

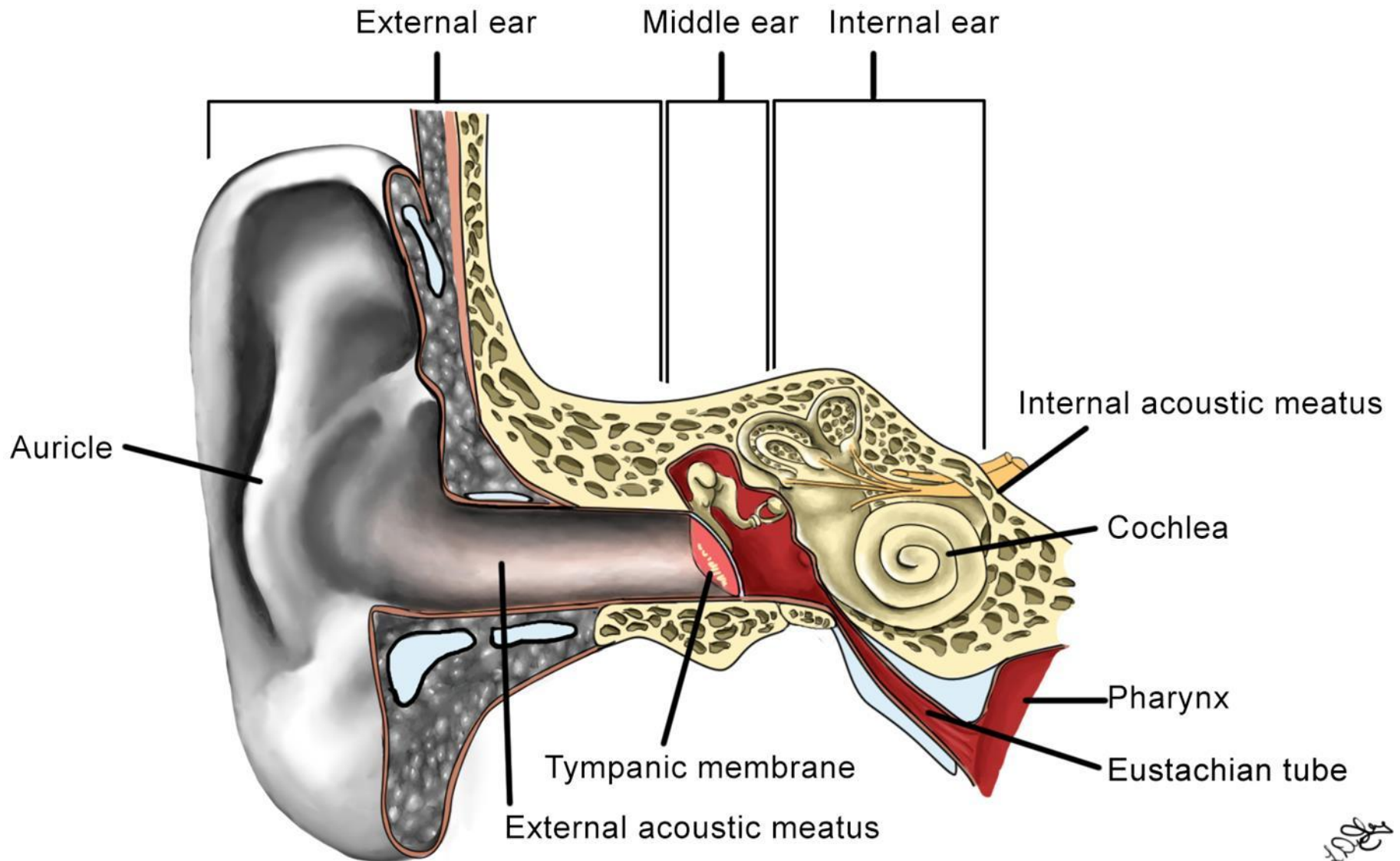
Hearing Aids



Course Code: XECO2

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Mr.S.Arunmurugan, AP/ECE**

The Ear





Human Hearing System





The infographic features a central white silhouette of a human head in profile, facing right. This silhouette is set against a dark grey circular background that has a torn-paper effect at the top and bottom edges. Surrounding the head are eight numbered signs of hearing loss, arranged in a circular pattern. The numbers 1 through 8 are in a large, bold, black font, and the corresponding descriptions are in a smaller, black, sans-serif font.

Signs of hearing loss

1 Misunderstanding people

8 Difficulties on the telephone

2 Turning the TV or radio up

7 Ringing in the ear or head

3 Cannot hear high pitched sounds

6 Speaking loudly

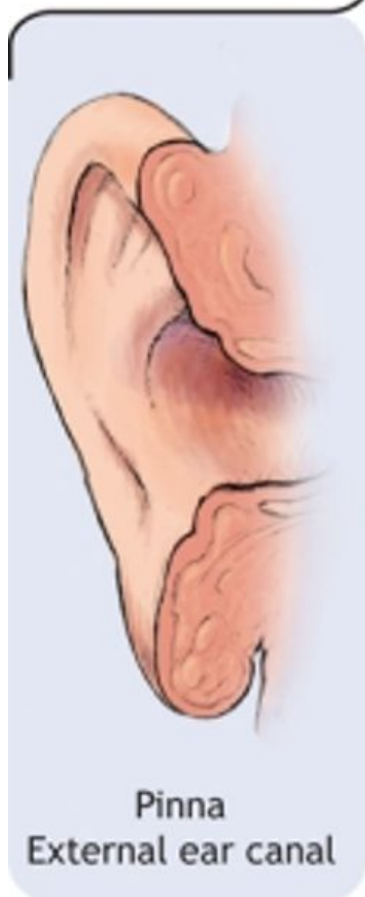
4 Asking people to repeat themselves

5 Problems in noisy environments

Conductive
hearing loss

Sensorineural
hearing loss

Central auditory
processing disorders



Pinna
External ear canal

External ear



Eardrum
Ossicles

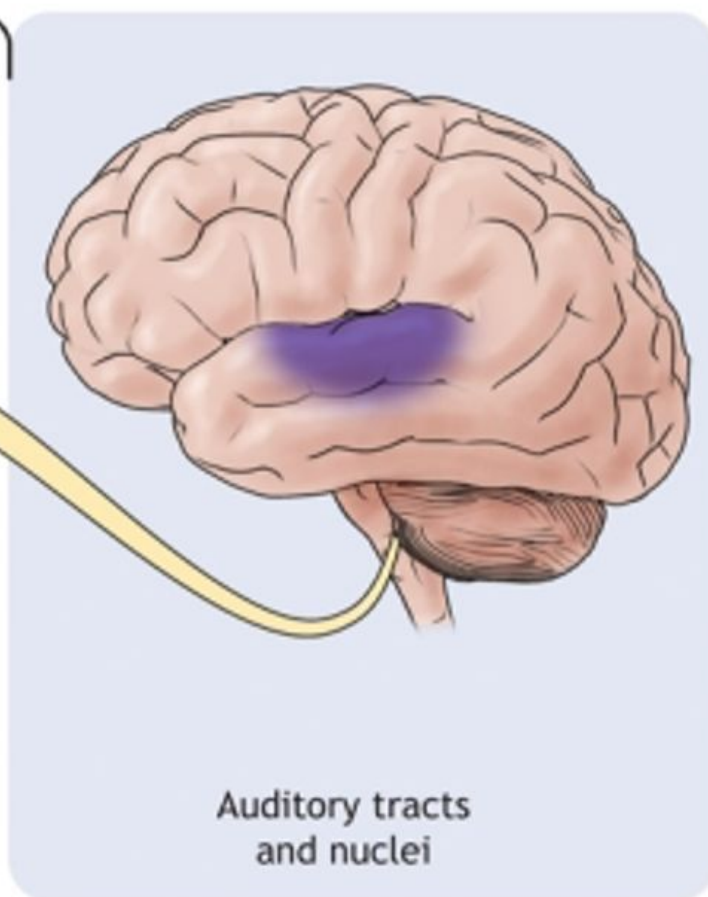
Middle ear

Cochlea

Inner ear

8th cranial
nerve

*Auditory
nerve*



Auditory tracts
and nuclei

Brain

Sites of auditory degeneration with aging

Types of Deafness

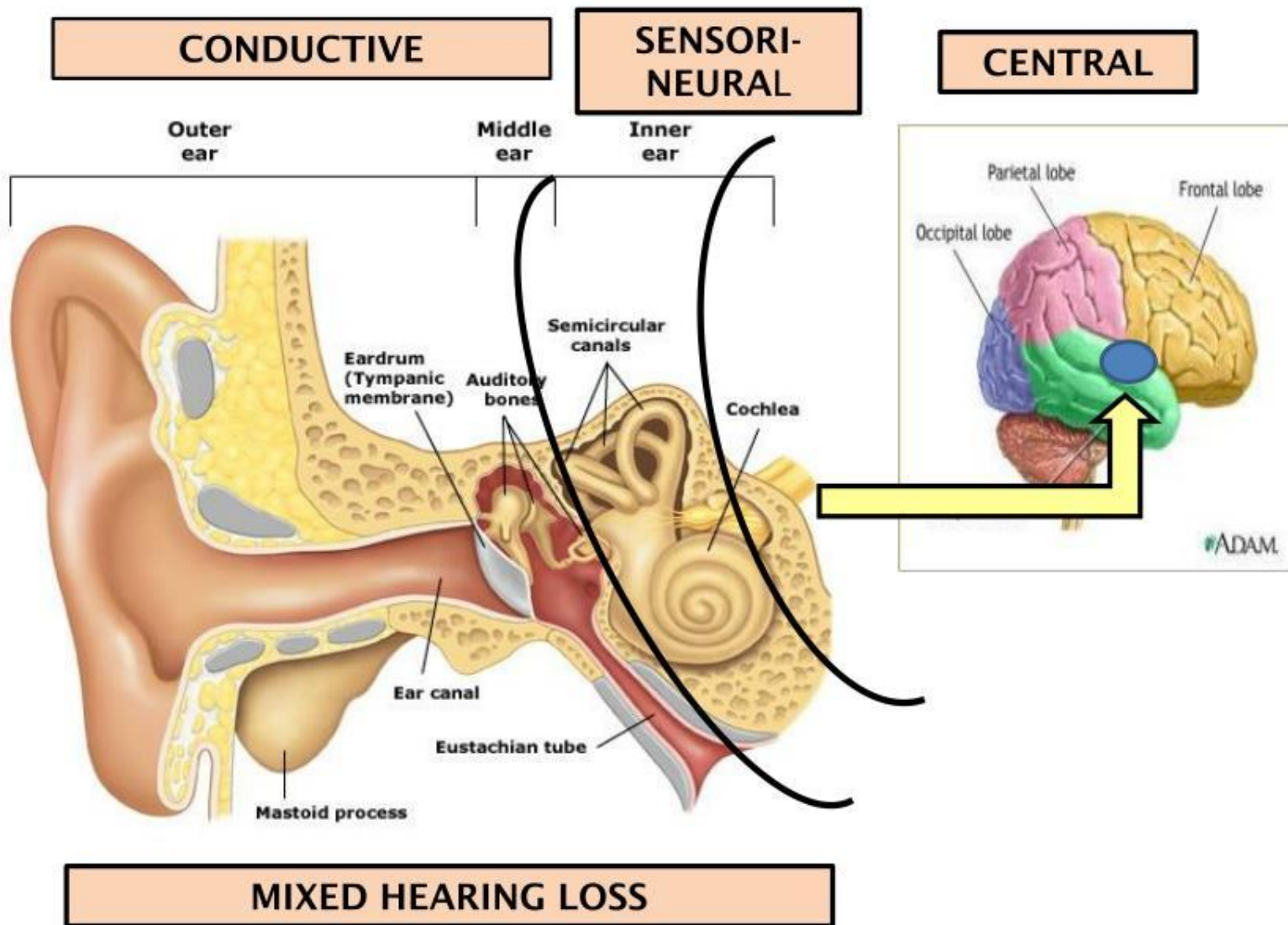
Conductive Hearing Loss

Sensorineural Hearing Loss

Mixed Hearing Loss

Central Hearing Loss

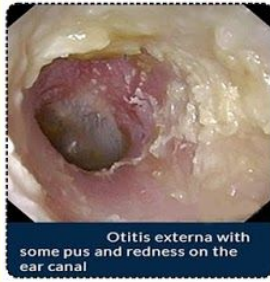




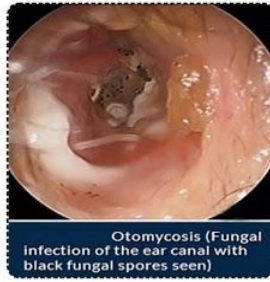
CAUSES OF HEARING LOSS



Malformation of outer ear
Microtia or Atresia



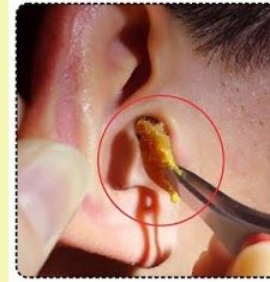
Otitis externa with
some pus and redness on the
ear canal



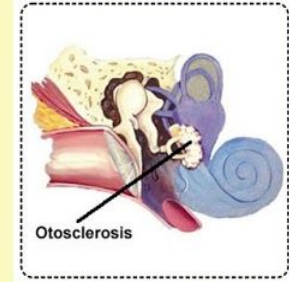
Otomycosis (Fungal
infection of the ear canal with
black fungal spores seen)



Perforated Ear Drum



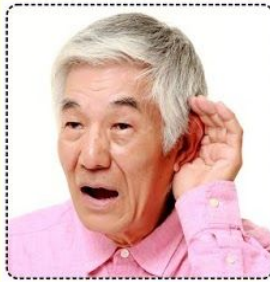
Impacted Ear Wax



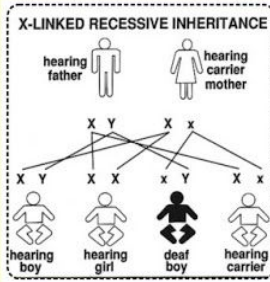
Otosclerosis



Foreign object in the ear



Aging (Presbycusis)



Heridity



Strong Medication



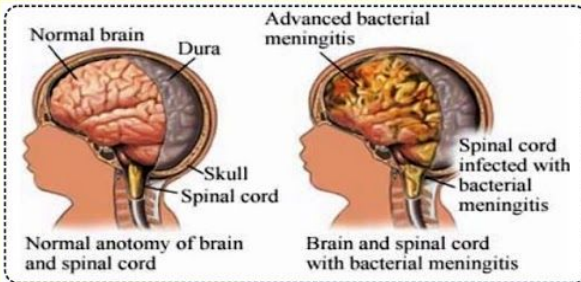
Occupational Noise



Head Trauma



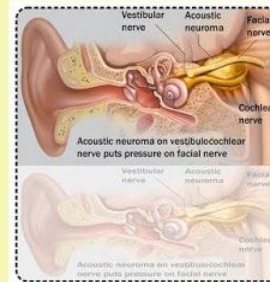
Noise Exposure



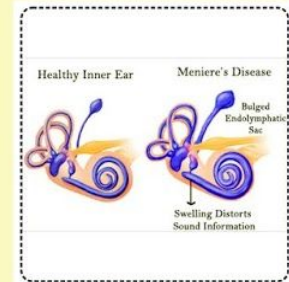
Illness - Menegitis/TB/Hypothyroidizm



Stress

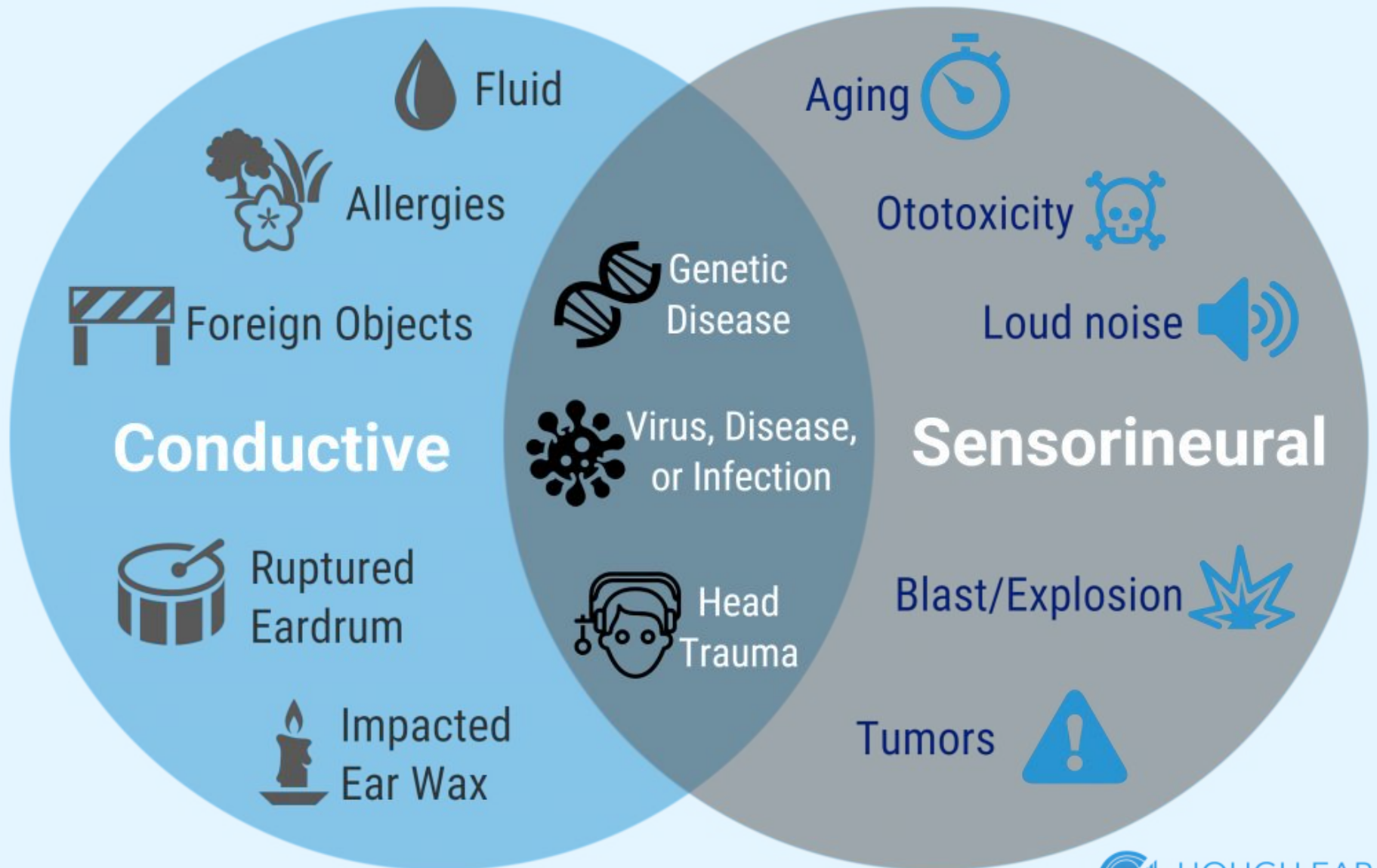


Acoustic Neuroma



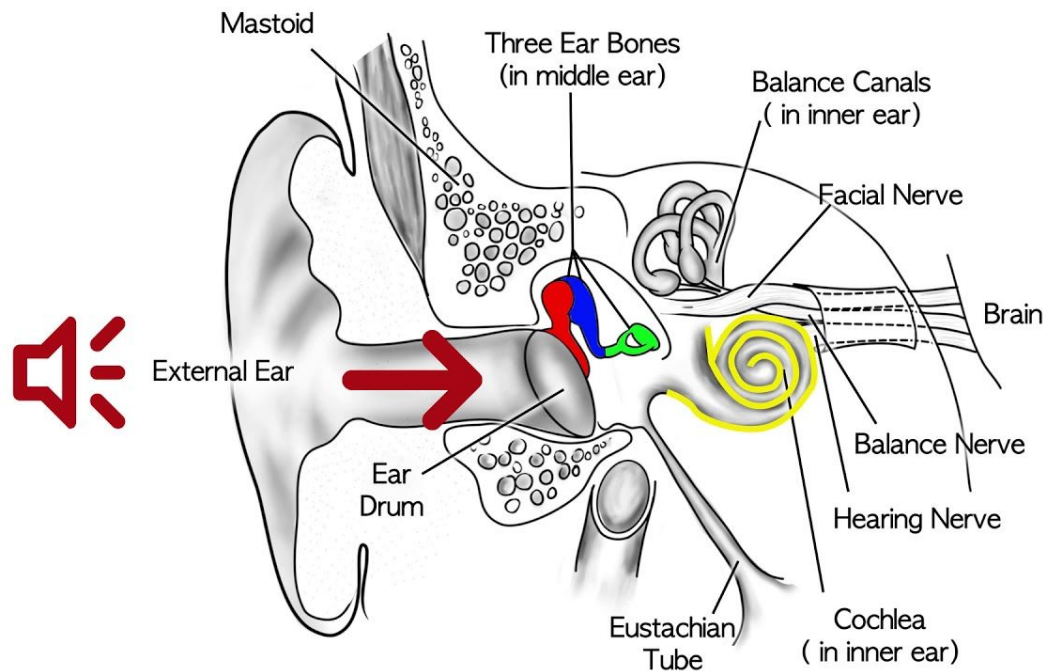
Meniere's Disease

Causes of Hearing Loss



Conductive Hearing Loss

- **Outer or middle ear** that interferes with sound transmission to the inner ear.
- Earwax, ear infections or problems with the ear canal.



(A)

Wax
Blocking Eardrum

A cross-sectional diagram of the human ear. The ear canal is filled with a large, yellow, irregular mass labeled 'Wax'. This mass is pressing against the eardrum, which is visible as a thin, pinkish membrane. The ossicles (small bones) and the cochlea (spiral-shaped structure) are visible behind the eardrum.

(B)

Middle Ear
Fluid

Eardrum

A cross-sectional diagram of the human ear. The eardrum is shown as a thin, pinkish membrane. Behind it, the middle ear cavity is filled with a green, cloudy substance labeled 'Middle Ear Fluid'. An arrow points to the eardrum, which is labeled 'Eardrum'. The ossicles and the cochlea are visible behind the eardrum.

(C)

Hole
In Eardrum

A cross-sectional diagram of the human ear. The eardrum is shown as a thin, pinkish membrane. There is a small, dark, circular opening in the center of the eardrum, labeled 'Hole In Eardrum' with an arrow pointing to it. The ossicles and the cochlea are visible behind the eardrum.

(D)

Inner Ear
Damage

A cross-sectional diagram of the human ear. The eardrum is shown as a thin, pinkish membrane. Behind it, the middle ear cavity is filled with a green, cloudy substance. The ossicles are visible, and the cochlea (spiral-shaped structure) is shown with a blue, irregular mass inside it, labeled 'Inner Ear Damage'.

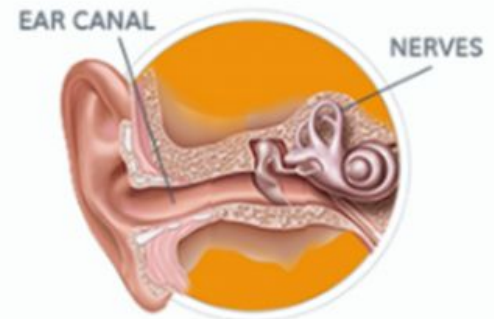
Sensorineural Hearing Loss

- **Damage to the inner ear** (cochlea) or the **auditory nerve**.
- It is often permanent and can result from aging, noise exposure, genetics or certain medical conditions.



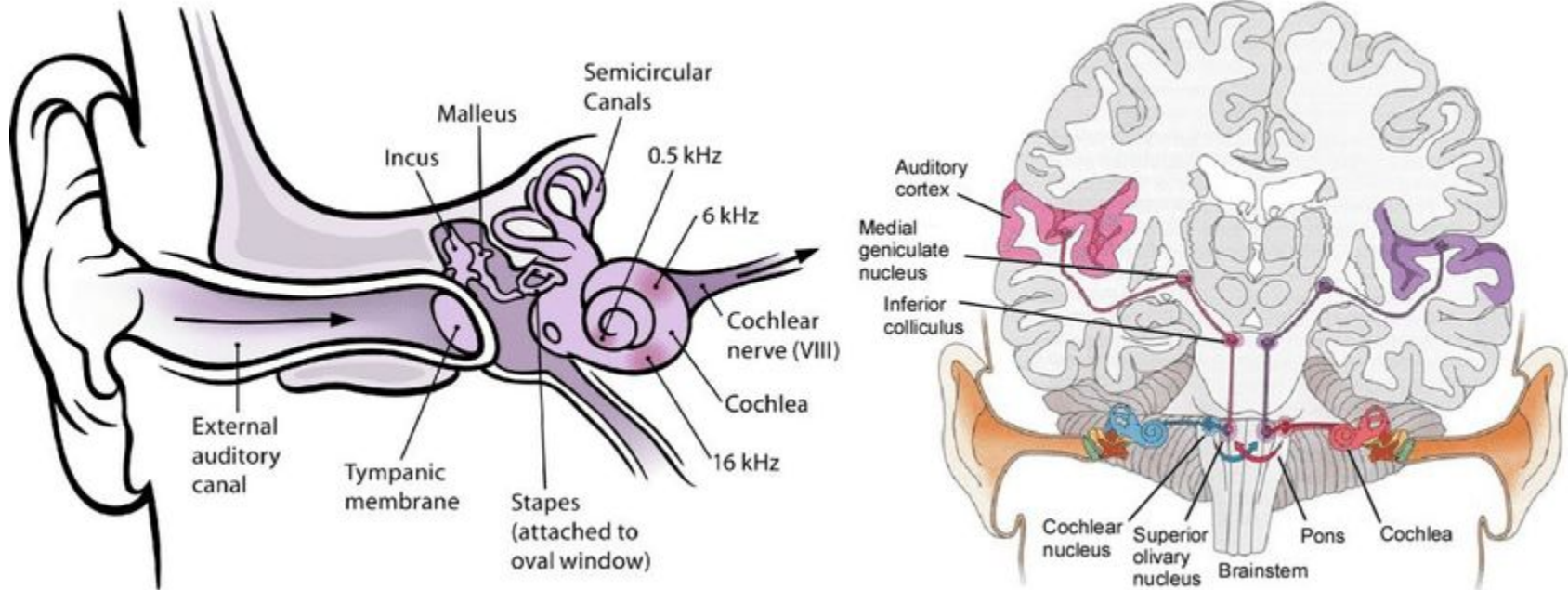
Mixed Hearing Loss

- A combination of conductive and sensorineural components:
 - Blockage in the outer or middle ear
 - AND
 - Damaged inner ear (cochlea) or auditory nerve



Central Hearing Loss

- Related to problems in the **central nervous system**, particularly the brain's ability to **process sound**.
- It can result from neurological conditions or brain injuries.



DIFFERENT STYLES OF HEARING AIDS

Behind-the-ear (BTE)



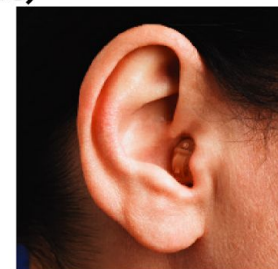
In-the-canal (ITC)



Receiver in canal (RIC)



Completely-in-the-canal (CIC)

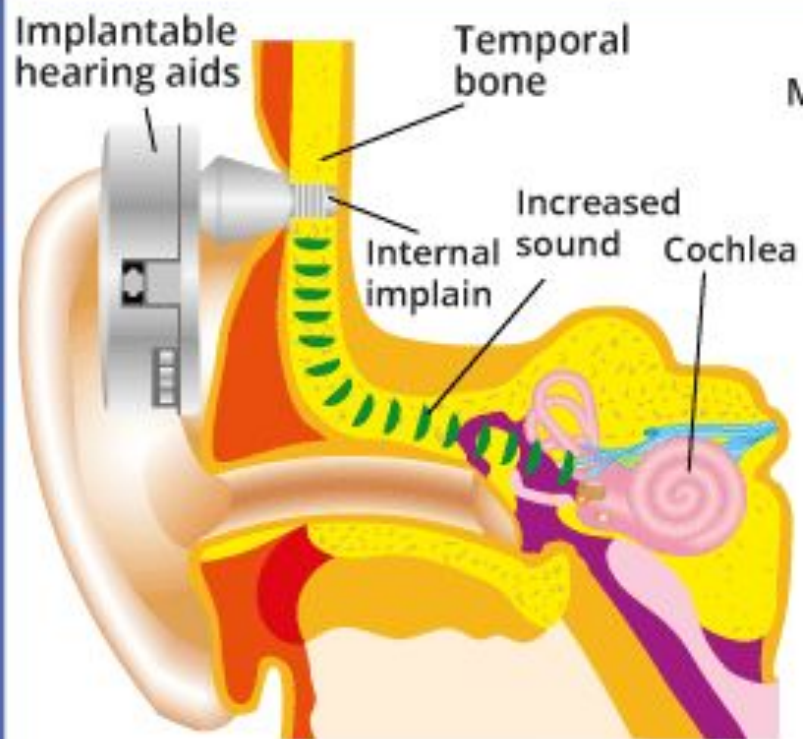


In-the-ear (ITE)

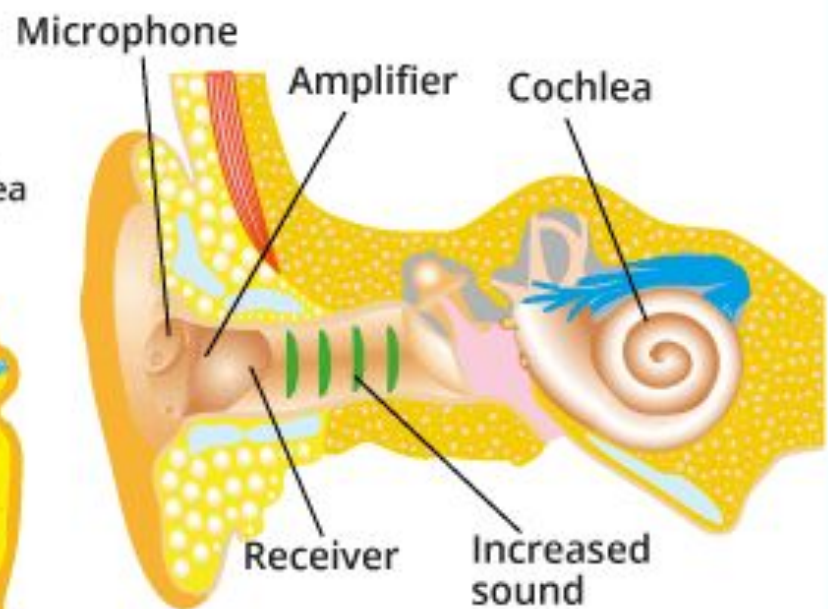


Invisible In-the-canal (IIC)





IMPLANTABLE HEARING AIDS

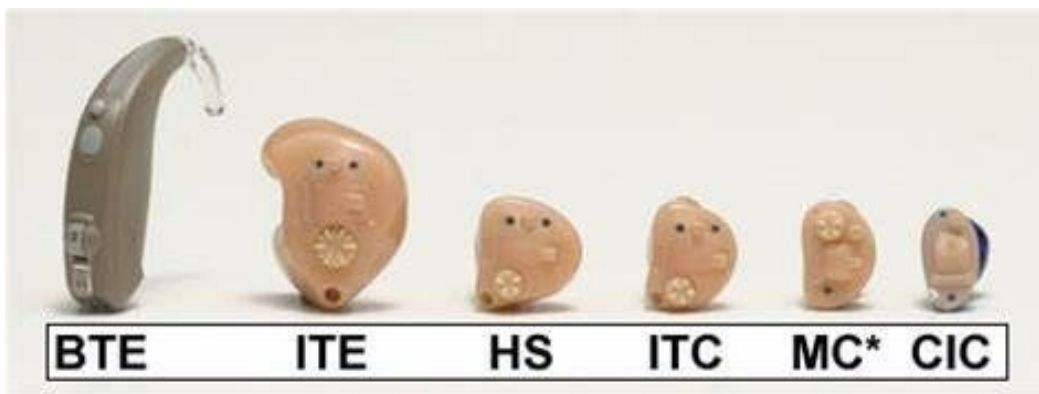


HEARING AIDS IN THE CANAL

Types of Hearing Aids

Hearing aids can help people who have lost some of their hearing.

- Behind-the-Ear (BTE)
- In-the-Ear (ITE)
- In-the-Canal (ITC) and Completely-in-the-Canal (CIC)
- Receiver-in-Canal (RIC) or Receiver-in-the-Ear (RITE)



Behind-the-Ear (BTE)

These devices rest **behind or on top of the ear** and are suitable for various types of hearing loss.

They can accommodate larger batteries and offer various features.



In-the-Ear (ITE)

To fit inside the ear

less visible but may have fewer features due to their smaller size.



In-the-Canal (ITC) and Completely-in-the-Canal (CIC)

These are among the smallest and most discreet hearing aids, fitting partly or **entirely inside the ear canal**.

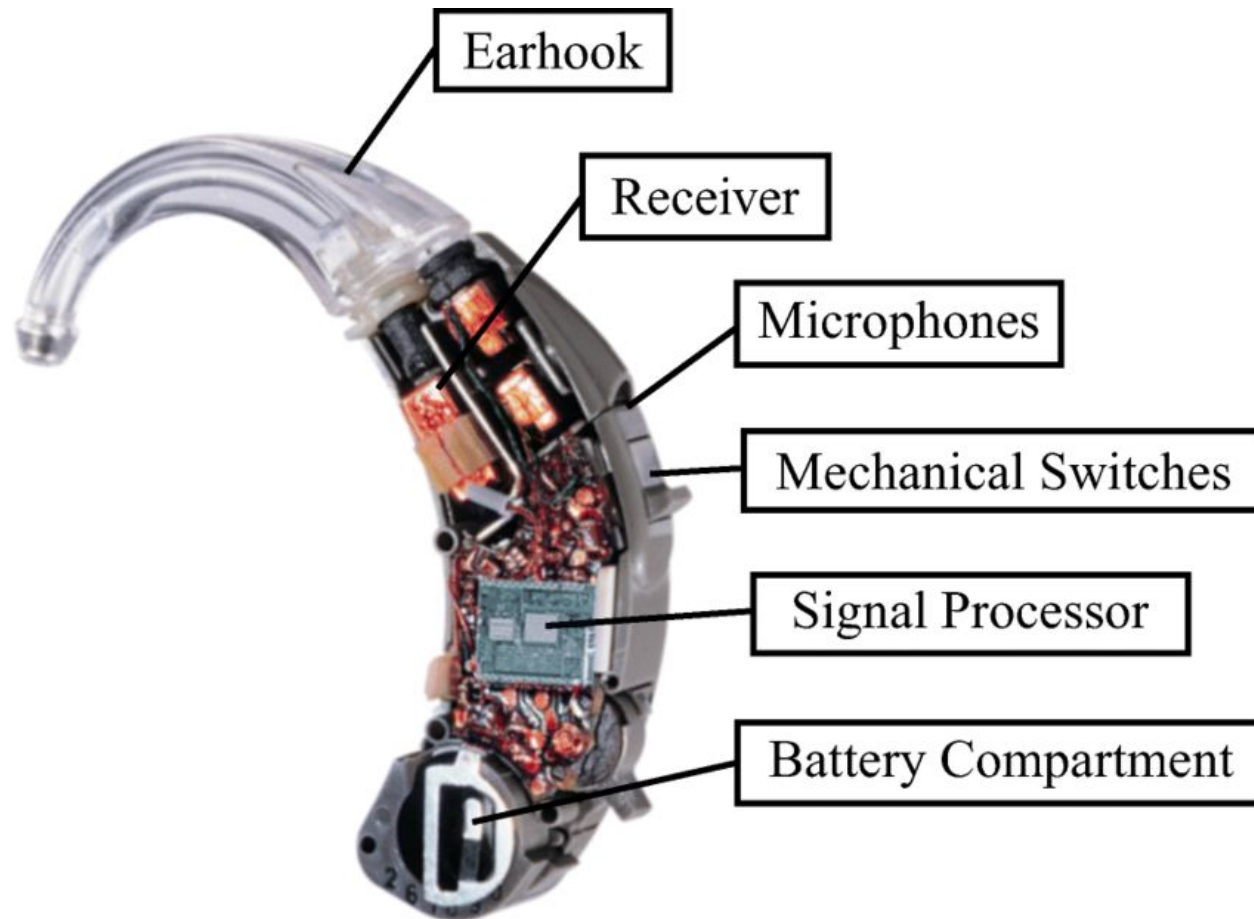


Receiver-in-Canal (RIC) or Receiver-in-the-Ear (RITE)

These models have a receiver (speaker) in the ear canal and connect to the main unit behind the ear via a wire.



Components of Hearing Aids



How Hearing Aids Work (The Basics)



**Someone
says hello**
*"ello ooreh ooo ee
you en!"*



A microphone picks up
the sound & and
converts it into an
electrical/ digital signal.



An amplifier increases the
strength of the signal. In more
sophisticated devices, the signal
is manipulated by advanced
processing



The receiver/speaker
converts it back into
sound & sends it to the
inner ear.



The brain "hears" and
understands the sound
as speech.



**We hear them
say hello**
*"Hello! It sure is good
to see you again."*

Components of Hearing Aids

Microphone: Collects sound from the environment.

Amplifier: Increases the volume of collected sounds.

Receiver (or speaker): Converts the amplified signals into sound and directs it into the ear canal.

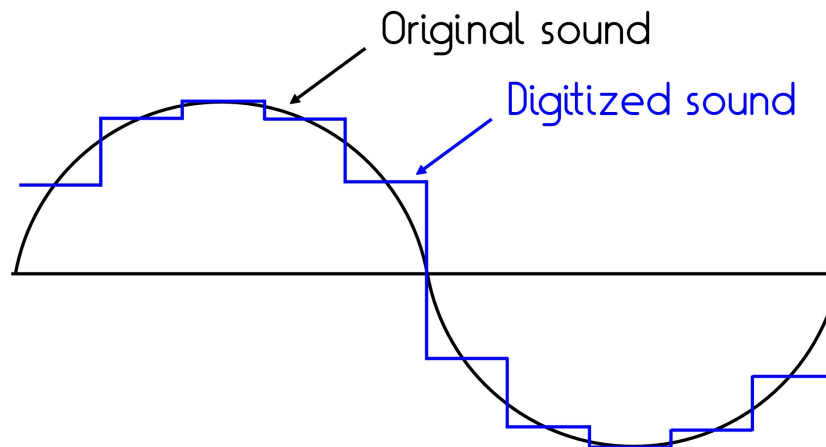
Battery: Provides power to the hearing aid.

Volume Control: Allows the wearer to adjust the volume.

Program Button: Permits users to switch between different listening modes or programs.

Digital vs Analog Hearing Aids

- Analog hearing aids **amplify all sounds uniformly** and are **less flexible** in terms of customization.
- Digital hearing aids are the most common type today, offering **more precise (accurate) sound processing and customization**.



Difference between analog and digital hearing aids

- Analog hearing aids make continuous sound waves louder. These hearing aids essentially amplify all sounds (e.g., speech and noise) in the same way. Analog hearing aids are becoming less and less common.
- Digital hearing aids have all the features of analog hearing aids, but they convert sound waves into digital signals and produce an exact duplication of sound. Digital hearing aids analyze speech and other environmental sounds.

Features of Modern Hearing Aids

Directional Microphones: Focus on sounds in front of the wearer while reducing background noise.

Noise Reduction: Helps filter out background noise for clearer speech.

Feedback Cancellation: Minimizes whistling or feedback sounds.

Bluetooth Connectivity: Allows hearing aids to connect wirelessly to smartphones and other devices.

Rechargeable Batteries: Some models have built-in rechargeable batteries for convenience.

Telecoil: Enables compatibility with hearing loop systems in public places.

Benefits of Hearing Aids

- **Improved hearing and speech understanding.**
- **Enhanced quality of life, social interactions and emotional well-being.**
- **Increased independence and safety.**

Fitting and Adjustment

- ▣ Hearing aids are custom-fitted by an audiologist or hearing care professional.
- ▣ The wearer may need multiple adjustment appointments to optimize settings and comfort.

Maintenance

- ▣ **Hearing aids require regular cleaning and maintenance to ensure their effectiveness.**
- ▣ **Batteries need replacement periodically or rechargeable models need recharging.**

Speech Intelligibility Index (SISI)

- SISI is a test
- To assess speech perception in individuals with hearing loss
- To measures a person's ability to understand
- To identify words or sentences at different levels of loudness
- To determine the optimal hearing aid settings for improved speech recognition

Masking Techniques

- Background noise to a hearing test or hearing aid fitting.
- **Audiologists** assess how well a person can hear and understand speech in challenging, noisy environments.
- Masking can also be used in **hearing aid programming** to suppress tinnitus (ringing in the ears) and **improve comfort in noisy situations**.

Wearable Devices for Hearing Correction

Personal Sound Amplification Products (PSAPs)

Amplify sounds for individuals - mild hearing loss

Cochlear Implants

Surgically implanted devices - sensorineural hearing loss

Bone Conduction Devices

Transmit sound vibrations through the bones - inner ear - conductive or mixed hearing loss

Assistive Listening Devices (ALDs)

Like FM systems, telephones and loop systems - to enhance sound clarity

Smart Hearing Aids

They can stream **audio directly to the hearing aids control settings via mobile apps** and even make adjustments based on the wearer's preferences and environment

Online Reference

- <https://www.youtube.com/watch?v=AxzVyMcmRcs>
- <https://www.youtube.com/watch?v=YdlTLuweXv8>
- <https://www.youtube.com/watch?v=zLCmJAY9agk>
- <https://www.youtube.com/watch?v=Q6iXwbBXACE>

1. <https://www.youtube.com/watch?v=Yz3R1InCO10>

2. <https://www.youtube.com/watch?v=ZyssSSzADC4&t=45s>