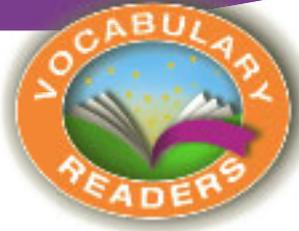


Sports and Motion



by Melissa McDaniel



HOUGHTON MIFFLIN

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Printed in China

ISBN-13: 978-0-547-02621-3

ISBN-10: 0-547-02621-8

1 2 3 4 5 6 7 8 0940 18 17 16 15 14 13 12 11

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What Makes Things Move?



A basketball player blocks a shot, exerting a force on the ball.

A basketball flies through the air. Two players leap for it, and one gives it a tap with his fingers. The ball heads towards the outstretched hands of a teammate. He pulls the ball to his body and races down the court, dribbling. The other players scramble to keep up. Near the basket the ball zips from one set of hands to another to another. Finally, one player sends it into the air toward the basket. Another player leaps high and swats it down. A third player grabs the ball and shoots. The ball rises through the air and then begins to fall. Swish!

Run, shoot, pass, pivot, jump. Basketball is all about motion. The players and the ball are moving constantly. What makes them move? Forces. Anything that pushes or pulls on something is applying a force.

Pushing

When you shoot a basketball, the ball soars toward the hoop. The ball moves because your arm exerts a force that pushes it.

What makes a soccer ball go from sitting still on the grass to flying through the air? The ball moves because of the force delivered by your foot.

 A soccer ball moves because your foot applies a force to it.



Pulling

When you pull something, you are using a kind of force. Whether you push a ball away from your body or pull it toward you, you're using a force on the ball.

Next time you're in the playground, reach for a bar above your head and pull. What happens? You can't pull the bar towards you because it's stuck in place, but you can pull yourself towards the bar. You've used a pulling force.

 A gymnast uses a pulling force to lift herself up.



Changing Direction



A batter uses a force that changes the ball's direction.

Forces set objects in motion. Motion is the movement of an object, its speed and direction. Forces can change either.

A pitcher streams a baseball toward home plate. The batter swings and hits the ball. The ball floats into the outfield.

When the pitcher threw the ball, he used a force that caused the ball to speed up. When the bat struck the ball, this new force **interrupted** the ball's motion. The ball's speed and direction changed.

In many sports, a ball's motion is changing constantly. A soccer ball changes speed and direction every time someone kicks it.

🔊 The Force of Friction



Friction helps a baseball player slide to a quick stop. 🔊

When you skateboard down the street, you have to push yourself over and over to keep moving. You can't coast forever.

The reason you can't is because another force is slowing down the skateboard. That force is friction. Friction takes place when two surfaces rub against each other. They create a force that resists forward motion.

🔊 A base runner trying to steal second wants to run as fast as he can until he reaches the base. But then he needs to stop suddenly so he doesn't go past the base and get tagged out. What does he do? He slides. By lying down, more of his body touches the ground. This increases the amount of friction, slowing him down quickly.

Friction

Friction exists because no surface is totally smooth. Every surface has little peaks and valleys, even if they're too small to see. The tiny bumps keep objects from sliding over each other easily.

 Some surfaces create more friction than others. Smooth surfaces like ice and snow cause less friction than rough surfaces like grass and cement. That's why skiers slide down hills covered with snow. Skiers whiz down the slopes because there is little friction between their skis and the snow. If you tried to ski down a grassy hill, you'd hardly move. It would be a dull ride.



 This skater can move easily because there is little friction between her skates and the ice.

Friction With the Air



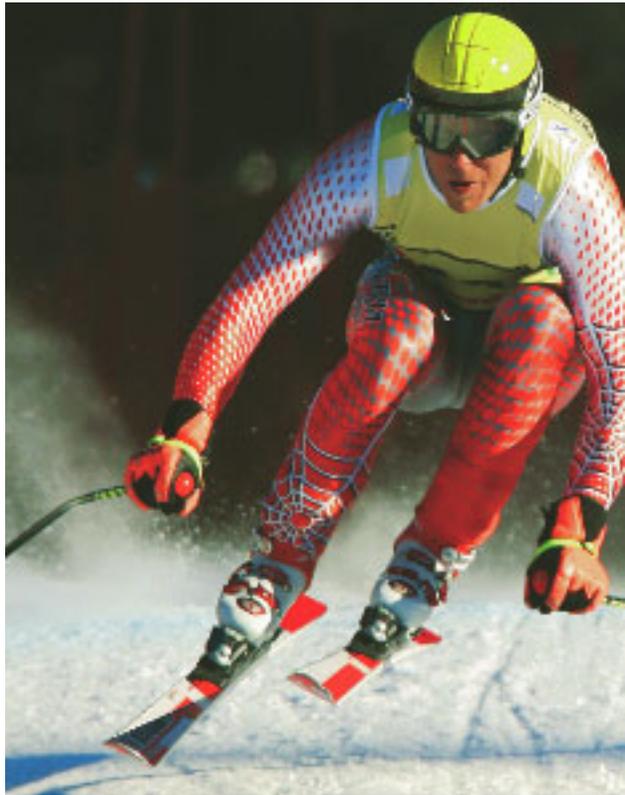
A parachute opens to slow a speeding racecar.

Even rubbing against the air causes friction. That's why a parachute slows a fall. A racecar stops by opening a parachute behind it. The parachute is shaped to catch as much air as possible. The friction between the parachute and the air causes the car to slow down.

Reducing Friction

Friction slows down a base runner sliding into base or a racecar braking to a stop. But often, athletes want to go as fast as possible. To do this, they need to reduce friction. Sleek clothing and gear produce less friction because the air can flow over them more easily. That's why skiers race down the slopes on smooth, waxed skis. Their tight bodysuits help them slice through the air.

Skiers wear sleek clothes and hunch over to reduce friction with the air.



🔊 Friendly Friction

Friction is your friend. Without friction, you couldn't walk, run, or ride a bike. You'd slip immediately. It would be like walking on ice, only worse.

🔊 If your shoes are too smooth and slippery, you can't stop or change direction. You need friction to **shift** your feet from one place to another. Basketball and tennis shoes have rough, sticky bottoms to increase friction. But even with sticky shoes, if you step on a wet spot on a basketball court, you might **collapse** in a heap.

This is because water has less friction than the wooden floor.



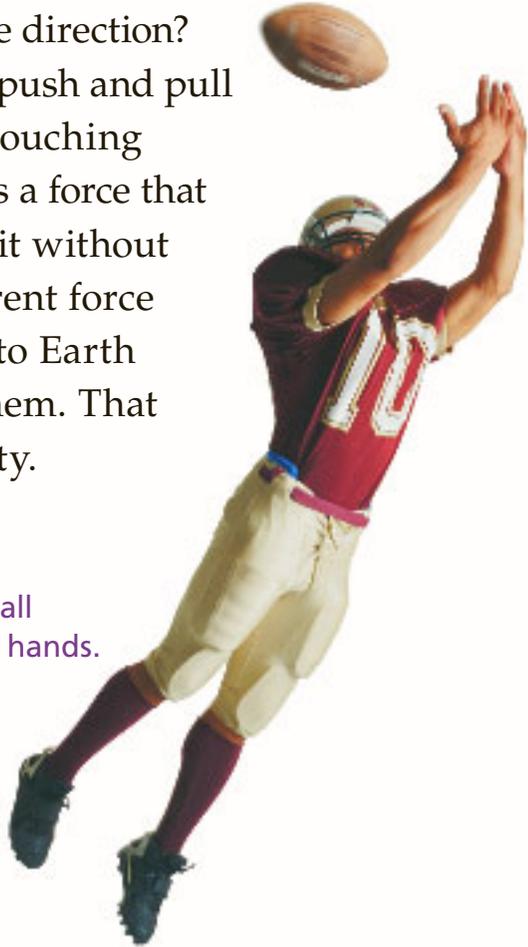
🔊 Tennis shoes have lots of bumps. This increases friction so players don't slip.

Forces Without Touching

When you throw a football downfield, you use a force that makes the ball go up in the air. But what makes it come back down? Nobody pushed or pulled the ball. So what force made the ball change direction?

 Some forces can push and pull on objects without touching them. A magnet uses a force that pulls metal toward it without touching it. A different force pulls objects down to Earth without touching them. That force is called gravity.

 Gravity pulls a football down into a player's hands.





▶ A diver uses a force to jump high in the air, and then gravity pulls her back down again.

Gravity ▶▶

Gravity is a force of attraction between objects. All objects use a gravitational pull on all other objects. With two small objects, the pull is too small to feel.

▶▶ But Earth is huge compared to everything nearby, so it pulls everything toward it. No matter how high you jump, the force of gravity always pulls you back down to Earth.

▶▶ Gravity can combine with other forces to produce a curving motion. You throw a ball sideways, but gravity is also pulling down on the ball. Gravity combines with the force you used to make the ball arc to the ground.

More Mass, More Gravity

The force of gravity is not the same for every object. The more mass an object contains, the stronger the gravitational force.

That's why it's harder for a weightlifter to hold up a big weight than a small one. If a weightlifter picks up a golf club, he can easily hold it in the air. But he must **struggle** to hold a heavy barbell in the air. Pushing up, he **wobbles** and **staggers**. The more iron in the bar, the stronger the force of gravity pulling it down—and the stronger the force needed to hold it up.



To hold up a barbell, a weightlifter must push up with the same force as gravity is pulling down.

🔊 Forces All Around You

Every great athlete has a **specialty**. Peyton Manning throws a football downfield just before he gets **squashed** by a tackler. Tiger Woods gently taps a golf ball, but not directly toward the hole. The ball rolls over a bump on the green, which **disturbs** its path. The ball curves right into the cup! Venus Williams tosses a tennis ball in the air and whacks it over the net. No woman puts more force into her serve.

🔊 These athletes practiced hour after hour, day after day, until they were **numb**. And they became experts at managing forces.

Everything that moves is moving because a force is at work. Everything that stops met a force that made it stop. Everything that changes direction, speeds up, or slows down does so because of a combination of forces.



🔊 The world is in motion because of forces.

Responding



TARGET VOCABULARY

Word Builder

Make a chart around the word **collapsed**. List things that might collapse and then tell why they collapsed. Copy the chart and add more words.

Things That Collapse	Why They Collapsed
balloon	loss of air pressure
?	?
?	?



Write About It

Text to Text Sometimes sports players collapse. Write a short paragraph about a sports player who has collapsed. Tell the reason why the player collapsed. Use words from the chart in your writing.



TARGET VOCABULARY

collapsed
disturbing
interrupted
numb
shifted

specialty
squashing
staggered
struggled
wobbled



TARGET STRATEGY

Summarize As you read, summarize what you have learned about sports and motion.



The first four letters of this word are another name for a deer.

Level: Q

DRA: 40

Science

Strategy:

Summarize

Word Count: 1,474

5.1.1 Build Vocabulary

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ISBN-13:978-0-547-02621-3

ISBN-10:0-547-02621-8



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