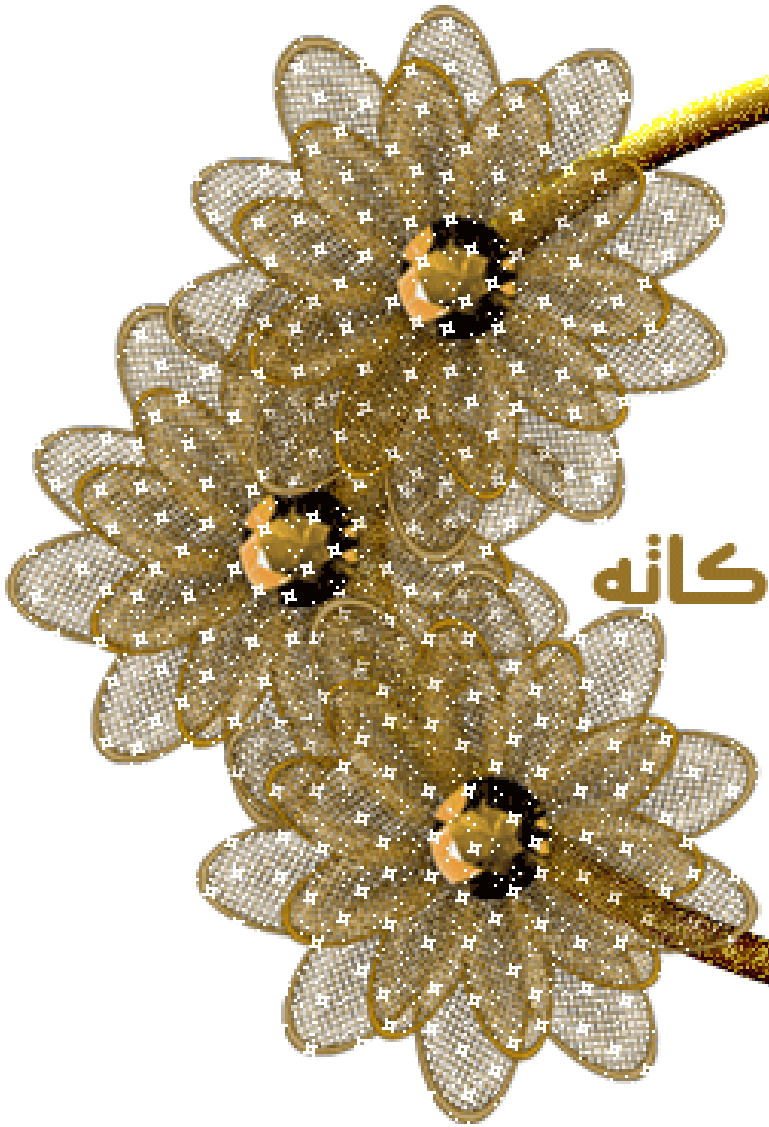


بسم الله الرحمن الرحيم

السلام عليكم ورحمه الله وبركاته

Ear and Facial Nerve
Vestibulo-Cochlear Nerve

Department of human Anatomy and Embryology
Faculty of Medicine
Mansoura National University, Egypt

OBJECTIVES

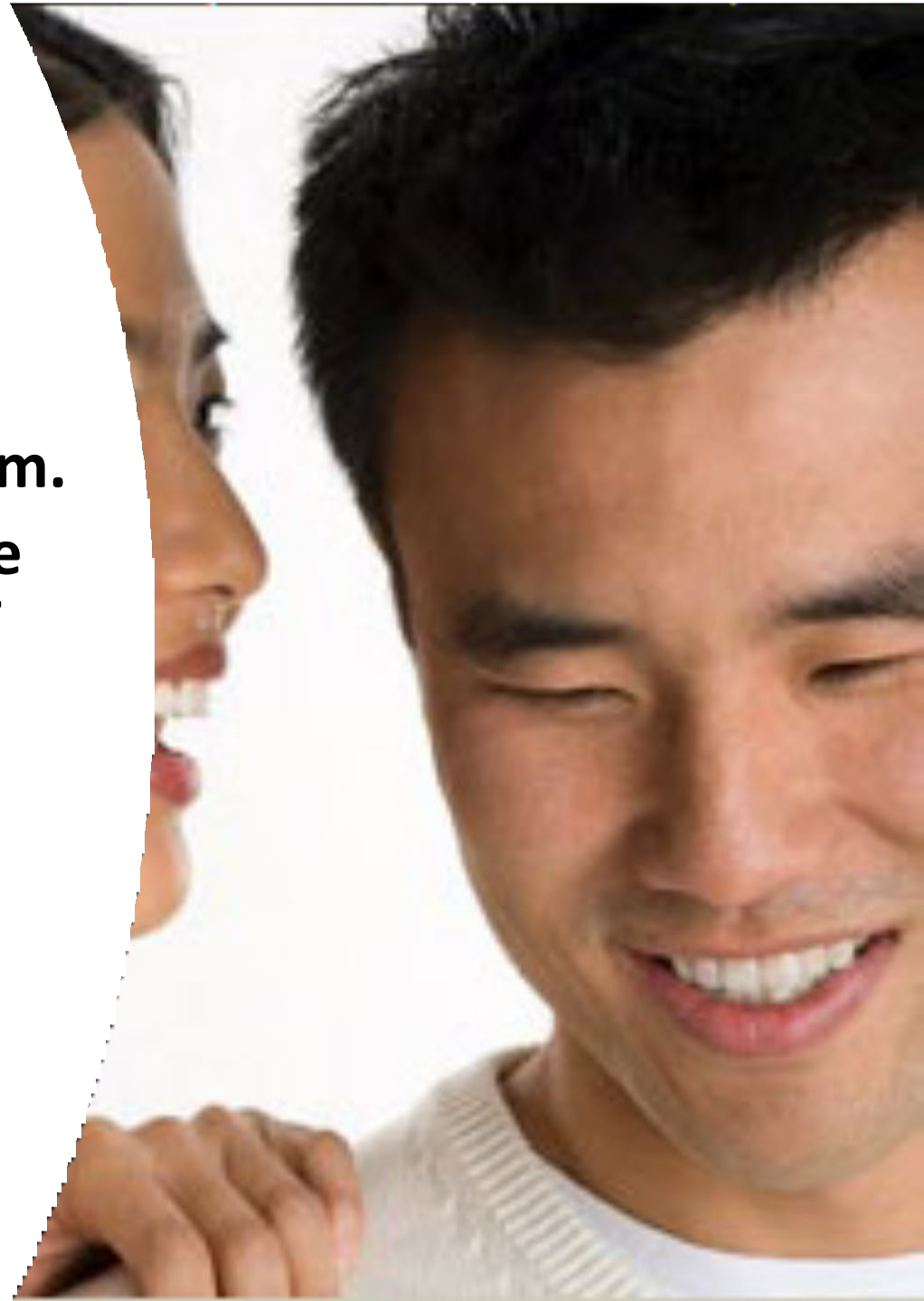
By the end of the lecture, the student will be able to:

- **Define parts of the ear.**
- **Describe the nuclei of facial nerve.**
- **Locate the site of lesion in facial nerve.**
- **Describe the vestibulo-cochlear nerve.**

Special senses:
The ear

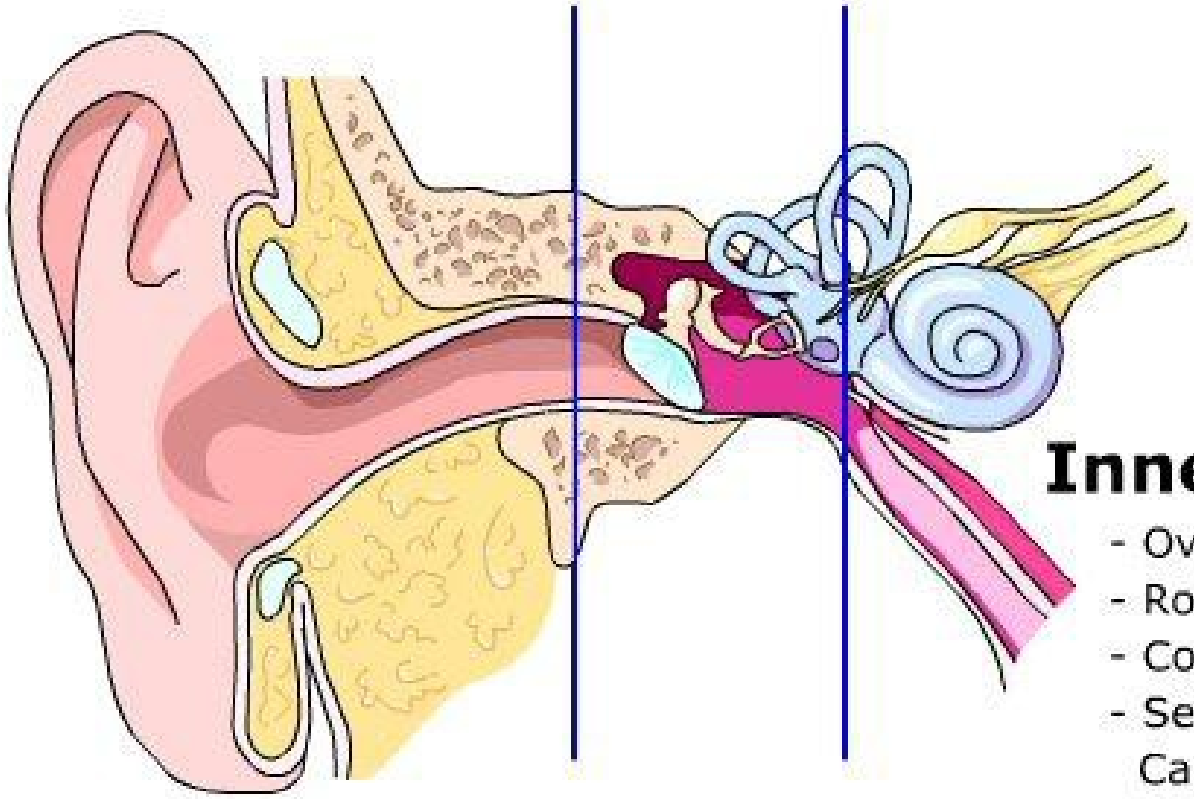
-The ear is designed for hearing and equilibrium.

- It receives sound vibrations, is sensitive to the force of gravity and reacts to the movement of the head.



3 Parts

- Sense of Hearing
  - Outer ear
  - Middle ear
  - Inner ear
- Ear also functions as sense of equilibrium



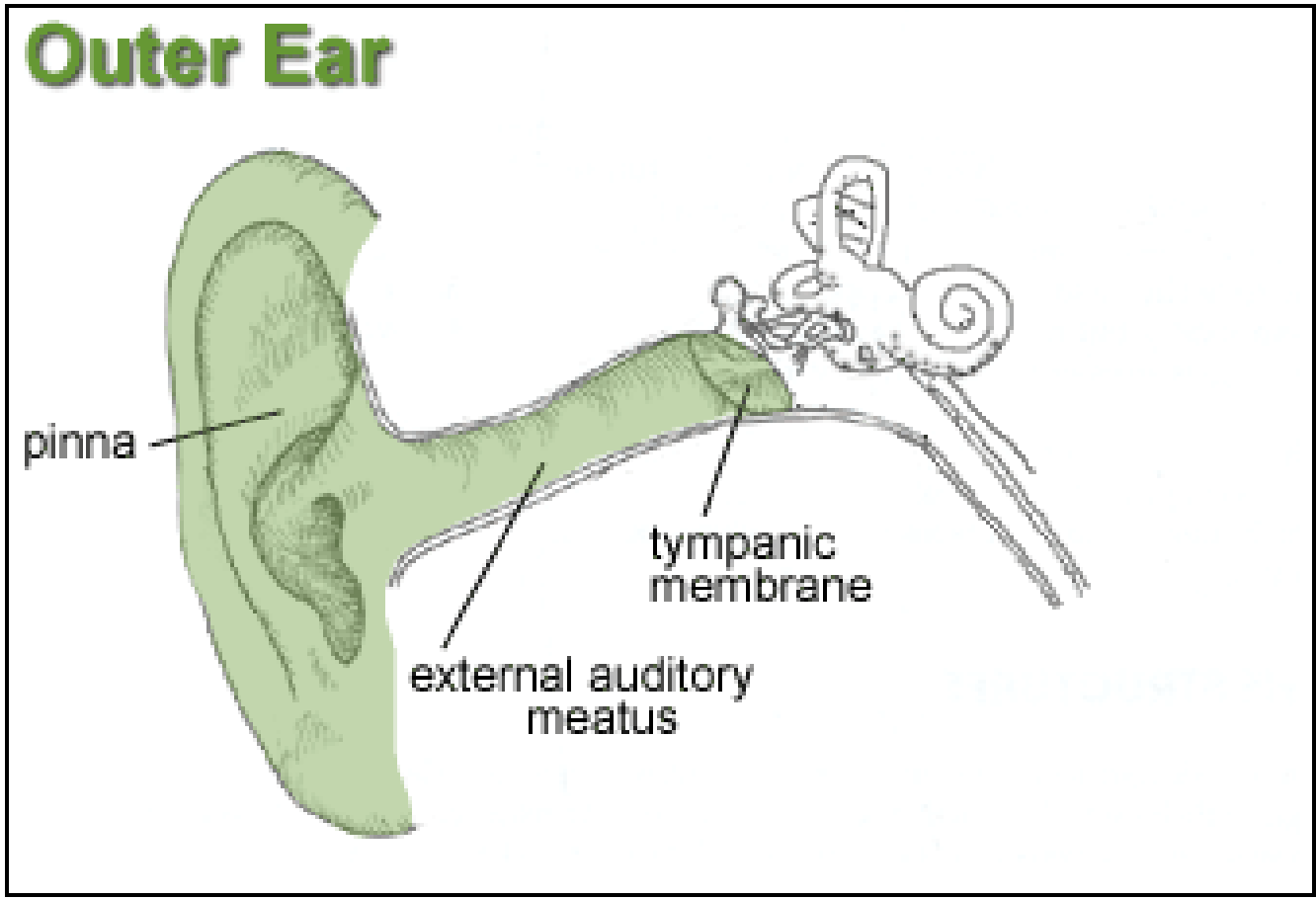
Inner Ear
- Oval Window
- Round Window
- Cochlea
- Semicircular Canals

Middle Ear
- Tympanic Membrane (Ear Drum)
- Auditory Ossicles (malleus, incus, stapes)
- Middle Ear Cavity
- Eustachian Tube

Outer Ear
- Pinna
- External Auditory Canal

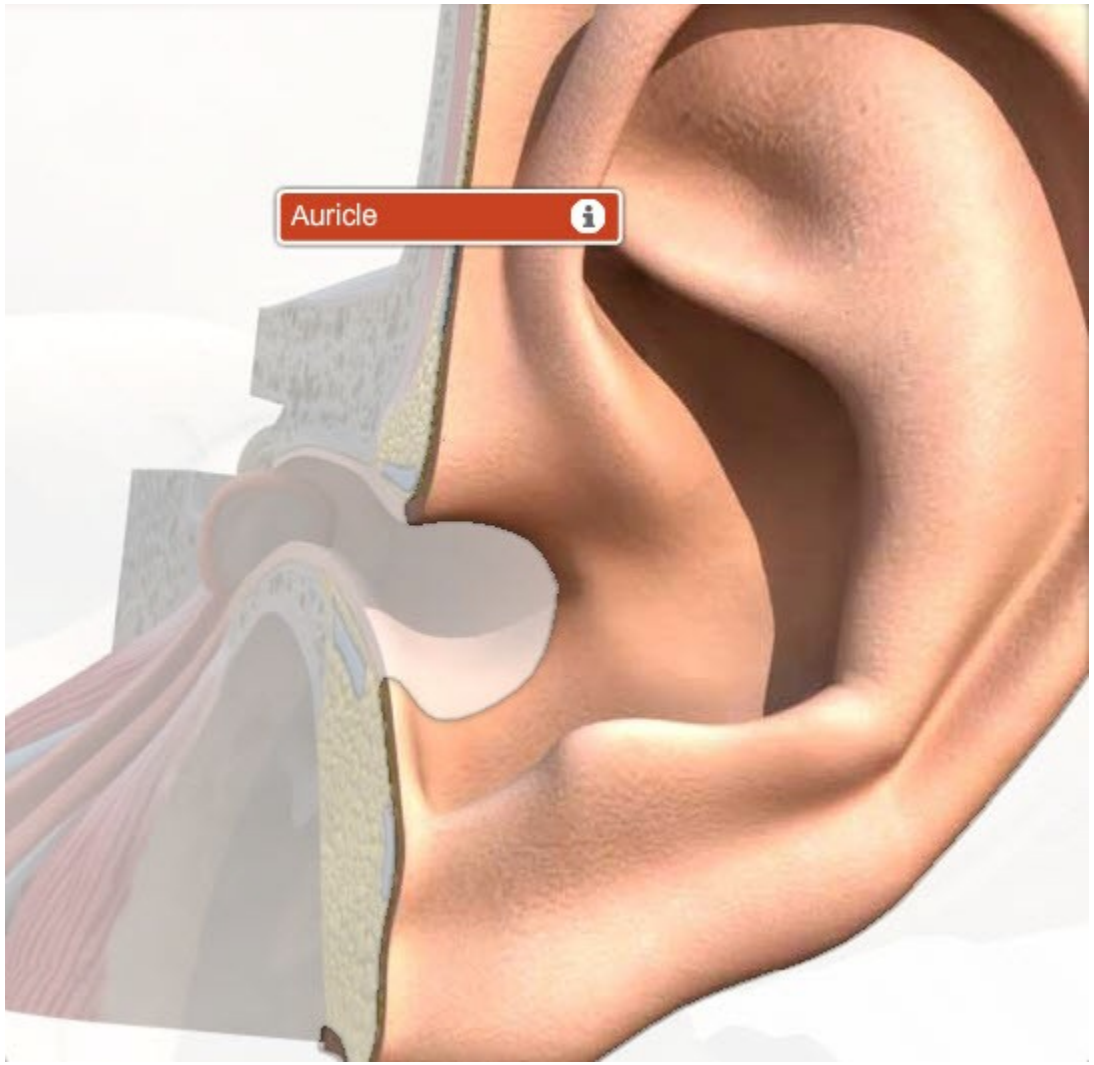
Outer (External) Ear

- 3 parts
  - **Auricle** (Pinna)
    - Funnel-like structure
  - **External Acoustic Meatus (External Auditory Canal)**
    - S-shaped tube
  - **Eardrum (tympanic membrane)**
    - Cone shaped
    - Sometimes considered part of middle ear



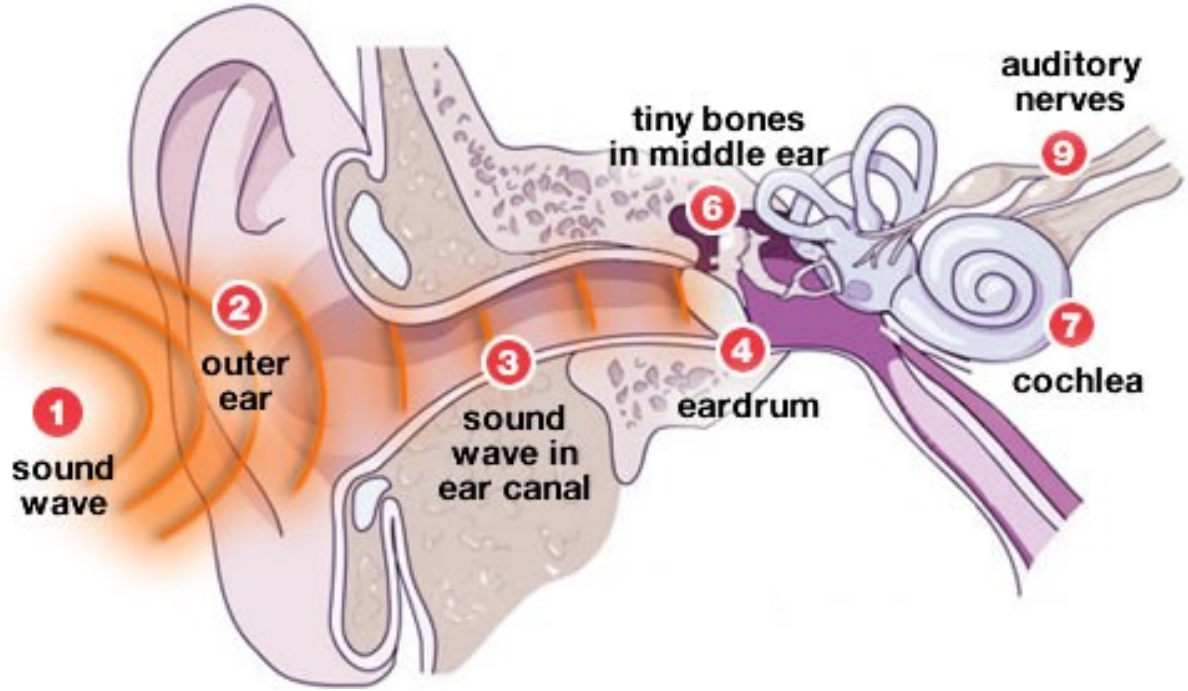
Auricle

- Helps collect sound waves traveling through the air and directs them into the external acoustic meatus.



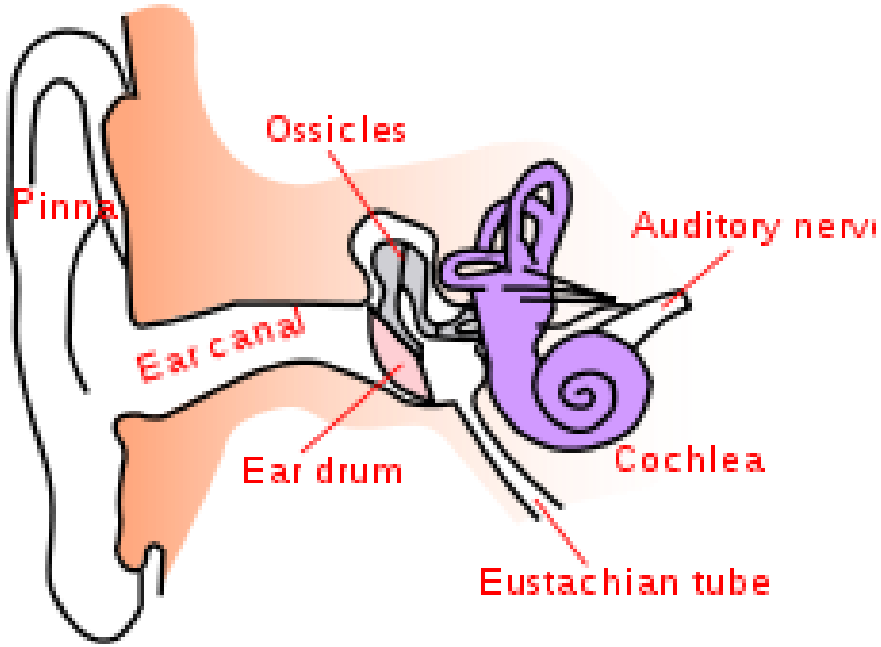
External Acoustic Meatus

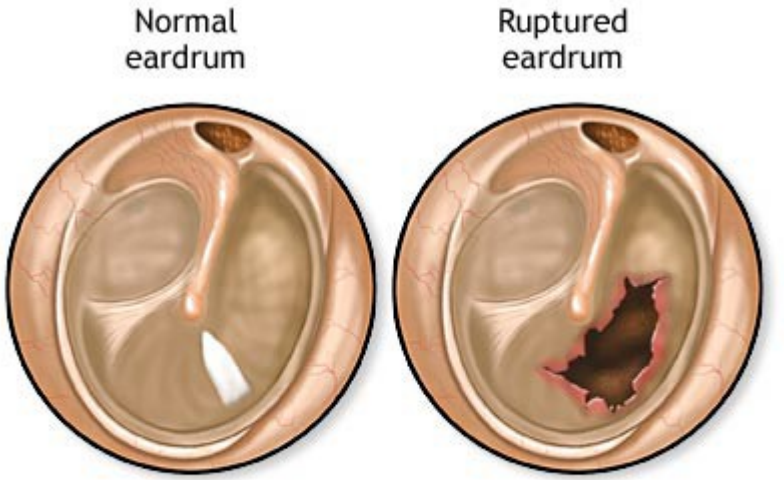
- As sound waves enter, they change the pressure on the eardrum.



Eardrum

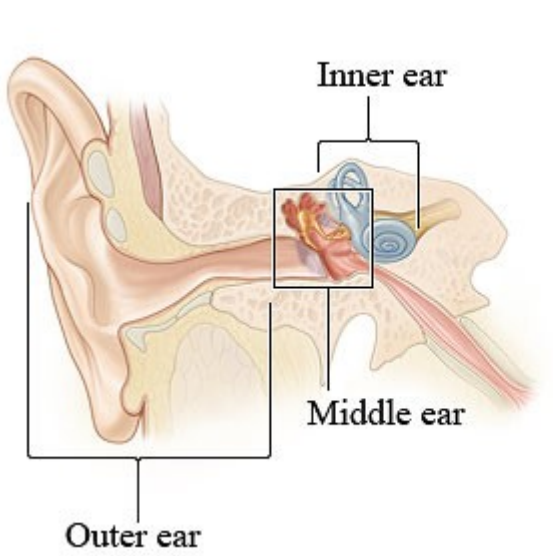
- Semitransparent membrane covered by a thin layer of skin on its outer surface and a mucous membrane inside
- Has an oval margin and cone-shape with the cone apex pointing inward.

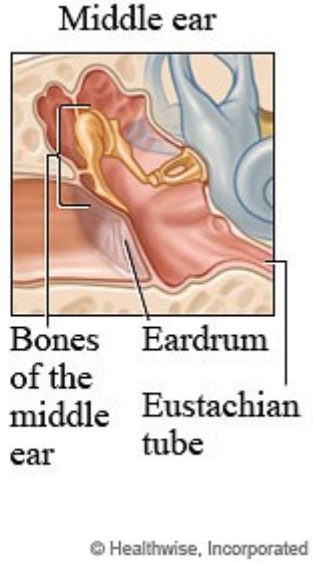


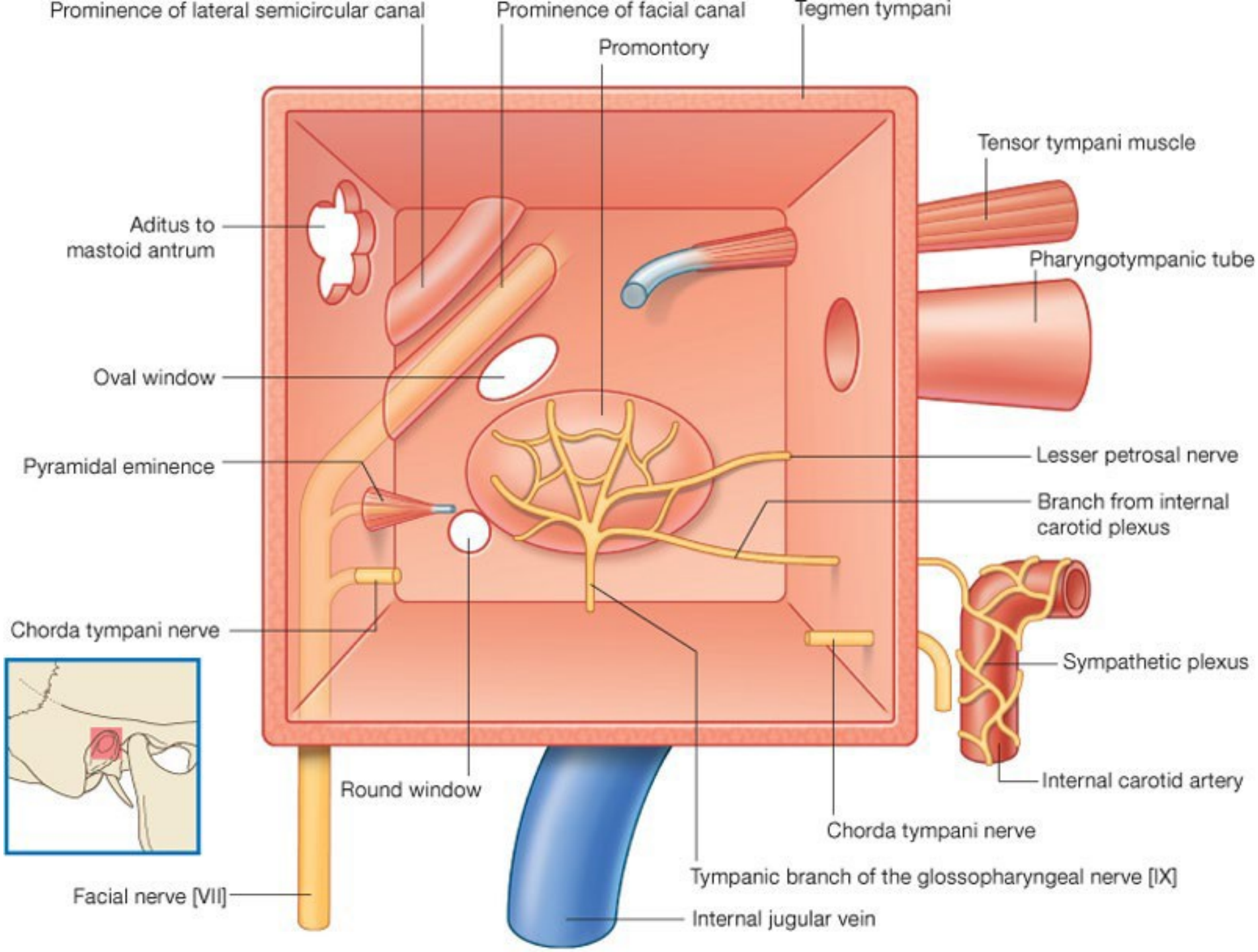


Middle Ear (Tympanic Cavity)

- Air-filled space in the temporal bone
- Contains three bones called Auditory Ossicles:
  - Malleus & Incus & Stapes
- Oval Window
  - Opening of tympanic cavity that leads to inner ear
- Auditory Tube (Eustachian Tube)
  - Connects middle ear to nasal cavity

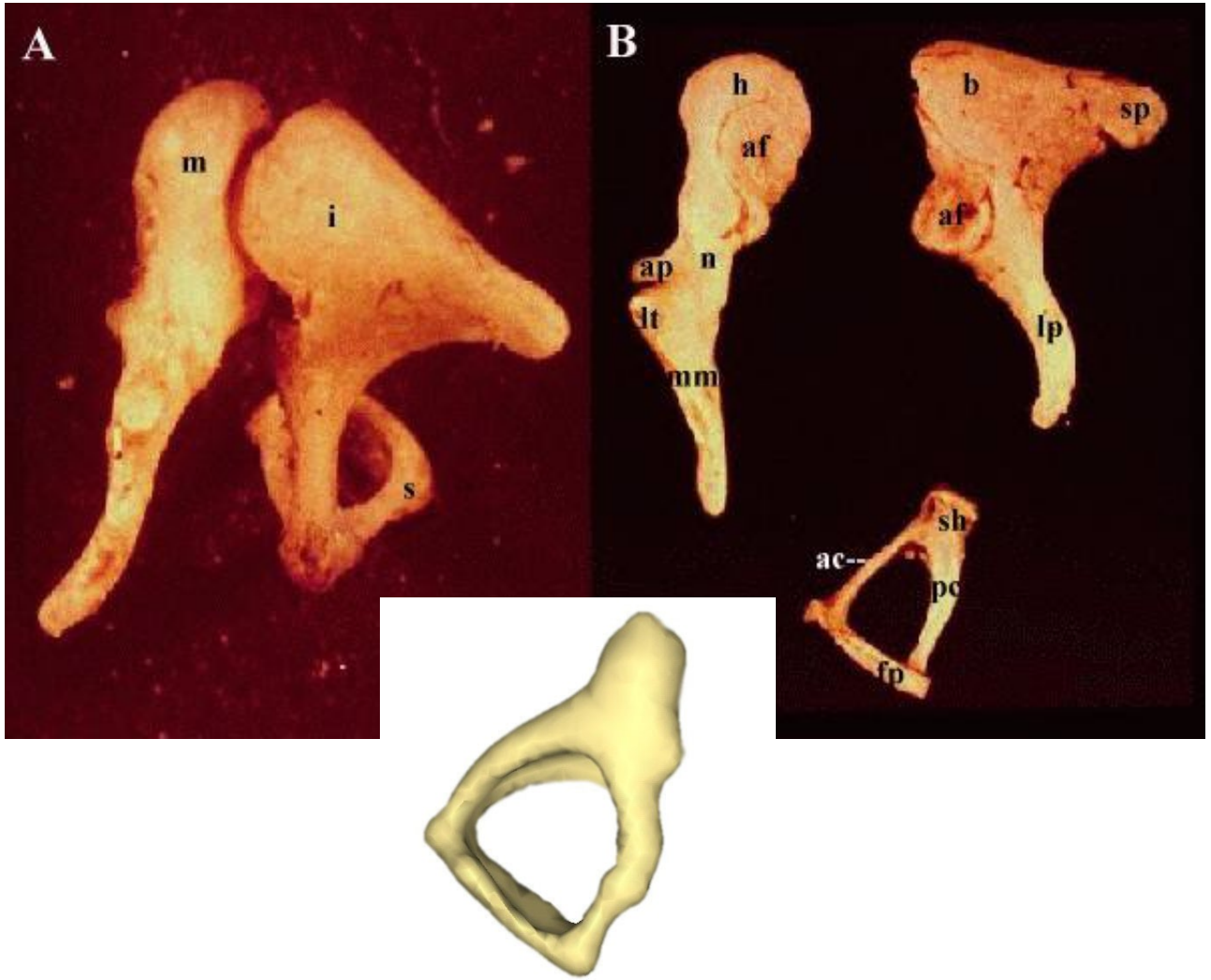


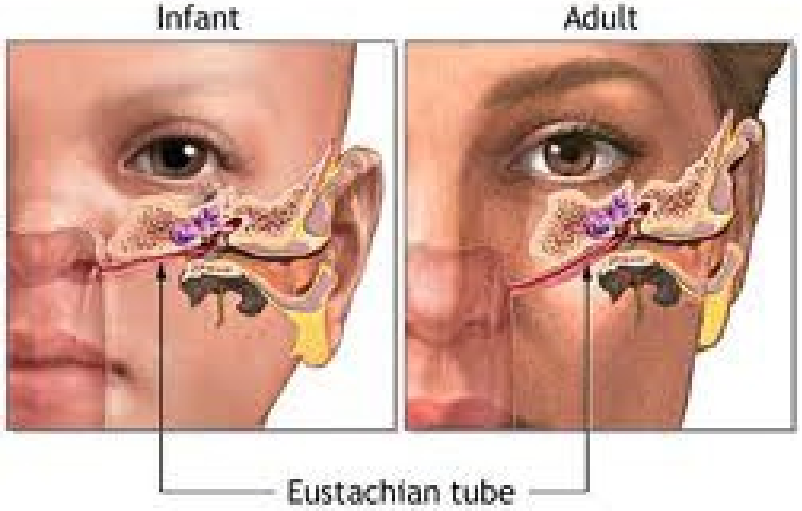



Prominence of lateral semicircular canal
Prominence of facial canal
Promontory
Tegmen tympani
Tensor tympani muscle
Aditus to mastoid antrum
Pharyngotympanic tube
Oval window
Pyramidal eminence
Lesser petrosal nerve
Branch from internal carotid plexus
Chorda tympani nerve
Sympathetic plexus
Round window
Internal carotid artery
Chorda tympani nerve
Tympanic branch of the glossopharyngeal nerve [IX]
Facial nerve [VII]
Internal jugular vein

Ossicles

- Malleus (hammer)
- Incus (anvil)
- Stapes (stirrup) smallest bone of the body





Auditory Tube
Eustachian Tube

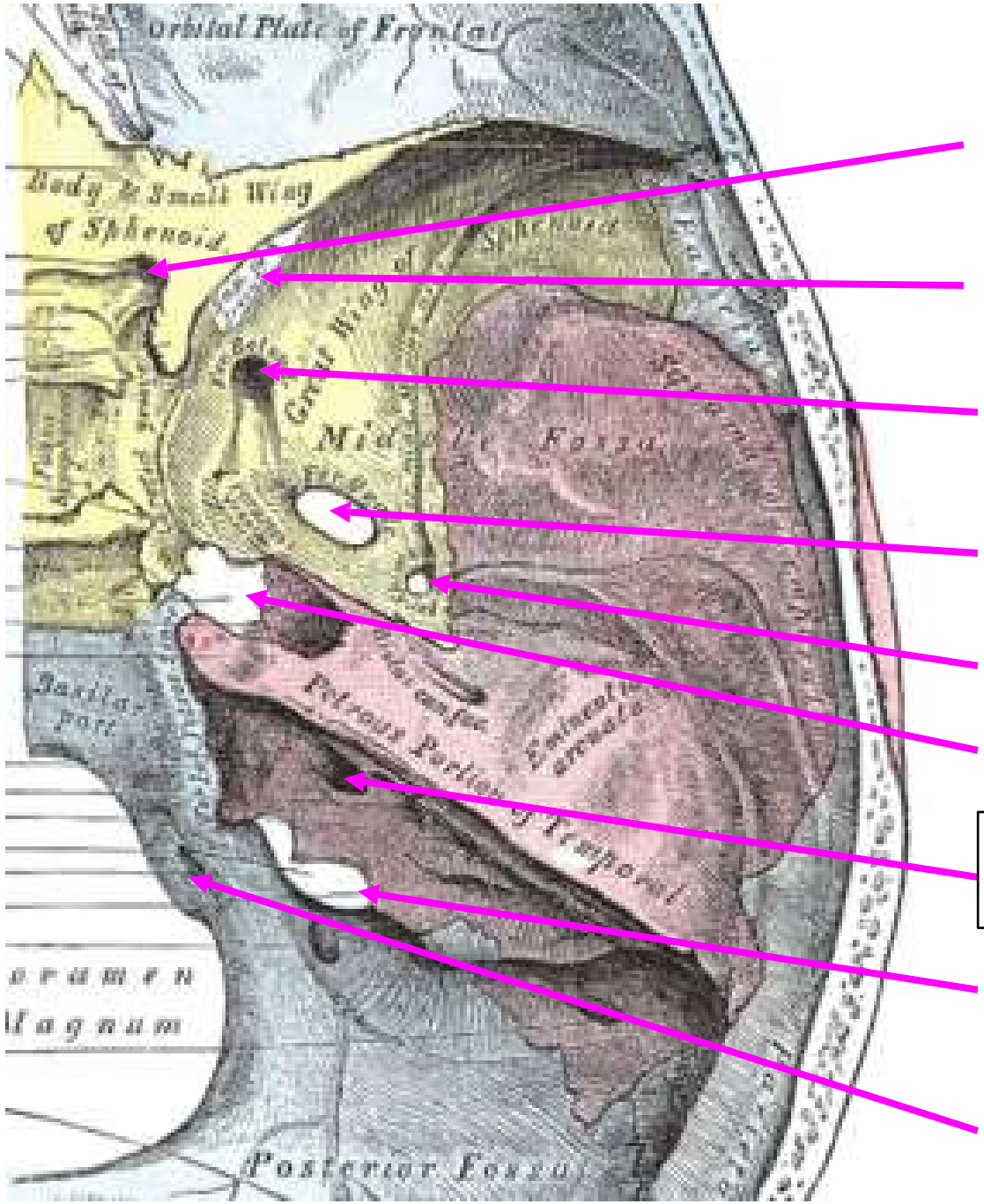
- Connects middle ear to back of nasopharynx
- Conducts air between tympanic cavity and the outside of body by way of nose and mouth
- Helps maintain equal pressure of both sides of eardrum
- Function is noticeable during rapid altitude changes
- Popping sound is heard when hearing is restored back to normal

Cranial Nerve VII: Facial nerve

- Fibers leave the pons, travel through the internal acoustic meatus, and emerge through the stylomastoid foramen to the lateral aspect of the face.

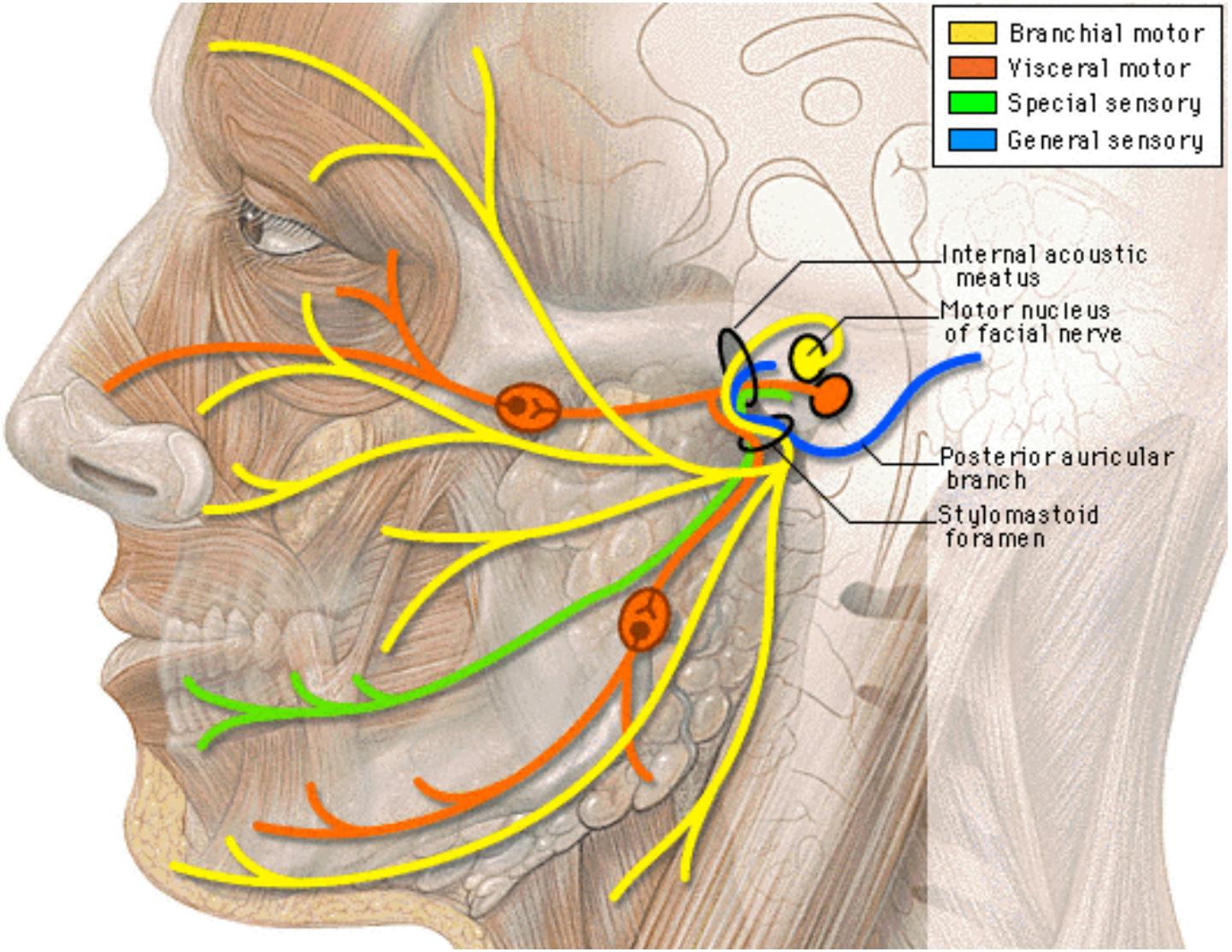
- Motor functions include facial expression and the transmission of autonomic impulses to lacrimal and salivary glands.

- Sensory function is a taste from the anterior two-thirds of the tongue



Internal acoustic meatus
(VII, VIII)

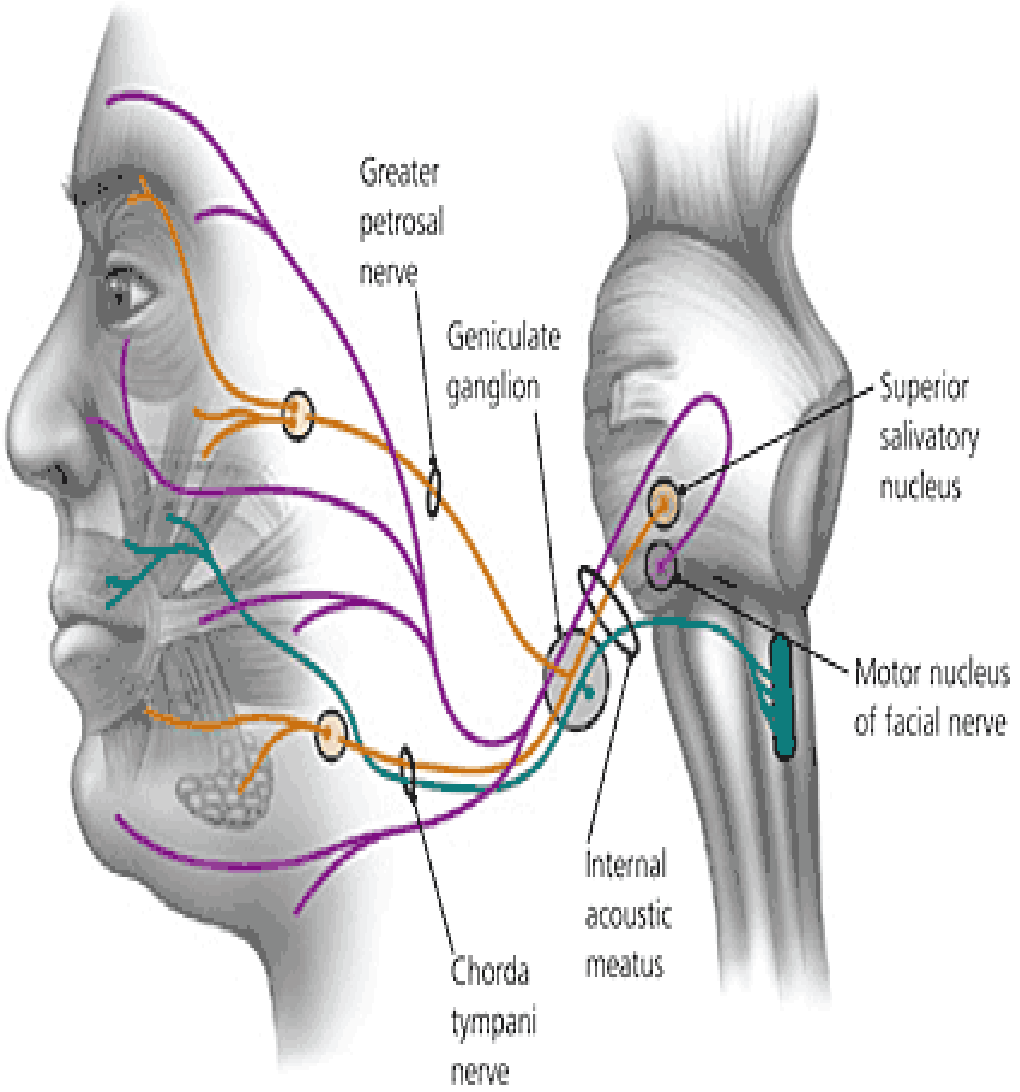
Facial Nerves VII



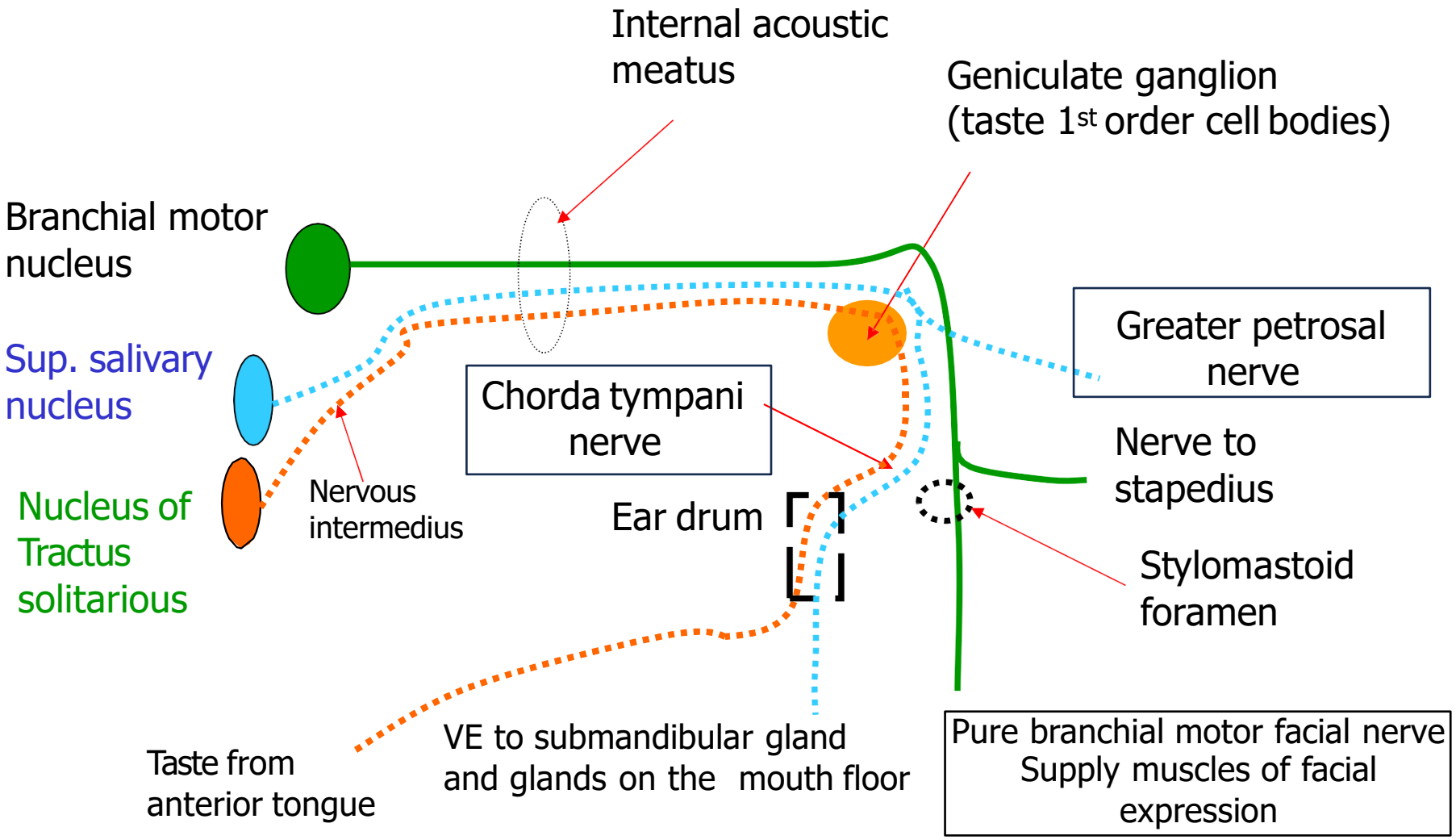
FACIAL NERVE NUCLEI

☐4 nuclei:

1) **Motor nucleus:**
   – lower Pons below 4th ventricle
1) **Superior salivatory nucleus:**
   – dorsal to motor nucleus
3) **Nucleus solitarius:**
   – medulla oblongata
4) **Spinal trigeminal nucleus**.



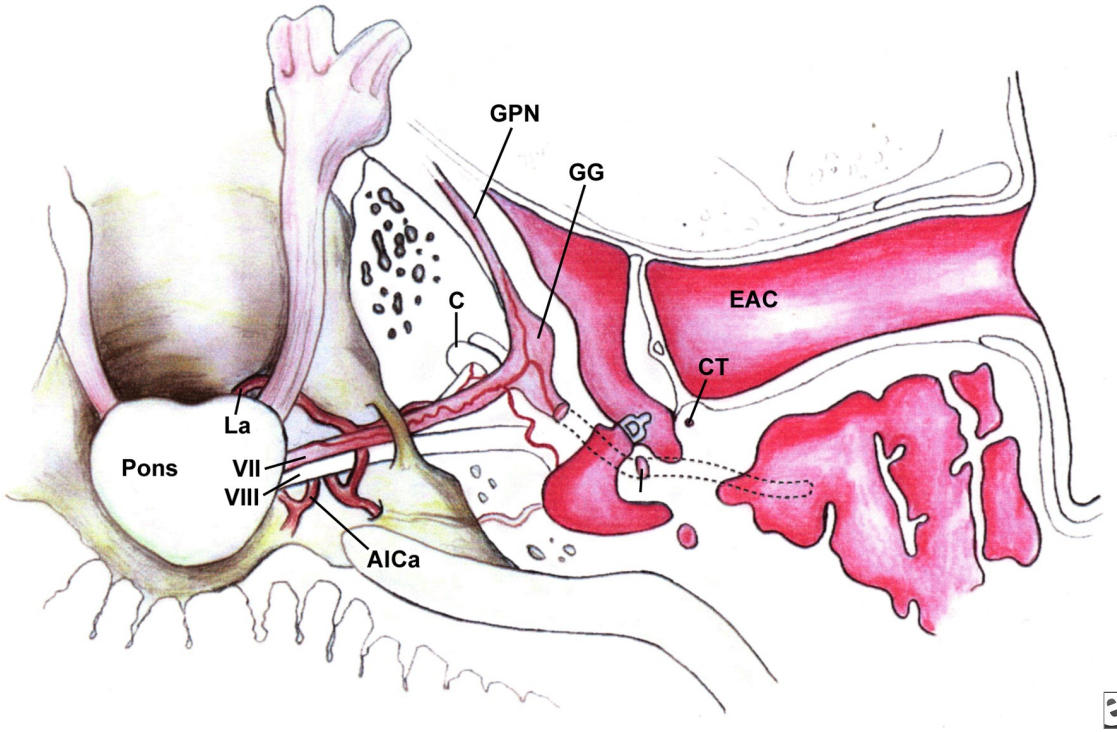
Facial Nerve



INTRA CRANIAL PORTION

- From *brainstem* (**Pons**)

- Facial Nerve **crosses CPA** (Cerebello-pontine angle) with 8th CN ***to the*** **Internal auditory meatus**



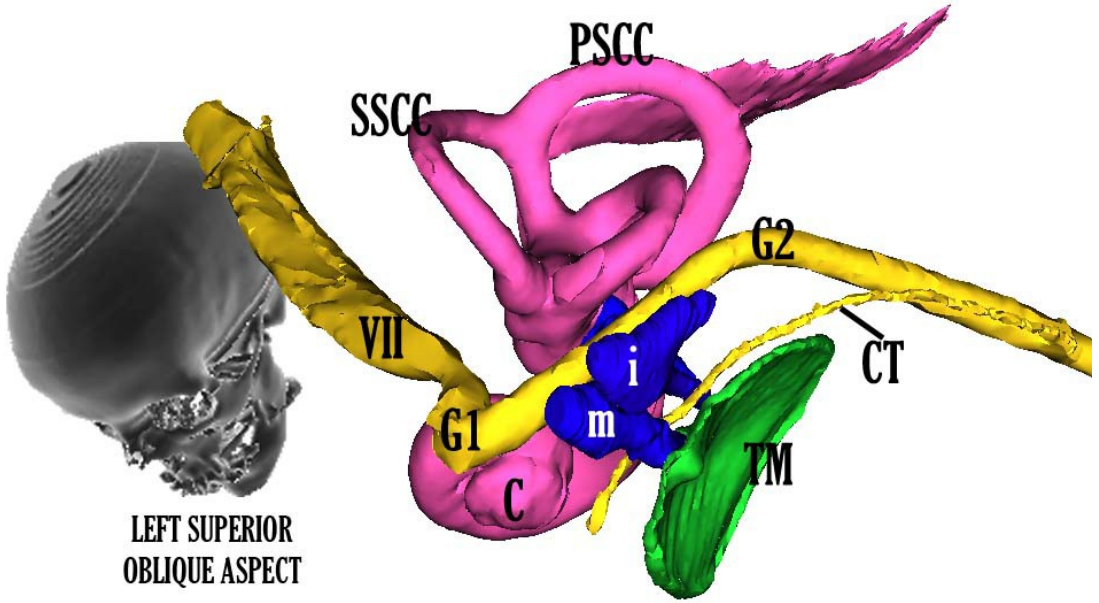
❖ Surgical importance:

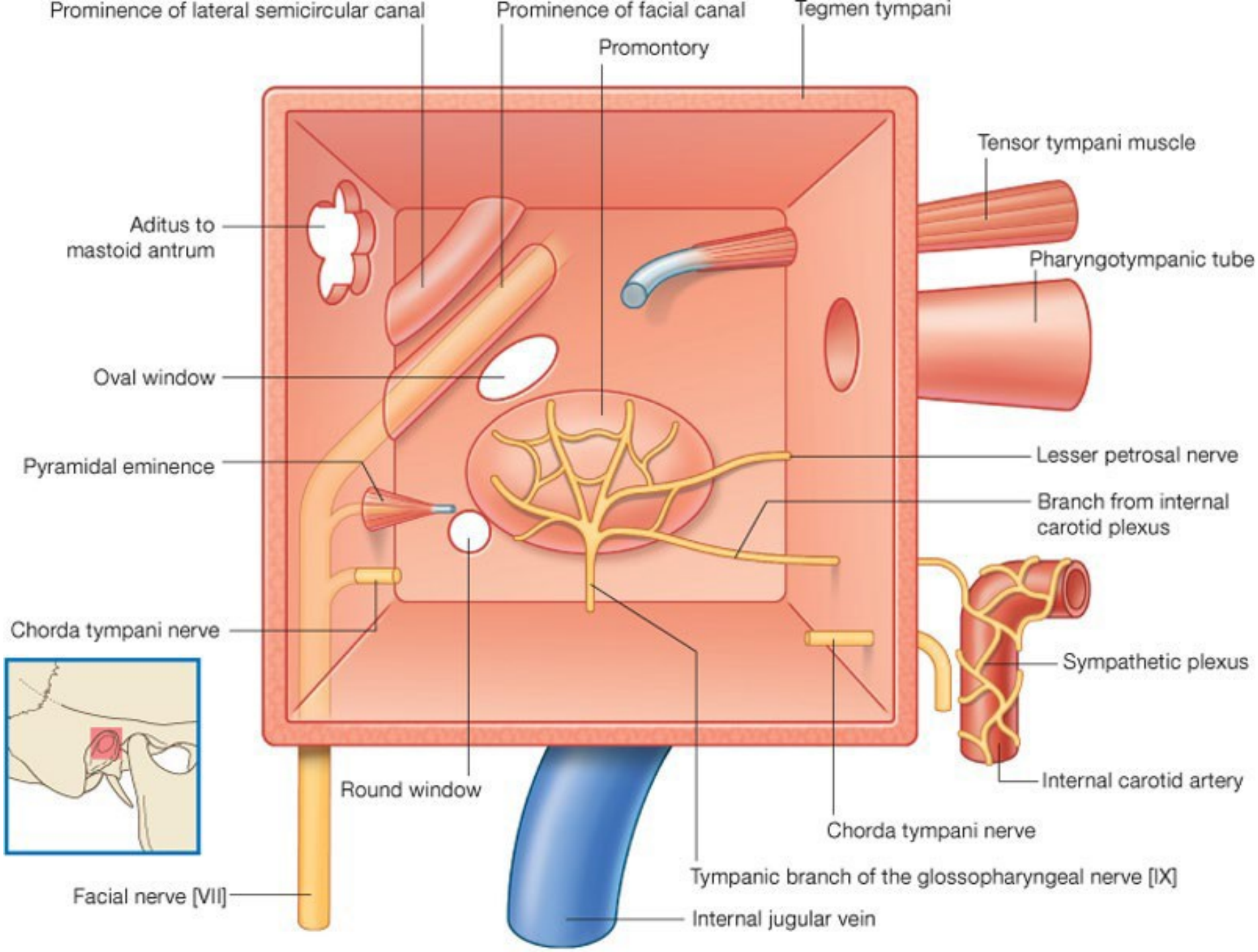
1) **Iatrogenic trauma:** in CPA tumor surgery
2) Difficult to identify in schwannoma (no connective tissue)

TYMPANIC SEGMENT

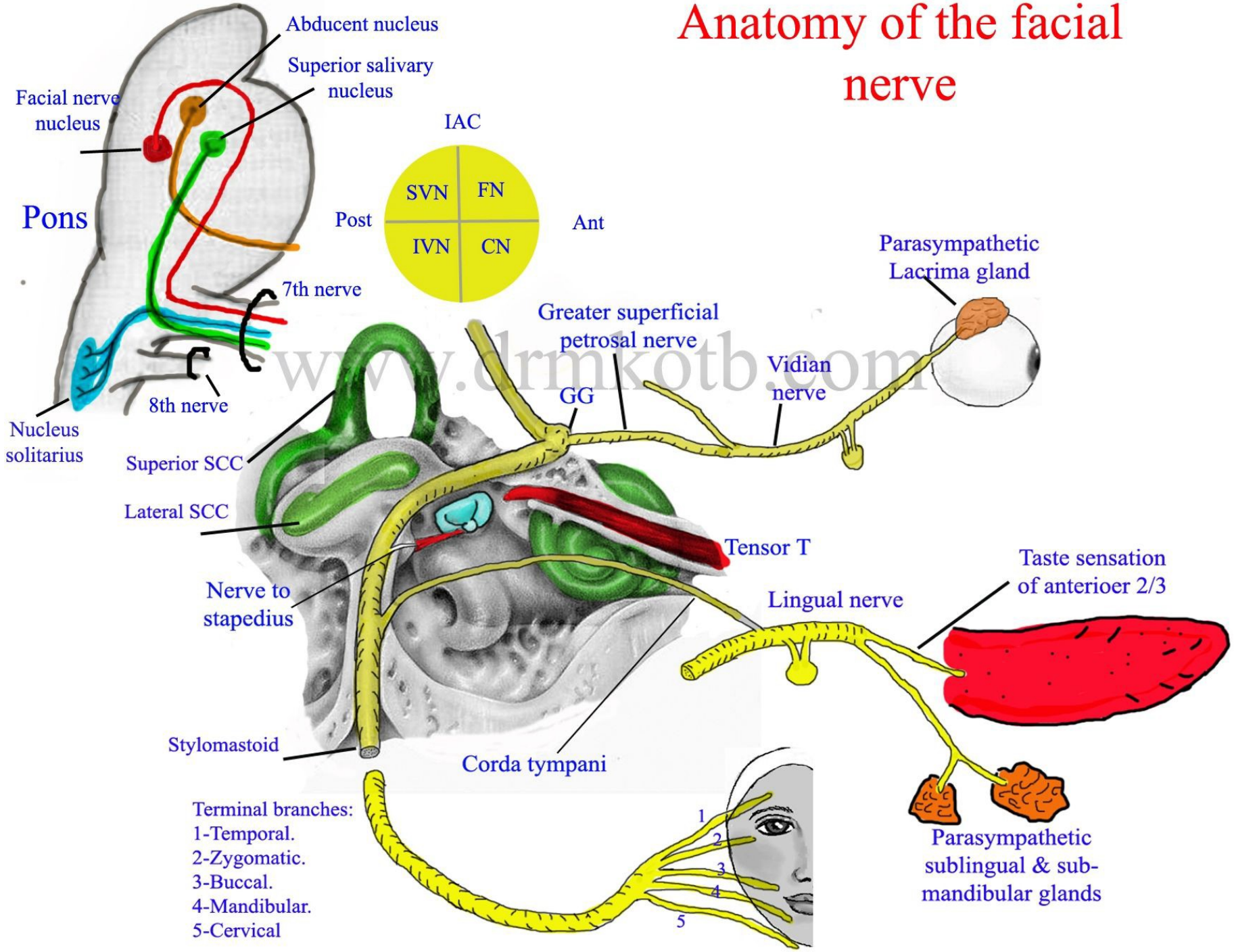
- ❑ *Geniculate ganglion*:
  - ➢ Bipolar ganglion cells.

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




Prominence of lateral semicircular canal
Prominence of facial canal
Promontory
Tegmen tympani
Tensor tympani muscle
Aditus to mastoid antrum
Pharyngotympanic tube
Oval window
Pyramidal eminence
Lesser petrosal nerve
Branch from internal carotid plexus
Chorda tympani nerve
Sympathetic plexus
Round window
Internal carotid artery
Chorda tympani nerve
Tympanic branch of the glossopharyngeal nerve [IX]
Facial nerve [VII]
Internal jugular vein

Anatomy of the facial nerve



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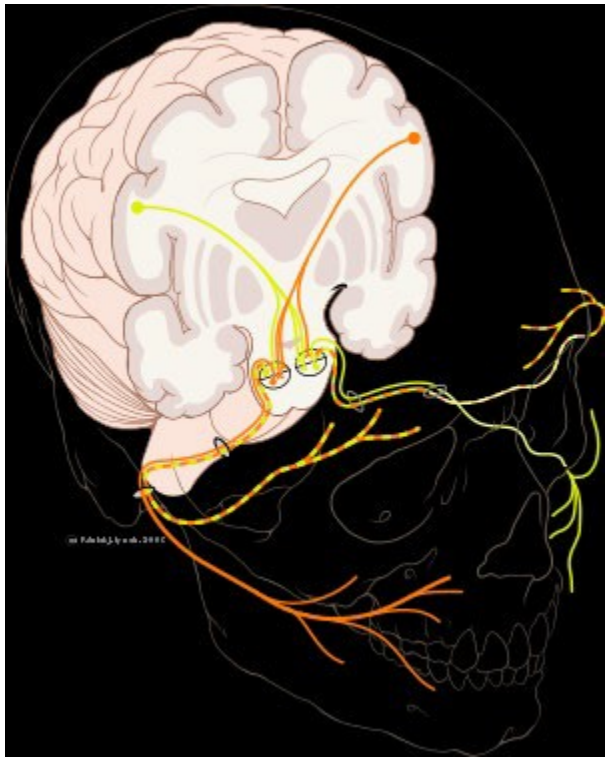
EXTRA TEMPORAL REGION

- From Stylomastoid Foramen to terminal branches.

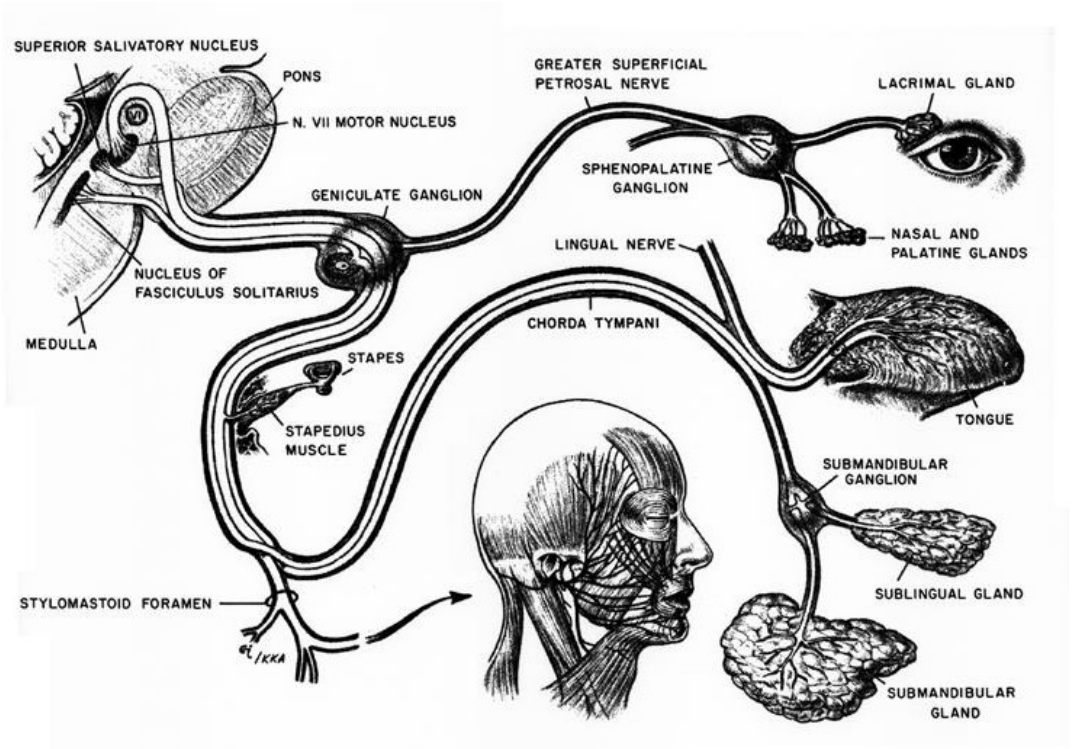
- Runs in the substance of parotid gland.

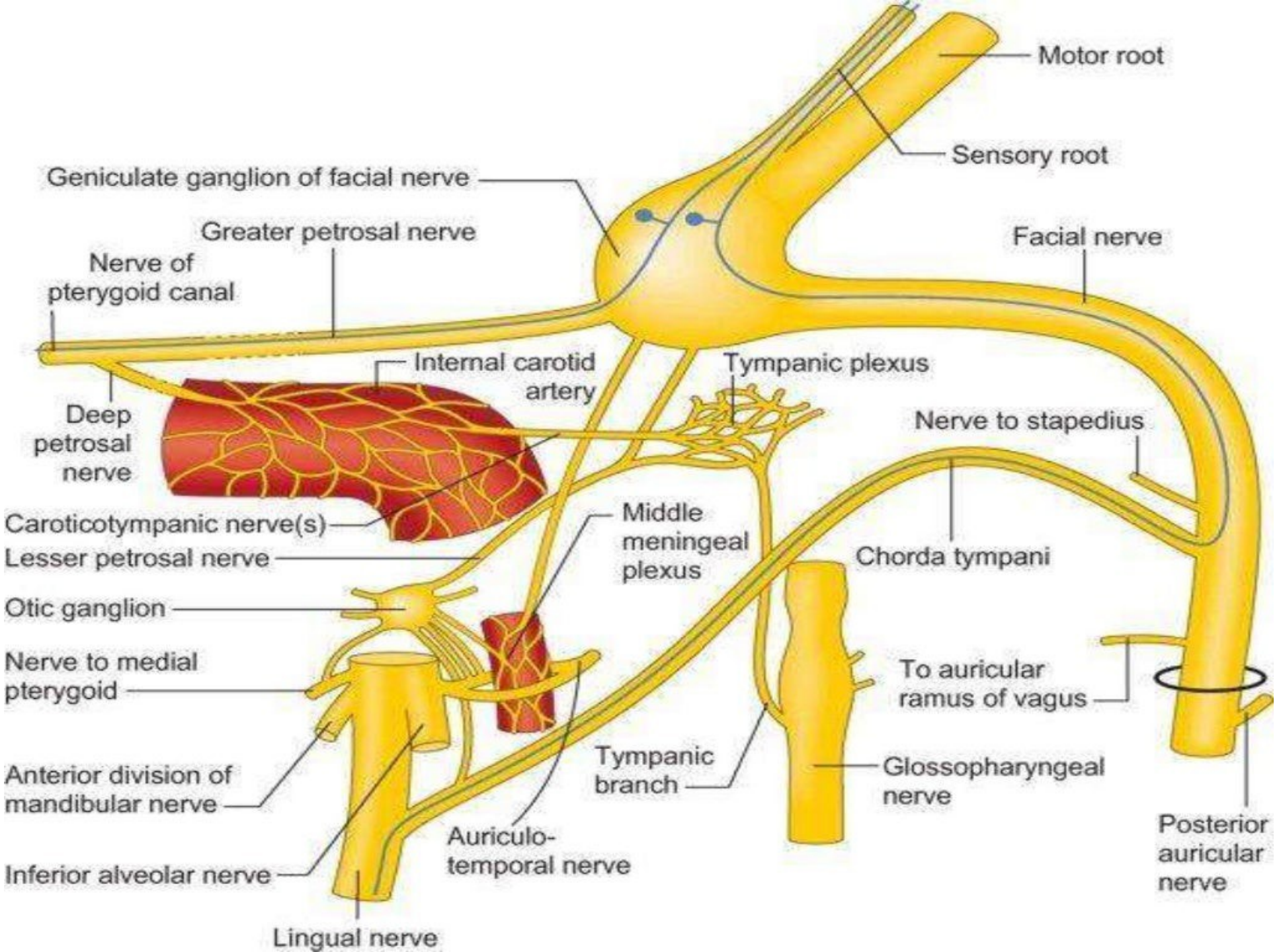


BRANCHES

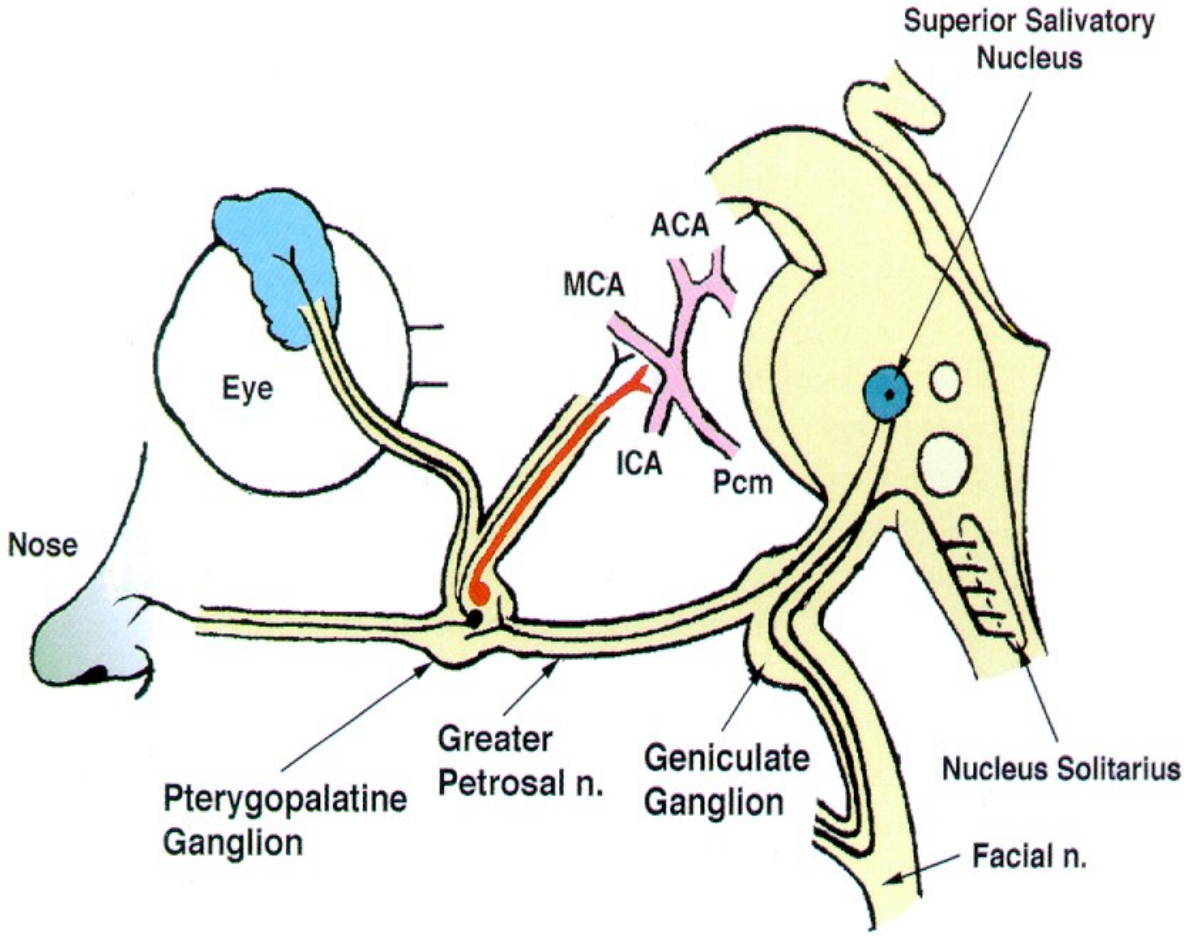
☐Intra temporal region :

1) GSPN
2) Nerve to stapedius
3) Chorda tympani
4) Sensory auricular branch




Motor root
Sensory root
Geniculate ganglion of facial nerve
Greater petrosal nerve
Nerve of pterygoid canal
Facial nerve
Internal carotid artery
Tympanic plexus
Deep petrosal nerve
Nerve to stapedius
Caroticotympanic nerve(s)
Middle meningeal plexus
Lesser petrosal nerve
Chorda tympani
Otic ganglion
Nerve to medial pterygoid
To auricular ramus of vagus
Tympanic branch
Glossopharyngeal nerve
Anterior division of mandibular nerve
Auriculo-temporal nerve
Posterior auricular nerve
Inferior alveolar nerve
Lingual nerve

Greater Superficial Petrosal Nerve



- From GG
- 2 types of fibers:

1.Parasymp – lacrimal G.

2.Sensory fibers to nasal & palatine glands.

☐NERVE TO STAPEDIUS

- Supply stapedius muscle

❑SENSORY AURICULAR BRANCH

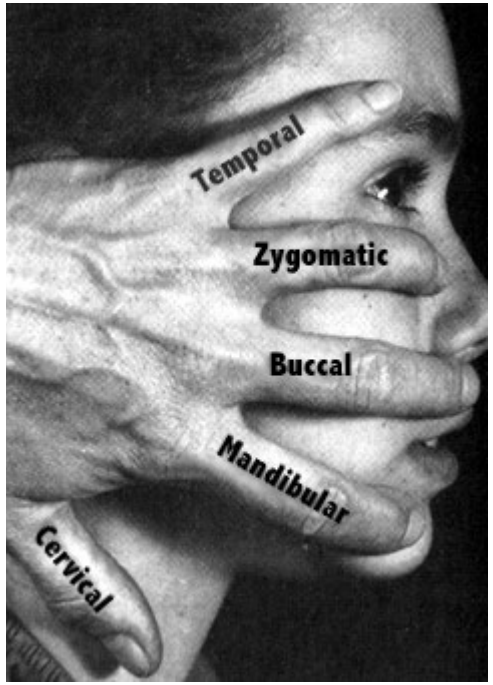
- Joins auricular branch of vagus
- Supply retro auricular groove & concha.

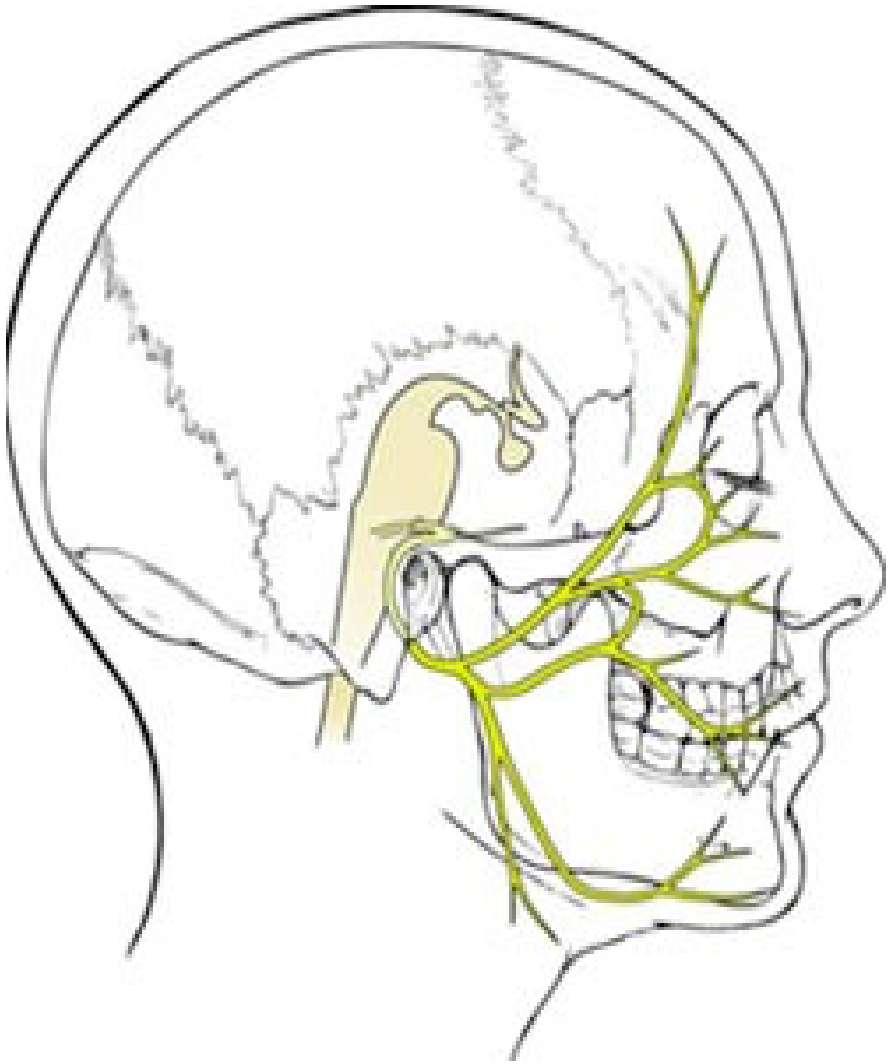
CHORDA TYMPANI

- 2 types of fibers

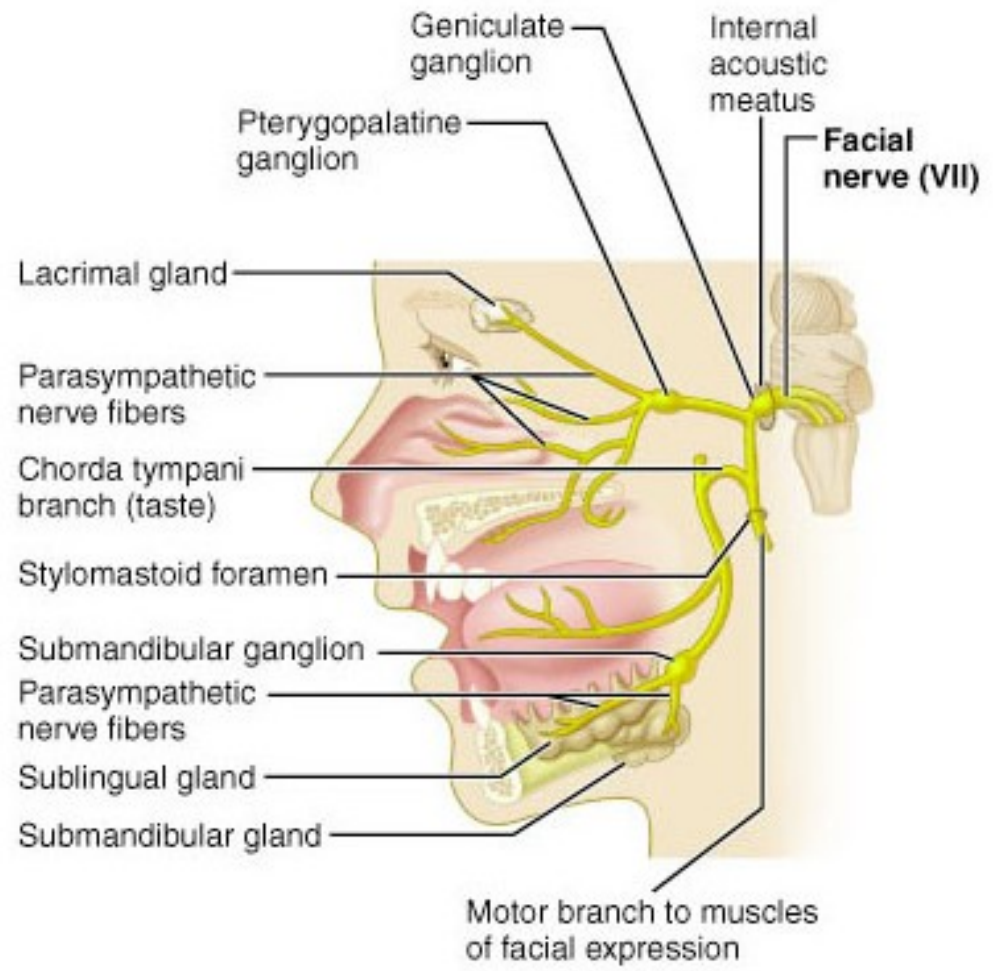
1. Preganglionic **Parasympathetic** – submandibular & sublingual Glands
2. **Special sensory** – anterior 2/3rd of tongue

TERMINAL BRANCHES

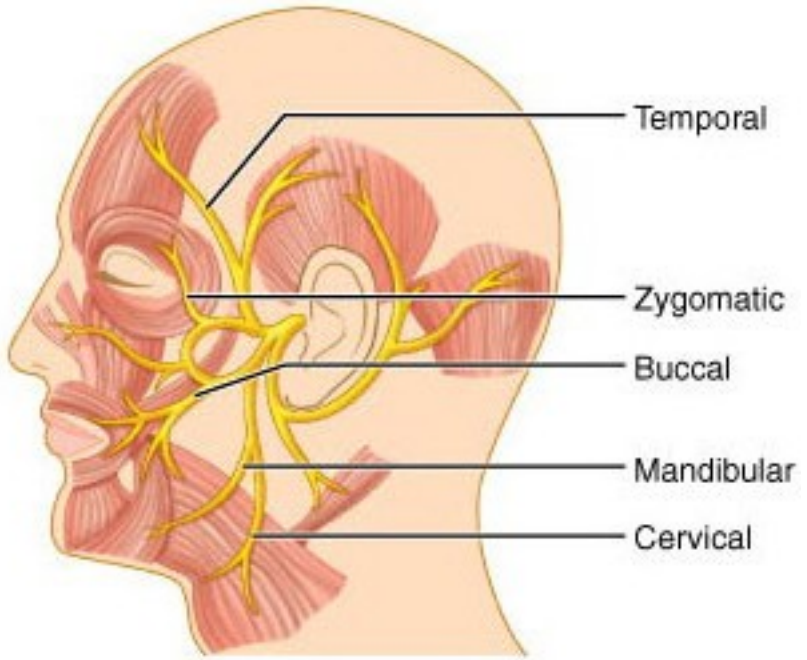




Cranial Nerve VII: Facial



(a) Parasympathetic efferents and sensory afferents



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

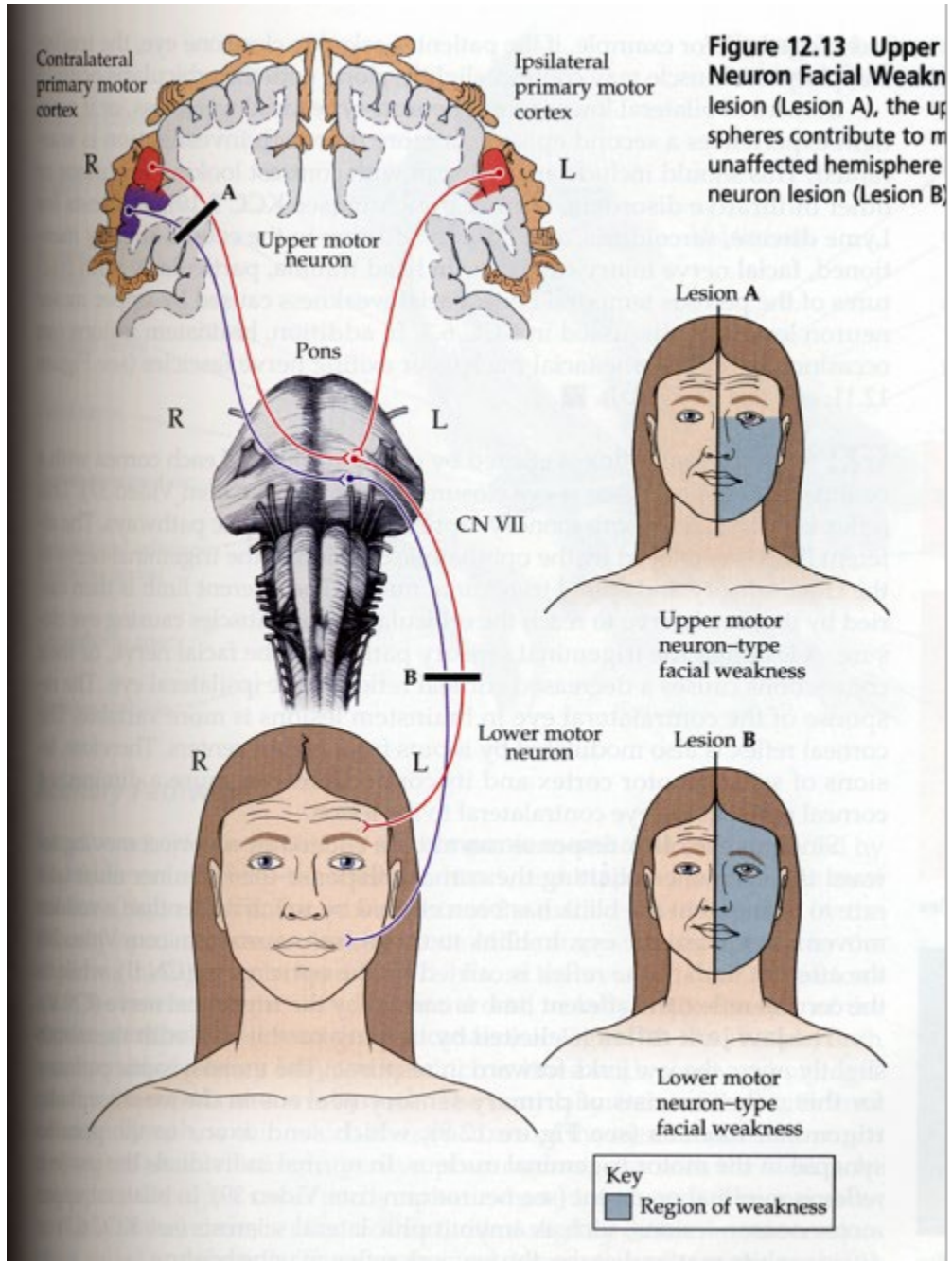
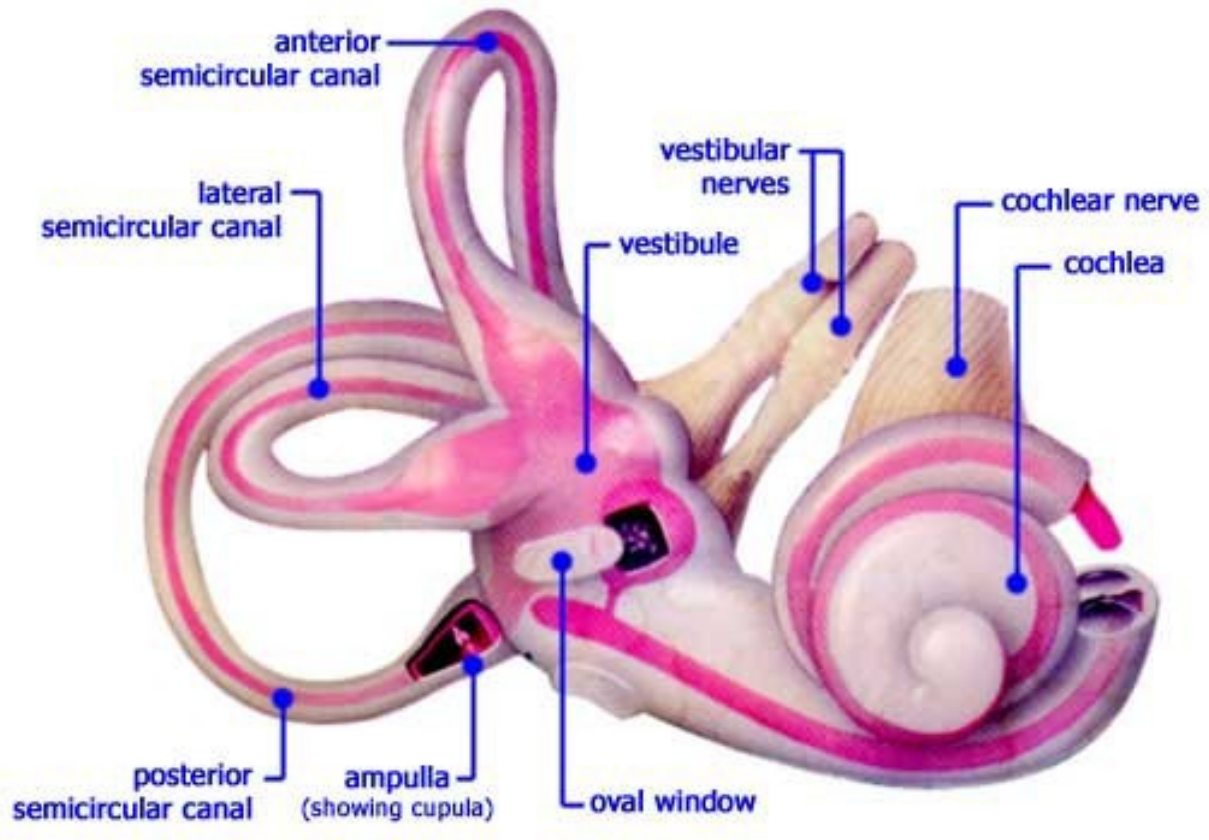


Figure 12.13 Upper Neuron Facial Weakn
lesion (Lesion A), the up
spheres contribute to m
unaffected hemisphere
neuron lesion (Lesion B)

Facial nerve injury (Bell's Palsy)

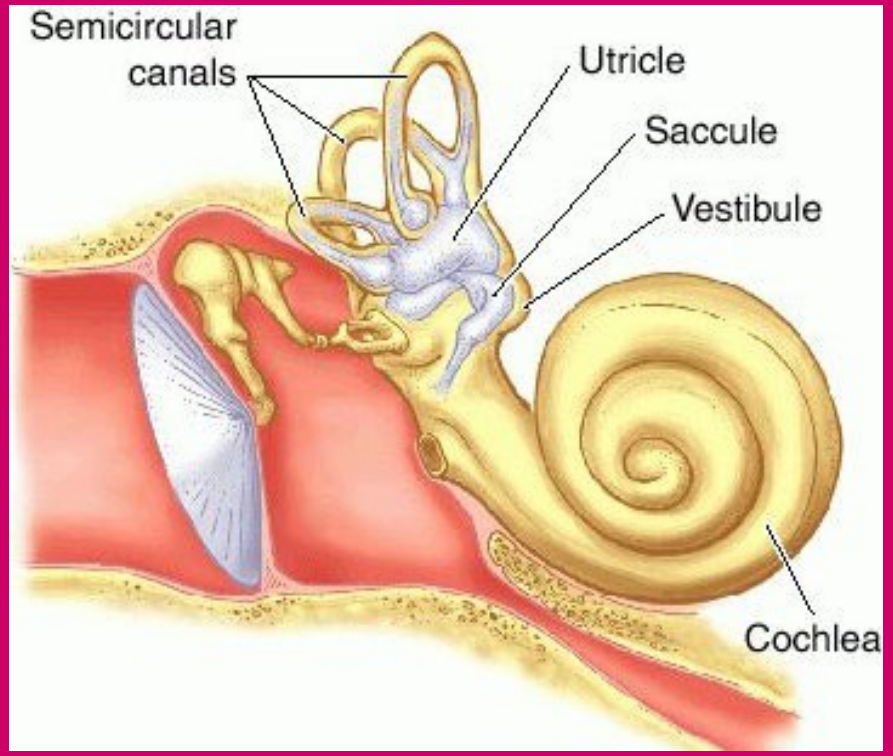
Inner (Internal) Ear

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



The inner ear: vestibule and semicircular canals

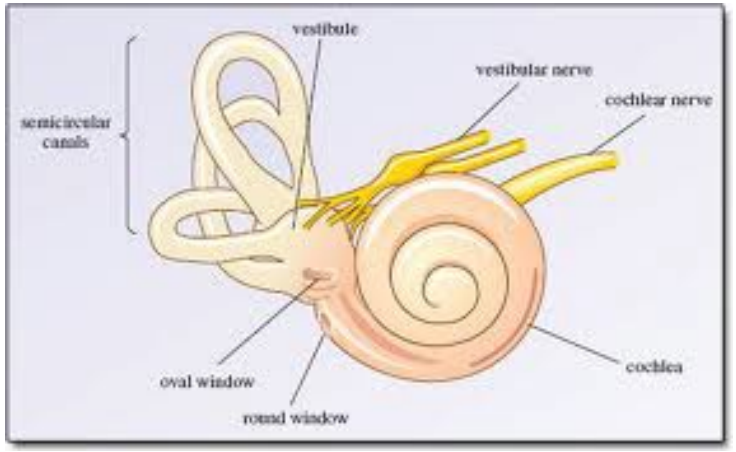
The vestibule and semicircular canals are bony structures lined with membranes and containing a fluid called perilymph which provides a sense of equilibrium.



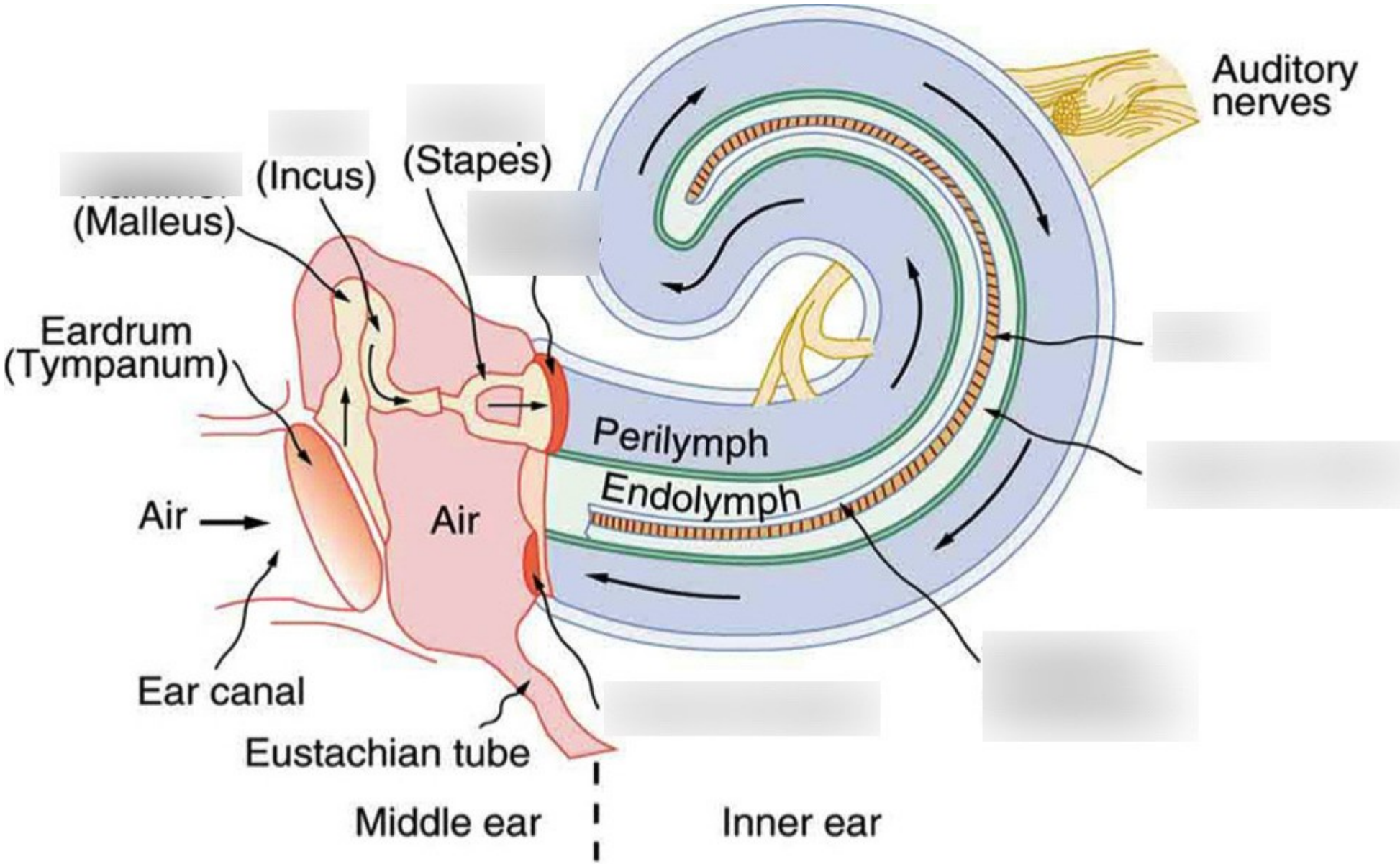
Changes in the position of the head cause this fluid to move against sensory receptors. Dizziness or motion sickness may be associated with rapid movements.

Semicircular Canals and 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


Auditory nerves
(Incus)
(Stapes)
(Malleus)
Eardrum (Tympanum)
Perilymph
Endolymph
Air
Air
Ear canal
Eustachian tube
Middle ear
Inner ear

Inner Ear

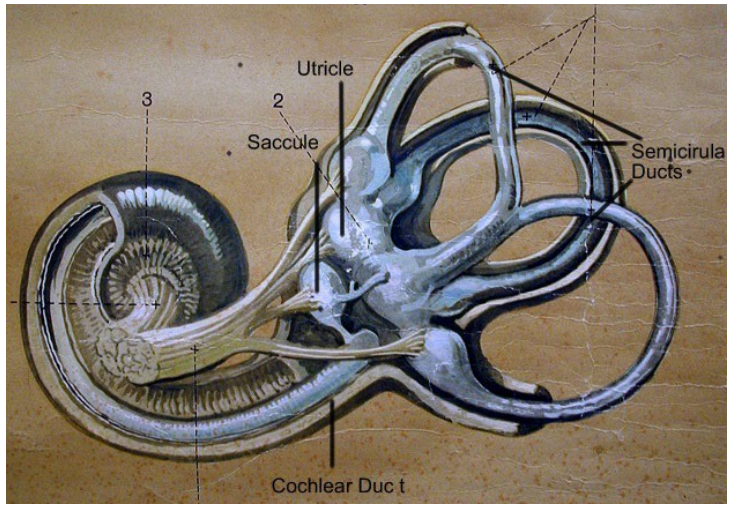
Vestibular

Auditory

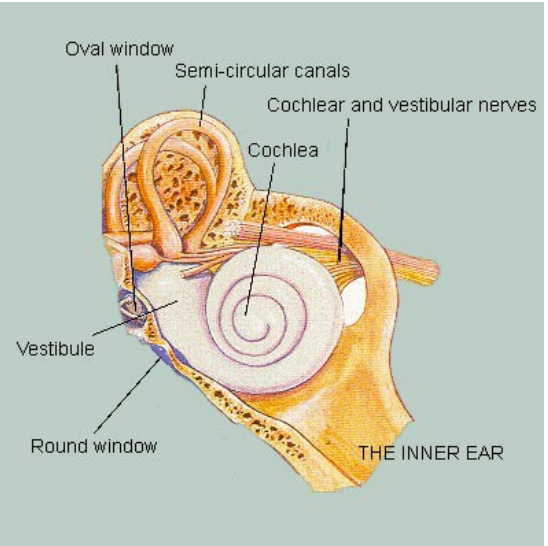
Vestibular

Semicircular canals

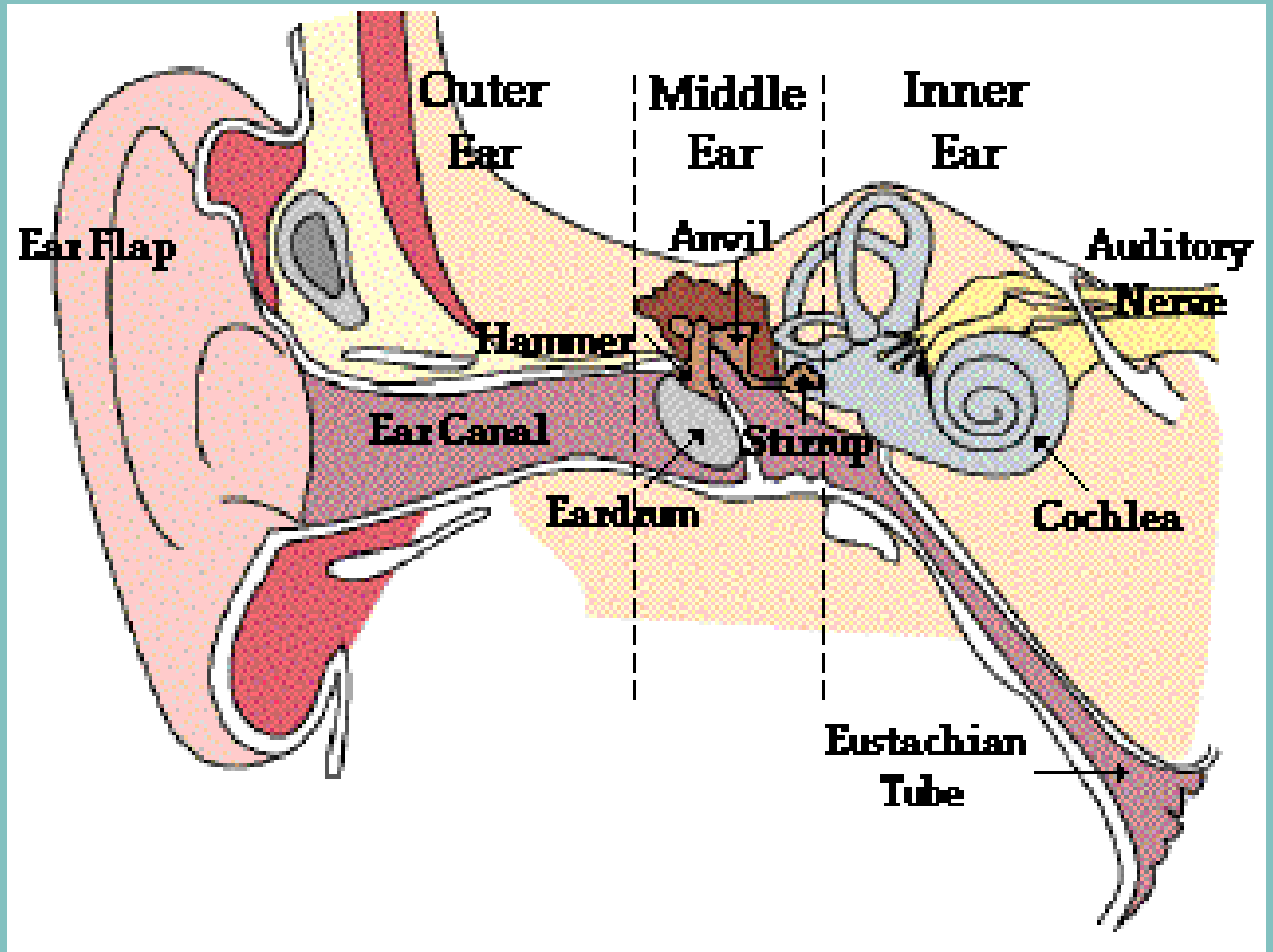
(utricle and saccule)



Cochlear



How Does the Ear Work?



Steps to Hearing:

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

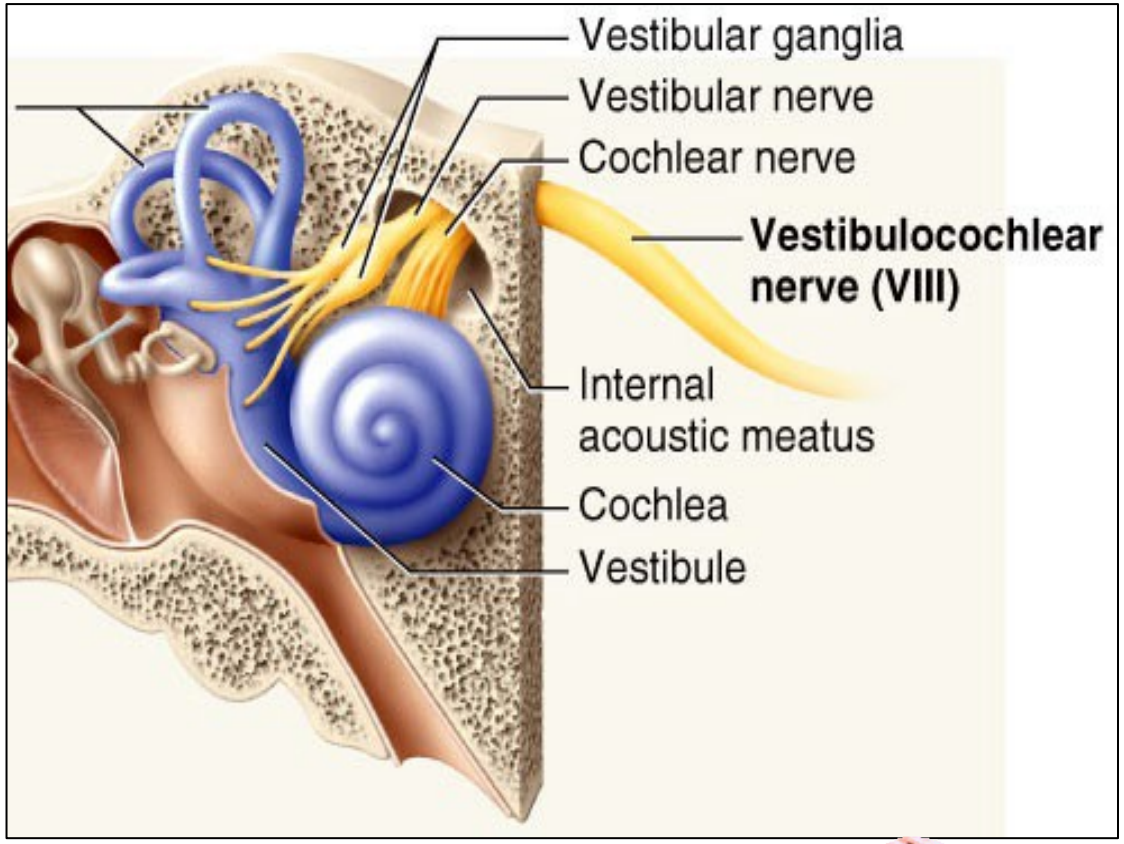
Cranial nerves – CN VIII

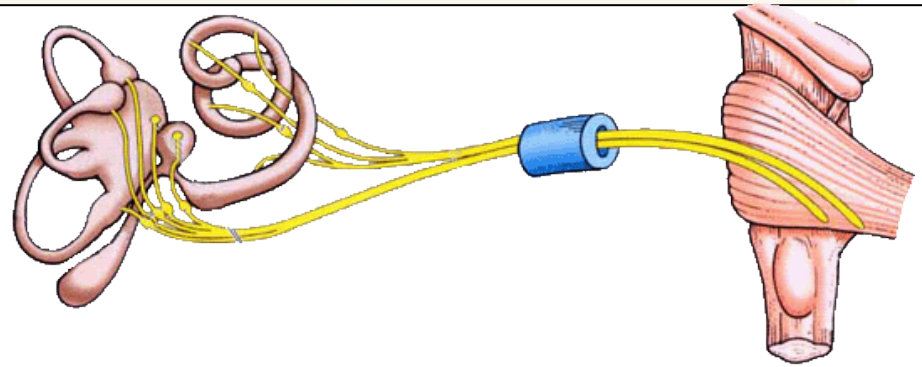
Vestibulo-Cochlear Nerve

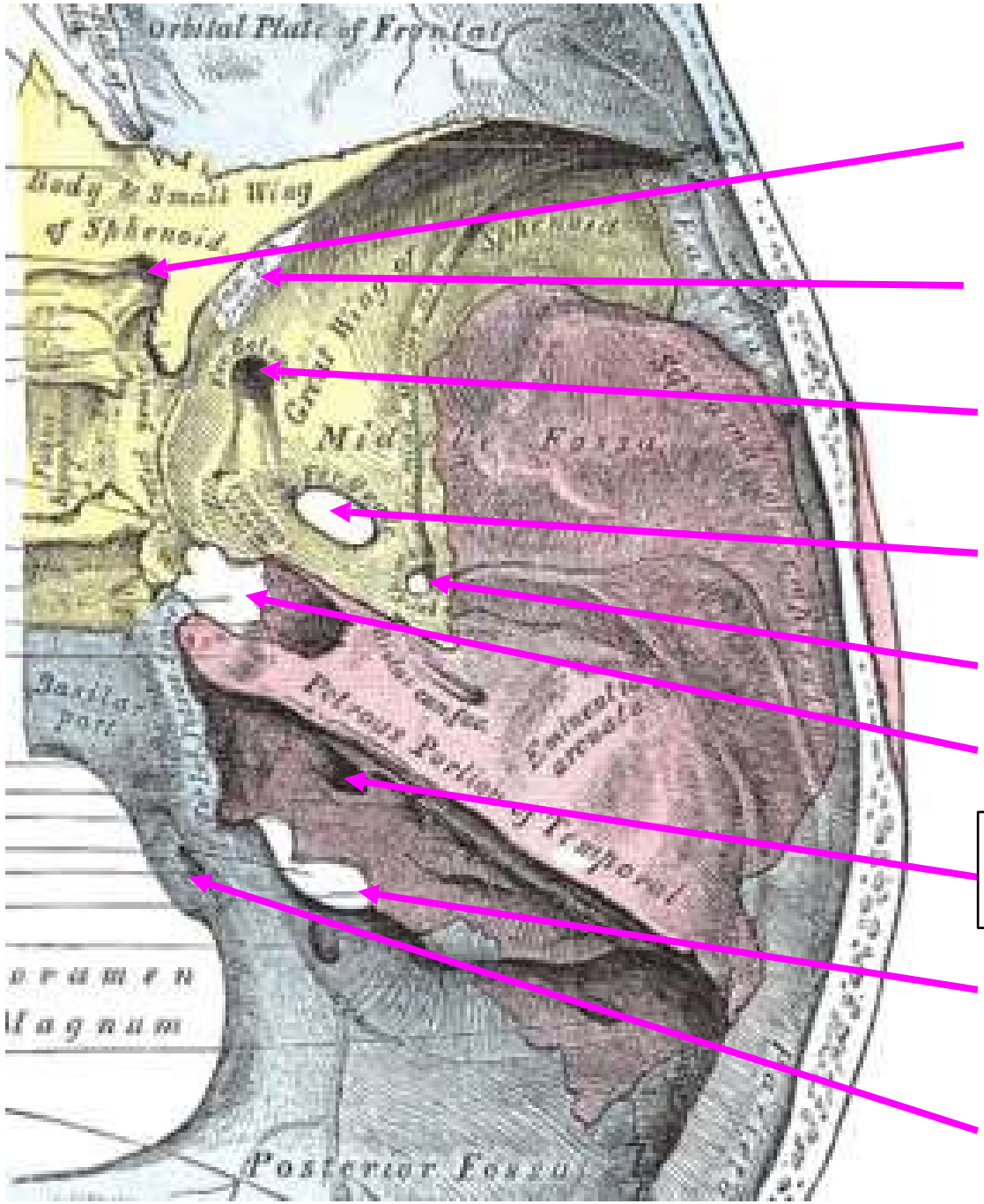
Special sensory (SSA)

- Vestibular part: balance of body (position & movement of the head)
- Cochlear part: hearing

- 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







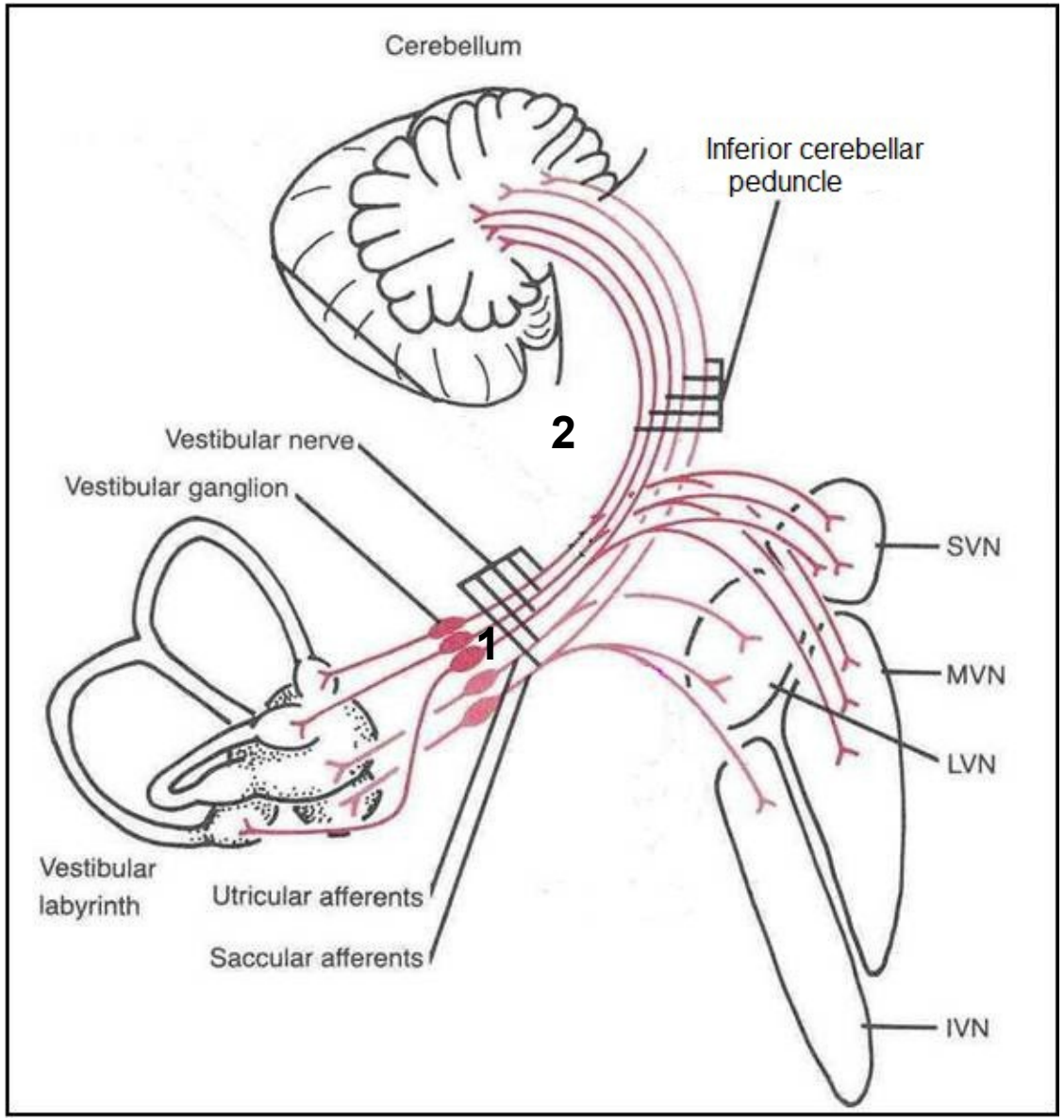
Internal acoustic meatus
(VII, VIII)

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:

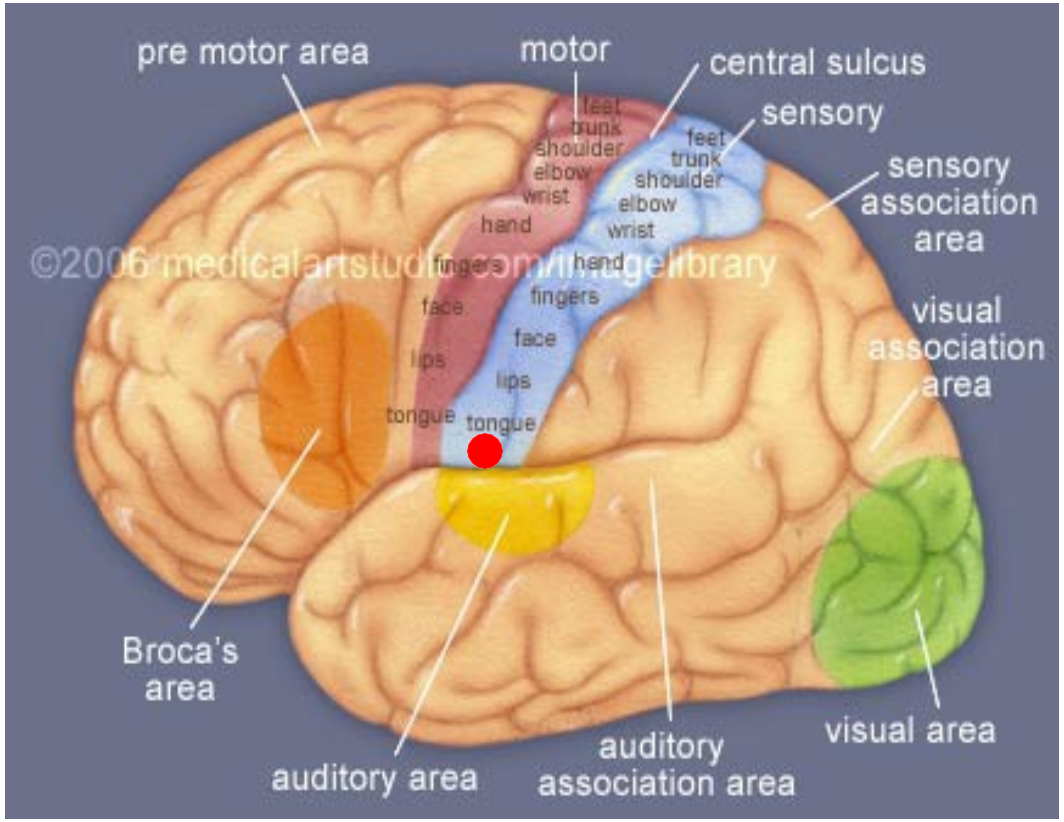
  Mostly end up in the lateral, medial, inferior and superior vestibular nuclei (**2nd order neurons**) of the medulla and pons.

  Some fibers go to the cerebellum through the inferior cerebellar peduncle



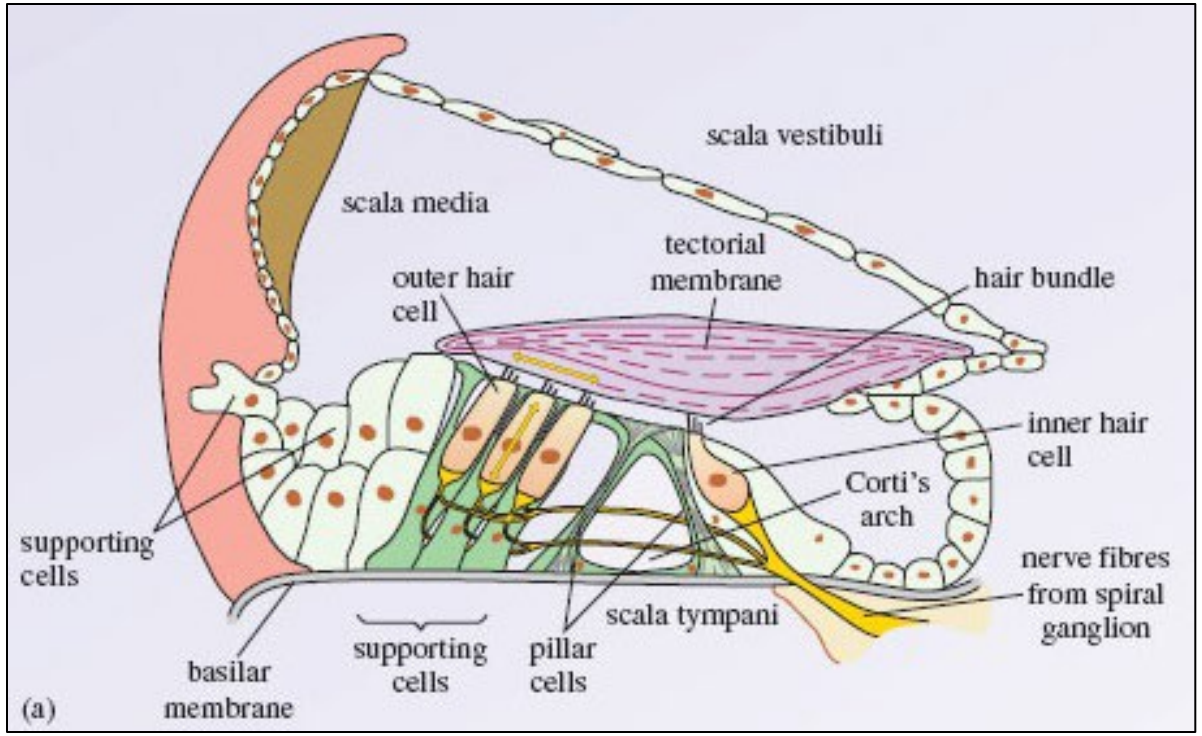
Vestibular Cortex

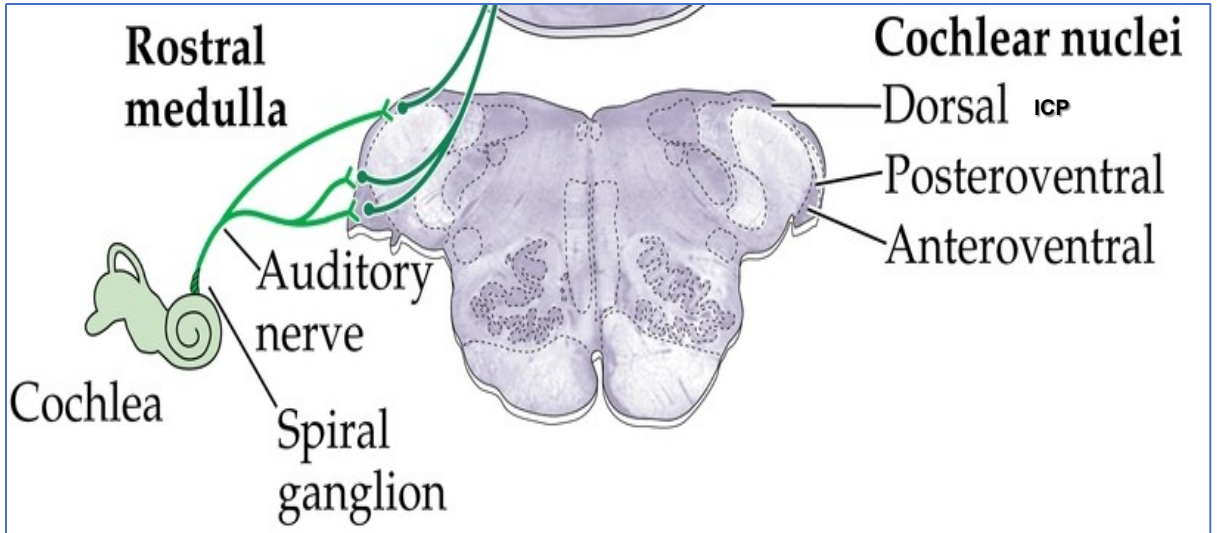
- Located in the lower part of post-central gyrus (head area).
- Responsible for conscious awareness of vestibular sensation (the position of the head in space).



Cochlear (Auditory) Nerve

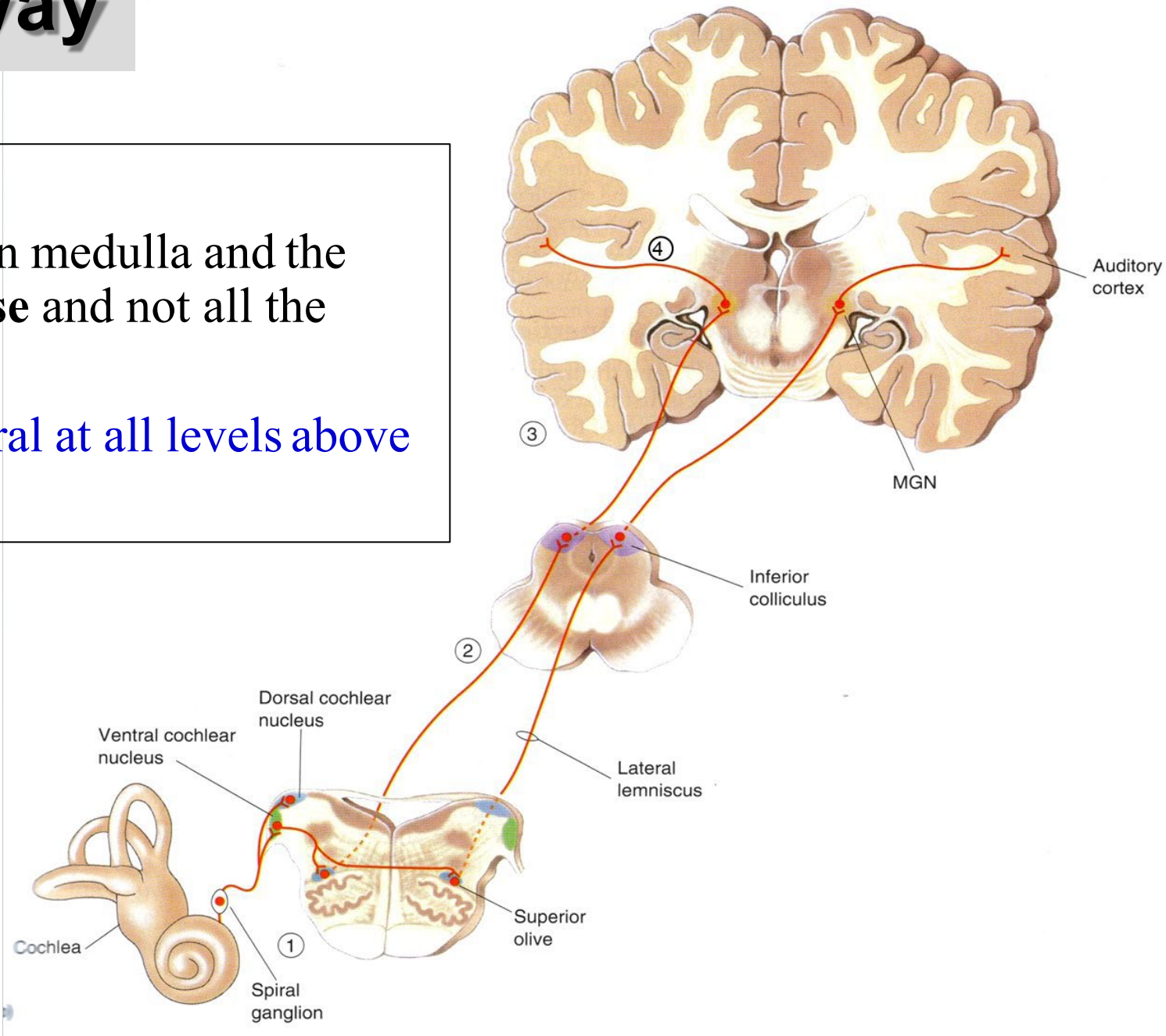
- The **cochlear nerve fibers** arise from hair cells of the organ of Corti within the cochlear duct of the inner ear.
- Their cell bodies (**1st order neurons**) are located within the cochlea in the spiral ganglion.
- Their central processes terminate in the dorsal and ventral cochlear nuclei (**2nd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



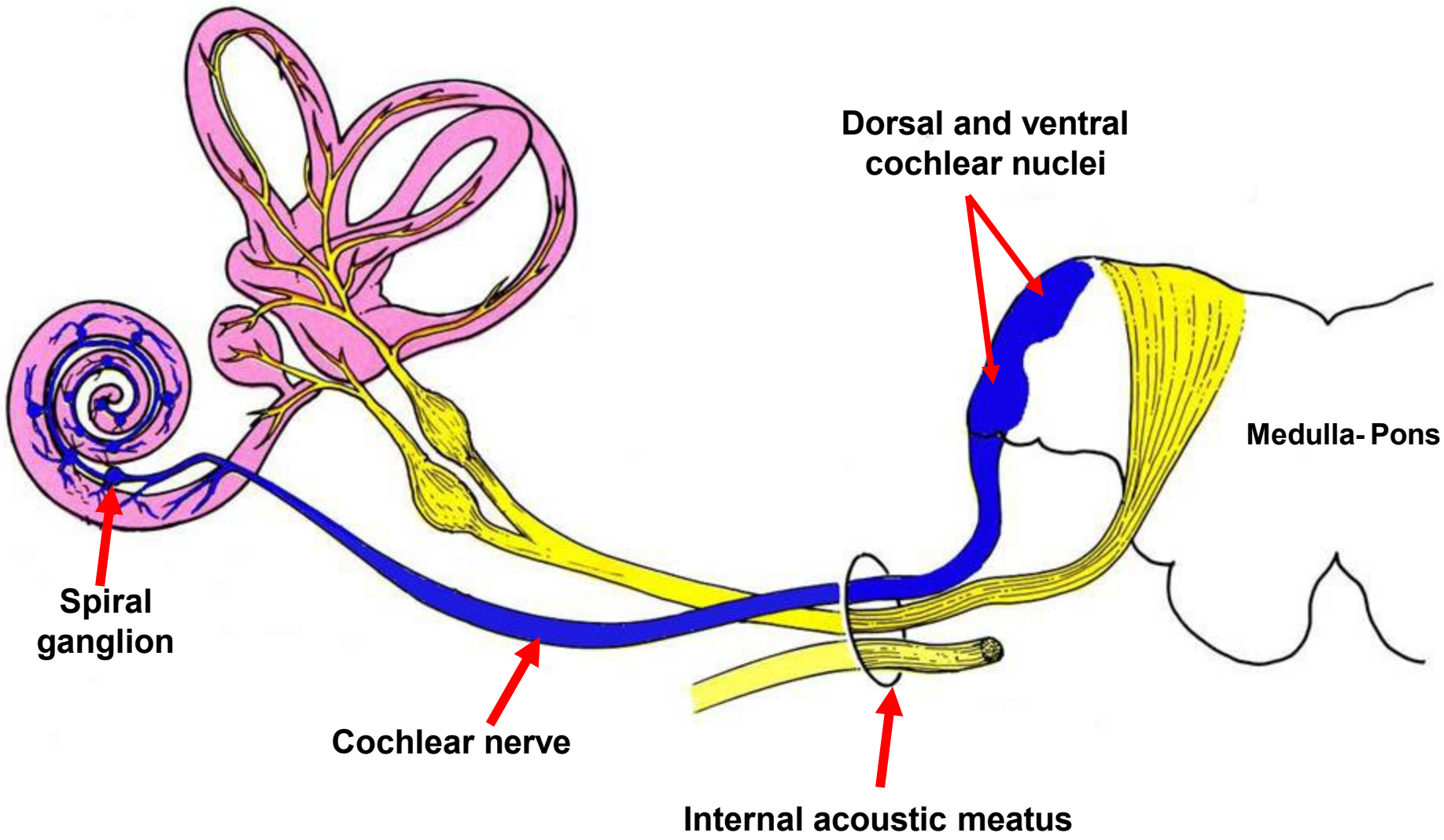


Auditory Pathway

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

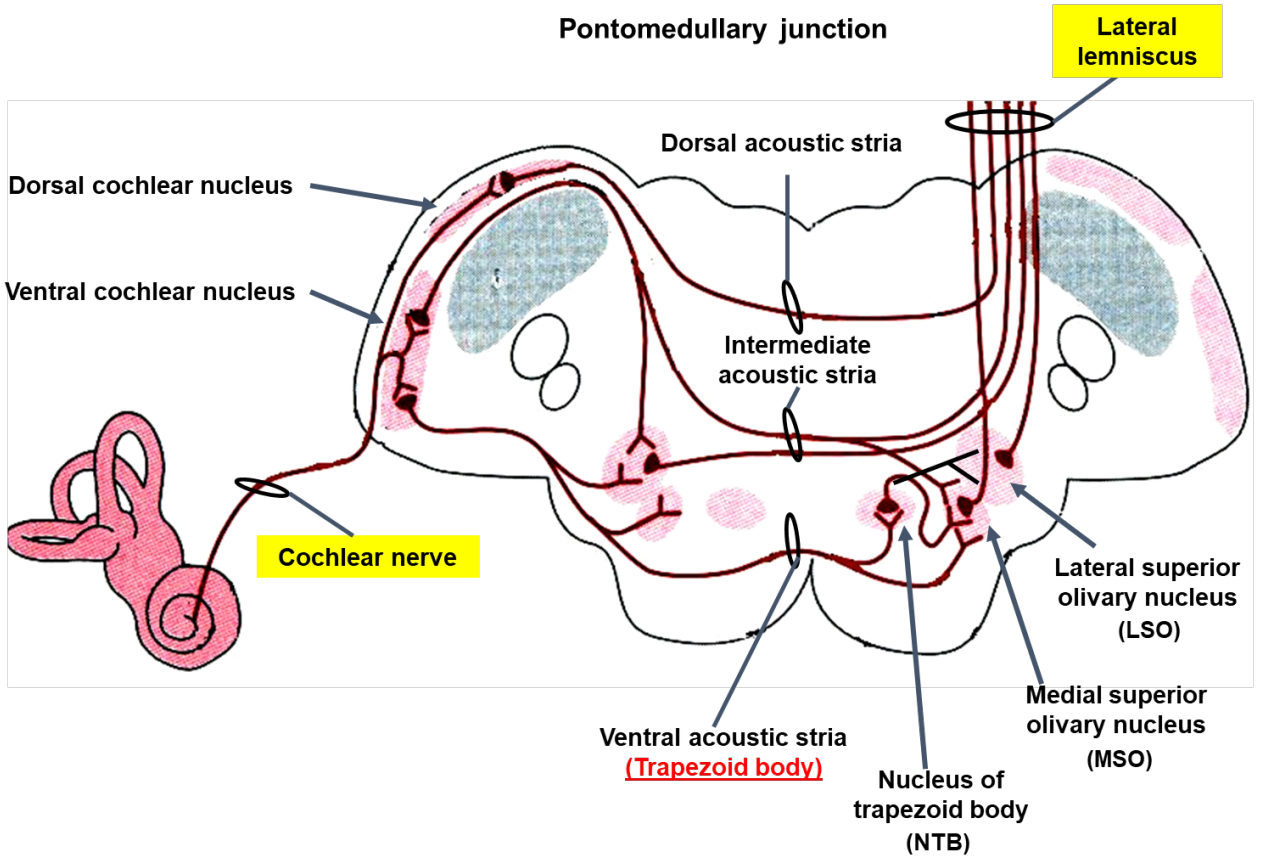


Cochlear nerve



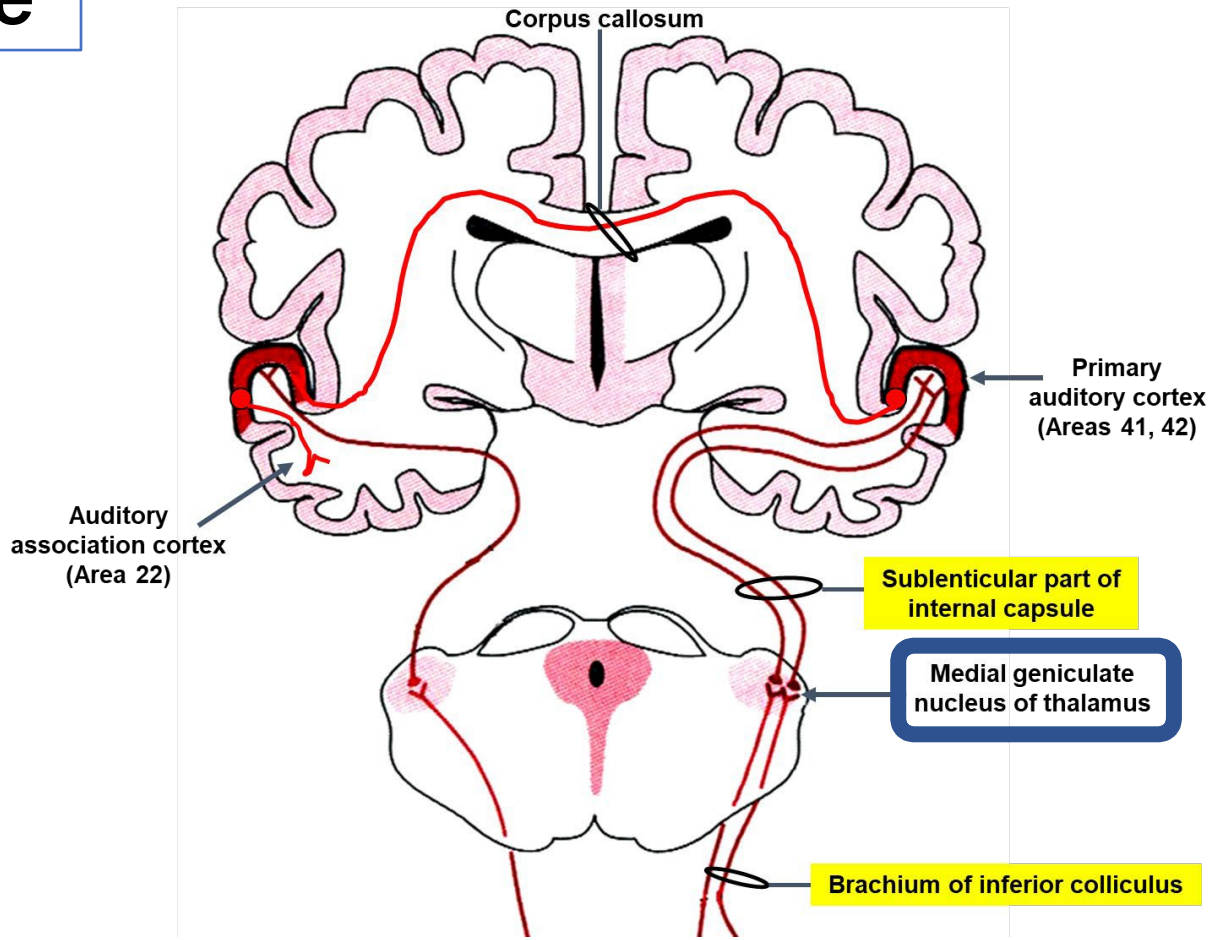
Cochlear (Auditory) Nerve

- 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.



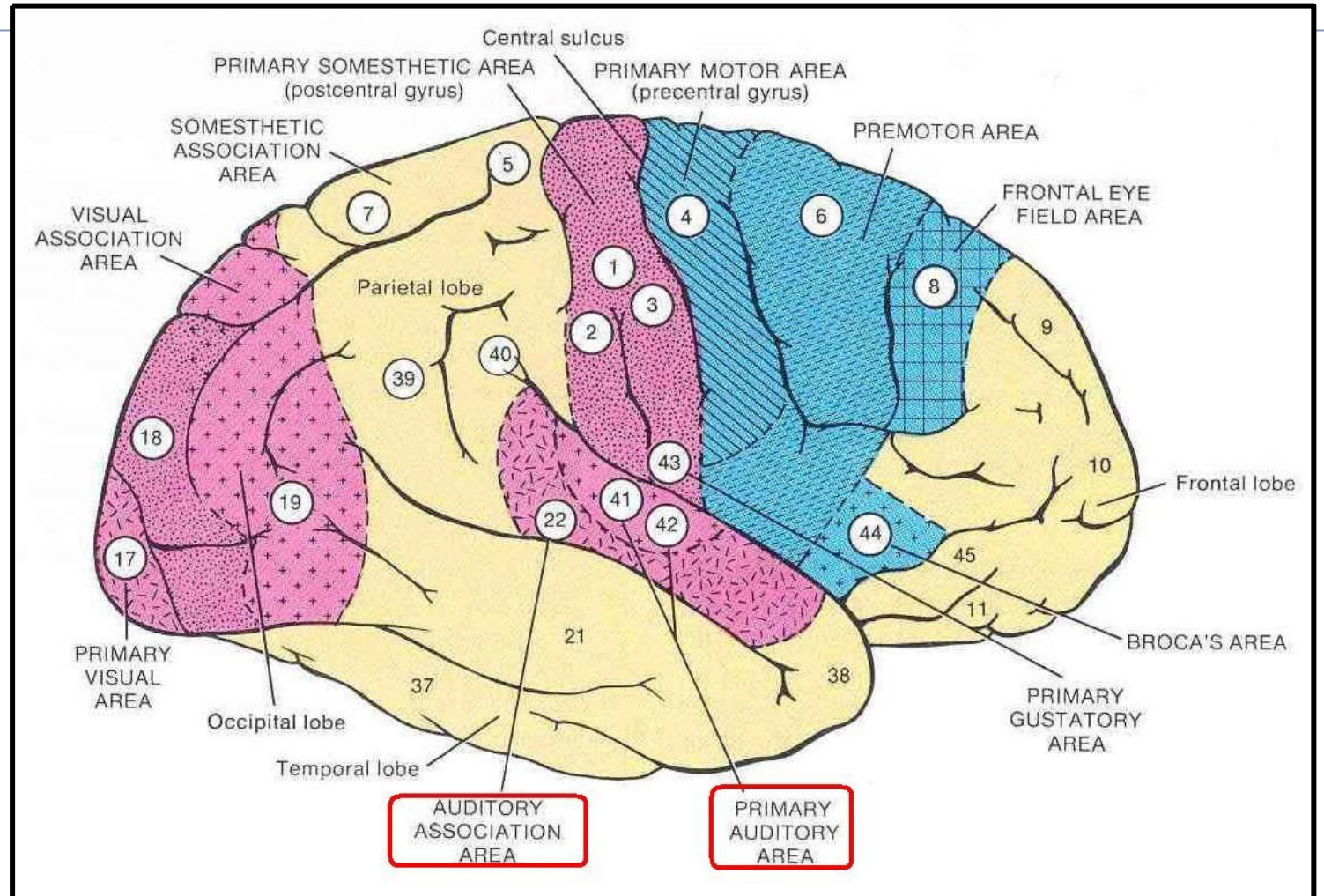
Cochlear (Auditory) Nerve

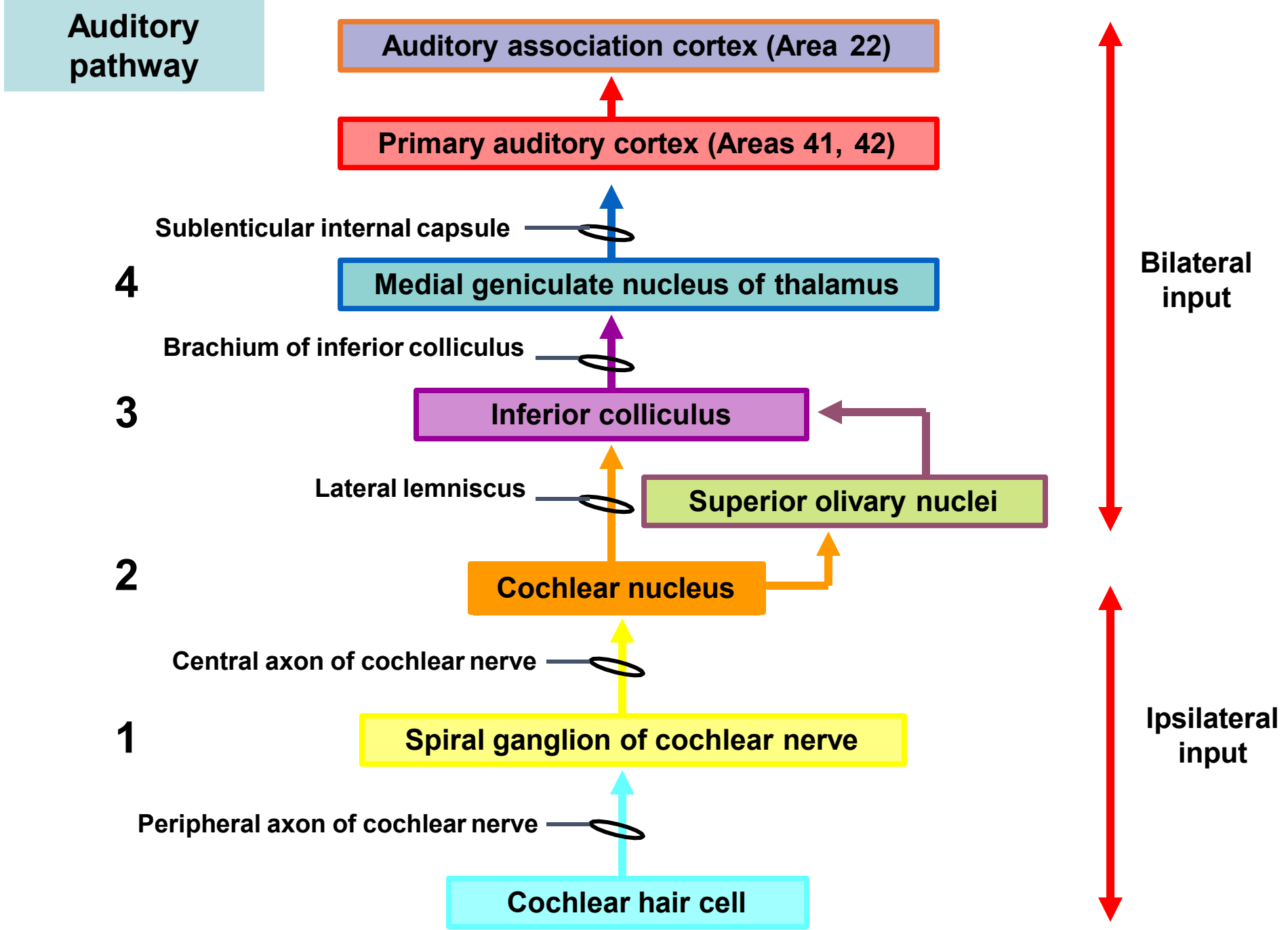
- Some axons within lateral lemniscus terminate in small nucleus of the lateral lemniscus
- The inferior colliculi project to medial geniculate nuclei of thalamus
- The axons originating in the medial geniculate nucleus (auditory radiation) pass through sublenticular part of the internal capsule to the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



Cochlear (Auditory) Nerve

- The region surrounding the primary auditory cortex is known as the auditory association cortex or Wernick's area (BA 22)
- Wernick's area is related to recognition and processing of language by the brain



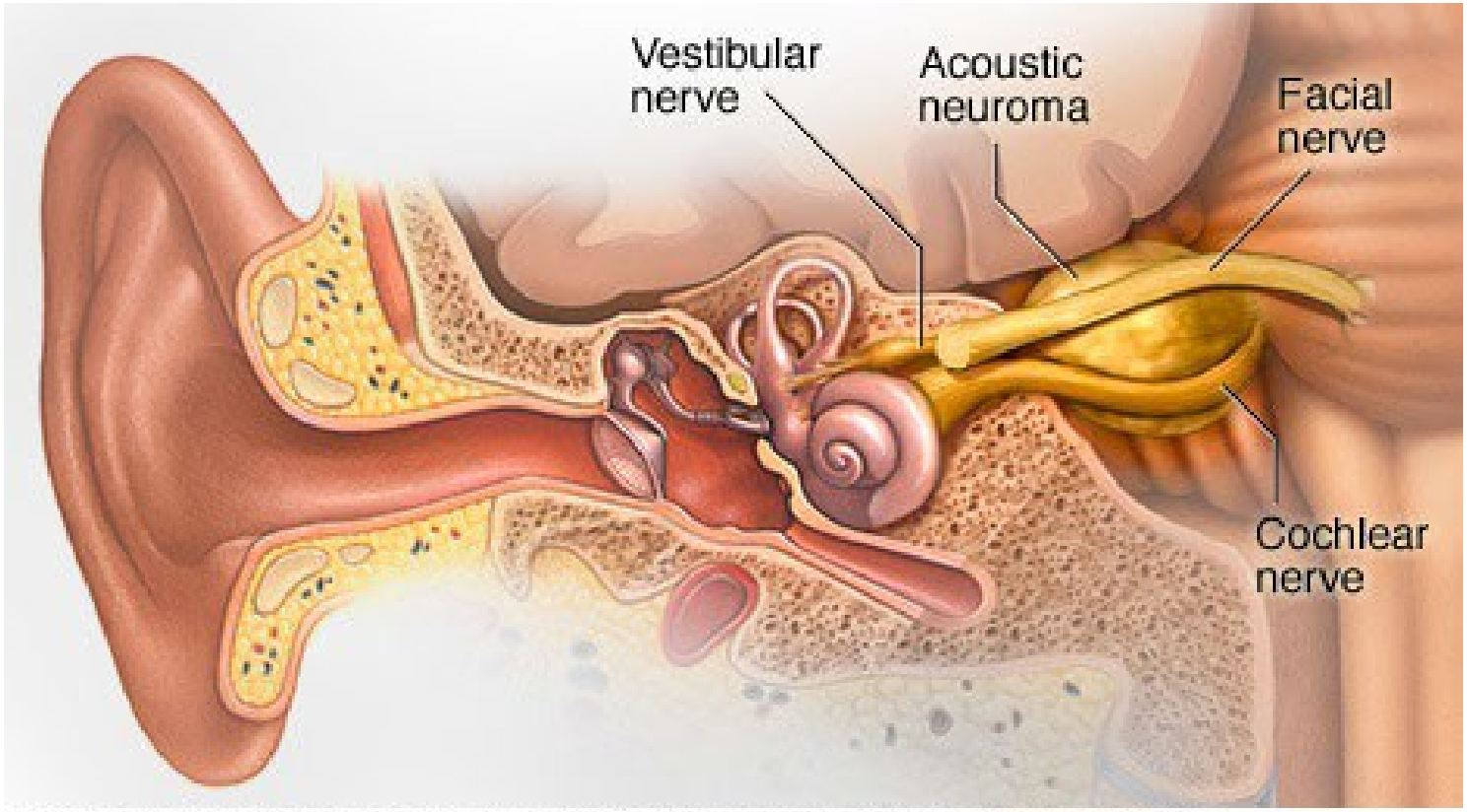

Auditory pathway
Auditory association cortex (Area 22)
Primary auditory cortex (Areas 41, 42)
Sublenticular internal capsule
4
Medial geniculate nucleus of thalamus
Brachium of inferior colliculus
3
Inferior colliculus
Lateral lemniscus
Superior olivary nuclei
2
Cochlear nucleus
Central axon of cochlear nerve
1
Spiral ganglion of cochlear nerve
Peripheral axon of cochlear nerve
Cochlear hair cell
Bilateral input
Ipsilateral input

- 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 & the nucleus of the lateral lemniscus establish reflex connections with motor neurons of trigeminal and facial motor 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



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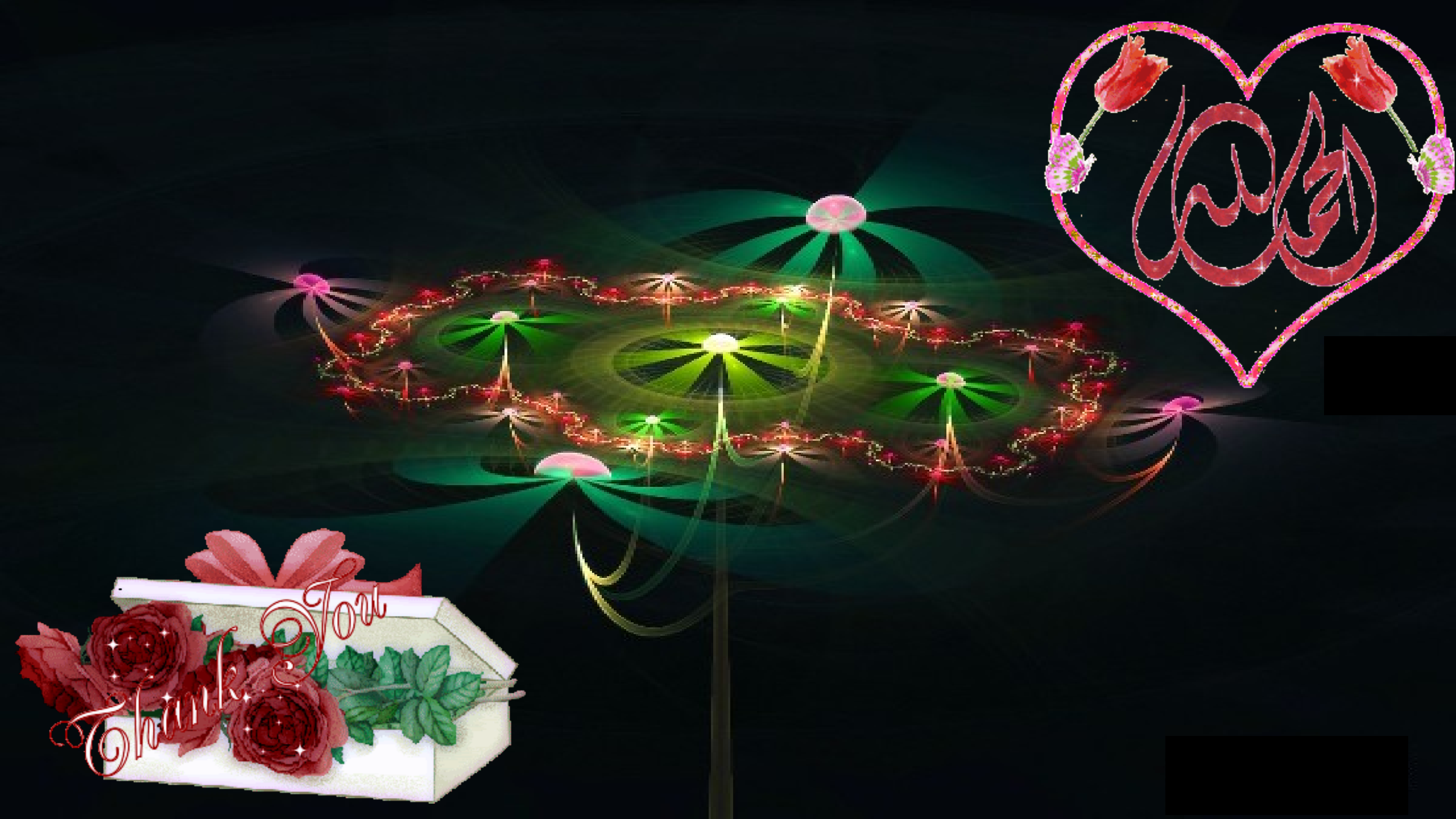
Lesion of vestibulocochlear nerve produces deafness (disturbance of cochlear nerve functions), tinnitus, vertigo, dizziness, nausea, nystagmus, loss of balance and ataxia (disturbance of vestibular nerve functions)

Acoustic neuroma: a benign tumor of 8th nerve leads to compression of the nerve leading to attacks of dizziness, and profound deafness and ataxia


الحمد لله
Thank You