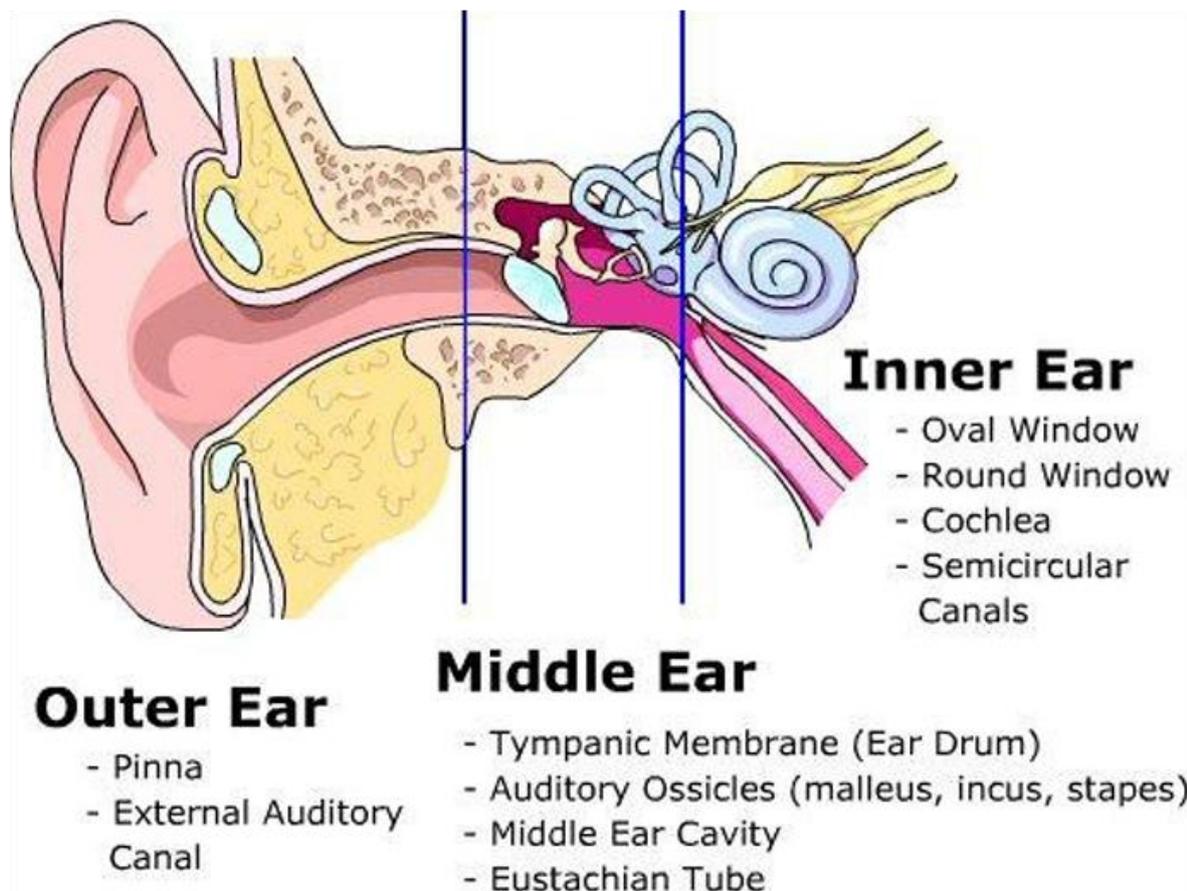


- The ear is designed for **hearing** and **equilibrium**.
- It receives sound vibrations, is sensitive to the force of gravity and reacts to the movement of the head.
- The ear consists of **3 parts**:
 - **Outer ear.**
 - **Middle ear.**
 - **Inner ear.**

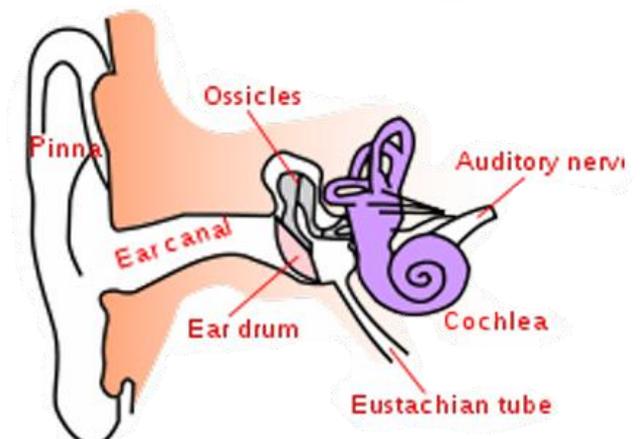
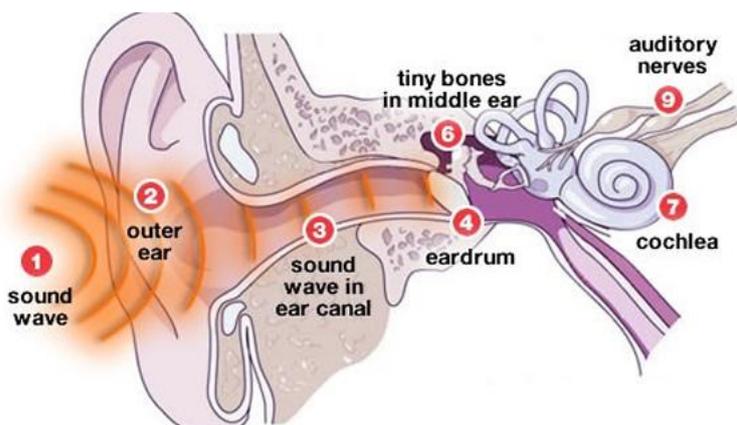
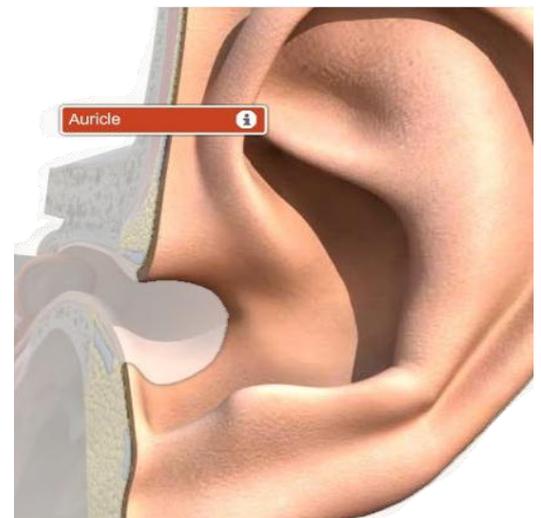
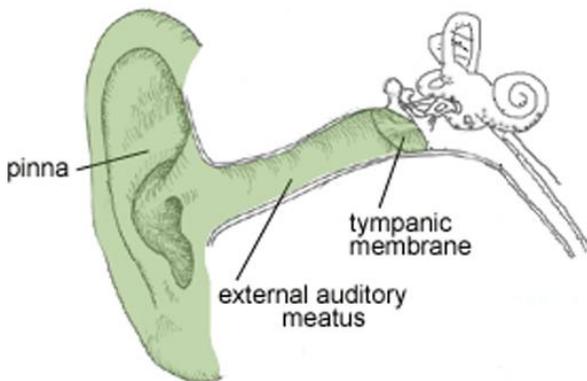


a) Outer (External) ear:

- It consists of 3 parts:

Auricle (Pinna)	Shape	Funnel-like structure.
	Function	Helps collect sound waves traveling through the air and directs them into the external acoustic meatus .
External Acoustic Meatus (External Auditory Canal)	Shape	S-Shaped tube.
	Function	As sound waves enter, they change the pressure on the eardrum .
Eardrum (Tympanic membrane)	Shape	- Cone shaped. - May be considered part of middle ear.
	Description	- Semitransparent membrane covered by a thin layer of skin on its outer surface and a mucous membrane inside. - Has an oval margin and cone-shape with the cone apex pointing inward .

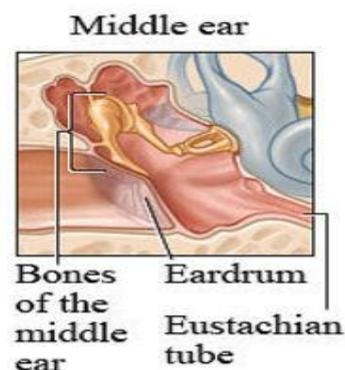
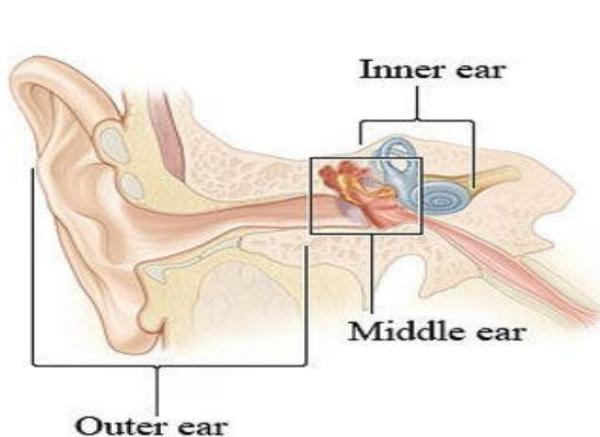
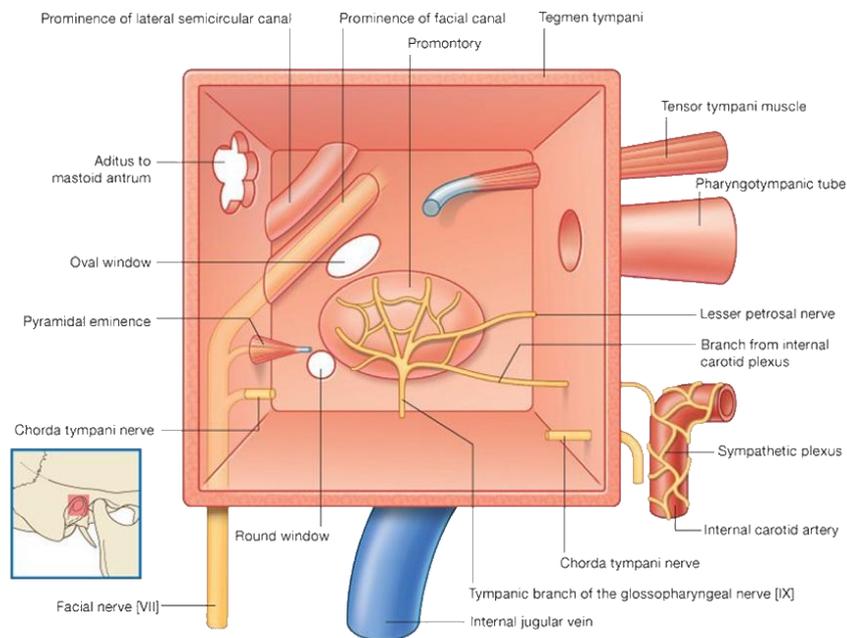
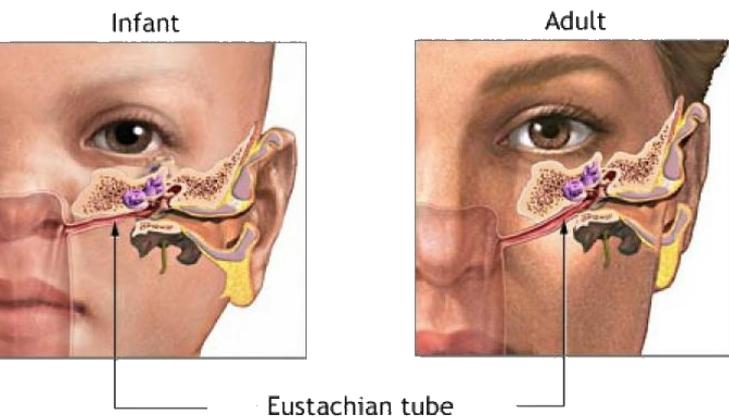
Outer Ear



b) Middle ear (Tympanic Cavity):

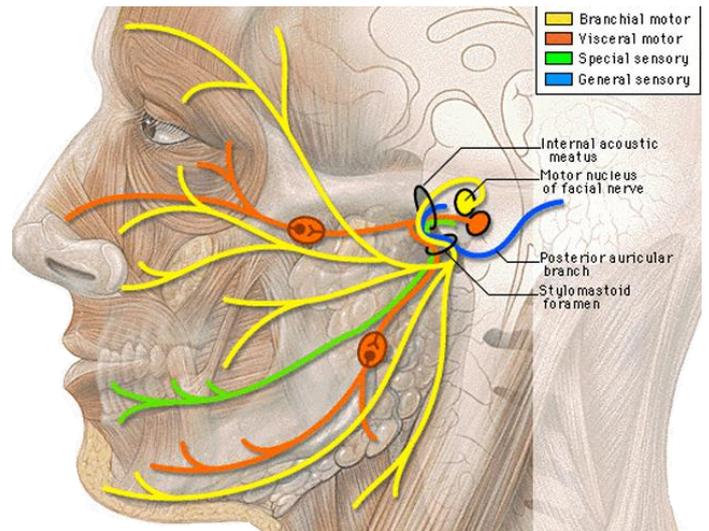
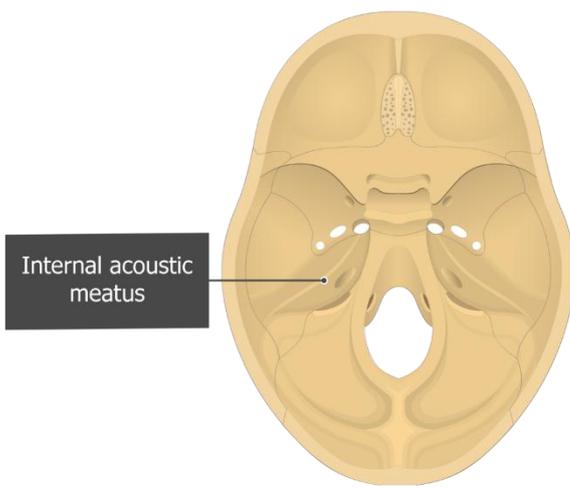
- **Air-filled space** in the temporal bone.
- It contains:

Three bones (Auditory Ossicles)	Malleus (hammer).
	Incus (anvil).
	Stapes (stirrup) smallest bone of the body.
Oval Window	Opening of tympanic cavity that leads to inner ear.
Auditory Tube (Eustachian Tube)	<ul style="list-style-type: none"> - Connects middle ear to back of nasopharynx. - Conducts air between tympanic cavity and the outside of body by way of nose and mouth - Helps maintain equal pressure of both sides of eardrum - Function is noticeable during rapid altitude changes - Popping sound is heard when hearing is restored back to normal



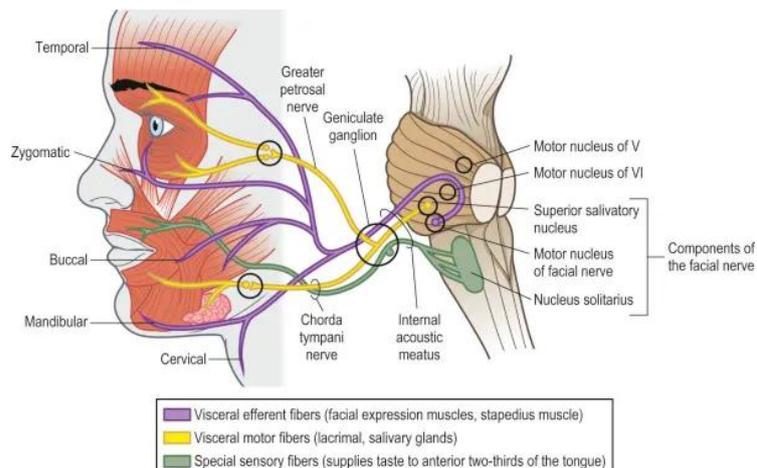
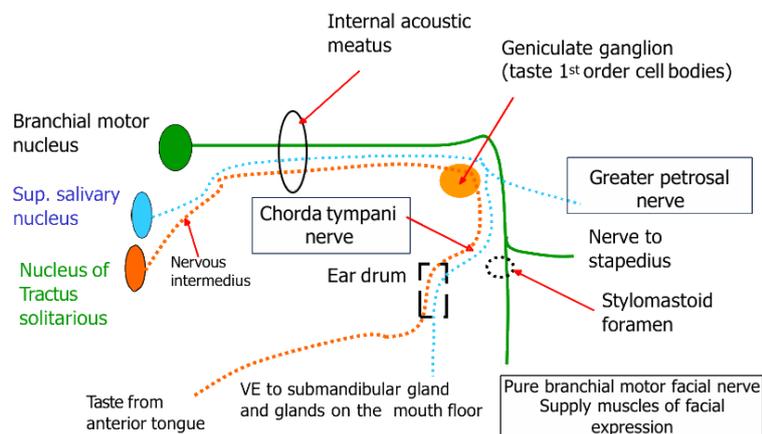
Facial Nerve (CN VII)

- Fibers leave the **pons**, travel through the **internal acoustic meatus**, and emerge through the **stylomastoid foramen** to the **lateral aspect of the face**.
- Motor functions:** **Facial expression** and the transmission of **autonomic impulses to lacrimal and salivary glands**.
- Sensory function:** Taste from the **anterior 2/3** of the tongue.



Facial Nerve Nuclei:

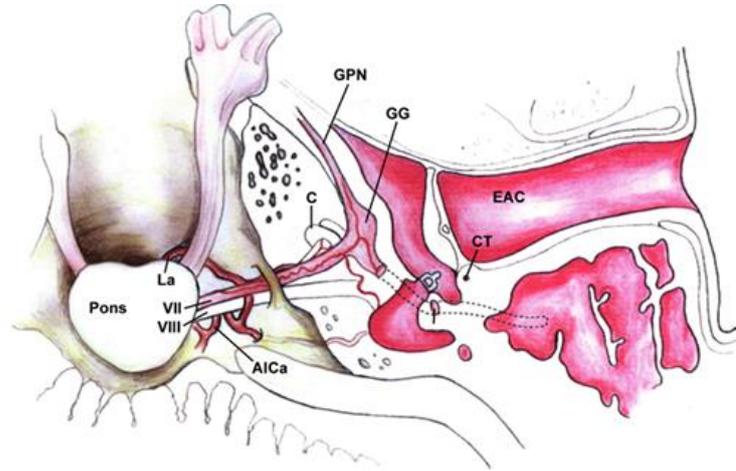
Motor nucleus	Lower Pons below 4th ventricle.
Superior salivatory nucleus	Dorsal to motor nucleus.
Nucleus solitarius	Medulla oblongata.
Spinal trigeminal	



Facial Nerve course:

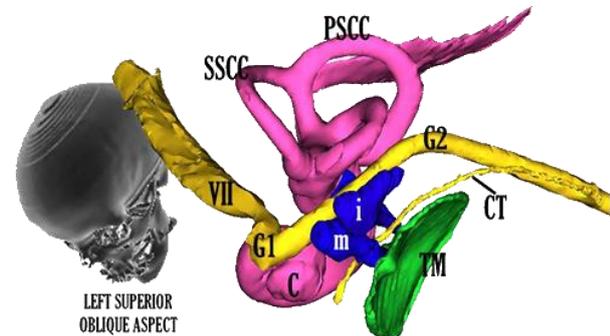
a) Intra-Cranial portion:

- From the brainstem (**Pons**), CN VII crosses **CPA** (Cerebello-pontine angle) with CN VIII to the **Internal auditory meatus**.
- **Surgical importance:**
 - Iatrogenic trauma: in CPA tumor surgery.
 - Difficult to identify in schwannoma (no connective tissue).



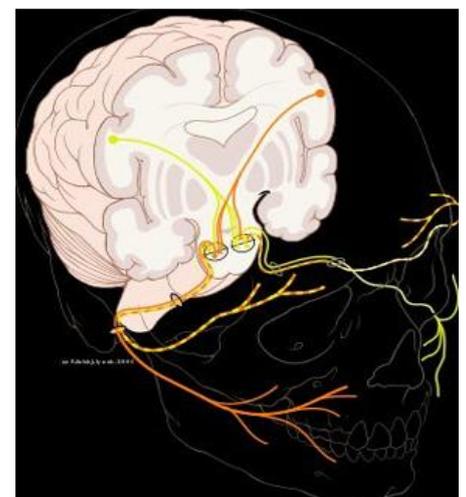
b) Tympanic segment:

- **Geniculate ganglion:** Bipolar ganglion cells.
- **Horizontal segment:**
 - From Geniculate ganglion to 2nd genu.
 - Lies beneath Lateral Semicircular Canal & above Oval Window.



c) Extra-temporal region:

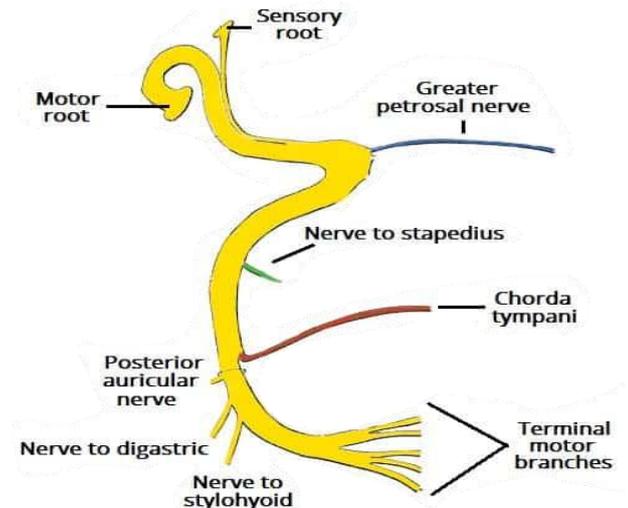
- From **Stylomastoid Foramen** to **terminal branches**.
- Runs in the substance of parotid gland.



Facial Nerve branches:

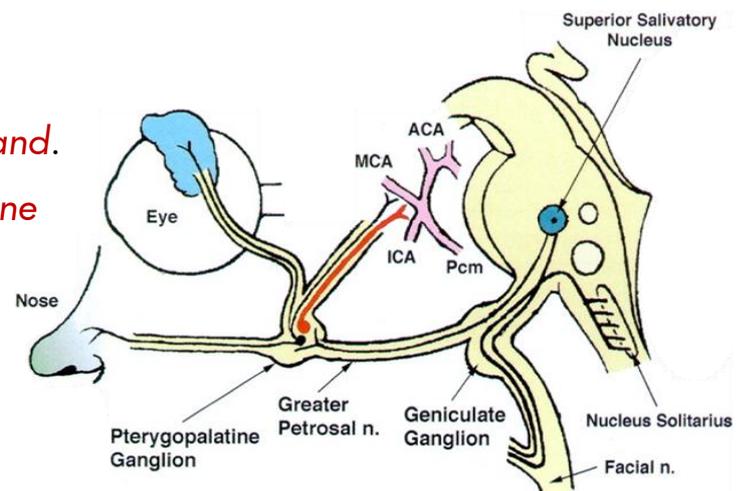
▪ Intra-temporal region:

- Greater Superficial Petrosal Nerve (GSPN).
- Nerve to Stapedius.
- Chorda Tympani.
- Sensory auricular branch.
- Terminal branches.



a) GSPN:

- From Geniculate Ganglion.
- Gives two types of fibers:
 - Parasympathetic → to **lacrimal gland**.
 - Sensory fibers → to **nasal & palatine glands**.



b) Nerve to Stapedius:

- Supply stapedius muscle.

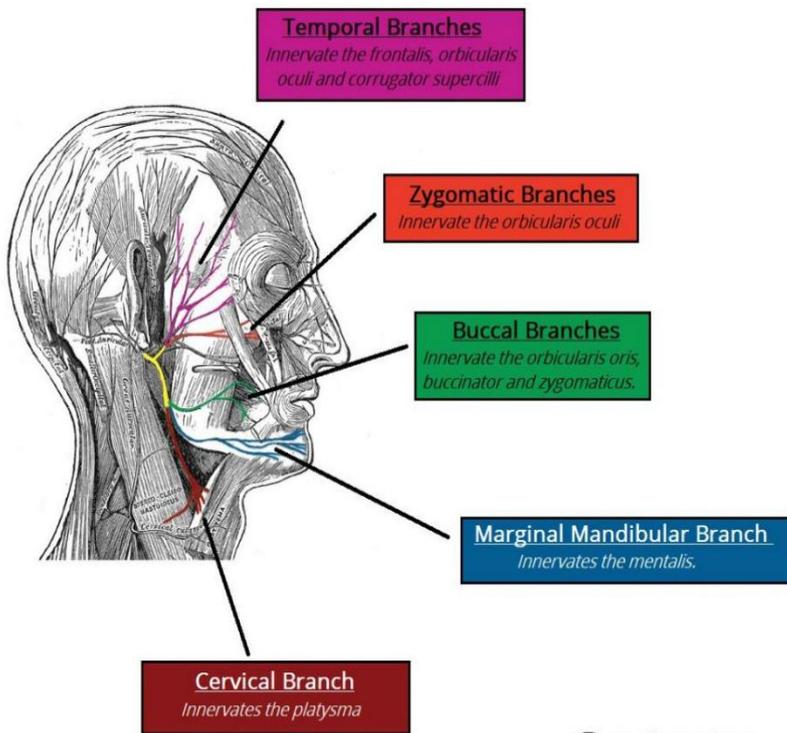
c) Sensory auricular branch:

- Joins auricular branch of vagus.
- Supply **retro auricular groove** & **concha**.

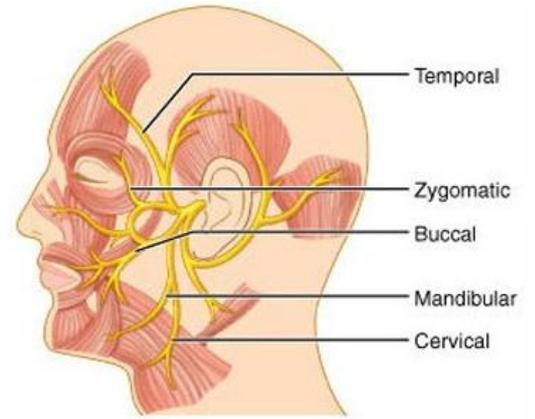
d) Chorda Tympani:

- Gives two types of fibers:
 - Preganglionic Parasympathetic → **submandibular & sublingual Glands**
 - Special sensory → **anterior 2/3 of tongue**.

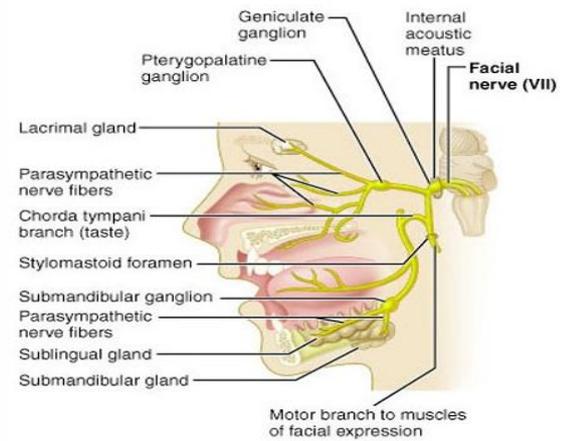
e) Terminal branches:



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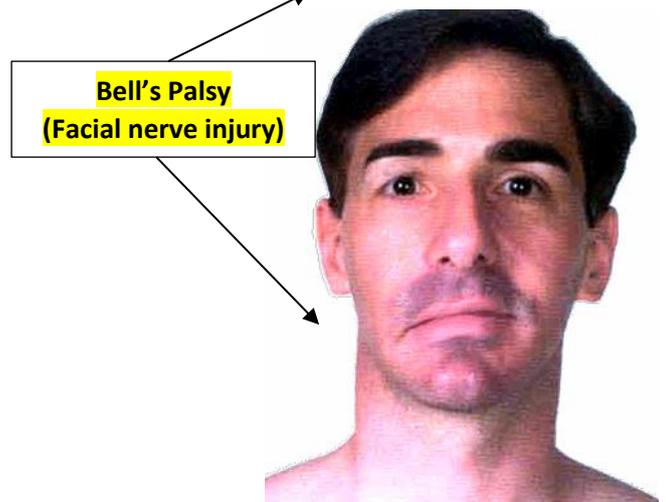
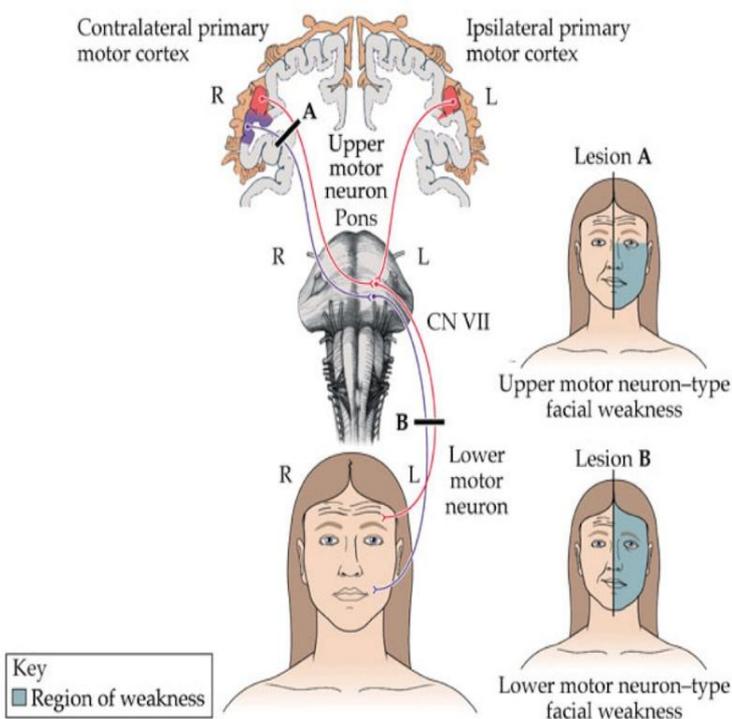


(b) Motor branches to muscles of facial expression and scalp muscles



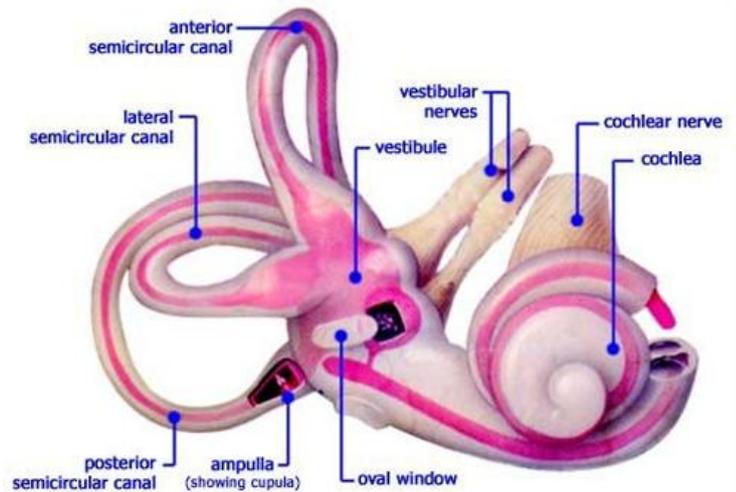
(a) Parasympathetic efferents and sensory afferents

Facial Nerve lesions:



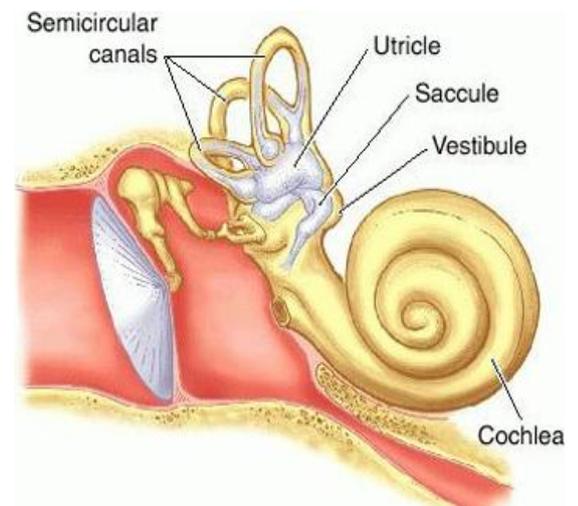
Inner (Internal) Ear:

- Consists of:
 - Labyrinth.
 - Semicircular canals (SCC).
 - Cochlea.
 - Round window.
 - Spiral Organ (Organ of Corti).



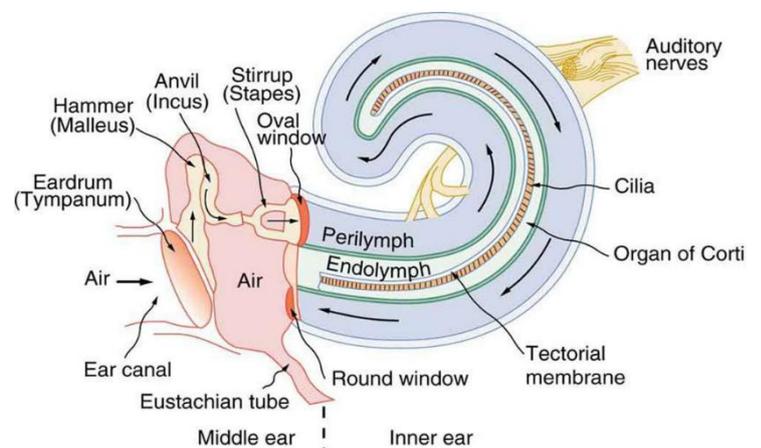
Vestibule and SCC:

- The **vestibule and semicircular canals are bony structures** lined with membranes and contains a **fluid called perilymph** which provides a sense of equilibrium.
- Changes in the position of the head cause this fluid to move against sensory receptors.
- Dizziness or motion sickness may be associated with rapid movements.



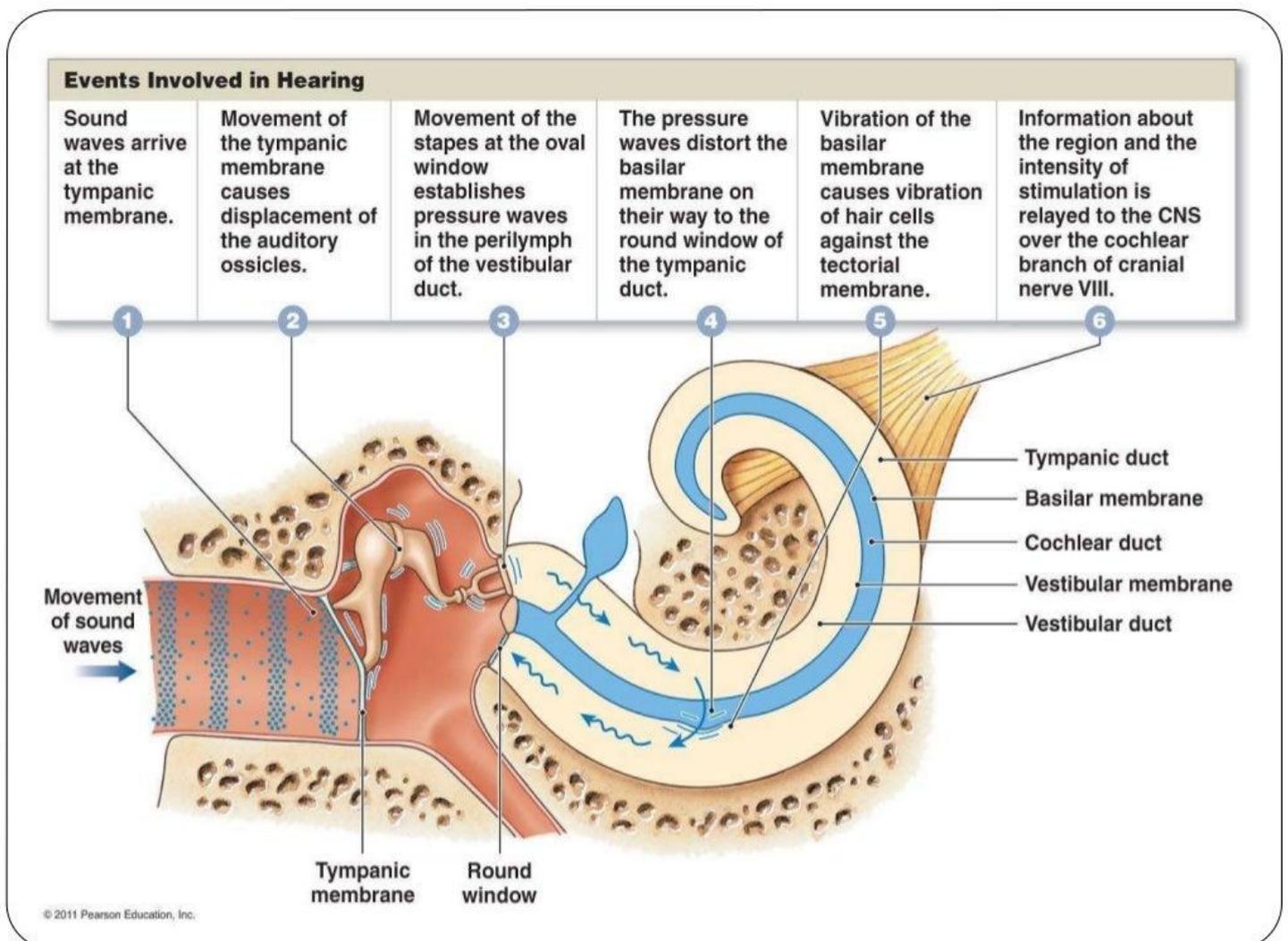
SCC & Cochlea:

- SCC:
 - Part of labyrinth.
 - Provide sense of **equilibrium**.
- Cochlea:
 - Functions in **hearing**.
 - Has bony core and thin bony shelf that winds around the core like the threads of a screw.



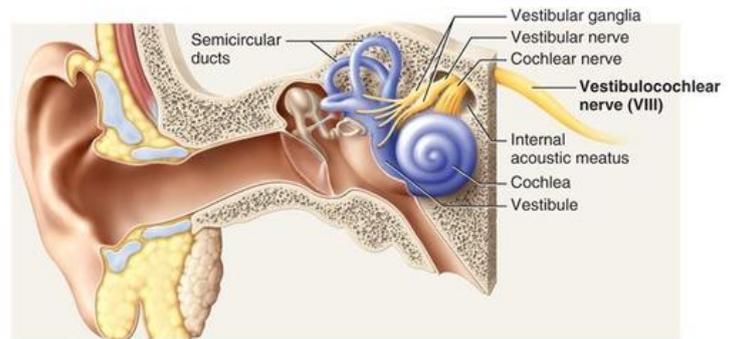
Steps to hearing:

- **Vibrations** move through the outer ear canal and **vibrate the eardrum**.
- The eardrum passes its energy through a chain of **three tiny bones**, the **anvil, hammer, and stirrup**, in the middle of the ear.
- The anvil, hammer, and stirrup **pass the energy onto the cochlea**.
- The vibrations **activate hair cells and fluid** inside the cochlea.
- **Electrical signals** are sent to the brain through the **auditory nerve**.



Vestibulocochlear Nerve (CN VIII)

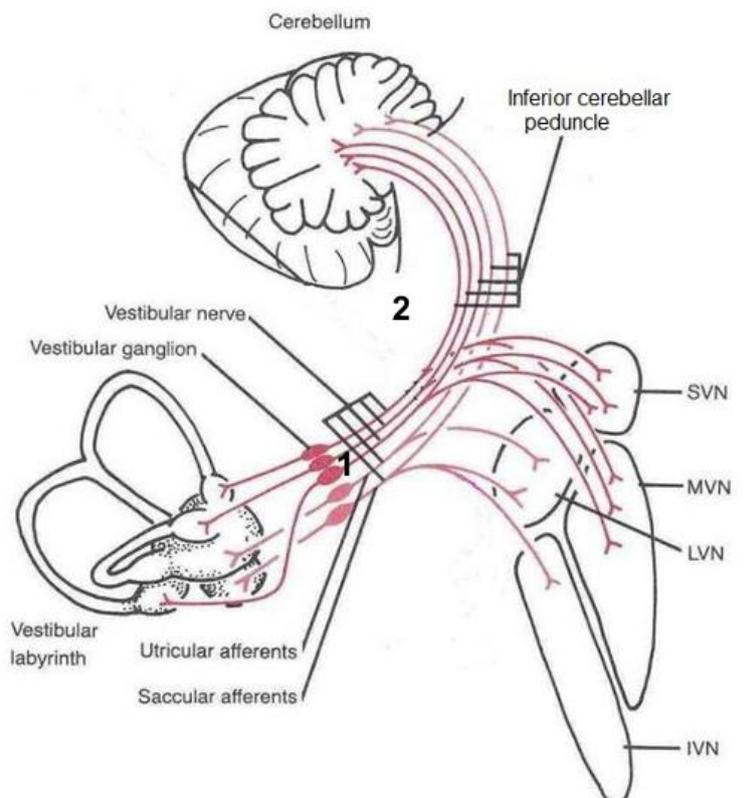
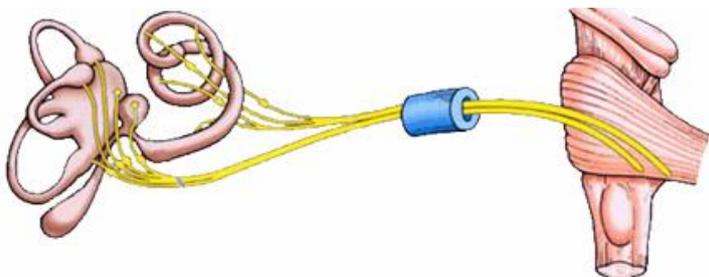
- Special sensory (SSA):
 - Vestibular part → balance of body (position & movement of the head).
 - Cochlear part → hearing.



- They arise from the **hearing and equilibrium apparatus of the inner ear**, pass through the **internal auditory meatus** and enter the brainstem at the **pons-medulla border**.

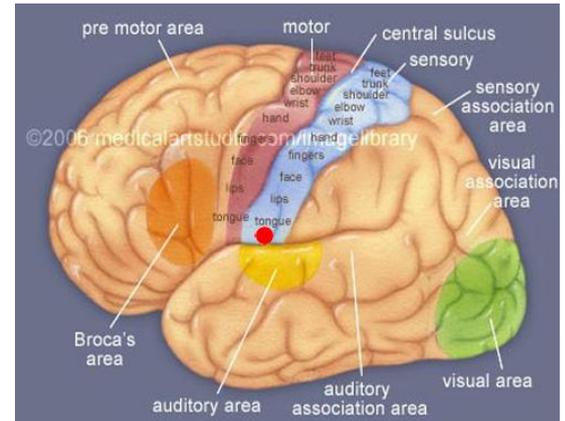
a) Vestibular Nerve:

- The vestibular nerve fibers **arise from hair cells** of the membranous labyrinth.
- Their cell bodies (**1st order neurons**) are located in the **vestibular "Scarpa's" ganglion** within the internal auditory meatus.
- Their central processes:
 - Mostly end up in the **lateral, medial, inferior and superior vestibular nuclei** (2nd order neurons) of the medulla and pons.
 - Some fibers go to the **cerebellum** through the inferior cerebellar peduncle.



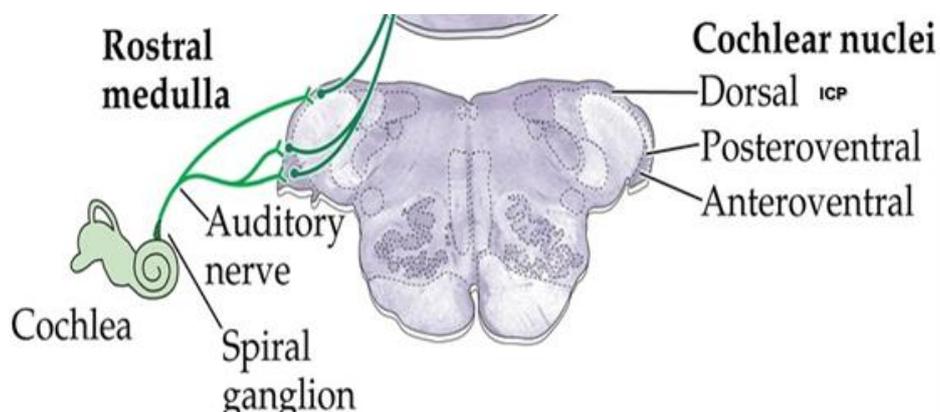
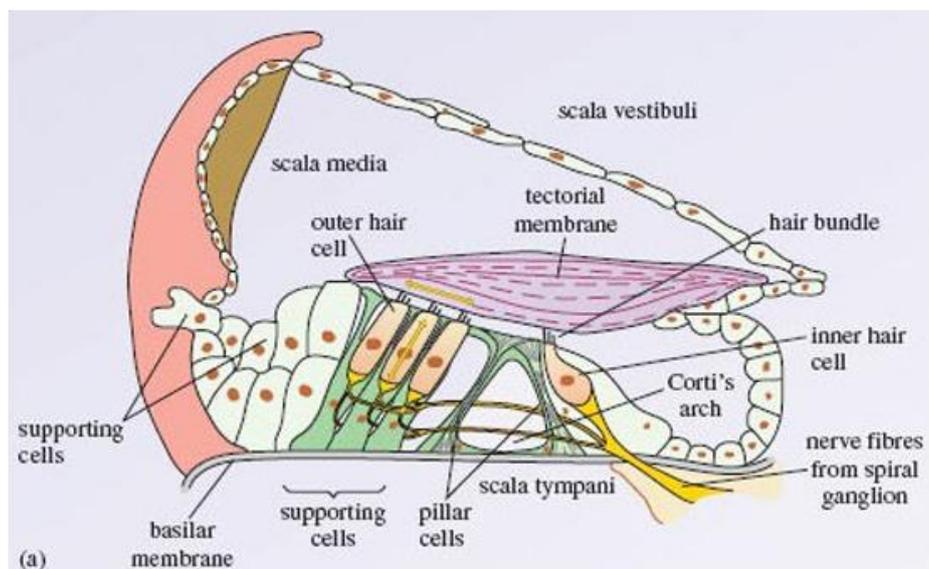
Vestibular Cortex:

- Located in the **lower part of post-central gyrus** (head area).
- Responsible for conscious awareness of vestibular sensation (**position of the head in space**).



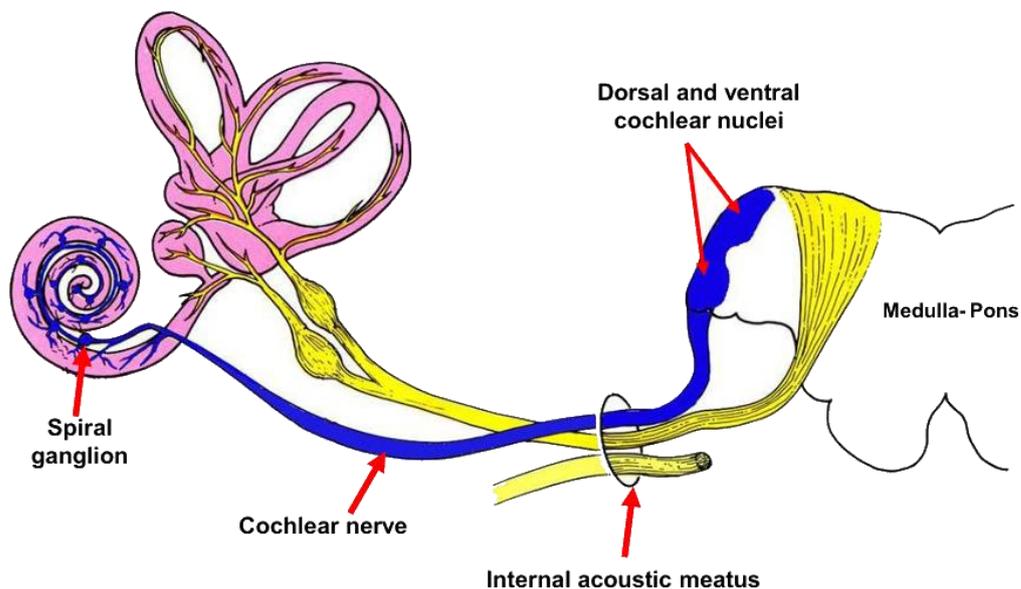
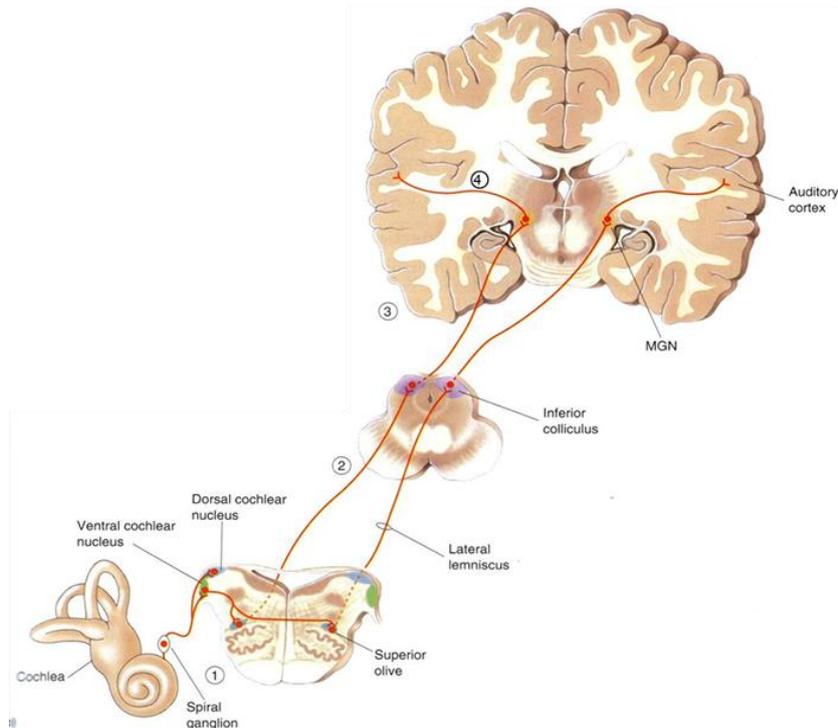
b) Cochlear (Auditory) Nerve:

- The cochlear nerve fibers **arise from hair cells of the organ of Corti** within the cochlear duct of the inner ear.
- Their cell bodies (**1st order neurons**) are located within the **cochlea** in the **spiral ganglion**.
- Their **central processes** terminate in the **dorsal and ventral cochlear nuclei** (2nd order neurons).



Auditory pathway:

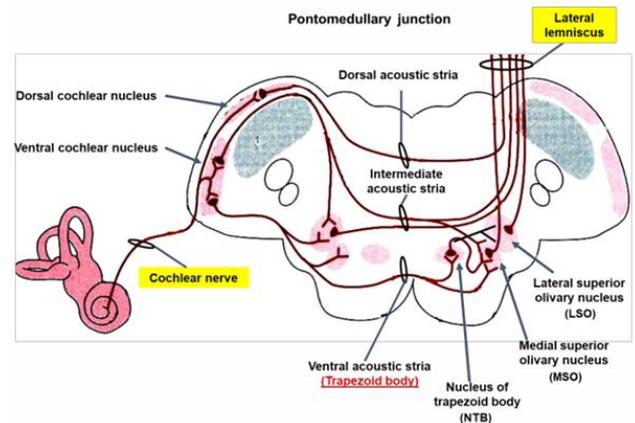
- It is a **multi-synaptic pathway**.
- There are several locations between medulla and the thalamus where axons may synapse (not all the fibers behave in the same manner).
- Representation of cochlea is **bilateral** at all levels above cochlear nuclei.



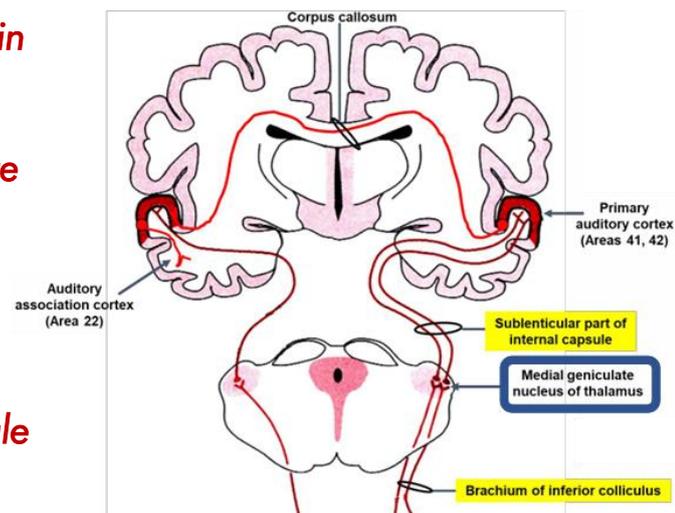
Cochlear (Auditory) Nerve (Continued):

- From the cochlear nuclei, 2nd order neurons ascend into the pons, where:
 - Some fibers cross** the midline in trapezoid body and terminate in the nucleus of trapezoid body or in the contralateral superior olivary nucleus.
 - Some fibers run ipsilaterally** and terminate in the superior olivary nucleus.

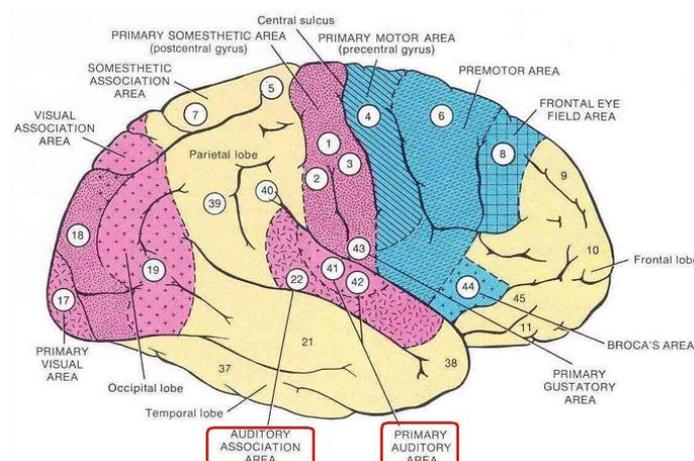
- From the superior olivary nuclei, ascending fibers comprise the **lateral lemniscus**, which runs through tegmentum of pons and **terminate in the inferior colliculus** of the midbrain.

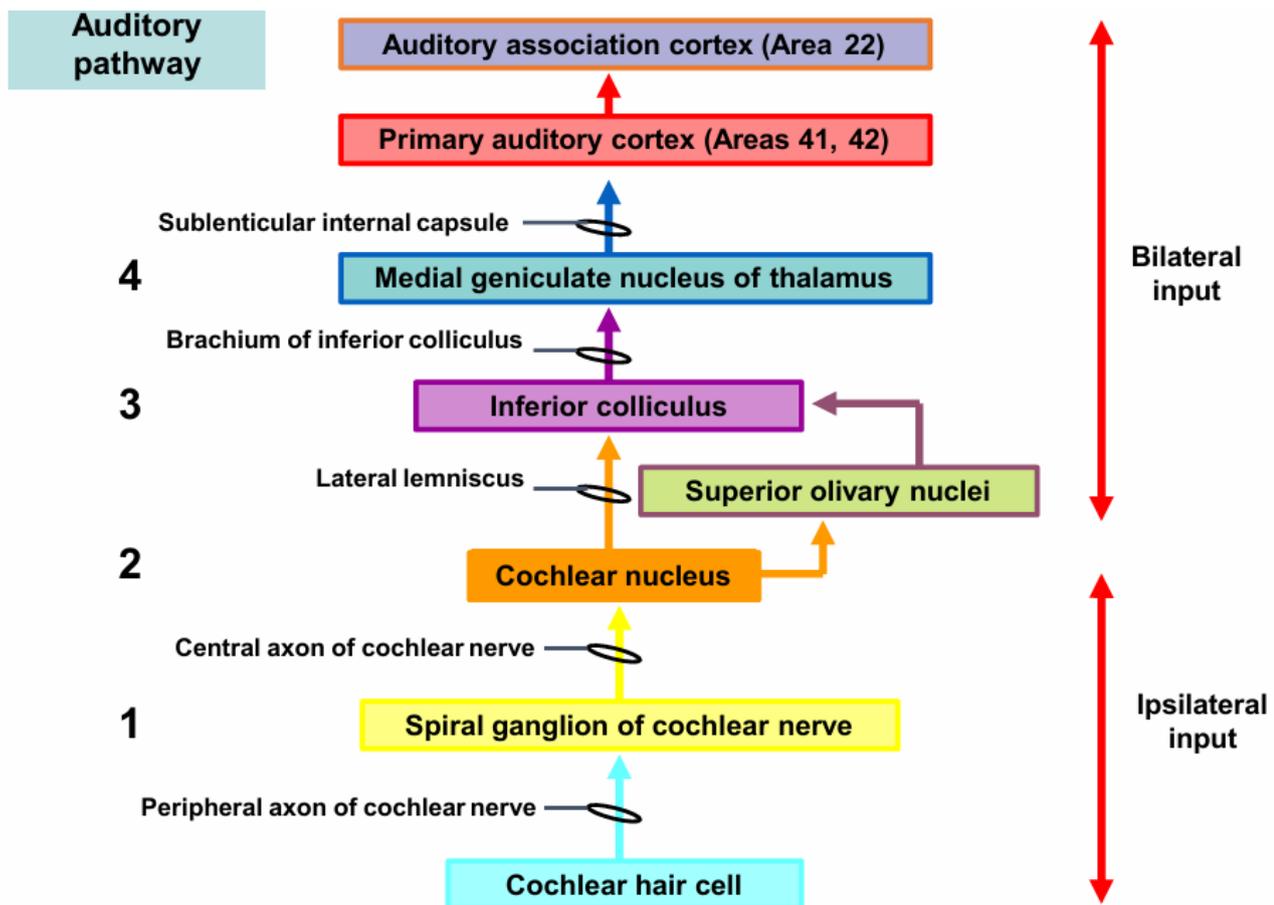


- Some axons within lateral lemniscus **terminate in small nucleus** of the lateral lemniscus
- The inferior colliculi project to **medial geniculate nuclei of thalamus**.
- The axons originating in the medial geniculate nucleus (**auditory radiation**) pass through **sublenticular part of the internal capsule** to the **primary auditory cortex (BA 41,42)**.



- The region surrounding the primary auditory cortex is known as the **auditory association cortex** or **Wernick's area (BA22)**.
- Wernick's area is related to recognition and processing of **language** by the brain.



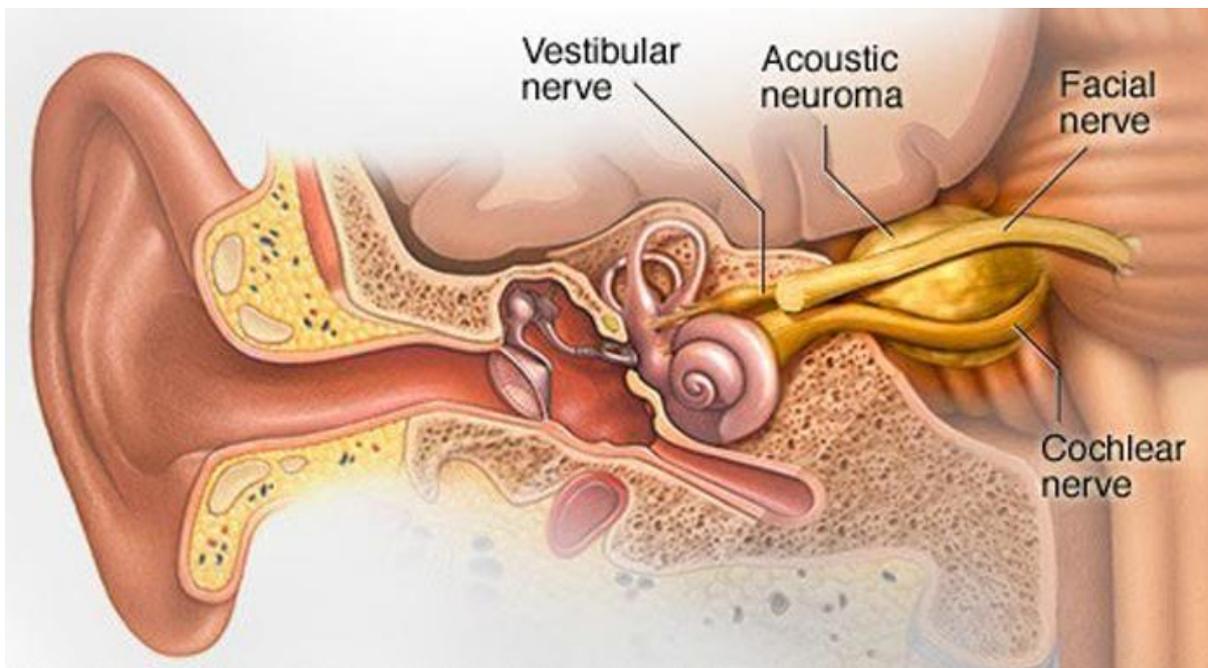


Reflex pathways:

- Superior Olivary Nucleus → sends **olivocochlear fibers** to end in **organ of Corti** through the **vestibulocochlear nerve**. These fibers are **inhibitory** in function and serve to modulate transmission to the cochlear nerve.
- Superior Olivary Nucleus + Nucleus of Lateral Lemniscus → establish reflex connections with **motor neurons of trigeminal and facial nuclei** mediating **contraction of tensor tympani and stapedius muscles** in response to **loud noise**.
- Inferior Colliculi → establish reflex connections with motor neurons in the cervical spinal segments (**tectospinal tract**) for the **movement of head and neck in response to auditory stimulation**.

Clinical Notes

- Lesion of vestibulocochlear nerve → **deafness** (disturbance of cochlear nerve functions), **tinnitus**, vertigo, dizziness, nausea, nystagmus, **loss of balance and ataxia** (disturbance of vestibular nerve functions).
- Acoustic neuroma (Schwannoma): a **benign tumor of 8th nerve** leads to compression of the nerve leading to attacks of dizziness, and **profound deafness and ataxia**.



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