Sound and hearing

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A brief description of how we perceive sound and how our hearing system functions

This is the first in a series of brochures from Widex on hearing and hearing-related subjects.

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From sound wave to hearing

Sound plays a very important part in most people's lives. It enables us to communicate and receive information, enjoy the sounds of nature and listen to music. Sound may also warn us of danger.

All sound originates from movement. When, for example, the wind blows, it causes the leaves on trees to move. The leaves push the molecules in the air, making them vibrate. These vibrations are called sound waves and can be perceived by the ear.

Slow vibrations (low frequency) are heard as deep tones (bass), while fast vibrations (high frequency) are heard as high tones (treble).

The human ear

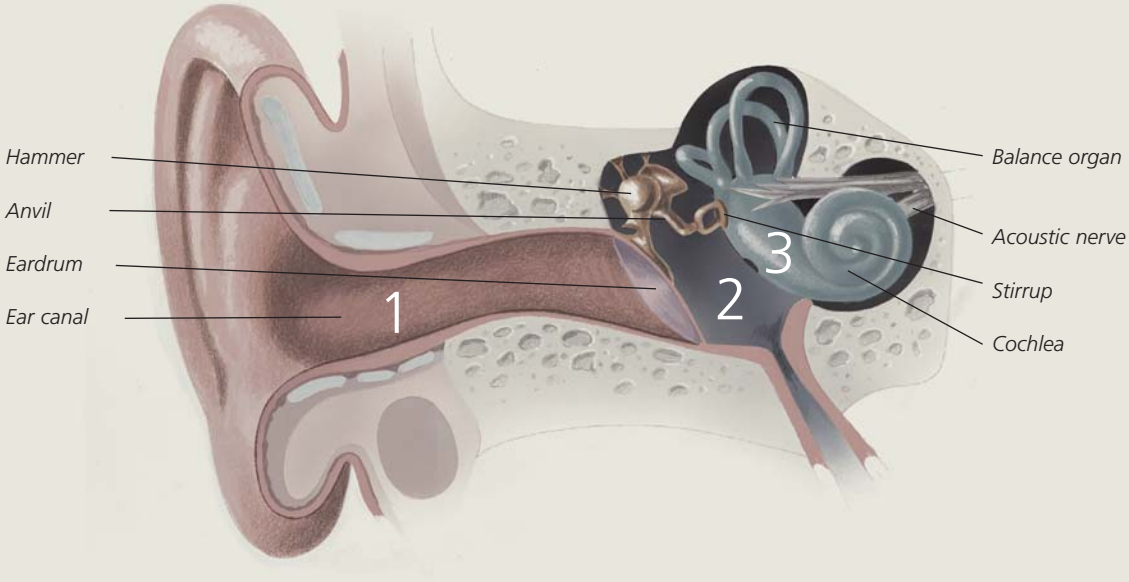
The ear is a sophisticated, sensitive and complex organ, which consists of three main sections:

The outer ear
The outer ear is made up of the external cartilaginous part of the ear and the ear canal. The eardrum is located at the end of the ear canal and forms the boundary to the middle ear. The outer ear functions as a kind of satellite dish that picks up sound waves and conducts them to the eardrum, causing it to vibrate.

The middle ear
The middle ear is an air-filled space, whose air pressure is regulated by the eustachian tube, which connects the middle ear to the throat. There are three tiny bones in the middle ear called the hammer, the anvil and the stirrup. This chain of bones forms a lever mechanism, conducting the vibrations from the eardrum to the inner ear (also referred to as the cochlea). Attached to the bones are two small muscles, which are activated when very loud sounds reach the ear. These muscles work to reduce the effects of excessive sound pressure before reaching the inner ear.

The inner ear
The inner ear, or cochlea, is shaped like a snail shell and filled with fluid. The balance organ is attached to the cochlea and is made up of three fluid-filled semicircular canals. The oval window connects the middle ear and the inner ear. The footplate of the stirrup is attached to the oval window and functions as a piston moving the fluid of the inner ear.

This movement of the fluid activates the hair cells in the inner ear (there are about 20,000 of these “sensory cells”). When the hair cells are activated, they send impulses via the acoustic nerve to the brain, which perceives these impulses as sound.



1. Outer ear **2. Middle ear** **3. Inner ear**

Via these fantastic, winding ways, the ear is able to pick up sound waves, transform them to bone vibrations then to wave movements in fluid and finally to nerve impulses that can be interpreted by the brain. Even the slightest flaw in this complex system can compromise hearing ability.

Hearing impairment

Millions of people worldwide are faced with hearing problems in the form of hearing loss or tinnitus (ringing or other sounds in the ear), but only a minority of them wear hearing aids. Hearing loss is not just an age-related problem but affects people of all ages including, to an increasing extent, young people. Physiological age-induced hearing loss is, however, still the most common type of hearing loss.

If the cause of the hearing loss is localised in the ear canal or the middle ear, it is called a conductive hearing loss. If the loss is the result of problems in the nerve fibres or sensory cells in the cochlea, it is called a sensorineural hearing loss.

Hearing loss does not only mean the inability to hear loudly enough. Some people may have great difficulty in hearing within a specific and narrow frequency region. This may result in a "discrimination loss", whereby one can hear speech but not understand speech.

If not detected and treated in time, hearing loss in a child can have a very adverse effect on the child's language development and learning ability.

With children as well as adults, untreated hearing loss can have broad-reaching effects. Hearing problems often make it difficult to "keep up", which can lead to a sense of isolation, fatigue and loneliness. As hearing loss is often associated with old age – and frequently interpreted as a lack of intelligence – it may affect life at school and work, as well as social interaction and general quality of life. It is therefore important to do something about hearing problems as soon as possible.

Treating hearing loss

Conductive hearing losses can sometimes be helped through surgical or medical treatment. In most cases, however, hearing aids are the only means of helping hearing loss. This is especially true with sensorineural hearing losses.

There is a wide variety of hearing aids available today in which sound reproduction can be tailored to the user's own unique hearing loss and needs. It is important to note that, while hearing aids may not restore normal hearing, they can significantly improve hearing ability in all situations – allowing for a fuller life in many ways.

For further information on hearing aids, please see the brochure "What is a hearing aid?" which is a part of this series.

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