Section 1

The Nature of Sound

Reading Preview

Key Concepts

- What is sound?
- How do sound waves interact?
- What factors affect the speed of sound?

Key Terms

- echo
- elasticity
- density

Target Reading Skill

Identifying Main Ideas As you read the Interactions of Sound Waves section, write the main idea—the biggest or most important idea—in a graphic organizer like the one below. Then write three supporting details that further explain the main idea.

Main Idea

Sound waves interact . . .

Detail | Detail | Detail

Lab zone Discover Activity

What Is Sound?

1. Fill a bowl with water.
2. Tap a tuning fork against the sole of your shoe. Place the tip of one of the prongs in the water. What do you see?
3. Tap the tuning fork again. Predict what will happen when you hold it near your ear. What do you hear?

Think It Over

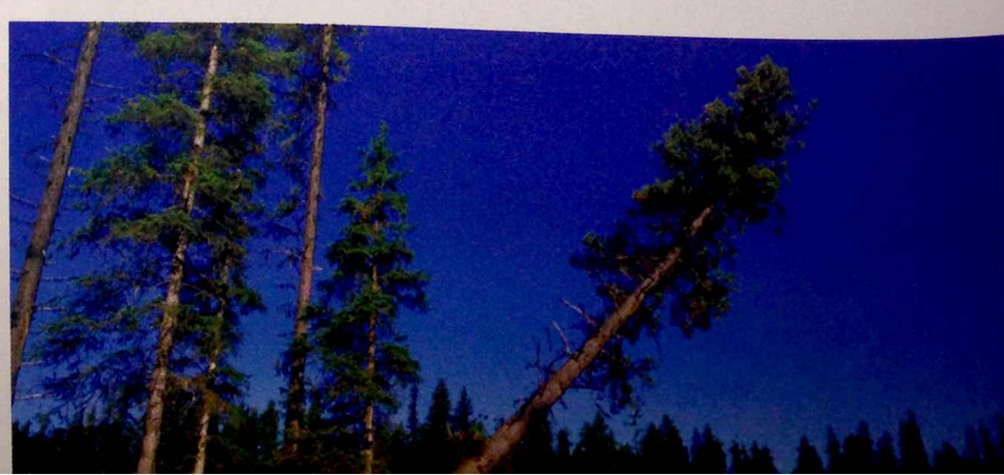
Observing How are your observations related to the sound you hear? What might change if you use a different tuning fork?

Here is an old riddle: If a tree falls in a forest and no one hears it, does the tree make a sound? To answer the riddle, you must decide what the word "sound" means. If sound is something that a person must hear, then the tree makes no sound. If sound can happen whether a person hears it or not, then the tree makes a sound.

Sound Waves

To a scientist, a falling tree makes a sound whether someone hears it or not. When a tree crashes down, the energy with which it strikes the ground causes a disturbance. Particles in the ground and the air begin to vibrate, or move back and forth. The vibrations create a sound wave as the energy travels through the two mediums. **Sound is a disturbance that travels through a medium as a longitudinal wave.**

A falling tree ▶



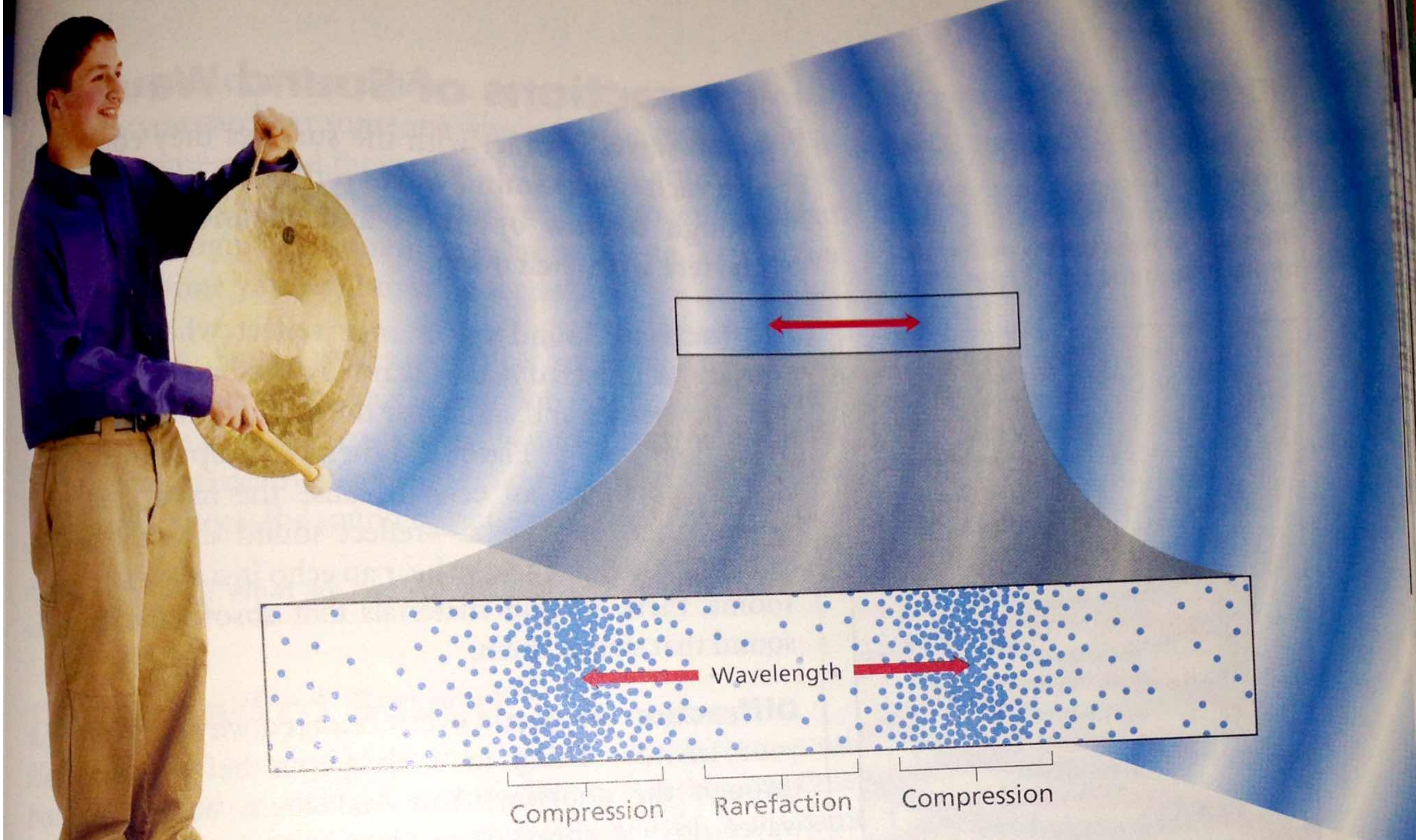


FIGURE 1
Sound Waves
As a gong vibrates, it creates sound waves that travel through the air. **Observing** *What do you observe about the spacing of particles in a compression?*

Making Sound Waves A sound wave begins with a vibration. Look at the metal gong shown in Figure 1. When the gong is struck, it vibrates rapidly. The vibrations disturb nearby air particles. Each time the gong moves to the right, it pushes air particles together, creating a compression. When the gong moves to the left, the air particles bounce back and spread out, creating a rarefaction. These compressions and rarefactions travel through the air as longitudinal waves.

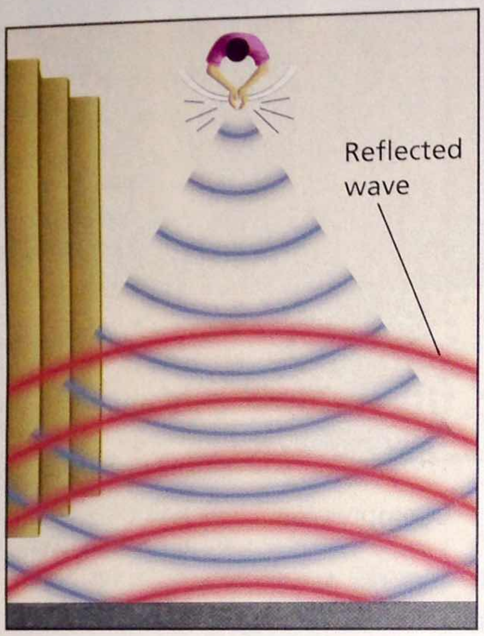
How Sound Travels Like other mechanical waves, sound waves carry energy through a medium without moving the particles of the medium along. Each particle of the medium vibrates as the disturbance passes. When the disturbance reaches your ears, you hear the sound.

A common medium for sound is air. But sound can travel through solids and liquids, too. For example, when you knock on a solid wood door, the particles in the wood vibrate. The vibrations make sound waves that travel through the door. When the waves reach the other side of the door, they make sound waves in the air on the far side.

Reading Checkpoint **What are three types of mediums that sound can travel through?**

Go Online
SCILINKS NSTA
For: Links on sound
Visit: www.SciLinks.org
Web Code: scn-1521

FIGURE 2
Reflection of Sound
Clapping your hands in a gym produces an echo when sound waves reflect off the wall.
Drawing Conclusions *What kind of material is the wall made of?*



Interactions of Sound Waves

Sound waves interact with the surfaces they contact and with each other. **Sound waves reflect off objects, diffract through narrow openings and around barriers, and interfere with each other.**

Reflection Sound waves may reflect when they hit a surface. A reflected sound wave is called an **echo.** In general, the harder and smoother the surface, the stronger the reflection. Look at Figure 2. When you clap your hands in a gym, you hear an echo because the hard surfaces—wood, brick, and metal—reflect sound directly back at you. But you don't always hear an echo in a room. In many rooms, there are soft materials that absorb most of the sound that strikes them.

Diffraction Have you ever wondered why you can hear your friends talking in a classroom before you walk through the doorway? You hear them because sound waves do not always travel in a straight line. Figure 3 shows how sound waves can diffract through openings such as doorways.

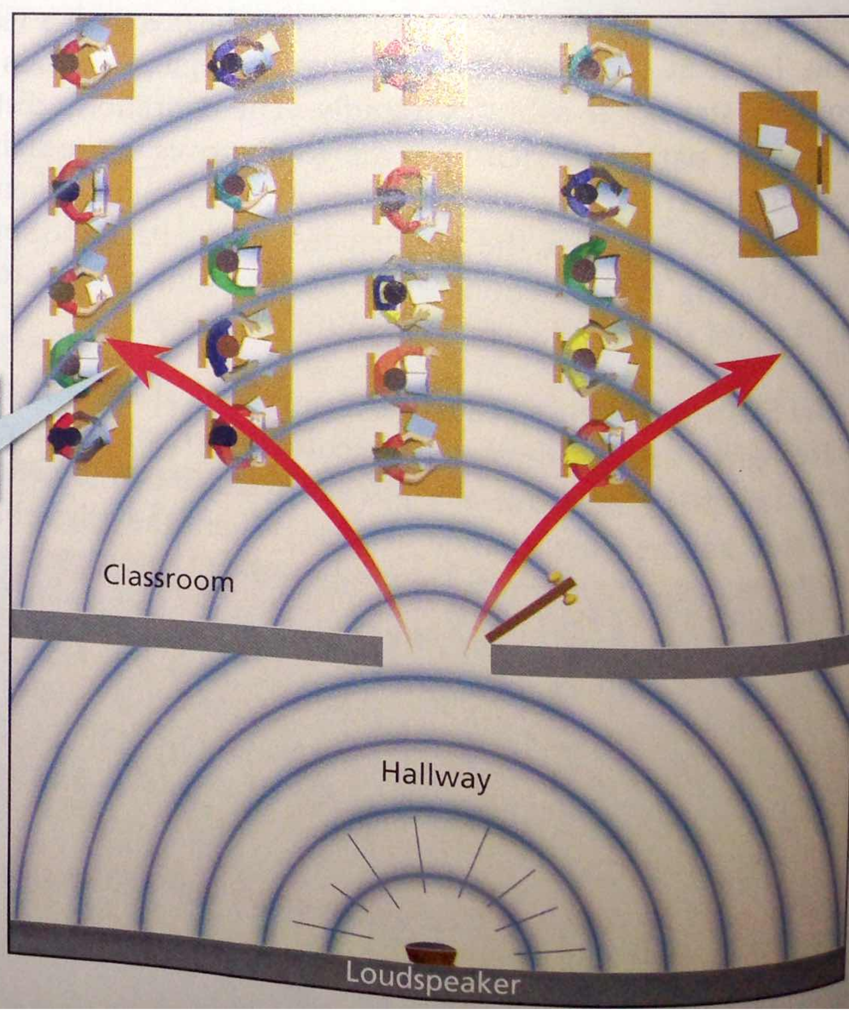


FIGURE 3
Diffraction of Sound
Sound waves can spread out after passing through a doorway, and can bend around a corner.

Sound waves can also diffract, or bend, around corners. This is why you can hear someone who is talking in the hallway before you come around the corner. The person's sound waves bend around the corner. Then they spread out so you can hear them even though you cannot see who is talking. Remember this the next time you want to tell a secret!

Interference Sound waves may meet and interact with each other. You may recall that this interaction is called interference. The interference that occurs when sound waves meet can be constructive or destructive. In Section 3, you will learn how interference affects the sound of musical instruments.

Reading Checkpoint What are two ways that sound waves diffract?

The Speed of Sound

Have you ever wondered why the different sounds from musicians and singers at a concert all reach your ears at the same time? It happens because the sounds travel through air at the same speed. At room temperature, about 20°C, sound travels through air at about 343 m/s. This speed is much faster than most jet planes travel through the air!

The speed of sound is not always 343 m/s. Sound waves travel at different speeds in different mediums. Figure 4 shows the speed of sound in different mediums. **The speed of sound depends on the elasticity, density, and temperature of the medium the sound travels through.**

Speed of Sound	
Medium	**Speed (m/s)**
Gases	
Air (0°C)	331
Air (20°C)	343
Liquids (30°C)	
Fresh water	1,509
Salt water	1,546
Solids (25°C)	
Lead	1,210
Cast iron	4,480
Aluminum	5,000
Glass	5,170

FIGURE 4
The speed of sound depends on the medium it travels through.

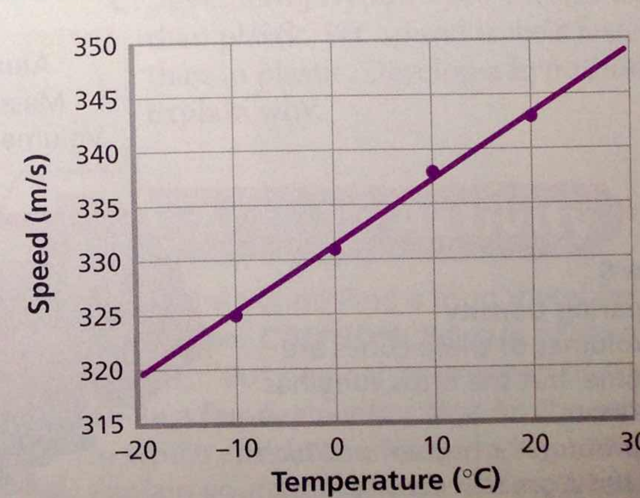
Math Analyzing Data

Temperature and the Speed of Sound

The speed of sound in dry air changes as the temperature changes. The graph shows data for the speed of sound in air at temperatures from −20°C to 30°C.

1. **Reading Graphs** What is the speed of sound in air at −10°C?
2. **Interpreting Data** Does the speed of sound increase or decrease as temperature increases?
3. **Predicting** What might be the speed of sound at 30°C?

Speed of Sound in Dry Air

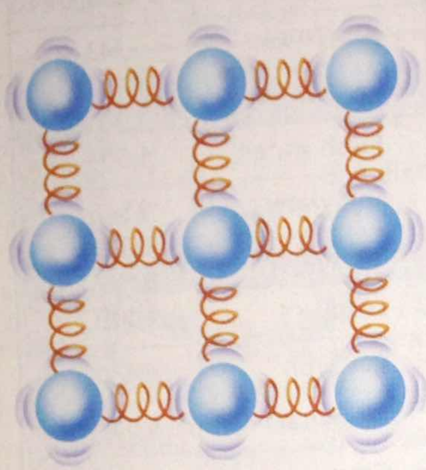


Elasticity If you stretch a rubber band and then let it go, it returns to its original shape. However, when you stretch modeling clay and then let it go, it stays stretched. Rubber bands are more elastic than modeling clay. **Elasticity** is the ability of a material to bounce back after being disturbed.

The elasticity of a medium depends on how well the medium's particles bounce back after being disturbed. To understand this idea, look at Figure 5. In this model, the particles of a medium are linked by springs. If one particle is disturbed, it is pulled back to its original position. In an elastic medium, such as a rubber band, the particles bounce back quickly. But in a less elastic medium, the particles bounce back slowly.

The more elastic a medium, the faster sound travels in it. Sounds can travel well in solids, which are usually more elastic than liquids or gases. The particles of a solid do not move very far, so they bounce back and forth quickly as the compressions and rarefactions of the sound waves pass by. Most liquids are not very elastic. Sound does not travel as well in liquids as it does in solids. Gases generally are not very elastic. Sound travels slowly in gases.

FIGURE 5
Modeling Elasticity
You can model elasticity by representing the particles in a medium as being held together by springs.



Density The speed of sound also depends on the density of a medium. **Density** is how much matter, or mass, there is in a given amount of space, or volume. The denser the medium, the more mass it has in a given volume. Figure 6 shows two cubes that have the same volume. The brass cube is denser because it has more mass in a given volume.

In materials in the same state of matter—solid, liquid, or gas—sound travels more slowly in denser mediums. The particles of a dense material do not move as quickly as those of a less dense material. Sound travels more slowly in dense metals, such as lead or silver, than in iron or steel.

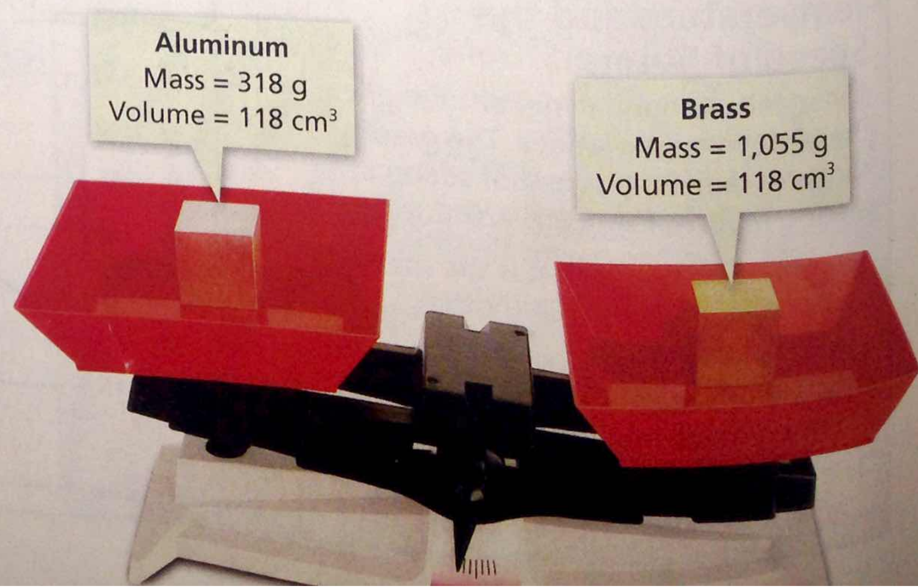


FIGURE 6
Comparing Density
The volumes of these cubes are the same, but the brass cube has more mass.
Interpreting Photographs *Which cube has a greater density: brass or aluminum?*

Temperature In a given medium, sound travels more slowly at lower temperatures than at higher temperatures. Why? At a low temperature, the particles of a medium move more slowly than at a high temperature. So, they are more difficult to move, and return to their original positions more slowly. For example, at 20°C, the speed of sound in air is about 343 m/s. But at 0°C, the speed of sound is about 330 m/s.

At higher altitudes, the air is colder than at lower altitudes, so sound travels more slowly at higher altitudes. On October 14, 1947, Captain Chuck Yeager of the United States Air Force used this knowledge to fly faster than the speed of sound.

To fly faster than the speed of sound, Captain Yeager flew his plane to an altitude of more than 12,000 meters. Here, the air temperature was –59°C. The speed of sound at this temperature is only about 293 m/s. At 12,000 meters, Captain Yeager accelerated his plane to a record-breaking 312 m/s. By doing this, he became the first person to "break the sound barrier."

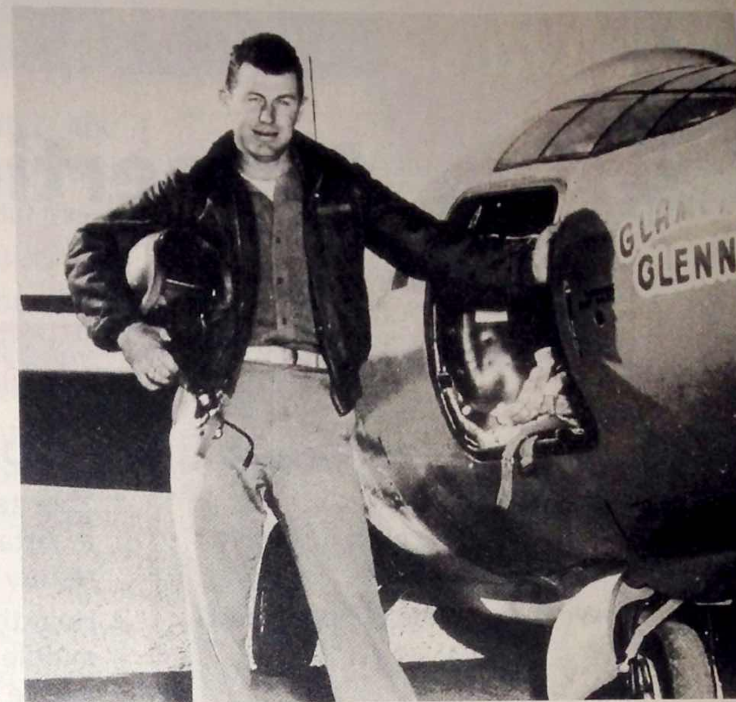


FIGURE 7
Breaking the Sound Barrier
On October 14, 1947, Captain Chuck Yeager became the first person to fly a plane faster than the speed of sound.

Reading Checkpoint How does temperature affect the speed of sound?

Section 1 Assessment

Target Reading Skill **Identifying Main Ideas** Use your graphic organizer to help you answer Question 2 below.

Reviewing Key Concepts

1. a. **Reviewing** What is sound?
   b. **Explaining** How is a sound wave produced?
   c. **Sequencing** Explain how a ringing telephone can be heard through a closed door.
2. a. **Listing** What are three ways that sound waves can interact?
   b. **Applying Concepts** Explain why you can hear a teacher through the closed door of a classroom.
   c. **Inferring** At a scenic overlook, you can hear an echo only if you shout in one particular direction. Explain why.
3. a. **Identifying** What property describes how a material bounces back after being disturbed?
   b. **Summarizing** What three properties of a medium affect the speed of sound?
   c. **Developing Hypotheses** Steel is denser than plastic, yet sound travels faster in steel than in plastic. Develop a hypothesis to explain why.

Lab zone **At-Home Activity**

Ear to the Sound Find a long metal fence or water pipe. **CAUTION:** *Beware of sharp edges and rust.* Put one ear to one end of the pipe while a family member taps on the other end. In which ear do you hear the sound first? Explain your answer to your family members. What accounts for the difference?

Section 2

Properties of Sound

Reading Preview

Key Concepts

- What factors affect the loudness of a sound?
- What does the pitch of a sound depend on?
- What causes the Doppler effect?

Key Terms

- loudness
- intensity
- decibel (dB)
- pitch
- ultrasound
- infrasound
- larynx
- Doppler effect

Target Reading Skill

Outlining An outline shows the relationship between main ideas and supporting ideas. As you read, make an outline about the properties of sound. Use the red headings for the main ideas and the blue headings for the supporting ideas.

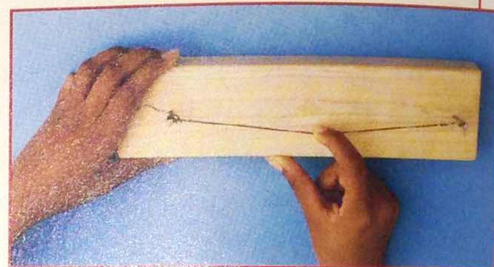
Properties of Sound

I. Loudness
  A. Energy of a sound source
  B.
  C.
II. Pitch
  A.

Lab zone Discover Activity

How Does Amplitude Affect Loudness?

1. Your teacher will give you a wooden board with two nails in it. Attach a guitar string to the nails by wrapping each end tightly around a nail and tying a knot.
2. Hold the string near the middle. Pull it about 1 cm to one side. This distance is the amplitude of vibration. Let it go. How far does the string move to the other side? Describe the sound you hear.



3. Repeat Step 2 four more times. Each time, pull the string back a greater distance. Describe how the sound changes each time.

Think It Over

Forming Operational Definitions How would you define the amplitude of the vibration? What effect did changing the amplitude have on the sound?

Suppose that you and a friend are talking on a sidewalk and a noisy truck pulls up next to you and stops, leaving its motor running. What would you do? You might talk louder, almost shout, so your friend can hear you. You might lean closer and speak into your friend's ear so you don't have to raise your voice. Or you might walk away from the noisy truck so it's not as loud.

Loudness

Loudness is an important property of sound. **Loudness** describes your perception of the energy of a sound. In other words, loudness describes what you hear. You probably already know a lot about loudness. For example, you know that your voice is much louder when you shout than when you speak softly. The closer you are to a sound, the louder it is. Also, a whisper in your ear can be just as loud as a shout from a block away. **The loudness of a sound depends on two factors: the amount of energy it takes to make the sound and the distance from the source of the sound.**

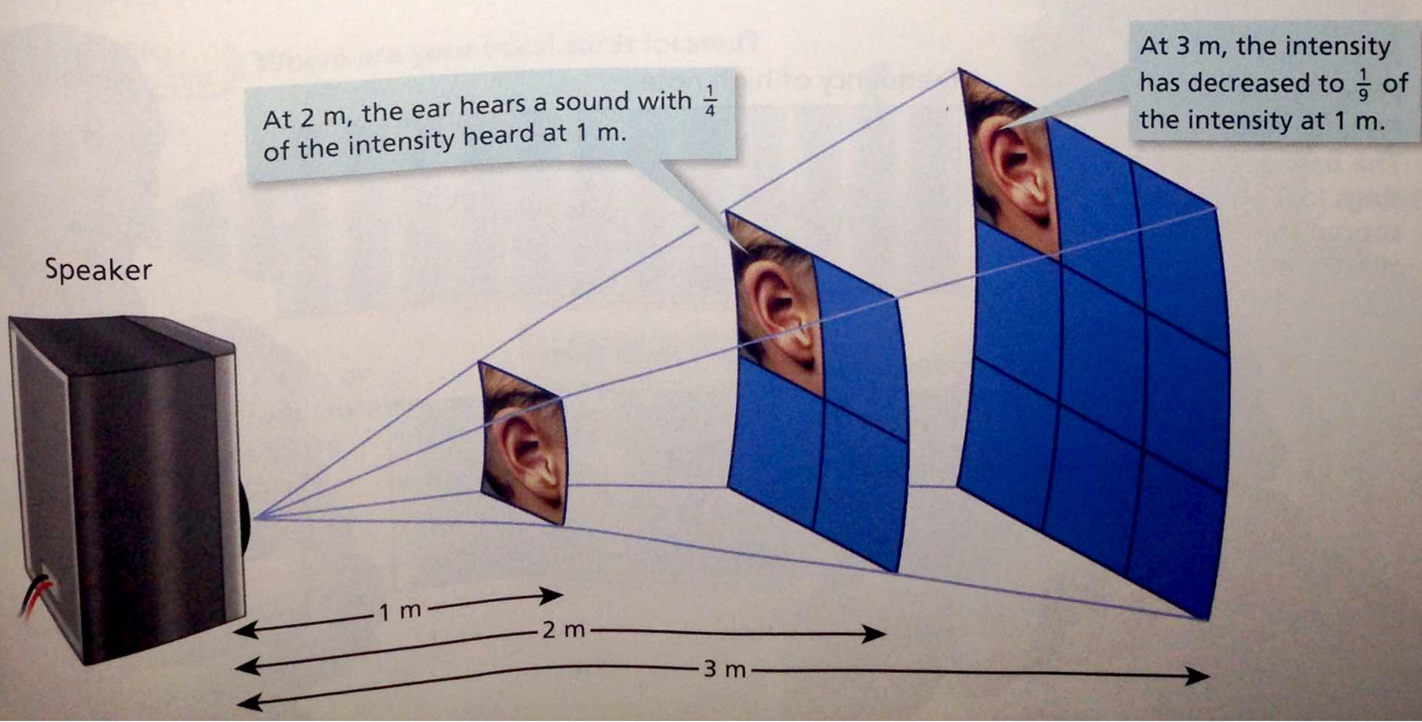
Energy of a Sound Source In general, the greater the energy used to make a sound, the louder the sound. If you did the Discover activity, you may have noticed this. The more energy you used to pull the guitar string back, the louder the sound when you let the string go. This happened because the more energy you used to pull the string, the greater the amplitude of the string's vibration. A string vibrating with a large amplitude produces a sound wave with a large amplitude. Recall that the greater the amplitude of a wave, the more energy the wave has. So, the larger the amplitude of the sound wave, the more energy it has and the louder it sounds.

Distance From a Sound Source If your friend is speaking in a normal voice and you lean in closer, your friend's voice sounds louder. Loudness increases the closer you are to a sound source. But why?

Imagine ripples spreading out in circles after you toss a pebble into a pond. In a similar way, a sound wave spreads out from its source. Close to the sound source, the sound wave covers a small area, as you can see in Figure 8. As the wave travels away from its source, it covers more area. The total energy of the wave, however, stays the same whether it is close to the source or far from it. Therefore, the closer the sound wave is to its source, the more energy it has in a given area. The amount of energy a sound wave carries per second through a unit area is its **intensity.** A sound wave of greater intensity sounds louder. As you move away from a sound source, loudness decreases because the intensity decreases.

FIGURE 8
Intensity and Distance

Because sound waves spread out, intensity decreases with distance from the source.
Interpreting Diagrams *How does the intensity at 3 meters compare to the intensity at 2 meters?*



Measuring Loudness	
Sound	Loudness (dB)
Rustling leaves	10
Whisper	15–20
Very soft music	20–30
Normal conversation	40–50
Heavy street traffic	60–70
Loud music	90–100
Rock concert	110–120
Jackhammer	120
Jet plane at takeoff	120–160

FIGURE 9
Some sounds are so soft that you can barely hear them. Others are so loud that they can damage your ears. **Interpreting Data** *Which sounds louder, a rock concert or a jet plane at takeoff?*

Measuring Loudness The loudness of different sounds is compared using a unit called the **decibel (dB).** Figure 9 shows the loudness of some familiar sounds. The loudness of a sound you can barely hear is about 0 dB. Each 10-dB increase in loudness represents a tenfold increase in the intensity of the sound. For example, soft music at 30 dB sounds ten times louder than a 20-dB whisper. The 30-dB music is 100 times louder than the 10-dB sound of rustling leaves. Sounds louder than 100 dB can cause damage to your ears, especially if you listen to those sounds for long periods of time.

Reading Checkpoint What is a decibel?

Pitch

Pitch is another property of sound you may already know a lot about. Have you ever described someone's voice as "high-pitched" or "low-pitched?" The **pitch** of a sound is a description of how high or low the sound seems to a person. **The pitch of a sound that you hear depends on the frequency of the sound wave.**

Pitch and Frequency Sound waves with a high frequency have a high pitch. Sound waves with a low frequency have a low pitch. Frequency is measured in hertz (Hz). For example, a frequency of 50 Hz means 50 vibrations per second. Look at Figure 10. A bass singer can produce frequencies lower than 80 Hz. A trained soprano voice can produce frequencies higher than 1,000 Hz.

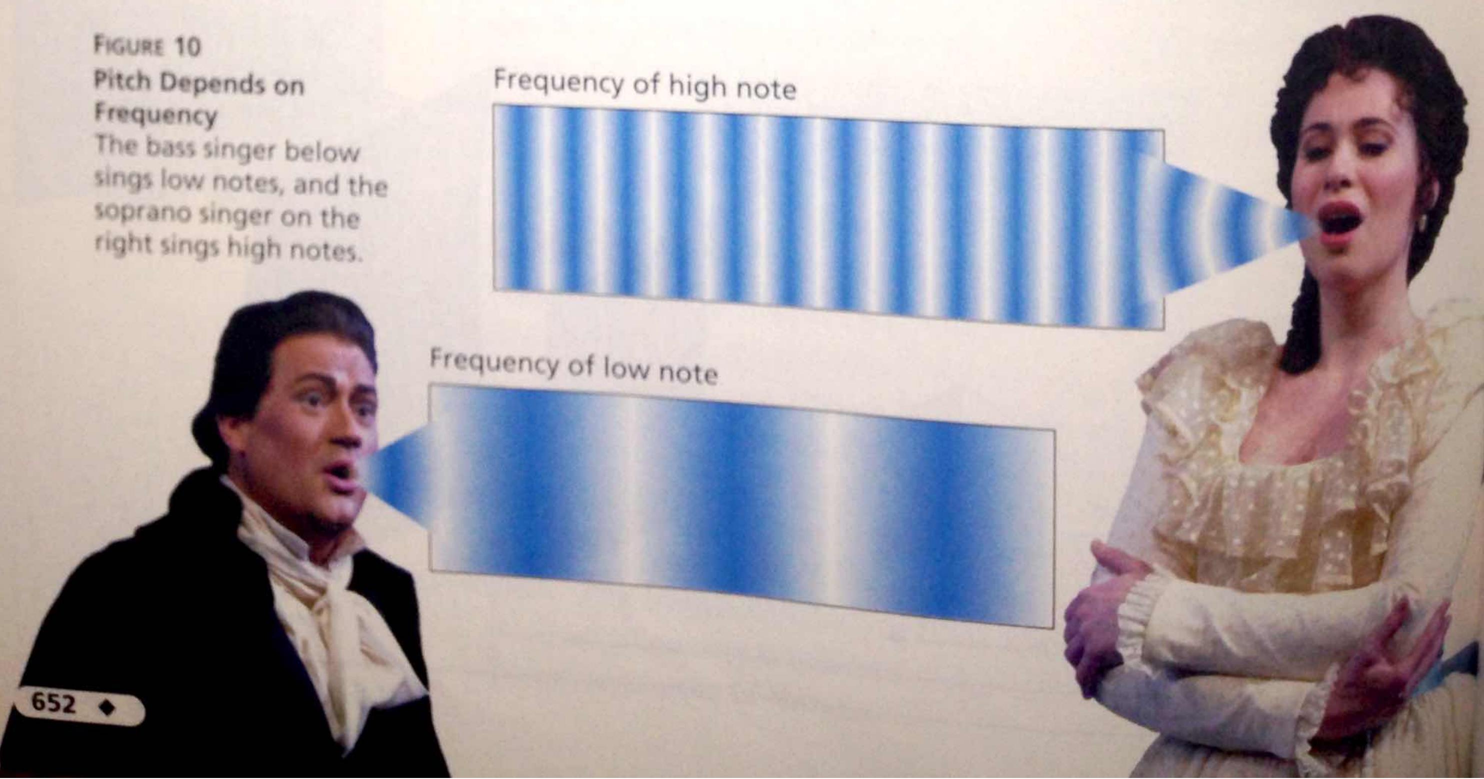


FIGURE 10
Pitch Depends on Frequency
The bass singer below sings low notes, and the soprano singer on the right sings high notes.

Most people can hear sounds with frequencies between 20 Hz and 20,000 Hz. Sound waves with frequencies above the normal human range of hearing are called **ultrasound.** The prefix *ultra-* means "beyond." Sounds with frequencies below the human range of hearing are called **infrasound.** The prefix *infra-* means "below." People cannot hear either ultrasound waves or infrasound waves.

Changing Pitch Pitch is an important property of music because music usually uses specific pitches called notes. To sing or play a musical instrument, you must change pitch often.

When you sing, you change pitch using your vocal cords. Your vocal cords are located in your voice box, or **larynx,** as shown in Figure 11. When you speak or sing, air from your lungs is forced up the trachea, or windpipe. Air then rushes past your vocal cords, making them vibrate. This produces sound waves. Your vocal cords are able to vibrate more than 1,000 times per second!

To sing different notes, you use muscles in your throat to stretch and relax your vocal cords. When your vocal cords stretch, they vibrate more quickly as the air rushes by them. This creates higher-frequency sound waves that have higher pitches. When your vocal cords relax, lower-frequency sound waves with lower pitches are produced.

With musical instruments, you change pitch in different ways depending on the instrument. For example, you can change the pitch of a guitar string by turning a knob to loosen or tighten the string. A tighter guitar string produces a higher frequency, which you hear as a note with higher pitch.

Reading Checkpoint Where are your vocal cords located?

Lab zone Skills Activity

Predicting

1. Flatten one end of a drinking straw and cut the end to form a point.
2. Blow through the straw. Describe what you hear.
3. Predict what changes you would hear if you shortened the straw by cutting off some of the straight end. Test your prediction by making two new straws of different lengths.

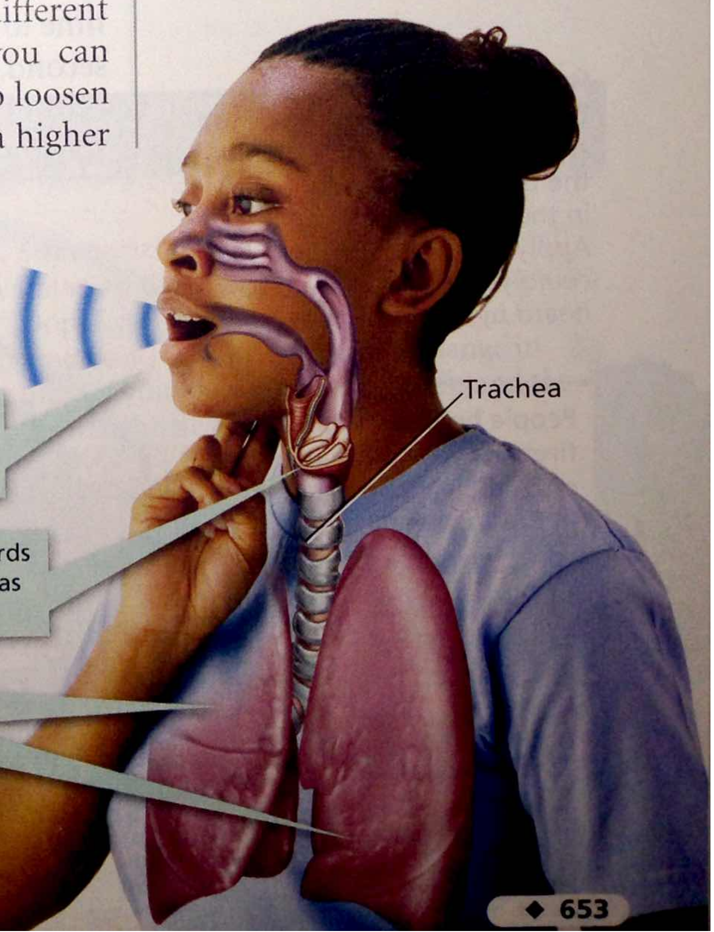


FIGURE 11
The Human Voice
When a person speaks or sings, the vocal cords vibrate. The vibrations produce sound waves in the air.

Lab zone **Try This Activity**

Pipe Sounds

1. Find an open space without objects or people nearby.
2. Hold the end of a flexible plastic tube firmly (a vacuum cleaner hose works well). Swing the tube in a circle over your head to produce a sound.
3. Keeping the speed steady, listen to the sound. Have a partner stand at a safe distance and listen at the same time.

Observing Describe the sound you heard. How is it different from the sound your partner heard? Explain the difference.

The Doppler Effect

If you listen carefully to the siren of a firetruck on its way to a fire, you will notice something surprising. As the truck goes by you, the pitch of the siren drops. But the pitch of the siren stays constant for the firefighters in the truck. The siren's pitch changes only if it is moving toward or away from a listener.

The change in frequency of a wave as its source moves in relation to an observer is called the **Doppler effect.** If the waves are sound waves, the change in frequency is heard as a change in pitch. The Doppler effect is named after the Austrian scientist Christian Doppler (1803–1853).

What Causes the Doppler Effect? Figure 12 shows how sound waves from a moving source behave. When the source moves toward a listener, the frequency of the waves is higher than it would be if the source were stationary. **When a sound source moves, the frequency of the waves changes because the motion of the source adds to the motion of the waves.**

To understand why the frequency changes, imagine that you are standing still and throwing tennis balls at a wall in front of you. If you throw one ball each second the balls hit the wall at a rate of one per second. Now suppose you walk toward the wall while still throwing one ball per second. Because each ball has a shorter distance to travel than the one before, each takes less time to get there. The balls hit the wall more often than one per second, so the frequency is higher. On the other hand, if you throw balls at the wall as you back away, each ball has farther to travel and the frequency is lower.

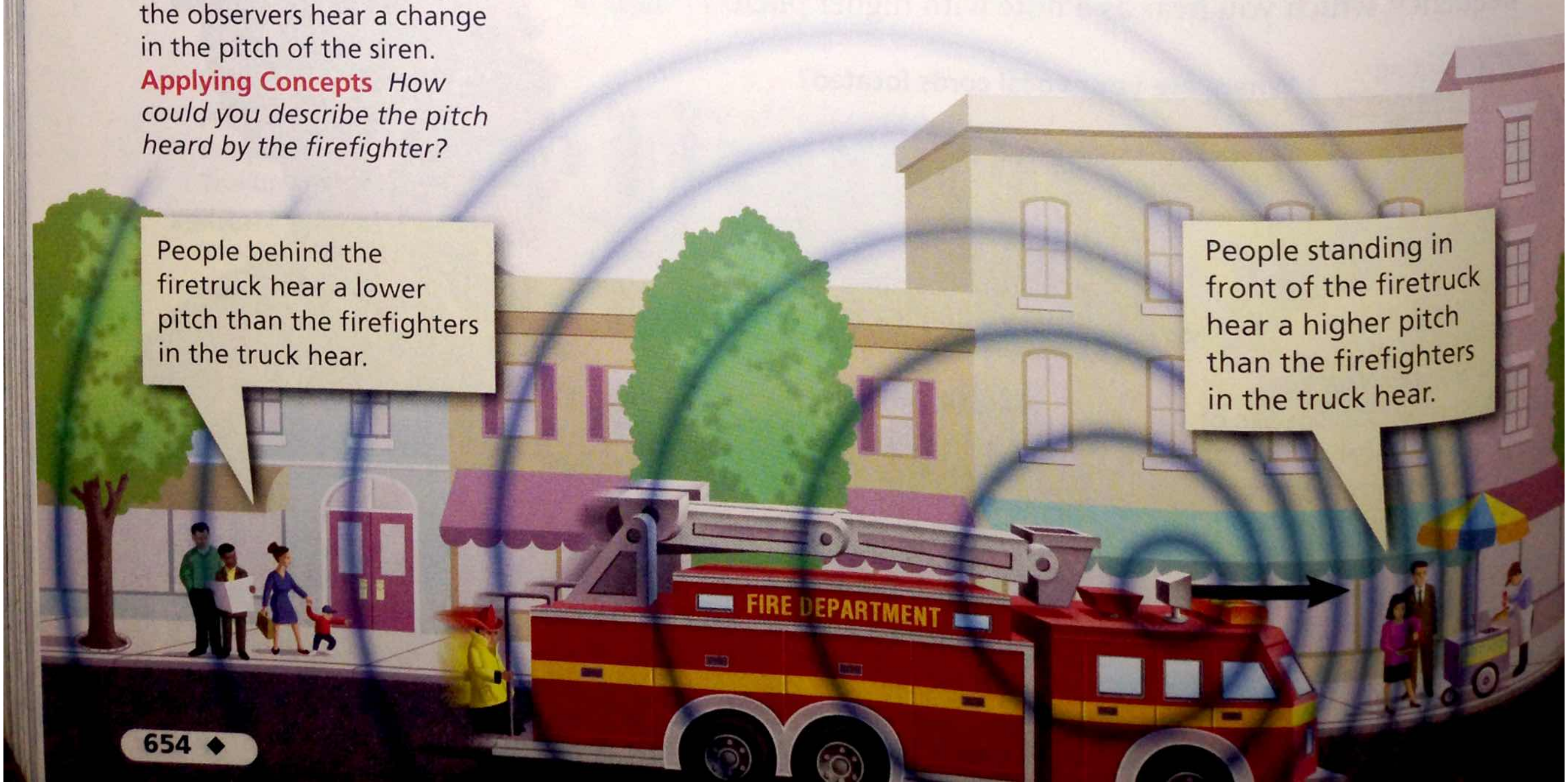
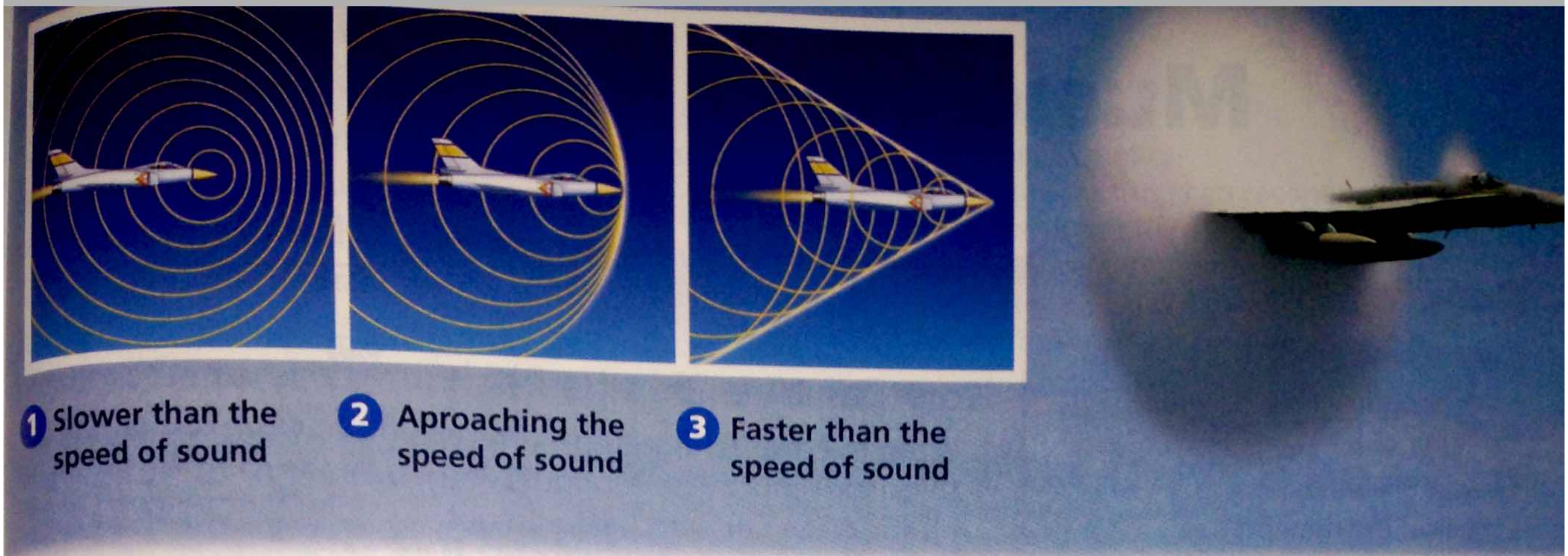


FIGURE 12
The Doppler Effect
As the firetruck speeds by, the observers hear a change in the pitch of the siren.
Applying Concepts *How could you describe the pitch heard by the firefighter?*



What Causes Shock Waves? At high speed, the Doppler effect can be spectacular. Look at Figure 13. When the plane travels almost as fast as the speed of sound, the sound waves pile up in front of the plane. This pile-up is the "sound barrier." As the plane flies faster than the speed of sound, it moves through the barrier. A shock wave forms as the sound waves overlap. The shock wave releases a huge amount of energy. People nearby hear a loud noise called a sonic boom when the shock wave passes by them.

FIGURE 13
Breaking the Sound Barrier
When a plane goes faster than the speed of sound, a shock wave is produced. The photo on the right shows how sudden changes in pressure at this speed can cause a small cloud to form.

Reading Checkpoint What is a shock wave?

Section 2 Assessment

Target Reading Skill Outlining Use the information in your outline about the properties of sound to help you answer the questions below.

Reviewing Key Concepts

1. a. **Identifying** What two factors affect the loudness of a sound?
   b. **Applying Concepts** Why does moving away from a radio affect the loudness you hear?
   c. **Calculating** A band plays music at 60 dB and then changes to a rock song at 80 dB. How many times louder is the rock song?
2. a. **Reviewing** What determines the pitch of a sound?
   b. **Comparing and Contrasting** How are high-pitch sounds different from low-pitch sounds?
   c. **Explaining** How do your vocal cords produce different pitches?
3. a. **Summarizing** What is the Doppler effect?
   b. **Relating Cause and Effect** What causes the Doppler effect?
   c. **Predicting** Would you hear a change in pitch if you are on a moving train and the train's whistle blows? Explain.

Lab zone At-Home Activity

Hum Stopper When listening to a cat's heart, a veterinarian will cover the cat's nostrils to keep the cat from purring. At home, ask family members to hum with their lips closed. Then ask them to cover both of their nostrils while humming. Use Figure 11 to explain what happened.

Section 4

Integrating Life Science

How You Hear Sound

Reading Preview

Key Concepts

- What is the function of each section of the ear?
- What causes hearing loss?

Key Terms

- ear canal
- eardrum
- cochlea

Target Reading Skill

Sequencing A sequence is the order in which the steps in a process occur. As you read, make a flowchart that shows how you hear sound. Put the steps of the process in separate boxes in the order in which they occur.

How You Hear Sound

The outer ear funnels sound waves into the ear canal.

↓

Sound waves make the eardrum vibrate.

↓

Lab zone Discover Activity

Where Is the Sound Coming From?

1. Ask your partner to sit on a chair, with eyes closed.
2. Clap your hands near your partner's left ear. Ask your partner what direction the sound came from. Record the answer.
3. Now clap near your partner's right ear. Again, ask your partner what direction the sound came from and record the answer. Continue clapping in different locations around your partner's head and face. How well did your partner identify the directions the sounds came from?
4. Switch places with your partner and repeat Steps 1–3.

Think It Over

Observing From which locations are claps easily identified? For which locations are claps impossible to identify? Is there a pattern? If so, suggest an explanation for the pattern.

The house is quiet. You are sound asleep. All of a sudden, your alarm clock goes off. Startled, you jump up out of bed. Your ears detected the sound waves produced by the alarm clock. But how exactly did your brain receive the information?

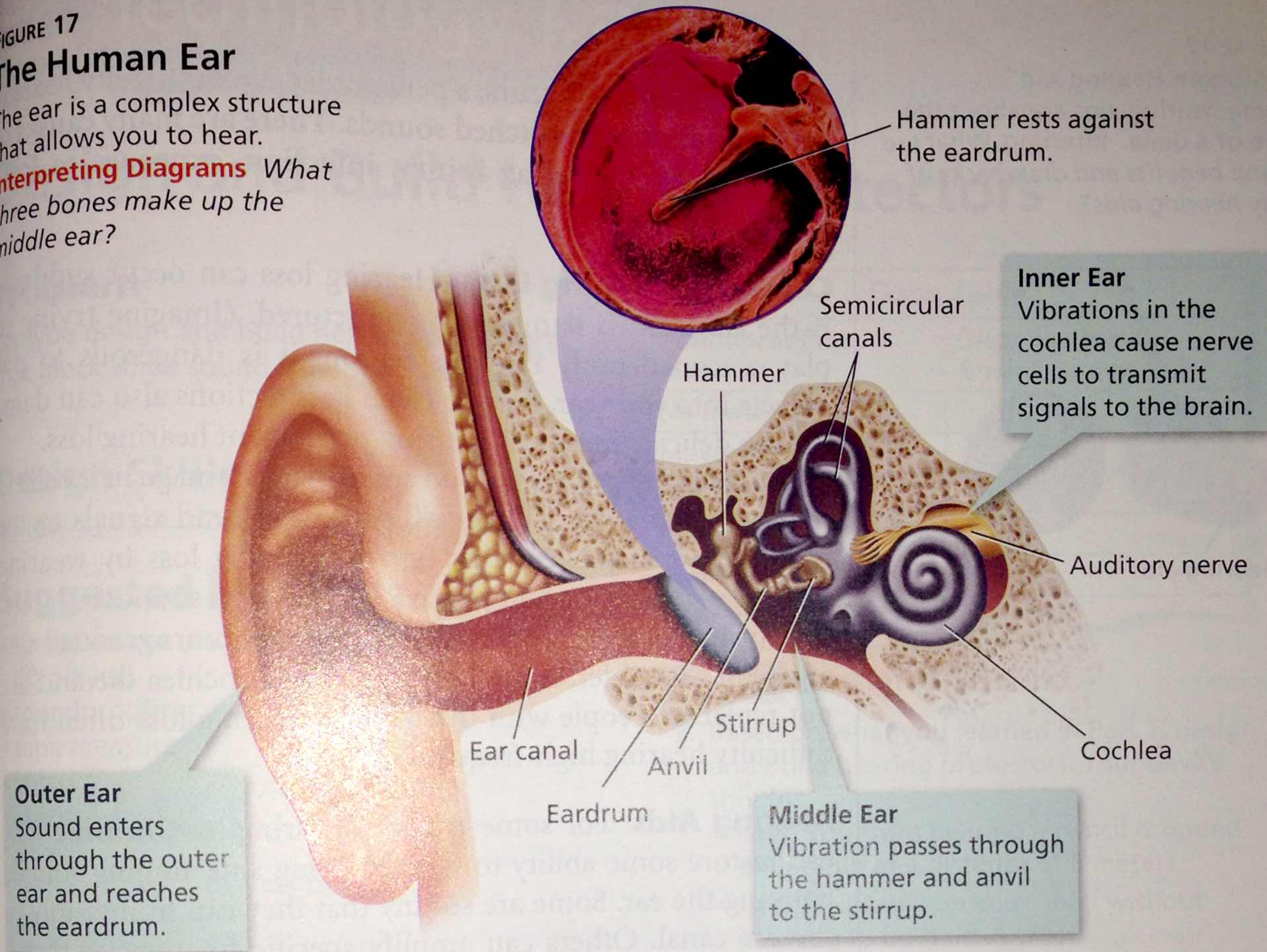
The Human Ear

The function of your ear is to gather sound waves and send, or transmit, information about sound to your brain. Your ear has three main sections: the outer ear, the middle ear, and the inner ear. Each section has a different function. **The outer ear funnels sound waves, the middle ear transmits the waves inward, and the inner ear converts sound waves into a form that travels to your brain.**

Outer Ear Look at Figure 17. The first section of your ear is the outer ear. The outermost part of your outer ear looks and acts like a funnel. It collects sound waves and directs them into a narrow region called the **ear canal.** Your ear canal is a few centimeters long and ends at the eardrum. The **eardrum** is a small, tightly stretched, drumlike membrane. The sound waves make your eardrum vibrate, just as a drum vibrates when you strike it.

FIGURE 17
The Human Ear

The ear is a complex structure that allows you to hear.
Interpreting Diagrams *What three bones make up the middle ear?*



Middle Ear Behind the eardrum is the middle ear. The middle ear contains the three smallest bones in your body—the hammer, the anvil, and the stirrup. The hammer is attached to the eardrum, so when the eardrum vibrates, the hammer does too. The hammer then transmits vibrations first to the anvil and then to the stirrup.

Inner Ear A membrane separates the middle ear from the inner ear, the third section of the ear. When the stirrup vibrates against this membrane, the vibrations pass into the cochlea. The **cochlea** (KAHK lee uh) is a fluid-filled cavity shaped like a snail shell. The cochlea contains more than 10,000 tiny structures called hair cells. These hair cells have hairlike projections that float in the fluid of the cochlea. When vibrations move through the fluid, the hair cells move, causing messages to be sent to the brain through the auditory nerve. The brain processes these messages and tells you that you've heard sound.

Reading What are the three main sections of the ear?

Lab zone Try This Activity

Listen to This

1. Tie two strings to the handle of a metal spoon. Each string should be about 40 cm long.
2. Hold the loose end of each string in each hand. Bump the spoon against a desk or other hard solid object. Listen to the sound.
3. Now wrap the ends of the string around your fingers. Put your index fingers against your ears and bump the spoon again. How is the sound different?

Inferring What can you infer about how sound travels to your ears?

FIGURE 18
A Modern Hearing Aid
Some hearing aids are about the size of a dime. **Inferring** *What are some benefits and drawbacks of tiny hearing aids?*

Hearing Loss

When hearing loss occurs, a person may have difficulty hearing soft sounds or high-pitched sounds. **There are many causes of hearing loss, including injury, infection, exposure to loud sounds, and aging.**

Causes of Hearing Loss Hearing loss can occur suddenly if the eardrum is damaged or punctured. (Imagine trying to play a torn drum!) For this reason, it is dangerous to put objects into your ear, even to clean it. Infections also can damage the delicate inner ear, causing permanent hearing loss.

Extended exposure to loud sounds can damage hair cells in the ear. The damaged cells will no longer send signals to the brain. You can prevent this type of hearing loss by wearing hearing protection when you are around loud sounds.

The most common type of hearing loss occurs gradually. As a person gets older, some hair cells in the cochlea die and are not replaced. People with this kind of hearing loss often have difficulty hearing high-frequency sounds.

Hearing Aids For some types of hearing loss, hearing aids can restore some ability to hear. Hearing aids amplify sounds entering the ear. Some are so tiny that they can fit invisibly in the ear canal. Others can amplify specific frequencies that a person has lost the ability to hear.

Reading Checkpoint What happens when a hearing loss occurs?

Section 4 Assessment

Target Reading Skill Sequencing Refer to your flowchart about hearing as you answer Question 1.

Reviewing Key Concepts

1. a. **Identifying** What is the function of each section of your ear?
   b. **Interpreting Diagrams** Look at Figure 17. What happens to a sound wave as it enters your ear canal?
   c. **Relating Cause and Effect** How are sound waves transmitted through the middle ear?
2. a. **Listing** What are four causes of hearing loss?
   b. **Explaining** How can loud sounds lead to hearing loss?
   c. **Making Judgments** Should people at a rock concert wear earplugs? Why or why not?

Lab zone At-Home Activity

Sound Survey Ask family members to survey the sounds they hear in a day. Ask them to rate the sounds as quiet, normal, loud, or painful. Then rate each sound as pleasant, neutral, or annoying. For each sound record the source, location, time of day, and time exposed to the sound. How are the ratings similar? How are they different?