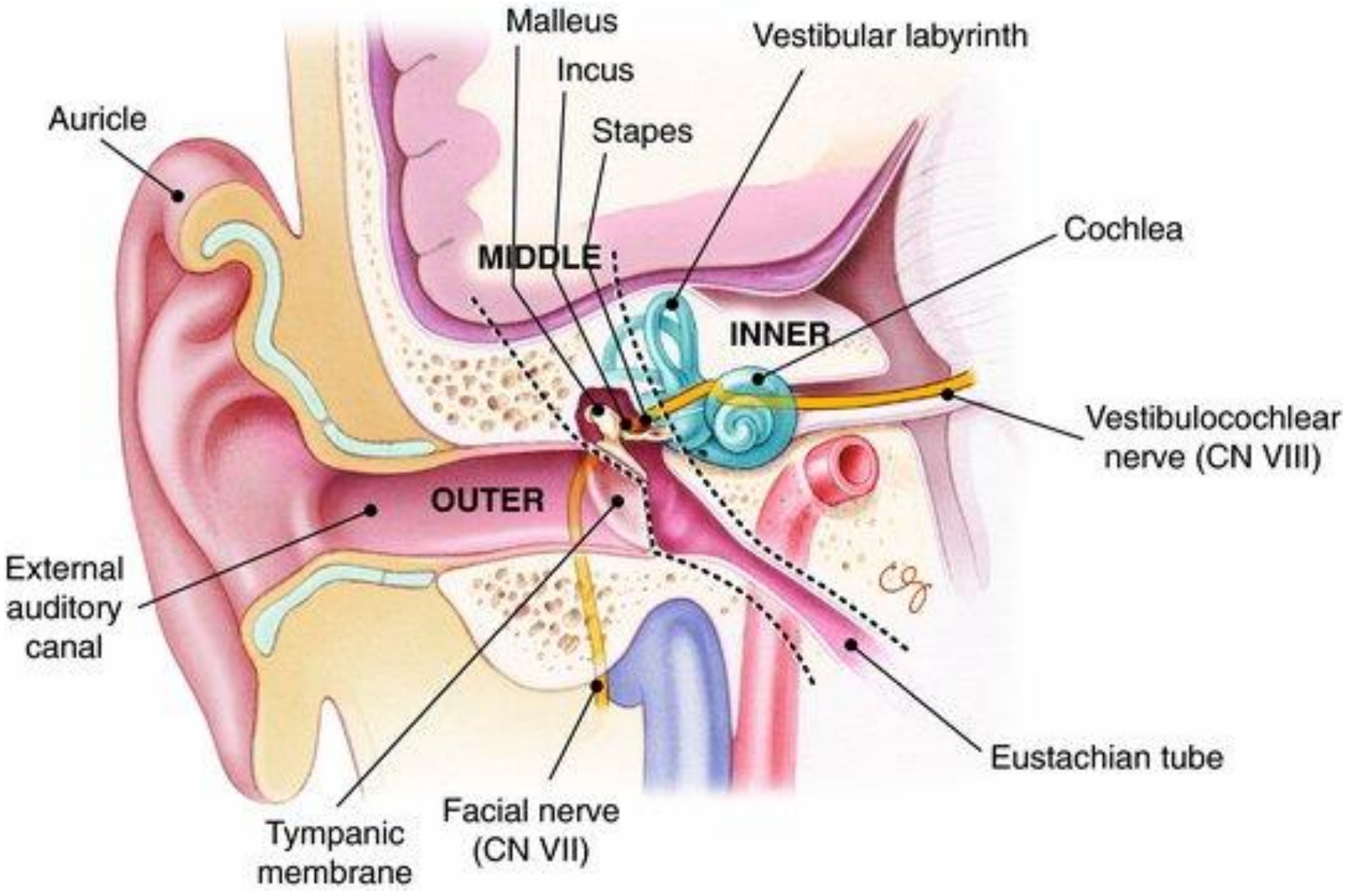
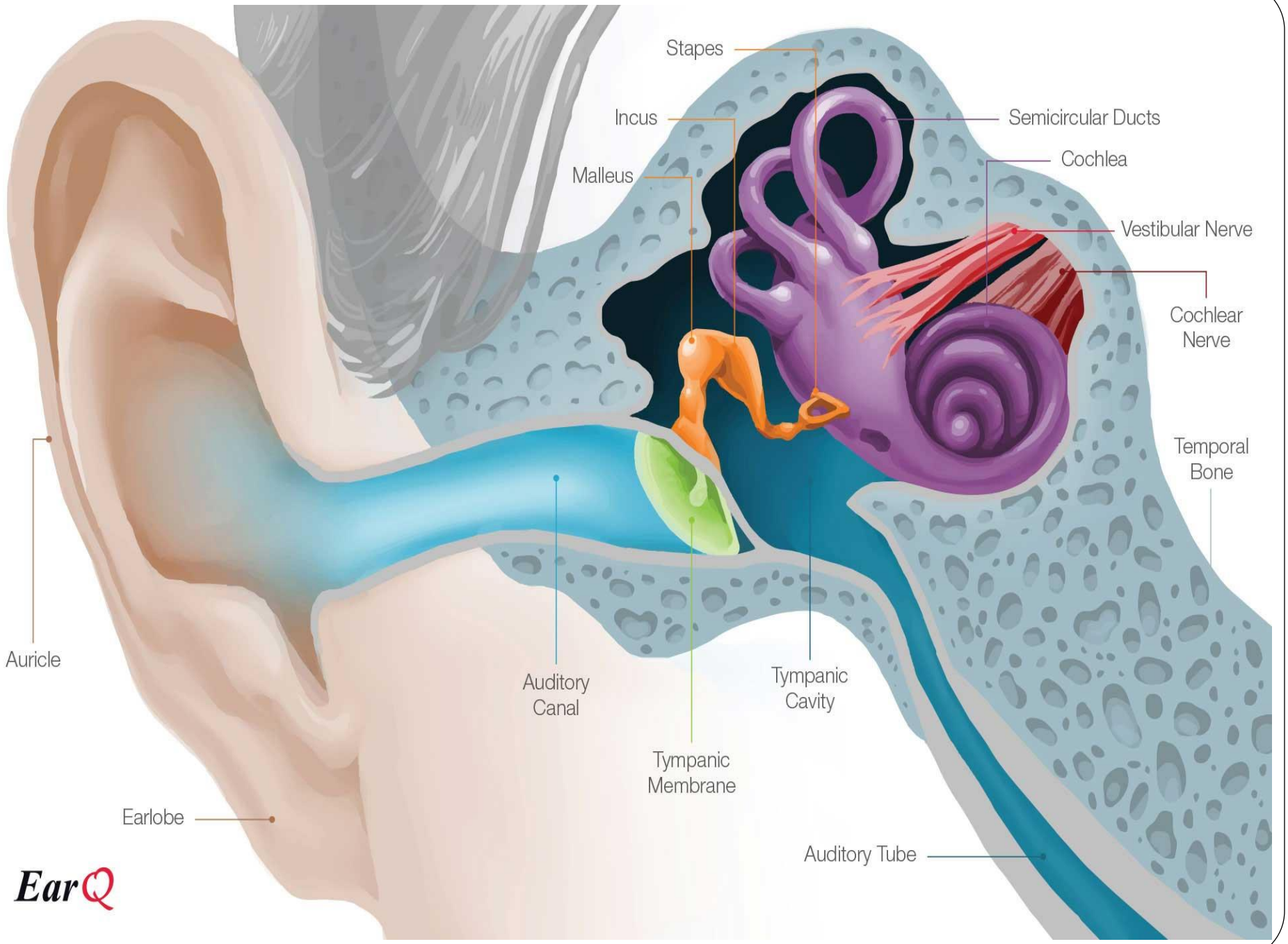
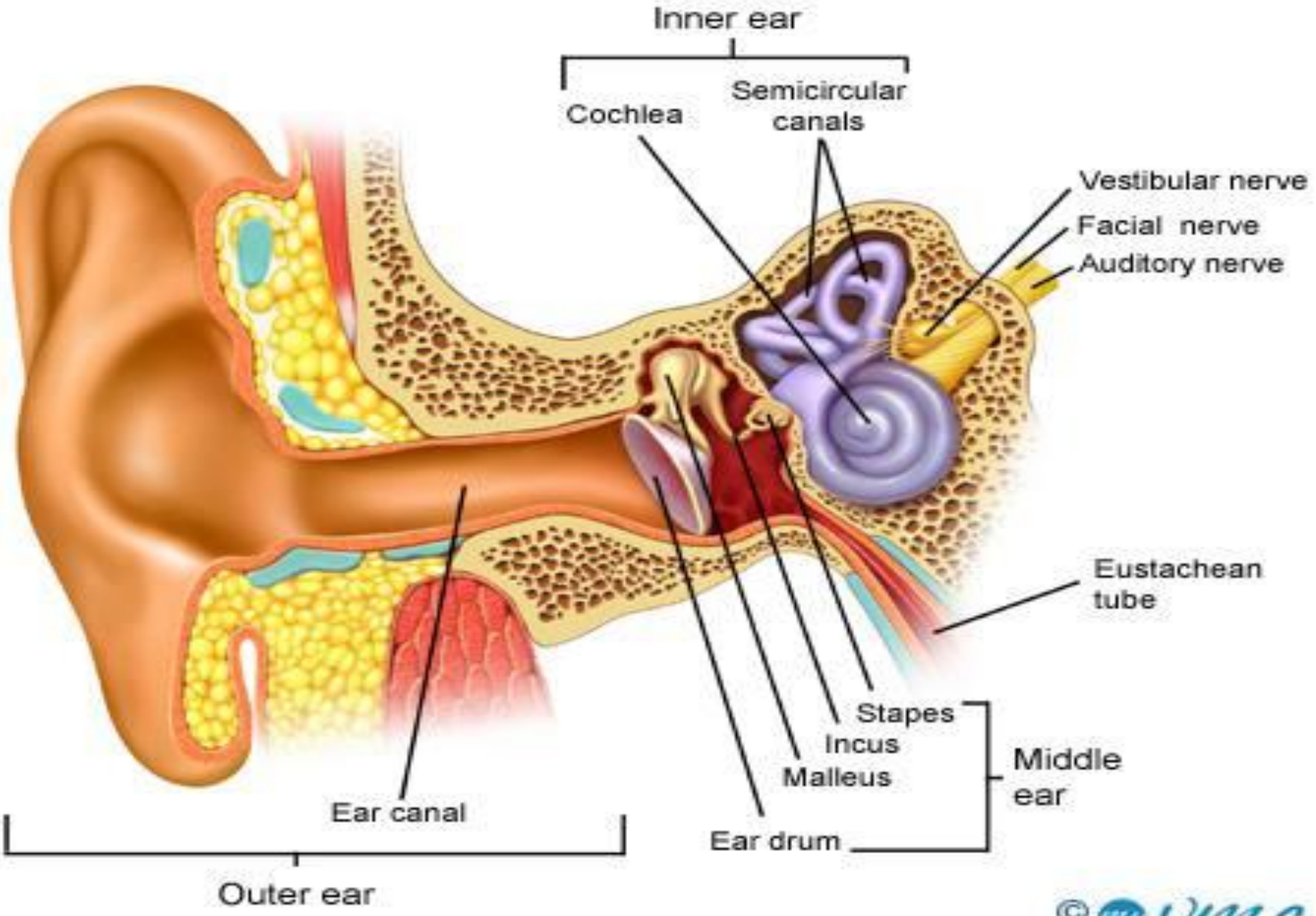
EAR


Malleus
Incus
Stapes
Vestibular labyrinth
Auricle
Cochlea
MIDDLE
INNER
Vestibulocochlear nerve (CN VIII)
OUTER
External auditory canal
Eustachian tube
Tympanic membrane
Facial nerve (CN VII)

The ear is divided into three main regions:

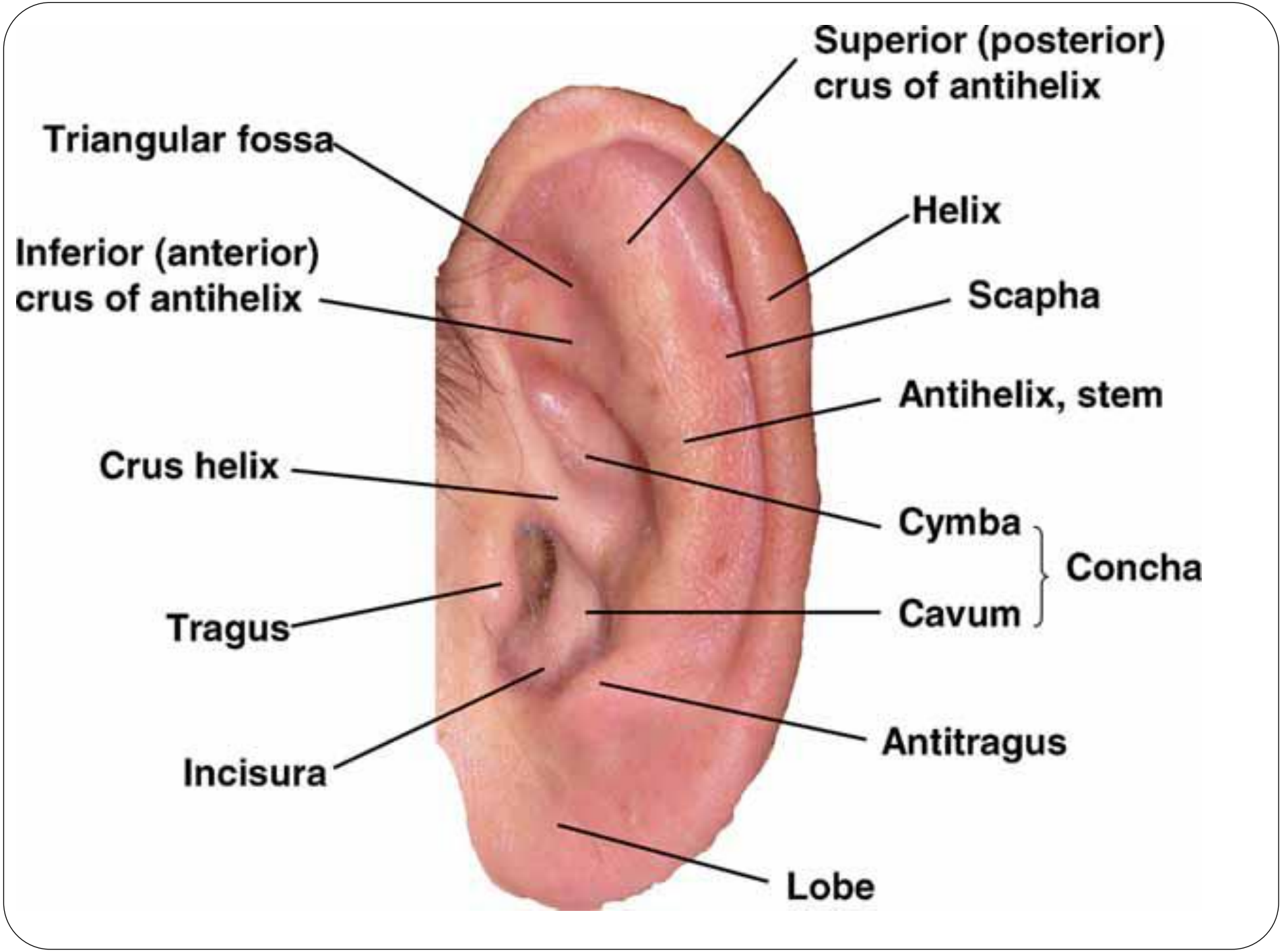
- **The external ear, which collects sound waves and channels them inward**
- **The middle ear, which conveys sound vibrations to the oval window**
- **The internal ear, which houses the receptors for hearing and equilibrium.**


Stapes
Incus
Malleus
Semicircular Ducts
Cochlea
Vestibular Nerve
Cochlear Nerve
Temporal Bone
Auricle
Auditory Canal
Tympanic Membrane
Tympanic Cavity
Earlobe
Auditory Tube
EarQ



External (Outer) Ear

- **The external ear consists of the auricle, external auditory canal, and eardrum**
- **The auricle (pinna) is a flap of elastic cartilage shaped like the flared end of a trumpet and covered by skin.**
- **The auricle has several depressions and elevations. The concha is the deepest depression, and the elevated margin of the auricle is the helix, the inferior portion is the lobule.**
- **The tragus is a tongue-like projection overlapping the opening of the external acoustic meatus.**


Superior (posterior) crus of antihelix
Triangular fossa
Helix
Inferior (anterior) crus of antihelix
Scapha
Antihelix, stem
Crus helix
Cymba
Concha
Cavum
Tragus
Antitragus
Incisura
Lobe

Auditory canal

- The external auditory canal is a curved tube about 2.5 cm (1 in.) long that lies in the temporal bone and leads to the eardrum.
- The lateral third of this slightly S-shaped canal is cartilaginous and lined with skin, which is continuous with the skin of the auricle.
- Its medial two thirds is bony and lined with thin skin that is continuous with the external layer of the tympanic membrane.

TYMPANIC MEMBRANE

- **The tympanic membrane or eardrum, approximately 1 cm in diameter, is a thin, oval, semitransparent membrane at the medial end of the external acoustic meatus.**

- **It forms a partition between the meatus and the tympanic cavity of the middle ear**

- **The tympanic membrane is covered by epidermis and lined by simple cuboidal epithelium.**

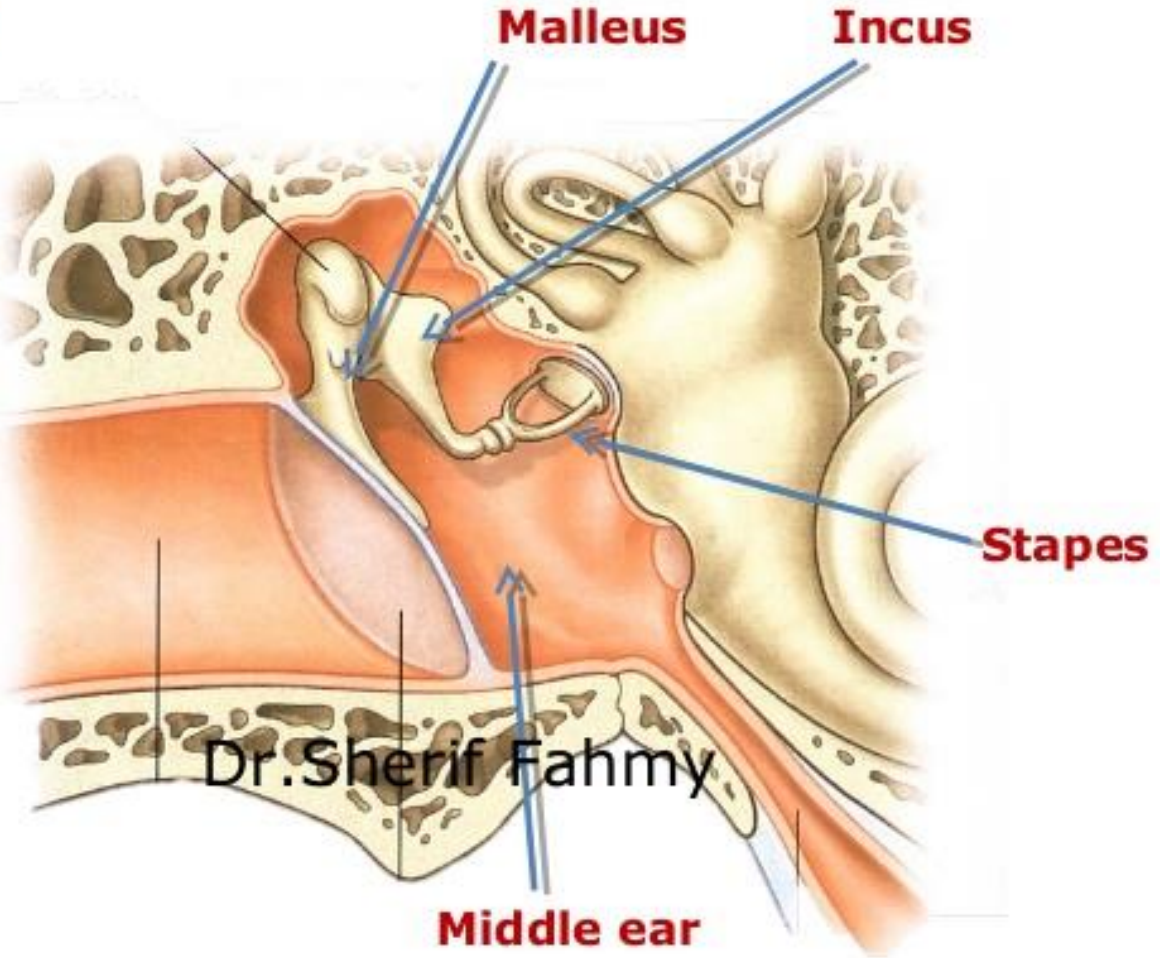
- **Tearing of the tympanic membrane is called a perforated eardrum.**

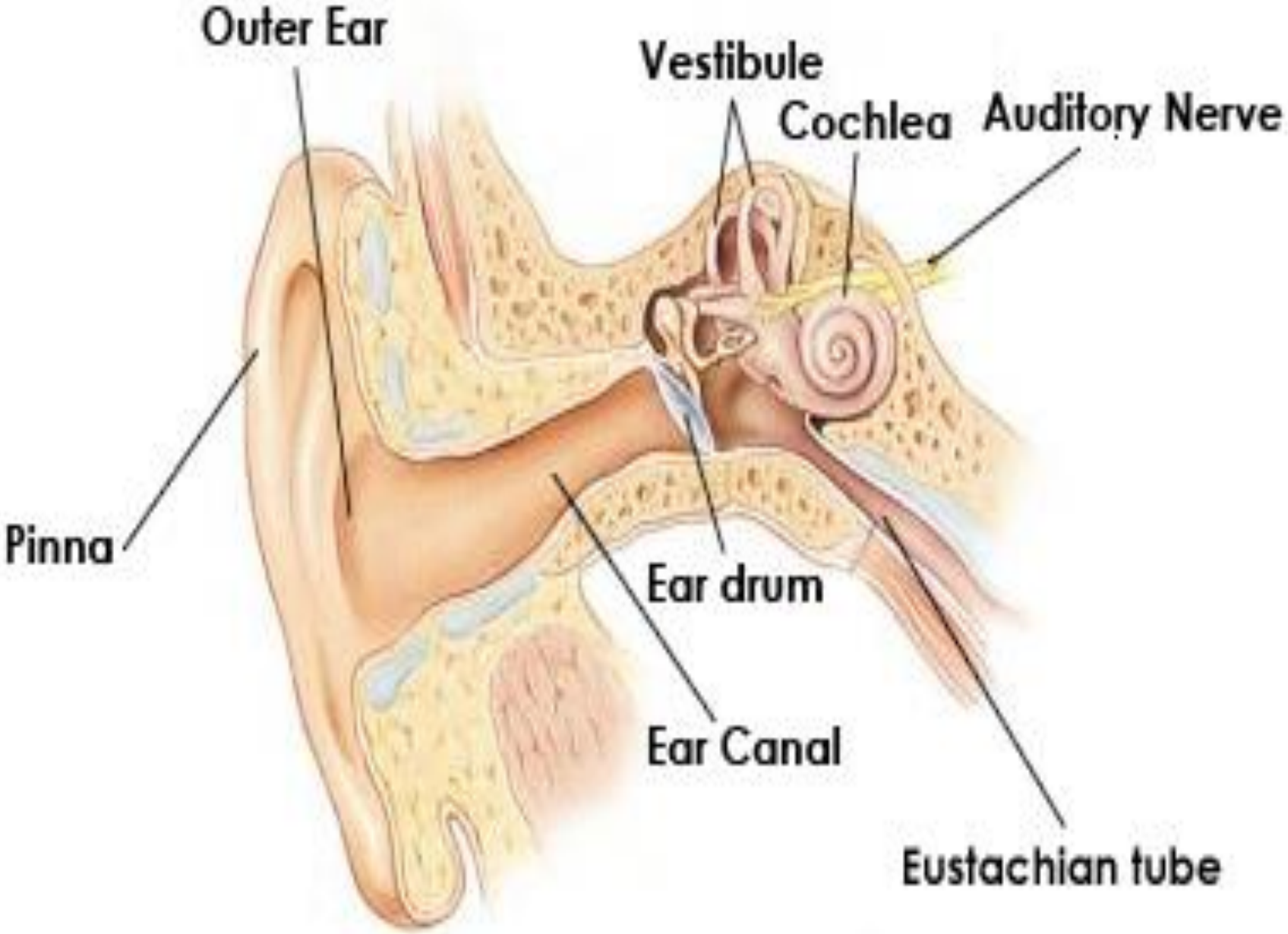
- **The tympanic membrane may be examined directly by an otoscope.**

- **Near the exterior opening, the external auditory canal contains a few hairs and specialized sweat glands called ceruminous glands that secrete earwax or cerumen.**

- **The combination of hairs and cerumen helps prevent dust and foreign objects from entering the ear**

Ossicles




Outer Ear
Vestibule
Cochlea
Auditory Nerve
Pinna
Ear drum
Ear Canal
Eustachian tube

Middle Ear

- **The middle ear is a small, air-filled cavity in the petrous portion of the temporal bone that is lined by epithelium.**

- **It is separated from the external ear by the tympanic membrane and from the internal ear by a thin bony partition that contains two small membrane-covered openings: the oval window and the round window.**

EUSTACHIAN TUBE

- **The tympanic cavity is connected anteromedially with the nasopharynx by the pharyngotympanic tube or eustachian tube**
- **It is a part of middle ear**
- **Measurment – 35 mm long and 3 mm diameter**
- **Function – pressure equalization**

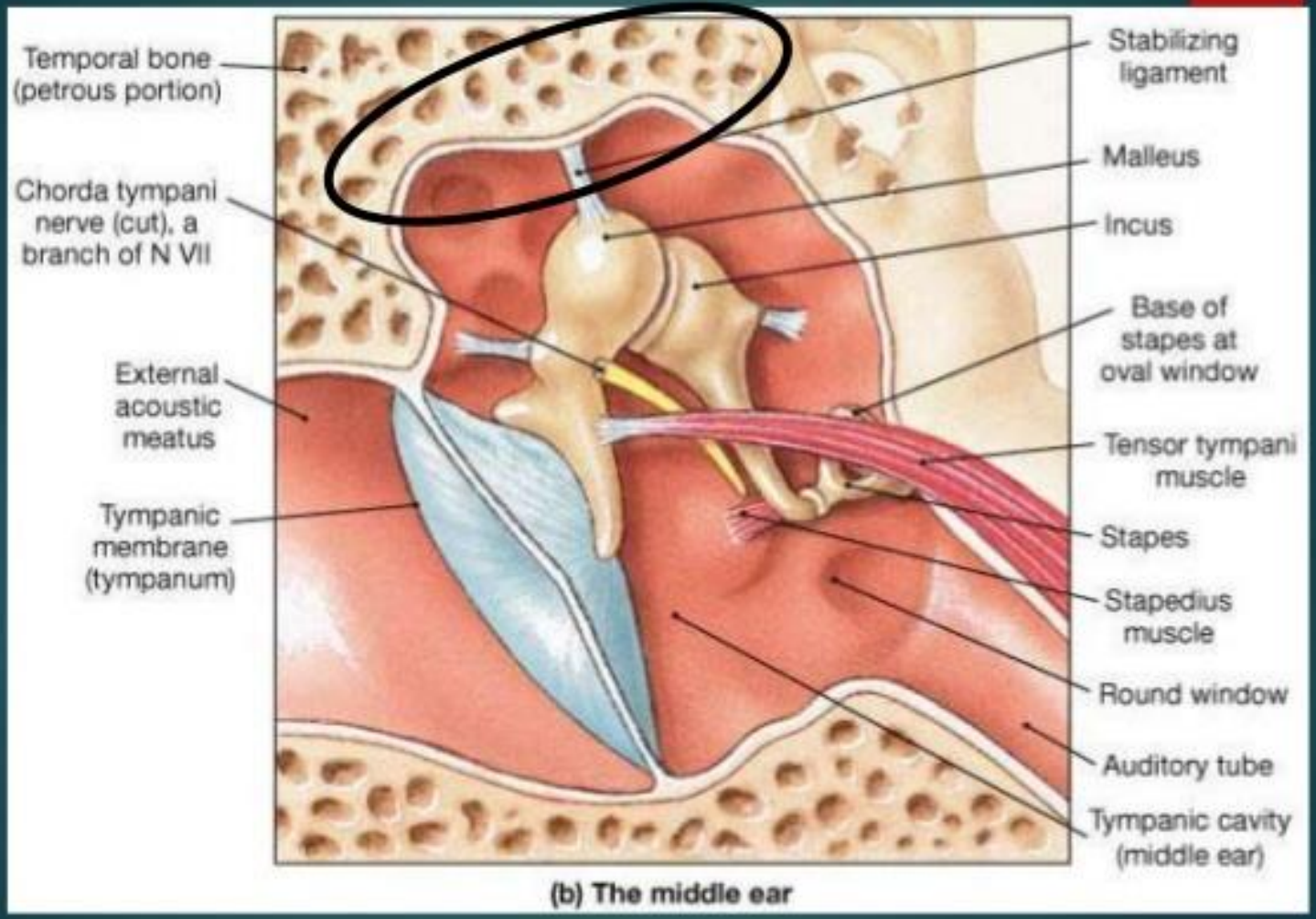
  mucus drainage

Clinical- Qtitis media affects the eustachian tube

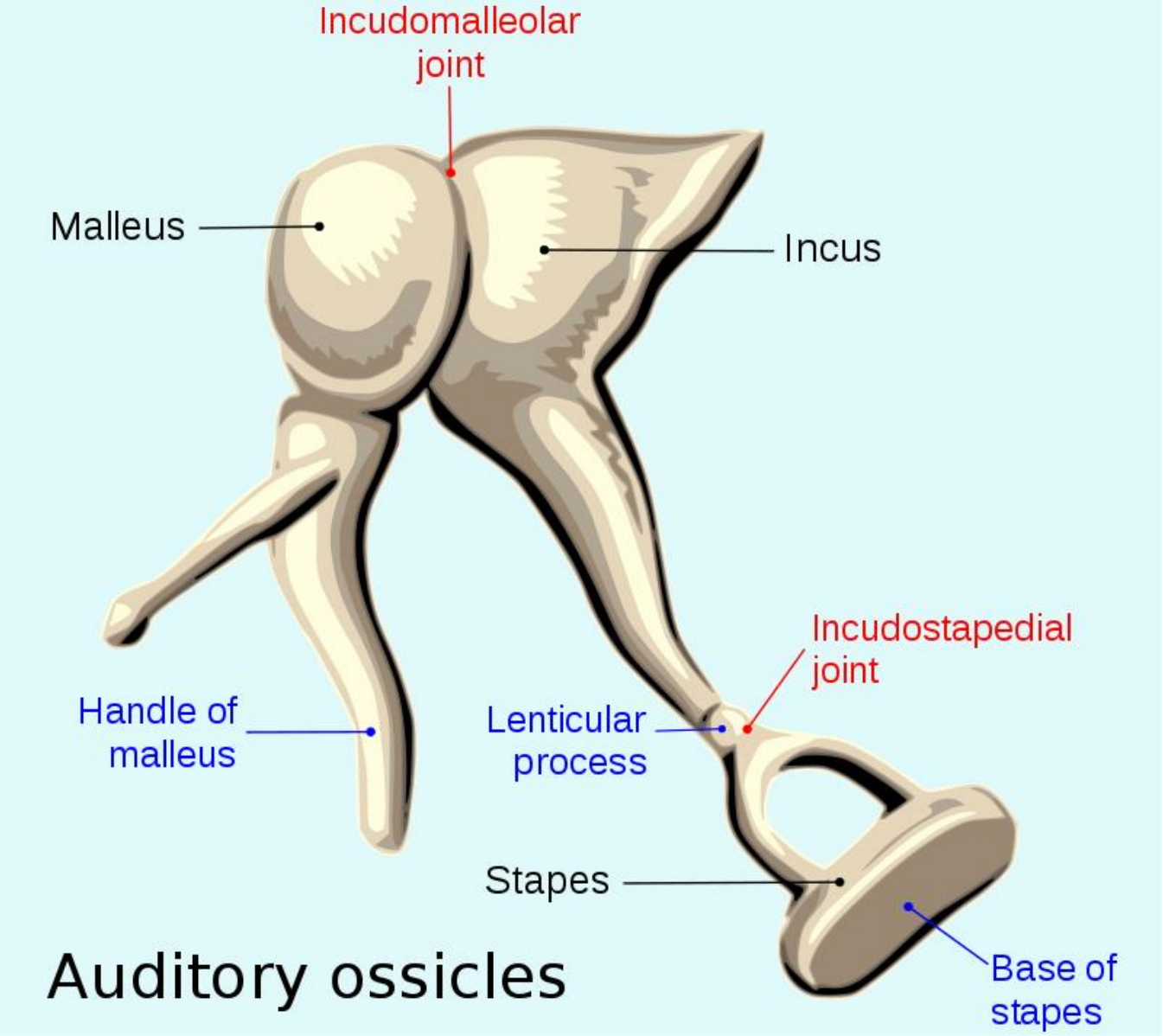
The contents of the middle ear are the:

- **Auditory ossicles: malleus, incus, and stapes.**
- **Stapedius and tensor tympani muscles.**
- **Chorda tympani nerve, a branch of CN VII.**
- **Joints- b/w malleus and incus- saddle joint and b/w incus and stapes- ball and socket joint**

- **The “handle” of the malleus attaches to the internal surface of the tympanic membrane.**
- **The head of the malleus articulates with the body of the incus.**
- **The incus , the middle bone in the series, articulates with the head of the stapes.**
- **The base or footplate of the stapes fits into the oval window**
- **Directly below the oval window is another opening, the round window, which is enclosed by a membrane called the secondary tympanic membrane**



(b) The middle ear


Incudomalleolar joint
Malleus
Incus
Incudostapedial joint
Handle of malleus
Lenticular process
Stapes
Base of stapes
Auditory ossicles

WALLS OFTYMPANIC CAVITY

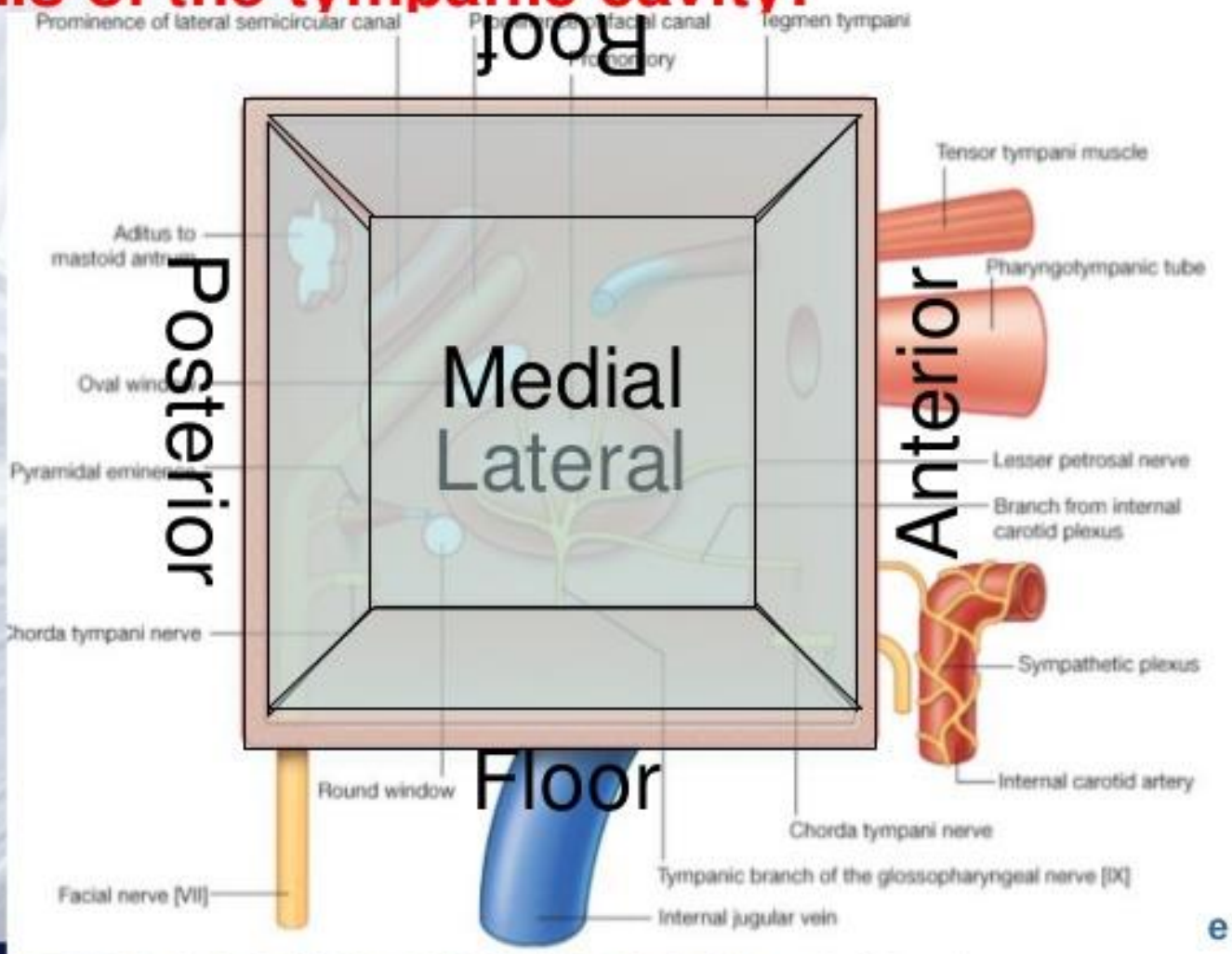
- **The middle ear, shaped like a narrow box with concave sides, has six walls –**

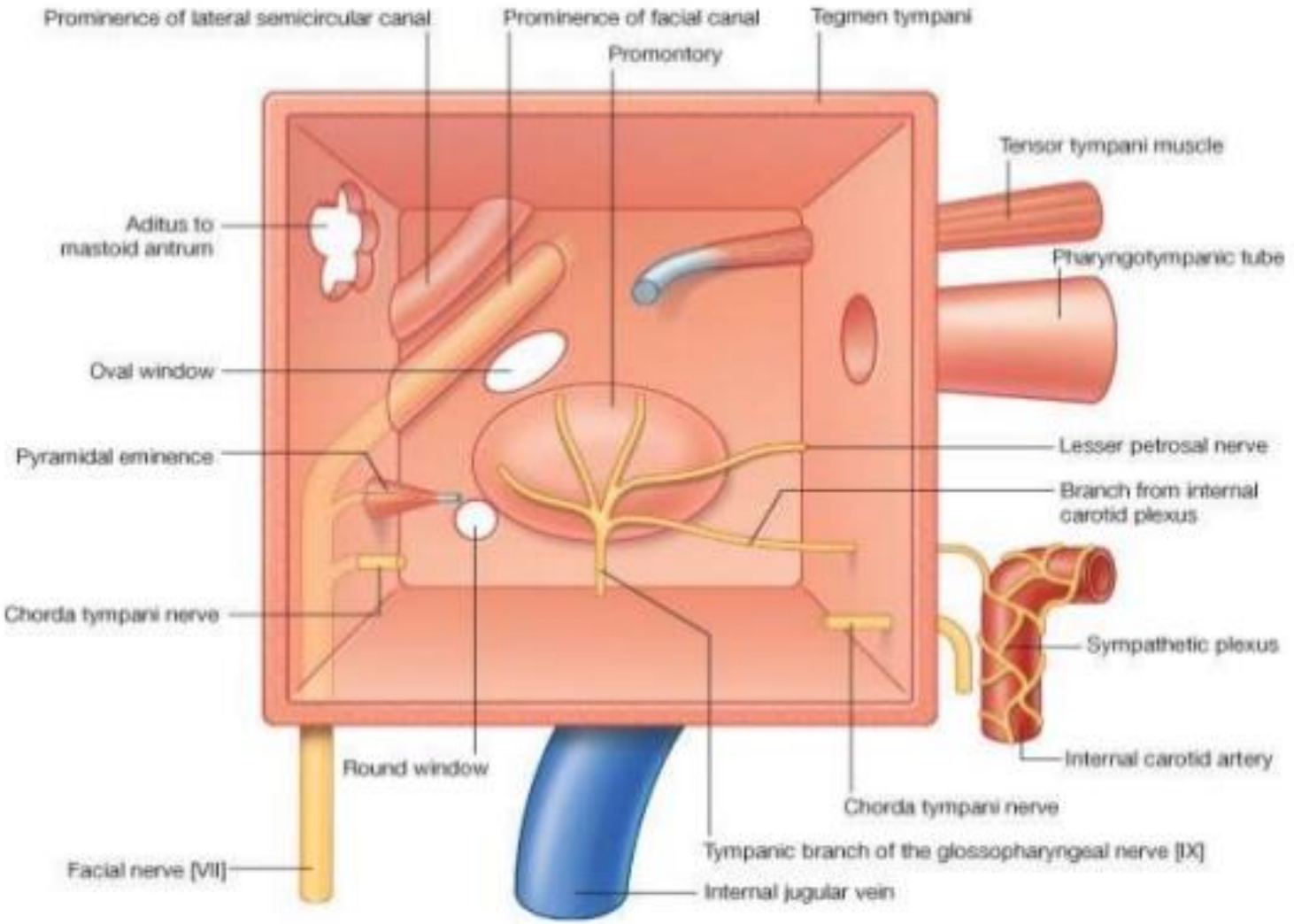
1. **Tegmental wall (roof)- is formed by a thin plate of temporal bone, the tegmen tympani, which separates the tympanic cavity from floor of the middle cranial fossa.**
2. **Jugular wall (floor)- separates the tympanic cavity from the superior bulb of the IJV.**
3. **Membranous wall (lateral wall)- is formed almost entirely by the the tympanic membrane.**

4. **labyrinthine wall (medial wall)- separates the tympanic cavity from the internal ear. formed by the initial part of the cochlea, and the oval and round windows.**
5. **Carotid wall (anterior wall)- separates the tympanic cavity from the carotid canal, which contains the internal carotid artery**
6. **Mastoid wall (posterior wall)- has an opening in its superior part, the aditus to the mastoid antrum.**

TYMPANIC CAVITY

Walls of the tympanic cavity:





INTERNAL (INNER) EAR

- **The internal (inner) ear is also called the labyrinth because of its complicated series of canals.**
- **Structurally, it consists of two main divisions: an outer bony labyrinth that encloses an inner membranous labyrinth.**

BONY LABYRINTH-

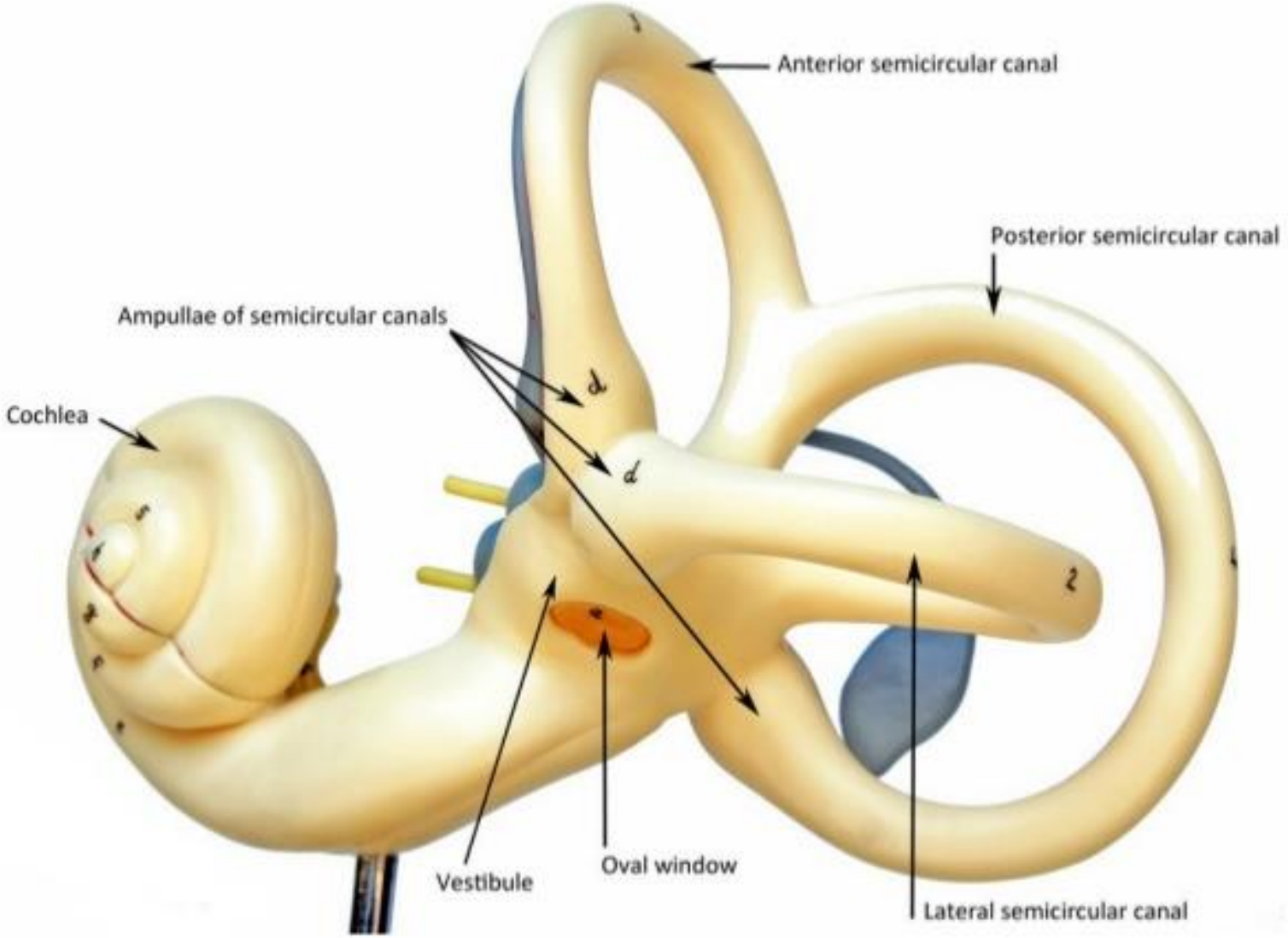
- **The bony labyrinth is a series of cavities in the petrous portion of the temporal bone divided into three areas:**

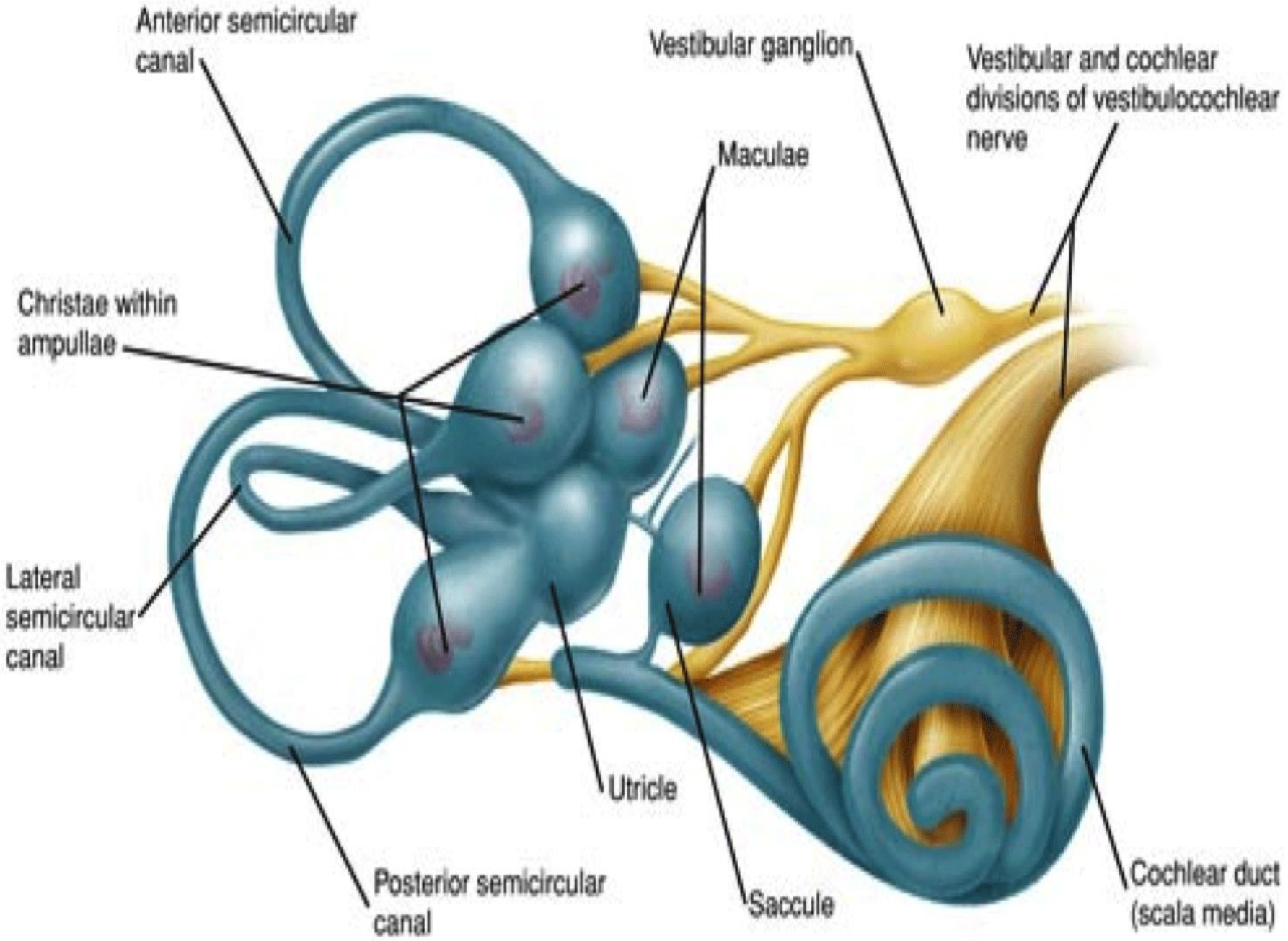
(1) The semicircular canals

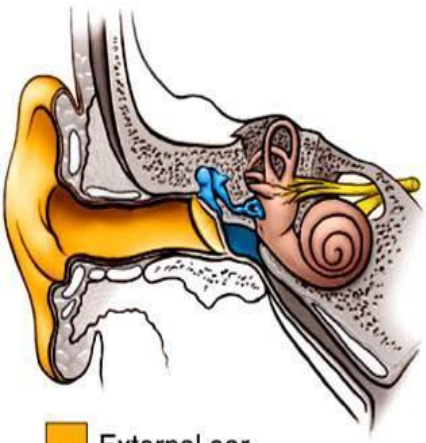
(2)The vestibule, both of which contain receptors for equilibrium

(3) The cochlea, shell-shaped part of the bony labyrinth that contains the cochlear duct, the part of the internal ear concerned with hearing

- **The bony labyrinth is lined with periosteum and contains perilymph. This fluid, which is chemically similar to CSF, surrounds the membranous labyrinth.**
- **The membranous labyrinth contains endolymph**


Anterior semicircular canal
Posterior semicircular canal
Ampullae of semicircular canals
Cochlea
Vestibule
Oval window
Lateral semicircular canal


Anterior semicircular canal
Vestibular ganglion
Vestibular and cochlear divisions of vestibulocochlear nerve
Maculae
Christae within ampullae
Lateral semicircular canal
Utricle
Posterior semicircular canal
Saccule
Cochlear duct (scala media)



External ear

Middle ear

Internal ear

Bony labyrinth (contains perilymph)

Membranous labyrinth (contains endolymph)

Semicircular canals (contain semicircular ducts):

Anterior

Posterior

Lateral

Ampulla of semicircular canal

Utricle

Vestibule

Oval window

Saccule

Cochlea

Cochlear duct

LATERAL

Ampulla of semicircular duct

Stapes in oval window

Round window

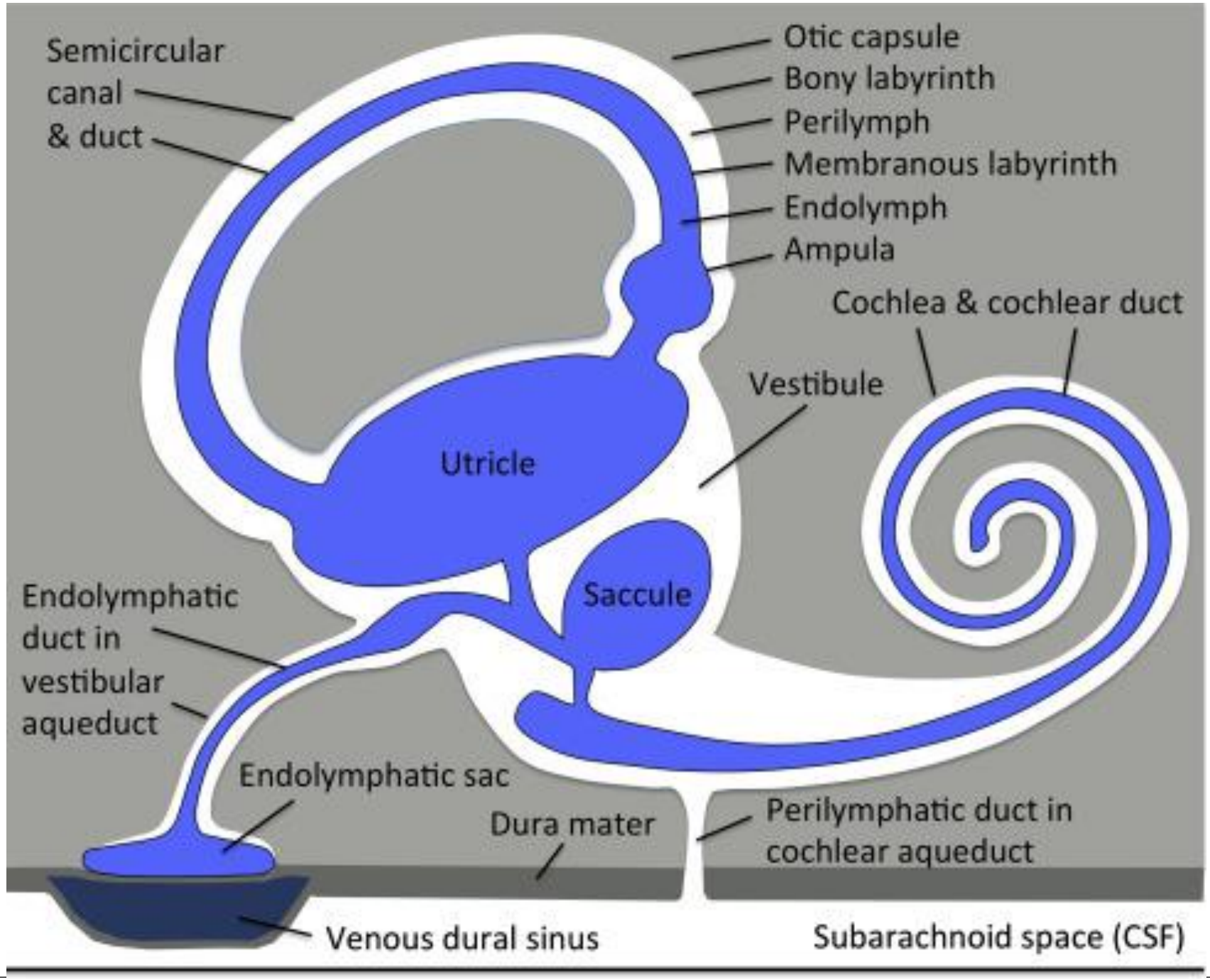
MEDIAL

(a) Components of the right internal ear

Figure 17.20 Tortora - PAP 12/e

Vestibule

- **The vestibule of the bony labyrinth is a small oval chamber (approximately 5 mm long) that contains the utricle and saccule which are parts of the balancing apparatus (vestibular labyrinth).**
- **The vestibule features the *oval window on its lateral wall, occupied by* the base of the stapes. The vestibule is continuous with the bony cochlea anteriorly, the semicircular canals posteriorly, and the posterior cranial fossa by the vestibular aqueduct . The aqueduct extends to the posterior surface of the petrous part of the temporal bone, where it opens posterolateral to the *internal acoustic meatus. The vestibular aqueduct transmits the endolymphatic duct and two small* blood vessels.**

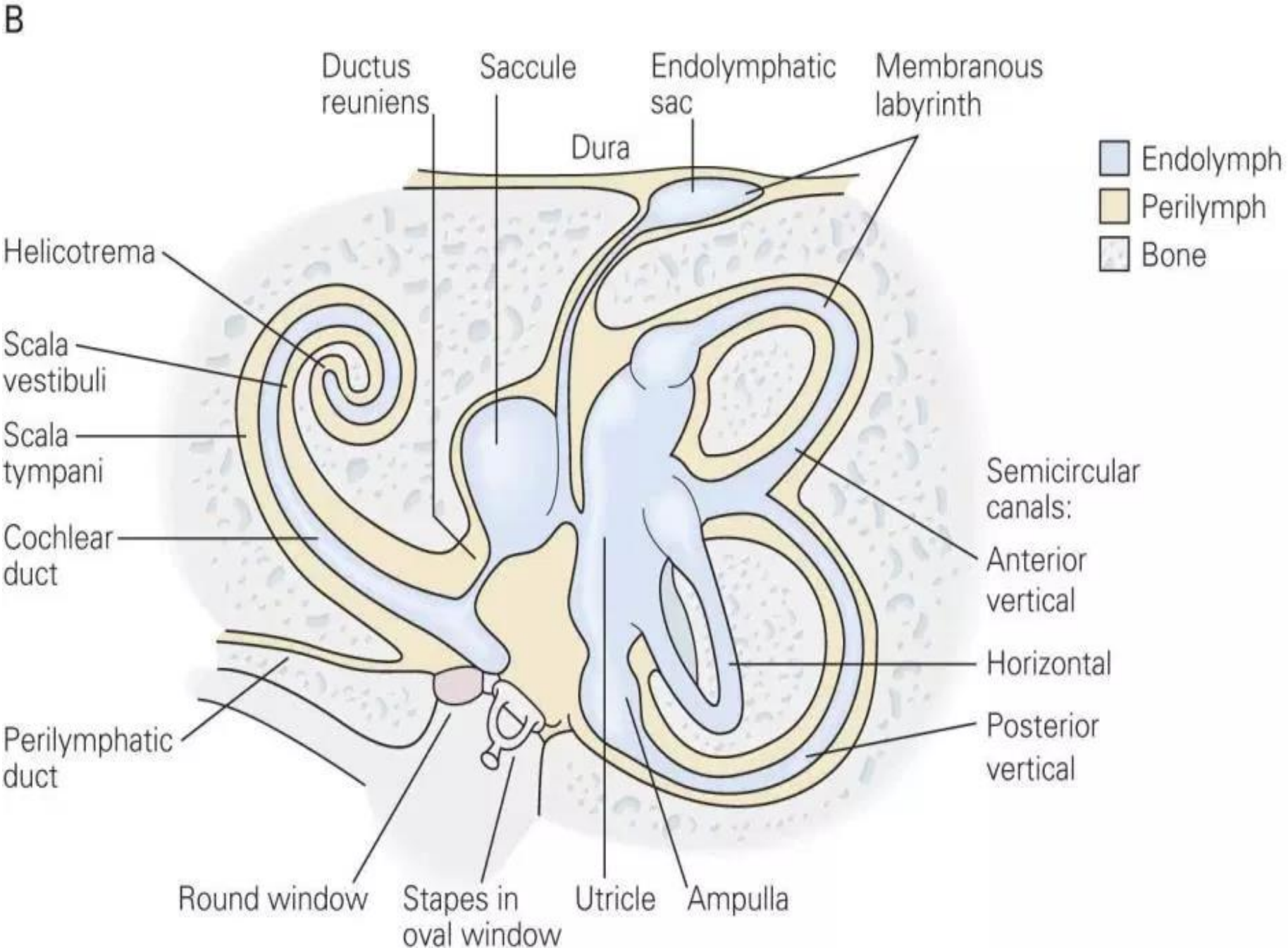

Semicircular canal & duct
Otic capsule
Bony labyrinth
Perilymph
Membranous labyrinth
Endolymph
Ampula
Cochlea & cochlear duct
Vestibule
Utricle
Saccule
Endolymphatic duct in vestibular aqueduct
Endolymphatic sac
Dura mater
Perilymphatic duct in cochlear aqueduct
Venous dural sinus
Subarachnoid space (CSF)

Semicircular canals

- **Projecting superiorly and posteriorly from the vestibule are the three bony semicircular canals, each of which lies at approximately right angles to the other two.**
- **Based on their positions, they are named the anterior, posterior and lateral semicircular canals.**
- **The anterior and posterior semicircular canals are vertically oriented; the lateral one is horizontally oriented.**
- **At one end of each canal is a swollen enlargement called the ampulla .**
- **The portions of the membranous labyrinth that lie inside the bony semicircular canals are called the semicircular ducts.**

Bony cochlea

- Anterior to the vestibule is the cochlea, a bony spiral canal that resembles a snail's shell and makes almost two and three quarter turns around a central bony core called the modiolus (conical central axis)
- A spiral ridge of the bone, the spiral lamina, partially divides the cochlear canal into the scala vestibuli above and the scala tympani below
- The scala vestibuli communicates with the scala tympani at the apex of the cochlea by a small opening, called the helicotrema
- The scala vestibuli is continous with the vestibule and the scala tympani opens into the middle ear through the fenestra cochlea, which closed by the secondary tympanic membrane.


B
Ductus reuniens
Saccule
Endolymphatic sac
Membranous labyrinth
Dura
Endolymph
Perilymph
Bone
Helicotrema
Scala vestibuli
Scala tympani
Cochlear duct
Semicircular canals:
Anterior vertical
Horizontal
Posterior vertical
Perilymphatic duct
Round window
Stapes in oval window
Utricle
Ampulla

MEMBRANOUS LABYRINTH

It continuous closed cavity filled with endolymph

It consists of three main parts

1. **The semicircular ducts with cristae the organ of kinetic balance**
2. **The utricle and saccule with maculae, the organs of static balance, within the vestibule**
3. **The spiral duct of the cochlea or organ of corti**

Semicircular ducts-

Lies within the corresponding bony canal

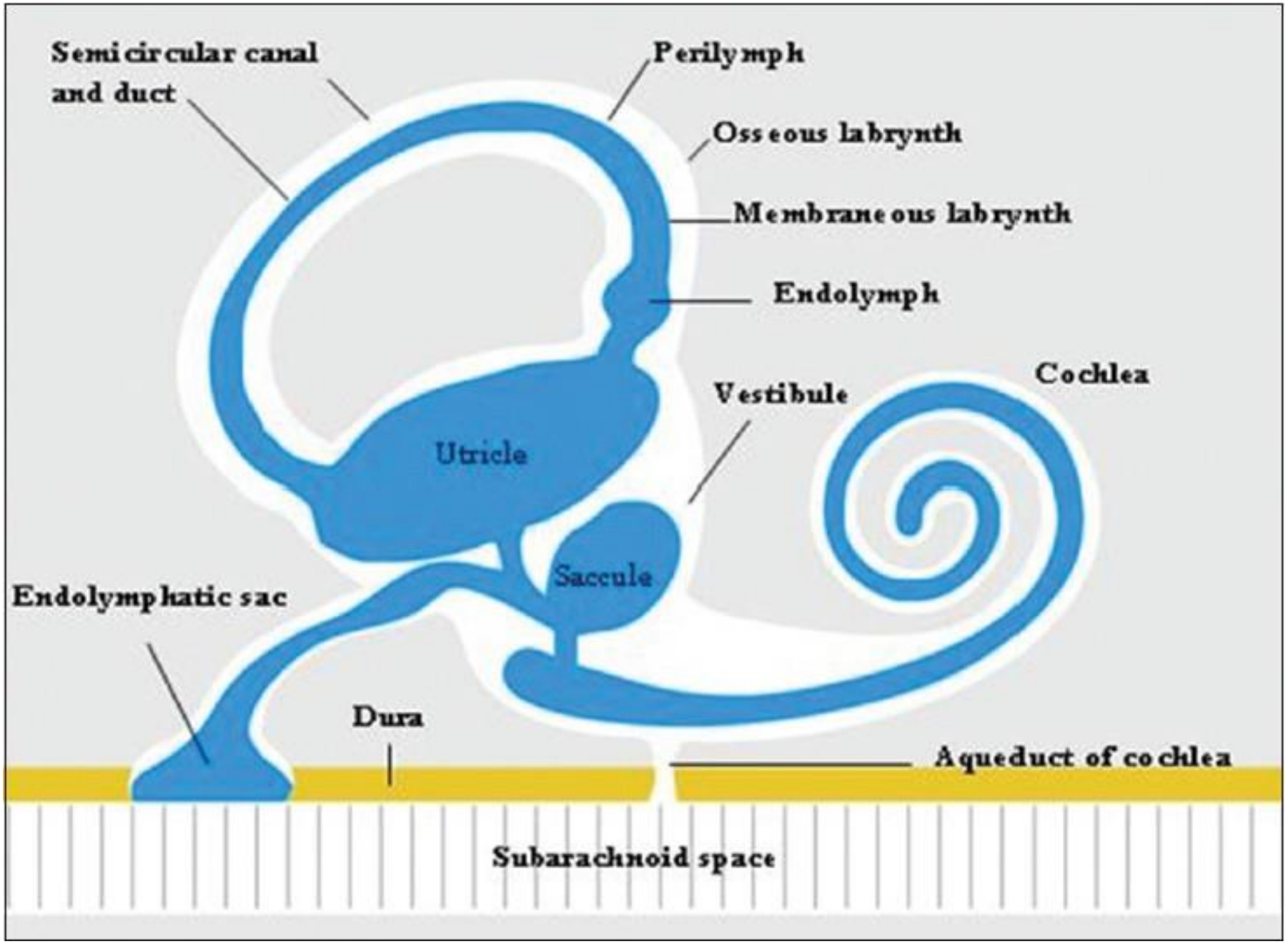
Each duct has ampulla, there is an end organ called the ampullary cristae

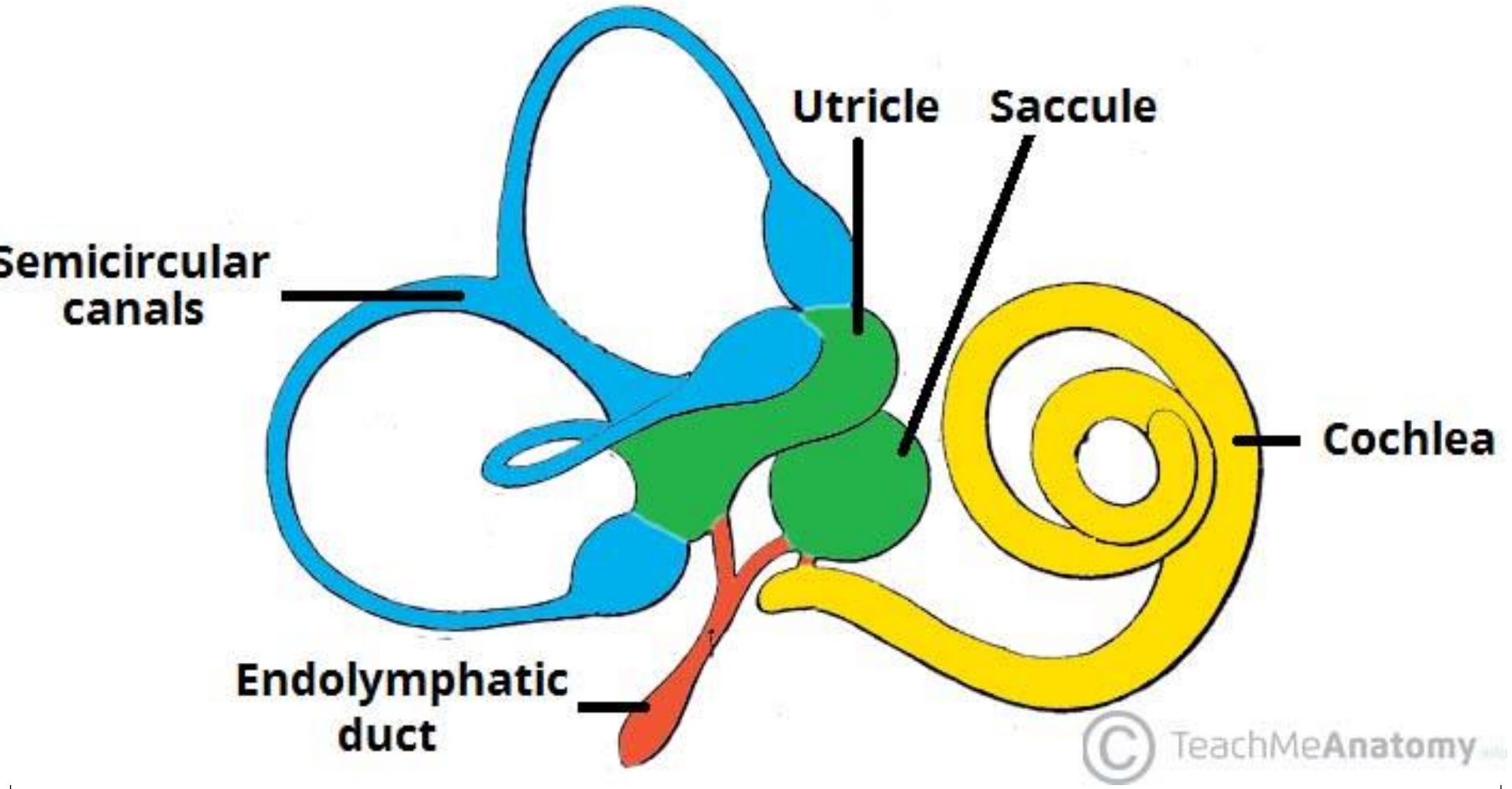
Cristae responds to pressure changes in the endolymph caused by movement of the head

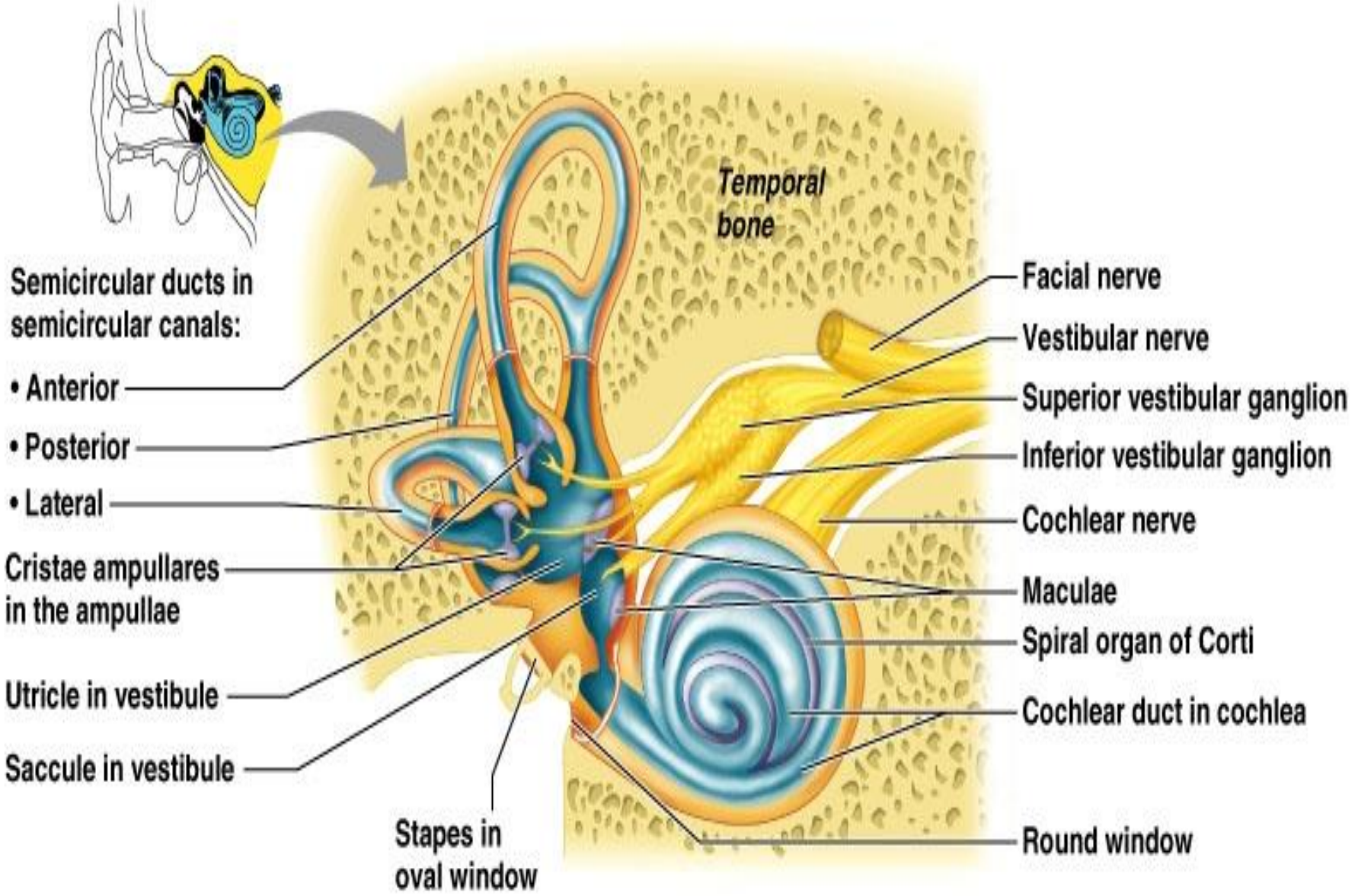
Vestibular apparatus

- **It consists of the two vestibular sacs called utricle and the saccule, are membranous sacs present within the bony cavity of the vestibule**
- **The utricle is the larger of the two vestibular sacs and occupies the posterosuperior portion of the vestibule**
- **It receives the end of three semicircular ducts through the five opening .**
- **The saccule globular in shape and is anterior to the utricle**

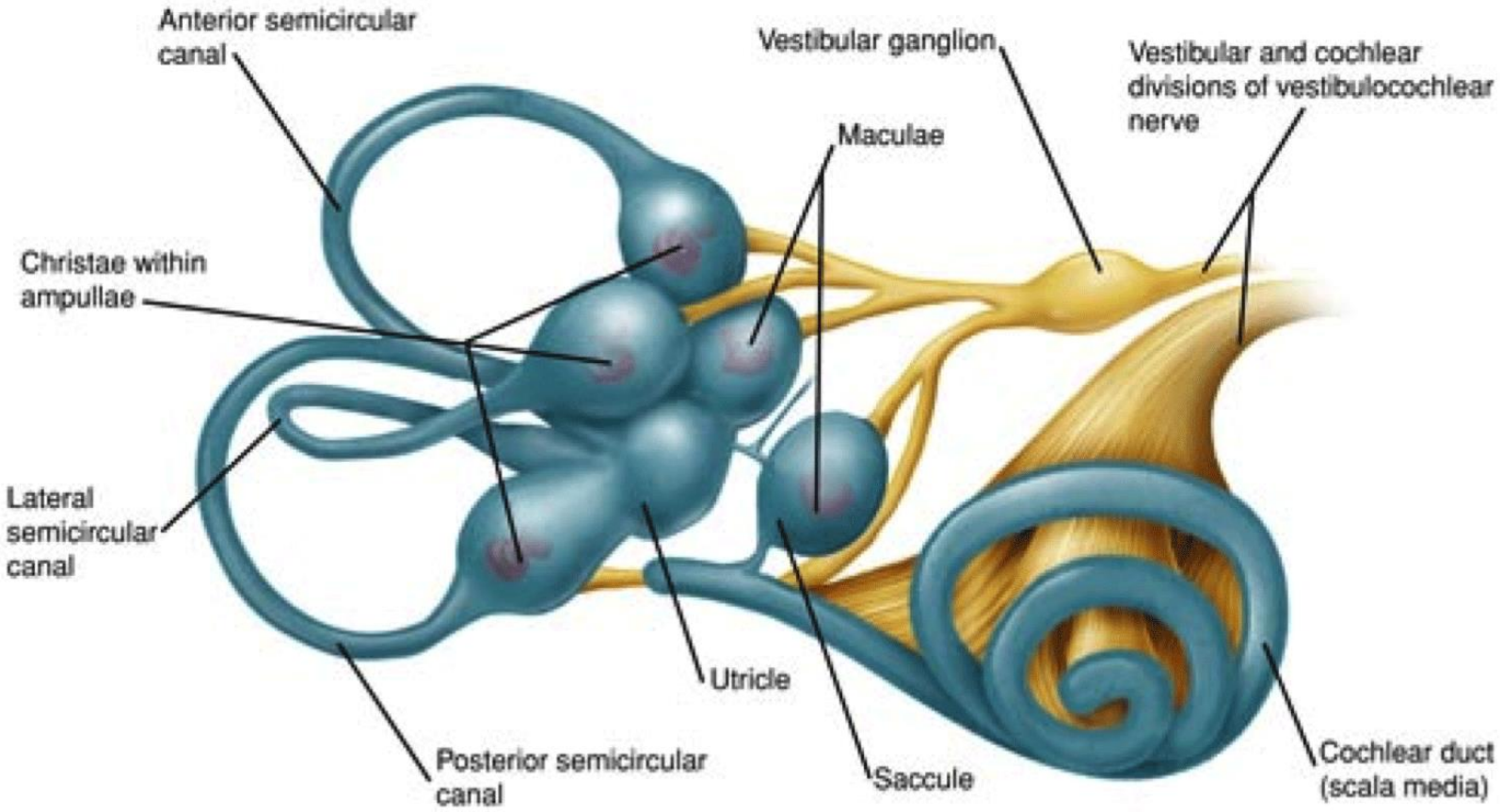
- **The saccule is connected to the cochlea by the duct of reuniens that start from the lower part of the saccule and curves up to join the base of the cochlear duct.**
- **The utricle is connected to the saccule by the utriculosaccular duct**
- **A slender endolymphatic duct strats from the lower part of the utriculosaccular duct**


Semicircular canal and duct
Perilymph
Osseous labrynth
Membraneous labrynth
Endolymph
Cochlea
Vestibule
Utricle
Saccule
Endolymphatic sac
Dura
Aqueduct of cochlea
Subarachnoid space


Utricle
Saccule
Semicircular canals
Cochlea
Endolymphatic duct
© TeachMeAnatomy



- **The medial wall of utricle and saccule are thickened to form a macula**
- **The maculae are end organs that give information about the position of the head. They are static balance receptor**


Anterior semicircular canal
Vestibular ganglion
Vestibular and cochlear divisions of vestibulocochlear nerve
Maculae
Christae within ampullae
Lateral semicircular canal
Utricle
Posterior semicircular canal
Saccule
Cochlear duct (scala media)

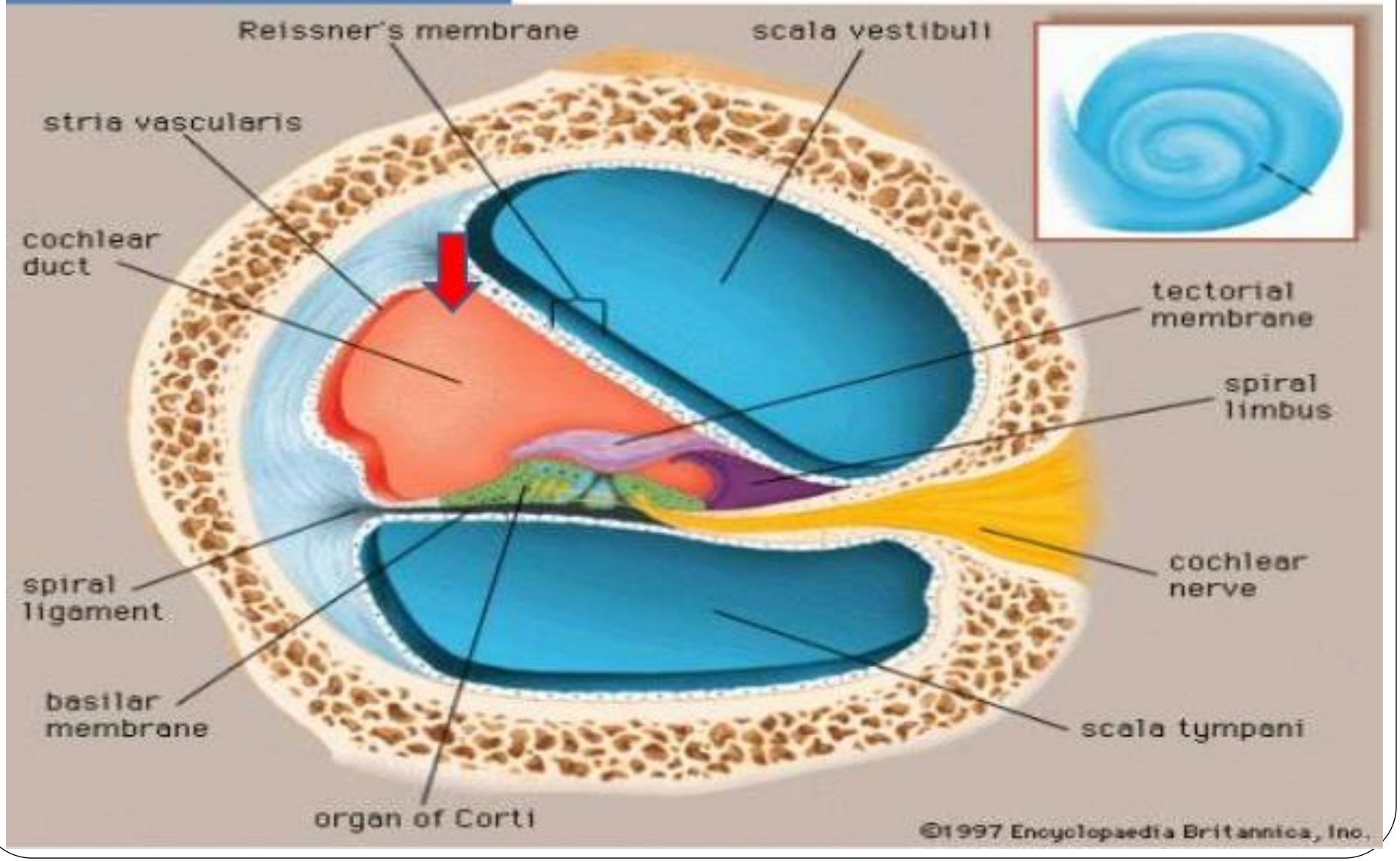
Cochlear Duct (Scala Media)

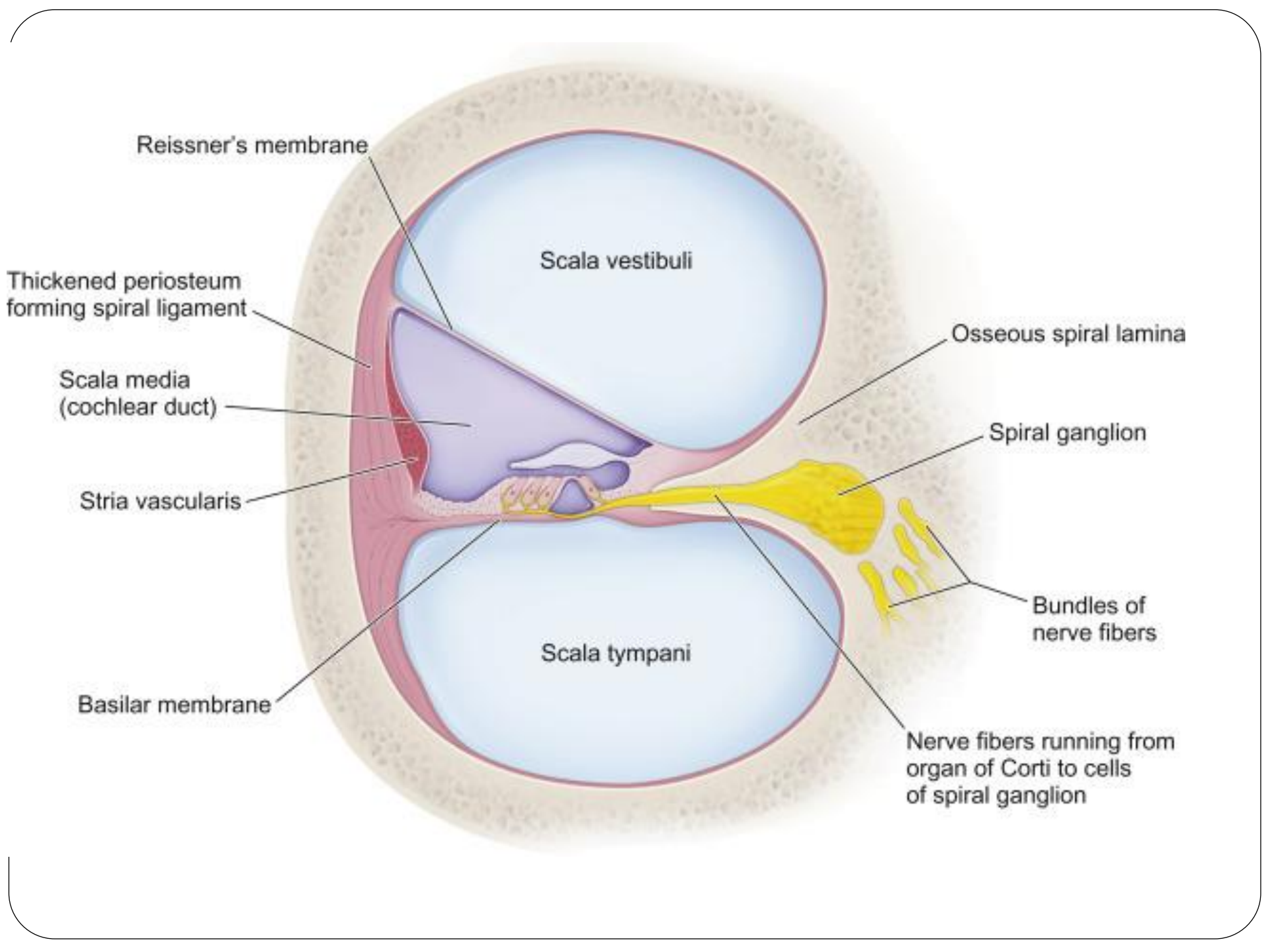
- **The cochlear duct (scala media) is a continuation of the membranous labyrinth into the cochlea; it is filled with endolymph.**
- **The cochlear duct lies between scala vestibuli and the scala tympani**
- **The floor is formed by the basilar membrane; the roof by the vestibular or reissners membrane**
- **The floor of the cochlear duct cantinas the organ of hearing called the organ of corti.**

- **The spiral organ contains hair cells, the tips of which are embedded in the tectorial membrane.**
- **The hair cells are the actual sensory receptors cells.**
- **Each hair cell is elongated, has bunch of modified apical microvillus (stereocilia).**
- **The organ of corti is innervated by peripheral process of bipolar cells located in the spiral ganglion**
- **The central processes of the ganglion cells form the cochlear nerve**

MEMBRANOUS LABYRINTH

COCHLEAR DUCT




Reissner's membrane
Scala vestibuli
Thickened periosteum forming spiral ligament
Osseous spiral lamina
Scala media (cochlear duct)
Spiral ganglion
Stria vascularis
Bundles of nerve fibers
Scala tympani
Basilar membrane
Nerve fibers running from organ of Corti to cells of spiral ganglion

BLOOD SUPPLY

EXTERNAL EAR

- **PINNA –Posterior auricular and superficial temporal**
- **EXTERNAL ACOUSTIC MEATUS – outer part same above and inner part deep auricular branch of maxillary artery**
- **TYMPANIC MEMBRANE**
- **Outer Surface – deep auricular branch of maxillary artery**
- **Inner Surface – Ant.- Tympanic branch of the maxillary artery**

  post.- Tymapnic branch of the post. Auricular artery

Middle ear – same above

Internal ear- Labyrinth branch of the basilar artery

Posterior auricular artery

CLINICAL ASPECT

External Ear Injury

- **Bleeding within the auricle resulting from trauma may produce an *auricular hematoma*. As the hematoma enlarges, it compromises the blood supply to the cartilage. If untreated (e.g., by aspiration of blood), fibrosis (formation of fibrous tissue) develops in the overlying skin, forming a deformed auricle (e.g., the cauliflower or boxer's ear of some professional fighters).**

Acute Otitis Externa

- *an inflammation of the external acoustic meatus. The infection often develops in swimmers who do not* **dry their meatus after swimming and/or use ear drops, but it may also be the result of a bacterial infection of the skin lining the meatus. The affected individual complains of itching and pain in the external ear.**

Otitis Media

- **An earache and a bulging red tympanic membrane may indicate pus or fluid in the middle ear, a sign of *otitis media*.**
- **Infection of the middle ear is often secondary to upper respiratory infections.**
- **Inflammation and swelling of the mucous membrane lining the tympanic cavity may cause partial or complete blockage of the pharyngotympanic tube.**

Perforation of Tympanic Membrane -"ruptured eardrum"

- **may result from otitis media and is one of several causes of middle ear deafness. Perforation may also result from foreign bodies in the external acoustic meatus, trauma, or excessive pressure .**
- **Because the superior half of the tympanic membrane is much more vascular than the inferior half, incisions to release pus from a middle ear abscess (*myringotomy), for example, are made posteroinferiorly through the membrane*.**

Otoscopic Examination

- **Examination of the external acoustic meatus and tympanic membrane begins by straightening the meatus.**
- **In adults, the helix is grasped and pulled posterosuperiorly (up, out, and back). These movements reduce the curvature of the external acoustic meatus, facilitating insertion of the *otoscope***