بسم الله الرحمن الرحيم

CNS REVISION

Dr. Dalia Eita

NERVOUS TISSUE

Dr. Dalia Eita

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:

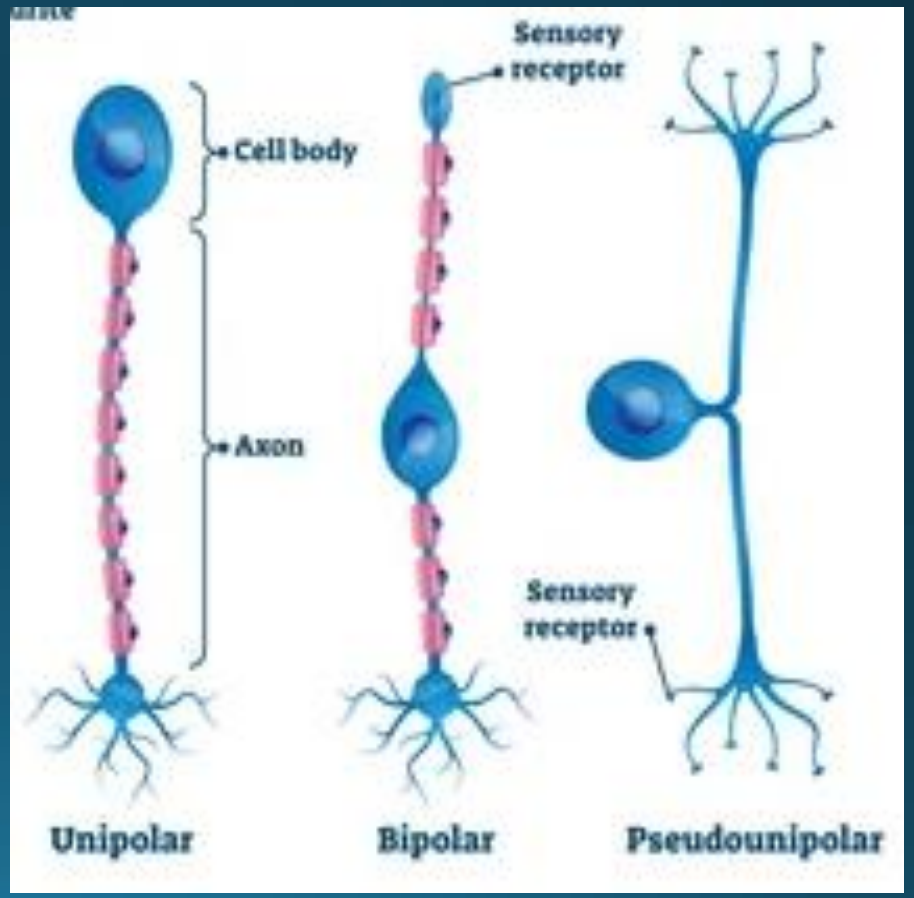
- **Site: spinal ganglia.**

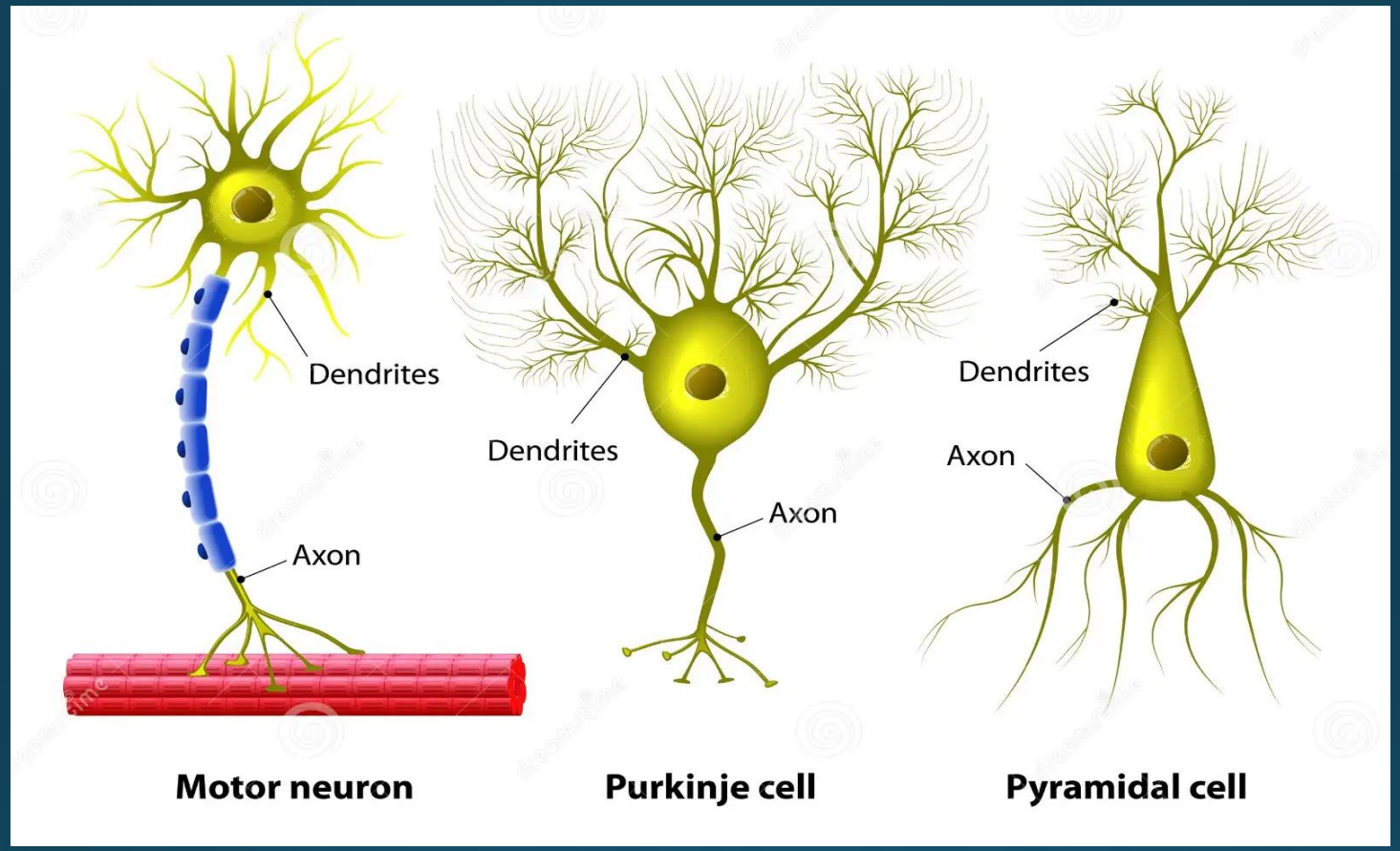
3- Bipolar nerve cells:

- **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.

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:

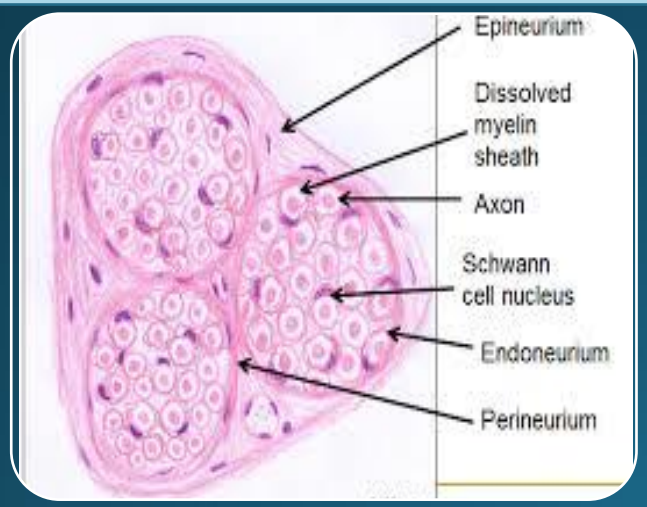
Groups of nerve fibers arranged in bundles.

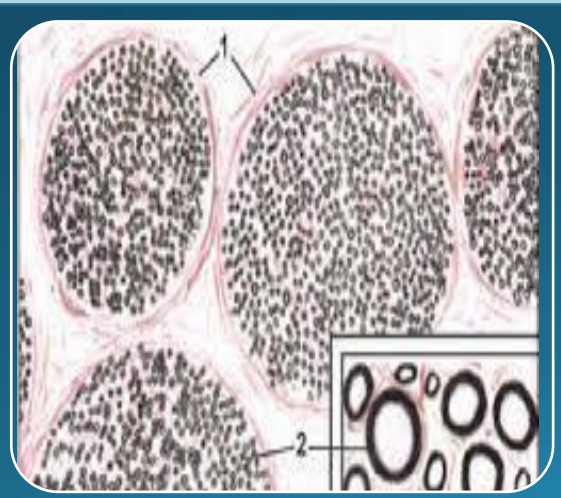
- ***In Hx. & E. stained section:***

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

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.

Which of the following cells is not one of the glial cells?

a. Astrocytes

b. Spongioblasts

c. Fibroblasts

d. Ependymal cells

Schwan cells

Which type of nerve cells is present in spinal ganglia?

a) Unipolar nerve cells

b) Pseudounipolar nerve cells

c) Bipolar nerve cells

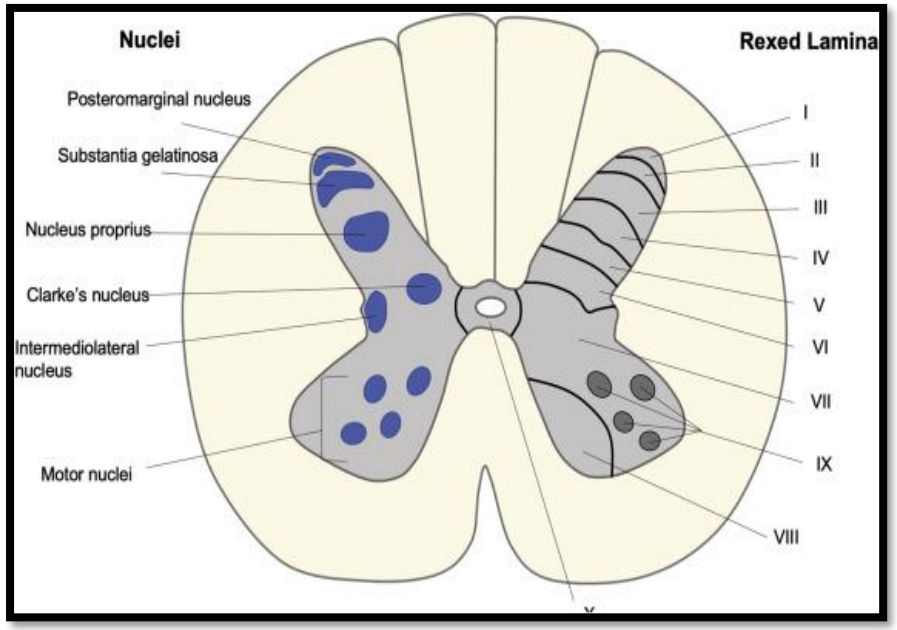
d) Polygonal nerve cells

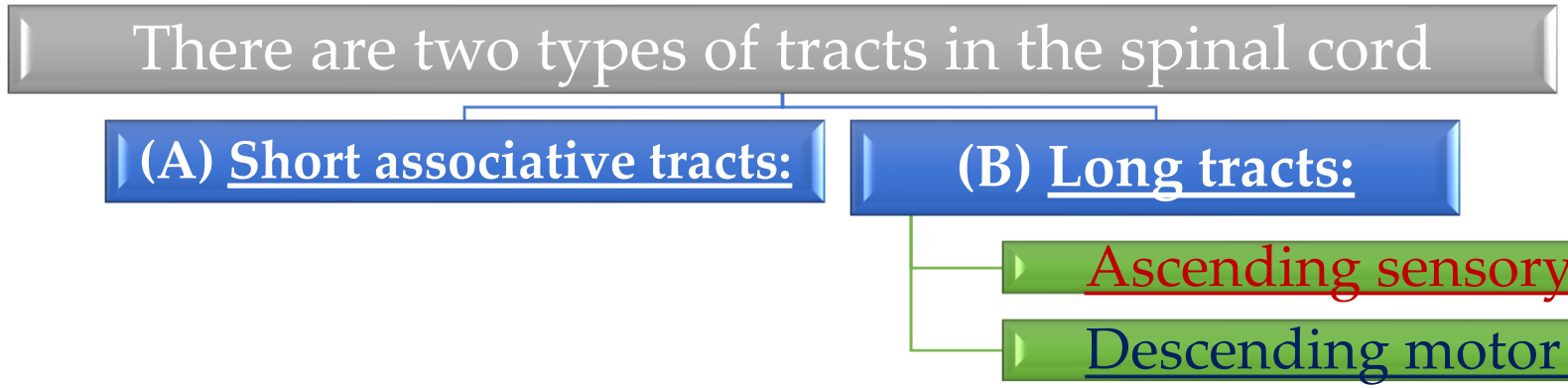
Pyramidal nerve cells

The Central Nervous System

Dorsal horn nuclei	Lateral horn nuclei	Ventral horn nuclei
4 sensory nuclei: Posteromarginal nucleus. Substantia gelatinosa of Rolandi. Main sensory nucleus. Clarke's nucleus.	• Sympathetic nucleus. • Parasympathetic nucleus.	(They are divided into medial, lateral and central NUCLEI)

PSM





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. <u>Four tracts carry sensations which are felt:</u>

- 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. <u>Four tracts carry sensations which are not felt:</u>

- 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
Pain and temperature from the opposite side of the body below the head.	Simple (crude) touch from the opposite side of the body below the head.	Proprioception, fine touch and vibration from the lower half of the body on the same side.	Proprioception, fine touch and vibration from the upper half of the body on the same side.

Dorsal spinocerebellar tract	Ventral spinocerebellar tract	Spinoolivary tract	Spinotectal tract
Unconscious proprioception from the trunk and lower limb to the cerebellum.	Unconscious proprioception from the lower limb to the cerebellum.	Unconscious proprioception to the cerebellum as part of the spino-olivo-cerebellar pathway.	for spinovisual reflexes.

The descending tracts of the spinal cord

The upper motor neurons (UMN

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 lower motor neurons (LMN)

- 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.

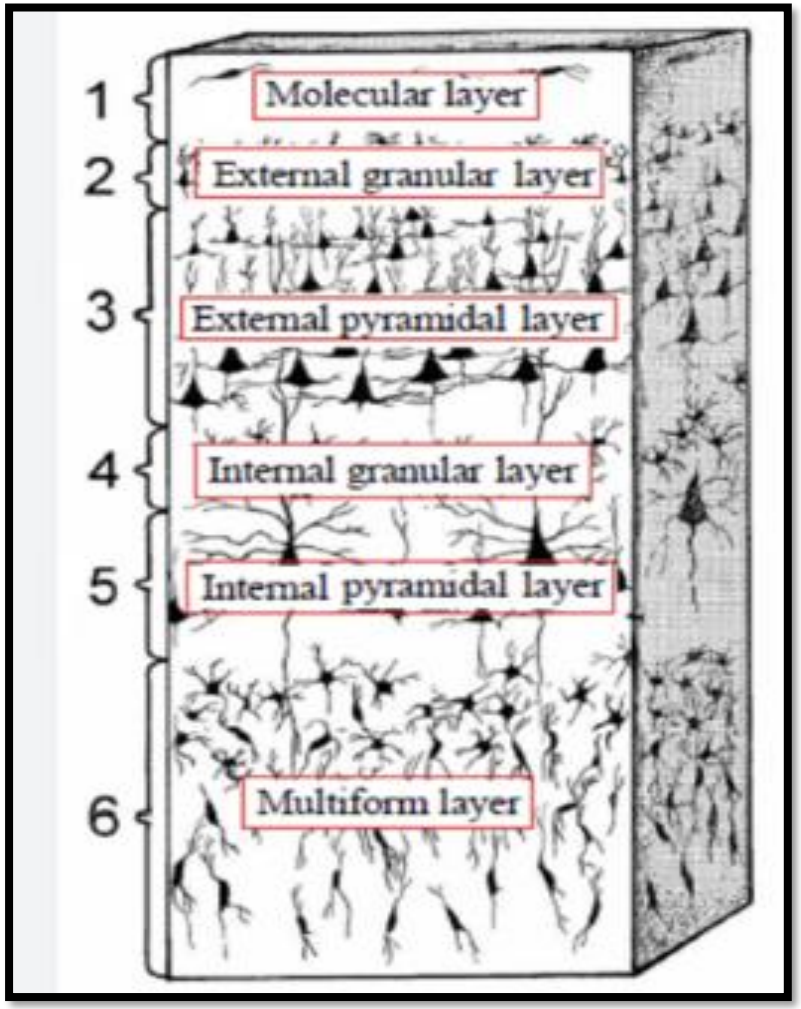
2. Outer granular layer:

3. Outer pyramidal layer:

4. Inner granular layer:

5. Inner pyramidal (ganglionic) layer

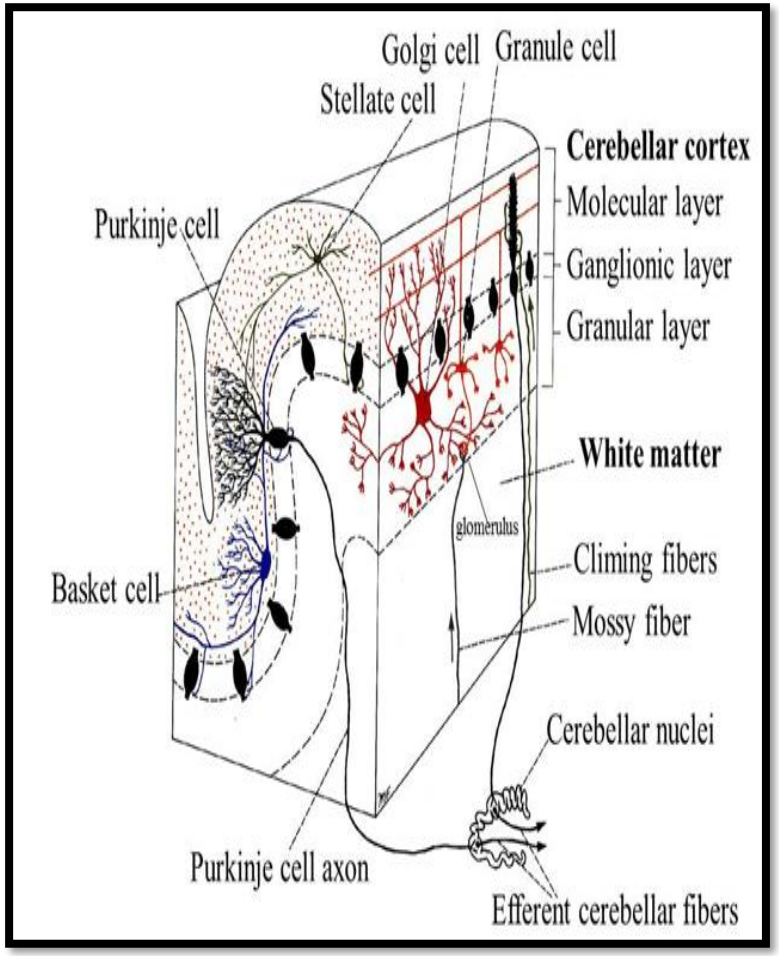
6. Pleomorphic (multiform) layer:



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.
• Cells: a. Molecular (stellate) neurons → they synapse with dendrites of Purkinje cells. b. Basket cells.		Cells: **1. Granular cells** 2. **Golgi II cells**
• **Fibers:** a. Axons & dendrites of molecular & basket cells. b. Dendrites of Purkinje cells. c. Axons of granular cells. d. Dendrites of Golgi II cells.		**Fibers:** • Axons of Purkinje cells • Climbing & Mossy fibers



Horizontal cells of Cajal are present in which layer of cerebral cortex

a) Inner pyramidal layer

b) Inner granular layer

c) Outer pyramidal layer

d) Outer granular layer

e) Molecular layer

Which of the following tracts is responsible for fine skillful movements

a) Comma shaped tract

b) Pyramidal tract

c) Extrapyramidal tract

d) Lissauer's tract

e) Septomarginal tract.

Ventral spinocerebellar tract carries which of the following

a) Fine touch

b) Pain

c) Temperature

d) Unconscious proprioception

e) conscious proprioception

Which of the following is a lateral horn nucleus

a)Substantia gelatinosa of Rolandi.

b)Main sensory nucleus.

c)Clarke’s nucleus.

d)Gama motor neurons

e)Sympathetic nucleus

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

1) Epithelium: **stratified squamous non keratinized epithelium**

2) Bowman's membrane:

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:

5- Descemet's endothelium

Causes of corneal transparency:

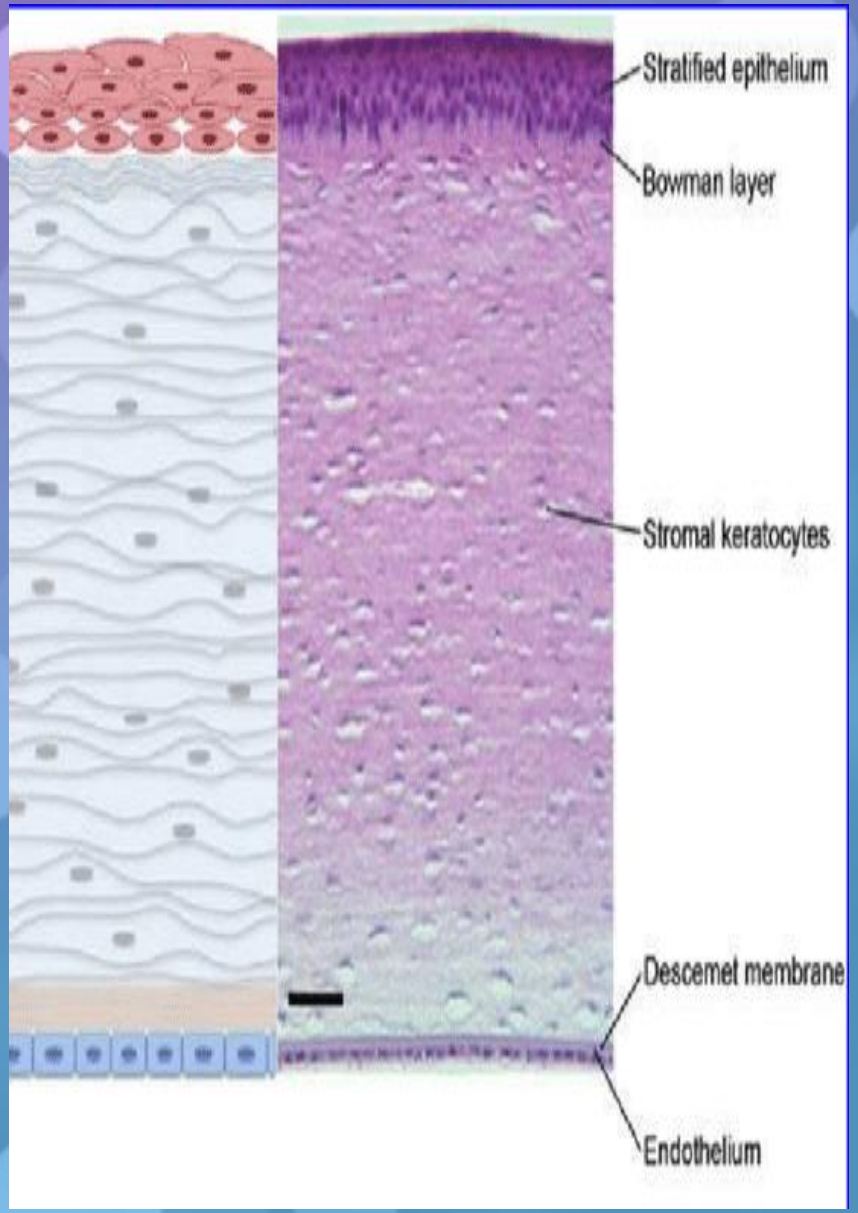
1- The continuous evaporation of water from its surface.

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

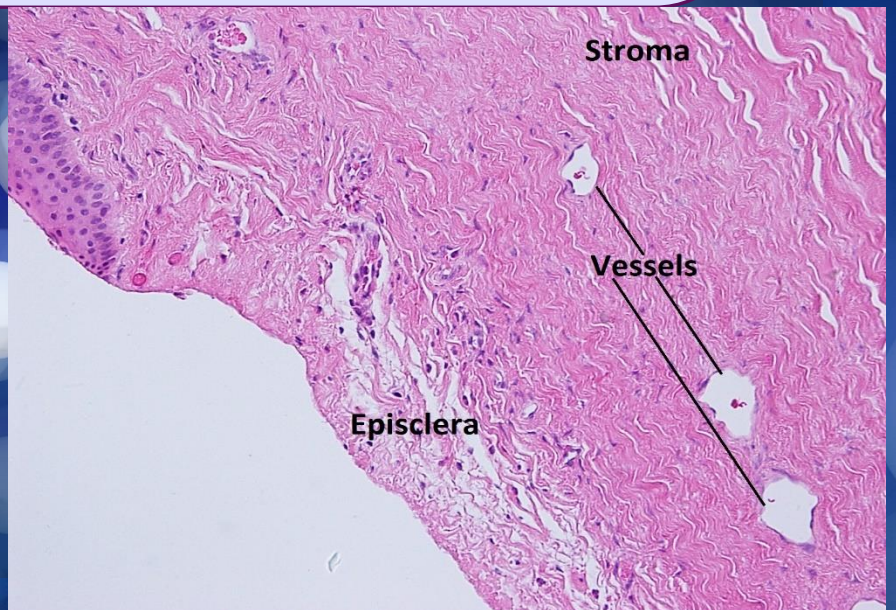
It is the white opaque posterior 5/6 of the eye.

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.

THE REFRACTIVE MEDIA OF THE EYE

- Cornea
- Aqueous humor
- Lens
- Vitreous body

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**

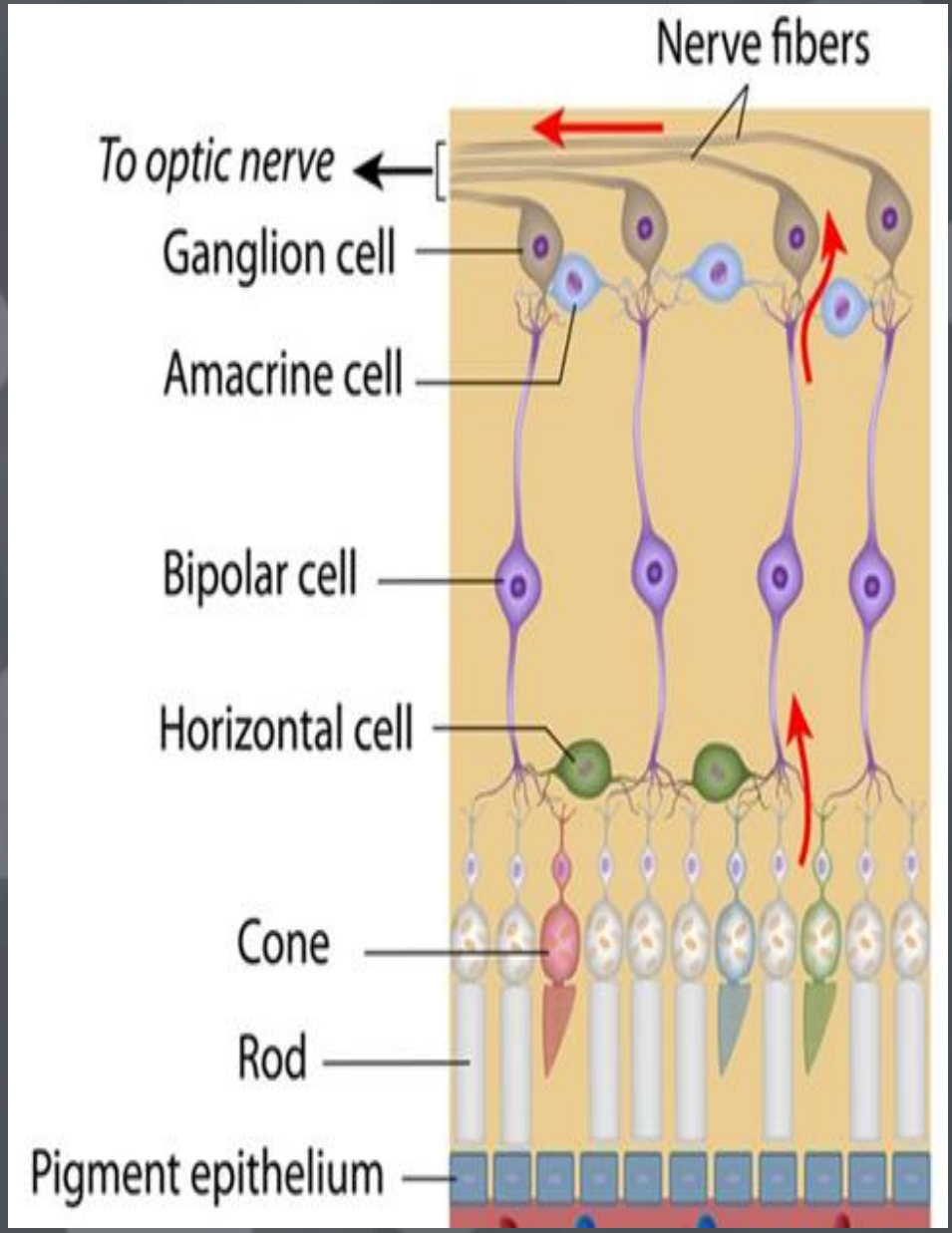
	Rods	Cones
(A) Number:	**120 millions**	**6-7 millions**
(B) Function:	– **Adapted to function in dim light**	– **Adapted to function in bright light.**
(C) Site:	**Not present at the fovea centralis**	**The only receptors found in the fovea centralis.**

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

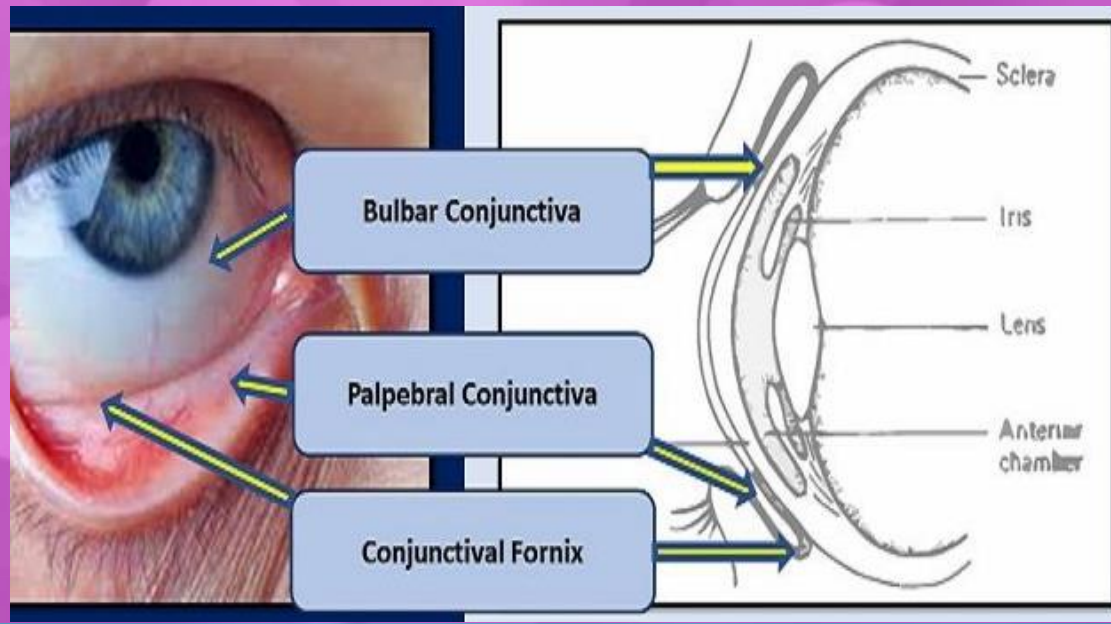
Site: It covers the anterior portion of the eye up to the cornea.
It also lines the internal surface of the eyelids.

Parts:

1- Bulbar conjunctiva which covers the anterior part of the sclera.
2- Palepebral 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 palbebral part: stratified squamous
2- Corium: loose connective tissue



(2) The Eyelids

Histological structure:

A perpendicular section shows the following layers from front backwards:

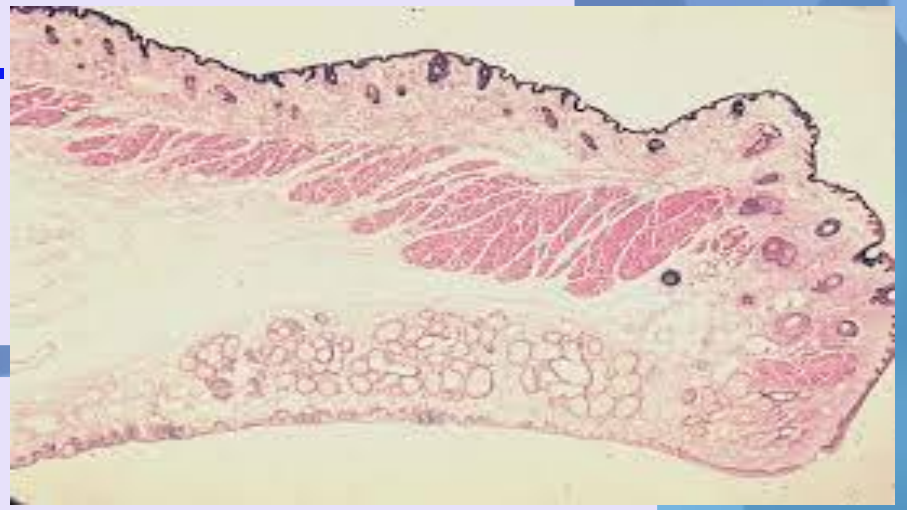
1-Skin

2-Skeletal muscles: bundles of the orbicularis occuli.

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.**

What type of epithelium forms the corneal epithelium?

a) Simple cuboidal keratinized

b) Stratified squamous non-keratinized

c) Simple squamous keratinized

d) Transitional epithelium

e) Pseudostratified columnar

Which of the following is not one of the refractive media of the eye?

a. The cornea.

b. The aqueous humor.

c. The lens.

d. The sclera

e. The vitreous body.

The Ear

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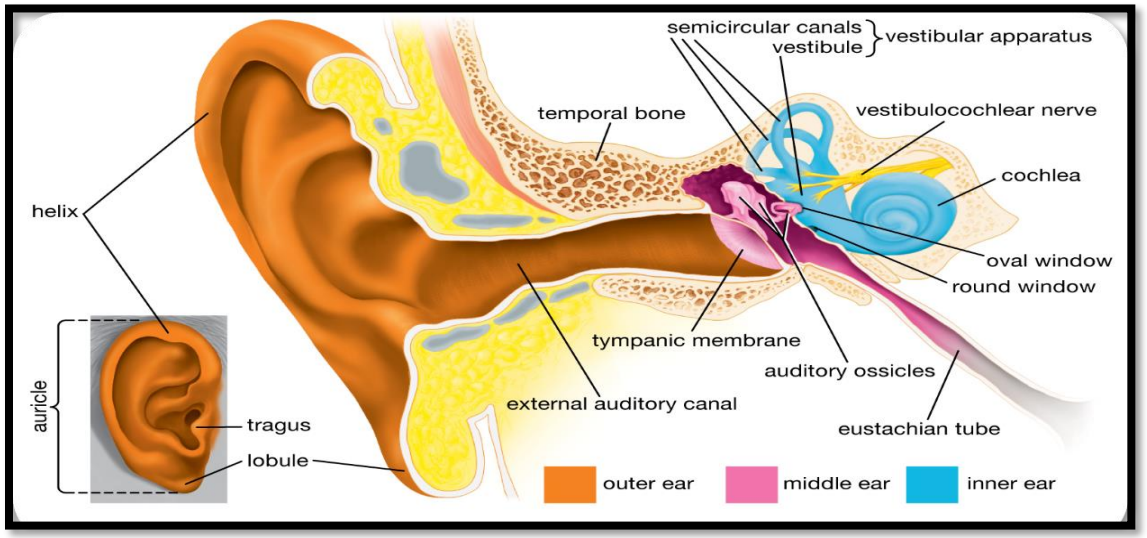
The external ear

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

The Auricle:

Structure:

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



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**

The tympanic membrane (the ear drum):

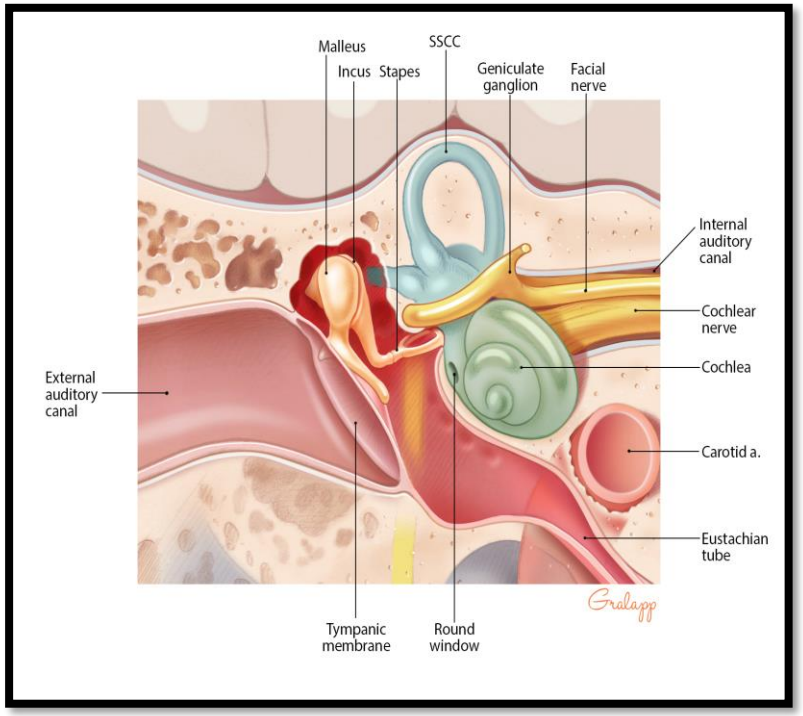
- **It consists of 2 layers of collagenous fibers:**

- **Both layers are covered externally by skin and internally by simple cubical epithelium.**

The middle ear

- **Lined with simple cuboidal epithelium.**
- **It Contains:**

- 3 ossicles
- 2 muscles
- 2 windows
- Chorda tympani nerve



The ossicles

1. Malleus
2. Incus
3. Stapes

The muscles

1. Tensor tympani
2. Stapedius

The windows

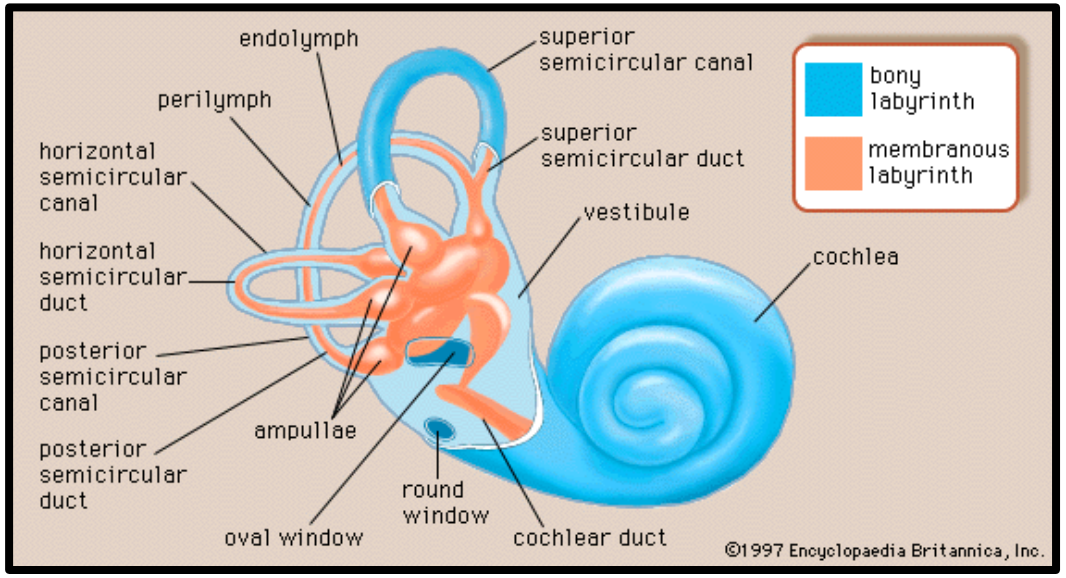
1. Oval window:
2. Round window

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.**



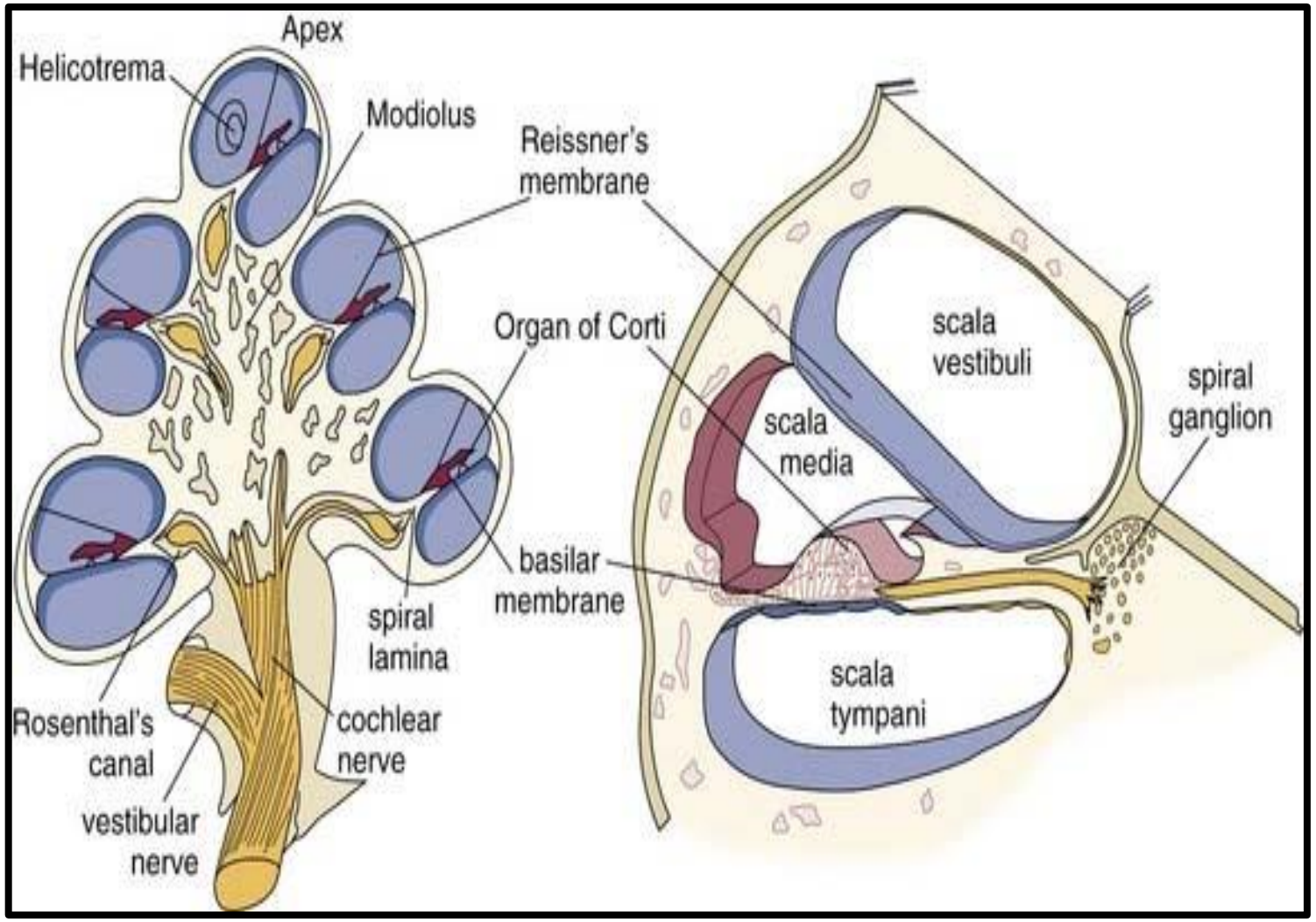
2. The bony labyrinth:

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

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.**



Organ of Corti

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:**

3. **Cells of Claudius**

4. **The Hensen's cells**

5. **The border cells**

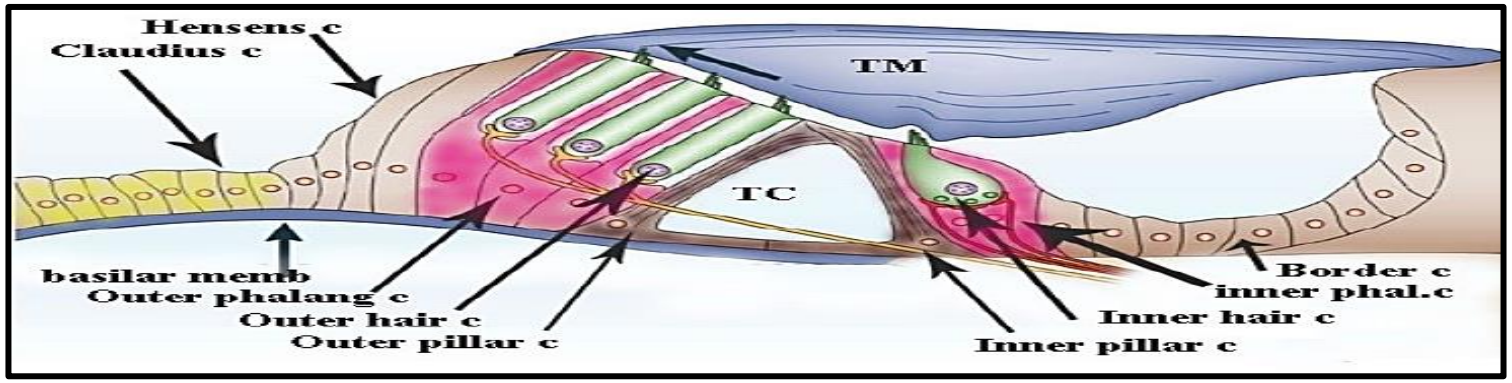
B- The hair cells:

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.



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:

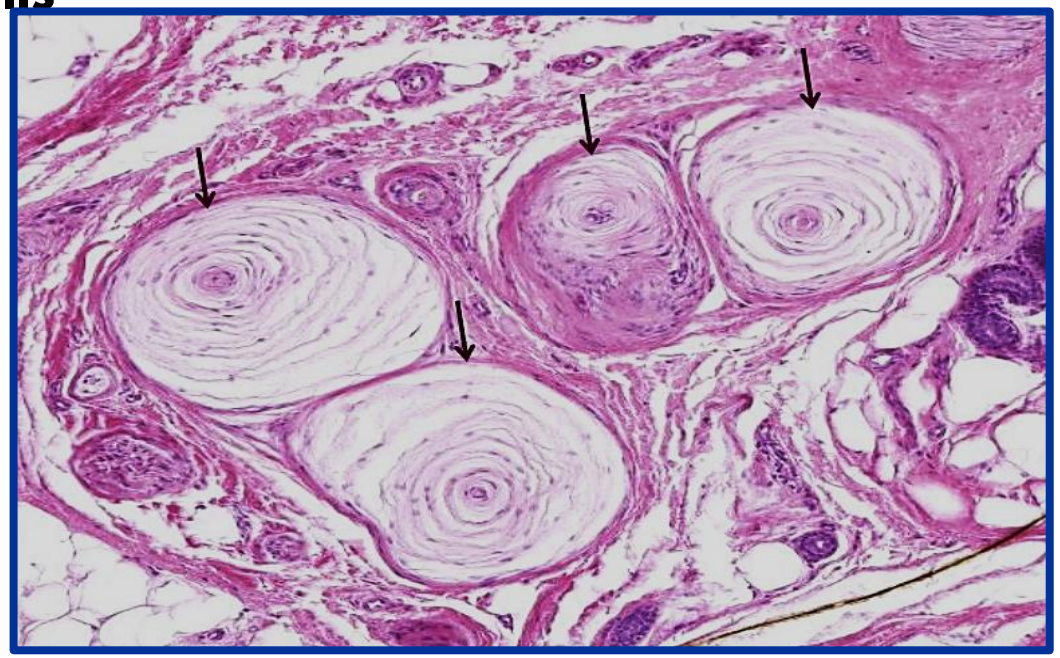
Thin separated from the corpuscle by a subcapsular space

Axial core:

- **20 – 80 concentric layers of flat modified Schwann cells**
- **L.S: onion like appearance.**

Nerve fiber:

Myelinated, penetrates the corpuscle at one pole to become non myelinated

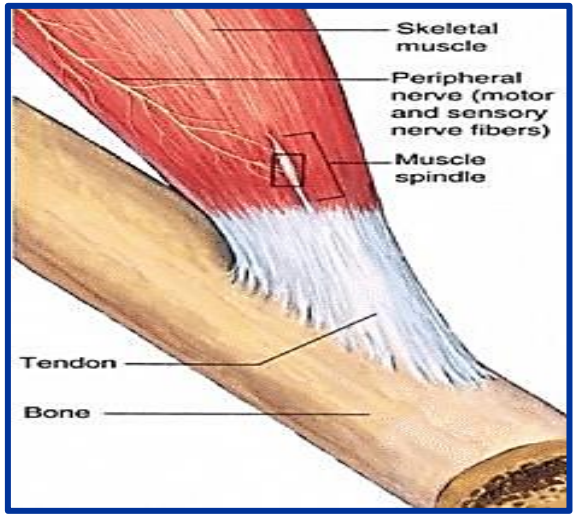


Muscle Spindle
(Neuro-Muscular Spindle)

Site:

1) Between the striated muscle fibers specially near their insertion.

2) Numerous in small muscles doing fine work e.g. Hand muscles.

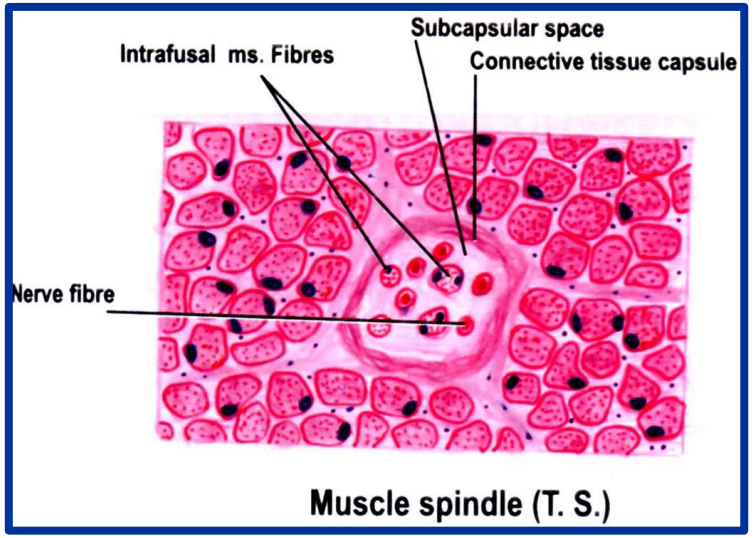


Shape: Fusiform.

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.



Muscle spindles are mostly found in:

A. Papillary Layer of dermis

B. Deep in the hypodermis

C. Large muscles

D. Small muscles doing fine work

E. Ligaments

Which type of epithelium lines the inner surface of the tympanic membrane?

A. Stratified squamous
B. Pseudostratified columnar
C. Simple squamous
D. Simple cuboidal
E. Transitional

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