

HUMAN ANATOMY AND PHYSIOLOGY 1(BP101T)

UNIT: 4 SPECIAL SENSES

CLASS: 6

TOPIC: STRUCTURE AND FUNCTIONS OF EAR AND ITS DISORDERS

It is the organ of hearing. It is supplied by 8th cranial nerve i.e. the **cochlear** part of the vestibulocochlear nerve which is stimulated by vibrations caused by sound waves.

ANATOMY OF EAR:

PARTS OF EAR:

- **EXTERNAL EAR:** which collects sound waves and channels them inward.
- **MIDDLE EAR:** which conveys sound vibrations to the oval window.
- **INTERNAL EAR:** the internal ear, which houses the receptors for hearing and equilibrium.
- **EXTERNAL EAR :** The external ear collects sound waves and channels them inwards. External ear consists of three basic parts:
 - Pinna (Auricle)
 - External Auditory Meatus
 - Drum (Tympanic Membrane)
 - **PINNA (AURICLE):**
 - Auricle is a sheet of **elastic cartilage covered** with skin. The rim of auricle is the **helix** and the inferior portion is called as **lobule**. Muscles and ligaments attach the auricle to the 2.5 cm long.
 - Pinna opens into the external auditory canal. The external auditory canal extends from pinna to eardrum.
 - **EXTERNAL AUDITORY CANALS:** contain many specialized **sebaceous glands** which **secrete wax** called as **ceremonious glands**.

Hairs are present in this canal and along with **earwax**; they prevent the entry of dust and foreign particles inside the ear.

- The external auditory canal ends at the **tympanic membrane** which is called as **eardrum**. The eardrum or tympanic membrane is a **thin, semi-transparent partition between the external auditory canal and middle ear**. It is covered by epidermis and is lined by **simple cuboidal epithelium**.

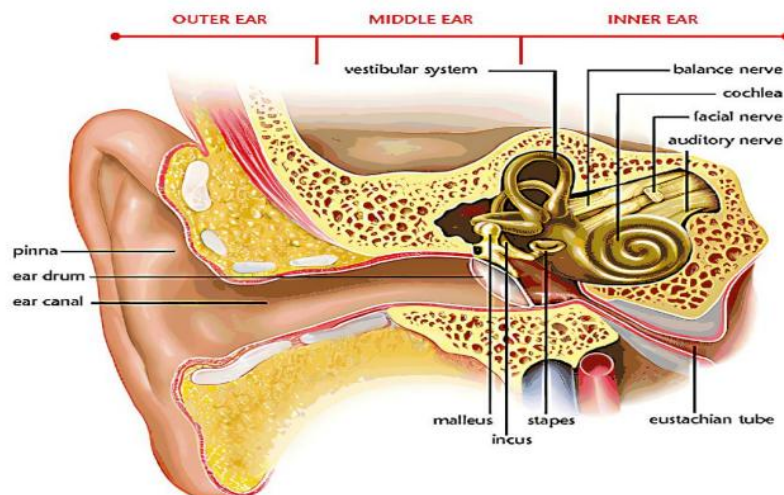
➤ **Function:** Desquamation

➤ **MIDDLE EAR:** Its conveys sound vibrations to the oval window. The middle ear is also called as **tympanic cavity**. The **middle ear is a small, air-filled cavity in the temporal bone** that is lined by **epithelium**. It is separated from the external ear by a thin bony partition that contains **two small membrane covered openings**.

➤ Oval window

➤ Round Window

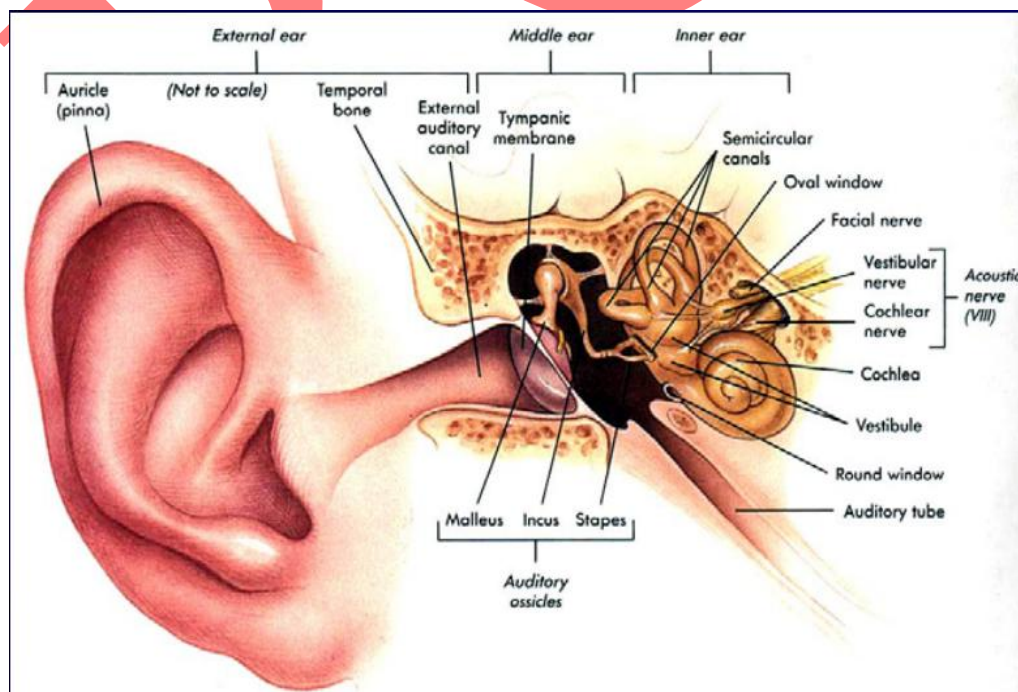
Three tiny ligaments attached bones are present in the middle ear. These bones are called as **auditory ossicles**.

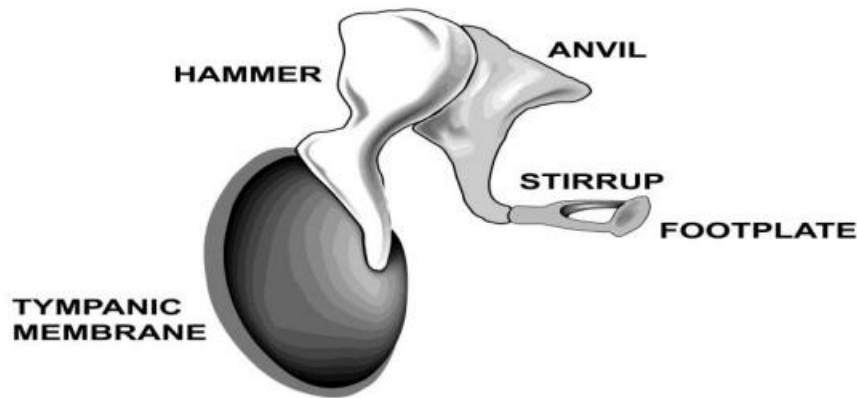


Internal structure of ear

These are named according to their shapes.

- The malleus or the hammer
- The incus or the anvil
- The stapes or the stirrup
- **THE MALLEUS:** The handle of malleus attaches to the **internal surface** of the eardrum. The head of the malleus articulates with the body of the incus.
- **THE INCUS:** The middle bone in the series articulates with the head of the stapes.
- **THE STAPES:** The **base or footplate of the stapes** fit into the **oval window**. Directly below the oval window is another opening the round window which is enclosed by a membrane called as **secondary tympanic membrane**. The middle ear also filled with air. The middle ear is connected to **pharynx** through a tube called as **eustachian tube**. It helps maintain equal air pressure on the two sides of the eardrum.





Auditory ossicles

INTERNAL EAR: The internal ear is also called as **labyrinth**. Structurally, it consists of two parts:

Bony labyrinth: Outer part of labyrinth

Membranous labyrinth: Inner part of labyrinth

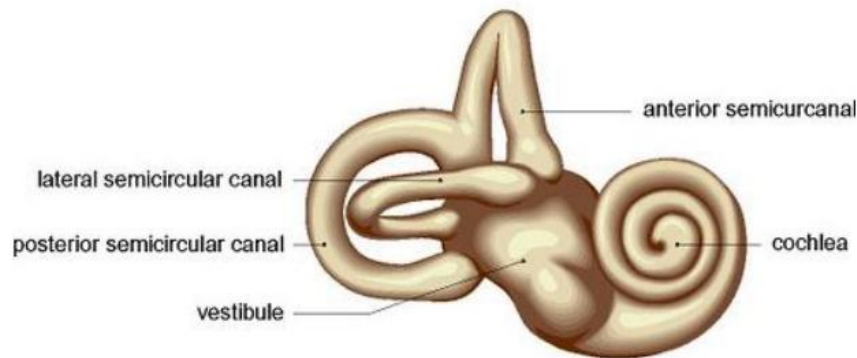
- The semi-circular canals
- Cochlea
- Vestibule: Utricle Saccule Semicircular Canals

The receptors for equilibrium are located in the **semi-circular canals**. The receptors for hearing are located in **cochlea**. The fluid present in bony labyrinth called as **perilymph**. The fluid present in membranous labyrinth called as **endolymph**. The central portion of bony labyrinth is the **vestibule**. The vestibule is connected with the three semi-circular canals in the posterior side whereas anteriorly it is connected with cochlea.

- Anterior semi-circular canal
- Posterior semi-circular canal
- Lateral semi-circular canal

The vestibule consists of two sacs are:

- Utricle
- Saccule



Internal ear

Each semi-circular canal lies at approximately right angles to the other two. At one end of each canal is a swollen enlargement called as ampulla.

Anterior to the vestibule is the cochlea, a bony spiral canal that resembles a snails shell and makes almost three turns around a central bony core called the modiolus. The receptor cells are located in the cochlea.

The cochlea is divided into cochlear duct and cochlear spiral. One side of the cochlear duct is made up of basilar membrane and the organ of corti is attached to it. The sensitive receptors of ear are present in the organ of corti. These cells are called as hair cells are responsible for converting the pressure waves into receptor potential. On the sides of cochlear duct are present the following fluid filled compartments:

✓Scala vestibule: It is located on sides of cochlear duct and ends at the oval window.

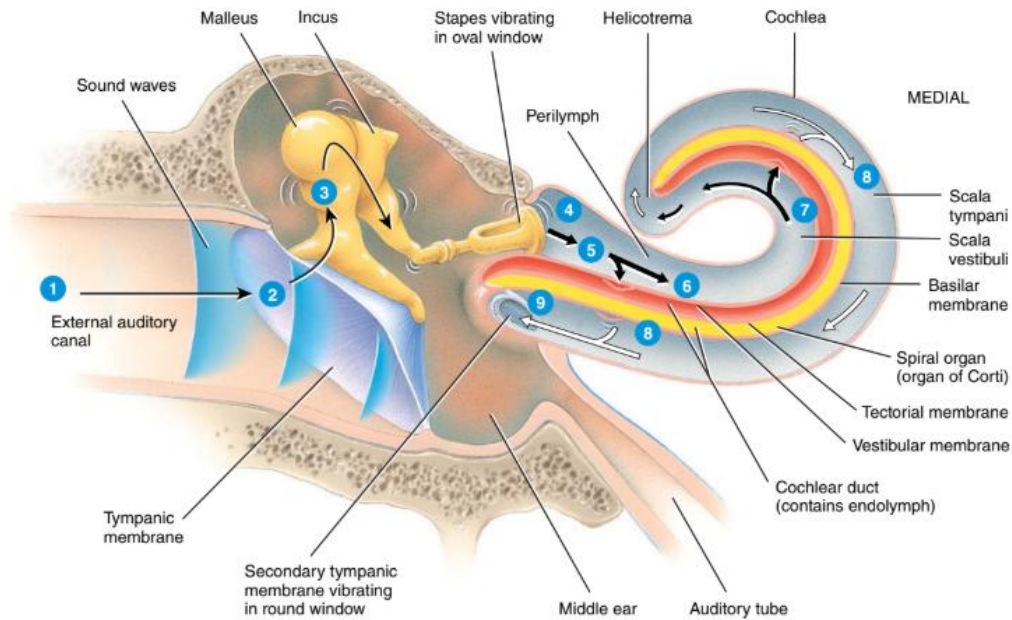
✓ Scala tympani: It is present below the cochlear duct and ends at round window.

PHYSIOLOGY OF HEARING:

The following events occur in hearing:

1. The auricle directs sound waves into the external auditory canal.
2. When sound waves strike the tympanic membrane, the alternating high and low pressure of the air causes the tympanic membrane to vibrate back and forth. The distance it moves, which is very small, depends on the intensity and frequency of the sound waves. The eardrum vibrates slowly in response to low-frequency (low-pitched) sounds and rapidly in response to high frequency (high-pitched) sounds.
3. The central area of the eardrum connects to the malleus, which also starts to vibrate. The vibration is transmitted from the malleus to the incus and then to the stapes.
4. As the stapes moves back and forth, it pushes the membrane of the oval window in and out.
5. The movement of the oval window sets up fluid pressure waves in the perilymph of the cochlea. As the oval window bulges inward, it pushes on the perilymph of the scala vestibuli.
6. Pressure waves are transmitted from the scala vestibuli to the scala tympani and eventually to the round window, causing it to bulge outward into the middle ear.
7. As the pressure waves deform the walls of the scala vestibuli and scala tympani, they also push the vestibular membrane back and forth, creating pressure waves in the endolymph inside the cochlear duct.

8. The pressure waves in the endolymph cause the basilar membrane to vibrate, which moves the hair cells of the spiral organ against the tectorial membrane.



This leads to bending of the hair cell stereocilia, which produces receptor potentials that ultimately lead to the generation of nerve impulses.

DEAFNESS: Deafness is significant or total hearing loss. Sensorineural deafness is caused by either **impairment of hair cells** in the **cochlea** or **damage of the cochlear branch** of the **vestibulocochlear (VIII) nerve**. This type of deafness may be caused by atherosclerosis, which reduces blood supply to the ears; by repeated exposure to loud noise, which destroys hair cells of the spiral organ; and/or by certain drugs such as aspirin and streptomycin.

MENIERE'S DISEASE: Results from an increased amount of endolymph that enlarges the membranous labyrinth. The symptoms are fluctuating hearing loss (caused by distortion of the basilar membrane of the cochlea) and roaring tinnitus (ringing).

OTITIS MEDIA: Otitis media is an acute infection of the middle ear caused mainly by bacteria and associated with infections of the nose and throat. Symptoms include pain, malaise, fever, and a reddening and outward bulging of the eardrum.

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