on three identical toy cars, as shown below. Then Suri measures how far each car rolls when she launches it from the same starting point using the same stretched rubber band.



Car 1 Car 2 Car 3

Which statement is true?

(A) Car 3 will travel the longest distance.
(B) Car 1 will travel the shortest distance.
(C) Car 1 will be the least affected by the force acting upon it.
(D) Car 3 will be the least affected by the force acting upon it.

7. When you coast down a hill on a bicycle, you move faster and faster. Then when you keep coasting on a level surface, you eventually stop moving. What causes you to stop?

(F) No force is acting on your bike on the level surface, so it stops moving.
(G) After you reach the bottom of the hill, you run out of energy, so you stop moving.
(H) Friction between the tires and the ground is an unbalanced force that changes your motion.
(I) Gravity affects you when you move downhill, but there is no gravity when you move on a level surface.

8. Katie uses all her force to roll a bowling ball away from her body. Then Katie repeats the same procedure with a soccer ball. How does the movement of the two balls contrast?

   (A) The soccer ball moves a greater distance because more force is acting on it.

   (B) The soccer ball moves a greater distance because it has less mass.

   (C) The bowling ball moves a greater distance because it has more mass.

   (D) The bowling ball moves a shorter distance because less force is acting on it.

9. An object is traveling in a straight line in space. No forces are affecting it. What will happen to the object's motion?

   (F) It will move faster and faster because there is no force to stop it.

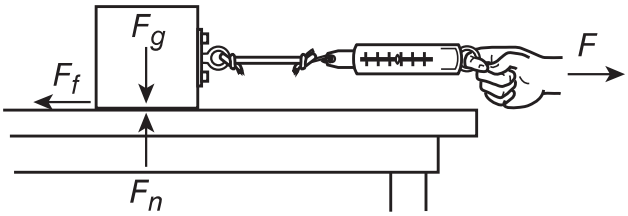
   (G) It gradually will stop because there is no force to keep it moving.

   (H) It will stop immediately when the force that started its motion goes away.

   (I) It will not change. It will continue in the same direction at the same speed.

10. Four forces are acting on the block shown in the following illustration:

    - F is the applied force.
    - F_f is friction.
    - F_g is the gravitational force.
    - F_n is the upward force of the table on the block.



    If a force F is applied to the block and it does not move, which statement is true?

    (A) F and F_f are equal.

    (B) F and F_g are equal.

    (C) F_f is greater than F.

    (D) F_g is greater than F.

11. A group of students measured the amount of force needed to move a weight across a dry plastic tabletop. Then they poured some water on the table and repeated the experiment on the wet surface. The students found that less force was needed to make the weight start moving on the wet surface than the dry surface. What caused the difference in the results of the two experiments?

    (F) change in the amount of gravitational force on the weight

    (G) change in the mass of the weight used in the experiment

    (H) change in the friction between the weight and the surface

    (I) change in the friction between the weight and the scale used to measure force

Name _____

12. Jean held a spring scale with a weight hanging on its hook. She observed that the force on the scale was 3 N. Why was the force greater than 0 N even though the weight was not moving?

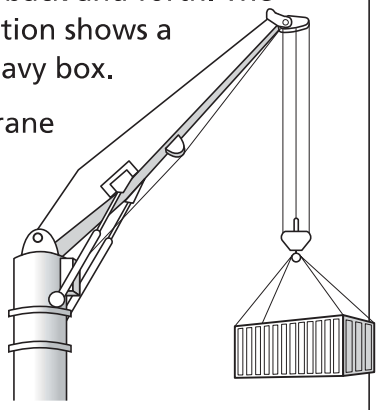
Ⓐ The 3-N force was balancing the force of gravity.

Ⓑ The weight was not moving, but the forces on it were constantly changing.

Ⓒ The spring scale was broken, so it showed 3 N even though the real force was zero.

Ⓓ The 3-N force was the amount of unbalanced force on the weight.

13. A crane raises and lowers objects and also moves them back and forth. The following illustration shows a crane lifting a heavy box.



What must the crane work against in order to lift the box upward?

Ⓕ wind

Ⓖ friction

Ⓗ gravity

Ⓘ cable tension

14. The following table shows the masses of several different objects. You want to toss each object a distance of 2 meters.

Object	Metal washer	Plastic disk	Rock	Wooden block
Mass (g)	1.5	34	16	22

Which object will require the most force to toss it 2 meters?

Ⓐ metal washer

Ⓑ rock

Ⓒ plastic disk

Ⓓ wooden block

15. The following table shows the masses of four blocks and the forces that are being applied to them.

Block color	Mass (g)	Pushing force (N)	Friction (N)
Red	50	24	6
Green	100	24	6
Blue	40	24	6
Yellow	75	24	6

Which block will have the greatest change in motion?

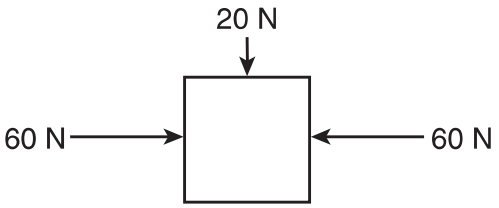
Ⓕ red

Ⓖ blue

Ⓗ green

Ⓘ yellow

16. The following illustration shows the forces that are acting on a box.



What type of motion will the forces cause?

Ⓐ The box will remain in its current position.

Ⓑ The box will move downward in a straight line.

Ⓒ The box will move to the right in a straight line.

Ⓓ The box will move back and forth from the left to the right.

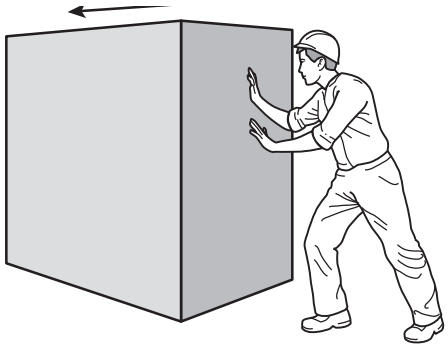
Apply Inquiry and Review the Big Idea

Write the answers to these questions.

17. Jermaine wondered if a heavy ball rolls down a ramp faster than a light ball. Use the space below to describe an investigation he could conduct in order to find out.

18. This worker is pushing a box with a force, which is shown by the arrow. The box does not move.

    Make a claim about what keeps the box from moving even though the worker is pushing on it?



19. Explain how forces can apply to objects in space, even though objects in space can look and feel weightless.

20. The spring scale shown has a weight attached to it. When the weight was attached, the pointer on the scale moved downward.

    Make a claim about what will happen if a second weight is added to the spring scale? Support your claim with evidence and explain your reasoning.