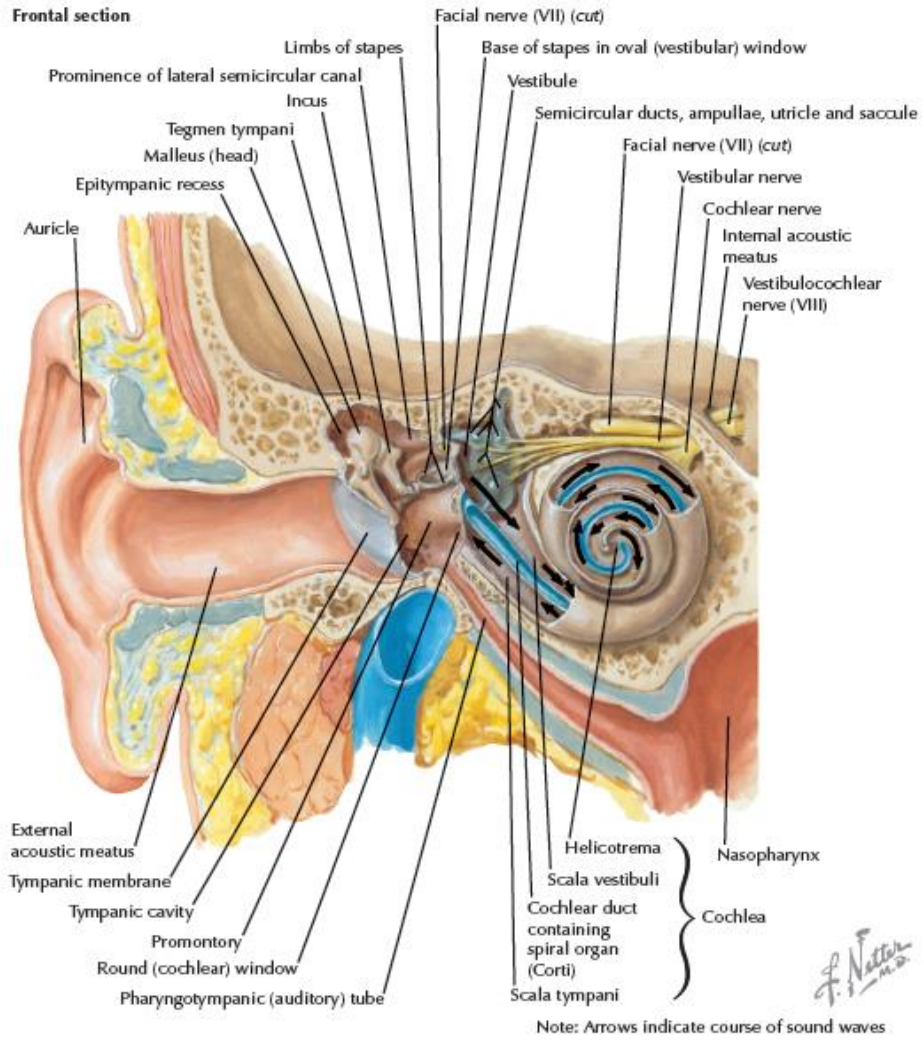
ANATOMY OF THE EAR

SECOND STAGE

DR. AHMED JASSAM ALNAQEEB
ORAL AND MAXILLOFACIAL SURGEON

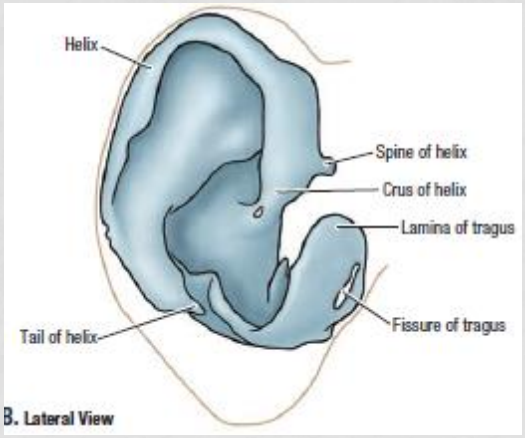
THE EAR

- The ear consists of
  - the external ear
  - the middle ear, or tympanic cavity
  - the internal ear, or labyrinth, contains the organs of hearing and balance.



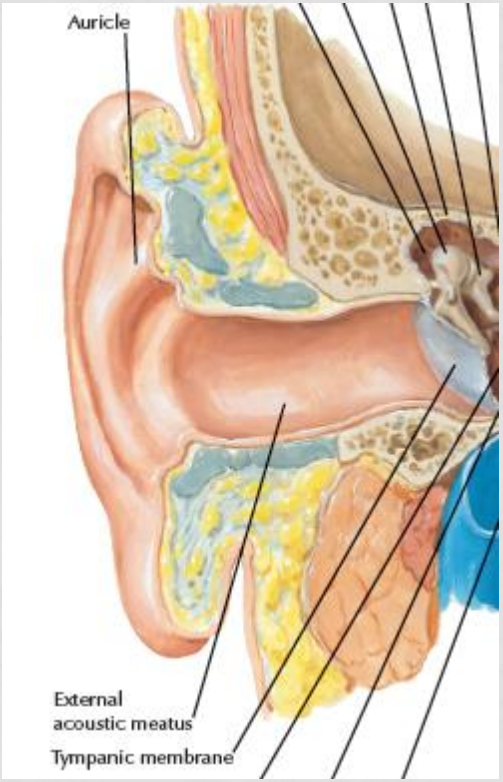
EXTERNAL EAR

- Consist of: auricle and an external auditory meatus.
- The auricle has a characteristic shape and collects air vibrations.
- thin plate of elastic cartilage covered by skin.
- It has extrinsic and intrinsic muscles, which are supplied by the facial nerve.



EXTERNAL EAR

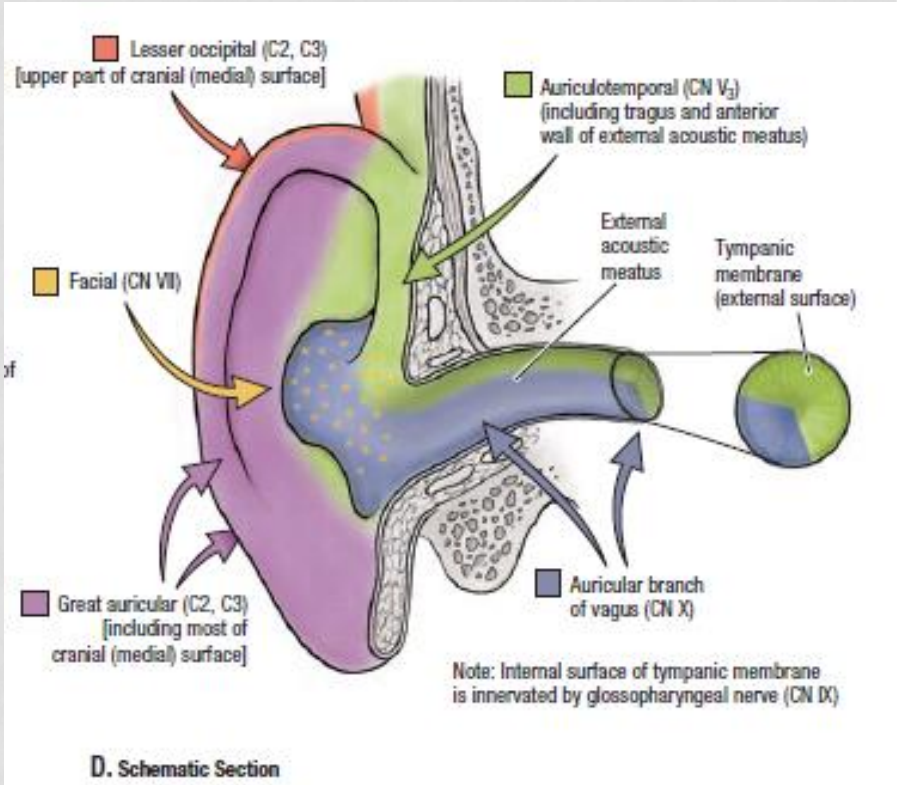
- The **external auditory meatus** is a curved tube from the auricle to the tympanic membrane
- It conducts sound waves
- framework of the meatus:
  1. outer 1/3: elastic cartilage
  2. inner 2/3: bone(tympanic plate)
- lined by skin
- outer 1/3 provided with **hairs**, **sebaceous** & **ceruminous glands.**
- hairs and wax provide sticky barrier .



EXTERNAL EAR

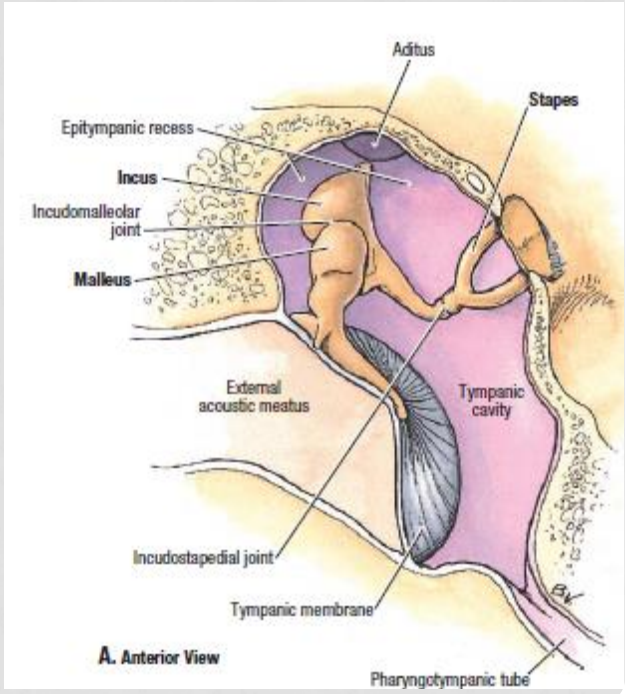
- **sensory nerve**
  1. auriculotemporal nerve
  2. the auricular branch of vagus
  3. Greater auricular N.
  4. Lesser occipital N.

- **lymph drainage**
  1. superficial parotid
  2. mastoid
  3. superficial cervical



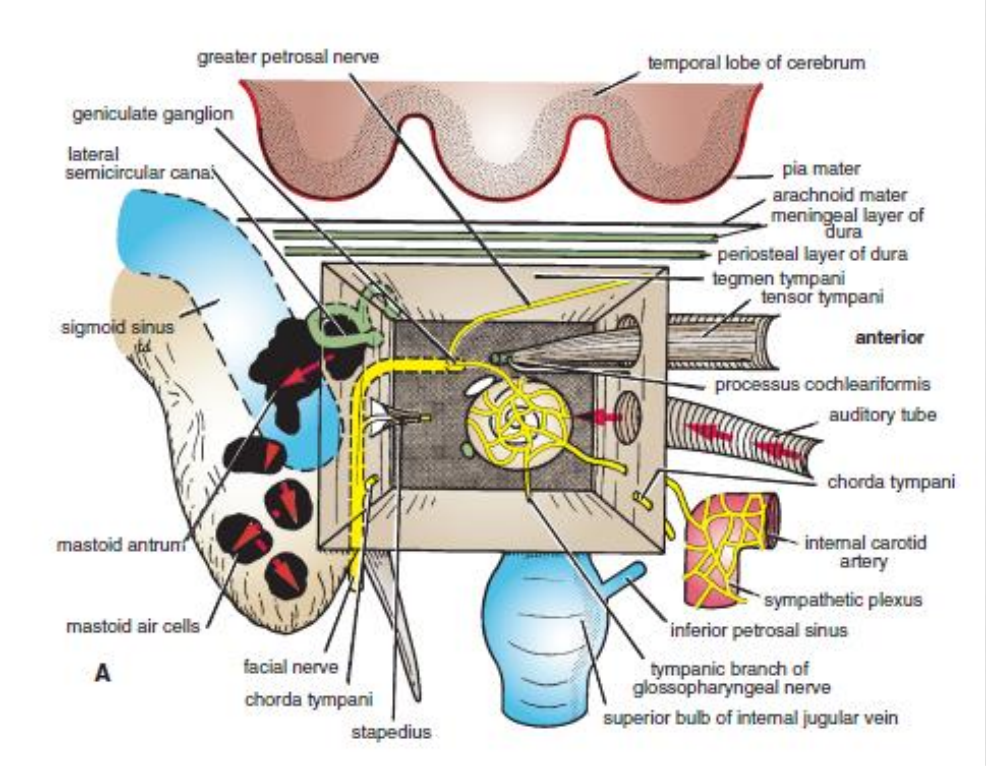
MIDDLE EAR (TYMPANIC CAVITY)

- An air-containing cavity in the petrous
- a narrow, oblique, slitlike long axis lies approximately parallel to the plane of the tympanic membrane
- lined with mucous membrane
- contains the auditory ossicles (transmit vibrations of eardrum to perilymph of the internal ear.
- . It communicates with the nasopharynx &with the mastoid antrum.



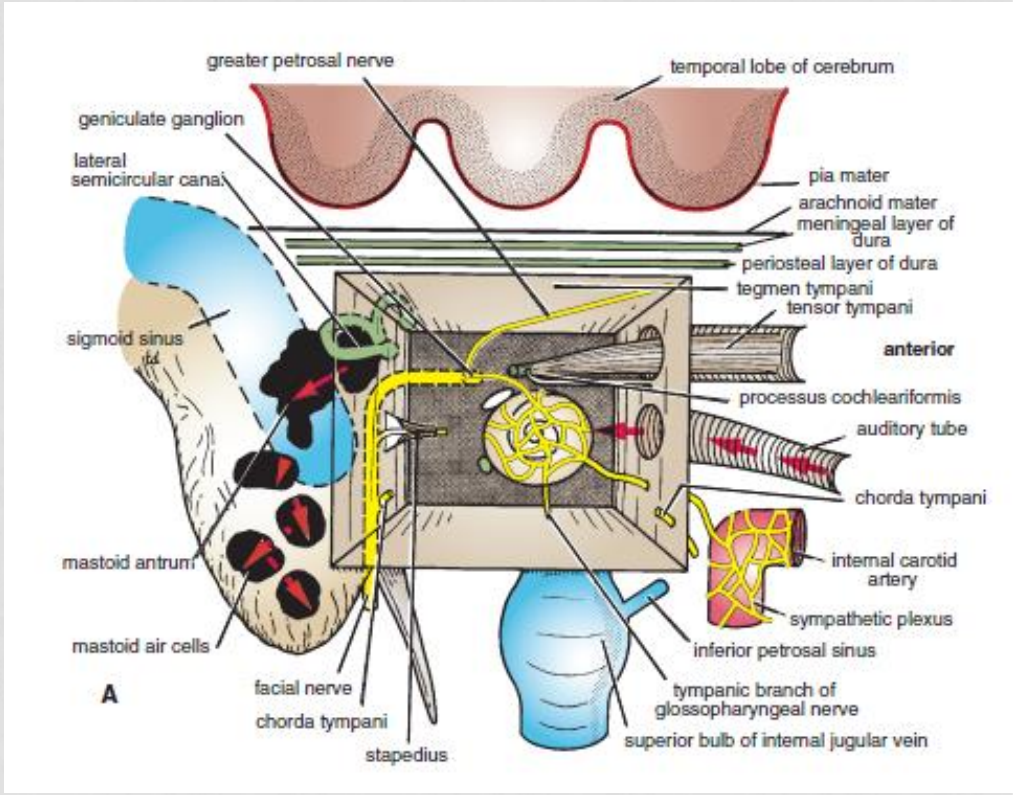
THE ROOF OF TYMPANIC CAVITY

- The **roof:** thin plate of bone, the **tegmen tympani,**
- separates the tympanic cavity from the meninges and the temporal lobe of the brain



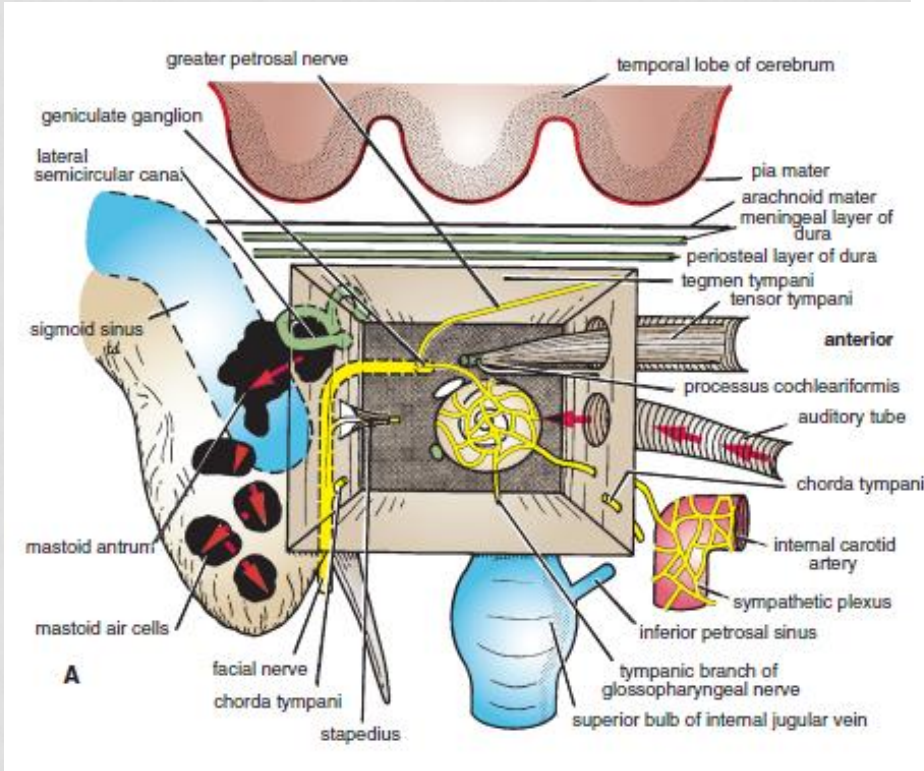
THE FLOOR OF TYMPANIC CAVITY

- The **floor**: thin plate of bone
- may be partly replaced by fibrous tissue
- separates the tympanic cavity from the superior bulb of the internal jugular vein



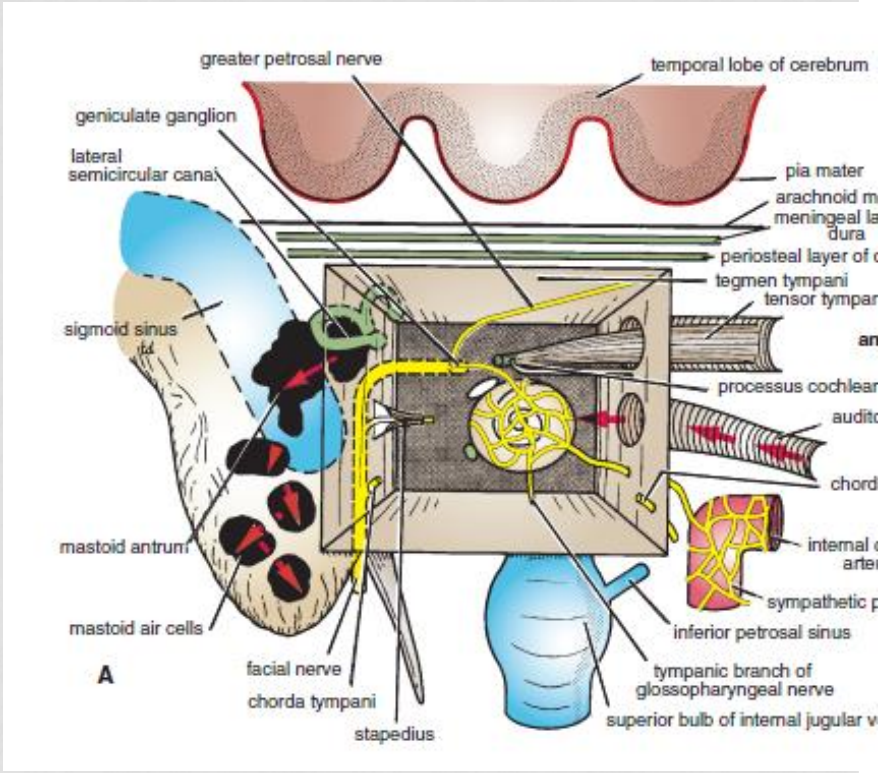
THE ANTERIOR WALL OF TYMPANIC CAVITY

- **anterior wall**
  - From below: thin bone separates TC from ICA
  - At upper part are the openings into two canals
  - The thin, bony septum, which separates the canals, is prolonged backward on the medial wall, forming a shelflike projection.



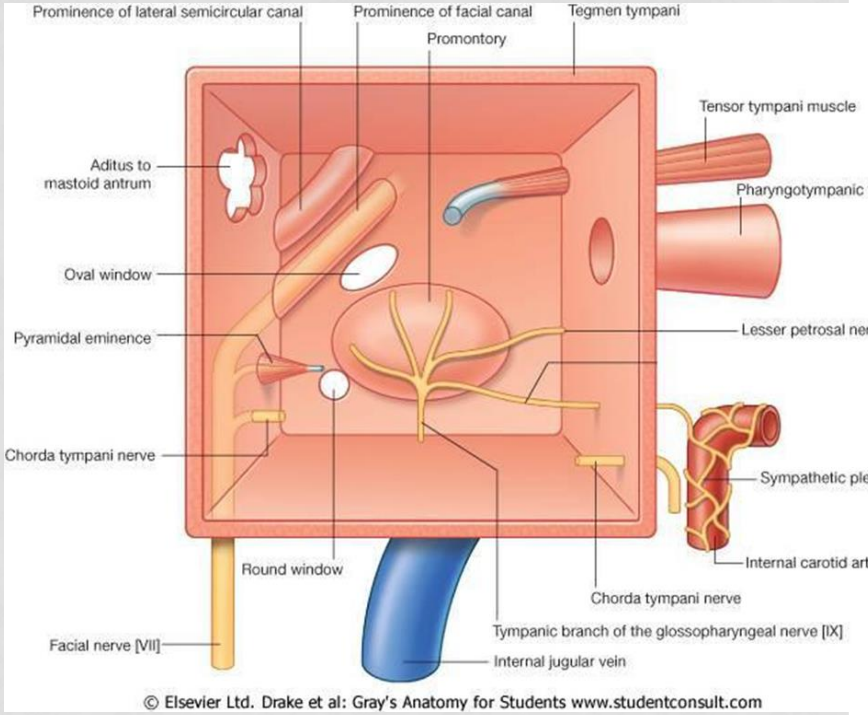
THE POSTERIOR WALL OF TYMPANIC CAVITY

- The **posterior wall**
  - upper part a large, irregular opening, the **aditus to the mastoid antrum**
  - Below this is a small, conical projection, the **pyramid,** from whose apex emerges the tendon of the **stapedius muscle.**



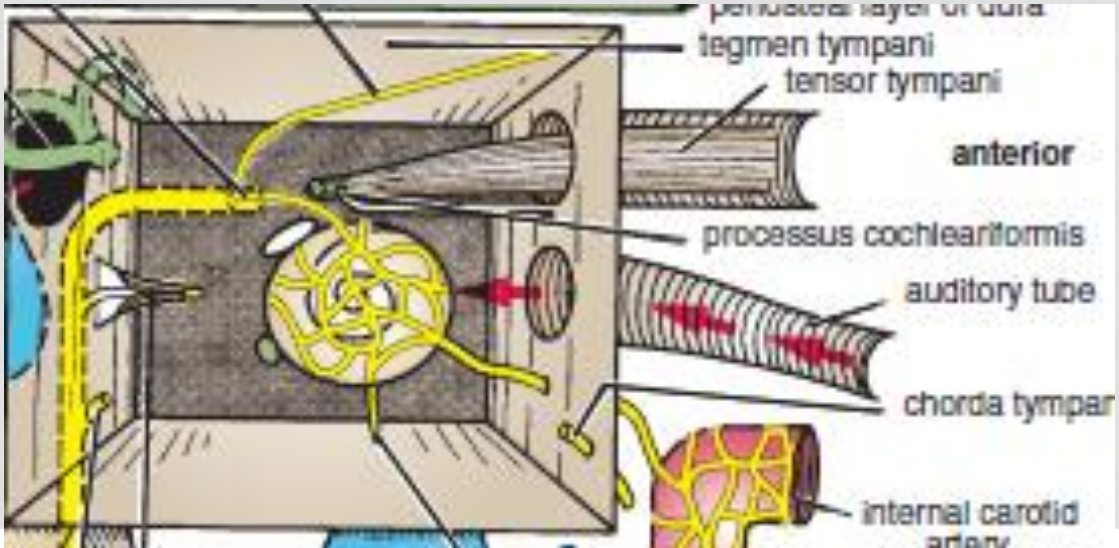
THE MEDIAL WALL OF TYMPANIC CAVITY

- formed by the lateral wall of the inner ear.
- **Promontory:** a rounded projection, which results from underlying first turn of the cochlea
- **Fenestra vestibuli (oval window):** above and behind promontory, closed by base of stapes. Medial to it there is perilymph of the scala vestibuli of the internal ear.
- **Fenestra cochleae (round window):** below promontory, its closed by the **secondary tympanic membrane.**
- medial to it, is perilymph of the blind end of the scala tympani



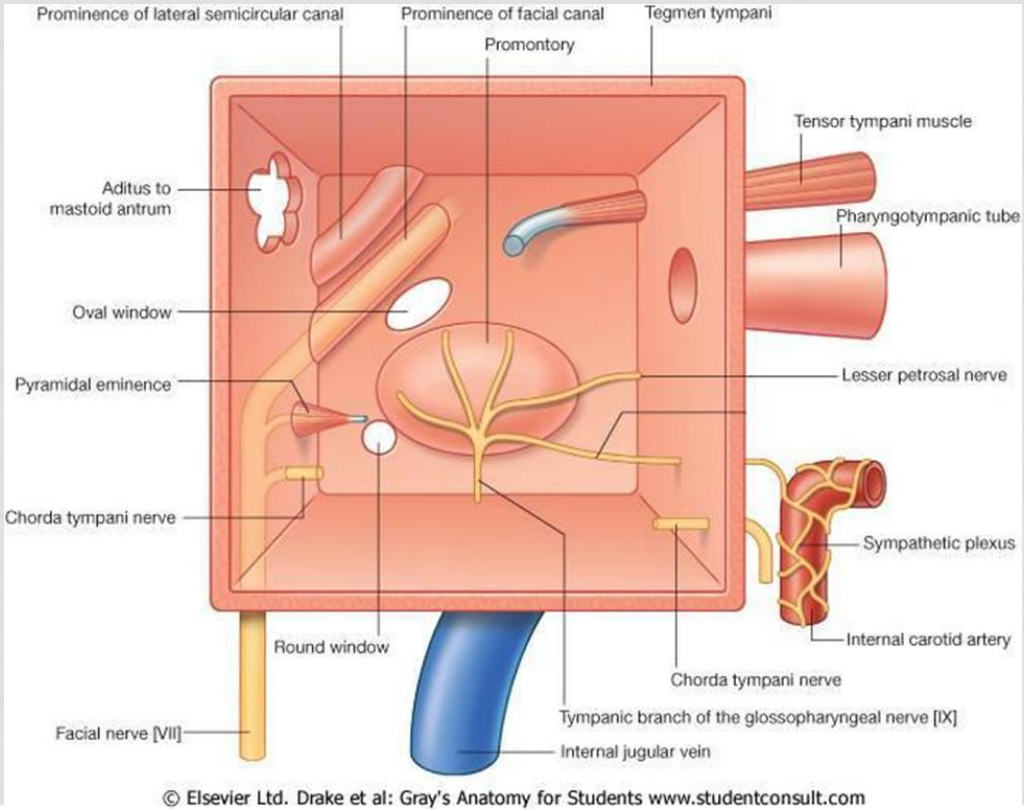
THE MEDIAL WALL OF TYMPANIC CAVITY

- bony shelf from anterior wall extends backward on medial wall above promontory and above fenestra vestibuli. It supports tensor tympani muscle.
- Its posterior end is curved upward and forms a pulley, the **processus cochleariformis,** around which the tendon of the tensor tympani bends laterally to reach its insertion on the handle of the malleus



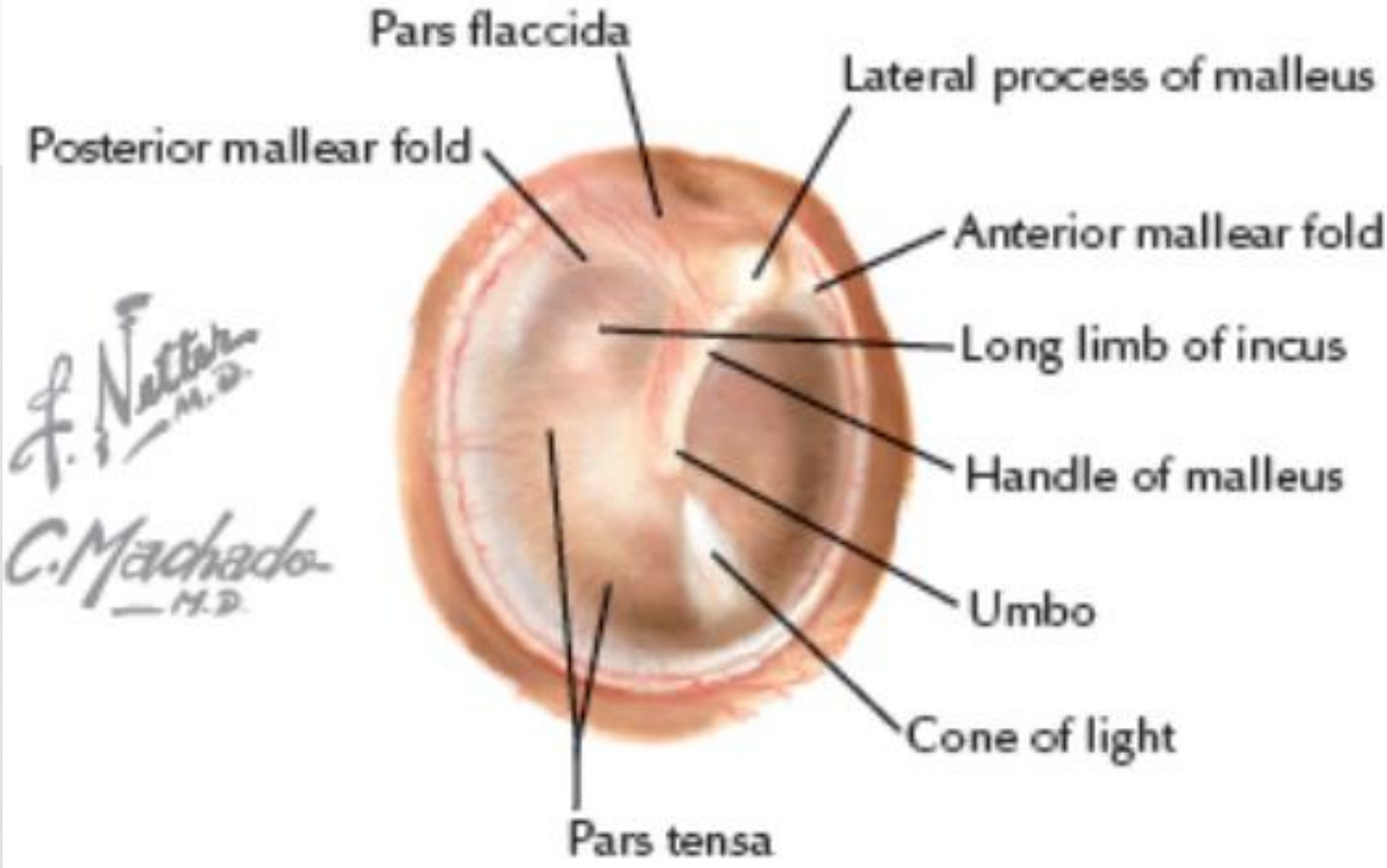
THE MEDIAL WALL OF TYMPANIC CAVITY

- A rounded ridge runs horizontally backward above P & FV known as the**prominence of the facial nerve canal.** On reaching the posterior wall, it curves downward behind the pyramid



THE LATERAL WALL OF TYMPANIC CAVITY

- Formed by tympanic membrane
- The **tympanic membrane** thin, fibrous membrane
- it is obliquely placed, facing downward, forward, and laterally
- It is concave laterally, and at the depth of the concavity is a small depression, the **umbo,** produced by the tip of the handle of the malleus
- The tympanic membrane is circular and measures about 1 cm in diameter
- The circumference is thickened and is slotted into a groove in the bone (**tympanic sulcus),** which is deficient superiorly forming a notch.
- From the sides of the notch, two bands, termed the **anterior** and **posterior malleolar folds,** pass to the lateral process of the malleus.


Pars flaccida
Lateral process of malleus
Posterior mallear fold
Anterior mallear fold
Long limb of incus
Handle of malleus
Umbo
Cone of light
Pars tensa
F. Netter M.D.
C. Machado M.D.

THE LATERAL WALL OF TYMPANIC CAVITY

- **pars flaccida:** small triangular area on the tympanic membrane bounded by the folds
- The remainder of the membrane is tense and is called the **pars tensa.**

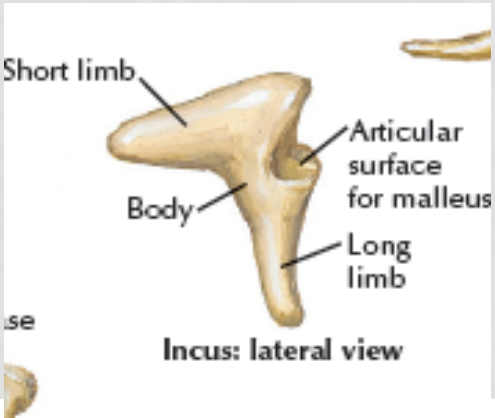
- The tympanic membrane is extremely sensitive to pain and is innervated on its outer surface by the **auriculotemporal nerve** and the **auricular branch of the vagus**

AUDITORY OSSICLES

- **Malleus** is the largest ossicle which has
- **Head:** rounded and articulates posteriorly with incus
- **Neck:** constricted part below the head
- **Handle:** passes downward and backward and is firmly attached to the medial surface of tympanic membrane
- **anterior process:** connected to anterior wall of tympanic cavity by a ligament
- **lateral process:** projects laterally and is attached to anterior and posterior malleolar folds

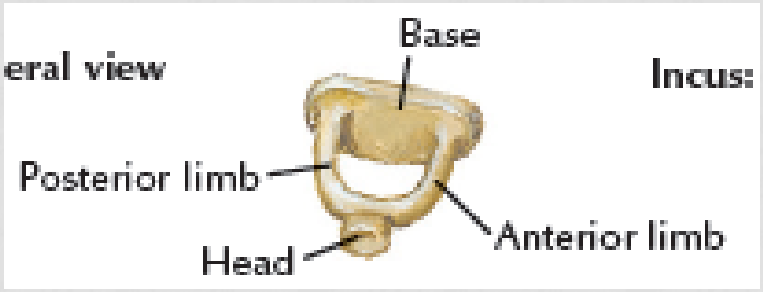
AUDITORY OSSICLES

- **Incus:** it possesses:
- **Body:** rounded and articulates anteriorly with head of malleus.
- **long process** descends behind and parallel to handle of malleus. Its lower end bends medially and articulates with head of the stapes
- **short process:** projects backward and is attached to posterior wall of tympanic cavity by a ligament.



AUDITORY OSSICLES

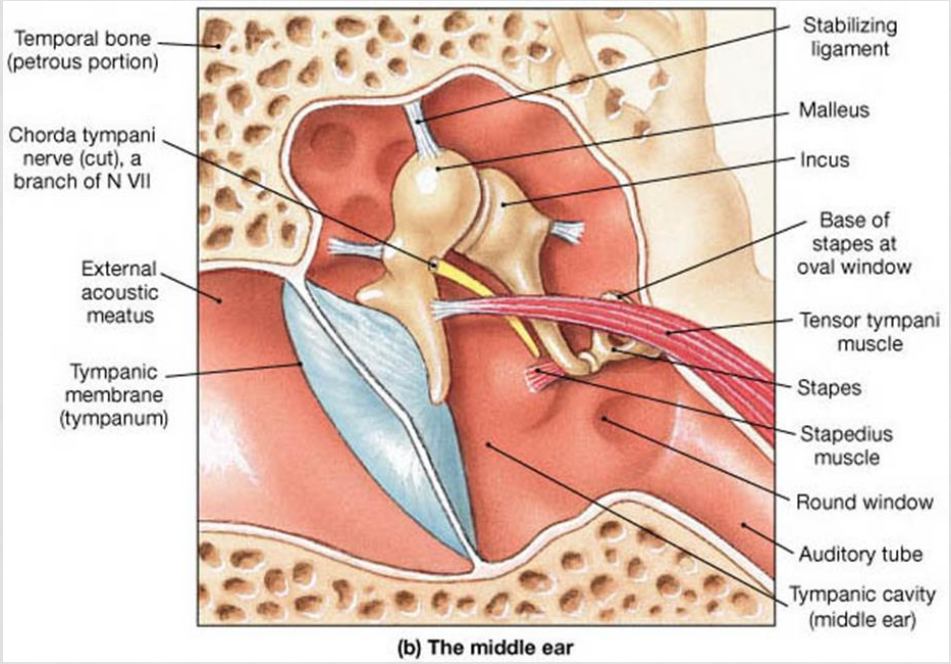
- **Stapes:** it has:
- **Head:** small and articulates with long process of incus
- **Neck:** narrow and receives insertion of stapedius muscle
- **two limbs:** diverge from neck and are attached to oval **base.**
- edge of base is attached to margin of fenestra vestibuli by a ring of fibrous tissue, **anular ligament.**



MUSCLES OF THE OSSICLES

TABLE 11.3 Muscles of the Middle Ear

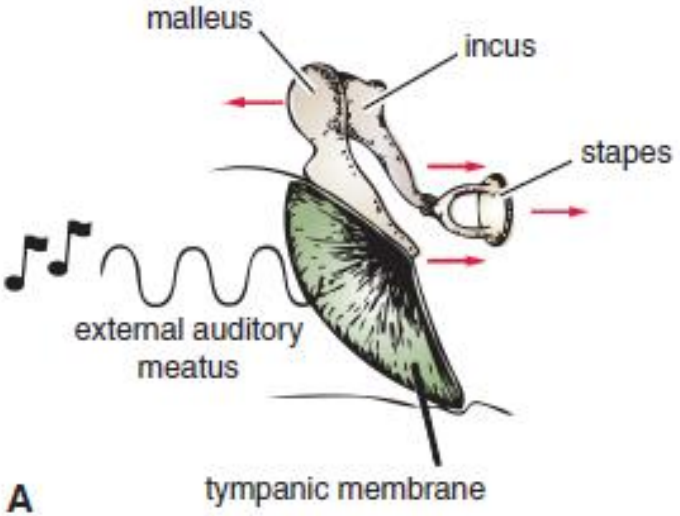
Muscle	Origin	Insertion	Nerve Supply	Action
Tensor tympani	Wall of auditory tube and wall of its own canal	Handle of malleus	Mandibular division of trigeminal nerve	Dampens down vibrations of tympanic membrane
Stapedius	Pyramid (bony projection on posterior wall of middle ear)	Neck of stapes	Facial nerve	Dampens down vibrations of stapes

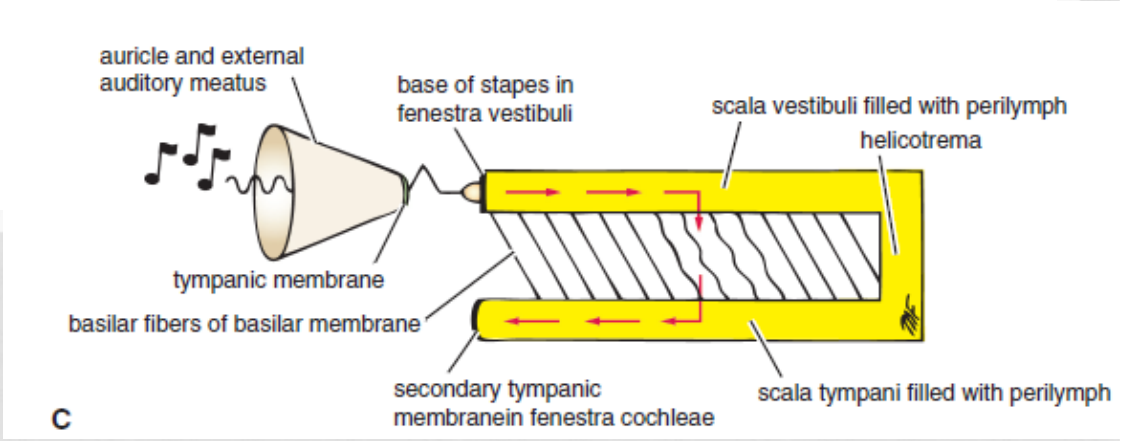


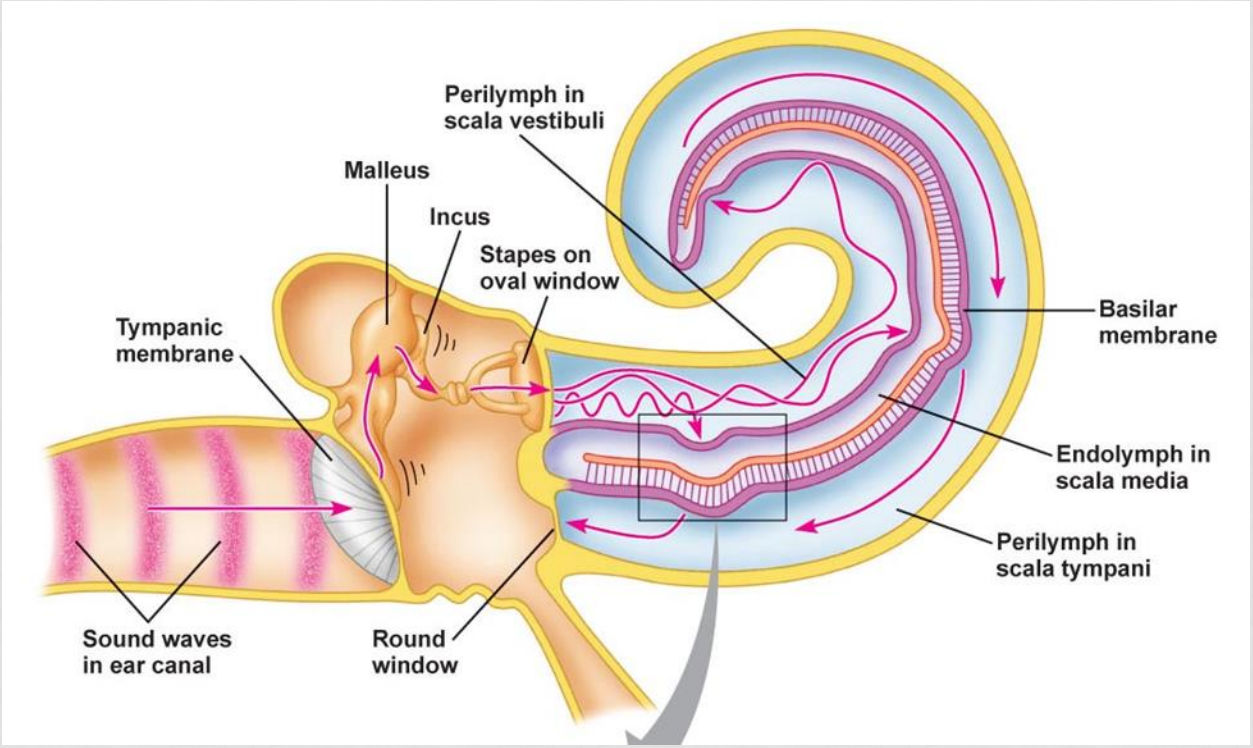
(b) The middle ear

MOVEMENTS OF THE AUDITORY OSSICLES

- The malleus and incus rotate on an anteroposterior axis
- When the tympanic membrane moves medially:
  1. handle of malleus moves medially
  2. head of malleus and body of incus move laterally
  3. long process of incus moves medially with stapes
  4. base of stapes is pushed medially in fenestra vestibuli, and the motion is communicated to the perilymph in the scala vestibuli
- Liquid being incompressible, the perilymph causes an outward bulging of the secondary tympanic membrane in the fenestra cochleae at the lower end of the scala tympani
- The above movements are reversed if the tympanic membrane moves laterally
- the effective pressure on the perilymph increase by a total of 22 to 1

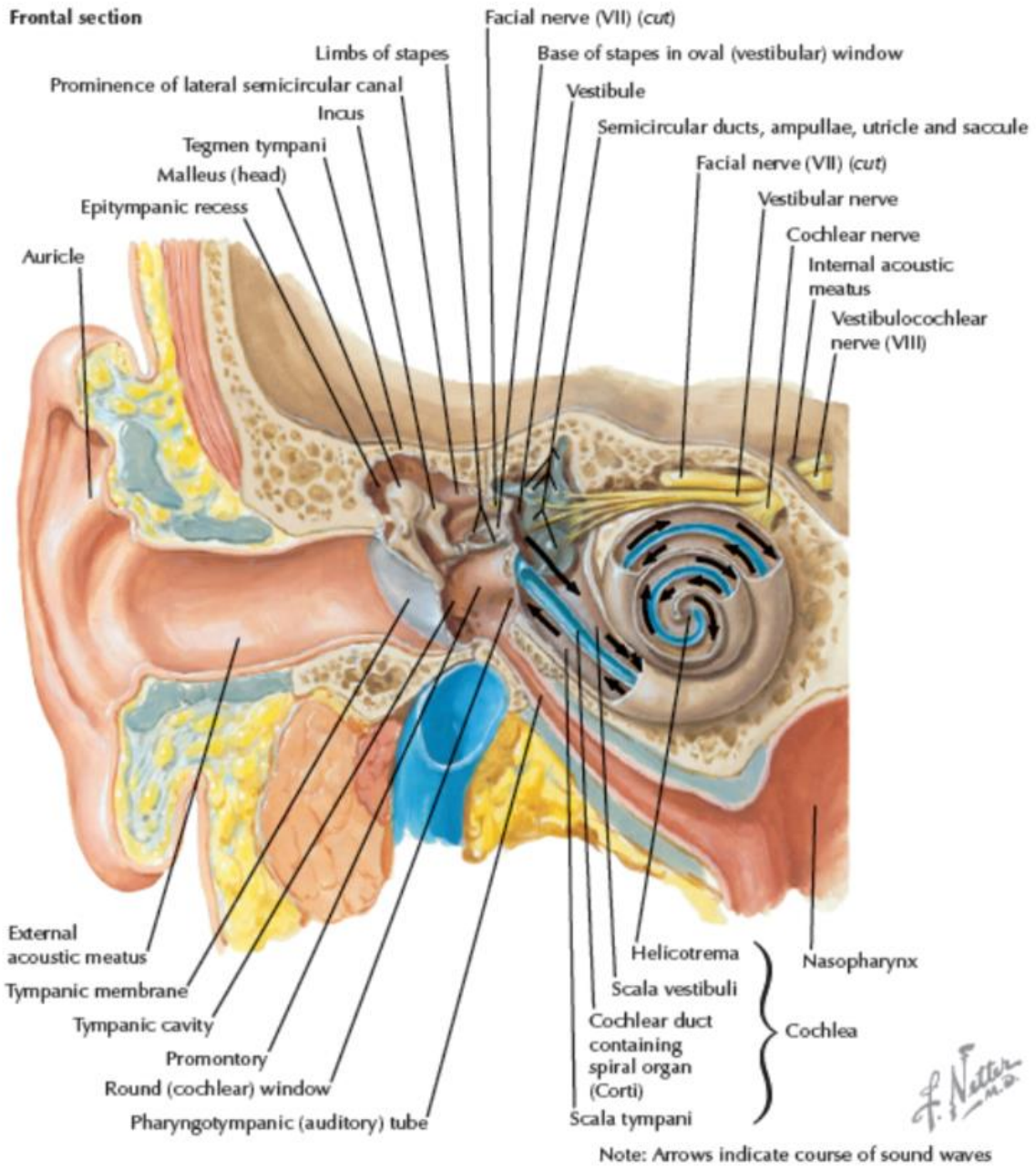

malleus
incus
stapes
external auditory meatus
tympanic membrane
A


auricle and external auditory meatus
base of stapes in fenestra vestibuli
scala vestibuli filled with perilymph
helicotrema
tympanic membrane
basilar fibers of basilar membrane
secondary tympanic membranein fenestra cochleae
scala tympani filled with perilymph
C


Perilymph in scala vestibuli
Malleus
Incus
Stapes on oval window
Tympanic membrane
Basilar membrane
Endolymph in scala media
Perilymph in scala tympani
Sound waves in ear canal
Round window

AUDITORY TUBE

- connects anterior wall of tympanic cavity to nasal pharynx
- posterior third is bony, and anterior two thirds is cartilaginous
- As the tube descends, it passes over the upper border of the superior constrictor muscle
- It serves to equalize air pressures in the tympanic cavity and the nasal pharynx

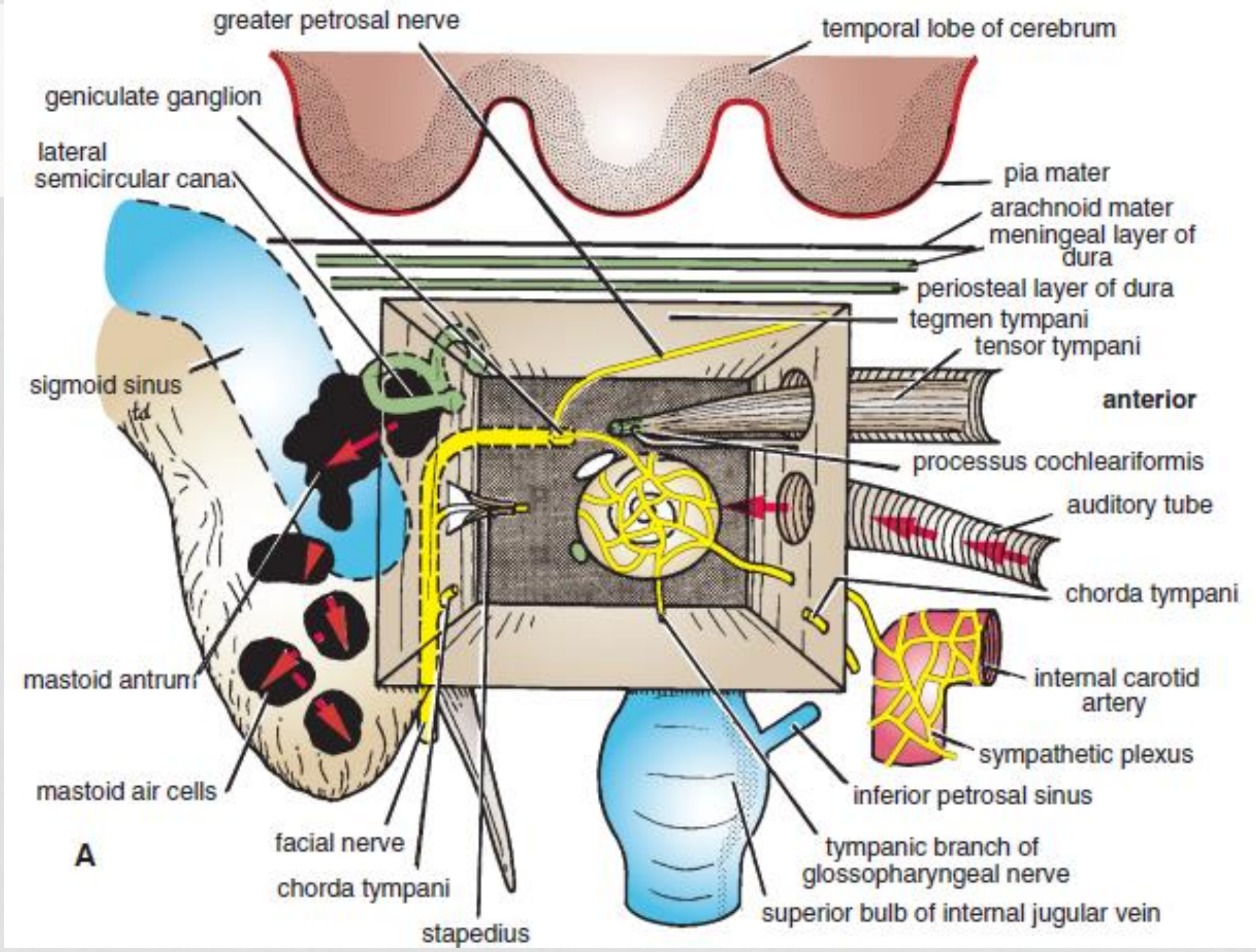

Frontal section
Facial nerve (VII) (cut)
Limbs of stapes
Base of stapes in oval (vestibular) window
Prominence of lateral semicircular canal
Vestibule
Incus
Semicircular ducts, ampullae, utricle and saccule
Tegmen tympani
Facial nerve (VII) (cut)
Malleus (head)
Vestibular nerve
Epitympanic recess
Cochlear nerve
Auricle
Internal acoustic meatus
Vestibulocochlear nerve (VIII)
External acoustic meatus
Helicotrema
Nasopharynx
Tympanic membrane
Scala vestibuli
Tympanic cavity
Cochlear duct containing spiral organ (Corti)
Cochlea
Promontory
Round (cochlear) window
Pharyngotympanic (auditory) tube
Scala tympani
Note: Arrows indicate course of sound waves

MASTOID ANTRUM

- The mastoid antrum lies behind the middle ear in the petrous bone
- It communicates with the middle ear by the aditus

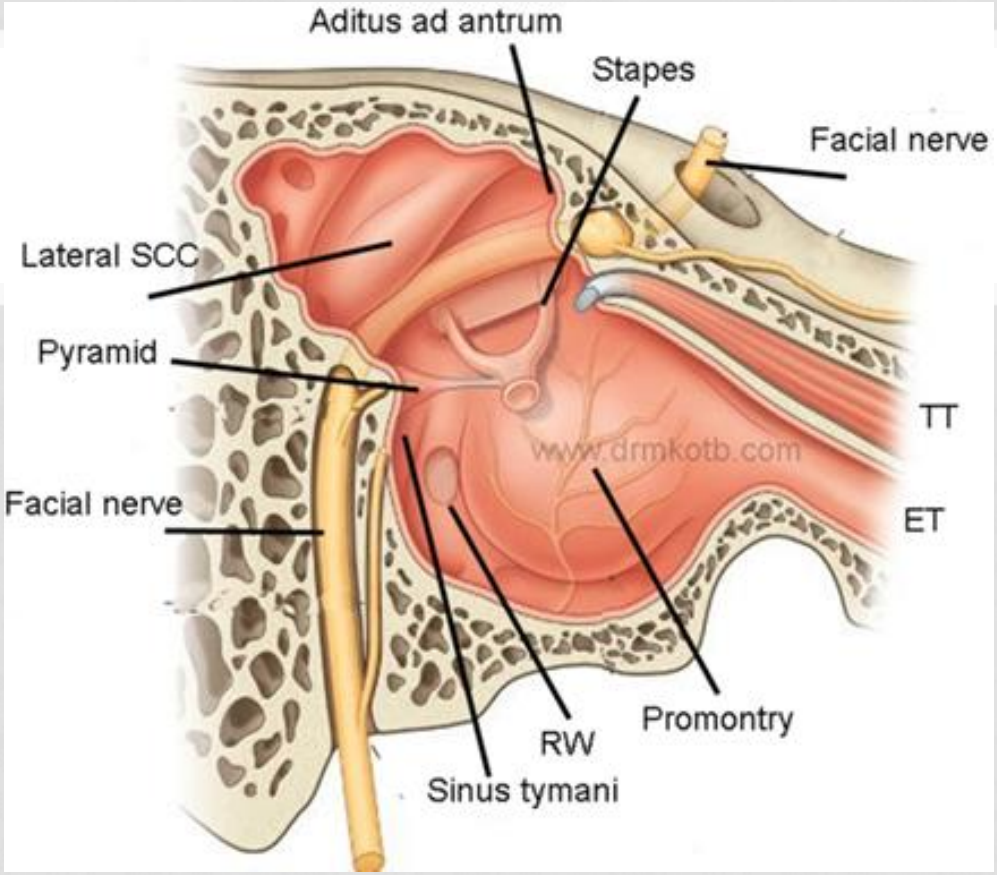
❑ **Relations**

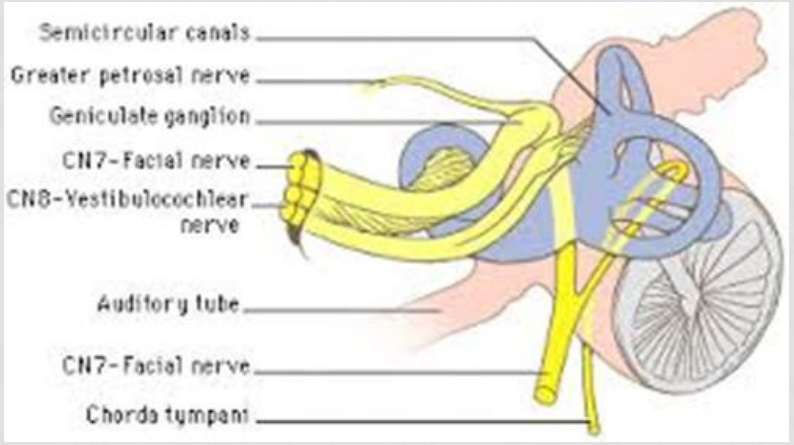
- **Anterior wall :**the middle ear and contains the aditus
- **Posterior wall :** separates the antrum from the sigmoid venous sinus and the cerebellum
- **Lateral wall** forms the floor of the suprameatal triangle
- **Medial wall** : the posterior semicircular canal
- **Superior wall** is the thin plate of bone, the tegmen tympani, which is related to the meninges of the middle cranial fossa and the temporal lobe of the brain
- **Inferior wall** is perforated with holes, through which the antrum communicates with the mastoid air cells


greater petrosal nerve
temporal lobe of cerebrum
geniculate ganglion
lateral
semicircular canal
pia mater
arachnoid mater
meningeal layer of
dura
periosteal layer of dura
tegmen tympani
tensor tympani
sigmoid sinus
anterior
processus cochleariformis
auditory tube
chorda tympani
mastoid antrum
internal carotid
artery
sympathetic plexus
mastoid air cells
inferior petrosal sinus
A
facial nerve
chorda tympani
tympanic branch of
glossopharyngeal nerve
superior bulb of internal jugular vein
stapedius

THE FACIAL NERVE

- Enters the internal acoustic meatus & then into facial canal
- nerve runs laterally above vestibule of the internal ear until it reaches the medial wall of the middle ear. Here, the nerve expands to form the sensory **geniculate ganglion**
- nerve then bends sharply backward above the promontory
- On arriving at posterior wall of middle ear, it curves downward on medial side of aditus
- It descends in posterior wall of middle ear, behind the pyramid, and finally emerges through the stylomastoid foramen into the neck


Aditus ad antrum
Stapes
Facial nerve
Lateral SCC
Pyramid
TT
www.drmkotb.com
Facial nerve
ET
Promontry
RW
Sinus tymani


Semicircular canals
Greater petrosal nerve
Geniculate ganglion
CN7-Facial nerve
CN8-Vestibulocochlear nerve
Auditory tube
CN7-Facial nerve
Chorda tympani

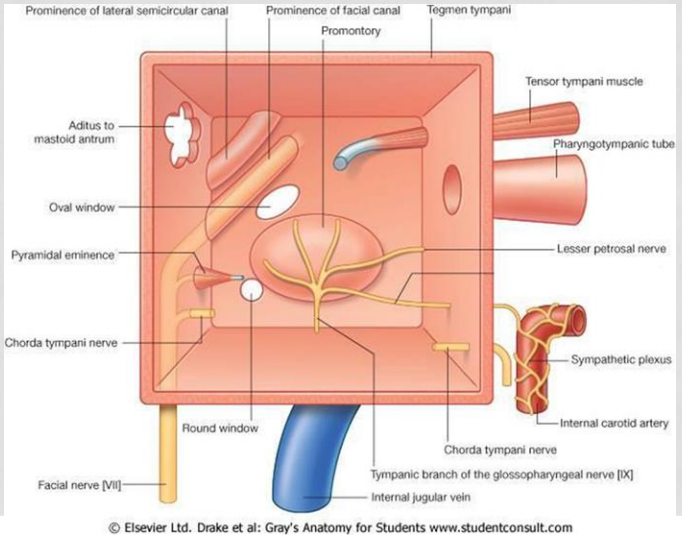
IMPORTANT BRANCHES OF THE INTRAPETROUS PART OF THE FACIAL NERVE

1. **Greater petrosal nerve** emerges on superior surface of petrous & joined by deep petrosal nerve to form **nerve of the pterygoid canal.**
2. **nerve to the stapedius** arises from facial nerve as it descends in its canal behind the pyramid
3. **chorda tympani** arises from facial nerve just above stylomastoid foramen. It enters the middle ear close to the posterior border of the tympanic membrane. It runs forward & leaves middle ear through petrotympanic fissure and enters infratemporal fossa, where it joins the lingual nerve

- It contain
  1. Taste fibers : ant. 2/3 of tongue & FOM
  2. Parasympathetic scretomotor fibers : to submand. & subling. glands

TYMPANIC NERVE

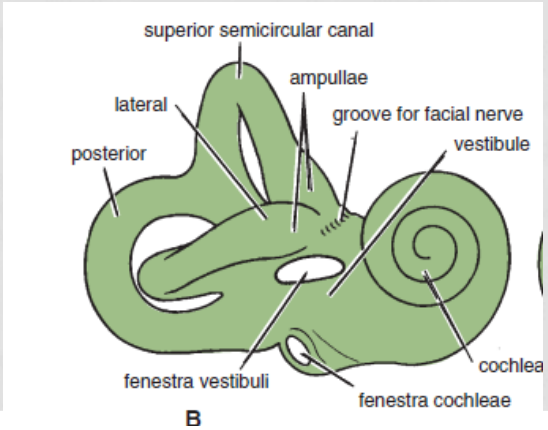
- arises from glossopharyngeal nerve, just below jugular foramen
- passes through the floor of the middle ear and onto promontory forming **tympanic plexus**.
- tympanic plexus supplies lining of middle ear and gives off lesser petrosal nerve, which sends secretomotor fibers to parotid gland via the otic ganglion. It leaves the skull through the foramen ovale.

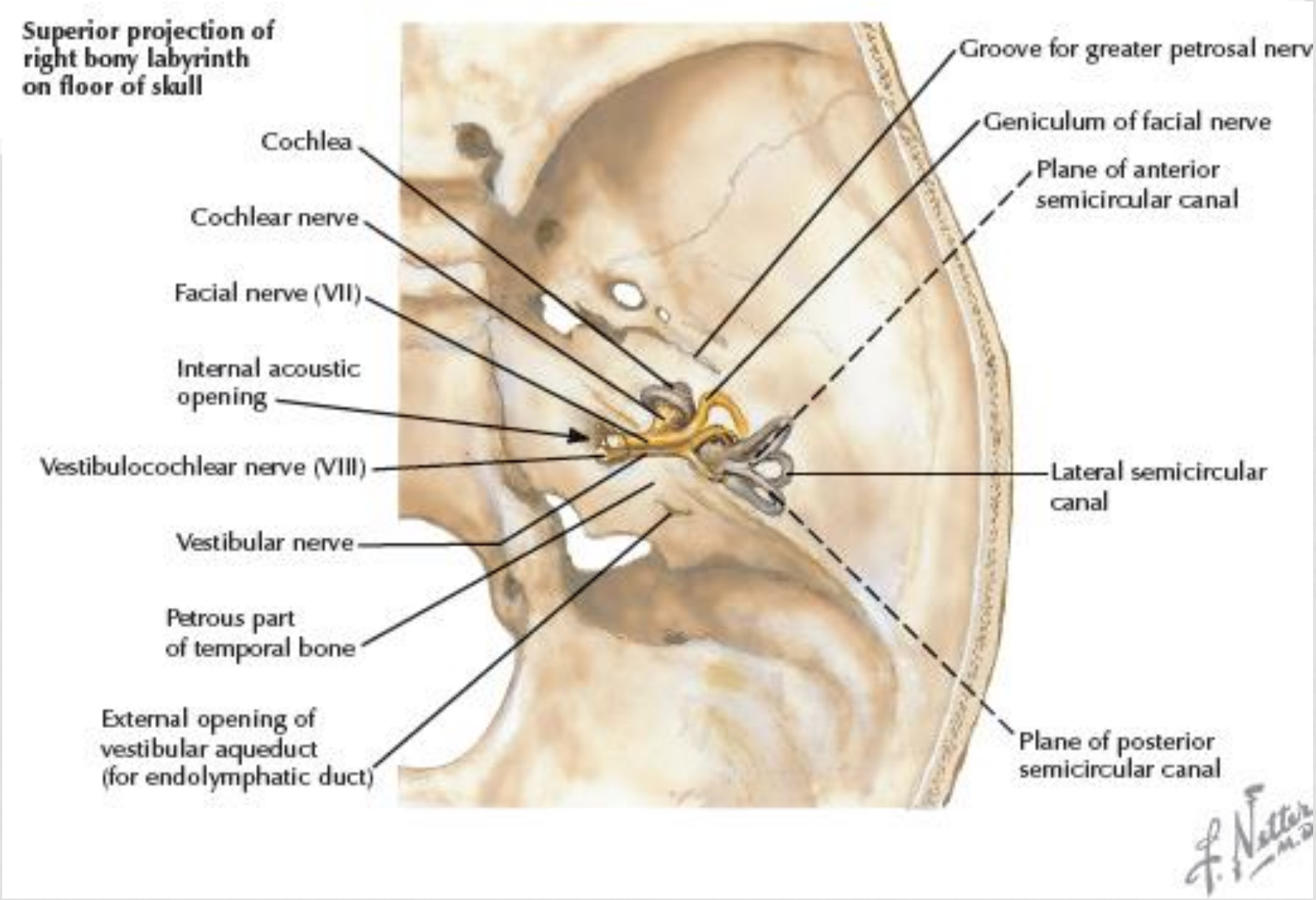


THE INTERNAL EAR, OR LABYRINTH

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

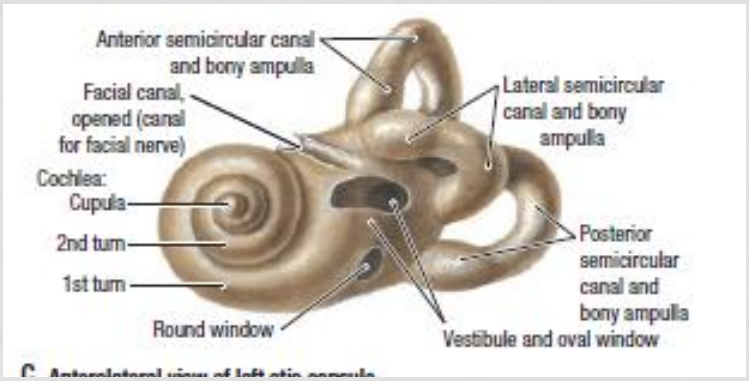
1. **bony labyrinth**, comprising a series of cavities within bone
2. **membranous labyrinth**, comprising a series of membranous sacs and ducts contained within bony labyrinth

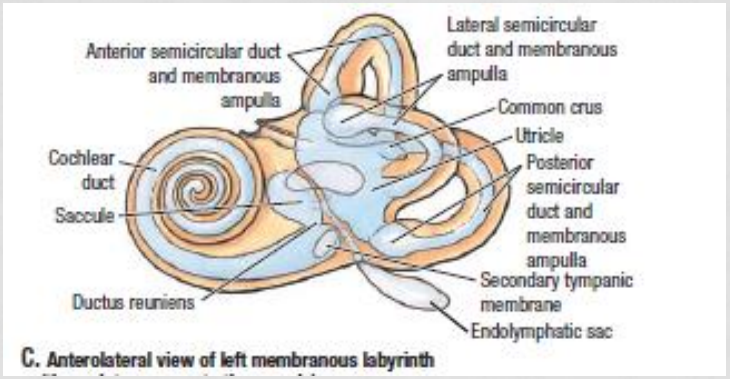



Superior projection of right bony labyrinth on floor of skull
Cochlea
Cochlear nerve
Facial nerve (VII)
Internal acoustic opening
Vestibulocochlear nerve (VIII)
Vestibular nerve
Petrous part of temporal bone
External opening of vestibular aqueduct (for endolymphatic duct)
Groove for greater petrosal nerv
Geniculum of facial nerve
Plane of anterior semicircular canal
Lateral semicircular canal
Plane of posterior semicircular canal
F. Netter

BONY LABYRINTH

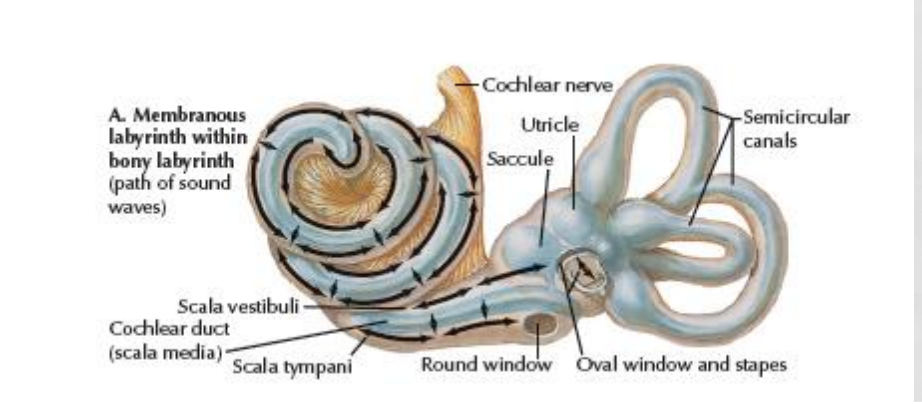
- The bony labyrinth consists of three parts: the vestibule, the semicircular canals, and the cochlea
- These are cavities situated in the substance of dense bone.
- They are lined by endosteum and contain a clear fluid, the perilymph, in which is suspended the membranous labyrinth.





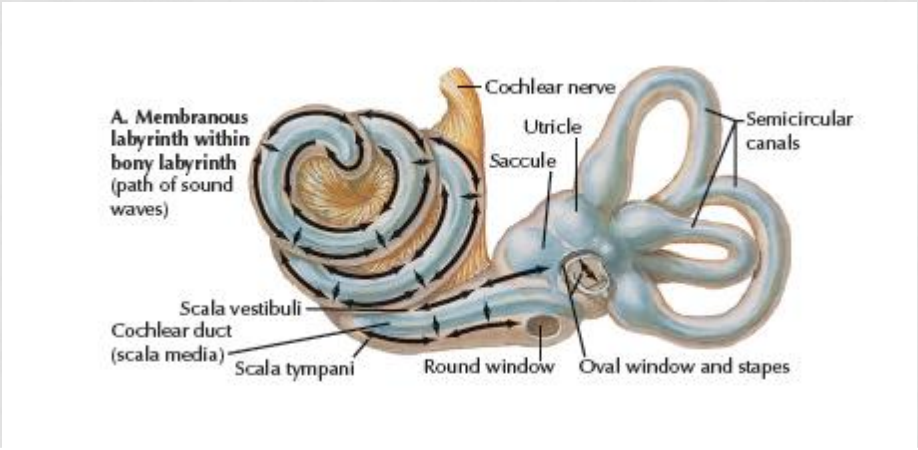
BONY LABYRINTH

- **The vestibule**
- central part
- Lies posterior to cochlea and anterior to semicircular canals
- In its lateral wall are the fenestra vestibuli, & fenestra cochleae
- within the vestibule are the saccule and utricle of the membranous labyrinth



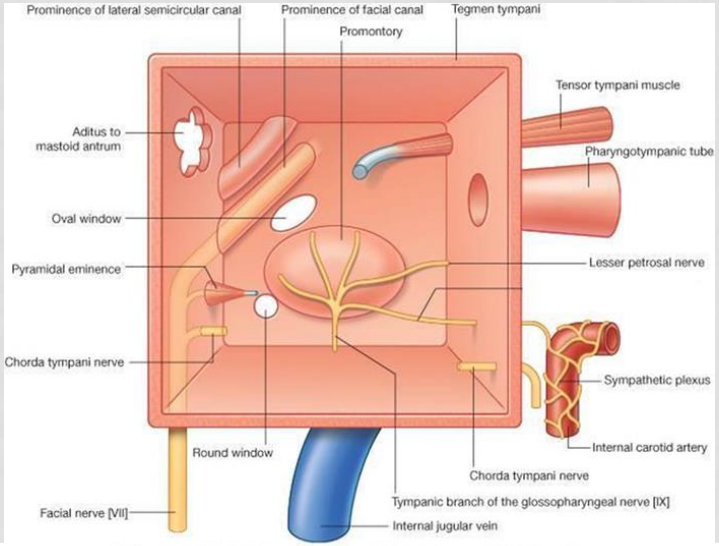
BONY LABYRINTH

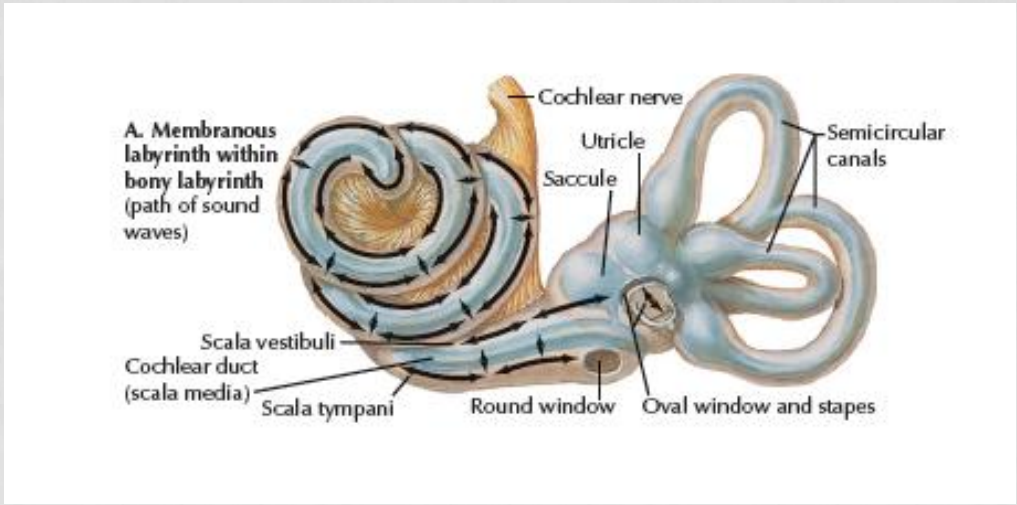
- **semicircular canals—superior, posterior,** and **lateral**
- open into posterior part of the vestibule.
- Each canal has a swelling at one end called the **ampulla.**
- The canals open into the vestibule by five orifices, one of which is common to two of the canals.
- Lodged within the canals are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



BONY LABYRINTH

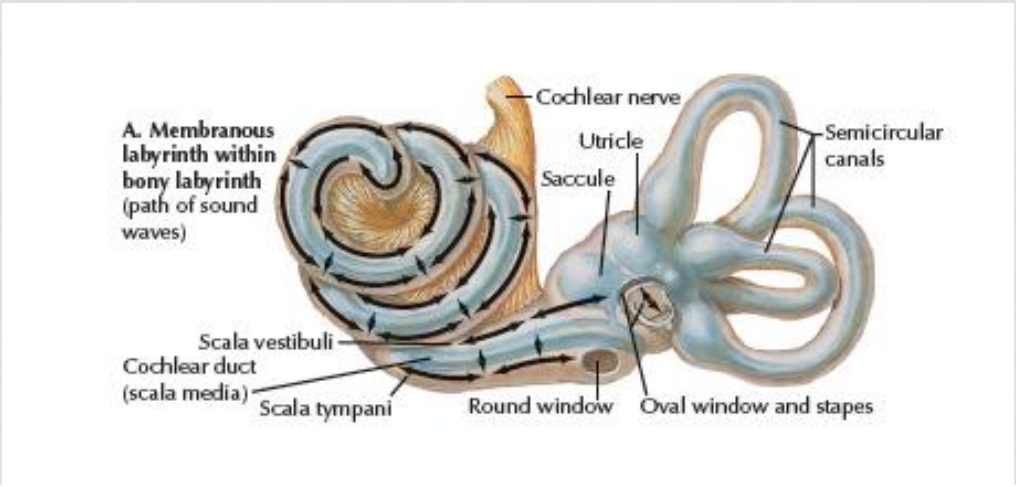
- The superior semicircular canal is vertical and at right angles to long axis of petrous bone.
- The posterior canal is also vertical but is parallel with long axis of petrous bone.
- The lateral canal is horizontal, and it lies in the medial wall of aditus above the facial nerve canal.

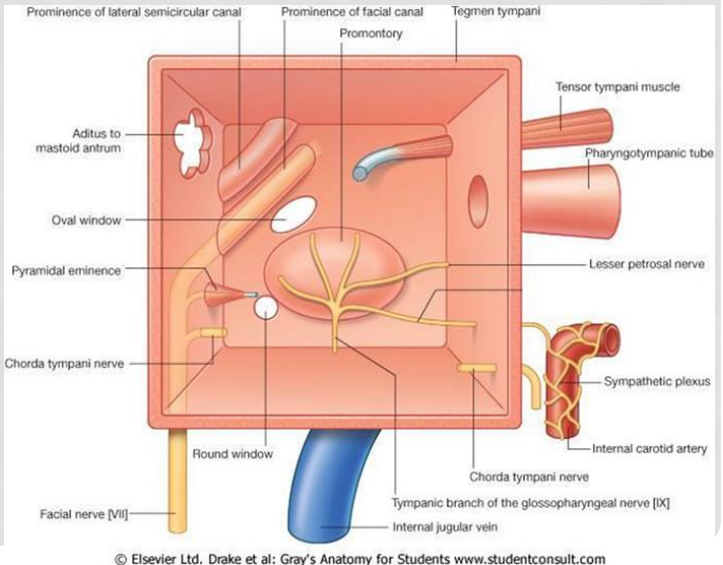


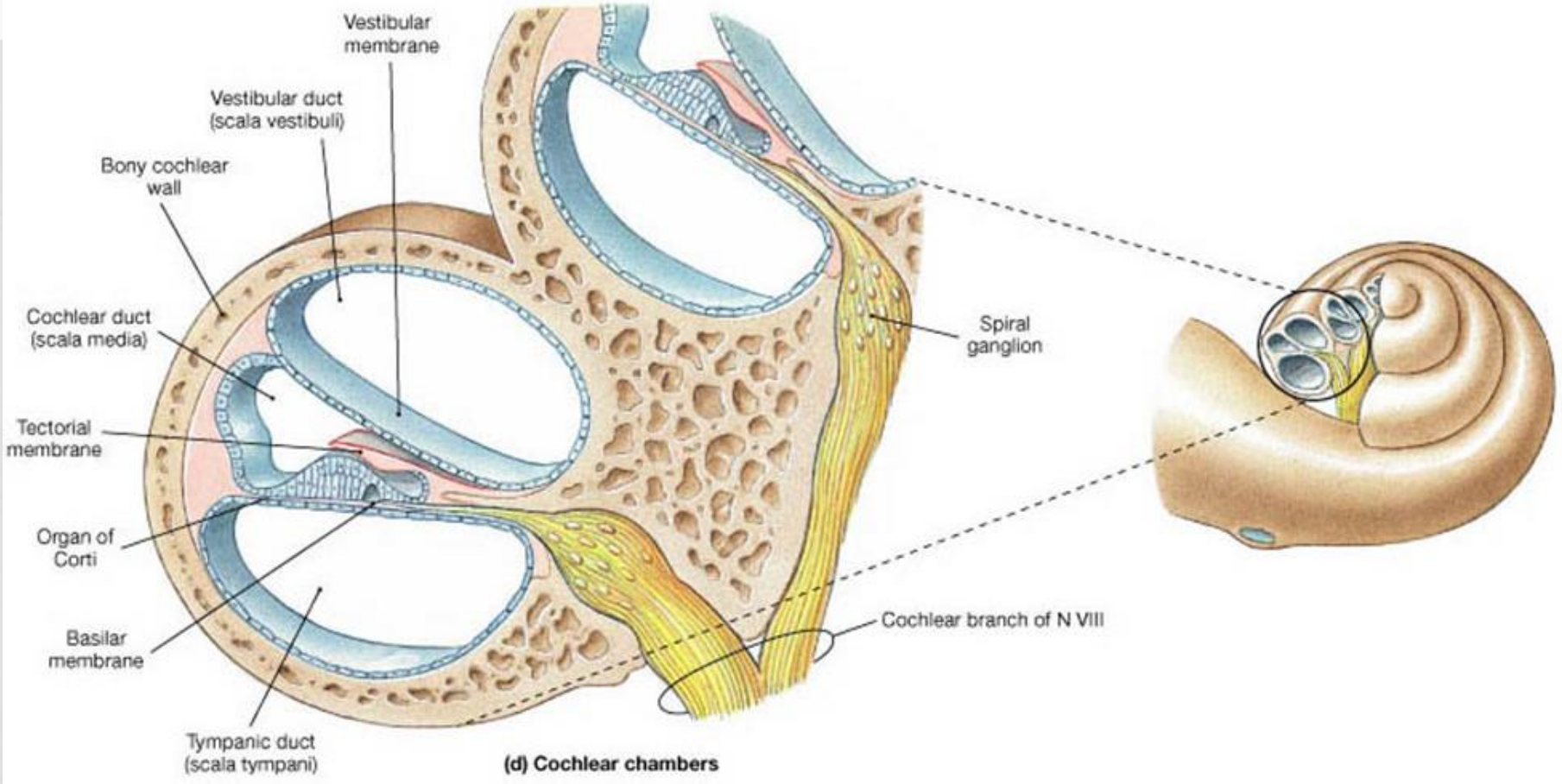


BONY LABYRINTH

- The **cochlea** resembles a snail shell.
- It opens into the anterior part of the vestibule
- it consists of a central pillar, the **modiolus**, around which a hollow bony tube makes two and one half spiral turns.
- The first basal turn of the cochlea is responsible for the promontory



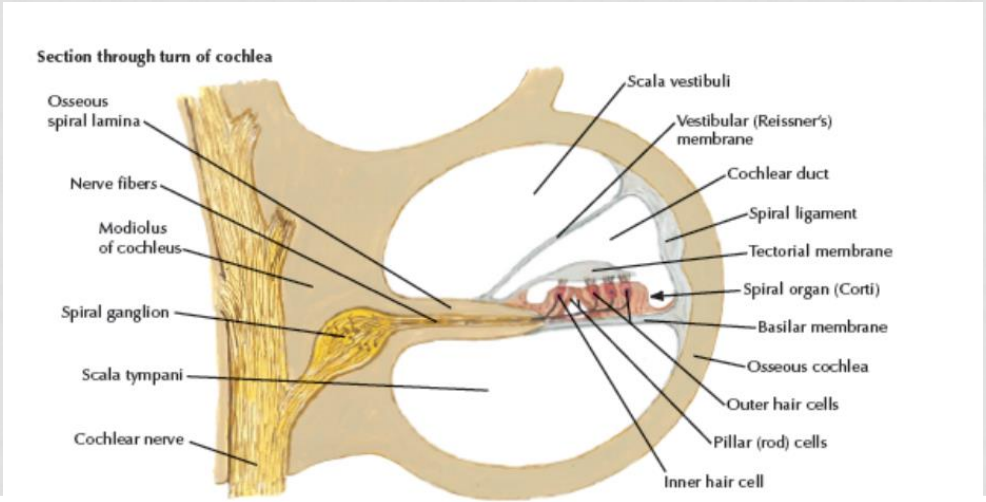




(d) Cochlear chambers

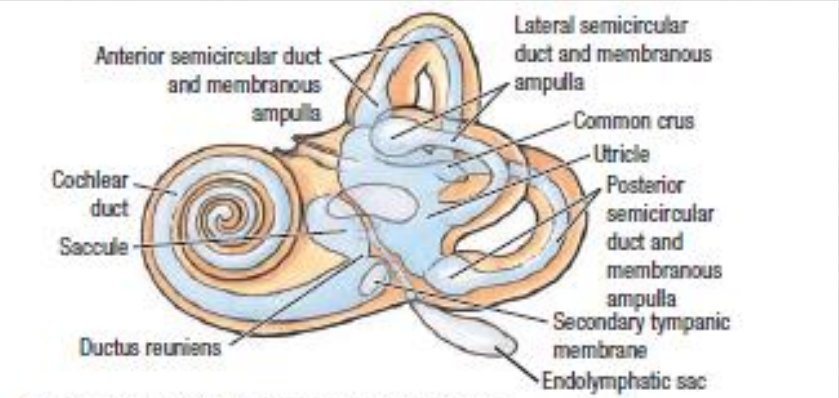
BONY LABYRINTH

- **Modiolus** is perforated by branches of the cochlear nerve.
- the **spiral lamina,** winds around the modiolus and projects into the interior of the canal and partially divides it.
- The **basilar membrane** stretches from the free edge of the spiral lamina to the outer bony wall, thus dividing the cochlear canal into the **scala vestibuli** above and the **scala tympani** below.



MEMBRANOUS LABYRINTH

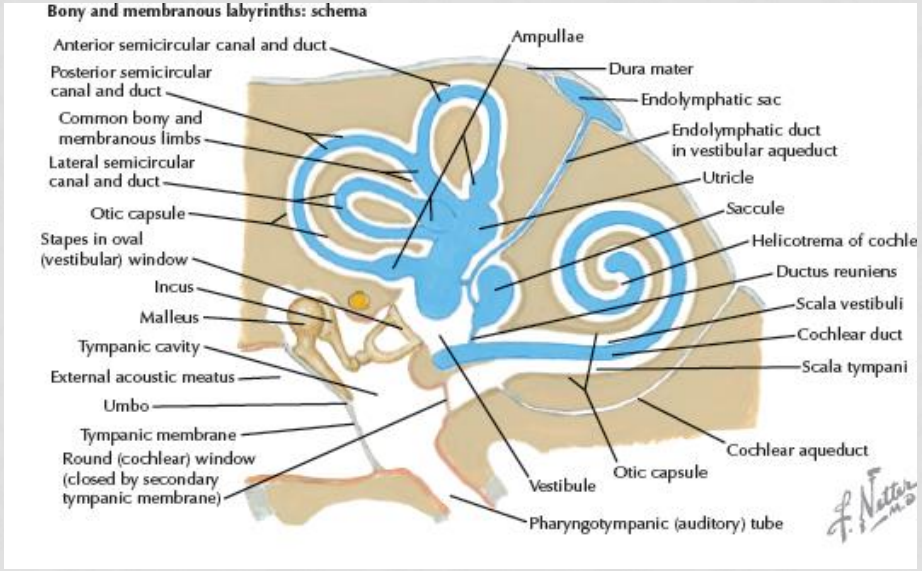
- lodged within bony labyrinth
- filled with endolymph and surrounded by perilymph.
- It consists of
- **utricle** and **saccule** (in the bony vestibule)
- three **semicircular ducts** (within bony semicircular canals)
- **duct of cochlea** (within the bony cochlea)
- All these structures freely communicate with one another.

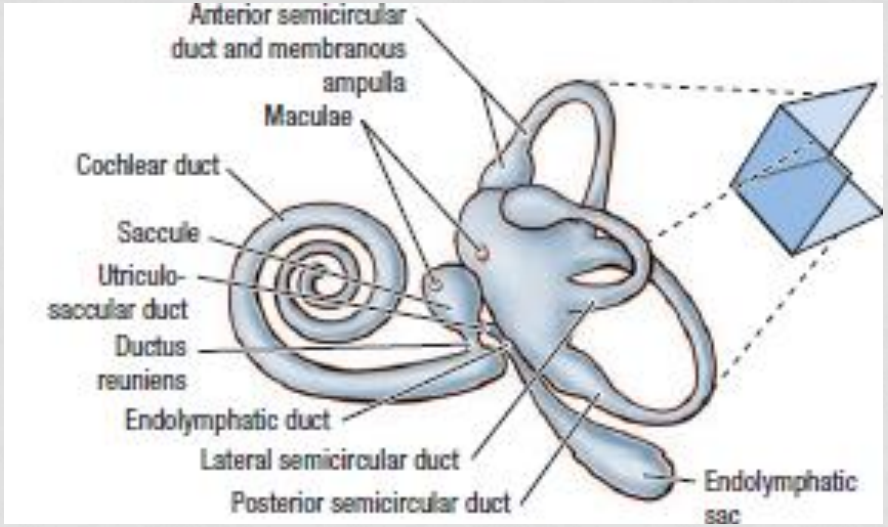


C. Anterolateral view of left membranous labyrinth

MEMBRANOUS LABYRINTH

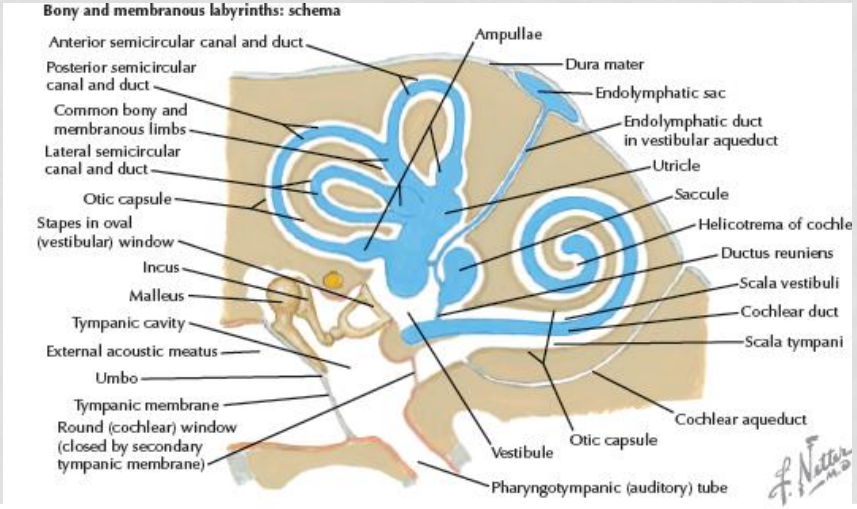
- The **utricle** is the larger of the two vestibular sacs
- indirectly connected to the saccule and the ductus endolymphaticus by the **ductus utriculosaccularis.**





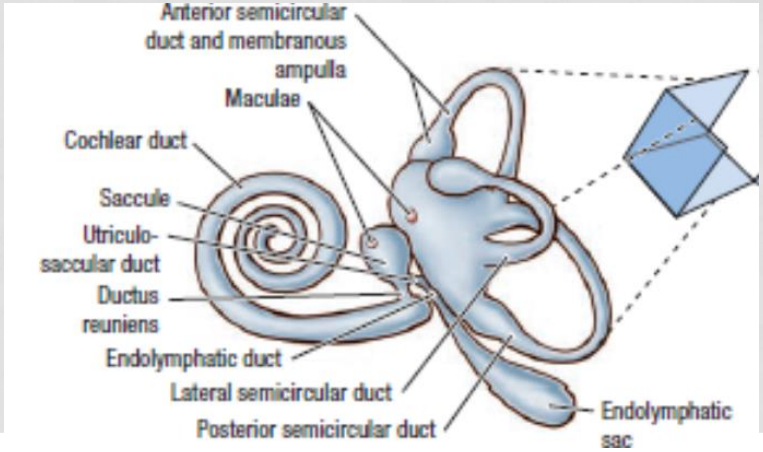
MEMBRANOUS LABYRINTH

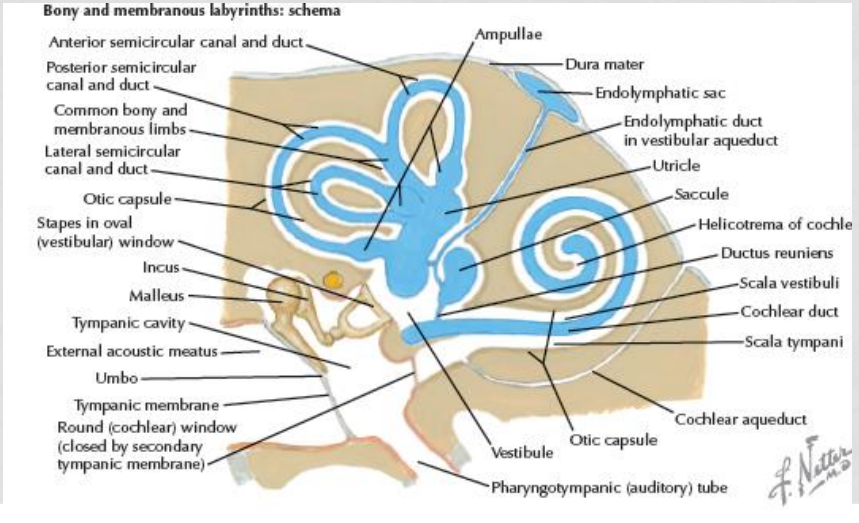
- **saccule** is globular and is connected to the utricle,
- **ductus endolymphaticus** end in a small blind pouch, the **saccus endolymphaticus**
- This lies beneath dura on posterior surface of petrous.
- Located on the walls of the utricle and saccule are specialized sensory receptors, which are sensitive to the orientation of the head to gravity or other acceleration forces.



MEMBRANOUS LABYRINTH

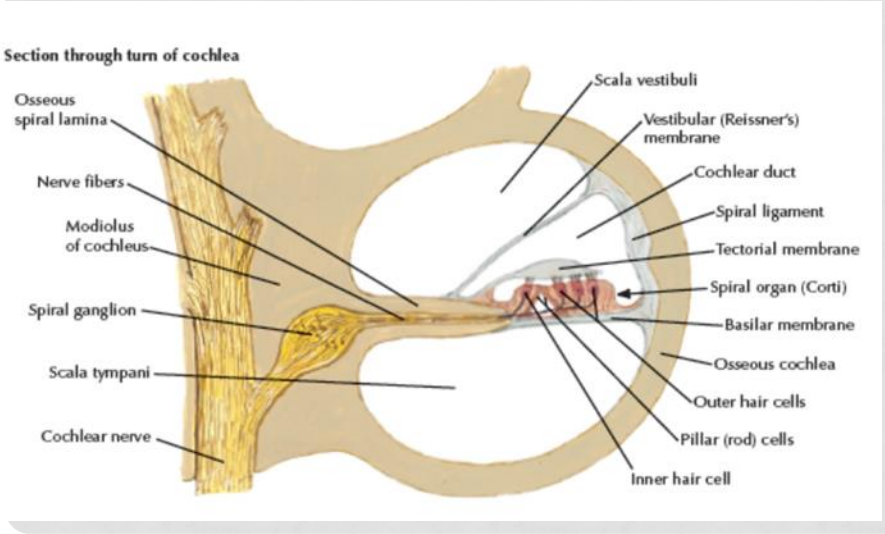
- **semicircular ducts** have smaller diameter than semicircular canals
- arranged at right angles to each other so that all three planes are represented
- Whenever the head begins or ceases to move, the endolymph in the semicircular ducts changes its speed of movement relative to that of the walls of the semicircular ducts. This change is detected in the sensory receptors in the ampullae of the semicircular ducts.

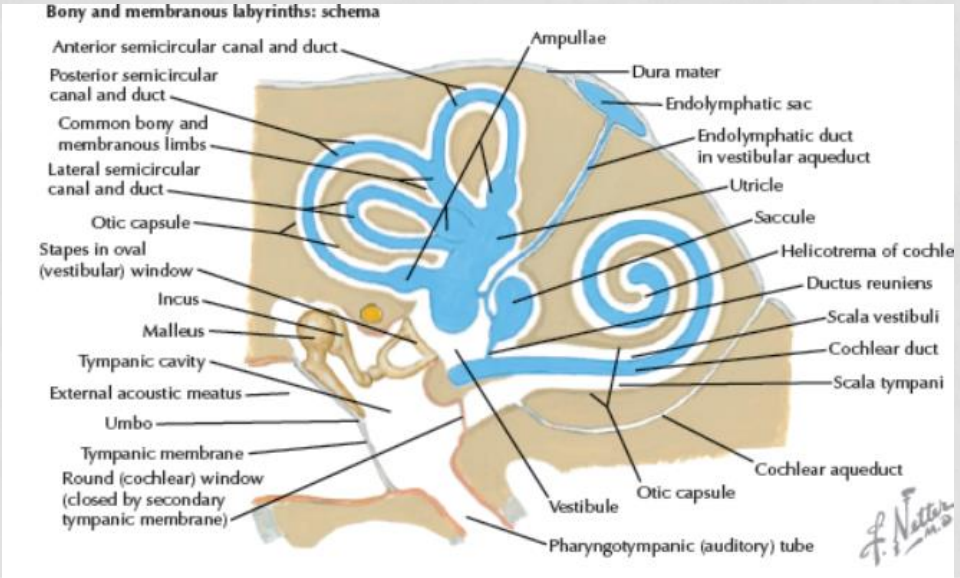




MEMBRANOUS LABYRINTH

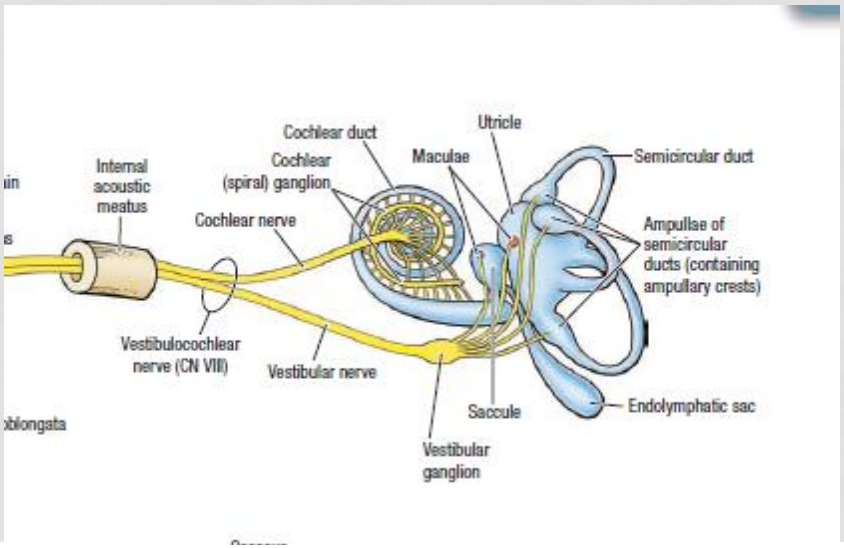
- **duct of the cochlea** is triangular in cross section
- connected to the saccule by the **ductus reuniens.**
- highly specialized epithelium that lies on the **basilar membrane** forms the **spiral organ of Corti** and contains the sensory receptors for hearing





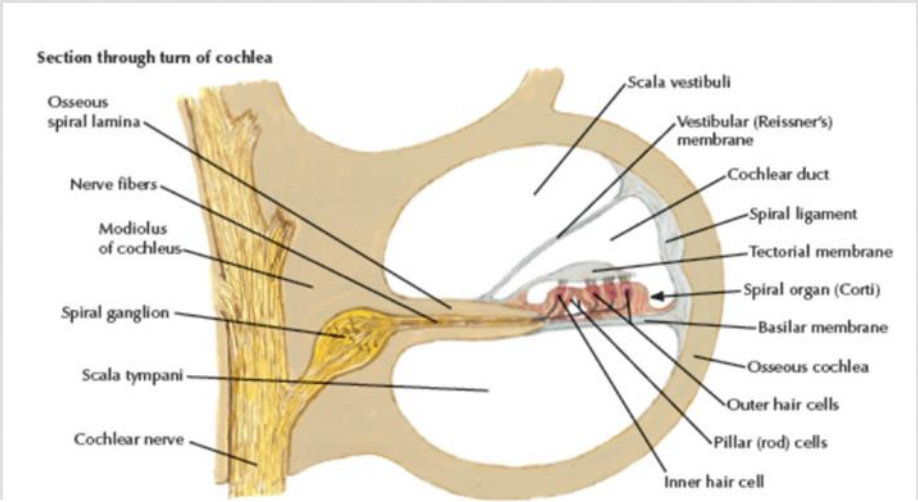
VESTIBULOCOCHLEAR NERVE

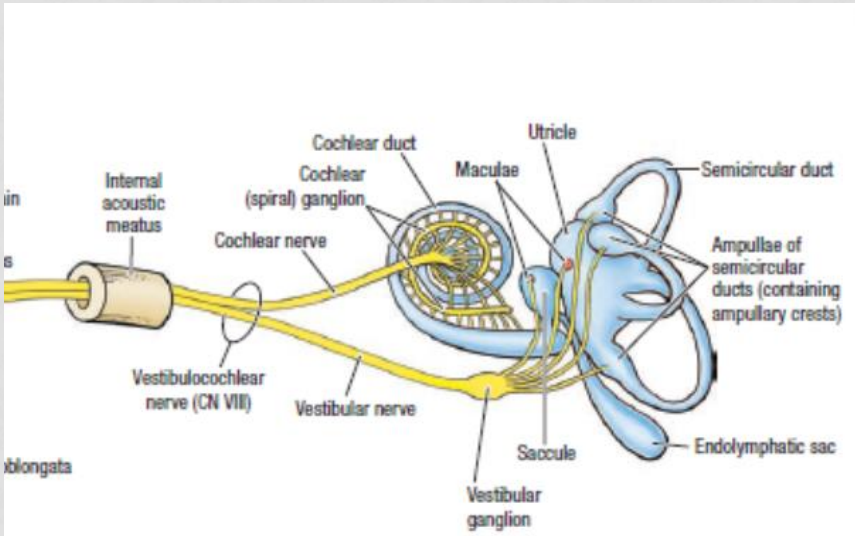
- At bottom of the internal acoustic meatus the nerve divides into vestibular and cochlear portions
- The **vestibular nerve**
- form the **vestibular ganglion.**
- Branches then enter to membranous labyrinth, supply utricle, saccule, and ampullae of semicircular ducts.



VESTIBULOCOCHLEAR NERVE

- **cochlear nerve** divides into branches, which enter foramina at the base of the modiolus.
- Has **spiral ganglion** that is lodged in a canal winding around the modiolus in the base of the spiral lamina.
- The peripheral branches of this nerve pass from the ganglion to the **spiral organ of Corti.**





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Thank You