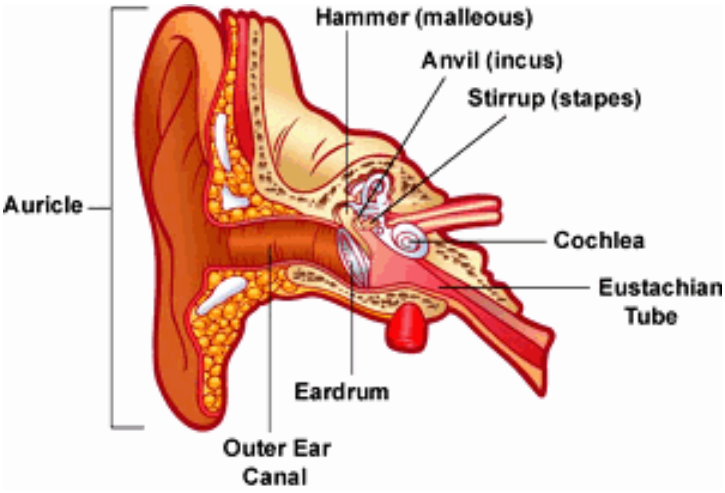


**The Ear**

Your ears are in charge of collecting sounds, processing them, and sending sound signals to your brain. Sound travels in the air as mechanical waves but the brain can only understand electrical signals. So your ears act as a translator. The ear translates mechanical information into electrical wave information for the brain. And that's not all — your ears also help you keep your balance.

The ear is made up of three different sections: the outer ear, the middle ear, and the inner ear. These parts all work together so you can hear and process sounds.

**The Outer Ear: Catch the Wave**

The outer ear is called the **pinna** or auricle (say: **or**-ih-kul) and it's a funnel to gather sounds into your ear.

**The Middle Ear: Good Vibrations**

The outer ear ends with the ear drum which is a membrane that vibrates when sound waves hit it. Then the vibrations enter a long hallway, called the middle ear, which consists of three bones called ossicles. They carry the vibration from the outer ear to the inner ear.

Ossicles are the three tiniest, most delicate bones in your body. They include:

- the **malleus** (say: **mah**-lee-us), which is attached to the eardrum and means "hammer" in Latin
- the **incus** (say: **in**-kus), which is attached to the malleus and means "anvil" in Latin
- the **stapes** (say: **stay**-peez), the smallest bone in the body, which is attached to the incus and means "stirrup" in Latin

**The Inner Ear: Nerve Signals Start Here**

Sound comes into the inner ear as vibrations and enters the **cochlea** (say: ko-klee-uh), a small, curled tube in the inner ear. The cochlea is filled with liquid, which is set into motion, like a wave, when the ossicles vibrate.

The cochlea is also lined with tiny cells covered in tiny hairs that are so small you would need a microscope to see them. They may be small, but they're awfully important. When sound reaches the cochlea, the vibrations cause the hairs on the cells to move, creating nerve signals that the brain understands as sound. The brain puts it together and hooray! You hear your favorite song on the radio.

Your brain knows what song it is based on which hairs are hit by the waves. High notes hit a certain part of the ear while the low notes hit another part. The combination of hairs that are hit help your brain know which song is on the radio.

**Day or Night, Ears Keep You Upright**

Ears do more than hear. They keep you balanced, too. In the inner ear, there are three small loops above the cochlea called semicircular canals. Like the cochlea, they are also filled with liquid and have thousands of microscopic hairs.

When you move your head, the liquid in the semicircular canals moves, too. The liquid moves the tiny hairs, which send a nerve message to your brain about the position of your head. In less than a second, your brain sends messages to the right muscles so that you keep your balance.

Sometimes the liquid in your semicircular canals keeps moving after you've stopped moving. To understand this, fill a cup halfway with water. Now move the cup around in a circle in front of you and then stop. Notice how the water keeps swishing around, even after the cup is still? That's what happens in your semicircular canals when you spin in circles or go on the Tilt-A-Whirl at the amusement park.

When you stop spinning or step off the ride, the fluid in your semicircular canals is still moving. The hairs inside the canals are sensing movement even though you're standing still. That's why you might feel dizzy — your brain is getting two different messages and is confused about the position of your head. Once the fluid in the semicircular canals stops moving, your brain gets the right message and you regain your balance.

**Three Cheers for the Ears!**

Your ears take care of you, so take care of them. Protect your hearing by wearing earplugs at loud music concerts and around noisy machinery, like in wood or metal shop at school. Keep the volume down on your stereo, especially if you're in the car or wearing headphones.

Exercise I: Observe how the distance of the origin of a sound in relation of your right and/or left ear helps to detect the direction of a sound.

a. Close your eyes!
b. Have a volunteer hit the tuning fork in his/her hands to make a good vibration
c. The volunteer will place the tuning fork (while vibrating) at different distance in all directions from your head (back, right, left and front).
d. Can you predict the position of the tuning fork?
e. Explain to your group how you perceived the sound!

Exercise II: Compare the transmission of sound waves through the air and through the skull

a. A volunteer will shake the tuning fork
b. The medical student will place the tuning fork along right side of your head, while you alternately close right and left eardrum with their own hands
c. Repeat procedure for left side of your head
d. A volunteer will place the vibrating tuning fork on top of your head. Alternately close your right and left eardrum
e. Can you describe the different perception of sound for all 4 conditions? Does the sound get louder or softer?

Exercise III: Compare your balance before and after spinning around—can you still walk in a straight line?

a. Swirl a cup full of water around, then stop. Place a drop of food coloring in the cup and watch. Does the colored water keep swirling?
b. Now here's your first test: can you walk a straight line? Try walking down the taped line on the floor to the end. Can you do it?
c. Now spin yourself around! Sit in the swivel chair and one volunteer will spin you around ten times. Now try to walk down the taped line on the floor? Can you do it? Is it easier or harder than before?


| | | |
|---|---|---|
| Teaching materials prepared by:<br>Dr. Helena Carvalho<br>Alice Chen<br>Katherine Dederer<br>Rebecca Kirschner | KTU Kids' Tech University | VTC Virginia Tech Carilion School of Medicine and Research Institute |


**Additional information available at: http://kidshealth.org/kid/htbw/ears.html**