FOCUS ON SCIENCE

Physical Science

Matter and Energy

Basic Level

Sound Is Energy

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- Core Curriculum Covered
- Student Book
- Assessments and Reading Activities

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Sound Is Energy

What are some ways that energy can be changed from one form to another?

CORE CURRICULUM STATEMENTS

Energy exists in many forms, and when these forms change energy is conserved.

Energy exists in various forms: heat, electric, sound, chemical, mechanical, light.

Energy can be transferred from one place to another.

Some materials transfer energy better than others (heat and electricity).

Energy and matter interact: water is evaporated by the Sun's heat; a bulb is lighted by means of electrical current; a musical instrument is played to produce sound; dark colors may absorb light, light colors may reflect light.

Interactions with forms of energy can be either helpful or harmful.

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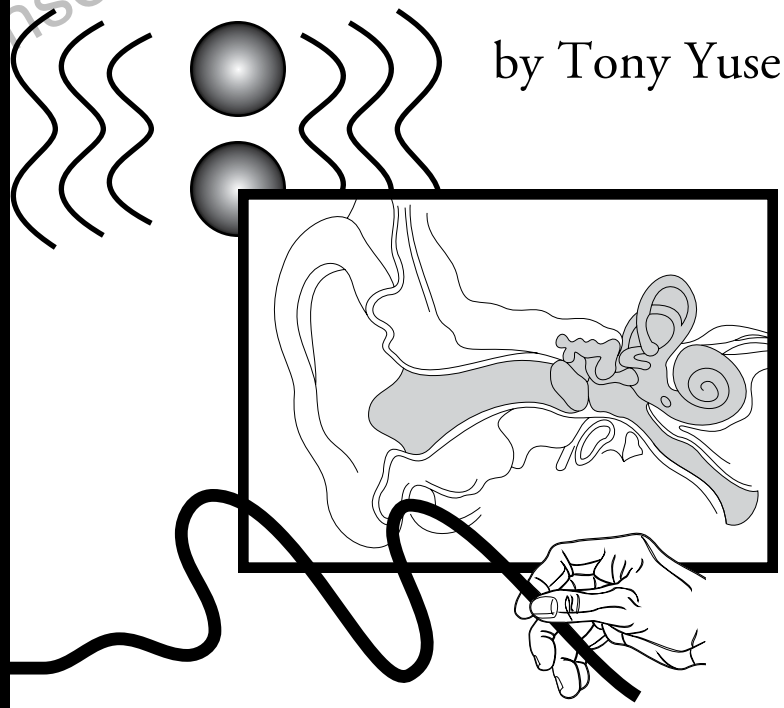
Sound Is Energy

by Tony Yuse



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Curriculum materials for **your** content standards

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INTRODUCTION

Sound Is All Around Us

Thump, Thump, Thump! Sudden sounds wake you from a deep sleep. What are they? An animal? A monster?

You hear the speed of the thumps. They are getting quicker. You notice the volume of the sound. It is getting louder. It must be something big or at least heavy.

The thumps have a low sound, like someone is dropping a book bag onto the floor over and over again. Should you run and hide?

Now, you are really awake. You decide that the sound is not as loud as you first thought. It's too light and quick to be the footsteps of a monster. Those sounds would be slow and clunky—wouldn't they?

Finally, you remember that you have heard these sounds before. Whew! It's just your little sister coming up the stairs.

At this moment, you're not thinking about how that thumping sound got to your ears. But just how did it?

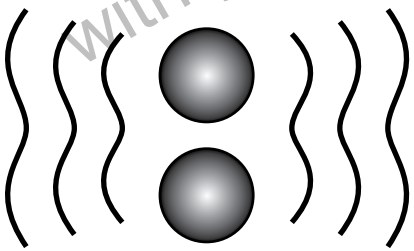
CHAPTER 1

What Is Sound?

The thumping sound you heard is energy. Sound is energy. Energy is the ability to cause a change in **matter**.

Sound energy makes things move, or **vibrate**. How? The air between your ears and the floor is full of tiny particles you can't see. Your sister's footsteps caused the particles of air to vibrate. The vibrations produced a sound wave.

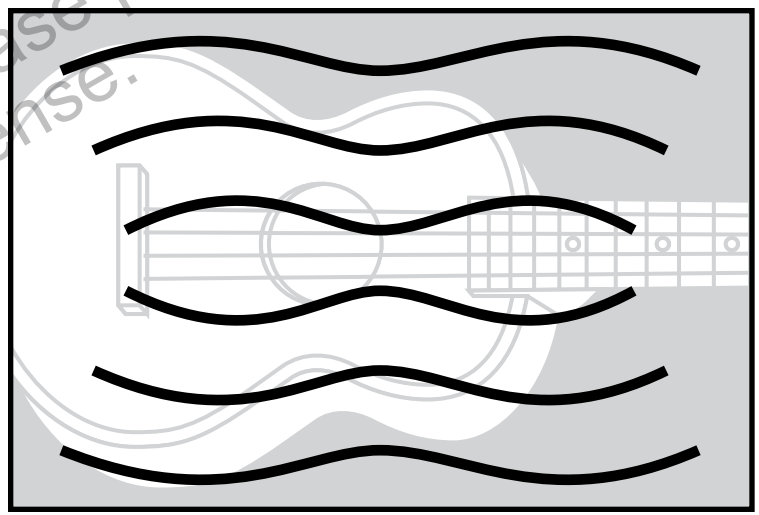
Particles of matter vibrate to create sound waves.



matter: anything that has mass and takes up space
vibrate: to cause a rapid motion back and forth

Here is another example. A person plucks a guitar string. The string vibrates. The vibration causes air particles to hit each other. This creates a wave of sound energy.

Your ears pick up the sound and send a message to your brain. Your brain then tells you it is the sound of a guitar string.

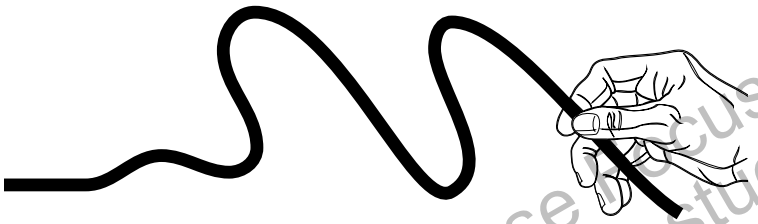


When a guitar string vibrates back and forth, it hits the air particles around it. This creates a sound wave.

CHAPTER 2

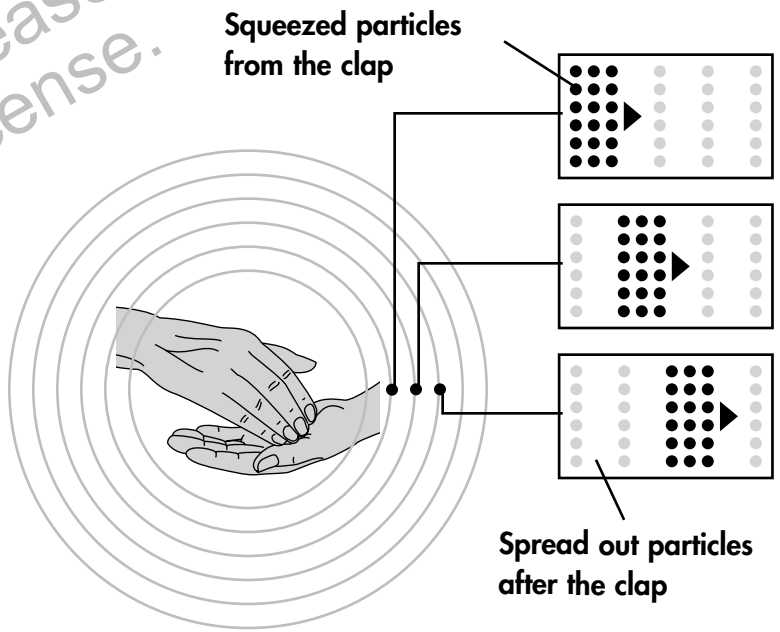
What Is a Sound Wave?

Flick a piece of rope up and down. The rope, the section of rope in your hand passes a wave of energy on to the next section of rope. That section passes it on again, and so on.



This is how sound travels. Slap your hands together. The loud clap gives a sudden push to the air around your hands. This push of energy passes on through the air like the wave traveling along the rope.

The energy from the clap causes air particles to vibrate. The particles move forward and squeeze together. When the sound wave passes, the air particles move back and spread out. The movement of a sound wave is this pattern of squeezed and spread out particles.



The air particles themselves do not travel to your ear, however. It is the wave of energy that moves.

You might have seen people doing "the wave" at a football or soccer game. The fans in Section 1 stand up, raise their arms over their heads, and then quickly sit down together. As they sit down, the fans in Section 2 do the same. Each section of fans does the same, one after another.

The result is a wave of motion that moves quickly around the stadium. The fans are not traveling around the stadium, though. They are moving energy from one location to another—just like a sound wave.

–Explain –
What causes sound waves?

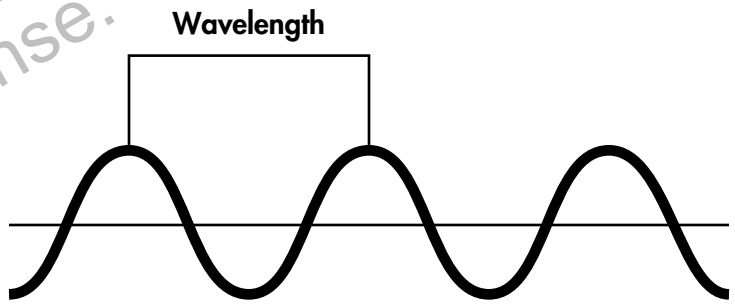
CHAPTER 3

Properties of Sound Waves

Scientists use three ways to describe a wave.

Wavelength

A wavelength is the distance from one point of a wave to the same point of the next wave.



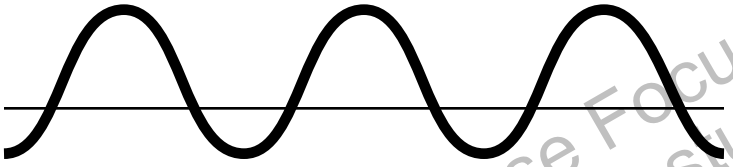
Frequency

The number of waves passing a given point every second is called the frequency of the sound wave.

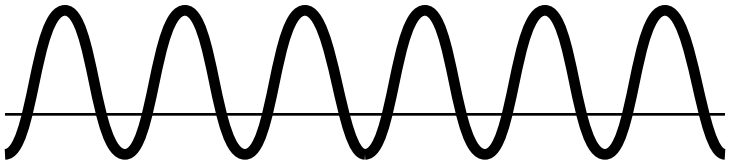
Pitch

Pull a rubber band tightly and pluck it. Then, hold it loosely and pluck it again. You will notice the sound is higher when you hold the rubber band tightly.

This difference in sound is called pitch. Pitch is determined by the frequency of the sound. The faster the sound wave, the higher the pitch.



Plucking a loose rubber band produces a low frequency sound wave. It has a longer wavelength. The longer the wavelength, the lower the pitch.

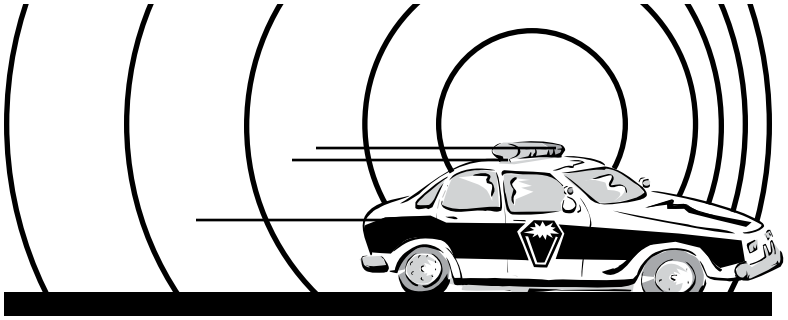


Plucking a tight rubber band produces a high frequency sound wave. It has a shorter wavelength. The shorter the wavelength, the higher the pitch.

The Doppler Effect

Have you ever noticed that the sound of a siren from a police car? The pitch of the siren is higher before it passes by you. Then the siren sounds lower after it goes by.

When the siren gets closer, the sound waves in front of the siren are squeezed tightly together. This makes a higher pitch sound. As the siren passes you, the waves behind are more spread out. The sound has a lower pitch.



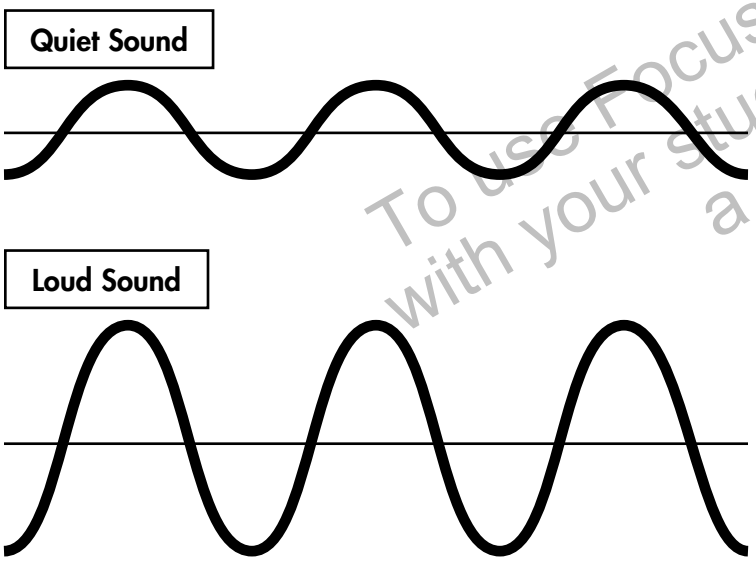
Long wavelength, low frequency, low pitch

Small wavelength, high frequency, high pitch

Amplitude

Sound waves can be tall or short, just like waves in the ocean. A taller wave has more amplitude than a shorter wave.

When more energy is used to create a sound, the sound becomes louder. Loud sounds have a higher amplitude than quiet sounds.



Scientists measure loudness of sounds in a unit called a decibel. The abbreviation for decibel is dB. The higher the decibel, the louder the sound.

The faintest sound that can be heard by the average person is defined as being 0 dB. At 130 dB, noise begins to be painful.

Sound	Decibels
Falling leaves	10 dB
Whispers	30 dB
Busy city street	70 dB
Rock concert	110 dB
Jet plane	120 dB

CHAPTER 4

Transmission of Sound Waves

A German scientist, Heinrich Hertz studied sound waves. Hertz discovered that sound waves travel through different types of materials—not just air.

Hertz discovered sound waves vibrate at different rates in different materials. Solid materials have tightly packed particles. He learned that sound travels quickly through solid materials.

Hertz also learned that liquids carry sound for longer distances than air.

transmission: the act of passing something along

Transmission

When a sound wave in air reaches the surface of another material, some of the sound bounces off it. It is **reflected**, off the surface. The rest of the sound wave goes into the material.

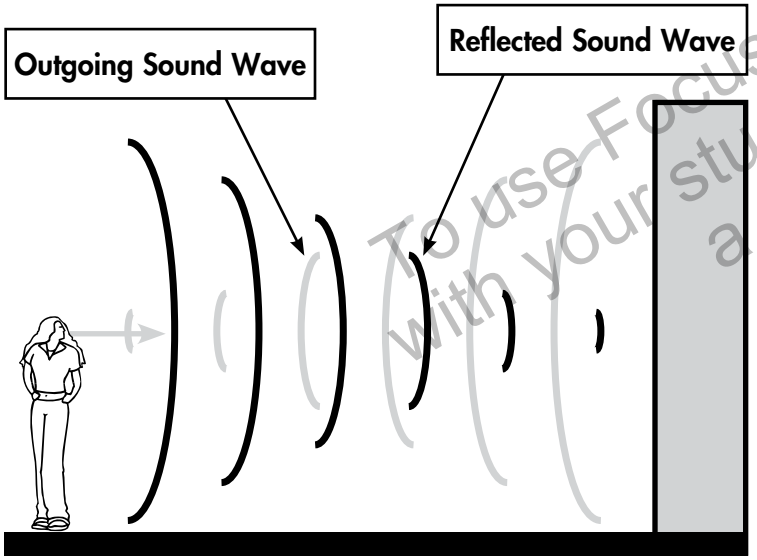
When a sound wave enters an object, it is transmitted into the object. For example, a sound wave can enter water and be transmitted in the liquid. Have you ever dunked your head in the bathtub or in a swimming pool? Could you hear sounds?

reflected: to throw back light, heat, or sound

Reflection

Have you ever heard a loud sound, and a few moments later you hear the sound again. How does that happen?

Sound waves reflect off the surface of solid, smooth surfaces such as the wall of a building. A sound that is reflected back to you is called an echo.



The sound waves of a person's voice can reflect off a solid surface and bounce back as an echo.

Absorption

Other types of materials absorb, or soak up sound. Soft materials like carpet and drapes absorb more sound than they reflect.

For example, if you shout in an empty room, you will probably hear an echo.

What if you put carpet, drapes, and soft furniture in the room? You probably will not hear an echo when you shout.

Why? More of the sound is absorbed into the soft materials rather than reflected back to you.

– Apply –

Listen to sounds in various locations. Describe sounds that are transmitted, reflected, and absorbed. Create a table to record and organize your observations.

absorption: the act of taking in and not reflecting or throwing back

CHAPTER 5

How Do We Hear Sound?

When a sound wave reaches your ear, the outer ear catches the sound and sends it into the ear canal.

Inside your ear is a piece of skin stretched like the skin on a drum. This is called the eardrum. The sound waves enter the ear and cause the eardrum to vibrate. This causes fluid inside the inner ear to vibrate in waves. Tiny hairs attached to **nerves** pick up these vibrations. This sends a message to brain which tells you it is sound.

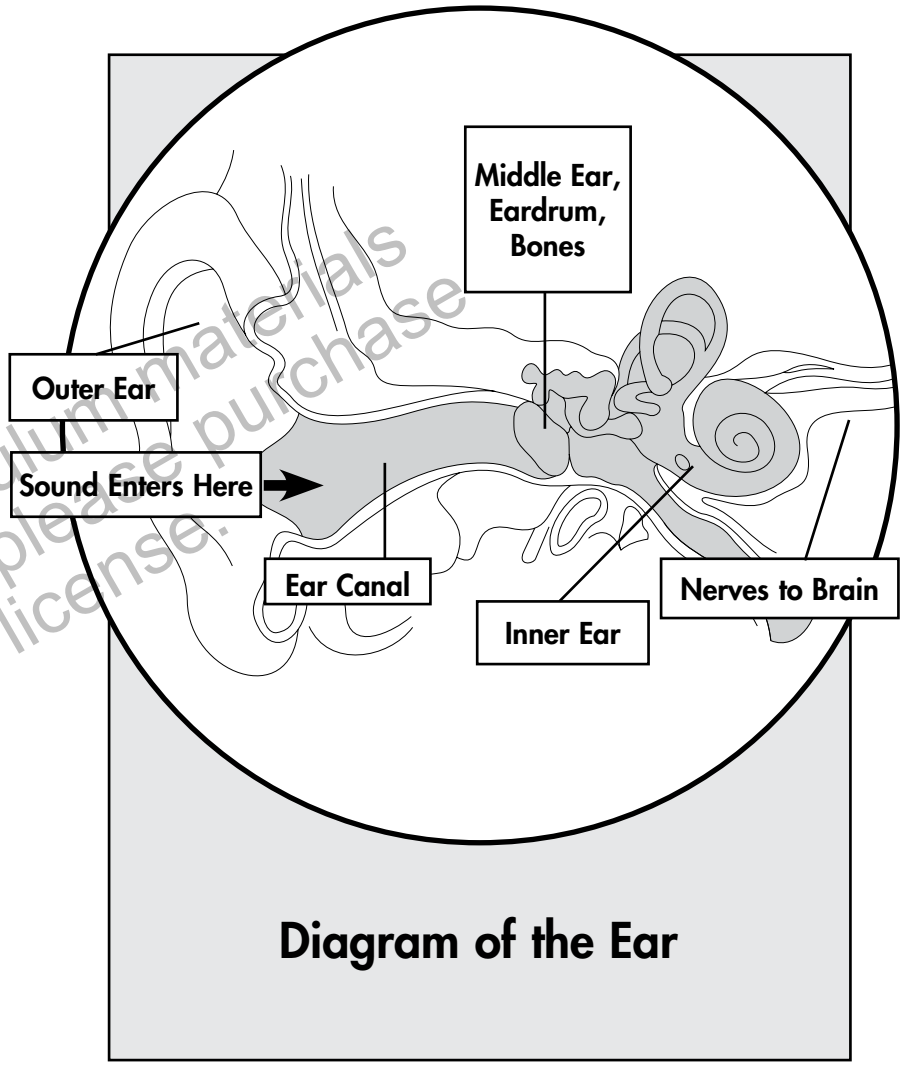


Diagram of the Ear

nerves: fibers that carry signals to the brain from muscles and organs

Glossary

absorption—the act of taking in and not reflecting or throwing back

matter—anything that has weight and takes up space

nerves—fibers that carry signals to the brain from muscles and organs

reflected—to throw back light, heat, or sound

transmission—the act of passing something along

vibrate—to cause a rapid motion back and forth

To Find Out More . . .

Want to learn more about sound?

Try these books

Sound Waves (Energy in Action) by Ian F. Mahaney. PowerKids Press, 2007.

Feel the Noise: Sound Energy (Raintree Fusion) by Anna Claybourne. Raintree, 2005.

Sound (Early Bird Energy) by Sally M. Walker. Lerner Publications, 2005.

Sound and Light (Hands-on Science) by Sarah Angliss, Kingfisher, 2001.

Access these Web sites

PBS ZOOMSCI
http://pbskids.org/zoom/activities/sci/

The NASA Sci Files
http://scifiles.larc.nasa.gov/text/kids/D_Lab/acts_sound.html

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Physical Science

Matter and Energy

Basic Level

Assessments

Sound Is Energy

Print pages 20–22 of this PDF for the assessments.

Sound Is Energy

Check Understanding

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

1. You are driving down a street when another car beeps its horn. What causes the sound of the horn?

Ⓐ the reflection of waves

Ⓑ vibrating particles of matter

Ⓒ the absorption of waves

Ⓓ the pitch of the horn

2. You pluck a guitar string and hear the sound it makes. You then tighten the string and pluck it again. What effect did tightening the string have on the second sound?

Ⓐ The second sound has a higher amplitude than the first.

Ⓑ The second sound has a lower amplitude than the first.

Ⓒ The second sound has a higher pitch than the first.

Ⓓ The second sound has a lower pitch than the first.

3. You dive in a swimming pool and swim down to grab a toy resting on the bottom. Your friend is standing along side the pool and you hear him shout, "It's over there." Identify the term used to explain this property of sound.

_____

Explain why you were able to hear your friend's voice.

_____

_____

_____

_____

_____

_____

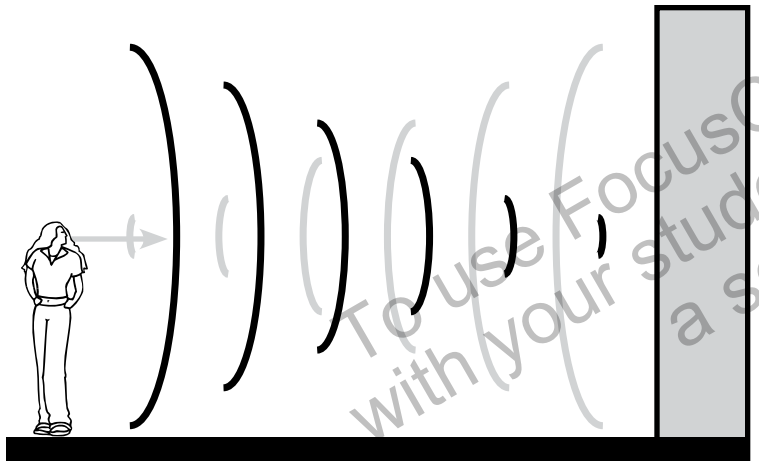
_____

_____

Check Understanding

Write your answers in the boxes.

4. A girl is standing near a wall as shown in the diagram below. She shouts to a friend who is standing on the other side of the wall.



Explain what happens when the girl shouts.

Explain what happens when the sound of her voice hits the wall.

Sound Is Energy

Assessment Scoring Guidelines

1. Answer B is correct.

2. Answer C is correct.

3. The term for sound travelling through an object is transmission.

The sound wave entered the water in the pool and travelled through the water.

4. When the girl shouts, she causes tiny particles in the air to vibrate. This creates a sound wave which is transmitted, or travels, through the air.

When the sound waves reach the wall, they are reflected, or bounced back. The girl then hears her voice as an echo.

Physical Science

Matter and Energy

Basic Level

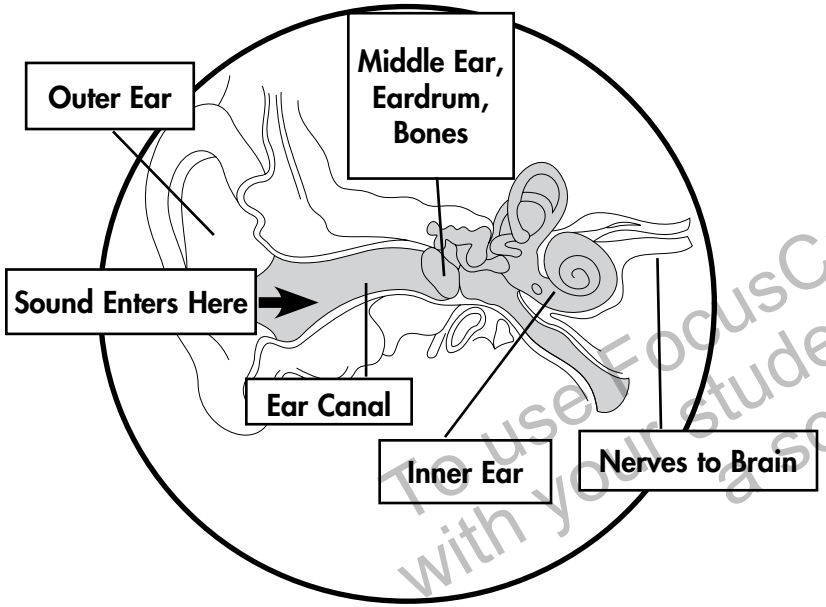
English Language Arts Activities

Sound Is Energy

Print pages 24–28 of this PDF for the reading activities.

Create Graphic Information

Graphic Information is found in maps, charts, tables, graphs and diagrams. It contains useful information. For example, look at the following chart. Then look at the questions and answers.



1. **Where does sound enter your ear?**

   the outer ear

2. **How does the ear send signals to the brain?**

   through nerves

3. **Where is the eardrum compared to outside of the ear?**

   almost in the middle

TRY THE SKILL

Draw a diagram of a sound wave created from a bat hitting a baseball. Label the diagram. Then ask a classmate to read and explain your diagram.

Similes and Metaphores

TRY THE SKILL

Similes and metaphors can make writing more interesting. They help to create a clear picture in the reader's mind.

A simile compares two different things, using the words *like* or *as*. Here is one example:

Inside your ear is a piece of skin stretched like the skin on a drum.

This simile compares an eardrum with a real drum.

A metaphor also compares two things, but it does not use the words *like* or *as*. Read this example:

The music was a soothing lotion.

This metaphor compares music and lotion.

Each of the following sentences contain a simile or metaphor. Shade the circle next to the sentence that explains what that simile or metaphor means.

1. The child's voice was like fingernails scratching a chalkboard.

Ⓐ The child was scratching the chalkboard with his fingernails.

Ⓑ The child was writing on the chalkboard.

Ⓒ The child had a screechy voice.

2. A sound wave works like an ocean wave.

Ⓐ Sound waves can make ripples in the water.

Ⓑ Sound waves help you hear ocean waves crash on the shore.

Ⓒ Energy moves the same way through a sound wave and an ocean wave.

3. An echo is like the reflection you see in the mirror.

Ⓐ An echo and a reflection are both made by bouncing waves.

Ⓑ Your reflection in the mirror is an echo of you.

Ⓒ If you shout at a mirror, you will hear an echo.

4. Soft drapes and carpeting are a sponge for sound.

Ⓐ Drapes and carpeting soak up sound.

Ⓑ You can clean drapes and carpeting with a sponge.

Ⓒ Music sounds better if a room has drapes and carpeting.

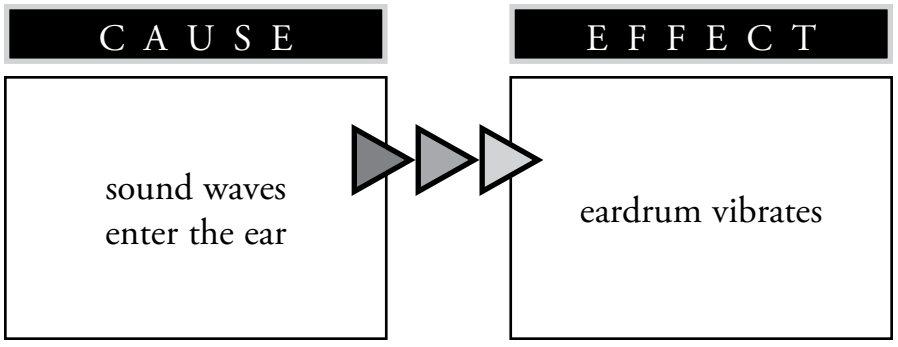
Cause and Effect

To find out an effect you ask, "What happened?" To find out a cause, you ask, "Why did that happen?" Identifying causes and effects is a way to understand what you read.

Read this passage from the book.

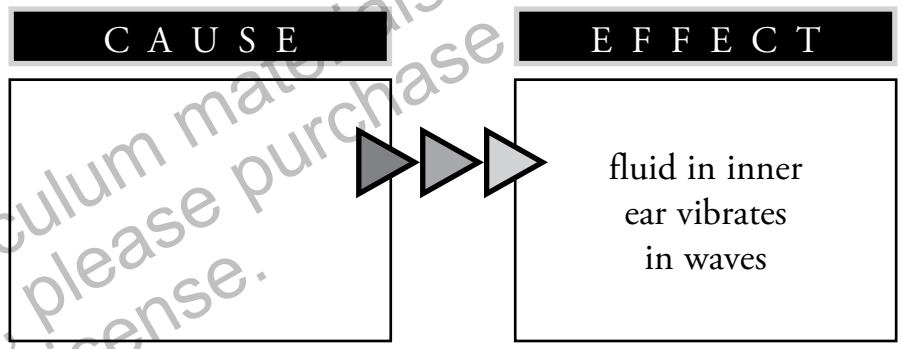
> Inside your ear is a piece of skin stretched like the skin on a drum. This is called the eardrum. The sound waves enter the ear and cause the eardrum to vibrate. This causes fluid inside the inner ear to vibrate in waves. Tiny hairs attached to nerves pick up these vibrations. This sends a message to brain which tells you it is sound.

This graphic explains what happened in the third sentence.

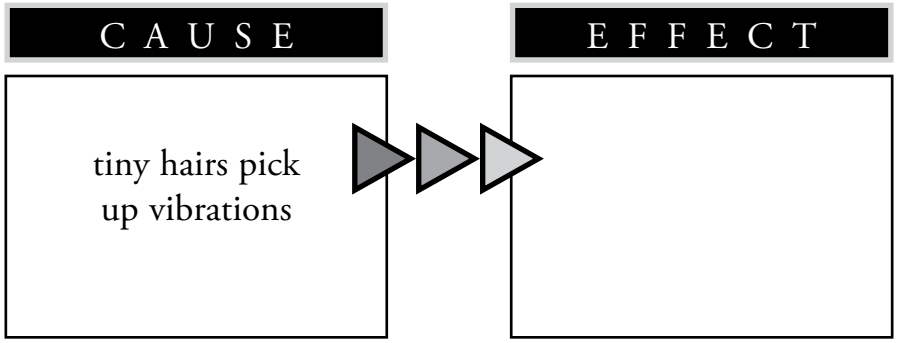


TRY THE SKILL

Read the passage again. Then complete this graphic organizer. Tell why fluid inside the inner ear vibrates.



Now complete this graphic. Tell what happens when the tiny hairs attached to nerves pick up vibrations.



Steps in a Process

Understanding the steps in a process can help you understand and remember what you read. You can summarize the steps in a process using words such as *first, then, next,* and *finally*.

Read this passage from *Sound Is Energy* and try to identify the steps in the process.

A person plucks a guitar string and it vibrates. The vibration causes air particles to smash into each other. This creates a wave of sound energy.

Step 1	First,a person plucks a guitar string.
Step 2	Then, the string vibrates.
Step 3	Next, the vibrations cause air particles to smash into each other.
Step 4	This creates a wave of sound energy.

TRY THE SKILL

Read this passage from *Sound Is Energy* and try to identify the steps in the process. Use the graphic organizer to help you.

The wave of energy from the clap causes air particles to vibrate. The particles move slightly forward and squeeze together. When the sound wave passes, the air particles move slightly back and spread out. The movement of a sound wave is this pattern of squeezed and spread out particles.

Step 1	
Step 2	
Step 3	
Step 4	

Answer Key

Create Graphic Information

Graphics will vary.

Similes and Metaphores

1. C

2. C

3. A

4. A

Cause and Effect

Cause: the eardrum vibrates

Effect: vibrations produce nerve impulses that go to the brain

Steps in a Process

Step 1: The clap causes air particles to vibrate creating a sound wave.

Step 2: Then, particles move forward and squeeze together.

Step 3: Next, the waves passes.

Step 4: The particles move slightly back and spread out.