

اسم الله
الجليل



CNS REVISION

Dr. Dalia Eita

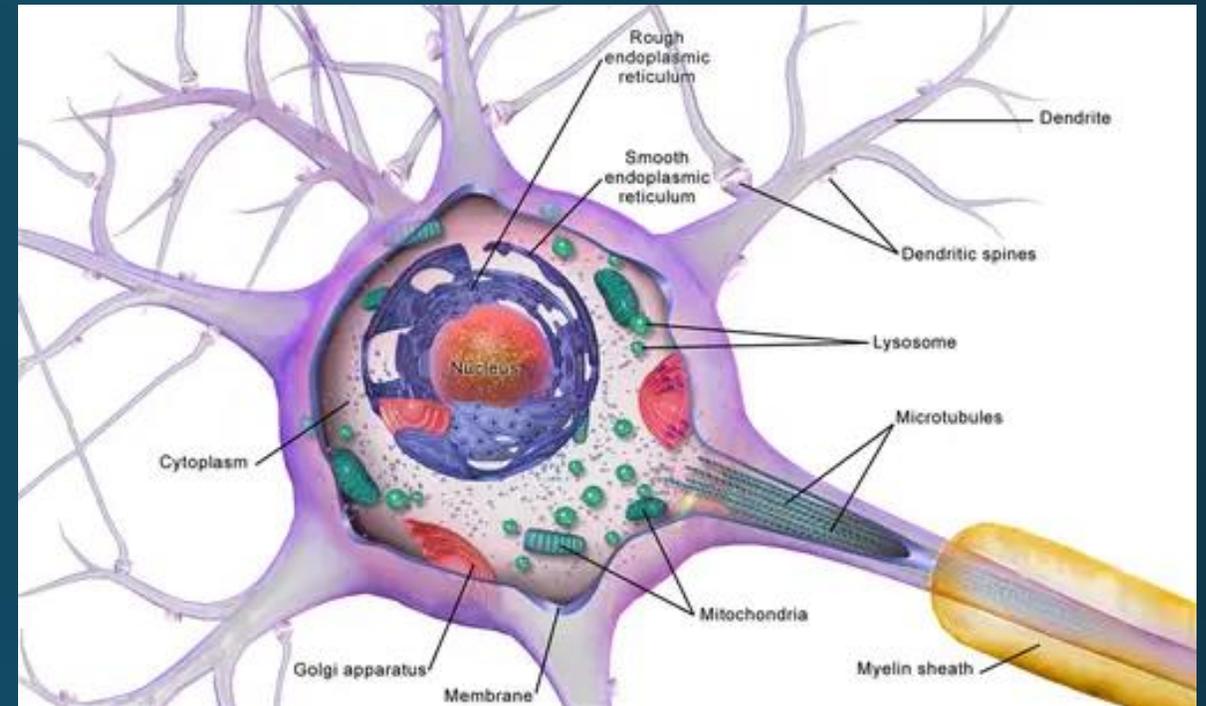


NERVOUS TISSUE

Dr. Dalia Eita

THE CELL BODY:

- **The Cell membrane:** very thin.
- **The nucleus:** Large, rounded, usually central and vesicular (open – face type) with a prominent nucleolus.
- **The cytoplasm:**
 - a. Organelles:
Nissl granules
Neurofibrils
Golgi apparatus
Mitochondria



b- Inclusions:

- **Melanin pigments:** e.g. cells of substantia nigra.
- **Lipofuscin pigments:** yellow pigments increase in old age.
- **Glycogen granules.**
- **Fat droplets.**



Nissl granules or bodies

LM:

Basophilic bodies or granules scattered in the cytoplasm.

Distribution:

All over the neuron **except** in:

- i. Periphery of the nerve cell.
- ii. Around the nucleus.
- iii. Axon.
- iv. Axon hillock .

Staining:

Nissl granules are known as “**chromophil substance**” as they like certain stains e.g. haematoxylin, toluidine blue.

EM:

Free and attached ribosomes

Function:

Synthesis of protein for nerve cells.

Neurofibrils

LM:

Thin fibrils or threads which cross one another in the cell body but run parallel in the axon and dendrites.

Distribution:

Scattered all over the neuron (cell body, dendrites and axon).

Staining:

Only with silver stain: black or deep brown.

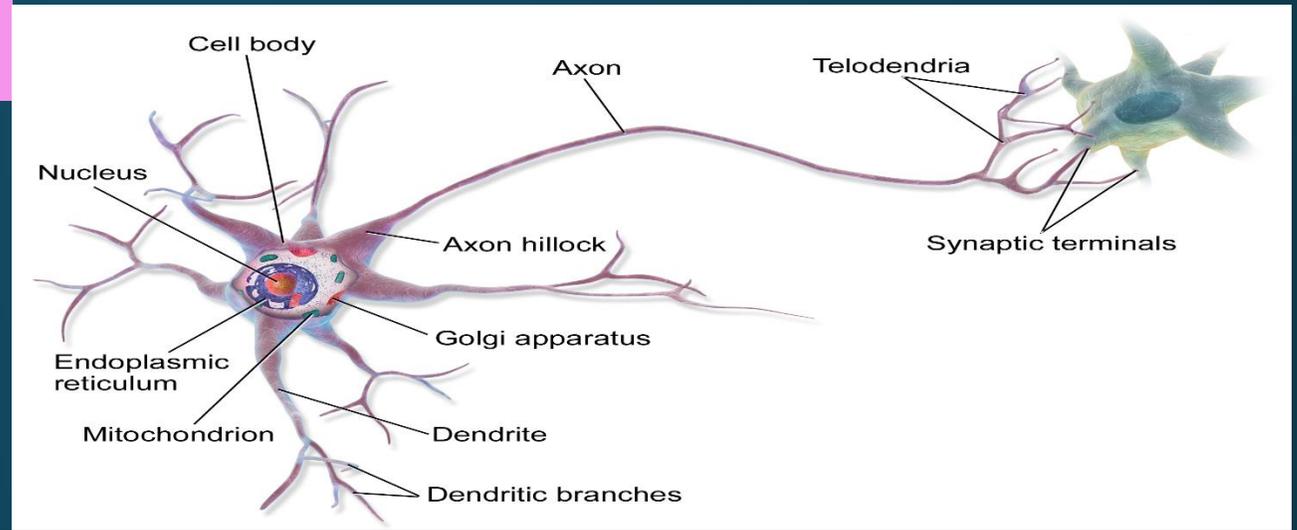
EM:

•fine neurofilaments, microfilaments and microtubules

Function:

- 1- Transmitters of nerve impulses.
- 2- Supporting elements i.e. maintenance of the shape of the nerve cells.

PROCESSES:



	The axon	The dendrites
Number:	Single.	Multiple.
Thickness and Length:	Thin & long.	Thick & short.
Diameter:	It has a constant diameter along its length.	Their diameter decrease gradually towards their ends i.e. tapering.
Content:	Contains mitochondria and neurofibrils only (no Nissl granules).	Contain neurofibrils and Nissl granules.
Conduction of nerve impulses:	It carries nerve impulses away <u>from</u> the cell body (<i>centrifugal conduction</i>)	They carry the impulses <u>to</u> the cell body (<i>Centripetal conduction</i>).

Classification of the neurons (nerve cells)

I) According to the number of processes (Polarity):

1- Unipolar nerve cells:

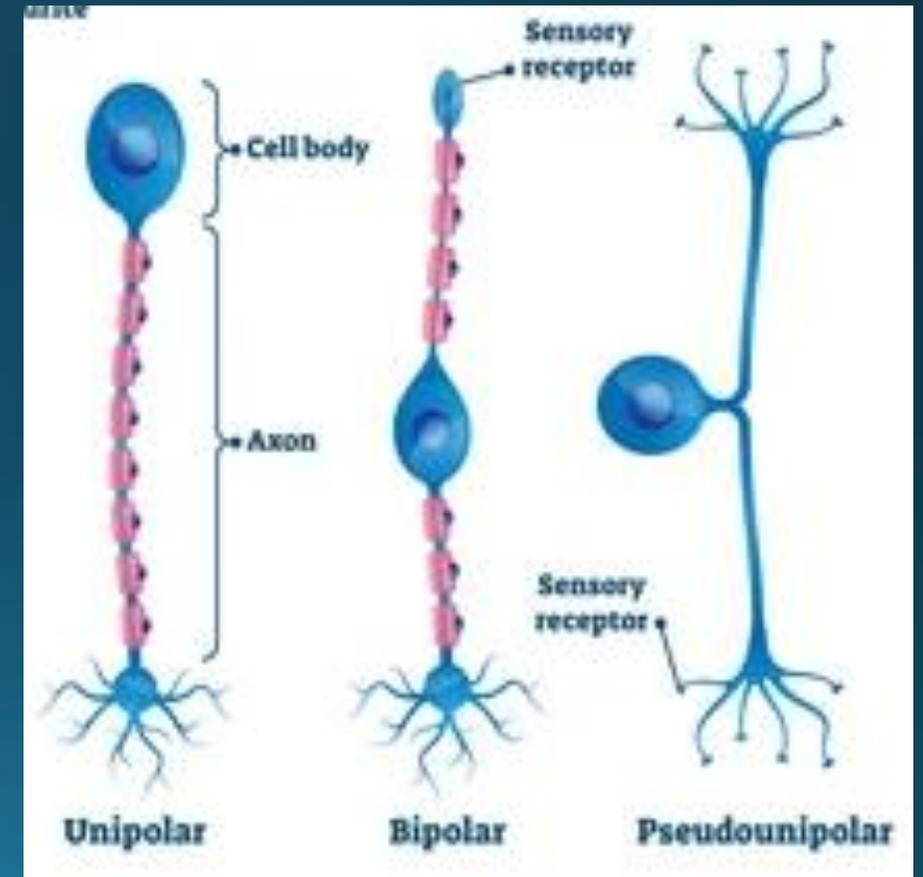
- **Site:** mesencephalic nucleus of the trigeminal nerve.

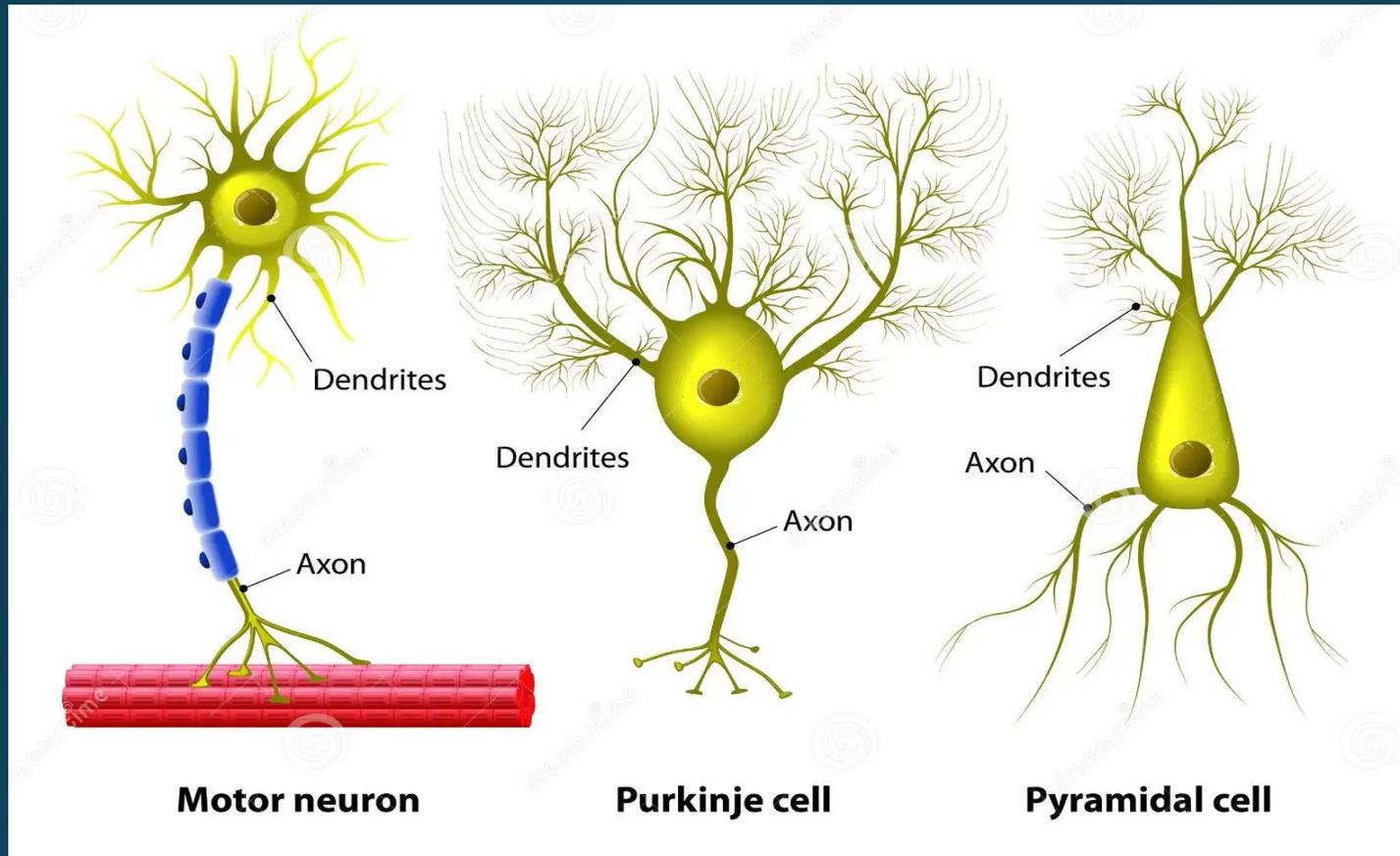
2- Pseudounipolar nerve cells:

- **Site:** spinal ganglia.

3- Bipolar nerve cells:

- **Site:** Retina of the eye.
Spiral ganglia and vestibular ganglia in the ear.
Olfactory epithelium of the nose.





4- Multipolar nerve cells: Have many dendrites and one axon.

i- Polygonal or stellate shaped: Site: - Sympathetic ganglia.

ii- Pyramidal: Site: cerebral cortex.

iii- Pyriform: Site: Purkinje cells of the cerebellum.

THE NERVE FIBER

Definition: It is the axon of a nerve cell.

may be naked or ensheathed (with myelin sheath, neurolemma or both).

The axon (Axis Cylinder)

Structure :

The axon is surrounded by a membrane called “axolemma” and its cytoplasm is known as “axoplasm”. It contains neurofilaments, neurotubules and mitochondria but no Nissl granules.

Length:

May be very long (Golgi type I) or very short (Golgi type II).

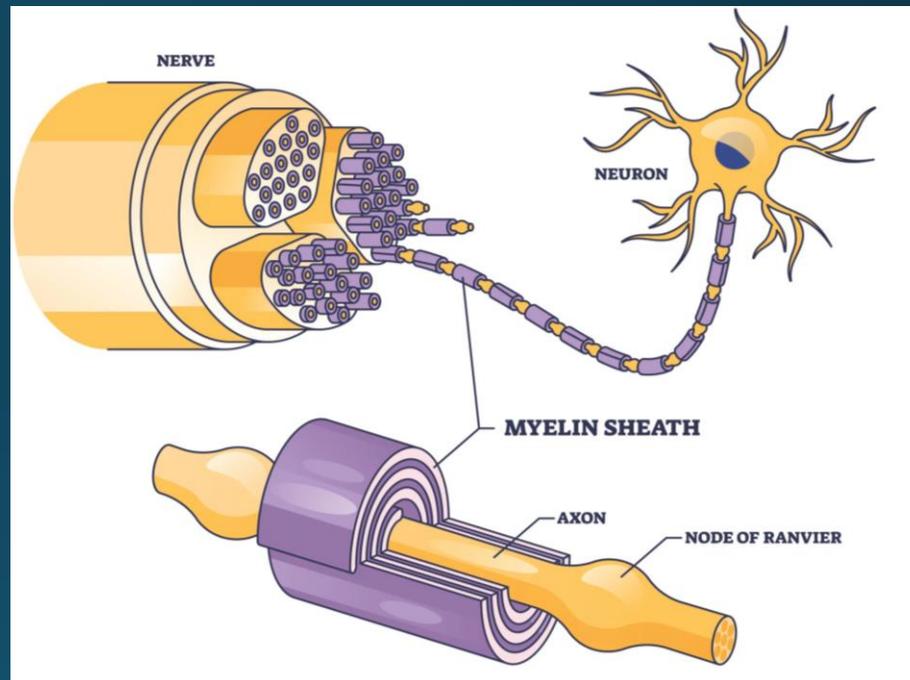
Diameter:

May be thick (of large diameter) conducting impulses rapidly or thin (of small diameter) conducting impulses slowly.

The myelin Sheath

Histological appearance:

- It is a white tubular covering for the axon.
- It is interrupted at intervals by constrictions called “nodes of Ranvier”. The segment between two successive nodes is called “internodal segment”.
- It appears in the form of concentric layers derived mainly from the lipid middle layer of the cell membrane of Schwann cell (in peripheral nerves) and oligodendroglia (in CNS).



Staining:

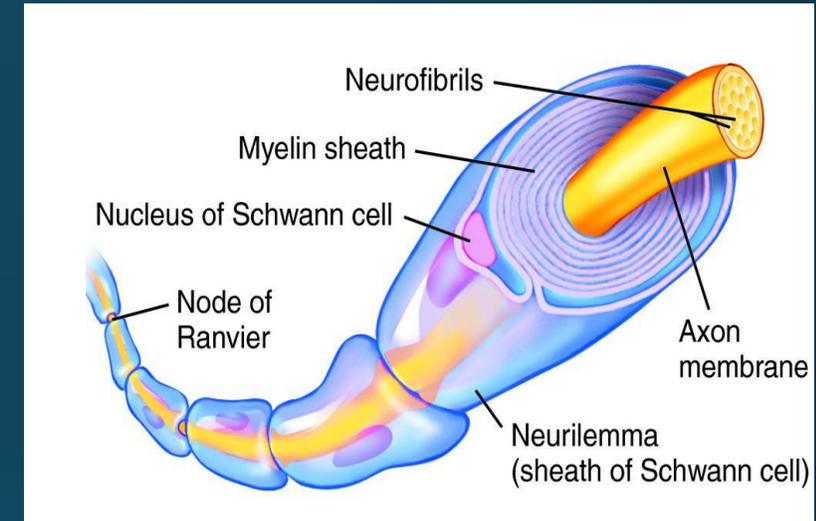
- In H & E preparation: the fat of myelin dissolves in fat solvent (xylol) and appears as an empty space.
- It is stained black by osmic acid.

Function: Insulation of the nerve impulses.

The Neurolemmal Sheath (Schwann Cells)

Histological appearance:

- **It is formed of a chain of cells forming a tube around myelin sheath.**
- **Each Schwann cell has a flat oval nucleus and corresponds to an internodal segment.**
- **The cells come in contact with the axon at the nodes of Ranvier.**



Function

- 1- **Insulation of nerve impulses in nonmyelinated nerve fibers.**
- 2- **Important role in regeneration of peripheral nerve after injury.**
- 3- **Formation of myelin sheath.**

Types of Nerve Fibers:

Naked Fibers:

Termination of peripheral nerves.

Fibers in the gray matter.

Ensheathed Fibers:

Myelinated with neurolemma:

- e.g. peripheral nerves.

Myelinated without neurolemma:

- e. g. nerve fibers in the white matter and optic nerve.

Non- myelinated with neurolemma:

- e.g. sympathetic nerve fibers.

Structure of a peripheral Nerve Trunk:

(I) Nervous component:

Groups of nerve fibers arranged in bundles.

- *In Hx. & E. stained section:*

centrally stained acidophilic axon, surrounded by an empty space of the dissolved myelin and a thin outer pink rim of Schwann cell cytoplasm.

- *In osmic acid-stained section:*

The myelin sheath of the nerve fibers appears as rounded black circles.

ii) C. T. component:

- ***Epineurium:***

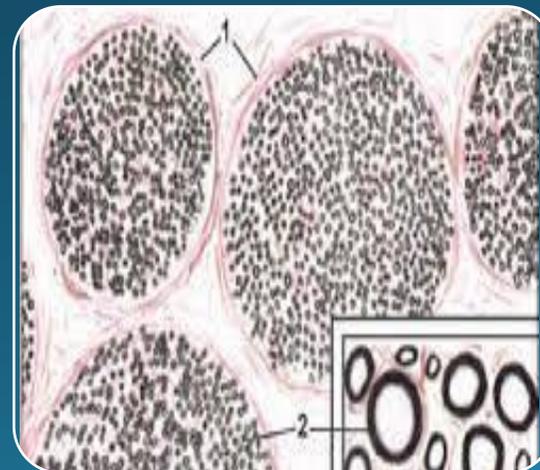
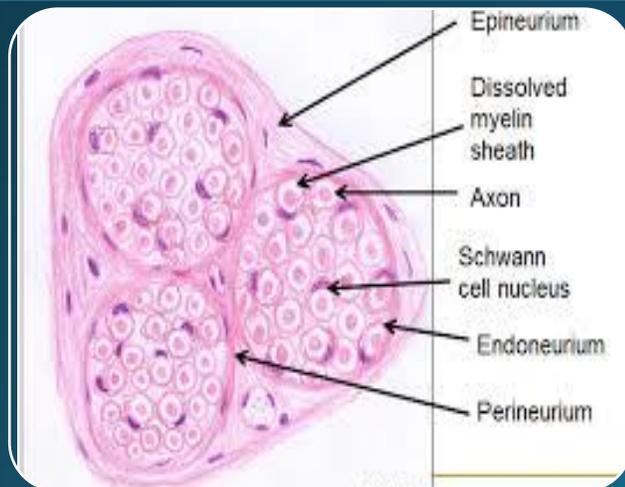
dense C. T. surrounds the whole nerve trunk.

- ***Perineurium:***

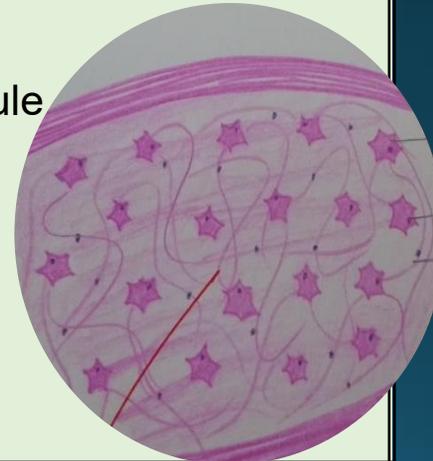
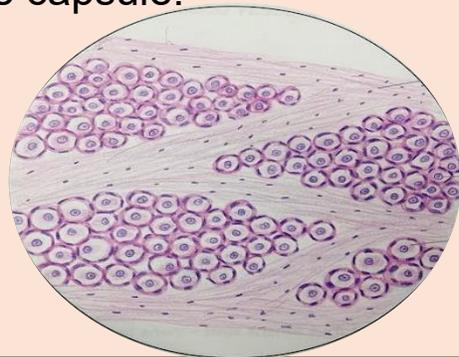
dense C. T. surrounds the bundles of nerve fibers.

- ***Endoneurium:(Henle's sheath)***

Loose C. T. between the individual nerve fibers



	Spinal (Dorsal root) ganglion	Sympathetic ganglion
Site :	Dorsal roots of spinal nerves.	Sympathetic chain
C.T.Capsule:	Thick and usually present.	Thin and may be absent
Function:	Acts as relay for different sensations before their entrance into the spinal cord.	Acts as relay for different motor functions arising from the spinal cord.
Nerve cells:	<p>i. Type: Pseudounipolar.</p> <p>ii. Size: Large or small .</p> <ul style="list-style-type: none"> • Large pale cells: fine Nissl granules. • Small dark cells: coarse Nissl granules. <p>i. Arrangement: In groups or rows.</p> <p>ii. Number: Few.</p> <p>iii. Nuclei: Central</p> <p>iv. Satellite or capsule cells: Numerous and form complete capsule.</p>	<p>Multipolar</p> <p>Mostly of the small uniform size and have similar appearance.</p> <p>Scattered irregularly.</p> <p>Numerous.</p> <p>Eccentric.</p> <p>Few and form incomplete capsule</p>
Nerve Fibers:	<p>i) Thick myelinated.</p> <p>ii) Parallel to the capsule.</p>	<p>Thin or non myelinated</p> <p>Irregularly distributed.</p>



THE NEUROGLIA

I- Neuroglia proper:

- 1- **Astrocytes (macroglia)**
- 2- **Oligodendroglia**
- 3- **Microglia (Mesoglia)**

II- Other types of neuroglia (Neuroglia – like cells):

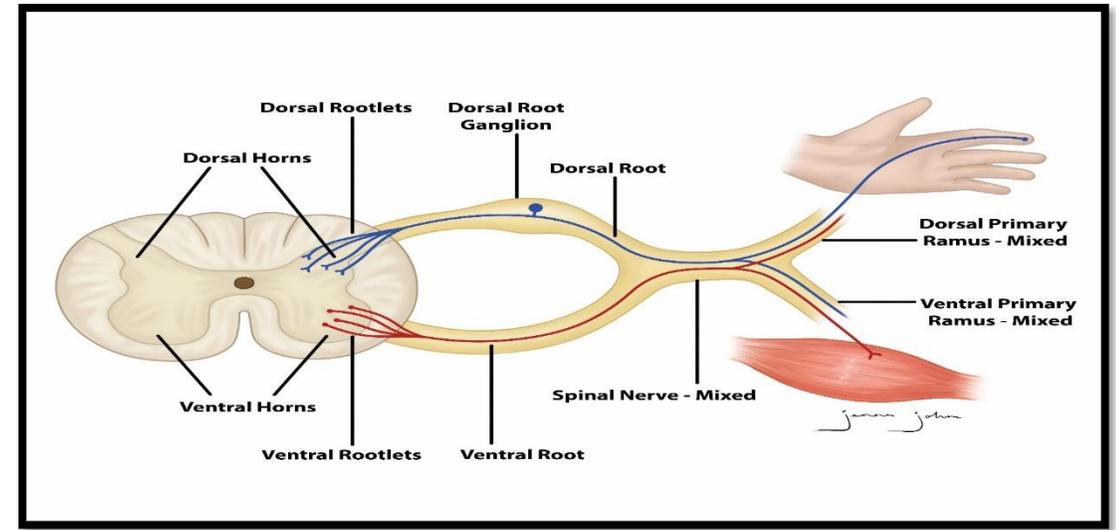
- 1- **Spongioblasts: lining the neural tube.**
- 2- **Ependymal cells:**
 - **line the central canal of spinal cord and brain ventricles.**
 - **They form the C.S.F.**
- 3- **Satellite cells: around the nerve cells of the ganglia.**
- 4- **Schwann cells.**
- 5- **Tanycyte cells: surround the neurons of hypothalamus.**



The Central Nervous System



The spinal cord:



- It is divided into 31 segments; 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and one coccygeal → give origin to the corresponding 31 pairs of spinal nerves.
- Each spinal nerve is attached to the spinal cord by 2 roots; a posterior sensory root and an anterior motor root.
- The anterior and posterior roots unite to form the spinal nerve.
- The spinal cord is divided into two similar halves. Each half consists of an inner core of grey matter and outer white matter.
- The grey matter is formed mainly of nerve cell bodies. The white matter is formed mainly of the axons of nerve cells which form tracts.



Histologically, the white matter is formed of:

- A. Ascending and descending nerve fibers which form tracts.
- B. Neuroglial cells and fibers.
- C. Blood capillaries.

The **white matter** of each half of the spinal cord is divided into:

1. Dorsal white column:

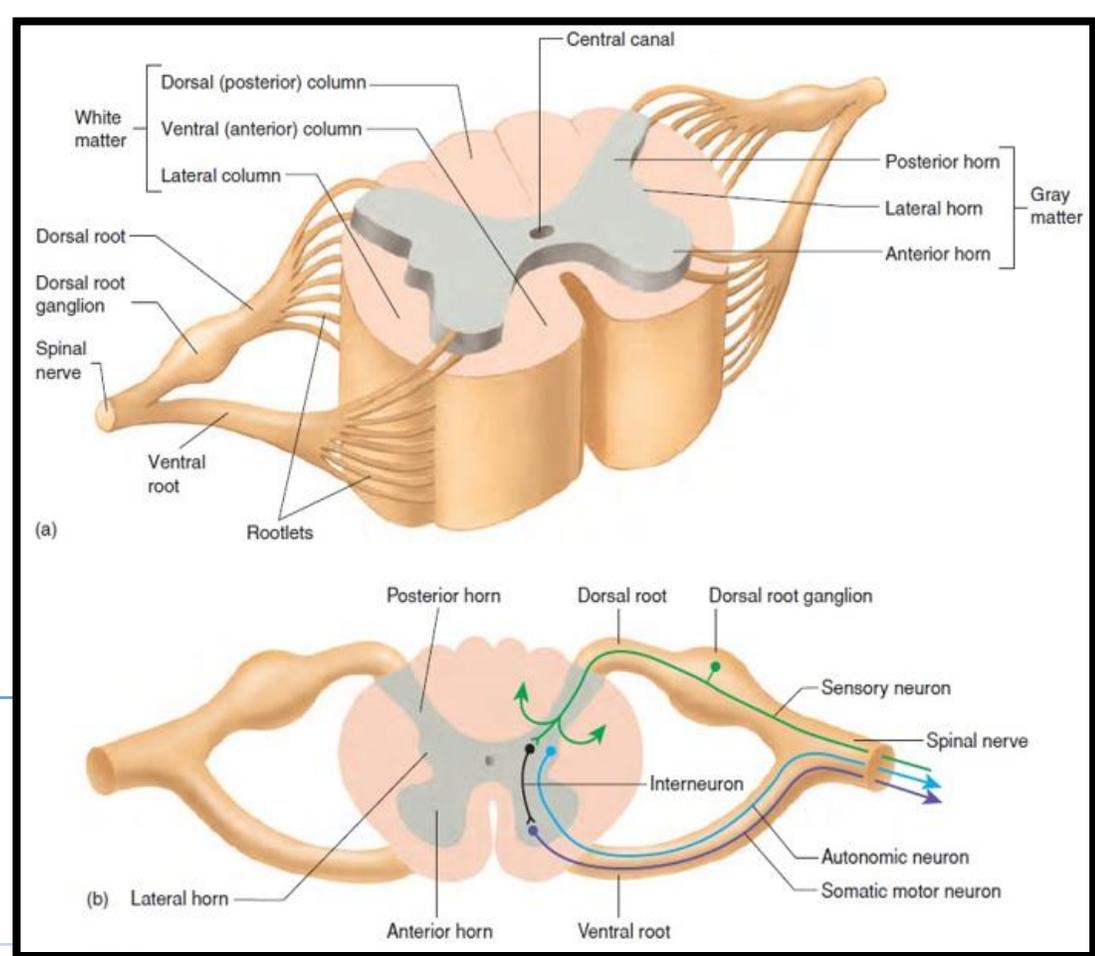
It contains **ascending tracts only**.

2. Ventral white column:

It contains both ascending and descending tracts.

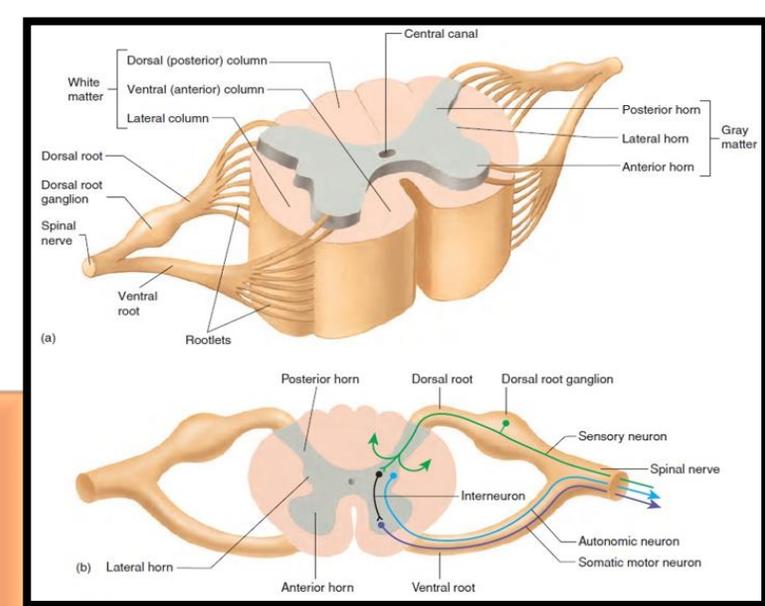
3. Lateral white column:

It contains both ascending and descending tracts.





The grey matter of each half of the spinal cord is formed of:



1. Posterior (dorsal) horn

2. Anterior (ventral) horn

3. Lateral horn

- Present in all spinal cord segments.
- It contains **sensory** neurons which receive different body sensations.

- Present in all spinal cord segments.
- It contains the lower **motor** neurons which supply skeletal muscles.

- Present only in the thoracic and upper lumbar segments (T₁- L₂ or L₃).
- It contains the nerve cells of **preganglionic sympathetic nerve fibers**.
 - Similar nerve cells are present in S₂, 3, 4 segments, but they merge with the anterior horn and do not project as a separate horn. Their axons form the **preganglionic parasympathetic nerve fibers**.



Dorsal horn nuclei

4 sensory nuclei:

Posteromarginal nucleus.

Substantia gelatinosa of Rolandi.

PSM

Main sensory nucleus.

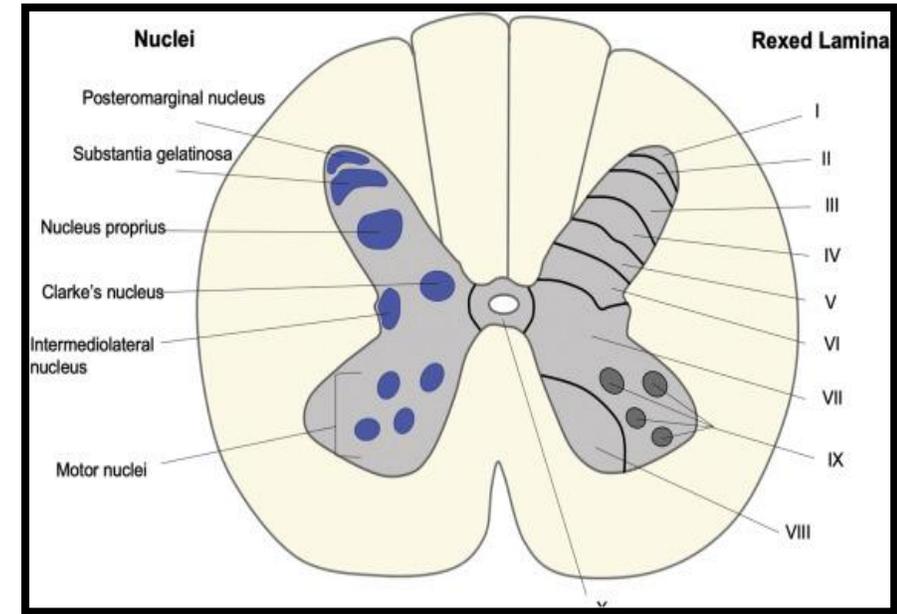
Clarke's nucleus.

Lateral horn nuclei

- Sympathetic nucleus.
- Parasympathetic nucleus.

Ventral horn nuclei

(They are divided into medial, lateral and central NUCLEI)





There are two types of tracts in the spinal cord

(A) Short associative tracts:

(B) Long tracts:

Ascending sensory tracts

Descending motor tracts:

Short associative tracts

Four types:

CSF Lis

1. Fasciculi proprii tracts.

- Short associative tracts that coordinate the function of the different segments of the spinal cord.

2. Comma – shaped tract.

- Carry proprioceptive information to the anterior horn cells to complete the stretch reflex arc of the upper limb.

3. Septomarginal tract.

- They carry proprioceptive information to the anterior horn cells to complete the stretch reflex arc of the lower limb.

4. Lissauer's tract.

- It carries pain and temperature sensation.



The ascending tracts of the spinal cord

- They arise from either the dorsal root ganglia or the dorsal horn nuclei.
- They end in the high sensory centers in the brain.

1. Four tracts carry sensations which are felt:

- They are sensations which reach the sensory area of the cerebral cortex.
- Cutting these tracts → loss of sensation.
- **These 4 tracts are:**
 - 1) Lateral spinothalamic tract
 - 2) Ventral spinothalamic tract
 - 3) Gracile tract
 - 4) Cuneate tract

2. Four tracts carry sensations which are not felt:

- They are sensations which don't reach the cerebral cortex.
- Cutting these tracts → no loss of sensation.
- **These 4 tracts are:**
 - 1) Dorsal spinocerebellar tract
 - 2) Ventral spinocerebellar tract
 - 3) Spinoolivary tract
 - 4) Spinotectal tract

Lateral spinothalamic tract	Ventral spinothalamic tract	Gracile tract	Cuneate tract
<p><u>Pain and temperature</u> from the opposite side of the body below the head.</p>	<p><u>Simple (crude) touch</u> from the opposite side of the body below the head.</p>	<p><u>Proprioception, fine touch and vibration</u> from the lower half of the body on the same side.</p>	<p><u>Proprioception, fine touch and vibration</u> from the upper half of the body on the same side.</p>
Dorsal spinocerebellar tract	Ventral spinocerebellar tract	Spinoolivary tract	Spinotectal tract
<p>Unconscious proprioception from the trunk and lower limb to the cerebellum.</p>	<p>Unconscious proprioception from the lower limb to the cerebellum.</p>	<p>Unconscious proprioception to the cerebellum as part of the spino-olivo-cerebellar pathway.</p>	<p>for spinovisual reflexes.</p>



Proprioceptive pathways

There are two types of proprioceptive sensation:

1. Conscious proprioceptive sensation:

- Carried from the body to the cerebral cortex by:
 - a. **Gracile tract** (from below T₆; the lower half of the body).
 - b. **Cuneate tract** (from above T₆; the upper half of the body).
- The same tracts carry also fine touch and vibration.

2. Unconscious proprioceptive sensation:

- Carried from the body to the cerebellum by:
 - a. **Dorsal Spinocerebellar tract** (from the trunk and lower limb).
 - b. **Ventral spinocerebellar tract** (from the lower limb).
 - c. **Spinoolivary tract** (from the body).
 - d. **Cuneocerebellar tract** (from the upper limb).



The descending tracts of the spinal cord

The upper motor neurons (UMN)

The lower motor neurons (LMN)

Pyramidal tract (the main descending tract):

It originates from the cerebral cortex.

It occupies the pyramid of the medulla.

Extrapyramidal tracts:

They originate from the cerebral cortex and subcortical nuclei e.g. basal ganglia, subthalamus and brainstem.

They descend to the spinal cord outside the pyramid of the medulla.

- The anterior horn cells of the spinal cord.
- The motor nuclei of cranial nerves in brainstem.
- Axons of anterior horn cells → peripheral nerves to striated muscles.
- Axons of cells of cranial nerve motor nuclei → motor fibers of cranial nerves to striated muscles of head and neck.



Pyramidal tract (Pyramidal system)

Divisions:

Corticospinal fibers or pyramidal tract proper

which terminates on the anterior horn cells of the spinal cord.

Corticobulbar fibers

which terminate on the motor nuclei of cranial nerves in the brainstem.

Extrapyramidal tracts

- Rubro-spinal tract
- Tecto- spinal tract
- Vestibulo-spinal tract.
- Medial reticulo-spinal tract
- Lateral reticulo –spinal tract
- Sulcomarginal tract



The Cerebrum

- Consists of:

1. Grey matter

2. White matter.

Cyto- architecture of the cerebral cortex (from outside inward)

1. Molecular layer:

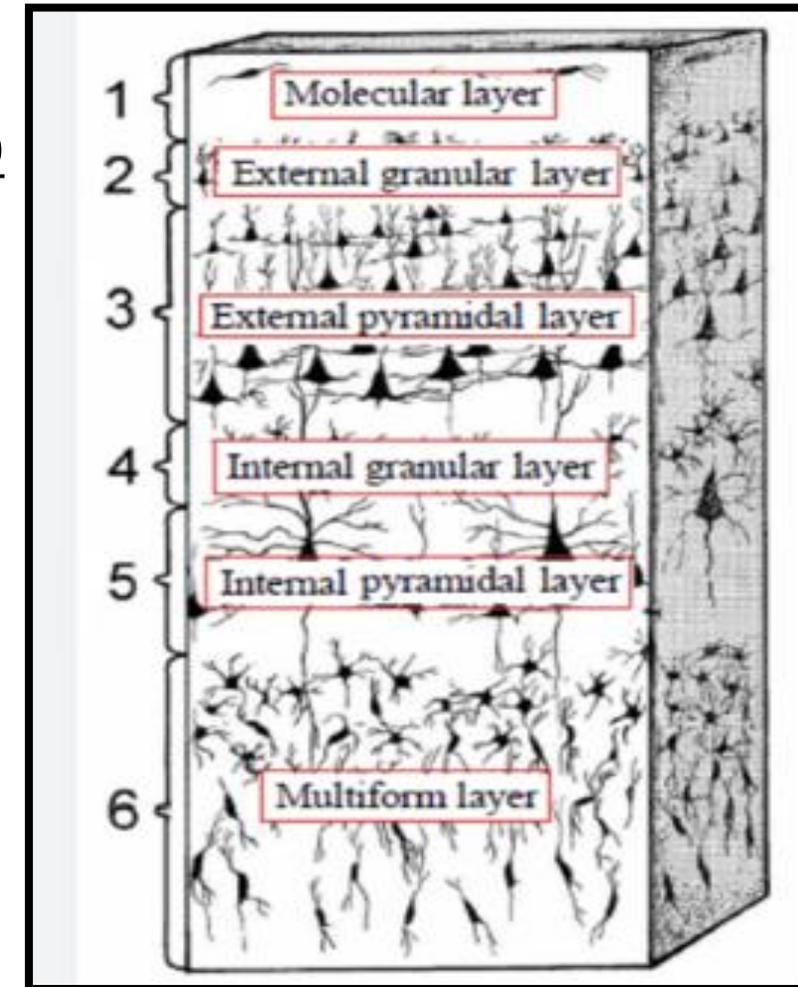
- Contains few scattered horizontal cells of Cajal.

2. Outer granular layer:

- Contains **small** pyramidal cells (pyramidal in shape with large vesicular nucleus) & stellate (granular) cells (polygonal or triangular with large vesicular nucleus).

3. Outer pyramidal layer:

- Contains predominantly **medium sized** pyramidal cells with the same characters as small pyramidal cells but larger.





Cerebral cortex

Cyto- architecture of the cerebral cortex (from outside inward)

4. Inner granular layer:

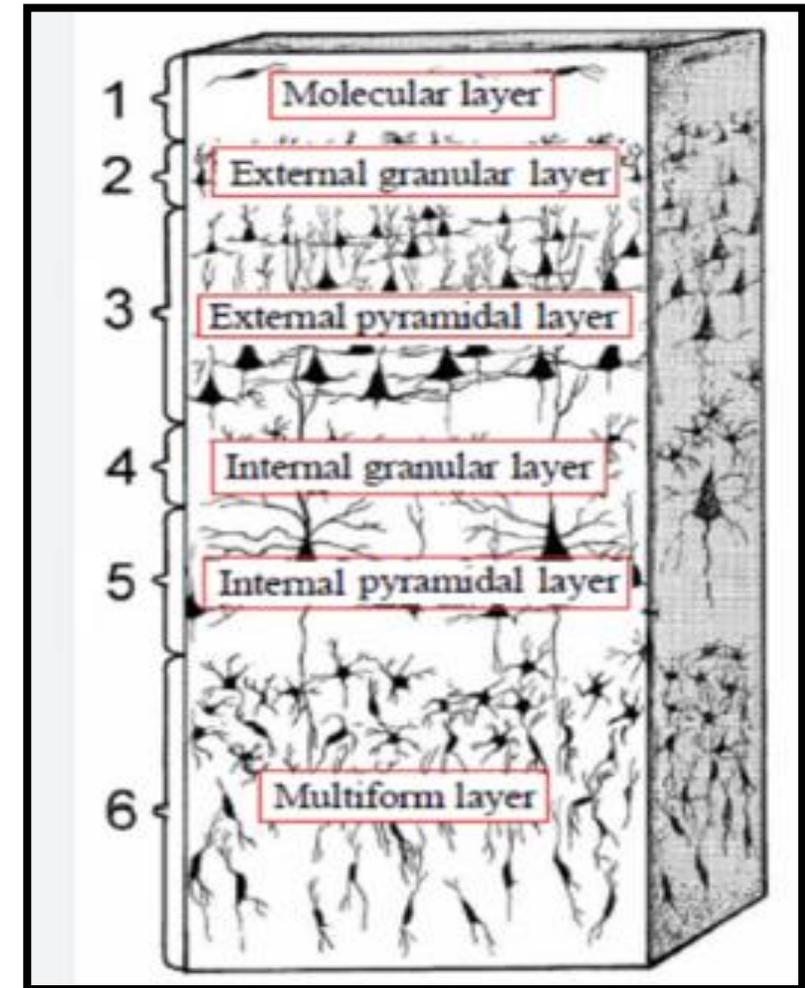
- Contains predominantly stellate (granular) cells.

5. Inner pyramidal (ganglionic) layer

- Contains predominantly **large** pyramidal cells with the same characters as small cells but larger.

6. Pleomorphic (multiform) layer:

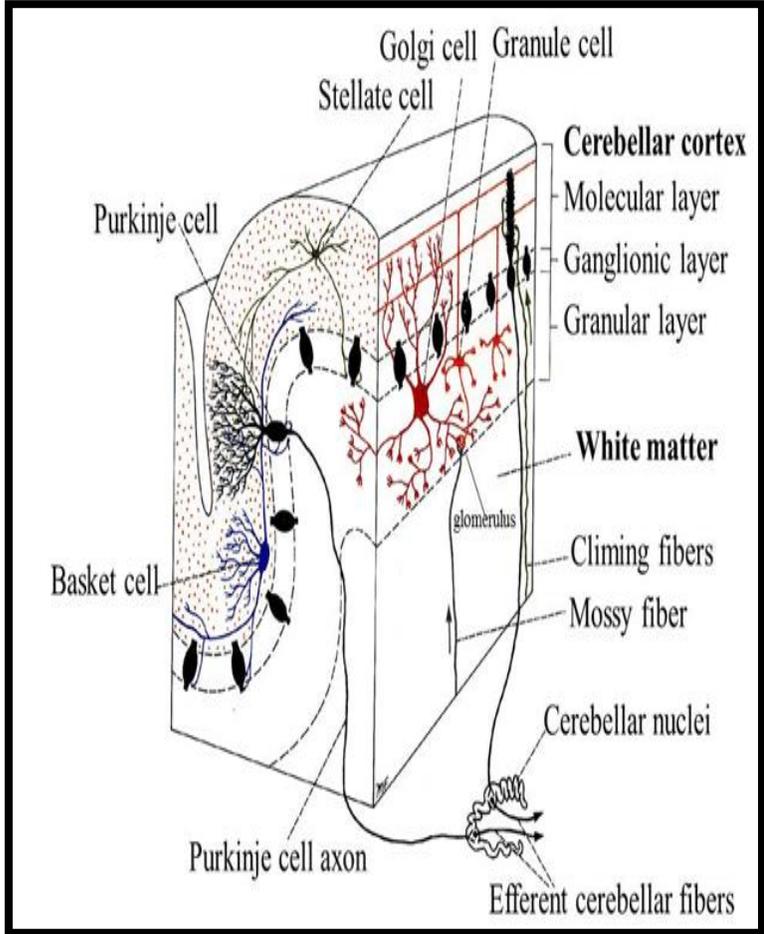
- Contains fusiform & stellate (granular) cells.



The Cerebellum

Cerebellar Cortex formed of three layers from outside inwards

1. Molecular layer	2. Purkinje cell layer	3. Granular (nuclear) layer
Composed mainly of fibers and few cells.	Composed of Purkinje cells only.	Composed mainly of cells & few fibers.
<ul style="list-style-type: none"> Cells: <ol style="list-style-type: none"> Molecular (stellate) neurons → they synapse with dendrites of Purkinje cells. Basket cells. Fibers: <ol style="list-style-type: none"> Axons & dendrites of molecular & basket cells. Dendrites of Purkinje cells. Axons of granular cells. Dendrites of Golgi II cells. 		<ul style="list-style-type: none"> Cells: <ol style="list-style-type: none"> Granular cells Golgi II cells Fibers: <ul style="list-style-type: none"> Axons of Purkinje cells Climbing & Mossy fibers





➤ Purkinje cells (Golgi I cells):

- **Body:** Large, pyriform, arranged in one row away from each other
- **Dendrites:** Fan out in the molecular layer to synapse with axons of molecular & granular cells and climbing Fibers.
- **Axon:** Enter the white matter to end in deep cerebellar nuclei & Vestibular nuclei.

➤ Granular cells

- **Body:** Very small & closely packed.
- **Dendrites:** Synapse with a **rosette** of Mossy fibers to form **cerebellar glomeruli**.
- **Axon:** Pass to the molecular layer.

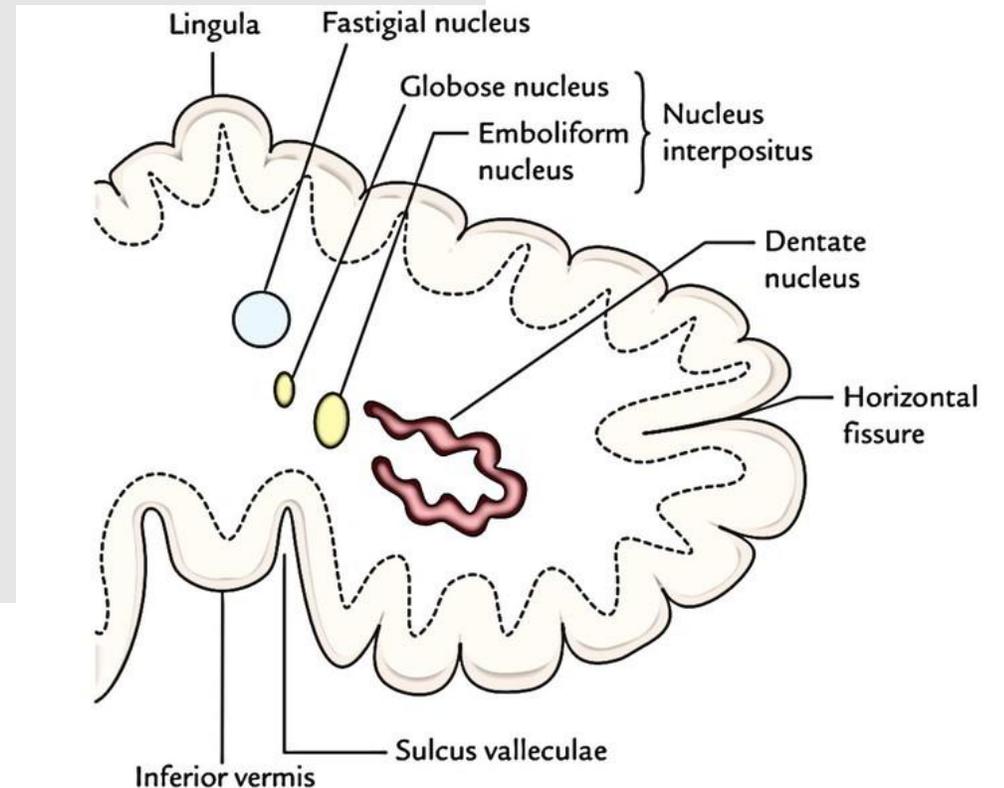
➤ Golgi II cells:

- **Body:** Like that of Purkinje cells.
- **Dendrites:** Fan out in various planes.
- **Axon:** Short, much branched, synapse with dendrites of granular cells.



CEREBELLAR NUCLEI

- They relay impulses from Purkinje cells to vestibular and red nuclei.
- They are four from lateral to medial:
 - 1- Dentate N. (Nucleus Dentatus).
 - 2- Embiliform N. (N. Embiliformis).
 - 3- Globose N (N. Globosus).
 - 4- Fastigial N (N. Fastigii).





THE EYE

Dr. Dalia Eita

The wall of the eyeball consists of 3 coats (layers):

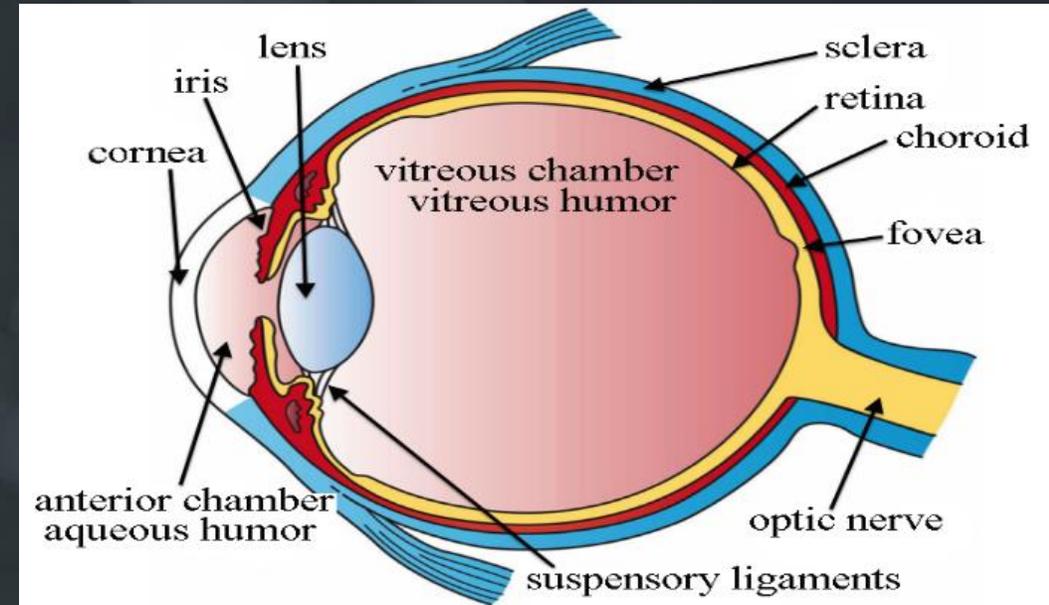
- 1- Outer fibrous layer : cornea and sclera.
- 2- Middle vascular or uveal layer : choroid, ciliary body and iris.
- 3- Inner nervous layer : retina.

The Cornea

L.M:

A transverse section shows that it consists of 5 layers from outside inwards:

1. Epithelium
2. Bowman's membrane
3. Substantia propria
4. Descemet's membrane
5. Descemet's endothelium



1) Epithelium: stratified squamous non keratinized epithelium

2) Bowman's membrane:

- ❑ transparent homogenous layer.
- ❑ It acts as a protective barrier against trauma and bacterial invasion. Once destroyed, it is not regenerated and healing from the underlying C.T. always leaves a scar causing **corneal opacity**.

3) Substantia propria

- ❑ 90% of the thickness of the cornea
- ❑ It is formed of about 20-25 regular lamellae of type I collagen bundles separated from each other by flattened fibroblasts (corneal corpuscles).

4- Descemet's membrane:

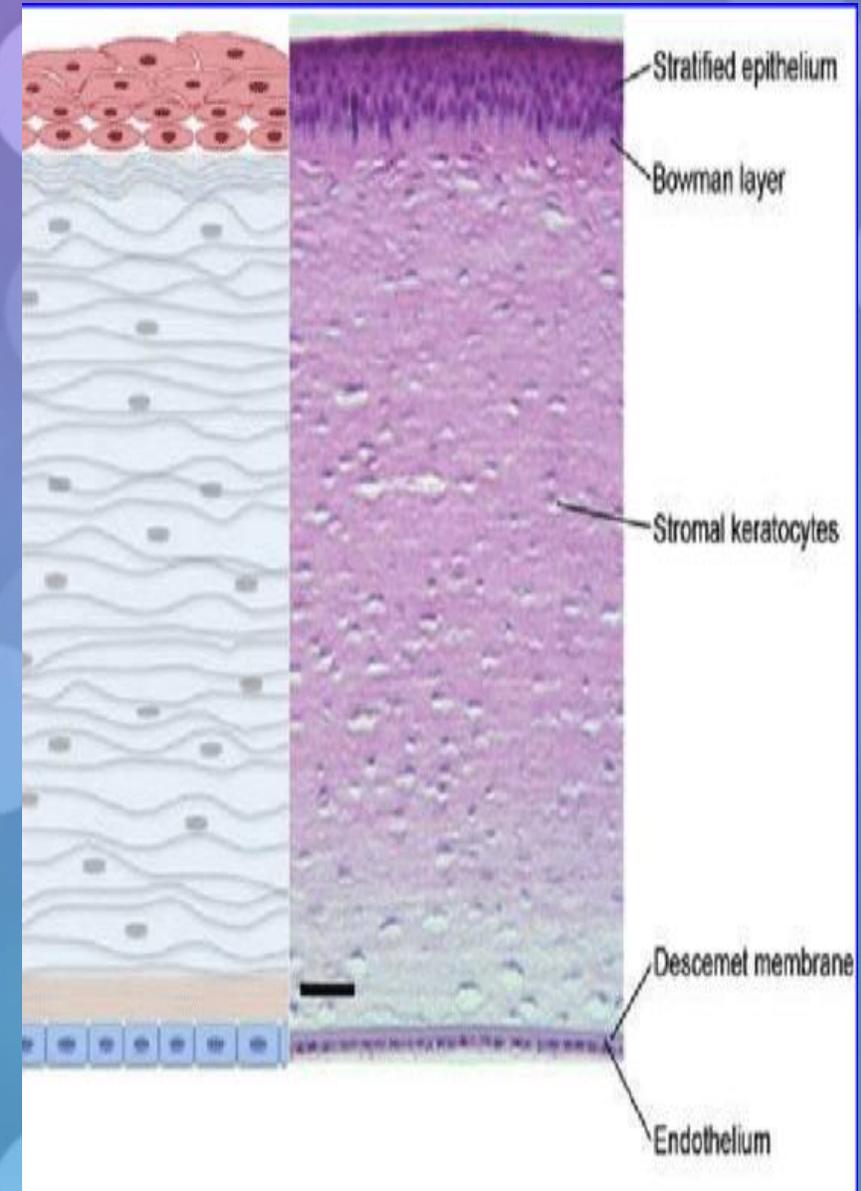
It is a homogenous, non cellular membrane formed of fine collagenous filaments and basement membrane materials.

5- Descemet's endothelium:

It is a simple squamous epithelium.

Causes of corneal transparency:

- 1- The continuous evaporation of water from its surface.**
- 2- The absence of blood vessels.**
- 3- The cells, fibers and matrix have the same refractive indices.**
- 4- The regular arrangement of the fibers and cells of the substantia propria.**
- 5- The regular arrangement of the cells of the covering epithelium.**



The Sclera

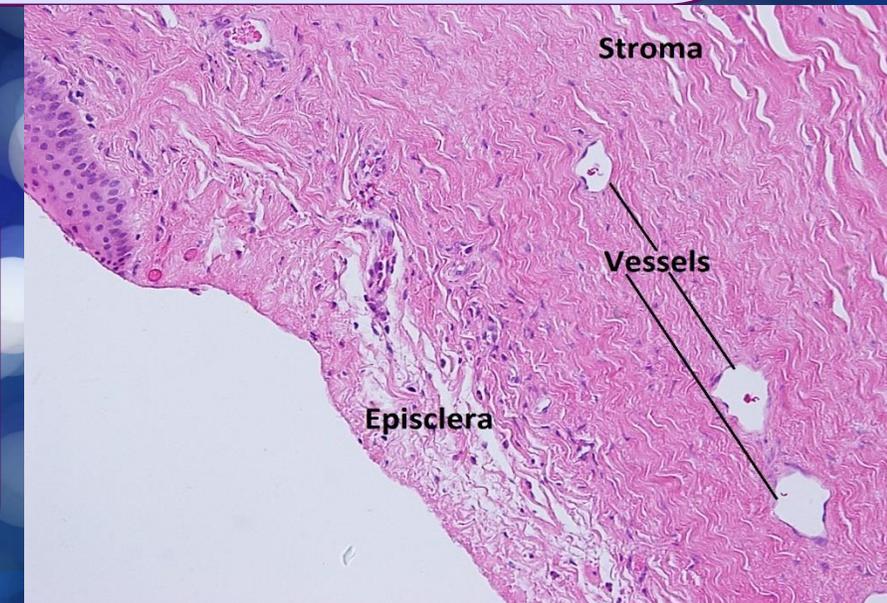
It is the white opaque posterior 5/6 of the eye.

L.M.:

- a) Its external surface which gives attachment to the tendons of the eye muscles “The episclera”. Surrounded by a dense layer of C.T. called tenon’s capsule (Fascia) between this capsule and the sclera is “Tenon’s space”
- b) Its middle part formed of irregular white dense C.T.
- c) Its inner most layer (the lamina fusca) (faces the choroid): a thin layer of loose CT rich in melanocytes, fibroblast and elastic fibers.

The sclera is opaque because:

- 1- The refractive indices of all its elements is not equal.
- 2- The irregular arrangement of its C.T. fibers.
- 3- The presence of great amount of water.



Choroid

Definition: Pigmented vascular C.T. layer lies between the retina and the sclera.

LM.: It is made up of 4 layers:

1. Epichoroid or suprachoroid.

It is the most outer layer. It consists of a loose C.T. layer rich in melanocytes, fibroblast, macrophages, nerve fibers and ganglion cells.

2. The vessel layer:

A highly vascular C.T. rich in elastic fibers and pigment cells.

3. The choriocapillaries:

It is formed of a single layer of fenestrated blood capillaries.

4. Bruch's membrane: formed of 5 layers by E.M.

- The central layer is composed of a network of elastic fibers which is lined on its two surfaces with layers of collagen fibers its outer most and inner most collagen layers are covered by basal lamina .
- plays an important role in limiting access of inappropriate macromolecules from the fenestrated capillaries to the retina.

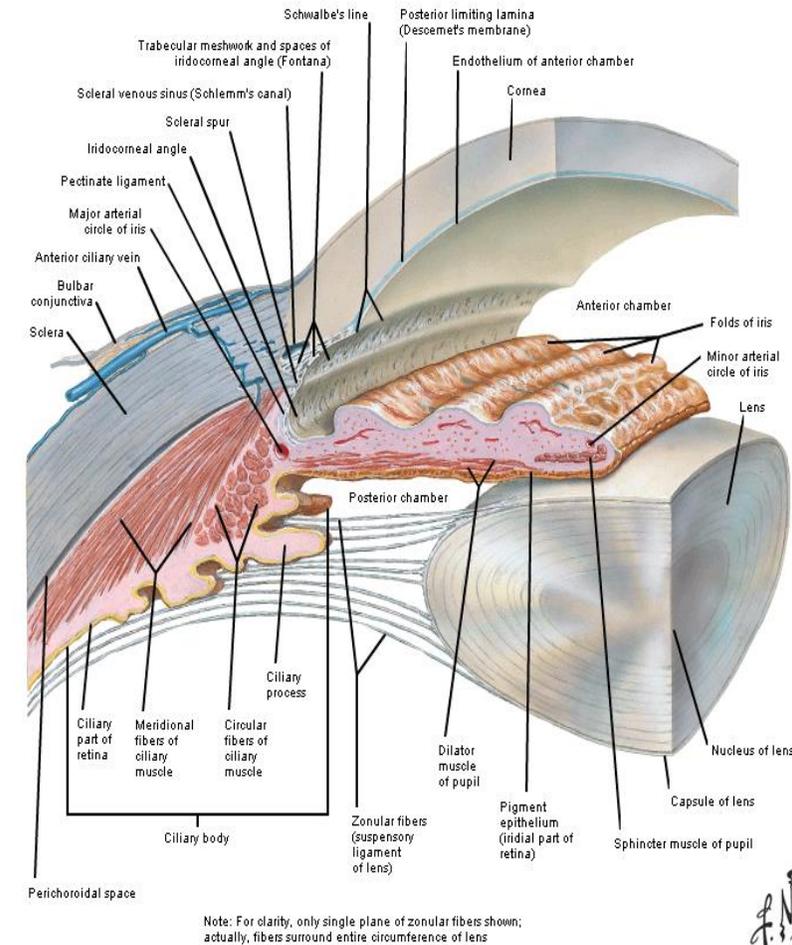
Ciliary body

Definition:

- **It is the thickened anterior part of the choroid. It appears as a thickened ring at the inner aspect of the sclera.**
- **In transverse section, it has a triangular shape, one of its faces is in contact with the vitreous body, one with the sclera and the third with the lens and posterior chamber of the eye. Its apex is continuous posteriorly with the choroid.**

Histological Structure:

- **made of loose C.T. rich in blood vessels and melanocytes in which the ciliary muscles (smooth muscles fibers) are embedded.**



Ciliary Processes:

- **Irregular processes arising from the medial side of the ciliary body extending toward the lens.**
- **Formed of loose C.T. core contains fenestrated capillaries covered by the ciliary epithelium.**
- **ciliary epithelium is formed of 2 layers of cubical cells the inner is nonpigmented while the outer layer is pigmented rich in melanin pigment.**

Function:

1. Formation of the aqueous humor by the ciliary processes.

2. The ciliary body are responsible for the processes of accommodation of the lens to near and far objects as the ciliary muscles are attached to the suspensory ligament of the lens.

- Contraction of the ciliary muscle fibers pulls the lens becomes more convex so change the focus for near vision.

- Relaxation of these muscle fibers cause flattening of the lens & focusing on distant vision.

Iris

Definition:

The iris is a disk shaped coloured diaphragm with a central adjustable aperture named the pupil.

Site:

The iris is present between the anterior and posterior chambers of the eye.

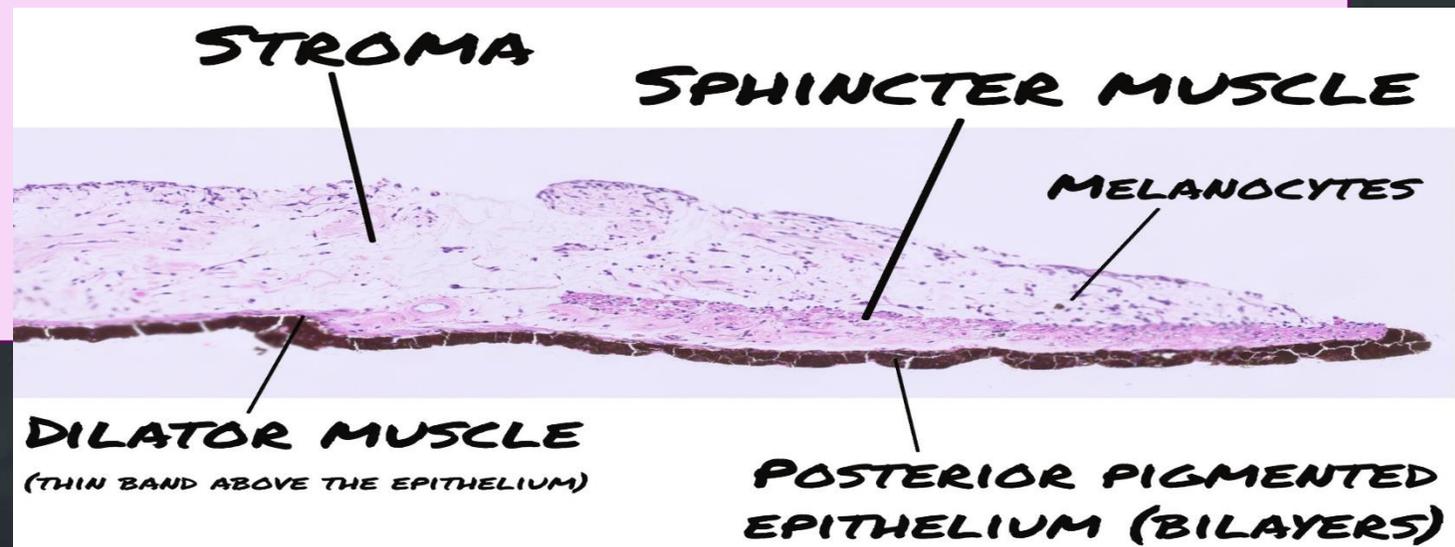
Function:

1. Changes the pupillary size.
2. Shares in the formation of aqueous humor.
3. Gives the color of the eye.



Histological structure:

- 1- The anterior surface is lined with a discontinuous layer of fibroblasts, melanocytes and collagen.
- 2- The stroma of the iris contains loose C.T. that differentiates into 2 layers:
 - a- **Anterior stromal layer** more pigmented but less vascular.
 - b- **Posterior vessel layer** is more vascular and contains the muscles of the iris:
 - The dilator pupillae muscles, which are myoepithelial cells, radially arranged lie near the back of the iris they dilate the pupil.
 - The constrictor pupillae muscle is a circular band of smooth muscle fibers that is situated at the pupillary margin of the iris they constrict the pupil.
- 3- The posterior surface is covered by two layers of heavily pigmented cuboidal epithelial cells “pars iridis retina”.



THE REFRACTIVE MEDIA OF THE EYE

Cornea

**Aqueous
humor**

Lens

**Vitreous
body**

The Lens

Histological structure:

a) Lens capsule

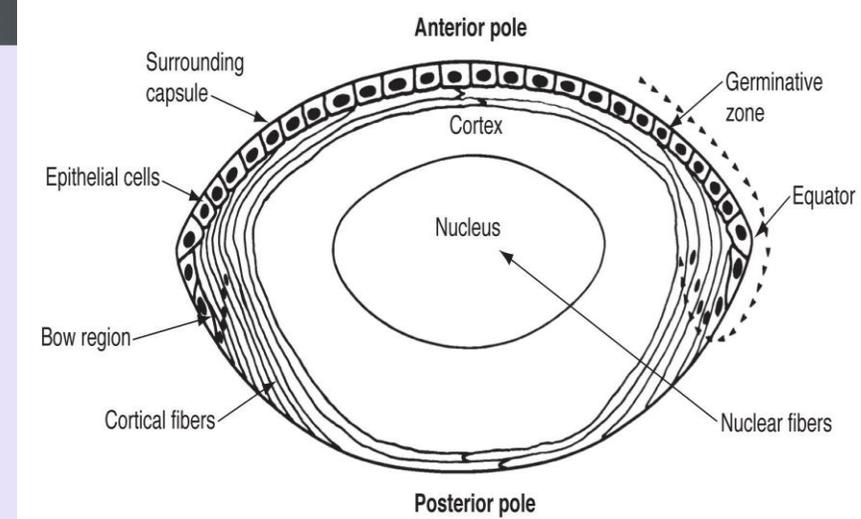
b) Lens epithelium:

- It consists of cuboidal cells.
- At the equator cells are high columnar.

c) Lens fibers

N.B.:

- ***Presbyopia:*** Is a normal aging process occurring after age of 40 in which the ability of the lens to change its curvature is lost
- ***In persons exposed to excessive amount of ultraviolet radiation and in diabetic patient especially elderly individuals. Their lens become gray and opaque leading to impairment of vision a condition called "cataract".***



THE INNER NERVOUS COAT (RETINA)

A- The pigmented epithelium:

Consists of high cubical cells with rounded nuclei. The cytoplasm contains melanin granules

B- The neural part of the retina: The retinal layers are 9 layers:

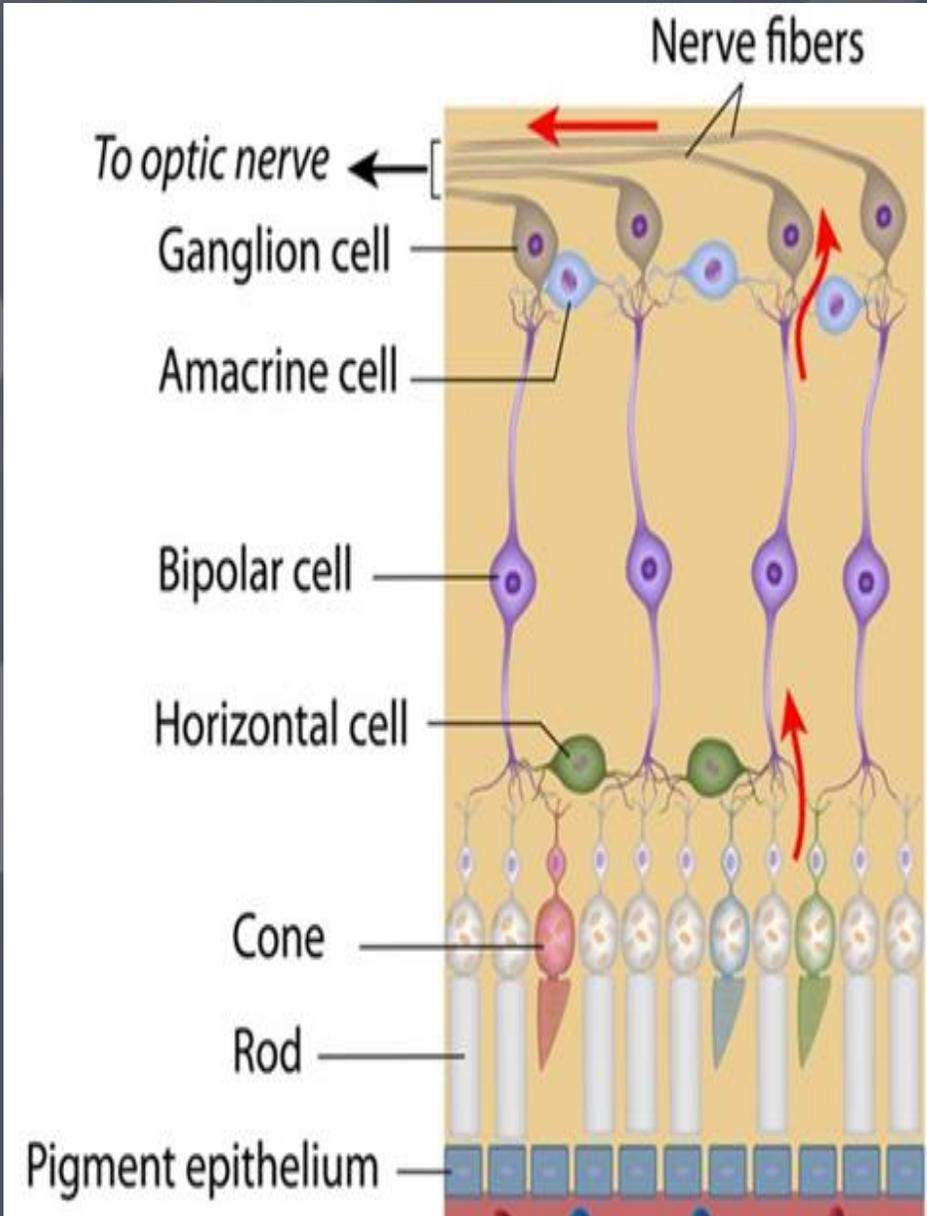
1- The rods and cones layer:

- It contains the dendritic processes of the rods & cones.
- These processes are photoreceptors

	Rods	Cones
(A) Number:	120 millions	6-7 millions
(B) Function:	– Adapted to function in dim light	– Adapted to function in bright light.
(C) Site:	Not present at the fovea centralis	The only receptors found in the fovea centralis.

- 2- **The outer limiting membrane: (dark line)**
- 3- **The outer nuclear layer: Contains the cell bodies of rod and cone cells (the 1st order neurons).**
- 4- **Outer plexiform (reticular) layer:**
- 5- **The inner nuclear layer:**
It contains the cell bodies of:
 - a. **The bipolar cells (the 2nd order neurons)**
 - b. **Horizontal cells**
 - c. **Amacrine cells**
 - d. **Muller Cells**

- 6- **The inner plexiform (reticular layer)**
- 7- **The ganglion cell layer (the 3rd order neuron)**
- 8- **The nerve fiber layer**
- 9- **The inner limiting membrane: (dark line)**



THE ACCESSORY STRUCTURES OF THE EYE

(1) The Conjunctiva

Site: It covers the anterior portion of the eye up to the cornea. It also lines the internal surface of the eyelids.

Parts:

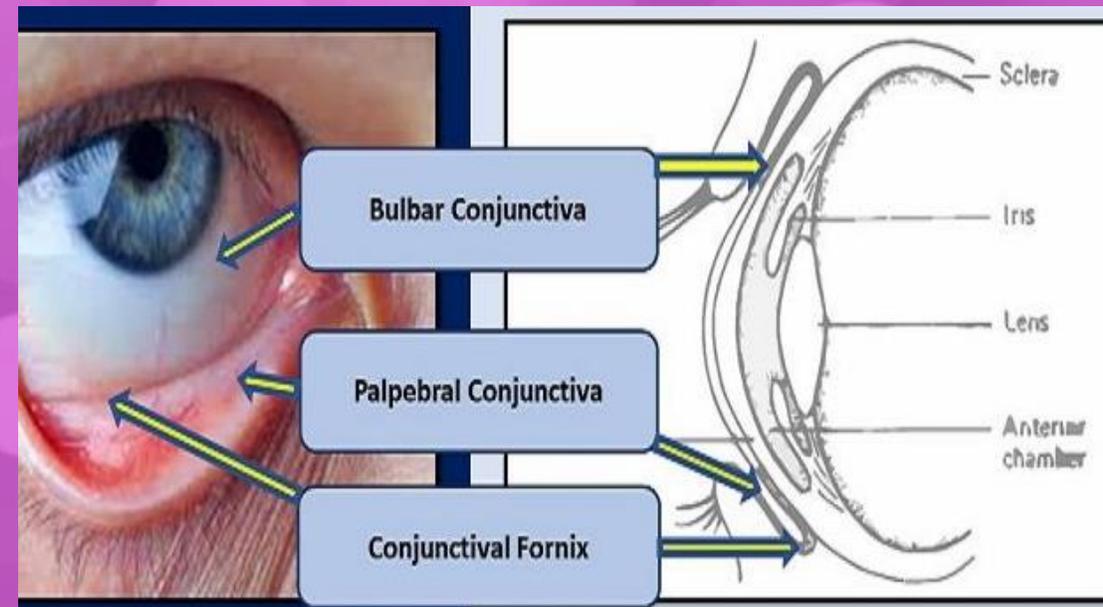
- 1- Bulbar conjunctiva which covers the anterior part of the sclera.
- 2- Palpebral conjunctiva which lines the skin of the eyelid from its inside.
- 3- Fornix of conjunctiva: at junction between part (1) & (2).

Histological structure:

1- Epithelium:

- a- At the fornix: stratified columnar with few goblet cells.
- b- At the bulbar part stratified squamous.
- c- At the palpebral part: stratified squamous

2- Corium: loose connective tissue



(2) The Eyelids

Histological structure:

A perpendicular section shows the following layers from front backwards:

1-Skin

2-Skeletal muscles: bundles of the orbicularis oculi.

3-The tarsus

4-Palpebral Conjunctiva

5-The Eye lashes



The three types of glands in lid are:

a) The meibomian glands: are sebaceous glands in the tarsal plate.

➤ **“Chalazion”** is a swelling as a result of the infection of the meibomian glands.

b) Gland of Moll: are modified sweat glands.

c) Gland of Zeis: Are modified sebaceous glands

➤ **“A sty”** is produced as a result of infection of either the gland of moll or the gland of Zeis.



The Ear

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The external ear

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

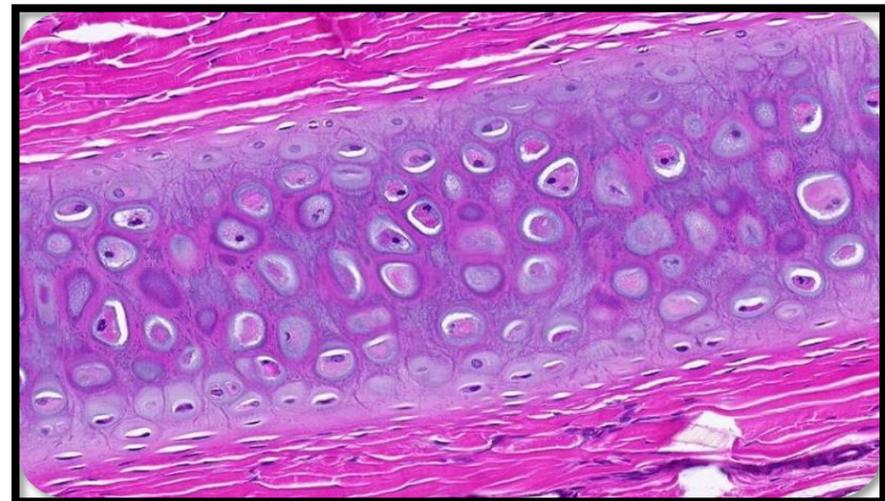
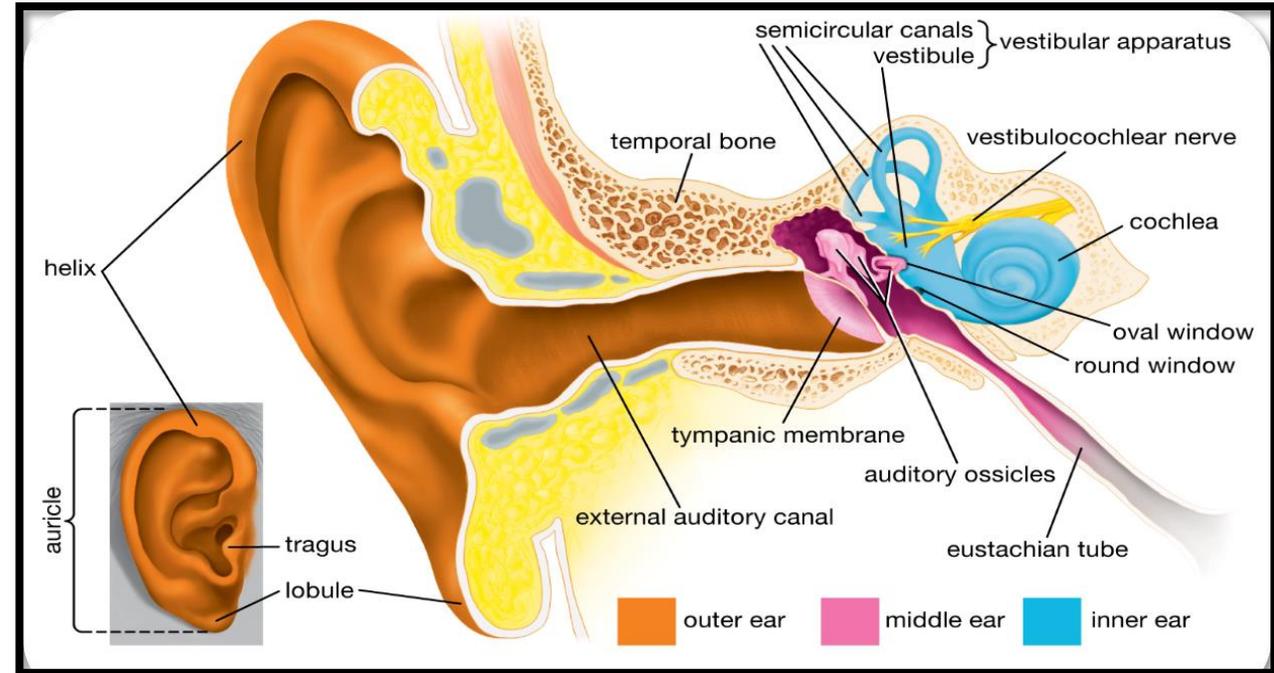
The Auricle:

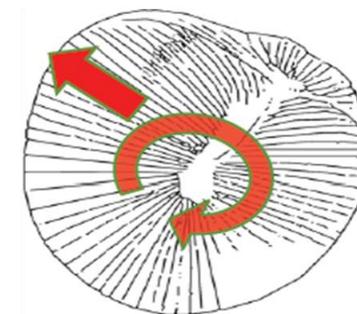
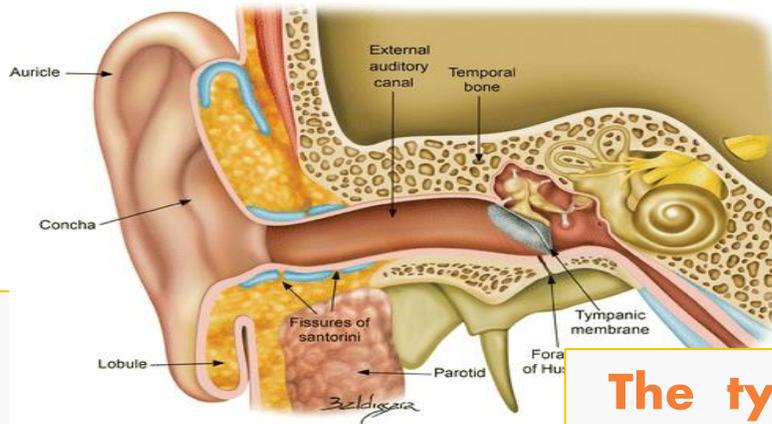
Structure:

- **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 consists of **2 layers of collagenous fibers**:
 - **Outer radial**
 - **Inner circular**
 - **Both layers are covered externally by skin and internally by simple cubical 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).

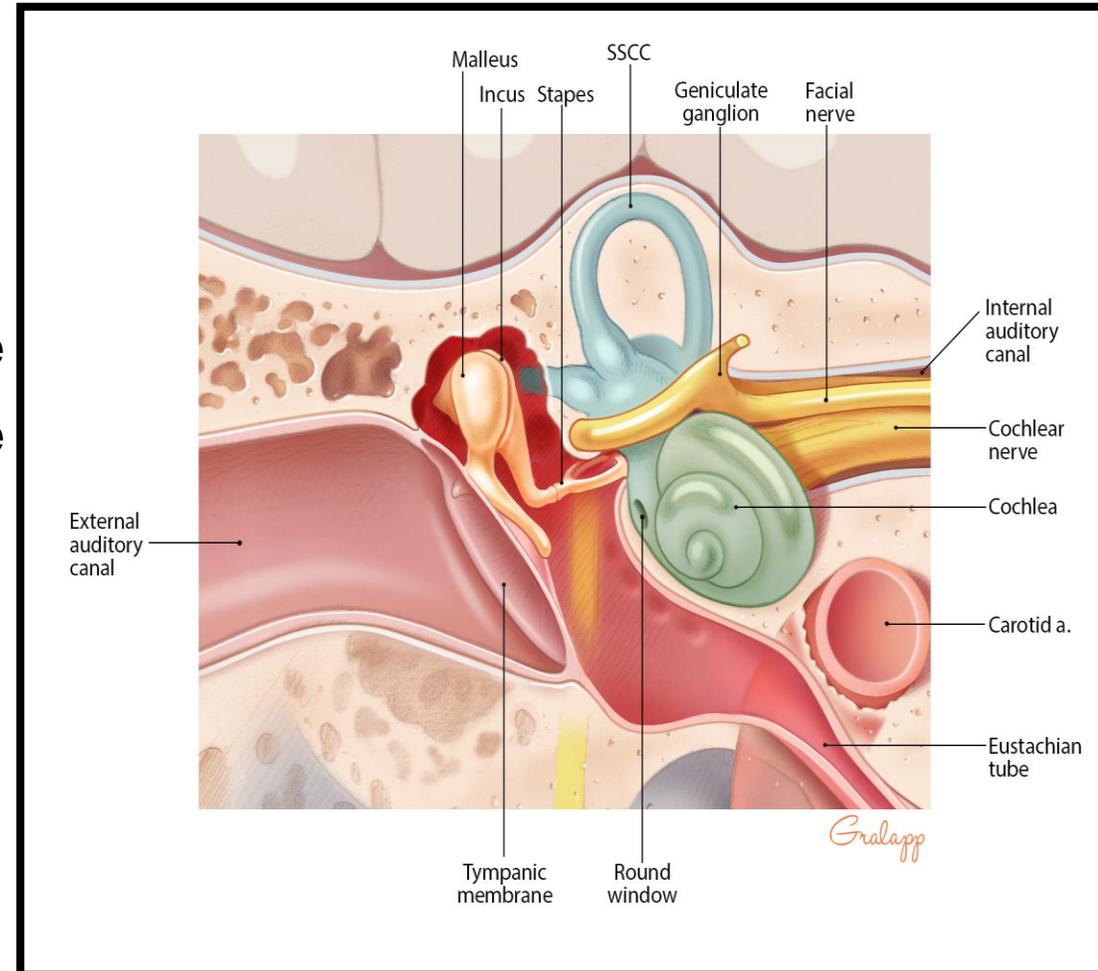
- **It Contains:**

- **3 ossicles**

- **2 muscles**

- **2 windows**

- **Chorda tympani nerve**



The ossicles

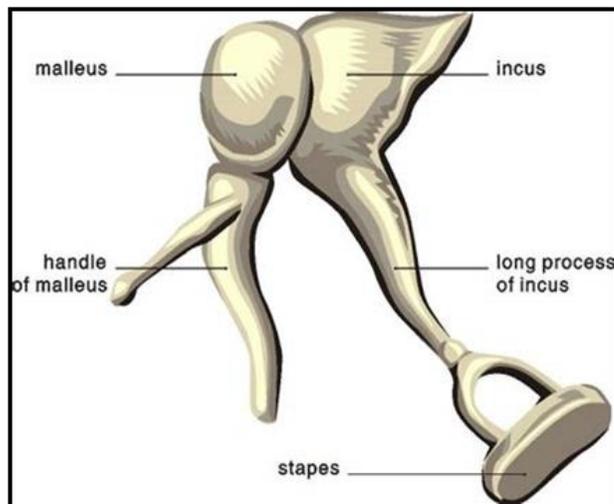
1. Malleus

attached to the tympanic membrane.

2. Incus

3. Stapes

closes the oval window



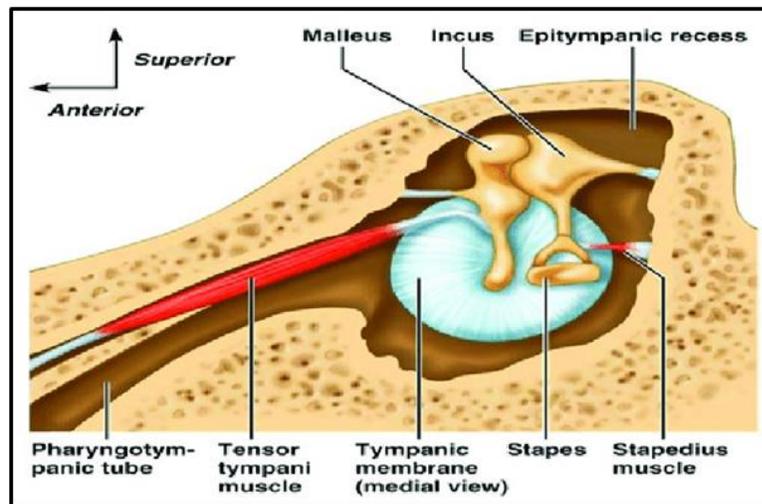
The muscles

1. Tensor tympani

(attached to malleus).

2. Stapedius

(attached to stapes).



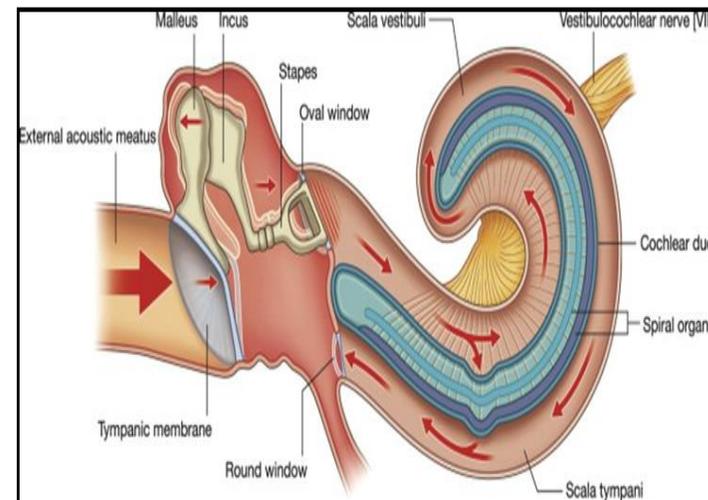
The windows

1. Oval window:

- Closed by the foot of stapes.

2. Round window:

Closed by elastic membrane (2ry tympanic membrane).

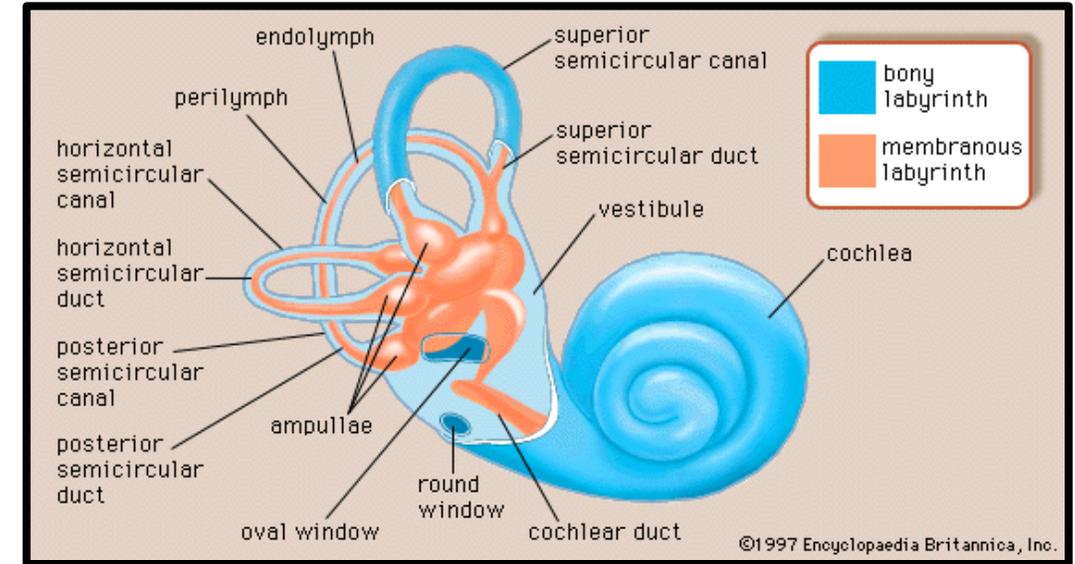


The inner ear

It is formed of:

1. The membranous labyrinth:

- Contains the receptors of hearing and equilibrium (neuro-epithelial structures).
- Filled with the **endolymph**
- Present inside the bony labyrinth.

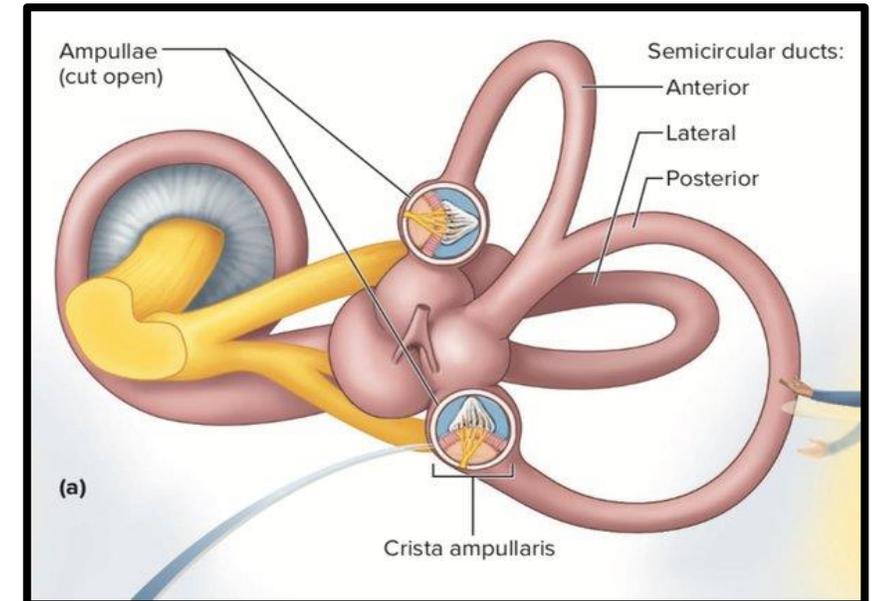
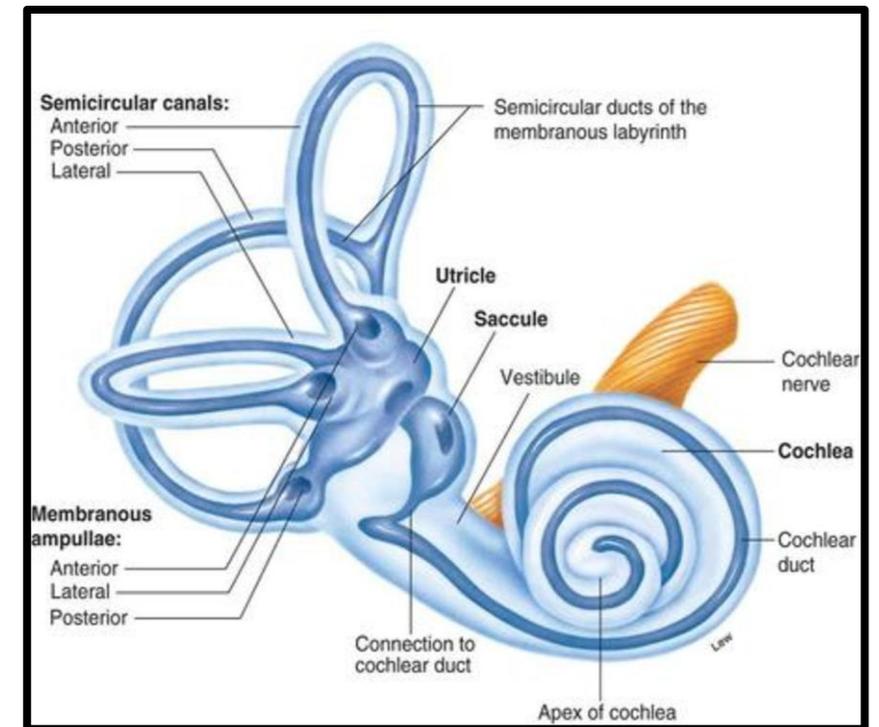


2. The bony labyrinth:

- Filled with **perilymph**
- Consists of:
 - The semicircular canals.
 - The vestibule.
 - The cochlea.

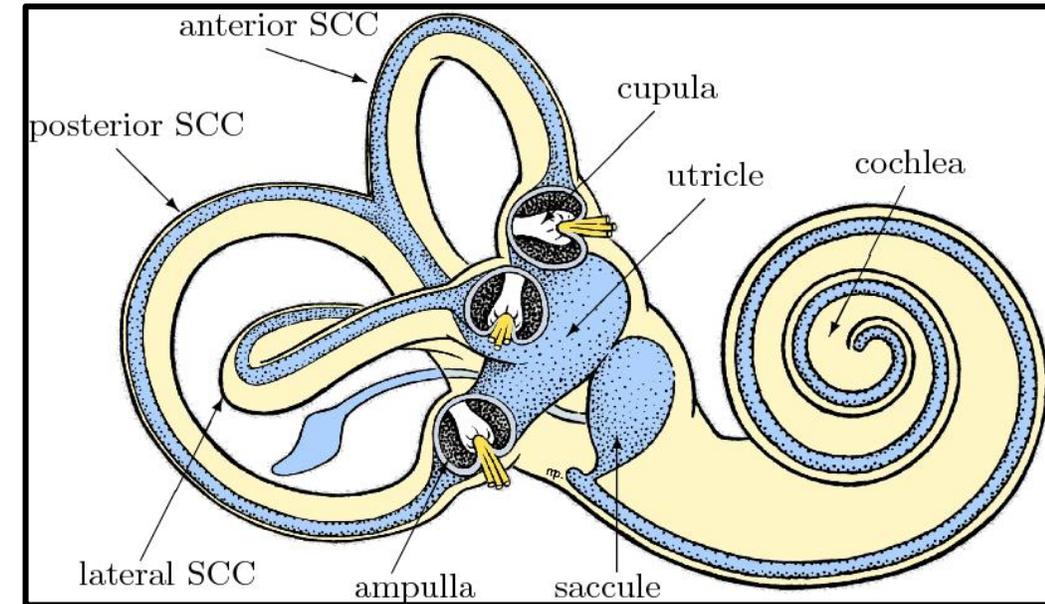
Semicircular canals

- **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.**



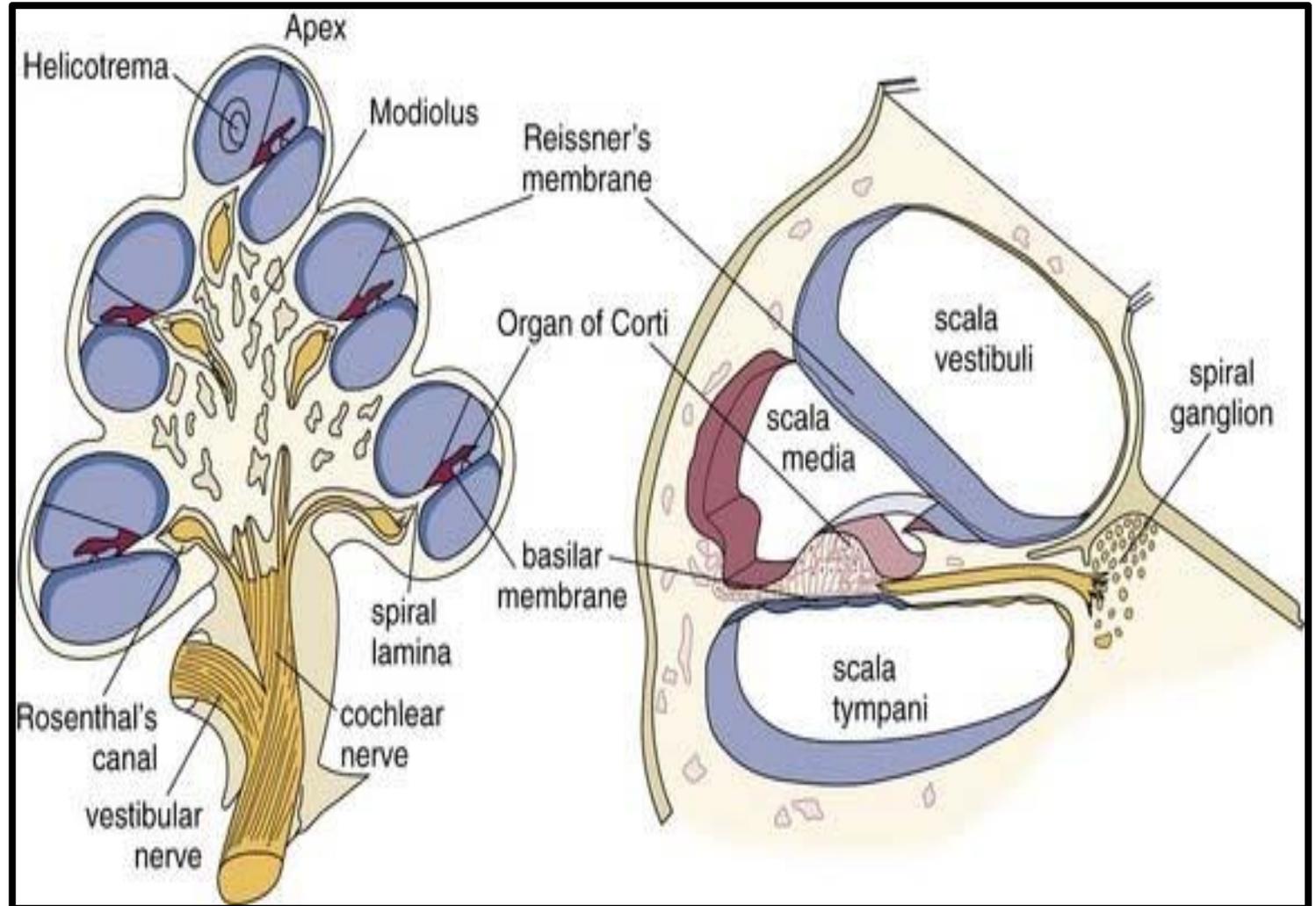
The Vestibule

- 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.



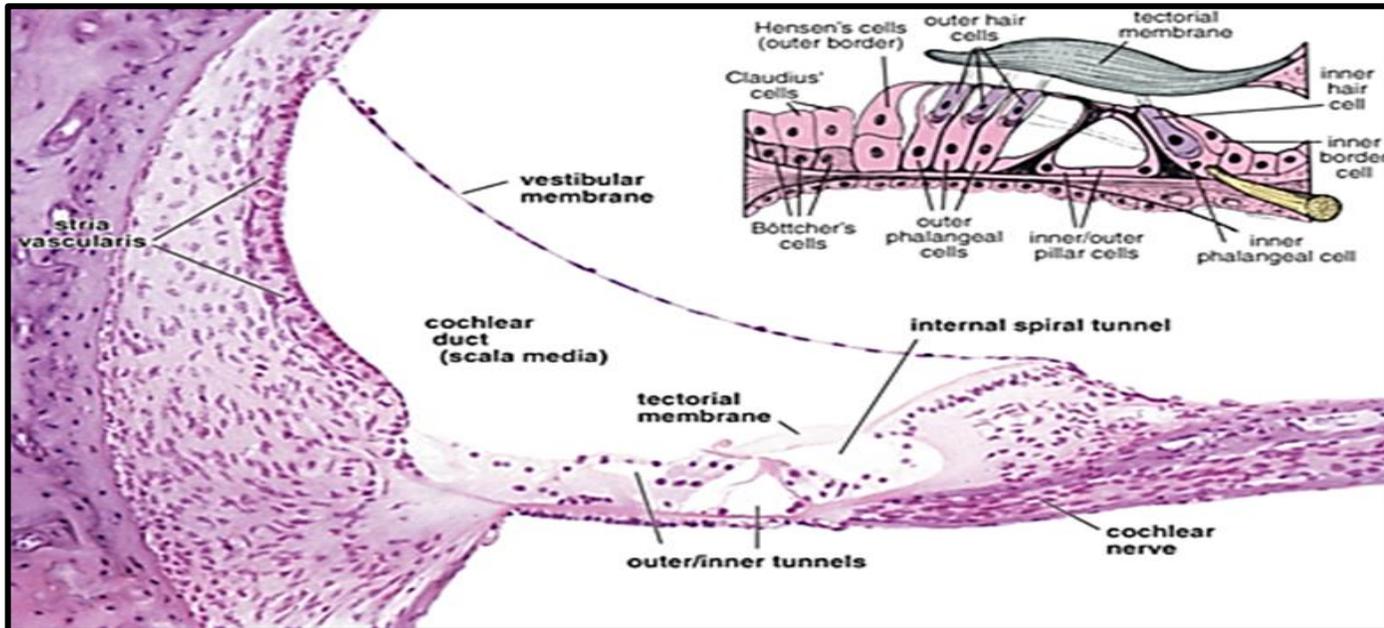
The cochlea

- 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 formed of:**
 1. **Supporting cells.**
 2. **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

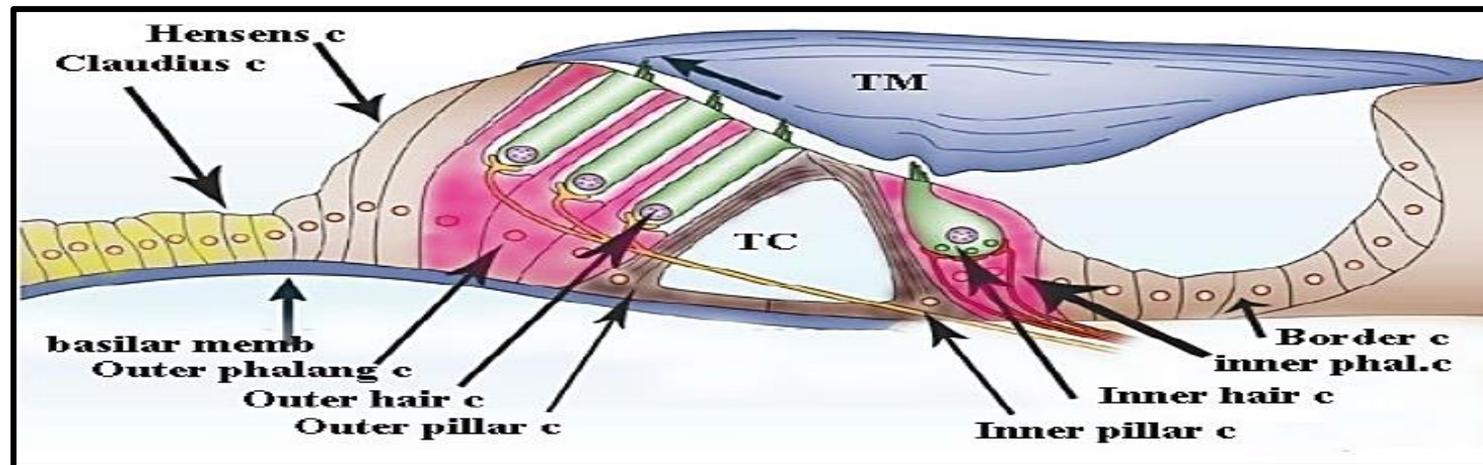
B- The hair cells:

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** is surrounded by the ends of the bipolar nerve cells of the spiral ganglia.



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

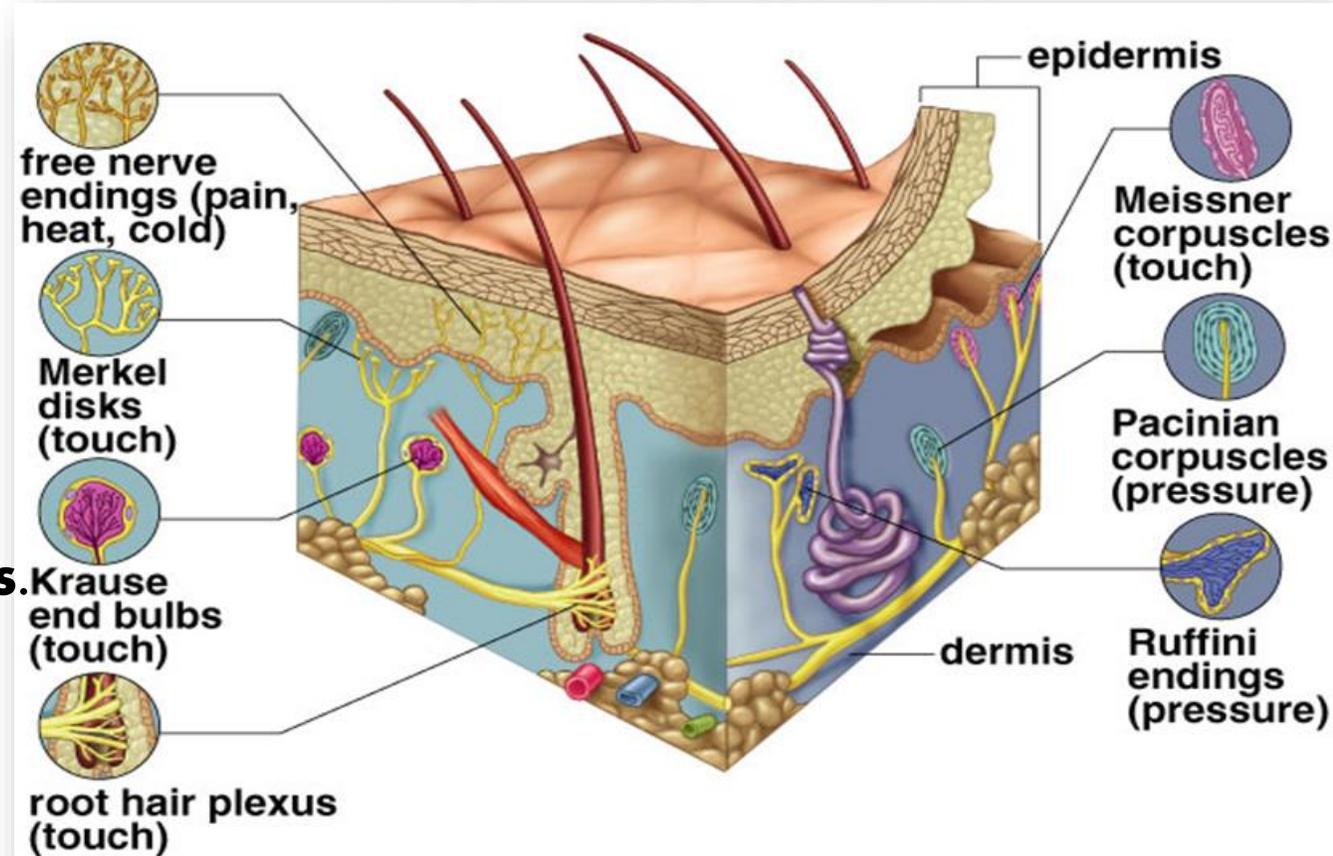
Motor end plate: motor to striated muscles.

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

Autonomic secretory endings: secretory to epithelial secretory cells.

Receptors for cutaneous sensation (Extroceptors)

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



Pacinian corpuscle

Site:

- **Deep in the dermis and hypodermis:** Numerous in Fingers and external genitalia.
- **Sites subjected to pressure:** inter muscular septa,

Shape: Oval

Capsule:

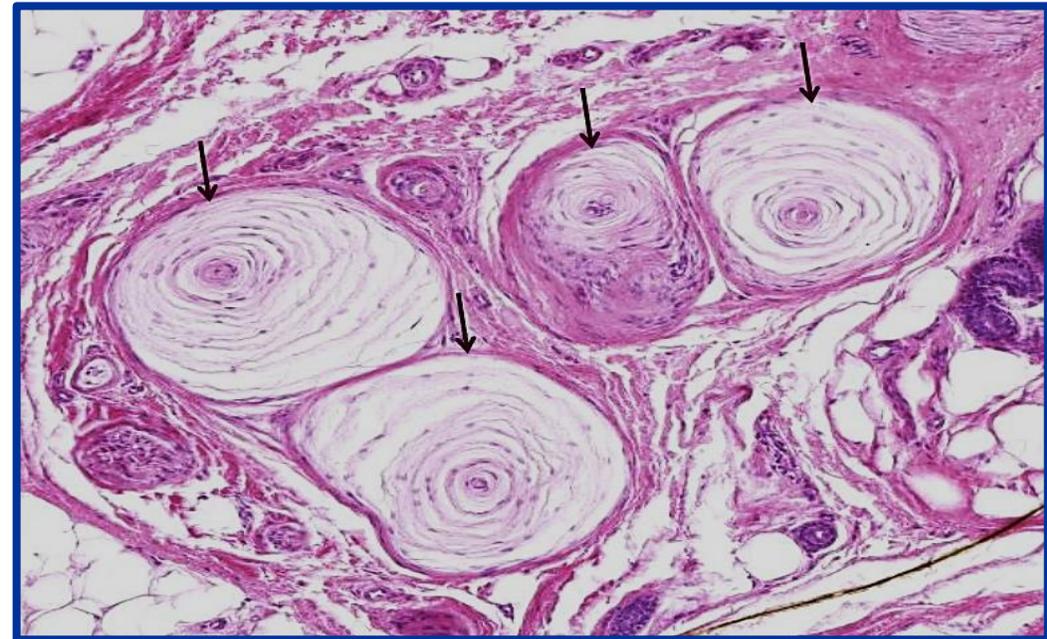
Thin separated from the corpuscle by a subcapsular space

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



Muscle Spindle (Neuro-Muscular Spindle)

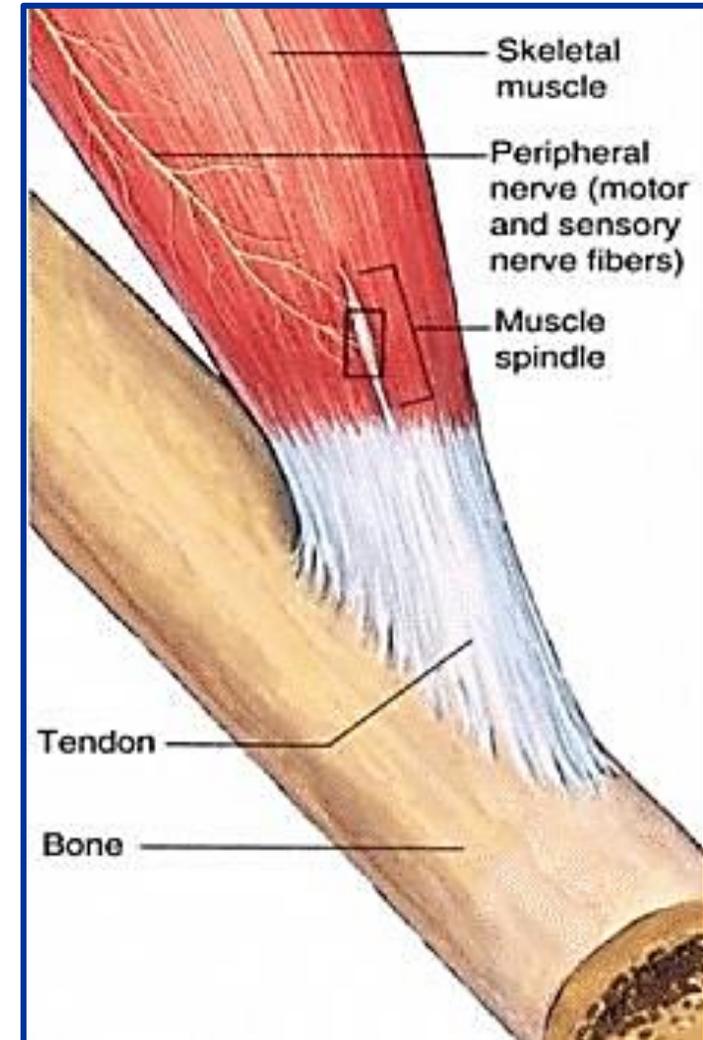
Function:

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

Site:

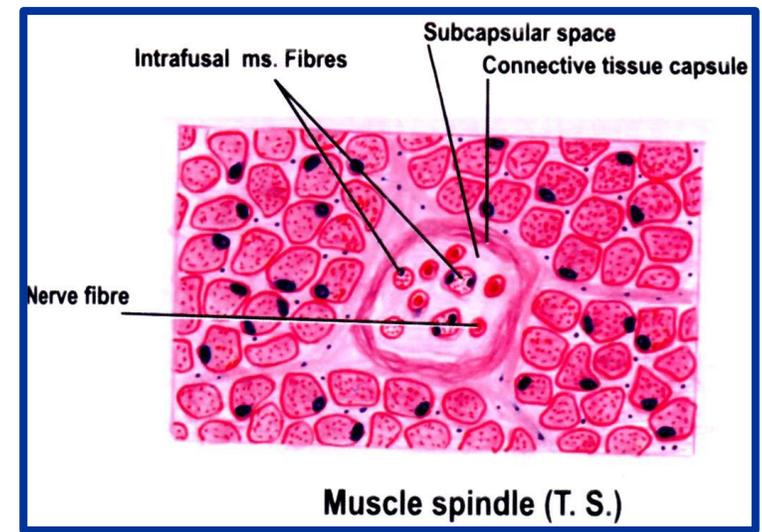
- 1) Between the striated muscle fibers specially near their insertion.
- 2) Numerous in small muscles doing fine work e.g. Hand muscles.

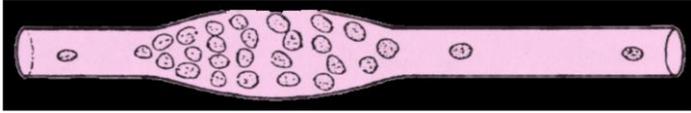
Shape: Fusiform.



Structure:

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



	Nuclear bag fibers	Nuclear chain fibers
		
Size:	Thicker × longer	Thinner × shorter
No:	Fewer	Numerous
Central Part:	<ol style="list-style-type: none"> 1) Expanded 2) Contains a bag of nuclei. 	<ol style="list-style-type: none"> 1) Not expanded 2) Contains a chain of nuclei



Thank
You!

Dr. Dalia Eita