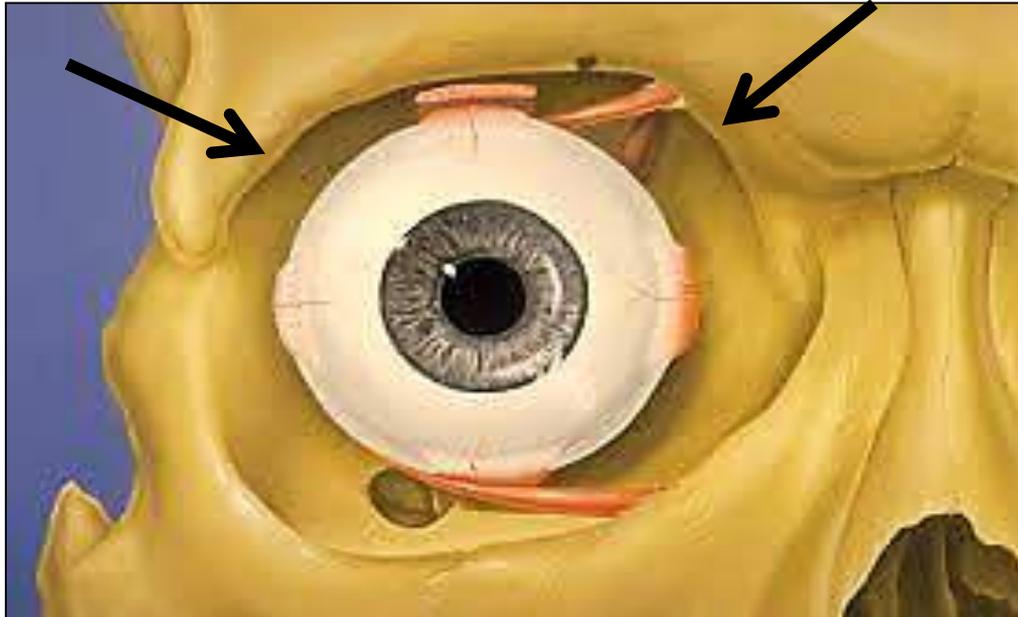


The eye

Professor Dr . Hala El-mazar

- The eye is the **organ of vision**
- **Photosensitive:** detect light and convert it into **electro-chemical** signals that travel in neurons to the cerebrum
- The eyes located in bony cavities in the skull called **orbits**



Histologically each eye is composed of **three layers (tunics)**:

1- The external layer (**fibrous**) composed of:

Cornea

Sclera

2- The middle layer (**vascular, muscular, pigmented**)
composed of:

Iris

Ciliary body

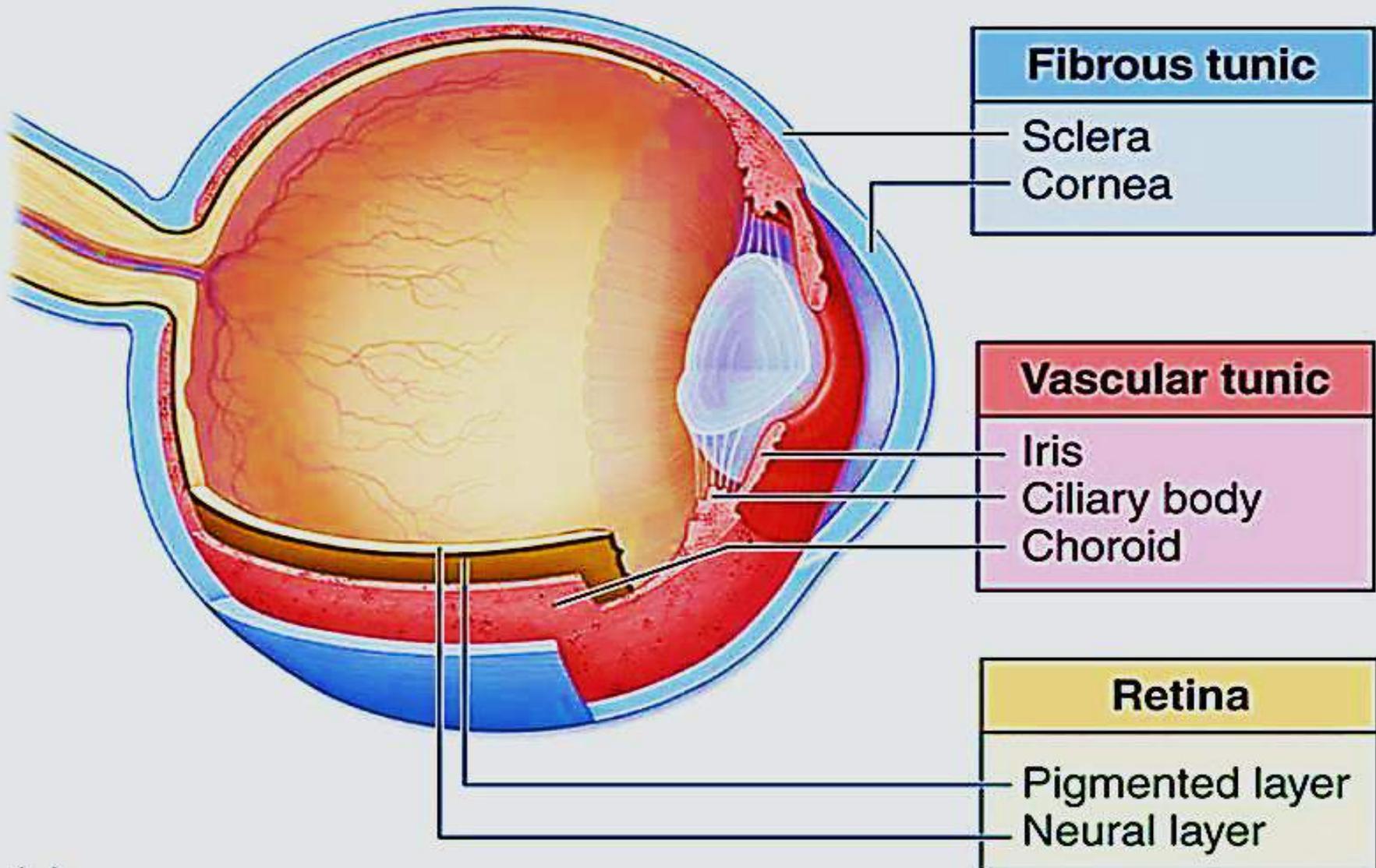
Choroid

3- The inner layer (**nervous**) composed of: **Retina**

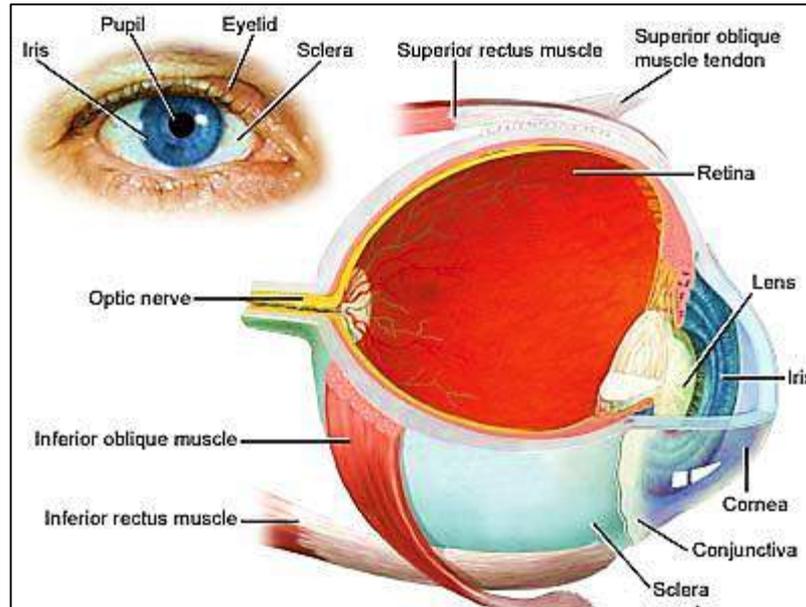
Pigmented epithelium

Neural layer

Layers (tunics) of the eye



(a)

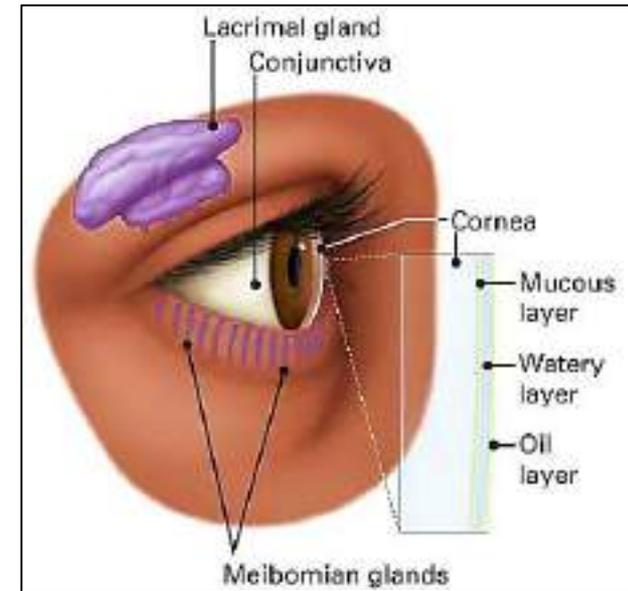
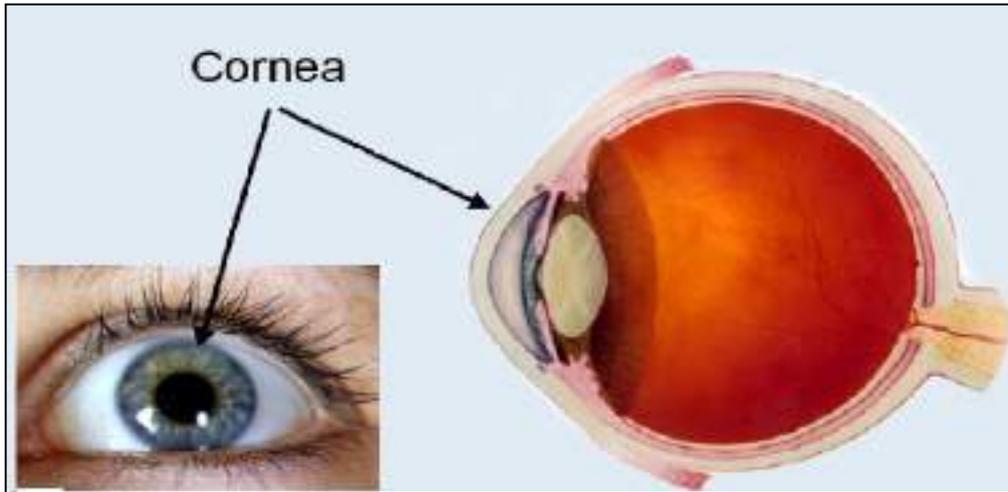


The external (fibrous) layer

A- the cornea

B- the sclera

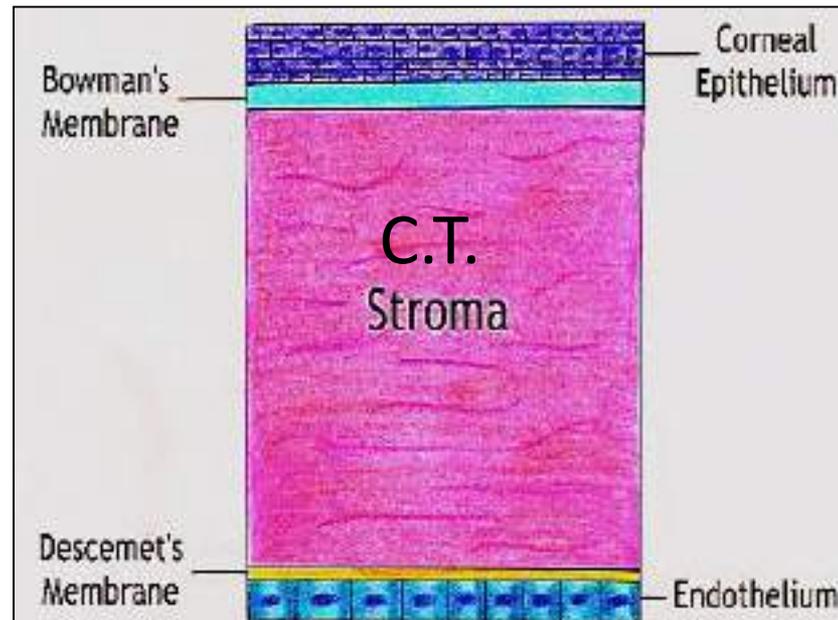
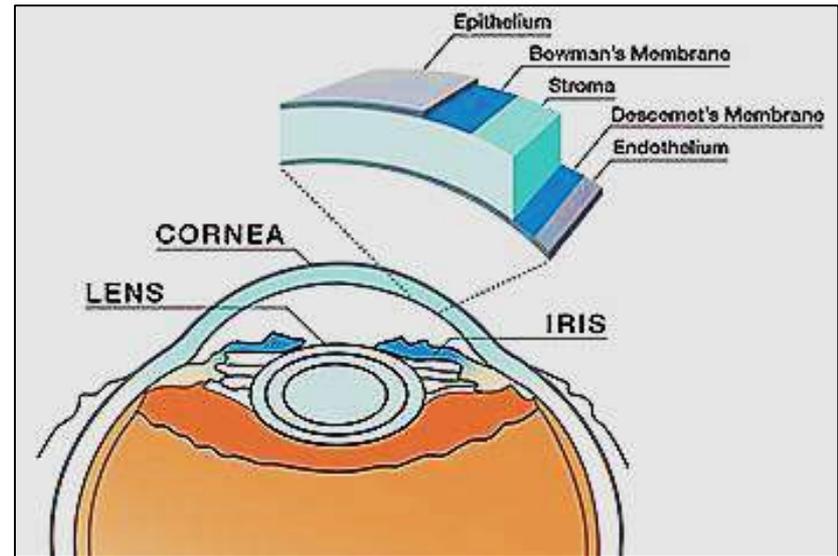
The cornea



- Dome shape, transparent (colorless)
- Non vascular anterior part of the outer (fibrous) layer
- Refracts (bend) the light entering the eye to help it focus on retina
- Is richly supplied with sensory nerve endings
- Is kept wet by the secretion of the tarsal & lacrimal glands

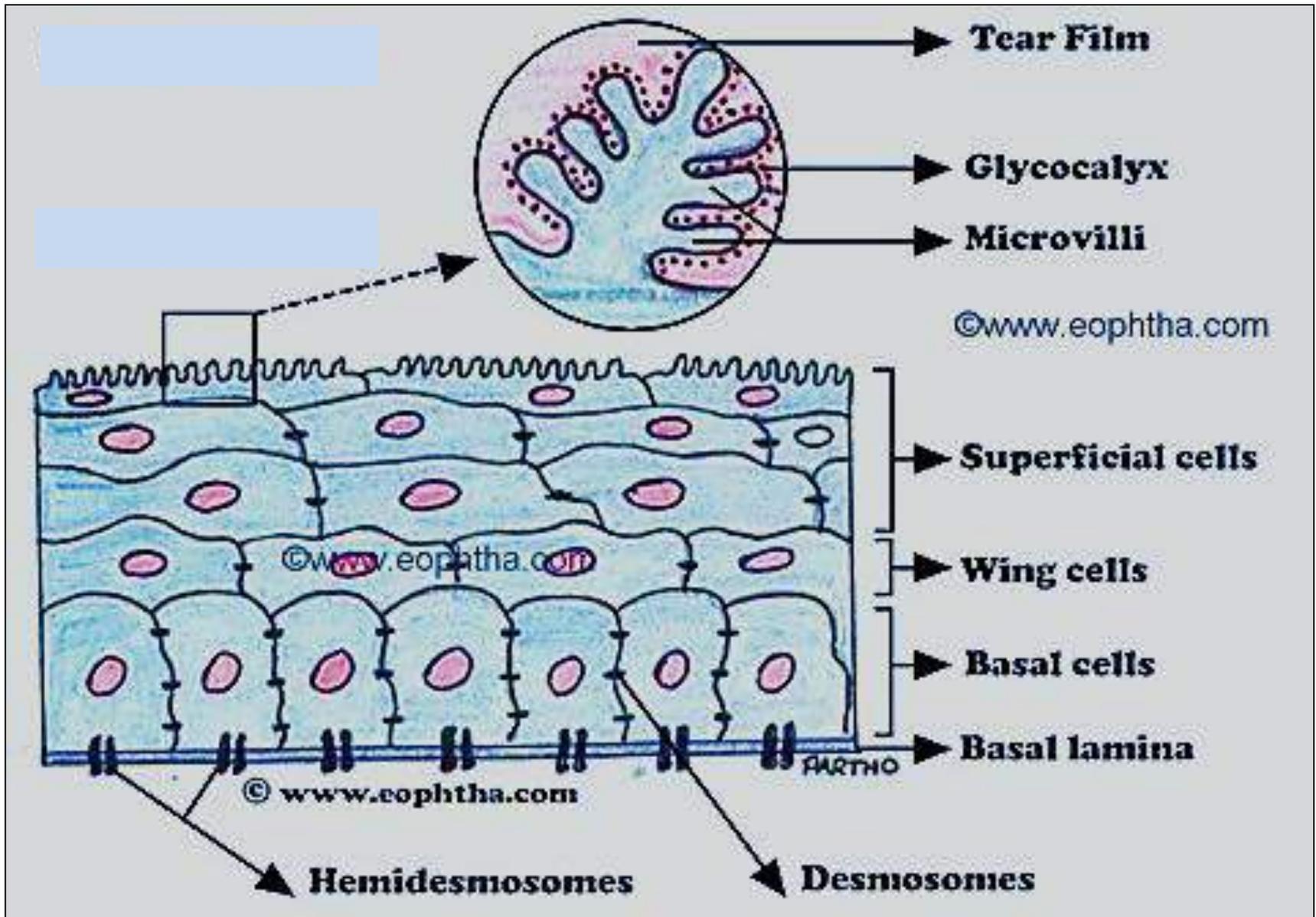
- Histologically the cornea composed of 5 layers:

- A-** Anterior epithelium
- B-** Bowman's membrane
- C-** C.T. layer or stroma
- D-** Descemet's membrane
- E-** Endothelium



1- Anterior epithelium (10%)

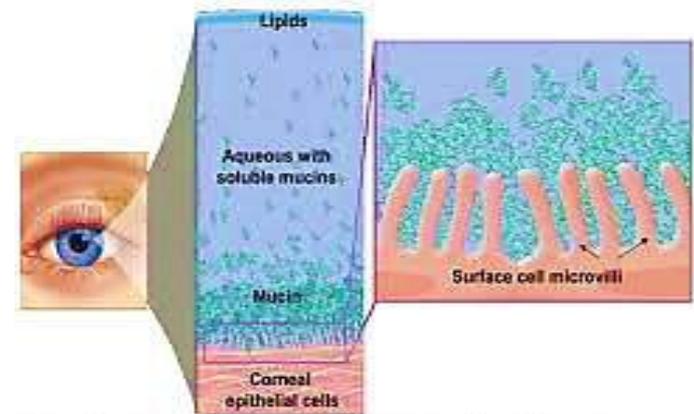
- It is non-keratinized stratified squamous epithelium
- It consists of 5-6 layers of cells
- The basal cells are **columnar**, show many mitotic figures, indicating high capacity of **cell renewal & repair**.
- intermediate layer consists of 3-4 layers of **polyhedral cells**, is **richly supplied with free nerve endings** (trigger blinking reflex)
- The surface corneal cells are **squamous** show microvilli which function to **retain a thin tear film over the corneal epithelium**. constantly shed
- The epithelium is transparent due to continuous evaporation of water from its surface, & active exocytosis from endothelium layer



(The corneal epithelium)

Importance of microvilli on the superficial cells of the cornea:

- **Increase the surface area:** of the epithelial cells which helps in better adherence of the tear film
- **Tear film stability:** tear film is essential to provide the corneal epithelium with nutrients & maintain its hydration
- **Transport and absorption:** absorb water , electrolyte & nutrients into epithelial cells



Tear film structure:

1- mucus layer:

covers microvilli & forms a network over the conjunctival surface, secreted by conjunctival goblet cells & the stratified squamous cells of the conjunctive

Function: Convert corneal epithelium from hydrophobic to hydrophilic layer → stabilize the tear film, provide lubrication for eyelid movements

2- Aqueous layer: (thick layer)

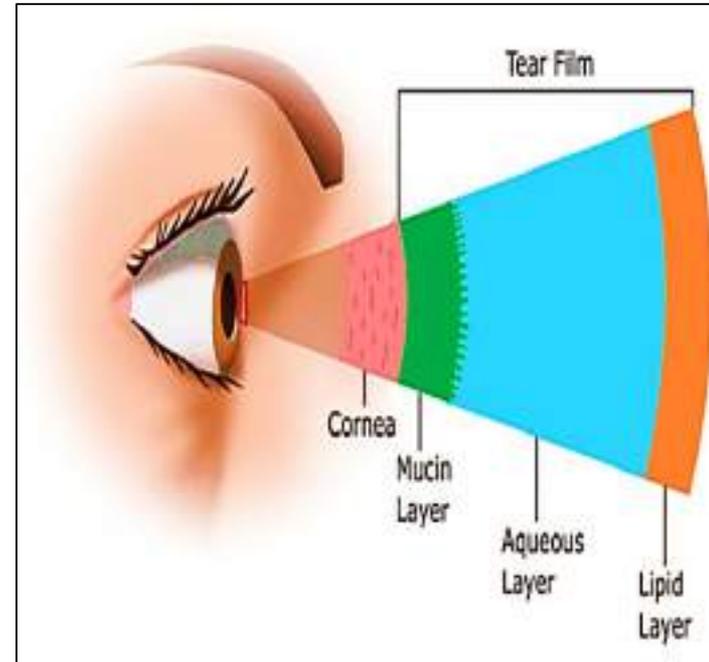
Secreted by lacrimal glands (watery secretion)

Function: supply oxygen to the avascular corneal epithelium & maintain constant electrolyte composition the corneal epithelium

3- Lipid layer :

Secreted by tarsal glands of eye lids

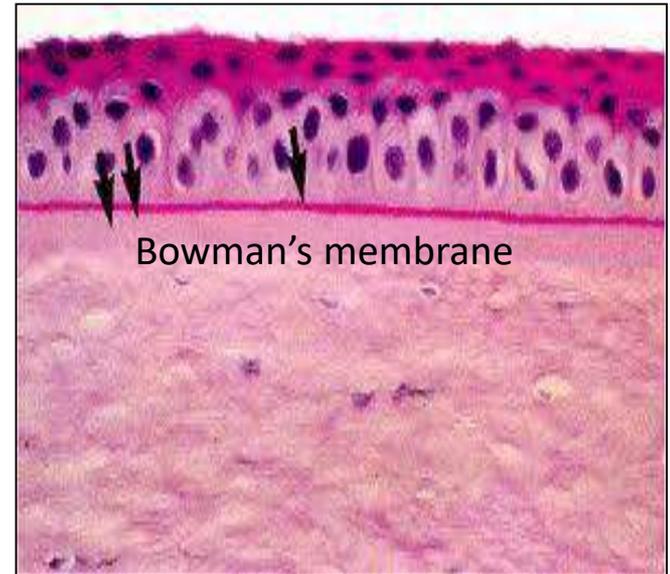
Function: prevent evaporation, reduces friction during blinking & protects the surface fro dryness



2- Bowman's membrane

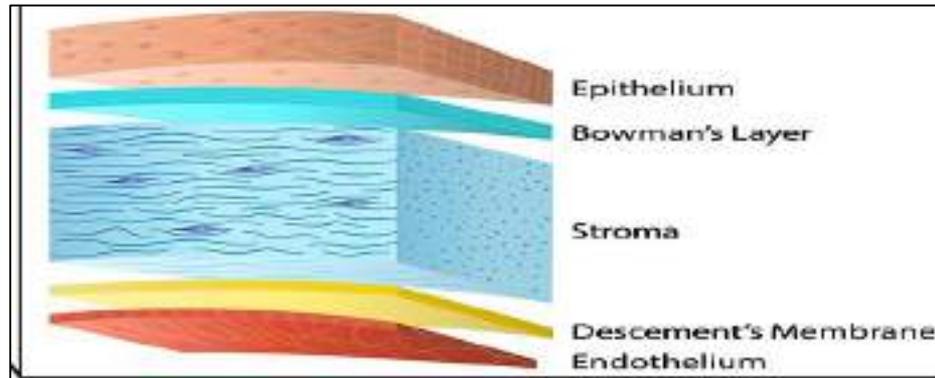
- It is a thick , **non-cellular membrane** BELOW the epithelium basement membrane
- Formed of protein fibers (collagen types I & V)

- It acts as protective barrier to the stroma(next layer) against infection & provide support to sub-epithelial nerve plexus
→ protect the epithelial innervation

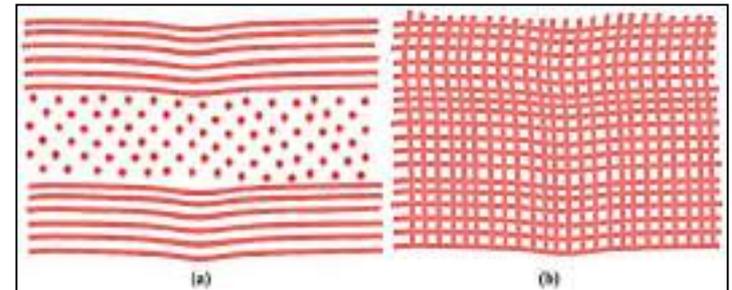


- If injured doesn't regenerate it heals by scar, and causes corneal opacity

3- C.T. (Stroma)

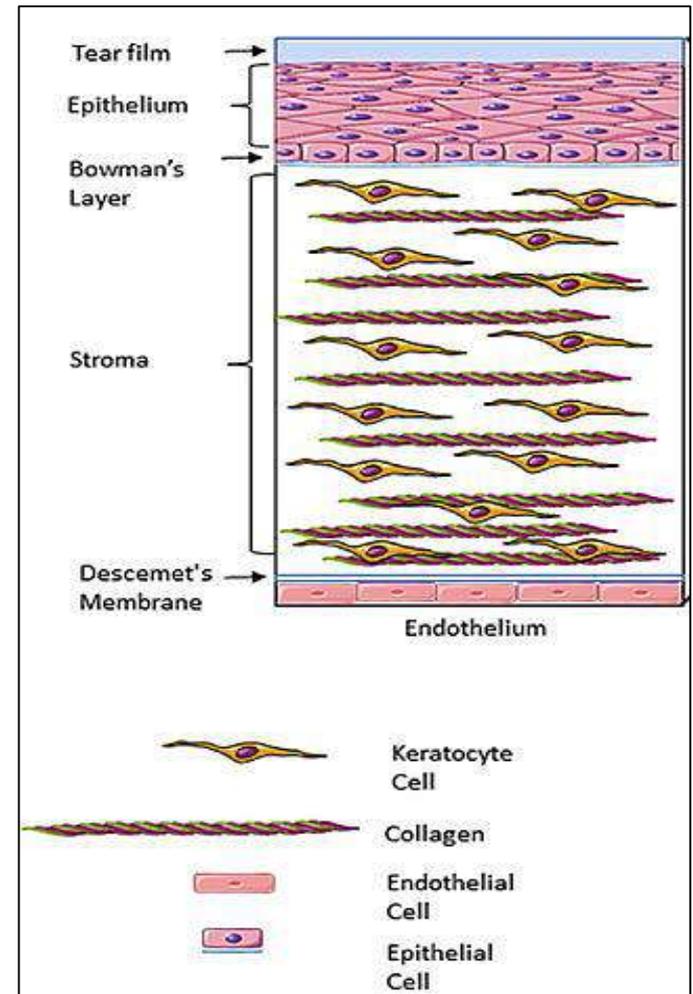


- The thick layer of cornea (**90%** of the corneal thickness)
- It is formed of layers of **parallel collagen fibers** (**types I predominantly**) arranged at right angles with each other.



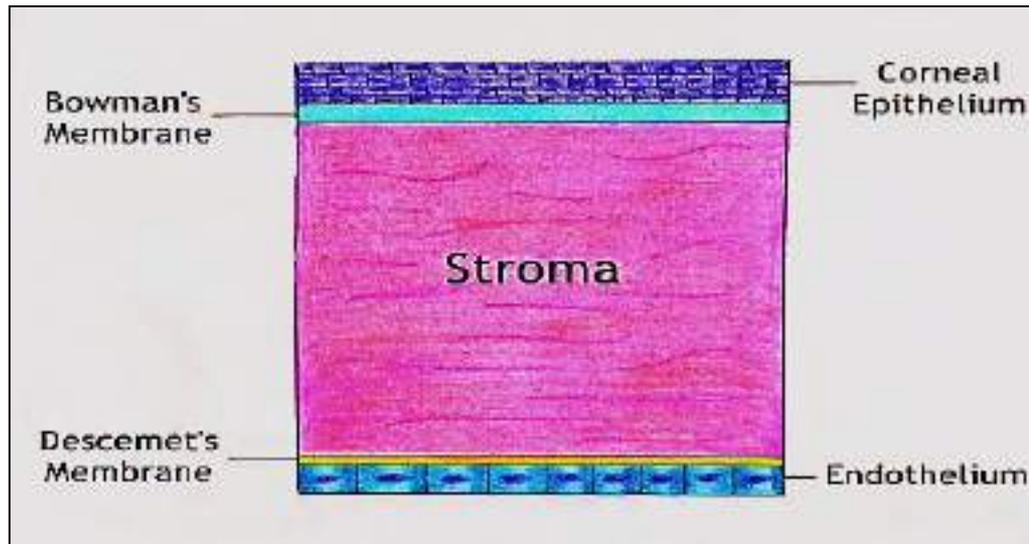
- the uniform arrangement of the
- Is called Lattice-like pattern . The collagen fibers are crucial for transparency & strength of the cornea

- Between the collagen fibers there are cells called **keratocytes**. they have role in synthesizing the collagen & matrix of stroma
- the matrix is secreted by these cells to maintain the nutriment & organization the spacing between stroma collagen fibers
- Stroma layer maintain the shape of cornea & withstand the pressure from inside the eye (intraocular pressure)



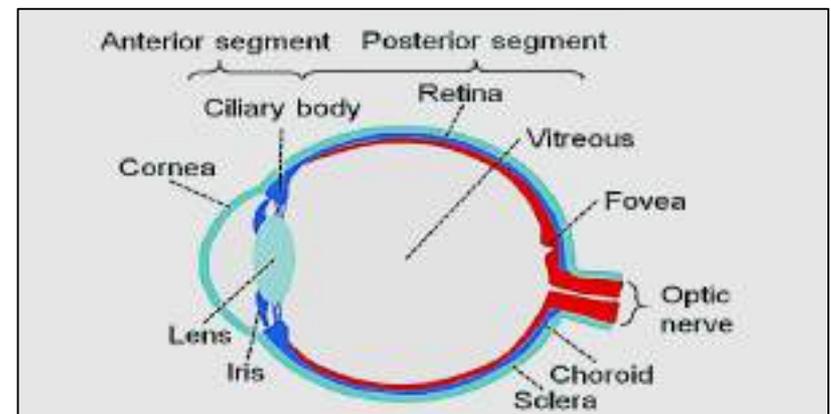
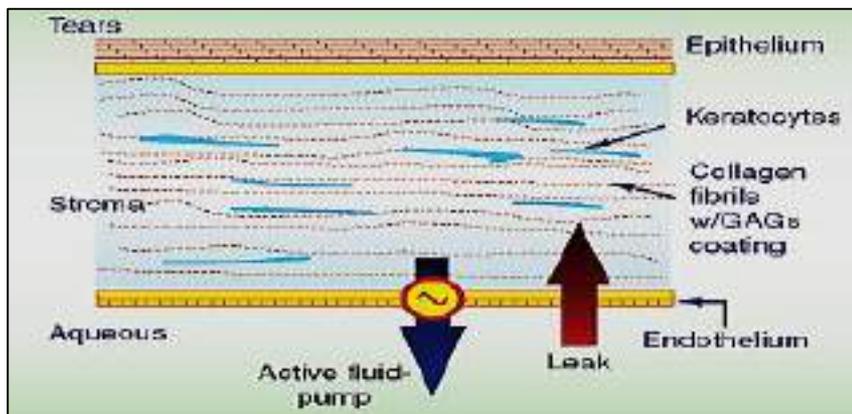
4- Descemet's membrane

- It is a thick homogenous, non-cellular membrane composed of fine collagen fibers (type IV & VIII)
- Made by the endothelial cells of the next layer but is not consider as basement membrane for them
- Provide structural support to the endothelial layer



5- Endothelium

- A layer of simple squamous cells (limited- regeneration), avascular
- Cells of this layer are active in:
 - **protein synthesis** to maintain the Descemet's membrane
 - **pumping excess water (active transport)** into the adjacent anterior chamber → dispose of any excess fluid in stroma → maintain corneal transparency
 - The endothelium responsible for maintaining state of hydration within the cornea that provide maximum transparency & optimal light refraction



Why is the cornea transparent?

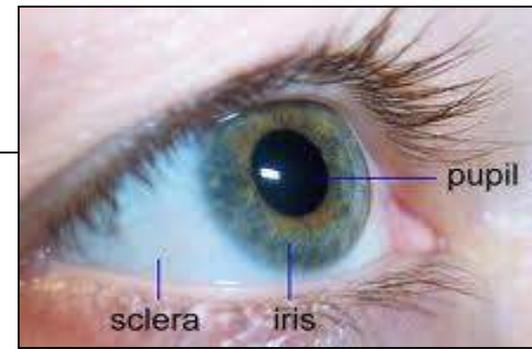
1. Avascular, no lymphatics. the cornea receives nutrients from aqueous humor and tear film
2. The surface epithelium is smooth & non-keratinized
3. Regular arrangement of collagen fibers cells, matrix in the stroma
4. Cells, fibers & matrix of corneal stroma have the same refractive index
5. The degree of hydration of the cornea is perfectly regulated through corneal endothelium

LASIK:

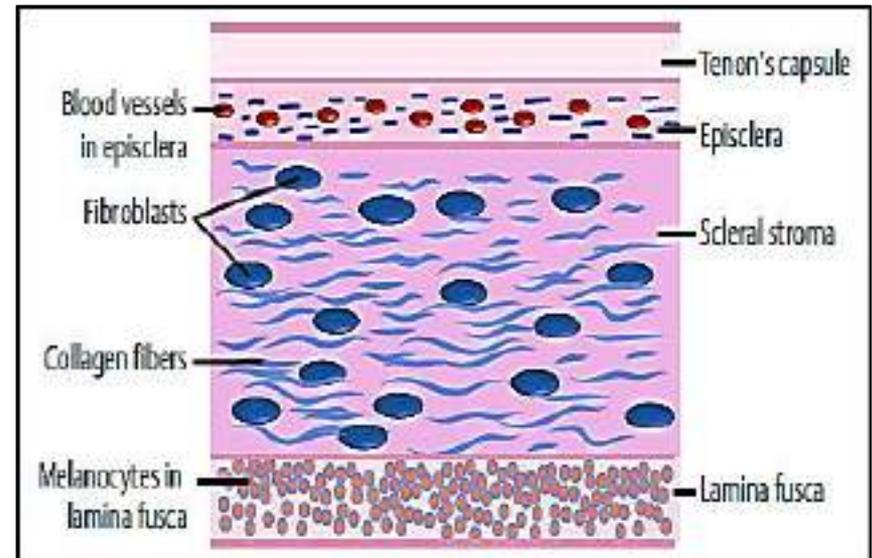
- Surgical technique used to improve the shape or curvature of cornea to correct certain visual abnormalities e.g. myopia, hyperopia, astigmatism
- In this technique the corneal epithelium is displaced as a flap & the stroma is reshaped by excimer laser. The laser removes microscopic amounts of stroma to change curvature of the cornea
- Then the epithelium is repositioned and the rapid regenerative response of the epithelium will reestablish normal corneal physiology



The sclera



- Is thick white, opaque, fibrous layer (5/6)
- It provides sites for ocular ms. Insertion, structural support & protection to the eye. it is mostly avascular
- It consists of irregular white (**type I collagen fibers**) , intersect in various directions, elastic fibers & fibroblasts
- Formed of **3 layers** :
 - Episclera**
 - Stroma (Sclera proper stroma)**
 - Lamina fusca**
- Is covered by **conjunctiva**
(clear mucus membrane)
Vascular



Is the sclera avascular?

Is the sclera avascular?

Question:

Is the sclera avascular?

Avascular:

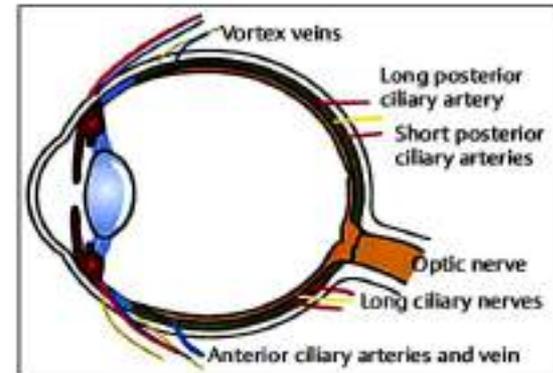
Avascular means that the part of the body does not have any blood vessels of its own. Blood vessels are the tubes or pathways for nutrient rich blood can reach that part of the body and take away the waste from that part of the body.

Answer and Explanation:

Yes, the sclera or the white of the eyes is mostly avascular. There is a layer on the outside called the episclera that has blood vessels that can become visible when the person has episcleritis. This is also the layer that provides most of the nutrients needed by the sclera. The inner lining of the sclera called the lamina fusca also has blood vessels but are not visible that also provides the other nutritional needs of the sclera. There are also blood vessels that pass through the sclera that supplies blood to other parts of the eye like the iris, the conjunctiva and the optic nerve. The sclera does not need that many blood vessels because it does not need to change the collagen and other cells as much as the other parts of the body.

Blood Supply

It is almost avascular and gets its nourishment from the episclera and choroid.



Is the sclera avascular (without blood vessels)?

JAN 31, 2019

Question:

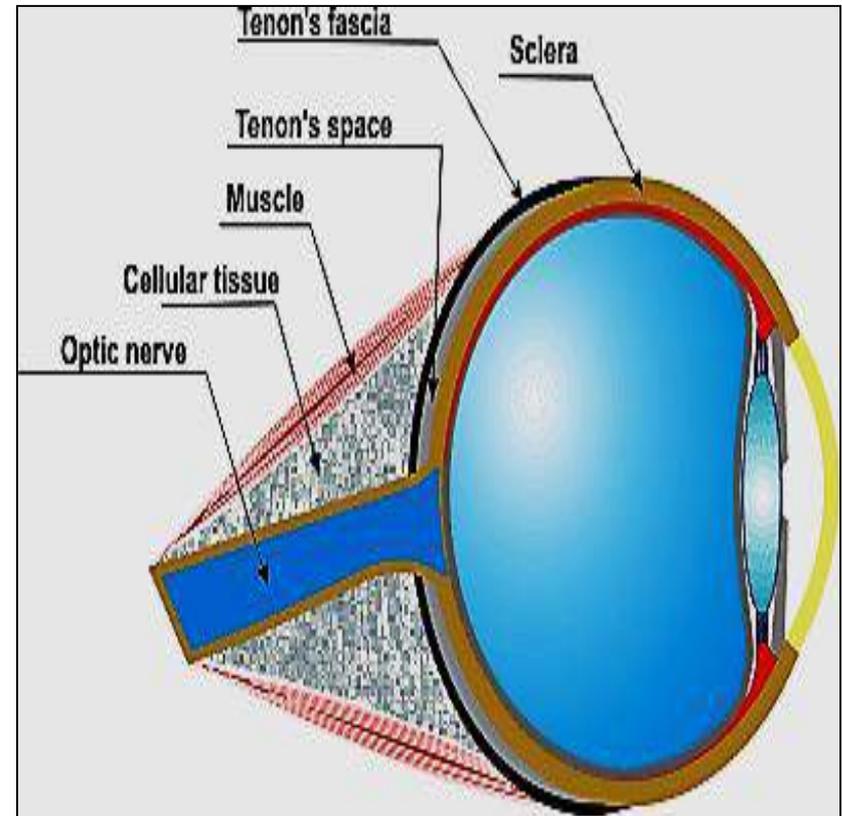
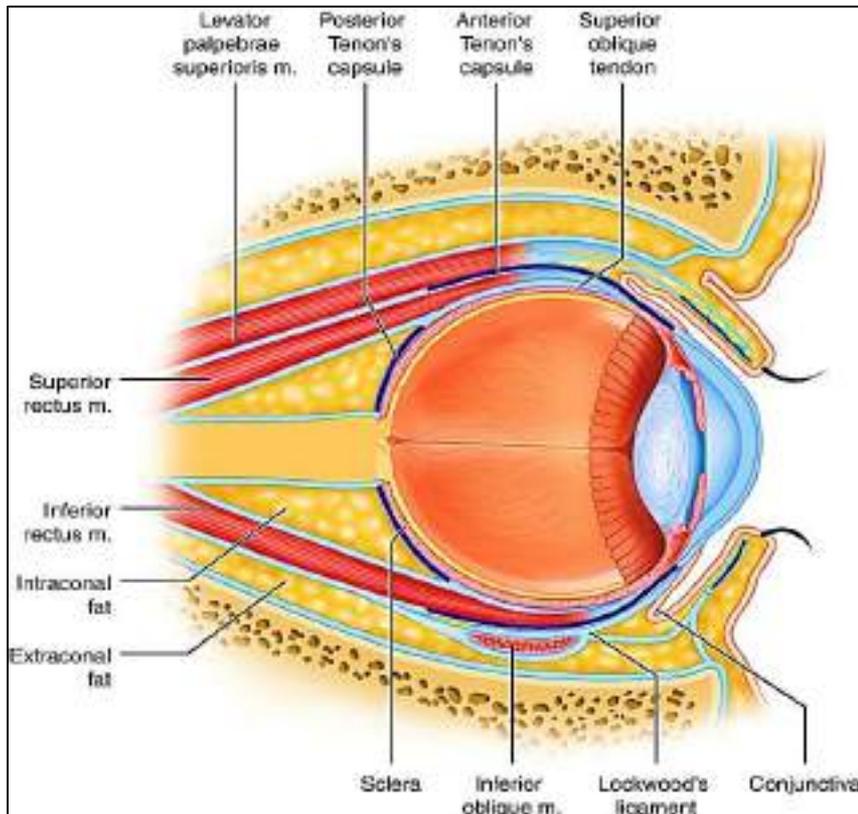
Is the sclera avascular (without veins)?

Answer:

There are three layers in the sclera (white part of the eye) and each of them contain blood vessels. They are usually not visible to the external observer except in certain inflammatory conditions. Blood vessels in the outermost layer, the episclera, dilate (widen) and become visible in a condition called episcleritis. The blood vessels in the middle layer of the sclera, called the stroma, are much sparser, but they also can be seen in someone with scleritis. The innermost portion of the sclera (called the lamina fusca) also contain blood vessels, but they are not visible.

In addition, there are a number of blood vessels passing through the sclera, including those that supply the conjunctiva (thin, transparent membrane covering the sclera), iris (colored part of eye), choroid (layer of tissue between the sclera and the retina), optic nerve (back of the eye that connects to the brain), extraocular muscles (muscles that control eye movement) and the sclera itself.

- The sclera is surrounded with Tenon's capsule (fascia): A thin fibrous layer surrounds the sclera & provides attachment to the extra-ocular muscles

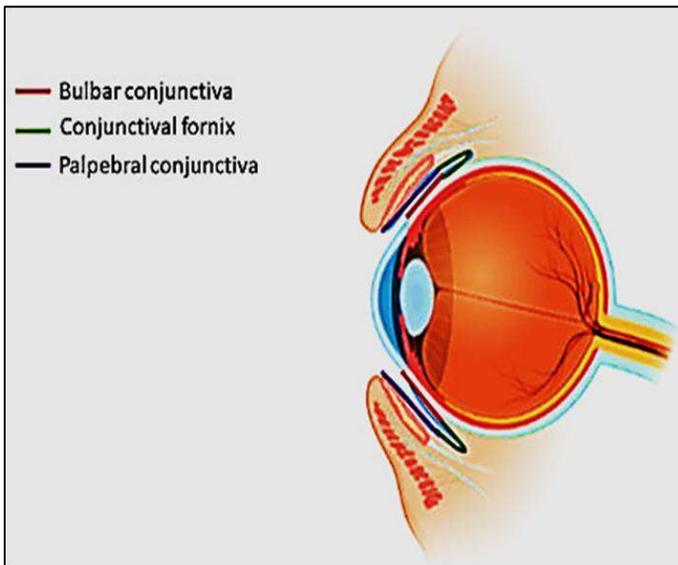


(Sclera and Ocular muscles)



Conjunctivitis (pink eye)
due to
Conjunctiva
inflammation of
conjunctiva .
Conjunctiva is vascular

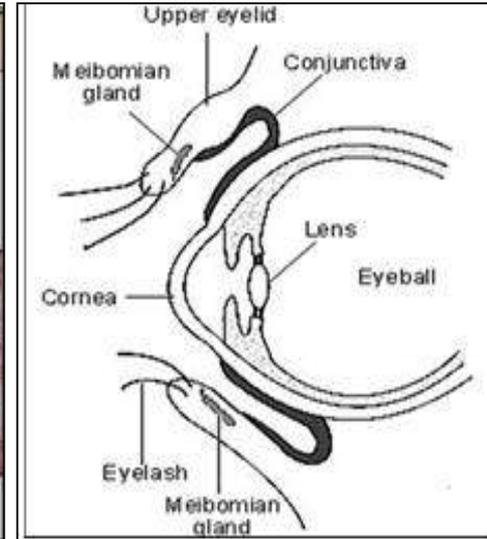
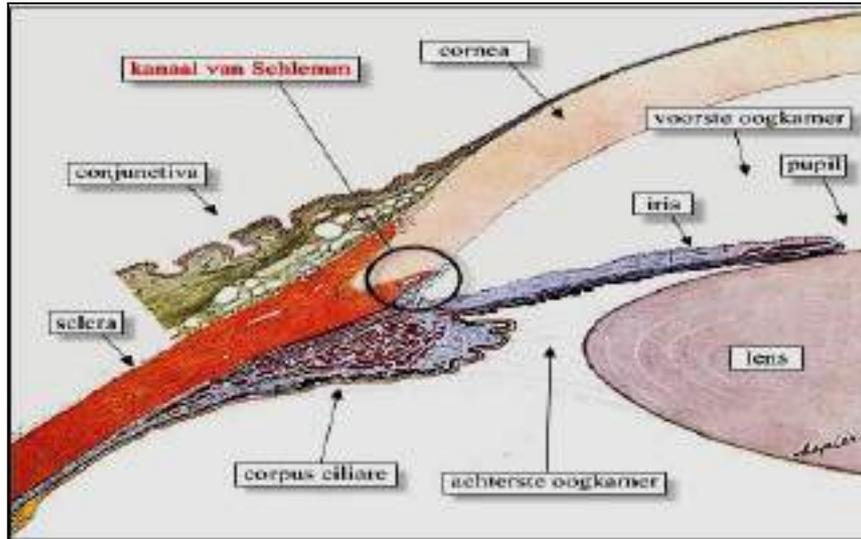
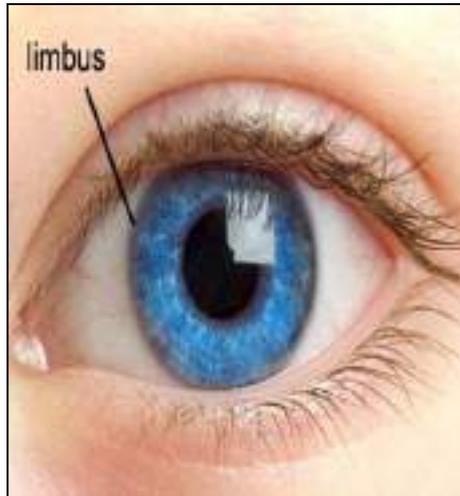
Conjunctiva



Jaundice

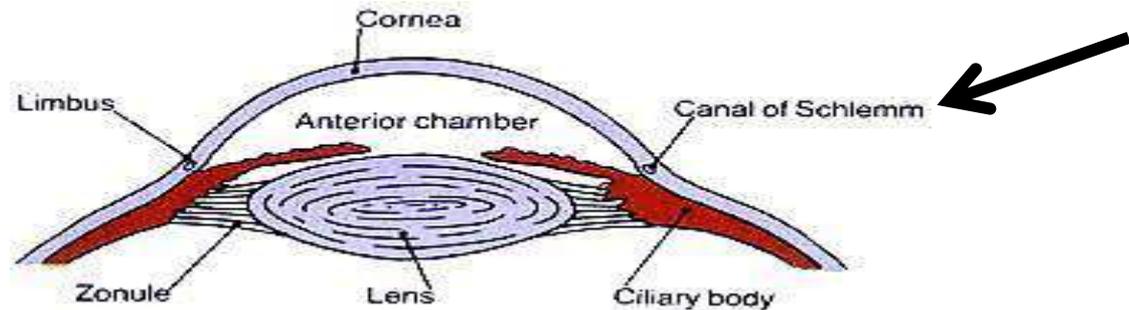
Yellow color of the sclera in jaundice
because collagen fibers can absorb and retain
bilirubin

The corneo- scleral junction (limbus)

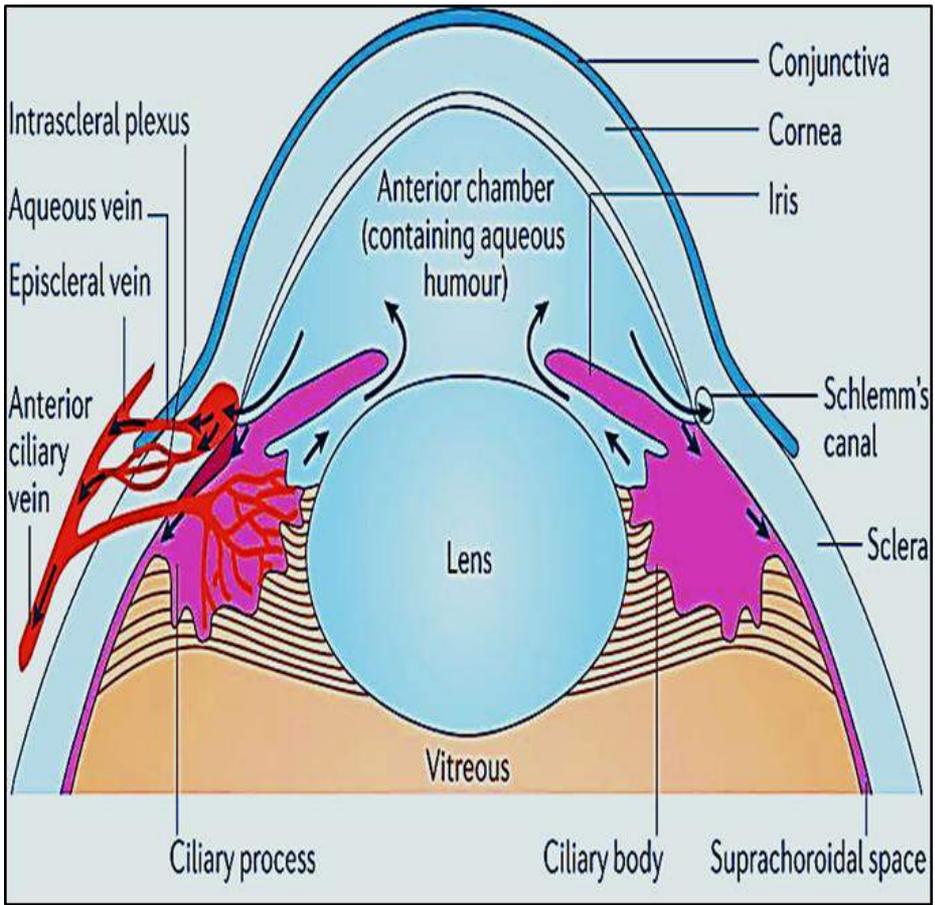
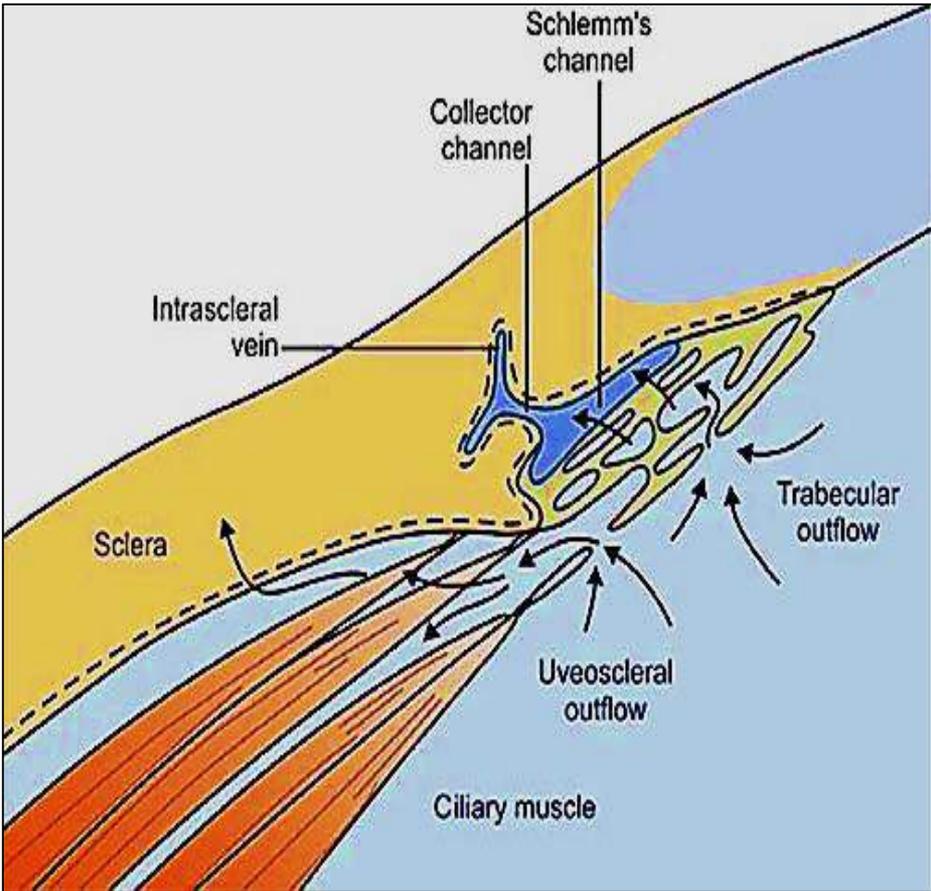


- Transitional area between cornea & sclera, contains **stem cells** for the corneal epithelium(limbal stem cells)
- Site for surgical incisions for cataract & glaucoma
- **Is a highly vascular zone**
- **The corneal epithelium** is continuous at the Limbus with the bulbar conjunctiva which covers the sclera
- **Bowman's membrane** stops abruptly at Limbus

- The regular **stroma of the cornea** is continuous with the irregular stroma of the sclera. At that point locate **the canal of Schlemm**(the aqueous humor is drained through that canal → venous system) .. **(Glaucoma)**

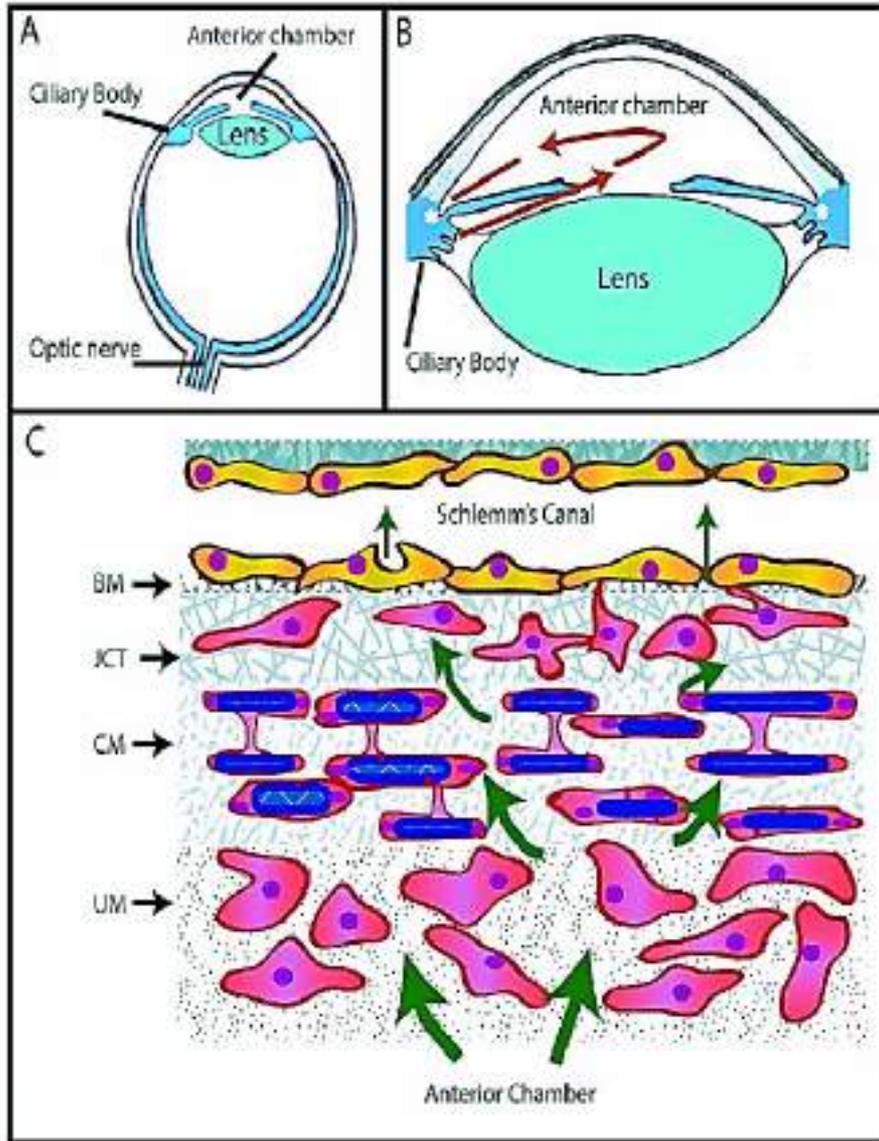


- Descemet's membrane become continuous with the Trabecular meshwork **(spaces of Fontana)**
- The endothelium on the posterior surface of the cornea extend & become reflected on the anterior surface of iris



Canal of Schlemm & Spaces of Fontana

- The spaces of Fontana : small spaces found at the irido-corneal angle, where the cornea meet with the iris.
- These spaces found within the trabecular meshwork (spongy tissue)& involved in the drainage of aqueous humor
- The spaces facilitate the flow of aqueous humor by providing passageways for the fluid to move before it enters Schlemm's canal → help maintain balance between aqueous humor production & drainage

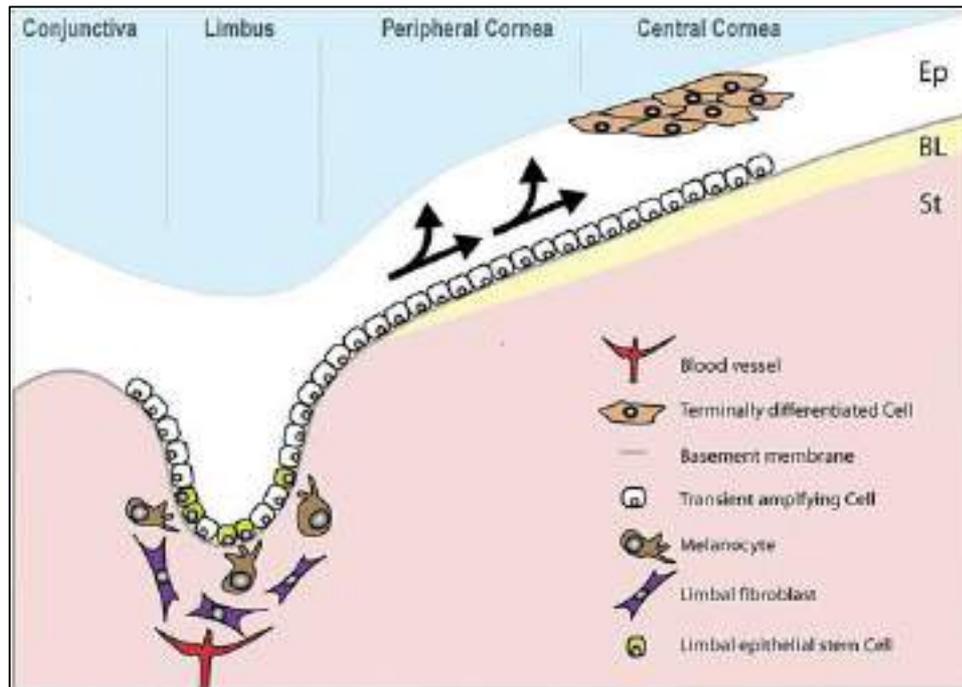


- **Schematic of the trabecular meshwork and Schlemm's canal**

Aqueous humor flows from the anterior chamber through the 3 layers of the trabecular meshwork called :

- 1- Uveoscleral meshwork (UM)
- 2- Corneoscleral meshwork (CM)
- 3- The juxtacanalicular tissue (JCT)

Aqueous humor (arrows) then crosses the basement membrane (BM) of Schlemm's Canal either paracellularly or transcellularly and enters into Schlemm's Canal.



The limbal epithelial stem cells are important for corneal epithelial cell renewal & regeneration . **Corneal epithelial cells have a lifespan of 7–10 days**

Limbal stem cell deficiency (LSCD) causes include: chemical & thermal burns, multiple ocular surgeries involving the limbal region, contact lens wear, and ocular surface inflammatory diseases.

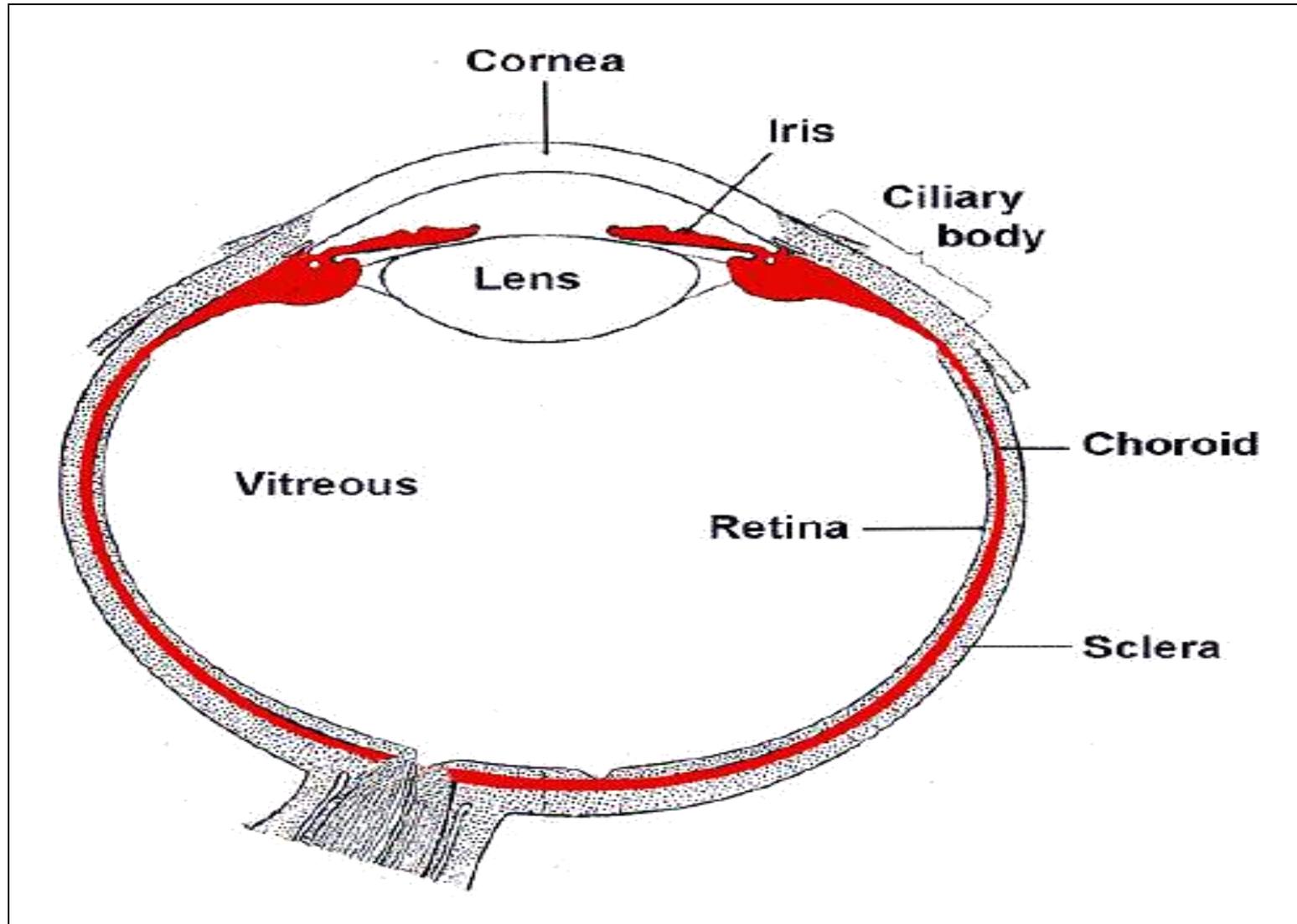
The middle (vascular) layer: uvea

A- Iris

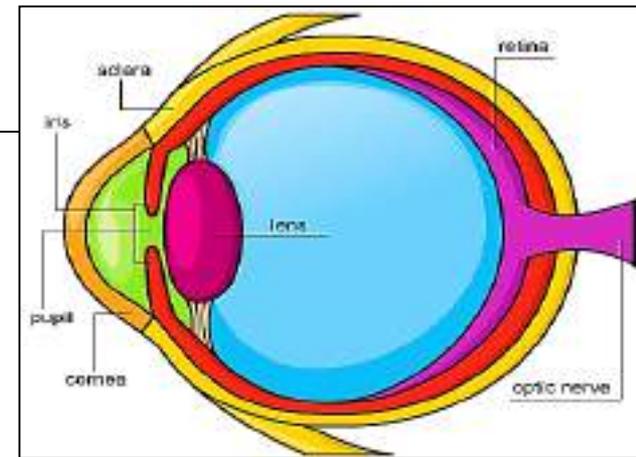
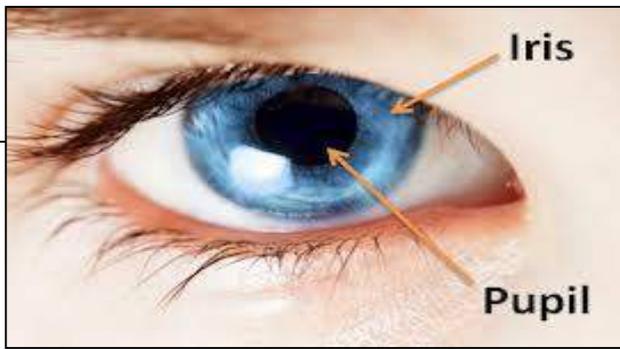
B- Ciliary body

C- Choroid

The middle (vascular, muscular, pigmented) layer of the eye



The Iris



- is the **colored disc** present between the anterior & posterior chambers of the eye (diaphragm of the eye)
- The **pupil** is the round open in the center of the iris
- The iris changes the pupil size to control amount of light & the depth of focus
- Its **posterior surface** share in the formation of aqueous humor

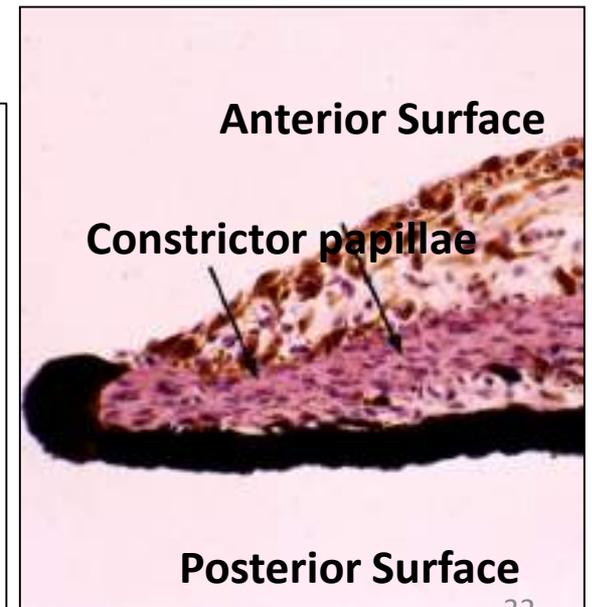
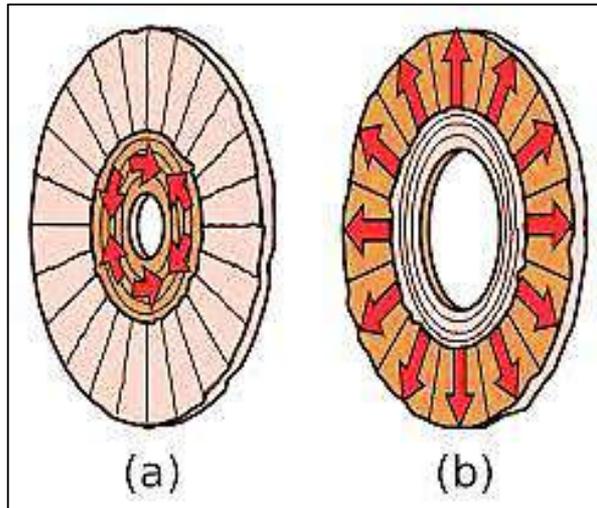
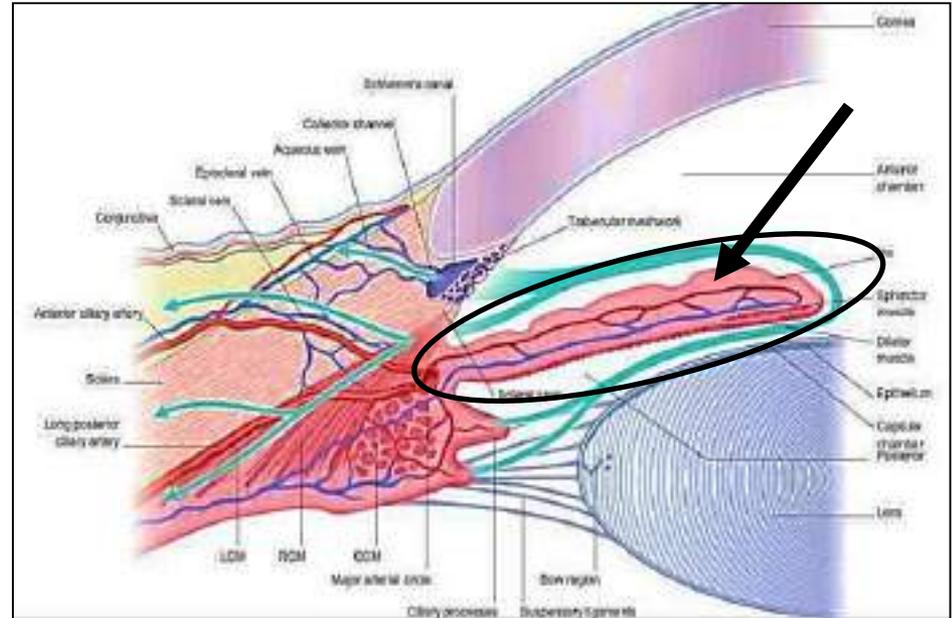
Structure of the iris

1- Anterior surface

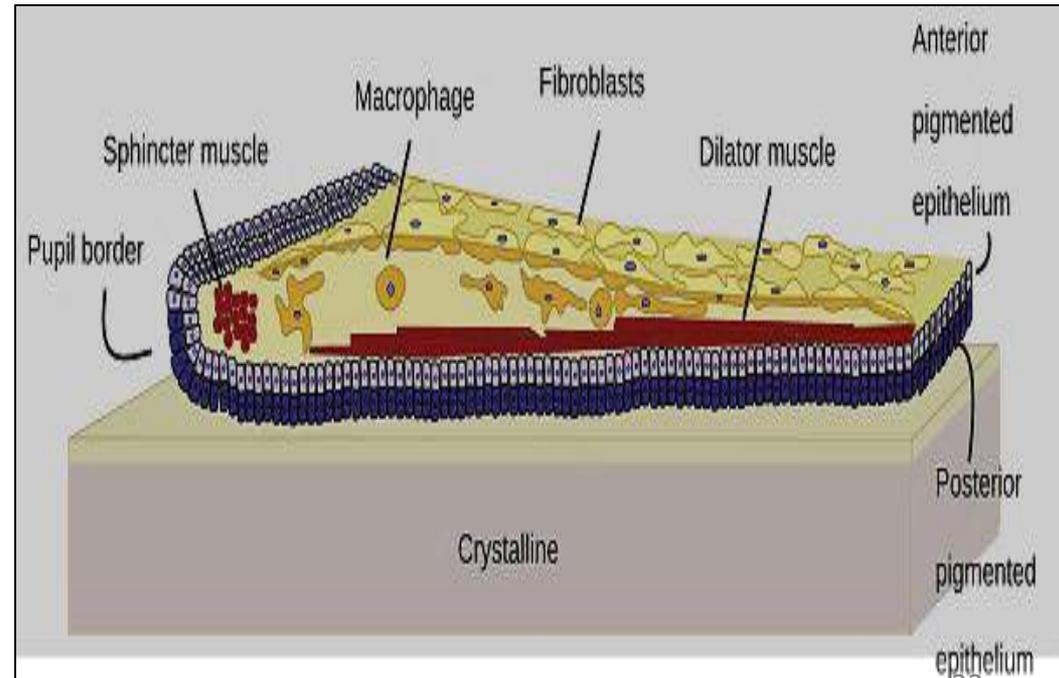
2- Stroma

- a. Loose vascular C.T.
- b. Muscles of the iris (2 ms)

3- Posterior surface



- **Anterior surface**: lined by **fibroblast & melanocytes (eye color)** is continuous with that covering the posterior surface of the cornea
- **Posterior surface**: made of **2 layers of pigmented cuboidal epithelium** continuous with that covering the Ciliary body, which prevents stray light rays from interfering with image formation

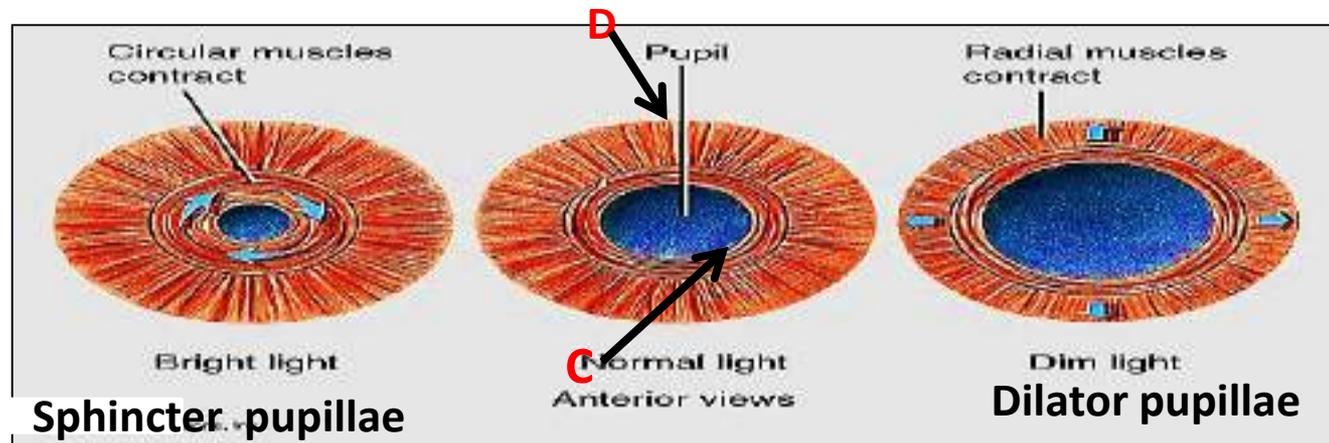


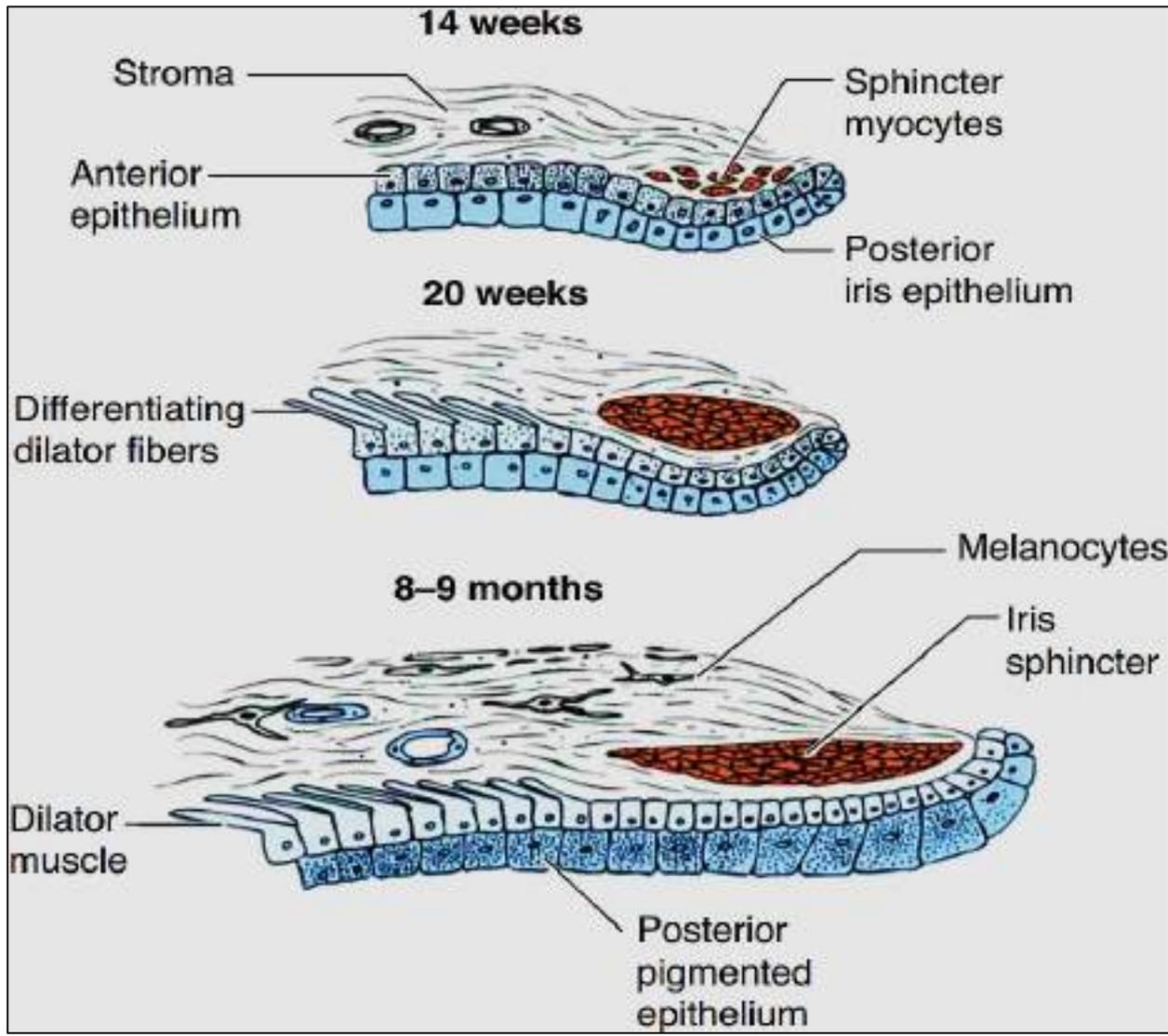
- Stroma (Inside of iris) :

- a. *Loose vascular C.T.*, rich in B.V. , fibroblasts, melanocytes

- a. *Muscles of the iris:*

- The **dilator pupillae muscle**: is **myoepithelial cells** **Radially arranged** at the periphery of the iris. Its contraction → dilate pupil (sympathetic)
 - The **sphincter pupillae muscle**: **circular band of smooth ms**, encircling the pupil. Its contraction → constrict the pupil ... (parasympathetic)

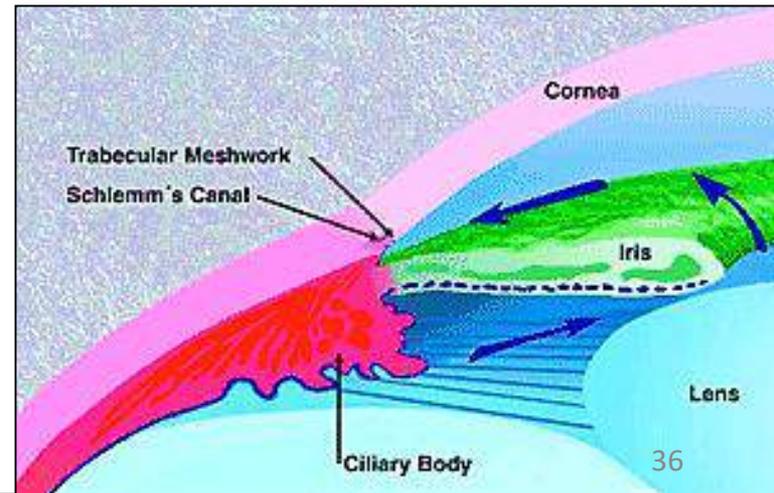




Dilator pupillae muscles are myoepithelial

The ciliary body

- Is a thick, triangular part at the level of the lens (composed of Ciliary processes & Ciliary muscles)
- Ciliary body located behind the iris & around the lens
Is positioned like a ring around the lens
- The Ciliary processes are attached to the suspensory ligaments of the lens & its epithelium form aqueous humor
- Ciliary body has 3 functions:
 1. Accommodation
 2. Production of aqueous humour
 3. Maintenance of lens zonules (ligaments)

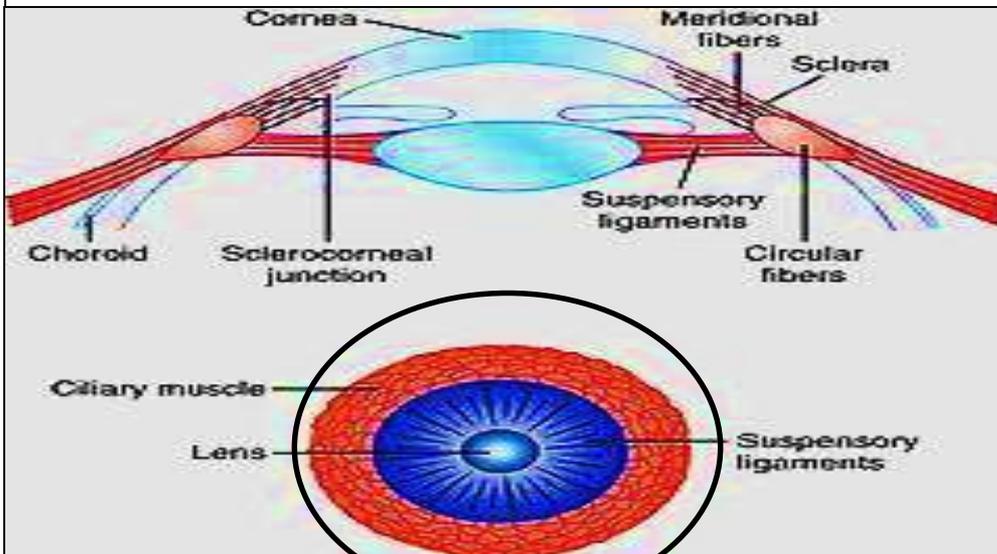
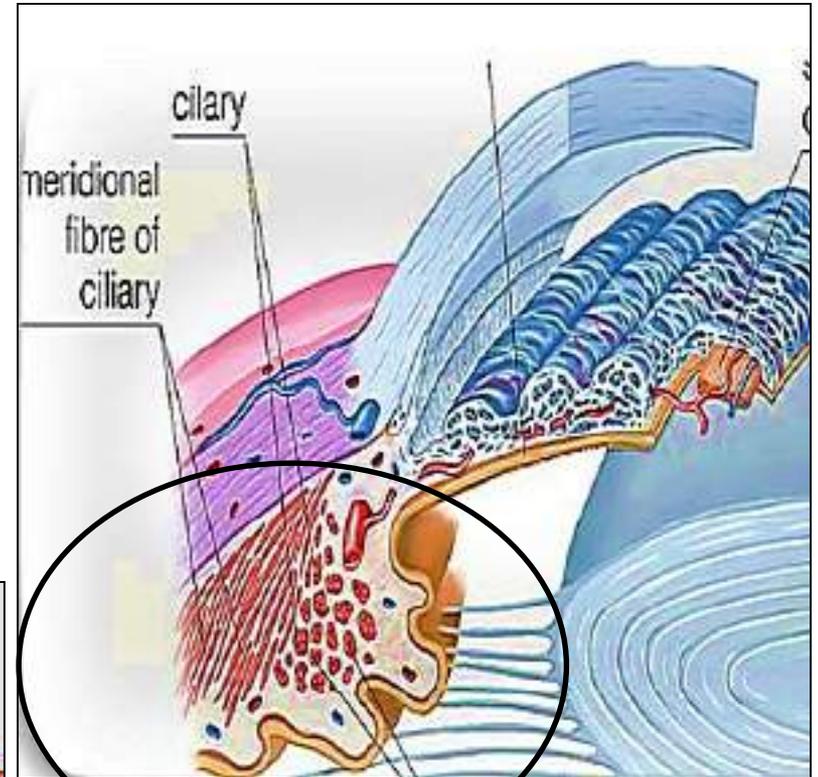


Histological structure of Ciliary body :

1- The ciliary epithelium

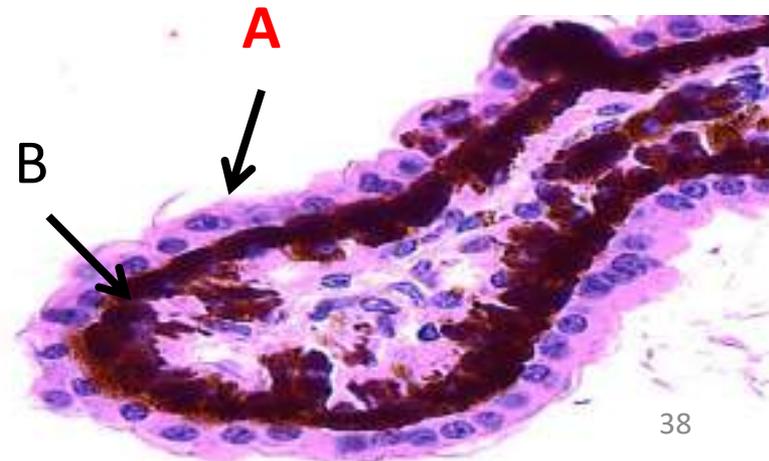
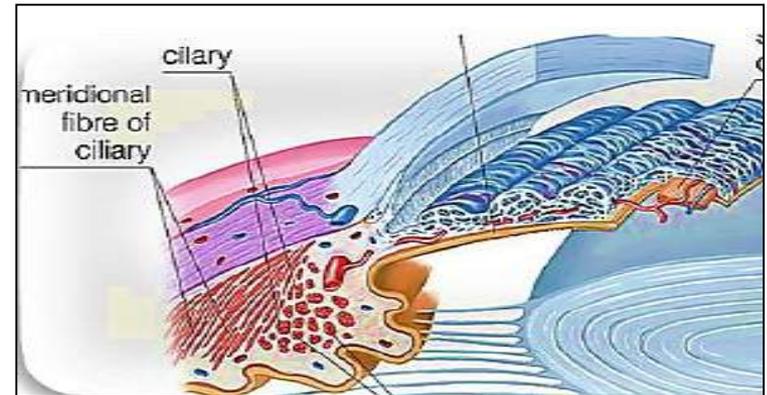
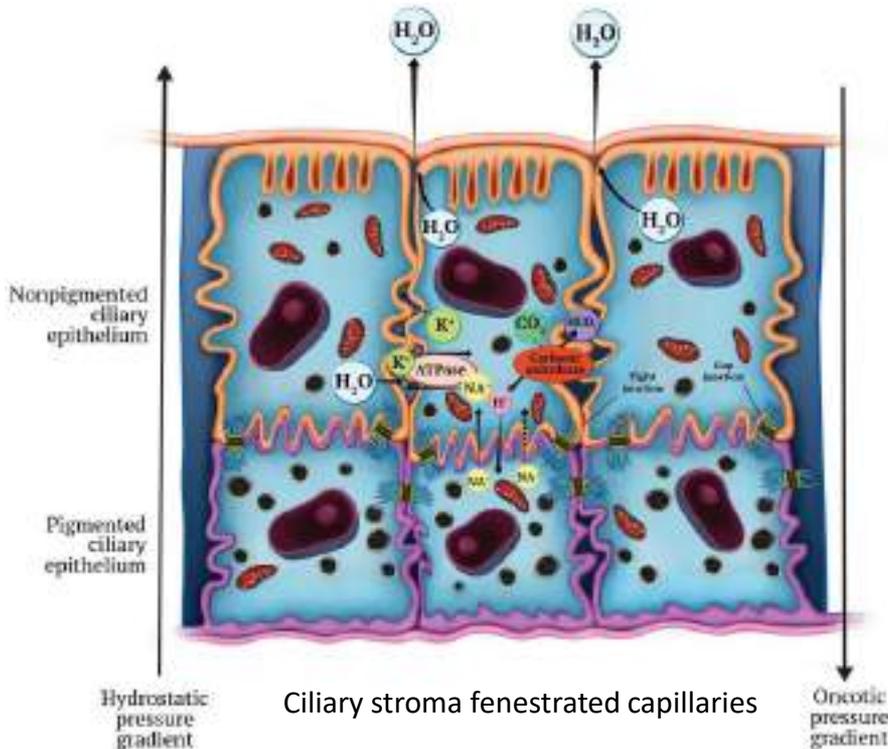
2- Vascular stroma

3- The ciliary muscle



1- The ciliary epithelium:

- a) It composed of two layers of cuboidal epithelium.
- b) The surface cell layer is **non-pigmented (A)** ???
while the deep cell layer is **pigmented (B)** rich in melanin
& continues with retinal pigmented epithelium
- c) It secretes the **aqueous humor**

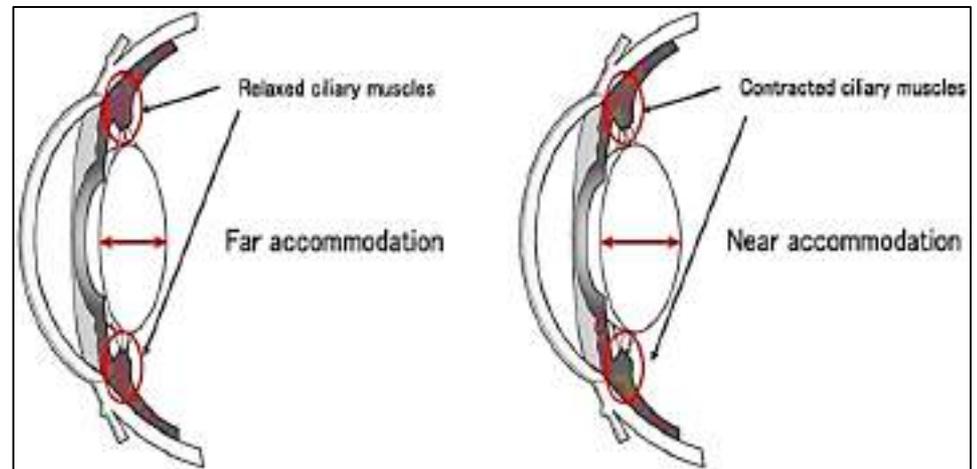
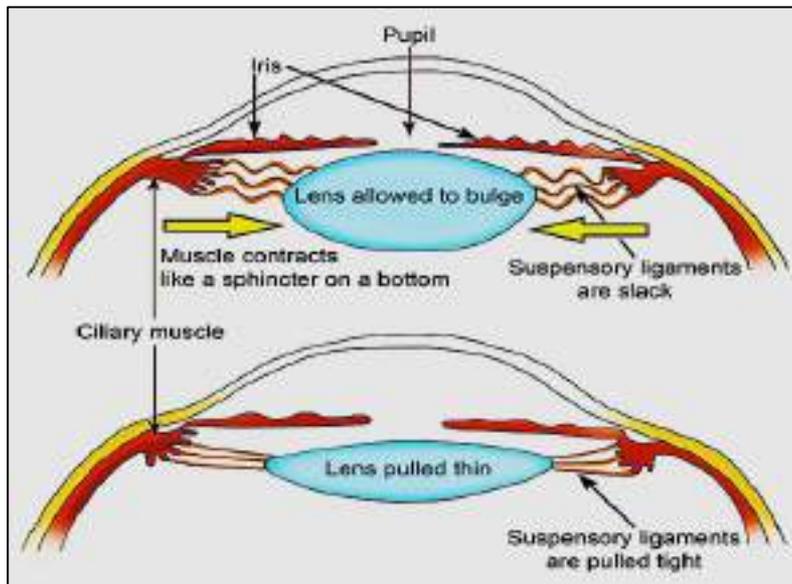


2- Stroma:

loose, highly vascular C.T., elastic fibers, & melanocytes

3- The ciliary muscle:

- smooth muscles attached to the suspensory ligament of the lens.
- They are responsible for the process of Accommodation



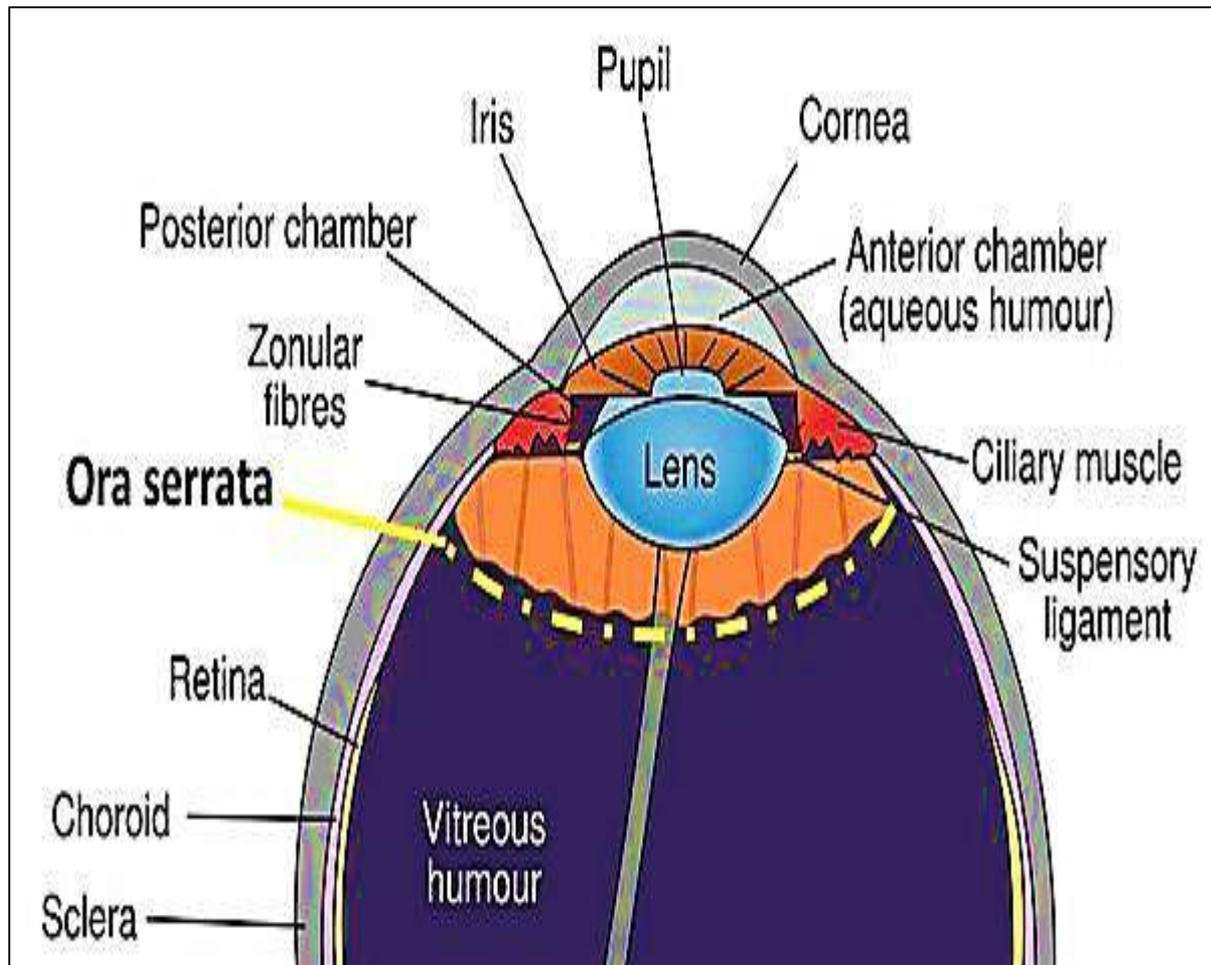
Accommodation :

the process by which the eye changes the shape of the lens to focus on objects at different distances

Accommodation is controlled by the ciliary muscle & zonules (ligaments of the lens)

The ciliary ms is a smooth ms when it contracts or relaxes it changes the shape of the lens

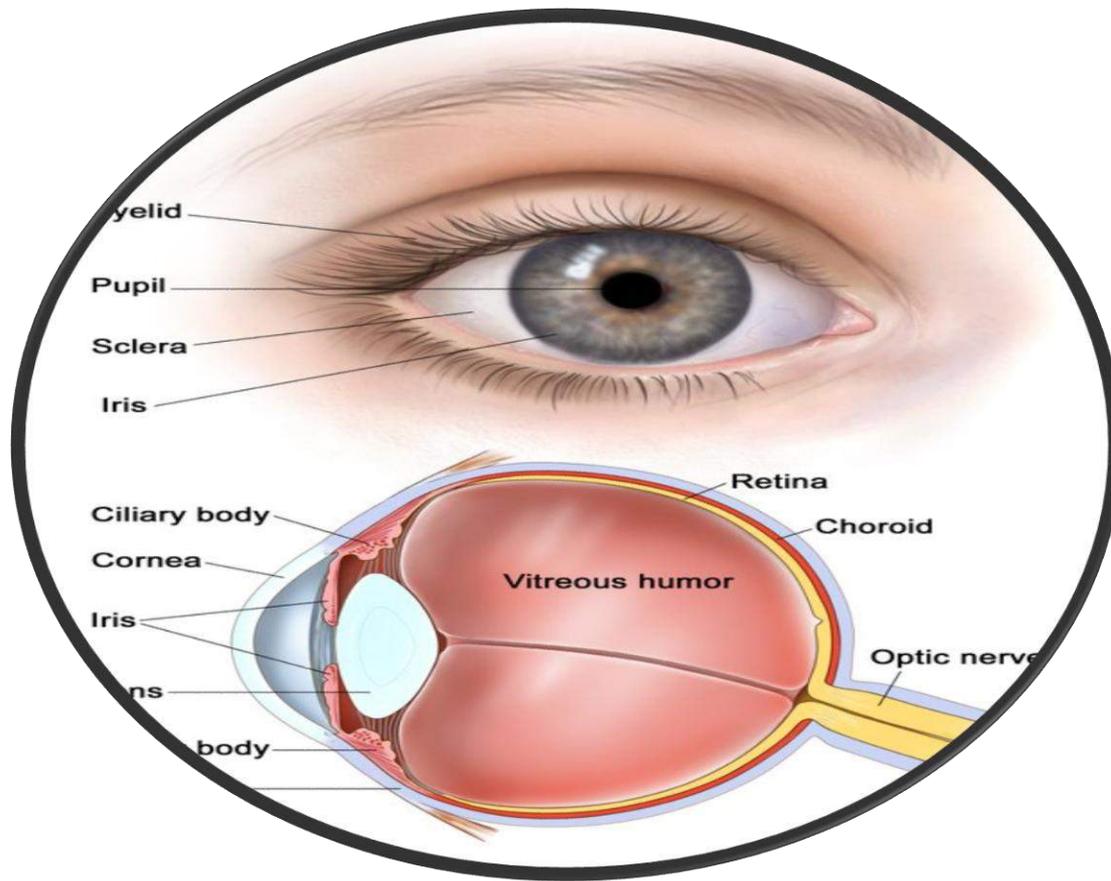
- Contraction of the ciliary ms reduces the tension on the ligaments allows the lens to become more rounded → ↑ curvature helps focus on near objects
- Relaxation of the ciliary ms increases the tension on the ligaments → cause the lens to flatten helps focus on far objects



Ora serrata and pigmented epithelium

Is located at the junction between the ciliary body & retina

it defines the boundary between the neural retina (involved in vision) and the ciliary body (involved in production of aqueous humor & accommodation)

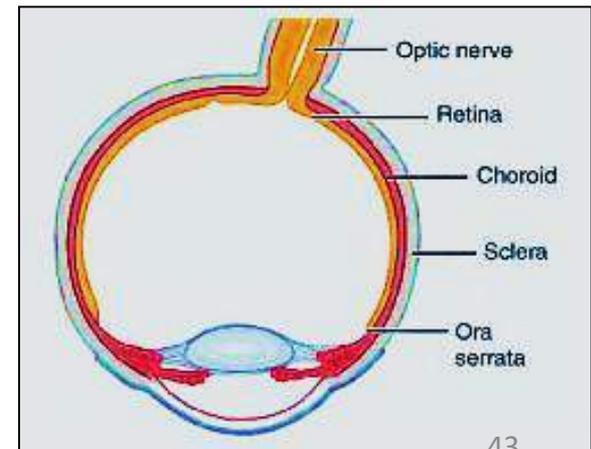


The eye (Part II)

Professor Dr . Hala El-mazar

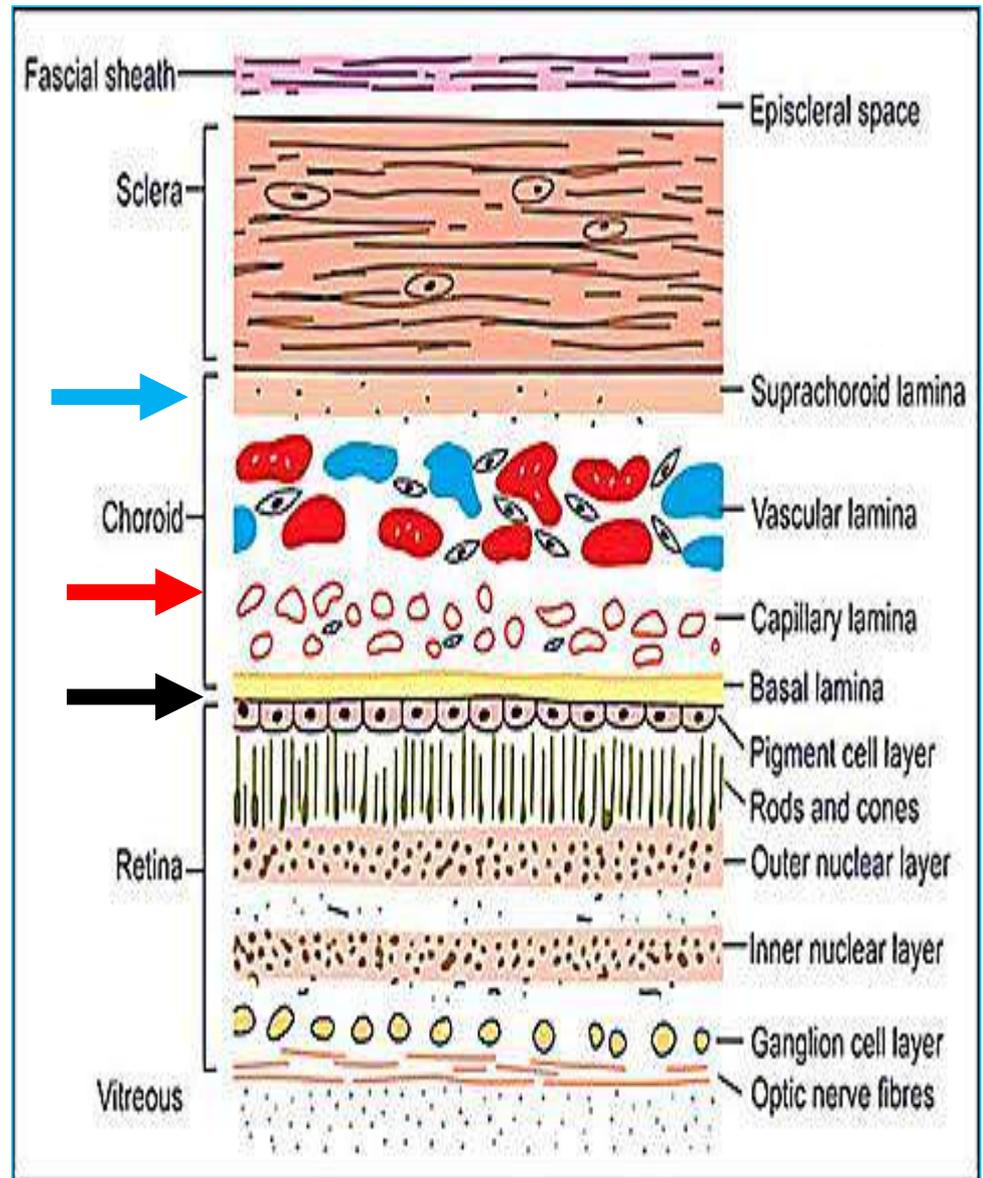
The choroid

- Is the highly vascular & pigmented
- part of the uvea. lies posterior to the Ciliary body & between the sclera & the retina
- Highly pigmented & highly vascular, it absorbs light & provides retina with O₂ & nutrients. Retinal cells are highly metabolic require a steady supply of O₂ & nutrients
- Thermal regulation to the retinal Temp.
- The choroidal circulation accounts for 85% of the total blood flow in the eye



Structure of the Choroid

- **Outer layer:** The suprachoroidal lamina (SCL)
- **Middle layer:** The choriocapillary lamina (CCL)
- **Inner layer:** Bruch's membrane



- **The suprachoroidal lamina:** (the outer layer)
 - loose CT beneath the sclera
 - Thin, ↑ with melanocytes, fibroblasts & macrophages
- **The choriocapillary lamina:** (the middle layer)
 - dense network of **fenestrated capillaries** which is essential for easy exchange of nutrition & maintenance of the retina

Since the photoreceptors of retina doesn't directly receive blood flow from retinal blood vessels, the choriocapillary BV is essential for its wellbeing
- **Bruch's membrane :** (the innermost layer – 5 layers)

A sheet composed of 5 layers (NO cells) separates between the retinal pigmented epithelium & the choroid. Plays role in transport of nutrients & waste between retina & choroid BV

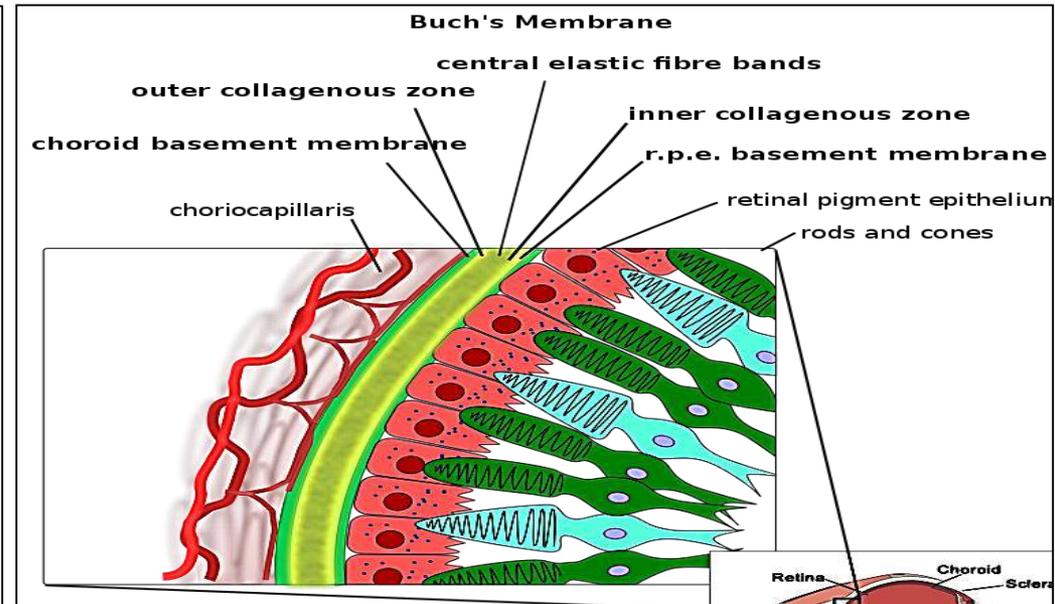
Layers of Bruch's membrane 5 layers :

- 1- Basement membrane of endothelial cells of chorio- capillary B.V.
- 2- Inner collagenous layer
- 3- Elastic layer ... between the collagen layers
- 4- Outer collagenous layer
- 5- Basal lamina of pigmented epithelium of the retina

Act as **blood –retinal barrier**

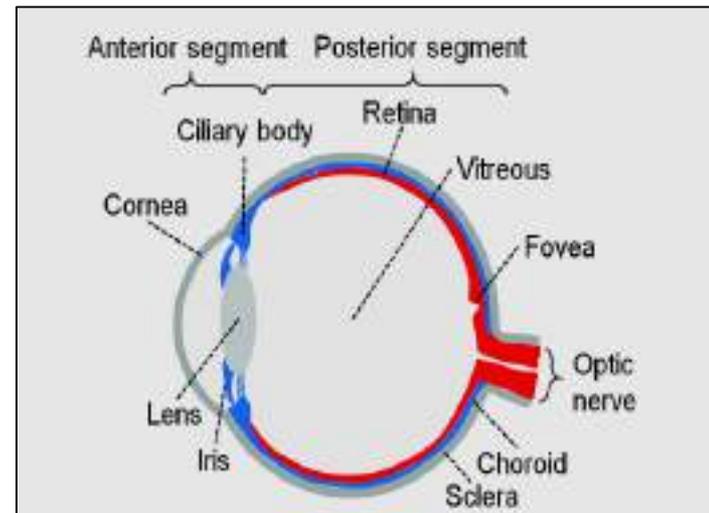
- ✓ Is inner most layer of the choroid
- ✓ Acts as a blood-retinal barrier
- ✓ Acts as a support structure to the choroid - the vascular layer The RPE transports metabolic waste from the photoreceptors across Bruch's membrane to the choroid.

Bruch's membrane gets thicker as we get older. This may **impede some of the transportation of waste material** which can cause a build up of deposits. The thickening also prevents nutrients and oxygen from being delivered to the retina

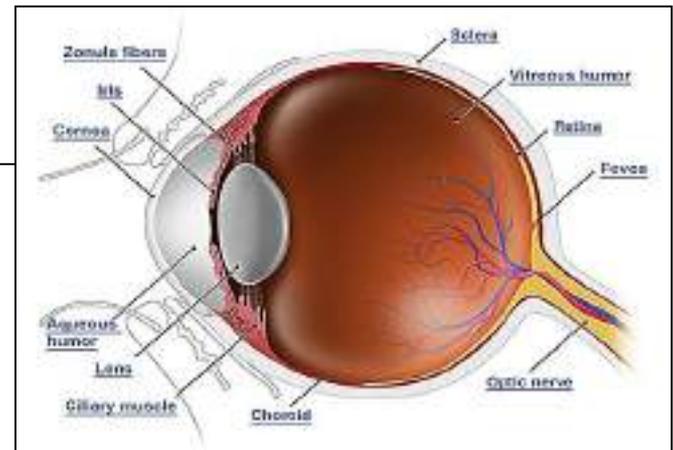


chambers of the eye

- **Anterior chamber**: between the cornea & iris contains Aqueous humor
- **Posterior chamber**: between the iris & lens contains aqueous humor
- **The vitreous chamber**: between the lens & retina contains transparent, colorless jelly- like mass called vitreous body
Doesn't recycle
Eye floaters?



The lens

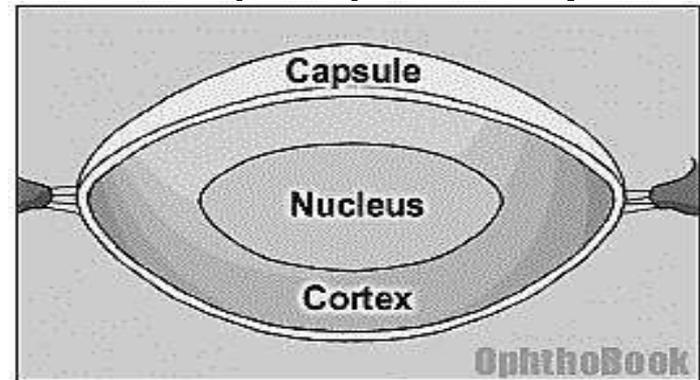


- Is transparent, avascular, flexible lacks nerves ,biconvex disc, behind the iris & pupil.

its main function is to focus light on the retina

- Attached to the Ciliary body by **zonule** (suspensory ligament of lens)
- Lens composed of 3 parts :

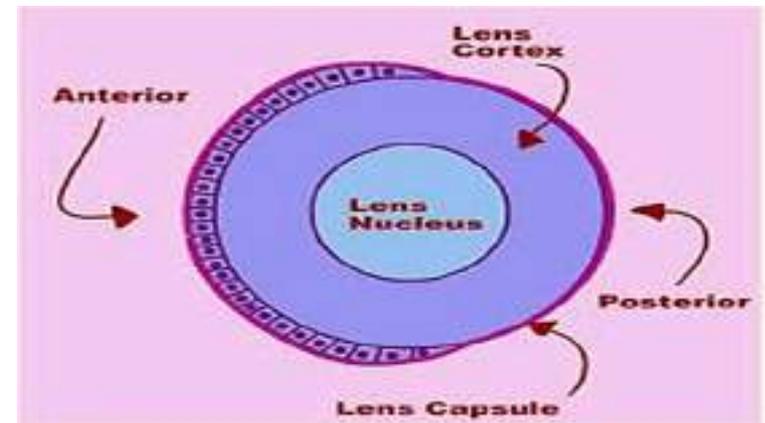
capsule, cortex, nucleus



- The capsule is transparent, surrounds the lens completely, elastic & is composed of **type IV collagen**. It is synthesized by the lens epithelium

Histological Structure of the lens:

- I. Capsule
- II. Subcapsular (lens) epithelium
- III. lens cortex (consist of Lens fibers)

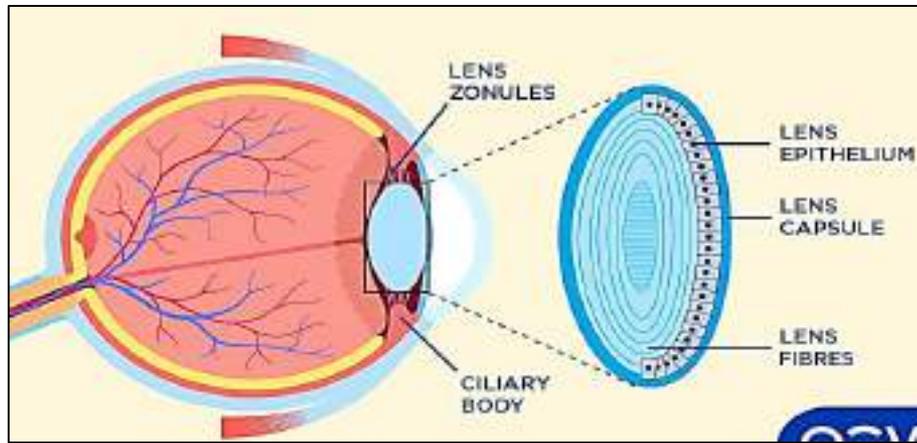
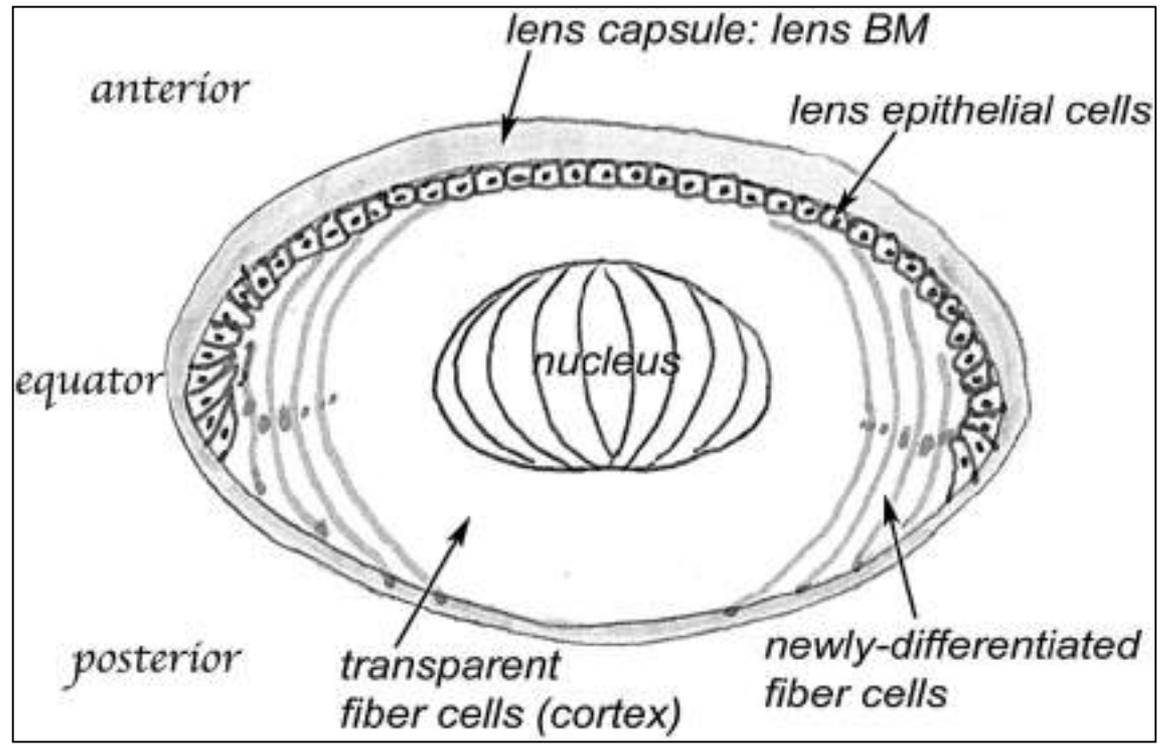


- **Lens epithelium:** single layer of cubical cells covers the anterior & lateral surfaces of the lens located between the lens capsule & cortex = subcapsular
- The lens epithelium regulate most of the homeostatic functions of the lens, providing the lens fibers with nutrients and removing
- The lens epithelium also serve as the **progenitors for new lens fibers**

- **The lens cortex (fibers)**

- these fibers make up the bulk of the lens. They are long, thin cells, which lost their nuclei & organelles and change to transparent fibers able to focus light, arranged concentrically in layers
- The new fibers being added at the periphery of the lens just beneath the lens epithelium. as the new fibers added the old fibers move toward the center.
- Mature lens fibers have no organelles or nuclei. They are filled with proteins (Crystallins) which is the key **for transparency & refractive properties** of the lens
- The cytoskeleton of the lens are actin filaments & intermediate filaments (Vimentin)
- The lens fibers adhere to one another with gap junctions & desmosomes. They depend on aqueous humor or nutrition

(Lens fibers)



The lens lays down fibers from embryo stage until death. Old fiber will form the nucleus

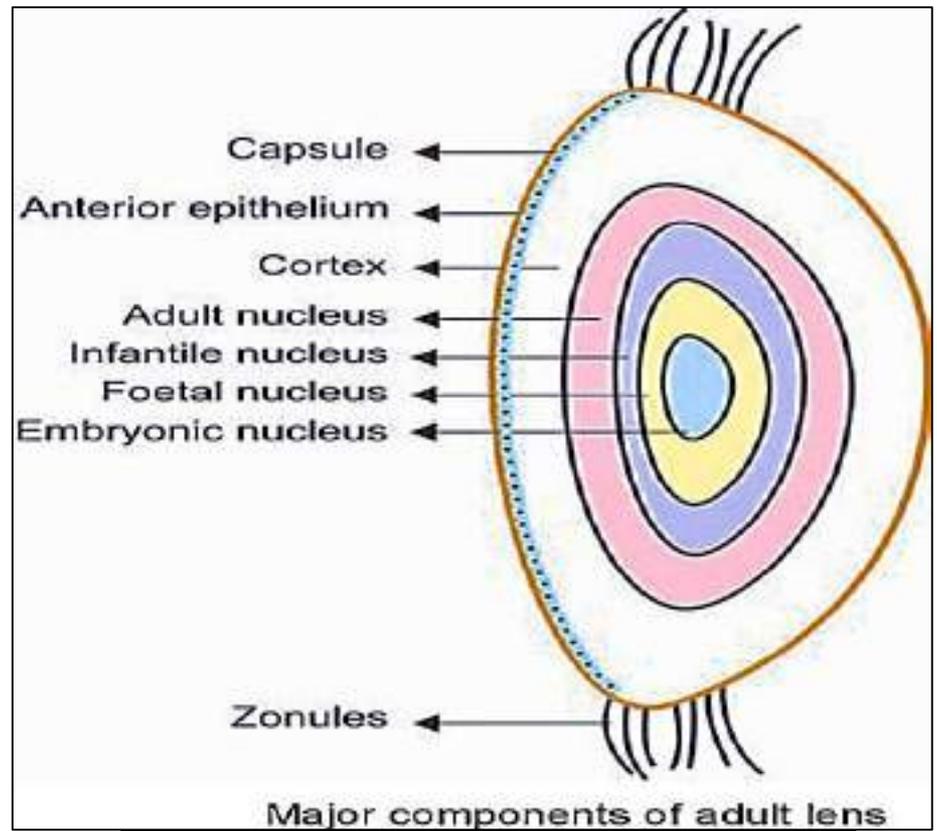
The nucleus of the lens is the innermost part of lens formed by the oldest lens fibers which have been progressively pushed toward the center of the lens as the new fibers added at the periphery

Function of the nucleus like the entire lens is to focus light

Layers from in to out:

- Embryonic nucleus
- Fetal nucleus
- Infantile nucleus
- Adult nucleus then then outer cortex.

Presbyopia: occur when the nucleus become rigid & opaque



Arrangement of layers lens nucleus

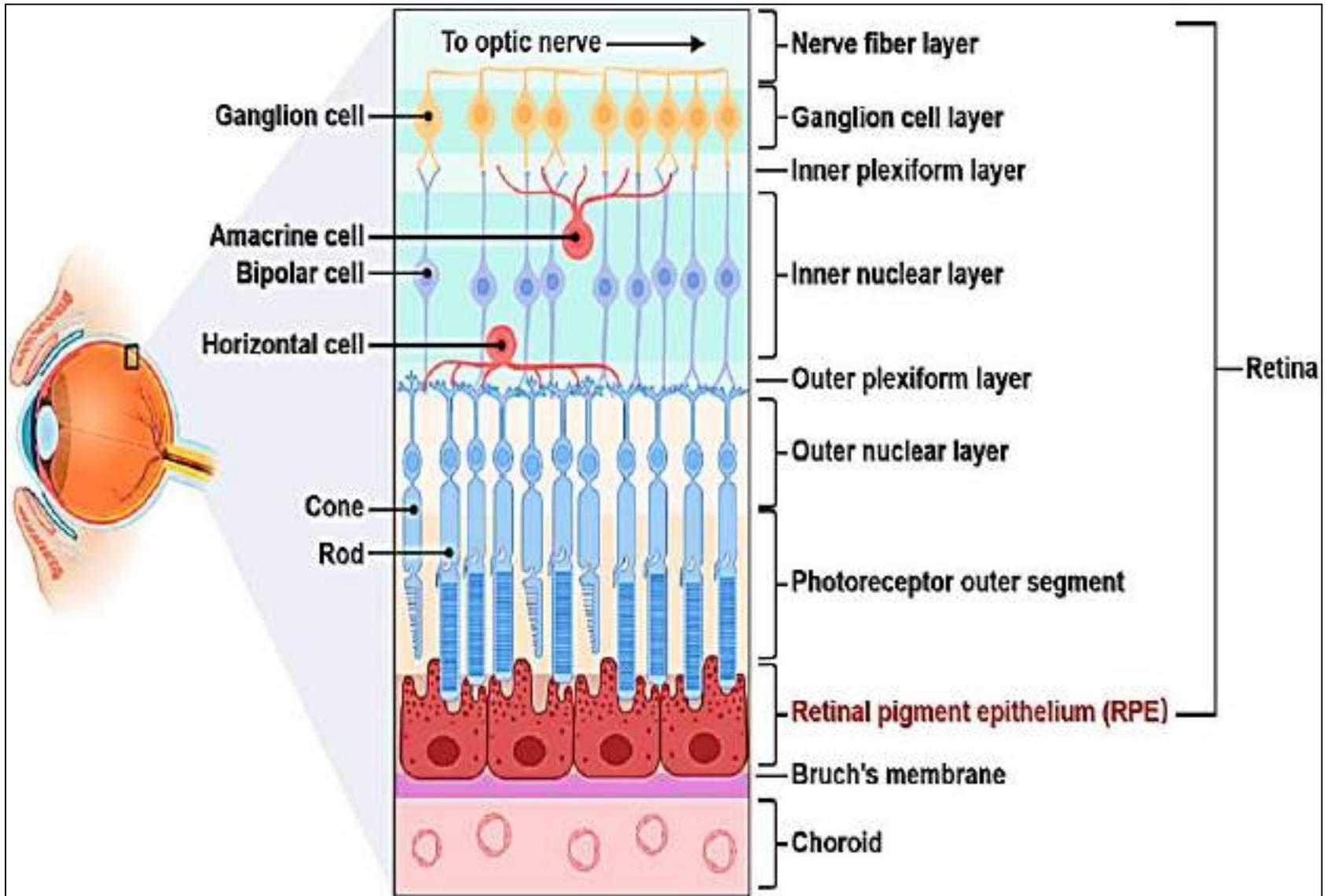


The inner (nervous) layer

The retina

The retina

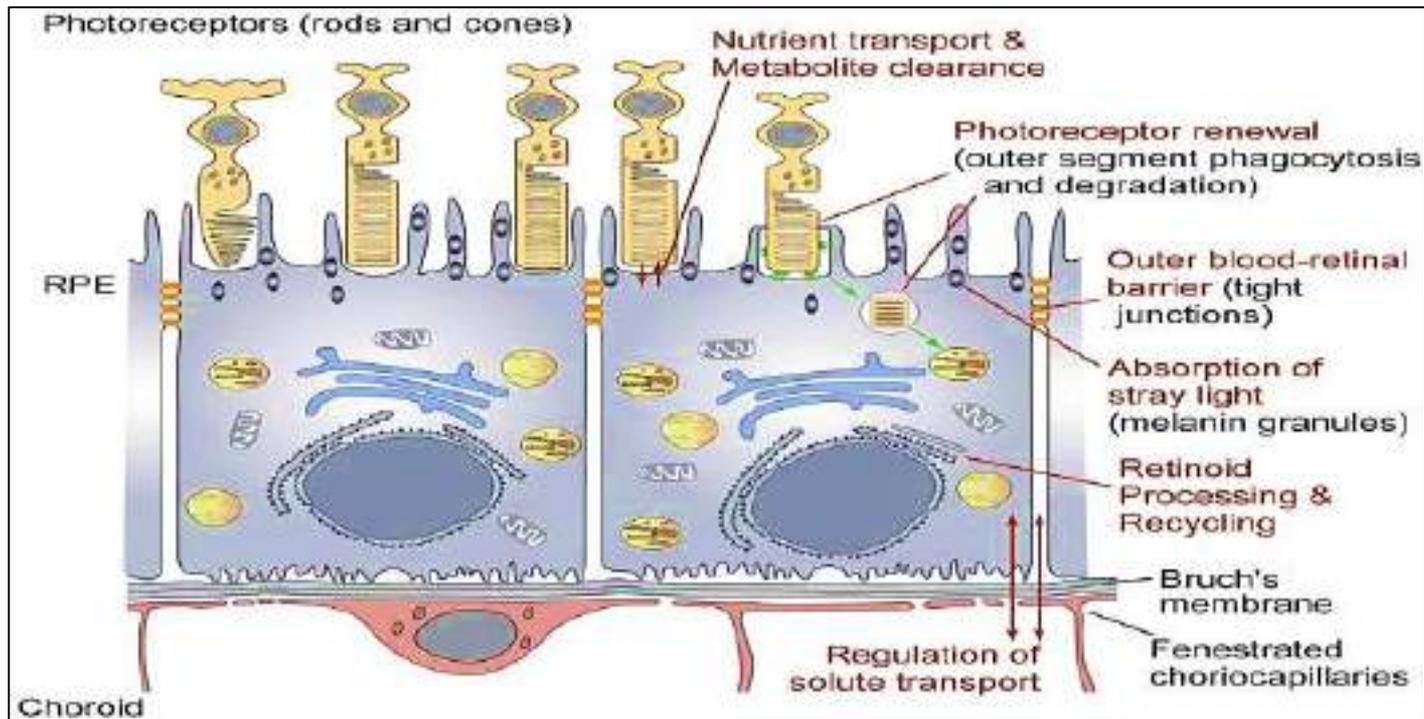
- is the inner most layer of eye , responsible for Photoreception
- Composed of 2 layers : pigmented epith. & photosensitive (neuronal) layers
- Neuronal layer consists of layers of neurons interconnected with each other through synapses
- **The photoreceptor cells are : Rods & Cones**
- **Rods** function mainly in dim light and black & white vision
- **Cones** support day time and the perception of color vision



The retina

1- Pigmented epithelium:

- Single layer of cuboidal cells their basal surfaces attached to the Bruch's membrane of choroid
- Their apical surface has many microvilli which interdigitate & support the tips of rods & cones (**Retinal detachment**)
- They contains numerous melanin granules → cells dark → filter the UV light → reduce oxidative damage to retina
- The lateral surfaces of adjacent cells shows tight junctions together with Bruch's membrane form blood- retinal barrier
- Their cytoplasm contains mitochondria, **phagocytic vacuoles** **i.e. phagocytose old photoreceptor outer segments**

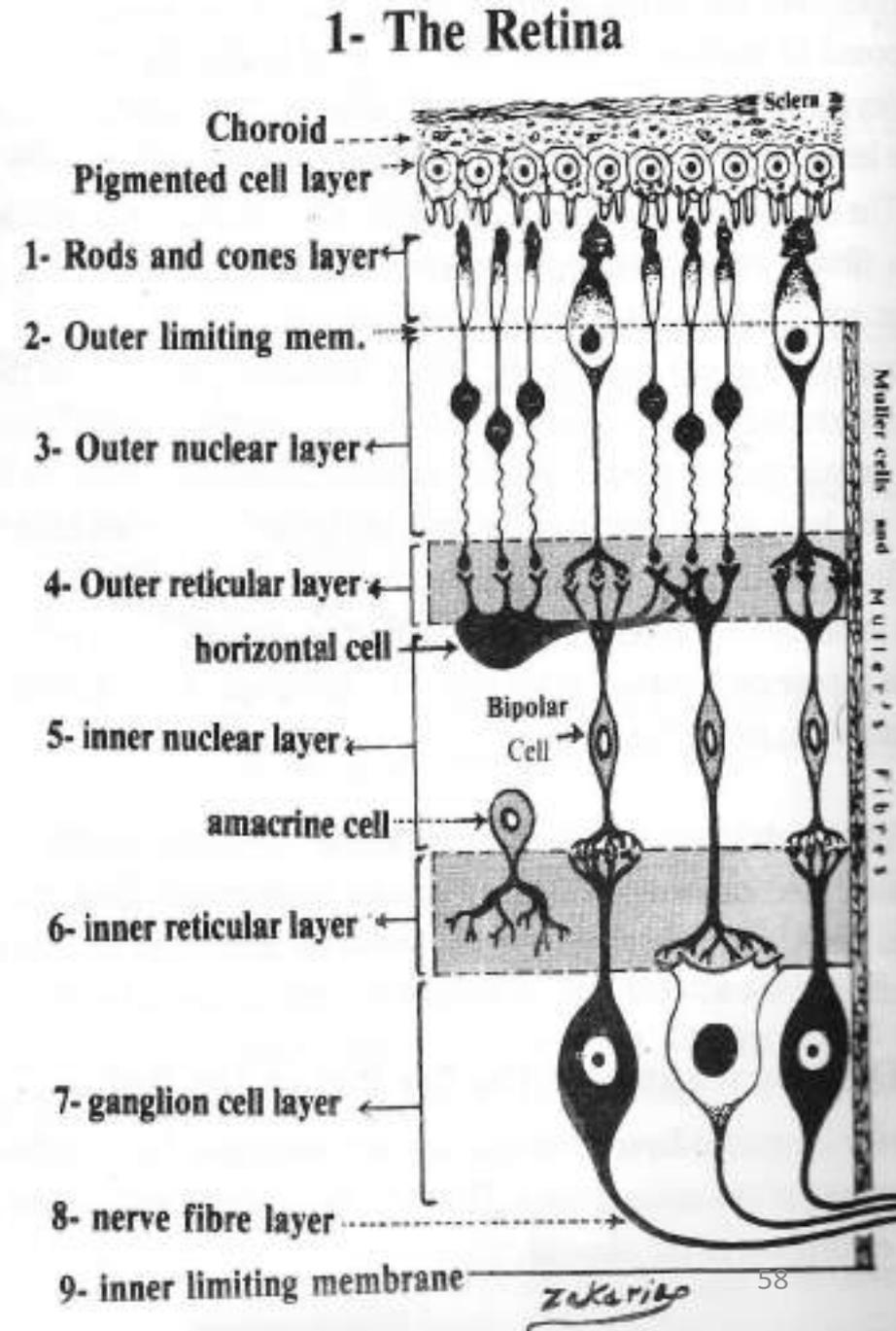


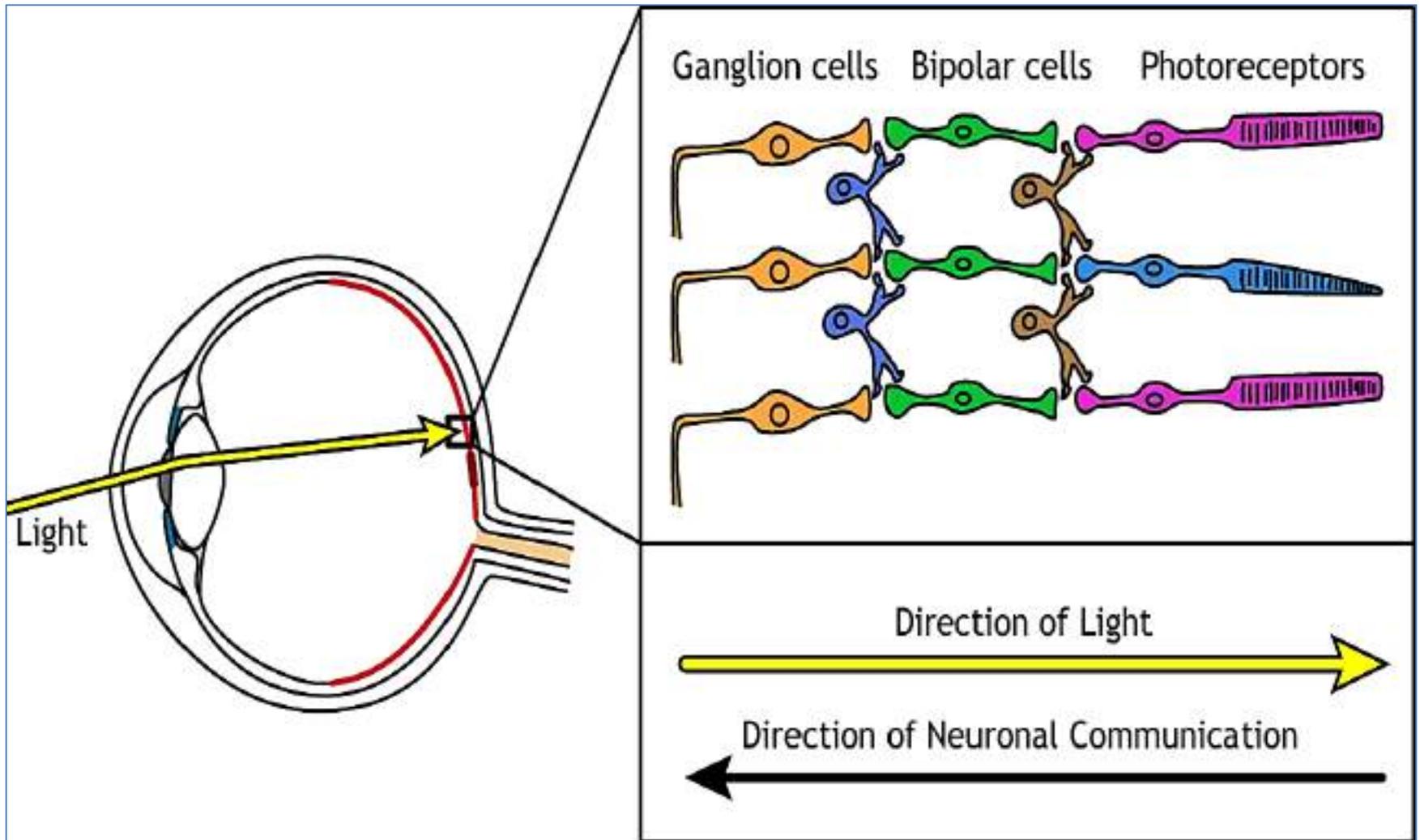
Function of Pigmented epithelium:

- Support the photoreceptors
- Form a dark layer that absorbs light & prevents glaring (melanin G)
- Store, release, transport **vit. A** to rods & cones
- Form the blood-retinal barrier
- Phagocytize old discs present at the tips of photoreceptors

Layers of the retina (10):

1. pigmented epithelium
2. Rods & cones layer
3. Outer limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion layer
9. Optic nerve layer
10. Inner limiting membrane

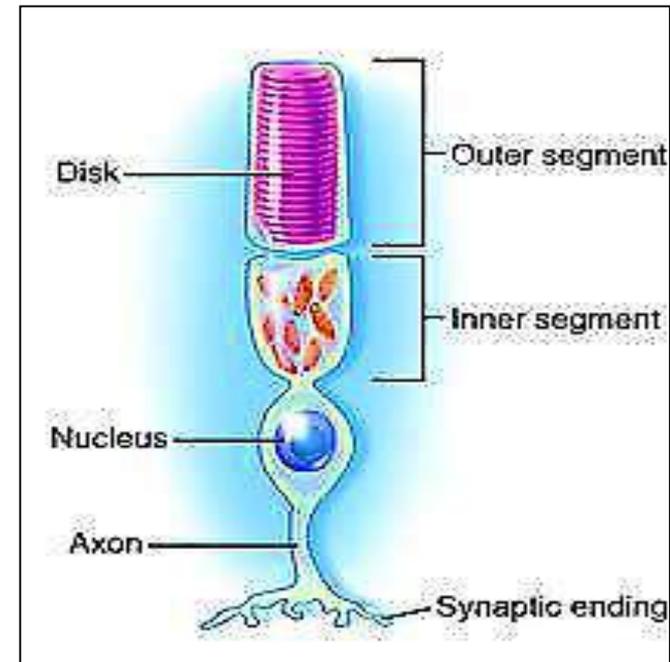




2- Rods & Cones layer: photoreceptors

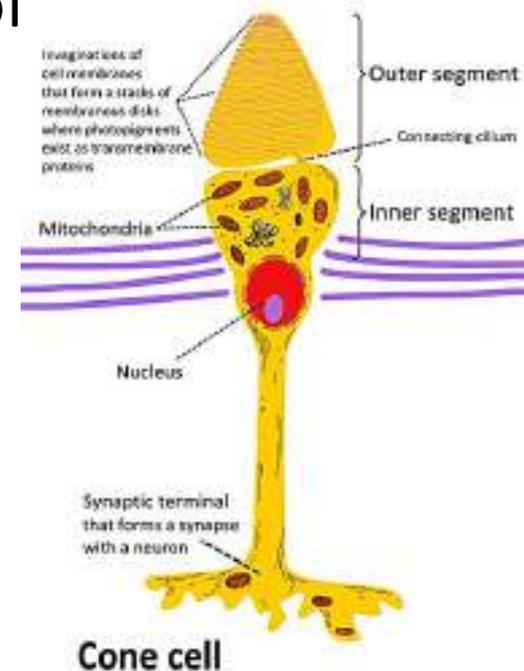
a- Rods : dim light vision (black & white) (↑ in #)

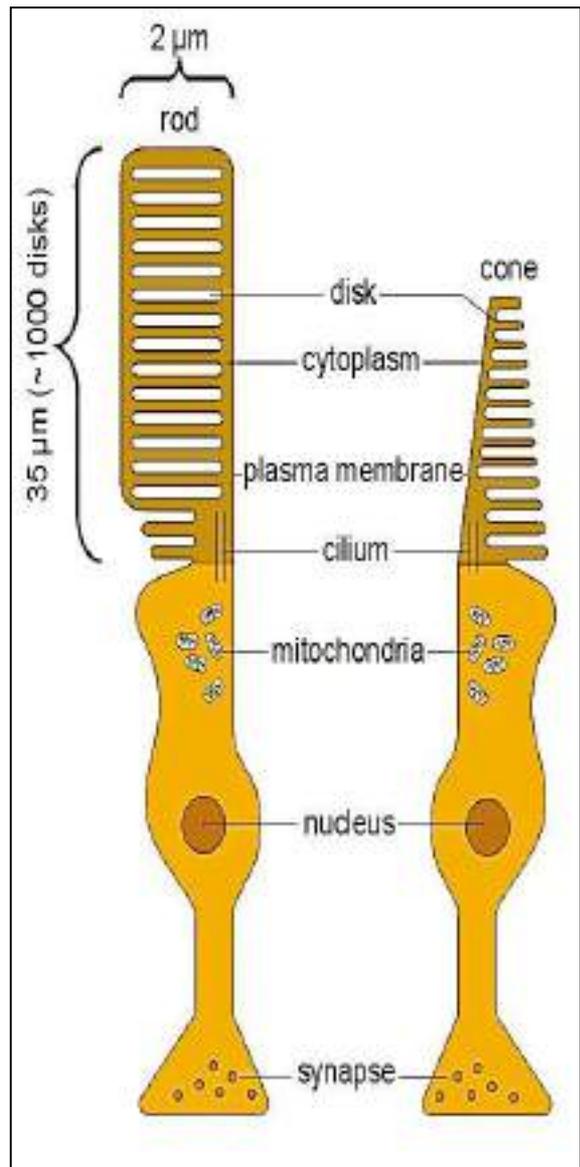
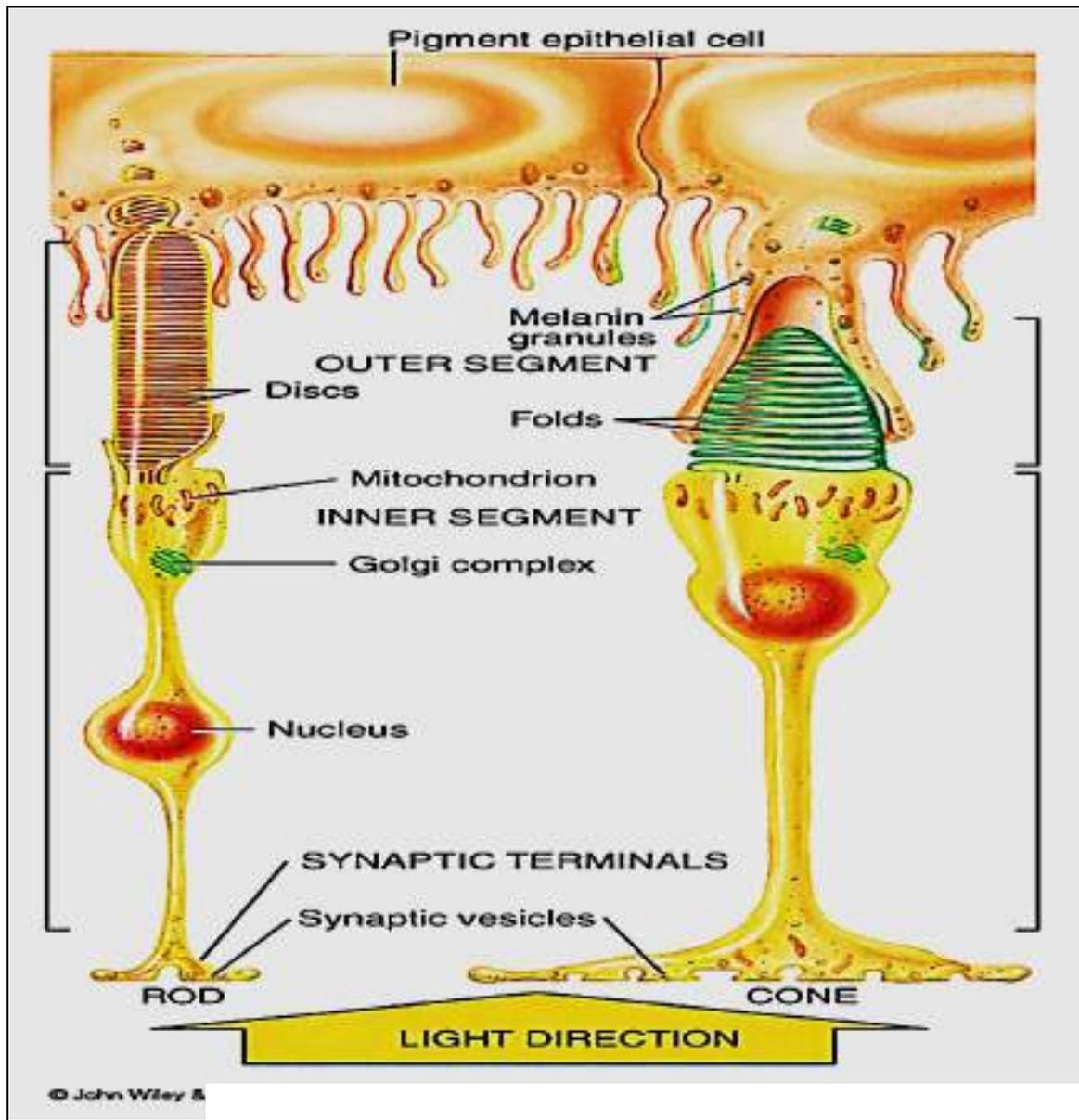
- **Outer thin segment:** contains transverse discs filled with Rhodopsin, discs are continuously renewed & separated from cell membrane
- **Connecting stalk:** contain modified cilium
- **Inner segment:** contains cell organelles that form the Rodopsin
- **Cell body:** contains nucleus
- **Synaptic region:** which synapse with bipolar nerve cells & horizontal cells



b- Cones : bright light & color vision

- **Outer cone shaped segment**: contains flat discs which contains iodopsin pigment. These discs are infolding of cell membrane
- **Connecting stalk**: contains cilium
- **Inner segment** : contains all cell organelles & forms iodopsin
- **The nuclei** of cones are arranged in one horizontal level near the outer limiting membrane
- **Synaptic region** :which synapse with bipolar nerve cells & horizontal cells





Structure of rods and cones

3- outer limiting membrane

Dark line represent junctional complexes between processes of Muller cells (glial cells) & the photoreceptors

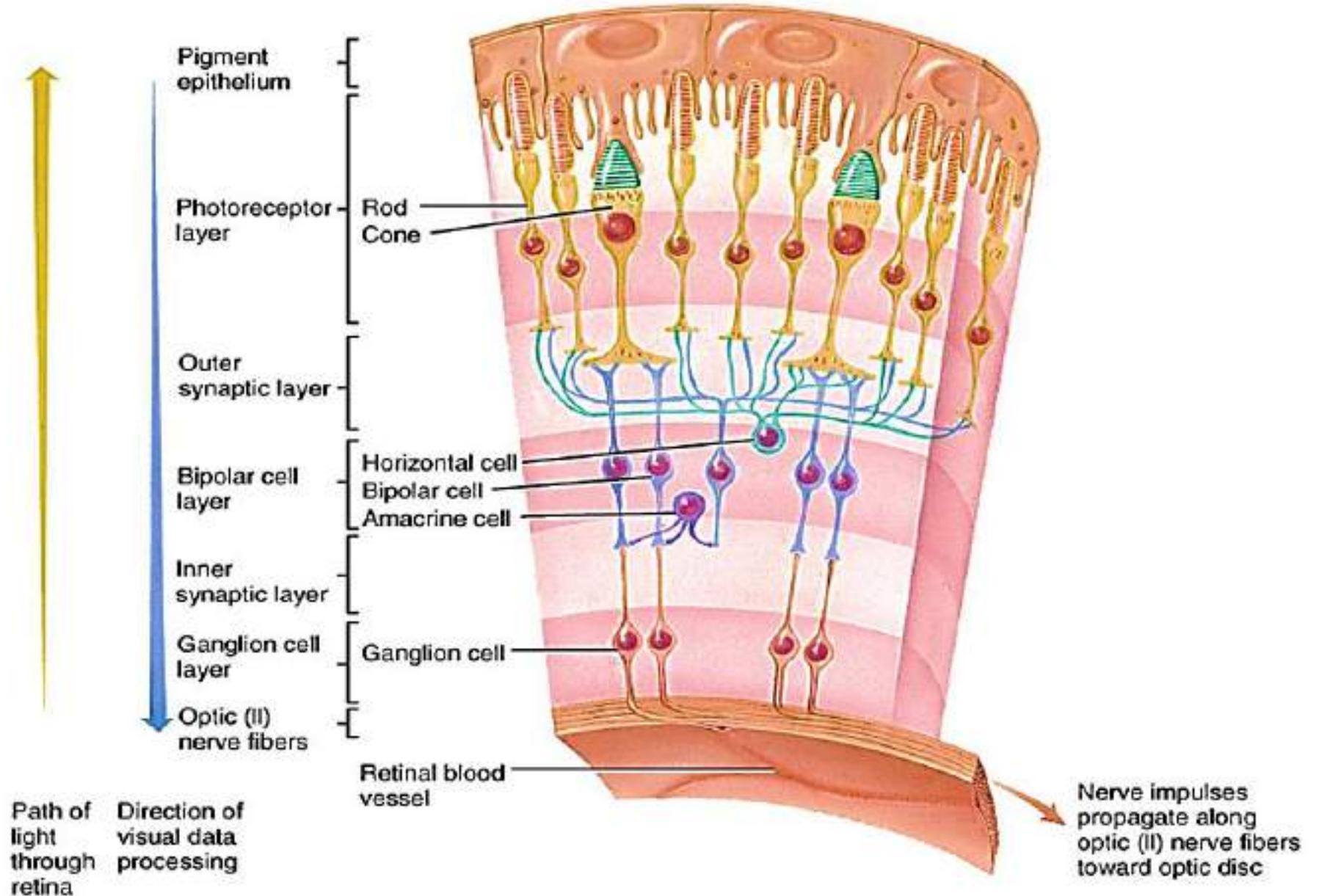
4- outer nuclear layer:

Contains the cell bodies of rods & cones

5- outer plexiform layer:

contains the synapses between synaptic processes of rod & cone cells and the dendrites of the bipolar & horizontal cells

sclera



6- Inner nuclear layer: contains the cell bodies of 4 cells:

- **Bipolar nerve cells** (**1st order neuron**) : its dendrites synapse with the synaptic processes of rods & cones
- **Horizontal cells**: large branched cells, interconnect the synaptic terminals of **rods & cones** with **bipolar cells**
- **Amacrine cells**: interconnect axons of **bipolar nerve** cells & dendrites of **ganglion cells**
- **Muller cells**: **neuroglia**, their processes extend from the inner limiting membrane to the outer limiting membrane

7- inner plexiform layer:

- contains synapses between axons of bipolar nerve cells & dendrites of ganglion cells which also synapses with amacrine cells

8- ganglion layer (RGCs):

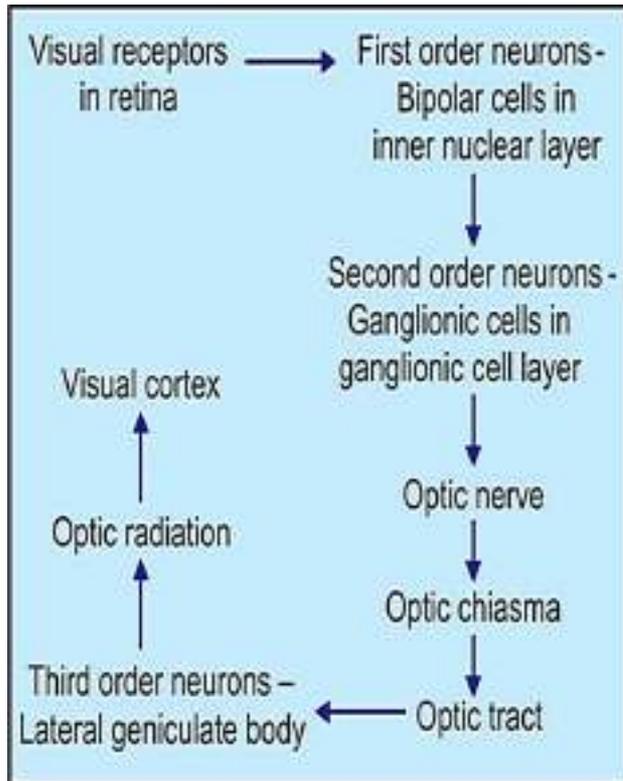
- Ganglion cells (**2nd order neuron**), are nerve cells with vesicular nuclei & basophilic cytoplasm. Their dendrites synapse with axons of bipolar cells . End at LGN
- Their axons form the fibers of **optic nerve**. Retinal B.V. present between ganglion cells

9- optic nerve layer:

- The axons of ganglion cells pass at right angle to form optic nerve. The optic nerve fibers are non myelinated at their origin , then they become myelinated after they traverse the sclera

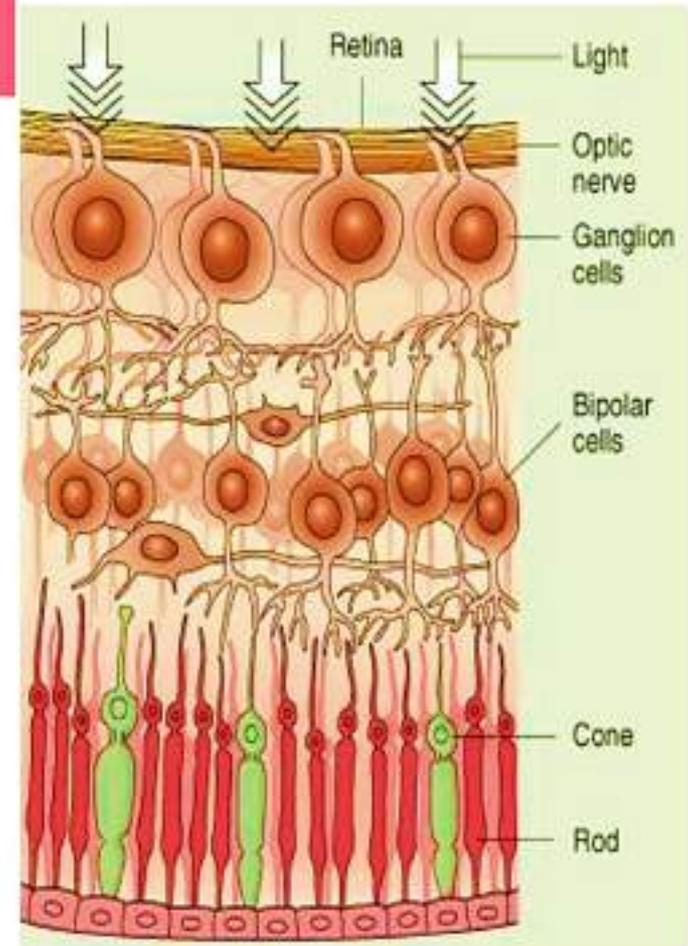
10- inner limiting membrane:

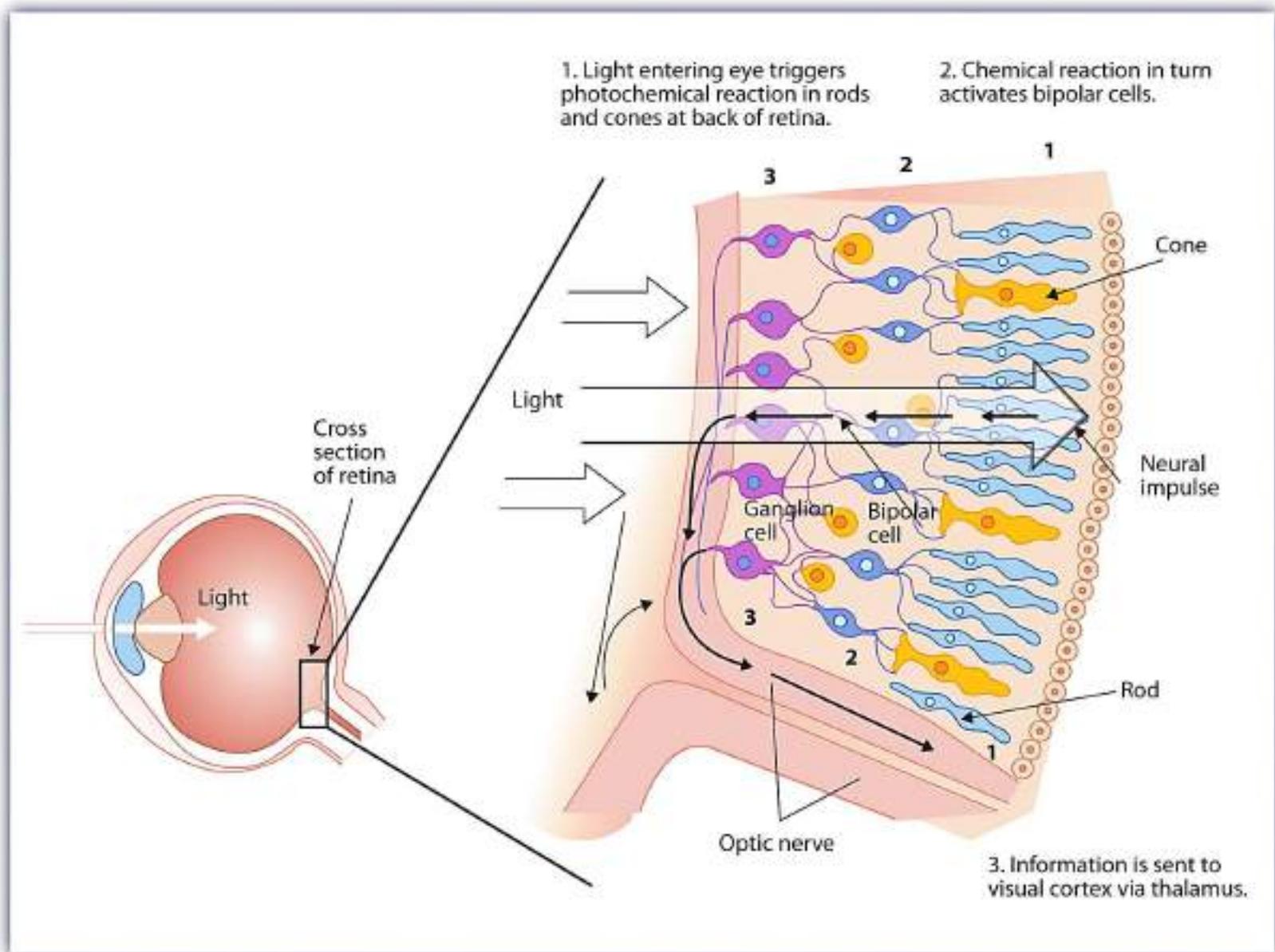
- Dark line formed by terminal processes of Muller cells
- Optic nerve → optic chiasma → optic tract → Lateral geniculate body (3rd order neuron) → optic radiation → visual cortex



Visual Pathway

- **Photoreceptors:**
Rods & Cones of retina
- **3 neuron pathway**
 - **1st order neurons:**
Bipolar cells of retina.
 - **2nd order neurons:**
Ganglion cells of retina. Their axons form the **optic nerve**
 - **3rd order neurons:**
Neurons in the lateral geniculate body. Their axons terminate in **primary visual cortex**.

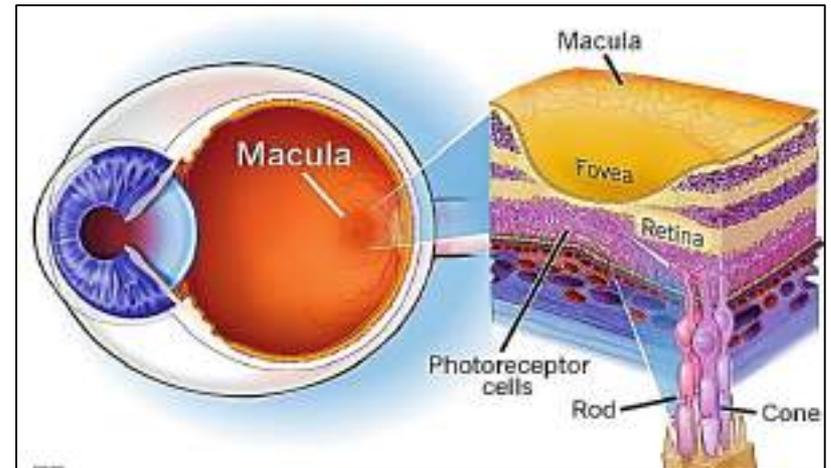
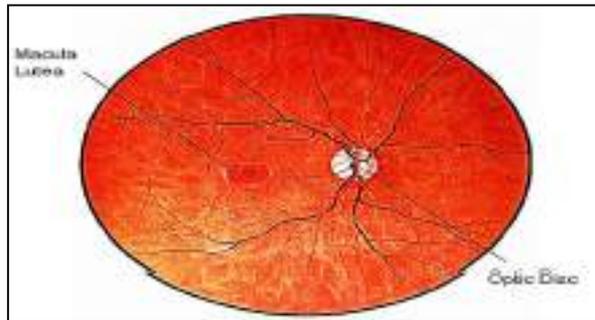




Mechanism of vision

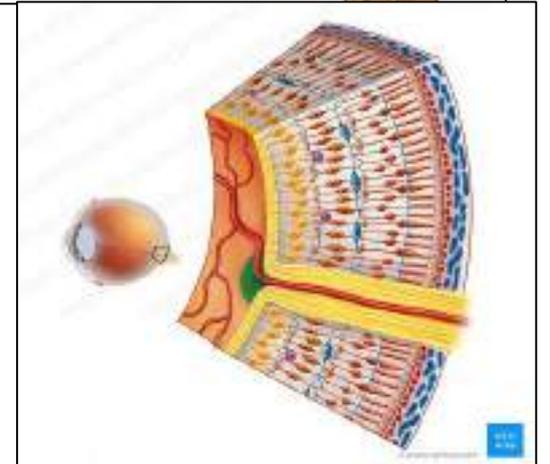
Fovea centralis:

- It is the area of **highest visual acuity** (sharp vision)
- Located in center of retina
- Is a central shallow depression called **macula**
- Lacks retinal blood vessels
- Contains Cones only



Optic disc (blind spot):

- has no photoreceptors .
- Consists of optic nerve fibers
- Entry point of the central retinal A & V

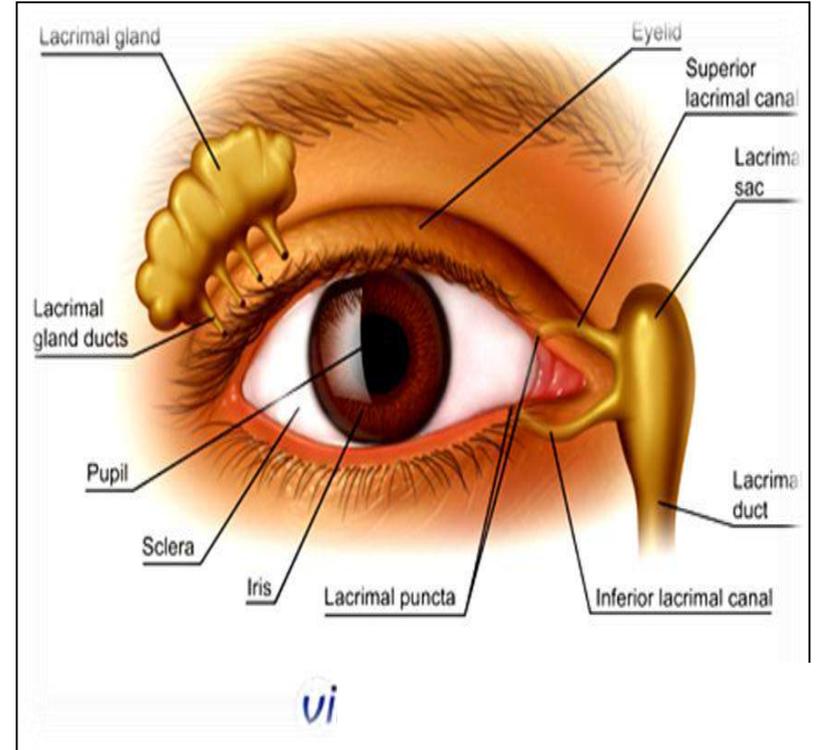


Accessory structures of the eye

1- the conjunctiva

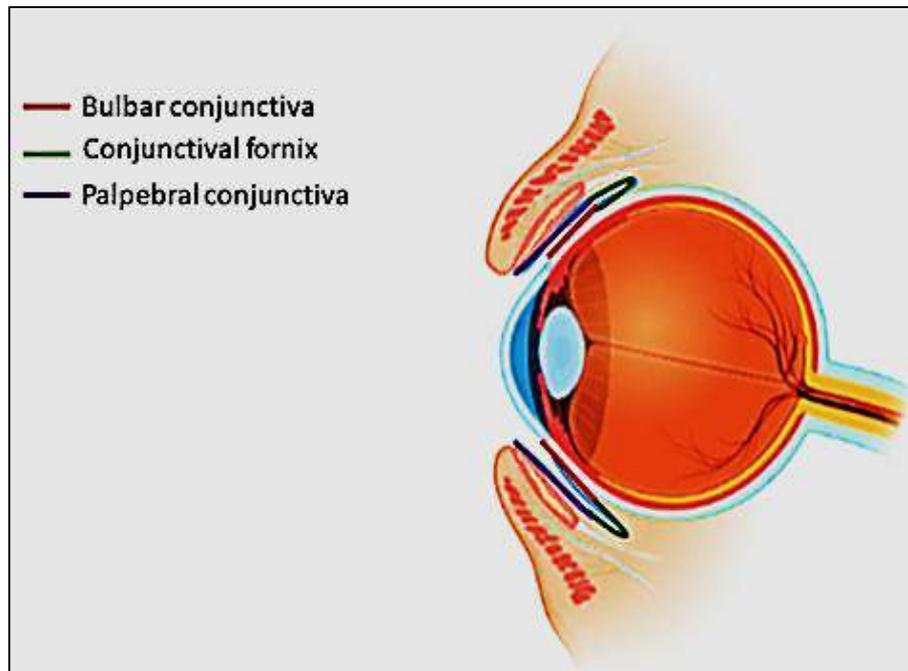
2- the eye lids

3- the lacrimal apparatus



Conjunctiva

- Very thin transparent mucus membrane
- Covers the anterior part of the eye except the cornea & lines internal surface of the eye lids



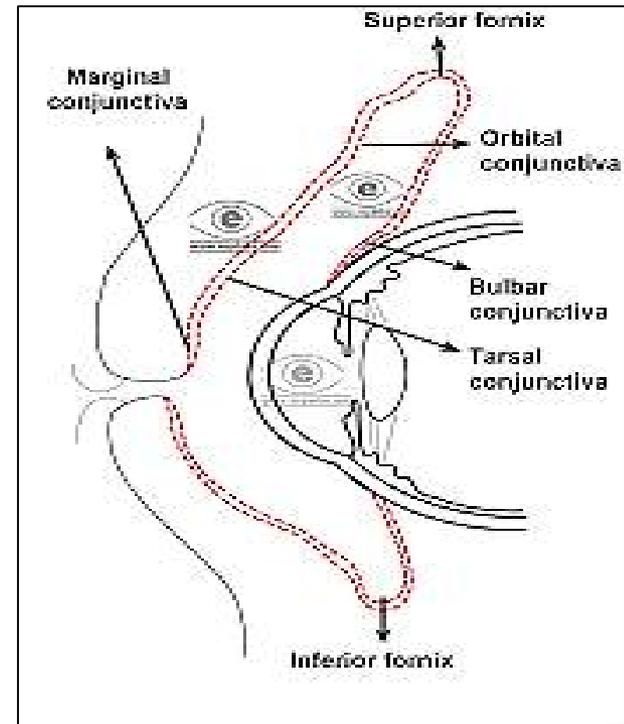
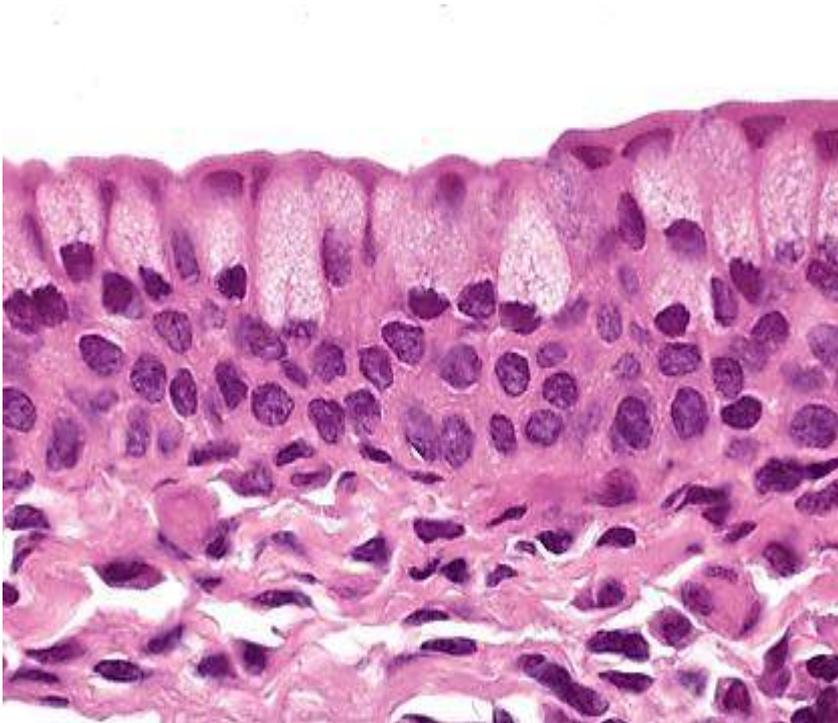
Parts of conjunctiva:

Conjunctiva composed of 3 parts:

- **Bulbar conjunctiva:** attached to anterior part of sclera.
- **Fornix:** is the junction between the bulbar & palpebral parts .
- **Palpebral conjunctiva:** lines the eye lid from inside.

The epithelium of the conjunctive is 3 - 5 layers, the outermost layer is non- K st. Sq. epith. and the deeper layers are made of stratified columnar with goblet cells these cells secrete mucus which form part of the tear film

Parts of the conjunctiva



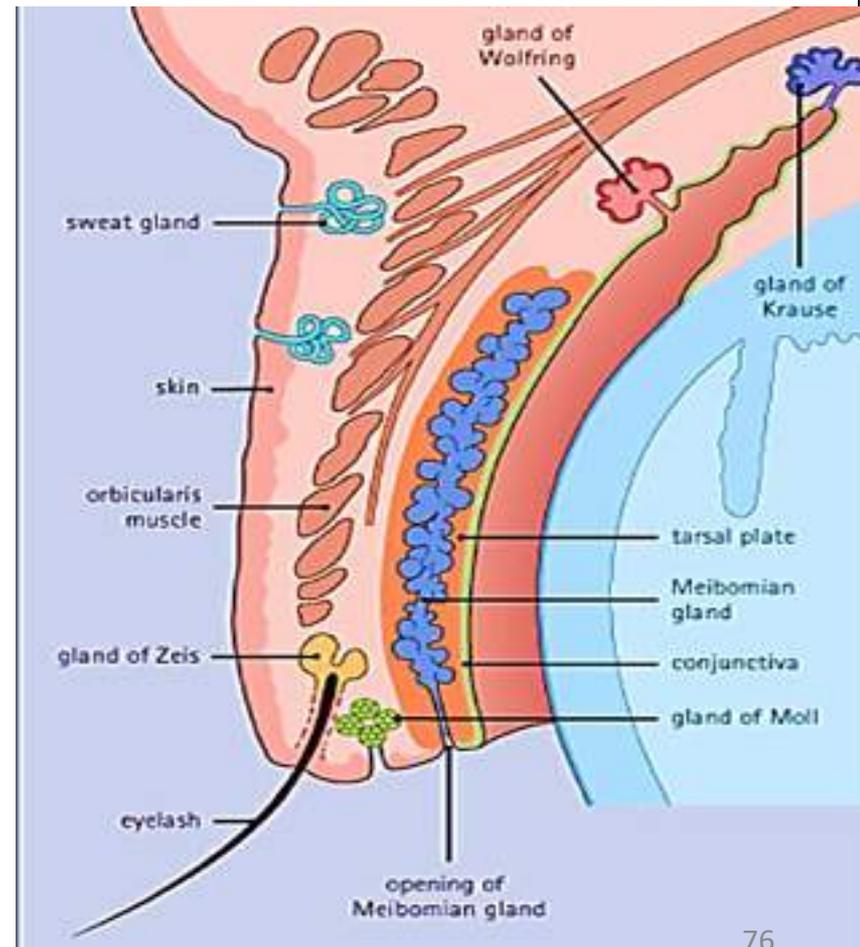
Conjunctival epithelium. The stratified squamous epithelium of the conjunctiva is Non-keratinized and contains mucin-producing goblet cells that are most numerous in the nasal bulbar conjunctiva.

Function of the conjunctiva:

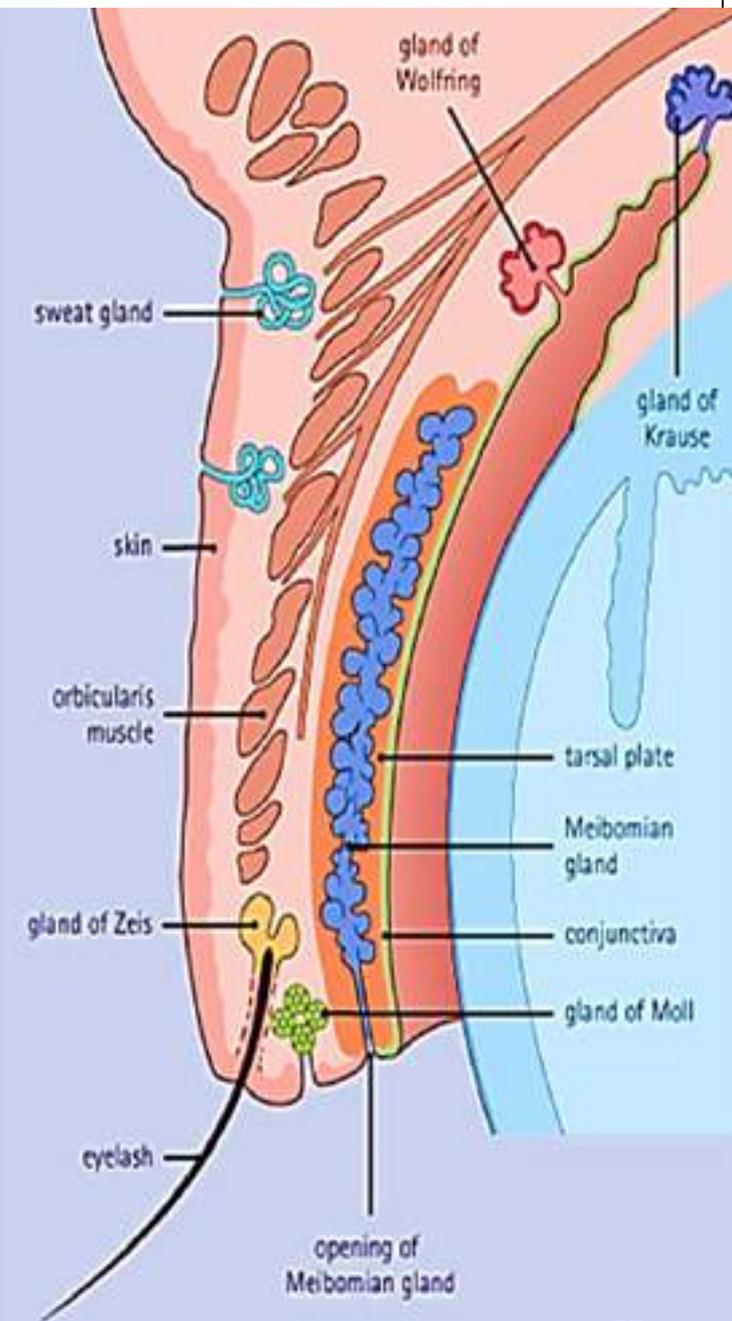
- Protection: the epithelium acts as a protective barrier against pathogens & foreign bodies
- Lubrication : goblet cells produce mucus, which helps spread tear film over surface of eye
- Immune defense conjunctiva contains immune cells contributes to immune surveillance of the eye
- The epithelium is well vascularized especially palpebral conjunctiva which helps with nutrition & immunity

Eye lid

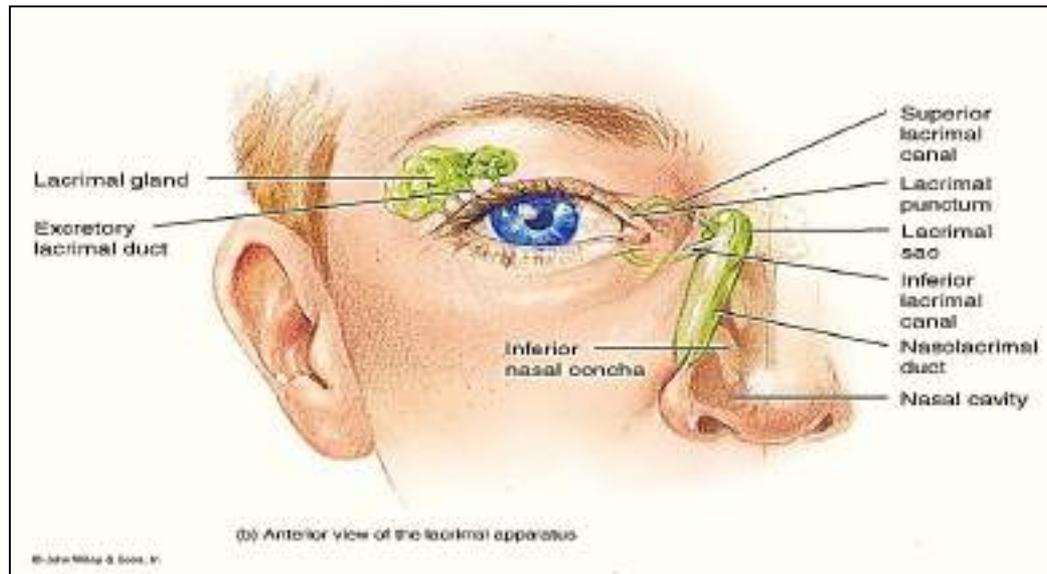
- From outside is covered by **thin skin that has no subcutaneous fat**. From inside is lined with palpebral conjunctiva.
- 3-4 rows of eye lashes at lid margin. **Zeis glands** are sebaceous glands open at the follicles of eye lashes. **Moll glands** are sweat glands open between the eye lashes



- bundles of Skeletal muscle: orbicularis oculi (function both voluntary & involuntary)
- **The tarsal plate** is fibrous plate contains the **Meibomian gland** (modified sebaceous gland-oily secretion) which adds to the surface of the tear film to minimize evaporation



Lacrimal apparatus



- The lacrimal glands: are compound tubulo- alveolar. They secrete tears
- Lacrimal canaliculi: present on the medial aspect of both upper & lower eyelid margins. They open into lacrimal sac. They drain the tears. Lined with **stratified squamous epithelium**
- Lacrimal sac: wide tube, lined with **pseudo- stratified columnar ciliated epithelium (motile cilia) & goblet cells (Respiratory epith)**
- Nasolacrimal duct: opens in the nasal cavity below **inferior concha**

Thank you

