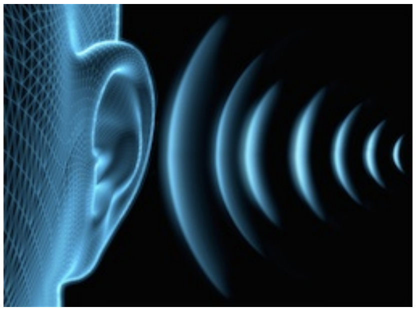
The AMAZING Ear and the Sense of Hearing



When people think about ears, they usually think only of those two things on the sides of their head. But is that all there is when it comes to hearing? What's inside? How many parts are involved in hearing? How does it all work? Why is it you can recognize where sounds come from? How is it that you can tell the difference between a low sound and a high sound? How is it that you can tell the difference between the voice of your mother and the voice of your friend? Why does your nose play an important part in your hearing?

How does hearing work? And how did it all come about?

Your ears are complex structures that are involved with two distinct functions: hearing and balance. Here we will only cover the parts of the ear that have to do with the sense of hearing.

The ear is divided into three parts: outer ear, middle ear, and inner ear.

The parts of the outer ear include the pinna, (the part on the side of your head), the ear canal, and the eardrum.

The parts of the middle ear include three tiny bones, called the ossicles, and the Eustachian tube. The three bones are called the malleus, the incus, and the stapes.

The cochlea is a snail-shaped structure in the inner ear. It contains fluid and the tiny sensory cells that change sound waves into the nerve impulses that are carried to the brain.

There are more parts but these are the basic ones.

Simply put, in order to process a sound, sound waves traveling through the air are funneled by the pinna into the ear canal and then to the eardrum. The eardrum vibrates which, in turn, causes the ossicles (three tiny bones) to vibrate. Vibrations of the ossicles cause the fluid in the cochlea to move as a wave, which then moves the tiny hairs that create the electrical impulses that are carried by the auditory nerve to the brain stem and then to the part of the brain that interprets the information.

Simple? Maybe not.

Why so many parts? What does each part do? And are they all necessary?

The pinna collects the sound waves and also helps you to determine the direction a sound is coming from.

The ear canal directs the sound waves to the eardrum and helps amplify them. In addition, tiny hairs in the ear canal along with the earwax produced by glands in the ear canal help protect the eardrum by trapping any dirt or insects that might enter the ear.

The eardrum vibrates in response to the sound waves entering the ear. It is these vibrations that will eventually be changed to the nerve impulses that are interpreted by the brain.

The Eustachian tube plays an important part in the hearing process. It runs from the middle ear to an area behind the nose and above the throat. Air entering through your nose or mouth can then reach behind the eardrum. This keeps an approximately equal amount of air pressure on both sides of the eardrum. This air pressure is adjusted every time you swallow, so it is something you don't even have to think about. If the air pressure becomes unequal, the eardrum will not be able to vibrate properly and there would be some loss of hearing. Also, because there are nerves in the eardrum, you could feel discomfort or pain such as when you take off or land in an airplane or travel up or down a hill. In those cases, you probably want to "pop" your ears in order to equalize the air pressure on the front and back sides of the eardrum.

The ossicles change the vibrations of the eardrum to vibrations that will cause the necessary fluid movement (waves) in the cochlea. This is done by transmitting the vibrations from the larger eardrum through the ossciles to the smaller stapes. By moving the vibrations from a larger to smaller area, there is an energy boost in the pressure of the sound wave without which there would be a significant reduction in the volume of the sound and resulting loss of hearing ability.[1] It is estimated that the total wave pressure at the stapes is 17 to 20 times greater than the wave pressure at the eardrum.[2, 3]

Once the vibrations reach the cochlea, the resulting wave movement of the fluid in the cochlea produces a response by the tiny sensory "hair cells" within. There are two types of these hair cells, a single row of "inner" hair cells and three rows of "outer" hair cells. It is estimated that there are between 17,500 and 23,500 hair cells in the human ear.[4] Inner cells transmit most of the information. Outer cells amplify the sound coming into the cochlea.

Movement of the fluid in the cochlea causes bending of the hair cells. However, not all hair cells will bend in response to a given sound. Hair cells near the wide end of the cochlea detect higher pitched sounds. Hair cells closer to the center of the cochlea detect lower-pitched sounds.[5] The bending of the cells creates electrical signals that are carried to the brain by the auditory nerve.

As you can see, each of the parts plays an important part in the overall process of hearing.

What does your brain do with the information it receives from the hair cells in the cochlea?

As your brain processes the sound information it receives, the result is the three basic characteristics of sound you "hear". These are pitch (the highness or lowness of the sound), volume (the loudness of the sound), and timbre (TAM-ber; what the sound sounds like).

The pitch of a sound can be measured in vibrations per second called hertz. One hertz is one vibration per second. 10,000 hertz is 10,000 vibrations per second. (This measurement of a sound wave is referred to as frequency.) More vibrations per second produce a higher pitch. Fewer vibrations per second produce a lower pitch. Human hearing is generally thought to range from 15 to 20 hertz at the low end to 18,000 to 20,000 hertz at the high end.[6]

The volume (loudness) of a sound is measured in decibels (dB). Decibels are a measurement of the strength/intensity/pressure of a sound wave. Using the decibel scale, healthy human hearing starts at 0 decibels, the point at which people can generally detect a sound. Here are some sounds and the suggested decibel levels produced: [7, 8]

• 10 dB – breathing
• 30 dB – whisper
• 50 dB – refrigerator
• 60 dB – normal conversation
• 90 dB - lawnmower
• 100 dB – motorcycle
• 115 dB – siren
• 140 dB – jet engine at takeoff

When sound volume reaches about 120 decibels, humans will likely begin to experience pain.[9] We hear the sound, but it is not pleasant. Prolonged exposure to sound volumes higher than 85 dB can damage your hearing by damaging the hair cells in the cochlea. Sounds louder than 120 dB can cause immediate damage to your hearing.[10]

Perhaps the most interesting of the three basic characteristics of sound is timbre: the quality of a sound that makes it different from other sounds.

With most sounds, there is a fundamental frequency, the one that is loudest. There are, however, additional frequencies that are a part of that sound. These additional frequencies are usually less loud. The combination of all of these frequencies create a distinctive sound, called timbre, which allows us to tell the difference between the sound of a piano and the sound of a guitar; between the sound of a hammer pounding on a nail and the sound of a saw cutting wood; between the sound of the voice of your mother and the voice of your friend. Just think: your eardrum responds in a unique way to the sound waves created by a piano or guitar or hammer or saw or voice which are then passed on to the ossicles and finally to the cochlea.

But even beyond that, the parts of your ear along with your brain allow you to "hear" many different sounds at the same time. Imagine being at a baseball game and hearing the sounds of the crowd AND the call of the peanut vendor AND the sound of a ball hit by a bat AND the sound of the organ playing ALL AT THE SAME TIME! In a fraction of a second, your ear receives and your brain processes sound waves from multiple sources containing multiple frequencies allowing you to "hear" multiple sounds!

An amazing system!

In summary, the pinna gathers the sound waves and funnels them into the ear canal to the eardrum. In response to the sound waves, the eardrum and ossicles vibrate. The vibrations are converted to fluid waves in the cochlea. The fluid waves cause tiny sensory hair cells to bend which, in turn, creates the electrical signals that go to the brain. Your brain interprets the sound signals as to pitch, volume, and timbre. And it all happens virtually instantaneously.

How did such a complex system come about? Which part could you do without?

Basic evolutionary theory holds that gradual changes over time along with natural selection produced the hearing system we have today. Beneficial changes helped an organism survive and were passed on to the next generation.

One example of evolutionary change evolutionists have suggested is the development of the ossicles. It has been said that two of the three tiny bones of the middle ear existed in reptiles as parts of the jaw. Over time, these two bone were "re-purposed" and, added to the stapes, became the ossicles we find in mammals today.[11]

(Hmmmmm. So somehow jaw bones just became part of the ear?)

Evolutionists don't know why it happened or how. It just did.

But does gradual change over time really make sense when it comes to our hearing?

The auditory nerve and the hair cells work together. It wouldn't make sense to have one without the other. The fluid in the cochlea is unnecessary if there are no hair cells. The ossicles are unnecessary if there is no fluid-filled cochlea. The ossicles can't vibrate if there is no eardrum. The eardrum can't vibrate properly without the Eustachian tube. And the whole system has to be able to handle the multiple pitches/frequencies present in a sound wave so that we can determine what is making the sound (timbre).

All the parts work together and are necessary for a fully-functioning sense of hearing. Could this really be something that "just happened"?

The truth about the evolution of the ear must be that it didn't evolve at all; it was designed by a designer and all the parts were formed all at once.

There is a God that created an ear that can hear various pitches, that can hear sounds that are loud or soft or anywhere in between. God created an ear that can respond to multiple sounds at once. God created an ear connected to a brain that can interpret sounds of danger or sounds that enable us to communicate with those around us. God created an ear that meets our needs.

But, in creating the ear, God did more than meet our needs. The functioning of the ear also points to His goodness. God created an ear that can tell the difference between a piano and a guitar; between the voice of your mother and the voice of your friend. Think of a world without music, without the sounds of birds singing, without the sound of a cat purring or a baby laughing. Due to the goodness of God, we have a hearing system that can interpret a wide variety of sounds that we find pleasant. God has shown His goodness by designing an ear that meets our needs and adds to our enjoyment of life.

The ear IS amazing. It didn't just happen. God did it!

If you would like to know more about why you can know there is a creator, visit www.AmazingByDesign.net. (.net NOT .com)

The God that created the ear wants to have a personal relationship with you. If you would like to know more about how you can have a personal relationship with the creator, visit www.AmazingByDesign.net. (.net NOT .com)

Endnotes:

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7 – "What Noises Cause Hearing Loss?" *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 7 Oct. 2019, www.cdc.gov/nceh/hearing_loss/what_noises_cause_hearing_loss.html.

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10 – "What Noises Cause Hearing Loss?" *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 7 Oct. 2019, www.cdc.gov/nceh/hearing_loss/what_noises_cause_hearing_loss.html.

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