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Mills & McKinney Hearing Practice

How our ears work

Are you listening to sound through speakers right now?

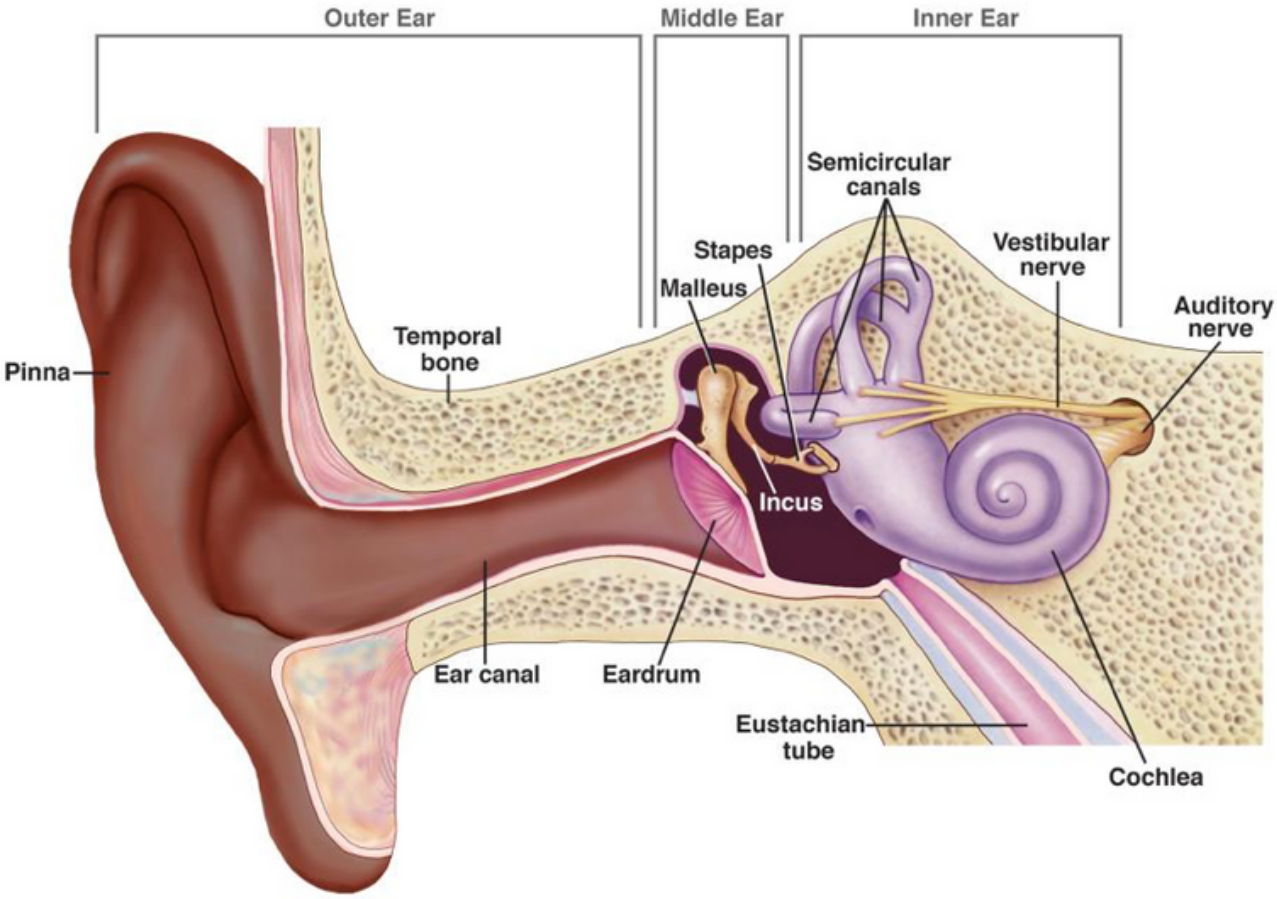
Well, you might know that your speakers are creating sound and your ears are listening to it. But there's a lot more going on.

Right now your speakers are vibrating the air particles close to them. They vibrate the air particles close to them, and so on. We call this a sound wave.

Eventually, when the air particles close to your ear start vibrating, we hear sound. But how does something as tiny as vibrating ear particles enable us to hear something like music?

Well, to answer that we need to look carefully at our ears. I mean the whole structure of the ear. So let's look at how the different parts of the ear work together to enable us to hear sound.

Our ear can be divided into three parts – the outer ear, the middle ear, and the inner ear.



The **outer ear** starts with the Pinna. It's the part that you can see or touch, or maybe the part that got tweaked when you were a child. Its job is to collect as many sound waves as possible, and channel them into the auditory canal. The sound waves pass through the auditory canal, and eventually reach the ear drum, which is shown in pink. The ear drum is a transferring membrane, which is super sensitive to the vibration of air particles. When the air particles vibrate, the ear drum vibrates – like the skin of a drum. And, as you can see, the ear drum also separates the outer ear, from the middle ear.

This brings us to the **middle ear**. The middle ear consists of the three tiniest bones in the human body, together called the ossicles. They have really interesting names – the Malleus, the Incus and the Stapes. Because of their shapes, they are commonly called the hammer, the anvil, and the stirrup.

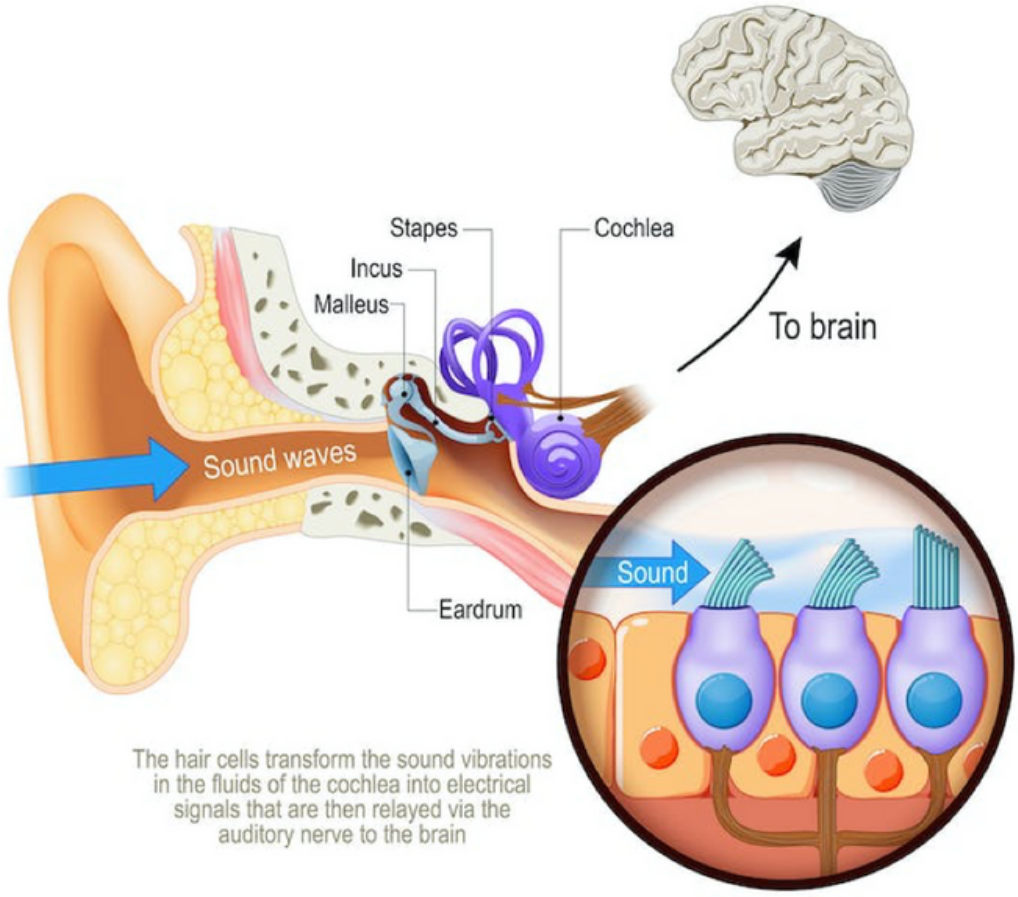
As the ear drum vibrates, the ossicles also start vibrating. This transfers the sound wave from the ear-drum to the **inner ear**. Their main job is to increase or amplify the pressure of the sound waves when they reach the inner ear.

But why do we need to increase the pressure of the sound waves? Because the inner ear consists of a liquid, not air, so the vibrations must transfer into a liquid. You might already know that moving particles of liquid, is much harder than moving particles of air. This is why it is pretty easy to swing your arms in air, but it is pretty difficult to do the same thing in water, for example in a swimming pool. So, to set this liquid in vibration, the pressure needs to be high enough. In fact, it turns out that our ossicles increase the pressure of the vibration by about twenty times.

But, how do they do that? Well, just take a look at the base of the stapes. It has a very small surface area compared to that of the ear drum. So, when the force of the vibrating air particles gets transferred from the ear drum to the stapes, it is concentrated in a very tiny area. You might know that when you concentrate force into a very tiny area, you increase its pressure.

And that brings us to the inner ear. The inner ear consists of a bony structure which is shown in purple. As you can see, the top part of this structure consists of three semi circular rings. They help us to maintain our balance whilst walking, running or dancing, so they are not so important to hearing. The part that's involved in hearing is the snail-like structure. This is called the cochlear. What does it do? Well, although the ossicles have already started dancing to the music, nothing gets heard until these vibrations are converted to electricity and sent to our brains. That's exactly what the cochlear does.

Now the cochlear is really complex, and also a little mysterious. Even today, there are certain things about it that we just don't know. We won't go into too much detail, but as you know it contains a liquid. When the stirrup hits our cochlear, this liquid starts vibrating. Then there are some specialized cells in the cochlear which convert these vibrations into electrical signals. These electrical signals go through your auditory nerve all the way up to the brain, where they finally get interpreted as sound.



The cells which do this in your cochlear are amazing. The electrical impulses that they generate are extremely sensitive to how loud the sound is, or how quiet the sound is, whether it is high frequency or low frequency. As a result your brain can differentiate between the tiniest differences in sound. So you can understand different letters, words, or even what you are listening to right now.

So, to summarise, the outer ear collects the soundwaves through the pinna, and directs them to the eardrum. The three ossicles of the middle ear amplify the sound waves, transferring them to the cochlear. The cochlear can work the back and forth vibrations of the particles into electrical signals, and send these to our brains.

Regardless of how many words I use to describe what's going on, the very fact that the back and forth movement of the air can be converted into this amazing experience that we call sound, is truly amazing.

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Department of Audiology & Audiological Medicine
The Portland Hospital, 234 Great Portland Street
London W1W 5QT

Tel: 020 7390 8057
Email: info@mmhearing.com
www.mmhearing.com