Sound from Left or Right?

Pre-Activity Quiz

1. How does our sense of hearing work?

2. Why do we have two ears?

3. How does a stethoscope work?
   (A device used by doctors to listen to the sound of your heart.)

Pre-Activity Quiz Answers

1. **How does our sense of hearing work?**

   Sound makes the ear drum move, and this movement is amplified by the middle ear. This amplified movement causes fluid in the inner ear to move, and the hairs in the inner ear convert movement into electrical impulses that are sent to the brain

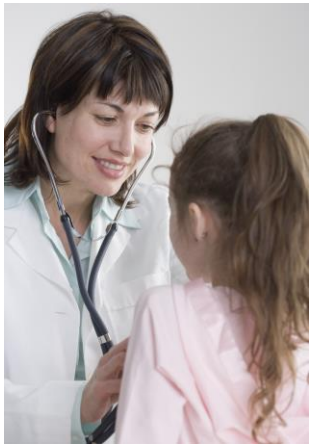
2. **Why do we have two ears?**

   Two ears enable us to determine the direction of the sound we hear because sounds from one side take longer to travel to the farther ear.

3. **How does a stethoscope work?**

   (A device used by doctors to listen to your heart sounds.)

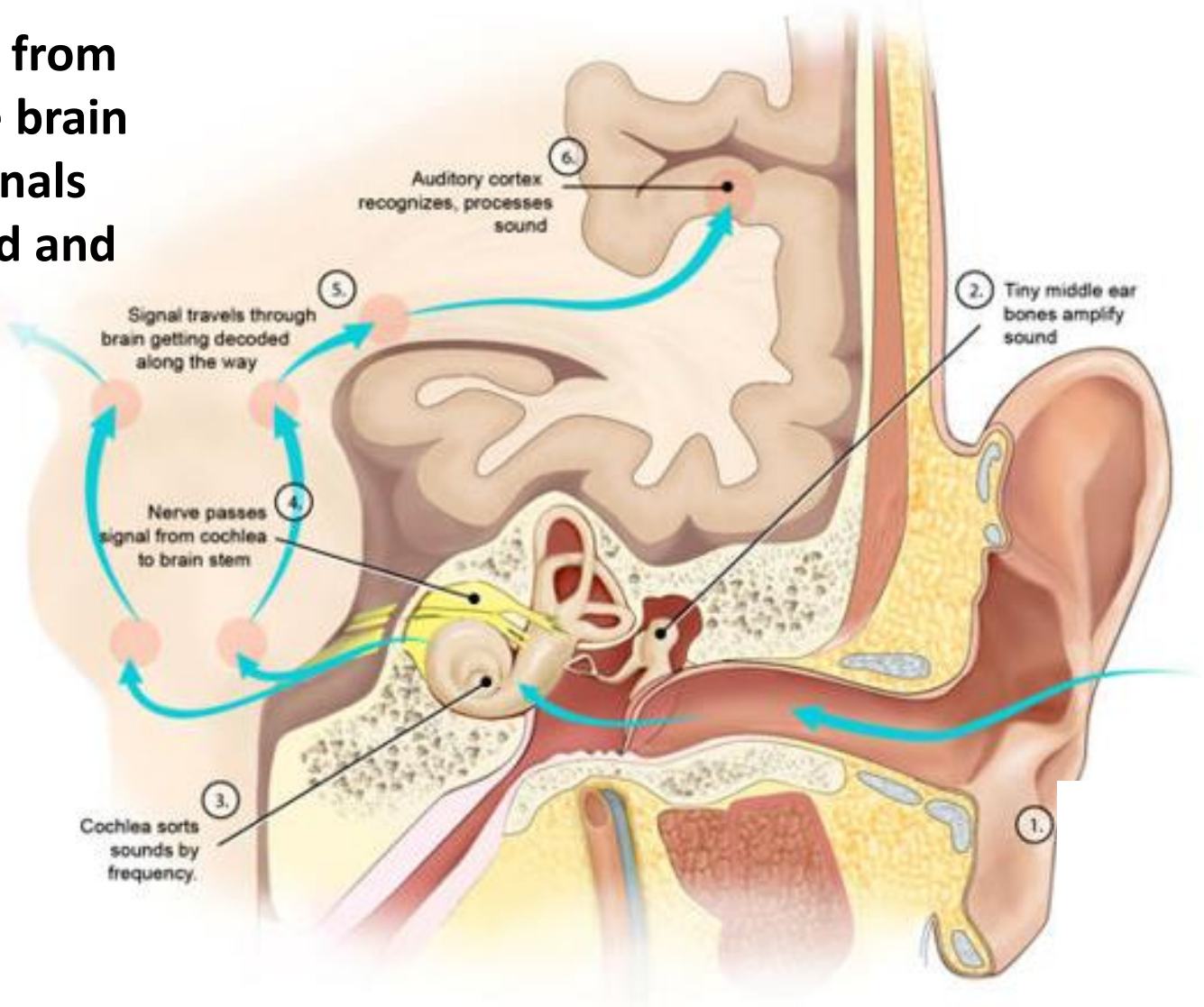
   A stethoscope is a tube that picks up vibrations of the skin on your chest via a diaphragm. The diaphragm converts the vibrations into sound that travels via the air in the tube to the doctor's ears.



How Does Our Sense of Hearing Work?

The steps involved in hearing:

- **Sound travels from the ear to the brain where the signals are recognized and decoded.**



Determining Direction: Left or Right?

Why do animals, including humans, have two ears?

- **Two ears helps us determine the direction of the sounds we hear.**
- **The time lag between the two ears provides our brains with information about the direction of the sources of sounds.**
- **Volume and sound quality also help in determining the distances sounds are coming from.**

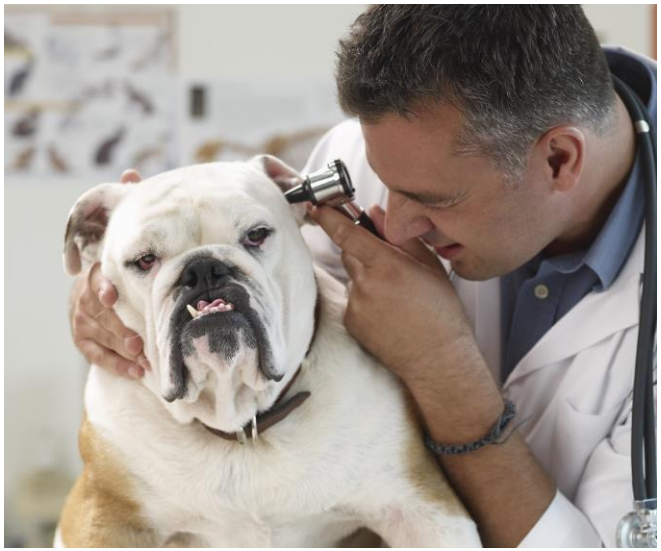
binaural = Having two ears.

binaural hearing = How animals use their two ears and the time lag of sound waves to determine direction of origin of sounds.

Determining Direction

Left or right?

- **By having an ear on each side of our heads, we can distinguish whether sounds are coming from the left or the right. The difference in arrival times of the sound at each ear helps our brain figure out where they are coming from.**

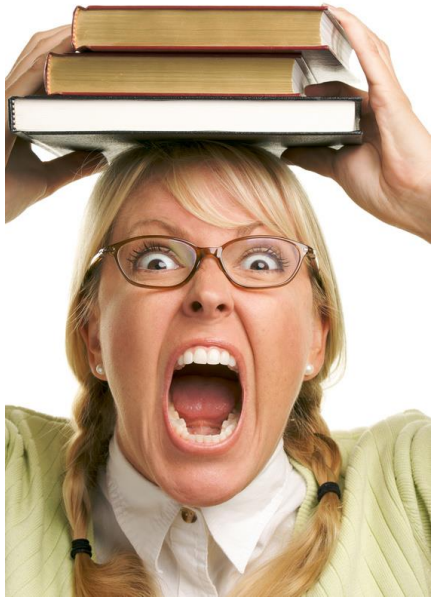


How much time difference?

- **A sound coming from one direction reaches the more distant ear approximately 1/500th of a second later. Our brain is an amazing machine that can distinguish between such a small difference in the arrival times between the two ears.**

sound localization = A person's ability to identify the location or origin of a detected sound in direction and distance.

Determining Direction



What about volume difference?

- Our ears also use the difference in loudness (volume) of the sounds perceived by the two ears to identify where they are coming from.

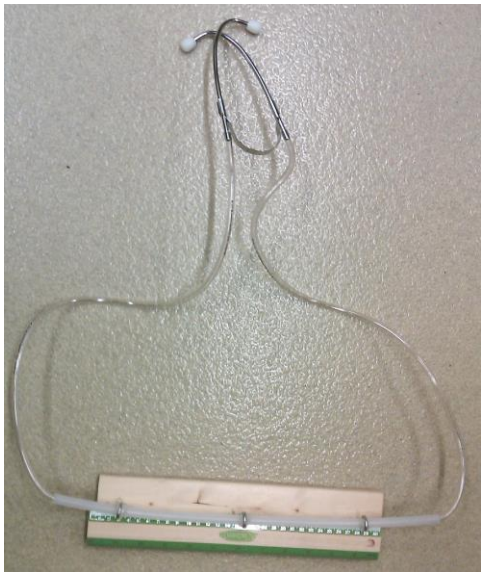
Humans can tell the direction of high-frequency sounds better than low-frequency sounds.

- High-frequency sounds are blocked by the head and do not easily reach the furthest ear, so the closest ear to the sound hears it more loudly than the distant one.
- If the frequency of the sounds is low, the head does not block the sound as readily and so both ears are able to capture the sound.

Directional Hearing Activity

- Why do people turn their heads when they cannot tell where a sound is coming from?
- Can you think of an activity we can perform to determine how we detect where sounds come from?

Directional Hearing Testing Instructions



- With his back to the wooden block, one student puts the stethoscope ear buds in his ears while the other, out-of-sight student uses a pen or pencil to tap on the tube at random locations.
- The listener tries to determine the direction the sound is coming from and says "left" or "right" aloud while the partner (who is tapping) records his directional hearing responses on the worksheet.
- Then the pair switches positions and repeats the experiment, filling out the second worksheet.

Directional Hearing Worksheet

- The teacher will explain how to use the set-up.
- Begin the activity only after the teacher's explanation.

Start the activity:

- Randomly tap the tube at the following measurement locations.
- Using the data table columns on your worksheet, the person tapping records whether the listener could determine a sound from the left (L), right (R), or is unable to tell (X).
- Do 3 trials for each measurement.

	1 in	2 in	3 in	4 in	5 in	6 in	7 in	8 in	9 in	10 in	11 in
Trial 1											
Trial 2											
Trial 3											

- Then, switch places with your partner and let the other person record your findings on a separate worksheet.

Directional Hearing Results & Analysis

- How accurately did the listener determine the directions?

- Was there a region in the middle where the listener could not determine a difference? Did the responses get better closer to the ends? Why do you think this does or does not happen?

Post-Activity Quiz

1. How does our sense of hearing work?

2. Why do we have two ears?

3. In the directional hearing testing activity, how did your ears sense the locations of the taps?

Post-Activity Quiz Answers

1. **How does our sense of hearing work?**
   Sound makes the ear drum move, and this movement is amplified by the middle ear. This amplified movement causes fluid in the inner ear to move, and the hairs in the inner ear convert movement into electrical impulses that are sent to the brain.
2. **Why do we have two ears?**
   Two ears enable us to determine the direction of the sound we hear because sounds from one side take longer to travel to the farther ear.
3. **In the activity using the stethoscope, how did your ears sense the locations of the taps?**
   If a tap is closer to one ear, the sound takes a shorter time to travel to that ear, and that ear signals faster to the brain, which figures out the location.

Vocabulary

binaural

- **Having (or relating to) two ears.**

binaural hearing

- **How animals use their two ears and the time lag of sound waves to determine direction of origin of sounds.**

directional

- **Related to a direction, such as sound coming from a direction.**

sound localization

- **A person's ability to identify the location or origin of a detected sound in direction and distance.**

stethoscope

- **An instrument used by doctor's to listen to the sound o your heart.**

Figure 1. The activity set-up.