

Anatomy of the Ear

Neuroanatomy block-Anatomy-Lecture 10

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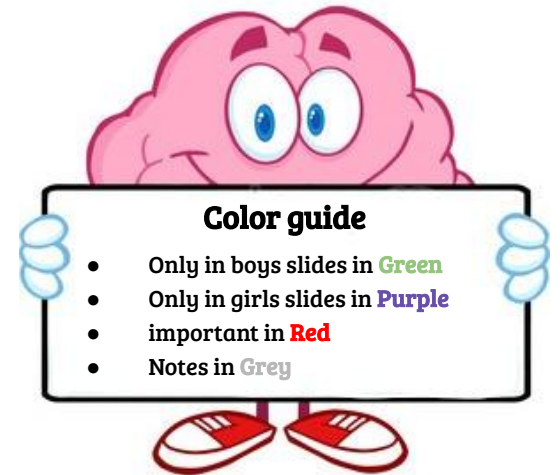




Objectives

 **At the end of the lecture, students should be able to:**

- List the parts of the ear: External, Middle (tympanic cavity) and Internal (labyrinth).
- Describe the parts of the external ear: auricle and external auditory meatus.
- Identify the boundaries of the middle ear : roof, floor and four walls (anterior, posterior, medial and lateral).
- Define the contents of the tympanic cavity:
 - I. Ear ossicles (malleus, incus, and stapes)
 - II. Muscles (tensor tympani and stapedius)
 - III. Nerves (branches of facial and glossopharyngeal)
- List the parts of the inner ear, bony part filled with perilymph (cochlea, vestibule, and semicircular canals), in which is suspended the membranous part that is filled with endolymph
- List the organs of hearing and equilibrium

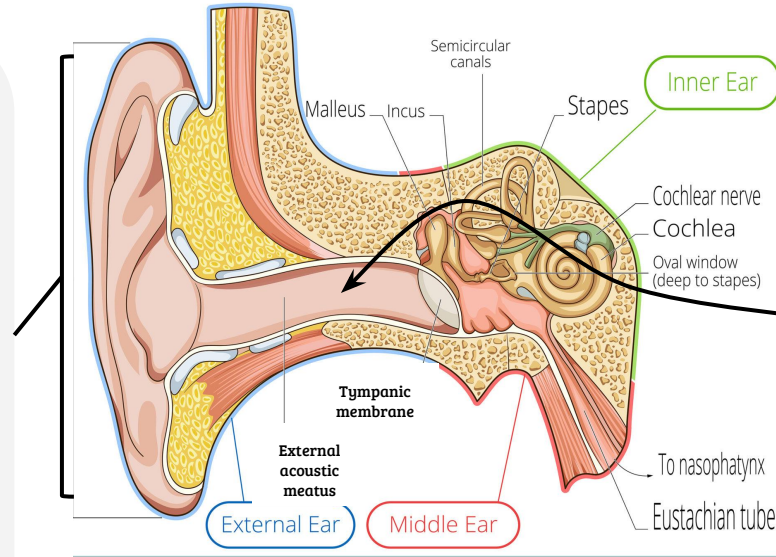


The External Ear

Formed By

The Auricle

- It has a characteristic shape and it collects air vibrations
- It consists of a thin plate of **elastic cartilage** covered by a double layer of skin
- It receives the insertion of extrinsic muscles which are supplied by the **facial nerve**. Sensation is carried by **greater auricular & auriculotemporal nerves**



The External Auditory Canal

- is a curved S-shaped tube about 2.5 cm, that conducts & collects sound waves from the auricle to the tympanic membrane. Its outer 1/3rd is **elastic cartilage**, while its inner 2/3rds are **bony**
- Its lined by skin, and its outer 1/3rd is provided with **hairs, sebaceous and ceruminous glands** (modified sweat glands that secrete a yellowish brownish substance called **ear wax**)

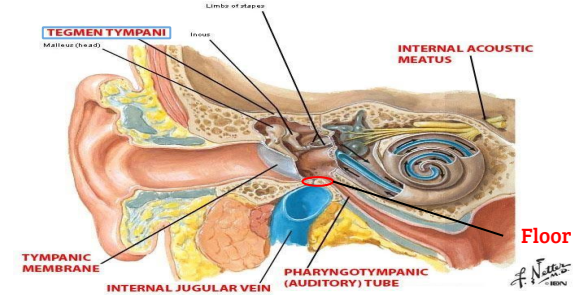
* The auricle is also called pinna

* The external auditory canal is also called the external auditory (acoustic) meatus



Middle Ear (Tympanic Cavity)

- The middle ear is a narrow, oblique slit-like cavity (air-filled) in the petrous temporal bone & lined with mucous membrane.
- It contains the **auditory ossicles**, which transmit vibrations of the tympanic membrane (eardrum) to the internal ear
- The middle ear communicates anteriorly with the **nasopharynx** through the **auditory tube** (it's also known as the **pharyngotympanic tube** or **eustachian tube**)
- which extends from the anterior wall downward, forward and medially to the nasopharynx.
- The posterior 1/3rd of the canal is bony and its anterior 2/3rds are cartilaginous
- its function is to equalize the pressure of both sides of the eardrum



It Has

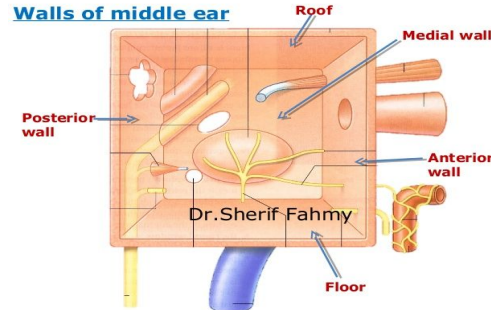
Anterior Wall

Medial Wall

Lateral Wall

Posterior Wall

Roof
 Formed by a thin plate of bone called **tegmen tympani** which is part of the petrous temporal bone. It separates the tympanic cavity from the temporal lobe of the brain.



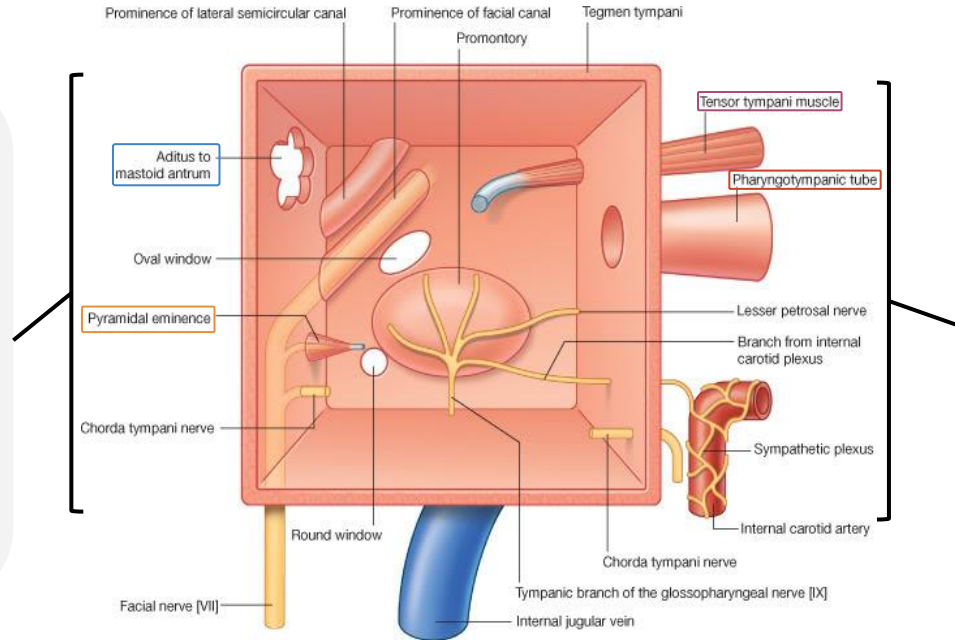
Floor
 Formed by a thin plate of bone which separates the **middle ear** from the **bulb of the internal jugular vein**.



Middle Ear (Tympanic Cavity)

Posterior Wall

- The posterior wall has in its upper part a large irregular opening, which is the **aditus to mastoid antrum** a cavity behind the middle ear, within mastoid process, it contains air cells)
- Below, a small, hollow, conical projection, the **pyramid**, which houses the **stapedius muscle** and its tendon
- The tendon **emerges** from the apex of the pyramid



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Anterior Wall

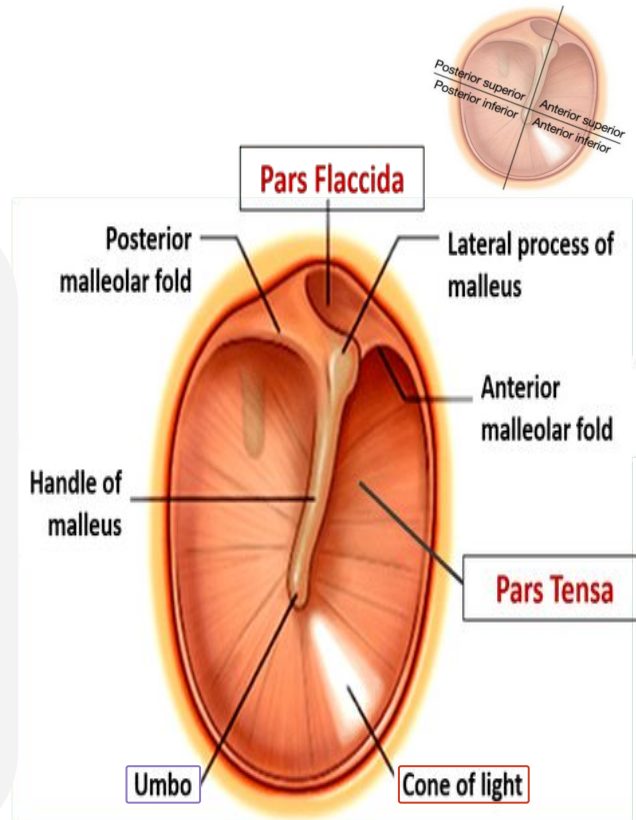
- The anterior wall is formed **below** by a thin plate of bone that separates the tympanic cavity from the **internal carotid artery**
- There are 2 canals at the upper part of the anterior wall:
 - Upper smaller, which is the canal for the **tensor tympani muscle**
 - Lower larger, which is for the **auditory tube**



Middle Ear (Tympanic Cavity)

The Lateral Wall

- It is largely formed by the **tympanic membrane**.
- The membrane is obliquely placed, facing downward, forward, & laterally.
- It's extremely sensitive to **pain**.
- **Nerve supply** of the eardrum:
 - Outer surface:
 - Auriculotemporal nerve
 - Auricular branch of vagus nerve
 - Inner surface:
 - Tympanic branch of the glossopharyngeal nerve



Tympanic Membrane

- It is **concave** laterally, & at the depths of its concavity there is a small depression, "**the umbo**", which is produced by the tip of the **handle of the malleus**.
- When the membrane is illuminated through an otoscope, the concavity produces a "**cone of light**", which radiates anteriorly & inferiorly from the umbo.
- Most of the membrane is tense and is called the **Pars Tensa**.
- A small triangular area on its upper part is slack and is called the **Pars Flaccida**.



Middle Ear (Tympanic Cavity)

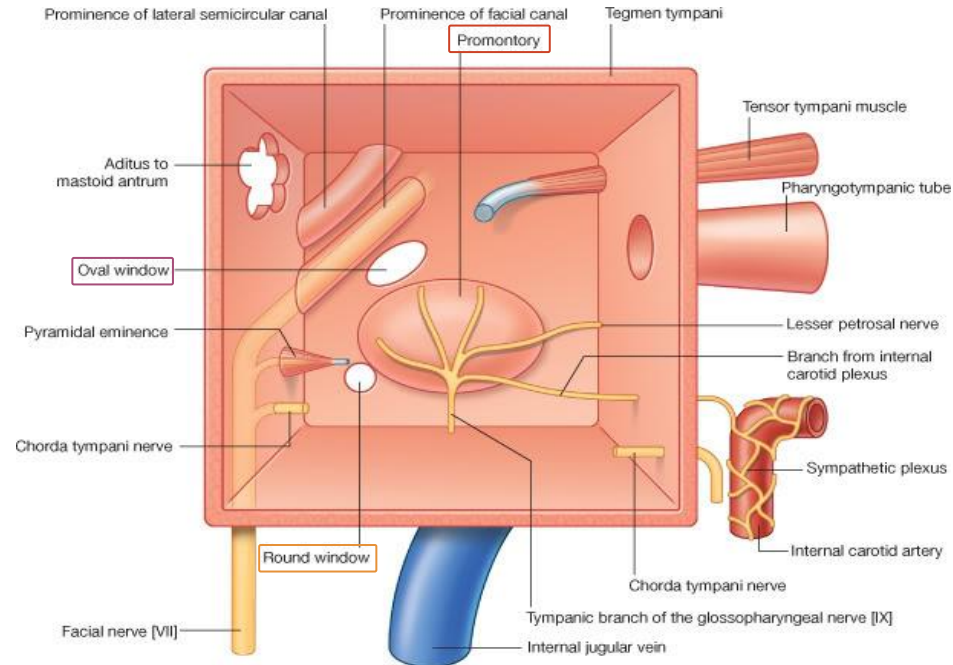
The Medial wall

The medial wall is formed by the lateral wall of the inner ear.

The greater part of the medial wall shows a rounded projection, called the **promontory**, that results from the underlying 1st turn of the cochlea.

Above & behind the promontory lies the oval window (**Fenestra Vestibuli**), which is closed by the **base of the stapes**.

Below & behind the promontory lies the round window (**Fenestra Cochleae**), which is closed by the **secondary tympanic membrane**.



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Middle Ear (Tympanic Cavity)

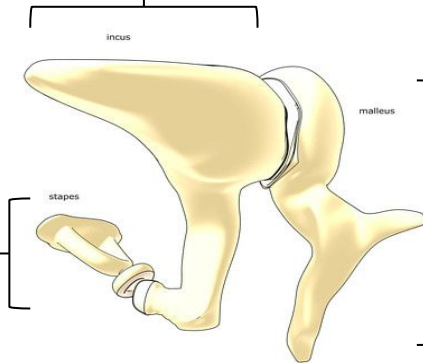
Auditory Ossicles

- They transmit sound waves from the tympanic membrane to the perilymph of the internal ear
- They are covered by mucous membrane & are articulated by synovial joints.

Stapes(Stirrup)

Incus (Anvil)

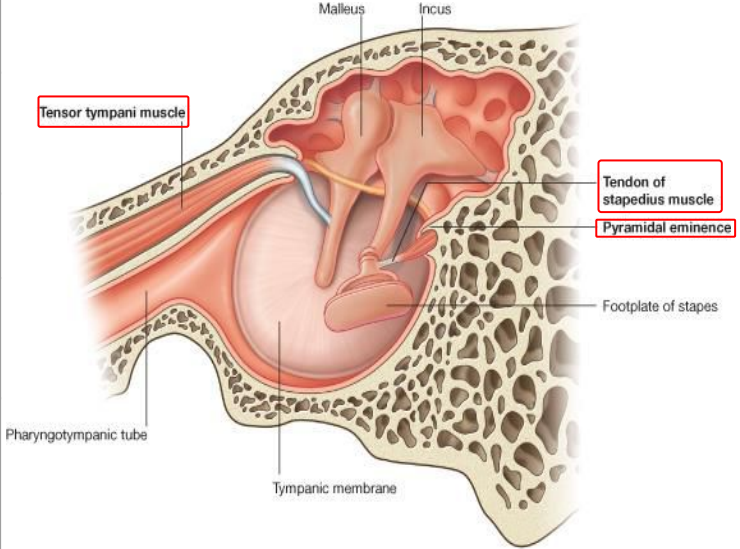
Malleus (Hammer)



Middle Ear (Tympanic Cavity)

Muscles of the Ossicles

Tensor Tympani	
Origin	Cartilage of the auditory tube & the bony walls of its own canal
Insertion	Into the handle of the malleus
Nerve Supply	Mandibular Nerve
Action	Contracts reflexly in response to loud sounds to limit the excursion of the tympanic membrane



Stapedius (the smallest voluntary muscle)	
Origin	Internal walls of the hollow pyramid
Insertion	The tendon emerges from the apex of the pyramid and is inserted into the neck of the stapes
Nerve Supply	Facial Nerve
Action	Reflexly damps down the vibrations of the stapes by pulling on the neck of that bone

Nerves in Middle Ear

Tympanic Nerve

1

The **tympanic nerve** is a branch of the glossopharyngeal nerve

2

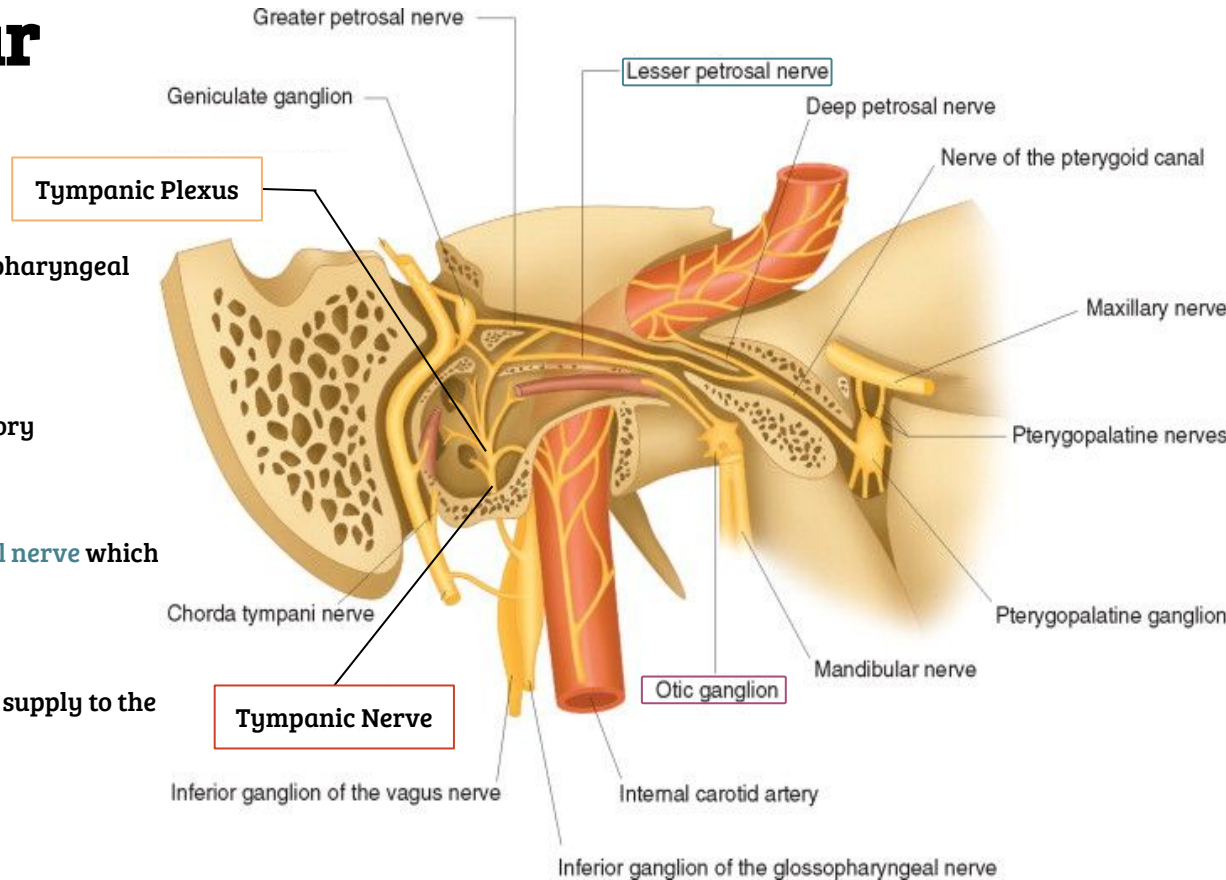
It gives the **Tympanic plexus** on the promontory

3

The tympanic plexus gives the **lesser petrosal nerve** which relays in the **otic ganglion**

4

The lesser petrosal nerve gives secretomotor supply to the **parotid gland**



Nerves in Middle Ear

Facial Nerve

1

The **facial nerve** enters through the **internal acoustic meatus** with the 8th nerve.

2

It expands to form the **geniculate ganglion**

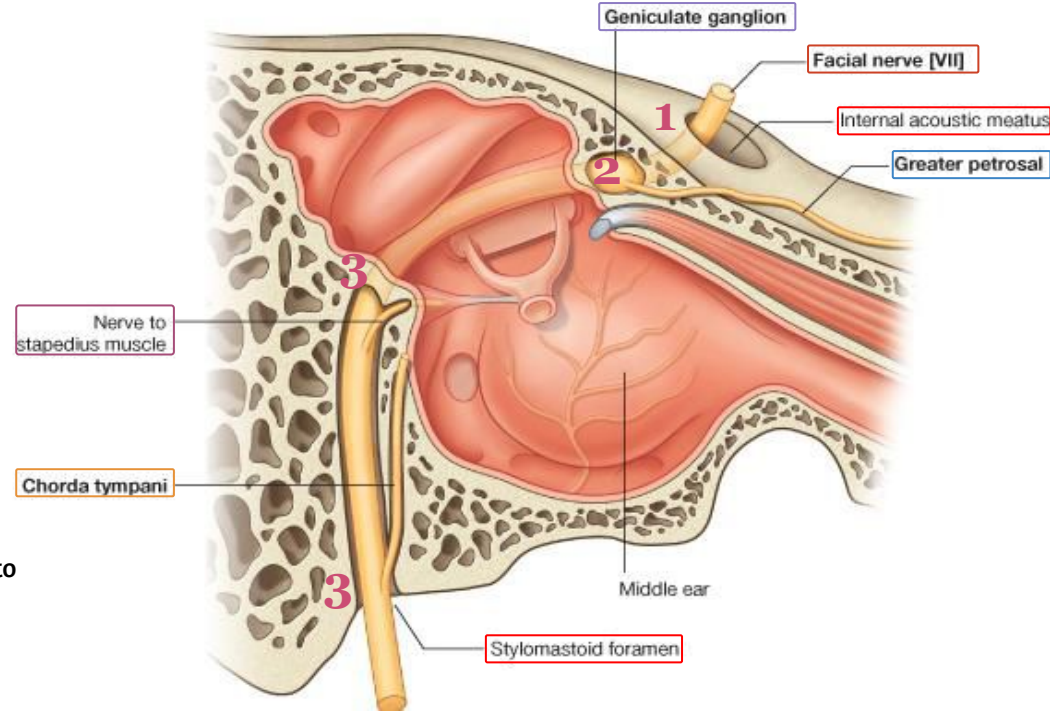
3

It passes vertically behind the pyramid & leaves the middle ear through the **stylomastoid foramen**

4

Branches:

- **Greater petrosal nerve**: arises from the geniculate ganglion & carries preganglionic parasympathetic to supply Lacrimal, nasal, & palatine glands.
- **Nerve to stapedius**
- **Chorda tympani**: arises just before the facial nerve exits



Internal Ear (Labyrinth)

Consists of

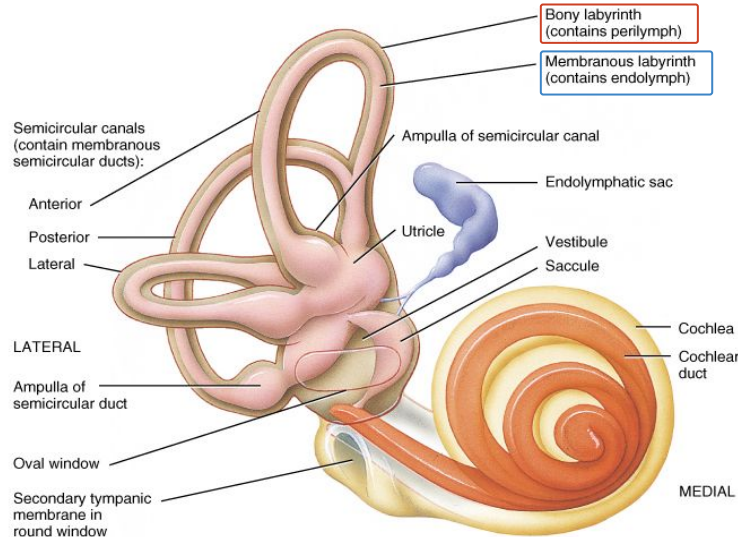
The labyrinth is situated in the petrous part of the temporal bone, medial to the middle ear.

Bony Labyrinth

A series of bony chambers lined by endosteum. They contain a clear fluid, the **perilymph**, in which is suspended the membranous labyrinth

Membranous Labyrinth

Consists of a series of membranous sacs & ducts within the bony labyrinth, its filled with **endolymph**



Internal Ear (Labyrinth)

The Bony Labyrinth consists of

Vestibule

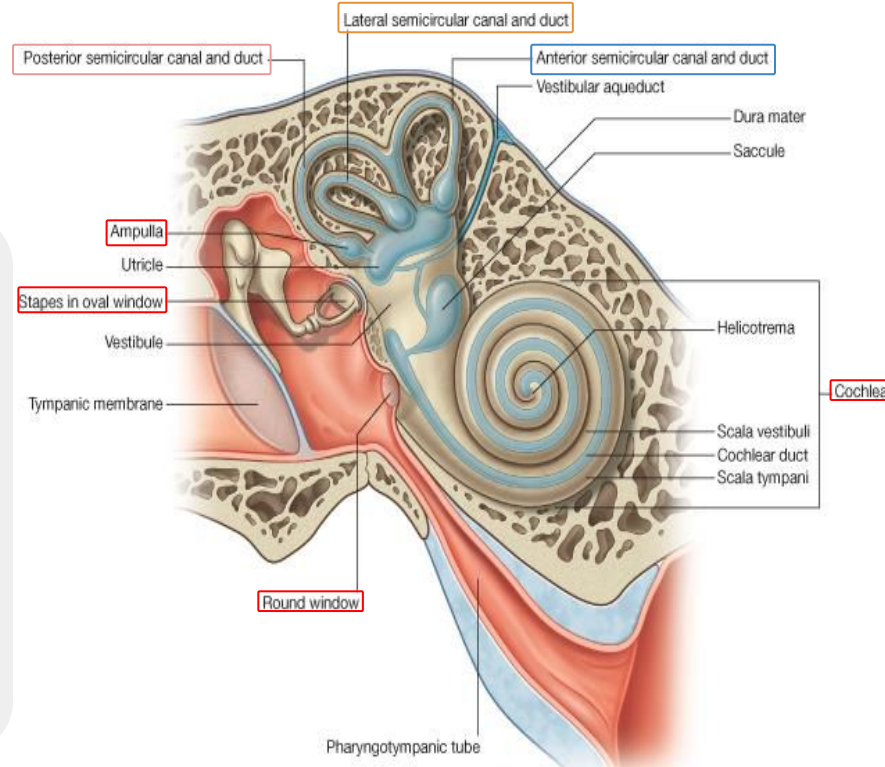
- The vestibule is the central part of the bony labyrinth
- It contains the **utricle** & **sacculle** (parts of the membranous labyrinth)
- In the lateral wall of the vestibule are the **fenestra vestibuli**, which is closed by the **base of the stapes**, & the **fenestra cochleae**, which is closed by the **secondary tympanic membrane**.

Semicircular Canals

- There are **3** semicircular canals:
 - Superior (anterior) canal**
 - Posterior canal**
 - Lateral canal**
- Each canal has a swelling at one end called the **ampulla**
- The canals open into the vestibule by **five** orifices, one of which is common to two canals
- Lodged within the canals are the **semicircular ducts**

Cochlea

- The **first turn** of the cochlea produces the **promontory** on the medial wall of the tympanic cavity
- It contains the **cochlear duct** (part of the membranous labyrinth)



Internal Ear (Labyrinth)

Membranous Labyrinth

The membranous labyrinth consists of four ducts & two sacs, which freely communicate with one another.

Sacs

Utricle & Sacculle (lodged in the bony vestibule)

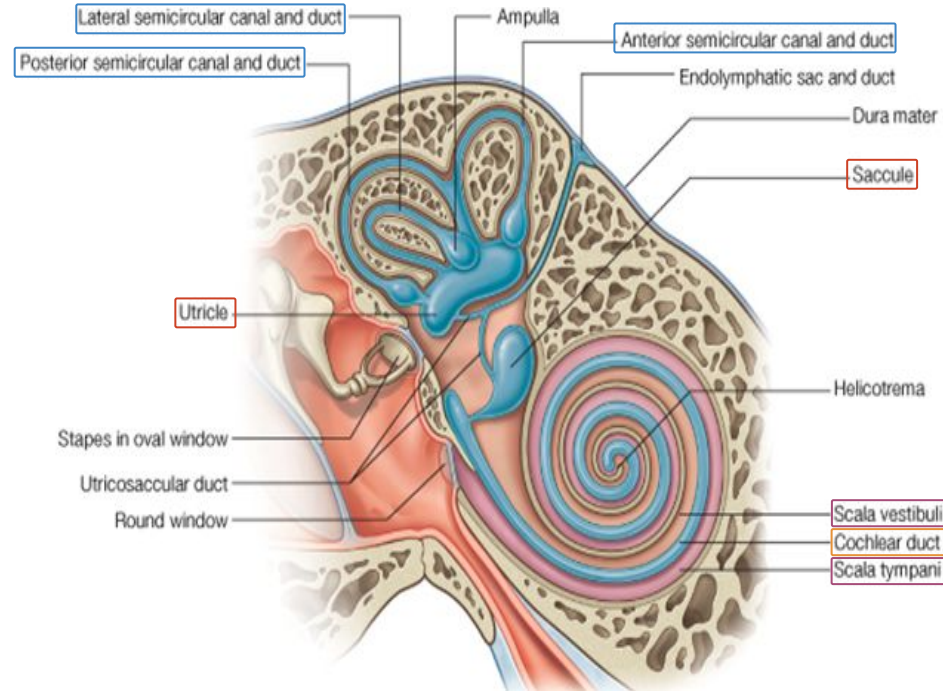
Ducts

Three semicircular ducts (lie within the bony semicircular canals)

Cochlear duct (lies within the bony cochlea). **The cochlear duct divides the bony cavity into Scala Vestibuli & Scala Tympani**

**only in boys slides*

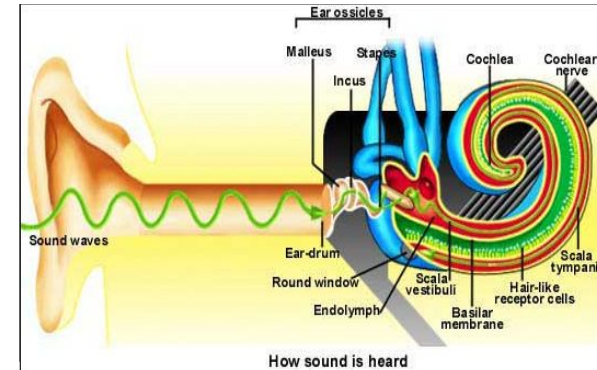
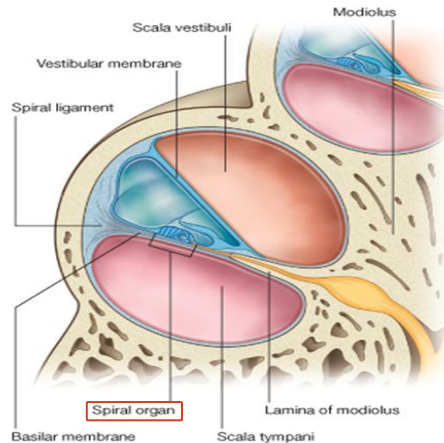
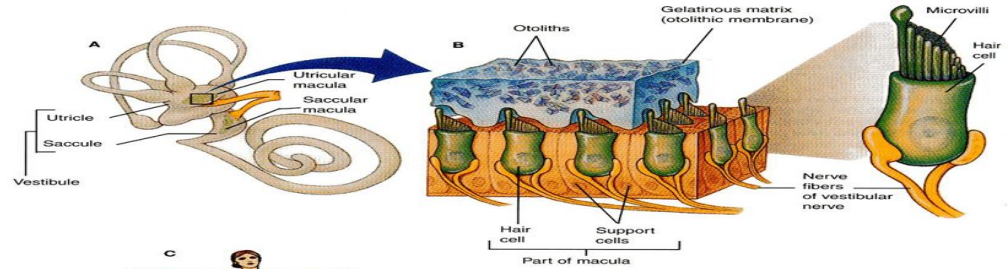
- The perilymph within the **scala vestibuli** is separated from the middle ear by the **base of stapes** at the **fenestra vestibuli** (oval window)
- The perilymph within the **scala tympani** is separated from the middle ear by the **secondary tympanic membrane** at the **fenestra cochleae** (round window)



Internal Ear (Labyrinth)

Equilibrium & Hearing

- Located on the walls of the **utricle** & **sacule** are specialized sensory receptors, which are sensitive to the orientation of the head to gravity or other acceleration forces.
- The **utricle**, **sacule**, & **semicircular ducts** are concerned with maintenance of **equilibrium**
- The highly specialized epithelium on the floor of the cochlear duct forms the **spiral organ of corti** that contains sensory receptors for **hearing**.



Practice



Q1: The outer 1/3rd of the external auditory canal is:

- A. Bony
- B. Elastic cartilage
- C. Fibrous cartilage
- D. Hyaline cartilage

Q2: The auditory ossicles are found in:

- A. External Ear
- B. Middle Ear
- C. Internal Ear
- D. Labyrinth

Q3: Which wall in the middle ear contains the aditus to mastoid antrum?

- A. Medial Wall
- B. Lateral Wall
- C. Anterior Wall
- D. Posterior Wall

Q4: The tympanic cavity communicates with the nasopharynx via the:

- A. External auditory meatus
- B. Internal auditory meatus
- C. The eustachian tube
- D. Lacrimal duct

Q5: The auditory ossicles are articulated by which type of joint?

- A. Synovial
- B. Fibrous
- C. Cartilaginous
- D. None of the above

Q6: The tensor tympani muscle is inserted into the:

- A. Lateral process of malleus
- B. Handle of stapes
- C. Handle of malleus
- D. Neck of stapes

Q7: Which of the following is responsible for the maintenance of equilibrium?

- A. Utricle
- B. Sacculle
- C. Semicircular ducts
- D. All of the above

Q8: Each of the semicircular canals has a swelling at one called:

- A. Utricle
- B. Ampulla
- C. Sacculle
- D. Fenestra vestibuli



Members board



Team leaders

- **Abdulrahman Shadid**

Boys team:

-  **Mohammed Al-huqbani**
- **Salman Alagla**
- **Ziyad Al-jofan**
- **Ali Aldawood**
- **Khalid Nagshabandi**
- **Omar Alammari**
- **Sameh nuser**
- **Abdullah Basamh**
- **Alwaleed Alsaleh**
- **Mohaned Makkawi**
- **Abdullah Alghamdi**

- **Ateen Almutairi**

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- **Sara Al-Abdulkarem**
- **Renad Al Haqbani**
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- **Danah Al Halees**
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