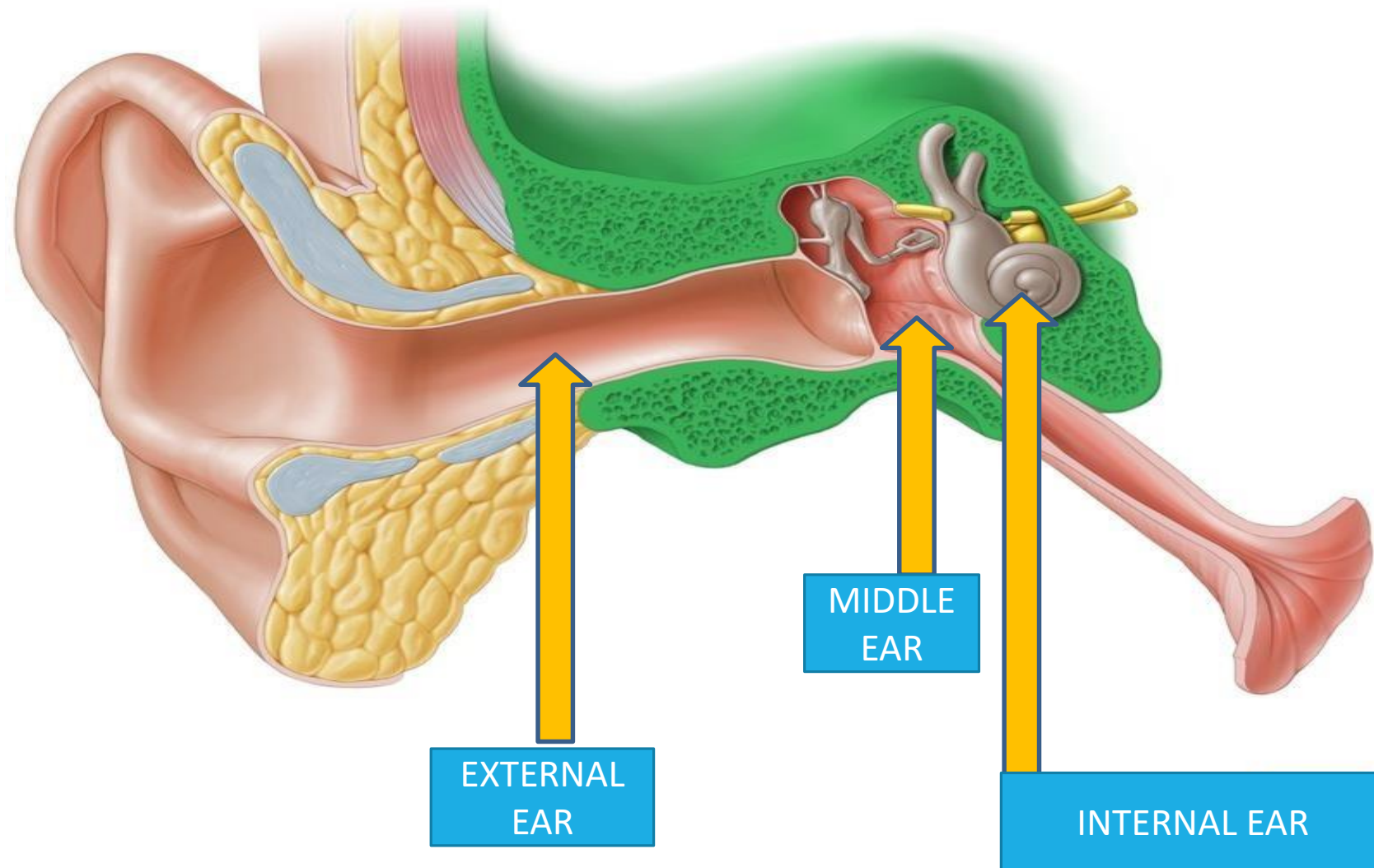


ANATOMY OF THE EAR



The Ear

The ear consists of :

External ear

Middle ear (Tympanic cavity)

Internal ear (Labyrinth): contains organs of hearing and balance

Sound is captured by
external ear

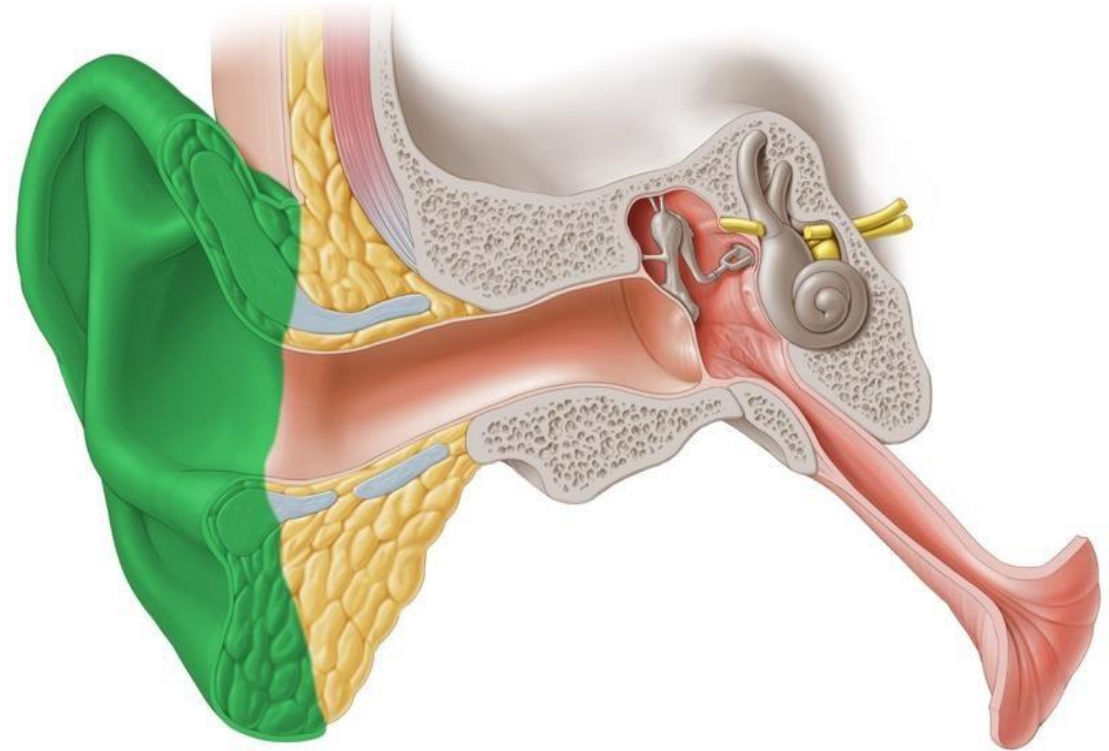
Mechanical signals in
the middle ear

Internal ear converts
mechanical signals to
electrical

External ear

1- Auricle (ear pinna)

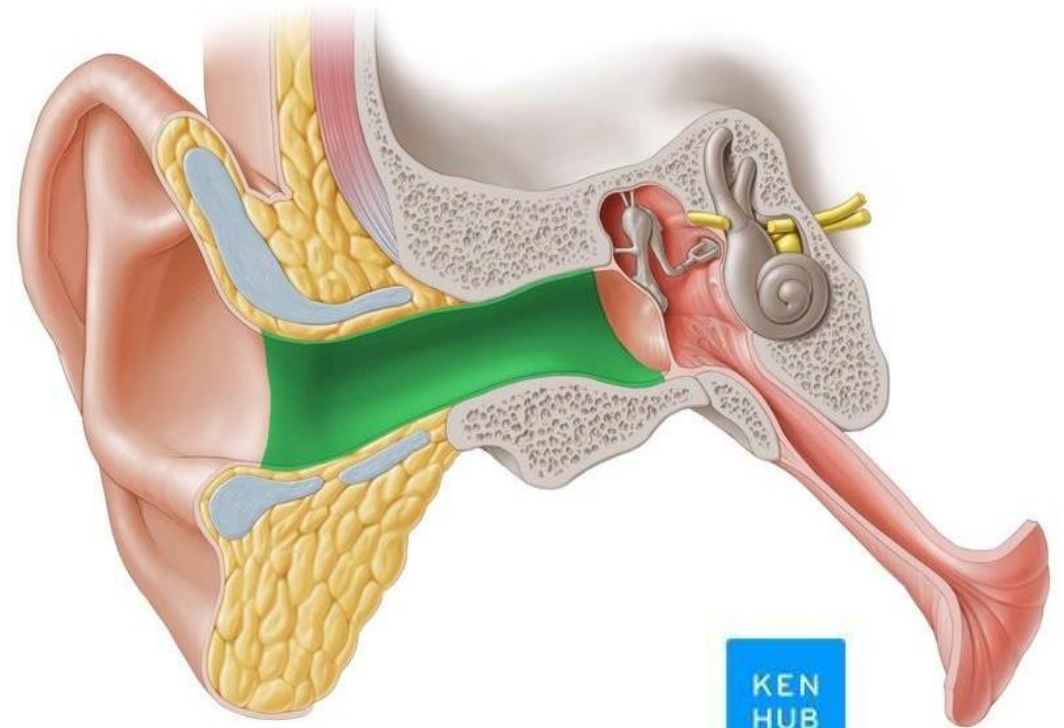
- The auricle has a characteristic shape
- It collects air vibrations
- It consists of a thin plate of elastic cartilage covered by skin



External ear

2- External auditory meatus

- The external auditory meatus is a curved tube that leads from the auricle to the tympanic membrane
- It conducts sound waves from the auricle to the tympanic membrane



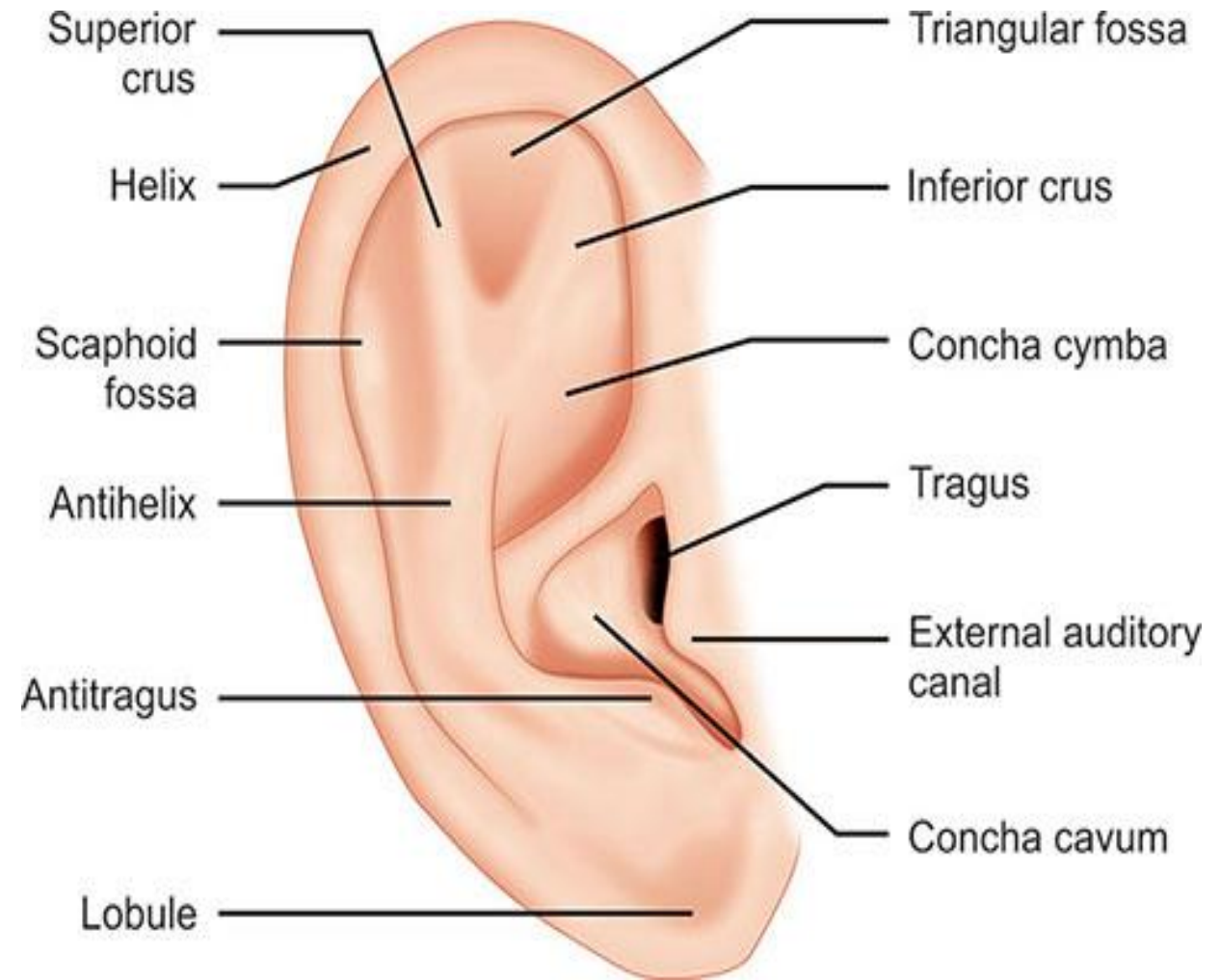
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The cartilage of the auricle is arranged in a pattern of elevations and depressions

Prominent ears (also known as ‘bat’ ears) are caused by the absence or inadequacy of an antihelical fold.

Anotia is complete absence of the external ear, and is most likely caused by a developmental disturbance between the seventh and eighth gestational week.



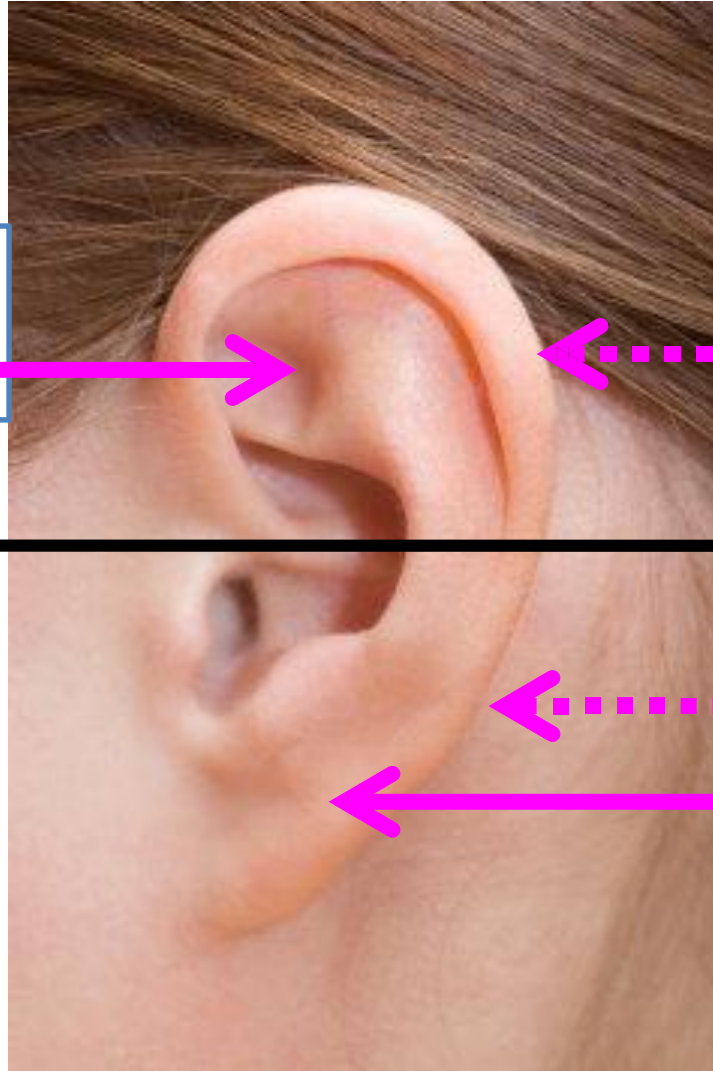
Nerve supply of the auricle

The sensory innervation of the auricle is **complex** and not fully determined. This is perhaps because the external ear represents an area where skin originally derived from a branchial region meets skin originally derived from a posbranchial region.

Auriculotemporal nerve:
upper part of the outer
surface

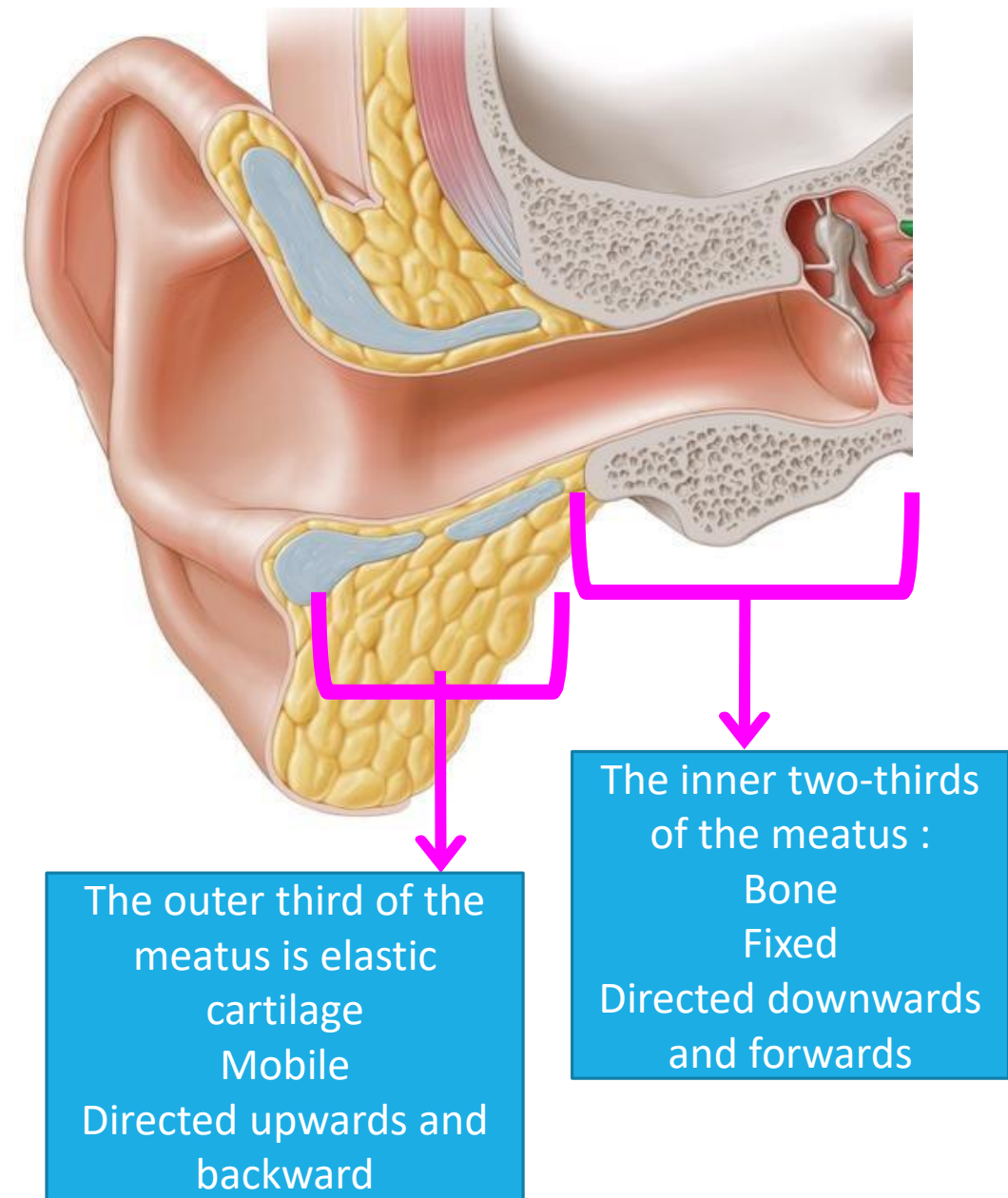
Lesser occipital nerve:
the upper part of the
inner surface

Great auricular nerve:
the lower part of both
inner and outer
surfaces

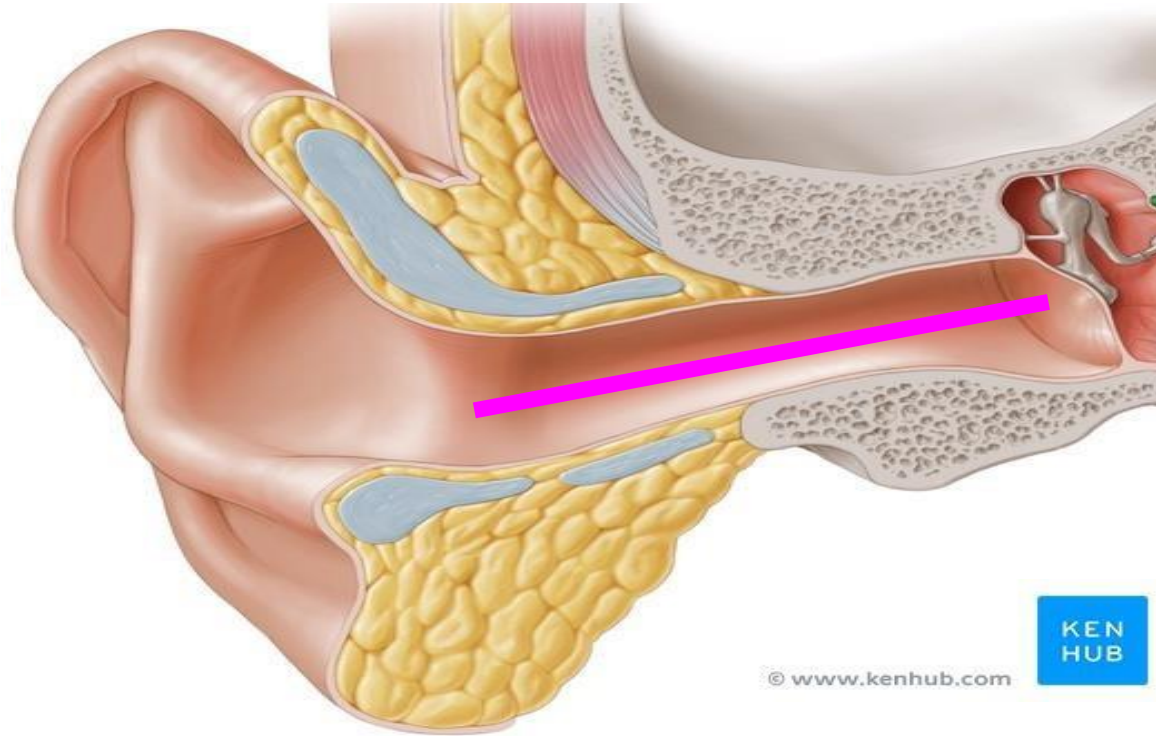


The external auditory meatus

- The meatus is lined by skin
- The outer third is provided with hairs and sebaceous and ceruminous glands
- **Ceruminous glands** are modified sweat glands that secrete (along with the sebaceous glands) a yellowish brown wax (cerumen=earwax)
- The hairs and the wax provide a sticky barrier that prevents the entrance of foreign bodies
- Cerumen is produced in the outer third of the ear canal
- pH is acidic in normal healthy canals and contains a bactericidal enzyme.



In the adult the external meatus is about 1 in. (2.5 cm) long and is narrowest about 0.2 in. (5 mm) from the tympanic membrane



External acoustic meatus



Tympanic membrane - ear drum

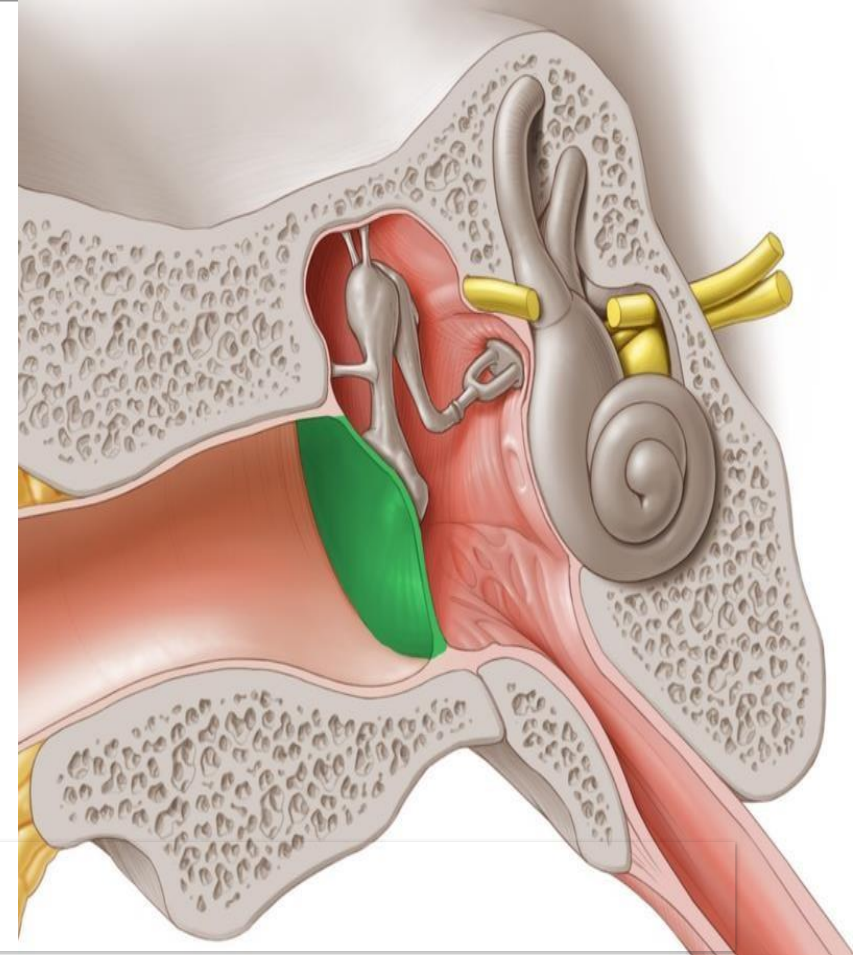
Is a thin, fibrous membrane, obliquely placed, facing downward, forward, and laterally

Is formed of:

- 1-An outer layer; skin
- 2-Middle layer; fibrous tissue
- 3-Inner layer ; mucous membrane

It is concave laterally, The inner surface of tympanic membrane is fixed to handle of Malleus

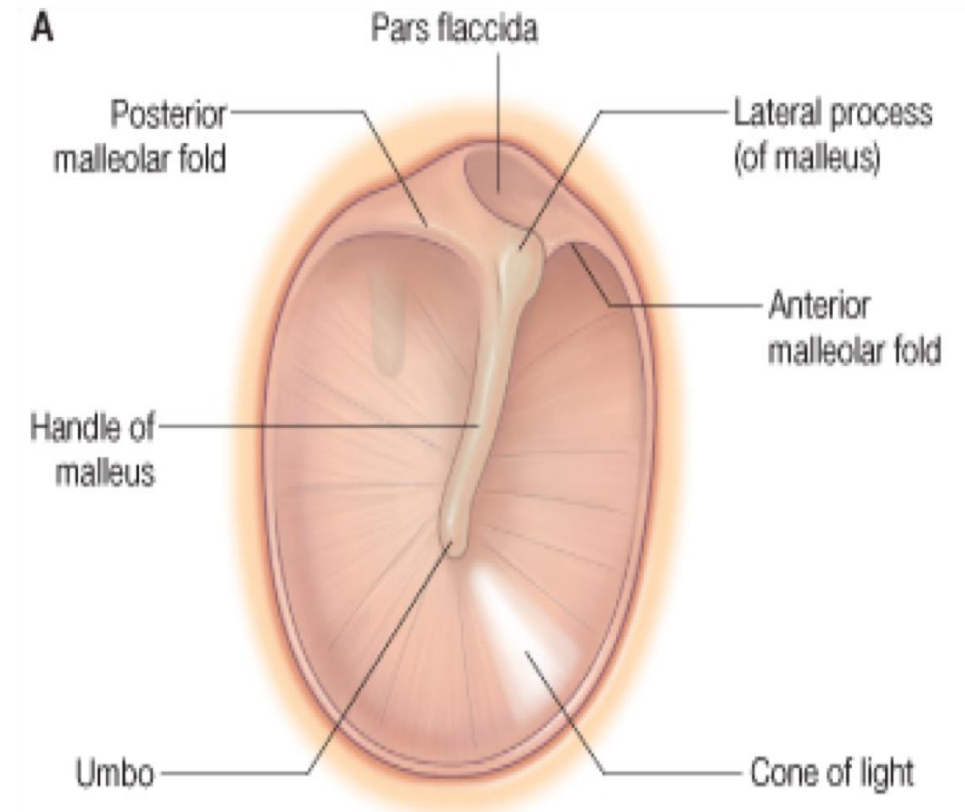
Umbo is a small depression produced by the tip of the handle of the malleus



The middle fibrous layer is present in the major parts of the ear drum which called **pars tensa**.

This layer is absent in the upper part of the ear drum which is called **pars**

The pars tensa and flaccida are separated from each other by two folds called **the anterior and posterior malleolar folds**



Tympanic Membrane Examination

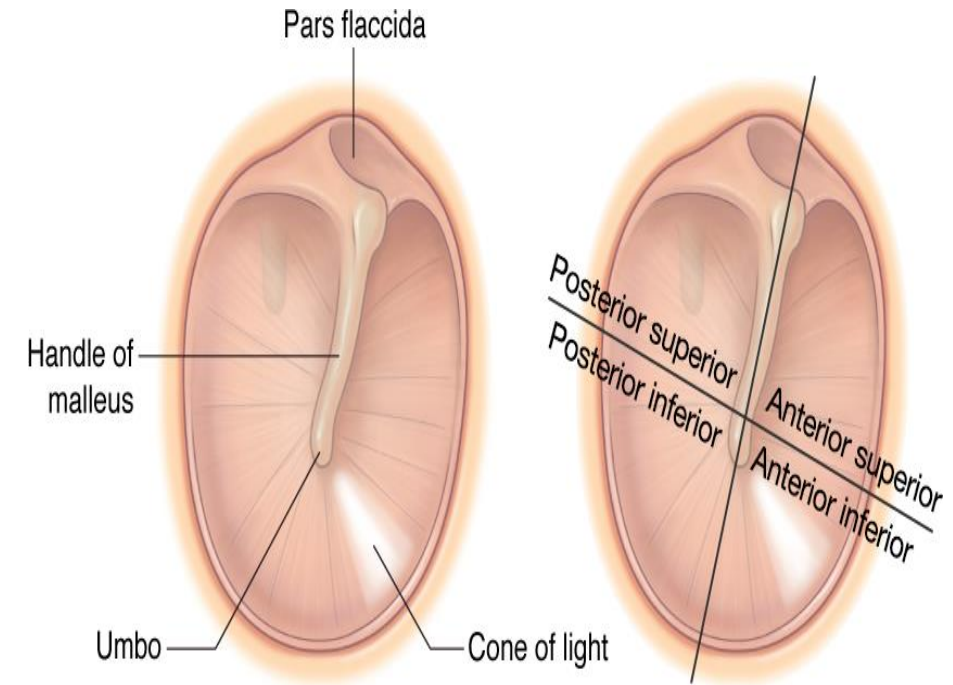
Otoscopic examination of the tympanic membrane is facilitated by first straightening the external auditory meatus by gently pulling the auricle upward and backward in the adult, straight backward or backward and downward in the infant



The translucency of the tympanic membrane allows the structures within the middle ear to be observed during otoscopy

When the membrane is illuminated through an otoscope, the concavity produces a **cone of light**, which radiates anteriorly and inferiorly from the umbo

- ✓ The tympanic membrane is pearly white or light gray, and you can see through it.
- ✓ You can see the tiny bones of the middle ear pushing on the tympanic membrane.





Left tympanic membrane



Right tympanic membrane

The cone of light is at the 5 o'clock position in the right ear
and at the 7 o'clock position in the left ear.

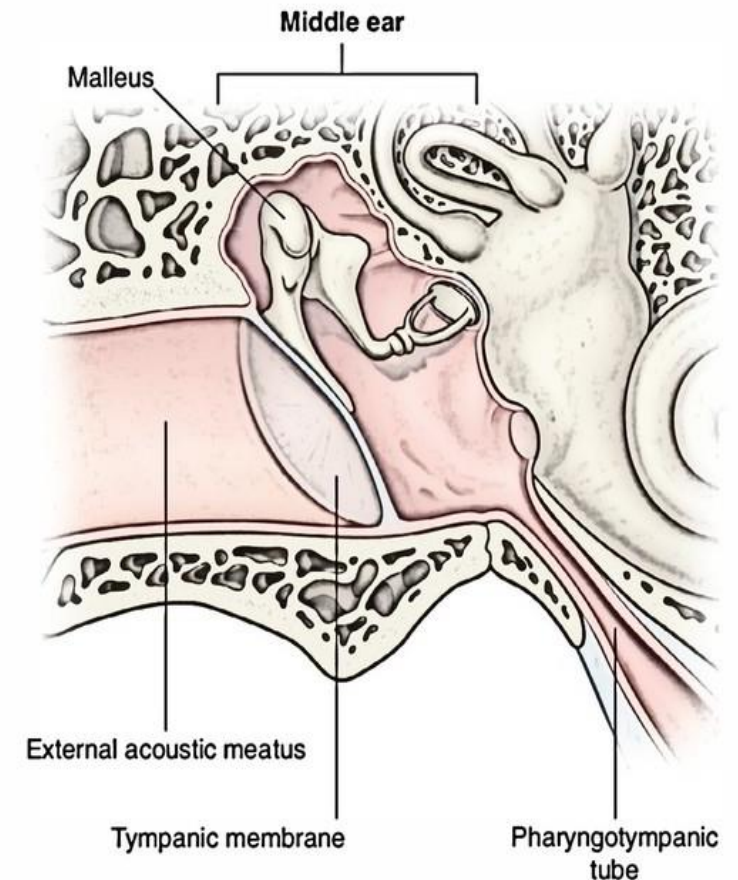
Clinical application

The tympanic membrane is a relatively thin connective tissue structure, and is susceptible to **perforation** (usually by trauma or infection).

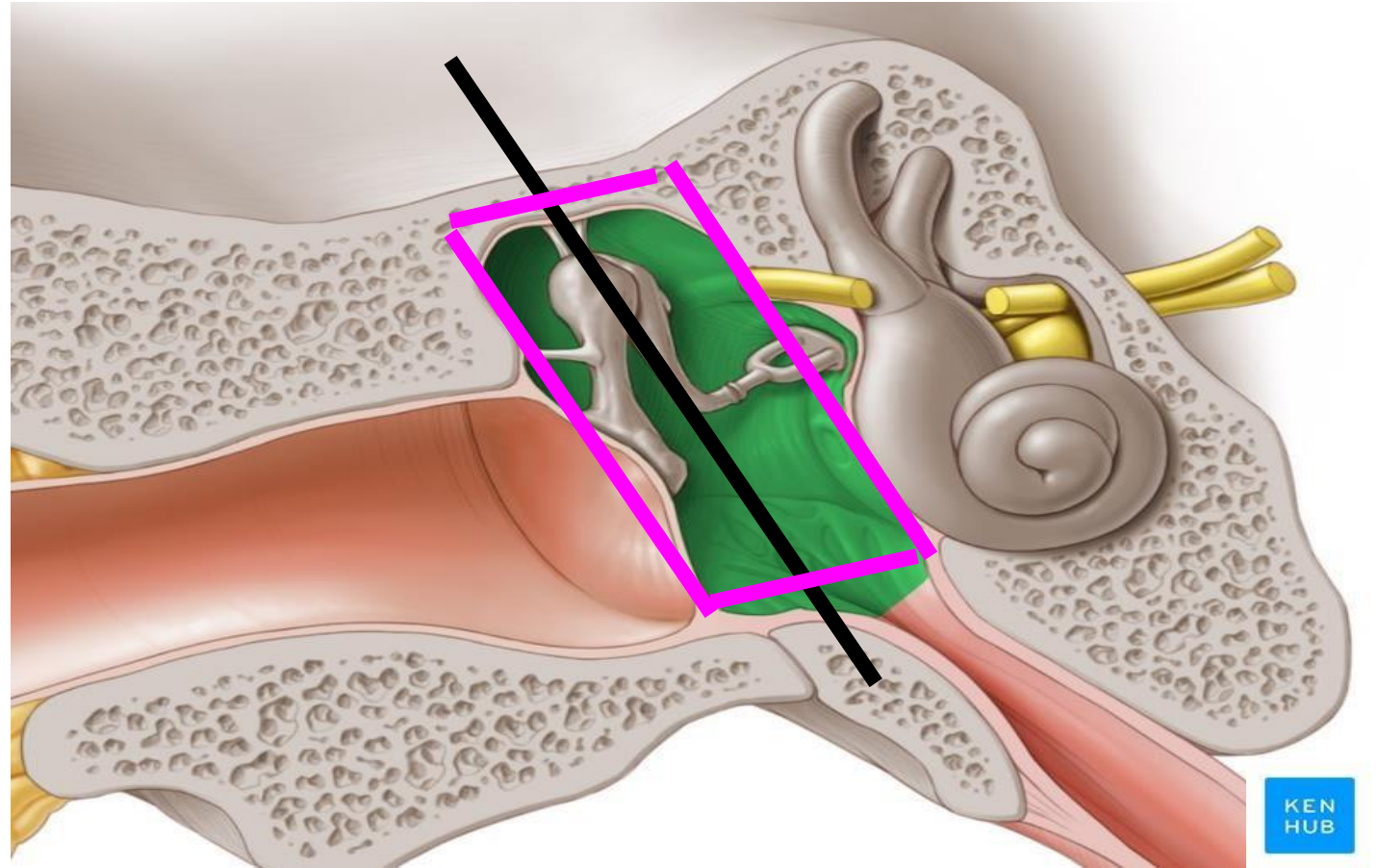
An infection of the middle ear (**otitis media**) causes pus and fluid to build up behind the tympanic membrane. This causes an increase in pressure within the middle ear, and eventually the eardrum can rupture.

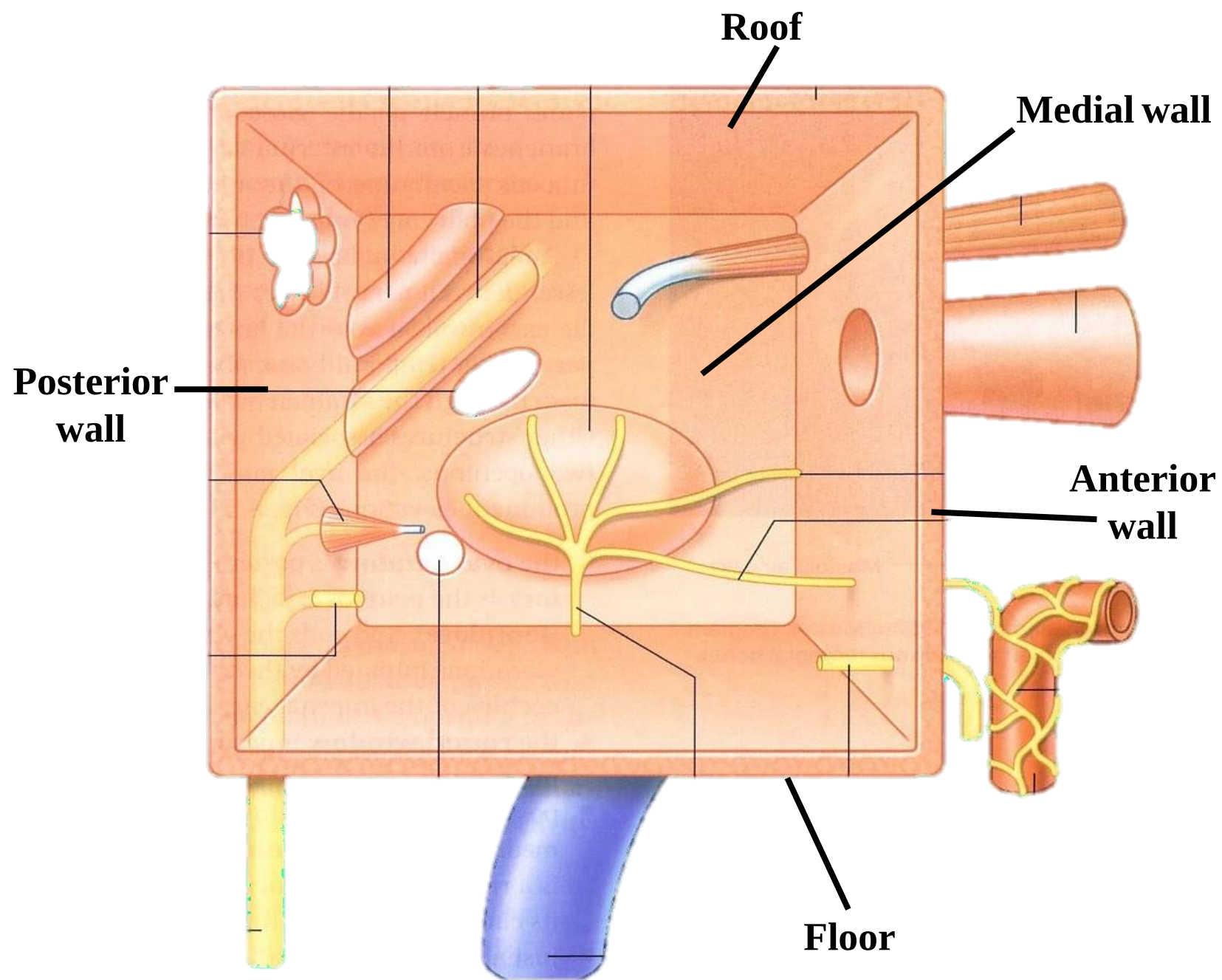
MIDDLE EAR (Tympanic Cavity)

- Is an air-containing cavity in the petrous part of the temporal bone, lined with mucous membrane
- It contains the auditory ossicles, which transmit vibrations of the tympanic membrane to the inner ear
- The middle ear has:
 - ROOF
 - FLOOR
 - ANTERIOR WALL
 - POSTERIOR WALL
 - LATERAL WALL
 - MEDIAL WALL



Tympanic cavity (middle ear) is a narrow, oblique, slitlike cavity whose long axis lies approximately parallel to the plane of the tympanic membrane





Walls of middle ear

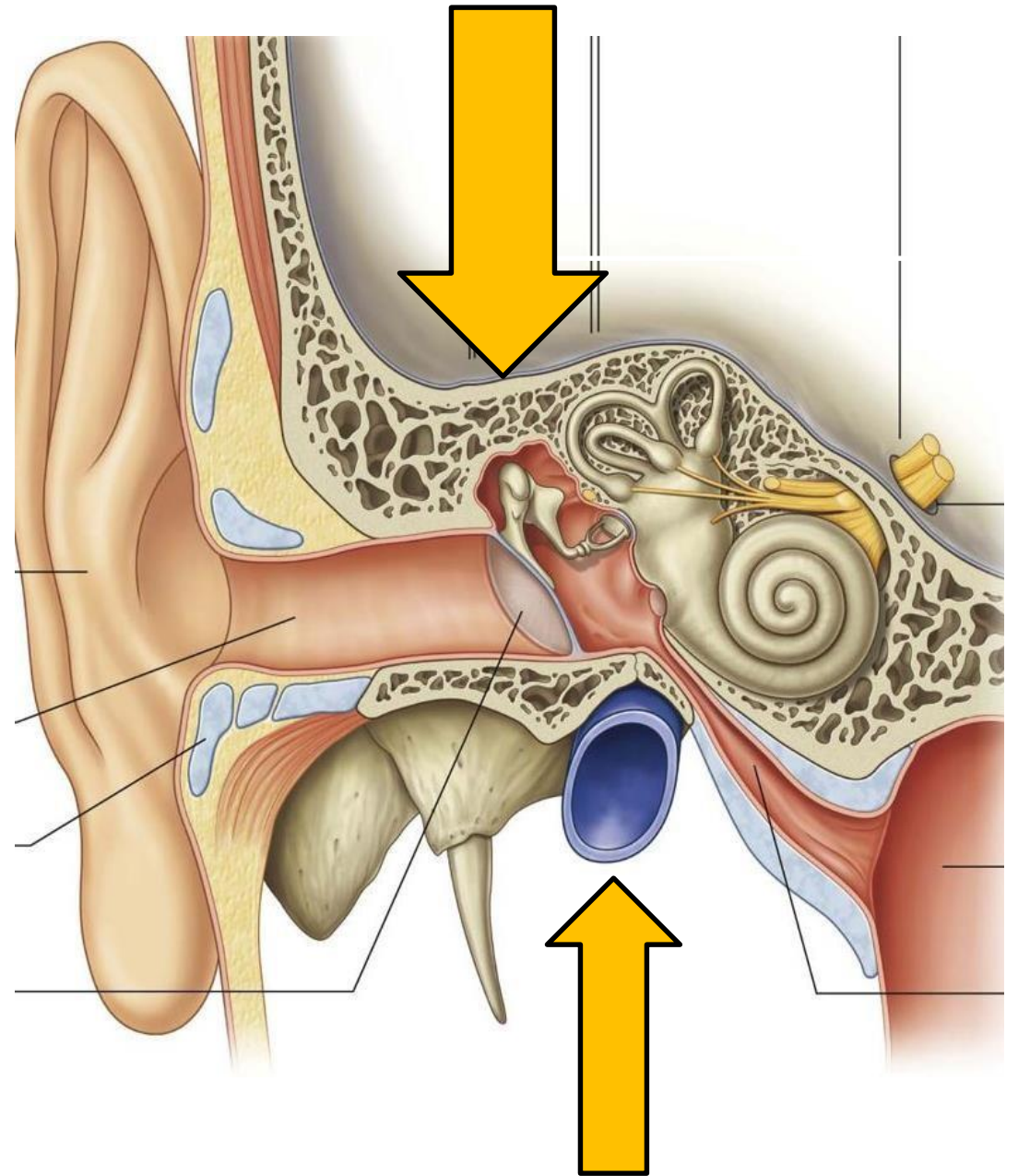
ROOF: TEGMENTAL WALL

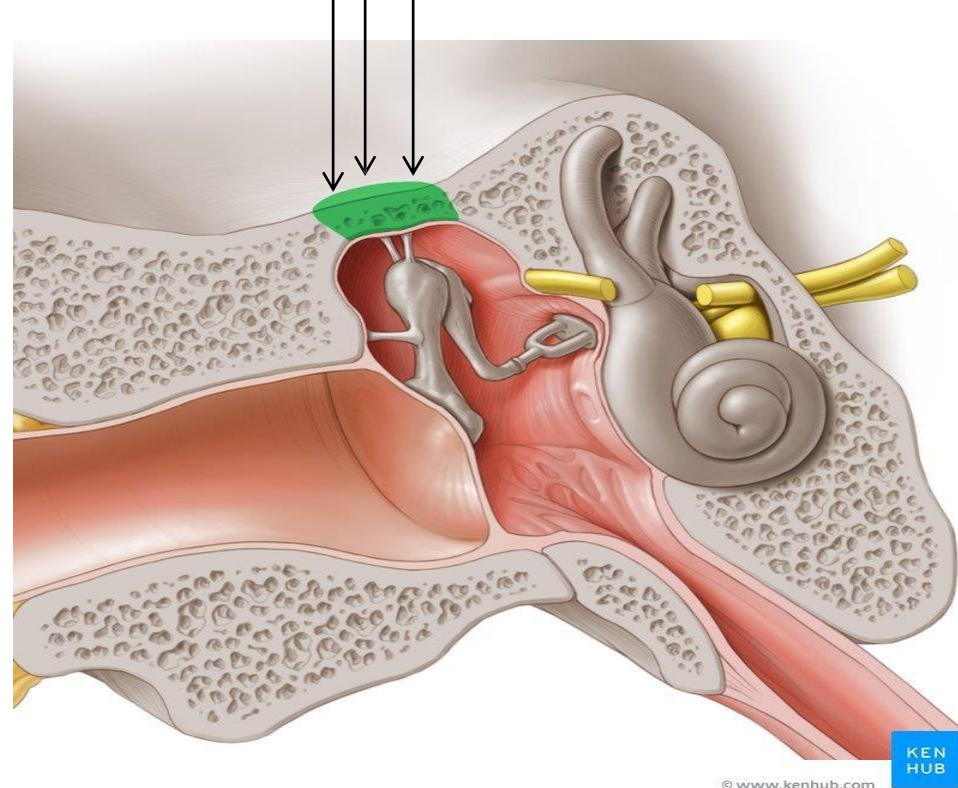
Is formed by **tegmen tympani**
(part of the petrous temporal bone)

It separates the tympanic cavity from the **meninges and the temporal lobe** of the brain in the middle cranial fossa.

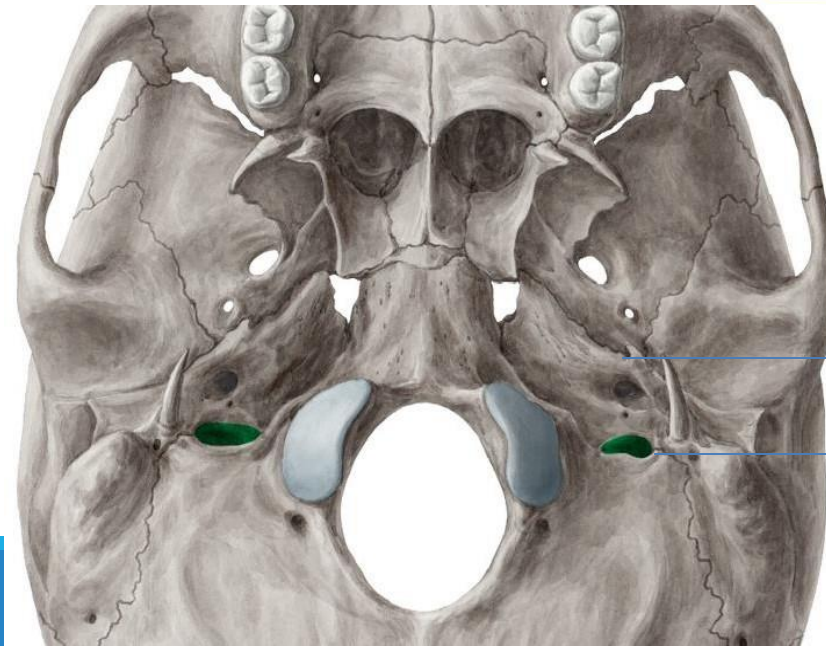
FLOOR: JUGULAR WALL

It separates the tympanic cavity from the **internal jugular vein**





Tegmen tympani

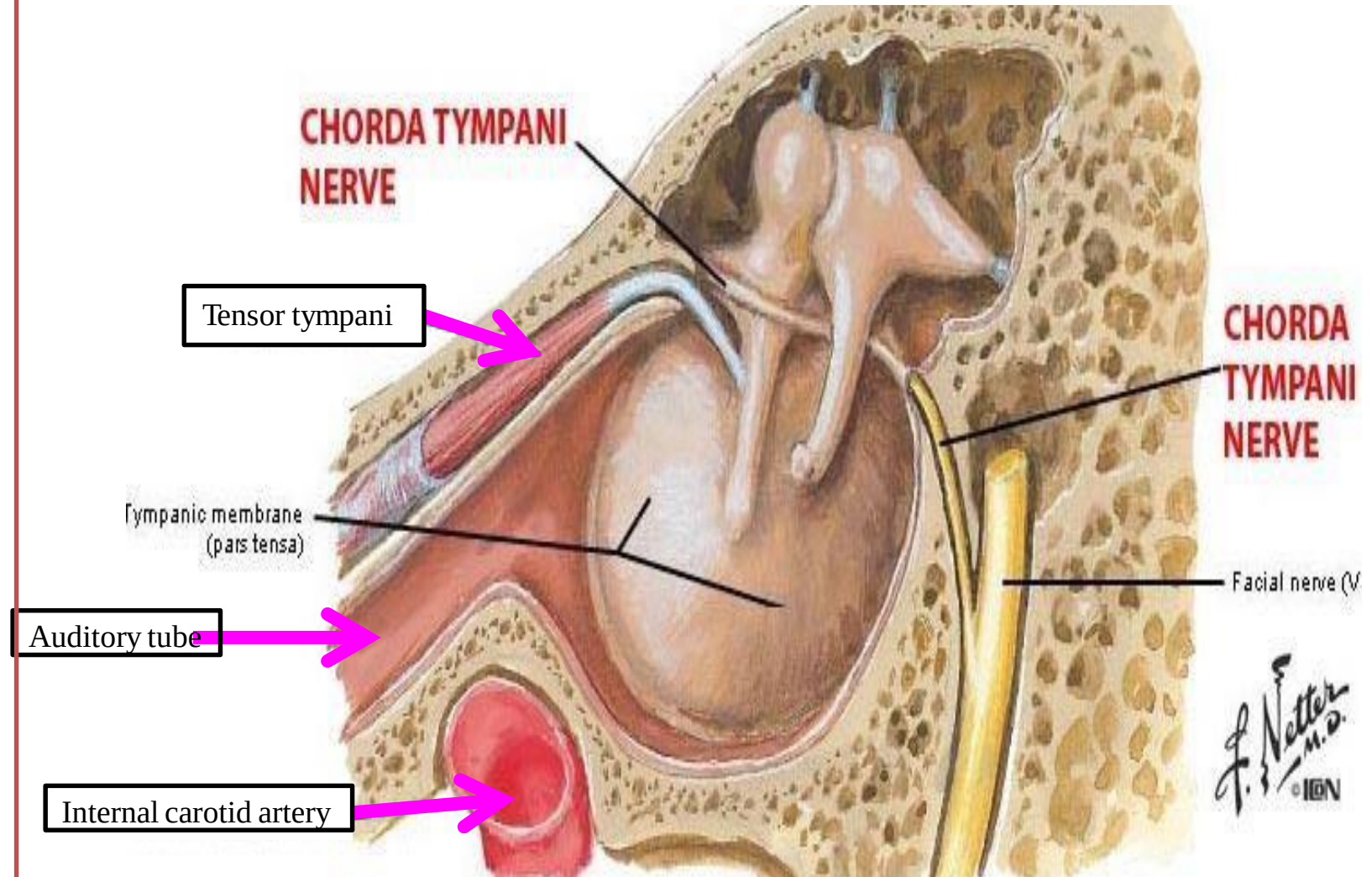


Petrous bone

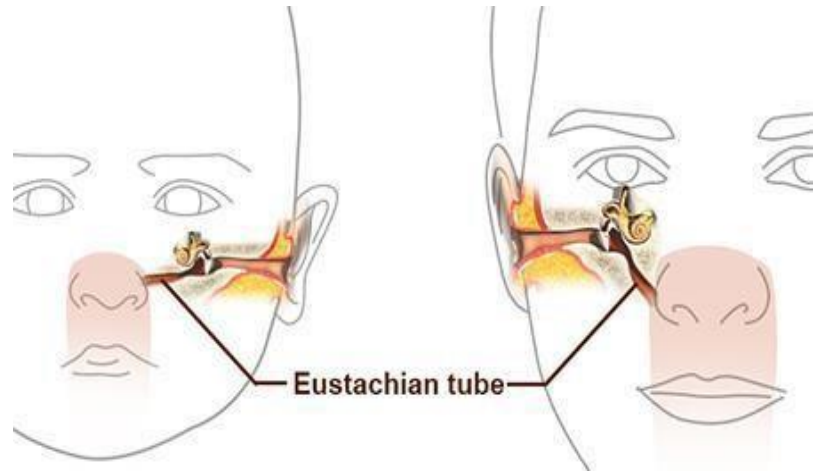
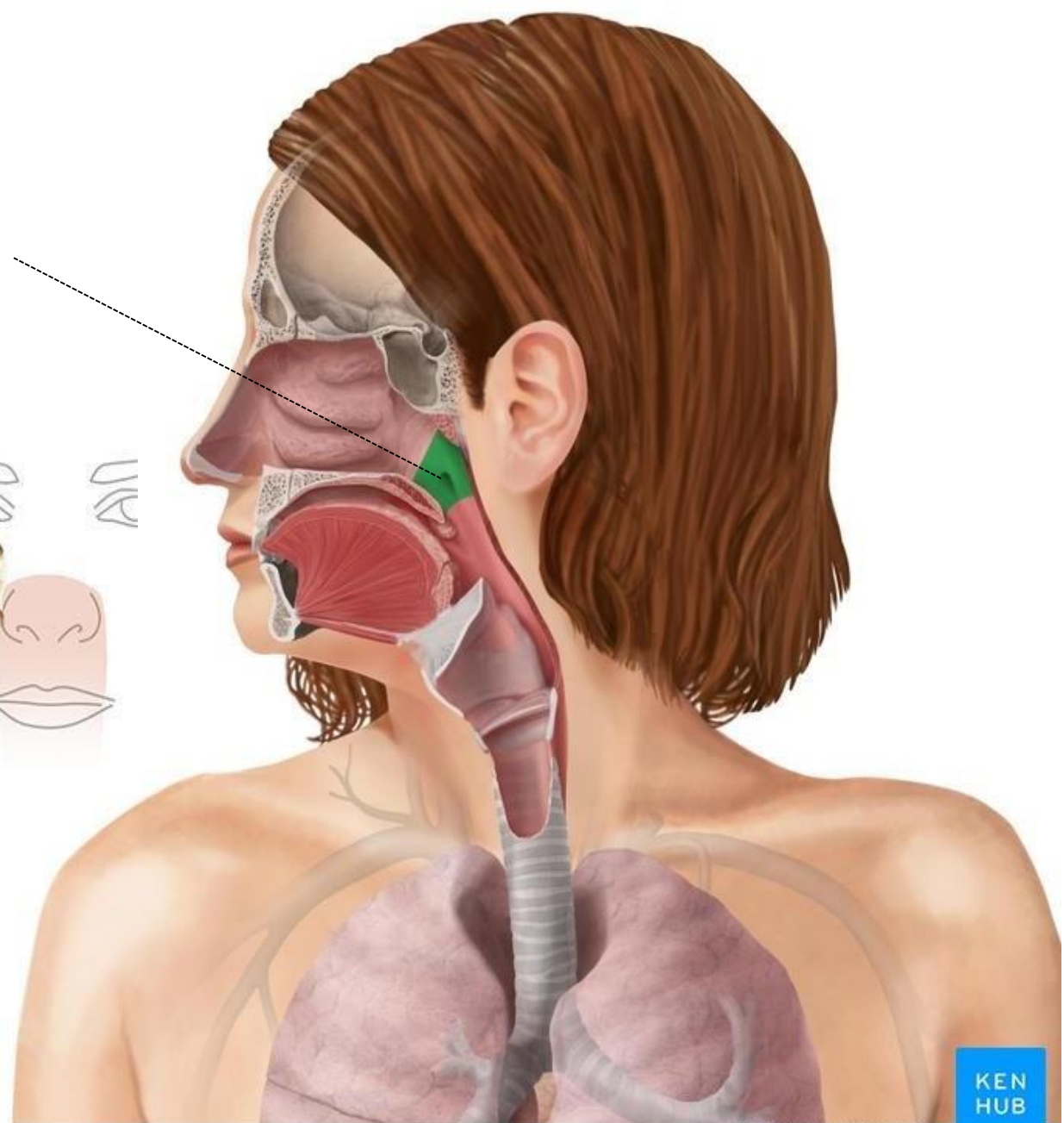
Jugular
foramen

THE ANTERIOR WALL: CAROTID WALL

- Is formed below by a thin plate of bone that separates the tympanic cavity from the **internal carotid artery**
- At the upper part of the anterior wall are the openings into two canals. The lower and larger leads into **the auditory tube**
- The upper and smaller is the entrance into **the canal for the tensor tympani muscle**

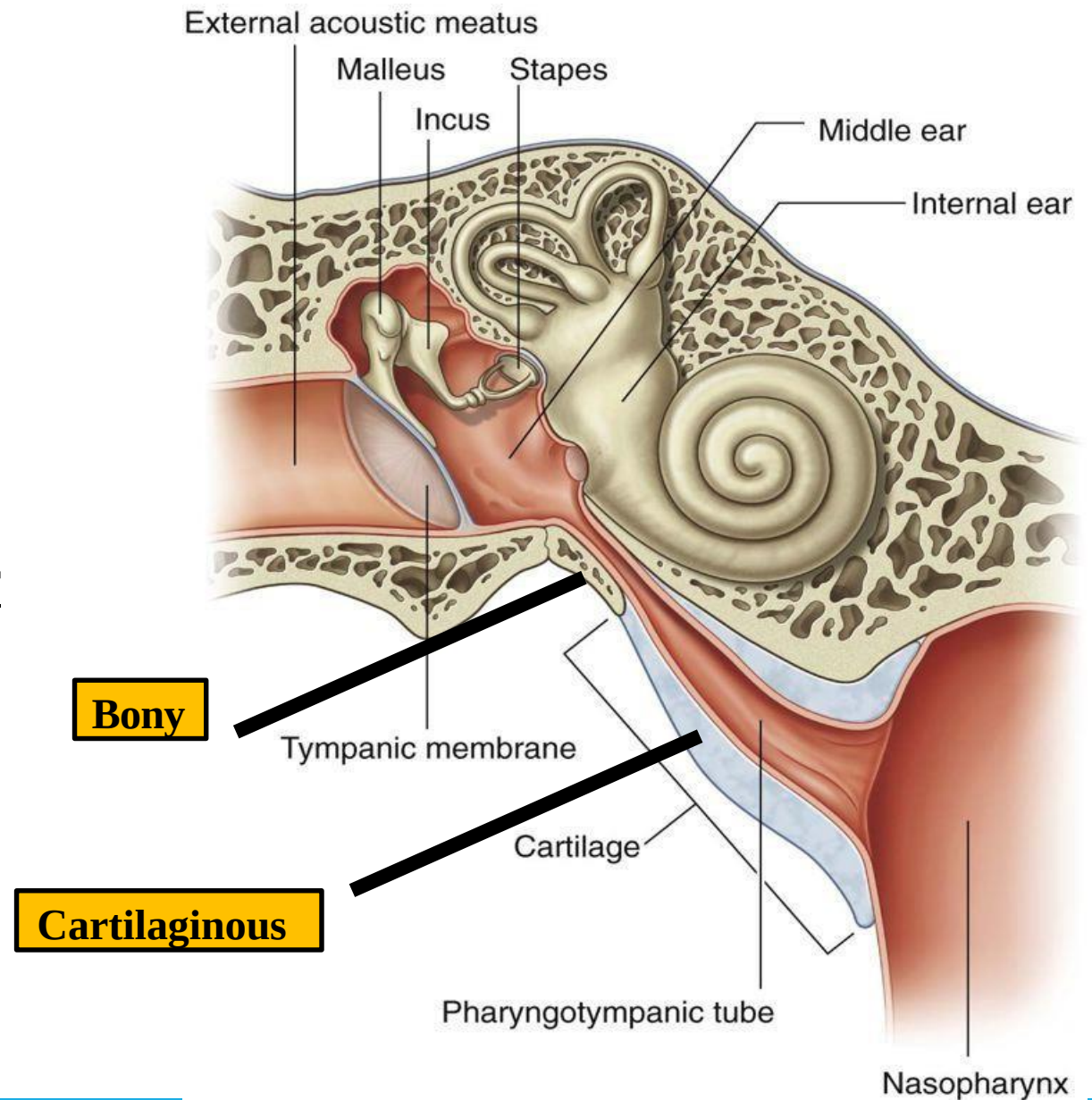


Opening of Eustachian tube into nasopharynx



EUSTACHIAN TUBE

- It connects the anterior wall of **the tympanic cavity** to the **nasopharynx**
- It serves to equalize air pressures in the tympanic cavity and the nasopharynx
- Its posterior inner third is **bony** Its anterior two thirds are **cartilaginous**
- Normally, the eustachian tube is collapsed but it opens with swallowing
- Pharyngo-tympanic tube
Auditory tube
Eustachian tube



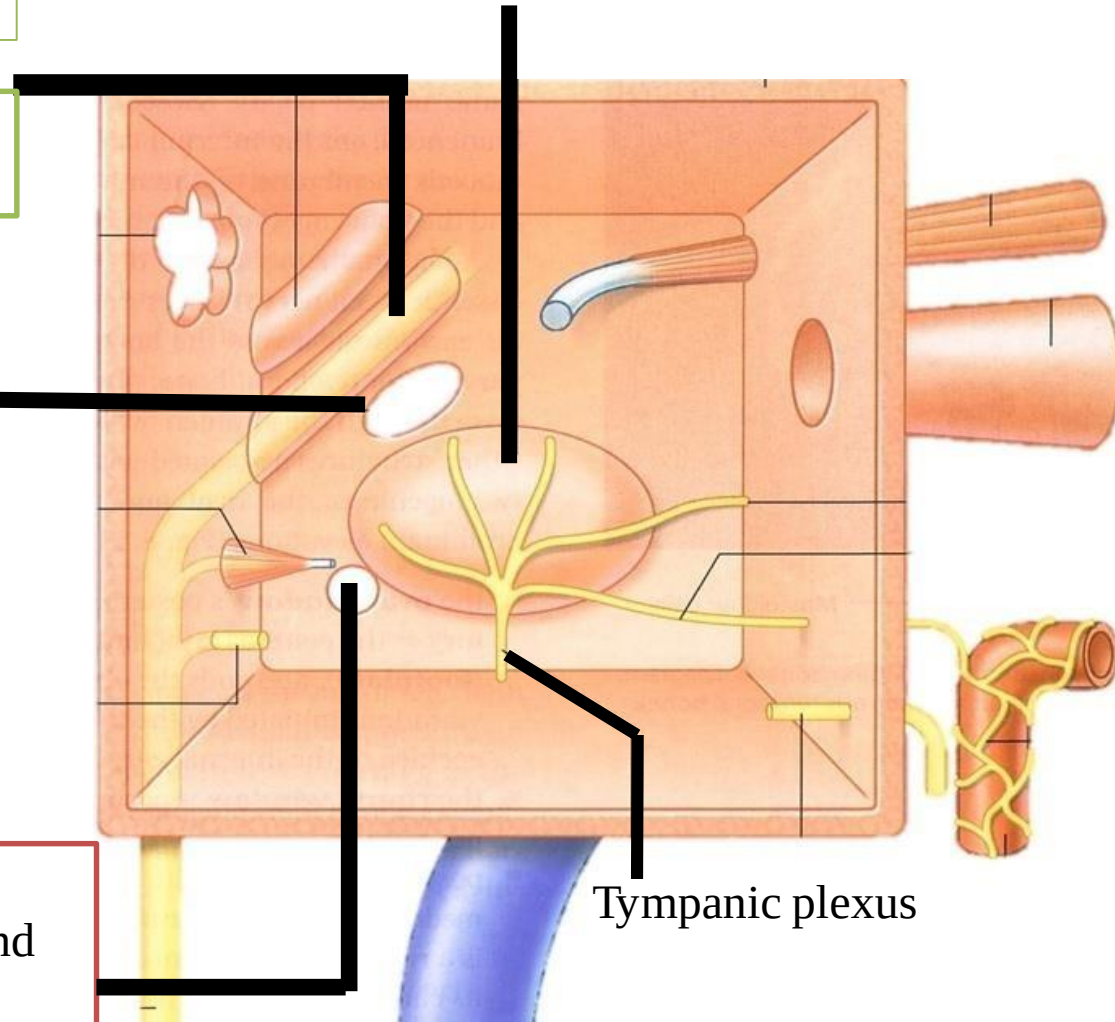
THE MEDIAL WALL: LABYRINTH WALL

The horizontal part of the facial nerve
arching above the promontory

Oval window:
Above and behind the promontory, oval
shaped and closed by the base of the stapes
(**Fenestra vestibuli**)

Round window:
Below the posterior end of the promontory, round and
closed by the secondary tympanic membrane
(**Fenestra cochleae**)

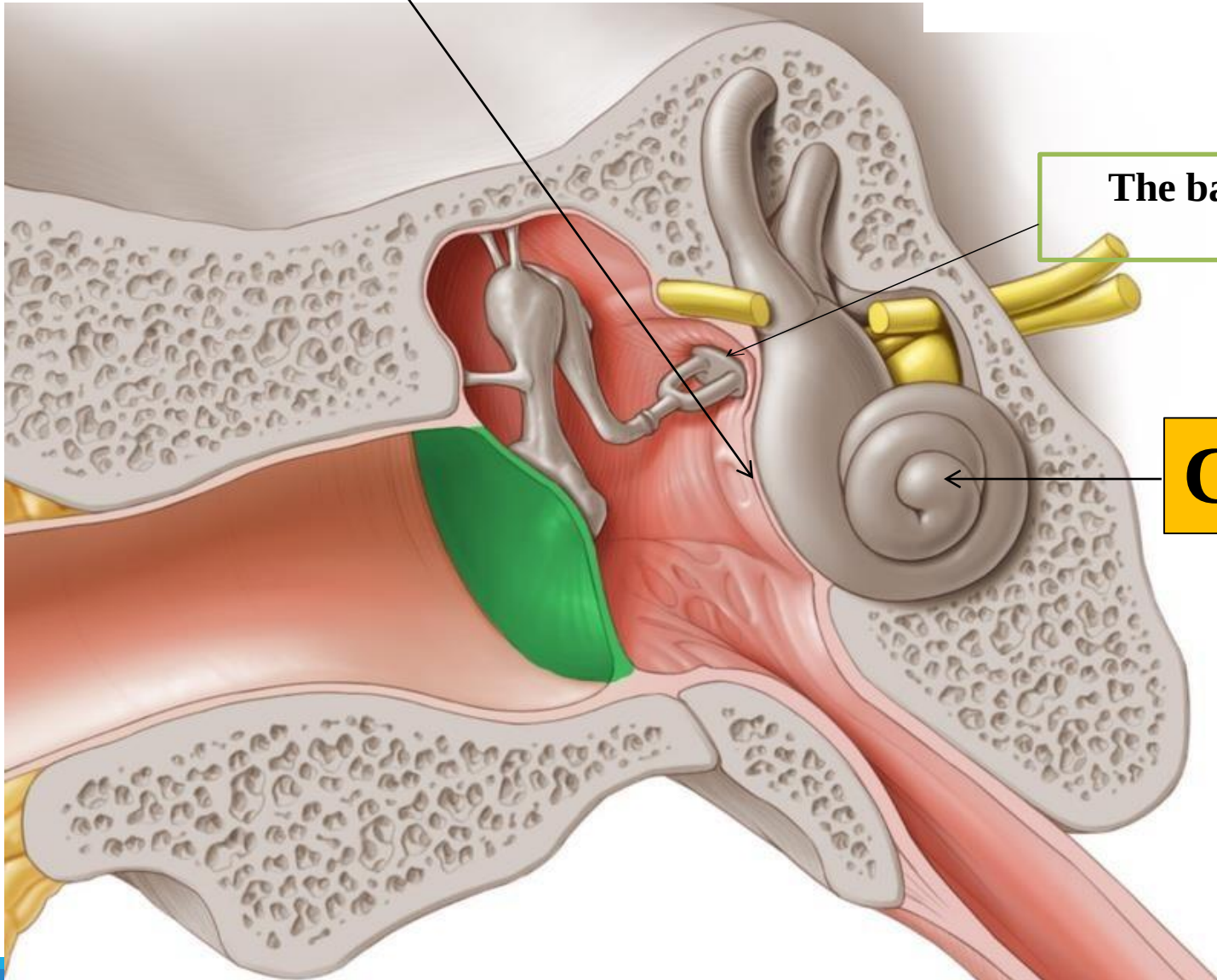
Promontory is a rounded projection (results from the
underlying first turn of the cochlea)

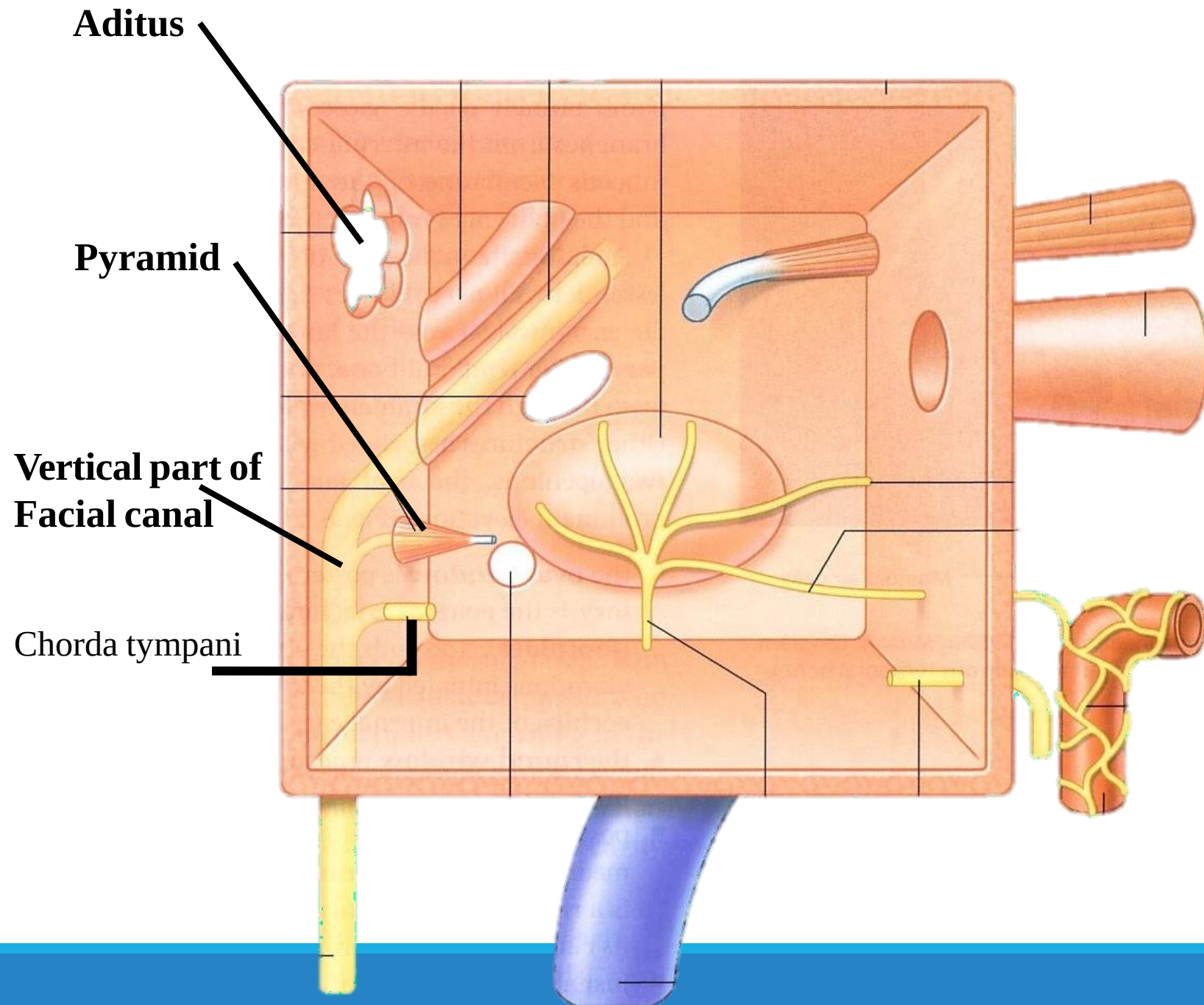


Promontory

The base of stapes closes the oval window of the internal ear

Cochlea



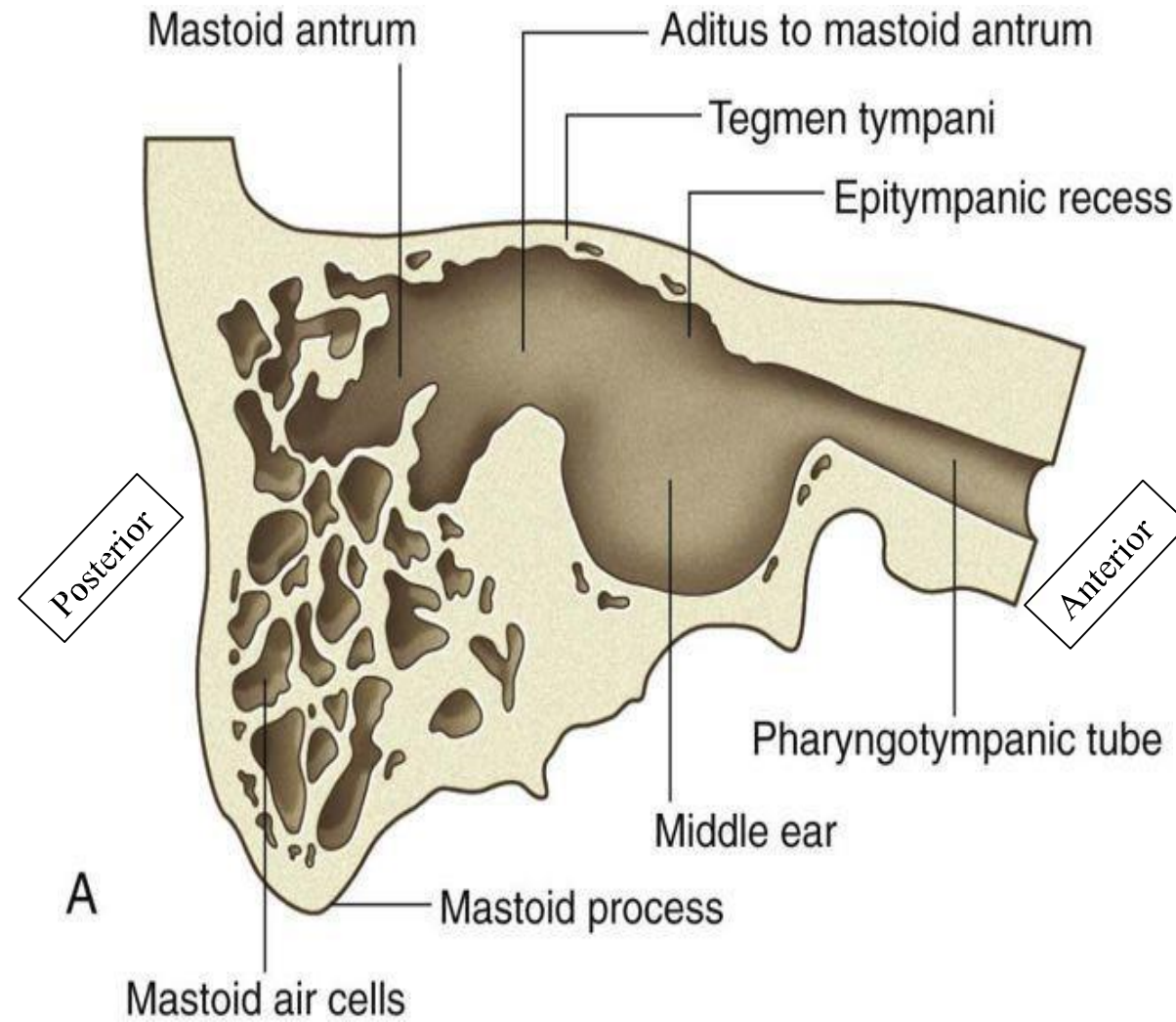


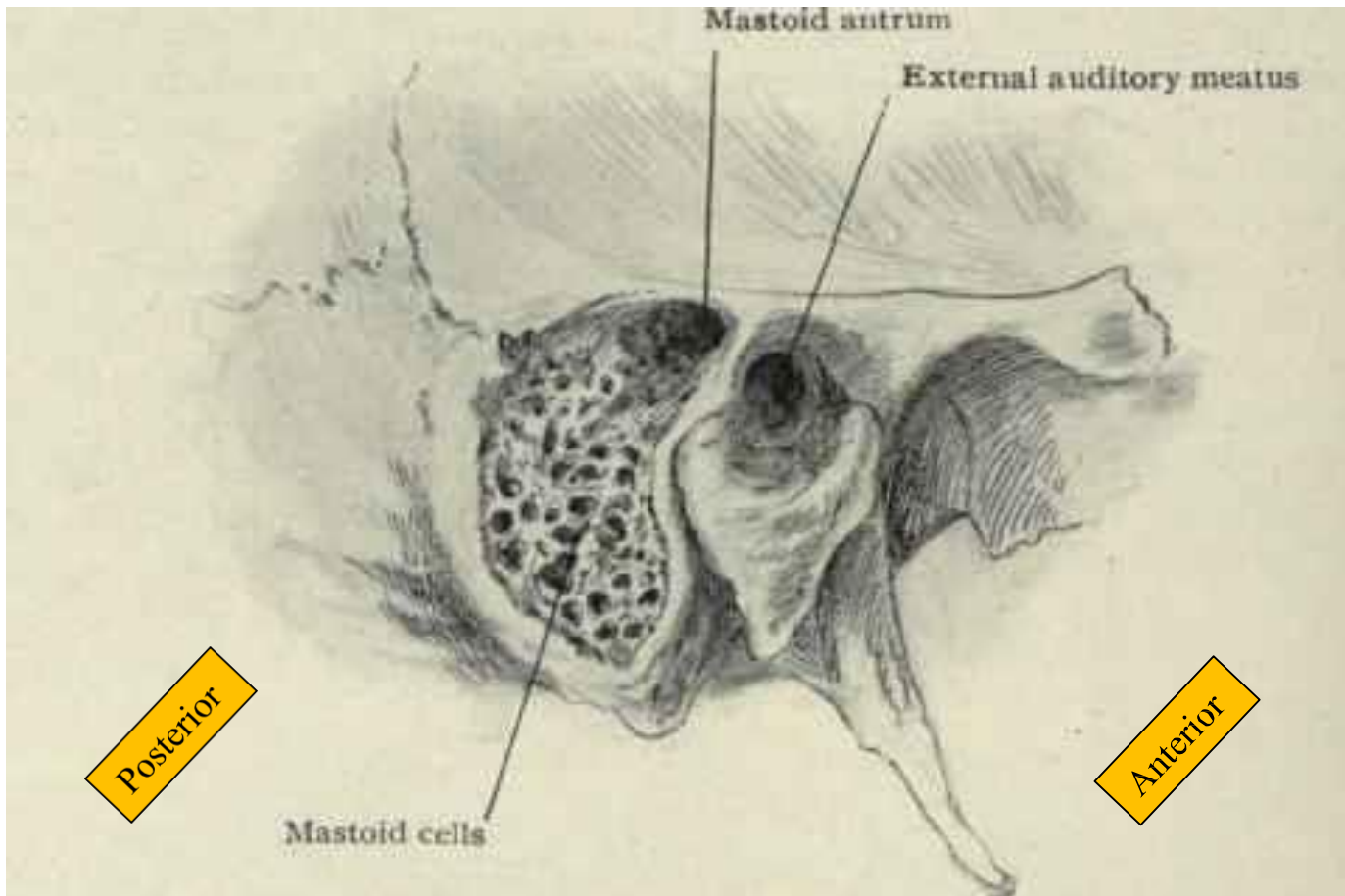
THE POSTERIOR WALL: MASTOID WALL

Has in its upper part a large, irregular opening, the **aditus** to the mastoid

Below, a small conical projection, the **pyramid**, from its apex emerges the tendon of the stapedius muscle

The **vertical part of the facial nerve**





Mastoid Antrum

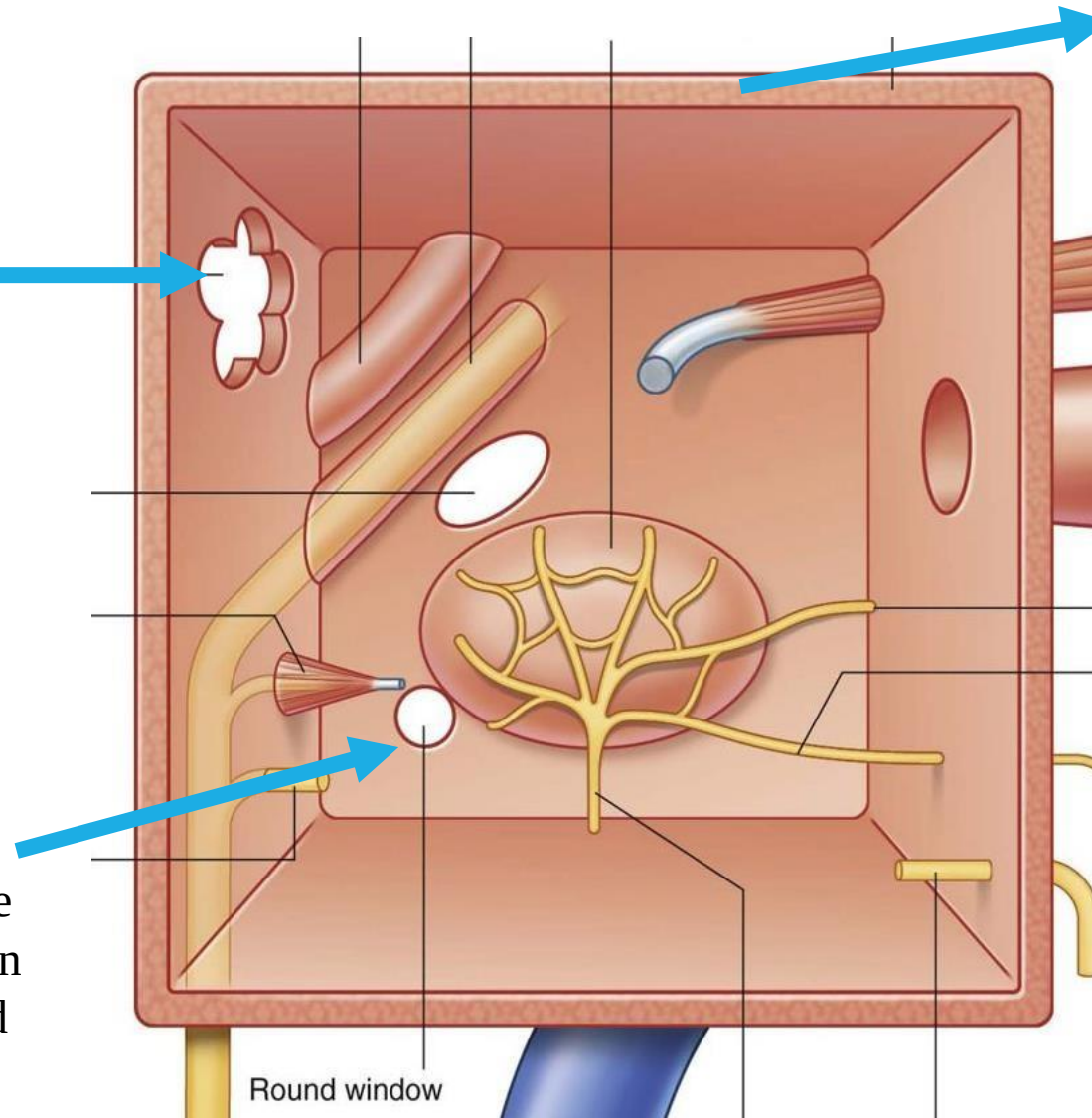
The mastoid antrum lies behind the middle ear in the petrous part of the temporal bone. It communicates with the middle ear by the aditus.

Infections and Otitis Media

The posterior wall of the mastoid antrum is related to **the sigmoid venous sinus**.

If the infection spreads in this direction, a thrombosis in the **sigmoid sinus** may take place

Medial wall: A spread of the infection in this direction can cause a facial nerve palsy and labyrinthitis with vertigo



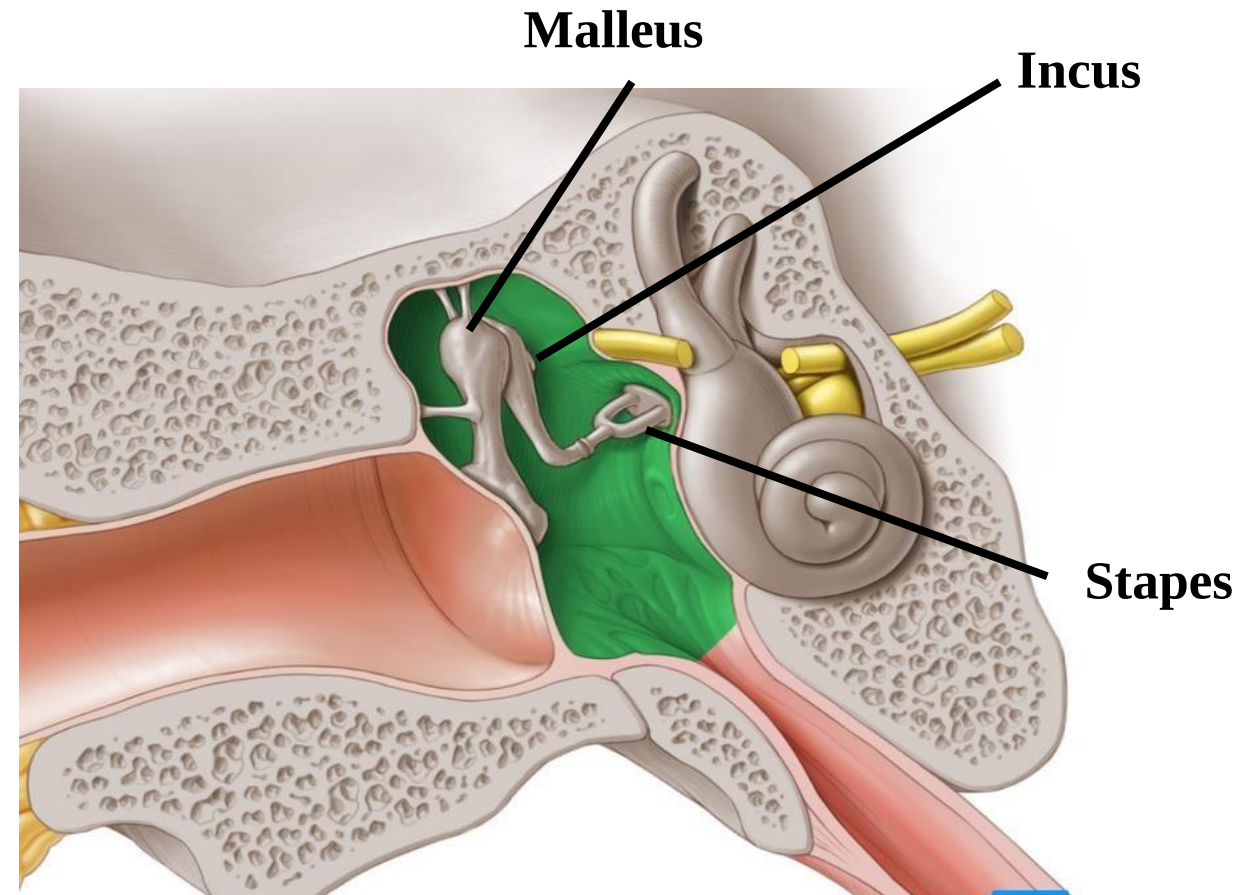
The meninges and the temporal lobe of the brain lie superiorly
(Meningitis and cerebral abscess in the temporal lobe)

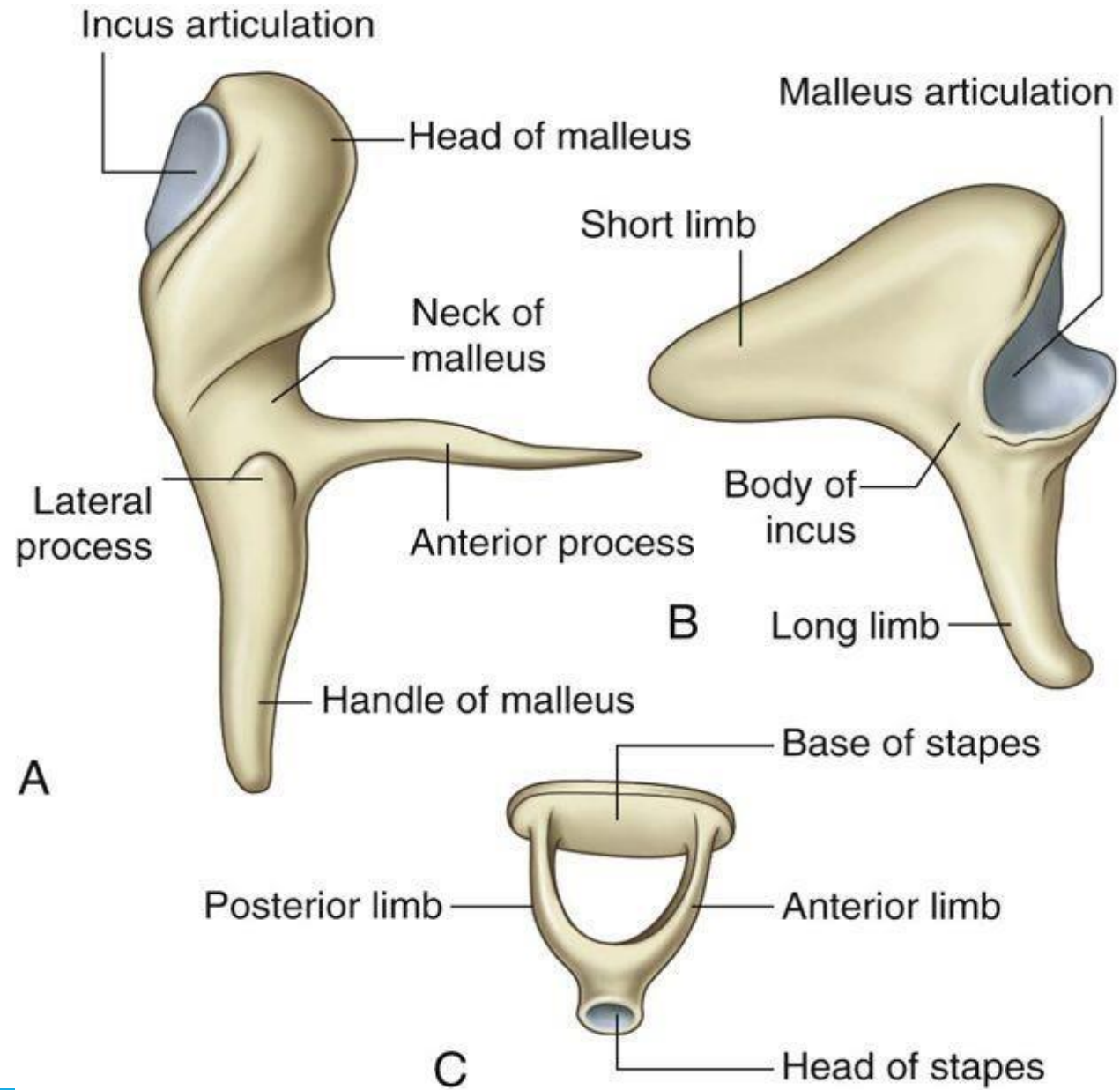
Through the auditory tube from nasopharynx.
(nasopharyngitis)

CONTENTS OF THE MIDDLE EAR

- A- 3 Auditory Ossicles
- B- 2 muscles
- C- 2 nerves (tympanic plexus and chorda tympani)
- D- Air

It contains the auditory ossicles, whose function is to transmit the vibrations of the tympanic membrane to the perilymph of the internal ear



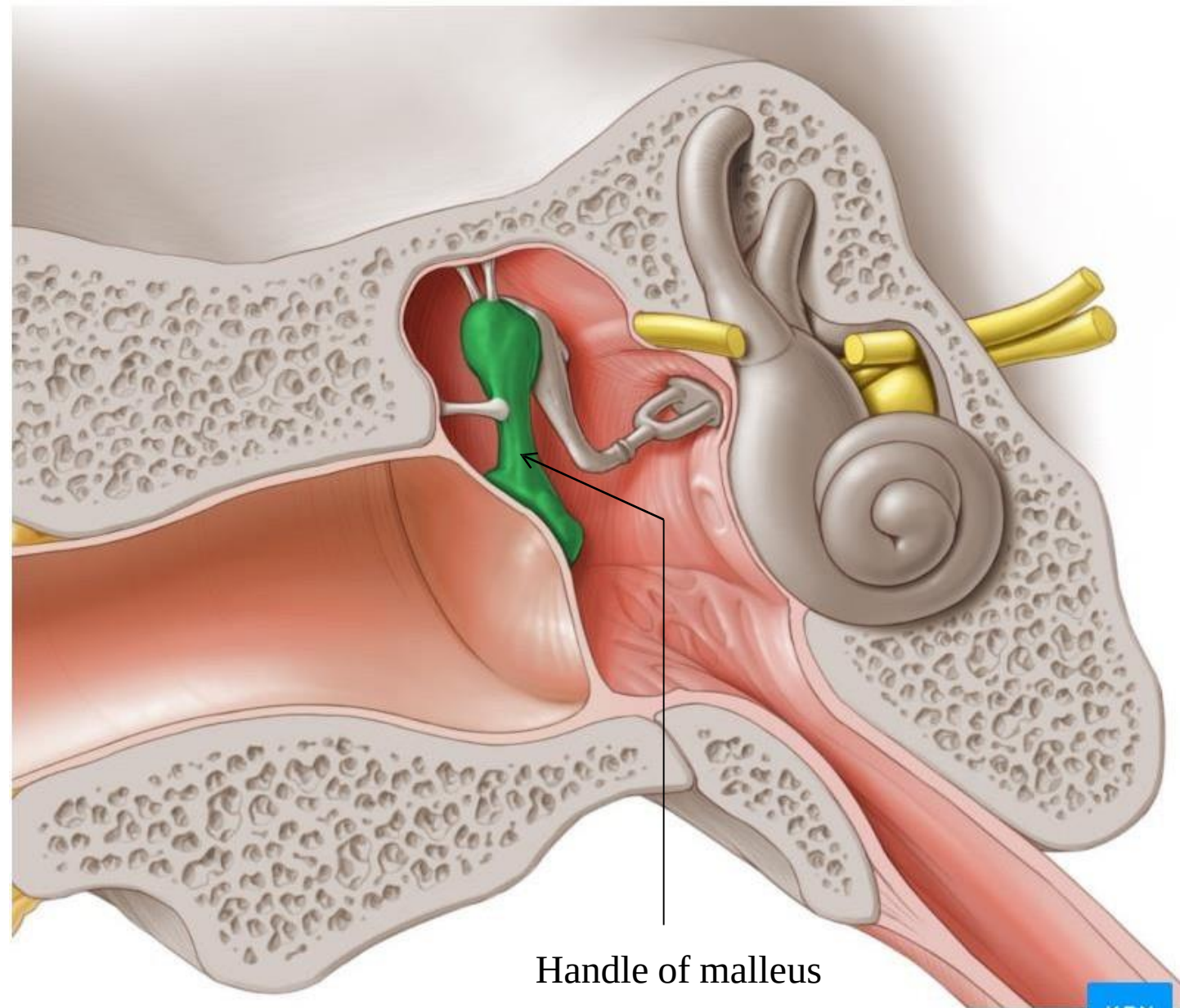


Ossicles

- The **malleus** is the largest ossicle and possesses head, a neck, a long process or handle, an anterior process, and a lateral process. its head is rounded and articulates posteriorly with the **incus**.
- **The incus** possesses large body and two processes:
The body articulates with the head of the malleus and long process articulates with the head of the stapes.
- **The stapes** has a head, a neck, two limbs, and a base, **the head** articulates with the long process of **the incus**. The neck is narrow and receives the insertion of the **stapedius** muscle. The two limbs diverge from the neck and are attached to **the oval base** which closes **the oval window** of the internal ear

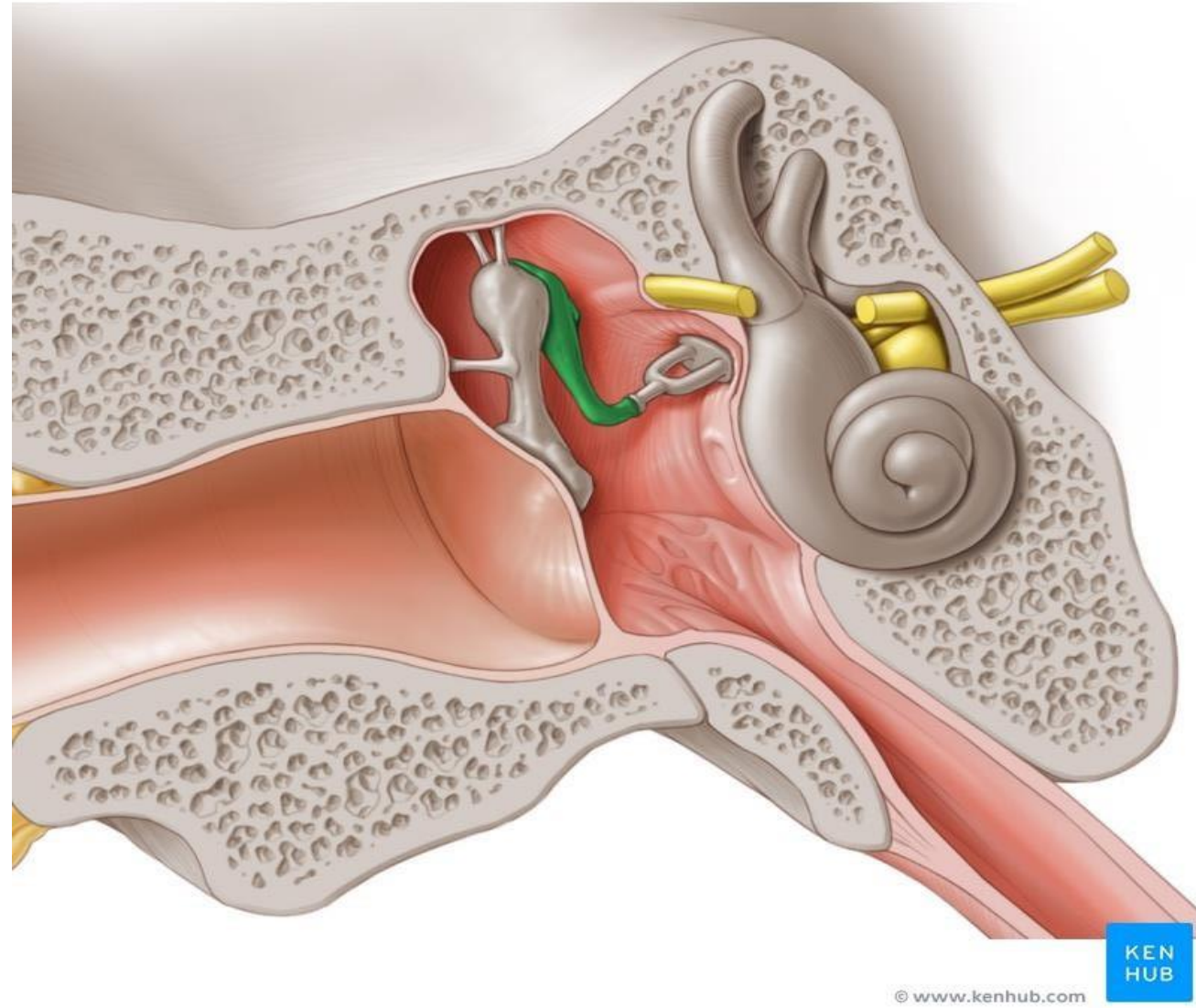
Malleus

The handle is firmly attached to the medial surface of the tympanic membrane



Handle of malleus

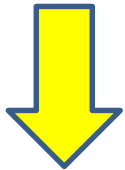
Incus



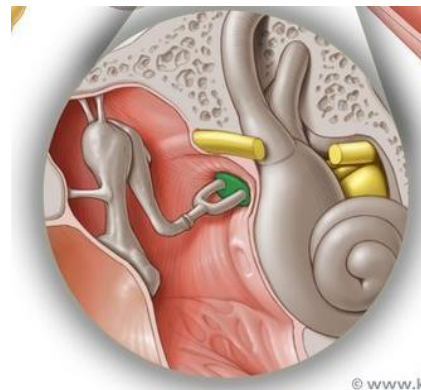
Stapes

The **base of stapes** closes the **oval window** of the internal ear

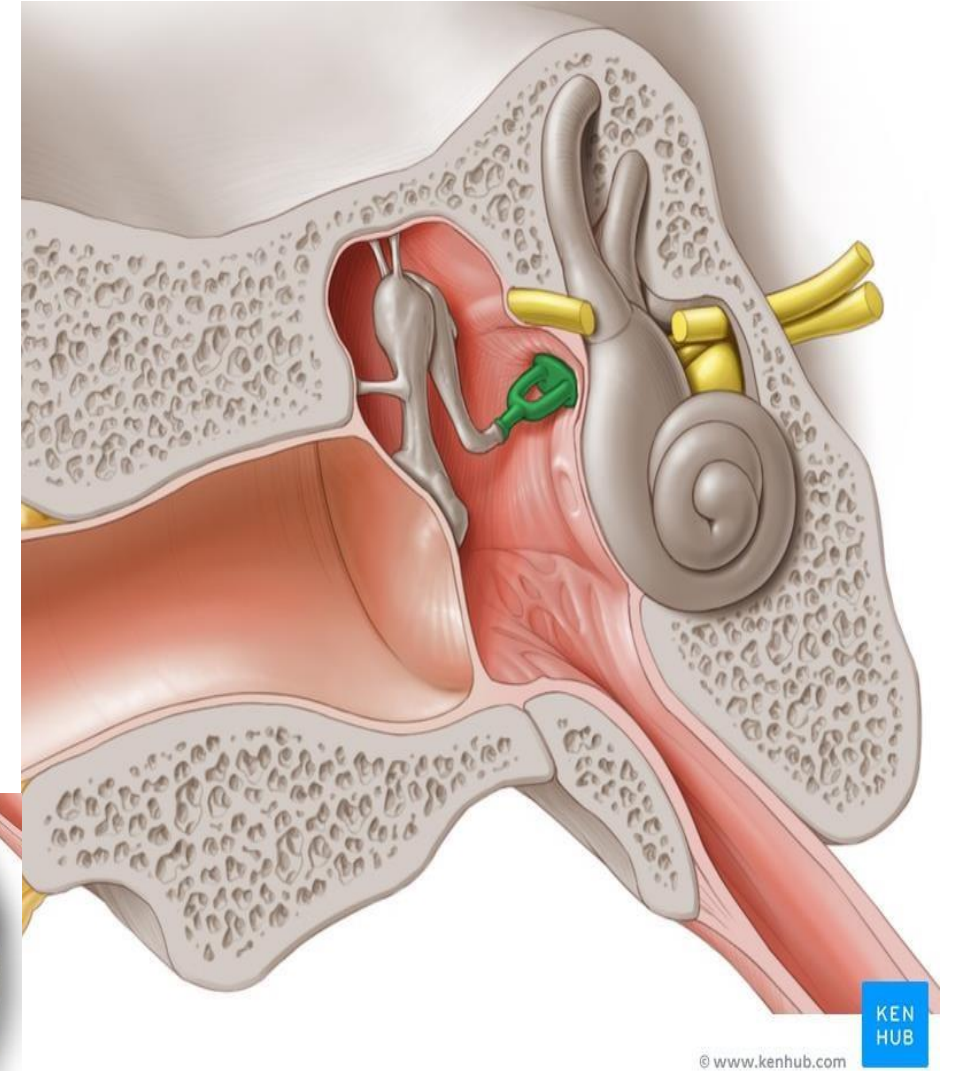
The **Annular stapedial ligament** is a ring of fibrous tissue that connects the base of the stapes to the oval window of the inner ear



Calcification and hardening of the annular ligament of the stapes (Otosclerosis) is a common cause of adult deafness



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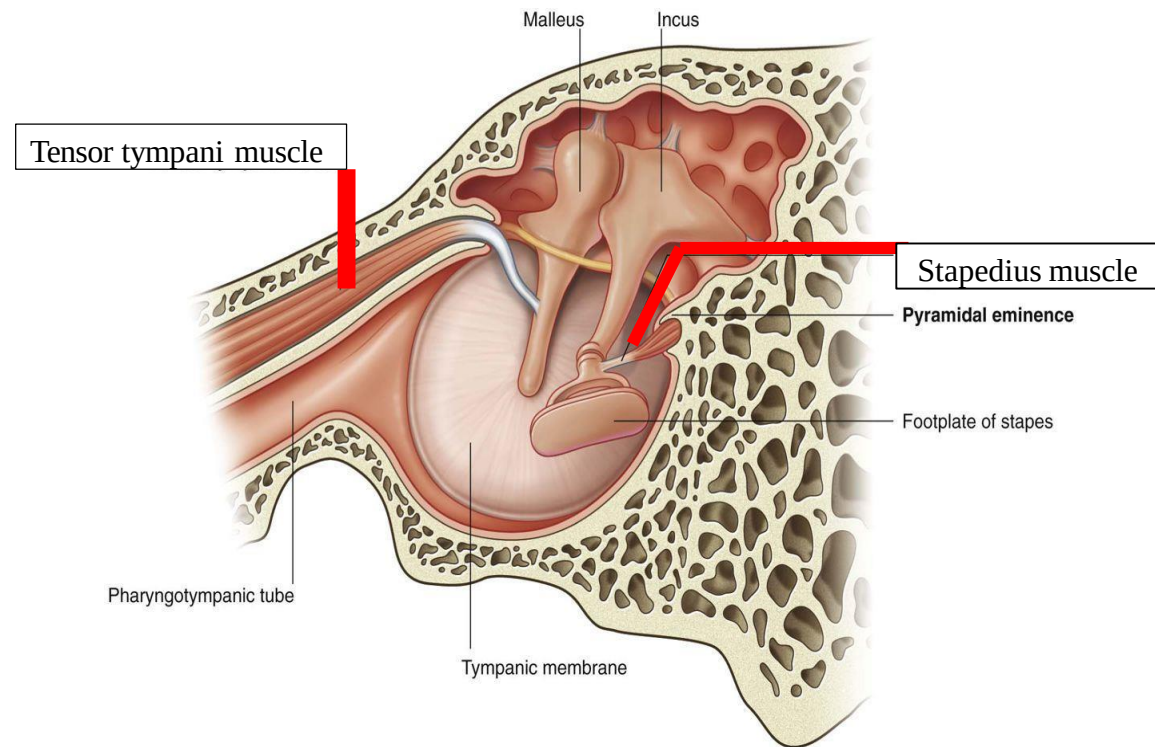


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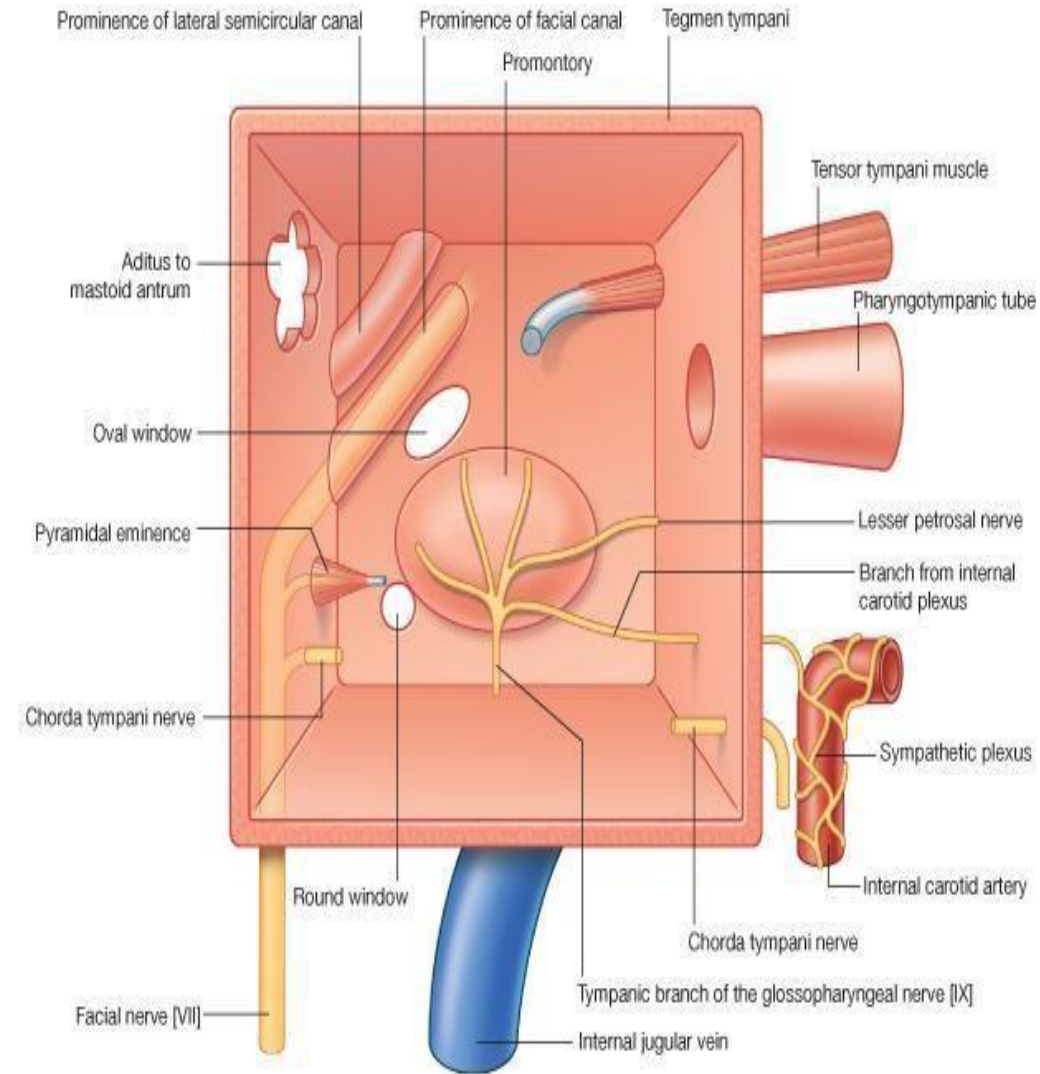
Muscles of the middle ear

Muscle	Nerve supply	Action
Tensor tympani	Mandibular division of trigeminal nerve	Dampens down vibrations of tympanic membrane
Stapedius	Facial nerve	Dampens down vibrations of stapes



THE CHORDA TYMPANI

- It arises from the facial nerve just above the stylomastoid foramen.
- It enters the middle ear close to the posterior border of the tympanic membrane.
- It then runs forward over the tympanic membrane and crosses the root of the handle of the malleus.
- It leaves the middle ear through the petrotympanic fissure and enters the infratemporal fossa, where it joins the **lingual nerve**.



The chorda tympani contains:

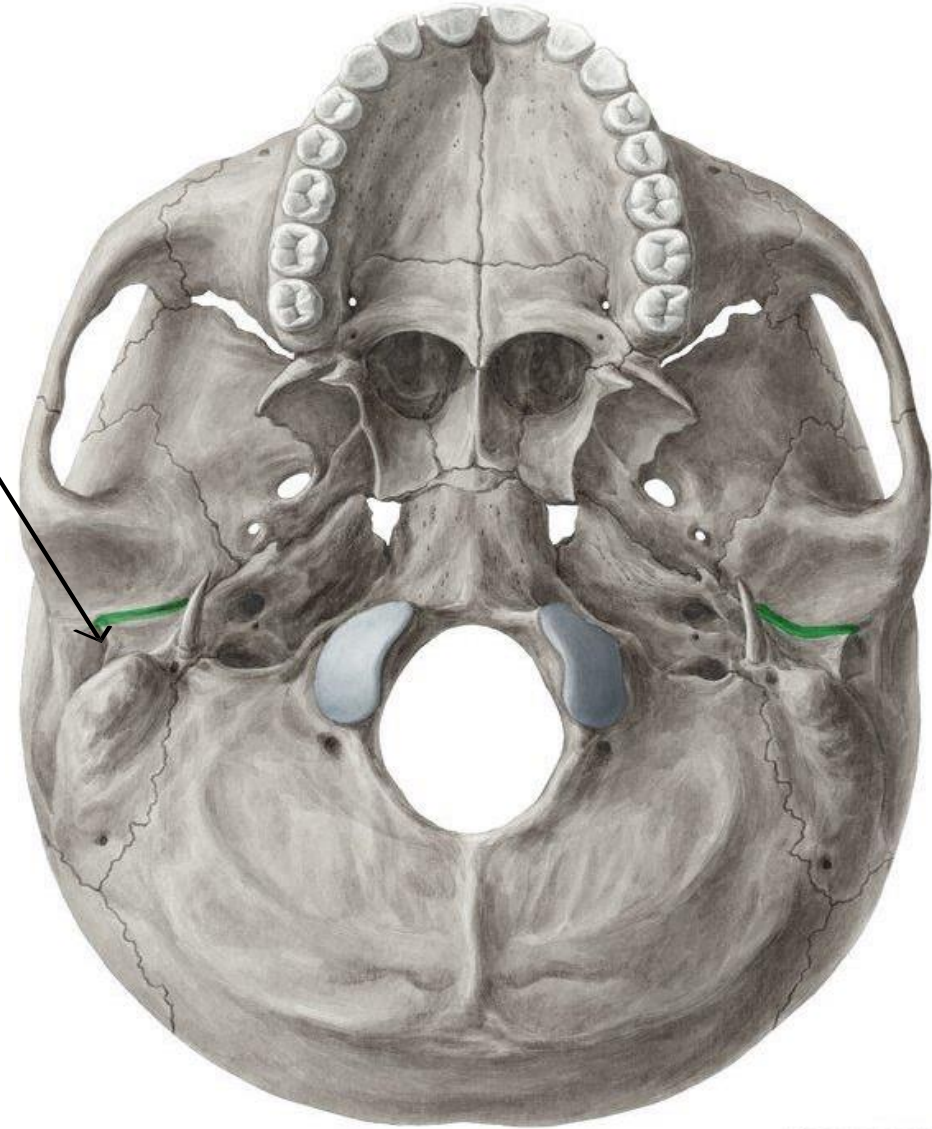
- Taste fibers from the mucous membrane covering the anterior two-thirds of the tongue and the floor of the mouth.
- Carries preganglionic parasympathetic fibers to the submandibular and sublingual glands via the **submandibular ganglion**.

The petrotympanic fissure is a fissure in the temporal bone

The chorda tympani runs through the fissure to join with the lingual nerve in the infratemporal fossa

The **chorda tympani** is a branch of the facial nerve

The **chorda tympani** passes medial to the tympanic membrane and the handle of the malleus, and again enters the temporal bone. It exits the skull through the petrotympanic fissure and descends in the infratemporal fossa.



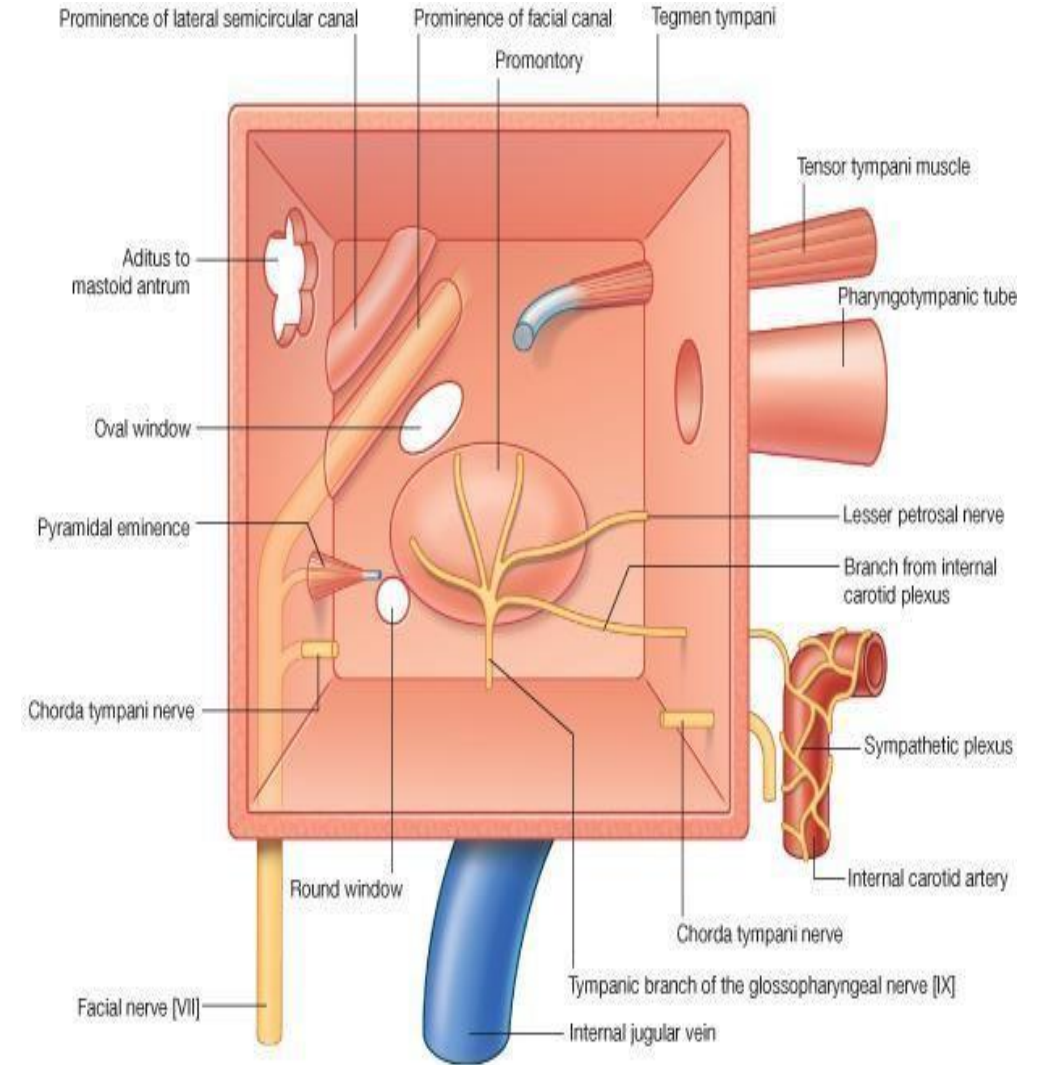
TYMPANIC NERVE

- The tympanic nerve arises from the glossopharyngeal nerve, just below the jugular foramen.
- It passes through the floor of the middle ear and onto the promontory.
- Here it splits into branches, which form the tympanic plexus.
- The tympanic plexus supplies the lining of the middle ear and gives off:

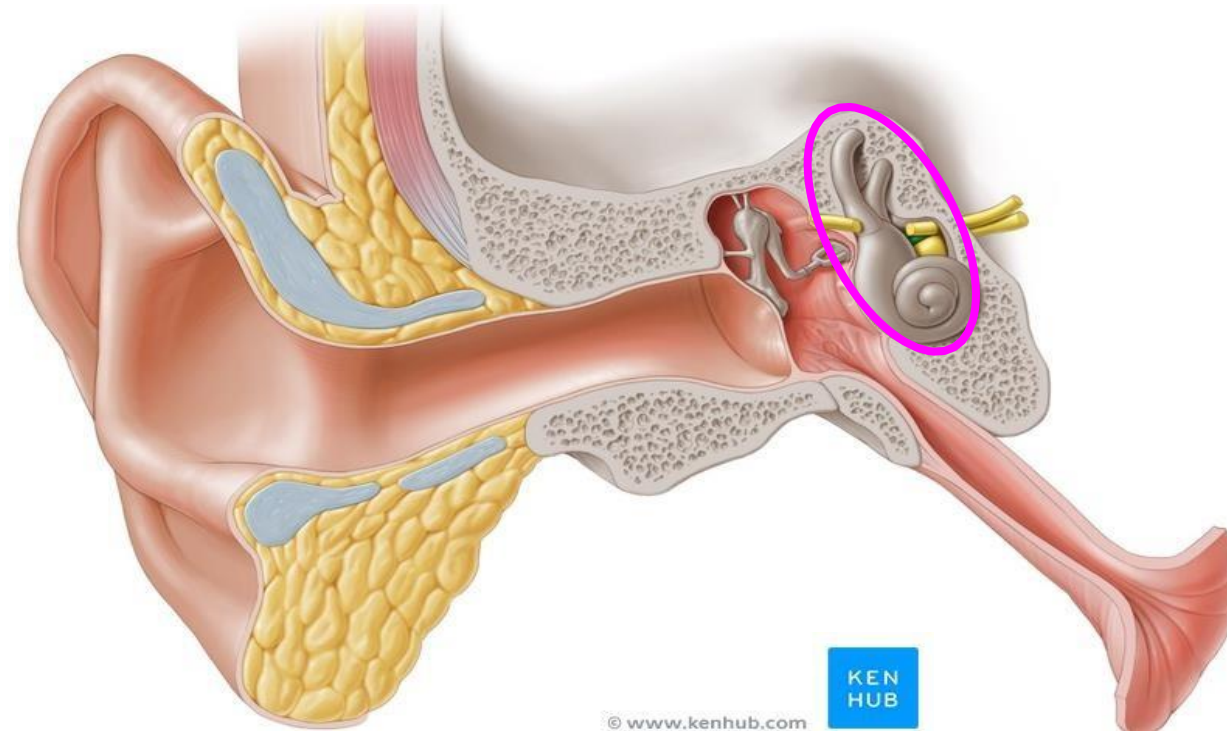
Lesser petrosal nerve

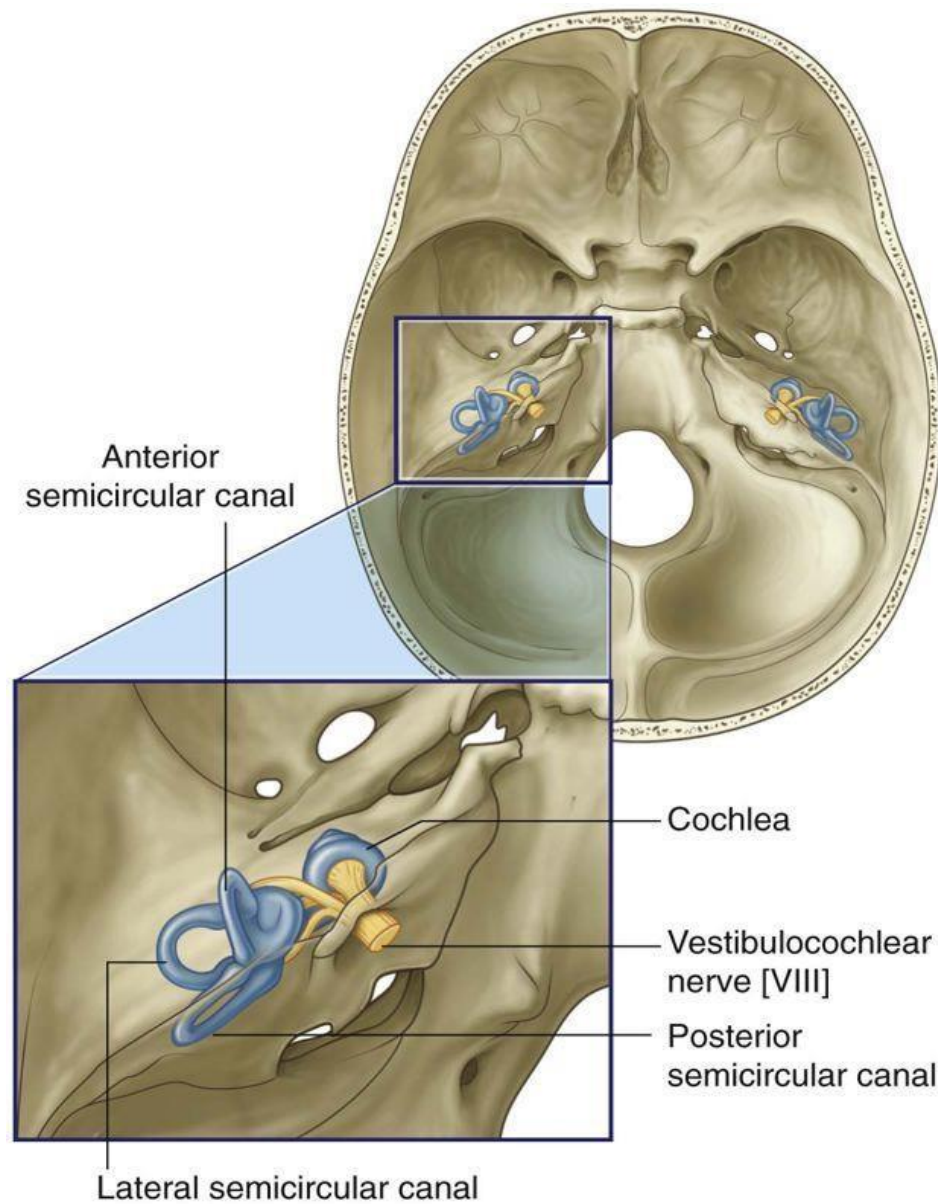
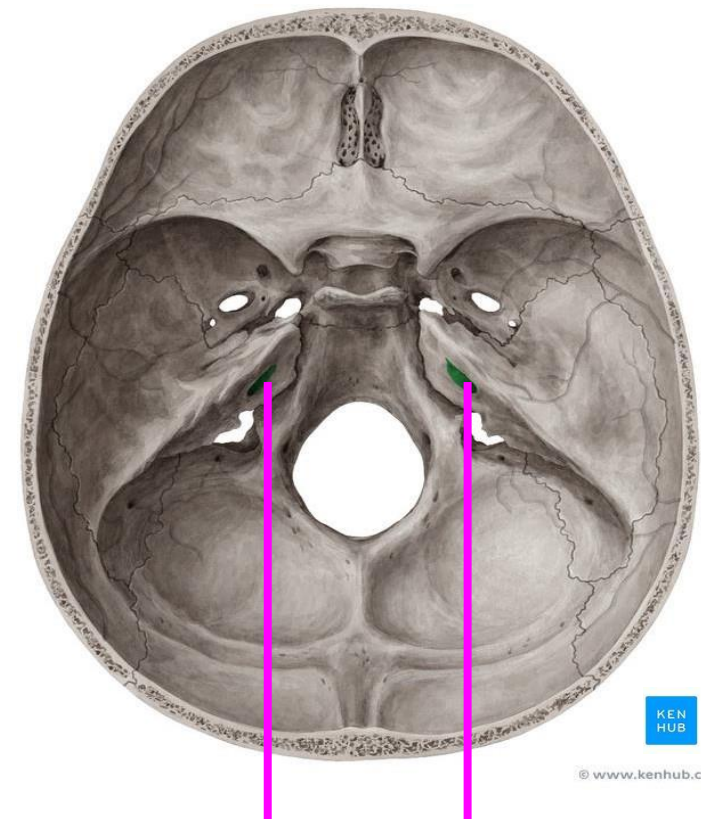


- It leaves the skull through the foramen ovale.
- Carries preganglionic parasympathetic fibers to the parotid gland via the **otic ganglion**



Inner Ear (labyrinth)

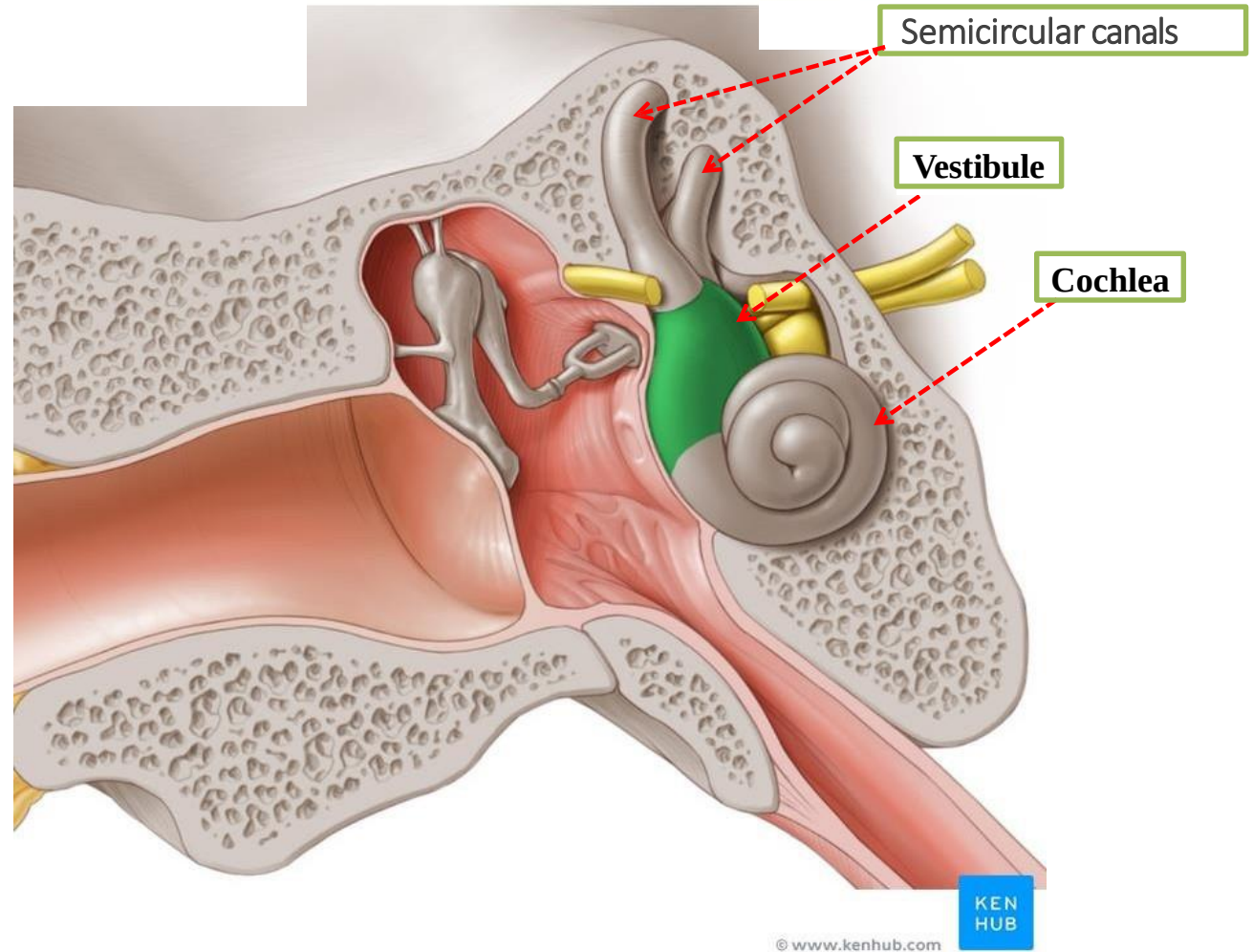




Inner ear is situated in the petrous part of the temporal bone

The inner ear consists of:

- 1- Bony labyrinth
- 2- Membranous labyrinth

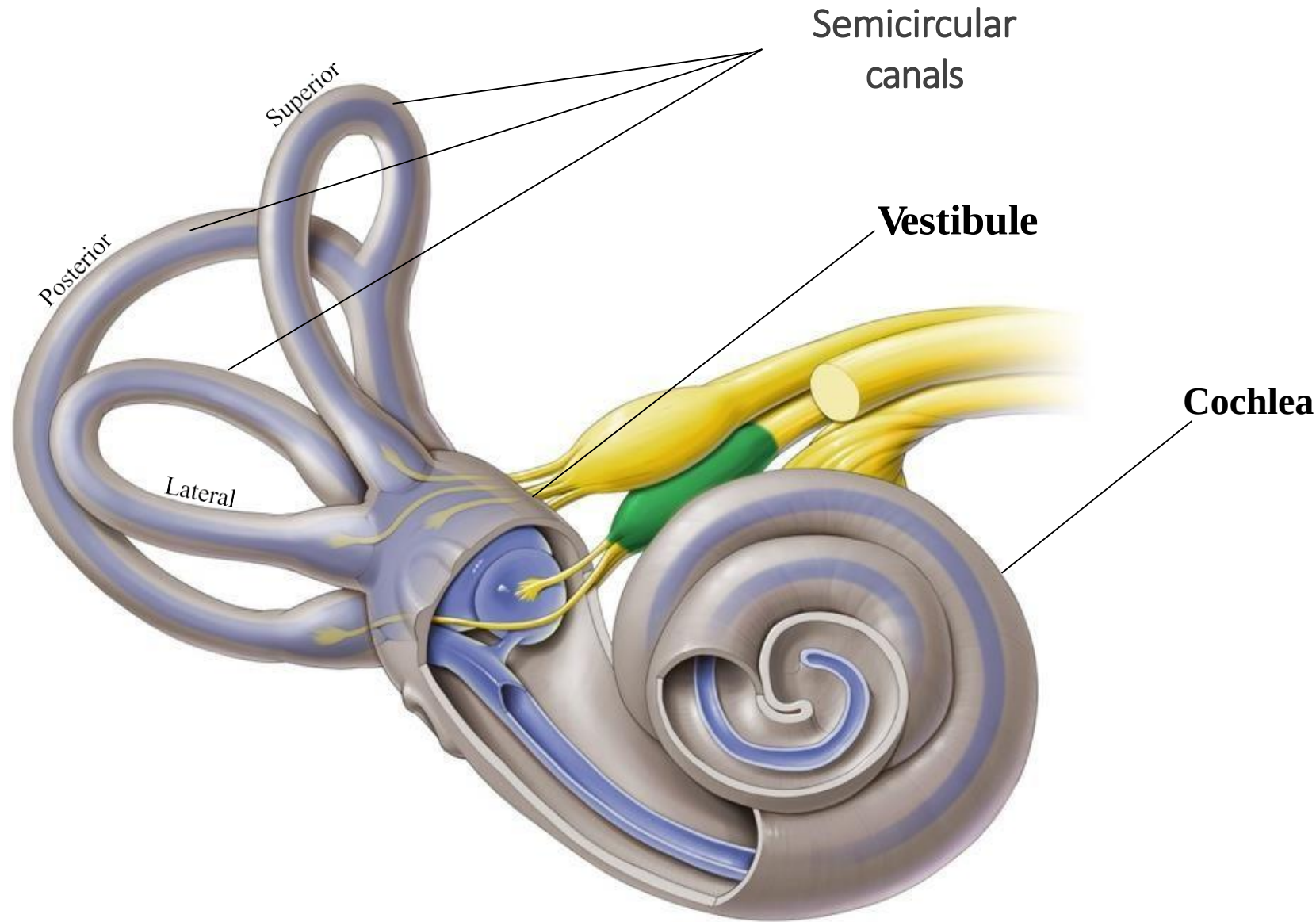


Bony labyrinth

Consists of the vestibule, the semicircular canals, and the cochlea.

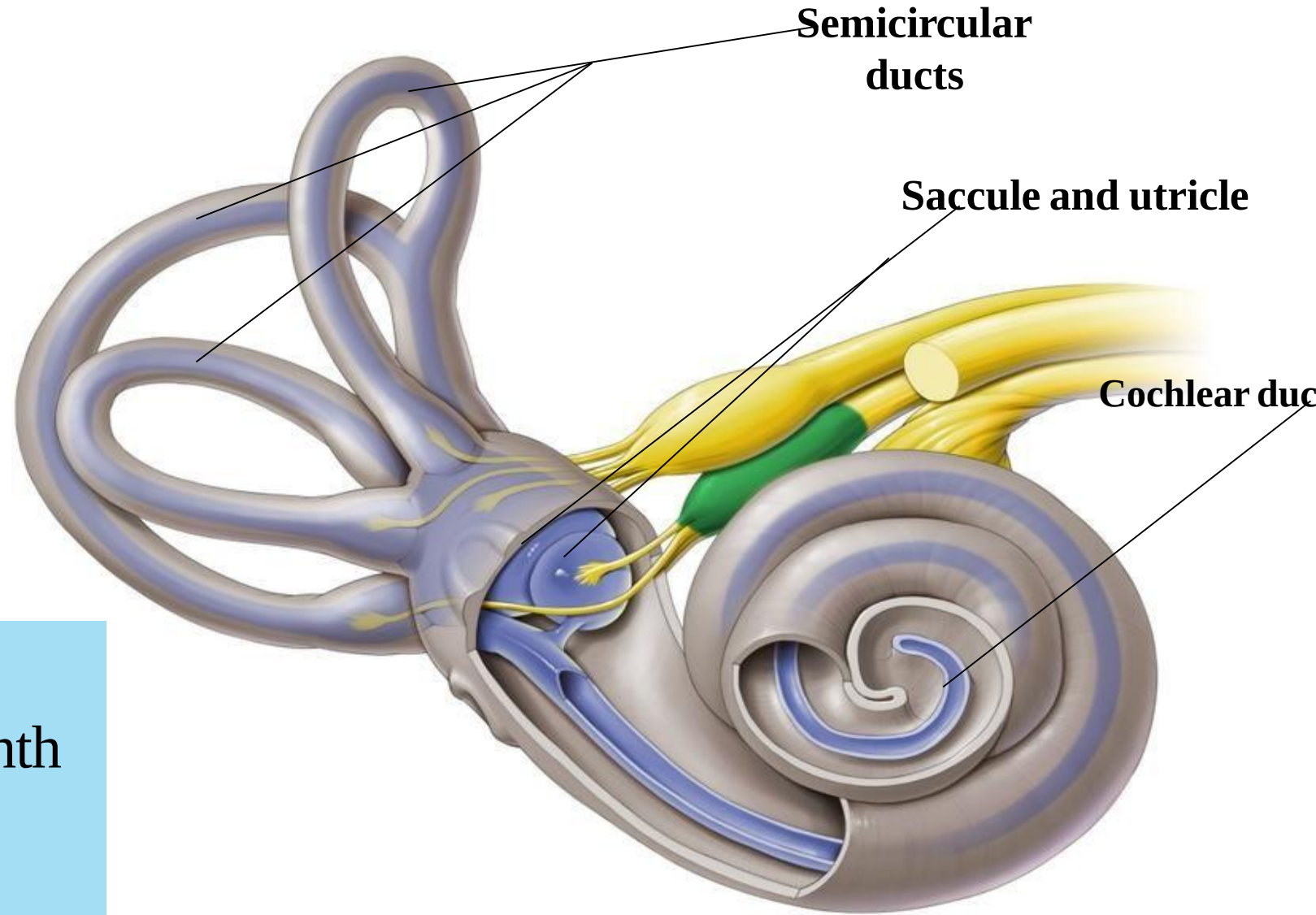
These are cavities situated in the substance of a dense bone.

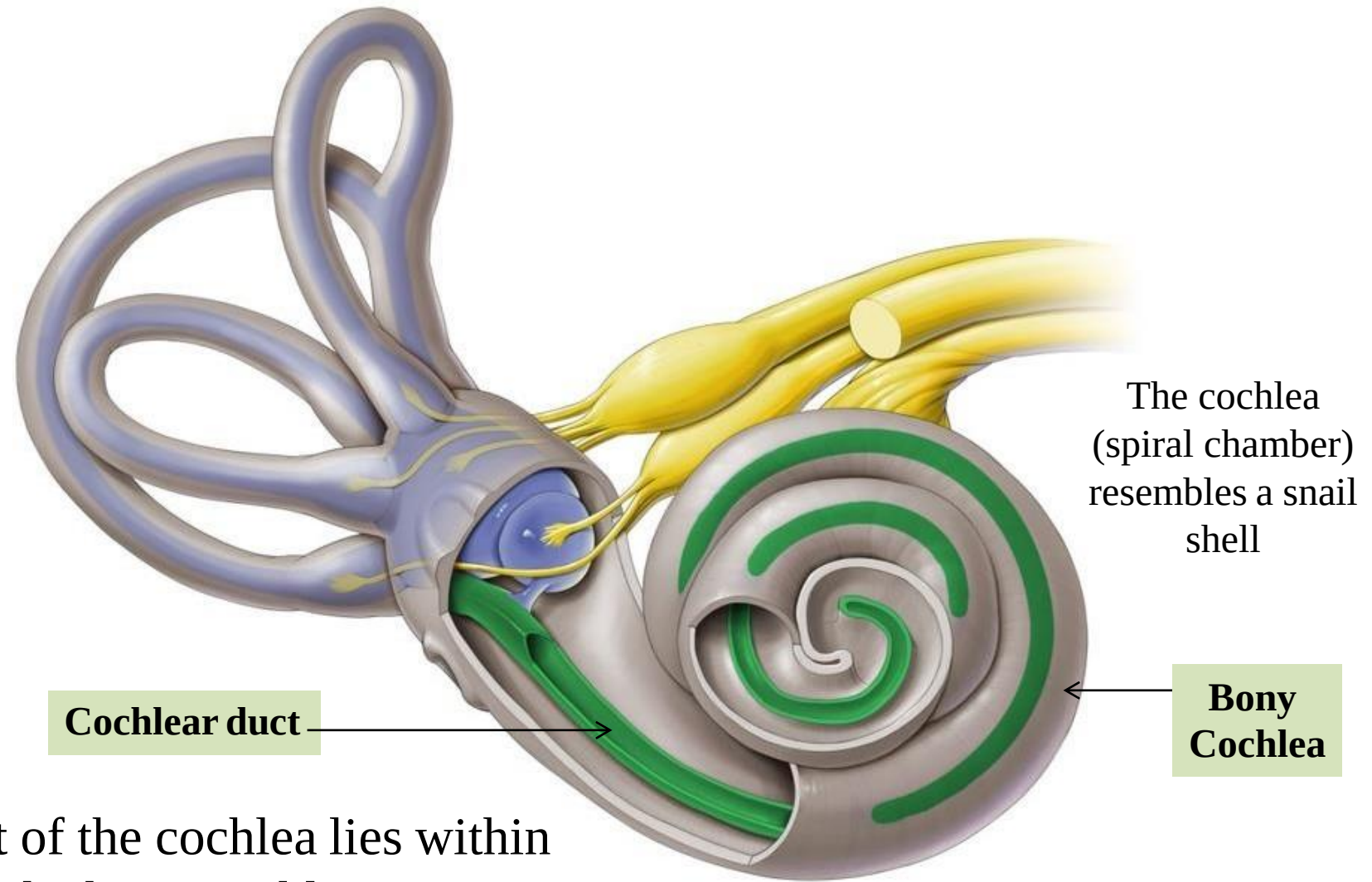
They are lined by endosteum and contain a clear fluid, the perilymph.



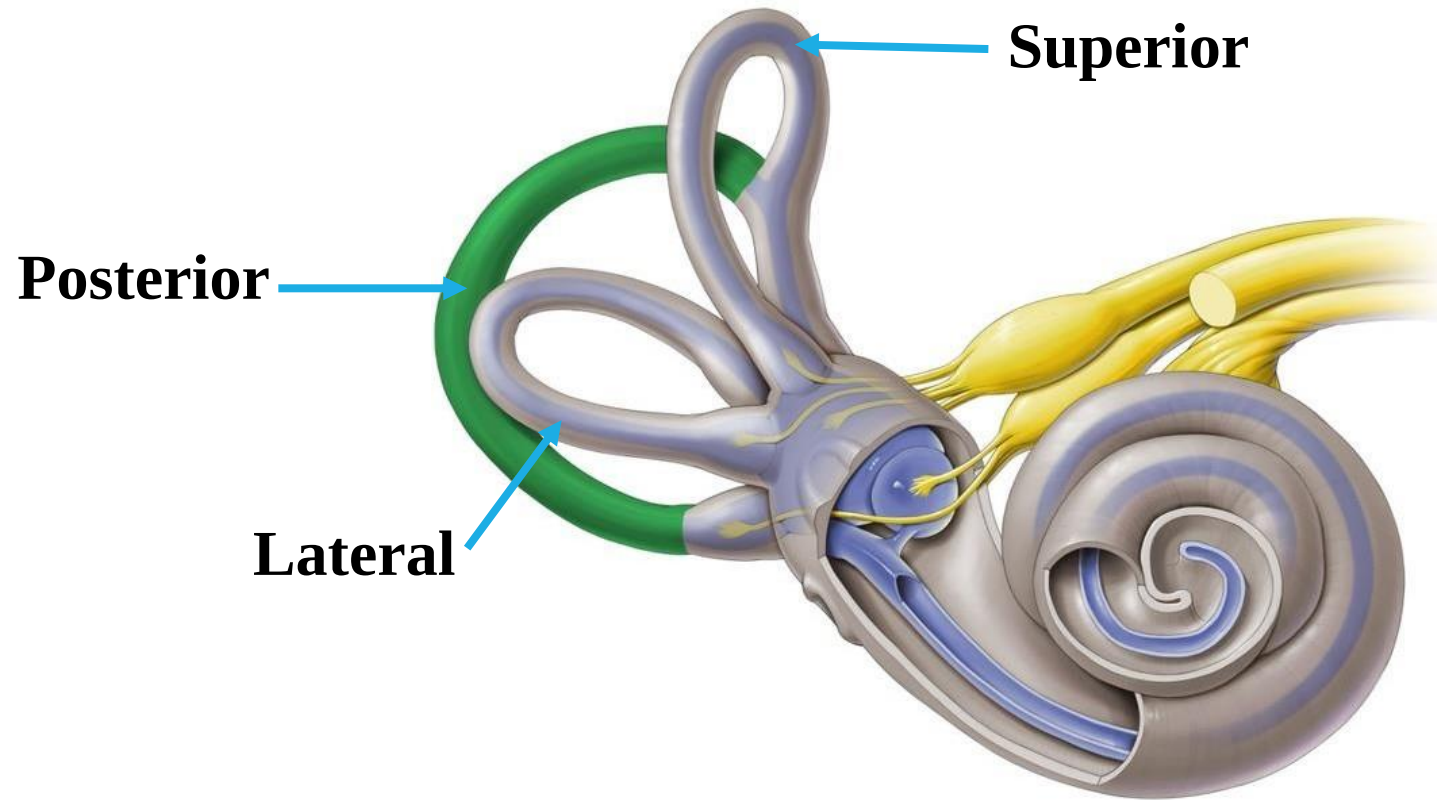
Membranous labyrinth

lodged within the bony labyrinth
It is filled with endolymph and
surrounded by perilymph

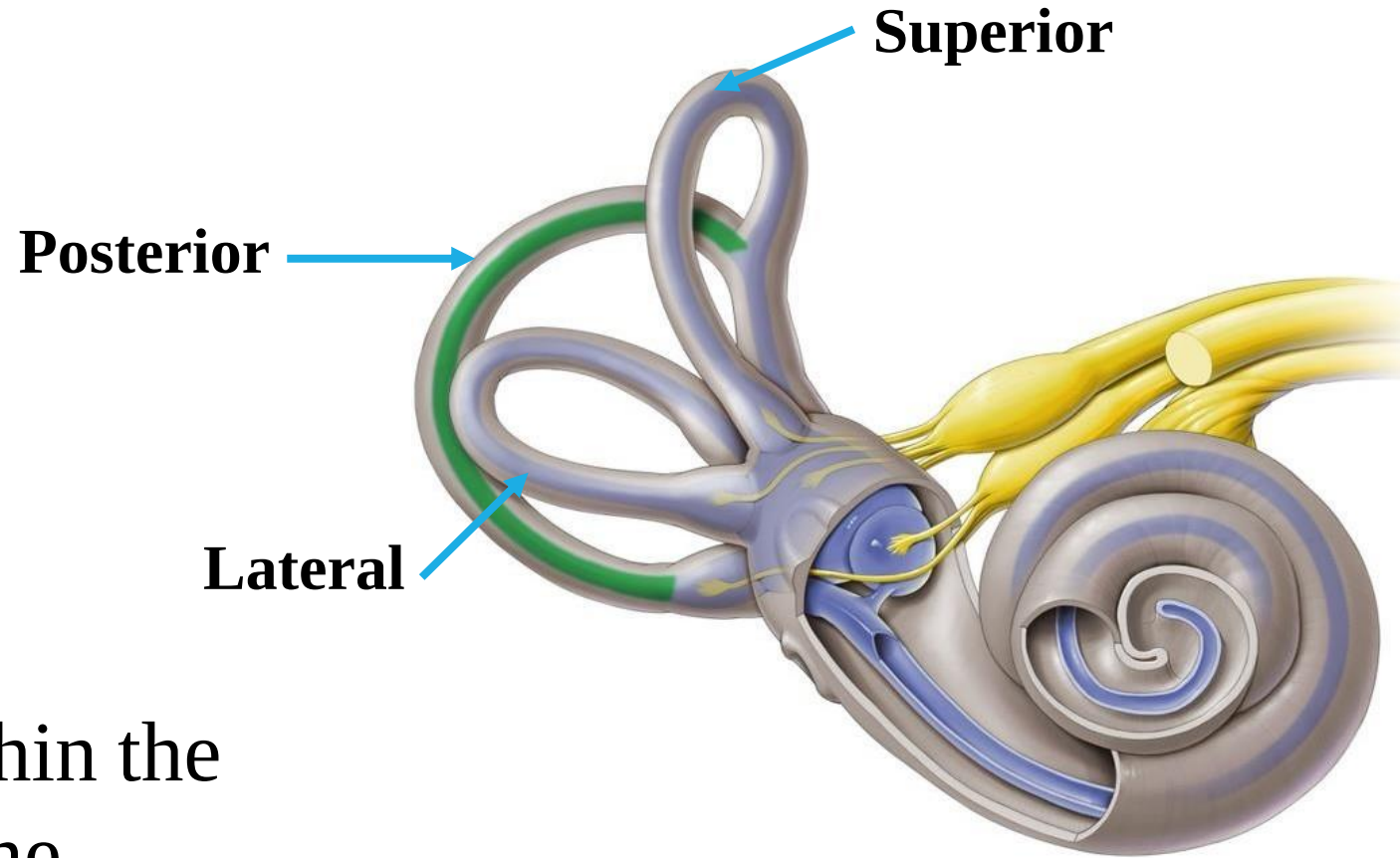




Semicircular canals

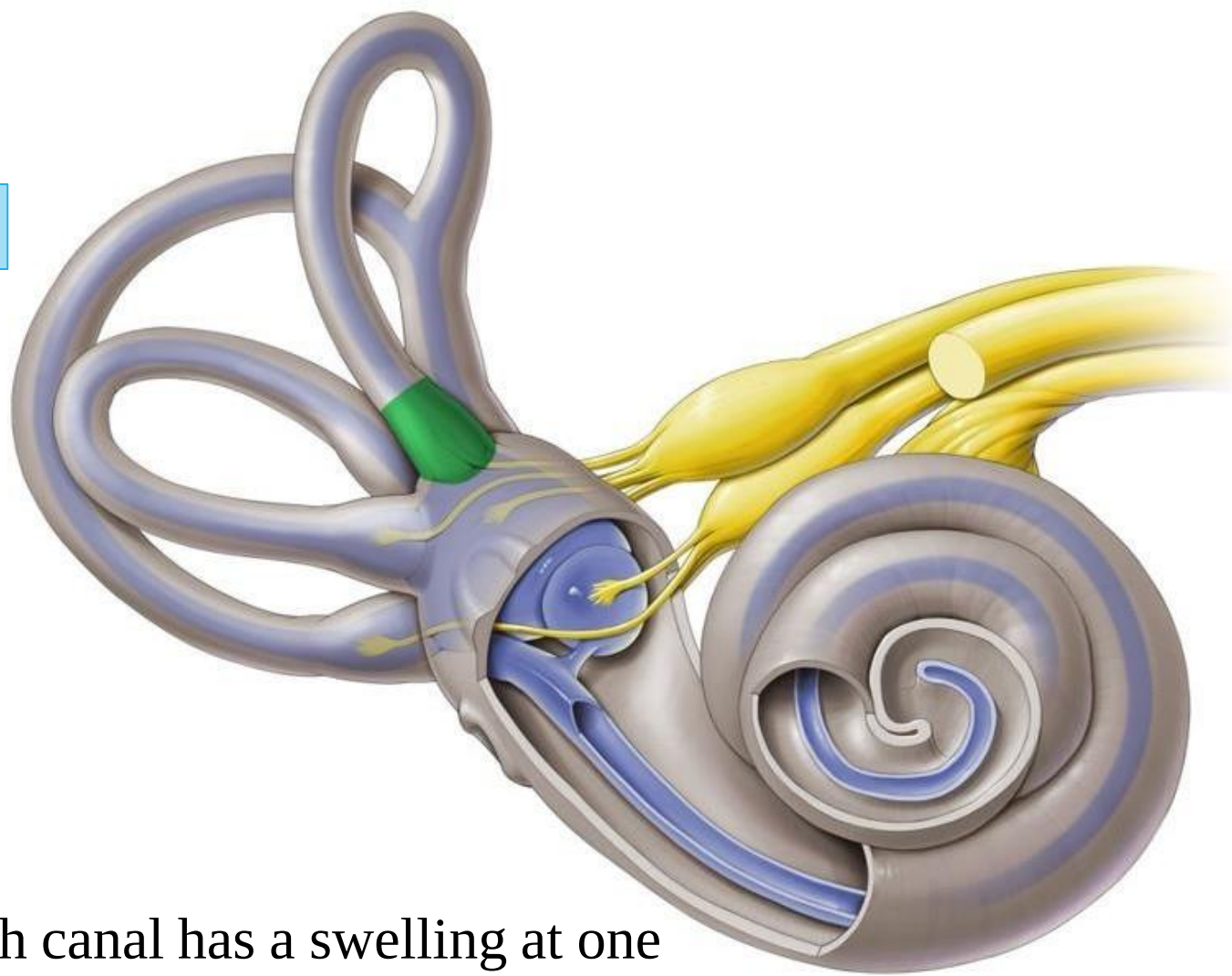


Semicircular ducts



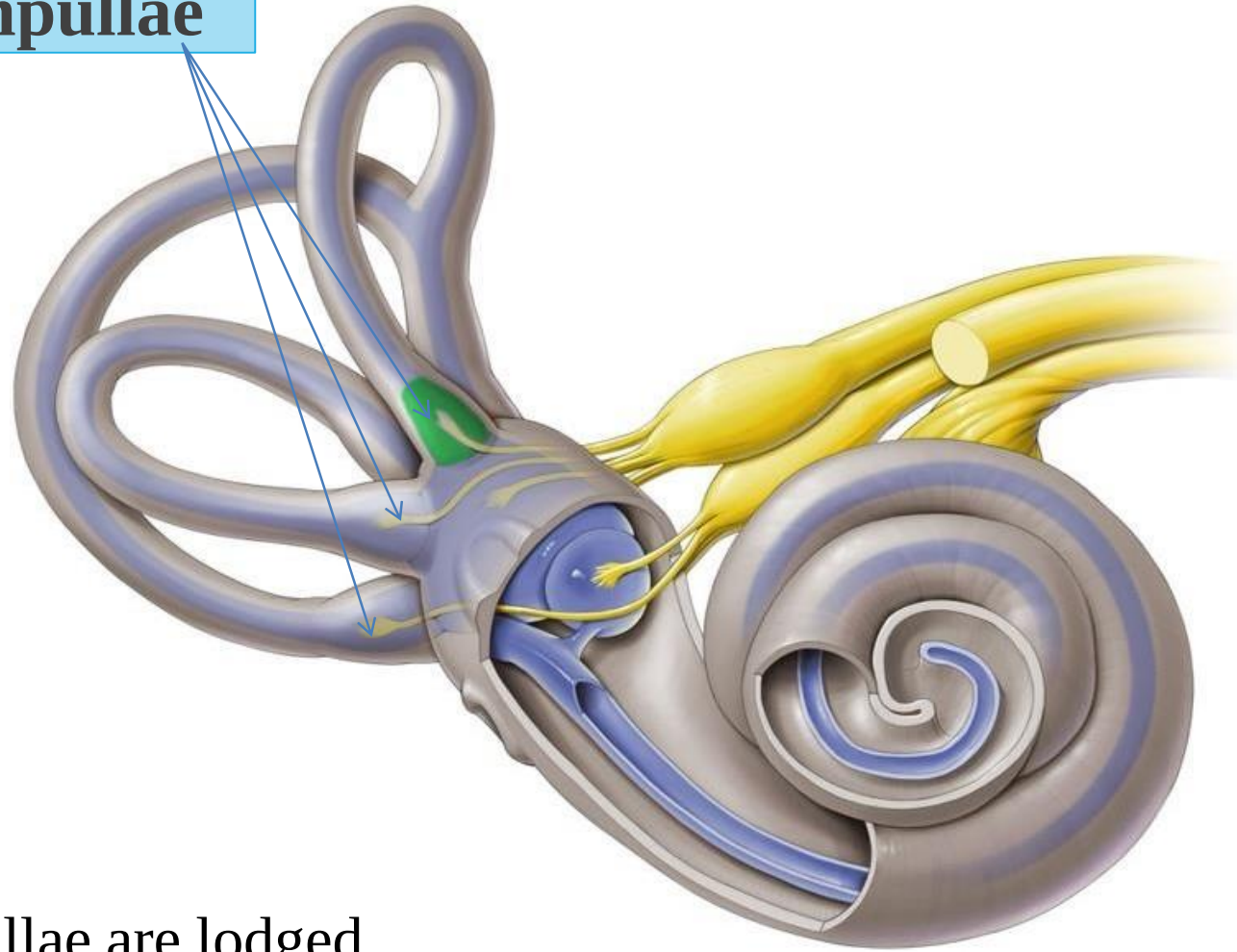
Lodged within the
canals are the
semicircular ducts

Bony ampullae



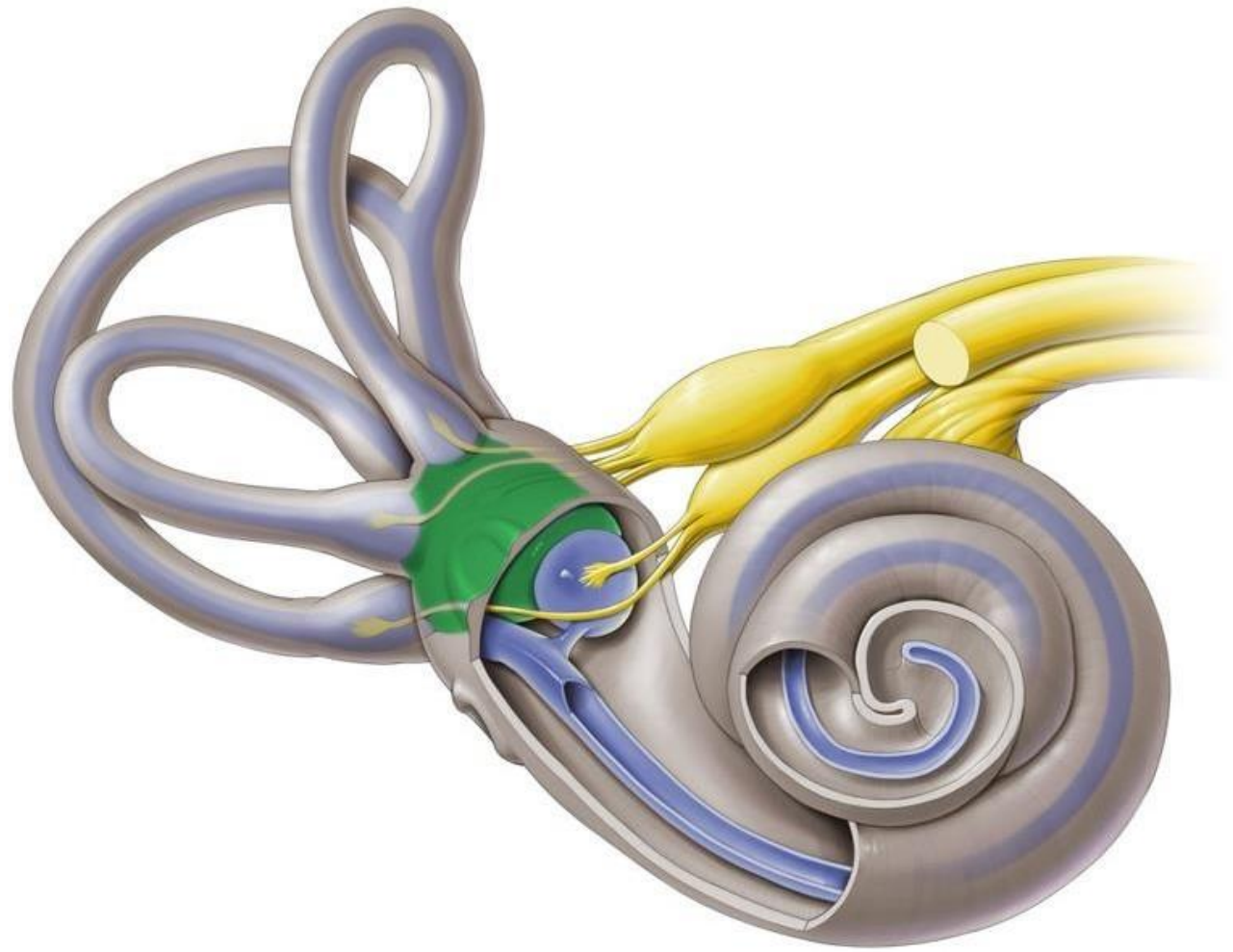
Each canal has a swelling at one end called the **ampulla**

Membranous ampullae



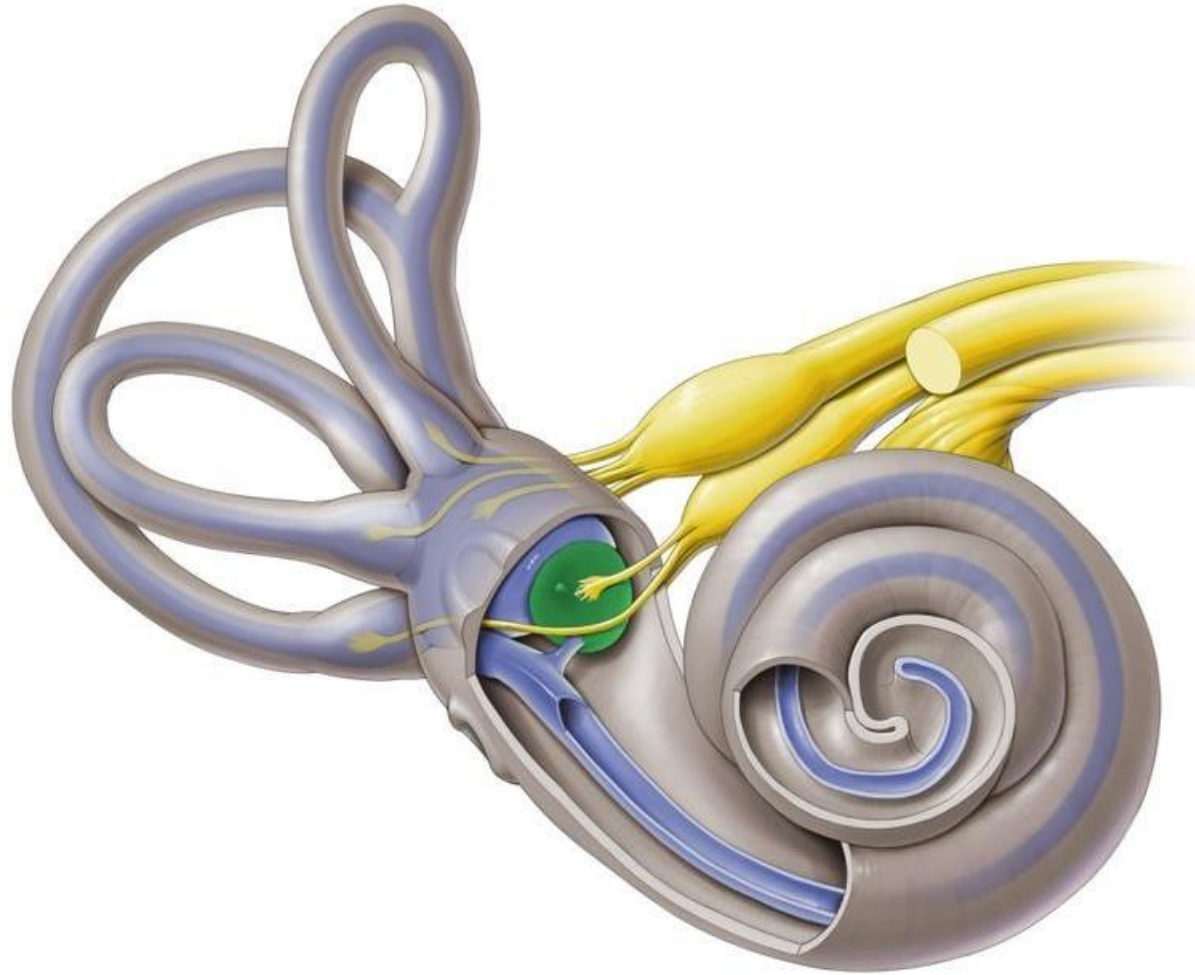
Membranous ampullae are lodged
in the bony ampullae

Utricle



Utricle and Saccule are lodged in the bony vestibule

Sacculle



Utricle and Sacculle are lodged in the bony vestibule

The vestibule:

Central part of the bony labyrinth, lies posterior to the cochlea and anterior to the semicircular canals.

In its lateral wall are the **fenestra vestibuli**, which is closed by the base of the stapes and its annular ligament, and the **fenestra cochleae**, which is closed by the **secondary tympanic membrane**.

The saccule and utricle of the membranous labyrinth are lodged within the vestibule.

The three semicircular canals (superior, posterior, and lateral) open into the 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.

The **semicircular ducts** are lodged within the canals.

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

The cochlea resembles a snail shell. It opens into the anterior part of the vestibule.

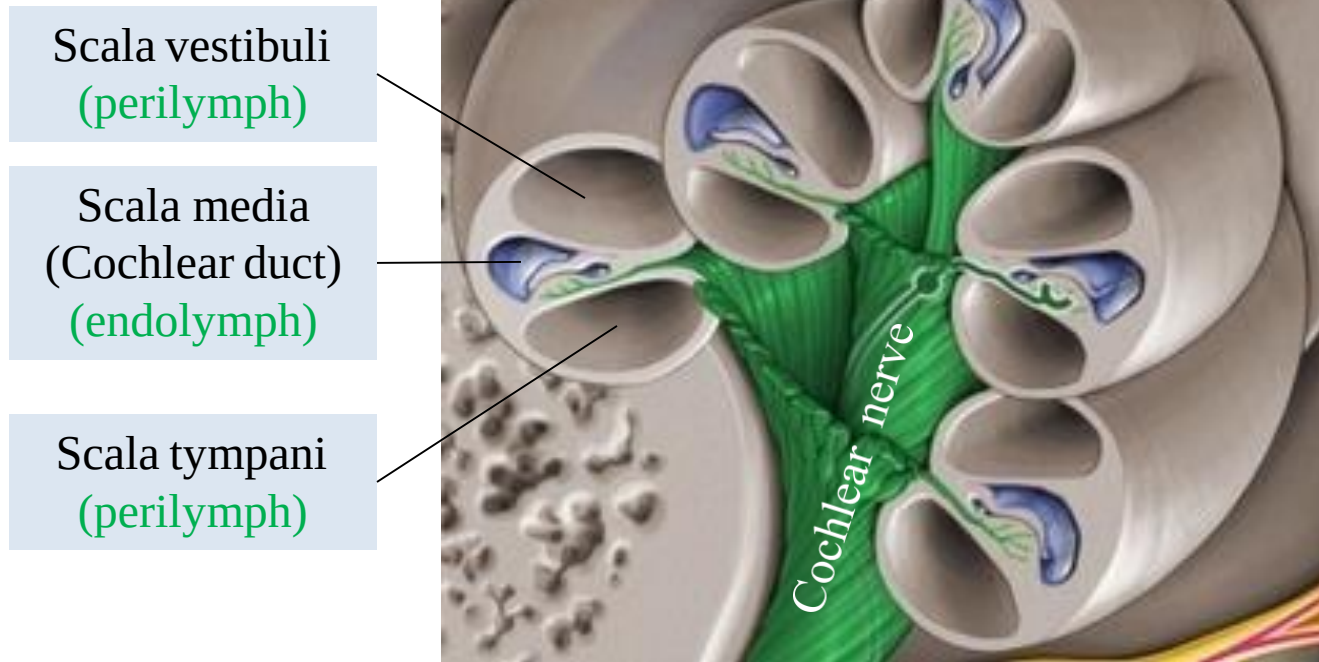
Basically, it consists of a central pillar, **the modiolus**, around which a hollow bony tube makes two and one-half spiral turns. Each successive turn is of decreasing radius so that the whole structure is conical.

The apex faces anterolaterally and the base faces posteromedially.

The first basal turn of the cochlea is responsible for the **promontory** seen on the medial wall of the middle ear.

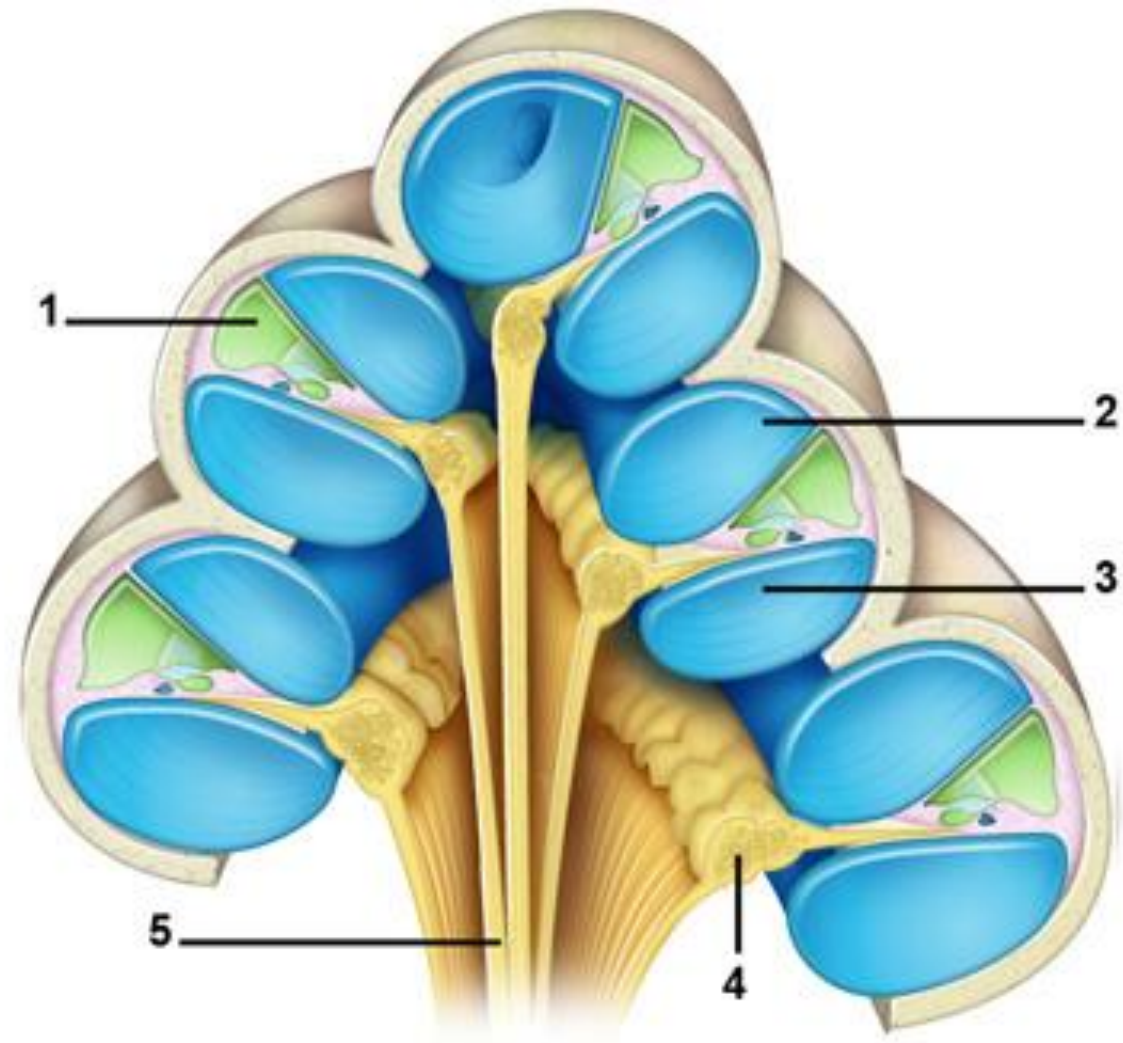
The **modiolus** has a broad base, which is situated at the bottom of the internal acoustic meatus.

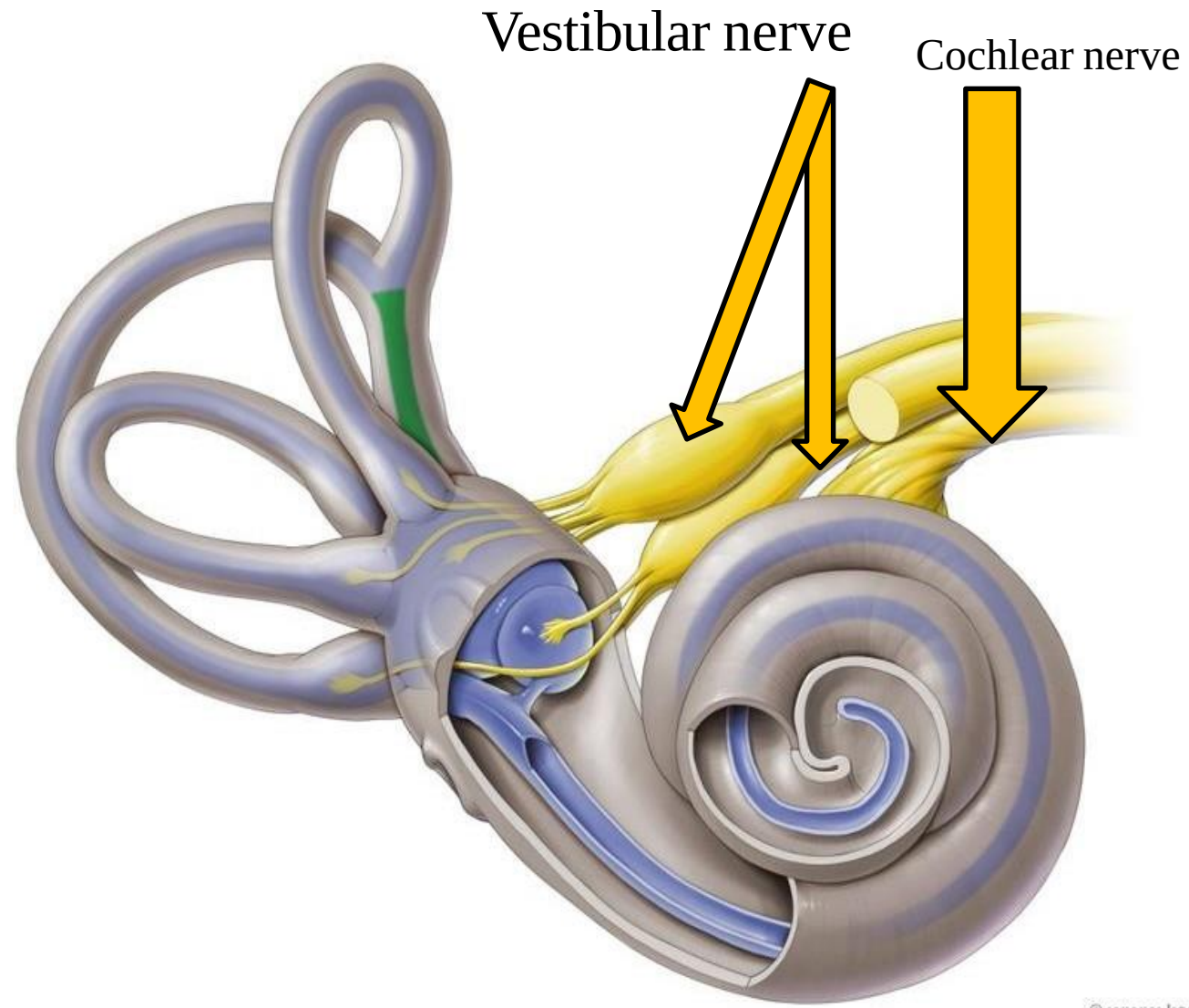
Branches of the cochlear nerve perforate it. A spiral ledge, the spiral lamina, winds around the modiolus and projects into the interior of the canal and partially divides it. The basilar membrane stretches from the free edge of the spiral lamina to the outer bony wall, thus dividing the cochlear canal into the **scala vestibuli** above and the **scala tympani** below.



Section through cochlea

- ✓ The cochlear duct itself forms the middle compartment, or scala media, filled with endolymph. It is continuous with the saccule and ends at the apex of the cochlea.
- ✓ The larger scala vestibuli contains perilymph and is separated from the scala media by the very thin vestibular membrane (Reissner membrane)
- ✓ The scala tympani also contains perilymph and is separated from the scala media by the basilar membrane



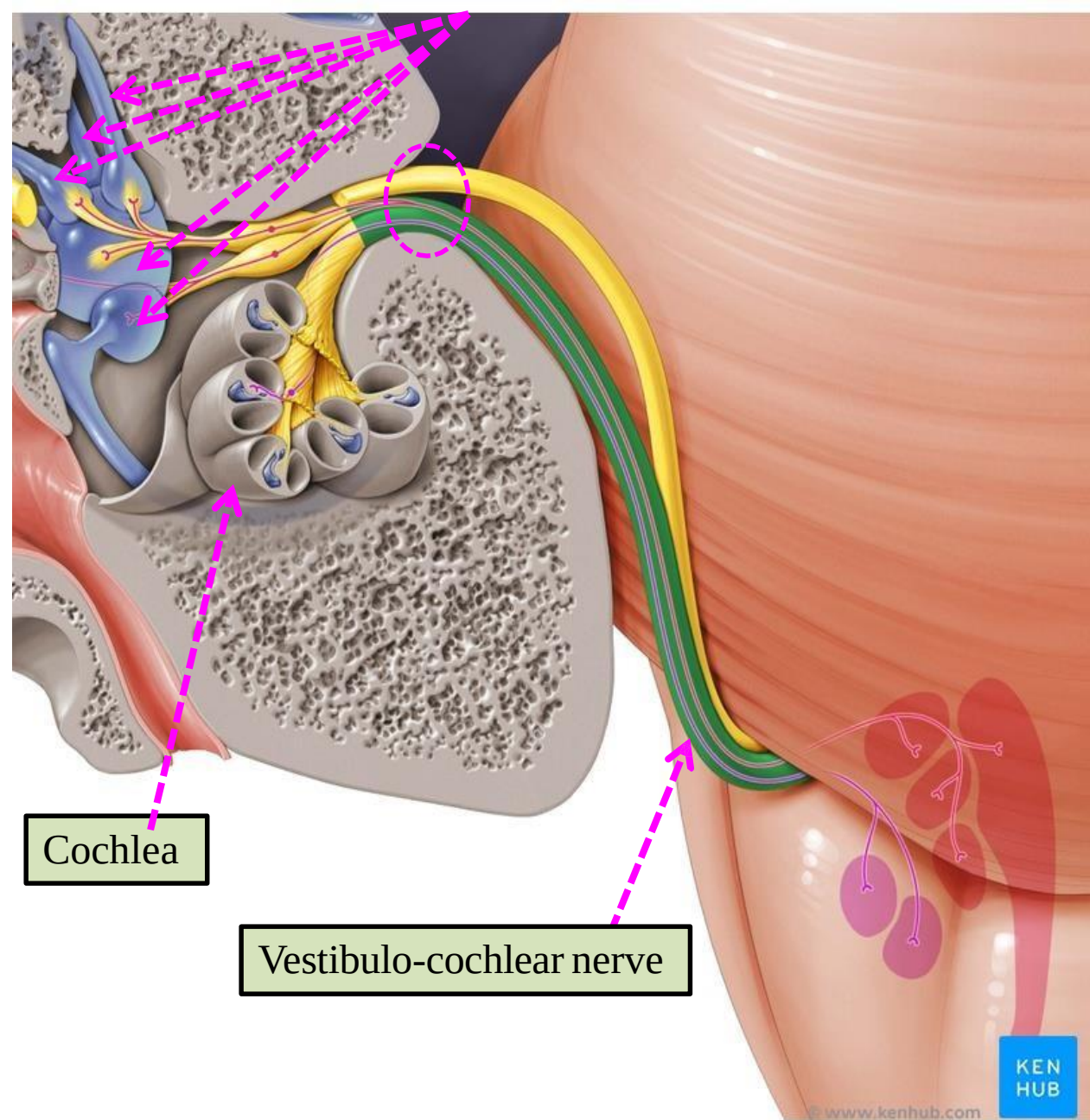


Vestibulo-cochlear nerve

**The inner ear contains
Sensory receptors for
hearing and balance
Mechanoreceptors/ Hair
cells (Columnar cells)**

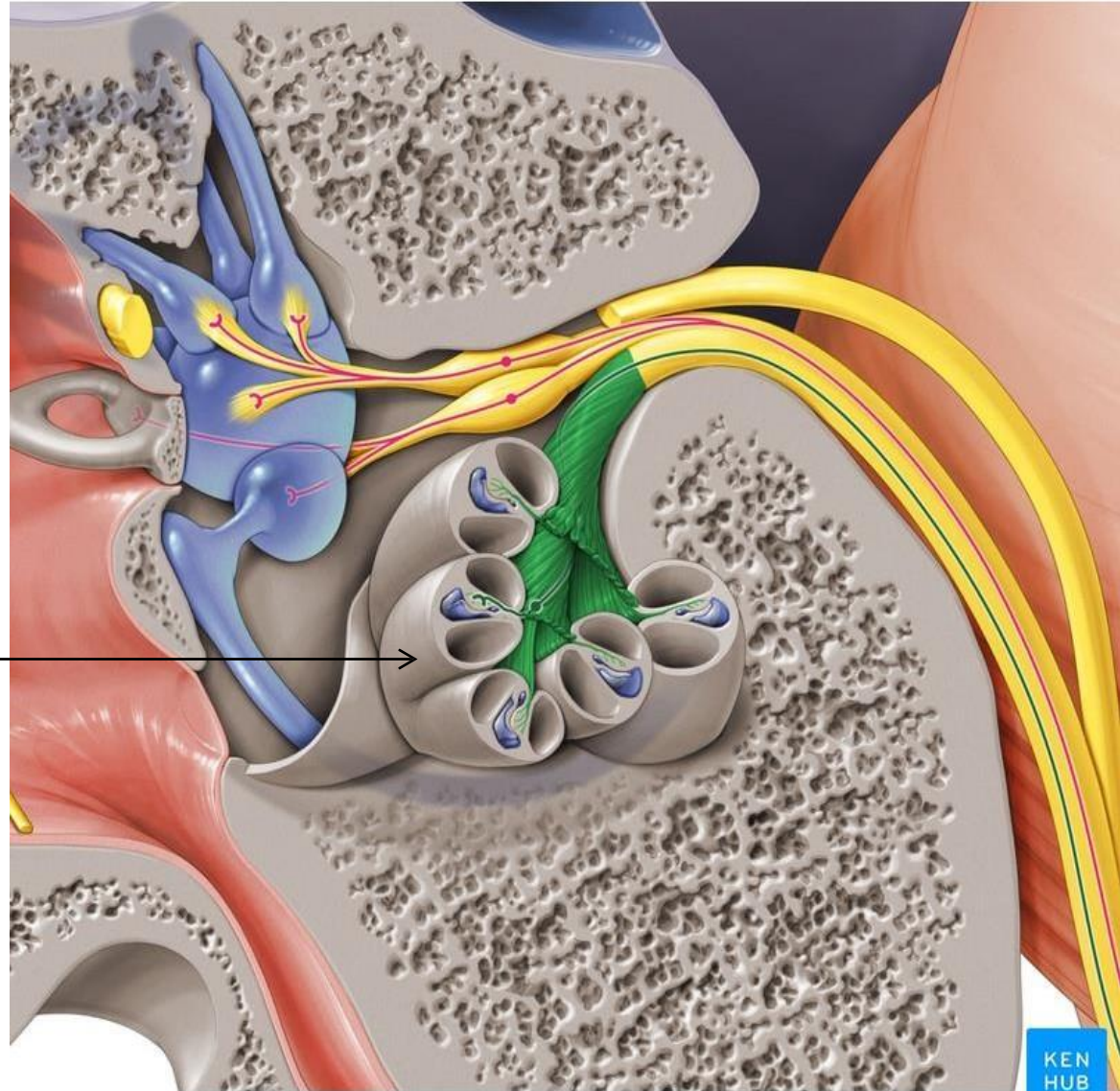


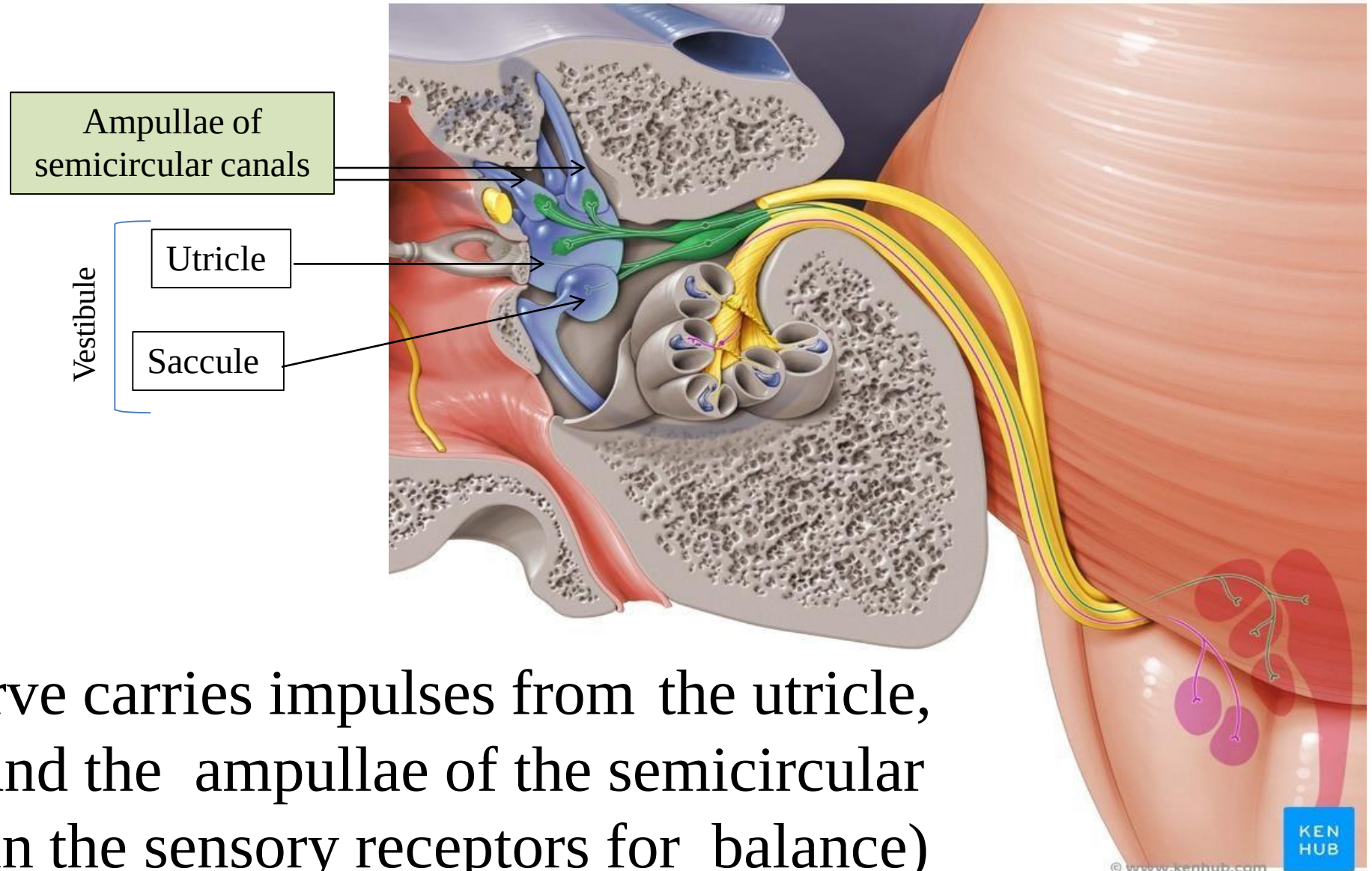
- ✓ Two maculae of the utricle and saccule,
- ✓ Three cristae ampullares in the ampullae of each semicircular duct
- ✓ The organ of Corti in the cochlear duct.



Cochlear nerve carries
impulses from organ of
Corti in cochlea
(contains the sensory
receptors for hearing)

Cochlea





Vestibular nerve carries impulses from the utricle, the saccule, and the ampullae of the semicircular ducts (contain the sensory receptors for balance)

THANK YOU