أهلا وسهلا

الأستاذ الدكتور يوسف حسين

كلية الطب - جامعة مؤتة – الأردن

دكتوراة من جامعة كولونيا المانيا

الواتس (أي استفسار)
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Inner Ear

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- it consists of 2 parts:

(1) **Bony labyrinth**: boney cavities inside the petrous part of temporal bone.

(2) **Membranous labyrinth**: interconnected sacs and ducts inside the bony labyrinth.

١٠ رمضان
1973
6 october
saturday

Bony Labyrinth

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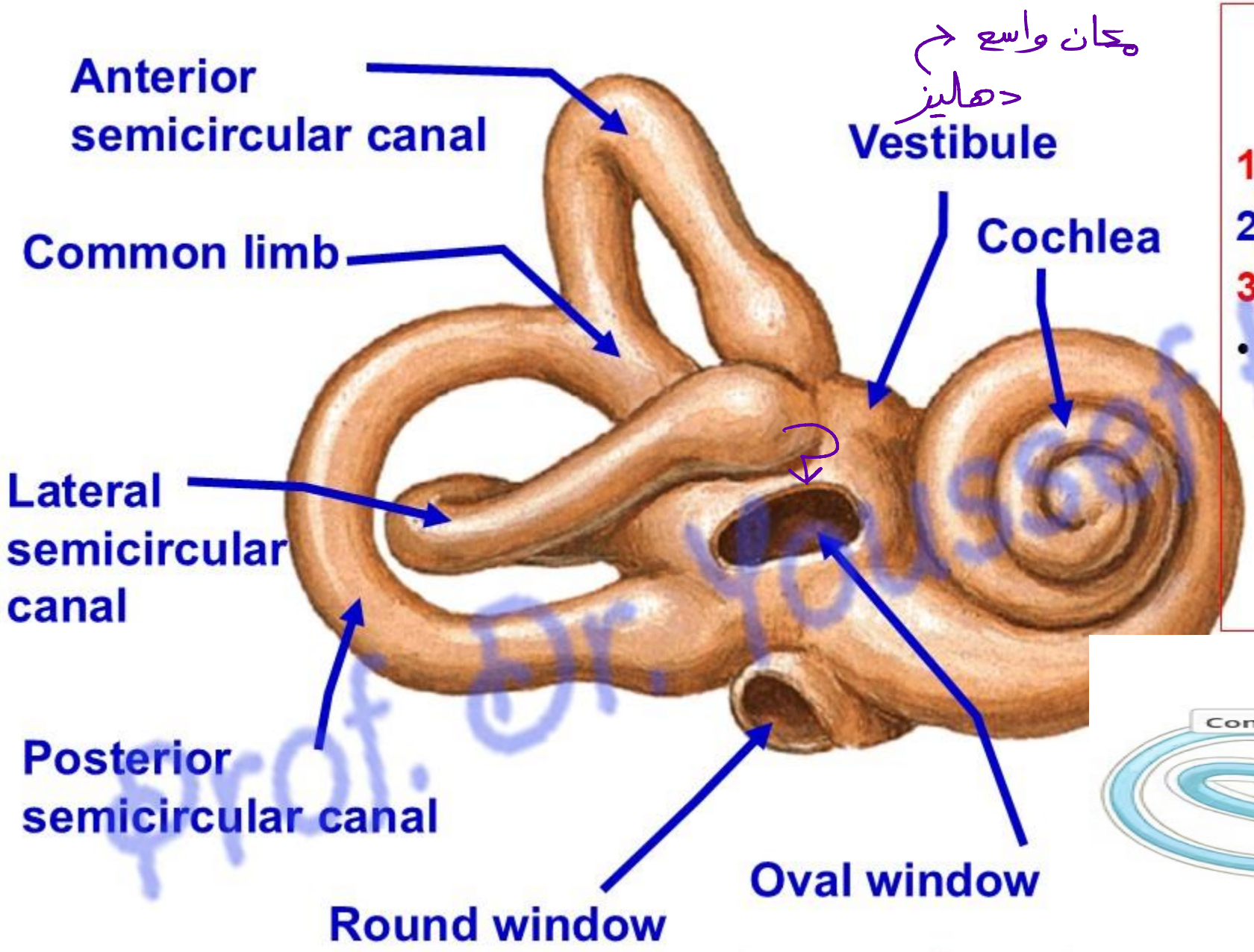
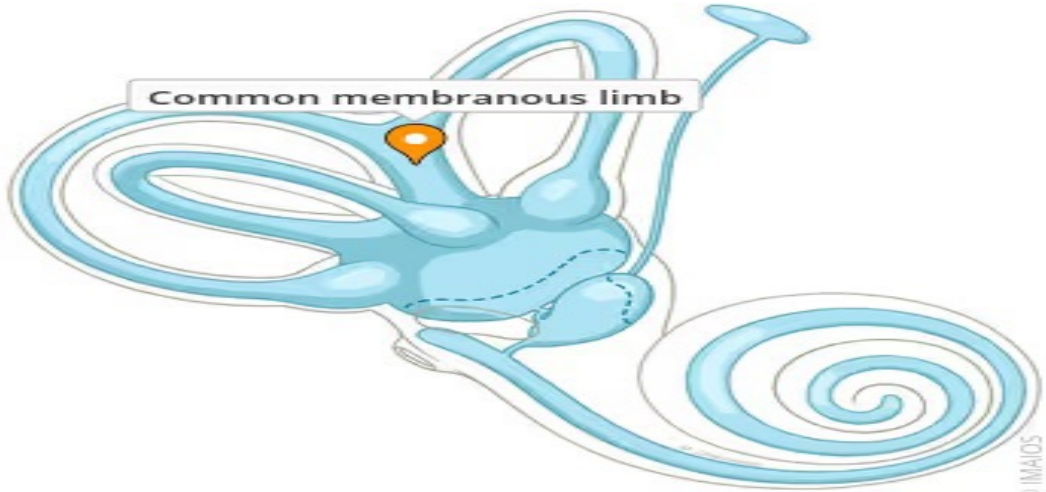
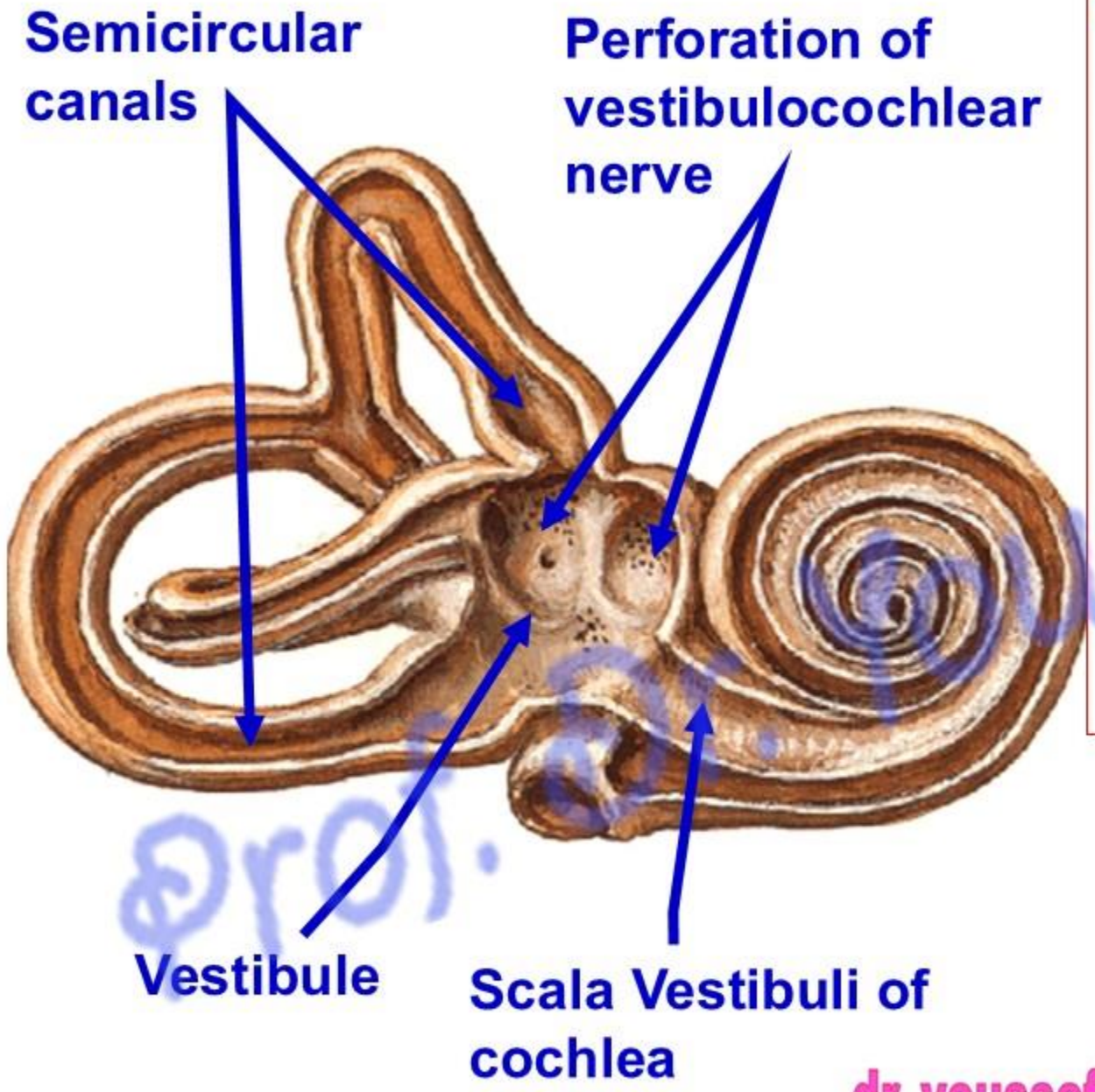


- 3 arched Semicircular canals

1) Anterior in vertical plane.
2) Posterior in vertical plane.
3) Lateral in horizontal plane.

- These 3 canals open in the posterior aspect of the vestibule by 5 orifices (common limb from anterior and posterior canals).





- **Vestibule:** central part of bony labyrinth.
  - **Its posterior wall** receives the 5 openings of the 3 semicircular canals.
  - **Its anterior wall** shows the opening of the scala vestibuli of the cochlea.
  - **Its lateral wall** is related to the middle ear and shows **fenstera vestibuli** (oval window) which is closed by the foot of stapes.
  - **Its medial wall** forms the bottom of the internal auditory meatus and is perforated by the 8th cranial nerve.

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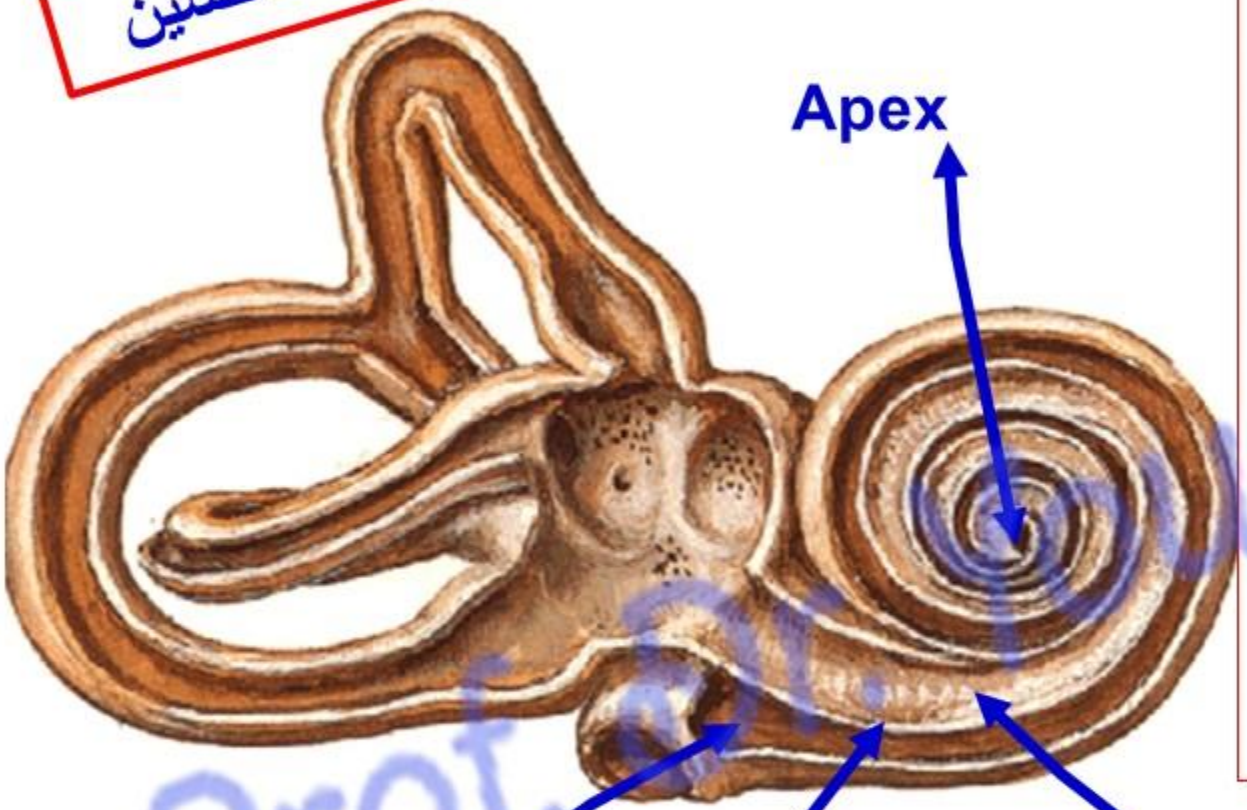
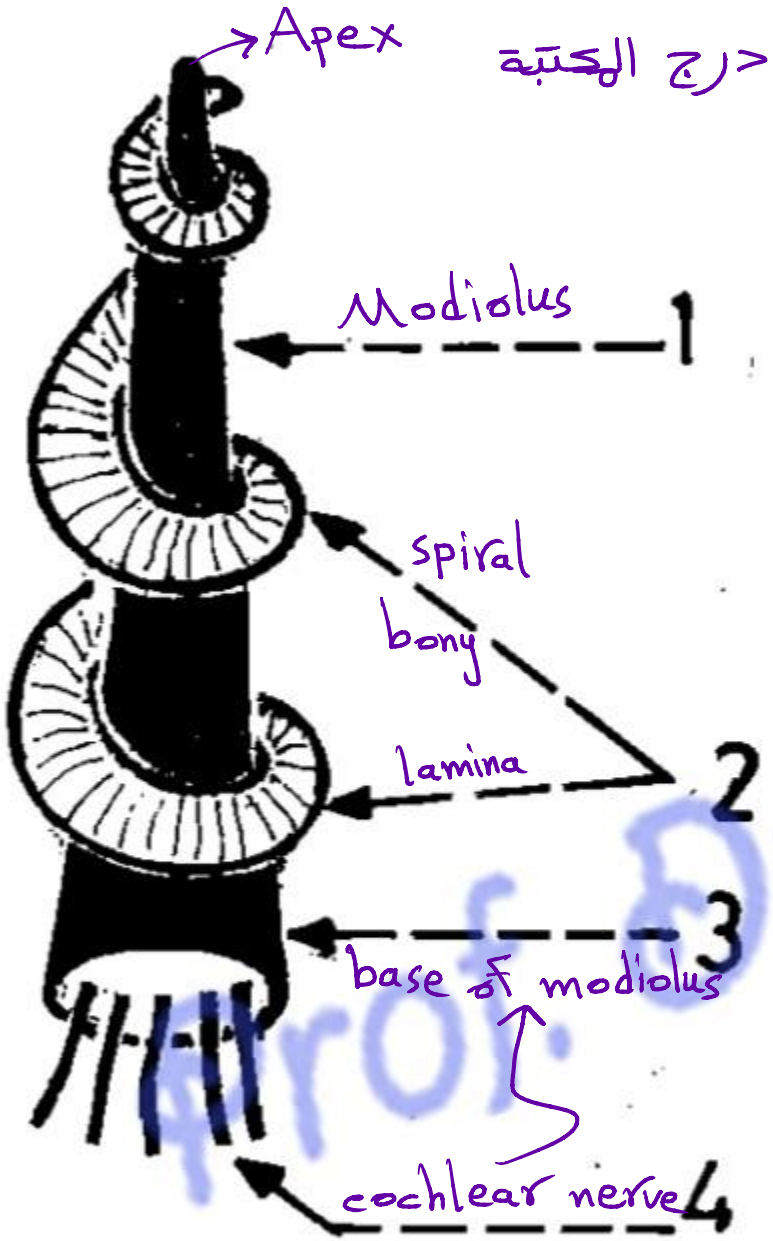
• Cochlea القوقعة

- Anterior part of boney labyrinth
- It resembles shell of a common snail forming 2 and 1/2 turns around its axis called modiolus.
- Its apex is directed laterally towards tympanic cavity.
- Its base is directed medially and is perforated by cochlear nerve → hearing part
- Spiral bony lamina projects from the modiolus dividing cochlear canal into Scala vestibuli above and Scala tympani below.
- The cochlear canal lodges cochlear duct.



حل لغة



• Modiolus

- It is the central pillar العمود المركزي of the **cochlea**
- It is conical in shape and its base directed to the bottom of the internal auditory (acoustic) meatus

1- Modiolus

2- Spiral bony lamina project from modulus dividing cochlear canal into **Scala vestibuli** above and **Scala tympani** below

scala media → cochlear duct

3- Base of modiolus is perforated by of cochlear nerve

4- Cochlear nerve

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Membranous Labyrinth

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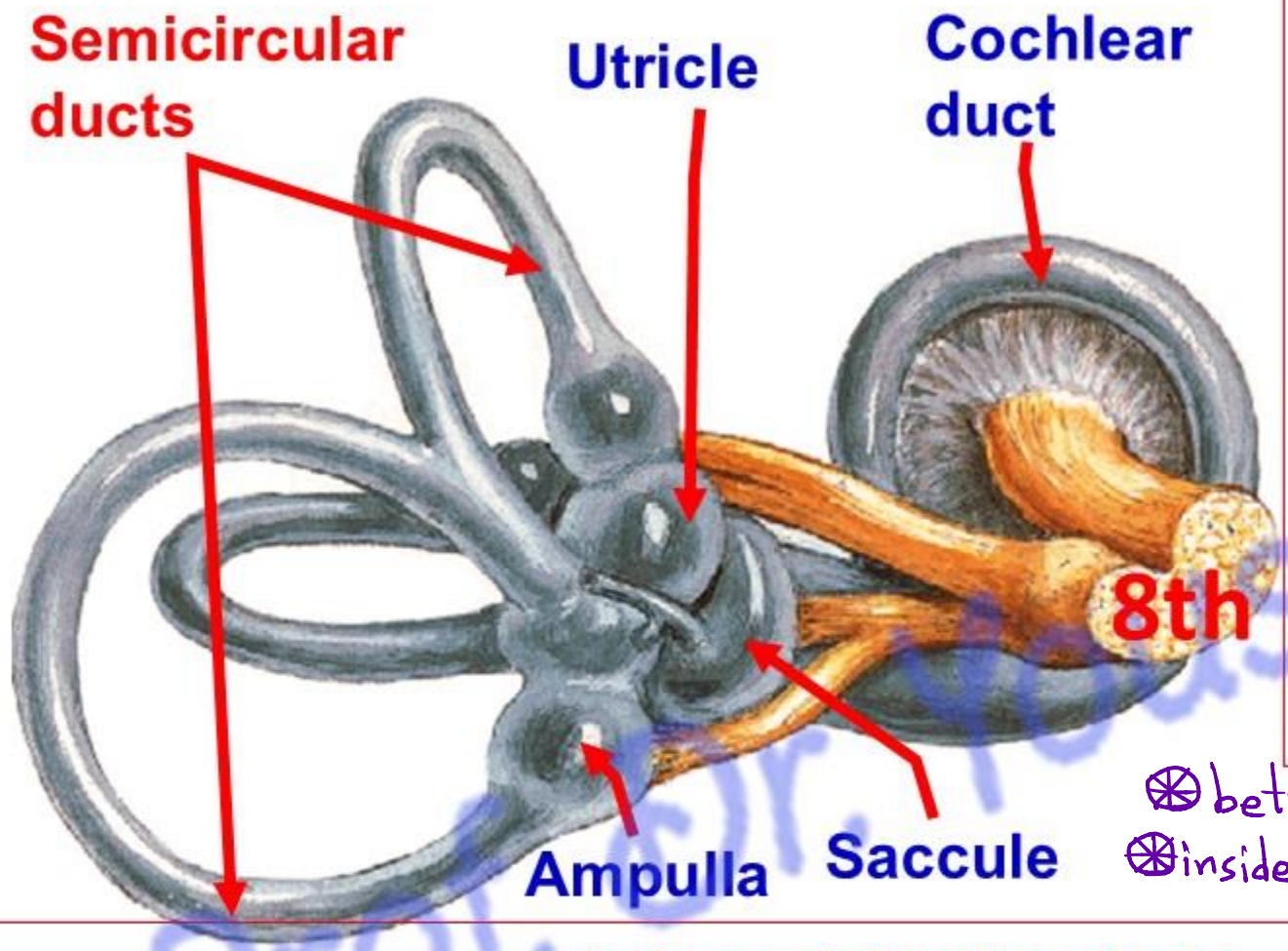


❖ MEMBRANOUS LABYRINTH

* It consists of number of membranous cavities inside the bony labyrinth.

- These cavities are filled with fluid called **endolymph**. → ↑K^+, ↓Na^+

- They are separated from the bony labyrinth by fluid called **perilymph** that **communicate with subarachnoid space** through **aqueduct of cochlea** ← to CSF

⊛ between membranous and bony → perilymph → ↑Na^+, ↓K^+

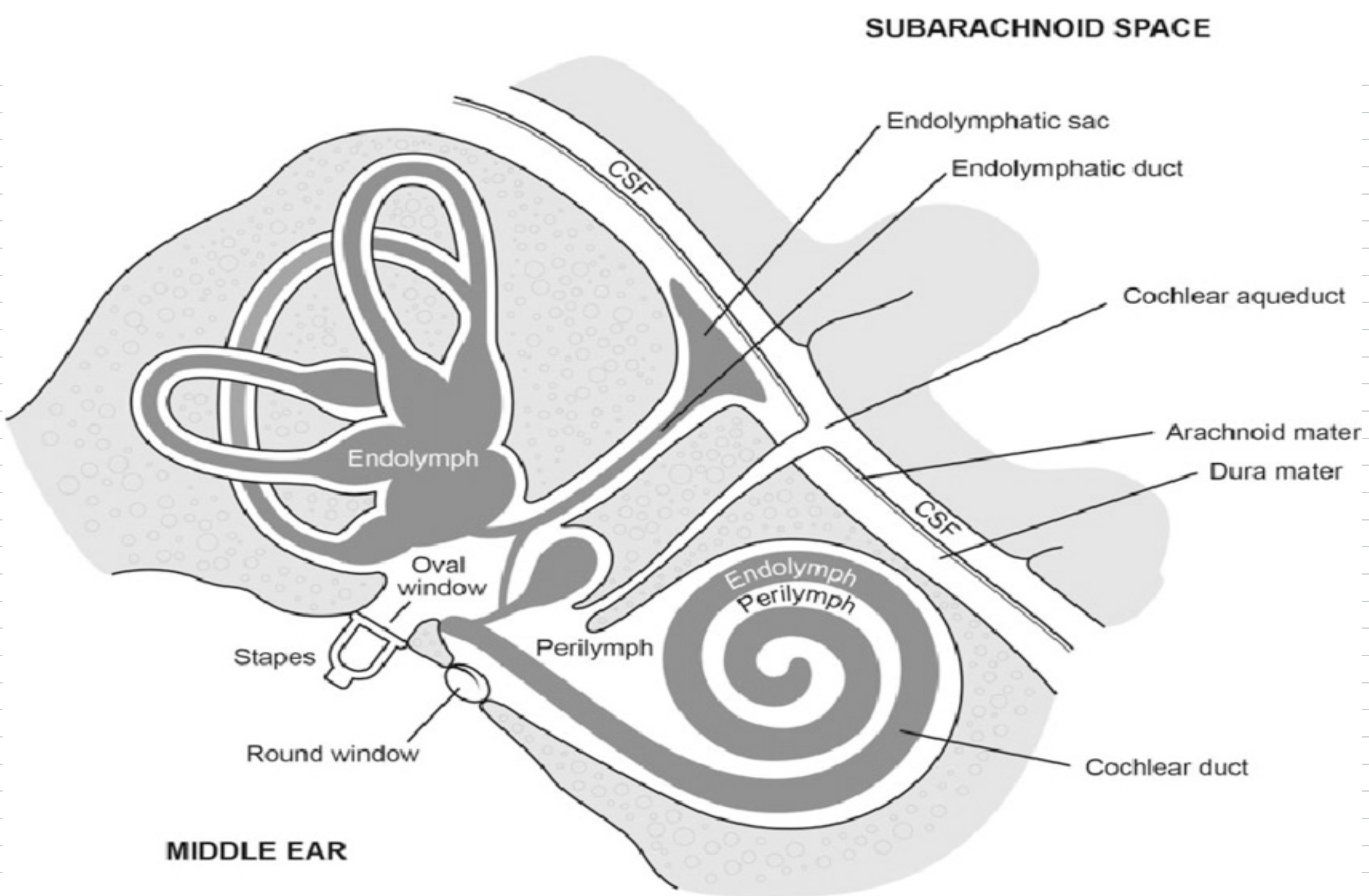
⊛ inside membranous → endolymph → ↑K^+, ↓Na^+

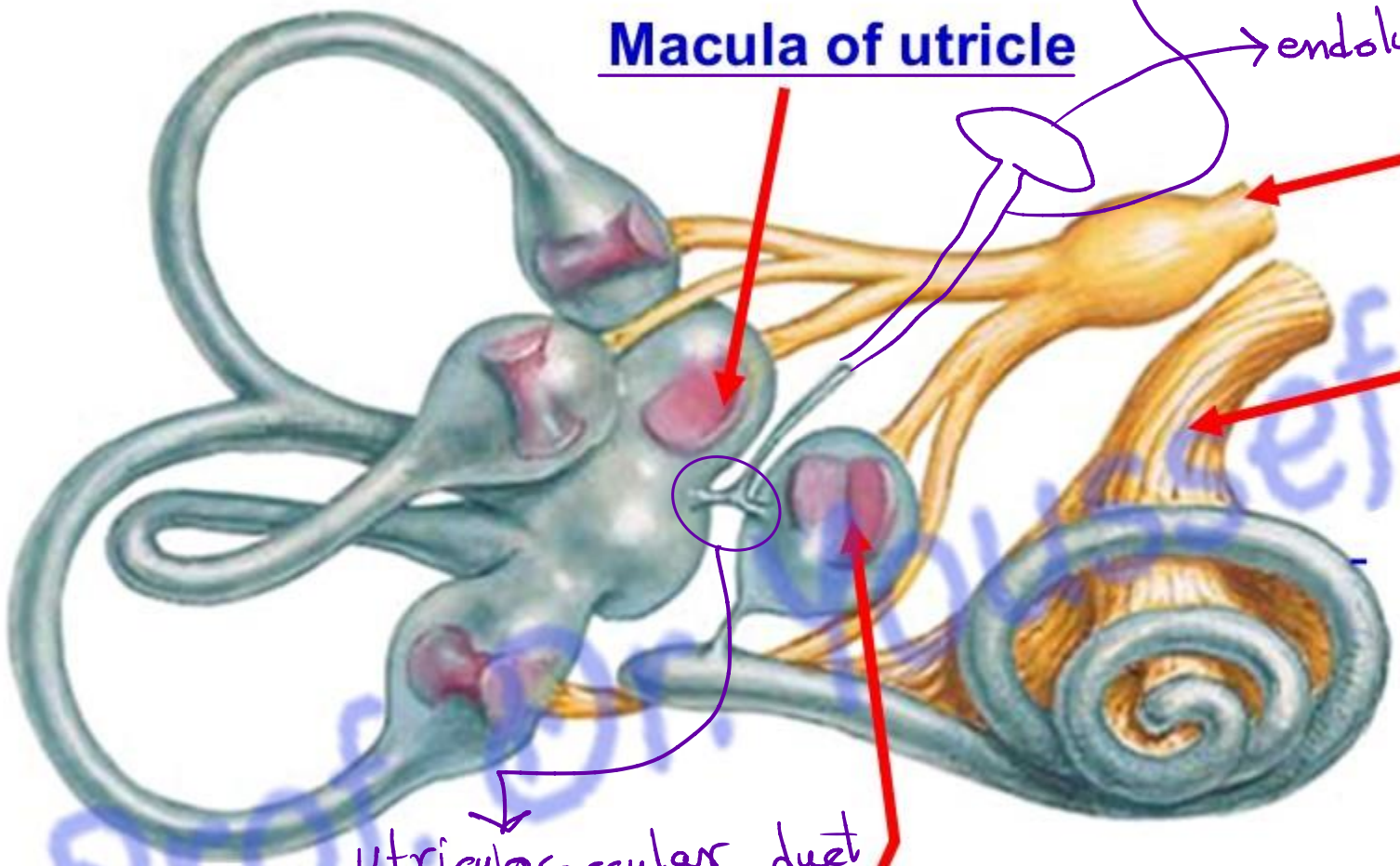
❖ 3 semicircular ducts

- They lie within the corresponding semicircular canals.
- They open in the utricle.
- Each duct has a dilatation at one of its ends called **ampulla**

duct → membranous

aqueduct → bony


SUBARACHNOID SPACE
Endolymphatic sac
Endolymphatic duct
CSF
Cochlear aqueduct
Arachnoid mater
Dura mater
CSF
Endolymph
Oval window
Endolymph
Perilymph
Perilymph
Stapes
Round window
Cochlear duct
MIDDLE EAR



Endolymphatic duct in vestibular aqueduct

endolymphatic sac → drainage of endolymph

Macula of utricle

Vestibular nerve → into subarachnoid space

Cochlear nerve

The macula receives the fibres of the vestibular nerve.

Utriculosaccular duct

Macula of saccule

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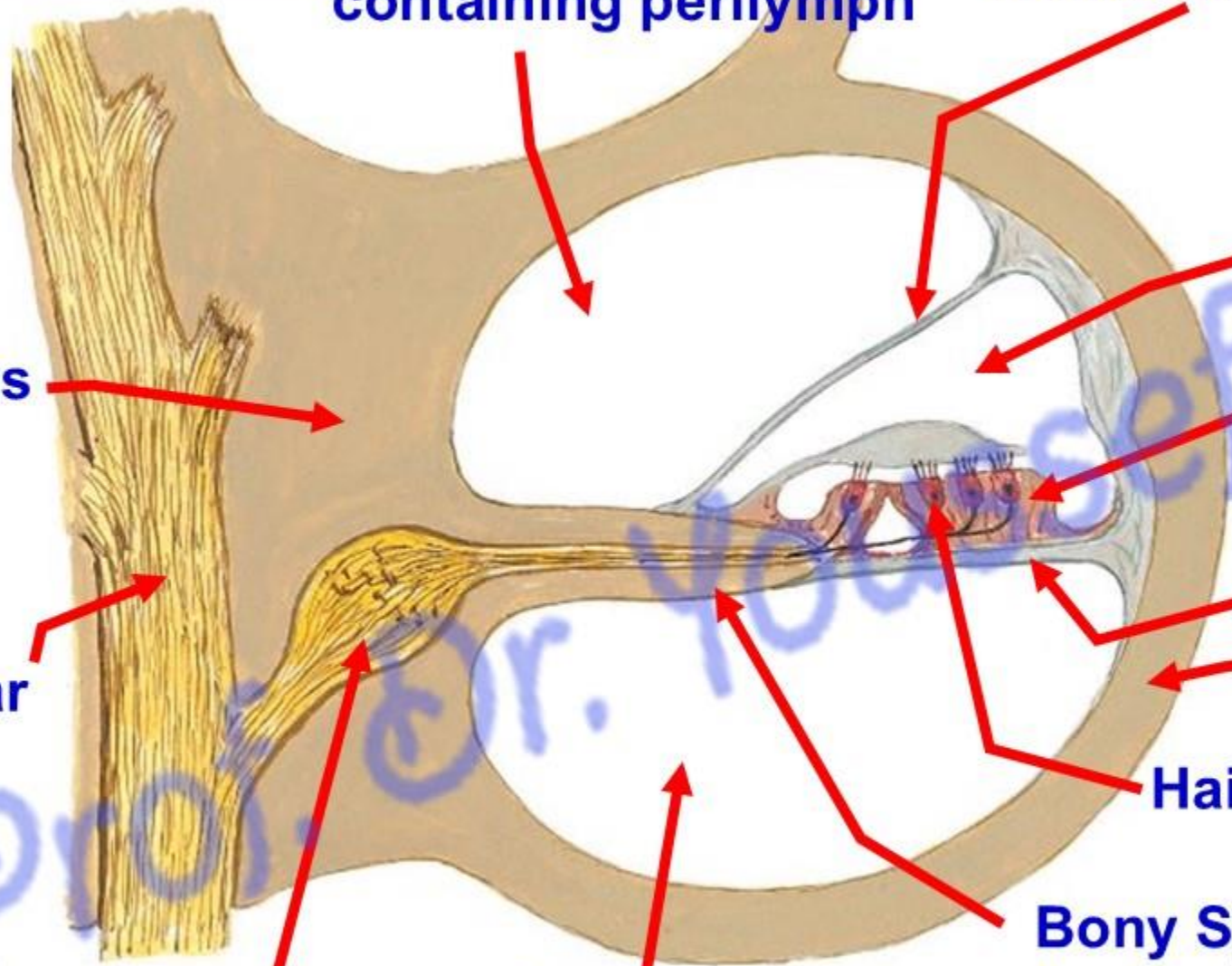
Cochlear duct



Scala vestibuli containing perilymph

Vestibular membrane

Cochlear duct containing endolymph

Modiolus

Organ of Corti

Basilar membrane

Bony cochlea

Cochlear nerve

Hair cells

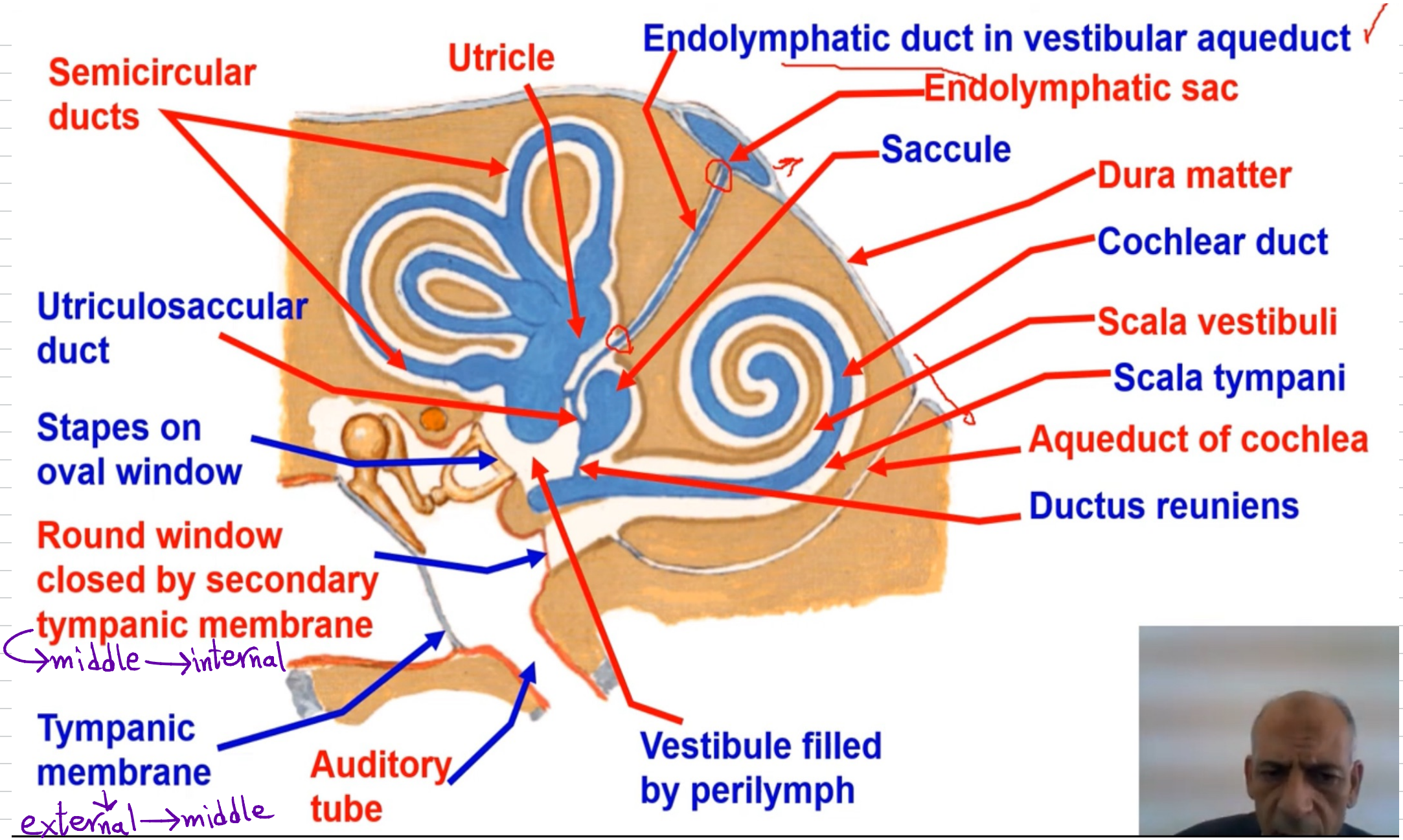
Bony Spiral lamina

Spiral ganglia

Scala tympani containing perilymph

- **Cochlear duct** (inside the cochlear canal)

- It contains endolymph and **organ of corti** (**(Ear receptors of sound)**).
- **It** extends between **scala vestibuli** above and **scala tympani** below.
- It is separated from the scala vestbuli (above) by the **vestibular membrane**.
- It is separated from the scala tympani (below) by the **basilar membrane**.
- **Spiral ganglion**, The peripheral processes receive the sensation from the **hair cells receptors** located on the basilar membrane (three outer and one inner, sensory receptors of cochlear nerve in organ of Corti) .
- Their central processes (axons) form **cochlear nerve**


Semicircular ducts
Utricle
Endolymphatic duct in vestibular aqueduct
Endolymphatic sac
Saccule
Dura matter
Cochlear duct
Utriculosaccular duct
Scala vestibuli
Scala tympani
Stapes on oval window
Aqueduct of cochlea
Ductus reuniens
Round window closed by secondary tympanic membrane
middle → internal
Tympanic membrane
external → middle
Auditory tube
Vestibule filled by perilymph

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Auditory Pathway

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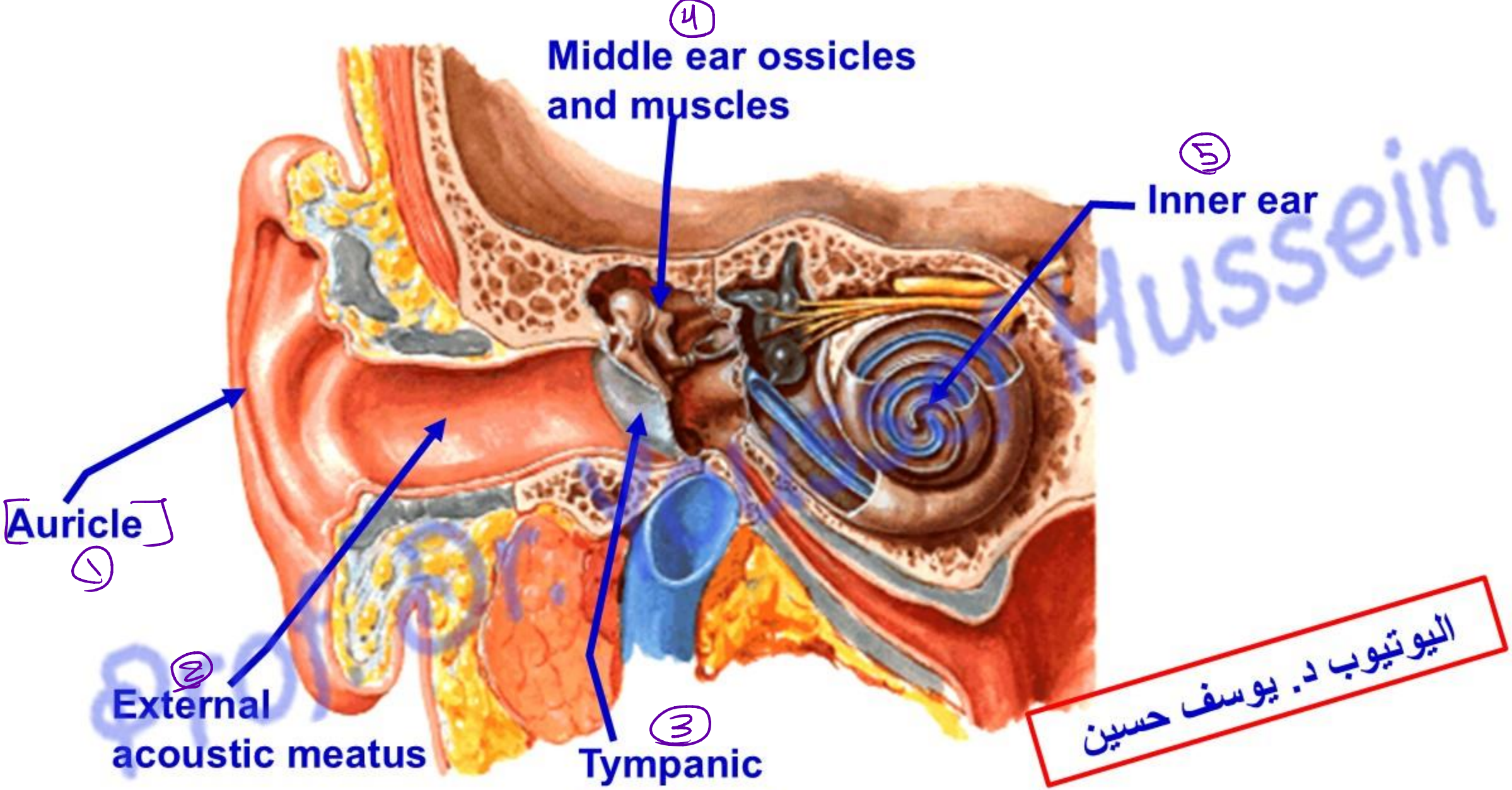

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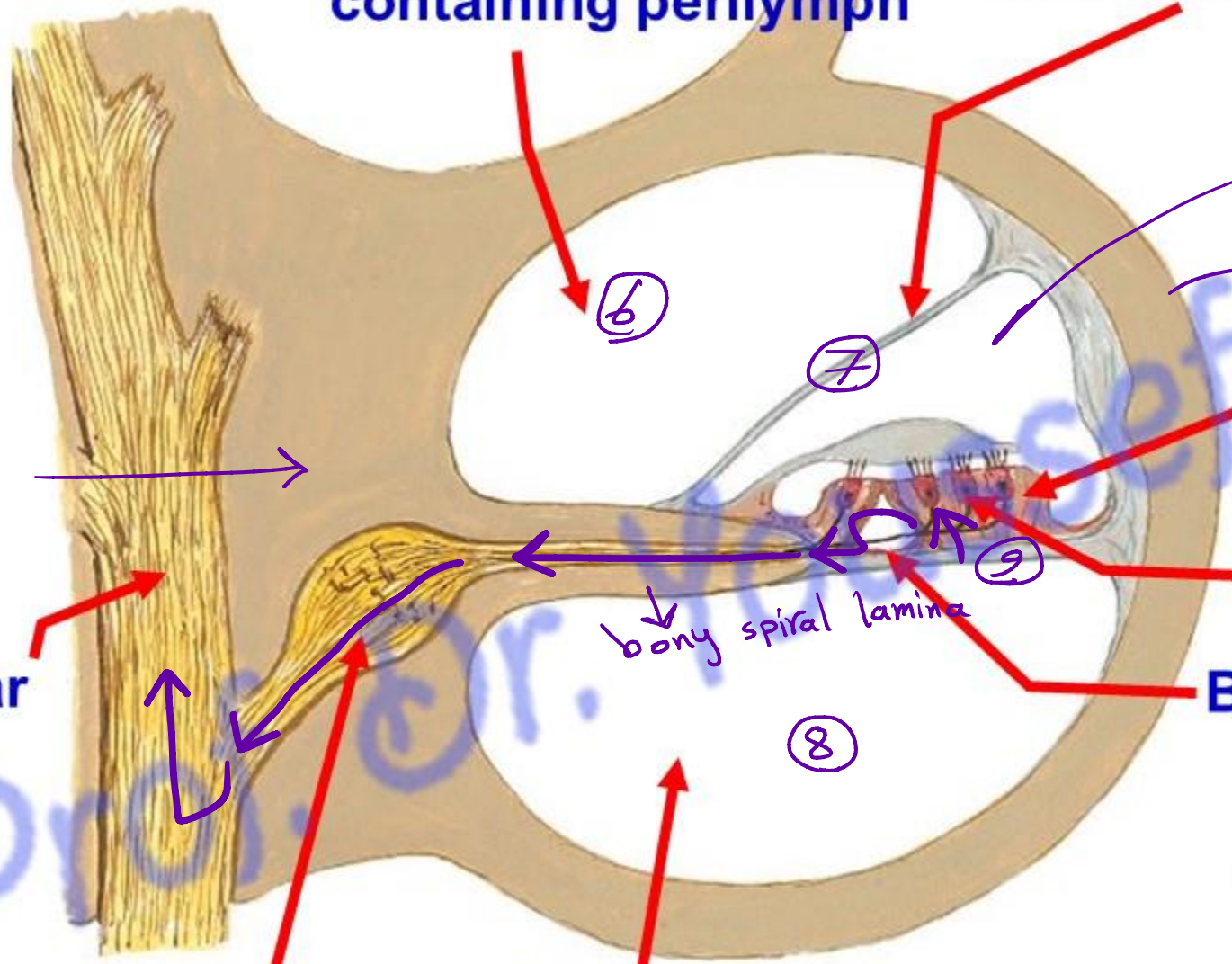
Receptors



Scala vestibuli containing perilymph

Vestibular membrane

cochlear duct containing endolymph

bony cochlea

Organ of Corti

Modiolus

Hair cells → receptors

bony spiral lamina

Basilar membrane

Cochlear nerve

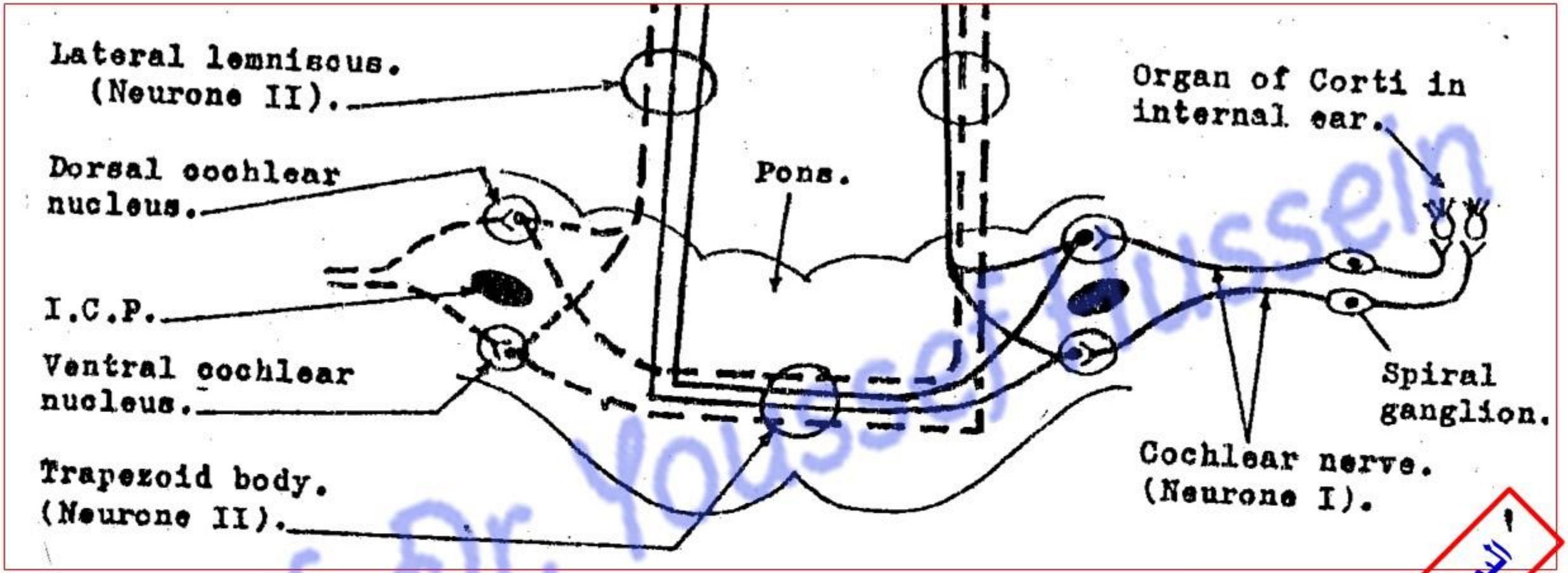
Spiral ganglia
1st order

Scala tympani containing perilymph

AUDITORY (Hearing) PATHWAY

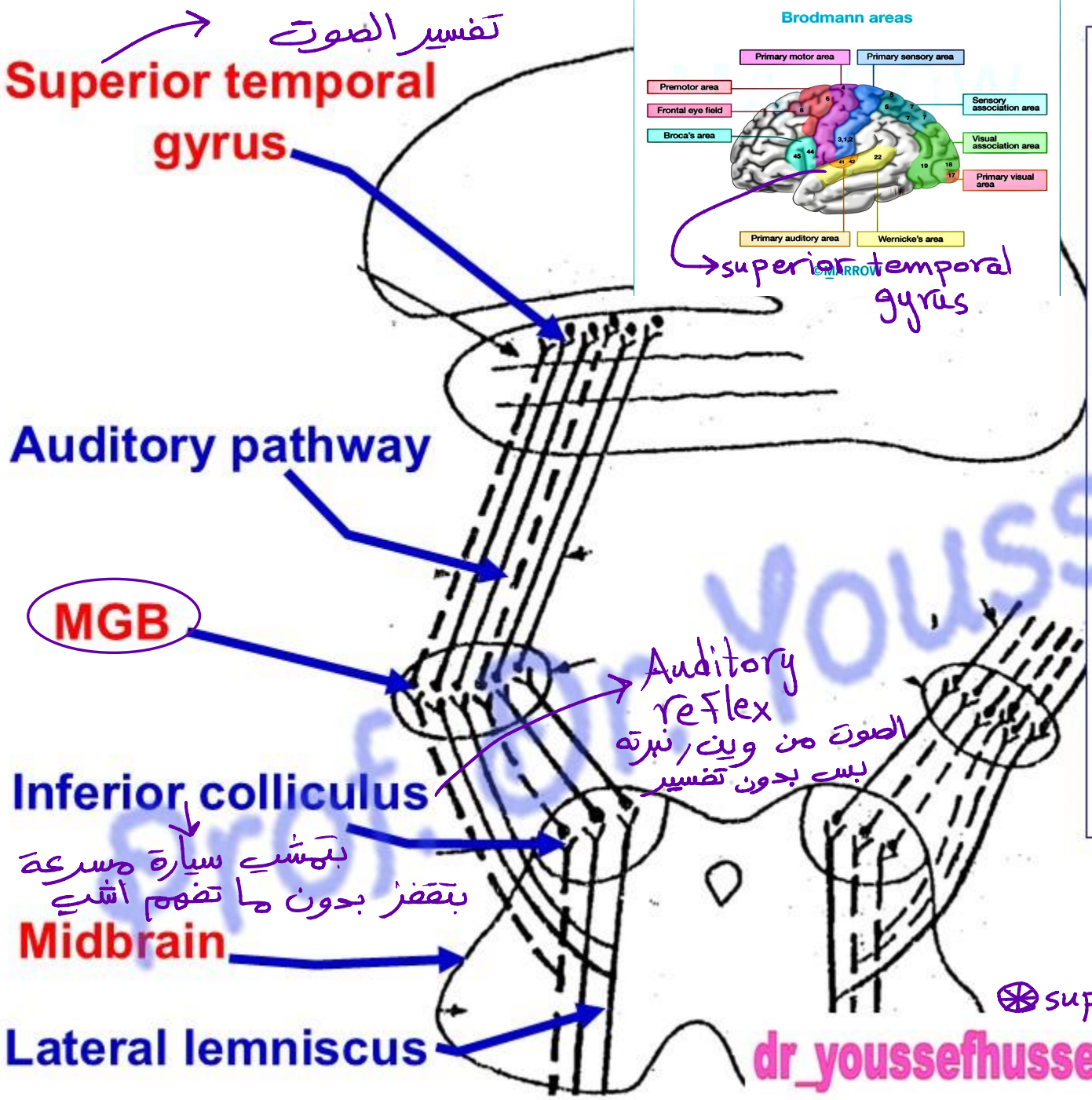
** **Receptors**

- Sound waves → External acoustic meatus ---- vibration of the tympanic membrane → sound waves and send vibrations to the auditory ossicles (malleus – incus and stapes) → send sound vibrations to cochlea → vibration of perilymph of the scala vestibule → vibration of vestibular membrane → vibration of perilymph of scala tympani → vibration of basilar membrane → Hair cells and organ of Corti located on the basilar membrane transform the **sound vibration** into **electrical signals** to spiral ganglia (**First neuron) to the cochlear nerve which ends in ventral and dorsal cochlear nuclei in pons.**



2- Second neuron: ventral and dorsal cochlear nuclei.

- **Most of the axons of these cells cross to the opposite side** → decussate with their fellows of the opposite side to form **trapezoid body** → ascend as a **lateral leminscus** with **some fibres from the same side** → **medial geniculate body** of the thalamus.



3- Third order neuron (Medial geniculate body, MGB):

- Their axons form **auditory radiation** passes through **sublentiform** of **internal capsule** to **auditory area** of cerebral cortex (superior temporal gyrus, area 41 & 42).

* **On the midbrain** some of the fibers terminate in the **inferior colliculus** (center of auditory reflex, sound localization and tonal discrimination)

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Vestibular Pathway

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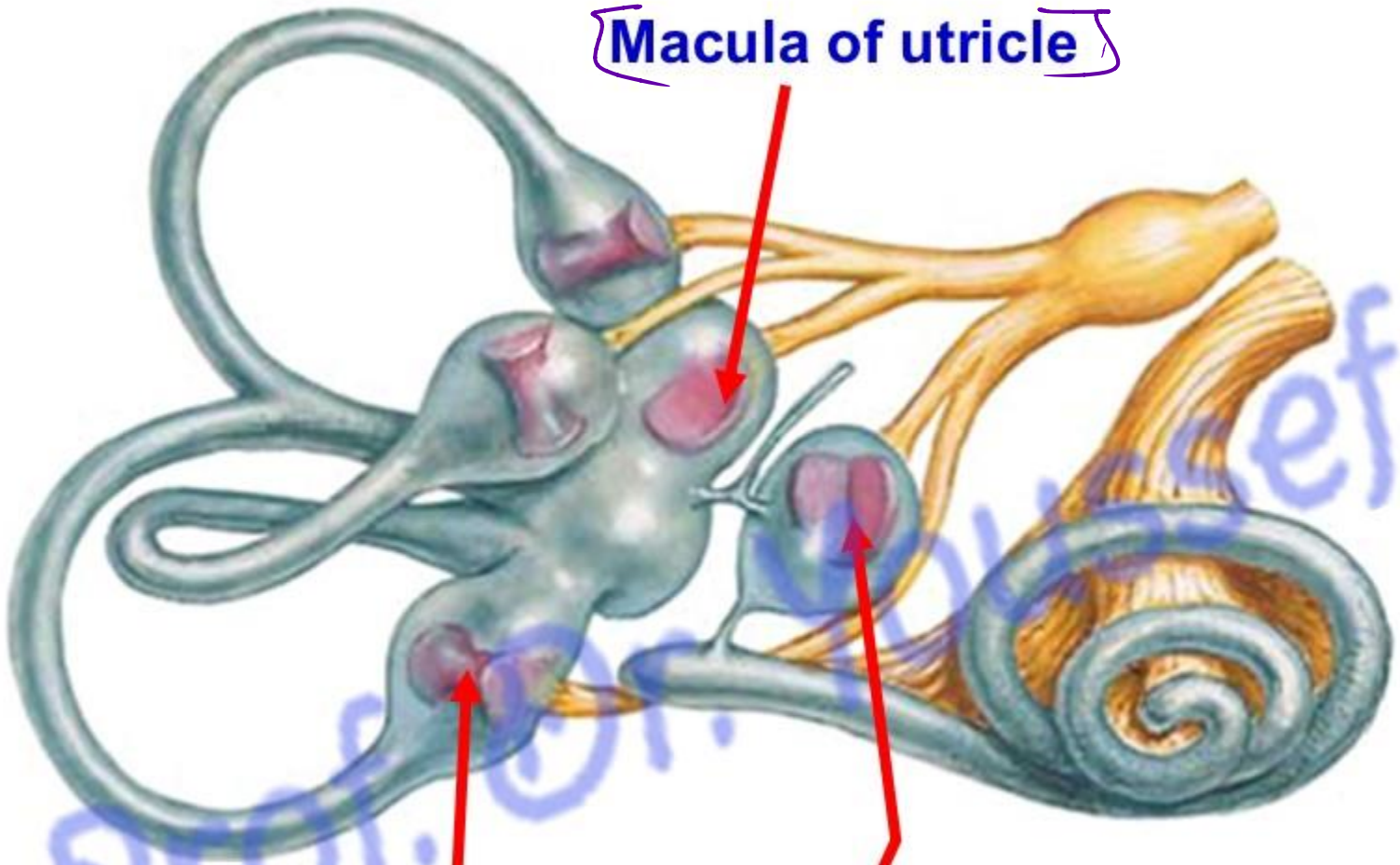
Vestibular receptors



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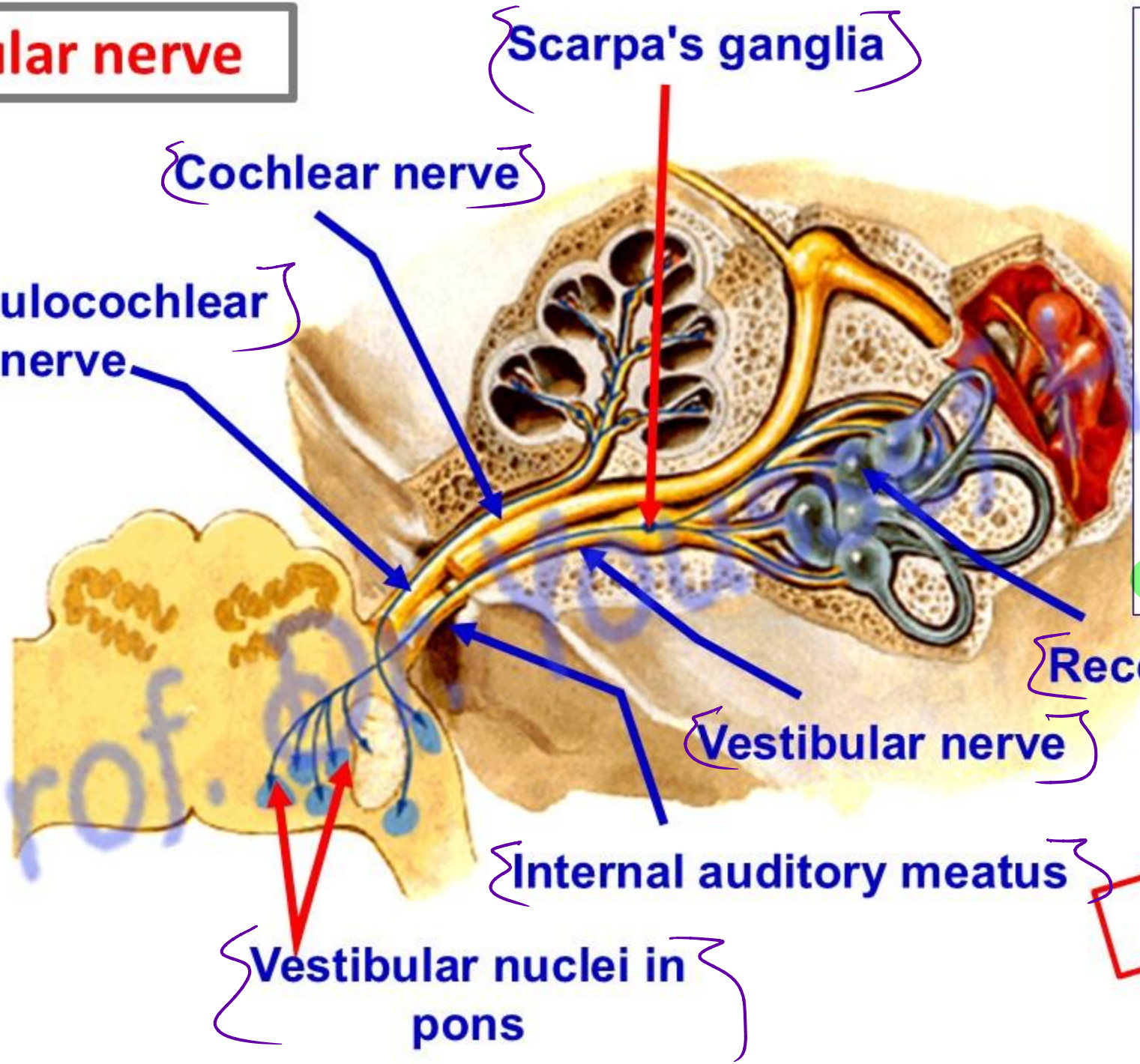
Vestibular nerve



1- First neuron: Scarpa's ganglion.

- Peripheral processes receive the sensation from the receptors.
- Their axons form **vestibular nerve** which ends vestibular nuclei in pons.

❖ **The second-order neuron:** four **vestibular nuclei**.

- These nuclei are located on the floor of the fourth ventricle.
- **From the vestibular nuclei,** fibers travel to
  - Motor nuclei of anterior horn cells of spinal cord
  - Motor nuclei of the 3rd, 4th & 6th cranial nerves
  - Cerebellum

❖ **The third order neuron: thalamus**

- **Terminal vestibular pathway** through **lateral lemniscus or reticular formation** extend to temporal lobe near auditory area **above and below lateral sulcus** (**Sylvian fissure**) **and insula** (at the bottom of the deep lateral sulcus).

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Thank you

Questions

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