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K-1: The Senses

Our Sense of Hearing

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Activities from the *K-1: The Senses Teacher's Guide* may be used alone or with integrated unit components. The Learning Brain: Senses unit is comprised of the guide, a PowerPoint® slide set, "What Sound Is It?" for use with the activity, "Our Sense of Hearing," and a student storybook, *Making Sense!* (available as a PowerPoint® file and in PDF format). All files are available free-of-charge at BioEd Online (www.bioedonline.org).

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Our Sense of Hearing

Guiding Questions

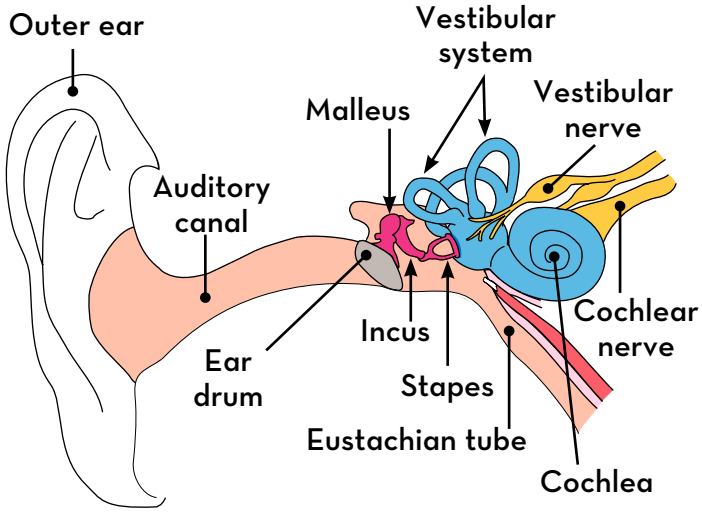
What causes sound? How do our ears detect sound? How do our brains recognize sound?

Concepts

- *All of the senses are connected to the brain.*
- *Our senses let us know what is going on inside and outside our bodies.*
- *The sense of hearing allows us to detect sounds.*
- *Sound is produced by vibration.*
- *Objects vibrate when they move back and forth in a regular fashion.*
- *Information about sound is collected by sensory receptors in the ears and transmitted to the brain.*

Time

Setup: 5 minutes
Class: 2 to 3 sessions of 45 minutes each



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Sound is produced when an object vibrates in air (or another medium, such as water) and produces alternating bands of high and low pressure, known as sound waves (or compression waves). Sound waves possess very low levels of energy, but our ears and brain are able to detect the frequency and loudness of many sounds, and to locate sound sources.

Listening to loud music through ear buds can lead to hearing loss. To protect hearing, avoid listening at high volume levels (above 85 decibels) or for long periods of time.

The human ear is designed to collect sound waves and detect minute changes in air pressure outside the body. The outer ear consists of the ear flap and a short passageway, known as the auditory canal. The eardrum, or tympanic membrane, is located at the inner end of the auditory canal. It bulges inward or outward in response to pressure changes caused by sound waves. The three tiny, interconnected bones of the middle ear (malleus, incus, stapes) amplify this movement.

Another membrane separates the middle ear from the inner ear, a complicated labyrinth of interconnected fluid-filled chambers and canals called the vestibular system. The upper group of canals is critical to our sense of balance. The lower canal, known as the cochlea, is coiled like a snail shell and filled with fluid. It converts

pressure waves into impulses that are sent along sensory neurons to the auditory centers in the brain. A special part of the cerebrum receives and interprets information about sound.

Humans and many other species have specialized organs to produce sounds, such as those in speech or songs, which are important for communication. Most mammals, reptiles and amphibians have a larynx, or voice box, in their necks. The larynx contains the vocal cords, which produce sound as air is expelled from the lungs. The tongue, lips and mouth also have important roles in configuring the sounds produced.

MATERIALS

Teacher (See Setup)

- 20-cm piece of string
- Aluminum pie pan
- Classroom human body diagram (see the activity, "The Brain: Protection")
- Large rubber band
- Pair of scissors
- Ping pong ball
- Set of images of "sound settings" (locations where a variety of sounds might be expected, such as a zoo, farm, band performance, stormy weather, etc.)
- Tape
- Tuning fork
- LCD projector and computer or whiteboard
- "Ear Diagram" page in PDF format (to project)
- Web Metronome's online metronome (see Setup)
- "What Sound Is It?" slide set (http://www.bioedonline.org/lessons-and-more/teacher-guides/k-1-the-senses/

Per Student

- 2 paper cups
- Mirror
- Pair of scissors
- Copy of both "What Sound Is It?" pages

SETUP

Collect pictures of settings where different sounds can be heard (zoo, farm, band performance, stormy weather, freeway, etc.). Gather enough images for groups of 2-4 students to share.

Make copies of the "What Sound Is It?" pages.

Part 1. Tape a 20-centimeter long piece of string to the ping pong ball.

Fill the pie pan halfway with water.

Prior to class, access the online metronome on the Web Metronome page (http://www.webmetronome.com), and adjust the volume so that a faint sound can be heard.

Part 2. Load a PDF of the "Ear Diagram" page for projecting.

Part 3. Load the slide set "What Sound Is It?" which contains audio files. Adjust the sound level for students to hear.

How Loud Is Too Loud?

The sound is too loud when any of the following occur.

- *You have to raise your voice to be understood by someone standing nearby.*
- *The noise hurts your ears.*
- *You develop a buzzing or ringing sound in your ears, even temporarily.*
- *You don't hear as well as you normally do until several hours after you get away from the noise.*

If you are around noises at this level, take protective action.

- *Turn down the sound.*
- *Avoid the noise (walk away).*
- *Block the noise (wear earplugs or earmuffs).*

Source: It's a Noisy Planet. National Institute on Deafness and Other Communication Disorders, National Institutes of Health. http://www.noisyplanet.nidcd.nih.gov/info/Pages/howloud.aspx

PROCEDURE

Part 1

1. Discretely start the online metronome. The volume should be just loud enough for students to hear the ticking sound.
2. Instruct students to sit quietly in a circle around you and tell them to listen carefully for sounds. After a minute or so, have students share their observations. Ask, *What sounds did you hear? Did you notice any sound that you don't normally hear? What do you think is causing the sound?* After discussion, reveal

the source of the sound and turn it off. Explain that students will be investigating their sense of hearing.

3. Ask, *How are sounds created?* Allow students to share ideas. Hold up a large rubber band and stretch it between your hands. Select a student to come up and pluck the rubber band. Have students listen carefully, and ask if they can hear a sound. It may be slight, but they should be able to hear the rubber band. Ask, *What did you observe when the rubber band made the sound?* (It moved back and forth.) Tell students this rapid back-and-forth motion is called vibration. Ask if they can think of any other place where they have seen vibration. Discuss their ideas.
4. Hold up the tuning fork. Ask if anyone knows what the object is and/or what it does. Direct students to be very quiet and listen. Make the tuning fork vibrate by holding the handle lightly and striking one of the tines or prongs on the sole of your shoe, or (softly) on a harder-edged surface. Be careful not to strike too hard, as the tuning fork could break.
5. Ask, *What did you hear? Was the sound loud or soft?* Strike the tuning fork again and move around the room so that all the students have a chance to hear the sound and observe the tuning fork up close.
6. Ask, *Can you see the tuning fork vibrating?* [It is usually not possible to observe the vibration.] Next, ask students to observe what happens when you strike the tuning fork and then dangle the ping pong ball next to it. Ask, *What happened?* (The ping pong ball will bounce back and forth when it touches the side of the vibrating tuning fork.)
7. For another demonstration, use an aluminum pie pan half-filled with water. As students look on, strike the tuning fork and immediately place the tip into the water. Ask, *What is happening?* Students will observe that the water "jumps" when it is contacted by the vibrating tuning fork.
8. Tell students that they can experience sound caused by vibration in their own bodies. Instruct them to hum softly while placing two fingers on the front of their throats. Ask, *Are you making sound? What is moving?* Explain that when they hum, talk or sing, or make any sound, air moves inside their throats and across the vocal cords, causing them to move back and forth. Make sure students understand that all sound is caused by vibration.
9. Tell students that a vibrating object pushes the material (air, water, etc.) that surrounds it. If an object vibrates in air, for example, the air is pushed outward in waves, like the movement they observed with the ping pong ball, or water in the pan. Have students draw and label the tuning fork and ball using wiggly lines to indicate vibration.

Typical Sounds in Decibels (dB)

160	Perforated eardrums possible: Rocket launches
150	Firecrackers
140	Jet engine takeoff
130	Immediate pain: Jackhammers
120	Immediate discomfort: Emergency sirens
110	Music concerts, sporting events
100	iPod/MP3 player with earbuds at full volume
90	OSHA required protection: Power tools, mowers
80	Busy traffic, school cafeteria
70	Vacuum cleaners, hair dryers
60	Normal conversation
50	Average home in the city, quiet office
40	Refrigerators
30	Whispers
20	Rustling leaves
10	Breathing
0	Threshold of human hearing (1,000 Hz)

Part 2

1. Ask, *Which sense enables you detect sounds?* [Hearing] Follow by asking, What part of your body enables you to hear? Ask students to point to their hearing detectors. [Ears] Remind students that they have been learning about how all of our senses are all connected to. . . what? Hopefully, they will reply, "The brain!"
2. Give each student a mirror with which to carefully observe his or her own ears. Students should then draw their ears in their notebooks. Or, have students observe and draw the ear of a partner.
3. Ask, *Are your ears like those of other animals?* Discuss. For instance, ask, *What do rabbit ears look*

Source: It's a Noisy Planet. National Institute on Deafness and Other Communication Disorders, National Institutes of Health. http://www.noisyplanet.nidcd.nih.gov/info/Pages/howloud.aspx

like? How do they compare to yours? Why do you think the ears of different animals are shaped differently, and are larger or smaller? Explain that ears are "sound catchers" that funnel sound into the ear canal.

4. Tell students that they observed the outer ear, which captures sound from vibrating objects. Follow by explaining there are many more parts inside our ears that help us to hear. Show students the "Ear Diagram." Point out the various parts without emphasizing the names of the parts. Note that sound travels through the ear to receptors that gather and send information about sounds to the brain.
5. Lead a simple investigation in which students test "outer ears" made from paper cups. Have students cut off the bottoms of the cups and place the cups over and around their ears. Then, they can investigate how "pointing" the cup toward a sound impacts their ability to hear it.
6. Using yarn and tape, connect one pair of cups to the brain on the classroom human body diagram. The yarn represents the nerve cells that collect information and deliver it to the brain.
7. Review the following concept with students: the ear receives sound and transmits information to the brain, which makes sense of what is heard. Our brain allows us to recognize and remember sounds, and determine the direction from which a sound is coming.

Part 3

1. Ask students to cheer (all say "yeah" together). Then ask, *Where have you heard cheering before?* Allow students to share answers with the class. Examples could include a ball game, spelling bee, musical event or pep rally.
2. Give each student a copy of both "What Sound Is It?" pages. Tell students that you will be playing some sounds, but instruct them not to shout out answers about what they hear. Instead, students should circle the picture that best represents each sound. Play sounds from the "What Sound Is It?" slide set. After the students have listened to all the sounds, lead a class discussion in which they share their answers. Review the correct answers with the class. (Answers: 1. Ice cream truck. 2. Duck, 3. Beach. 4. Fire truck. 5. Recess. 6. Baby).
3. To extend the lesson, show a picture of a zoo. Ask students to think about sounds they have heard at the zoo, and then share those sounds with the class.
4. Group the class into teams of four students, and provide a different "sound setting" image (collected during setup) to each group. Each image should depict a scene or location where many different sounds can be heard. Explain to students that they will create sounds to accompany their pictures. Allow time for them to brainstorm and practice their sounds.
5. Have each group share its sounds with the class, without identifying their setting. After each presentation, ask the other groups to guess where the sounds might be heard. After several attempts, have the presenting group show its image to the rest of the class.
6. Close by reminding students that all or their senses are controlled by the brain.
7. Have students write one or two sentences about what they learned about sound from this activity.

EXTENSION

Create a simple instrument to observe vibration and sound production. String three large rubber bands around a tissue box. Pluck the rubber bands near the hole of the box. Have students observe what happens. Then, ask, *Are the rubber bands moving back and forth? What is this motion called? Is this vibration producing a sound?*

RECOMMENDED RESOURCE

- Rissman, Rebecca. *Hearing (The Five Senses).* (2010) Heinemann. ISBN: 978-1432936860

What Sound Is It?

Name _____

Circle your answer.

1. What made this sound?

Ambulance

Fire Truck

Ice Cream Truck

2. What made this sound?

Duck

Pigeon

Parrot

3. What made this sound?

Pond

Beach

Waterfall

What Sound Is It?

Name _____

Circle your answer.

4. What made this sound?

Garbage Truck

Fire Truck

Helicopter

5. What made this sound?

Recess

Art

Music

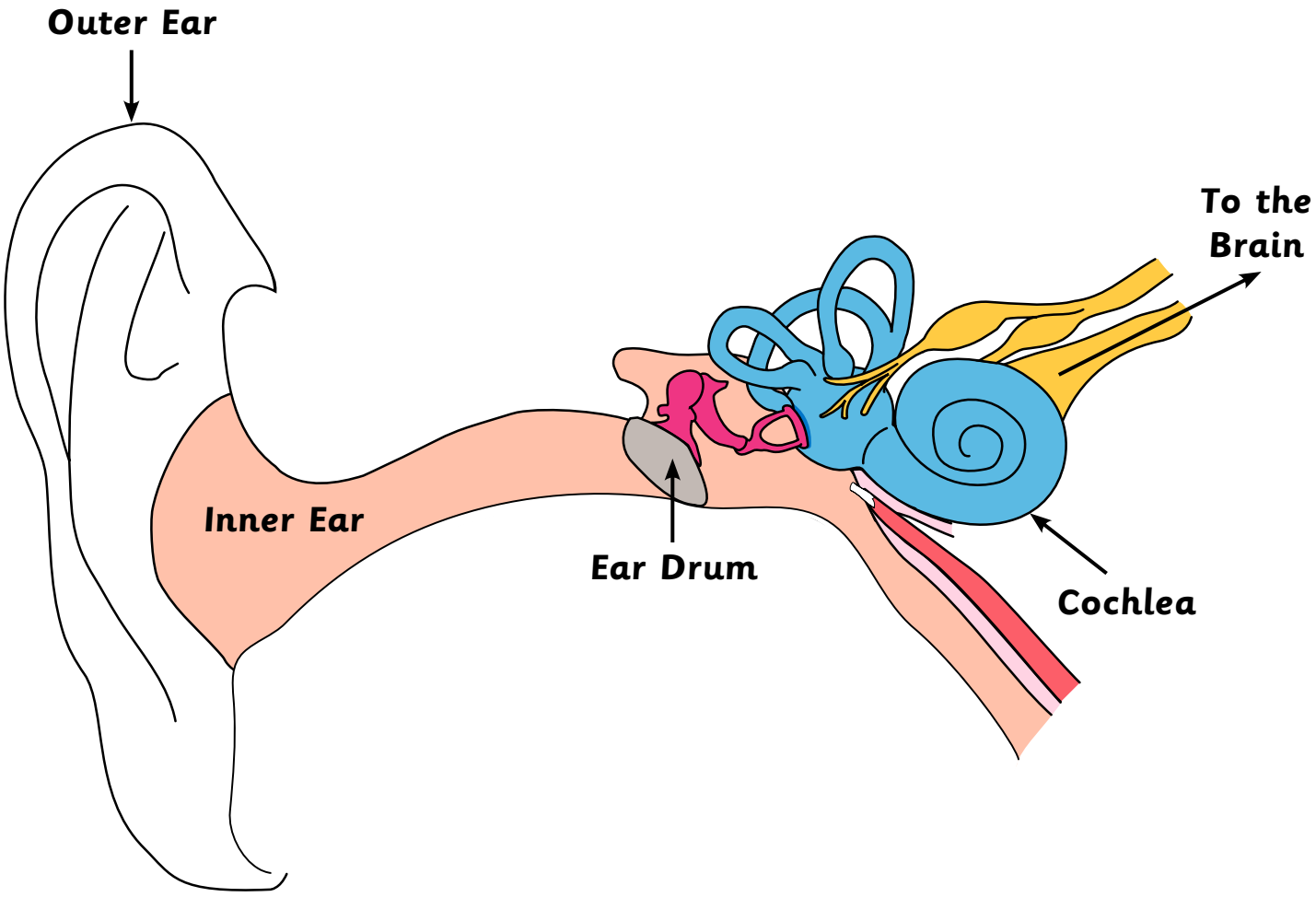
6. What made this sound?

Kitten

Puppy

Baby

Ear Diagram



My Science Journal

Name _____

Drawing

Key Words to Use

I Observed...