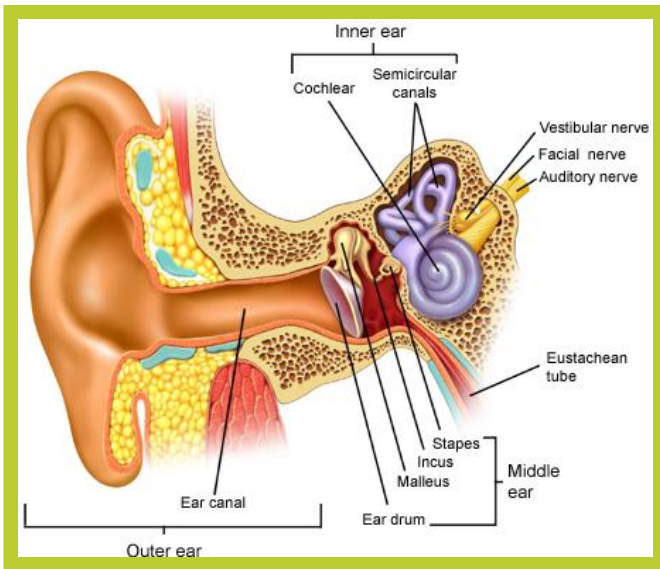


Deaf / Hearing Impaired

A Resource for School Psychologists



Terminology

deaf: A person with little or no measurable hearing, i. e. 90+ dB hearing loss.

Deaf: When capitalized, Deaf refers to those who consider themselves a part of the Deaf culture, and choose to communicate using a signed language such as American Sign Language (ASL), instead of spoken communication.

Hard of hearing: A term used to describe people with hearing loss. Their losses can range from slight to profound. Hard of hearing people understand some speech with or without hearing aids.

Hearing impaired: Describes people with any degree of hearing loss. This term is disliked by both deaf and hard of hearing people and is no longer politically correct. The preferred terms are "people with hearing loss," "hard of hearing" or "Deaf".

Each year in the United States, more than 12,000 babies are born with a hearing loss; often, the cause is unknown.

-Centers for Disease Control and Prevention, 2010

How the Ear Works

The ear consists of three main parts:

- **Outer Ear**
- **Middle Ear**
- **Inner Ear**

The Outer Ear

The auricle or pinna (pin'-uh) is the visible portion of the outer ear. It collects sound waves and channels them into the external auditory meatus (ear canal) where the sound is amplified.

The sound waves then travel toward a flexible, oval membrane at the end of the external auditory meatus called the tympanic membrane (eardrum). The tympanic membrane begins to vibrate.

The Middle Ear

The vibrations from the eardrum set the ossicles into motion. The ossicles (ah'-sikuls) are three tiny bones (smallest in the human body): malleus (mal'-ee-us) or hammer, incus (in-kus) or anvil, and stapes (stay-pee-z) or stirrup which further amplify the sound.

The stapes attaches to the oval window that connects the middle ear to the inner ear. The Eustachian tube, which opens into the middle ear, is responsible for equalizing the pressure between the air outside the ear to that within the middle ear.

The Inner Ear

The sound waves enter the inner ear and then into the cochlea, a snail shaped organ. The cochlea is filled with a fluid that moves in response to the vibrations from the oval window. As the fluid moves, 25,000 nerve endings (hair cells) are set into motion. These nerve endings transform the vibrations into electrical impulses that then travel along the VIII cranial nerve (auditory nerve) to the brain.

The brain then interprets these signals and this is how we hear. The inner ear also contains the vestibular organ that is responsible for balance.

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Sound

Fun fact: Sound travels much more slowly than light. You see a distant lightning bolt before you hear the thunder, even though the lightning and thunder occur simultaneously.

Sound waves vary in amplitude and in pitch.

Pitch, or frequency, refers to how high or low a tone sounds.

- The **hertz** is the unit of measurement for the pitch of sound.
- Examples of sounds in everyday life that would be considered “low-frequency” are a bass drum, tuba, and vowel sounds such as “oo” in “who.”
- Examples of sounds in everyday life that would be considered “high-frequency” are a bird chirping, a triangle being played, and the consonant sound “s” as in “sun.”

Amplitude, or intensity, refers to the sensation of loudness. The higher the amplitude, the louder the sound.

- The **decibel** is the unit of measurement for the intensity of sound. Sound that is comfortably audible to humans ranges from about 50 to 100 decibels.

Profound deafness occurs in 4-11 per 10,000 children; in at least 50% of these cases, the cause is genetic.

-American Speech-Language-Hearing Association



Decibel Level	Example	Time to Damage Hearing Without Ear Protection
0	Lowest sound audible to human ear (threshold)	--
30	Quiet library, soft whisper	--
40	Quiet office, living room, bedroom away from traffic	--
50	Light traffic at a distance, refrigerator, gentle breeze	--
60	Air conditioner at 20 feet, conversation	--
70	Busy traffic, noisy restaurant	Critical level begins with constant exposure
80	Subway, heavy city traffic, alarm clock 2 feet away, factory noise	More than 8 hours
90	Truck traffic, noisy appliances, shop tools, lawn mower	Less than 8 hours
100	Chain saw, boiler shop, pneumatic drill	2 hours
120	Rock concert in front of speakers, sandblasting, thunderclap	Immediate danger
140	Gunshot blast, jet plane	Any exposure is dangerous
180	Spacecraft launch	Hearing loss inevitable

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Measures of Hearing Loss

A hearing screening is typically administered for newborns and for school-age children periodically.

At a typical school screening, a **pure-tone air conduction hearing test** is used. It determines the faintest tones a person can hear at selected pitches (frequencies), from low to high. During this test, earphones are worn so that information can be obtained for each ear. The person taking the test may be asked to respond to the sounds in a variety of ways, such as by:

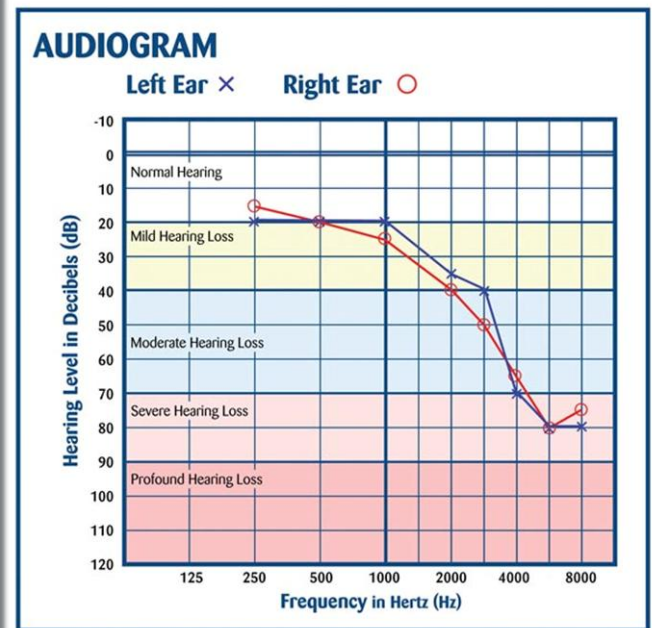
- Raising a finger or hand
- Pressing a button, pointing to the ear where the sound was received
- Saying "yes" to indicate that the sound was heard

The results are recorded in an **audiogram**.

The audiologist uses a red O to indicate the right ear and a blue X to record the left ear. The farther down the audiogram the Xs and Os appear, the worse the hearing.

If indicated by the screening, a more in-depth hearing evaluation should be given by a pediatric otolaryngologist or audiologist. Pediatric hearing testing usually involves the following hearing tests:

- **Visual Reinforcement Audiometry:** is a behavioral audiometric test obtained in a sound-treated room. This test is used to measure the hearing of children age 7 months to 2 1/2 years.
- **Play Audiometry:** is a behavioral test obtained in a sound-treated room, and is used to test the hearing of children age 2 1/2 years to 5 years.
- **Otoacoustic Emissions:** are sounds that are produced by healthy ears in response to acoustic stimulation. This test is most appropriate for use in difficult-to-test patients: newborn infants, young children, and developmentally delayed populations.
- **Tympanometry** (also called impedance audiometry): is a test that can be performed in most physician offices to help determine how the middle ear is functioning. It does not tell if the child is hearing or not, but helps to detect any changes in pressure in the middle ear. This is a difficult test to perform in younger children because the child needs to sit very still and not be crying, talking, or moving.



Degrees of Hearing Loss

Hearing Threshold (decibels)	Degree of Hearing Loss	Ability to Hear Speech
0–25 dB	None	No significant difficulty
26–40 dB	Mild	Difficulty hearing soft speech and conversations, but can manage in quiet environments
41–55 dB	Moderate	Difficulty understanding conversational speech, especially when there is background noise. Higher volume levels are required for hearing TV and radio.
56–70 dB	Moderate to Severe	Clarity of speech is significantly affected. Speech must be loud and you may have difficulty in group conversations
71–90 dB	Severe	Normal conversational speech is inaudible. You may also have difficulty with loud speech or only be able to understand shouted or amplified speech
91+ dB	Profound	Unable to clearly understand even amplified speech

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Types of Hearing Loss

Sensorineural Hearing Loss (SNHL)

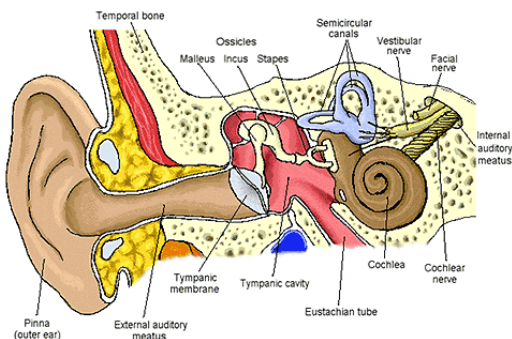
- Occurs when there is damage to the inner ear (cochlea), or to the nerve pathways from the inner ear to the brain. Most of the time, SNHL cannot be medically or surgically corrected.
- Most common type of permanent hearing loss.
- Affects the ability to hear certain frequencies. Thus, even with amplification to increase the sound level, a person with a SNHL may perceive distorted sounds, sometimes making the successful use of a hearing aid impossible.

Conductive Hearing Loss

- Occurs when sound is not conducted efficiently through the outer ear canal to the eardrum and the tiny bones (ossicles) of the middle ear.
- Generally involves a reduction in sound level and results in the inability to hear faint sounds. However, you can still hear people speaking to you, but their speech may sound muffled, weak or far away.
- A person with a conductive hearing loss is usually able to use a hearing aid or can have their hearing loss treated and corrected medically or surgically.

Mixed Hearing Loss

- Sometimes a **conductive** hearing loss occurs in combination with a **sensorineural** hearing loss (SNHL). In other words, there may be damage in the outer or middle ear and in the inner ear (cochlea) or auditory nerve. When this occurs, the hearing loss is referred to as a *mixed* hearing loss.



Signs of Hearing Loss

Parents may notice that their child:

- does not respond consistently to sounds or to his or her own name;
- asks for things to be repeated or often says "huh?"
- is delayed in developing speech or has unclear speech;
- turns the volume up loud on the TV and other electronic devices.

Central Hearing Loss (Cortical Deafness)

- Persons afflicted with this condition often consider themselves to be deaf even while having reactions to sounds in their environment.
- Patients usually have poor scores on speech reception threshold (SRT), or word recognition scores (WRS) portions of the audiogram.
- Patients with central hearing loss typically have inconsistent auditory behavior that may cause them to be misdiagnosed as having "functional" or psychogenic hearing disturbances.

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Causes of Hearing Loss in Children

1. **Otitis media** is an inflammation in the middle ear (the area behind the eardrum) that is usually associated with the buildup of fluid. When fluid is present, vibrations are not transmitted efficiently and sound energy is lost. The result may be mild or even moderate hearing loss. Therefore, speech sounds are muffled or inaudible.

Generally, this type of hearing loss is conductive and is temporary. However when otitis media occurs over and over again, damage to the eardrum, the bones of the ear, or even the hearing nerve can occur and cause a permanent, sensorineural hearing loss.

2. **Acquired hearing loss** appears after birth, at any time in one's life, perhaps as a result of a disease, a condition, or an injury. The following are examples of conditions that can cause acquired hearing loss in children:

Ear infections (otitis media)	
Ototoxic drugs	Chicken pox
Mumps	Influenza
Head injury	Noise exposure
Meningitis	Measles
Encephalitis	

3. The term **congenital hearing loss** implies that the hearing loss is present at birth. It can include hereditary hearing loss or hearing loss due to other factors present either in utero (prenatal) or at the time of birth.

Genetic factors are thought to cause more than 50% of all incidents of congenital hearing loss in children. Genetic hearing loss may be autosomal dominant, autosomal recessive, or X-linked (related to the sex chromosome).

Other causes of congenital hearing loss that are not hereditary in nature include prenatal infections, illnesses, toxins consumed by the mother during pregnancy or other conditions occurring at the time of birth or shortly thereafter. These conditions typically cause sensorineural hearing loss ranging from mild to profound in degree.

Examples include:

- Intrauterine infections including rubella (German measles), cytomegalovirus, and herpes simplex virus
- Complications associated with the Rh factor in the blood
- Prematurity
- Maternal diabetes
- Toxemia during pregnancy
- Lack of oxygen (anoxia)



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Educational Implications

Hearing loss or deafness does not affect a person's intellectual capacity or ability to learn. However, children who are hard of hearing or deaf generally require some form of special education services in order to receive an adequate education. Such services may include:

- regular speech, language, and auditory training from a specialist;
- amplification systems;
- services of an interpreter for those students who use sign language;
- favorable seating in the class to facilitate lip reading;
- captioned films/videos;
- assistance of a notetaker, who takes notes for the student with a hearing loss, so that the student can fully attend to instruction;
- instruction for the teacher and peers in alternate communication methods, such as sign language; and counseling.

Children who are hard of hearing will find it much more difficult than children who have normal hearing to learn vocabulary, grammar, word order, idiomatic expressions, and other aspects of verbal communication. For children who are deaf or have severe hearing losses, early, consistent, and conscious use of visible communication modes (such as sign language, fingerspelling, and Cued Speech) and/or amplification and aural/oral training can help reduce this language delay.

It is important for teachers and audiologists to work together to teach the child to use his or her residual hearing to the maximum extent possible, even if the preferred means of communication is manual. Since the great majority of deaf children (over 90%) are born to hearing parents, programs should provide instruction for parents on implications of deafness within the family.

Definition in IDEA

The terms “**hearing impairment**” and “**hearing loss**” are often used to describe a wide range of hearing losses, including deafness; however, IDEA actually defines the two terms separately, as follows:

Hearing impairment is defined by IDEA as “an impairment in hearing, whether permanent or fluctuating, that adversely affects a child's educational performance.”

Deafness is defined as “a hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification.”

Thus, deafness is viewed as a condition that prevents an individual from receiving sound in all or most of its forms. In contrast, a child with a hearing loss can generally respond to auditory stimuli, including speech.

The U.S. Department of Education (2006) reports that 14,787 children received audiology services in early intervention programs in the fall of 2004, while 139,643 children received speech-language pathology services. The Department (2007) also reports that, during the 2003 school year, 79,522 students aged 3 to 21 received special education services under the category of “hearing impairment.” However, the number of children with hearing loss and deafness is undoubtedly higher, since many of these students have other disabilities and may be served under other categories.



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Classroom Acoustics

A student's ability to hear and understand what is being said in the classroom is vital for learning. Unfortunately, this ability can be reduced in a noisy classroom. Poor classroom acoustics occur when the background noise and/or the amount of reverberation in the classroom are so high that they interfere with learning and teaching. We know that when classroom acoustics are poor it can affect:

- speech understanding
- reading and spelling ability
- behavior in the classroom
- attention
- concentration
- academic achievement

All children are affected by poor classroom acoustics, but it can be a particular problem for children with the following problems:

- hearing loss, including children with a hearing loss in one ear
- temporary hearing loss in one or both ears (ear infection or build up of middle ear fluid)
- learning disabilities
- auditory processing disorders
- speakers of another language
- speech and language delay
- attention problems

Available from the American-Speech-Language-Hearing Association



“The Noisy Classroom: How to create a listening-friendly classroom” brochure discusses how High levels of noise and reverberation can negatively affect educational achievement for children with normal hearing as well as those with hearing loss, auditory processing disorders, attention deficit disorder, and learning disabilities. This brochure provides helpful suggestions, in easy to understand language, for improving the acoustics of noisy classrooms.



Tips for Creating a Good Listening Environment in the Classroom

If your classroom is too noisy here are some simple tips to help make the environment quieter:

- Place some rugs or carpet in the room if there none.
- Hang window treatments such as curtains or blinds.
- Hang soft materials such as felt or corkboard on the walls.
- Place tables at an angle around the room to interfere with the pathways of sound.
- Hang soft materials such as flags or student artwork around the room and from the ceiling.
- Turn off noisy equipment when it is not in use.
- Try to keep windows and doors closed when possible.
- Replace noisy light fixtures.
- Avoid open classrooms where many classes are taught in a large space.
- Talk to the students about noise and demonstrate how it can be difficult to hear when many children are talking at the same time.
- Avoid dividing the class into groups where one group is listening to audiovisual equipment such as the TV and the other group is listening to the teacher.
- Remind visitors to the classroom that they should not be talking when the teacher is talking.

Deaf / Hearing Impaired Web Resources

- Alexander Graham Bell Association for the Deaf and Hard of Hearing | www.agbell.org
- American Hearing Research Foundation | www.american-hearing.org
- American Society for Deaf Children | 1.800.942.2732 | www.deafchildren.org/
- ASHA | American Speech-Language-Hearing Association | 1.800.638.8255 | www.asha.org/public/hearing/
- Beginnings | For parents of children who are deaf or hard of hearing | <http://www.ncbegin.org/index.php>
- Better Hearing Institute | 1.800.327.9355 | <http://www.betterhearing.org>
- CDC | Centers for Disease Control and Prevention | 1.800.CDC.INFO | www.cdc.gov/ncbddd/dd/ddhi.htm
- Deaf Children and Parents | <http://www.deafchildrenandsigning.com/index.html>
- Deaf Culture Online | <http://www.deaf-culture-online.com/index.html>
- Hands and Voices | <http://www.handsandvoices.org/>
- Hearing Loss Association of America | <http://www.hearingloss.org/>
- How's Your Hearing? | <http://www.howsyourhearing.com/>
- Info to Go | Laurent Clerc National Deaf Education Center | 202.651.5051 | http://clerccenter.gallaudet.edu/Clerc_Center/Information_and_Resources/Info_To_Go.html
- Listen Up! | <http://www.listen-up.org>
- Medline Plus | <http://www.nlm.nih.gov/medlineplus/hearingdisordersanddeafness.html>
- National Association of the Deaf | <http://www.nad.org>
- National Center for Hearing Assessment & Management | 435.797.3584 | <http://www.infanthearing.org/>
- NIDCD | National Institute | on Deafness and Other Communication Disorders | 1.800.241.1044 | <http://www.nidcd.nih.gov/health/hearing/>
- PEPNET | Regional postsecondary education centers to increase access to postsecondary education for persons who are deaf. <http://www.pepnet.org>

Helpful Readings

Your Child's Hearing Development Checklist | <http://www.nidcd.nih.gov/health/hearing/silence.asp>

To Parents of Deaf Children | <http://www.deaf-culture-online.com/parents-of-deaf-children.html>

Early Intervention | <http://www.infanthearing.org/earlyintervention/index.html>

Assistive Technology for Hearing | http://www.asha.org/public/hearing/treatment/assist_tech.htm

Communications Considerations A-Z | <http://www.handsandvoices.org/comcon/index.html>

Communication Plan for a Child Who is Deaf or Hard of Hearing | http://www.handsandvoices.org/pdf/communication_plan

Cochlear Implants | www.nidcd.nih.gov/health/hearing/coch.asp

IEPs for Children who are Deaf or Hard of Hearing | <http://www.helpkidshear.com/resources/advocacy/advocacy.htm#iep>

Resources for People Who Can't Afford Hearing Aids and Cochlear Implants | <http://www.hearingexchange.com/articles/paulas-110601.htm>

Strategies for Teachers | <http://www.as.wvu.edu/~scidis/hearing.html>

Tips for Teachers | <http://deafness.about.com/od/schooling/a/inclassroom.htm>



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- <http://nichcy.org/disability/specific/hearingloss#types>
- http://www.gallaudet.edu/Clerc_Center/Information_and_Resources/Info_to_Go/Hearing_Loss_Information/Hearing_Loss_For_Older_Children.html
- http://www.umm.edu/otolaryngology/ear_works.htm
- http://www.hopkinsmedicine.org/hearing/hearing_loss/how_the_ear_works.html:
- <http://www.hopkinsmedicine.org/hearing/pediatric/testing.html>
- <http://www.asha.org/public/hearing/Hearing-Testing/>
- <http://www.urmc.rochester.edu/audiology/conditions/degrees.cfm>
- <http://www.hearinglosshelp.com/glossary.htm#H>
- <http://www.ncheatingloss.org/gloss.htm>
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