



MED437  
KING SAUD UNIVERSITY



# Anatomy of the Ear

Lecture (10)

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هذا العمل مبني بشكل أساسي على عمل دفعة ٤٣٦ مع المراجعة والتدقيق وإضافة الملاحظات ولا يغني عن المصدر الأساسي للمذاكرة

- **Important**
- **Doctors Notes**
- Notes/Extra explanation

{وَمَنْ يَتَوَكَّلْ عَلَى اللَّهِ فَهُوَ حَسْبُهُ}

# Objectives

**By the end of the lecture the student should be able to:**

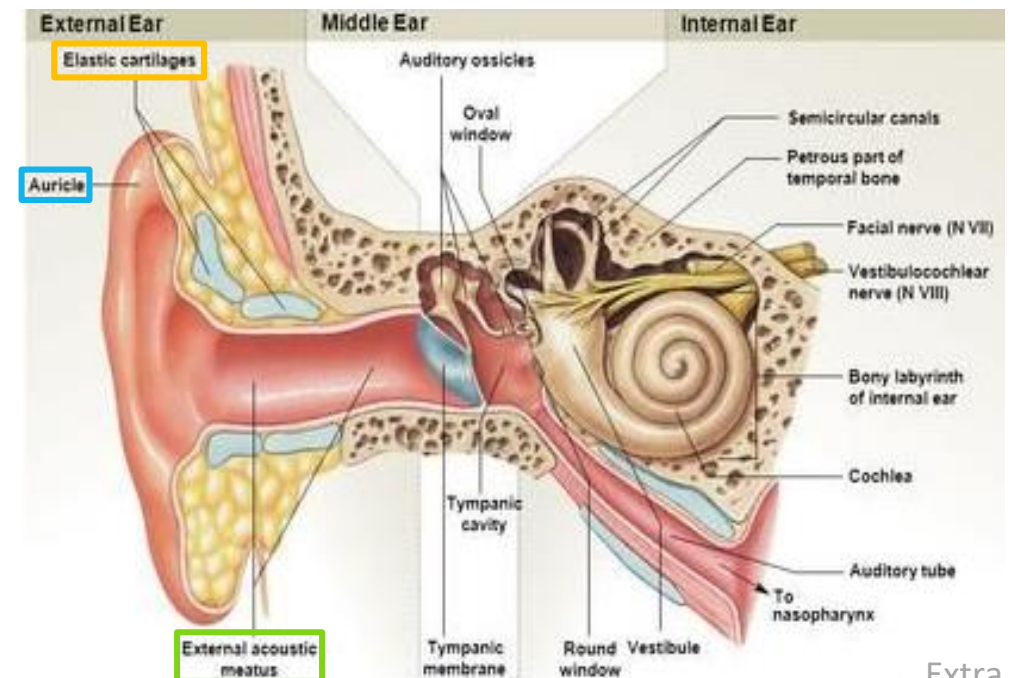
- ✓ List the parts of the ear: External, Middle (tympanic cavity) and Internal (labyrinth).
- ✓ Describe the parts of the external ear: auricle and external auditory meatus.
- ✓ Identify the boundaries of the middle ear: roof, floor and four walls (anterior, posterior, medial and lateral).
- ✓ Define 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 filled with endolymph).
- ✓ List the organs of hearing and equilibrium.

# External Ear



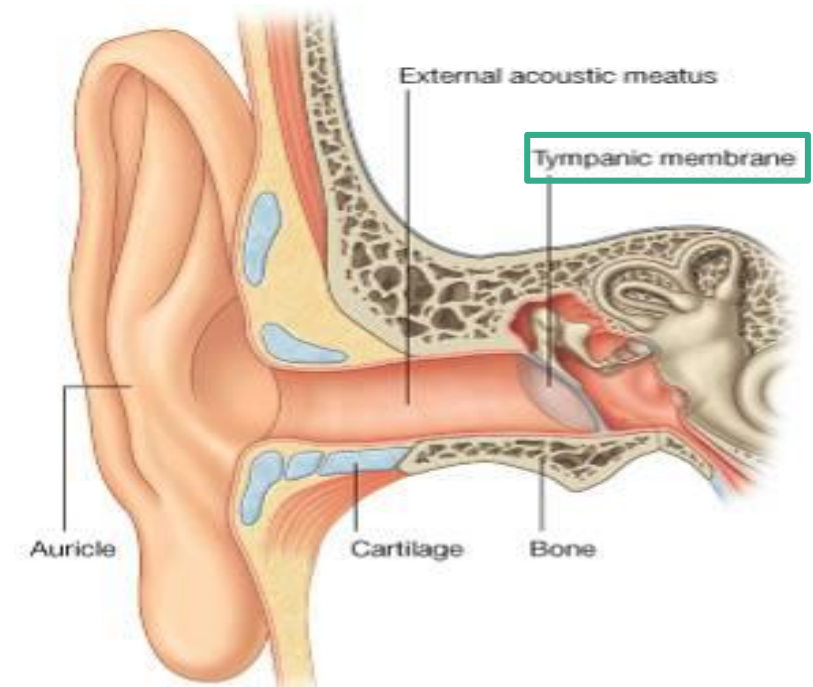
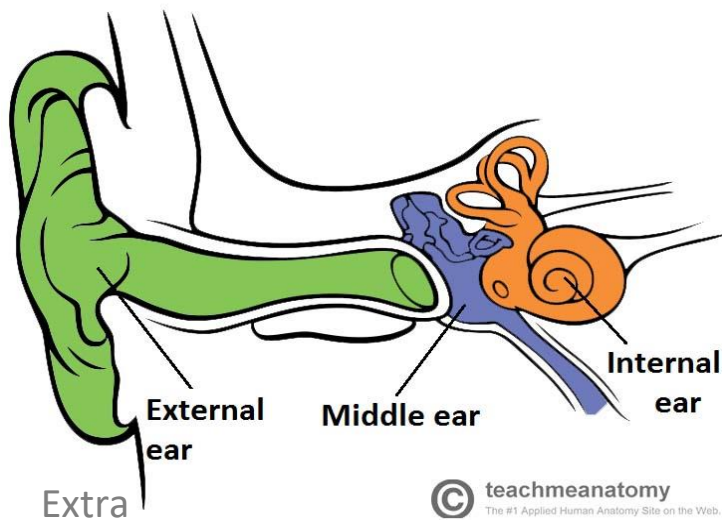
- It is formed of the **auricle**, & the **external auditory meatus**.
- The Auricle has a characteristic shape and collects *air vibrations* *reception of sound*.
- It consists of a thin plate of **elastic cartilage** covered by a double layer of skin.
- It receives the insertion of *extrinsic muscles\**, which are supplied by the *facial nerve*.
- Sensation is carried by **great auricular** (from cervical plexus) & **auriculotemporal** (from mandibular) nerves.

\*these muscles are insignificant in humans because they don't move but are prominent in animals, example: bunnies



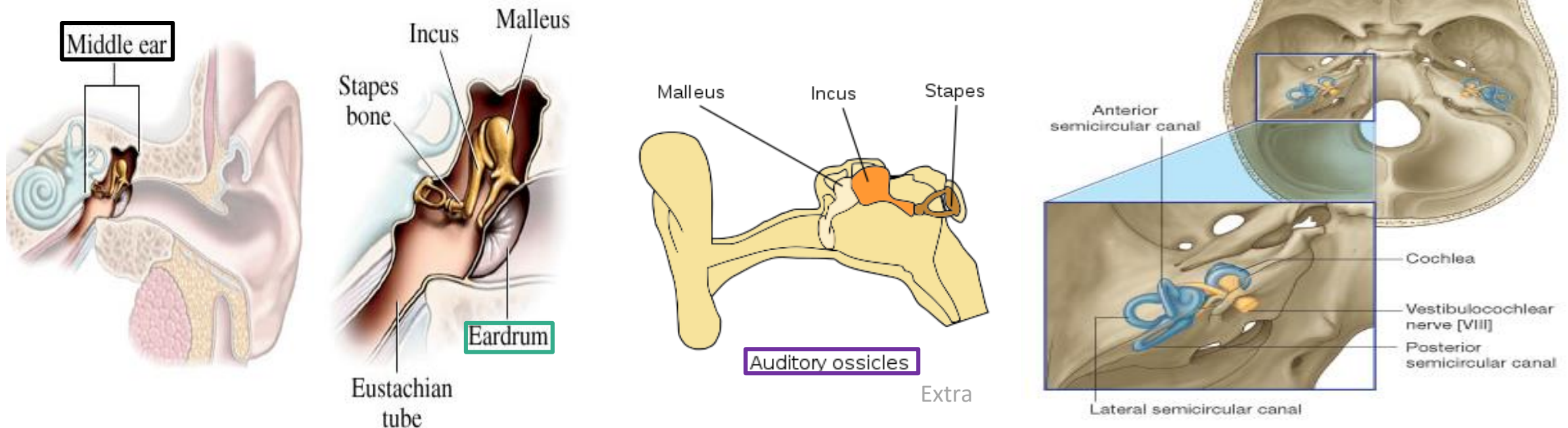
# External Ear

- The external auditory canal is a curved S-shaped tube about 2.5cm (one inch), that conducts & collects sound waves from the *auricle* to the tympanic membrane. Its outer 1/3<sup>rd</sup> is **elastic cartilage**, while its inner 2/3<sup>rd</sup>s are **bony**.
- It is lined by skin, and its outer 1/3<sup>rd</sup> is provided with *hairs, sebaceous and Ceruminous Glands*: (modified sweat glands that secrete a yellowish brownish substance called the ear wax). خول الأتربة والحشرات الصغيرة.



# Middle Ear (Tympanic Cavity)

- **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** (the ear bones), which transmit the vibrations of the tympanic membrane (eardrum) to the internal ear.

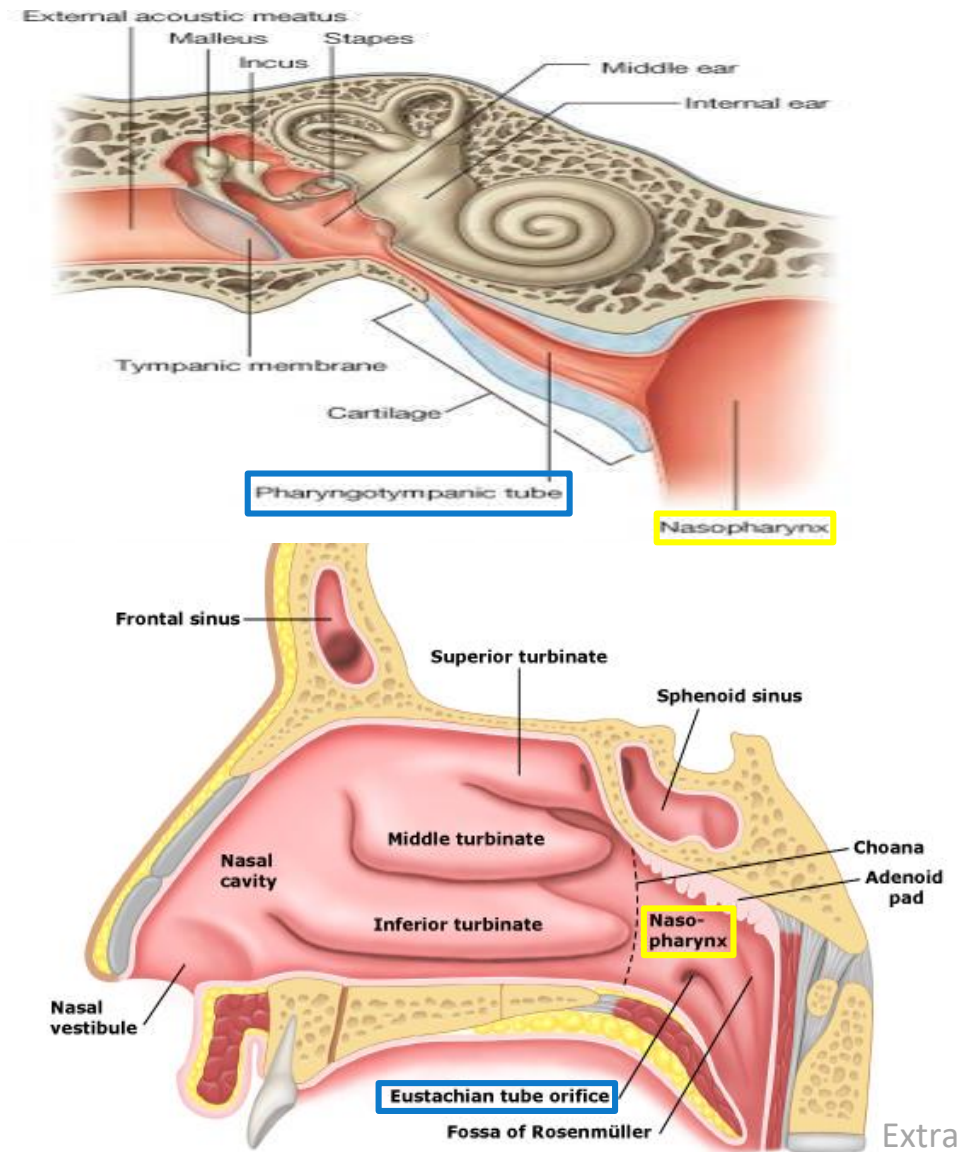


\*\*you have to know all 3 names

# Middle Ear (Tympanic Cavity)

- Communicates **anteriorly** with the Nasopharynx\* through the Auditory Tube (also called pharyngotympanic or eustachian tube)\*\* , which extends from the anterior wall *downward, forward, and medially* to the nasopharynx).
- The posterior 1/3<sup>rd</sup> of the canal is **bony**, and its anterior 2/3<sup>rd</sup>s are **cartilaginous**.  
(the external ear was the opposite)
- Its function is to *equalize the pressure* on both sides of the ear drum. (normally it is closed but it opens to balance the pressure)

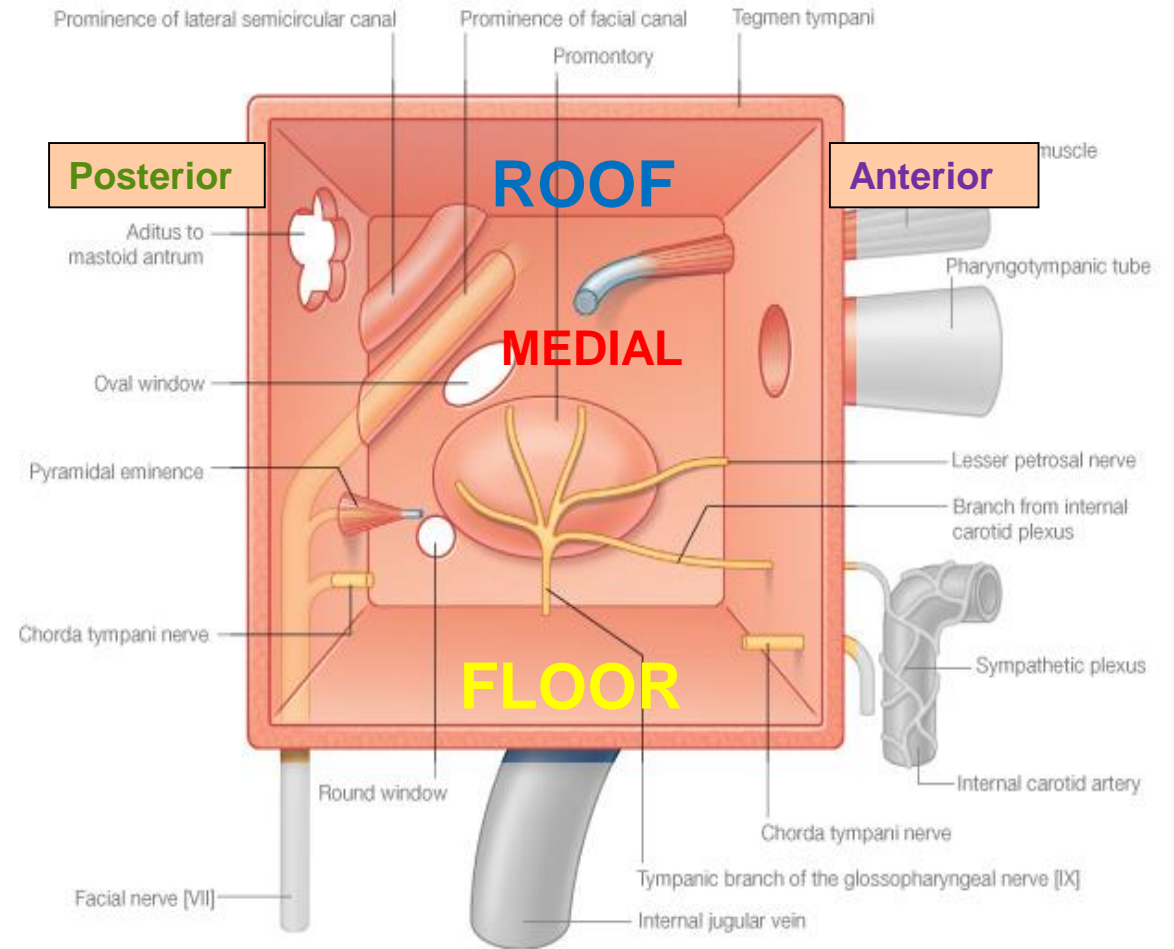
\*this is significant clinically because recurrent throat infections can travel to the ear



# Middle Ear (Tympanic Cavity)

The middle ear has:

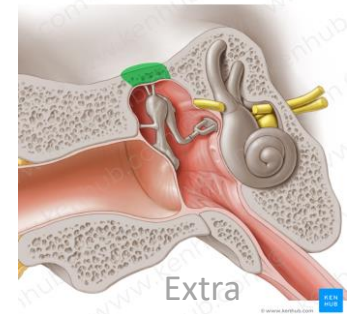
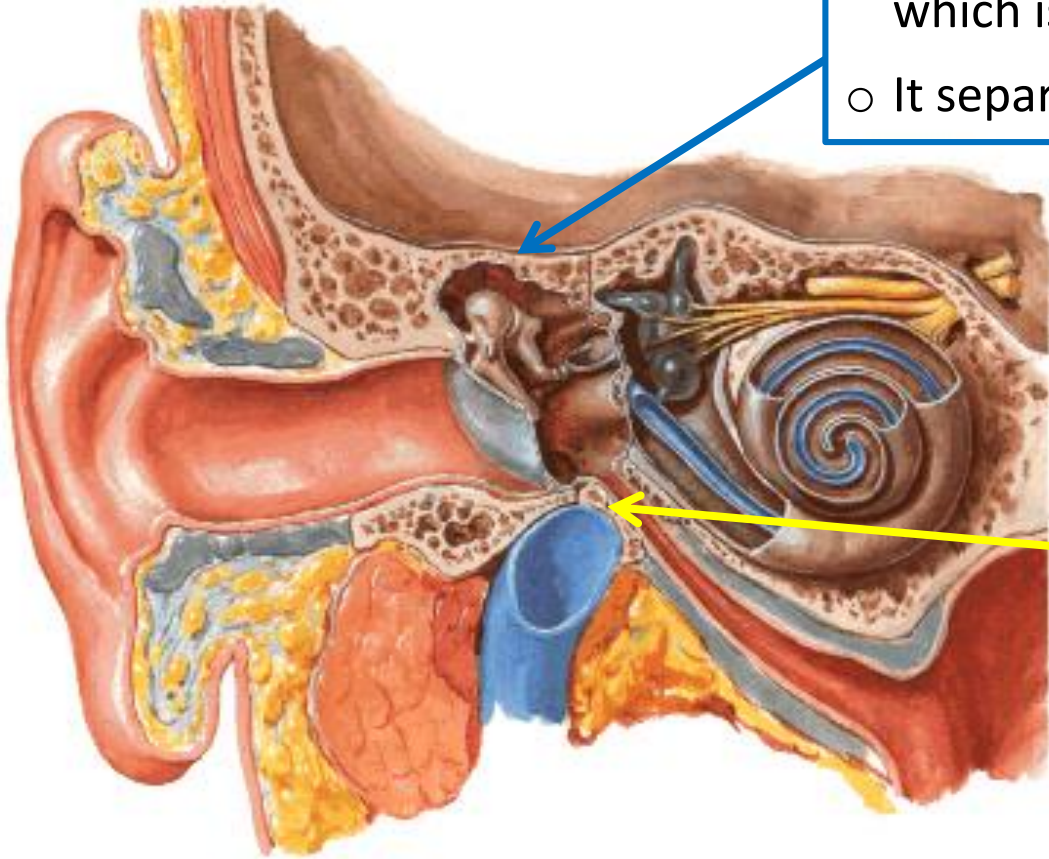
- Roof,
- Floor,
- and 4 walls:
  1. Anterior,
  2. Posterior,
  3. Lateral, and
  4. Medial.



# Middle Ear (Tympanic Cavity) Roof & Floor

- The **Roof** is 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.

Can transmit infection in the middle ear to temporal lobe of the brain

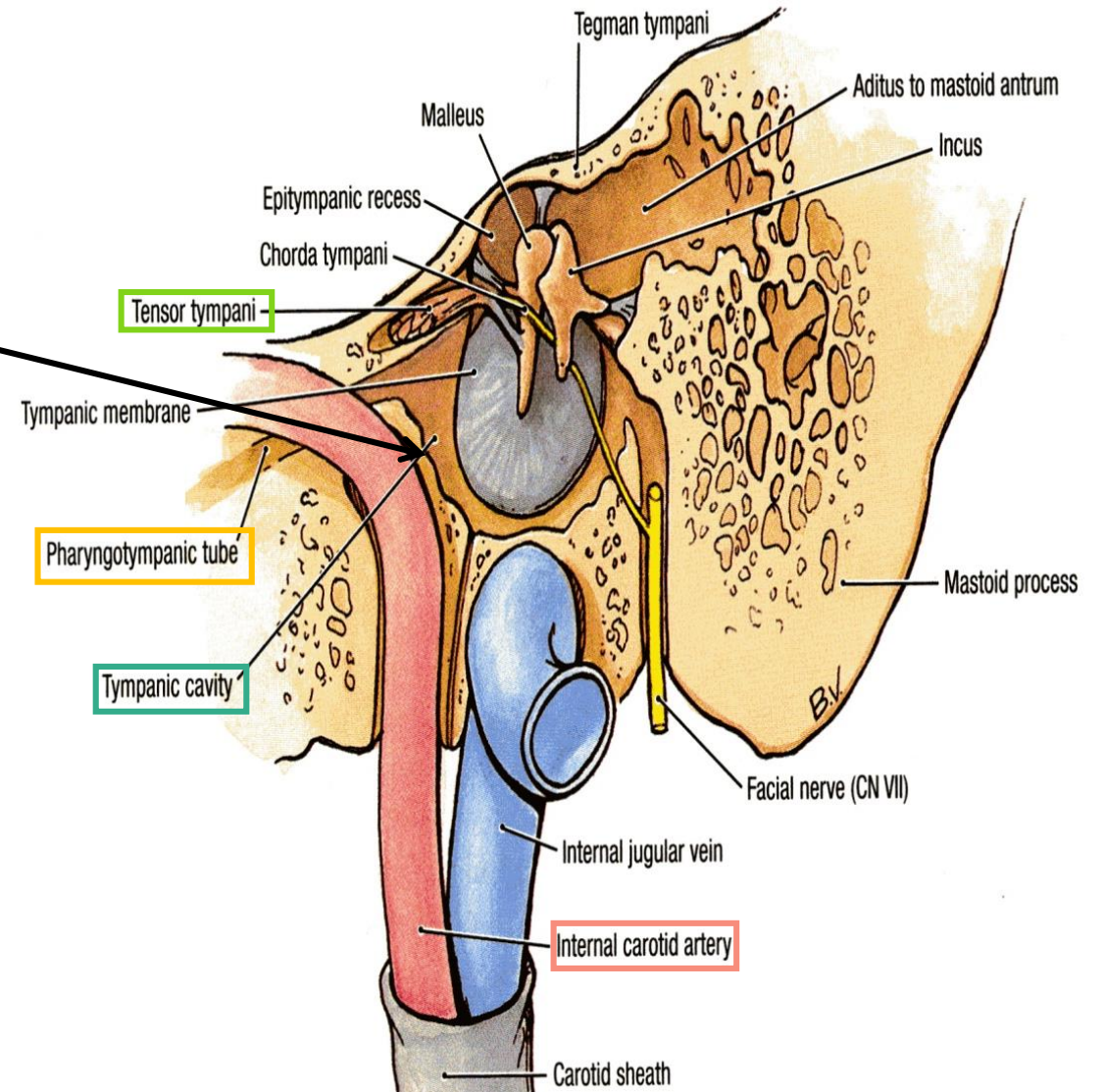


The **Floor** is formed by a thin plate of bone, which separates the *middle ear* from **the bulb of the internal jugular vein**.



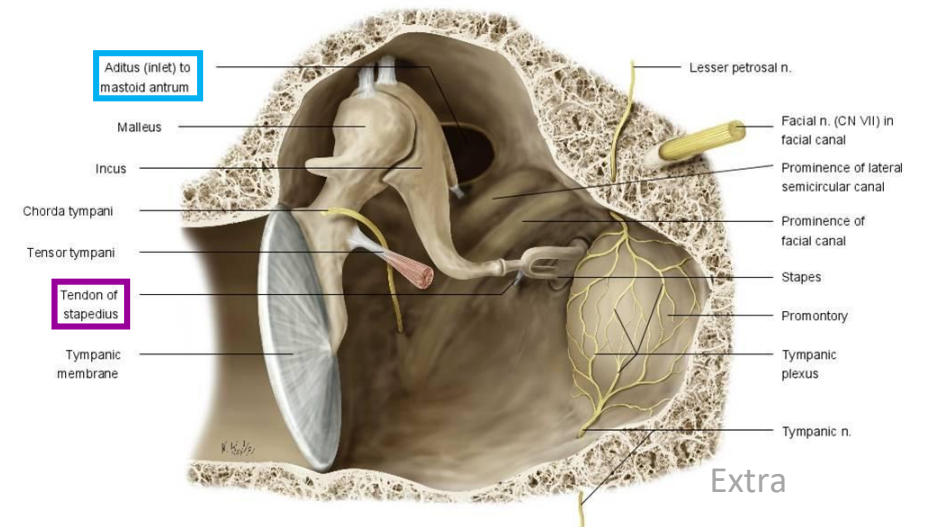
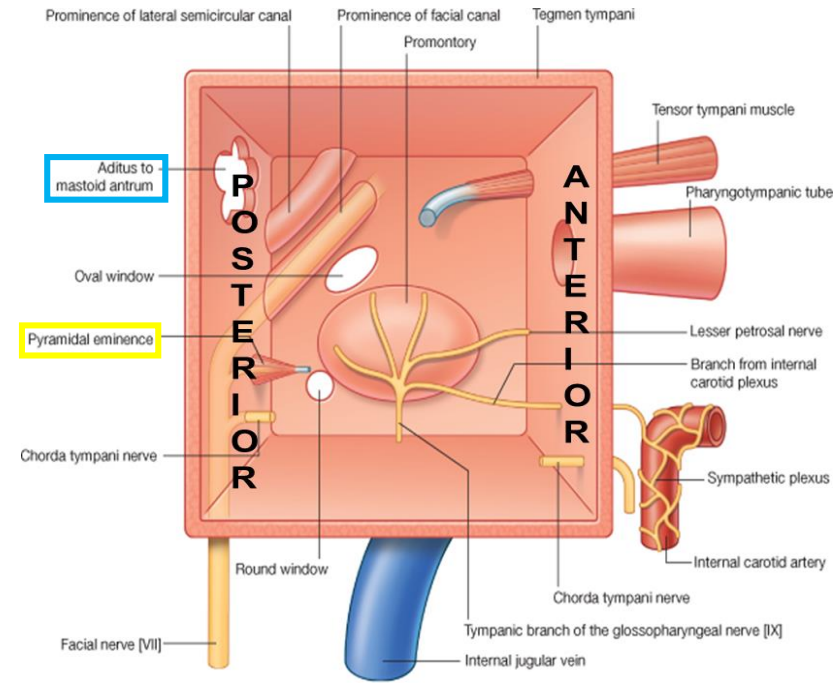
# Middle Ear (Tympanic Cavity) Anterior Wall

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



# Middle Ear (Tympanic Cavity) Posterior Wall

- The **posterior wall** has in its
  - **Upper part** a large, irregular opening, the **aditus to the 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.)

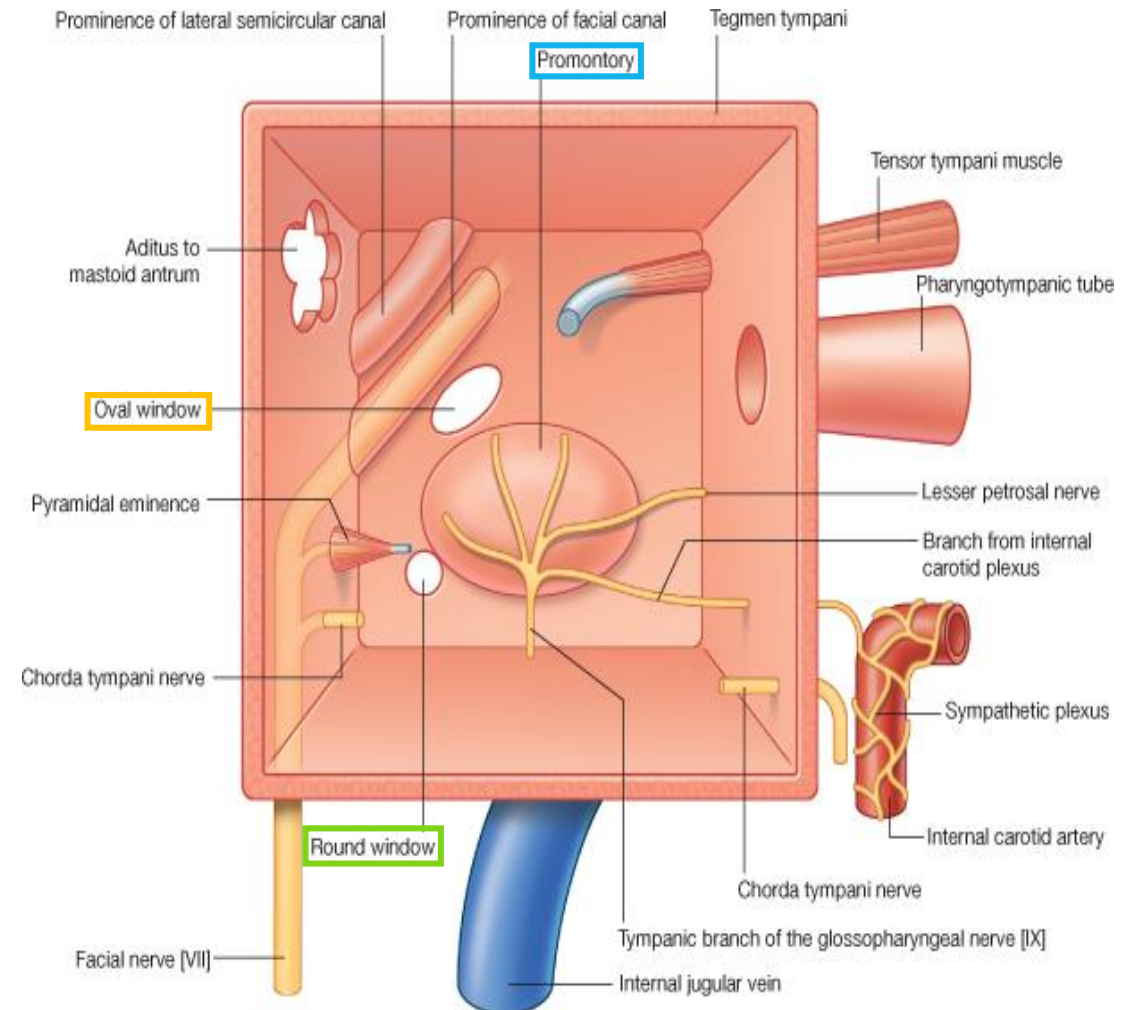


# Middle Ear (Tympanic Cavity)

## Medial Wall (separates tympanic cavity from internal ear)

- Greater part of the **medial** wall shows a rounded projection, (**Promontory**) that results from the underlying *1<sup>st</sup> turn of the cochlea*.
- *Above* and behind the promontory lies the Oval window\* (**Fenestra Vestibuli**), which is closed by the **base of the stapes**.
- *Below* and behind the promontory lies the Round window (**Fenestra Cochleae**). Which is closed by the **secondary tympanic membrane** مهمته بخفض الغط على ال Fluid in the inner ear لما يكون الصوت عالي
- **It is formed by the lateral wall of the inner ear.** To transmit sound waves, the oval and round windows should close

\*also called foramen ovale

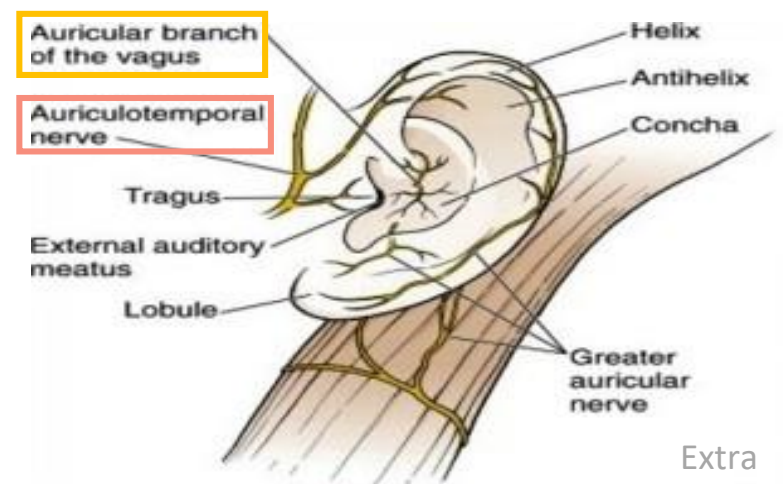
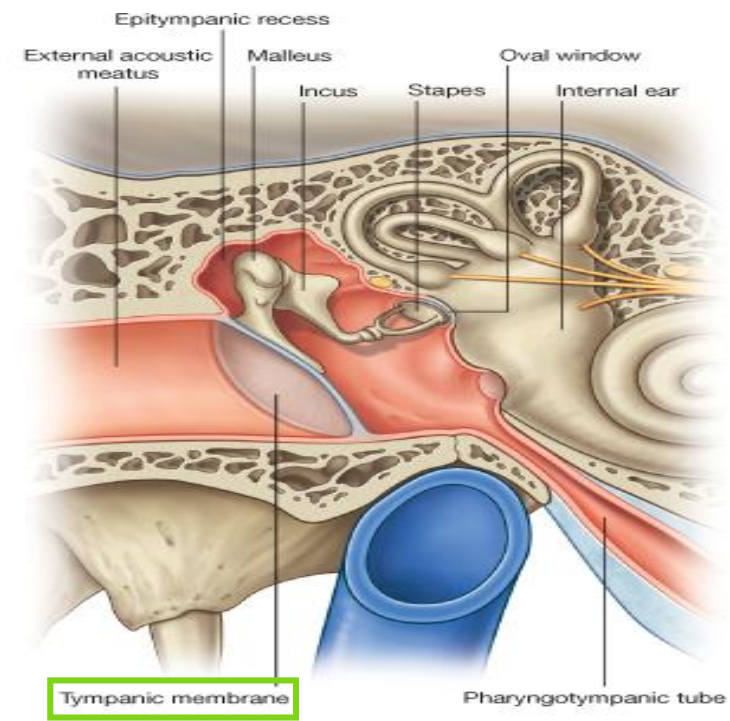


All the walls are bony except the lateral one which is the drum

# Middle Ear (Tympanic Cavity)

## Lateral Wall separates tympanic cavity from external ear

- The lateral wall is largely formed by the tympanic membrane (its like a satellite to collect sound).
- The membrane is *obliquely* placed, facing downward, forward, & laterally.
- It is extremely **sensitive to pain**.
- **Nerve supply of ear drum:**
  - **Outer surface:**
    - 1- Auriculotemporal nerve. Recall: this is a branch from 5<sup>th</sup> nerve (mandibular)
    - 2- Auricular branch of vagus.
  - **Inner surface:**  
Tympanic branch of the glossopharyngeal nerve.



The **lateral** wall is toward the **external** ear  
 The **medial** wall is toward the **inner** ear

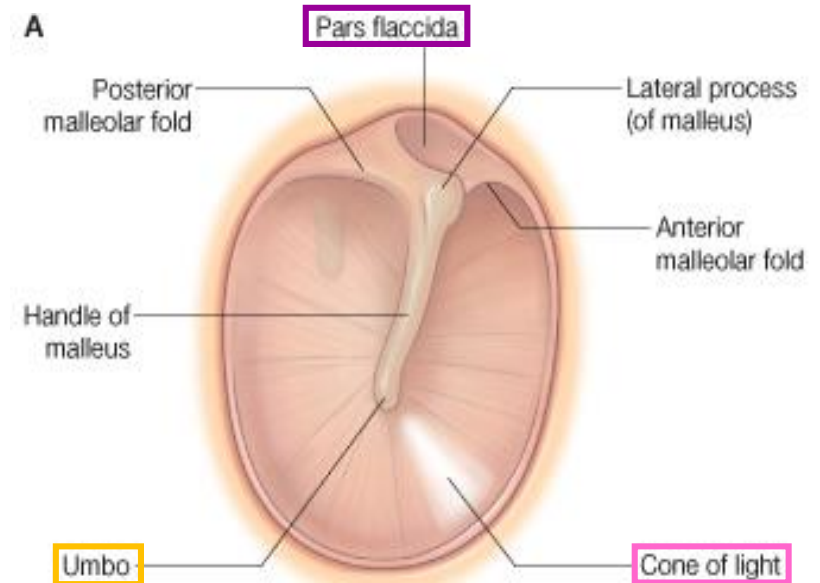
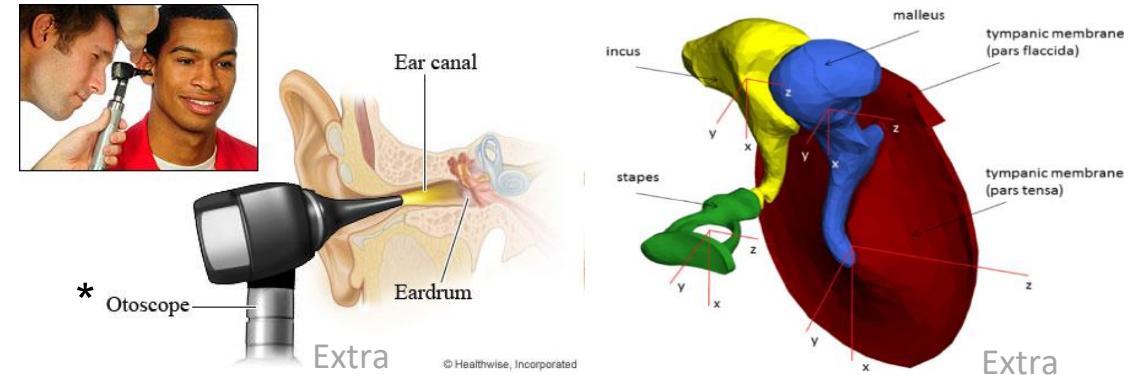
Extra

# Middle Ear (Tympanic Cavity) Tympanic Membrane

- Normally, It is **concave** laterally, and at the depth of its concavity there is a small depression, “ **the Umbo**” 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 and inferiorly from the umbo.
- Most of the of the membrane is tense and is called the **Pars Tensa**.
- A small triangular area on its upper part is slack and called the **Pars Flaccida**.

Pars Tensa → tense end

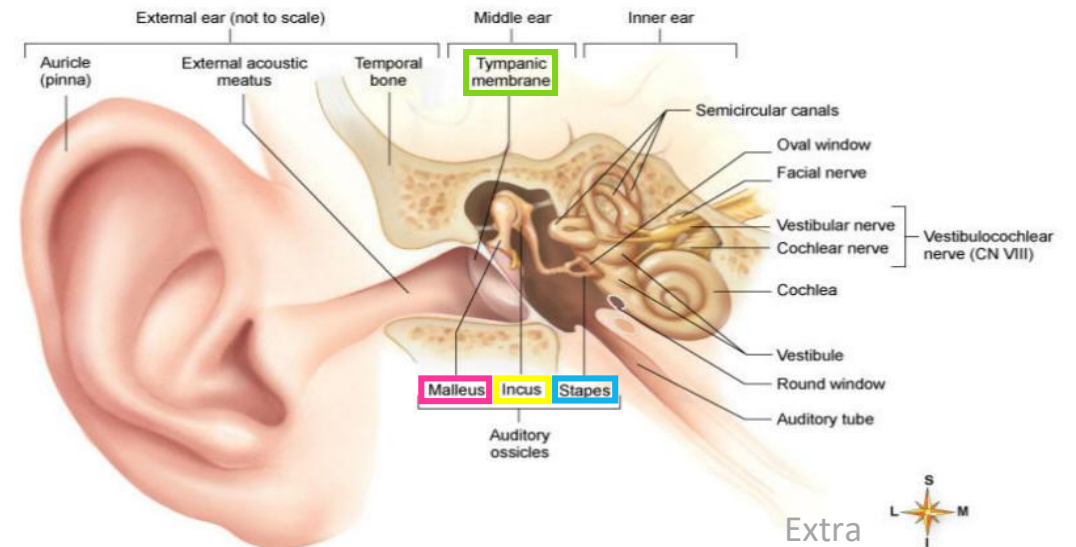
Pars Flaccida → flaccid which means loose



# Middle Ear (Tympanic Cavity) Auditory Ossicles

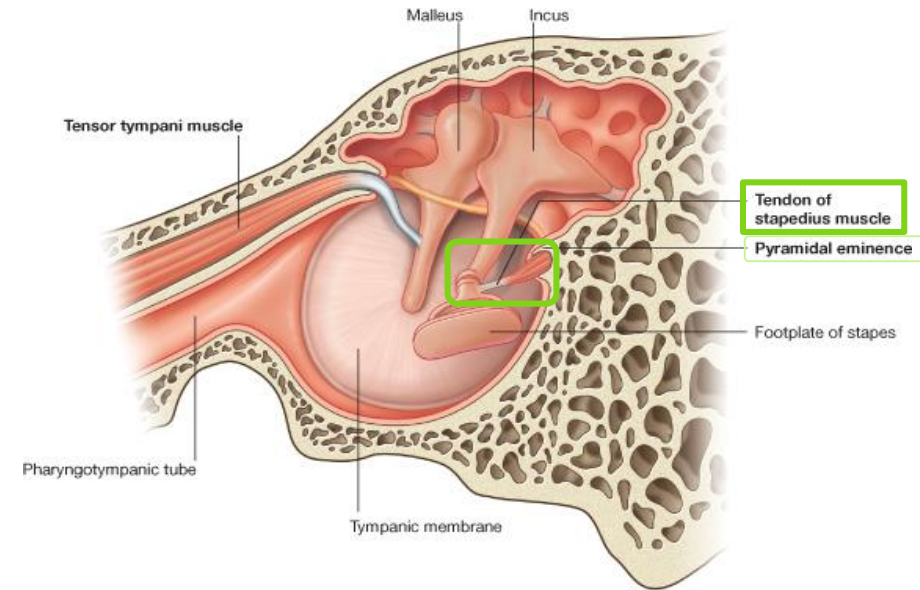
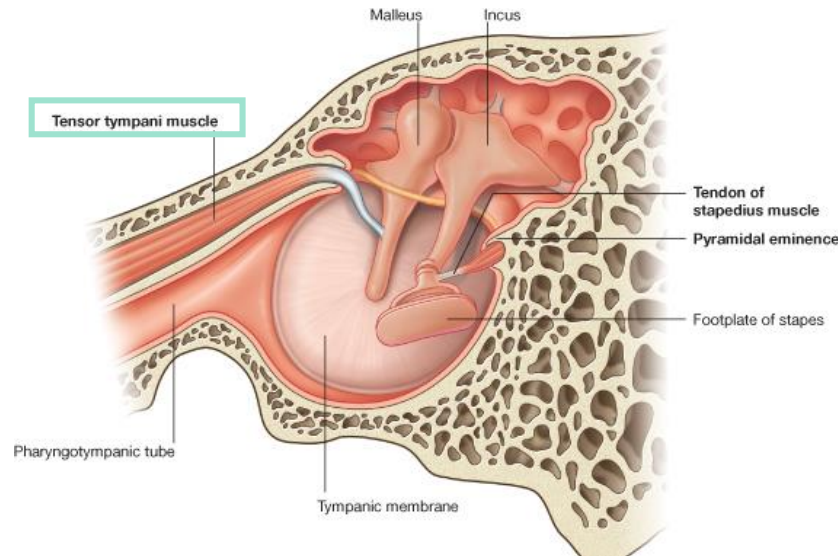
- The auditory ossicles are 3:
  1. **Malleus** (hammer), (lateral)
  2. **Incus** (anvil), (middle)
  3. **Stapes** (stirrup). (to inner ear)
- They transmit sound waves from tympanic membrane to the perilymph of the internal ear.
- They are covered by mucous membrane & articulate by **synovial joints**\*.

\*المشاكل في هذه المفاصل لدى كبار السن هي سبب ضعف السمع لدى بعضهم



# Middle Ear (Tympanic Cavity)

## Muscles of the Ossicles skeletal muscles



### *TENSOR TYMPANI*

- **Origin:** Cartilage of the auditory tube and 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.

1- contraction of stapedius 2-contraction of tensor tympani secondary tympanic membrane will response يعني لما يجي صوت عالي, للحماية يصير:

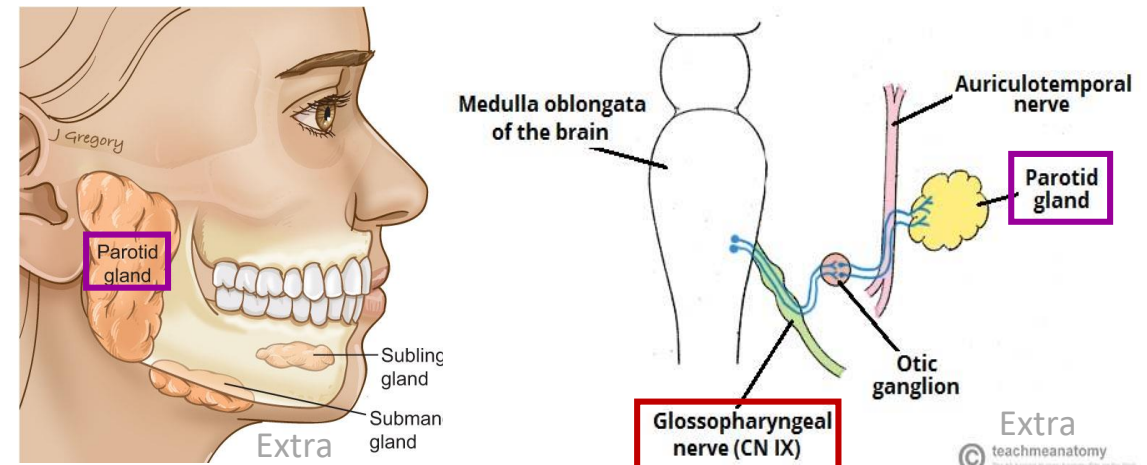
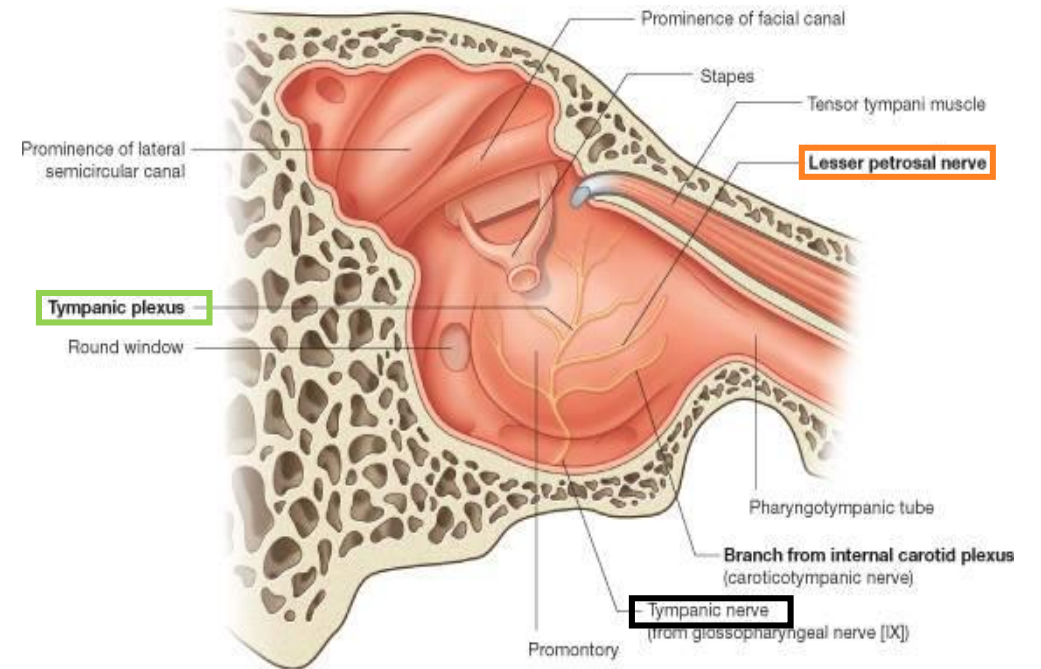
# Middle Ear (Tympanic Cavity) Nerves

## Tympanic nerve

- It is a branch of the glossopharyngeal nerve.
- *It gives:*
  - Tympanic plexus on the promontory
  - The tympanic plexus gives the, Lesser petrosal\* nerve which relays in the otic ganglion.
  - It gives secretomotor supply to the parotid gland

*\*Compare:*

<b>Lesser petrosal</b> (glossopharyngeal)	<b>Otic ganglion</b>	Supply <b>parotid gland</b>
<b>Greater petrosal</b> (facial) <i>you have a great face</i>	<b>Geniculate ganglion</b>	supply <b>Lacrimal, Nasal, and Palatine glands</b>





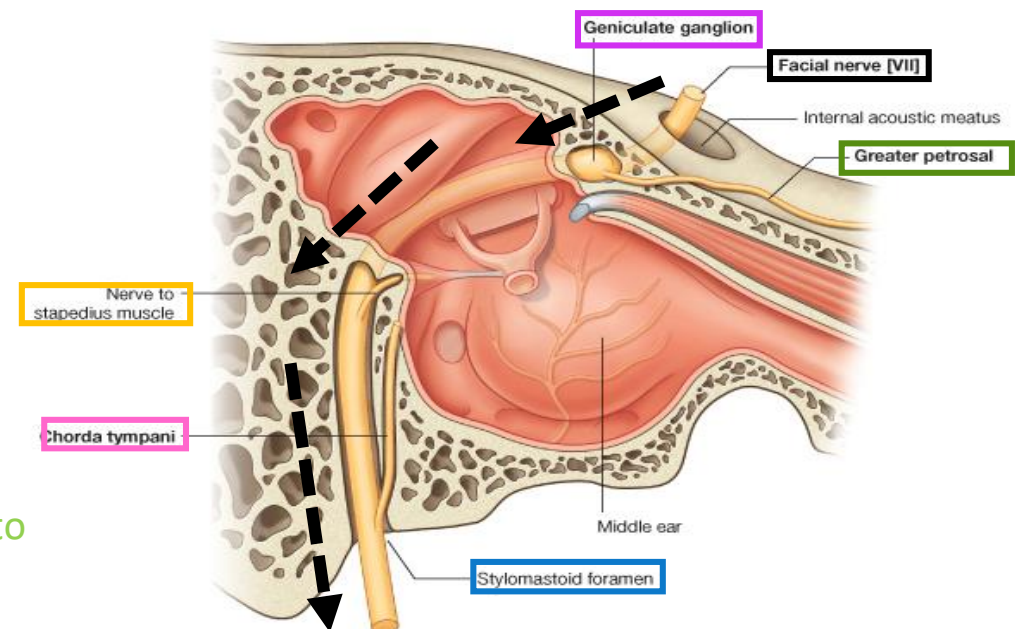
# Middle Ear (Tympanic Cavity) Nerves

## Facial nerve (VII)

- Enters through the Internal acoustic meatus with the 8<sup>th</sup> vestibulocochlear nerve.
- It expands to form **Geniculate ganglion**.
- It passes vertical behind the pyramid.
- It leaves the middle ear through the **stylomastoid foramen**.
- Branches:
  1. **Greater Petrosal nerve**.
    - Arises from Geniculate Ganglion.
    - Carries *preganglionic parasympathetic* to supply: Lacrimal, Nasal, and Palatine glands.
  2. **Nerve to Stapedius**.
  3. **Chorda Tympani**:
    - Arises just before the facial nerve exits.

Recall: chorda tympani carries taste fibers. So if there was any damage to this nerve the patient will experience dyspepsia Ex: during ear surgeries

To remember: chorda → chocolate or dates



# Internal Ear, Or Labyrinth

- Labyrinth is situated in the petrous part of the temporal bone, medial to the middle ear.
- It consists of :

## **Bony** labyrinth: (outer)

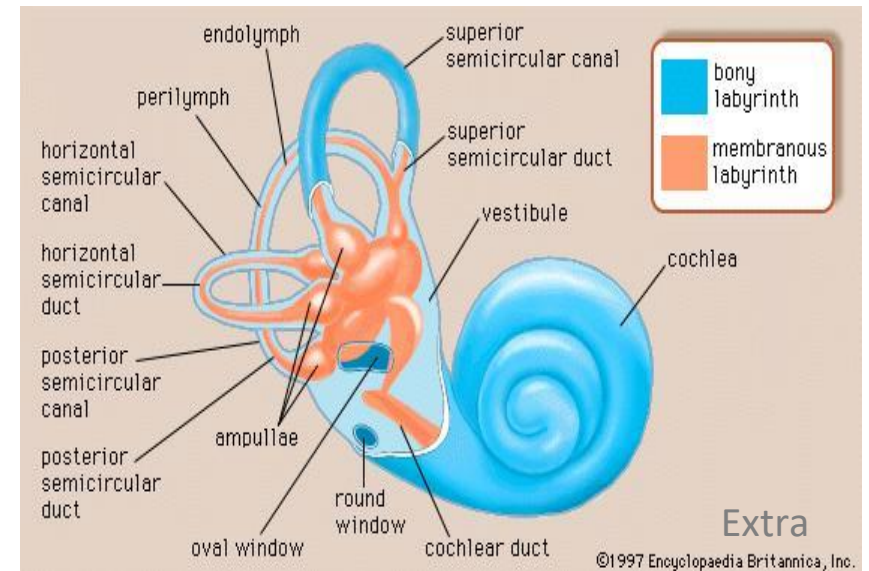
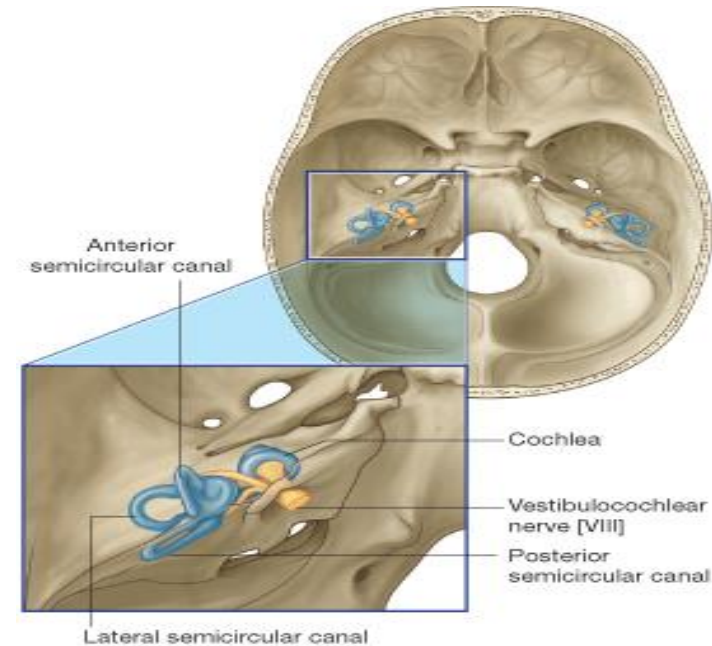
- A series of bony chambers lined by endosteum.
- They contain a clear fluid, the **perilymph**, in which is suspended the membranous labyrinth.

## **Membranous** labyrinth: (inner)

- consists of a series of membranous sacs and ducts within the bony labyrinth, it is filled with **endolymph**.

Note:

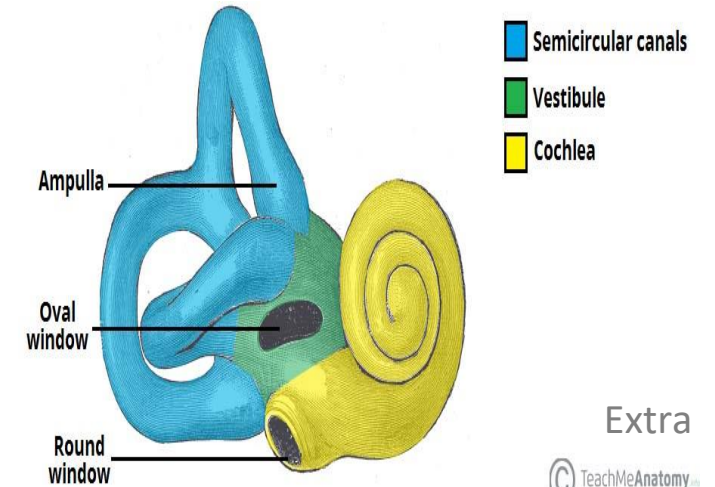
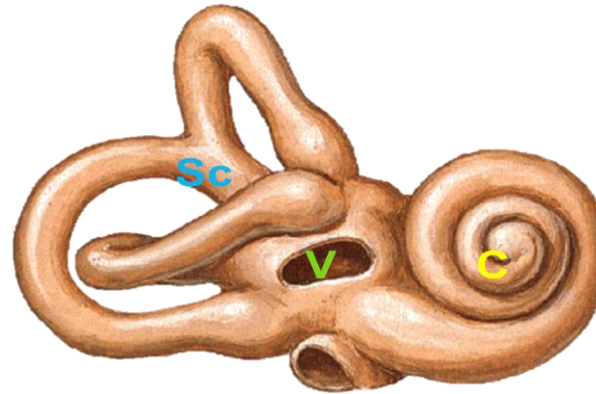
The middle ear was filled with air, but the inner ear is filled with fluid. In the **bony** labyrinth that fluid is **perilymph** and in the **membranous** labyrinth is it **endolymph**.



# Internal Ear (Labyrinth)

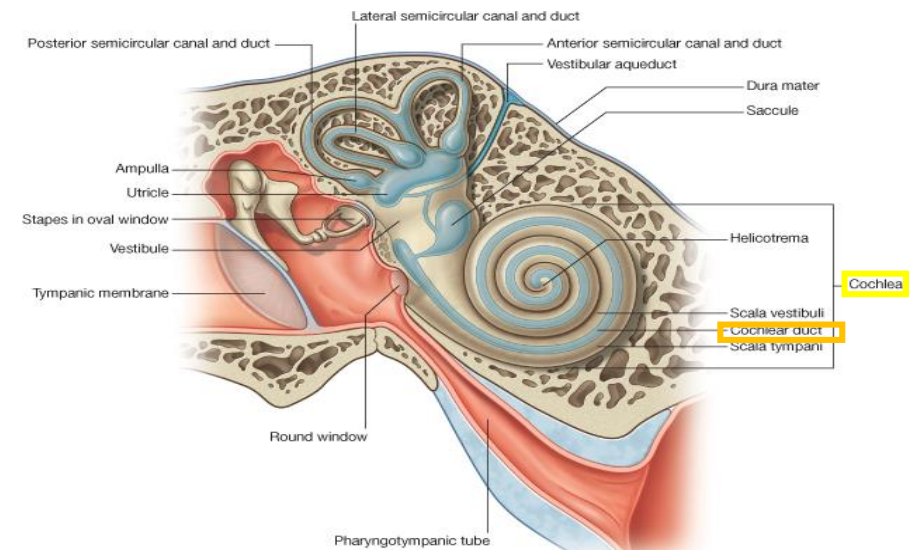
## Bony Labyrinth

- The bony labyrinth consists of:
  - **Cochlea** (المدخل)
  - **Vestibule**, (equilibrium)
  - **Semicircular canals**, (hearing)



### Cochlea

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



# Internal Ear (Labyrinth)

## Bony Labyrinth

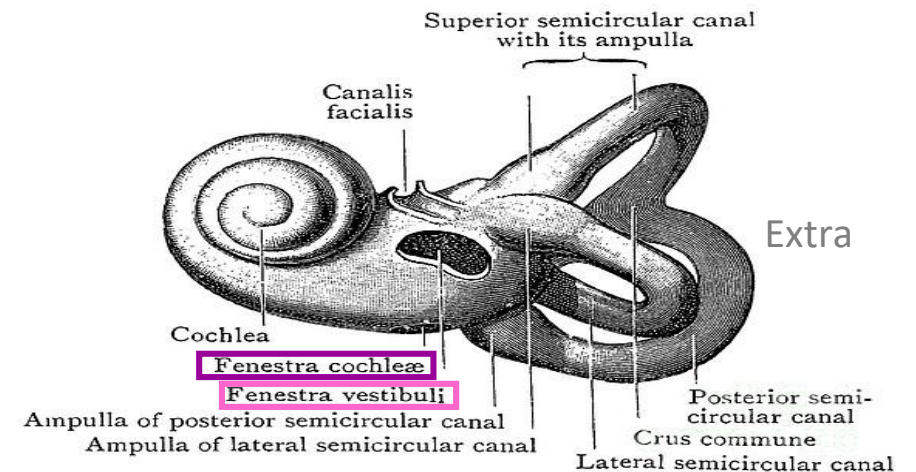
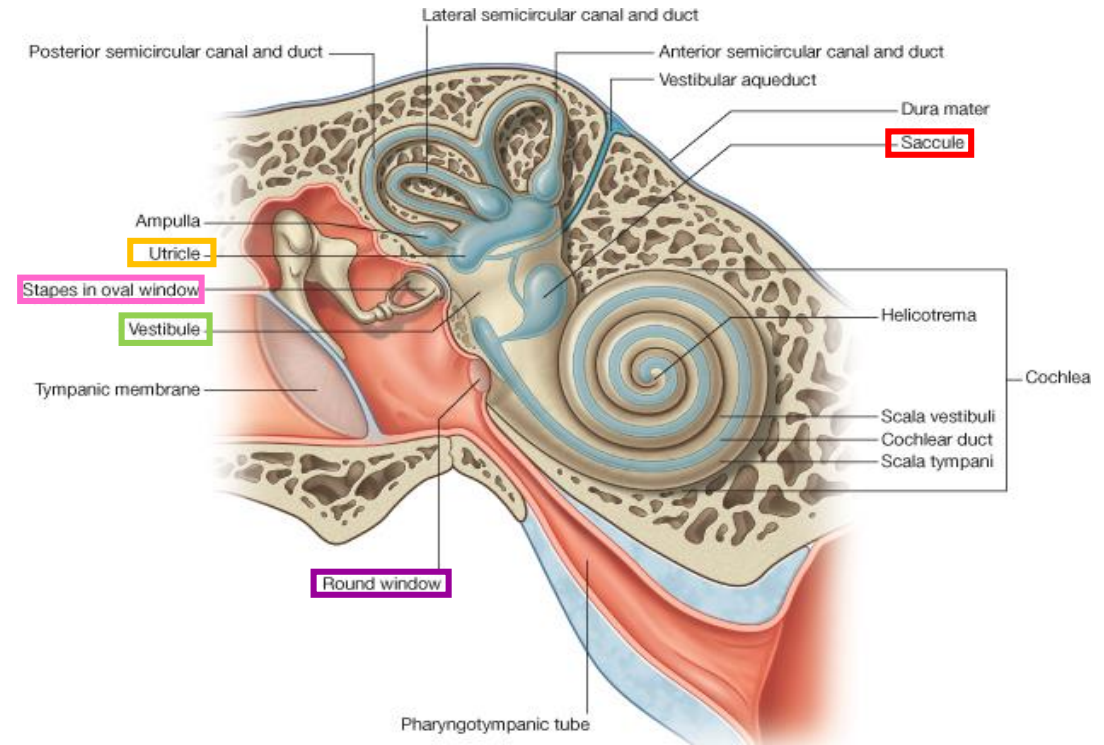
### Vestibule

- Is the central part of the bony labyrinth.
- Contains the **utricle** & **sacculle** (parts of the membranous labyrinth)
- In the lateral wall of the vestibule are:
  - the **fenestra vestibuli** (oval window), which is closed by the base of the stapes, and
  - the **fenestra cochleae** (round window), which is closed by the secondary tympanic membrane.

To remember:

oval → vestibuli

round → cochleae

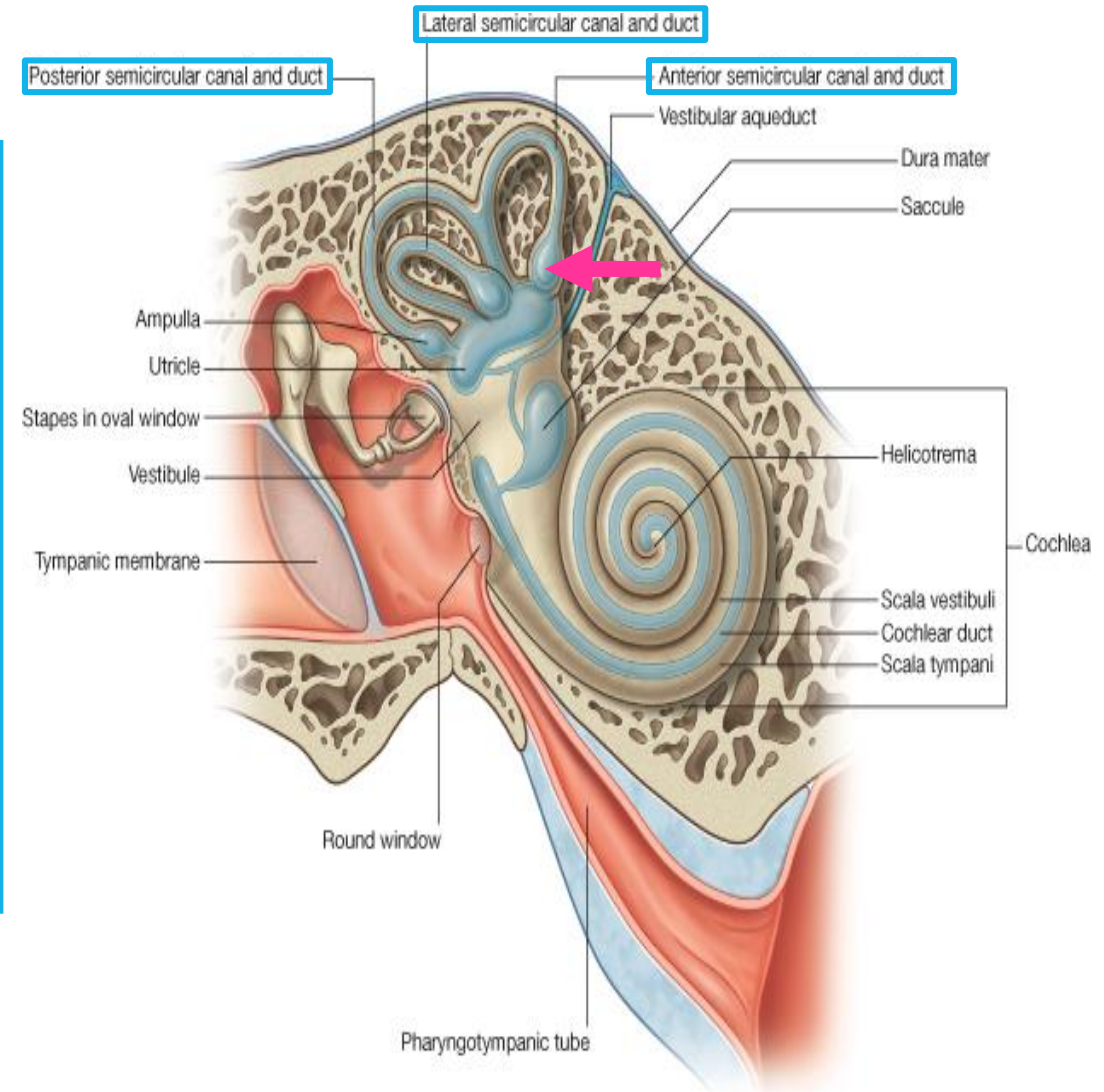


# Internal Ear (Labyrinth)

## Bony Labyrinth

### Semicircular Canals

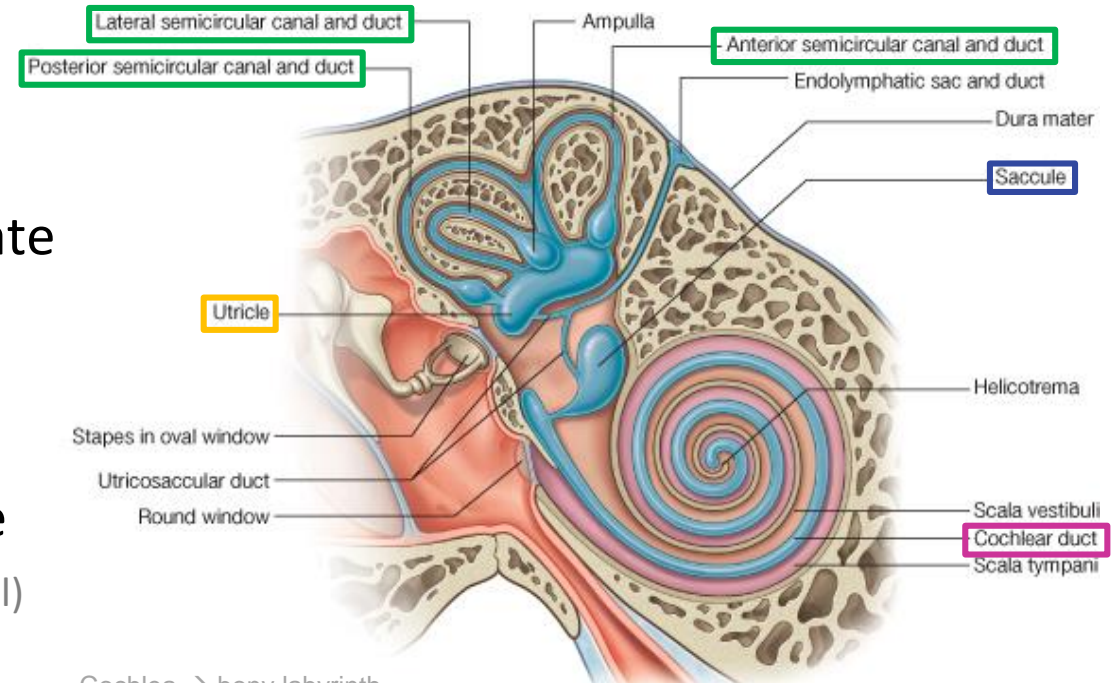
- Semicircular canals: superior (anterior), posterior & lateral.
- Each canal has a swelling at one end called the **ampulla**.
- The canals open into the vestibule by five **orifices**, one of which is common to two of the canals.
- Lodged within the canals are the **semicircular ducts**.



# Internal Ear (Labyrinth)

## Membranous Labyrinth

- The **membranous labyrinth** consists of (Four ducts & Two sacs) which are freely communicate with one another :
  - **Sacs:** **Utricle** & **Sacculle** lodged in the bony **vestibule**.
  - **Ducts:** Three **semicircular** ducts lie within the bony **semicircular** canals. (anterior, posterior, lateral)
  - **Cochlear Duct:** lies within the bony **cochlea**.



Cochlea → bony labyrinth  
Cochlear duct → membranous labyrinth

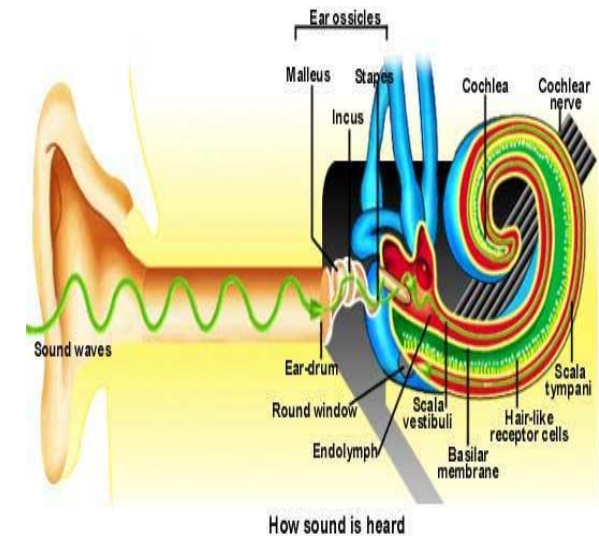
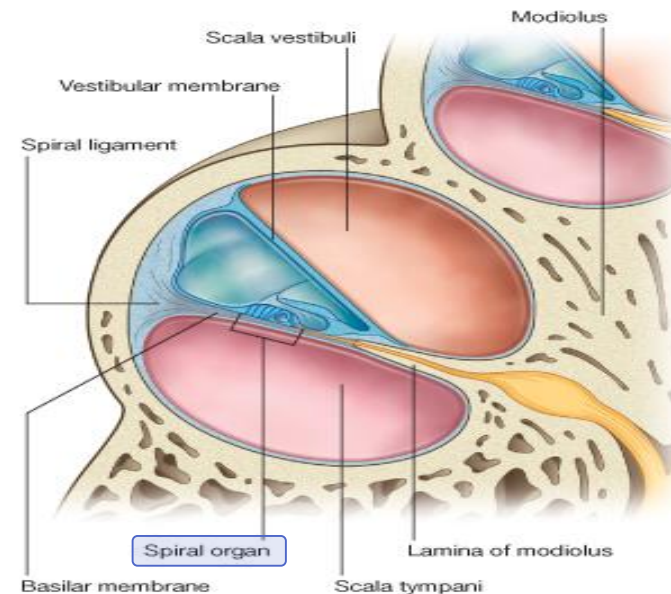
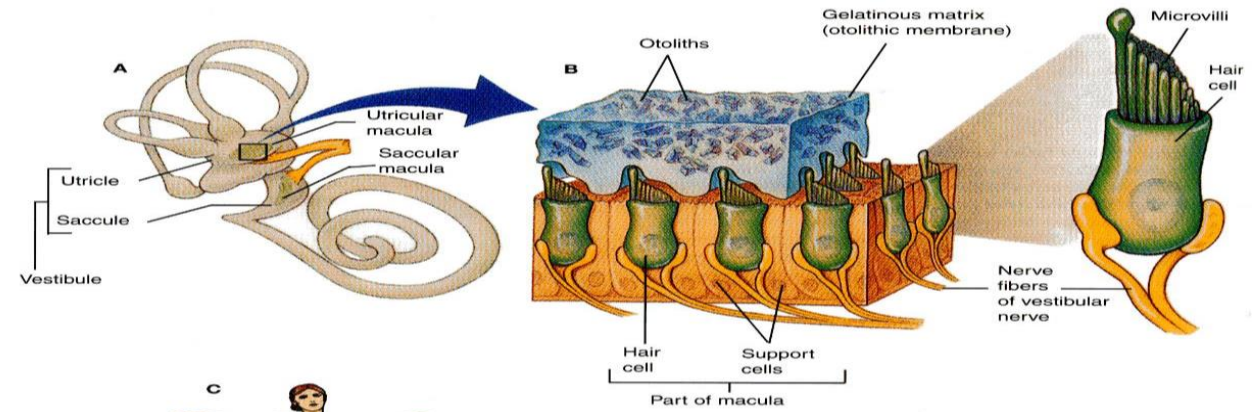
*Only on the boys' slides*

The cochlear duct divides the bony cavity into

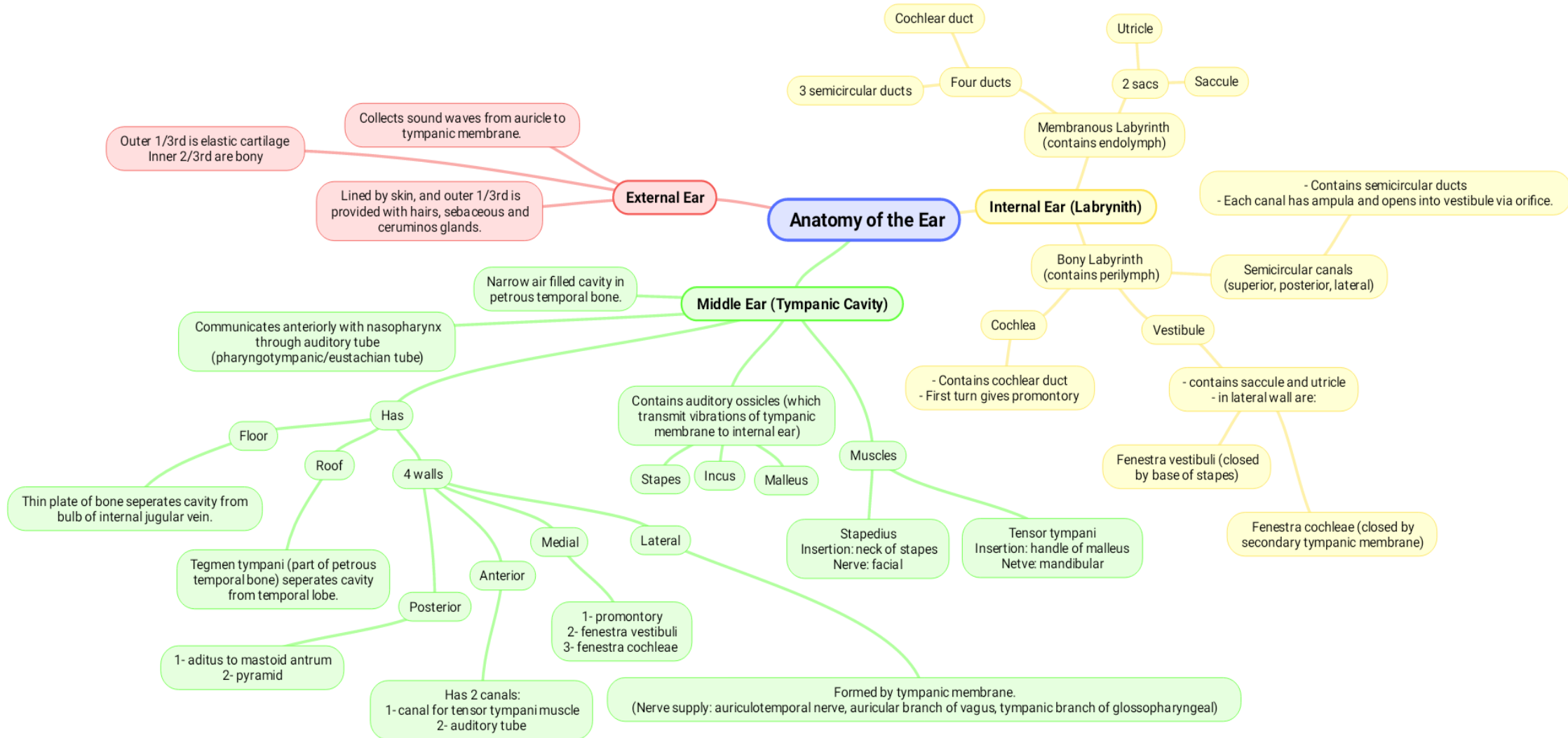
- **Scala Vestibuli** (the perilymph is separated from the middle ear by the **base of the stapes** at the **fenestra vestibuli**)
- **Scala Tympani** (the perilymph is separated from the middle ear by the **secondary tympanic membrane** at the **fenestra cochleae**)

# Internal Ear (Labyrinth) Membranous Labyrinth

- Located on the walls of the utricle and saccule are specialized sensory receptors, which are sensitive to the orientation of the head to gravity or other acceleration forces.
- The **utricle**, **saccule** and **semicircular ducts** are concerned with maintenance of **Equilibrium**.
- The highly specialized epithelium on the floor of **cochlear duct** forms the *Spiral organ of Corti* that contains the sensory receptors for **Hearing**.



# Summary





# MCQs

1. The outer 1/3<sup>rd</sup> of the external auditory canal is:

- A- bony
- B- elastic cartilage
- C- fibrous cartilage
- D- hyaline cartilage

Answer: B

2. The auditory ossicles are found in:

- A- external ear
- B- middle ear
- C- internal ear
- D- labyrinth

Answer: B

3. The tympanic cavity communicates with the nasopharynx via:

- A- laryngotympanic duct
- B- lacrimal duct
- C- internal acoustic meatus
- D- eustachian tube

Answer: D

4. The floor of the middle ear separates it from the bulb of :

- A- internal jugular vein
- B- external jugular vein
- C- internal carotid artery

Answer: A

5. The auditory ossicles articulate by \_\_\_\_\_ joints:

- A- fibrous.
- B- cartilaginous.
- C- synovial.

Answer: C

6. Stapedius is inserted into:

- A- handle of the malleus
- B- handle of the stapes
- C- neck of the stapes
- D- neck of the malleus

Answer: C

7. Utricle & saccule are lodged within the:

- A- cochlea
- B- vestibule
- C- semicircular canal
- D- tympanic cavity

Answer: B

8. Which of the following is responsible for hearing:

- A- utricle
- B- saccule
- C- semicircular duct
- D- cochlear duct

Answer: D



Good luck  
Special thank for team436 ❤️

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- References:
  1. Girls' & Boys' Slides
  2. Greys Anatomy for Students
  3. TeachMeAnatomy.com

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