



Physical Science

Force and Motion

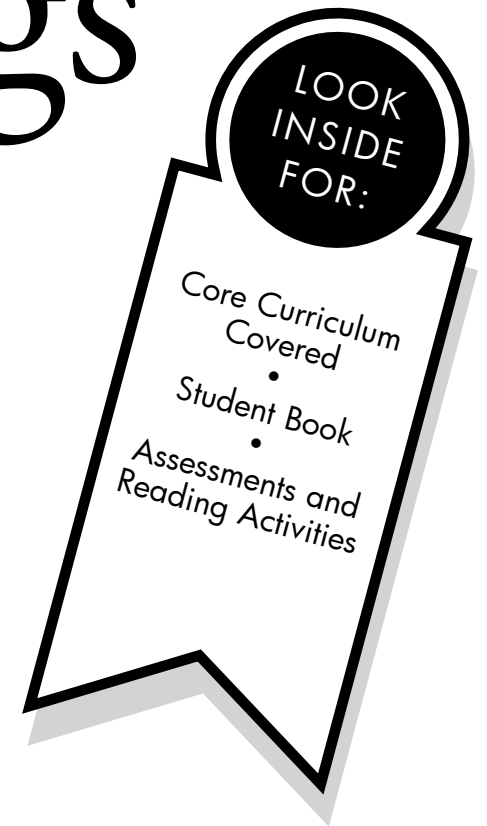
Advanced Level

# How Things Move

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# How Things Move

What causes objects to move?

## CORE CURRICULUM STATEMENTS

### **Energy and matter interact through forces that result in changes in motion.**

The position of an object can be described by locating it relative to another object or the background (e.g., on top of, next to, over, under, etc.).

The position or direction of motion of an object can be changed by pushing or pulling.

The force of gravity pulls objects toward the center of Earth.

The forces of gravity and magnetism can affect objects through gases, liquids, and solids.



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Advanced Level

# Student Book

How Things Move

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# How Things Move

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## CORE CURRICULUM STATEMENTS

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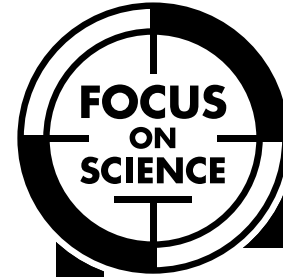
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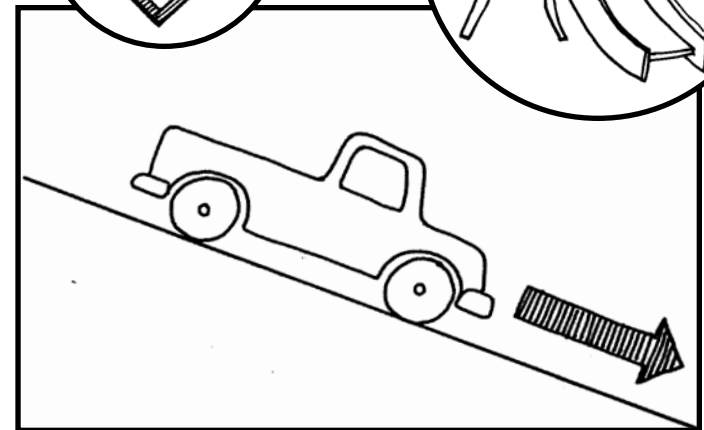
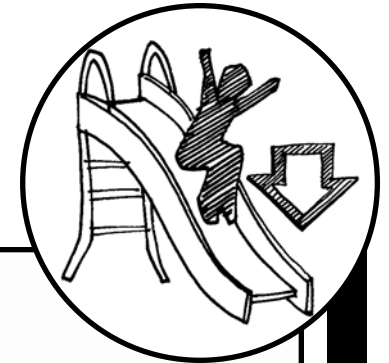
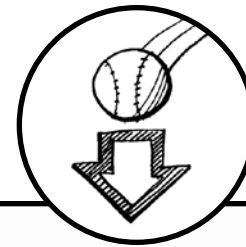


Physical Science

Force and Motion

# How Things Move

by Tom Sibila





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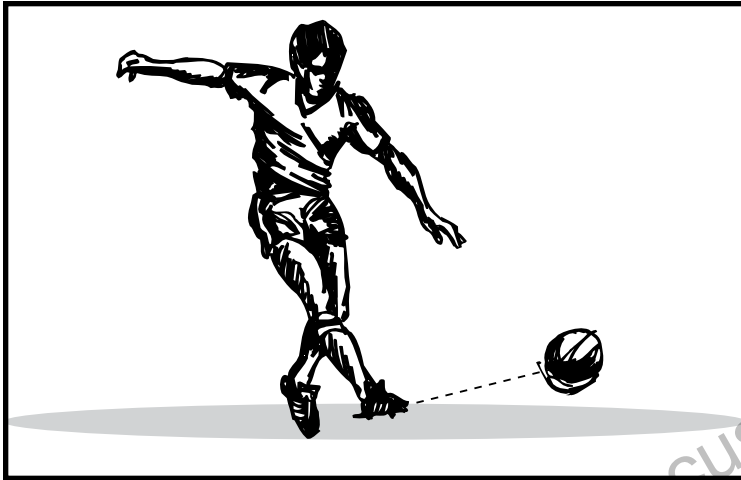
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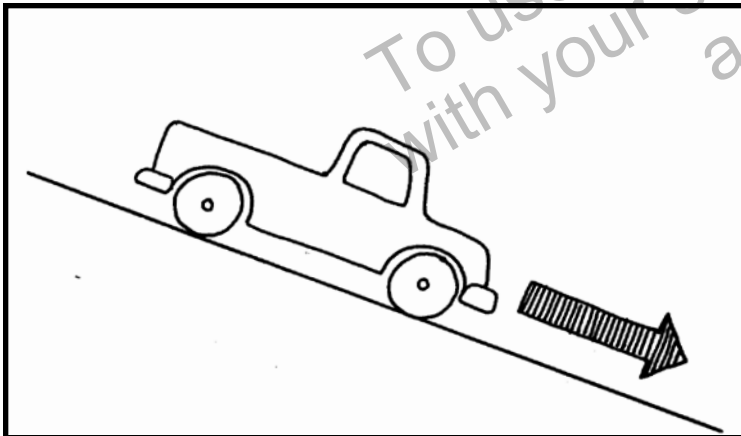
– Predict –

*What do you think you will  
learn from reading this book?*

## Objects Move When Forces Push or Pull on Them



This ball is being pushed by the boy's foot.



This car is being pulled down hill by the force of gravity.

## INTRODUCTION

### What Is Motion?

At a playground, a boy is on top of a slide. He is above his friend waiting at the bottom. Gravity pulls the boy down the slide. His friend climbs up the ladder. She is now above the boy.

Everything that moves is put in motion by a **force** applied to it. A force is a push or pull upon an object. There are different types of forces that affect motion.

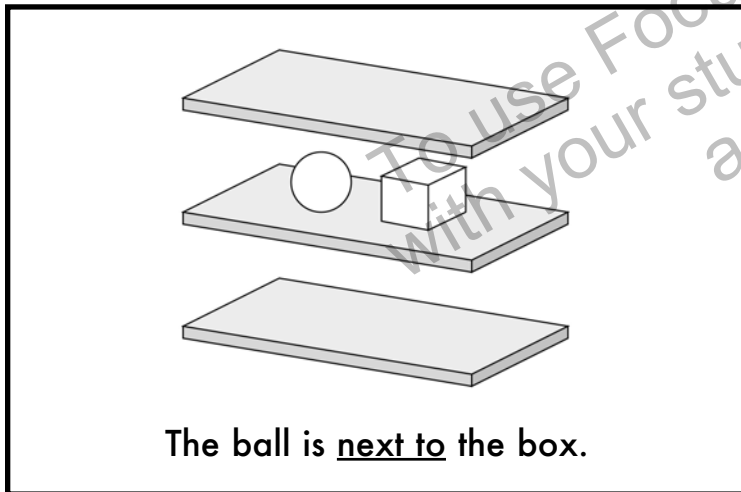
One is contact force, where objects physically come into contact with each other. Examples include friction and collision. Another type of force is noncontact force, where objects do not come in contact with each other. Gravity and magnetism are examples. Keep reading to learn more about these forces.

**force:** a push or pull that changes the movement of an object

# Locating Positions of Objects

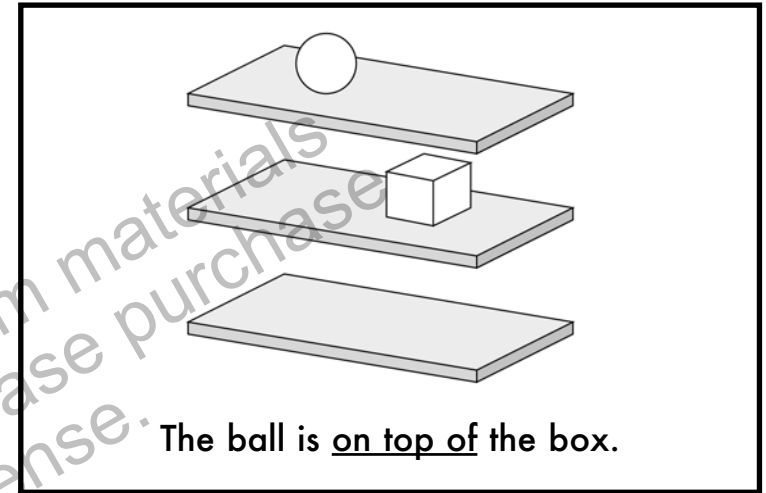
When a force moves an object, the object changes its position **relative** to other objects.

For example, in this picture the ball is next to the box on the shelf. You could also say the ball is to the left of the box. However, the box is to the right of the ball.

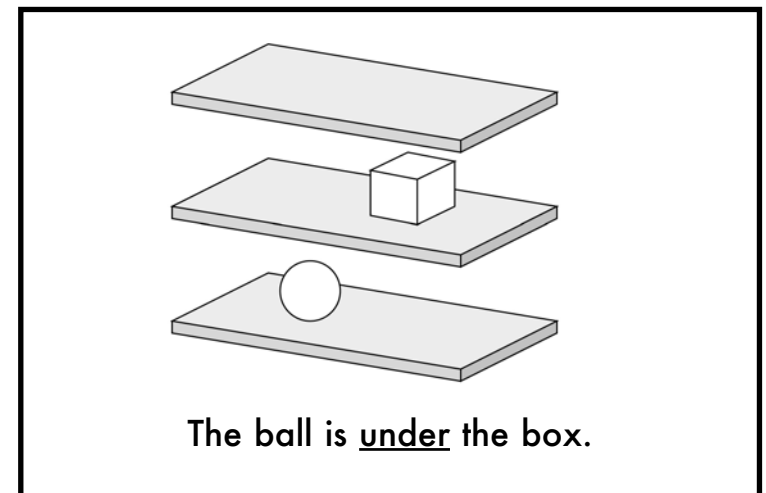


**relative:** compared to others

You could move the ball to be on top of the box.

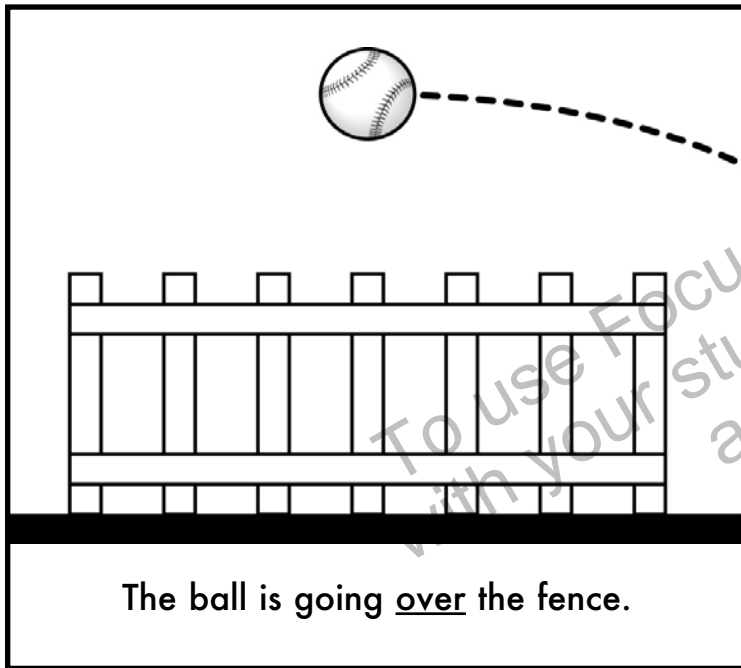


You could also move the ball to be under the box.





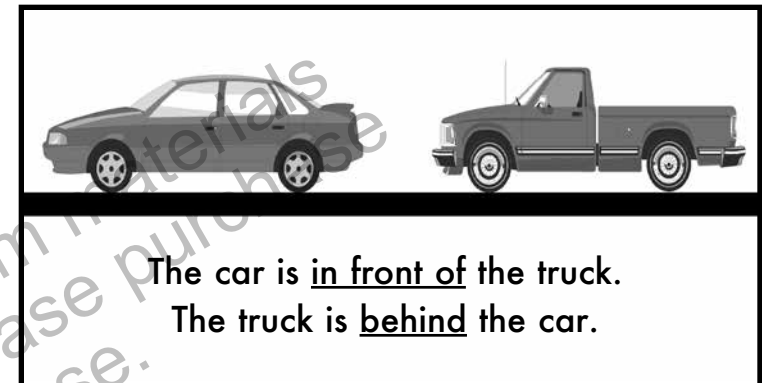
We describe the location of objects by comparing them to the position of other objects. In the diagram below, we compare the location of the baseball with the position of the fence.



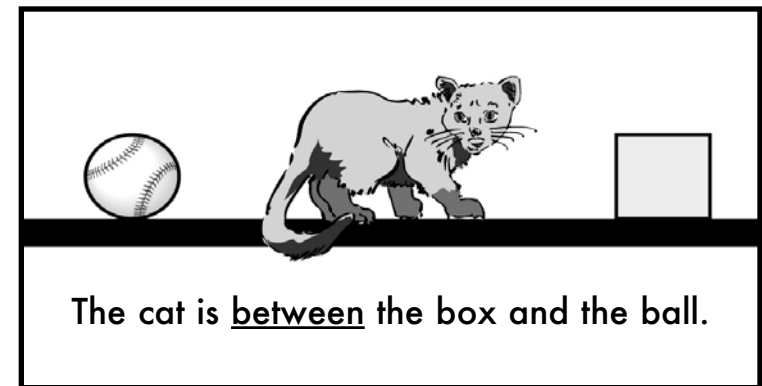
– Extend –

*What other words describe the location of objects? Brainstorm a list with a friend.*

In the drawing below, we compare the location of the car with the position of the truck in two ways.



Below, we compare the location of a cat with two objects. Can you make other comparisons from this drawing?



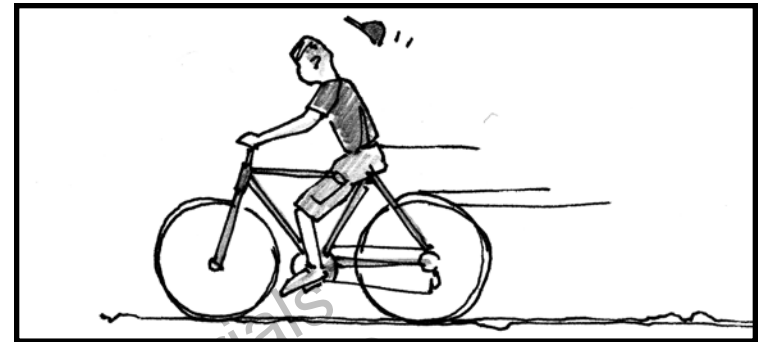
## Pushes and Pulls

Remember the ball and box on the shelf? In one picture, the ball was next to the box. In another, the ball was above the box. How did the ball get there? It was moved, or was put into motion. What caused this motion?

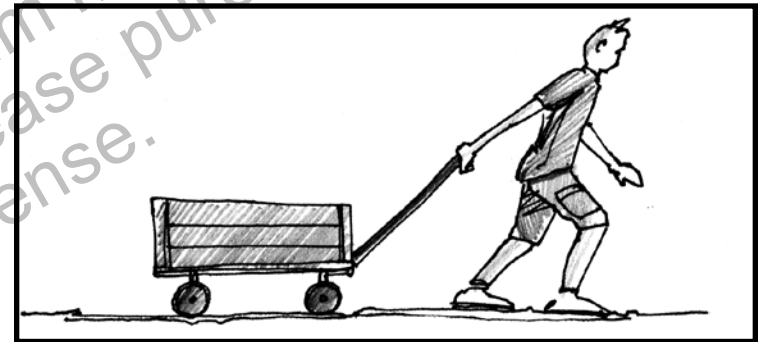
You have learned that motion is caused by a force. A force is a push or a pull. Pushes and pulls usually move things. Someone pulled the ball off the middle shelf. He or she then pushed the box to the upper shelf. You cannot see the force used to move the ball. It is **invisible**. But, you can see its effect. The ball is now in a new location.

Look around and you will see the effects of pushes and pulls. You can see a friend ride a bicycle. You can tug on a wagon to move it forward. You can see a leaf fall from a tree.

**invisible:** not able to be seen



*This boy is pushing the pedals to move the bicycle.*



*This boy is pulling the wagon to move it forward.*

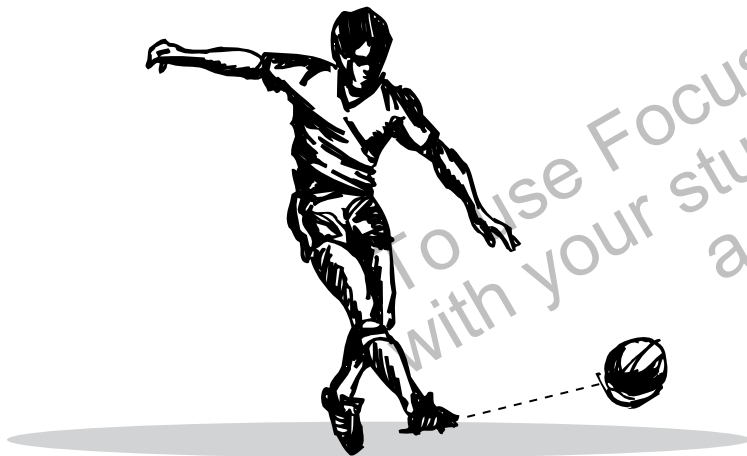


*This leaf is being pulled to the ground.*

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A force can move an object that is at rest. A force can also act on objects that are already moving.

Imagine you are dribbling a soccer ball forward. You can kick the moving soccer ball to make it go faster and farther. When you kick the ball, you increase the force acting on the ball. The ball **accelerates**. It moves faster.



If you kick a soccer ball that is already moving, it will move faster and farther.

**accelerate:** to get faster and faster

---

Push a friend on a swing. Your friend starts to move. Push a little harder. Your friend moves faster and higher. Push again even harder. Your friend goes even faster and higher.



*The harder you push, the more force is used.  
The swing will move faster and higher.*

# Gravity

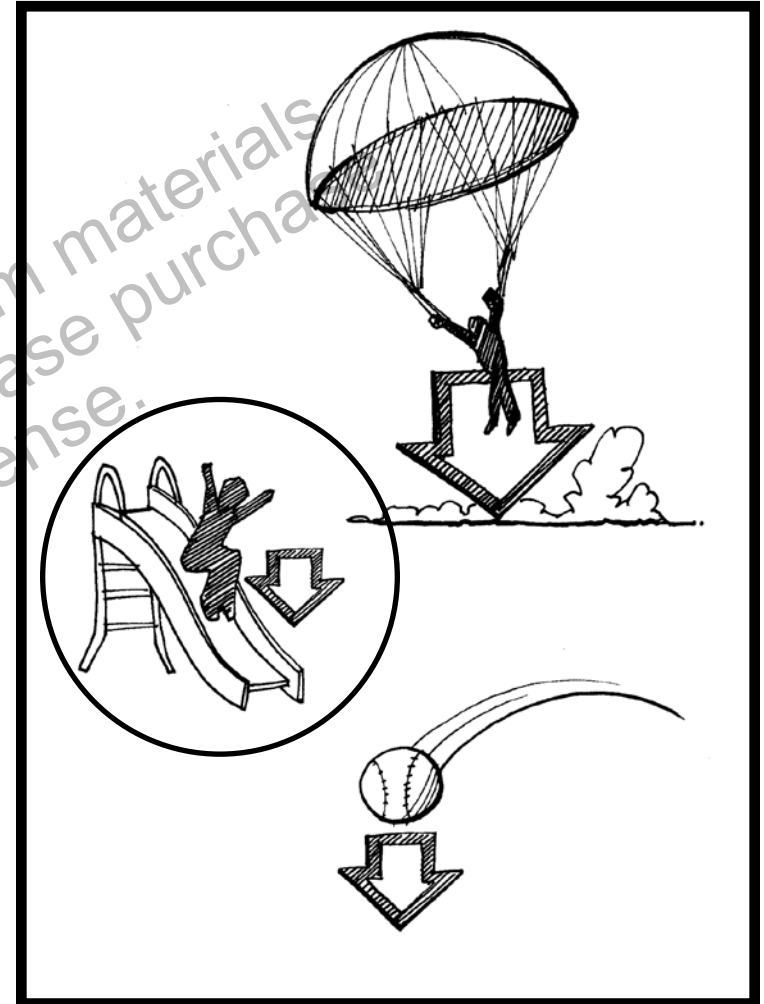
All objects on Earth are pulled toward the center of Earth. Gravity, the force that pulls things to Earth, is invisible. Still, we can see the results of gravity everywhere. Acorns fall from trees in Central Park. Water pours over a waterfall. Dandelion seeds ride the wind until they settle on the ground.

This pull to Earth is the result of the force of gravity. Gravity is a pull that **matter** has on other matter. The more massive the matter, the stronger gravity's pull will be.

It may sound funny to say, but Earth is the biggest thing in our world. Its gravity is so strong that it pulls everything on it toward its center.

**matter:** anything that has weight and takes up space

## The Force of Gravity

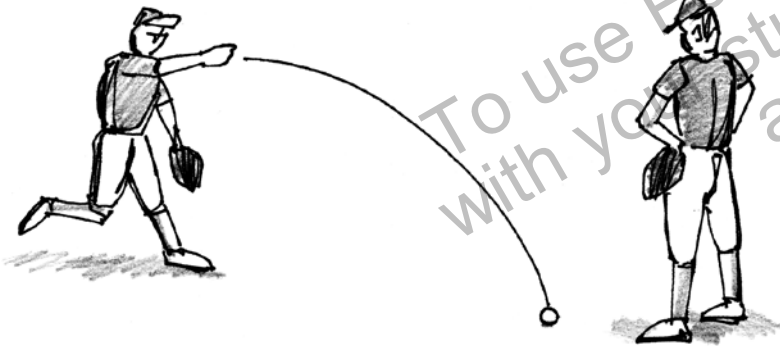


*The force of gravity pulls all matter on Earth toward the planet's center.*

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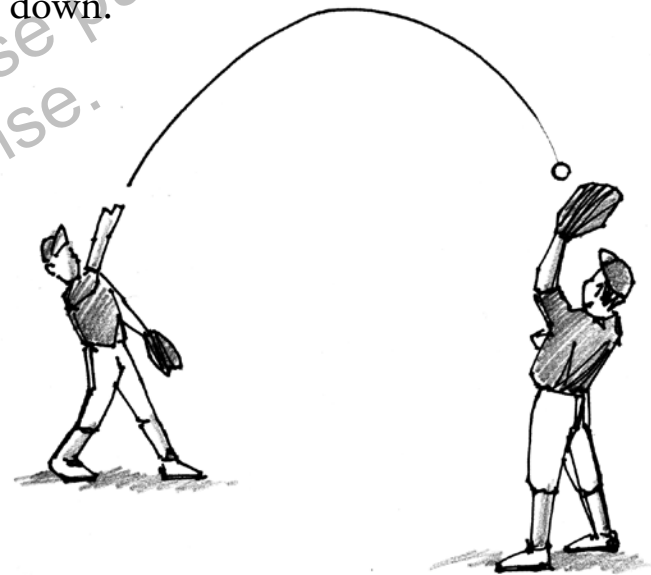
Gravity has an effect on other forces. Have you ever thrown a ball to a friend far away, but the ball landed short of him or her? What happened?

When you threw the ball to a friend, you **exerted** a force to make the ball move forward. However, you probably noticed that the ball did not move in a straight line to your friend. It moved lower and lower the farther it traveled. Why?



---

Gravity pulls on the ball. The ball you threw continues on its path until the effect of gravity becomes stronger than the force of your throw. In order to get the ball to your friend, you need to throw the ball upward with more force. If you throw the ball high enough and with enough force, it will reach your friend before gravity pulls it down.



Next time you see something moving, remember it was a force pushing or pulling that set it in motion.

**exerted:** put into use

---

## Glossary

**accelerate**—to get faster and faster

**exerted**—put into use

**force**—a push or pull that changes the movement of an object

**invisible**—not able to be seen

**matter**—anything that has weight and takes up space

**relative**—compared to others

---

## To Find Out More . . .

Want to learn more about how things move?

### Try these books

*Force & Motion* by Peter Lafferty.  
Dorling Kindersley, Inc. 1992

*Speed and Acceleration* by Richard Spilsbury. Heinemann Library, 2007.

### Access these Web sites

The Little Shop of Physics  
<http://littleshop.physics.colostate.edu/>

Fizzics Fizzle! An Interactive Guide to Physics  
<http://library.thinkquest.org/16600/>

### Write for more information

National Student Research Center  
606 Lafitt Street  
Mandeville, Louisiana 70448

National Academy of Engineering  
500 Fifth Street, NW  
Washington, DC 20001

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# Assessments

How Things Move

Print pages 18–20 of this PDF for the assessments.



# Check Understanding

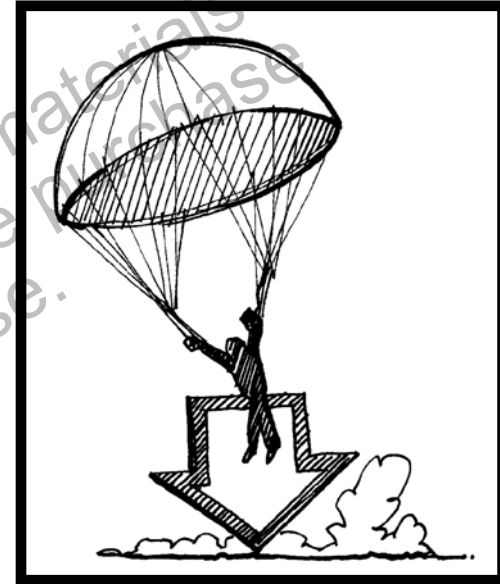
**Shade the circle next to the correct answer.**

1. A ball rolls down a hill. What force is acting on the ball?
- Ⓐ collision
  - Ⓑ magnetism
  - Ⓒ friction
  - Ⓓ gravity

Note that question 2 has only three choices.

2. If you kick a ball that is already moving, it will
- Ⓐ go faster.
  - Ⓑ go slower.
  - Ⓒ stop.

3. The following picture shows a person and a parachute.



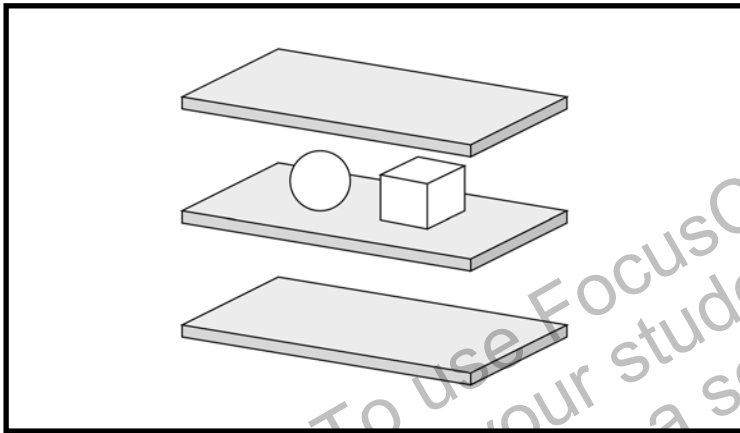
What is the position of the person relative to the parachute?

- Ⓐ The person is above the parachute.
- Ⓑ The person is next to the parachute.
- Ⓒ The person is under the parachute.
- Ⓓ The person is inside the parachute.

# Check Understanding

Shade the circle next to the correct answer or write your answer on the lines provided.

4. The diagram below shows two objects on a shelf.



Describe the position of the box in two ways.

(1) \_\_\_\_\_

(2) \_\_\_\_\_

5. Gravity's pull is stronger on objects that are

- Ⓐ faster.
- Ⓑ more massive.
- Ⓒ round.
- Ⓓ invisible.

6. An apple rests on the table. Identify the two types of force that could move the apple to a different position.

(1) \_\_\_\_\_

(2) \_\_\_\_\_

# Assessment Scoring Guidelines

1. Answer D is correct.
2. Answer A is correct.
3. Answer C is correct.
4. The box is next to the ball. The box is between two shelves.
5. Answer B is correct.
6. A push. A pull.

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# English Language Arts Activities

How Things Move

Print pages 22–26 of this PDF for the reading activities.



# Question and Answer

## TRY THE SKILL

Listing questions and identifying answers helps you find meaning in what you have read.

Read this passage. Then list a question that comes to mind. List a possible answer to that question. Remember, you do not have to be right in your answer.

Everything that moves is put in motion by a force applied to it. A force is a push or pull upon an object. There are different types of forces that affect motion.

Question

What are the different types of forces?

Possible Answer

Contact force and noncontact force are two types of forces.

**Read the passage, then list a question that comes to mind. Try to answer the question based on what you read and what you already know.**

All objects on Earth are pulled toward the center of Earth. Gravity, the force that pulls things to Earth, is invisible. Still, we can see the results of gravity everywhere. Acorns fall from trees in Central Park. Water pours over a waterfall. Dandelion seeds ride the wind until they settle on the ground.

Question: \_\_\_\_\_

\_\_\_\_\_

Possible Answer: \_\_\_\_\_

\_\_\_\_\_

# Use Context Clues

## TRY THE SKILL

Some words have several meanings. You can use context clues to decide which meaning is being used in a sentence. For example, the word *spot* can mean “a mark.” Or, it can mean “to notice something.”

Read the sentence below and decide which meaning is being used here.

*The spots on a giraffe help it blend in with its surroundings.*

In this sentence, *spot* means “mark.” The context—the rest of the sentence—tells you which meaning is being used.

**Read each word and its meanings. Then read each sentence and write the letter of the correct meaning on the line.**

swing A. move with a sweeping motion  
B. a seat hanging from a rope

1. Sharks \_\_\_\_\_ their tail fins from side to side and up and down to push against water.

pulls A. moves an object B. handles

2. The force that \_\_\_\_\_ things to Earth is invisible.

power A. the ability to control others  
B. a force that can be put to work

3. Machines have allowed humans to move faster than we could using the \_\_\_\_\_ of our muscles alone.

# Prepositions

## TRY THE SKILL

Words that are used to describe the location of an object relative to other objects are prepositions.

Here are some examples of prepositions:

behind

between

in front of

next to

on top of

over

under

A preposition tells you where something is located.

The dog is sleeping under the table.

My cousin lives in the apartment above me.

**Read this passage. Underline the prepositions.**

Go straight down Main Street. You'll see the library on the left. It's between two big oak trees. You can leave your bike under one of the trees. The event is taking place behind the library, on the patio.

Go through the library and out the back door.

If you see lots of animals, you're in the right place! The pet parade will start behind the library at noon and circle the block. Be sure to watch under your feet—last year there was pet snake on the loose!



# Answer Key

## Summarize

Students' answers will vary. A sample answer is given below.

Words such as over, under, behind, and between are location words. They are used to describe the location of objects compared to other objects.

Motion is caused by a push or pull force. You cannot see force, but you can see the effect of force.

Gravity is a force that pulls all matter on Earth to the planet's center.

## Question and Answer

Question: How do we know gravity exists?

Answer: We can see evidence of gravity such as acorns falling from trees.

## Use Context Clues

1. A
2. A
3. B

## Prepositions

Go straight down Main Street. You'll see the library on the left. It's between two big oak trees. You can leave your bike under one of the trees. The event is starting behind the library, on the patio. Go through the library and out the back door.

If you see lots of animals, you're in the right place! The pet parade will start at noon and circle the block. Be sure to watch beneath your feet—last year there was pet snake on the loose!