

Hearing and the Ears

Hearing is one of the most crucial means of survival in the animal world, and speech is one of the distinctive characteristics of many species. Hearing is the process of converting the sensation of vibrations hitting our ears into sounds we can perceive. There are three major parts of the ear:

The outer ear

The outer ear has three sections:

1. **The pinna or auricle:** This is the part of the ear on the outside of our heads—the part we usually are referring to when we talk about our ear. It helps gather and focus sound vibrations.
2. **The ear canal:** This is a tube that channels vibrations further inside our ear.
3. **The eardrum:** The eardrum is a thin sheet that vibrates when vibrations hit it. The eardrum is very sensitive and fragile. It's never a good idea to put anything in your ear, even something that seems safe and soft—such as Q-Tips—can damage the eardrum.

The middle ear

The middle ear is filled mostly with air. It has three bones which amplify the vibrations coming from the eardrum, and transfer them to fluid in the inner ear. Bones of the middle ear:

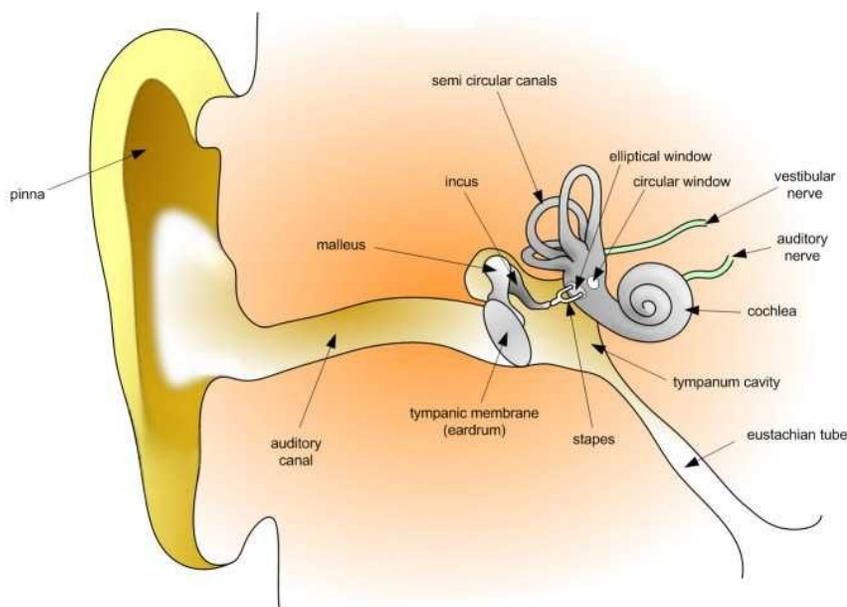
1. hammer (malleus)
2. anvil (incus)
3. stirrup (stapes). The stirrup is the smallest bone in the body.

The inner ear

The inner ear is filled with fluid and has a hearing organ called the *cochlea*. This organ translates vibrations into electrical signals which are transferred over nerves to the brain. The brain then interprets these signals as sound. The *cochlea* uses tiny hairs that vibrate with the sound waves in the fluid. The inner ear also has fluid filled tubes that help us balance.

Why two ears?

Having two ears helps us determine the direction of sound. We can sense when a sound hits one ear before the other and when it is slightly louder on one side.



The Frequency of Sound

We can hear sound within a certain frequency range of around 20 Hz to 20,000 Hz. Some animals have different ranges. Dolphins, for example, can't hear sounds as low as we can, but can hear high sounds over 100,000 Hz. Dogs and cats can also hear much higher pitched sounds than we can. Because our ears can be damaged by dangerous levels of sound, young people can often hear better than older people.

Why we get dizzy?

The brain takes in a number of signals from your body to keep it balanced. One of them is from the fluid in the inner ear. The brain can tell a lot by how the fluid in your ear is moving or tilted. The brain also uses your eyes and sense of touch to tell it about your balance and position. When you spin fast and then stop, the fluid in your ear is still spinning, but your eyes and body have stopped moving. Your brain gets confused for a bit and you feel dizzy.

Loss of Hearing

Loud sound can damage your ears and cause loss of hearing. Even sounds as loud as 85 decibels can ruin your ears if you listen to them over a long period of time. For this reason, it's a good idea to not listen to loud music or have your headphones turned up too loud.

Musical Intervals

Many musical systems are based on these ideas. In one system of musical tuning, the tones in between are given in following order of ratios:

- 2:1 for C
- 16:9 for D
- 8:5 for E
- 3:2 for F
- 4:3 for G
- 6:5 for A
- 16:15 for B

The diatonic scale appears in writing throughout history, consisting of seven tones in each octave. The diatonic scale can be constructed using the three simplest intervals within the octave, the perfect fifth ($3/2$), perfect fourth ($4/3$), and the major third ($5/4$). The following table shows the ratios between the frequencies of all the notes of the major scale and the fixed frequency of the first note of the scale.

C	D	E	F	G	A	B	C
1	9/8	5/4	4/3	3/2	5/3	15/8	2