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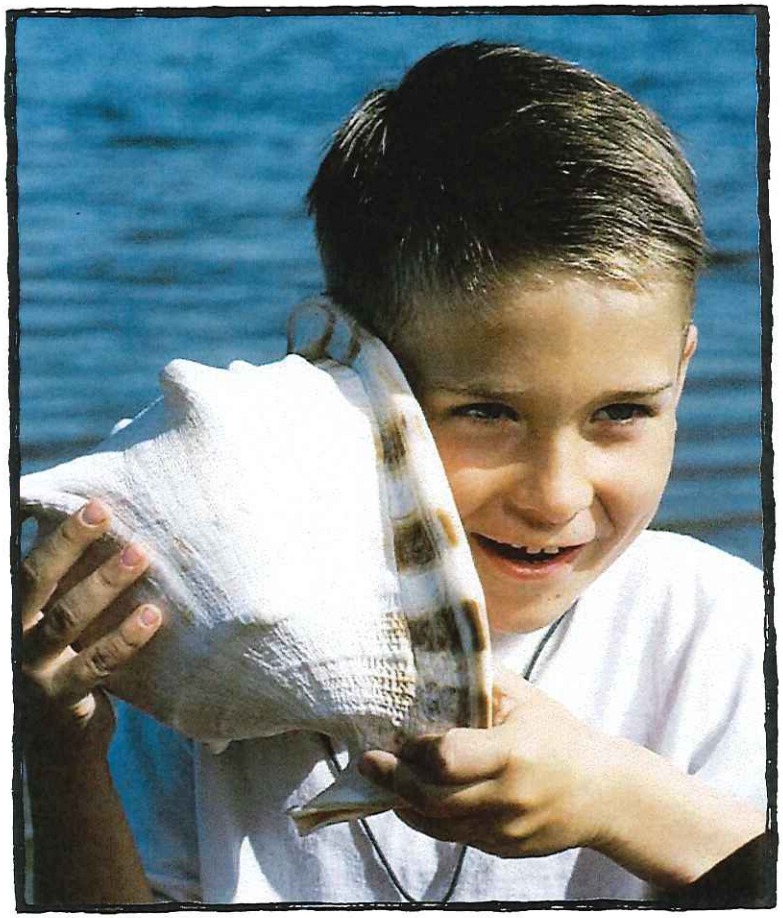
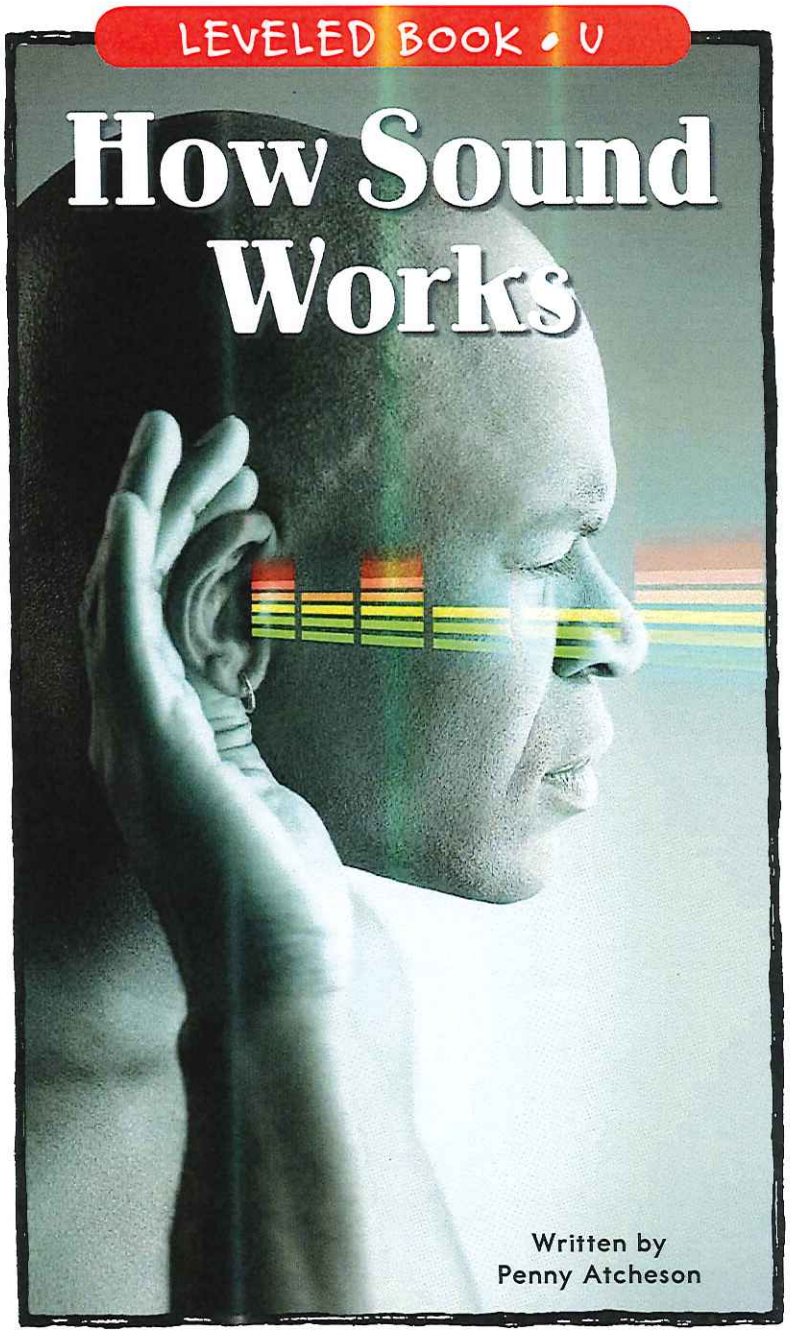
# 4th grade English Week 7 May 11-15th

# How Sound Works

*A Reading A–Z Level U Leveled Book*
*Word Count: 1,637*







# How Sound Works


Written by Penny Atcheson

**www.readinga-z.com**

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Level U Leveled Book

Written by Penny Atcheson
Illustrated by Craig Frederick



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**Correlation**

| LEVEL U | |
|---|---|
| Fountas & Pinnell | Q |
| Reading Recovery | 40 |
| DRA | 40 |

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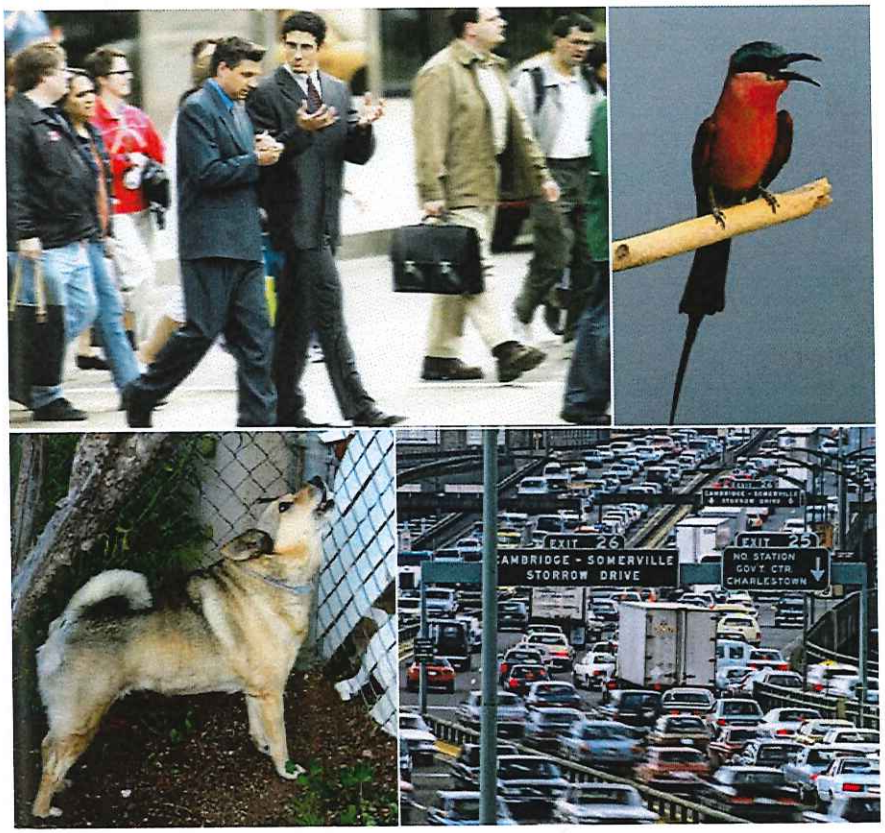



## Listening for Sound

Choose a spot and close your eyes. Listen carefully to what you hear. If you are in a classroom, you might hear voices, lights humming, or even pages turning. If you are outside, you might hear traffic noises or animal sounds, such as dogs barking or birds chirping. If you're in your living room, you might hear other sounds.

## Where Do Sounds Come From?

Ponder this—if a tree falls in the forest and no one is around to hear it fall, does it still make a sound? The scientific answer is yes.

Sound is a form of energy caused by something **vibrating**. Vibration occurs when an object moves quickly back and forth. The greater the vibration, the more sound energy is created. When the tree falls, it moves the surrounding air and makes it vibrate. Sound moves outward in all directions from the falling tree. A crashing sound would be heard if someone were around to hear it.

A tree falling in the forest creates sound waves.



Sound moves away from the tree in waves. **Sound waves** move through air, water, and solids. That means when an object vibrates, it causes vibrations in the matter that surrounds it. When the tree falls, it sends out sound waves in all directions through the air and through the ground on which it falls.

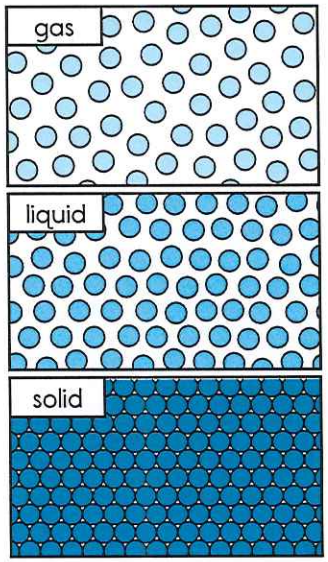
Bees' wings provide another example of how sound moves. The wings make the air around them vibrate, which causes a buzzing sound. The sound waves created by the bee's wings move away from the bee in all directions. No matter where you stand in relationship to the bee, you can hear the buzzing sound.

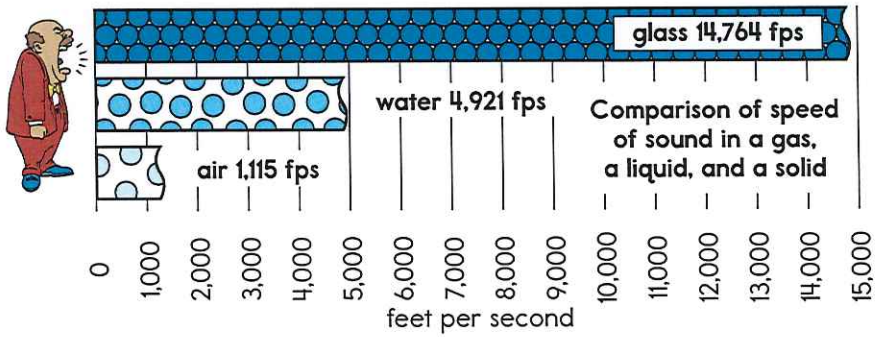
Beating wings create the buzzing sound that bees make.

## Try This! Vibration

- Hold a ruler flat on a desk or table with one hand.
- Hang one end of the ruler over the edge.
- Pull the ruler down with your other hand and let it go.
- Watch carefully to see the vibration of the ruler.
- Listen to hear the sound that it produces.
- Is the sound like a buzz or a hum? Maybe it is more like a "twang." Feel the ruler vibrate.
- Try this with different lengths of the ruler hanging over the edge. How does the sound change? Why does it change?

Sound travels differently through different types of matter. The distance between particles in matter is what causes the difference. In gases, such as air, the particles are farther apart than they are in liquid. In liquids, such as water, the particles are farther apart than they are in solids.




Particles that are closer together transfer sound energy more easily to one another. Sound transfers quickly through solids because the particles that make up most solids are close together. The transfer of sound is much slower in liquids and air because the particles are farther apart. Overall, the speed of sound varies, especially in gases. Sound travels more quickly in colder air than in warmer air because the particles are closer together.

## Try This! Sound in Solids

- Tap on your desk with a pencil.
- Listen to the sound.
- Put your head down so your ear touches the top of the desk.
- Tap on the desk again. How is the sound different? Why?

## Math Minute

On average, sound travels about 1,082 feet per second through air. Some jet planes travel faster than the speed of sound. When they break the **sound barrier**, a loud **sonic boom** can be heard for miles away.

There are 5,280 feet in one mile. A jet flying six miles above the ground breaks the sound barrier. How long will it take for someone on the ground to hear the sonic boom?

# A Closer Look at Sound

There are many different kinds of sound. The characteristic of a sound wave determines what kind of sound it is. Two of the more common characteristics of sound are **pitch** and **intensity**, or loudness.

Pitch has to do with how high or low a sound is. A siren or whistle has a high pitch. Thunder or a bass drum has a low pitch.

Pitch depends on something called **frequency**. Frequency is determined by how fast an object

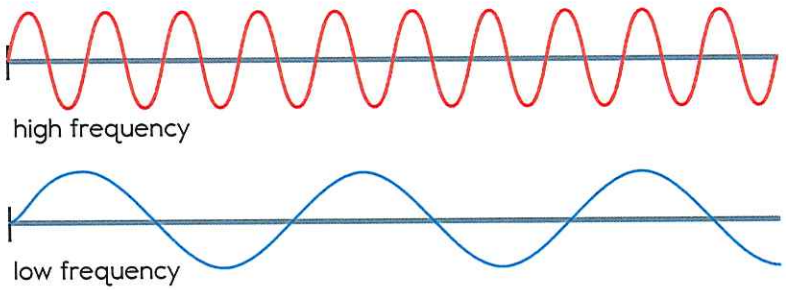


Hummingbird wings vibrate rapidly to make a high-pitched sound.

vibrates. An object that vibrates fast has high frequency and makes a high-pitched sound. An object that vibrates slowly has low frequency and makes a low-pitched sound.

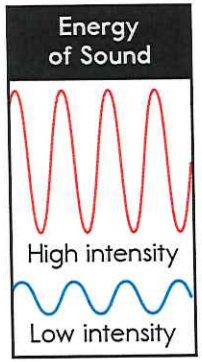
High-frequency sound waves are more **compressed**, or closer together. Low-frequency sound waves are farther apart. Because high-frequency sound waves are more compressed, more waves pass by a given point in one second than in low-frequency waves, which are more spread out.

**Sound Wave Frequency**




Frequency is measured in a unit called **hertz** (hurts). One hertz means one wave passes by a point every second—in other words, one vibration occurs each second. Humans hear sounds that have a frequency between 20 and 20,000 hertz.

If an object vibrates less than 20 times per second or more than 20,000 times per second, you probably will not hear it. Some animals, such as dogs, can hear sounds above 20,000 hertz. Each different sound has a different frequency. For example, humans can make different sounds that range from about 100 to 1,000 hertz.




Now let's look at intensity. Intensity has to do with how loud a sound is. It also has to do with the amount of energy a sound wave contains. Loud sounds have more energy than quiet sounds. Thunder has lots of energy and can be very loud. The buzzing sound of a mosquito has very little energy and is not very loud. As sounds move away from their source, they lose energy and become softer. The intensity of a sound gets less and less as you get farther away from the object making the sound.

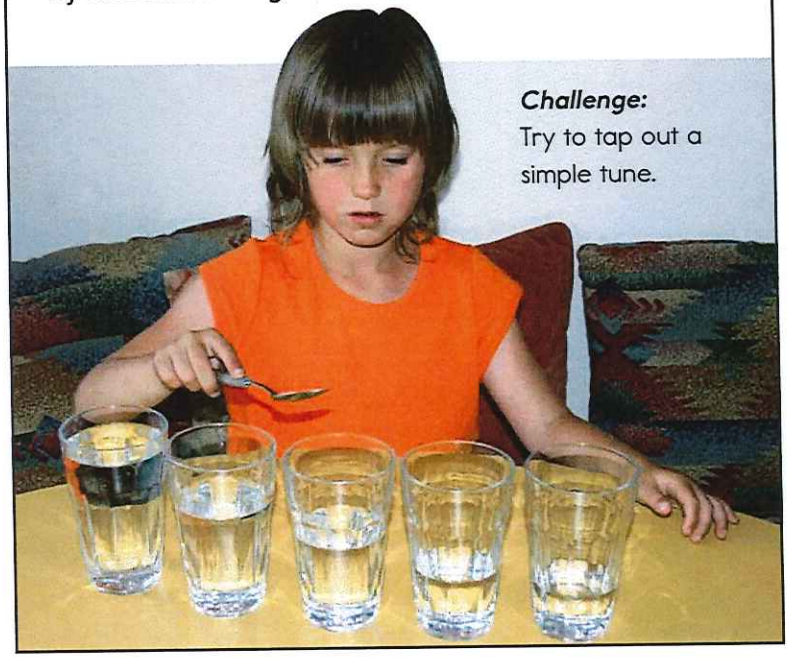
Loudness or intensity is measured in a unit called a **decibel** (DES-eh-bel). You can barely hear a sound of 10 decibels. But a sound of 70 decibels is considered loud. In fact, a 70-decibel sound has about 1,000 times more energy than a 40-decibel sound. If a sound reaches 140 decibels, it has so much energy that it will damage your ears.

**Table of Decibels**

| Sound Source | Decibels | Sound Source | Decibels |
|---|---|---|---|
| Whisper | 20 | Leaf blower | 110 |
| Hair dryer | 60–90 | Rock band or siren | 120 |
| Telephone ring | 80 | Jet airplane | 150 |

## Try This! Pitch Practice

- Gather a group of same-sized drinking glasses. Use glass, not plastic.
- Fill each glass with a different amount of water.
- Tap on the lip of each glass with a metal spoon.
- Listen to the pitch.
- See if you can arrange the glasses from high to low pitch.
- Try changing the amount of water in each glass.
- Try different-sized glasses or containers.



***Challenge:*** Try to tap out a simple tune.

## Hearing Sound

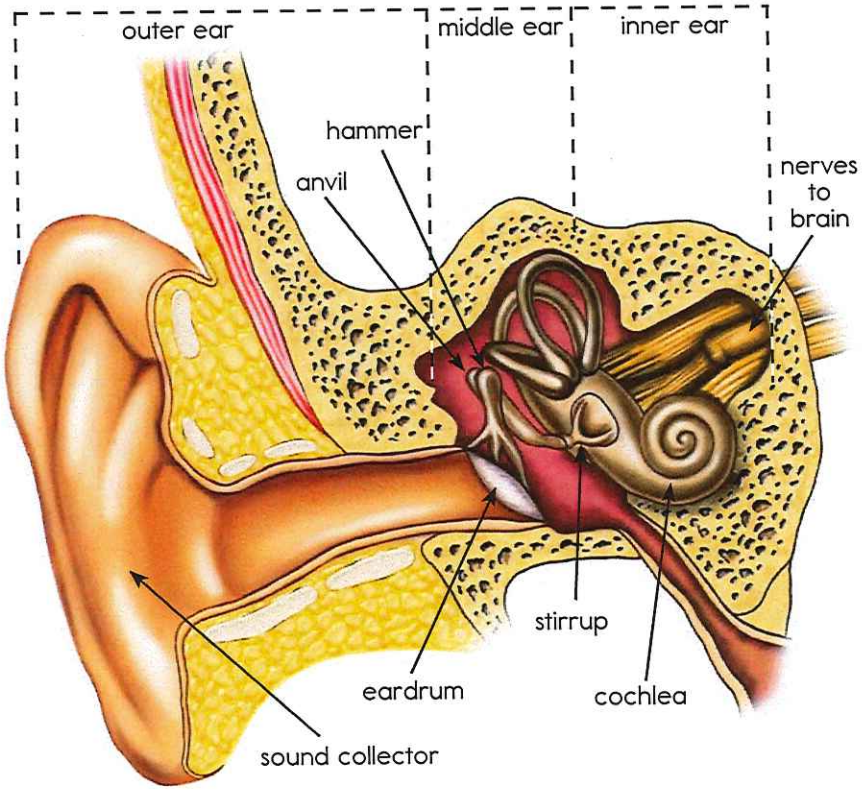
Ears play a big part in the ability to hear sounds. The outer ear plays only a small part in the hearing process. It acts like a sound collector. Its shape helps gather sound waves and move them along to the middle ear. The middle ear and inner ear are designed to transfer sound waves to nerves that carry signals to the brain. The brain then interprets the sound and gives your body commands to respond to the sound. For example, if the sound of an alarm clock reaches your brain, the brain tells your muscles to get you out of bed.

Your middle ear has an eardrum that vibrates when sound waves hit it. The eardrum transfers vibrations to three tiny, sensitive bones. It is important to be careful around loud noises, such as loud music or machinery, which can damage the middle ear. Some damage can cause permanent hearing loss.



The tiny bones transfer the sound waves to the inner ear. The inner ear has a snail-shaped part called a **cochlea**. It contains liquid and tiny nerve cells that change the sound vibrations into electrical impulses that are sent along nerves to the brain. The brain can then figure out what sound is being heard and tell your body how to react.

**Parts of the Human Ear**




The ear is what makes it possible for humans to hear.

## Do You Know?

Many people with hearing difficulties learn to communicate without sound. They use sign language and their other senses to communicate with the world around them. These children have hearing aids to help them hear.

Devices can be used to help people hear. Hearing aids change the sound frequency and help sound waves to travel through the ear. There's also an operation that involves inserting a cochlear implant. This operation has helped many people hear what they couldn't hear before. It takes time for the brains of people with new hearing aids or cochlear implants to learn what sounds are being heard.



## How to Describe Sound

The brain connects the message it receives from the ear with your own knowledge. Sound is often described by what makes the noise—for example, it sounds like a horn.


Sometimes sound is described by the noise it makes, such as a beeping sound. Words that imitate sounds are called **onomatopoeia** (ahn-o-mat-o-PEE-ah). *Plop*, *screech*, *bang*, and *swoosh* are all examples of onomatopoeia. So are the sounds animals make—*meow*, *woof*, *growl*, and *hiss*.

| What could be making the noises in this chart? | | | |
|---|---|---|---|
| **Pitch** | **Intensity** | **Onomatopoeia** | **Object** |
| high | loud | whee | |
| low | soft | splash | |
| high | soft | ribbit | |
| low | loud | roar | |

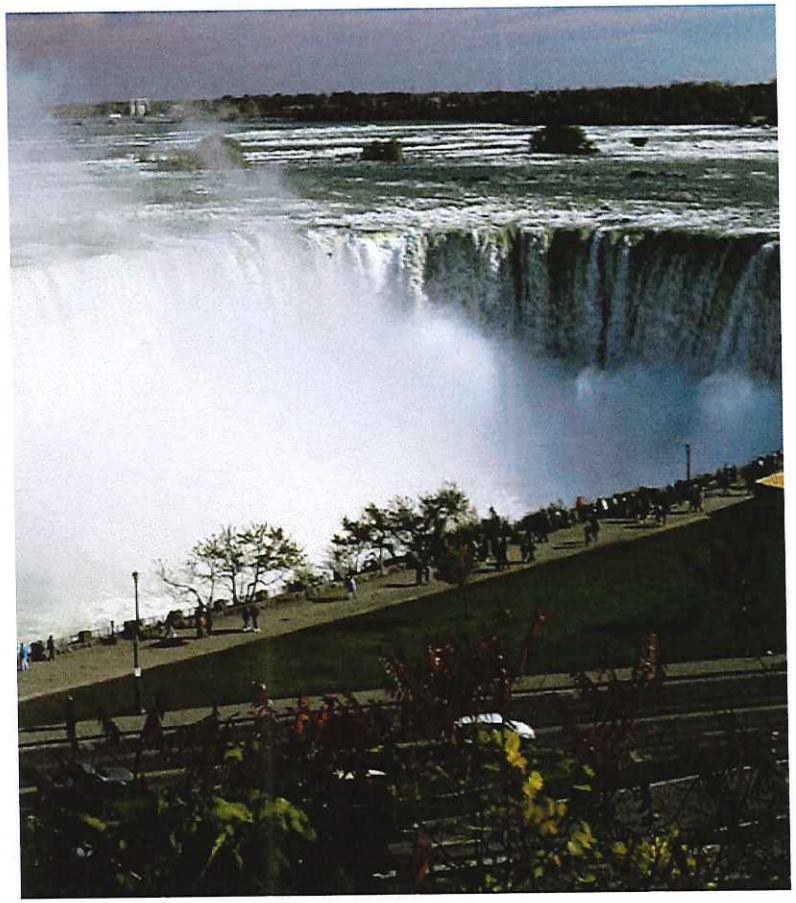
## How Is Sound Used?

People and other animals have always used sound. People communicate by talking and listening. Laughter is a sound people make when they are happy. The sound of someone crying usually means they are sad or hurt.

Wolves howl to communicate with other members of their packs.

Other animals also communicate with sounds. Animals make noises that can say, "Danger is near" or "I'd like to get to know you." Different sounds mean different things. For example, a loud bang might mean "WATCH OUT!" to both people and other animals.



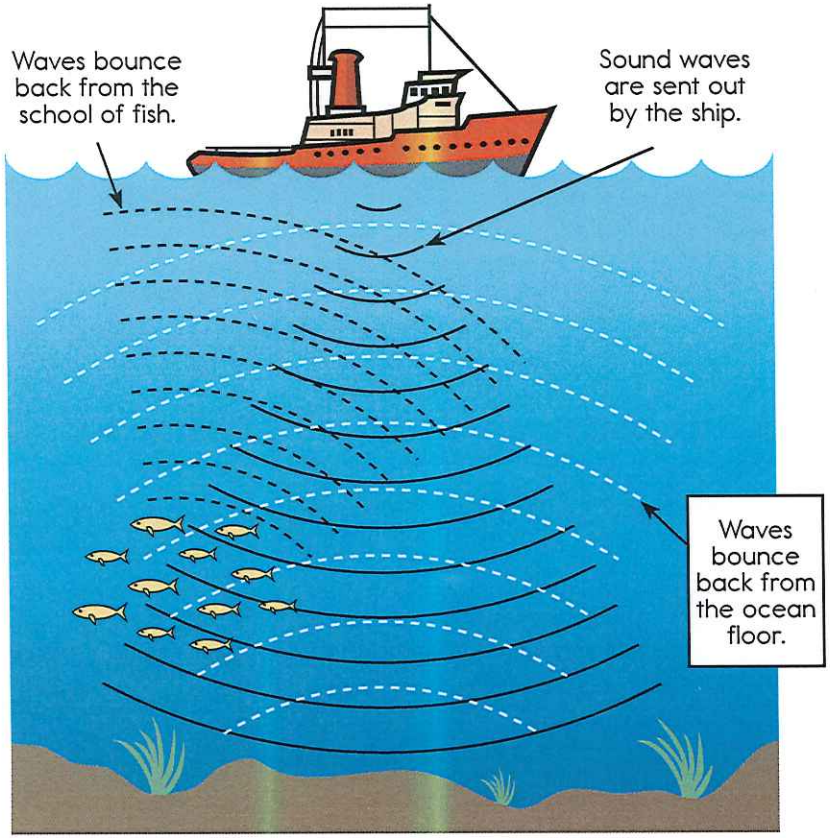


Waterfalls often can be heard long before they are seen.

Sounds also can give immediate information about the environment. A low rustling in the bushes, for example, tells that something is moving around in there. A whistling in the trees might mean it is getting windy. Dripping or trickling noises indicate that water is nearby. A foghorn signals a ship that a dangerous object might be in its path.

In modern times, humans have found new ways to use sound. People use sound waves to search for schools of fish in deep ocean waters. **Sonar** uses waves that are sent out and return with a different frequency when they bounce off objects. Using this sounding technique, fishers can tell when fish are under their boats.

Many animals have built-in sounding systems to help them navigate and find food.

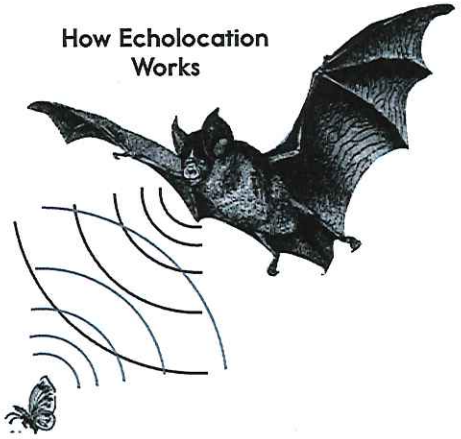



When hit by sound waves, objects reflect different frequencies.



Bats use a technique called **echolocation**. They send out sound waves that are reflected back by insects, trees, or other objects. When the waves bounce off objects and come back to the bats, the waves are a different frequency. This technique allows bats to find food at night when they hunt. Dolphins also use sonar to help them find their way around the ocean.

**How Echolocation Works**



❶ The bat sends out a constant stream of beeping noises.

❷ The sound waves spread out ahead of the flying bat.

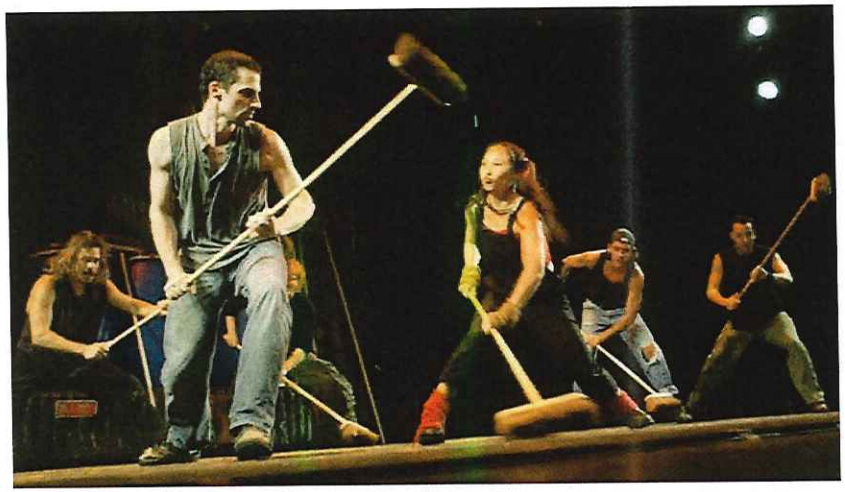
❸ Sound waves strike objects, such as flying insects.

❹ Sound waves bounce off the insects and echo back to the bat.

❺ The bat picks up the reflected sound with its super-sensitive ears.

❻ Nerves carry a signal from the bat's ears to its brain. The brain interprets the size, distance, speed, and direction of the insect. Zap—it's dinnertime.

Sound waves also are used to take pictures inside a human body. Using **ultrasound**, doctors can see a baby inside its mother's body before it is born. As with sonar, sound waves reflect off the baby and return at a different frequency.



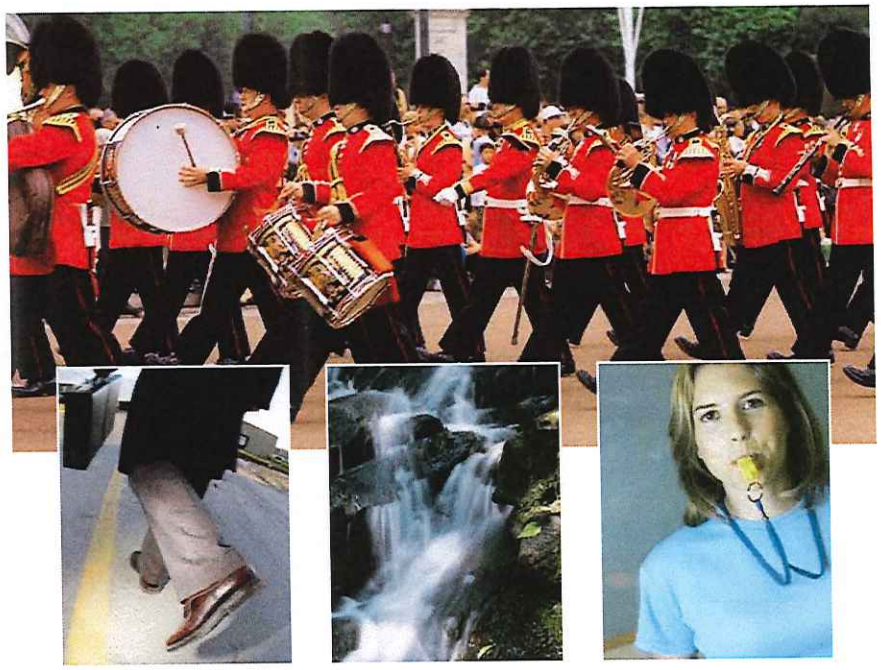
The group Stomp uses brooms to make music.

## Enjoying Sound

Musical instruments have been created from experiments with different types of sounds. A famous group called Stomp uses garbage cans, brooms, and pipes to make music. Once they even danced on top of an old school bus as part of a concert. Sounds can make people feel strong emotions. Even a kitten purring or a mother humming to her baby can create feelings of calm and love.

People can describe their experiences based on sounds. If someone talks about the ocean, you can almost hear the water crashing on the beach. Or you might hear sea gulls squawking or squeals of delight from other beach-goers.





## Conclusion

The world is filled with sound energy caused by objects vibrating all around us. Many kinds of sound waves moving through the air cause sounds that may be loud or soft, high or low, pleasant or annoying.

Pay close attention and discover new sounds that can provide information about the world around you. Sound helps to explain things, gives details about settings and objects, and creates emotions and feelings. Think about all the ways sound enters your life.

# Glossary

**cochlea** snail-shaped tube with nerve fibers, which is found in the inner ear (p. 14)

**compressed** squeezed together (p. 10)

**decibel** a unit that measures the loudness or softness of sounds (p. 11)

**echolocation** a method of locating objects using sound waves bounced off objects (p. 20)

**frequency** rate of vibration of a sound wave (p. 9)

**hertz** unit of measure of sound frequency (p. 10)

**intensity** the amount of energy per unit of sound (p. 9)

**onomatopoeia** words that imitate sounds and noises, such as *hiss* or *beep* (p. 16)

**pitch** the highness or lowness of a sound (p. 9)

**sonar** system that sends high-frequency sound waves through water and registers the vibrations reflected by an object (p. 19)

**sonic boom** explosive sound made by aircraft moving faster than the speed of sound (p. 9)

**sound barrier** large increase in air resistance encountered by aircraft flying at the speed of sound (p. 9)

**sound waves** the movement of energy through a gas, liquid, or solid (p. 6)

**ultrasound** sound with a frequency above what humans can hear (p. 20)

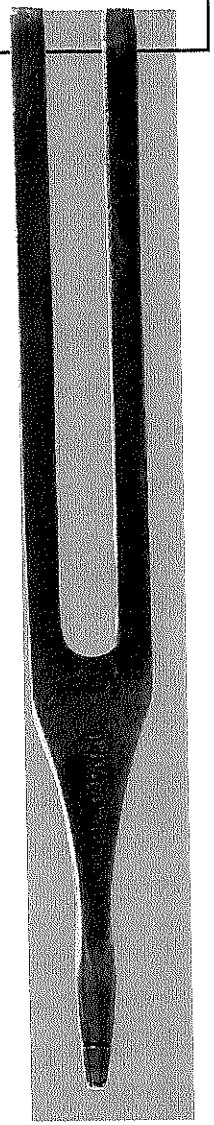
**vibrating** moving back and forth quickly (p. 5)



# Explore More

On the Internet, use *www.google.com* to find out more about topics presented in this book. Use terms from the text, or try searching for glossary or index words.

Some searches to try: *sound waves, onomatopoeia,* or *hearing loss.*



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Quick Check

# How Sound Works

Name _____ Date _____

**Instructions:** Read each question carefully and choose the best answer.

1. What is true about sound?
   - Ⓐ It is a form of energy.
   - Ⓑ It is caused by vibrations.
   - Ⓒ Its waves move through air, water, and solids.
   - Ⓓ All of the above

2. Low-frequency sound waves create a sound that _____.
   - Ⓐ travels quickly
   - Ⓑ has a low pitch
   - Ⓒ has a low volume
   - Ⓓ travels through water

3. What is a **cochlea**?
   - Ⓐ a type of hearing aid
   - Ⓑ a snail-shaped part of the inner ear
   - Ⓒ a device used to measure the frequency of sound
   - Ⓓ a musical instrument used to make a low frequency

4. Which statement is true?
   - Ⓐ A high-frequency wave always has loud volume.
   - Ⓑ All sound waves travel at the same rate of speed.
   - Ⓒ A high pitch is caused by fast-moving sound waves.
   - Ⓓ A sonic boom is created by the low pitch of thunder.

5. What is **onomatopoeia**?
   - Ⓐ a bone in the middle ear
   - Ⓑ words that imitate sounds
   - Ⓒ a certain frequency of sound
   - Ⓓ the nerve running from the ear to the brain

*Quick Check continued on following page*

Name _____ Date _____

6. Which of the following is the best summary statement for the section titled "How Is Sound Used?"
   - Ⓐ Animals are able to use sound to communicate what they want to other creatures.
   - Ⓑ Sound is used by people and other animals to warn, to live better, and to communicate.
   - Ⓒ There are many new and innovative ways humans are using sound today.
   - Ⓓ Sound is helpful to humans because it warns them of danger.

7. **Echolocation** helps bats _____.
   - Ⓐ find their homes
   - Ⓑ hear their young
   - Ⓒ find food at night
   - Ⓓ communicate with others

8. What could cause permanent hearing loss?
   - Ⓐ machinery
   - Ⓑ loud music
   - Ⓒ clanging metal
   - Ⓓ all of the above

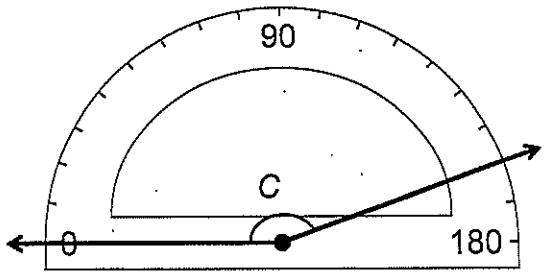
9. Why does sound travel more quickly in colder air than in warmer air?
   - Ⓐ Colder air is closer to the earth.
   - Ⓑ Particles are closer together in colder air.
   - Ⓒ Particles are closer together in warmer air.
   - Ⓓ All of the above

10. Which substance would sound travel through the slowest?
    - Ⓐ oxygen
    - Ⓑ milk
    - Ⓒ door
    - Ⓓ wall

11. **Extended Response:** Explain in sequence how human ears work.

12. **Extended Response:** What is the author's purpose for writing this book?

**1** Look at angle *C* below.




What is the measure of angle *C*?

**A** 200° **B** 182° **C** 160° **D** 97°

7C

**2** Hannah sells ice cream. To make one ice cream cone with one topping, she has the expenses listed below.

| | |
|---|---|
| Cost of ice cream | $0.65 |
| Cost of cone | $0.25 |
| Cost of topping | $0.05 |

If she sells one ice cream cone for $2.00, how much profit will she earn?

**F** $1.25 **G** $1.15 **H** $1.05 **J** $0.95

10B

**3** Four students played a game of basketball at recess.

- Emma scored 24 points.
- Lucas scored half as many points as Emma.
- Mario scored 4 more points than Lucas.
- Lexie scored twice as many points as Mario.

How many points did Lexie score during the game?

**A** 32 **B** 42 **C** 36 **D** 40

4H

**4** Saniyah wrote an 8-digit number. One of the digits in the number was a 7 that had a value of (7 × 10,000). Which could be the number that Saniyah wrote?

**F** 63,174,500

**G** 63,714,500

**H** 63,147,500

**J** 67,143,500

2B

**5** Christopher is making the table shown below.

| Number | × 10 |
|---|---|
| 21,510 | 215,100 |
| 59,200 | 592,000 |
| 80,050 | ? |

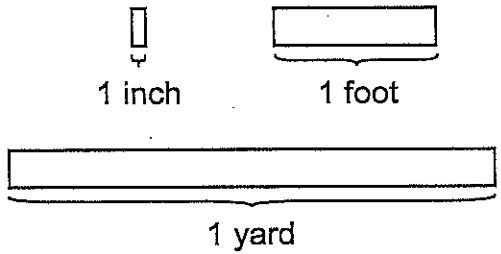
Which number completes this table?

**A** 805,000 **C** 8,000,500

**B** 800,500 **D** 8,005,000

4B

**6** Maya has three pieces of ribbon.




What is the combined length of the pieces of ribbon in inches?

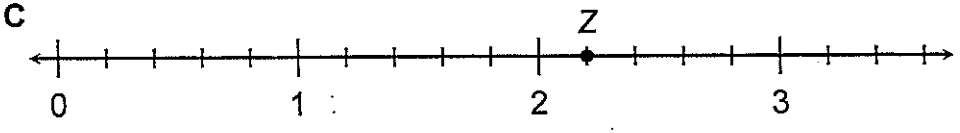
**F** 47 **G** 49 **H** 51 **J** 53

8C

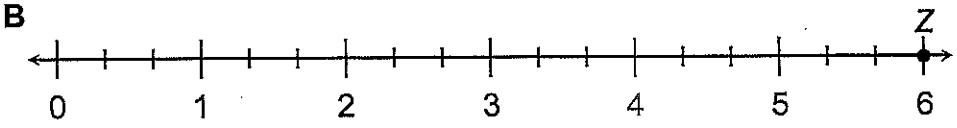
**7** On which number line is point *Z* equal to six fifths?

**A**

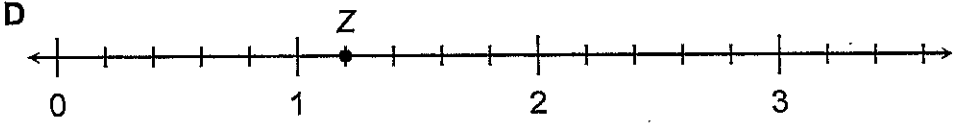

**C**




**B**




**D**




3G

**1** The table shows the color and number of vehicles a car company manufactured.

| Gray | Red | White |
|---|---|---|
| 5,759 | 11,367 | 6,278 |

How many vehicles were NOT red?

**A** 12,127 **C** 11,927

**B** 12,037 **D** 11,367

4A

**2** Lin-Yao spent a total of $25 for 1 book and 3 magazines. Each magazine cost $5. Which equation can be used to find *B*, the cost of the book?

**F** $B = 25 - 1 - 3 - 5$

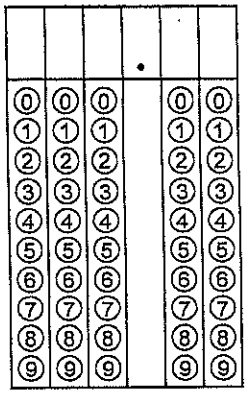
**G** $B = 25 + 1 + 3 + 5$

**H** $B = 25 - (5 + 3)$

**J** $B = 25 - (5 \times 3)$

5A

**3** Mr. Peterson was paid $3,450 total to paint 6 portraits. He was paid the same amount to paint each one. In dollars, how much money was he paid to paint each portrait?



4F

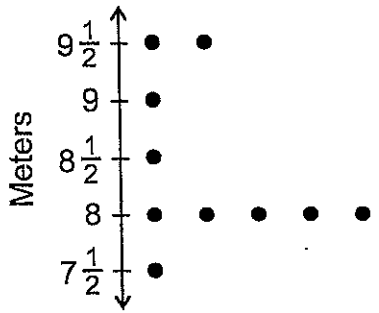
**4** The list below shows the number of meters that 10 athletes threw a javelin.

Damon: 8 Park: $7\frac{1}{2}$ Allan: $8\frac{1}{2}$ Isaiah: $9\frac{1}{2}$ Robert: 8

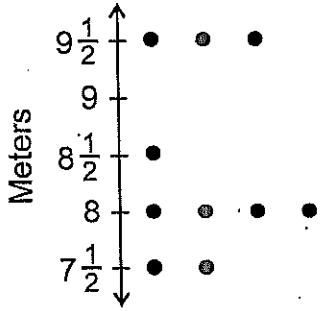
Otilio: $9\frac{1}{2}$ Keyah: 8 Morgan: 8 Jenna: $7\frac{1}{2}$ Wyatt: $9\frac{1}{2}$

Which dot plot correctly represents this information?

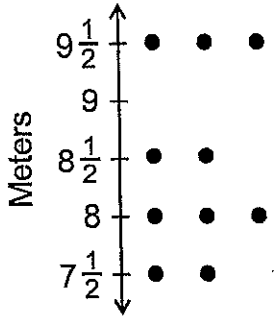
**F** Javelin Throw



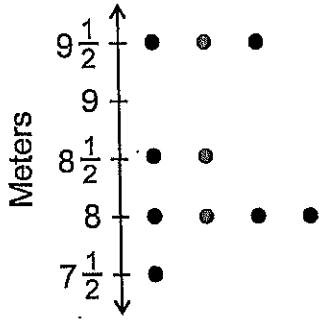

**H** Javelin Throw




**G** Javelin Throw

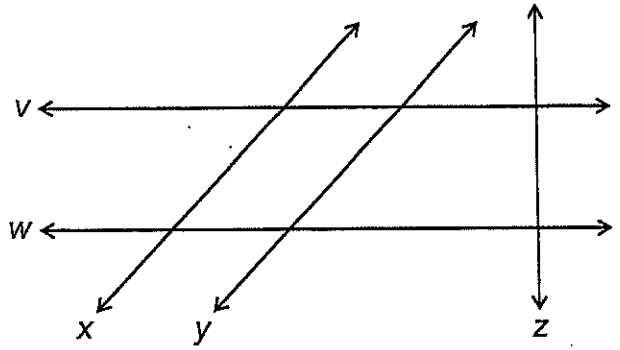



**J** Javelin Throw




9A

**5** Grant drew the diagram below.

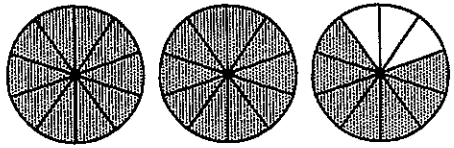



Which line is perpendicular to line *v*?

**A** *w* **B** *x* **C** *y* **D** *z*

6A

**6** Which decimal and fraction does this model represent?



**F** 2.07 and $2\frac{7}{10}$ **H** 2.7 and $2\frac{7}{10}$

**G** 2.7 and $2\frac{7}{100}$ **J** 2.07 and $2\frac{7}{100}$

2G

**1** Joseph performs sit-ups, push-ups, and pull-ups each morning. He performs 9 sit-ups followed by 3 times as many push-ups. Then he performs 12 fewer pull-ups than push-ups. Which frequency chart represents this information?

**A**

Morning Exercise

| | |
|---|---|
| Sit-ups | 𝍸 \|\|\|\| |
| Push-ups | 𝍸 𝍸 𝍸 |
| Pull-ups | \|\|\| |

**B**

Morning Exercise

| | |
|---|---|
| Sit-ups | 𝍸 𝍸 |
| Push-ups | 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 |
| Pull-ups | 𝍸 𝍸 𝍸 \|\|\| |

**C**

Morning Exercise

| | |
|---|---|
| Sit-ups | 𝍸 \|\|\|\| |
| Push-ups | 𝍸 𝍸 𝍸 𝍸 𝍸 \|\|\|\| |
| Pull-ups | 𝍸 𝍸 𝍸 \|\| |

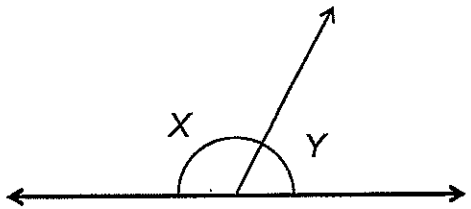
**D**

Morning Exercise

| | |
|---|---|
| Sit-ups | 𝍸 \|\|\|\| |
| Push-ups | 𝍸 𝍸 𝍸 𝍸 𝍸 \|\| |
| Pull-ups | 𝍸 𝍸 𝍸 |

9A

**2** Angles $X$ and $Y$ equal 180° combined.

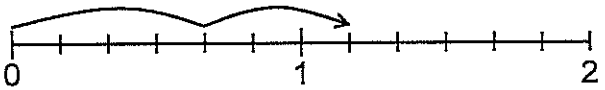



If angle $Y$ measures 62°, what is the measure of angle $X$?

**F** 162° **G** 128° **H** 118° **J** 108°

7E

**3** Look at the addition model shown here.



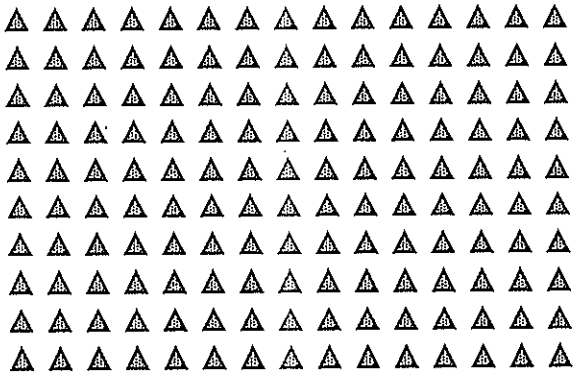

Which number sentence does the model best represent?

**A** $\frac{4}{6} + \frac{3}{6} = \frac{7}{6}$ **C** $\frac{4}{4} + \frac{3}{4} = \frac{7}{4}$

**B** $\frac{4}{5} + \frac{3}{5} = \frac{7}{5}$ **D** $\frac{4}{4} + 3 = 1\frac{1}{6}$

3E

**4** Look at the array below.



The array represents the product of which two numbers?

**F** 14 and 10 **H** 15 and 9

**G** 15 and 10 **J** 14 and 9

4C

**5** Four students ran 100 meters. Sophia ran this distance in $\frac{1}{3}$ minute and Vito ran it in $\frac{1}{2}$ minute. Sadie ran this distance in $\frac{2}{6}$ minute and Dalton ran it in $\frac{2}{10}$ minute. Which shows a correct comparison between Sophia's time and Dalton's time?

**A** $\frac{1}{3} < \frac{2}{10}$ **C** $\frac{1}{2} > \frac{2}{10}$

**B** $\frac{1}{3} = \frac{2}{6}$ **D** $\frac{1}{3} > \frac{2}{10}$

3D

**6** Martina paid $127.59 for a new cell phone. Which shows a way to represent the value of the 9 in this amount?

**F** $(9 \times \frac{1}{100})$ **H** $(9 \times 100)$

**G** $(9 \times \frac{1}{10})$ **J** 0.9

2B

**7** Which statement is true?

**A** 1 centimeter = $\frac{1}{10}$ meter

**B** 1 centimeter = $\frac{1}{100}$ meter

**C** 1 centimeter = $\frac{1}{2}$ meter

**D** 1 centimeter = $\frac{1}{5}$ meter

8A