



- The ear is an organ with 2 functions:

- Hearing.
- Maintenance of equilibrium/balance.

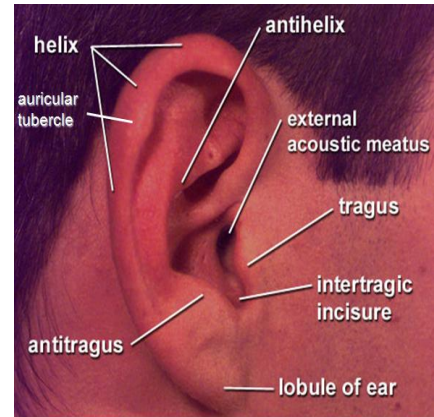
- The ear is divided into 3 parts:

- External ear.
- Middle ear (which is also known as tympanic cavity).
- Inner ear (which is also known as labyrinth).

- External ear (composed of the auricle, external auditory canal and outer portion of tympanic membrane):

• **Auricle (الصوان: الجزء الغضروفي من الأذن):**

- ✓ It is composed of elastic cartilage and functions in collecting sound waves.
- ✓ It has many parts:
 - ❖ Helix.
 - ❖ Antihelix.
 - ❖ Tragus.
 - ❖ Antitragus.
 - ❖ Lobule.



- ✓ The auricle has a thin skin which lacks a fatty layer and composed of 1 layer of blood vessels.
- ✓ Muscles of the auricle: anterior, posterior and superior auricular muscles which are innervated by the facial nerve (7th CN).
- ✓ Arterial supply:
 - ❖ Anterior auricular artery: from superficial temporal artery.
 - ❖ Posterior auricular artery: from external carotid artery.
- ✓ Innervation:
 - ❖ Auricular branch of the vagus nerve (X).
 - ❖ Auriculotemporal branch of mandibular nerve (V3).
 - ❖ C2 and C3
- ✓ Lymphatic drainage:
 - ❖ Superficial parotid lymph nodes.
 - ❖ Superficial cervical lymph nodes.
 - ❖ Mastoid lymph nodes.

• **External auditory canal:**

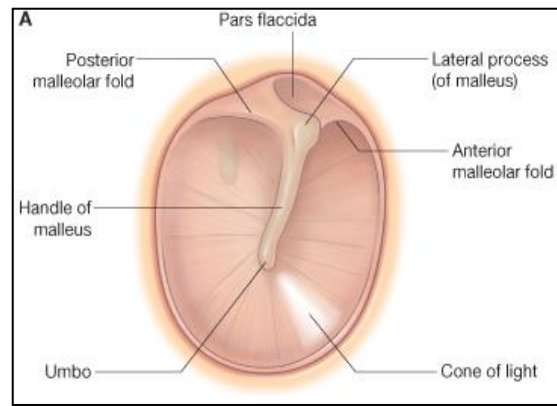
- ✓ It is an S-shaped, curved tube which is 2-3 cm in long.
- ✓ It is composed of:
 - ❖ *A cartilaginous (elastic) portion in the outer 1/3:* this portion contains skin, hair, sebaceous glands and ceruminous glands.
 - ❖ *Osseous portion in the inner 2/3:* formed by the tympanic membrane. Notice that ceruminous glands are absent in this portion.
- ✓ Function: conducting sound waves and vibrations from the auricle to the tympanic membrane.
- ✓ Arterial supply:
 - ❖ Superficial temporal artery.
 - ❖ Posterior auricular artery.
 - ❖ Deep auricular branch of maxillary artery.
- ✓ Innervation:
 - ❖ Auricular branch of vagus nerve (X).
 - ❖ Auriculotemporal branch of mandibular nerve (V3).

• **Tympanic membrane:**

- ✓ It is composed of 3 layers:



- ❖ **Outer layer:** stratified squamous epithelium (thin skin).
- ❖ **Middle layer:** fibrous. The area containing fibrous layer is known as pars tensa while the area which is devoid of fibrous layer is known as pars flaccida.
- ❖ **Inner layer:** cuboidal epithelium.



- ✓ **In otoscopy:**
 - ❖ It is cone-shaped, pearly gray in color, positioned obliquely, concave from outside and convex from inside.
- ✓ **Innervation:**
 - ❖ **Externally:**
 - ✚ Auricular branch of vagus nerve (X).
 - ✚ Auriculotemporal branch of mandibular nerve (V3).
 - ❖ **Internally:**
 - Glossopharyngeal (IX).

- **Middle ear:**

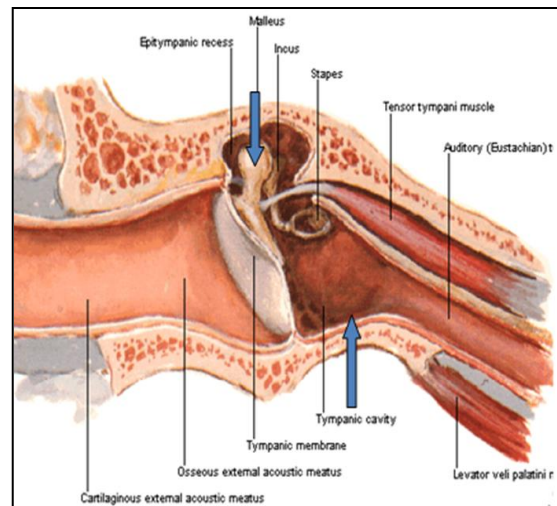
• **It is composed of 2 parts:**

- ✓ Tympanic cavity proper.
- ✓ Epitympanic recess: where the bodies of the incus and malleus are located.

• **Function:** transmission of vibrations from tympanic membrane.

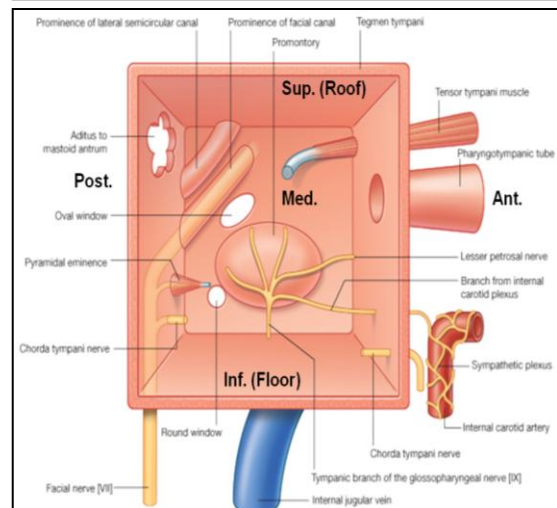
• **Boundaries:**

- ✓ **Roof:** tegmen tympani (a thin part of the temporal bone).
- ✓ **Floor:** jugular wall (in relation to the internal jugular vein).
- ✓ **Medial wall:** promontory (projection formed by the cochlea).
- ✓ **Lateral wall:** tympanic membrane.
- ✓ **Anterior wall:** auditory tube + canal of tensor tympani.
- ✓ **Posterior wall:** aditus to antrum + pyramid of stapedius.



• **Pharyngotympanic tube:**

- ✓ It is connecting the tympanic cavity to the nasopharynx.
 - ✓ It functions to equalize pressure in the middle ear with atmospheric pressure and balances it on both sides of the membrane (this is associated with activities such as swallowing and yawning).



- ✓ **Arterial supply:**
 - ❖ Ascending pharyngeal artery: branch of external carotid artery.
 - ❖ Middle meningeal artery.
- ✓ **Venous drainage:**



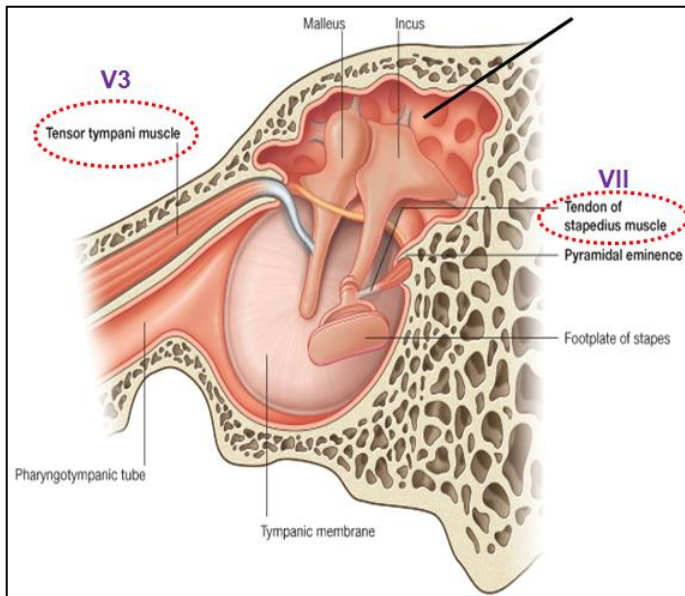
- ❖ Pterygoid venous plexus.
- ✓ Innervation: tympanic plexus (from CN IX).
- ✓ Lymphatic drainage: deep cervical lymph node.

- **Auditory ossicles:**

- ✓ They are 3: malleus, incus and stapes.

- **Muscles of the tympanic cavity:**

- ✓ Tensor tympani: it dampens the vibrations of the malleus and is innervated by mandibular division of trigeminal nerve (5th CN).
- ✓ Stapedius: it dampens the vibrations of the stapes and is innervated by facial nerve (7th CN).



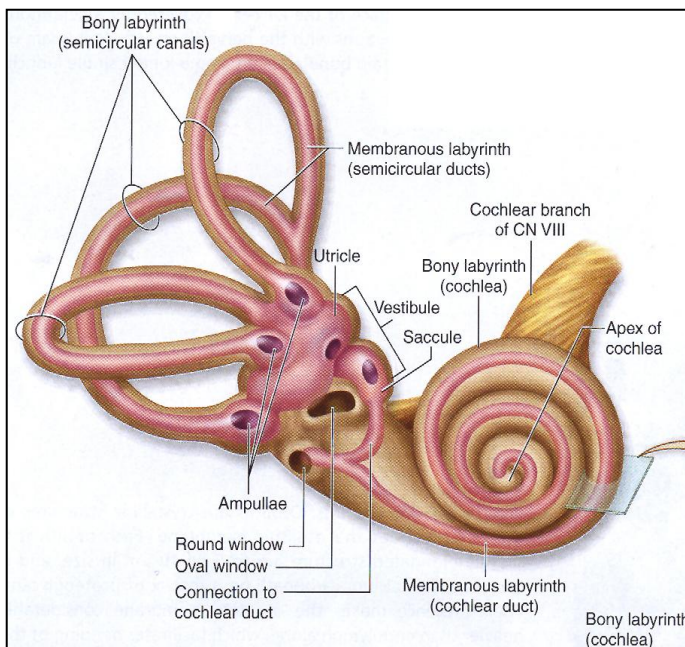
- ✓ Arterial supply:
 - ❖ Tympanic branch of maxillary artery.
 - ❖ Stylomastoid branch from posterior auricular artery.
- ✓ Venous drainage:
 - ❖ Pterygoid plexus.
 - ❖ Superior petrosal sinus.
- ✓ Innervation:
 - ❖ Tympanic plexus.

- Inner ear:

- **The bony part:**

- ✓ It contains the perilymph (which has Na⁺).
- ✓ It is composed of 3 parts:

- ❖ Vestibule: which contains the utricle and saccule and concerned with balance.
- ❖ Semicircular canals: these are 3 (superior, posterior and lateral).



- ❖ Cochlea: a spiral shell making 2.5 turns around a central bony pillar called the modiolus where the nerve cell bodies of the cochlear nerve are located. The cochlea is concerned with hearing and the tube is divided into 3 cavities:

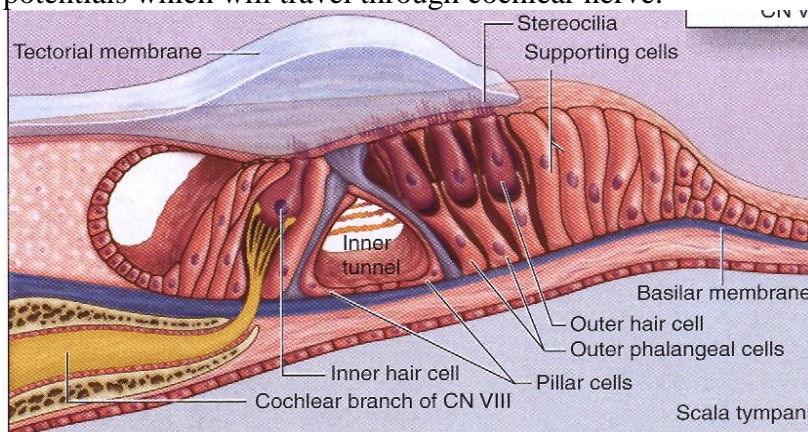
- ✚ Scala vestibule.
- ✚ Scala media.
- ✚ Scala tympani.

Note: scala vestibule and scala tympani merge with each other at helicotrema.



- **The membranous part:**

- ✓ It contains the endolymph (which has K^+).
- ✓ It is composed of 3 parts:
 - ❖ *Utricle and saccule.*
 - ❖ *Semicircular ducts:* well-innervated hair cells have long stereocilia embedded in a viscous fluid. Movement of this fluid under the influence of gravity and momentum bends the hairs triggering a nerve impulse which passes into the CNS along the vestibular nerve → to vestibular nucleus (which is located in the lateral part of the floor of the 4th ventricle).
 - ❖ *Cochlea:*
 - ✚ Cochlea is divided into its 3 cavities by 2 membranes: basilar and Reissner's.
 - ✚ Inner and outer hair cells are present in the middle cavity (scala media) which contains endolymph.
 - ✚ Tectorial membrane is present at the superior aspect of inner and outer hair cells.
 - ✚ Inner hair cells are those which are responsible for hearing and resting on the basilar membrane.
 - ✚ When vibrations reach the basilar membrane → inner hair cells will move → their stereocilia will be bent by tectorial membrane → leading to influx of potassium from endolymph → resulting in depolarization and generation of actions potentials which will travel through cochlear nerve.



- ✓ Arterial supply:
 - ❖ Internal auditory artery (basilar artery).
 - ❖ Stylomastoid artery (posterior auricular artery).
- ✓ Venous drainage:
 - ❖ Internal auditory vein.
 - ❖ Superior petrosal sinus/ transverse sinus.

- **Transmission of sound:**

- Sound waves → pinna → external auditory canal → tympanic membrane → ossicles vibrate → pressure waves in the perilymph → moves basilar membrane → stimulate hair cells → auditory nerve → medula geniculate body → temporal lobe.

- **Facial nerve (7th cranial nerve):**

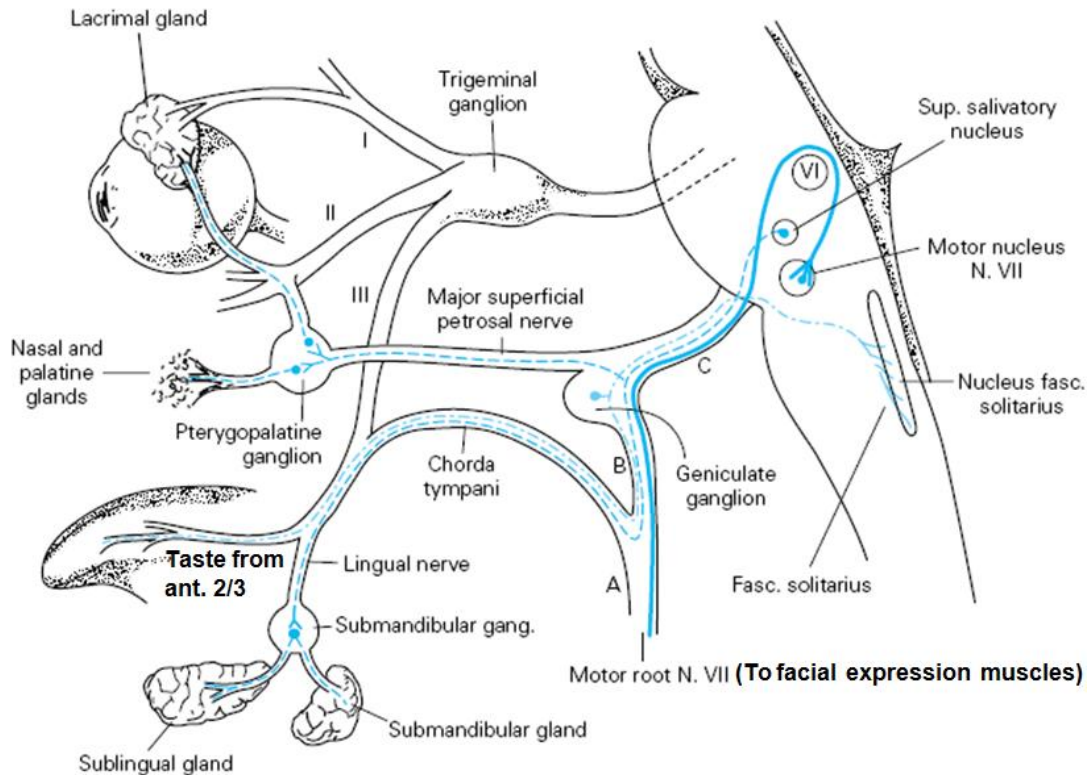
- **Supplying:** muscles of facial expression (frontalis, orbicularis oculi, baccinator, levator angularis, nasalis and orbicularis ori) + stapedius + stylohyoid + posterior belly of digastrics muscle.
- **Course of the nerve:** it is originating laterally in pontomedullary junction (accompanied by nervus intermedius) → enters the internal auditory canal with



vestibulocochlear nerve → at the lateral end of the canal facial nerve turns sharply backward above tympanic cavity (forming the genu which contains the geniculate ganglion for the sensory component) → then it turns sharply downward behind tympanic cavity → emerging through stylomastoid foramen → going to parotid gland → where it breaks up into its major branches

- **Nervus intermedius:**

- **Carrying preganglionic parasympathetic fibers from superior salivary nucleus in pons to:**
 - ✓ Pterygopalatine ganglia → going to lacrimal glands.
 - ✓ Submandibular ganglia → going to submandibular and sublingual salivary glands.
- **It is also carrying taste from anterior 2/3 of the tongue** → to geniculate ganglion → to nucleus solitarius in rostral part of medulla oblongata.



- **Cochlear nerve (branch of 8th cranial nerve):**

- **Course:** cochlear nerve from both ears end in cochlear nuclei → second order neurons will cross (forming trapezoid body) and then fibers will ascend → to reach superior olivary nucleus which helps in determining the source of the sound and giving branches to the following:
 - ✓ 3rd, 4th and 6th cranial nerves → causing movement of eyes in response to sound.
 - ✓ 5th and 7th cranial nerves → initiating the protective reflex contraction of tensor tympani and stapedius.
 - ✓ Inferior colliculus → fibers from here will project to medial geniculate body of thalamus → and then to the primary auditory cortex in the upper surface of superior temporal gyrus → from here fibers will project to auditory association cortex (Wernicke's area) for interpretation of the information.