



# **The Ear**

**Dr. Nora Hamada**

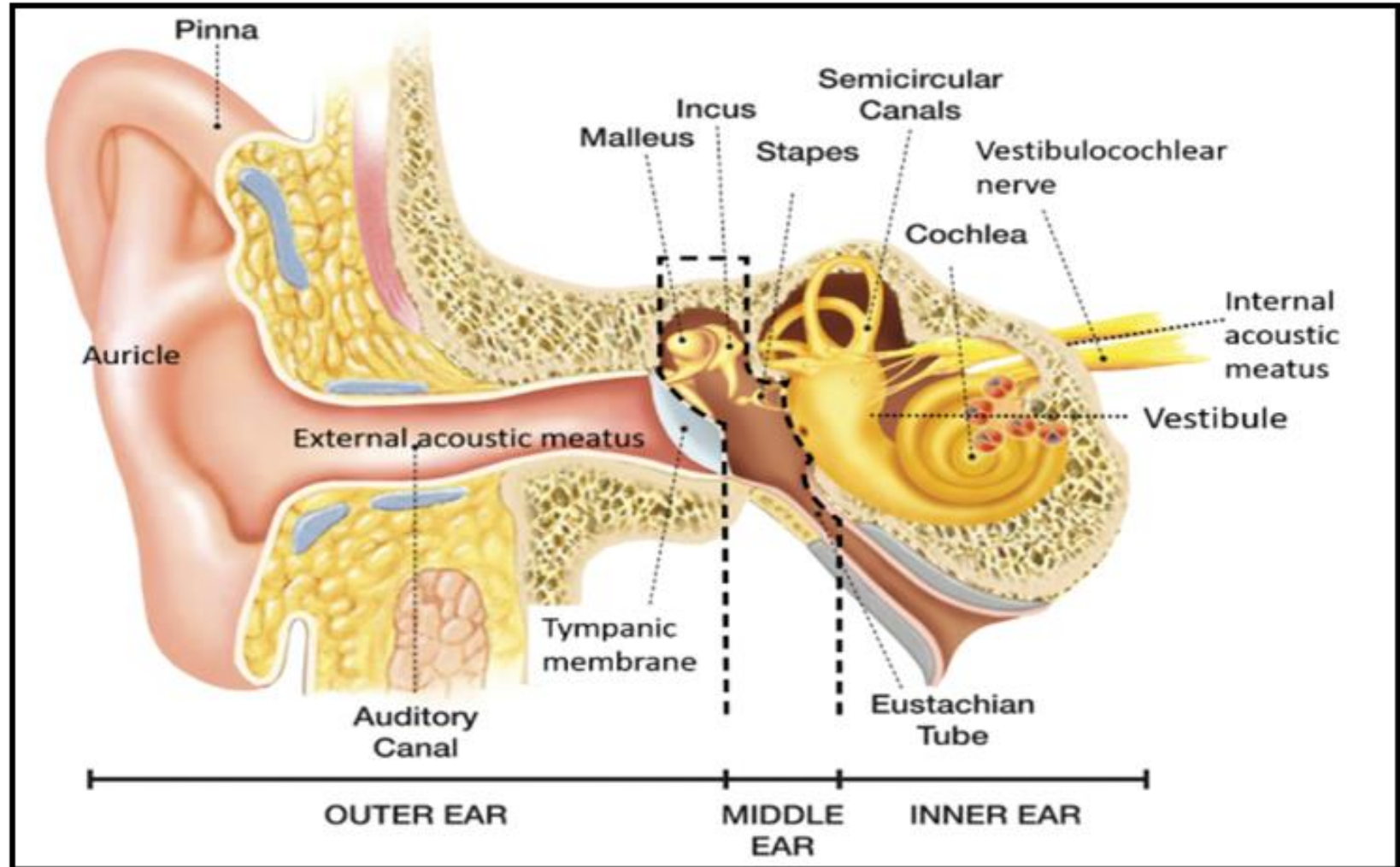
**Assistant lecturer of Medical Histology & Cell  
Biology**

**Faculty of Medicine - Mansoura University**

# The Ear

Formed of:

1. The **external** ear.
2. The **middle** ear  
(Tympanic Cavity)
3. The **inner** ear  
(Labryinth)



# The external ear

1. **Auricle**
2. **External auditory meatus & canal**
3. **Tympanic membrane ( ear drum )**

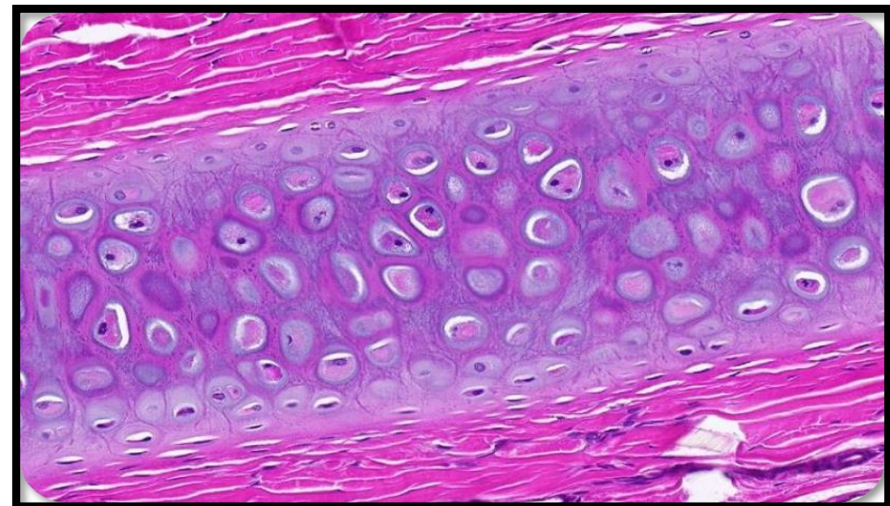
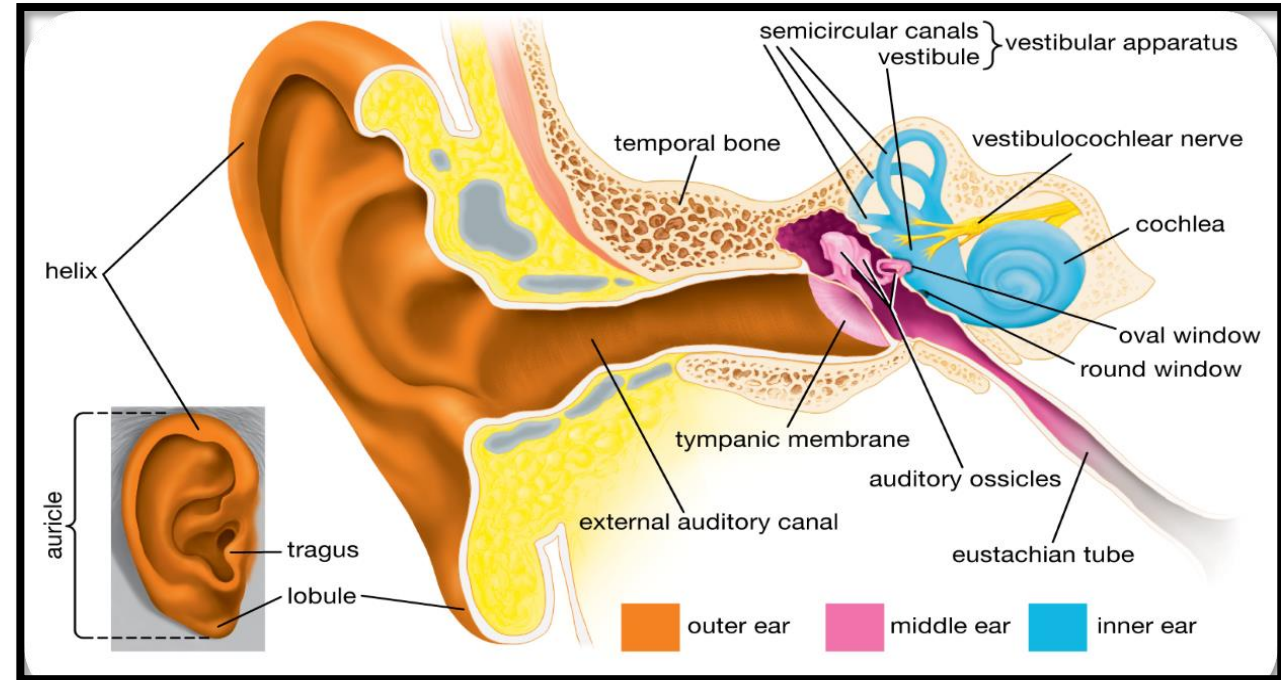
## **The Auricle:**

### Structure:

- **Yellow elastic fibro-cartilage**
- **Thin skin on both sides**

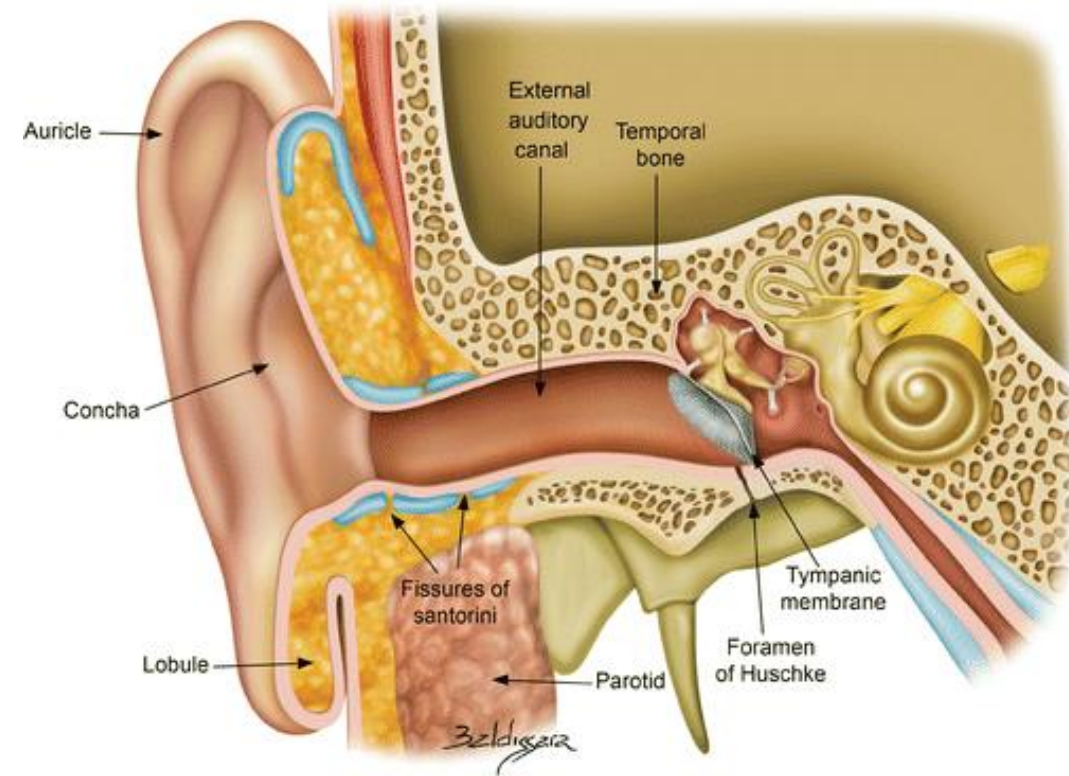
### Function:

- **Collects the sound waves and directs them towards the external auditory meatus.**



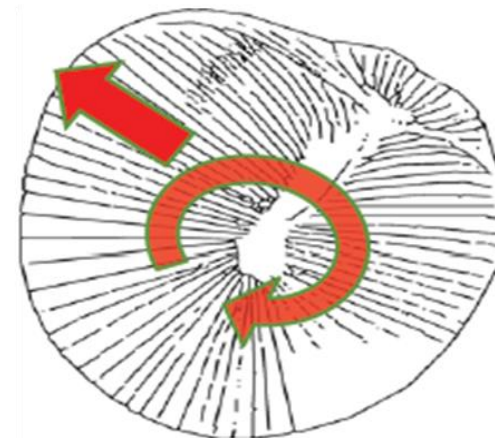
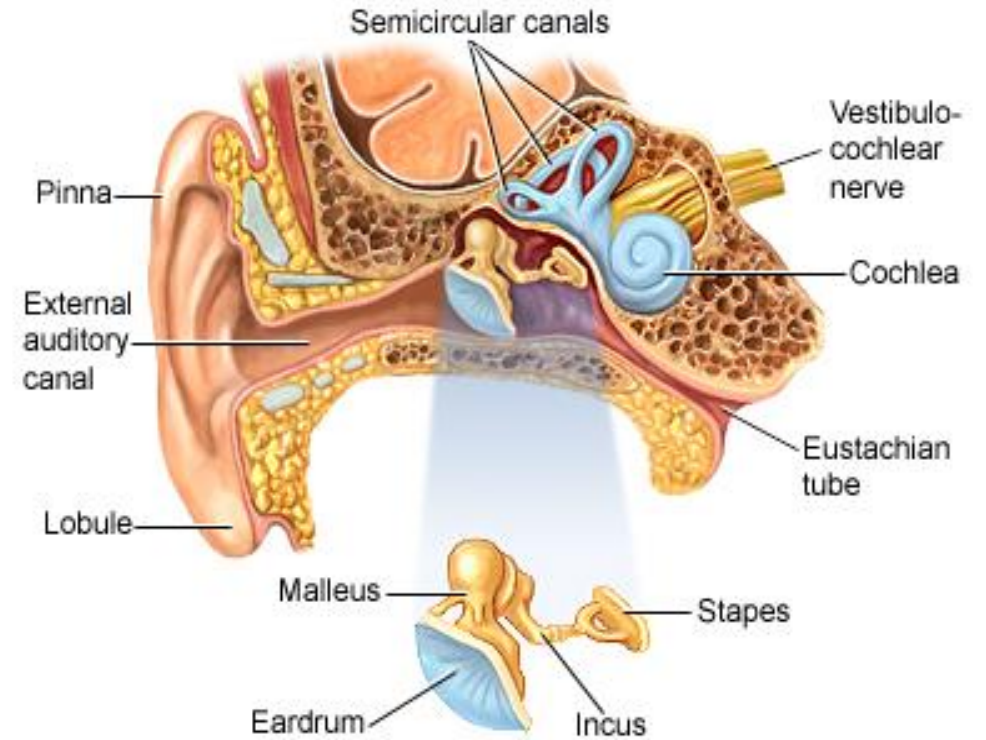
## The external auditory meatus:

- This canal leads to the middle ear.
- Its wall is formed of:
  - **Outer 1 / 3 cartilaginous** (yellow elastic)
  - **inner 2 / 3 bony** (spongy)
- It is lined by **thin skin** which contains:
  - **Stiff hairs** (outer part)
  - **Sebaceous gland.**
  - **Ceruminous gland**
  - **The secretion of both glands forms the cerumen or the wax of the ear.**



## The tympanic membrane (the ear drum):

- It separates the external auditory meatus from the middle ear cavity.
- It consists of 2 layers of collagenous fibers.
- Both layers are covered externally by skin and internally by simple cuboidal epithelium.
- The tympanic membrane transmits the vibrations of sound to the middle ear.



# The middle ear

- **Boundaries:**

**laterally: tympanic membrane**

**medially: bony wall of the inner ear**

- **Lined with simple cuboidal epithelium.**

- **Connected to the pharynx through the Eustachian tube (equalize the air pressure in the middle ear and the naso-pharynx).**

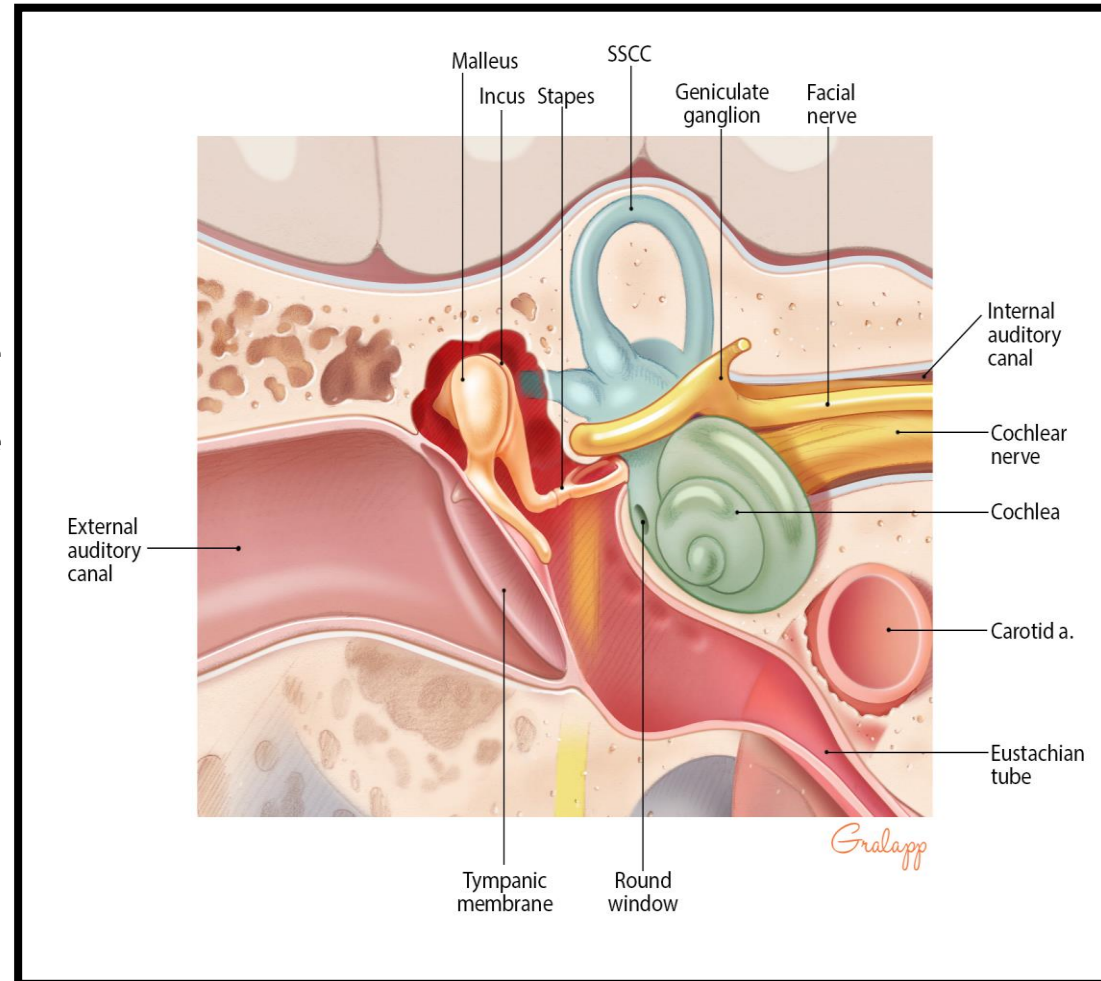
- **It Contains:**

- **3 ossicles**

- **2 muscles**

- **2 windows**

- **Chorda tympani nerve**



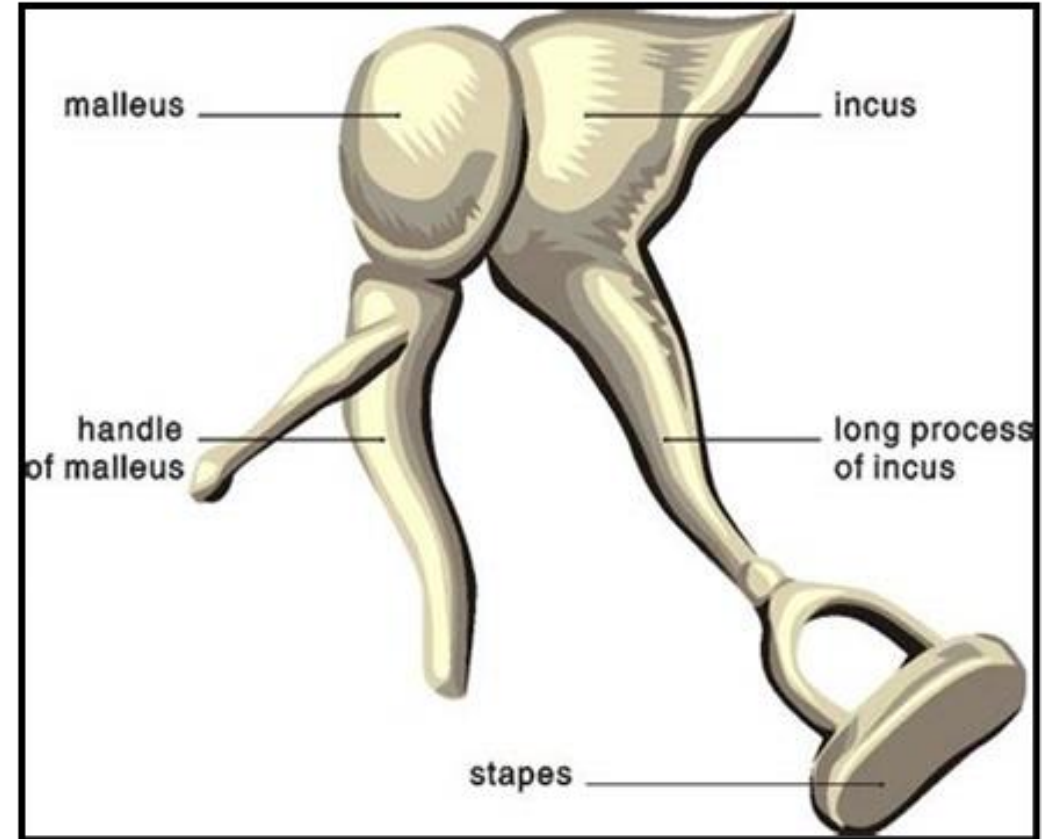
# The ossicles

- **Spongy bone.**
- **From lateral to medial:**
  1. **Malleus:**

**Its handle is attached to the tympanic membrane.**
  2. **Incus:**

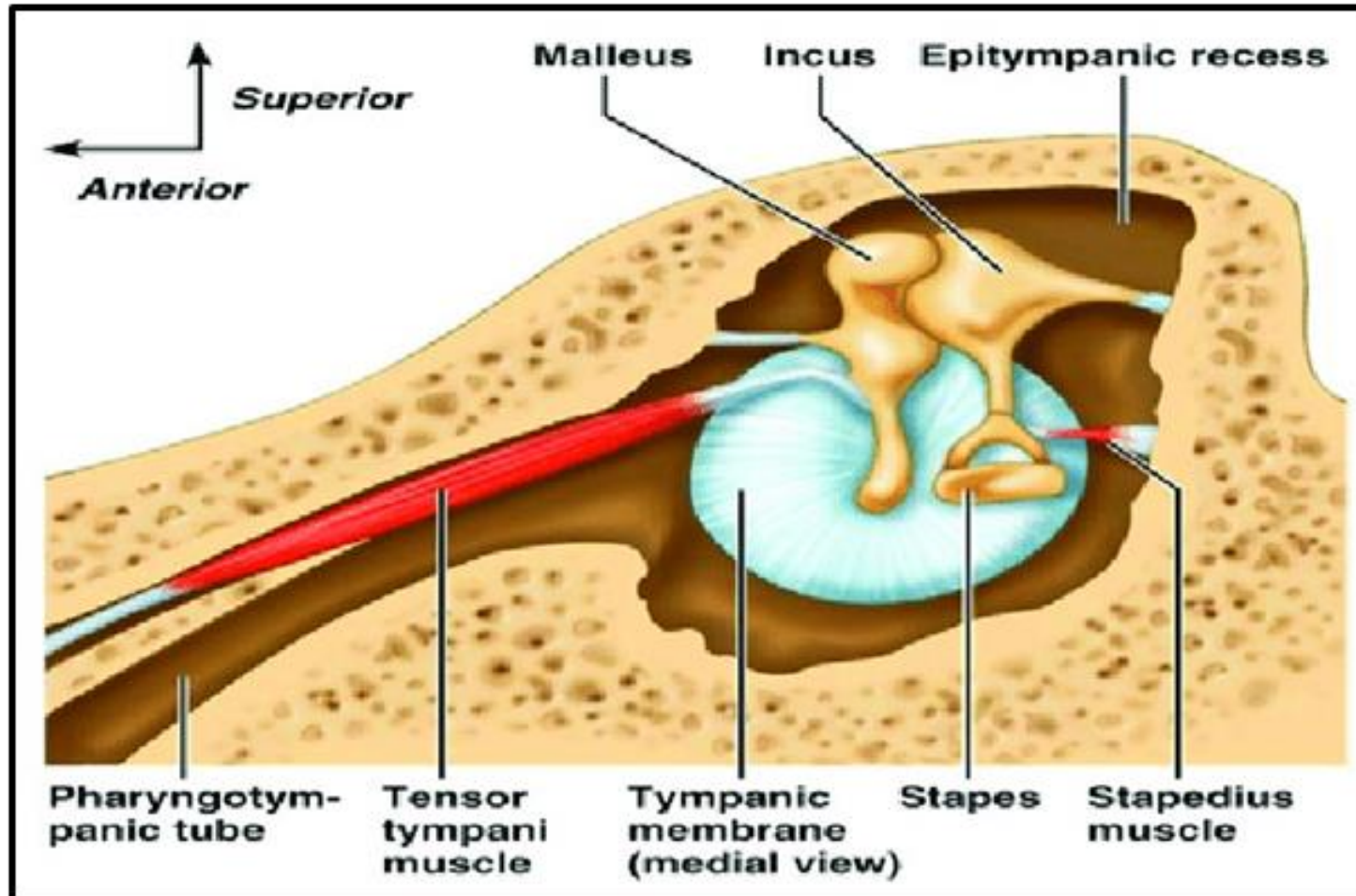
**present between malleus and stapes.**
  3. **Stapes:**

**Its foot closes the oval window.**



# The muscles

1. **Tensor tympani** (attached to malleus).
2. **Stapedius** (attached to stapes).



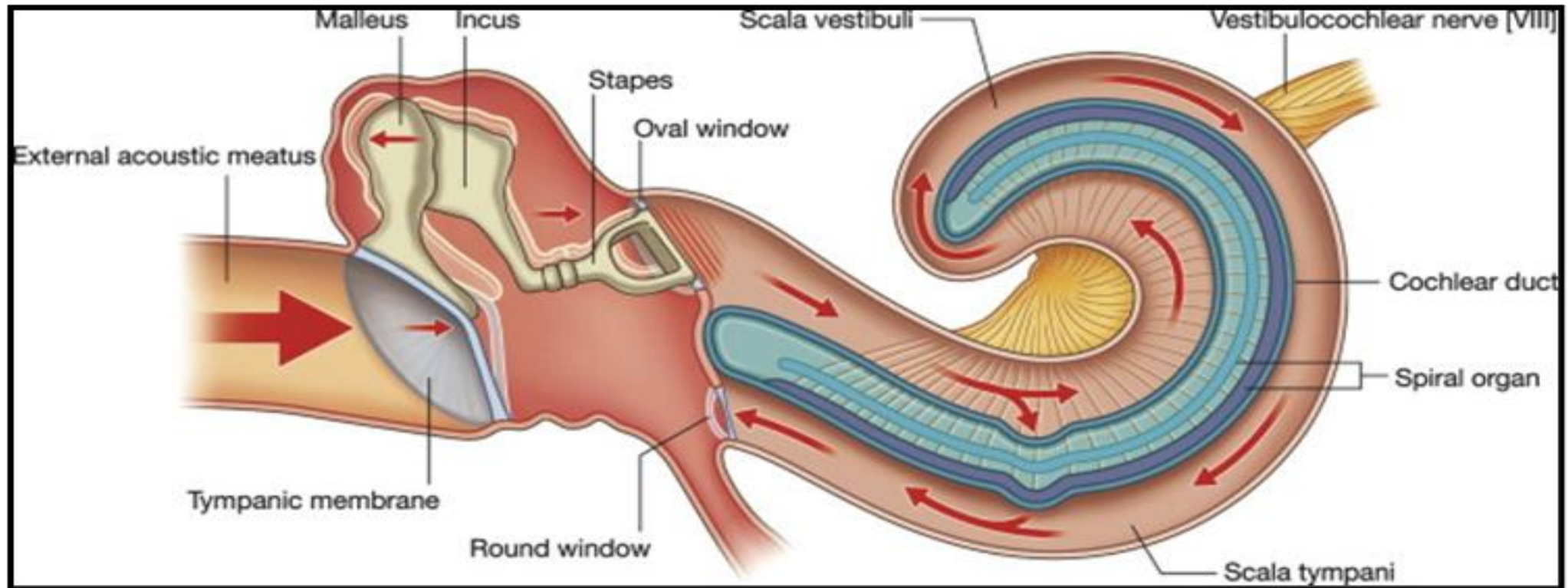
# The windows

## 1. Oval window:

- Closed by annular ligament which is attached to the foot of stapes.

## 2. Round window:

- Closed by elastic membrane (2ry tympanic membrane).





# MCQ Time

**Which of the following ossicles closes the oval window:**

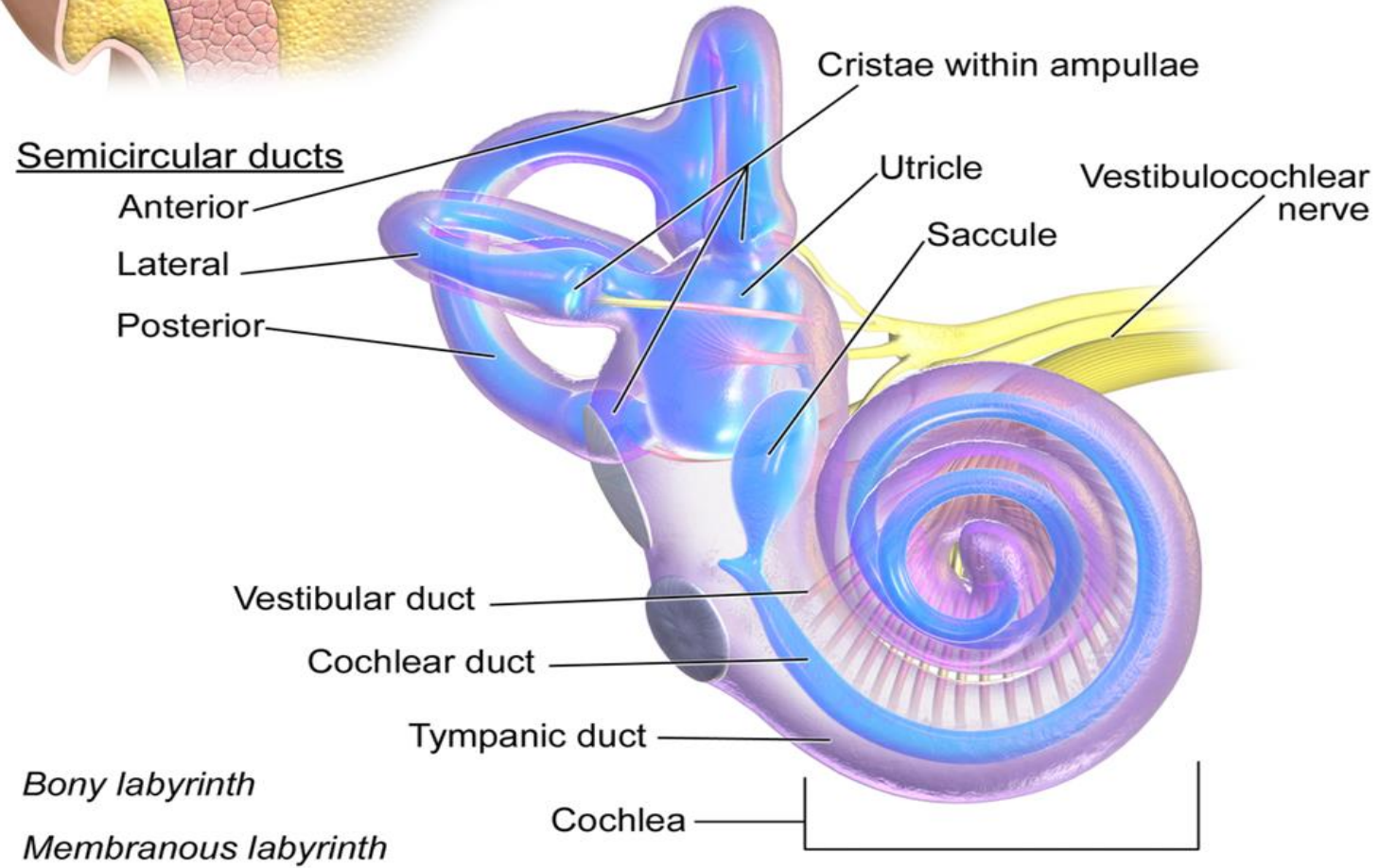
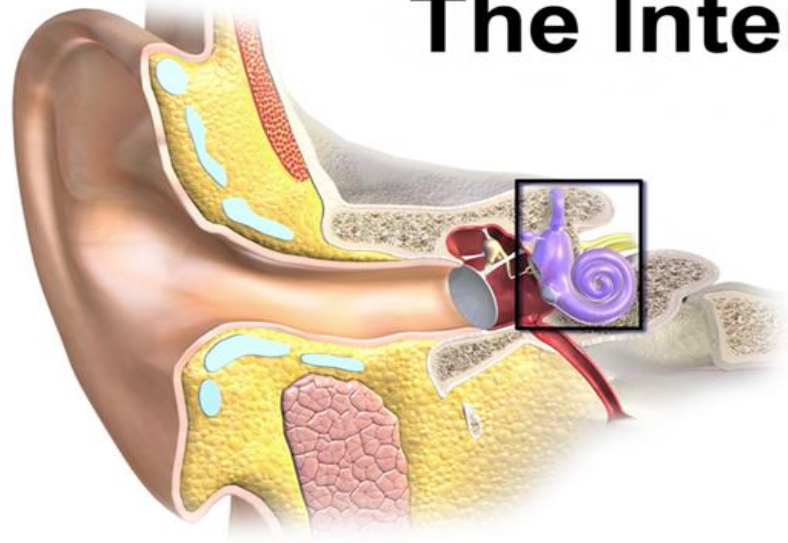
- A. Malleus**
- B. Incus**
- C. Stapes**



**The middle ear is lined with:**

- A. Simple squamous epithelium**
- B. Simple cubical epithelium**
- C. Stratified squamous epithelium**

# The Internal Ear

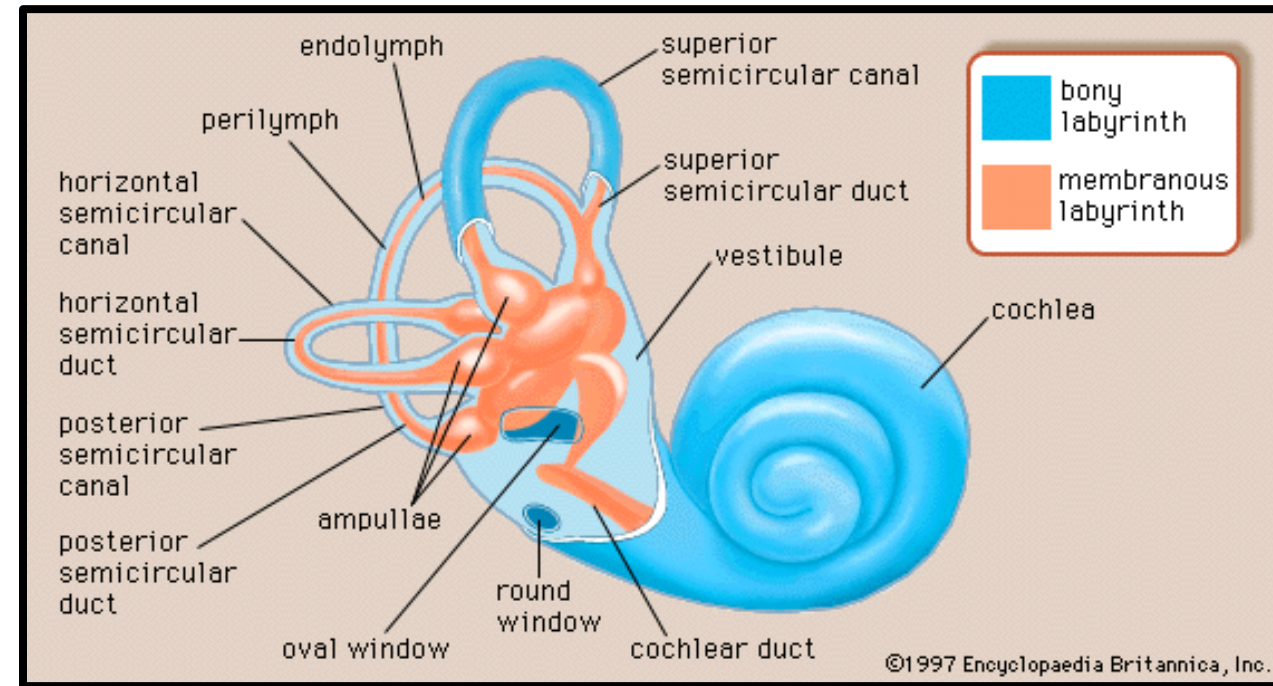


# The inner ear

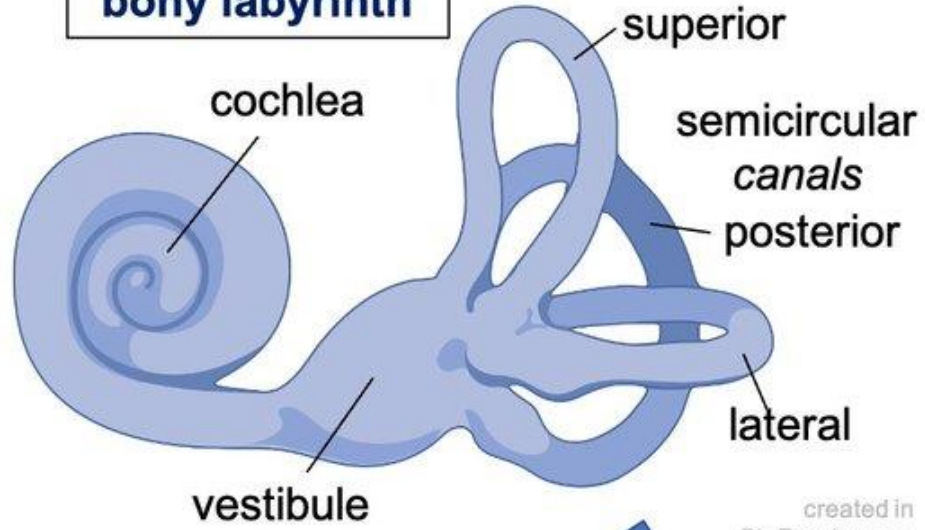
It is formed of:

## 1. The membranous labyrinth:

- Contains the receptors of hearing and equilibrium (neuro-epithelial structures).
- Filled with the endolymph ( $\uparrow K$  &  $\downarrow Na$ ).
- Present inside the bony labyrinth.

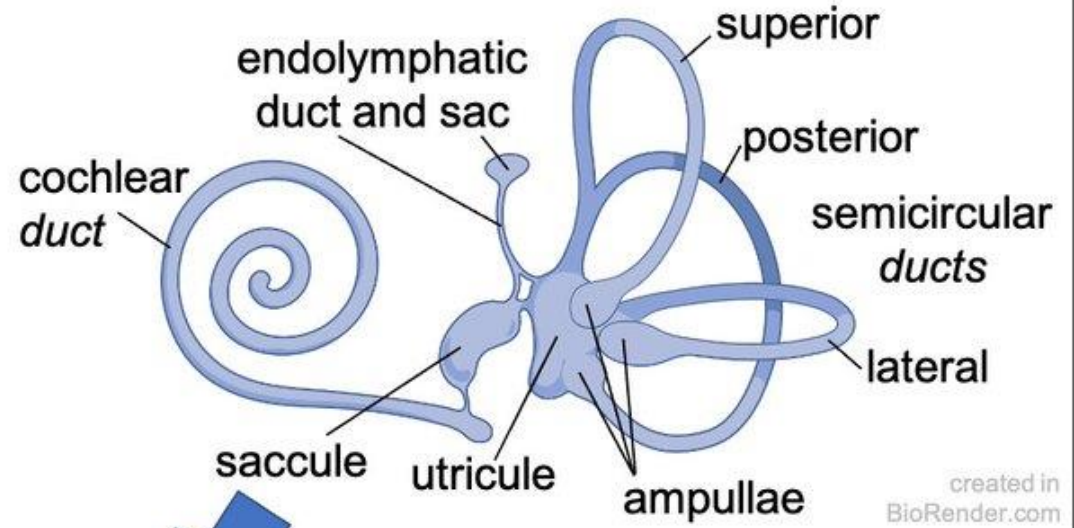


### bony labyrinth

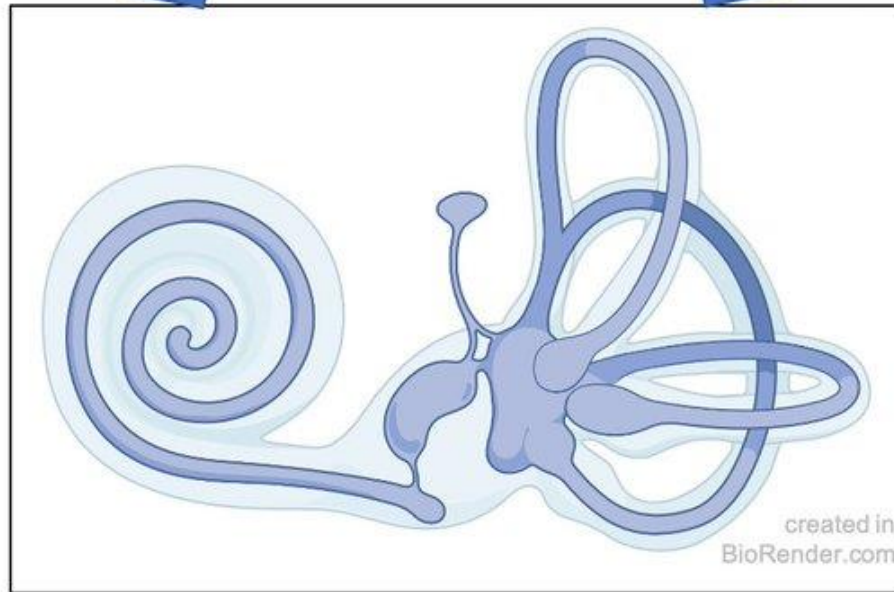


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### membranous labyrinth



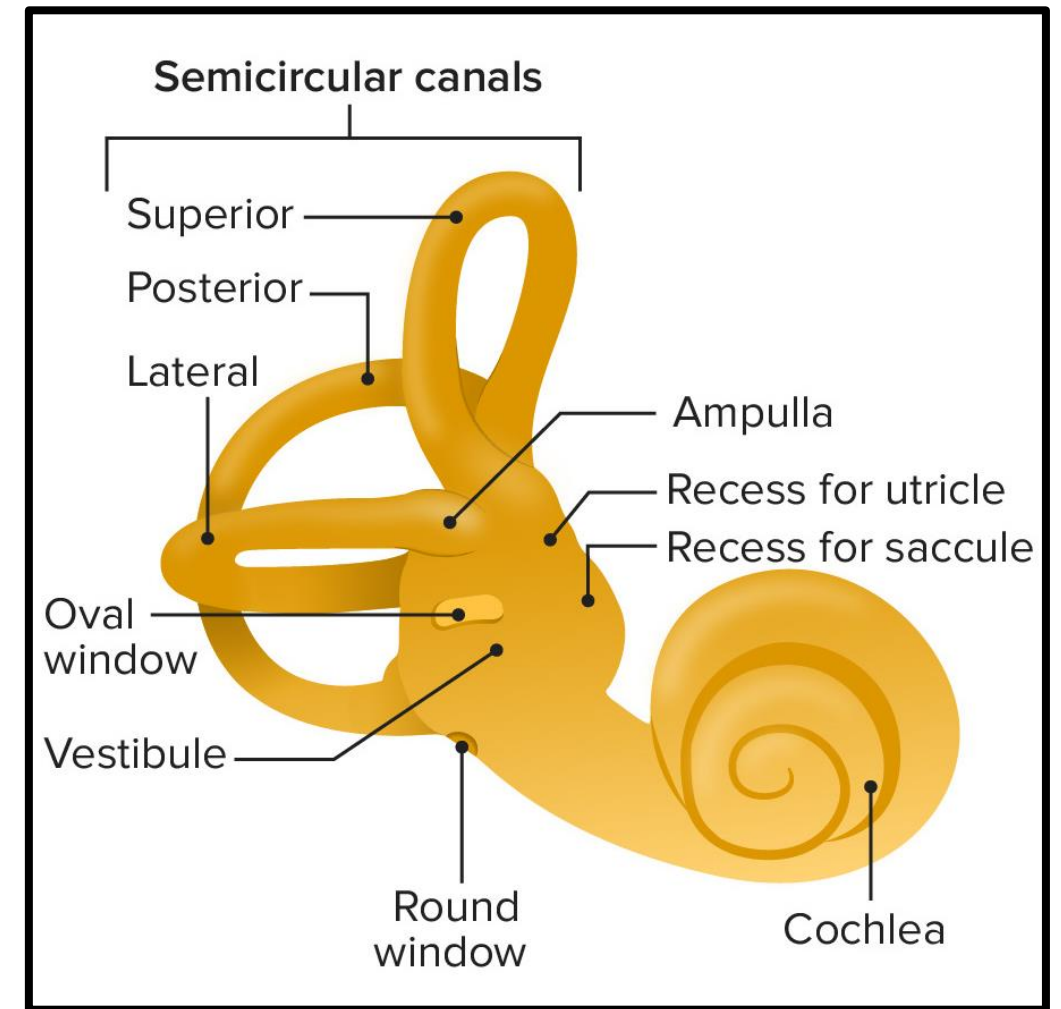
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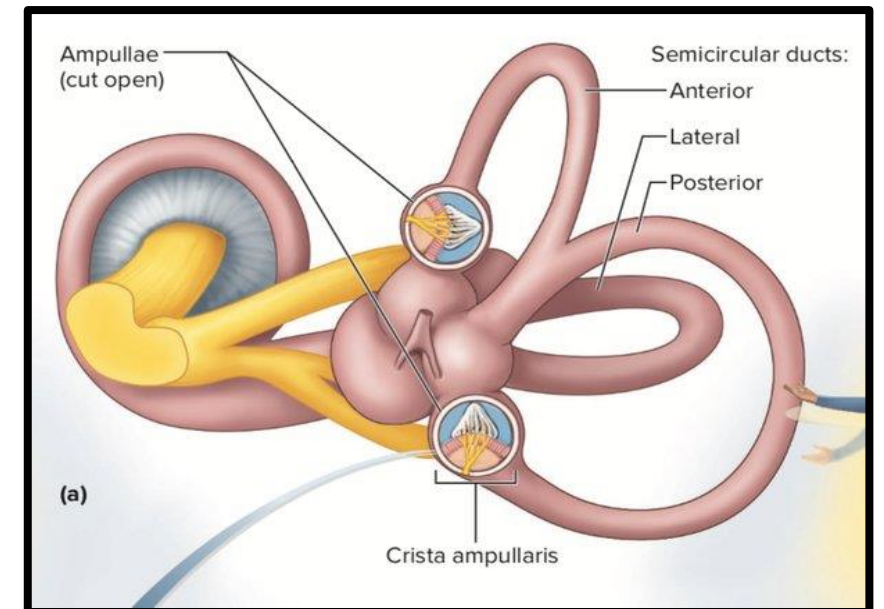
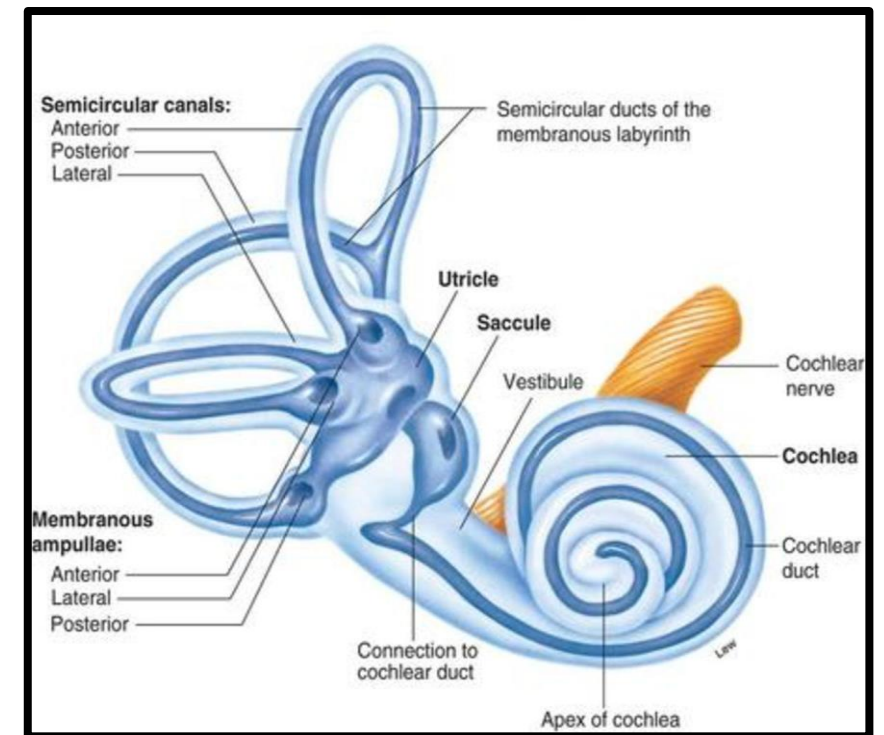
## 2. The bony labyrinth:

- **Consists of bony spaces and cavities in the petrous part of the temporal bone in which membranous labyrinth is present.**
- **Filled with perilymph ( $\uparrow$ Na).**
- **Consists of:**
  - **The semicircular canals.**
  - **The vestibule.**
  - **The cochlea.**



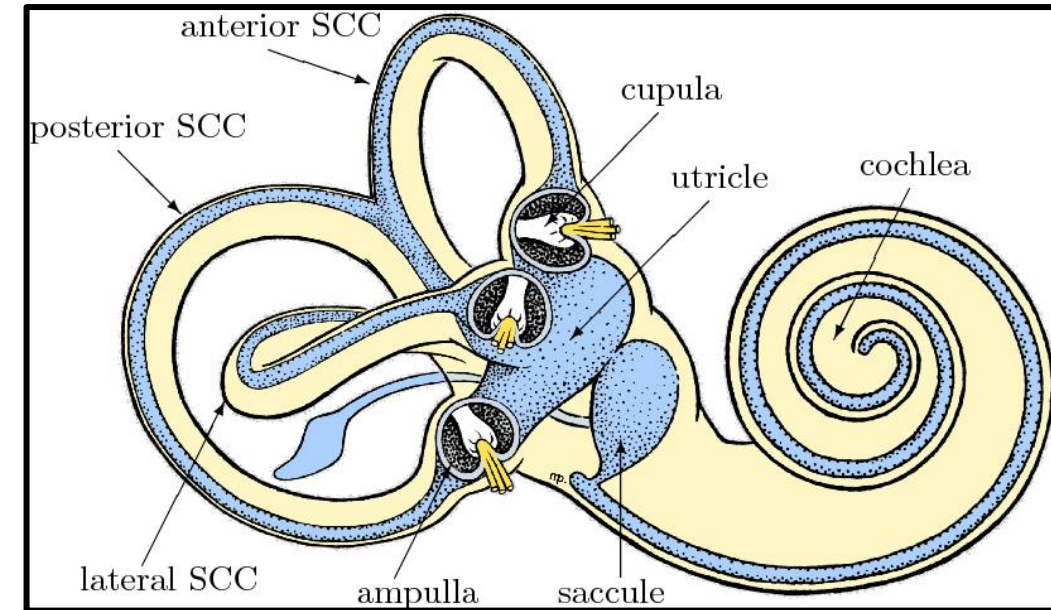
# Semicircular canals

- **3 bony semi-circular canals arranged in 3 different planes at right angles to each other.**
- **Each bony semicircular canal contains a membranous canal which is filled with endolymph.**
- **Each membranous semicircular canal has an expanded end called **crista ampullaris** which regulate the body position in relation to the movements of the head.**



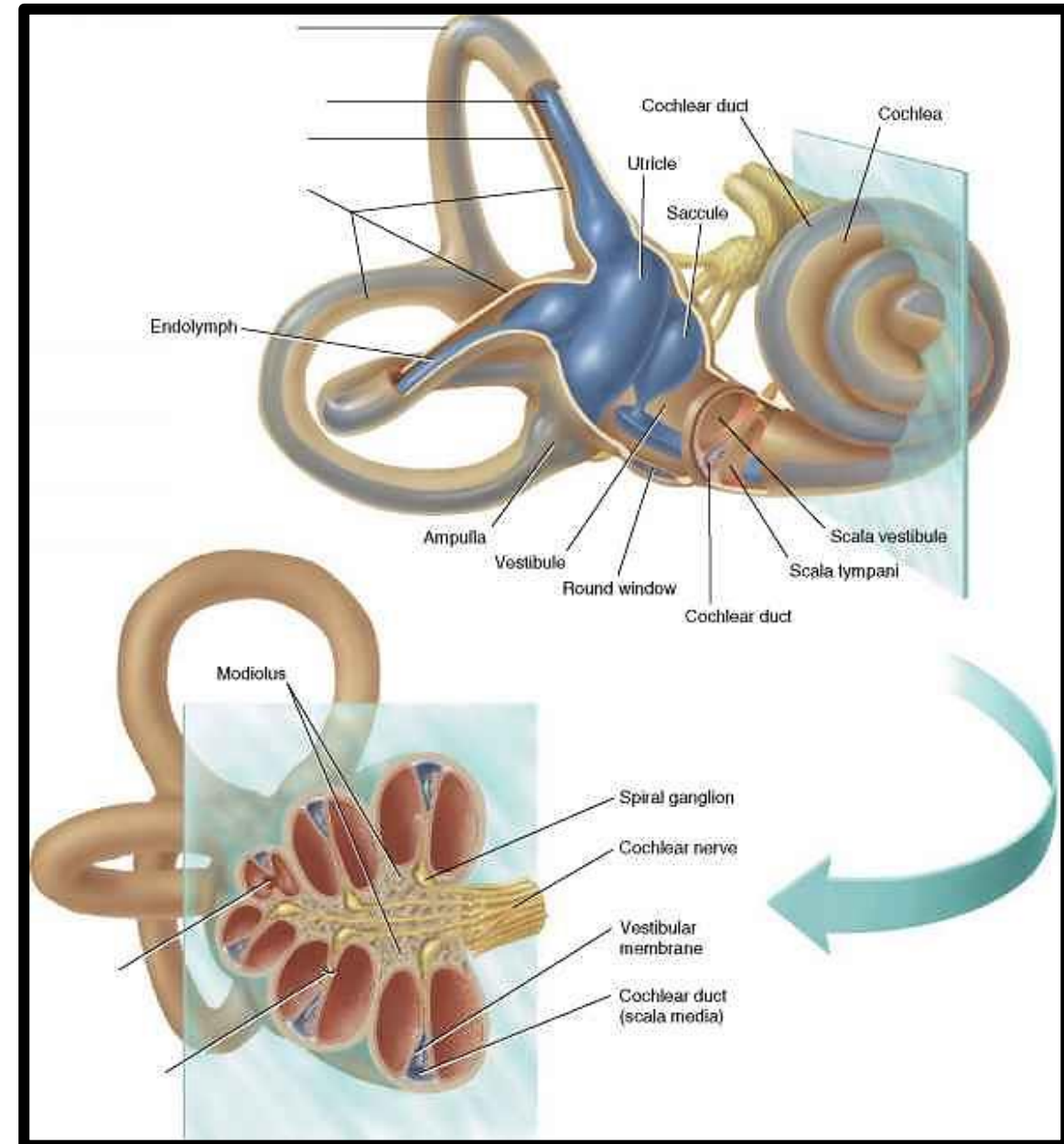
# The Vestibule

- It contains 2 membranous structures: **utricle** and **saccul**.
- The utricle and the saccul are filled with endo-lymph.
- Each of the utricle and the saccul contains a neuro-epithelial structure: **macula utriculi** and **macula sacculi** respectively.
- The function of the maculae: maintain the body equilibrium in relation to gravity.



# The cochlea

- It is a hollow bony spiral tubule that turns upon itself **2½** turns around a central bony axis called the modiolus.
- In section; it appears as **5 cavities** because the **2 complete** turns are cut **twice**.

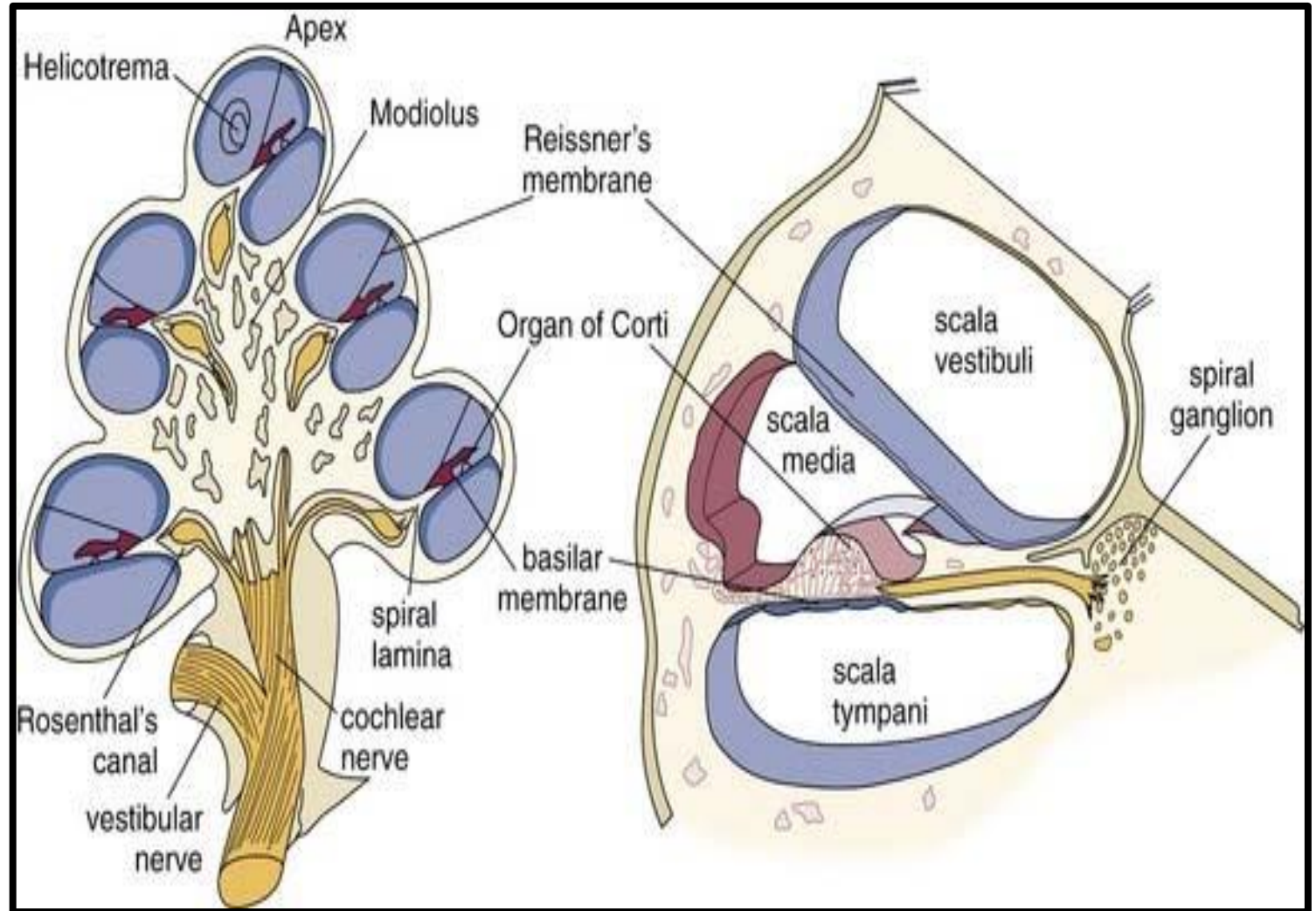


- The cochlea is divided by basilar and vestibular membranes into three compartments:

- The scala **vestibuli**.

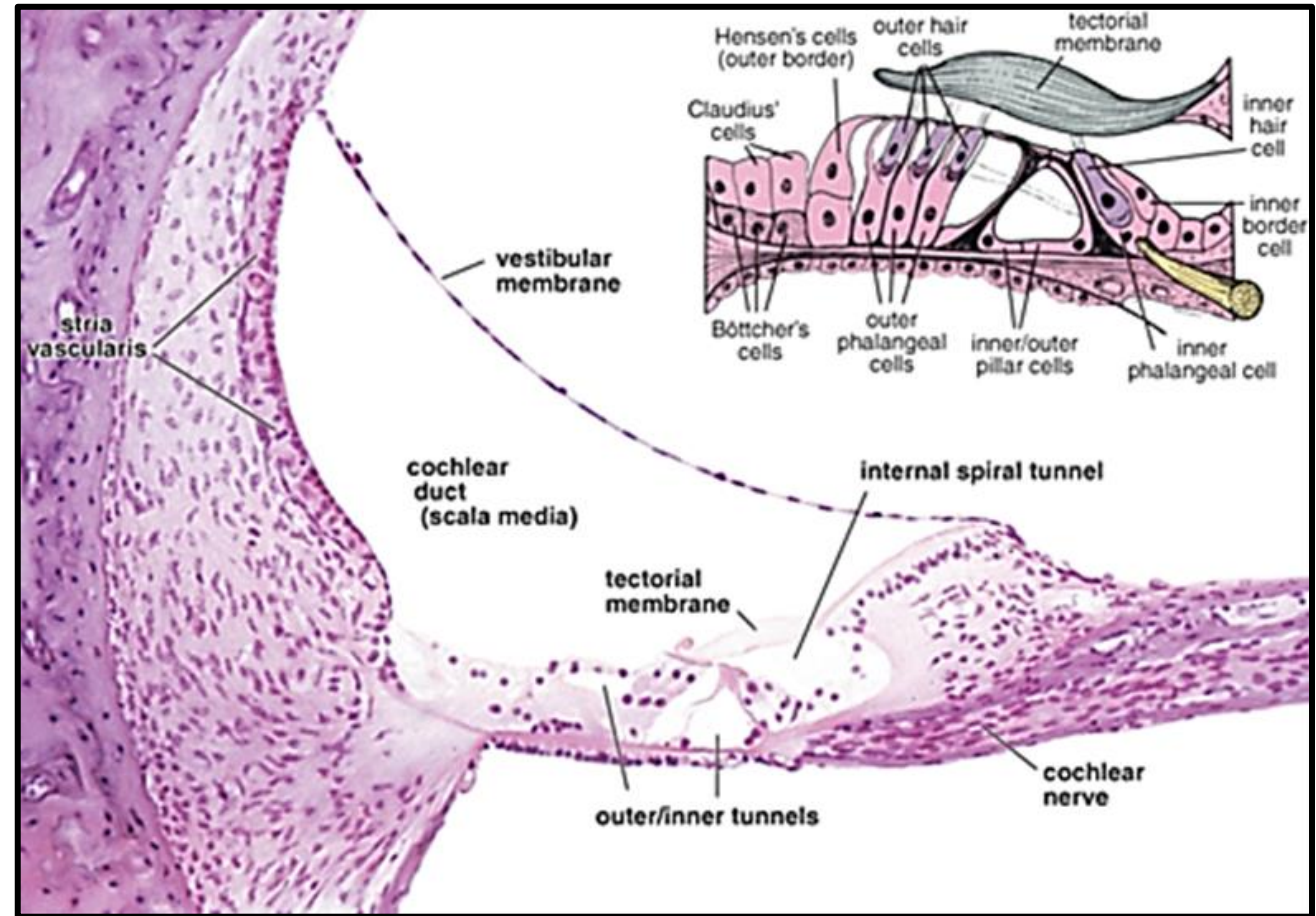
- The cochlear duct  
(Scala **media**)

- The scala **tympani**.



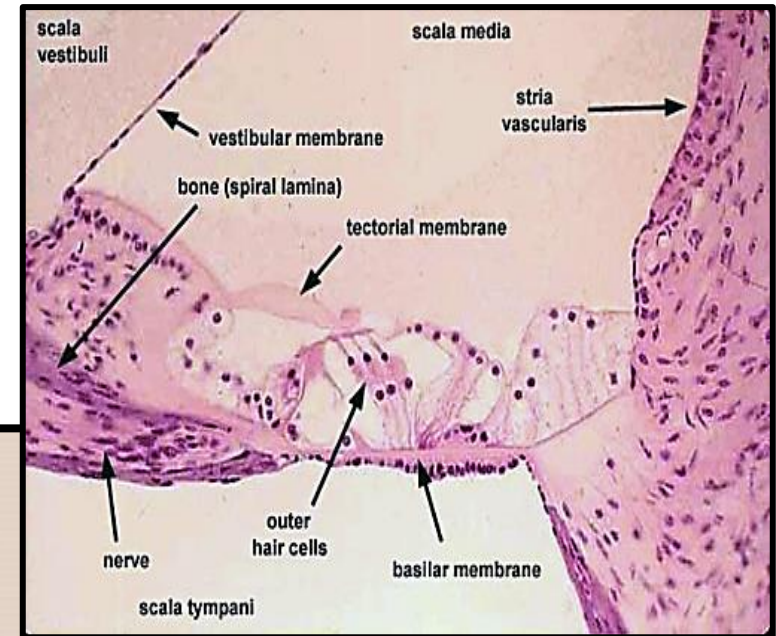
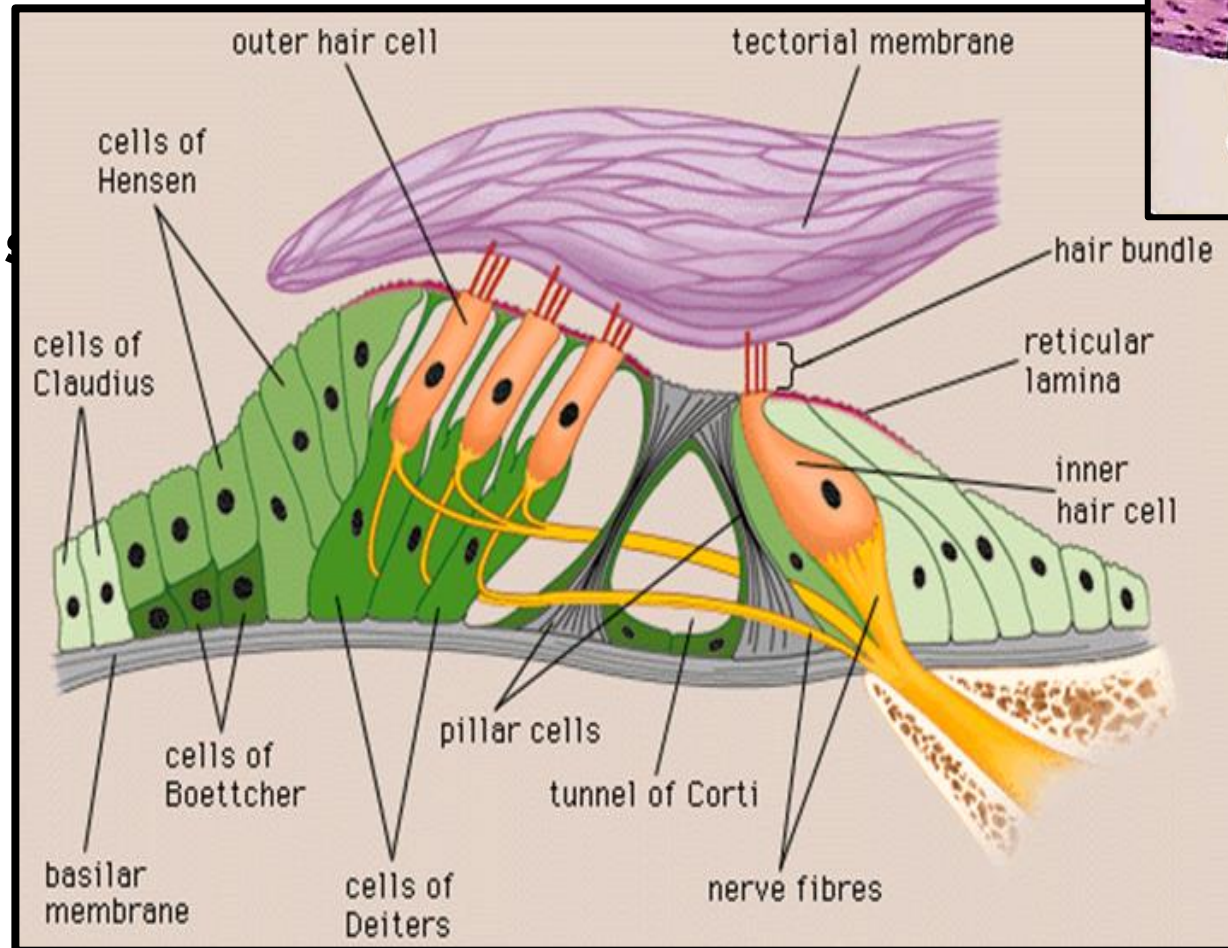
# The cochlear duct

- **Triangular** in cross section
- **Boundaries:**
  - **Vestibular membrane**
  - **Basilar membrane**
  - **Stria vascularis**
- **Contents:**
  - **Endolymph**
  - **Organ of Corti**



# Organ of Corti

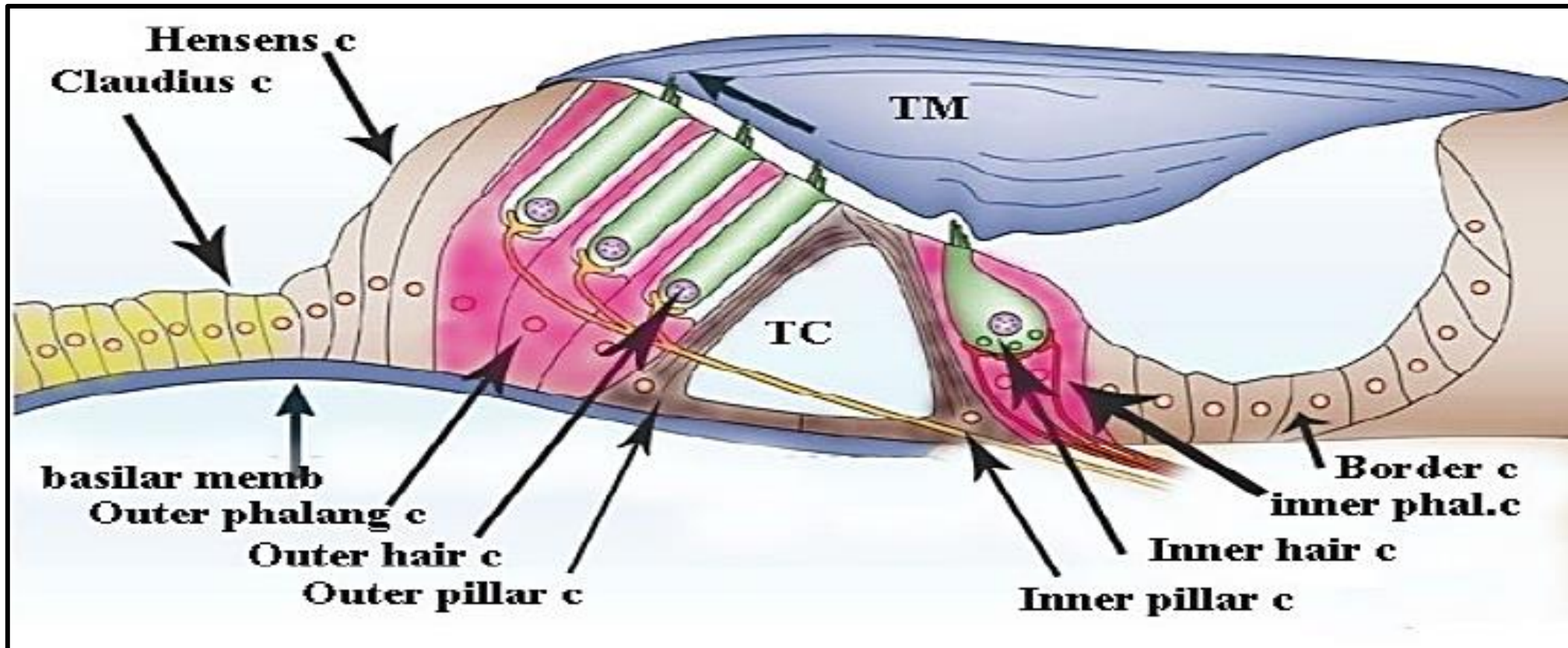
- It is a neuro-epithelial structure present in the cochlear duct on the upper surface of basilar membrane.
- It is formed of:
  - Supporting cells
  - Hair cells.



## A- The supporting cells:

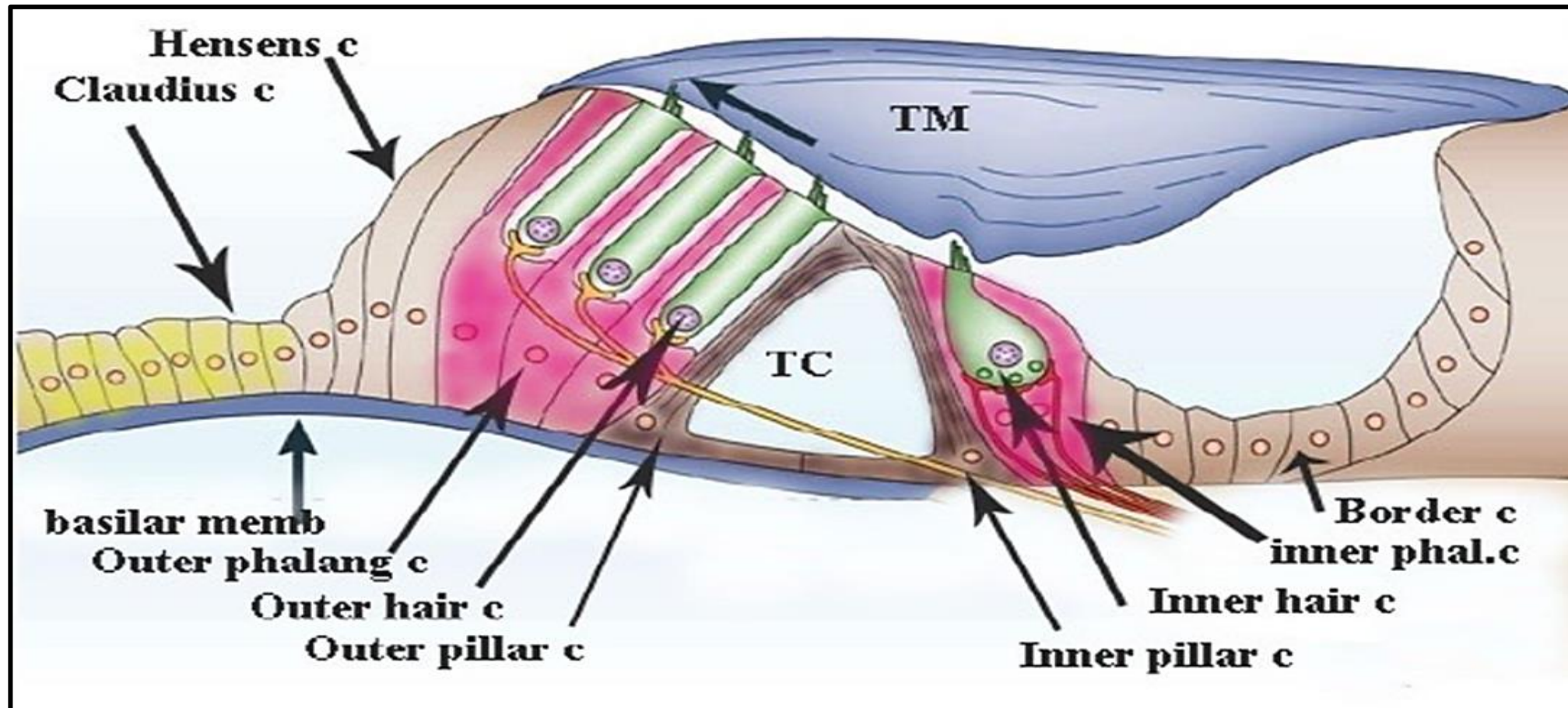
### 1. The inner and outer pillar cells:

- Pillar cells form with the basilar membrane a triangular space called the tunnel of Corti.



## 2. The inner and outer phalangeal cells:

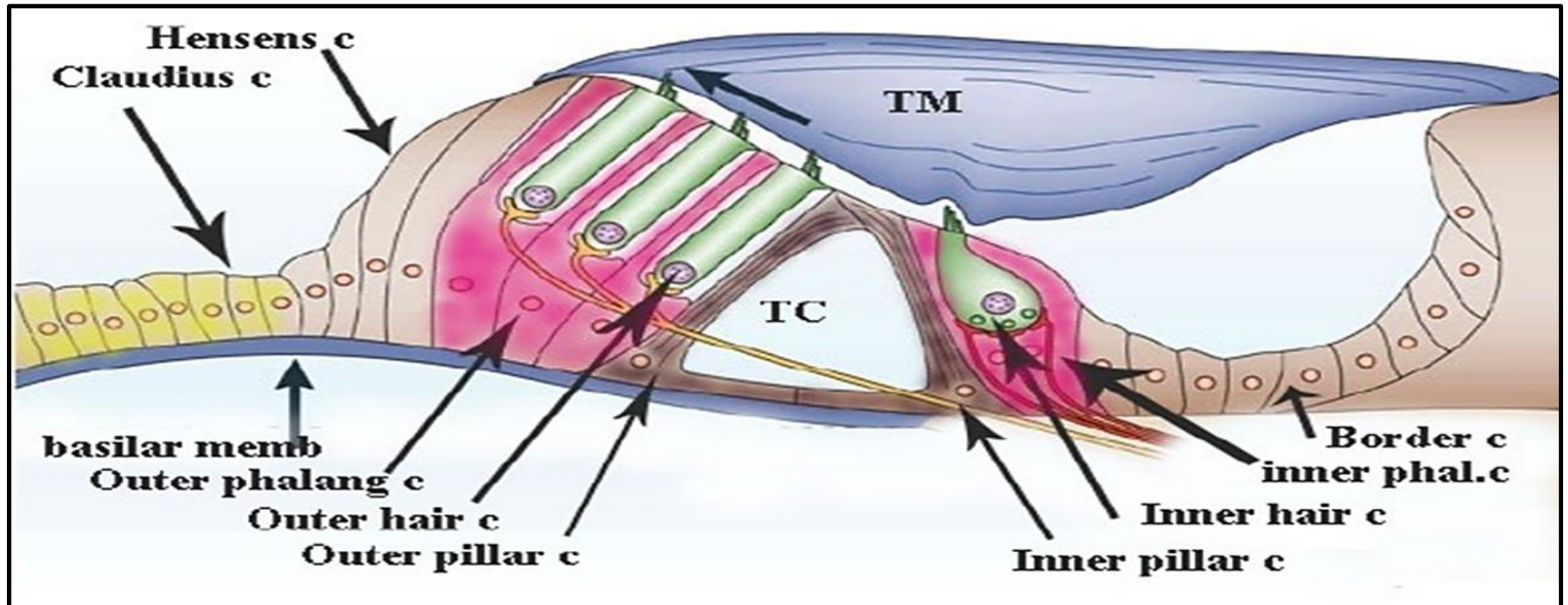
- They support the hair cells. The inner phalangeal cells are arranged in one row while the outer ones are arranged in 3-5 rows.



### 3. Cells of Claudius

### 4. The Hensen's cells

### 5. The border cells



## B- The hair cells:

### 1. The inner hair cells:

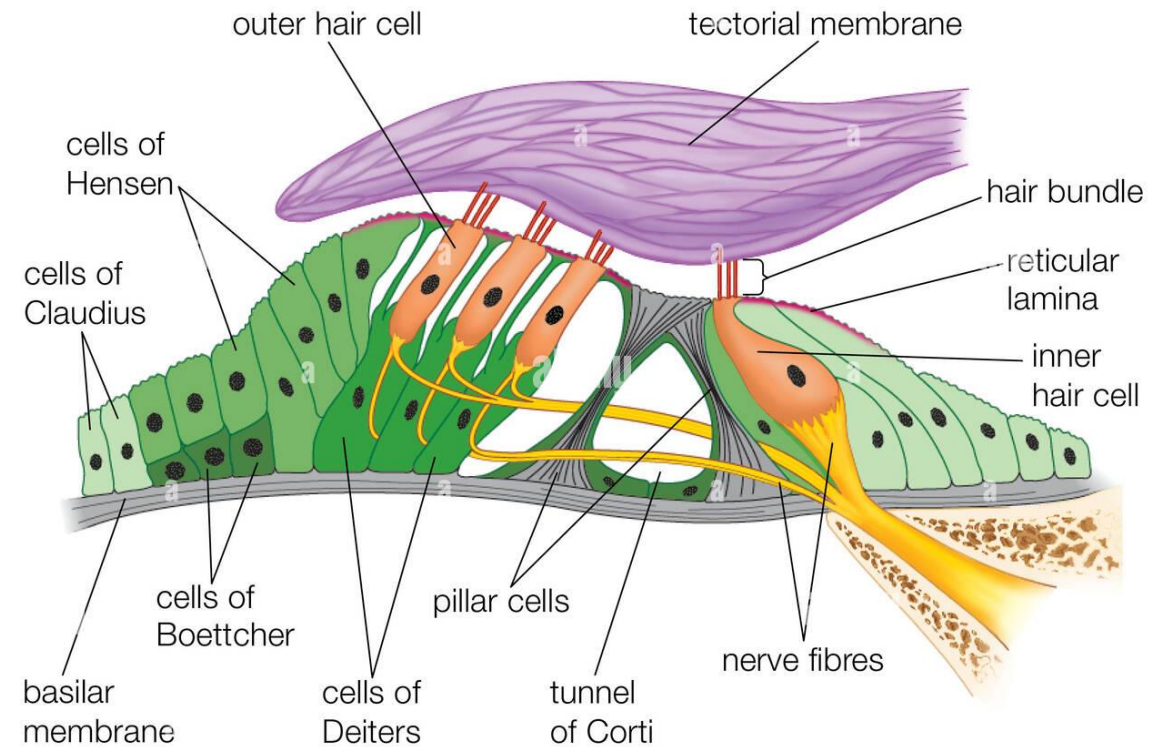
arranged in one row lying on the inner phalangeal cells.

### 2. The outer hair cells:

- arranged in 3-5 rows lying on the outer phalangeal cells.

- The **free surface** of each hair cell is provided with stereocilia (non-motile cilia).

- The **basal part** of each cell is surrounded by the terminal ends of the dendrites of the bipolar nerve cells of the spiral ganglia.





# MCQ Time

**The outer hair cells of the organ of coti arranged in:**

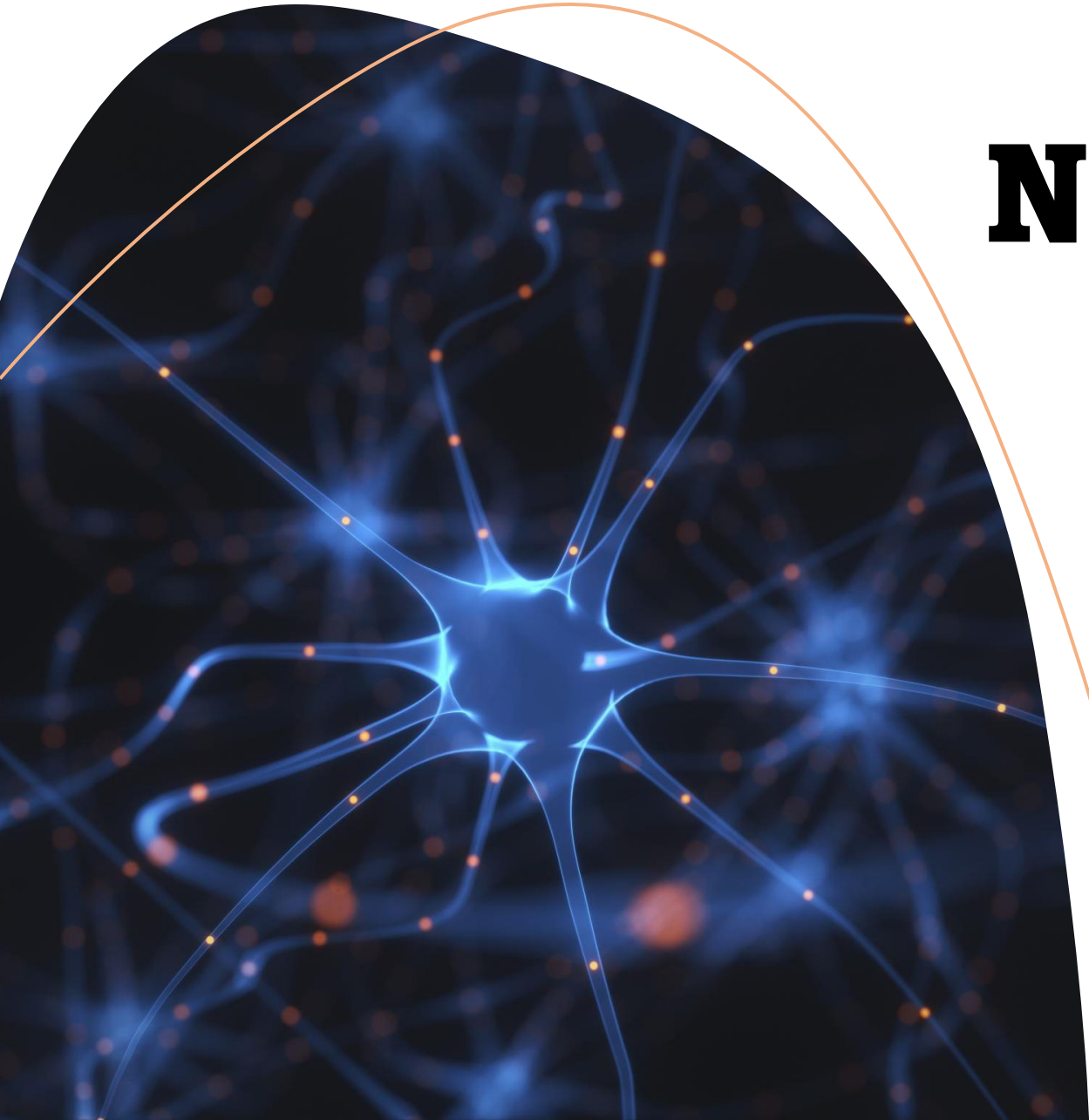
- A. 1 row**
- B. 3-5 rows**
- C. 8 rows**

**The cochlear duct doesn't contain:**

- A. Endolymph**
- B. Perilymph**
- C. Organ of corti**



# NERVE ENDINGS



# Nerve Endings

## Receptors

**Special sense:** Retina, organ of corti, olfactory epithelium & taste buds.

**Cutaneous sensation:** Free nerve endings, Merkel's, Meissner's, Ruffini & Krause end bulbs.

**Deep sensation:** Pacinian corpuscle, muscle spindle, tendon spindles & joint receptors.

**Visceral sensation:** Via the autonomic nervous system.

## Effectors

**Motor end plate:** motor to striated muscles.

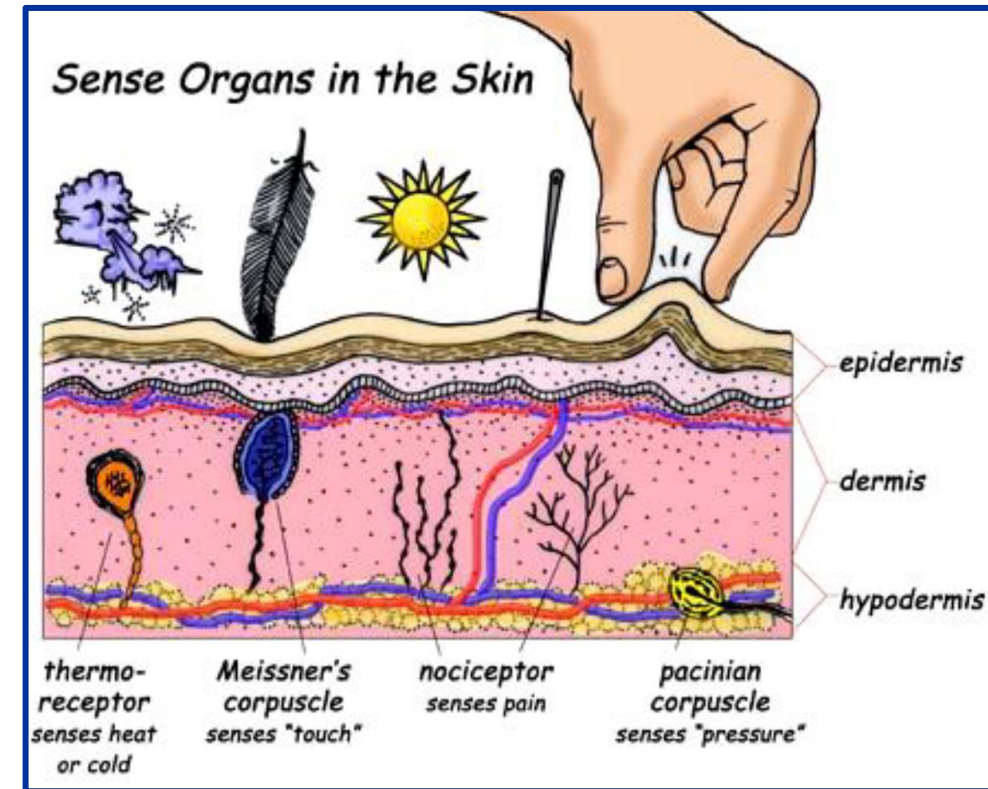
**Autonomic motor endings:** motor to smooth muscle fibers & myoepithelial cells.

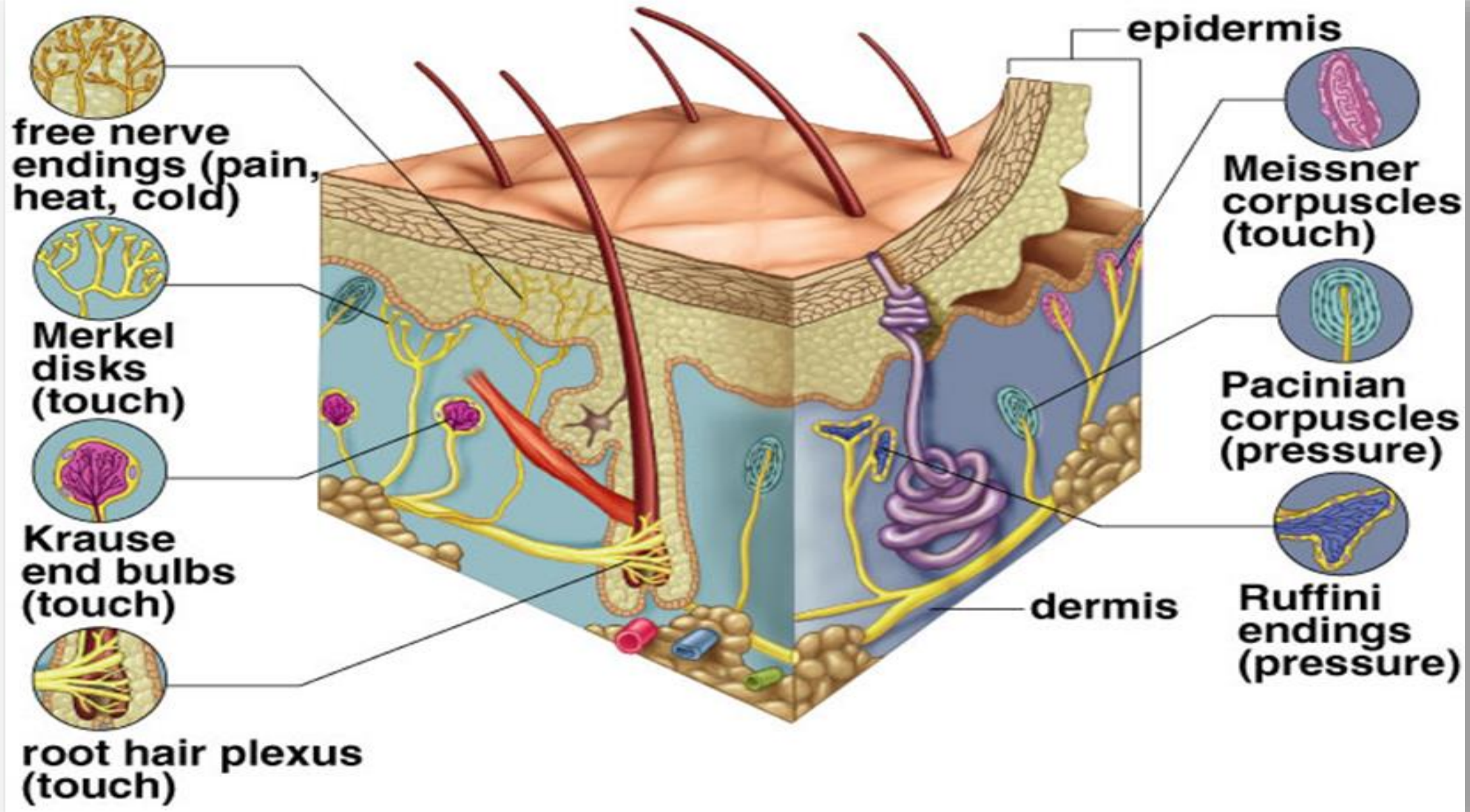
**Autonomic secretory endings:** secretory to epithelial secretory cells.

# Receptors for cutaneous sensation (Extroceptors)

React to stimuli from the external environment as :

1. **Pain** (nocireceptors) → Free nerve endings.
2. **Temperature** (thermoreceptors) → Free nerve endings.
3. **Touch** (mechanoreceptors):
  - **Epidermal:** Merkel's complex and peritrichial free nerve endings.
  - **Dermal:**
    - i. **Papillary Layer** → Meissner's corpuscles.
    - ii. **Reticular Layer** → Pacinian, Ruffini corpuscles & Krause end bulbs.





# Touch (Mechanoreceptors) in dermis

## Meissner's corpuscle

### Site:

In dermal papillae  
Numerous in Fingers, soles

### Shape:

- Oval

### Capsule:

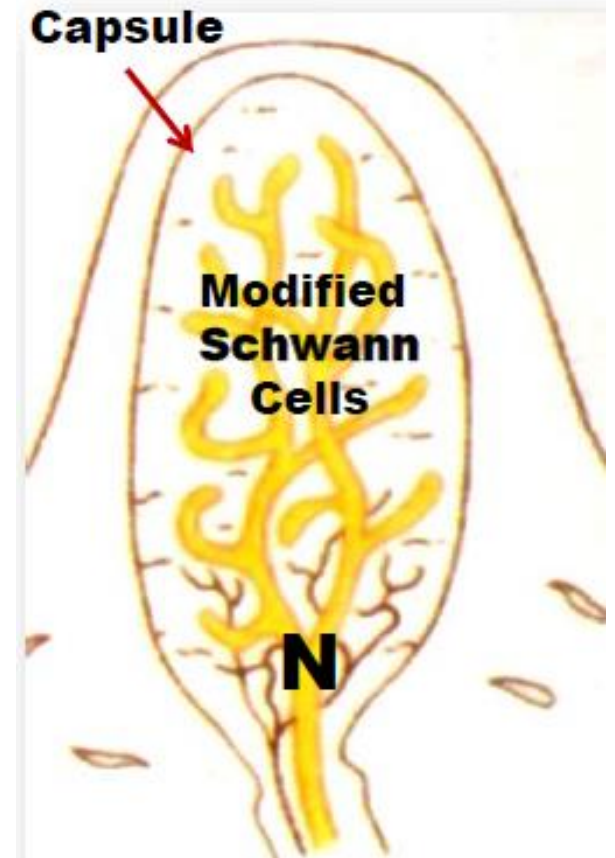
- Thick

### Axial core:

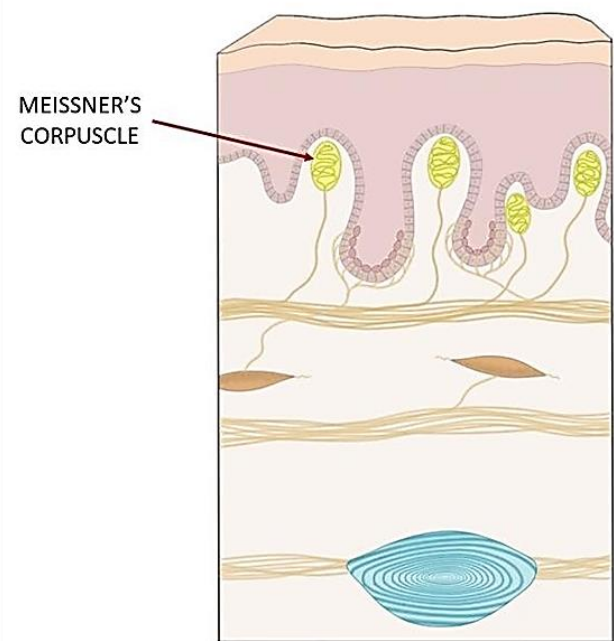
Transversally arranged **modified Schwann cells** and some intercellular collagenous fibers.

### Nerve fiber:

Myelinated, penetrates the corpuscle base giving **2 - 9** non myelinated spirally running branches that end between collagenous fibers.



# Meissner's corpuscle



A histological micrograph of skin tissue stained with hematoxylin and eosin (H&E). The image shows the epidermis and the underlying dermis. The epidermis is composed of several layers of cells. The stratum spinosum is the thick, middle layer, and the stratum basale is the deepest layer. A Meissner's corpuscle is visible in the dermis, appearing as a pale, oval structure. Labels include 'stratum spinosum' at the top, 'stratum basale' on the left and right, 'Meissner's corpuscle' with an arrow pointing to the central structure, and 'dermis' at the bottom right. A scale bar in the top right corner indicates 50 μm.

A micrograph showing the boundary between the epidermis and dermis. The epidermis is the upper, darker red layer, and the dermis is the lower, lighter red layer. A Meissner's corpuscle is clearly visible in the dermis, appearing as a pale, oval structure. Labels 'Epidermis' and 'Dermis' are present at the top and bottom of the image, respectively.

# Pacinian corpuscle

## Site:

- **Deep in the dermis and hypodermis: Numerous in Fingers.**
- **Sites subjected to pressure: inter muscular septa & joint capsules.**

## Shape:

**Oval**

## Capsule:

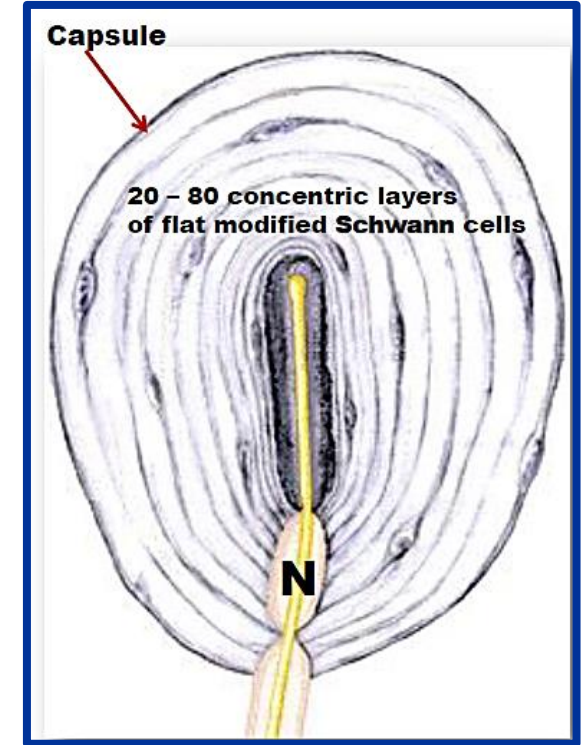
**Thin separated from the corpuscle by a subcapsular space**

## Axial core:

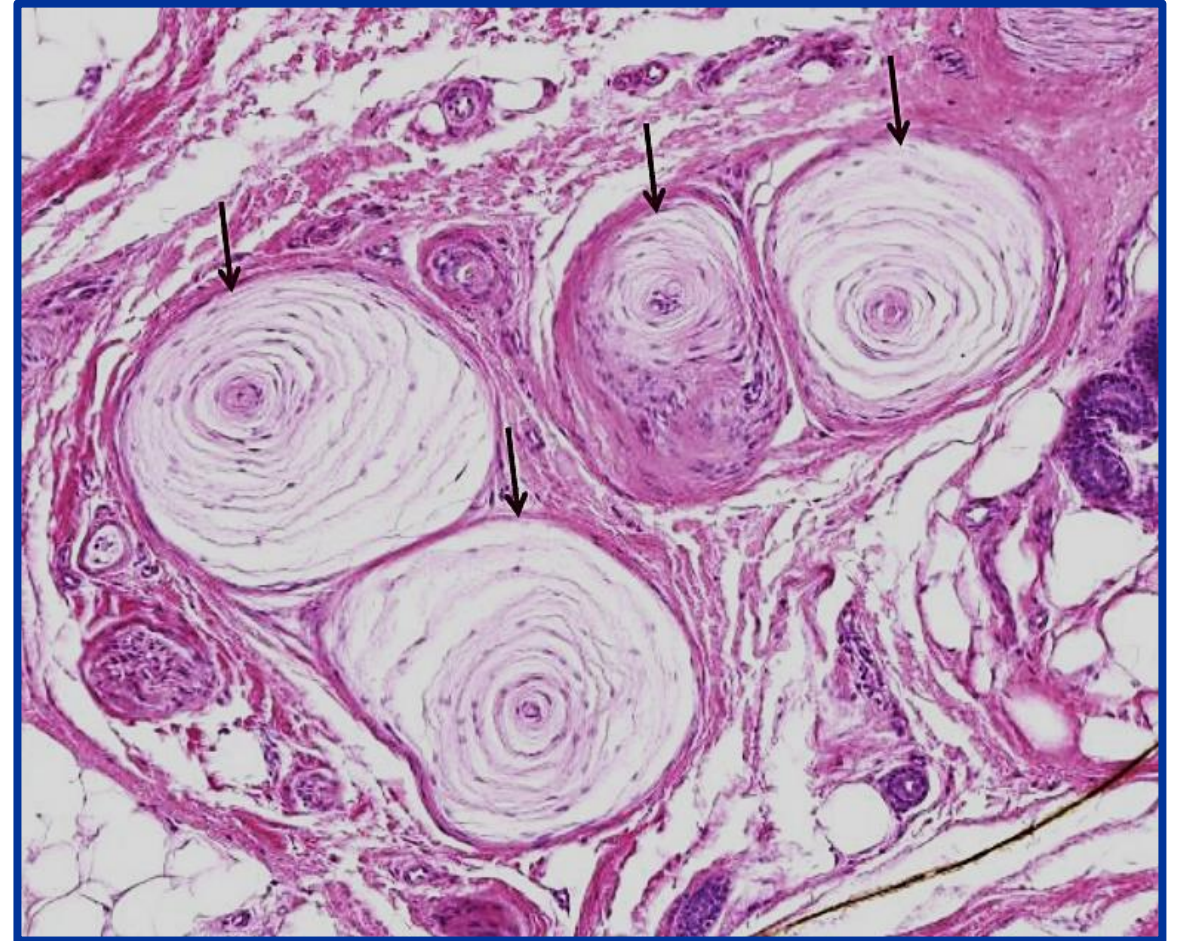
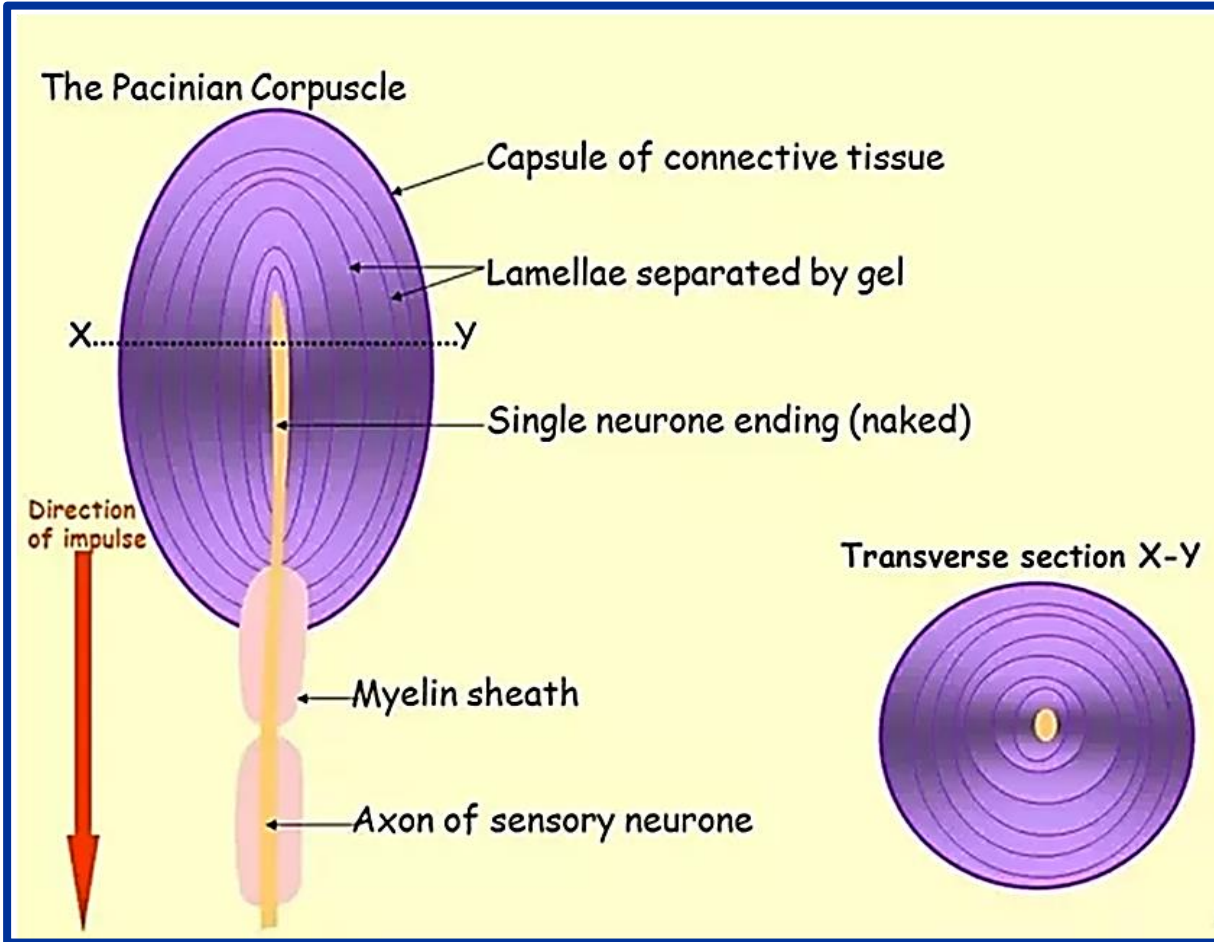
- **20 – 80 concentric layers of flat modified Schwann cells joined together by desmosomes and separated by intercellular spaces containing collagen fibers and tissue fluid.**
- **L.S: onion like appearance.**

## Nerve fiber:

**Myelinated, penetrates the corpuscle at one pole to become non myelinated, then run to the opposite pole to terminate by an expanded terminal**



# Pacinian corpuscle





# MCQ Time

## **Meissner's Corpuscles:**

- a. are found in dermal papillae.**
- b. are numerous in intermuscular septa.**
- c. Have no C.T. capsule.**
- d. Their long axis is parallel to skin surface.**
- e. are stretch receptors.**





# MCQ Time

## **Pacinian corpuscles are:**

- a. found at dermo-epidermal junction.**
- b. few in fingers & external genitalia.**
- c. supplied by 2-9 spiral nerve branches.**
- d. formed of modified Schwann cells & collagen.**
- e. thermoreceptors.**



# Muscle Spindle (Neuro-Muscular Spindle)

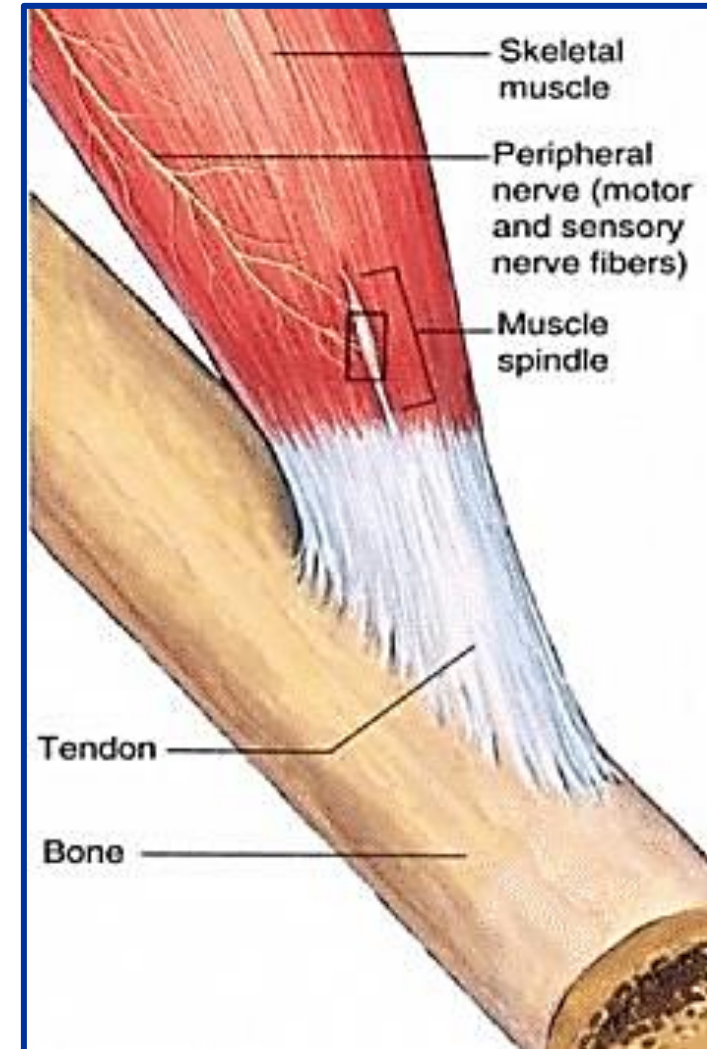
## Function:

- A stretch receptor for kinesthesia
- Reflex control of muscle tone, movement and posture.

## Site:

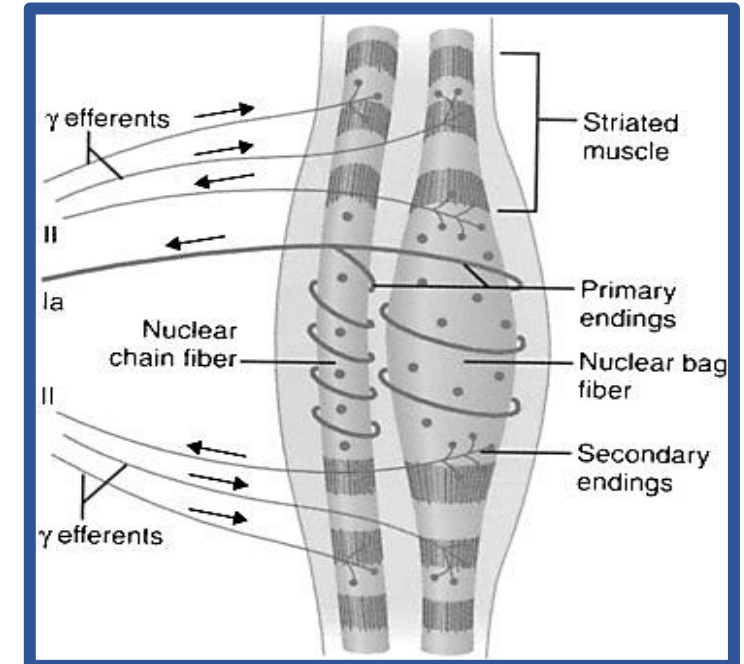
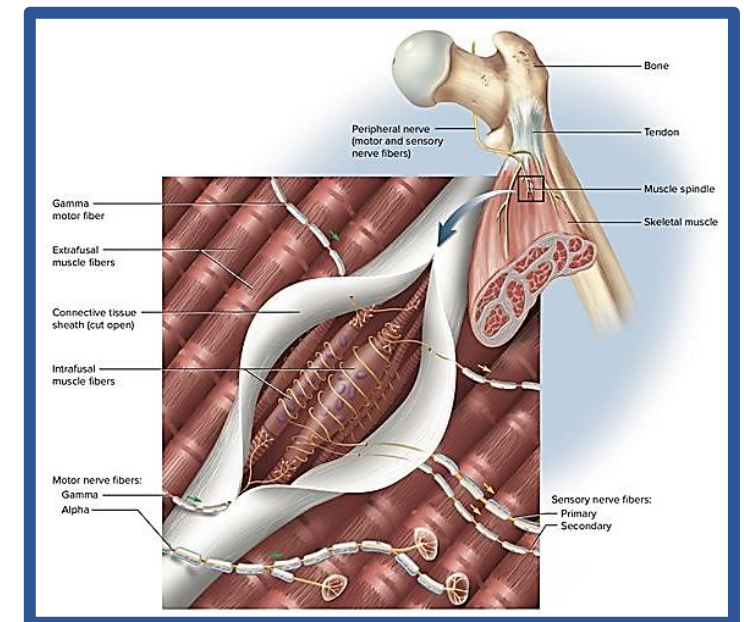
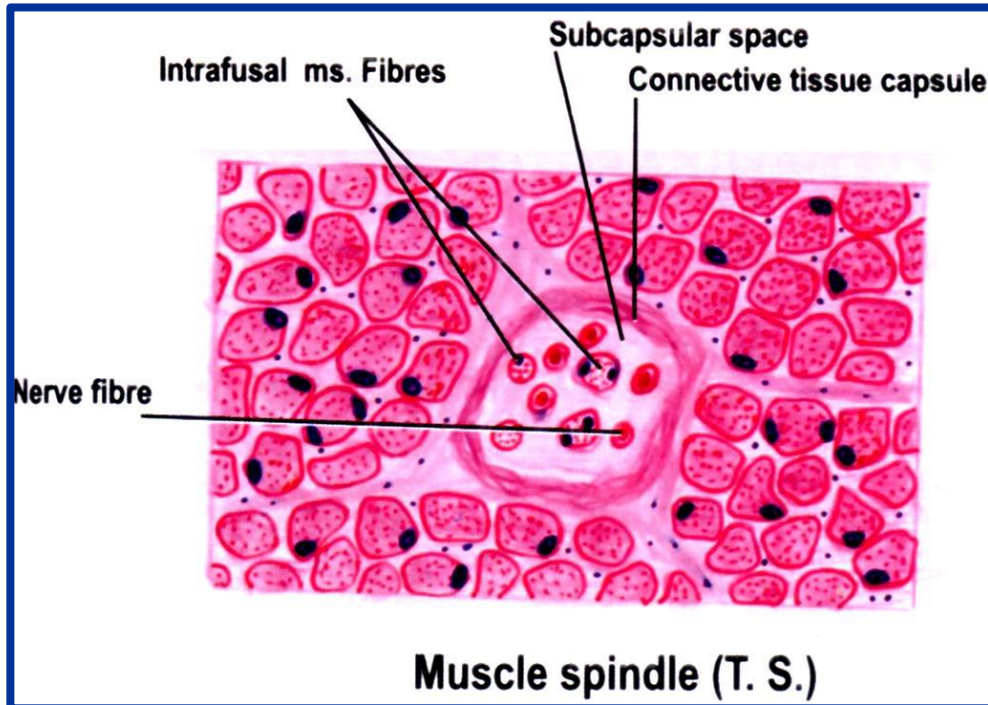
- 1) Between the striated muscle fibers specially near their insertion.
- 2) Numerous in small muscles doing fine work e.g. Hand muscles.

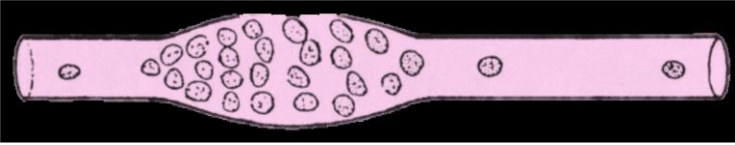

Shape: Fusiform.



# Structure:

- 1) **Capsule:** stretchable connective tissue.
- 2) **Intrafusal muscle fibers:** 2 – 12 bag and chain fibers bathed in tissue fluid. Each fiber is formed of a non-contractile central part and contractile two poles.



	<p><b>Nuclear bag fibers</b></p> 	<p><b>Nuclear chain fibers</b></p> 
<b>Size:</b>	<b>Thicker × longer</b>	<b>Thinner × shorter</b>
<b>No:</b>	<b>Fewer</b>	<b>Numerous</b>
<b>Central Part:</b>	<p>1) <b>Expanded</b></p> <p>2) <b>Contains a bag of nuclei.</b></p>	<p>1) <b>Not expanded</b></p> <p>2) <b>Contains a chain of nuclei</b></p>

Thank  
You!

