TOOLS for SCHOOLS™

BECOMING FAMILIAR WITH COCHLEAR IMPLANTS

How the Ear Works

For sound to be heard, the ear needs to convey the message to the brain. The ear consists of four main parts: outer ear, middle ear, inner ear, and the auditory nerve. Each of these parts plays a key role in sound transmission to the brain.

The Outer Ear

The outer ear (or pinna) captures sound and then directs the sound down the ear canal to the eardrum.

The Middle Ear

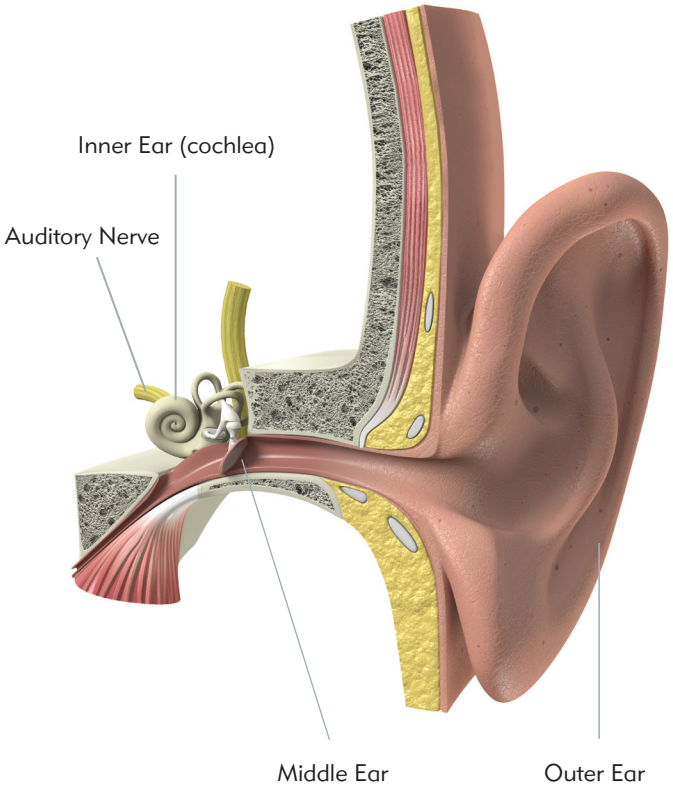
Sound vibrates the eardrum and is transmitted to the middle ear which consists of three tiny bones (the mallues, incus, and stapes). These vibrations then travel to the inner ear.

The Inner Ear

The inner ear is a snail shaped organ called the cochlea, that contains sensory hair cells. As the middle ear bones vibrate and push against the cochlea, the hair cells inside the cochlea bend and sway. As they move, they communicate information about pitch and loudness in an electrical code to the auditory nerve.

The Auditory Nerve

The auditory nerve (or hearing nerve) is responsible for transmitting the sound information from the inner ear to the higher processing centers of the brain. The brain is responsible for interpreting sound.



What is "Normal" Hearing?

When the ear mechanisms work properly, the ear can detect a range of pitches (frequencies) over a wide range of loudness levels (intensity). Frequency is measured in Hertz (Hz) and intensity in decibels (dB). Normal-hearing persons can detect very soft sounds of 0 dBHL to very loud sounds of 120 dBHL, over a wide range of frequencies.

An audiogram plots a person's threshold—the softest level the person can hear as a function of frequency and intensity. People with thresholds of 20 dBHL or below (0 – 20dBHL) are considered to have normal hearing.

What is Hearing Loss?

Hearing loss refers to a decrease in a person's sensitivity to sound. Alternatively, hearing loss is an increase in a person's thresholds to sound. Permanent hearing loss typically involves damage to the sensory hair cells of the inner ear. There may also be damage to the auditory nerve itself. This type of hearing loss is referred to as sensorineural hearing loss. There is no medical cure for sensorieural hearing loss.

What is a Hearing Aid?

For persons with hearing loss, the most commonly recommended treatment to improve hearing sensitivity is a hearing aid. Hearing aids are prosthetic devices that are worn externally on or in the ear. A hearing aid amplifies sound, or more simply, makes sound louder. By amplifying sound, any remaining, healthy sensory hair cells in the ear are stimulated to transmit sound information to the auditory nerve and brain.

What is a Cochlear Implant?

For patients with severe-to-profound sensorineural hearing loss, hearing aids are often not able to improve speech understanding. While very powerful hearing aids exist that increase the volume of sound to very loud levels, these hearing aids can not improve hearing if there are too few remaining hair cells to stimulate. In these cases, the sound information cannot be properly delivered to the brain. For these patients, a cochlear implant may be recommended. Cochlear implants attempt to restore hearing by bypassing the damaged hair cells of the inner ear and delivering electrical stimulation directly to the auditory nerve. Cochlear implants are prosthetic devices with internal components that are surgically placed and external components that require fitting and programming. Cochlear implants are considered the only medical treatment for severe-to-profound hearing loss.

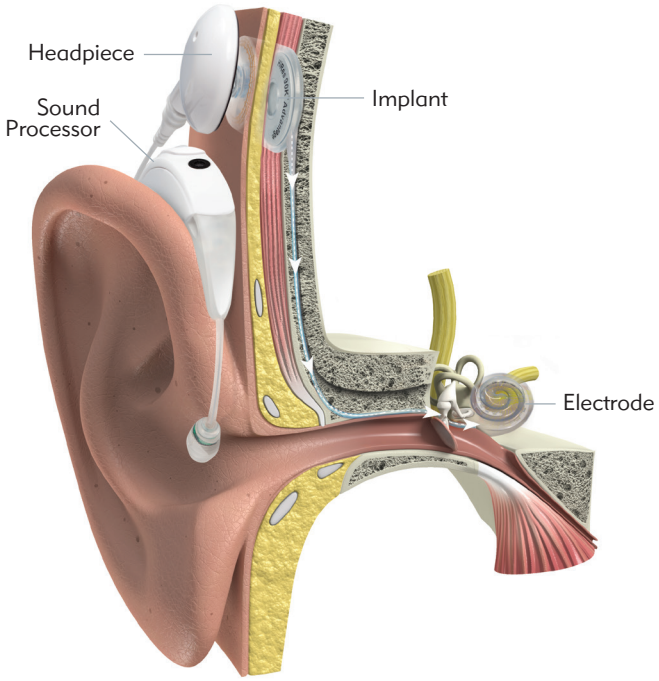
Hearing losses will range in degree from mild to profound, depending on the extent of damage.

Mild Hearing Loss is designated by hearing sensitivity in the 25 – 40 dBHL range.

Moderate Hearing Loss is designated by hearing sensitivity in the 40 – 70 dBHL range.

Severe Hearing Loss is designated by hearing sensitivity in the 70 – 90 dBHL range.

Profound Hearing Loss is designated by the 90 dBHL and greater range. Often, persons with profound hearing loss are referred to as deaf.



Cochlear implants attempt to restore hearing to people with severe-to-profound hearing loss by bypassing the damaged hair cells of the inner ear and delivering electrical stimulation directly to the auditory nerve.

How is a Cochlear Implant Different from a Hearing Aid?

Hearing aids acoustically amplify sound and rely on the responsiveness of healthy sensory hair cells to receive that sound and send the message to the brain. A cochlear implant, however, bypasses the absent or damaged sensory hair cells and stimulates the hearing nerve directly by converting acoustic sound input into an electrical pattern that is recognizable to the hearing nerve for the transmission of sound information to the brain.

Who is a Candidate for a Cochlear Implant?

Adults and children 12 months of age and older with severe-to-profound sensorineural hearing loss may be candidates for a cochlear implant. Typically, candidates will have been fitted with hearing aids but received minimal benefit.

A team approach is most often taken to determine if a child is a candidate. A surgeon rules out medical contraindication with a physical examination, an MRI or a CT scan, and medical review of records. An audiologist evaluates the degree of hearing loss, functional benefit with hearing aids, and the potential benefit to be gained from a cochlear implant. A speech-language pathologist evaluates communication development, including speech and language skills. A psychologist assesses cognitive, sensory, and motor development as well as parental expectations and motivations. Educators provide information regarding the child's academic progress. The key member of the team is the parent(s)/caregiver(s) whose observations are essential in evaluating the child's overall development and communicative function in the home and outside the educational setting.

The evaluation allows the team to share experiences and knowledge with the family so that appropriate goals and expectations regarding outcome and rehabilitation can be made. If the team determines the child is a candidate, each member of this team will also play a crucial role in the child's success with the device.

Preparing the Child for Surgery

Once a child is determined to be a candidate for a cochlear implant, it is helpful to prepare the child for the surgical placement of the internal portion of the device. It is recommended that the child be familiarized with the surgical setup—clothing (caps, gowns, and masks) and the anesthesia mask. Many hospitals or implant centers have materials and programs to assist families and educators in familiarizing the child with this process. Advanced Bionics sends either Bionic Buddy or Melody, our monkey mascots, with each child's implant system. Bionic Buddy and Melody wear a sound processor(s) and may be useful in explaining the device to the child.

Surgical Placement of Internal Components

The surgical placement of the internal portion of the device is performed under general anesthesia and takes approximately two hours. Typically, the surgery is done on an outpatient basis in which the child arrives in the morning and goes home that same day. Occasionally, an overnight stay may be necessary.

Fitting the External Components

Following a three-to-six-week recovery period, the child will return to the audiologist for fitting of the external components. This first fitting is often referred to as the initial stimulation or hook-up. An audiologist programs the device during the fitting process. Programming involves setting specific parameters of stimulation for the recipient, particularly the levels perceived as soft and comfortable. Programming children is different than programming adults. Children typically do not have the language or experience with sound to report when stimulation is perceived as soft or loud. In addition, children do not have the attention span to sit for an hour of programming. Audiologists who specialize in pediatrics use their experience to fit the device for this more challenging population.

Programming requires frequent adjustments or fine-tuning as the child adapts to the device. While some children adjust very quickly, others require several weeks or months. How much sound a child understands depends on several factors, including age at implantation, length of deafness, previous experience with sound, and access to aural rehabilitation and therapy services.

Is Aural Rehabilitation Required for Cochlear Implant Recipients?

Aural rehabilitation listening therapy is a key factor for successful use of a cochlear implant. The implant is not a cure for hearing loss. A new user will need to practice listening with the device to reach maximum performance. For children, rehabilitation is crucial for the development of oral language and speech skills. Parents of children with hearing loss will have several options in education and therapy methodologies. Some of these options use manual forms of communication, such as sign language, while others emphasize oral communication and/or lipreading. Regardless of which educational approach, some form of aural rehabilitation or listening practice is needed to maximize performance. We encourage you to visit The Listening Room™ at *TheListeningRoom.com*, an AB online rehabilitation resource for you, your child and his or her educational team.

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AB's global rehabilitation & educational programs

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