

Can You Explain It?

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Your dog sled is sliding along on the snow. The dogs are happy and eager to run. All the dogs together are strong enough to move the sled. You can signal your dogs to go faster or slower. You can turn the sled left or right.

1. Does it take a strong force or a weak force to move the dog sled? How do you turn the sled left or right?



EVIDENCE NOTEBOOK Look for this icon to help you gather evidence to answer the questions above.

Forces Everywhere

I Like to Move It, Move It

You have probably made a swing move. How does a swing move when you push it? How does it move when you pull it?

A swing moves because a force acts on it. A **force** is a push or a pull. When you push or pull the swing, you add a force that makes the swing move. If you push or pull a moving swing, you can make it move more or even stop.

Swingin'

2. What makes a swing start or stop moving?
Write your answer on the line.



Explore
Online

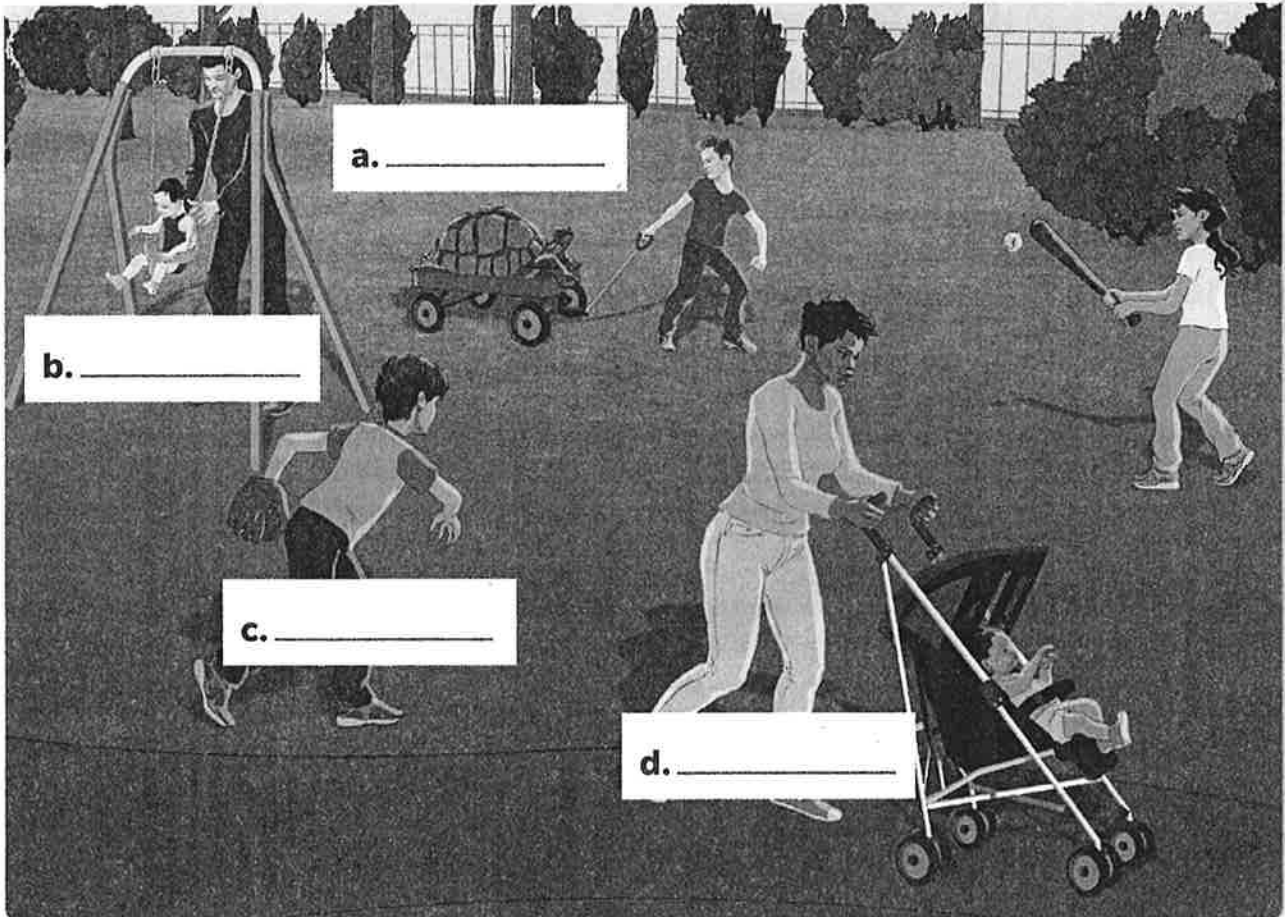
air force rope



When you pull something, you use force to move it toward you. When you push something, you use force to move it away from you. You might pull a closed door toward you to open it. Then you push the door away from you to close it again. Your arm provides the force that opens and closes the door.

Push or Pull?

3. Look at the park picture. Can you tell which actions most likely show a push and which actions show a pull? Identify each action as either a “push” or a “pull” to show what happened to the object. Write your answers on the lines:



HANDS-ON Apply What You Know

Playground Pushes and Pulls

4. Your teacher will arrange for you to observe another group of students on the playground or elsewhere in your school. Look for forces as you observe the students for 15 minutes. Record the number of times you see pulls and the number of times you see pushes. Use your data to make a graph comparing the number of pushes and pulls. Based on your observations, was there more pushing or more pulling? Cite your evidence.

Special Delivery

The dog sled team has a heavy load to deliver. It will take all of the team working together to move the sled. The whole team can push or pull with more force than if only part of the team helps.



If the dogs push the sled, the sled may move, but not for very long.



If the people pull the sled, it may move, but not very fast.



If the dogs apply a force to the sled as a team, it will move far and fast.

- 5.** Write your ideas about the best way for the dog sled team to move the sled. Explain whether they should push it or pull it.



Engineer It!

Engineering a Dog Sled Race

It takes more than a team of strong dogs to win a modern dog sled race. Look at the pictures, and read about how engineering can increase a team's chances of winning a big race.



The dog sled must be made of lightweight materials to make it easy for the team to pull.



Dog sled races often go through wilderness areas. A GPS device helps racers find their way to the finish line.

6. Why would a large sled made of heavy materials be a poor choice for moving through the snow?



Language SmArts

Give an Oral Report

7. Do research to find out about some other technologies related to dog sled racing. Choose one technology. Prepare a one-minute talk that explains how or why it is used. Write the main idea of your talk on the lines below.

Tip

The English Language Arts Handbook can provide help with understanding how to give an oral report.

Strong Enough

Strong or Weak

A force can be weak or strong. You can tap lightly on a door by using your fingers to create a weak force. Or you can use your fist to apply a strong force to knock loudly.

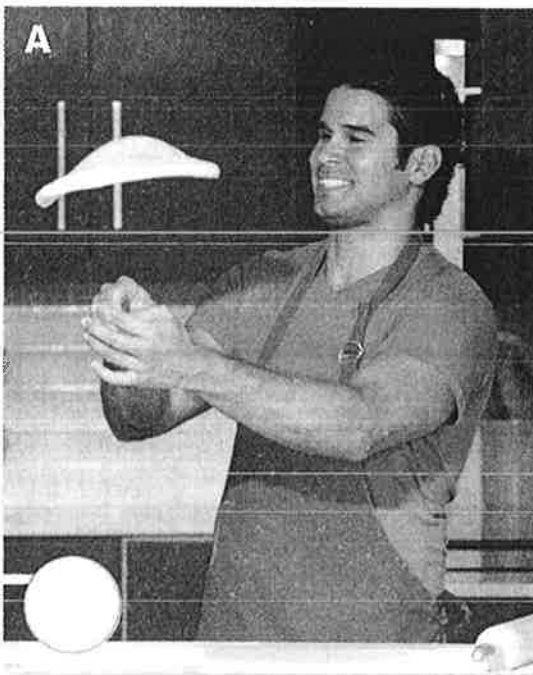
The strength of any force can be changed. If your friend across the room doesn't hear what you say, you can put more force into your voice to make it louder.

Pizza Problem

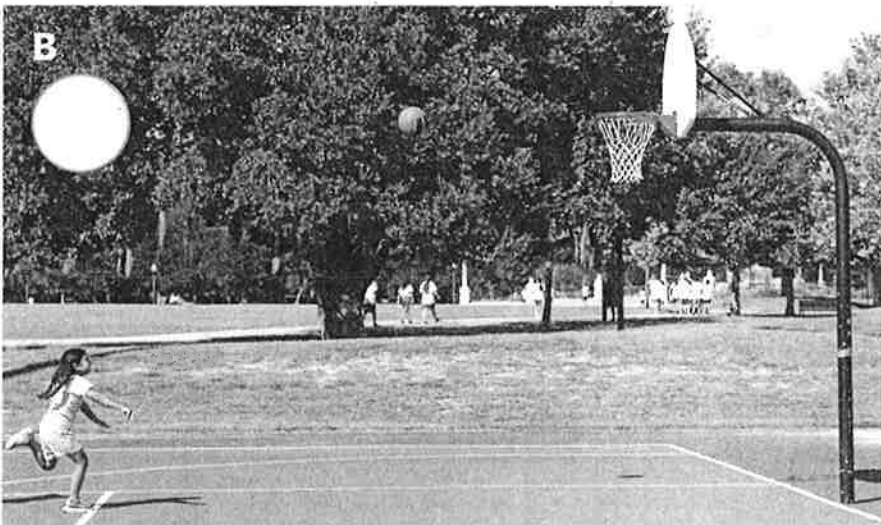
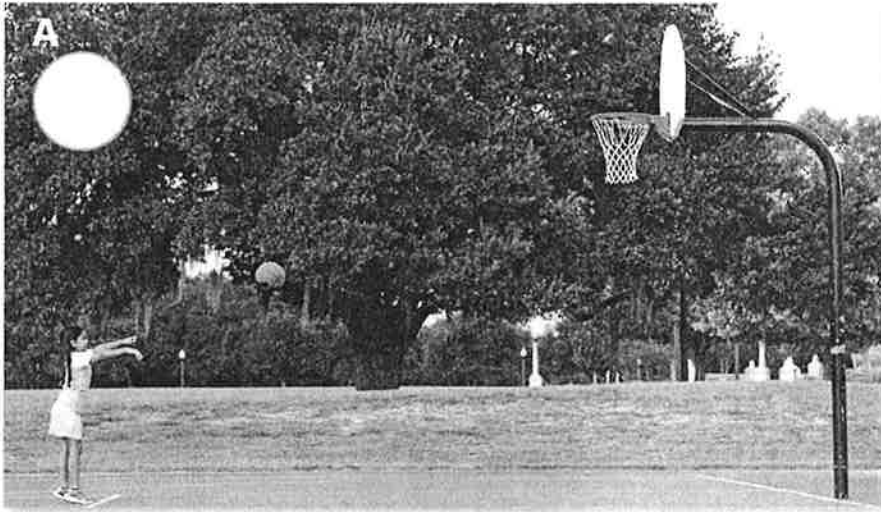
8. Is a stronger force always better? Look at what happened when different forces were used to toss different objects.



In both pictures below, the pizza maker uses force to push the dough into the air. In which picture does the pizza maker use a weaker force? Put an X in the correct circle.



9. Put an X in the circle on the picture that shows the girl using a stronger force to throw the ball more accurately.



10. What would happen if you threw a basketball with too much force?



EVIDENCE NOTEBOOK The amount of force you need changes. Sometimes you need to use less force. Sometimes you need to use more force.

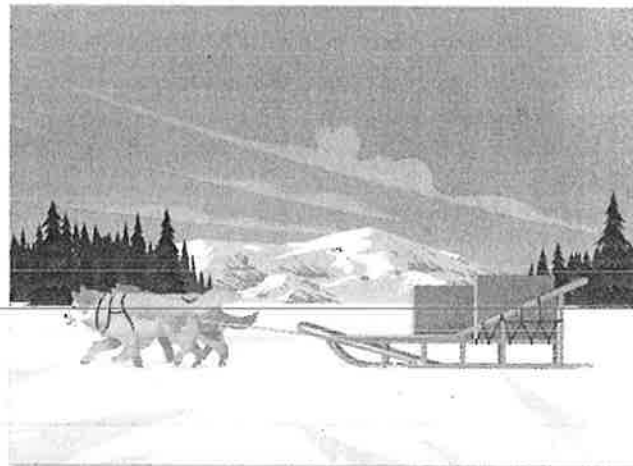


Do the Math

How Many Dogs?

Why do dogs pull a sled as a team? Why can't just one dog pull the whole sled? When there are more dogs, they can pull with more force.

Pretend that you are a dog sled driver. You must carry big, heavy boxes on your sled. You know that each dog can pull $\frac{1}{2}$ the weight of one box.



- 11.** Fill in this table to show how many boxes can be pulled by 3 dogs, 4 dogs, and more.

Number of dogs on the team	1	2	3	4	5	6
Number of boxes that can be moved	$\frac{1}{2}$	1				

Putting It Together

- 12.** How does changing the strength of the force change the amount of weight that can be moved?

Tip

Cause and Effect

When two things have a cause-and-effect relationship, changing one changes the other.

Reading and Writing in Science.

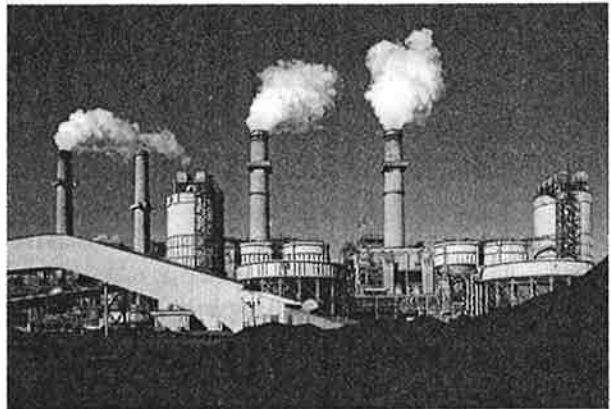
Electricity

It's Electric!

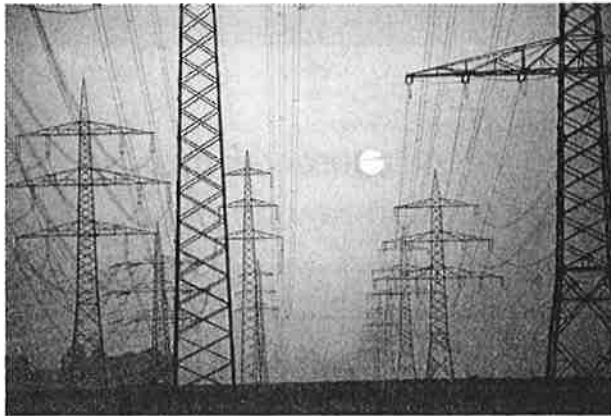
Electricity can make things move! **Electricity** is a form of energy. It comes to your home from energy-generating stations. It travels through wires to electrical outlets in your building, ready to be used.



Coal is a fossil fuel that can be burned to produce electricity.



At this energy-generating station, heat from burning coal provides the force to spin a generator.



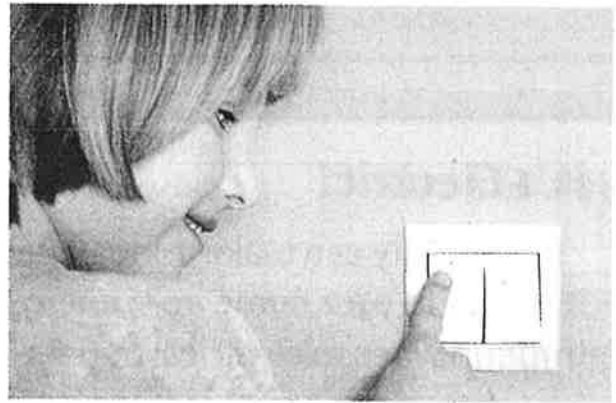
Electrical lines like these carry electricity from the generating station across great distances.



Electrical lines like these carry electricity short distances to homes and businesses.



An electrical meter measures the amount of electricity used by the people inside buildings.



Electrical wires inside a building carry electricity to each light switch and outlet in the building.

11. Choose the best answer to complete the sentence below.

electrical meters generators high-voltage lines

Electricity travels long distances through _____.



EVIDENCE NOTEBOOK Suppose a storm knocks out one of the electrical lines in your neighborhood. What evidence from the pictures on pages 115 and 116 explains why you would lose electricity?



HANDS-ON Apply What You Know

Meter Reader

12. With an adult, find an electrical meter. Are the numbers on it changing slowly or quickly? Write down the current number.

What is the number after 1 minute?

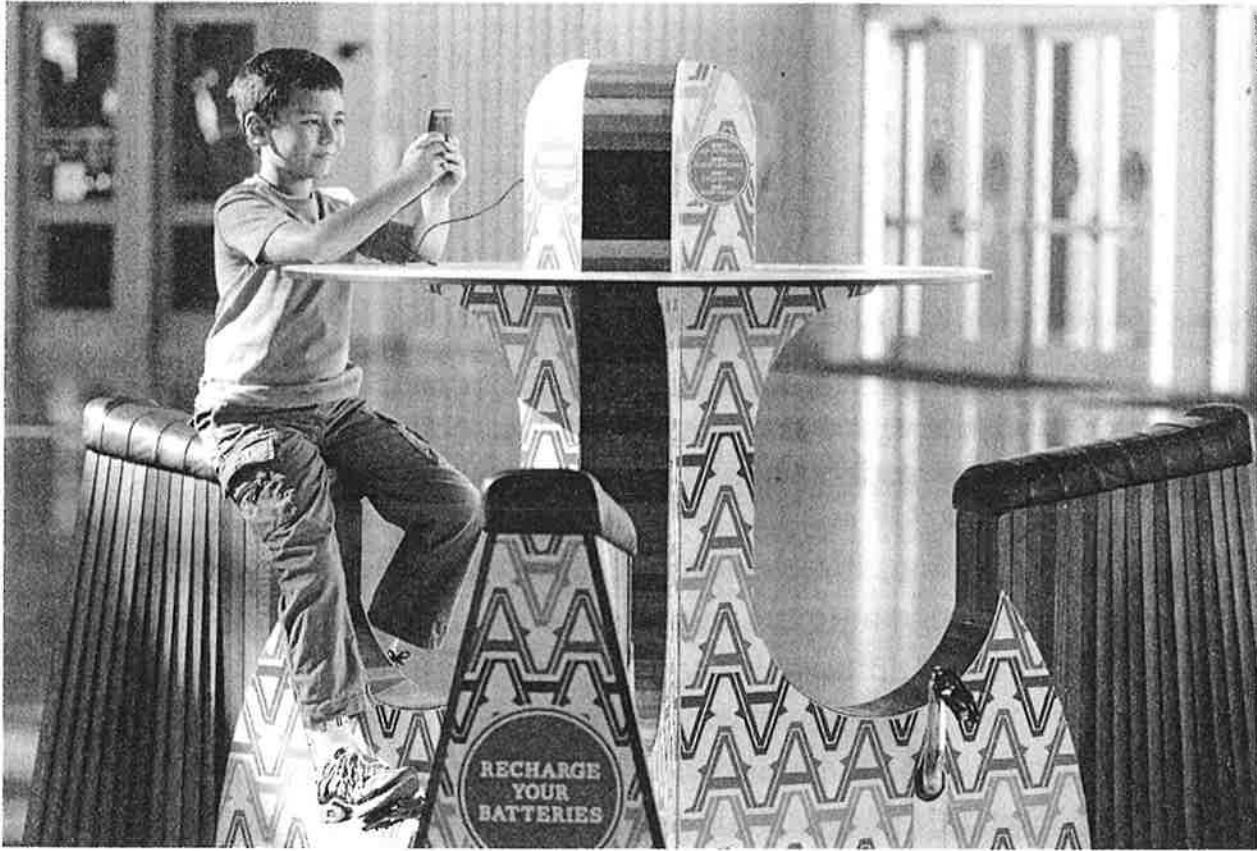
If energy usage stays the same, predict the number in 10 minutes.



Engineer It!

Foot Energy

Did you know you can use energy from your own body to power small electrical devices? You can! A bike such as this can change the energy from pedaling motion into electrical energy that can charge the battery in a device such as a cell phone. This is one small way to save natural resources and get some exercise at the same time!



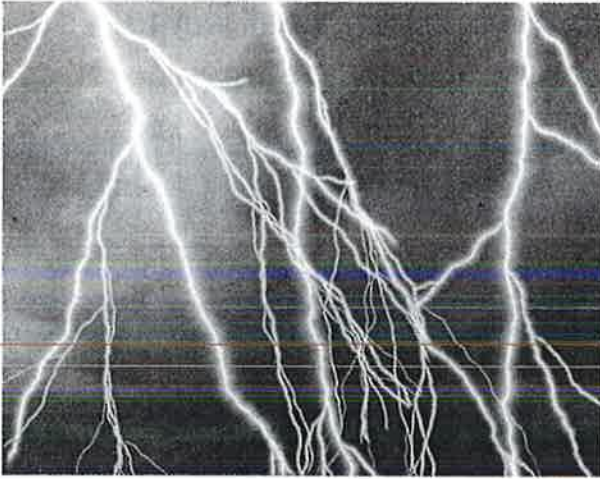
Language SmArts

Body Power

- 13.** Research other methods that allow people to convert energy from their own bodies to power small electrical devices. Describe one device, and explain how it works.
-
-
-

Zap! Static Electricity!

Remember the picture of the girl whose hair stuck out in all directions? At that moment, her hair had an electrical charge, or static electricity. **Static electricity** is a charge that builds up on an object. It is a type of electricity.



Sometimes an electrical charge builds up inside a cloud. When the charge releases suddenly, what happens? Lightning!



Your hair stands up after a slide ride on a dry day. Your clothing rubs against the slide, causing a static charge to build.

Like magnetic force, static electricity also can work across a distance. Recall how magnets can pull or push, attract or repel. Static charges also attract or repel. In magnets, two like poles repel each other. In static electricity, two like charges will repel each other, too. In magnets, two opposite poles will attract each other. If two objects have opposite static charges, they will attract, or stick to, each other.

14. Select as many answers as are true.

Static electricity _____

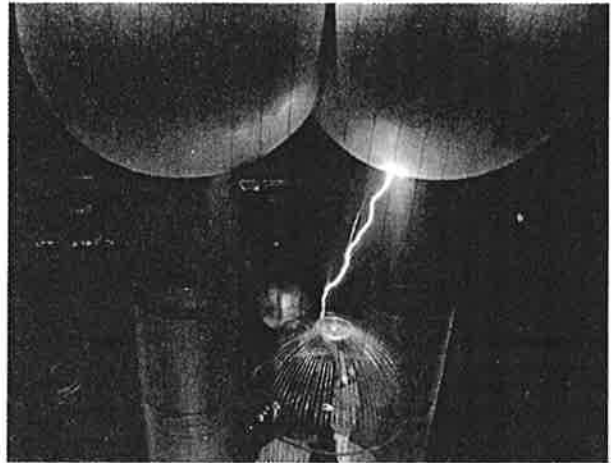
- a.** can be caused by objects rubbing together.
- b.** moves in all directions.
- c.** is a charge that builds up on an object.
- d.** has two poles.

Jump, Spark!

Like magnetic force, electric force can act across a distance. And like a magnet, electricity can produce a field—an electrical field. An electrical field is strongest nearest the charged object. Van de Graaff machines such as the ones shown below make a field of static electricity. The attraction is strong enough to pull a charge across the gap. You see (and maybe feel) a spark!



A spark jumps across an electrical field when the static charge reaches a certain distance away.



How does the electrical field made by this machine differ from the field generated by the other machine?

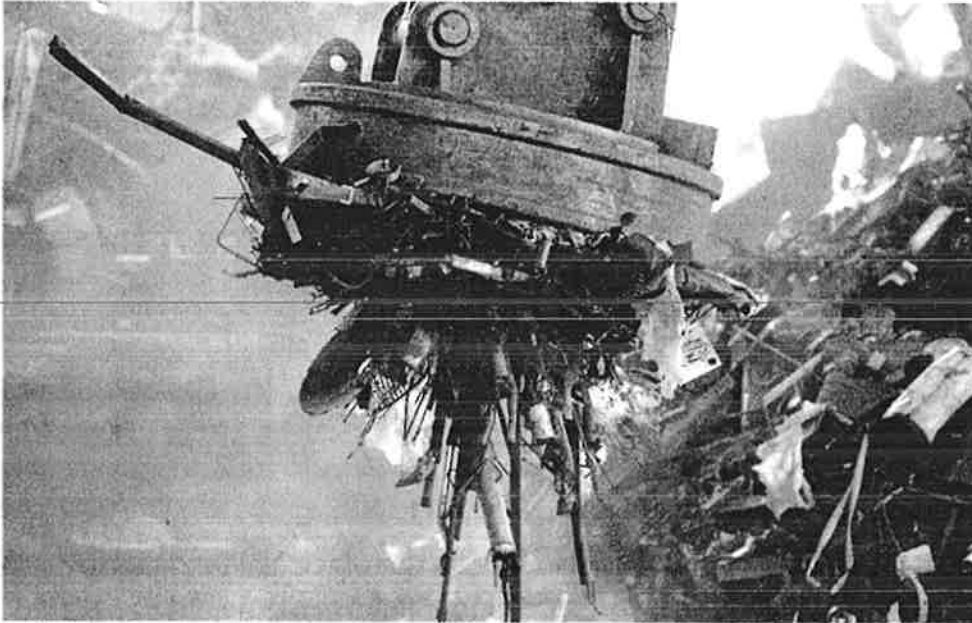
15. Fill in the blanks using the word bank below.

charged	repel	spark	static electricity
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A Van de Graaff machine causes _____ to build up on an object. When opposite charges come into contact, you may see a _____ as the charges cross the gap.

Making Magnetism

Recall how some magnets in your home are electrical. Such magnets are called electromagnets. Electromagnets are a kind of temporary magnet. When electricity passes through wire wrapped around a piece of iron, it causes the metal to become magnetic. When the electricity is turned off, the magnetism goes away.



16. What causes an electromagnet to pick up scrap metal?

Putting it Together

17. Explain how magnetic and electric forces act across a distance. Use two examples in your answer.

Tip

Recount Details

Examples are details that help prove your information is correct.

Reading and Writing in Science.

Lesson Roundup

A. Look at the pictures. Decide whether the objects are attracting or repelling each other. Write what you observe in the correct column.



Objects Attracting

Objects Repelling

B. Select all the answers that are true.

How do you know electrical force works from a distance?

- a.** An electrical transformer changes the force of the electricity.
- b.** Objects charged with static electricity repel or attract.
- c.** Sparks sometimes jump between a charged object and another object.

C. Select all the answers that are true.

How do you know magnetic force works from a distance?

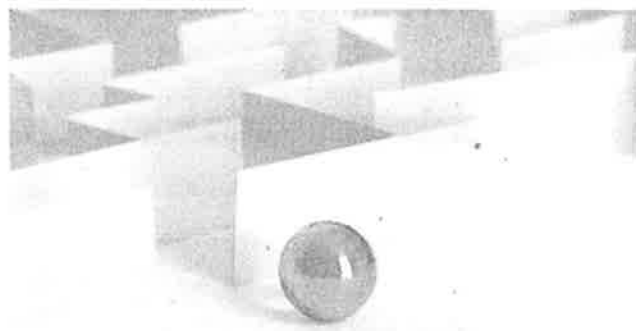
- a.** Metal objects are pulled toward magnets.
- b.** Like poles push each other apart.
- c.** Unlike poles pull together.



ENGINEER IT!

Moved without Touching

In small groups, design and build a maze through which you can move an object. The goal is to move the object through the maze without touching the object. Work with materials provided by your teacher.



FIND A PROBLEM: What problem do you need to solve?

Before beginning, look at the checklist at the end of this project to be sure you are meeting all the requirements.

RESEARCH: Study the various forces that cause objects to move. Use online or library sources for research. Use multiple sources and cite them.

BRAINSTORM: Brainstorm three or more ideas with your group to solve the problem. Keep in mind the criteria and constraints.

Criteria

- ☐ Object must move through the full maze.
- ☐ The maze must use some form of force.

Constraints

- ☐ You cannot touch the object.
- ☐ Use only the materials provided by your teacher.

Unit Review

Day 9

1. Identify the examples in the word bank as examples of a push or a pull.

soccer kick	putting on socks
tug of war	rolling a mat

Push	Pull

2. Look at the scene. What would happen if the person uses strong force to put the books away? Select the best answer.



- The books could fall off the shelves.
 - The books would be fine.
 - The books would make a small sound.
3. Emily's ice cream cone tips over. Her ice cream falls to the floor. Which force caused it to fall?
- gravity
 - friction
 - magnetism
 - static electricity
4. Soojinn and Michael are playing tug of war. The game is about even, meaning Soojinn and Michael are not moving the rope too much. Which concept of force describes what would happen if Soojinn had two friends to help her pull? Select the best answer.
- The pulling force is faster with more people.
 - The pushing force is stronger with more people.
 - The pulling force is stronger with more people.
 - The pulling force is slower with more people.

MAKE A PLAN: Make a plan by considering the questions below.

1. Which force or forces will you use to move the object through the maze?
2. How will the force or forces affect the type of design for the maze?

Present a step-by-step plan here.



DESIGN, BUILD, AND EXPERIMENT: Draw out a design of the maze, and build the maze using the materials provided by your teacher. Conduct the final experiment to move the object through the course of the maze without touching it.

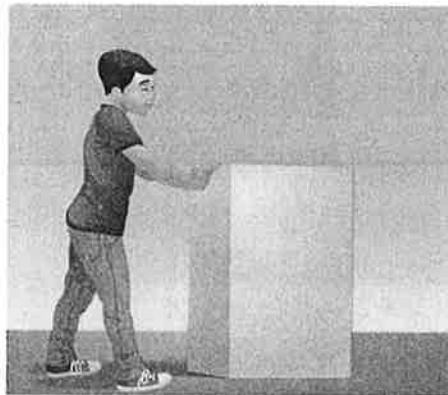
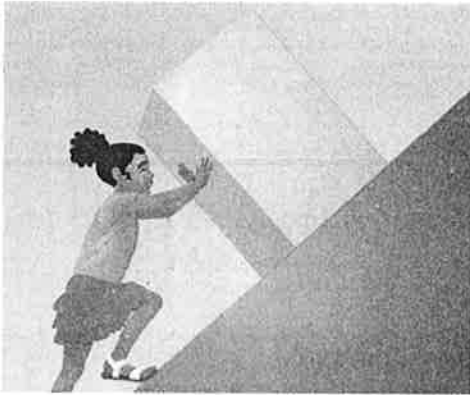
EVALUATE AND REDESIGN: Did you meet the criteria and constraints? What are ways you could improve the design of the maze? Make changes to your design to improve it.

☒ Checklist

Review your project and check off each completed item.

- _____ Includes a list of materials used.
- _____ Includes the force or forces used to move the object.
- _____ Includes a design of the course or maze.
- _____ Includes a physical, built course or maze.

5. Write if the force used is more or less to move the box.



6. Imagine there is a puppy sitting in a wagon. Describe the forces on the puppy. Are they balanced or unbalanced? A girl comes along and pulls the wagon. Have the forces changed? Are they balanced or unbalanced?

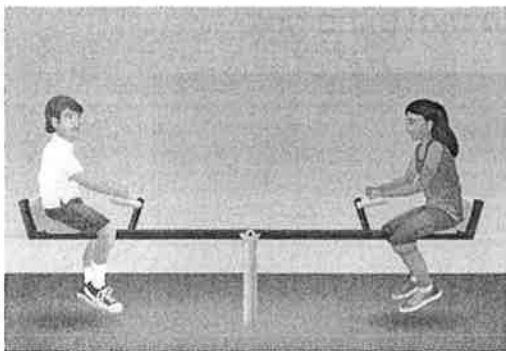
7. Using the word bank below, complete the table about friction.

Water slide
Skis

Snow
Gym floors

Sneakers
Inner tube

Item	Surface	Friction (High or Low)
		Low
		Low
		High



8. Which concept of force is being shown in the image?
Select all that apply.

- a.** The seesaw has contact force.
- b.** The forces are balanced.
- c.** Forces are moving in opposite directions.
- d.** There is no motion.

9. Put the correct phrase into the table to decide if the two objects will attract or repel.

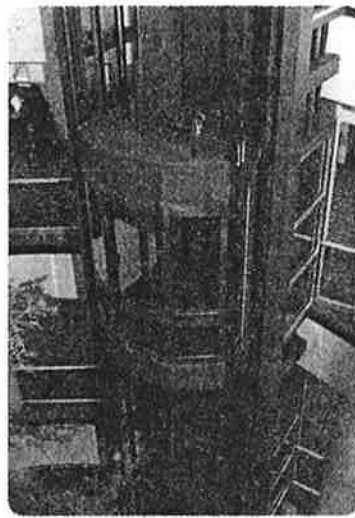
north pole to south pole
north pole to north pole
south pole to south pole

Attract	Repel

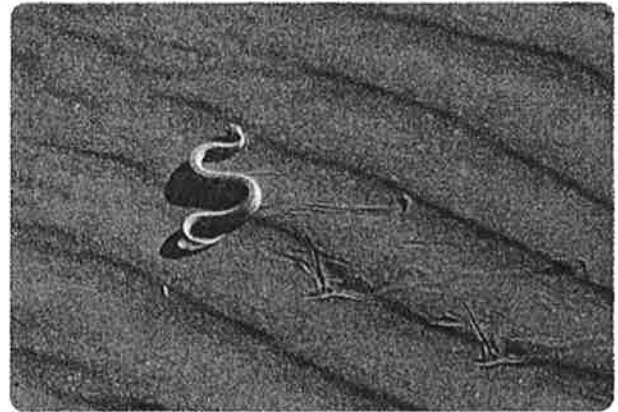
10. Which concept of force is shown in the image?
Select the best answer for the question.

- a.** static electricity
- b.** magnetism
- c.** gravity
- d.** friction





c. back and forth spinning up and down zigzag



d. back and forth spinning up and down zigzag

3. Write or draw an example of each type of motion in the chart.

back and forth	spinning	up and down	zigzag



EVIDENCE NOTEBOOK Think of objects that can move in more than one way. In your Evidence Notebook, describe how they move.

Moving Many Ways!

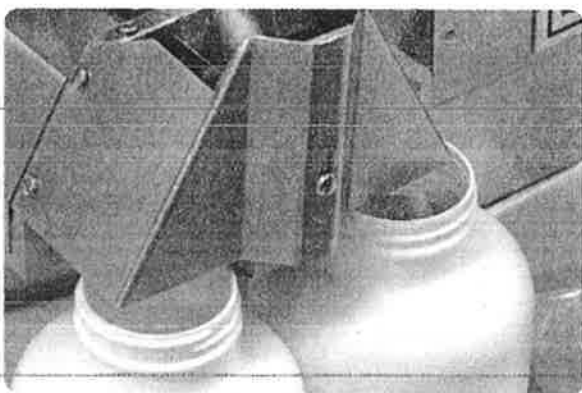
An elevator only moves up and down, but often an object moves in more than one way. When you walk somewhere in school, you may go upstairs, walk back and forth along the hall, zigzag around people in front of you, and circle around the room to get to your seat.

Ways of Moving

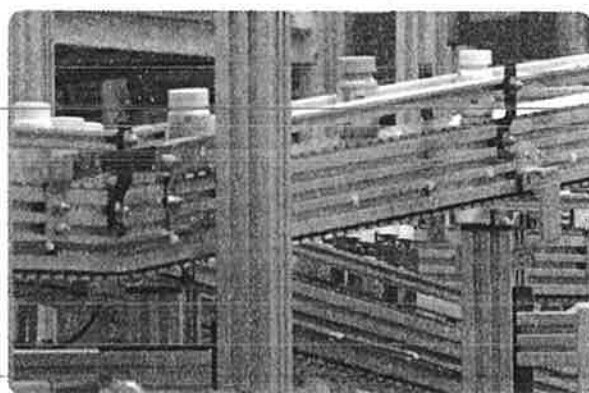
4. Draw arrows on each picture of medicine bottles to show the patterns of motion.



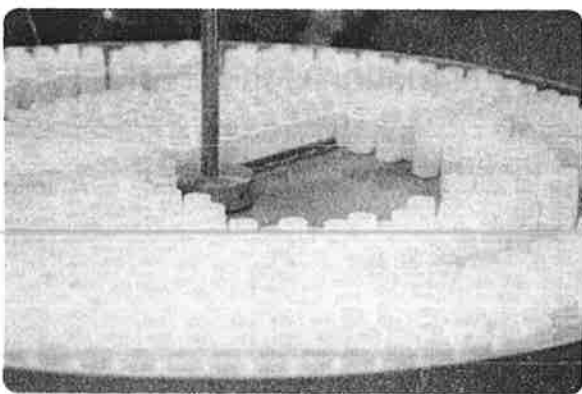
Explore
Online



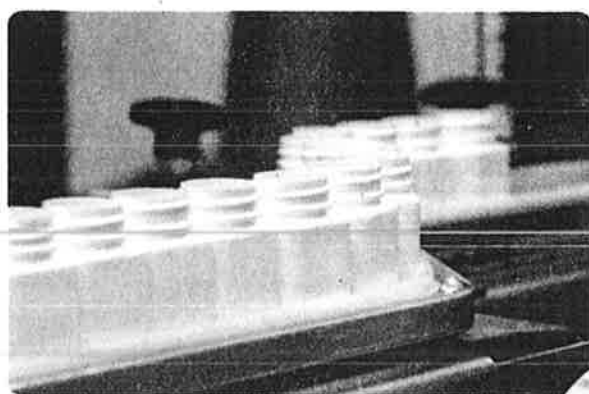
pills dropping into the bottles



traveling to get put in boxes



preparing bottles for filling



moving through the factory

5. Choose the best words or phrases to complete the sentences.

circular

back and forth

up and down

zigzag

When luggage is taken out of a plane and lifted onto a cart, it has a(n) _____ pattern of motion. The bag's motion pattern is _____ on the moving luggage carousel.

To avoid banging into other people in the crowded airport, the owner walks with the bag in a(n) _____ motion pattern. While leaving the airport on level ground, the bag's movement follows a(n) _____ motion pattern.



HANDS-ON Apply What You Know

Engineering Motion

6. Think about materials you could use to make a path for a marble to roll along. How could you cause the marble to move in different ways? Design a path to make a marble move in several different patterns. Make a detailed drawing of your design. Be sure to label the materials in your drawing. If your teacher provides the materials to do so, build and test your design.



7. **Language SmArts** When you roll a ball down a hill, what do you expect it to do? When you roll a ball up a hill, what do you expect it to do?

Tip

The English Language Arts Handbook can provide help with understanding cause and effect.

How Will it Move?

When you see a pattern of motion, you can predict how an object will move next. You can predict that the hands of a clock continue to move in a circle. But you cannot predict a butterfly's next movement.

Predictions

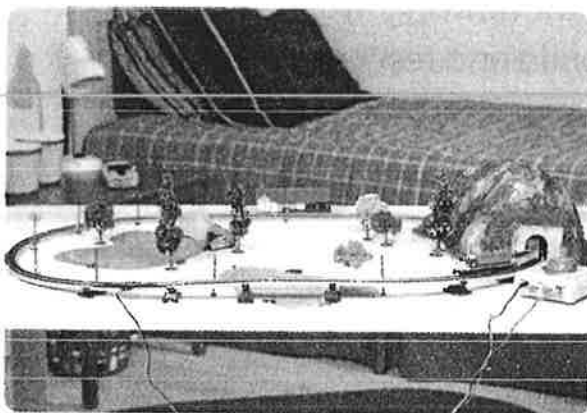
8. For each image, make a prediction of what you think will happen next. Enter your answer in the table.

Then circle the motions that do not have a pattern.

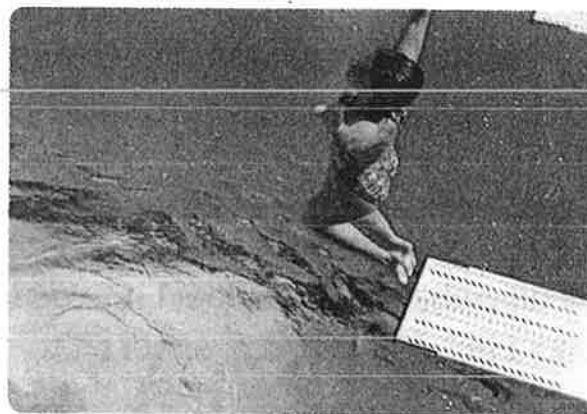


Explore
Online

Situation	What motion will happen next?
A Ferris Wheel	
Window washer on a platform at the top of a tall building	
An adult rocking a baby in a rocking chair	
A snow skier moving down a hill, making a wavy path	



The toy train's motion is easy to predict because it will go where the track is. You can see exactly where it will go next.



Divers bounce to go up, and then they fall into the pool. They may twist or flip. That part of their motion is not predictable.