

The Ear

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The Ear

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

External Ear

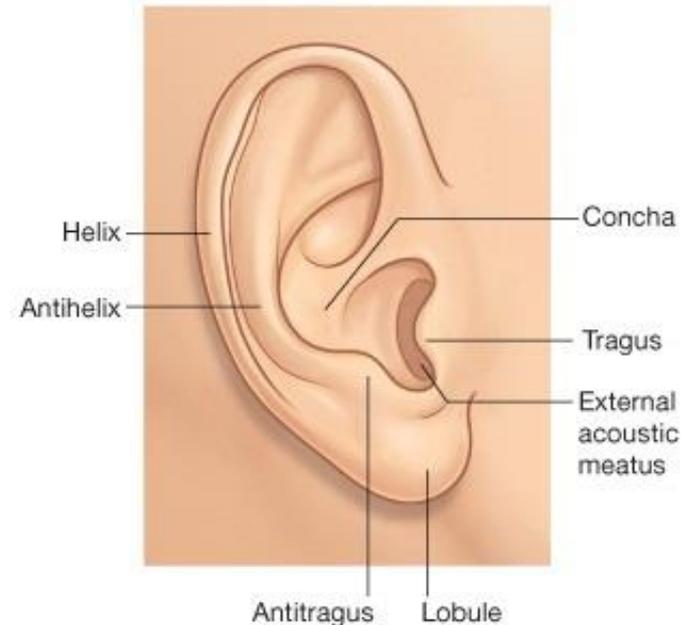
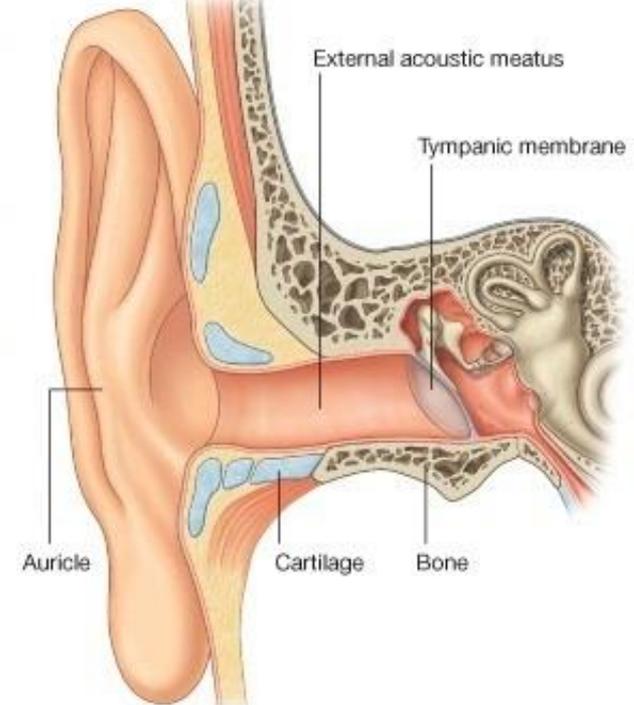
- The external ear has an **auricle** and an **external auditory meatus**.

The Auricle

- it has a characteristic shape and collects air vibrations.
- It consists of a thin plate of elastic cartilage covered by skin.
- It possesses both extrinsic and intrinsic muscles, which are supplied by the facial nerve.

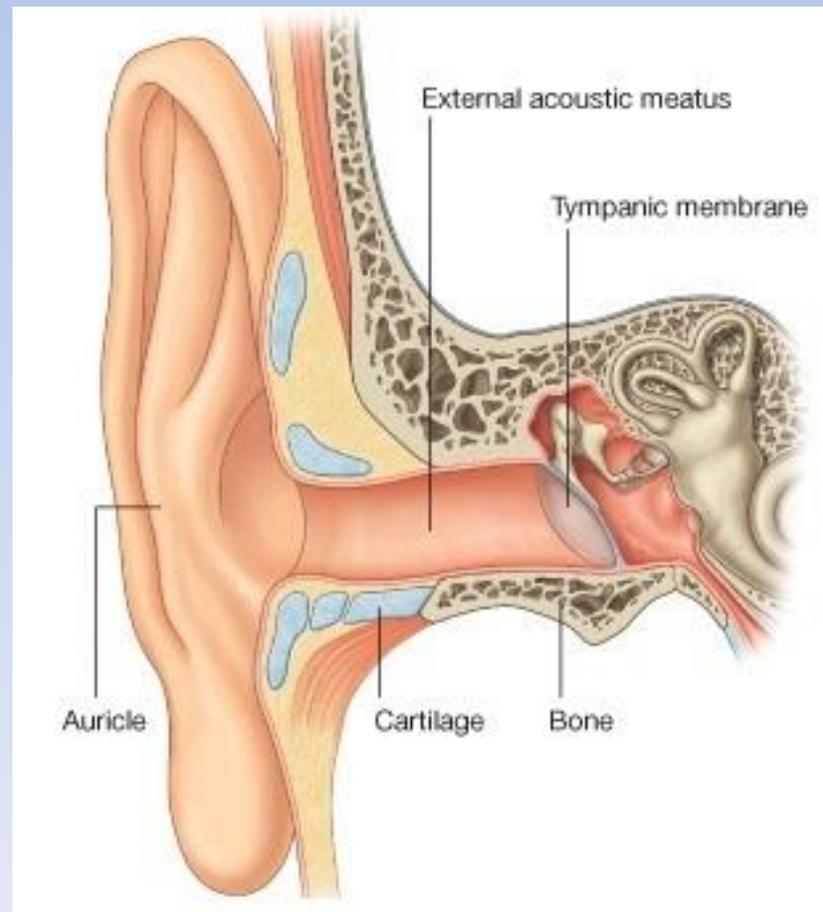
The External Auditory Meatus

- It is a curved tube that leads from the auricle to the tympanic membrane.
- It conducts sound waves from the auricle to the tympanic membrane.



External Ear

- The framework of the outer third of the meatus is **elastic cartilage**, and the inner two thirds is bone, formed by the **tympanic plate**.
- The meatus is lined by skin, and its outer third is provided with **hairs** and **sebaceous** and **ceruminous glands**.
- The ceruminous glands are modified sweat glands that secrete a yellowish brown wax.
- The hairs and the wax provide a sticky barrier that prevents the entrance of foreign bodies.



Nerve Supply of the External Ear

The sensory nerve

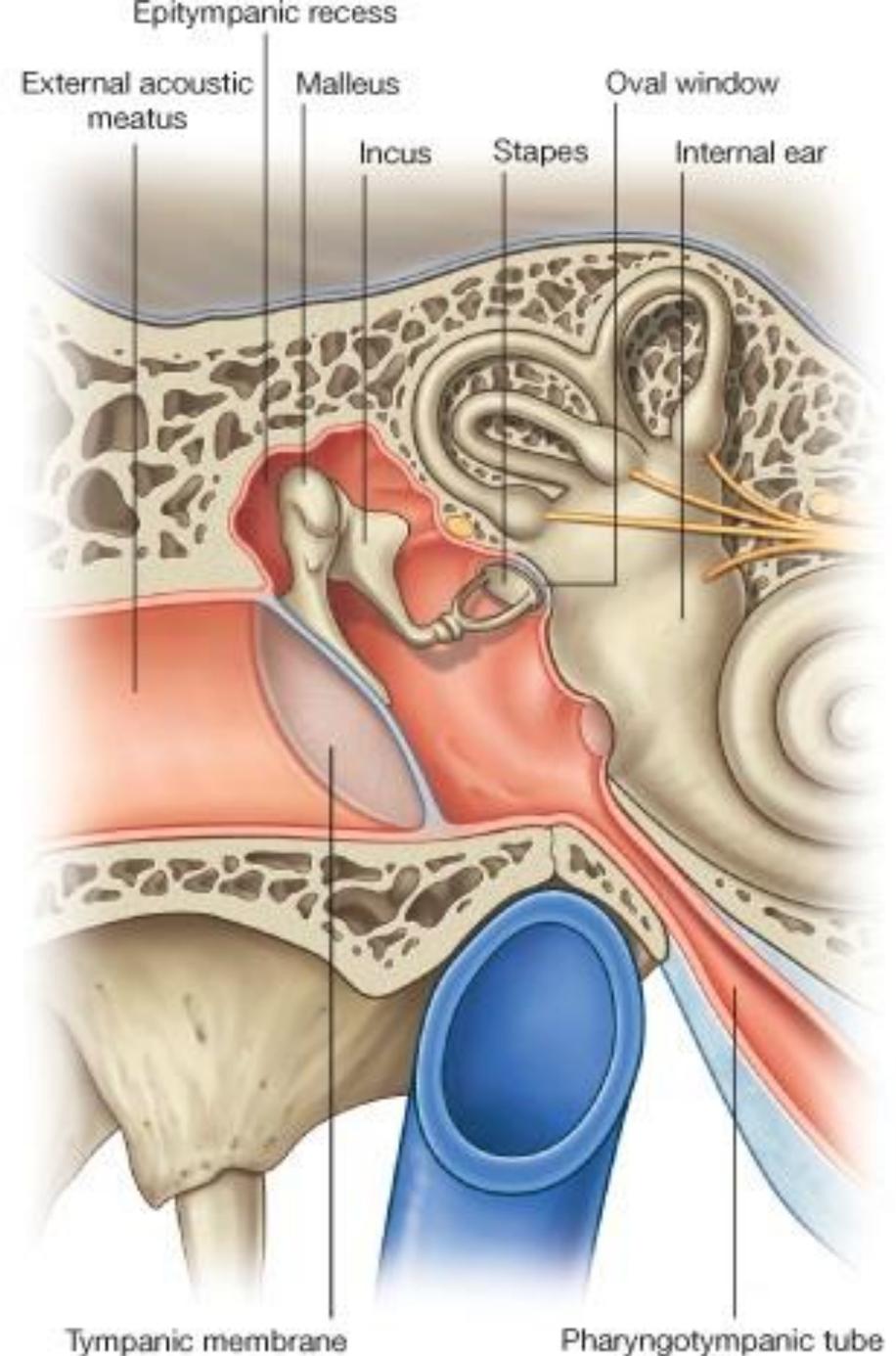
- supply of the lining skin is derived from the auriculotemporal nerve and the auricular branch of the vagus nerve.

The lymph drainage

- is to the superficial parotid, mastoid, and superficial cervical lymph nodes.

Middle Ear (Tympanic Cavity)

- The middle ear is an air-containing cavity in the petrous part of the temporal bone and is lined with mucous membrane.
- It is a narrow, oblique, slitlike cavity whose long axis lies approximately parallel to the plane of the tympanic membrane.
- It communicates in front through the **auditory tube** with the **nasopharynx** and behind with the **mastoid antrum**.
- It contains the **auditory ossicles**, whose function is to transmit the vibrations of the tympanic membrane (eardrum) to the perilymph of the internal ear.



Walls of Middle Ear

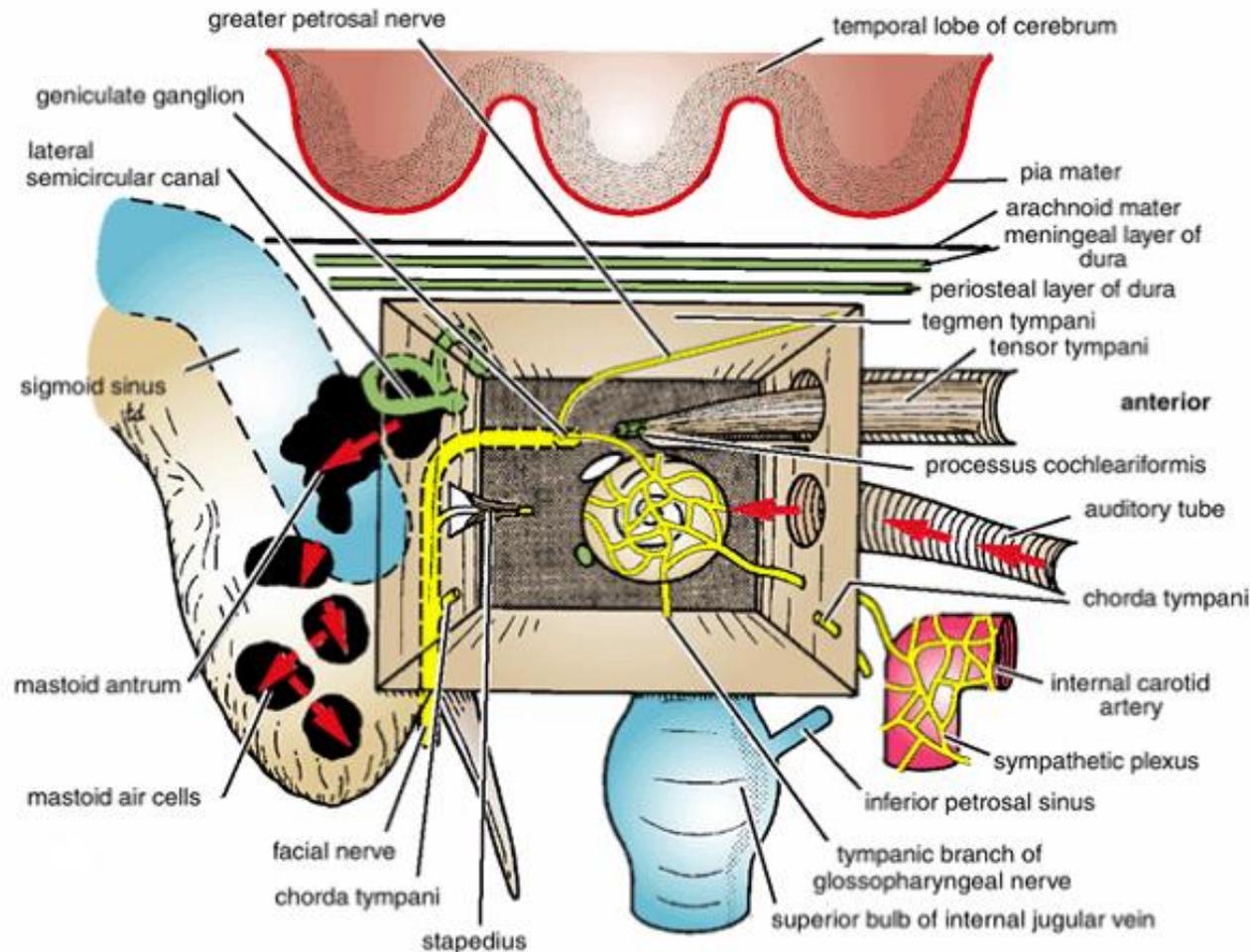
- The middle ear has a roof, floor, anterior wall, posterior wall, lateral wall, and medial wall.

The roof

- is formed by a thin plate of bone, the **tegmen tympani**, which is 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

The floor

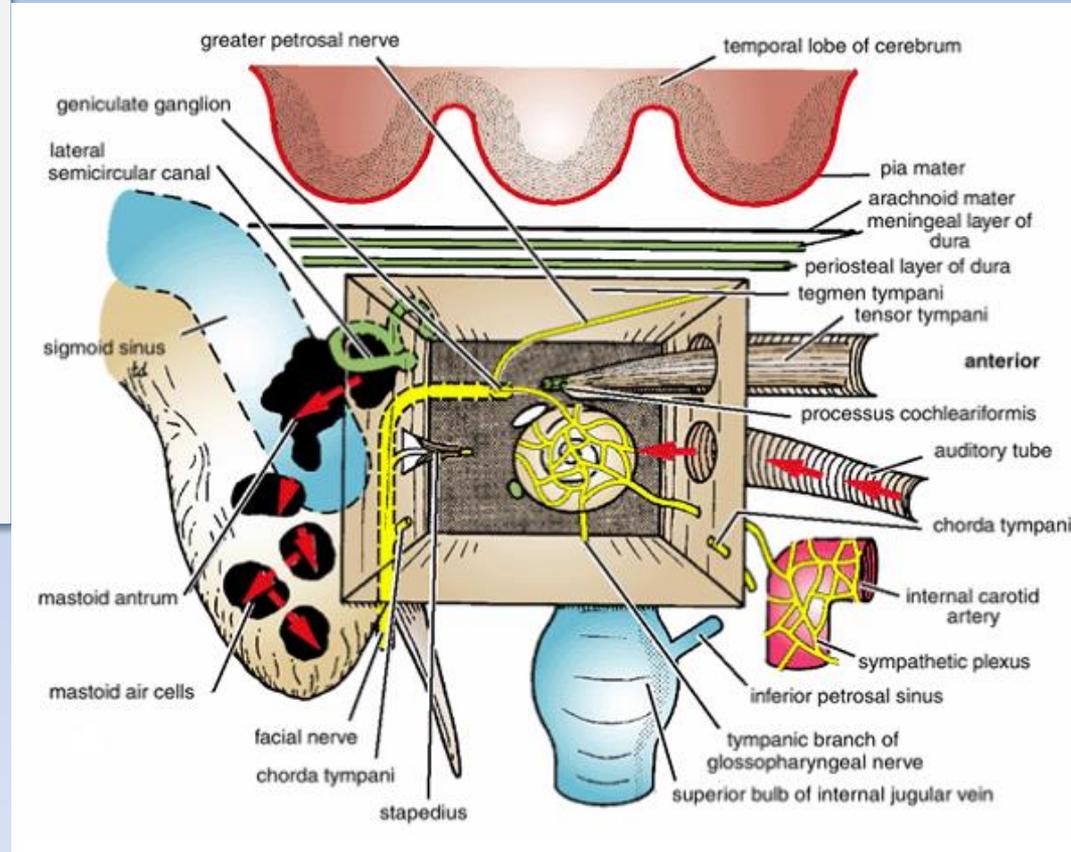
- is formed by a thin plate of bone, which **may be partly replaced by fibrous tissue**.
- It separates the tympanic cavity from the superior bulb of the internal jugular vein.



The anterior 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 of these leads into the uditory tube, and the upper and smaller is the entrance into the canal for the tensor tympani muscle.
- The thin, bony septum, which separates the canals, is prolonged backward on the medial wall, where it forms a shelflike projection.
- 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.

Walls of Middle Ear



The posterior wall

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

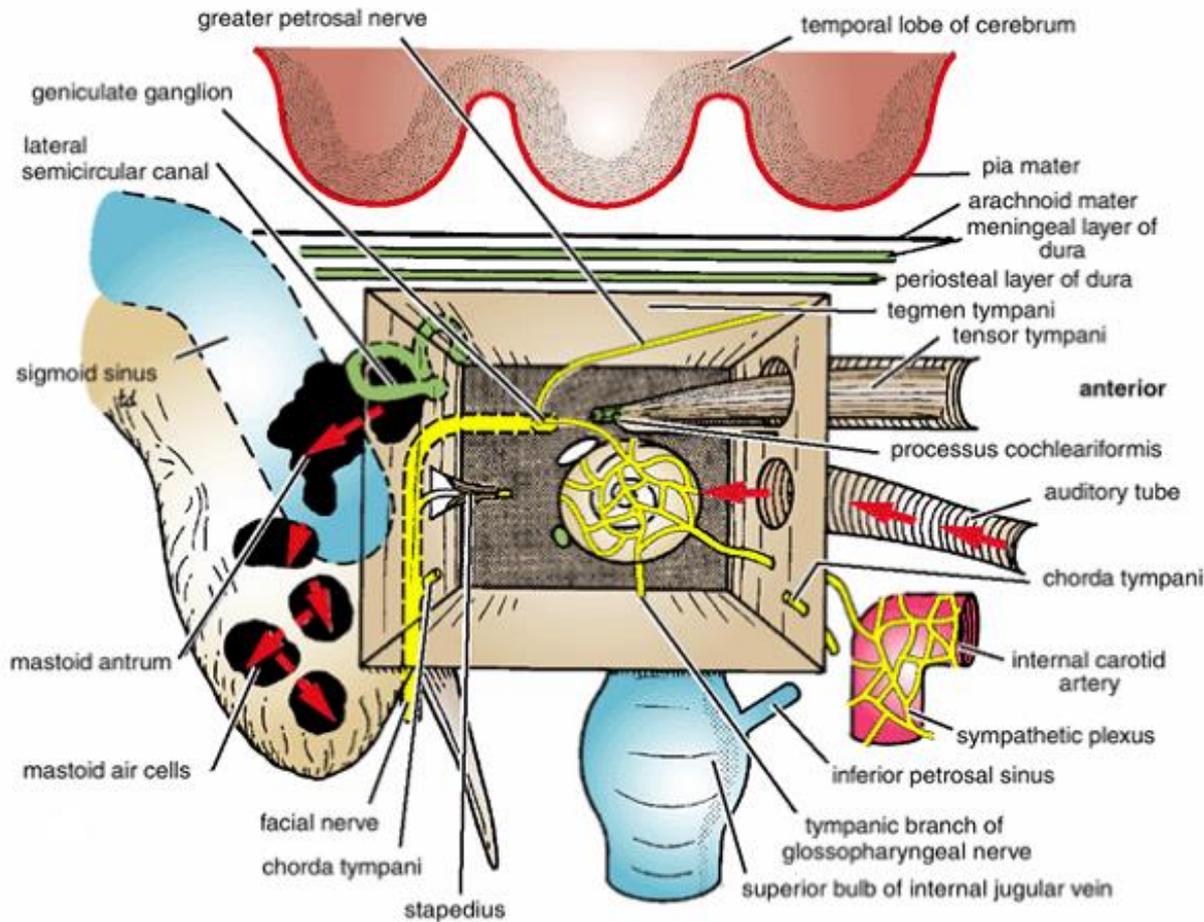
Walls of Middle Ear

The lateral wall

- is largely formed by the tympanic membrane.

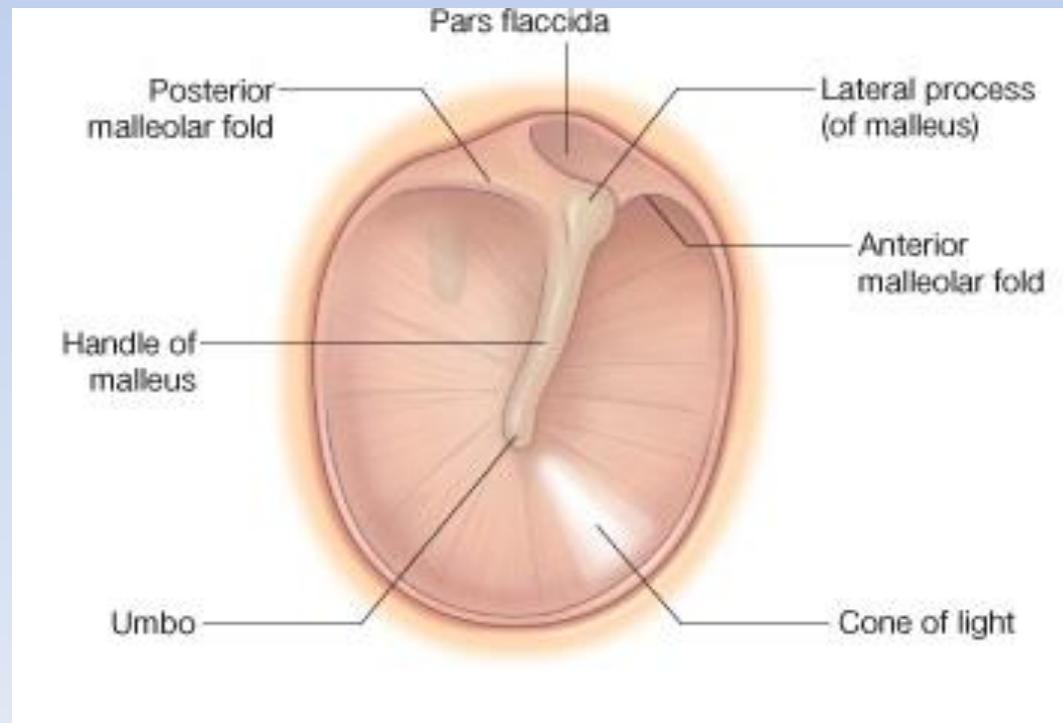
The medial wall

- is formed by the lateral wall of the inner ear.
- The greater part of the wall shows a rounded projection, called the **promontory**, which results from the underlying first turn of the cochlea.
- Above and behind the promontory lies the **fenestra vestibuli**, which is oval shaped and closed by the base of the stapes.
- On the medial side of this window is the perilymph of the **scala vestibuli** of the internal ear.
- Below the posterior end of the promontory lies the **fenestra cochleae**, which is round and closed by the secondary tympanic membrane.
- On the medial side of this window is the perilymph of the blind end of the **scala tympani**.



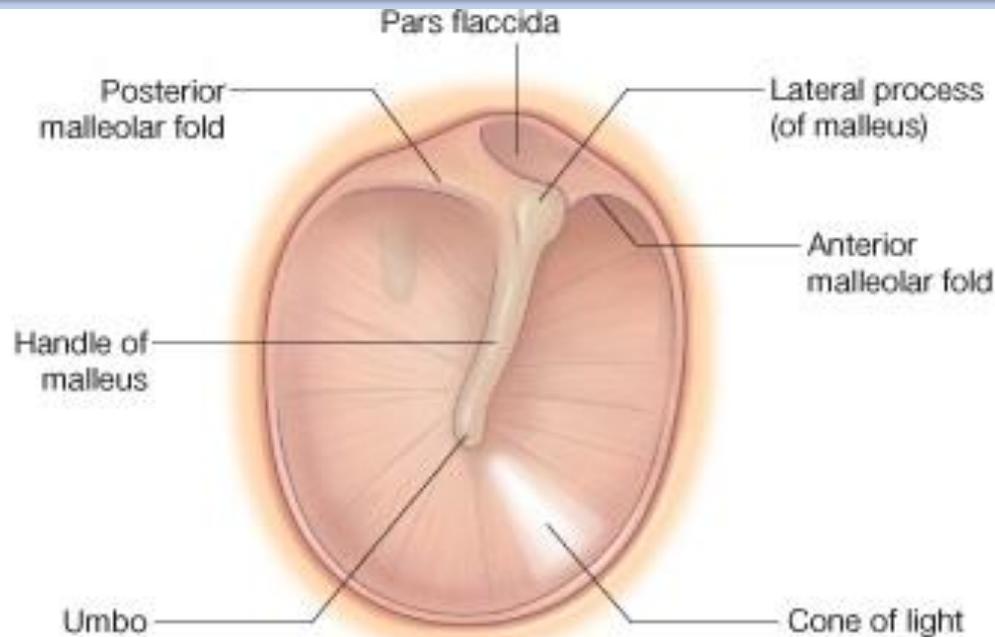
Tympanic membrane

- Is a thin, fibrous membrane that is pearly gray. The membrane 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.
- 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 circular and measures **about 1 cm** in diameter.
- The circumference is thickened and is slotted into a groove in the bone. The groove, or **tympanic sulcus**, is deficient superiorly, which forms a notch.



Tympanic Membrane

- From the sides of the notch, two bands, termed the **anterior** and **posterior malleolar folds**, pass to the lateral process of the malleus.
- The small triangular area on the tympanic membrane that is bounded by the folds is slack and is called the **pars flaccida**.
- The remainder of the membrane is tense and is called the **pars tensa**.
- The handle of the malleus is bound down to the inner surface of the tympanic membrane by the mucous membrane.
- 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.

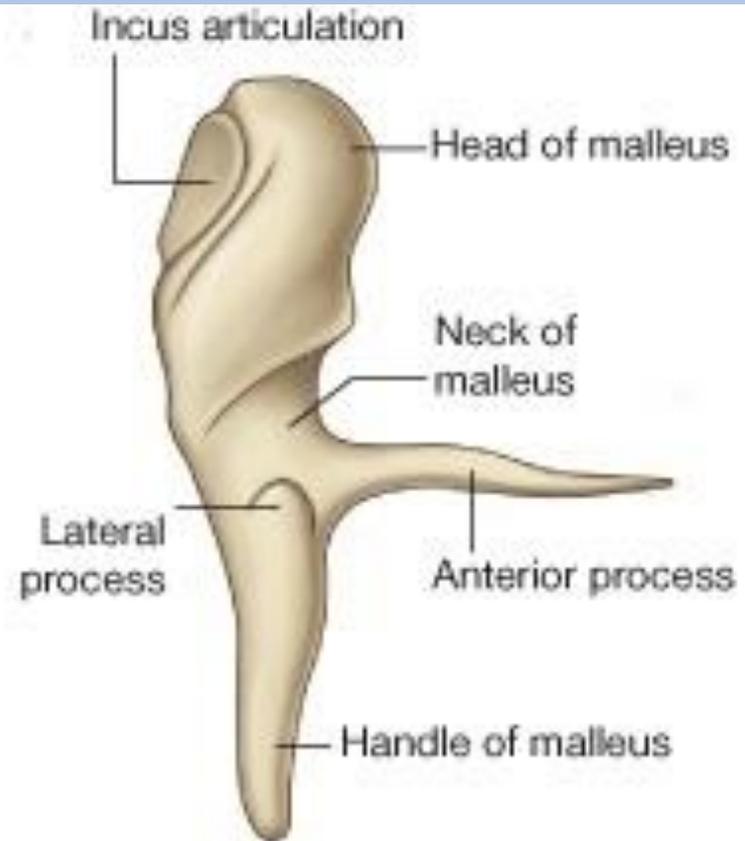


Auditory Ossicles

- The auditory ossicles are the **malleus**, **incus**, and **stapes**.

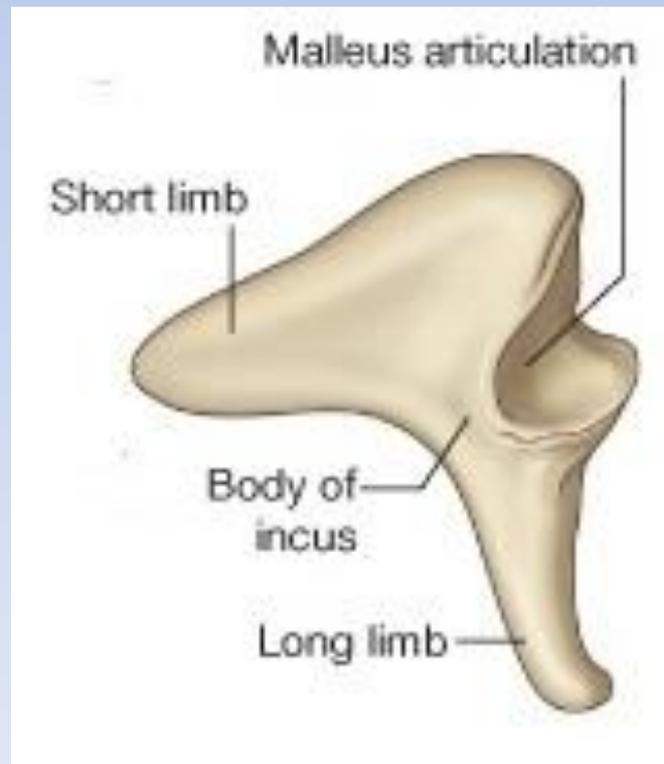
The malleus

- is the largest ossicle and possesses a head, a neck, a long process or handle, an anterior process, and a lateral process.
- The **head** is rounded and articulates posteriorly with the incus.
- The **neck** is the constricted part below the head.
- The **handle** passes downward and backward and is firmly attached to the medial surface of the tympanic membrane.
- It can be seen through the tympanic membrane on otoscopic examination.
- The **anterior process** is a spicule of bone that is connected to the anterior wall of the tympanic cavity by a ligament.
- The **lateral process** projects laterally and is attached to the anterior and posterior malleolar folds of the tympanic membrane.



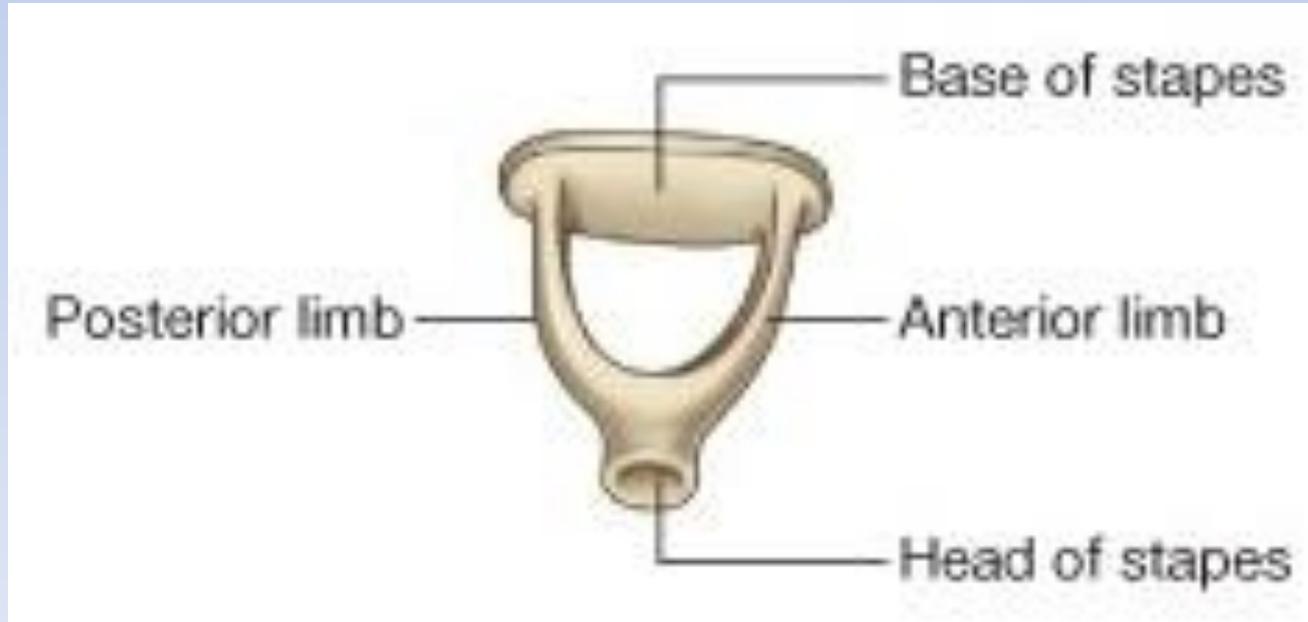
incus

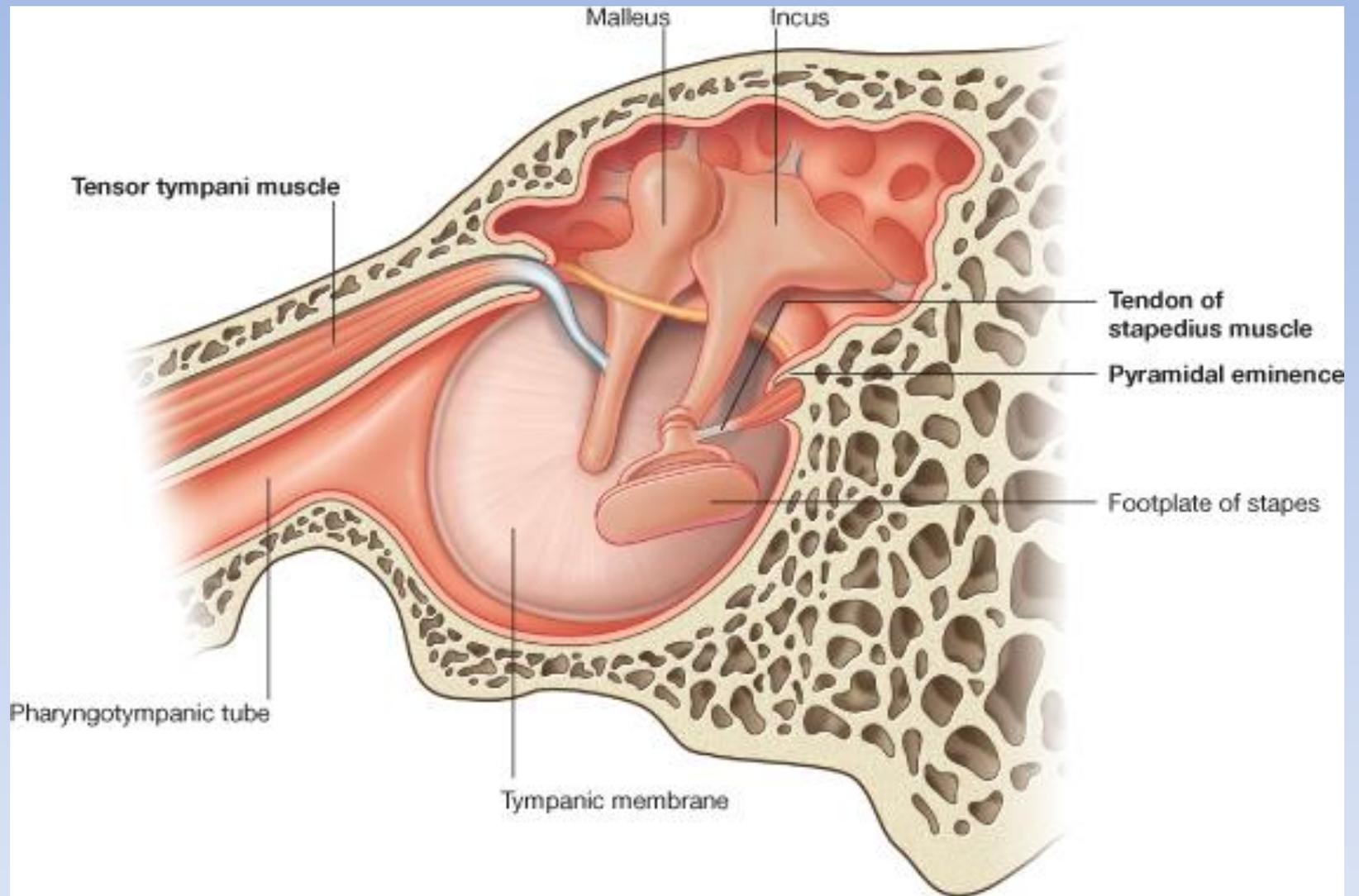
- The **incus** possesses a large body and two processes.
- The **body** is rounded and articulates anteriorly with the head of the malleus.
- The **long process** descends behind and parallel to the handle of the malleus.
- Its lower end bends medially and articulates with the head of the stapes.
- Its shadow on the tympanic membrane can sometimes be recognized on otoscopic examination.
- The **short process** projects backward and is attached to the posterior wall of the tympanic cavity by a ligament.



stapes

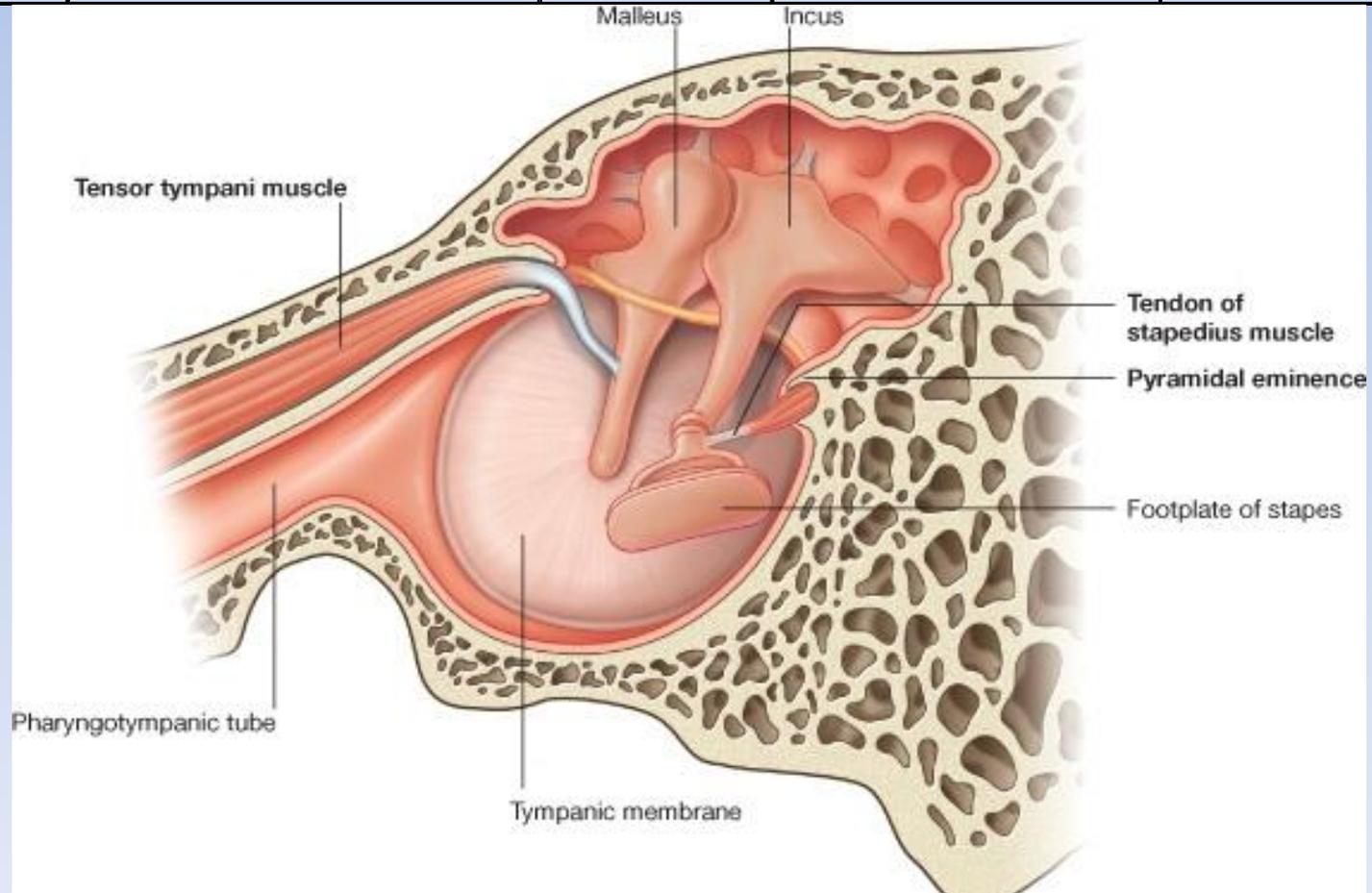
- The **stapes** has a head, a neck, two limbs, and a base.
- The **head** is small and articulates with the long process of the incus.
- The **neck** is narrow and receives the insertion of the stapedius muscle.
- The **two limbs** diverge from the **neck** and are attached to the oval **base**.
- The edge of the base is attached to the margin of the fenestra vestibuli by a ring of fibrous tissue, the **annular ligament**.





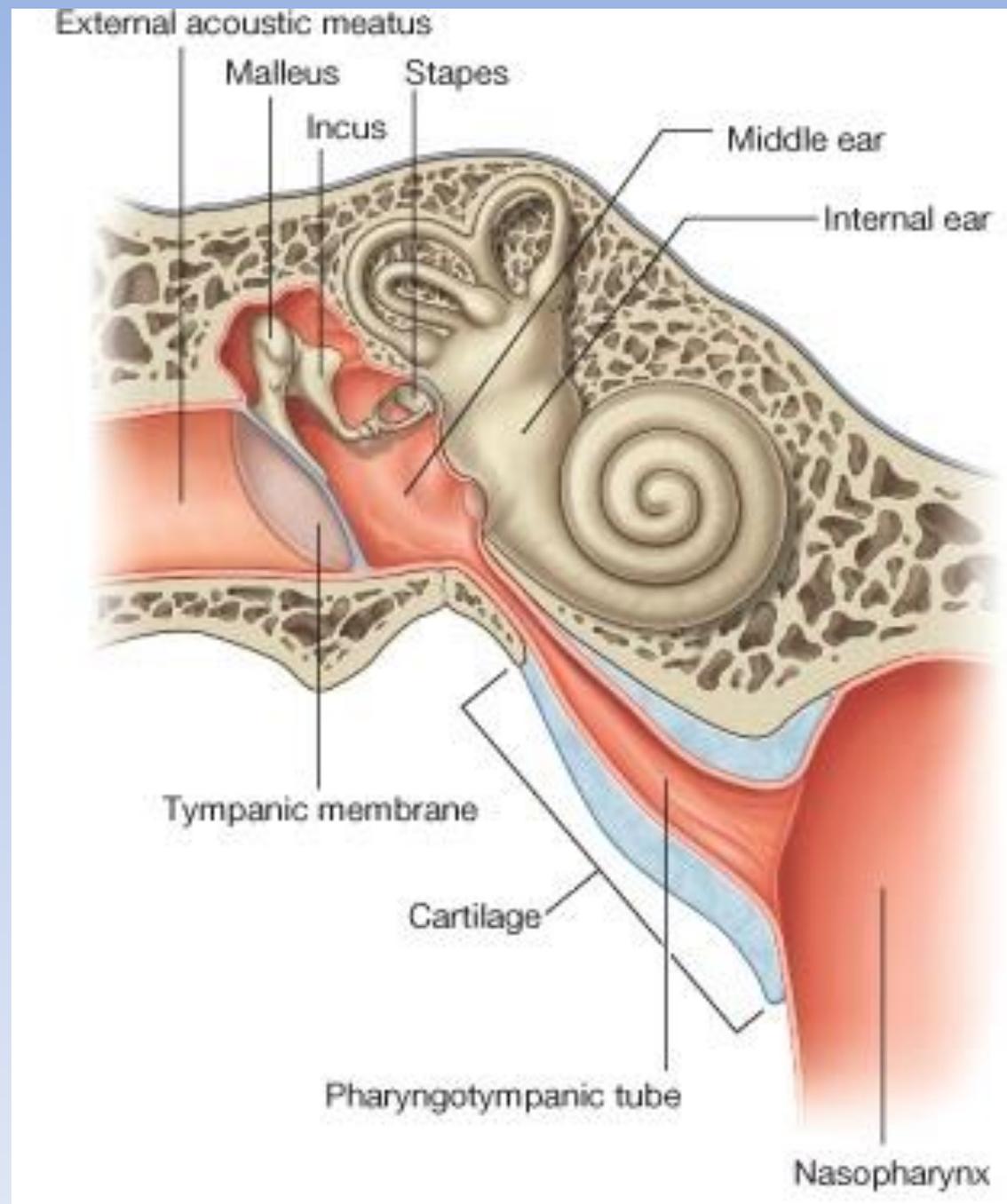
Muscles of the Middle Ear

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



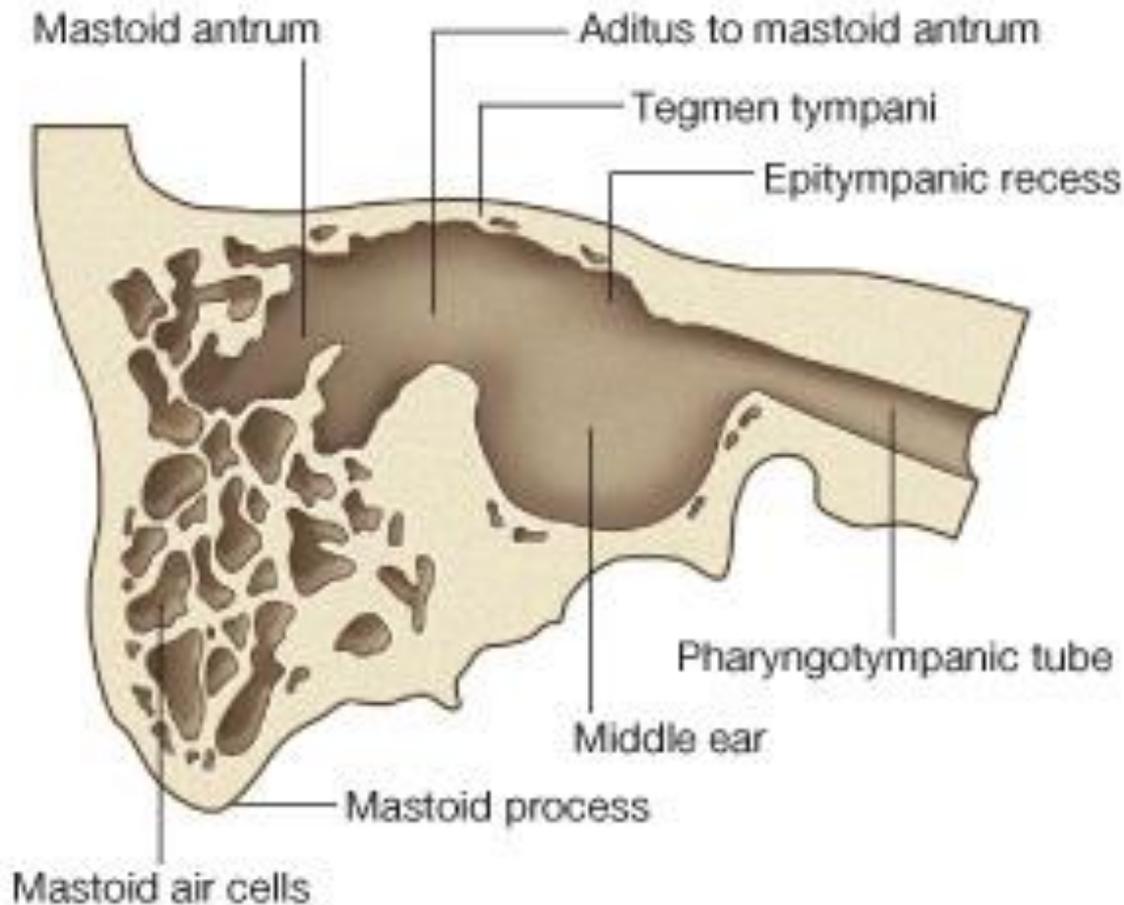
Auditory Tube

- The auditory tube connects the anterior wall of the **tympanic cavity** to the **nasal pharynx**.
- Its posterior third is bony, and its 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.



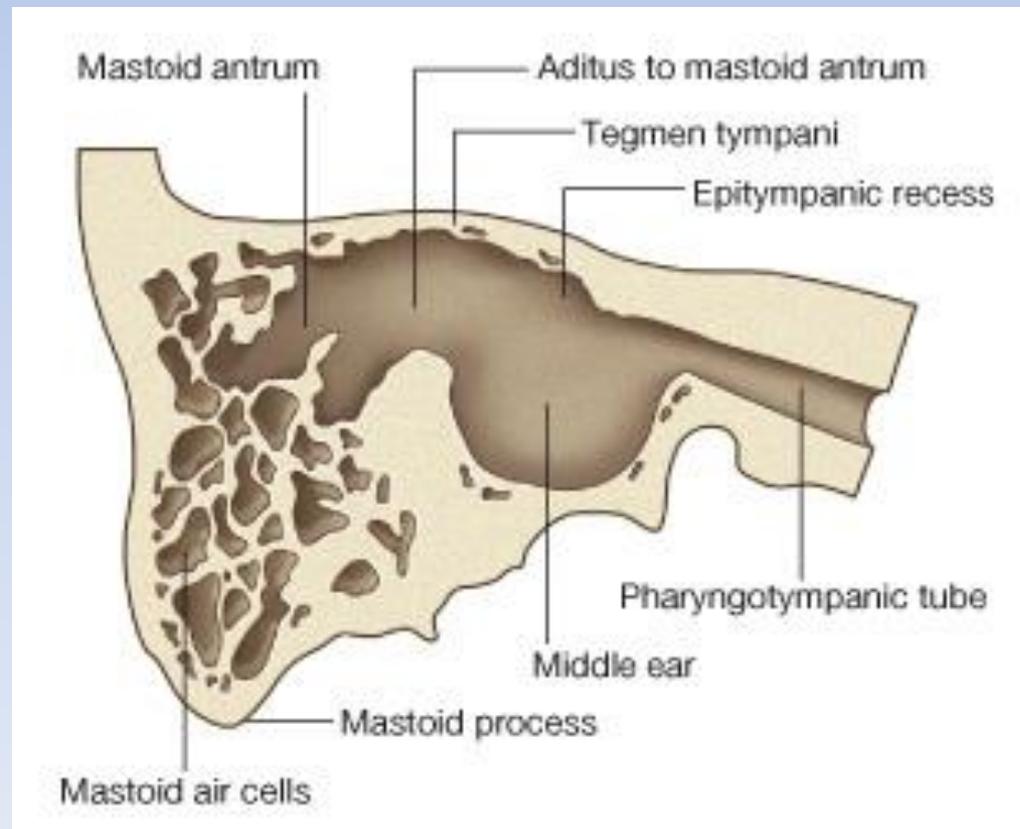
Mastoid Antrum

- 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.
- **Inferior wall** is perforated with holes, through which the antrum communicates with the mastoid air cells.



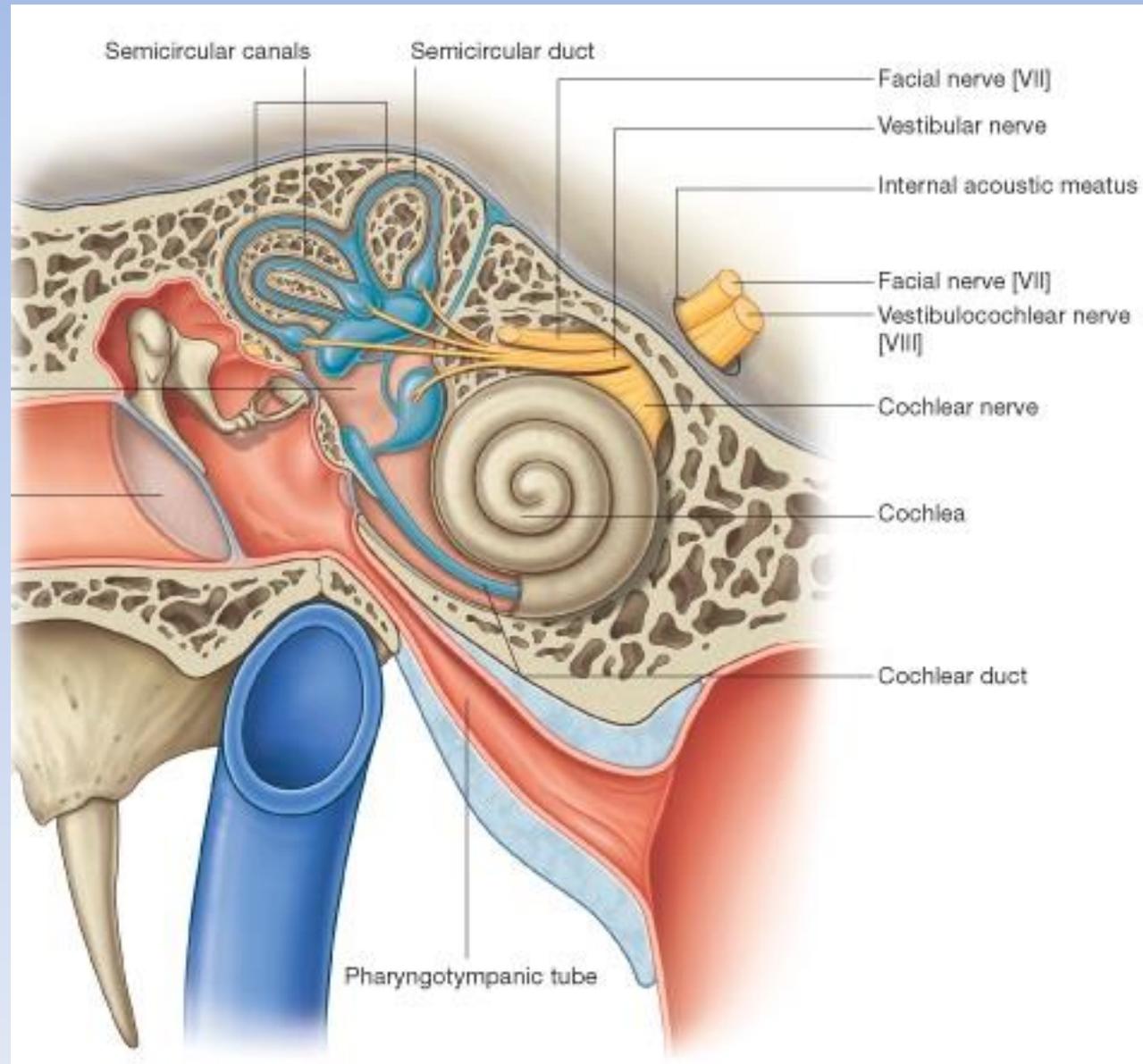
Mastoid Air Cells

- The mastoid process begins to develop during the second year of life.
- The mastoid air cells are a series of communicating cavities within the process that are continuous above with the antrum and the middle ear.
- They are lined with mucous membrane.



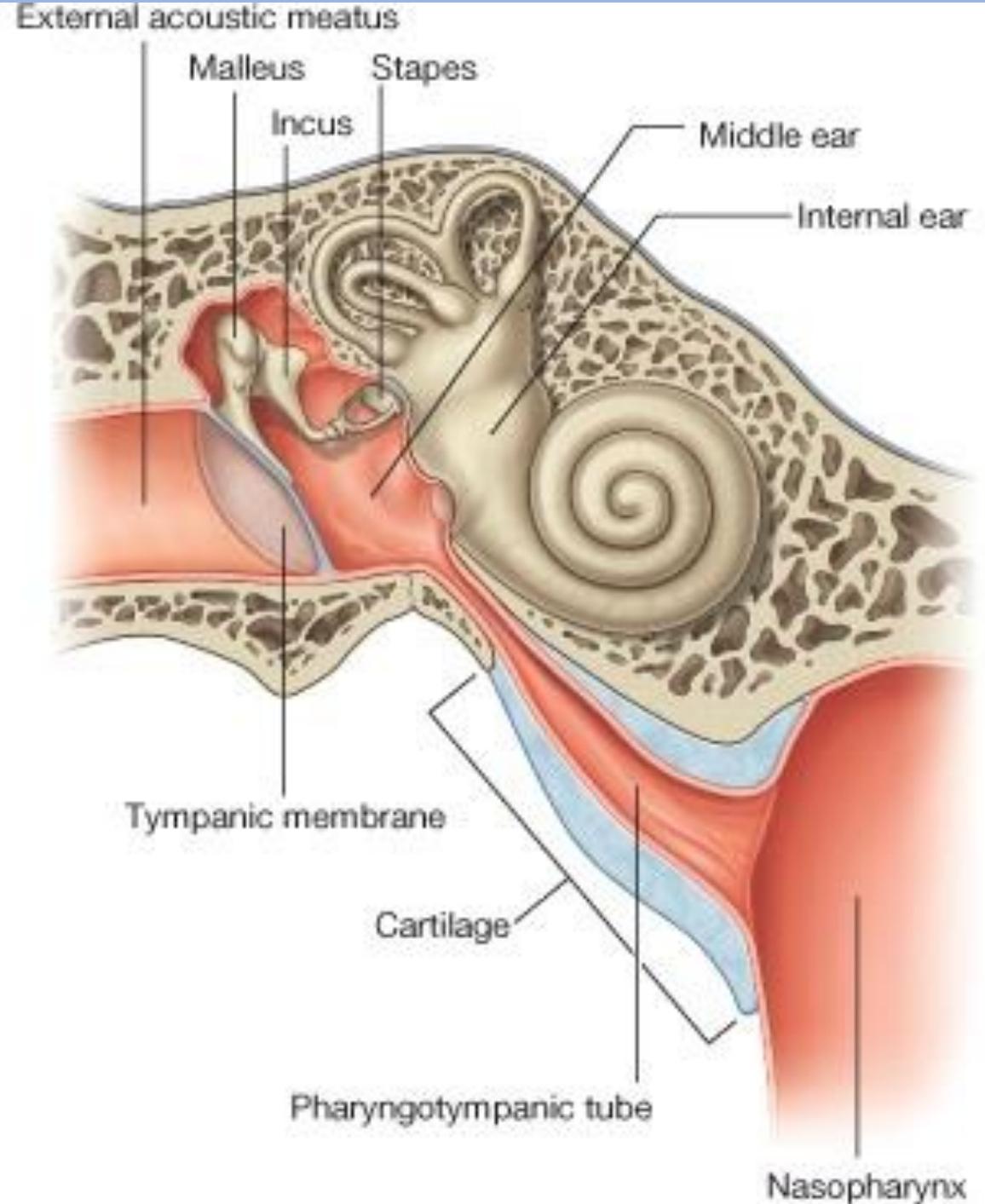
The Internal Ear, or Labyrinth

- The labyrinth is situated in the petrous part of the temporal bone, medial to the middle ear.
- It consists of the **bony labyrinth**, comprising a series of cavities within the bone, and the **membranous labyrinth**, comprising a series of membranous sacs and ducts contained within the bony labyrinth.



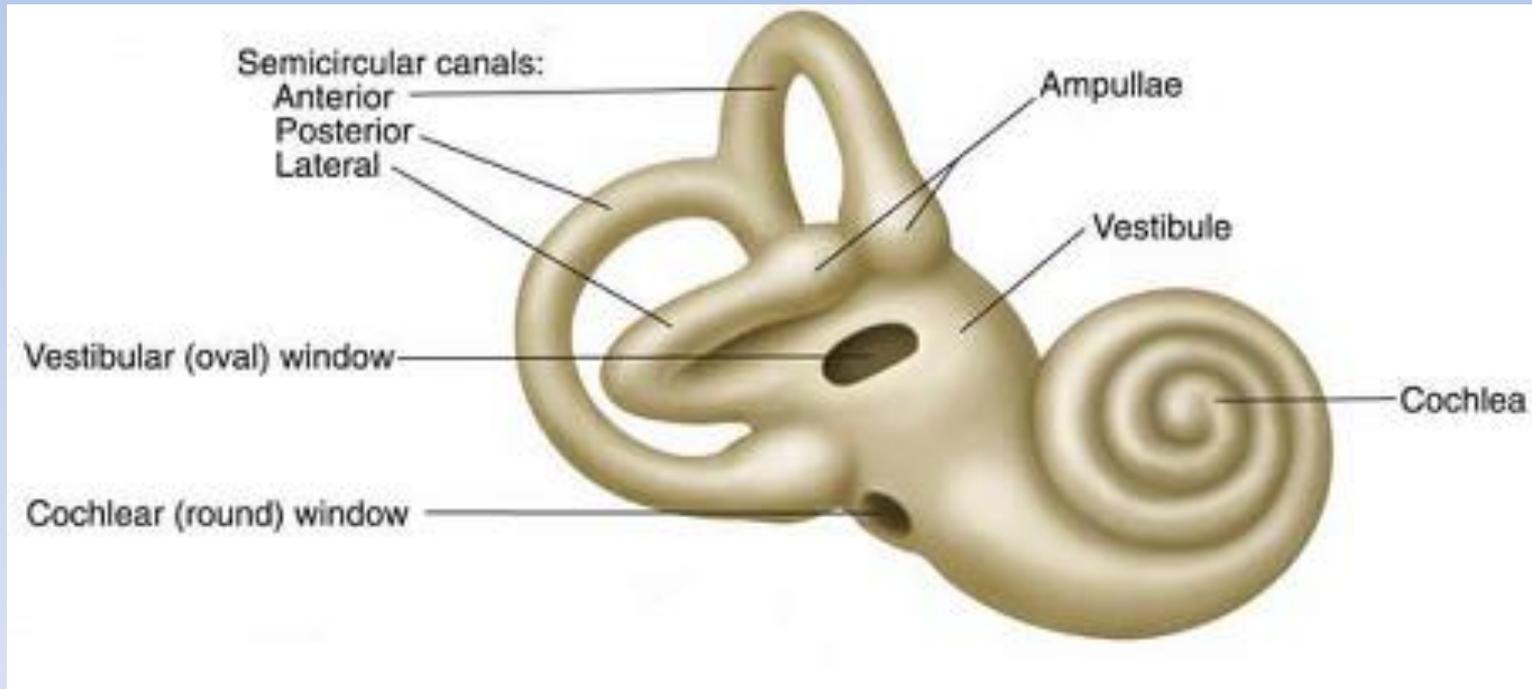
Bony Labyrinth

- The bony labyrinth consists of three parts: the vestibule, the semicircular canals, and the cochlea.



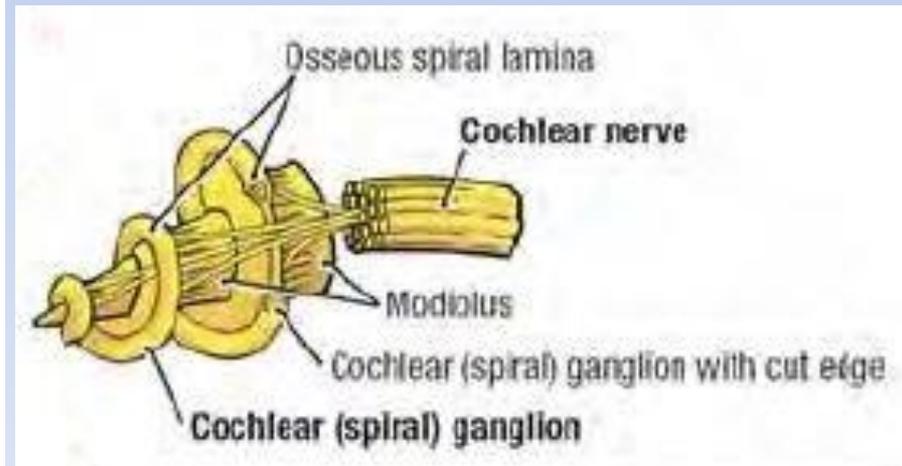
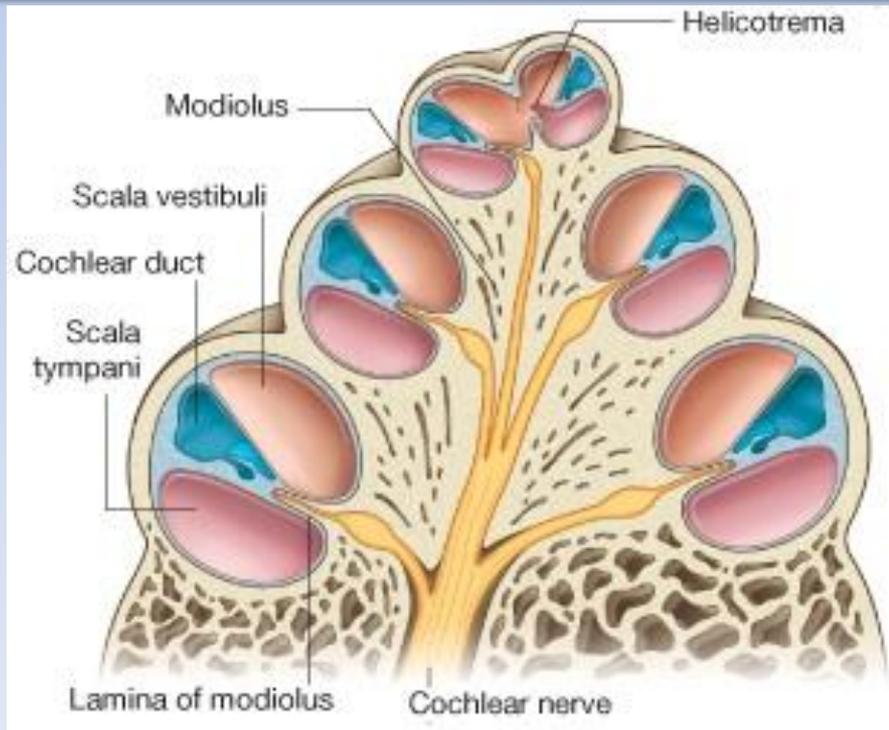
Cochlea

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



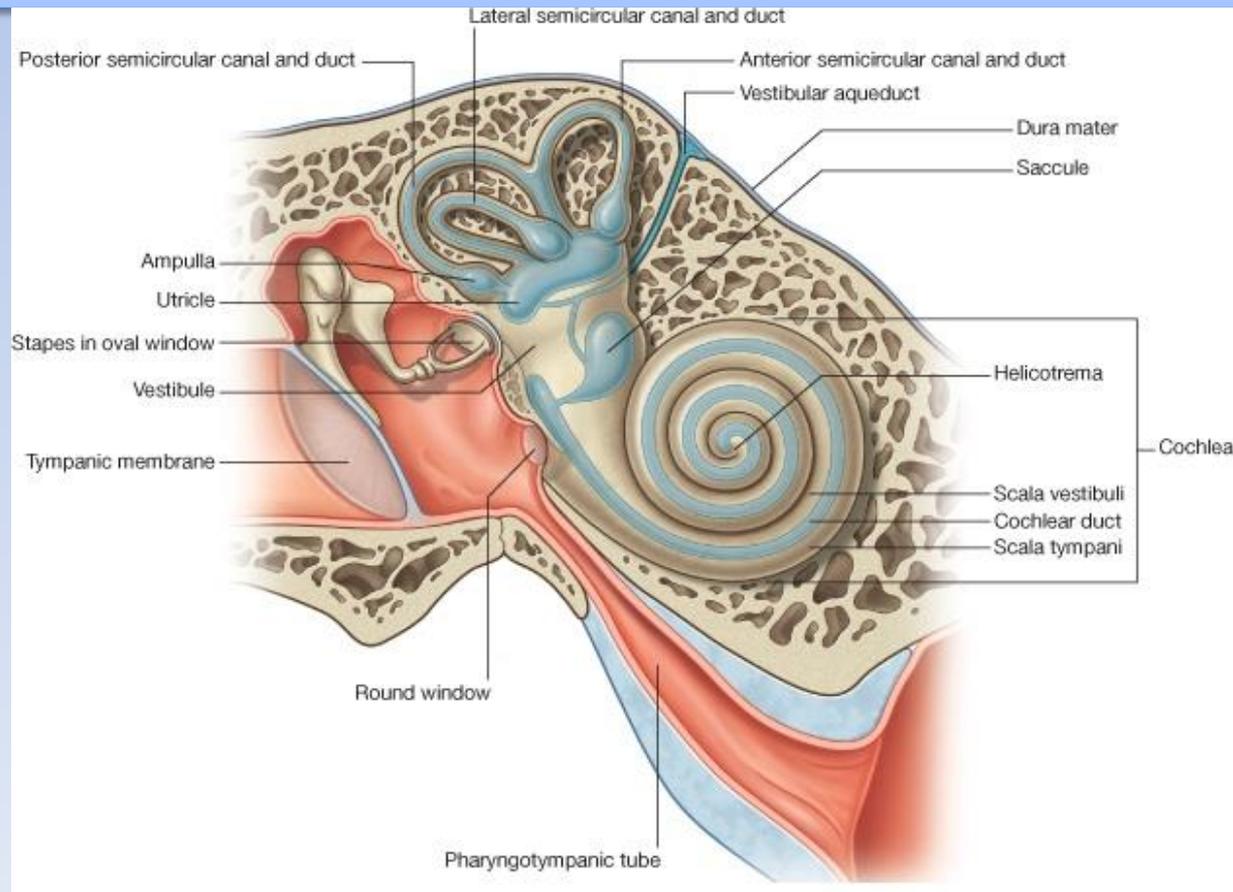
Modiolus

- The **modiolus** has a broad base, which is situated at the bottom of the internal acoustic meatus.
- It is perforated by branches of the cochlear nerve. 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.
- The perilymph within the scala vestibuli is separated from the middle ear by the base of the stapes and the annular ligament at the fenestra vestibuli.
- The perilymph in the scala tympani is separated from the middle ear by the secondary tympanic membrane at the fenestra cochleae.



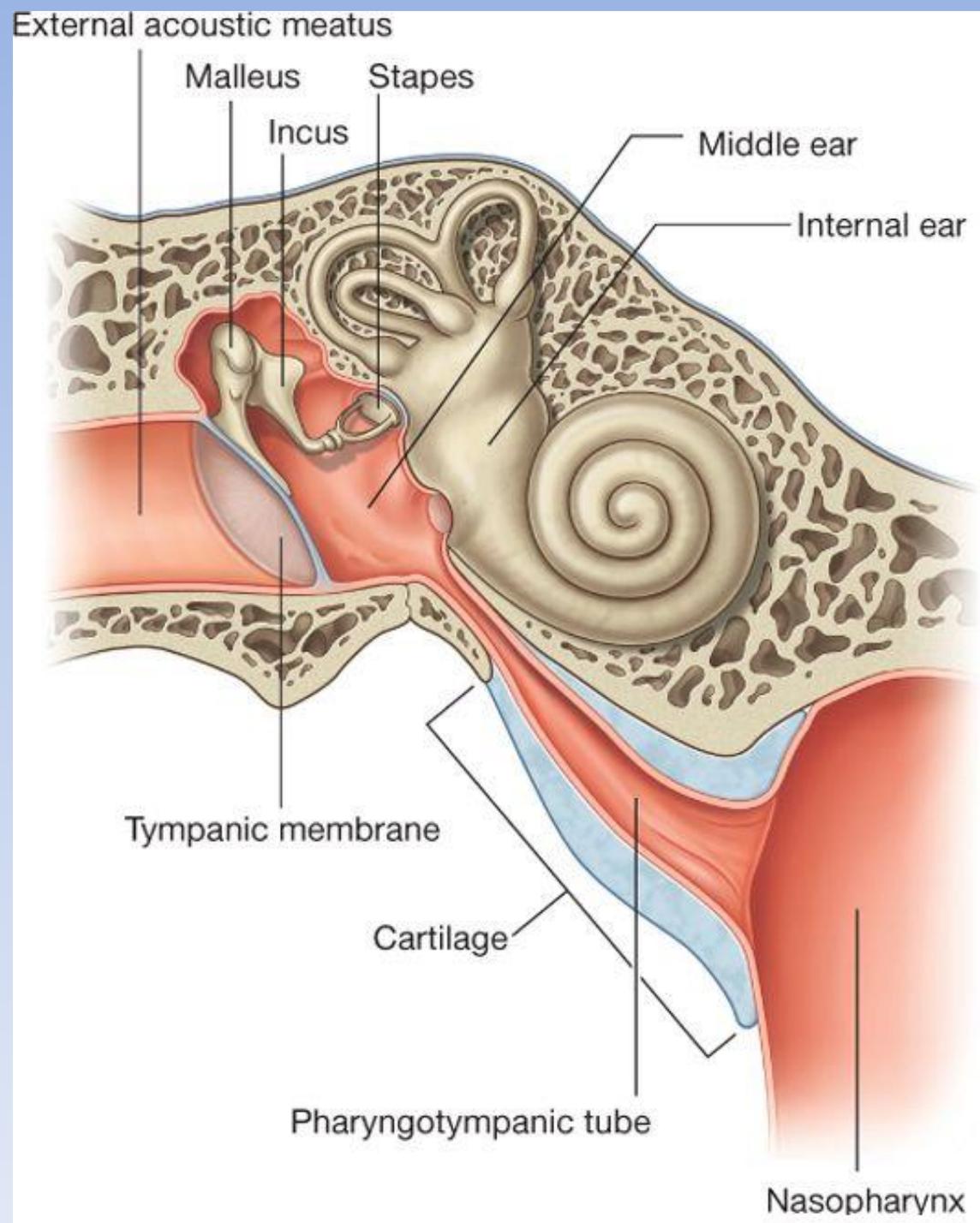
The Vestibule

- The **vestibule**, the 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 **anular ligament**, and
- the **fenestra cochleae**, which is closed by the **secondary tympanic membrane**.
- Lodged within the vestibule are the **saccul**e and **utricle** of the membranous labyrinth.



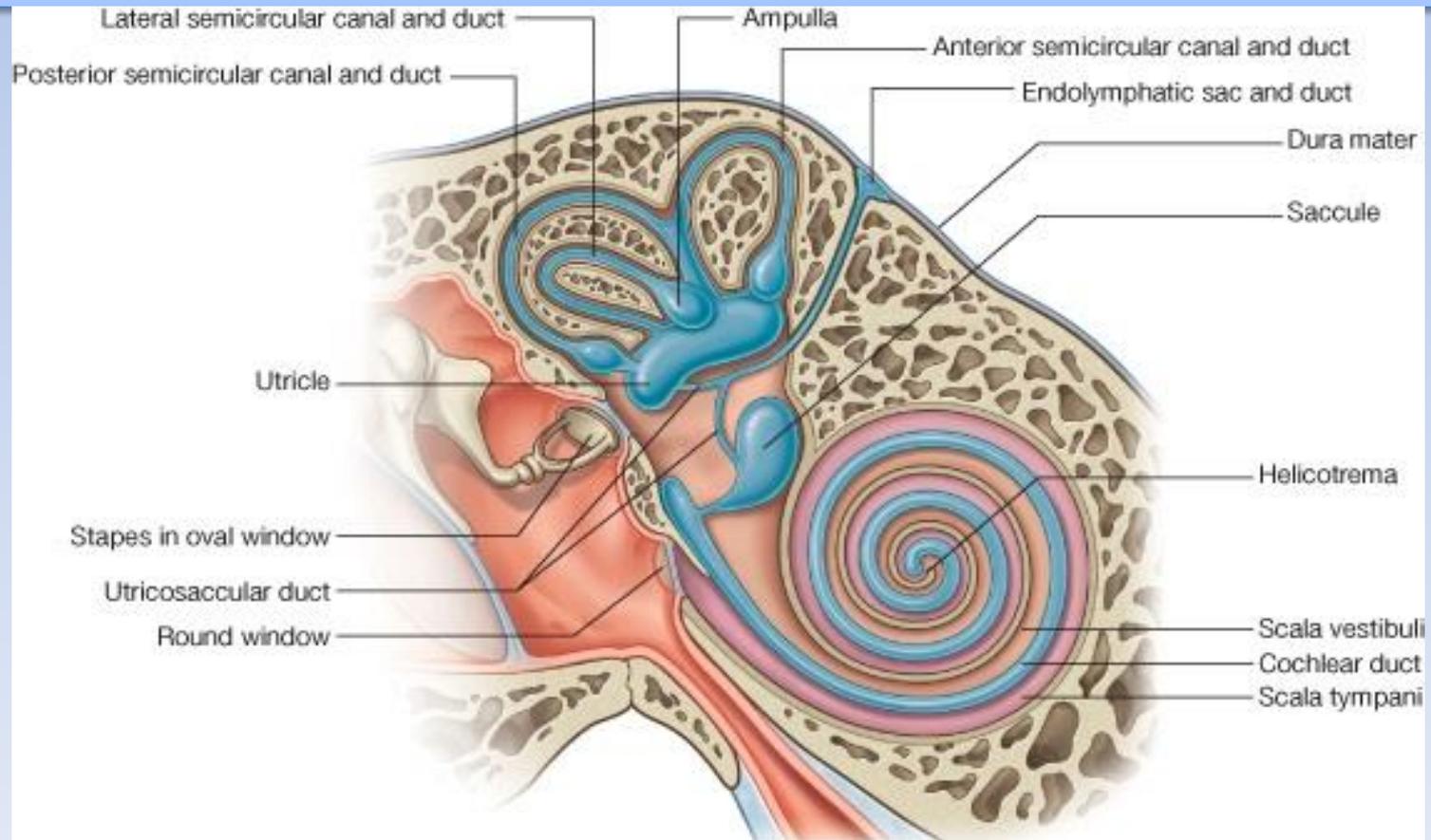
Semicircular Canals

- 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. Lodged within the canals are the **semicircular ducts**.
- 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,



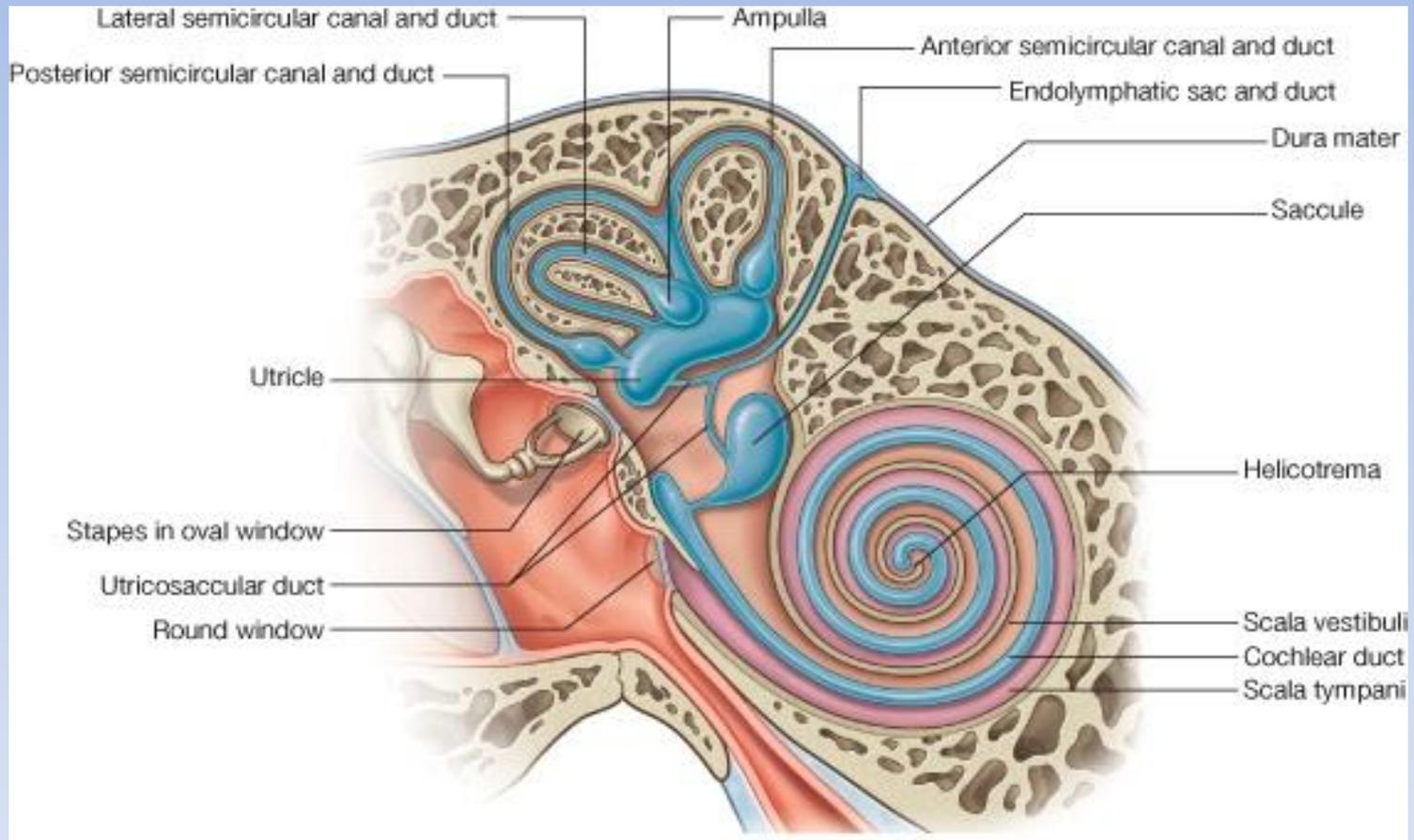
Membranous Labyrinth

- The membranous labyrinth is present within the bony labyrinth.
- It is filled with **endolymph** and surrounded by **perilymph**.
- It consists of the **utricle** and **sacculle**, which are lodged in the bony vestibule; the three **semicircular ducts**, which lie within the bony semicircular canals; and the **duct of the cochlea**, which lies within the bony cochlea.
- All these structures freely communicate with one another.



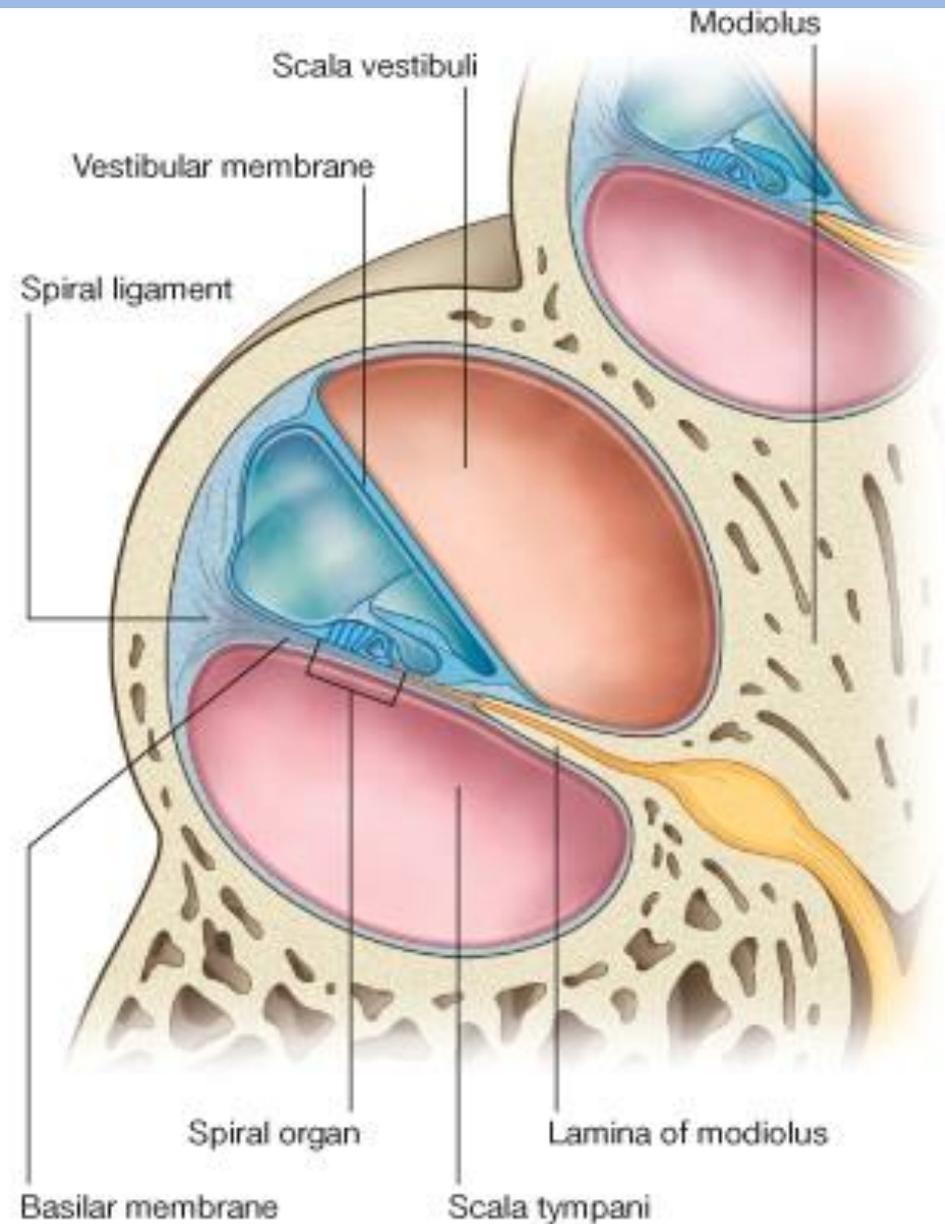
Utricle and Saccule

- 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.



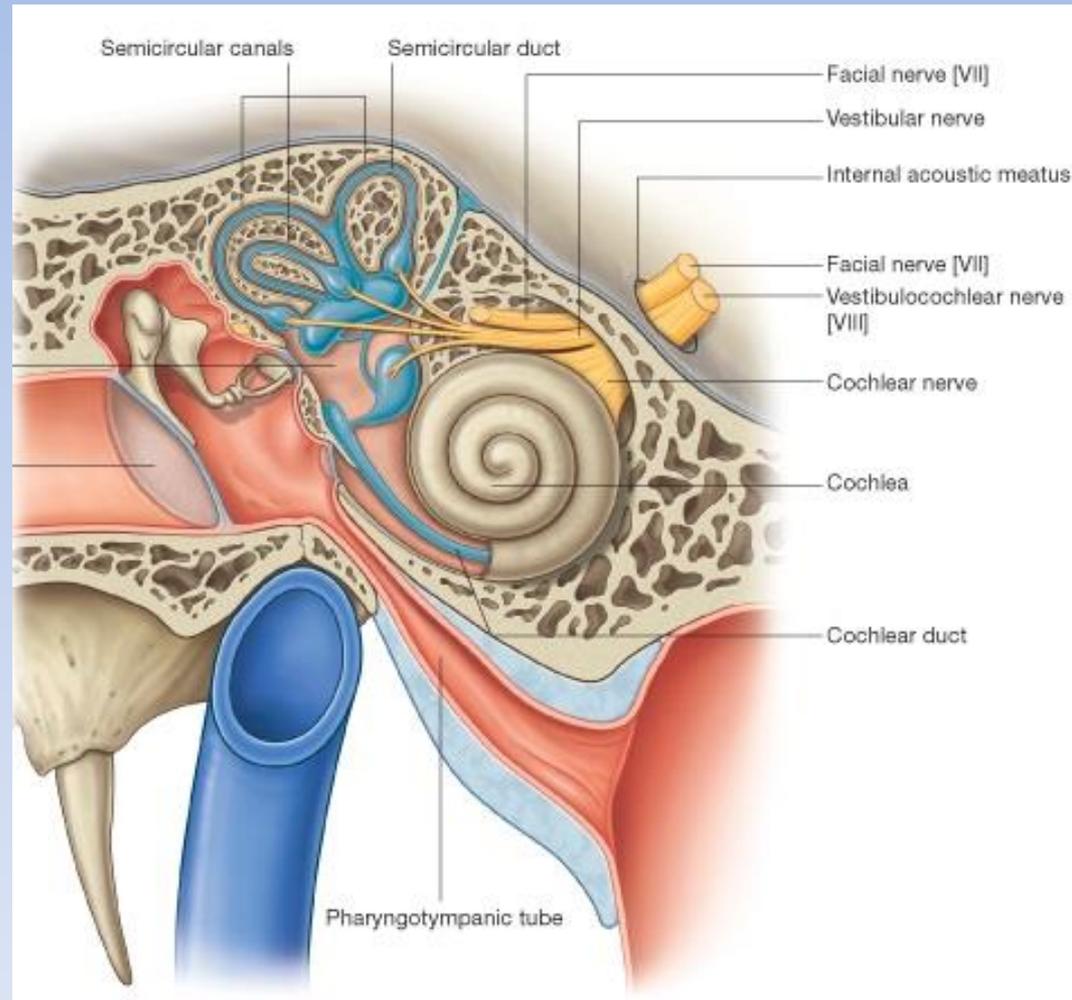
Duct of the Cochlea

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



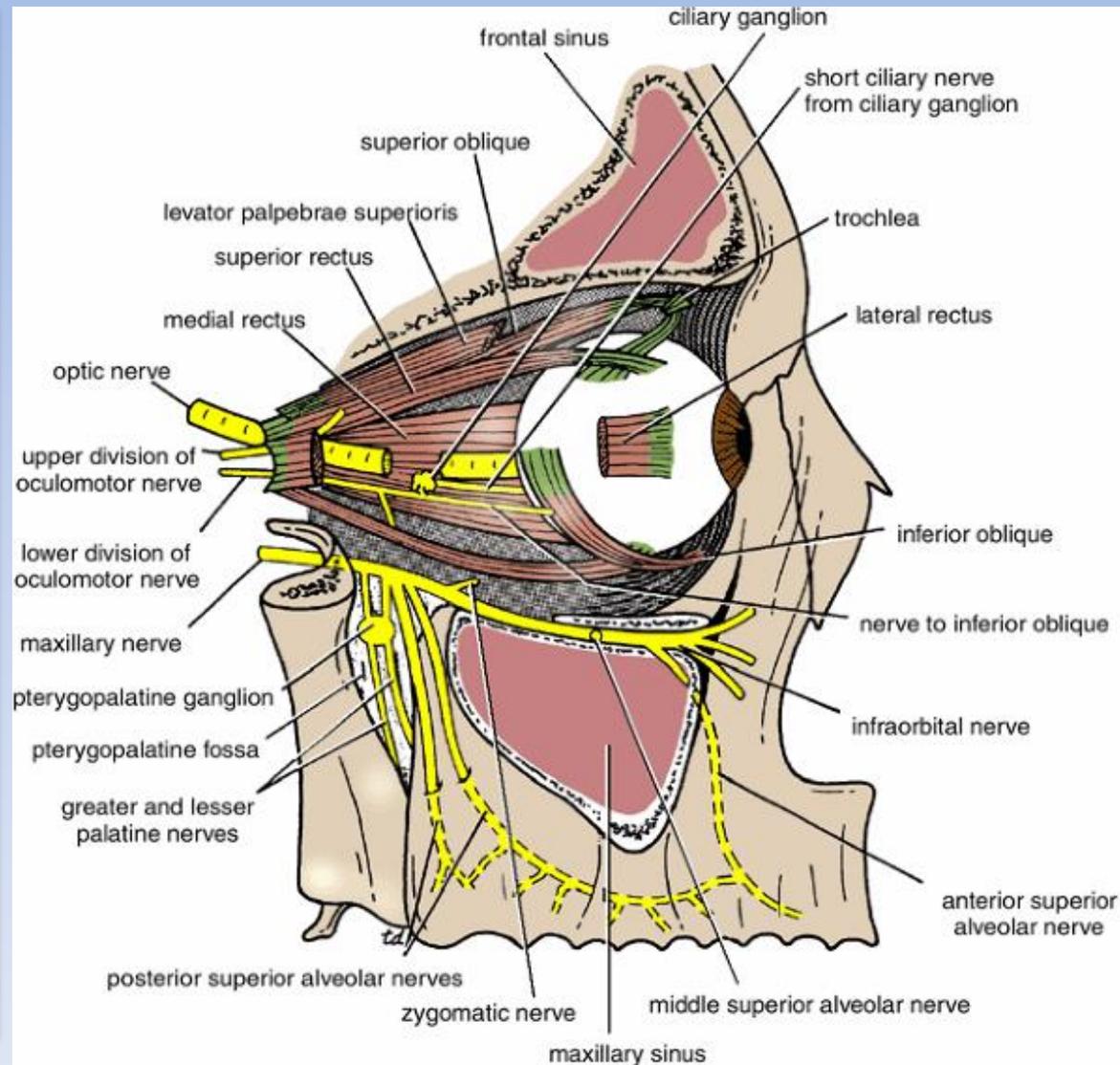
Vestibulocochlear Nerve

- On reaching the bottom of the internal acoustic meatus, the nerve divides into vestibular and cochlear portions.



Maxillary Nerve (V2)

- The maxillary nerve arises from the trigeminal ganglion in the middle cranial fossa.
- It passes forward in the lateral wall of the cavernous sinus and leaves the skull through the **foramen rotundum** to enter the **pterygopalatine fossa**.
- The nerve crosses the fossa and enters the orbit by passing through the **inferior orbital fissure**.
- The nerve is now called the **infraorbital nerve**, and it runs forward on the floor of the orbit, first in the infraorbital groove and then in the infraorbital canal.
- It appears on the face by emerging through the **infraorbital foramen**.



A meningeal branch

- supplies the dura in the middle cranial fossa.

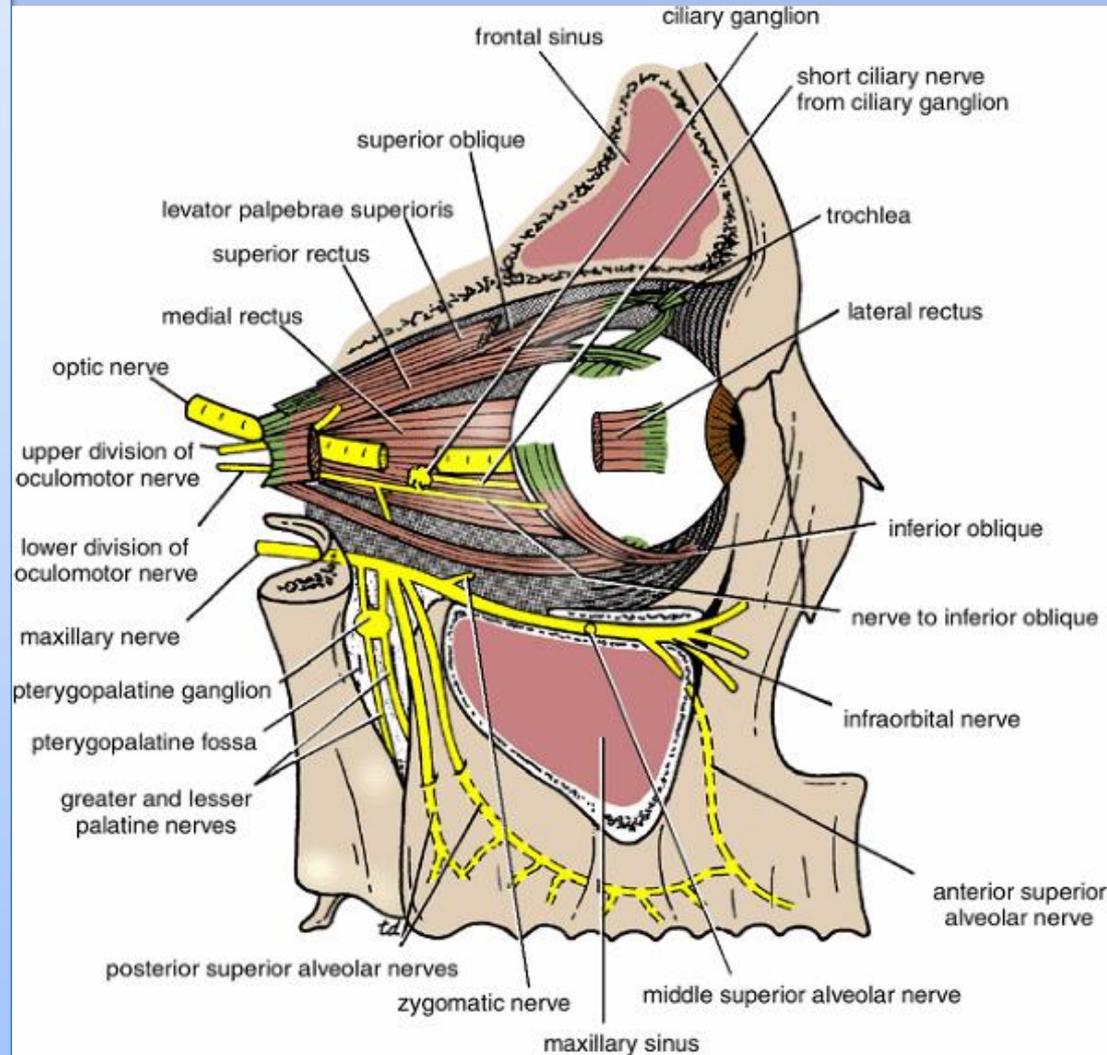
The ganglionic branches

- are two short nerves that hold the pterygopalatine ganglion in the pterygopalatine fossa.
- They contain sensory fibers that without interruption have passed through the ganglion from the nose, palate, and pharynx.
- They also contain postganglionic parasympathetic fibers that are going to the lacrimal gland.

The zygomatic nerve

- It arises in the pterygopalatine fossa and enters the orbit through the inferior orbital fissure.
- It ascends on the lateral wall of the orbit and divides into the zygomaticotemporal and zygomaticofacial nerves, which are distributed to the skin of the face.

Branches of the Maxillary Nerve



The Posterior superior alveolar nerve

- arises in the pterygopalatine fossa.
- It passes downward on the back of the maxilla and pierces its posterior surface.
- It supplies the maxillary sinus, the upper molar teeth, and the adjacent parts of the gum and cheek.

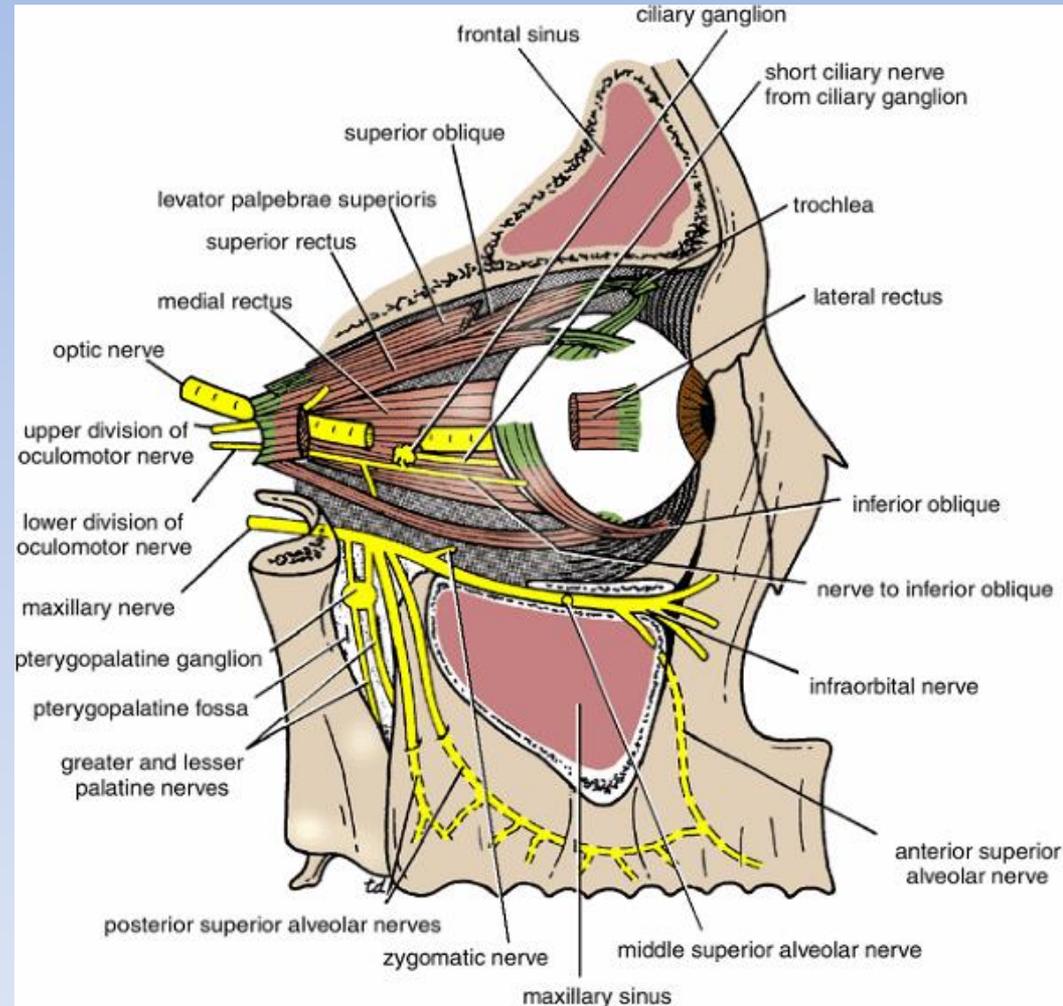
The middle superior alveolar nerve

- arises from the infraorbital nerve as it lies in the infraorbital groove.
- It descends in the lateral wall of the maxillary sinus and supplies the upper premolar teeth and the adjacent parts of the gum and cheek.

The anterior superior alveolar nerve

- arises from the infraorbital nerve as it lies in the infraorbital canal.
- It descends in the lateral wall of the maxillary sinus and supplies the upper canine and incisor teeth.
- A **small terminal branch** supplies part of the lateral wall and floor of the nose.

Branches of the Maxillary Nerve



Pterygopalatine Ganglion

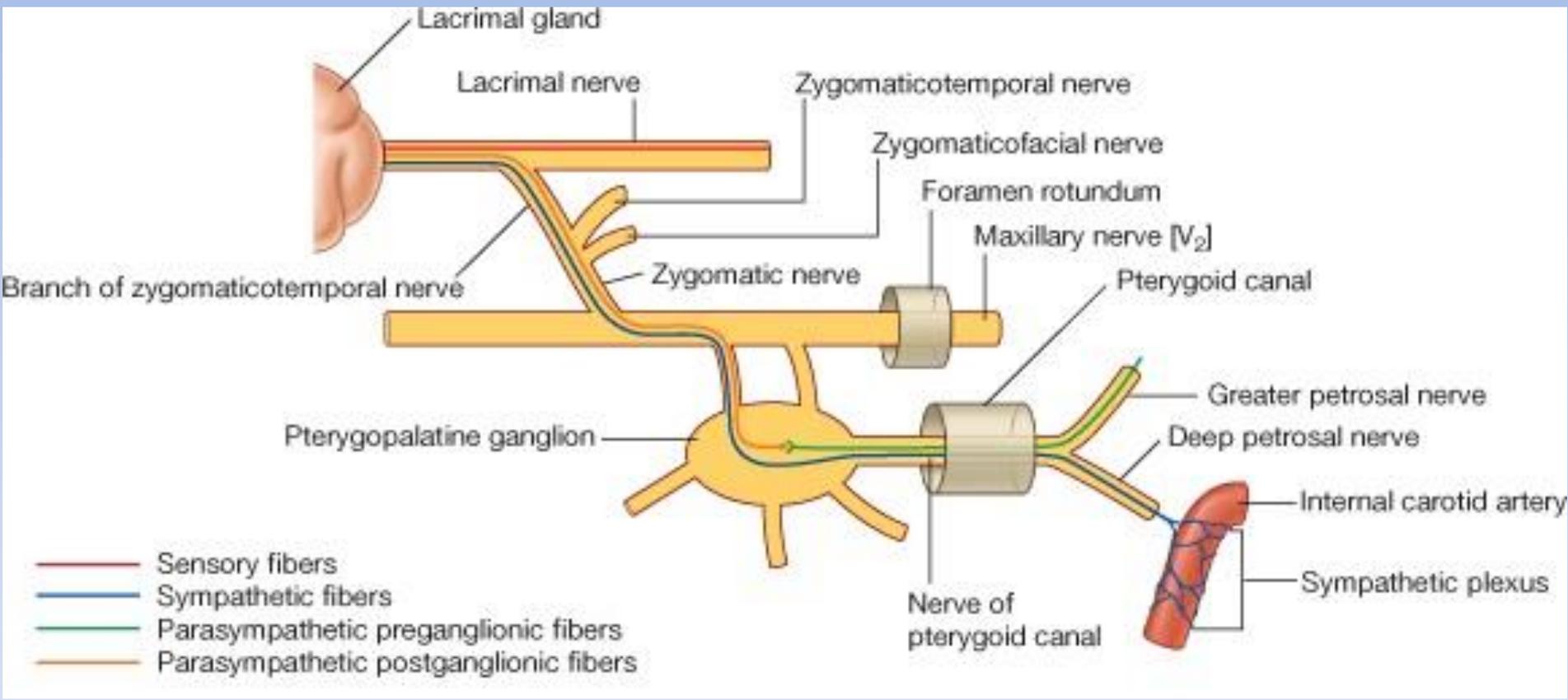
- The pterygopalatine ganglion is a parasympathetic ganglion that is deeply placed in the pterygopalatine fossa.

The preganglionic secretomotor fibers

- arise in the **lacrimal nucleus** of the facial nerve. They run in the sensory root of the facial nerve, then in the greater petrosal branch, and then in the nerve of the pterygoid canal, which enters the posterior surface of the ganglion.
- The postganglionic fibers reach the maxillary nerve by one of its ganglionic branches. They then run in the zygomatic, the zygomaticotemporal nerve, and the lacrimal nerve to reach the lacrimal gland.
- Other postganglionic fibers run in the palatine nerves and nasal nerves to the palatine and nasal glands.

Sympathetic postganglionic fibers

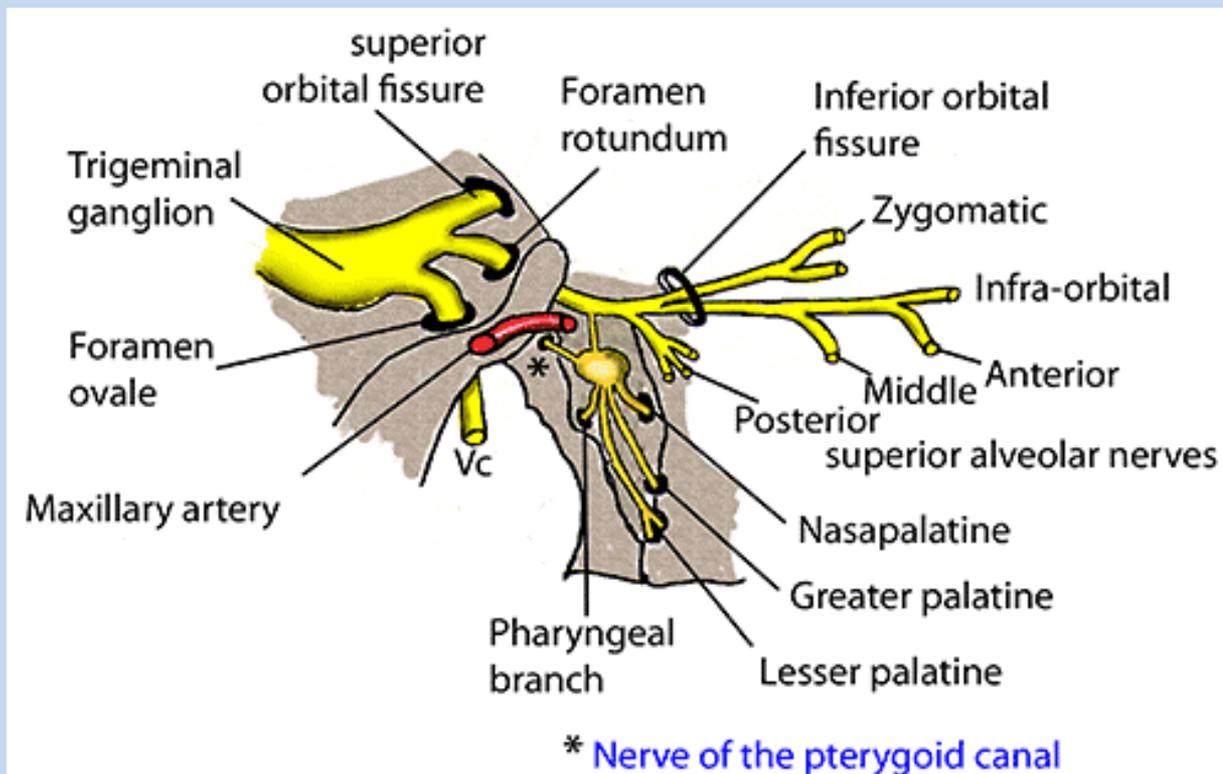
- reach the ganglion via the internal carotid plexus, the deep petrosal nerve, and the nerve of the pterygoid canal.
- They pass without interruption through the ganglion and emerge in the orbital branches of the ganglion. They supply the orbital muscles.



Pterygopalatine Ganglion

Branches

- **Orbital branches:** enter the orbit through the inferior orbital fissure.
- **Greater** and **lesser palatine** nerves supply the mucous membrane of the palate, tonsil, and nasal cavity.
- **Nasal branches** enter the nose through the sphenopalatine foramen and supply the mucous membrane of the nasal cavity.
- **Pharyngeal branch** supplies the mucous membrane of the nasal part of the pharynx.



Maxillary Artery

- The maxillary artery leaves the infratemporal fossa by passing through the pterygomaxillary fissure into the pterygopalatine fossa.
- Here, it splits into branches that accompany the branches of the maxillary nerve.