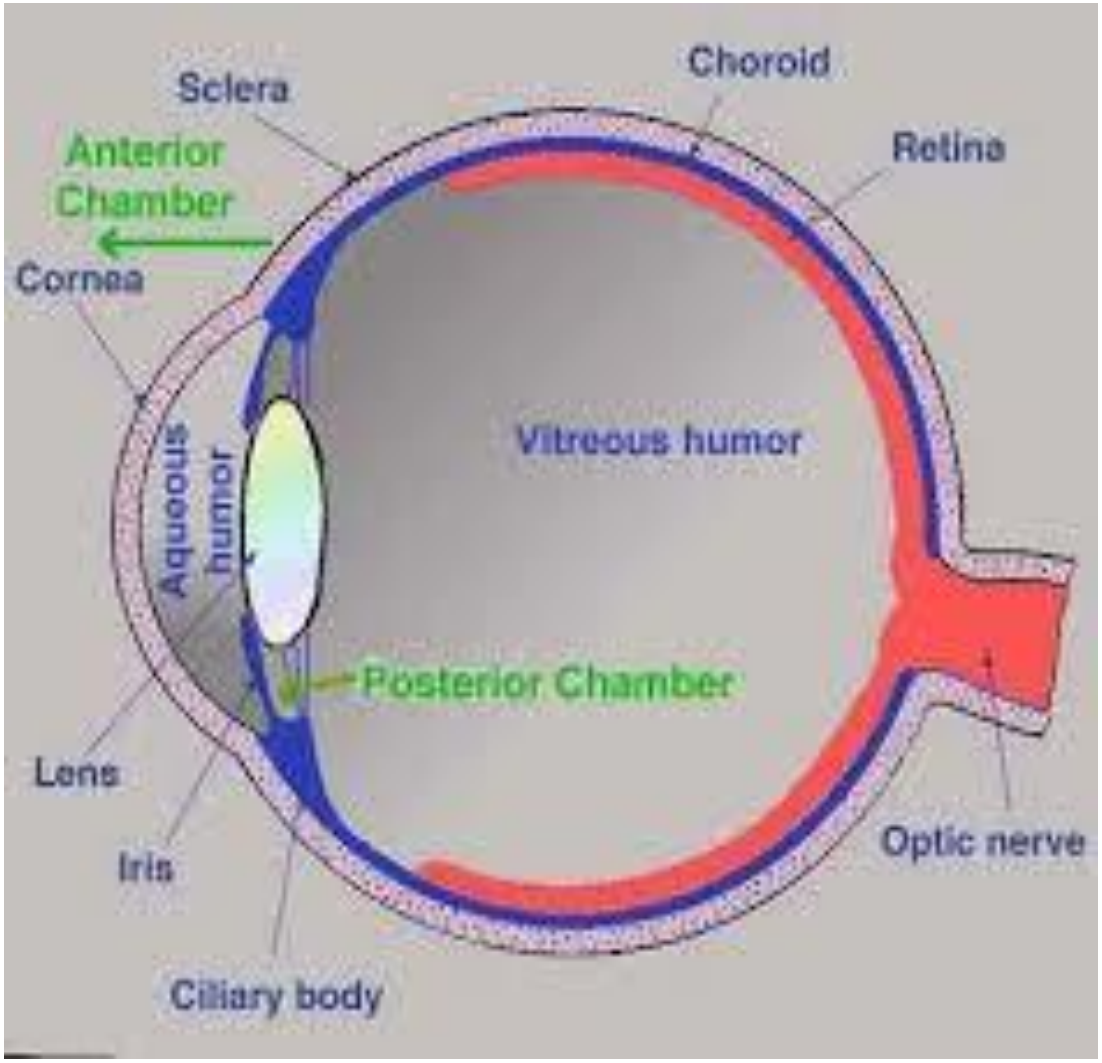
Histology of the Eye

Objectives

- **By the end of this lecture, the student should be able to describe:**
  - *The general structure of the eye.*
  - *The microscopic structure of:*
    - *Cornea.*
    - *Retina.*

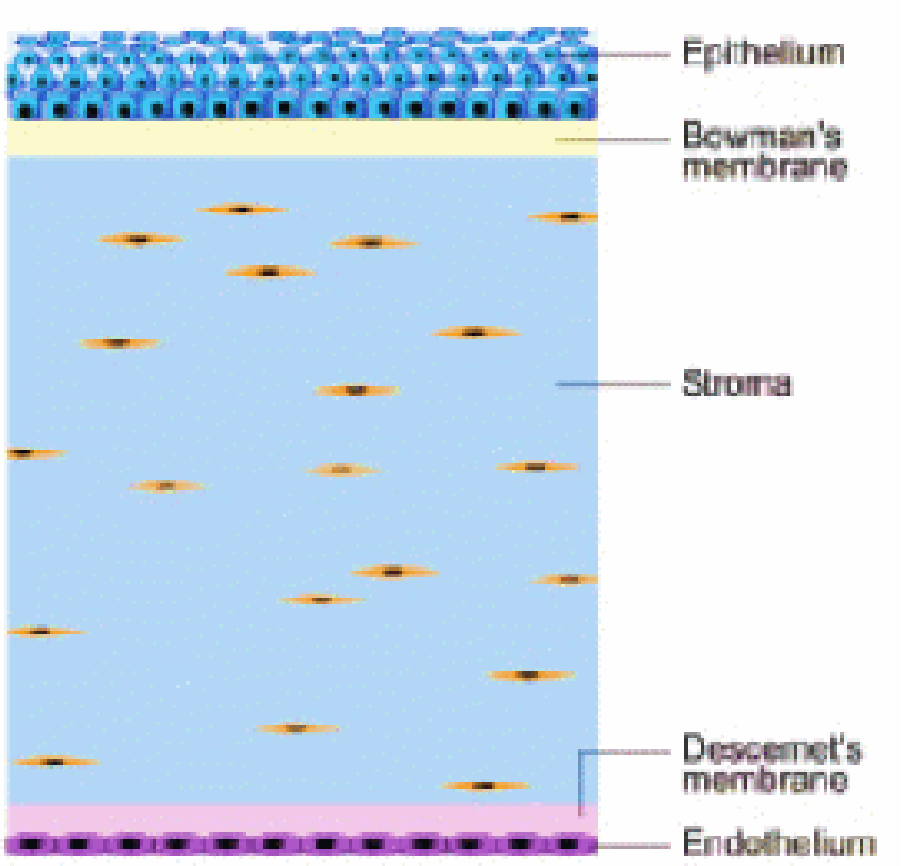
EYE BULB

- Three coats
  (3 Tunics):
- **1- Fibrous tunic:**
  Cornea.
  Sclera.
- **2- Vascular tunic:**
  Choroid.
  Ciliary body.
  Iris.
- **3- Neural tunic:**
  Retina.



CORNEA

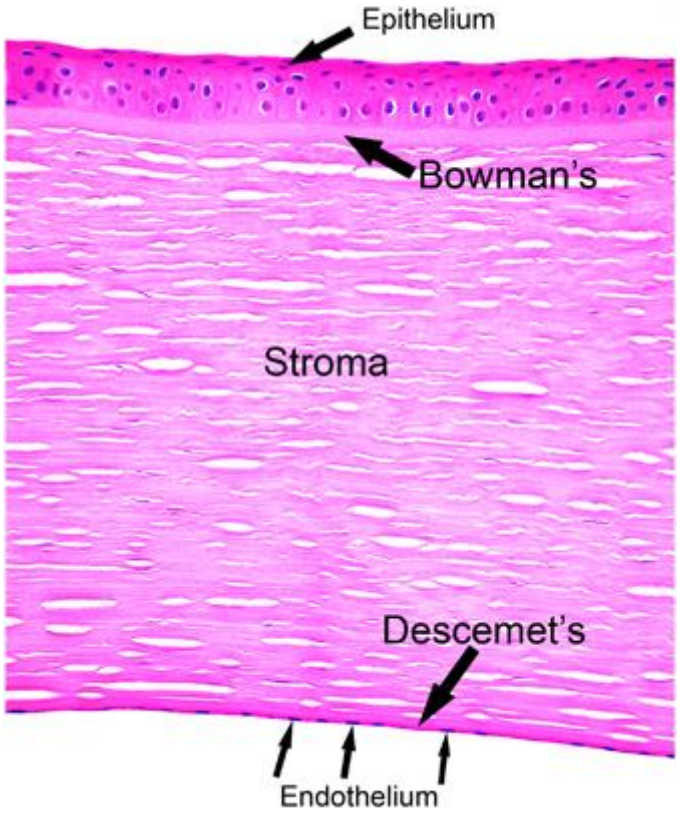
- It is the transparent, avascular and highly innervated anterior portion of the fibrous coat.
- It is composed of 5 distinct layers:
  1. Corneal epithelium.
  2. Bowman’s membrane.
  3. Stroma.
  4. Descemet’s membrane.
  5. Corneal endothelium.



CORNEA (Cont.)

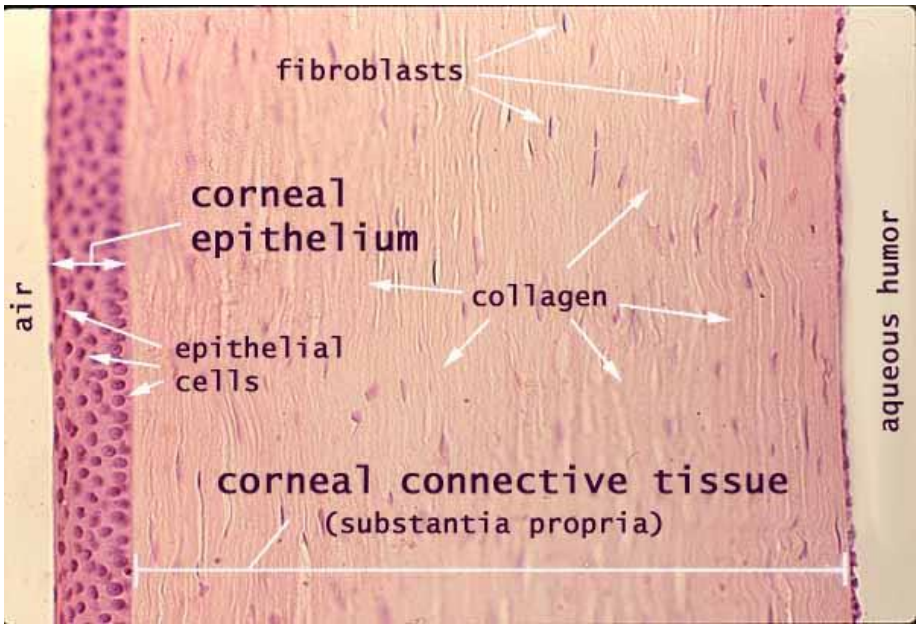
- **Corneal epithelium:**
  - Non-keratinized Stratified squamous epithelium.
  - Contains numerous free nerve endings.

- **Bowman's membrane:**
  - It is homogenous non-cellular layer containing type I collagen fibrils.



CORNEA (Cont.)

- **Stroma:**
  - It is the thickest layer (about 90%).
  - It is composed of parallel lamellae of dense collagenous C.T.
  - Each lamella is composed mainly of parallel type I collagen fibers with long fibroblasts.



CORNEA (Cont.)

- **Descemet's membrane:**
  - It is a thick basement membrane.

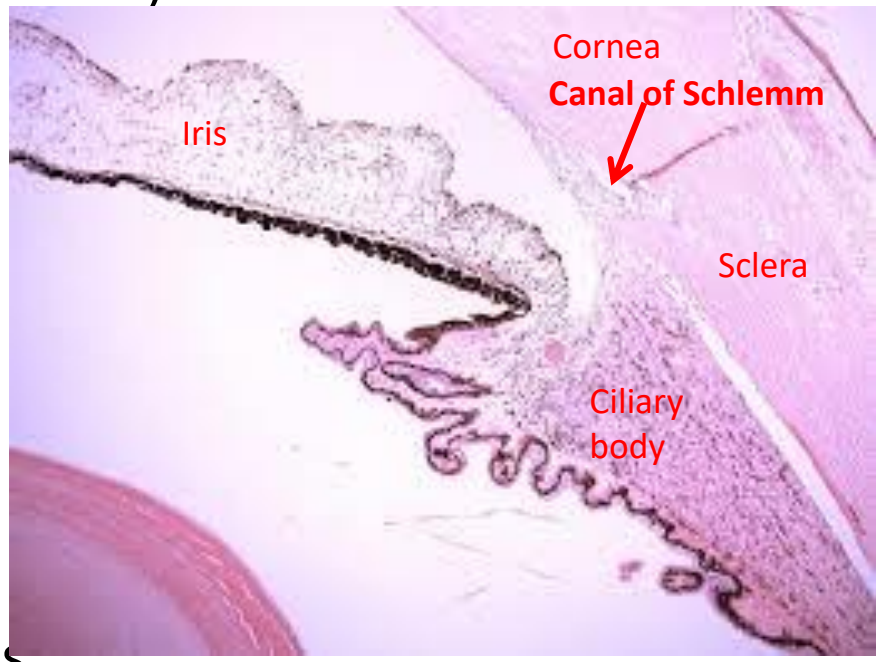
- **Corneal endothelium:**
  - It is s simple squamous epithelium.
  - **Functions:**

    1- Formation of Descemet's membrane.

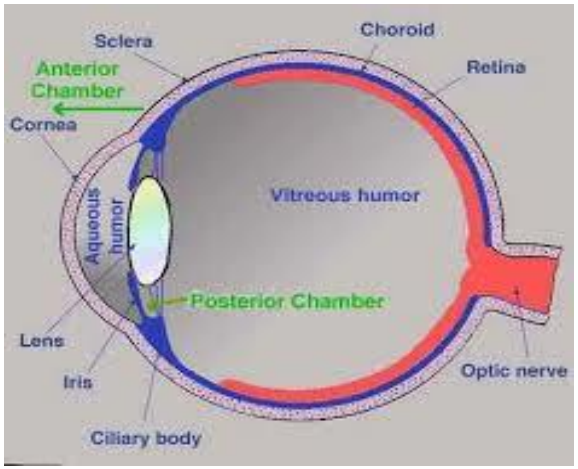
    2- Keeping the stroma relatively dehydrated

    (sod. pump → water withdrawal from the stroma).

LIMBUS
(CORNEO SCLERAL JUNCTION)



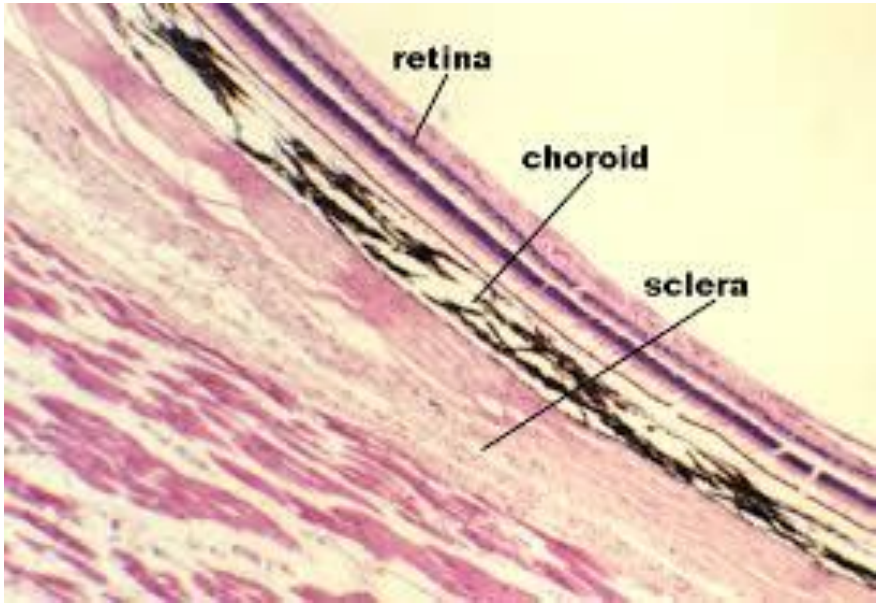
- It is the transition region between the cornea and sclera.
- It is about 1.5 mm width.
- It is highly vascular.
- It contains:
  1. Trabecular meshwork:
     Endothelium-lined spaces. It leads to canal of Schlemm.
  2. Canal of Schlemm:
     It drains the aqueous humor into the venous system.



SCLERA

- It covers the posterior 5/6 of the fibrous tunic.
- **Sclera Proper:** consists of interlacing bundles of type I collagen

  (dense collagenous C.T., irregular type).
- Melanocytes are located in the deeper regions.

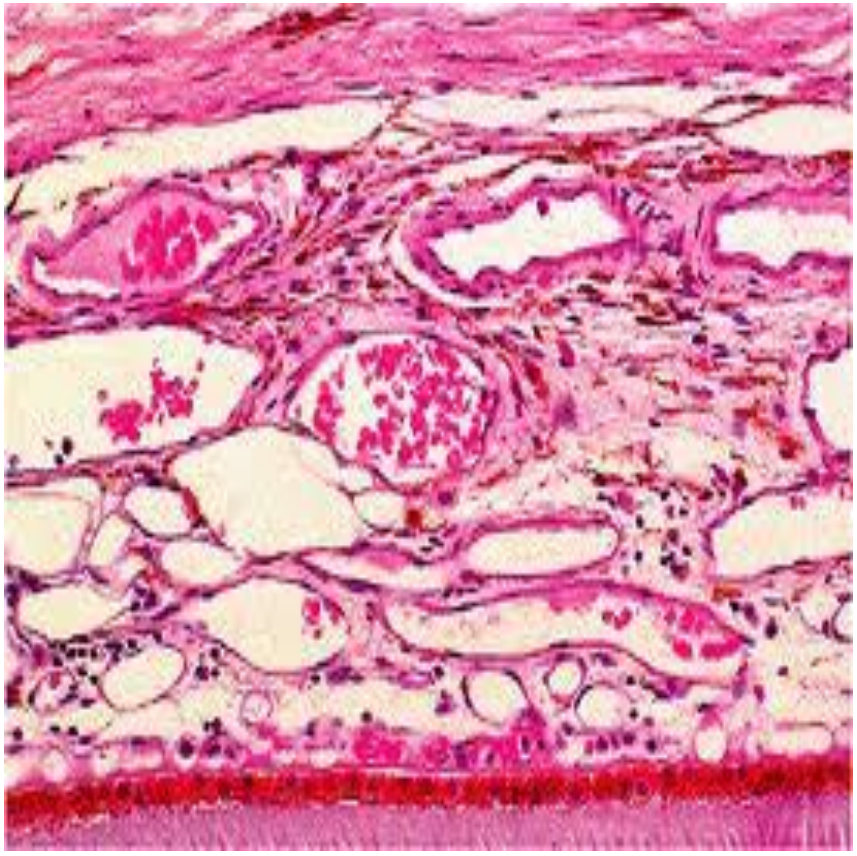


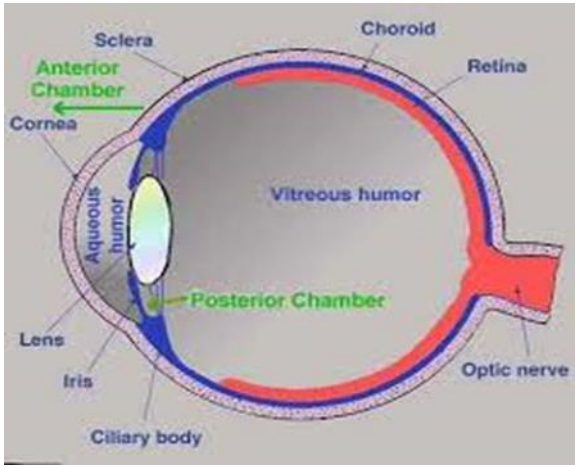
CHOROID

- It is the vascular, pigmented posterior portion of the middle vascular tunic.
- **Structure:**

  It is composed mainly of loose C.T. with melanocytes.

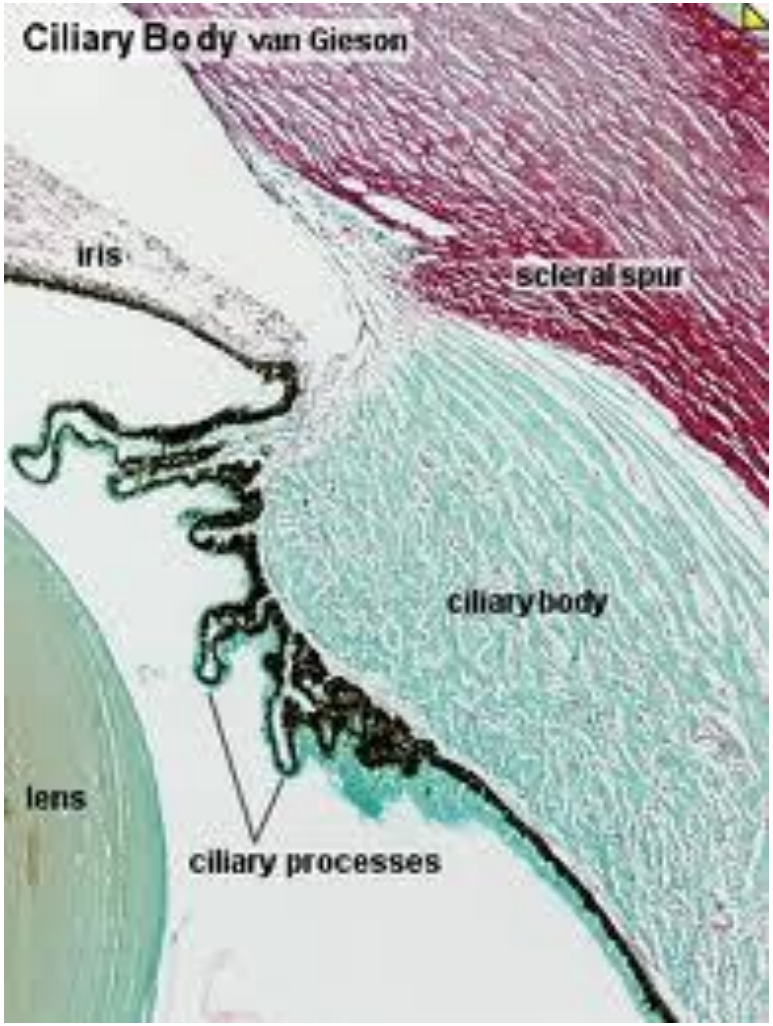
  It is separated from the retina by its Bruch's membrane.





CILIARY BODY

- It is the anterior continuation of the choroid. It surrounds the lens.
- **Structure:**
  - It is formed of loose vascular and pigmented C.T. that contains 3 bundles of smooth muscle cells (ciliary muscle).
  - Its inner surface is lined by pars ciliaris retinae (2 rows of columnar cells; outer pigmented and inner non-pigmented layers) .
  - Its inner surface is highly folded forming the ciliary processes.



CILIARY PROCESSES

- Processes project from the inner surface of the anterior 1/3 of the ciliary body towards the lens.
- Are covered by pars ciliaris retinae (2 rows of columnar cells).
- They give attachment to the lens suspensory ligaments (zonule fibers).

IRIS

It is formed of 5 layers:

- 1- Anterior border layer:

  Incomplete layer of fibroblasts and melanocytes.

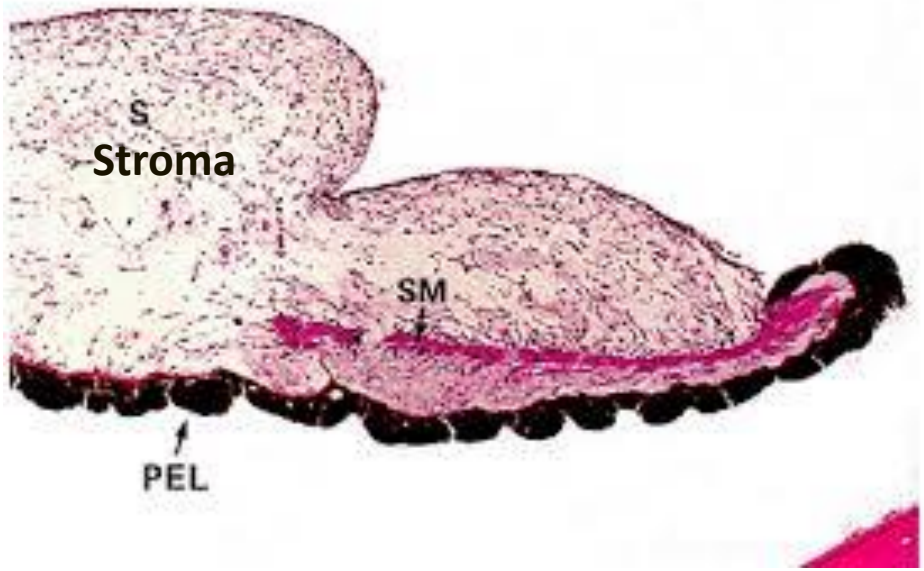
- 2- Stroma:

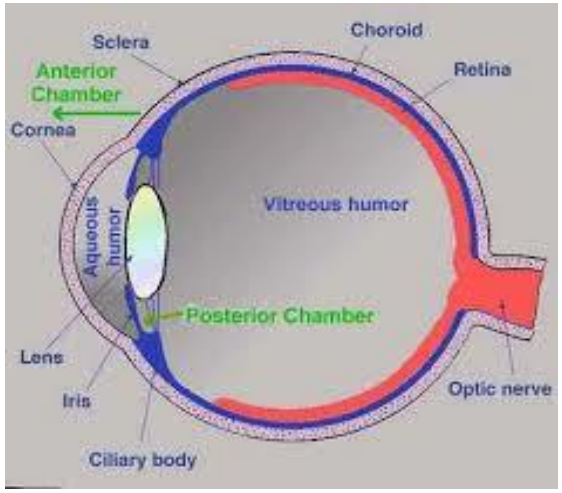
  Poorly vascularized C.T. with fibroblasts and melanocytes.

- 3- Vessel layer:

  Well-vascularized loose C.T.

  Centrally, it contains circularly arranged smooth muscle fibers (sphincter pupillae muscle).





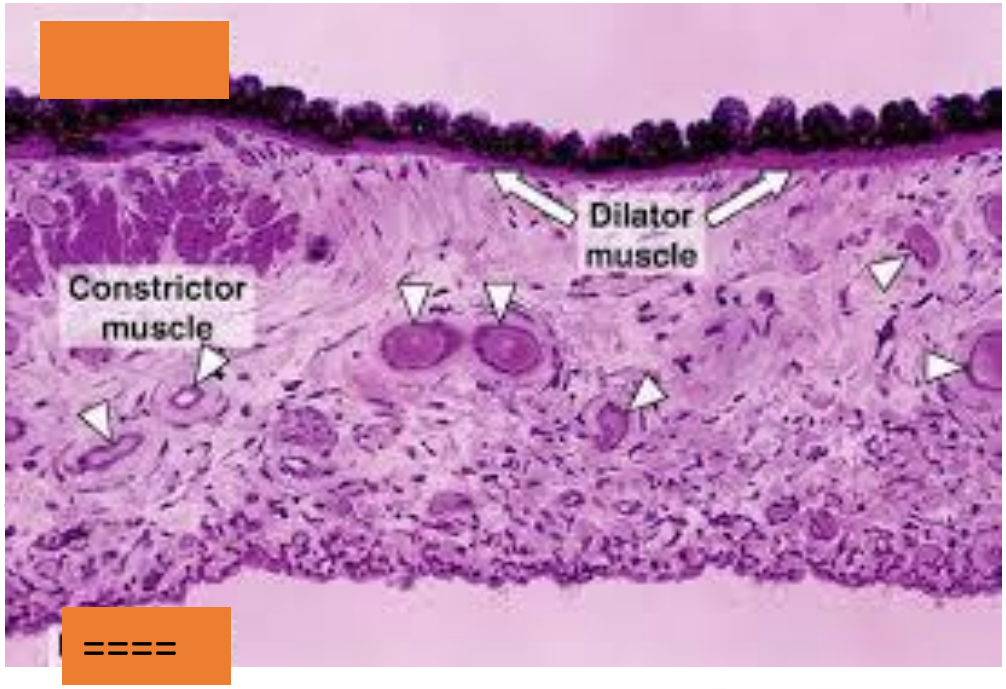
IRIS

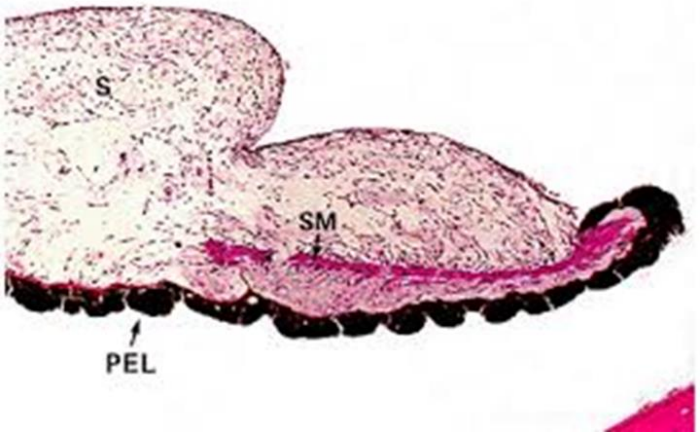
- 4- Dilator pupillae muscle layer:

  Contains radially arranged myoepithelial cells.
- 5- Posterior surface layer (pigmented epithelium layer):

  It is composed of 2 rows of pigmented epithelial cells (pars iridi retinae).

  They are the continuation of pars ciliaris retinae.

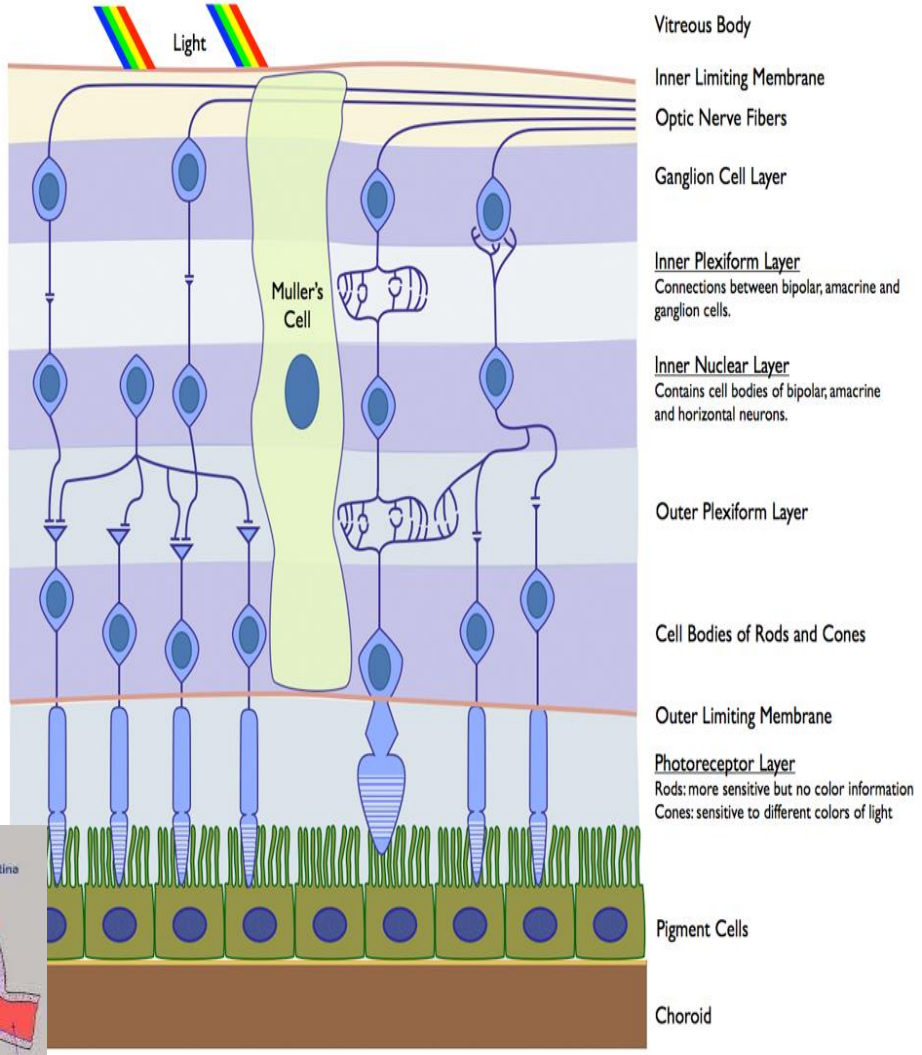


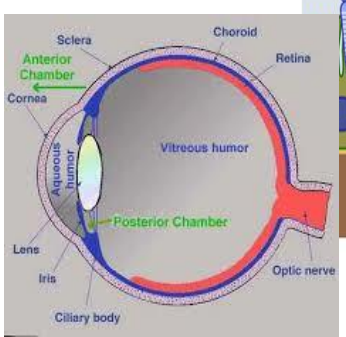


RETINA

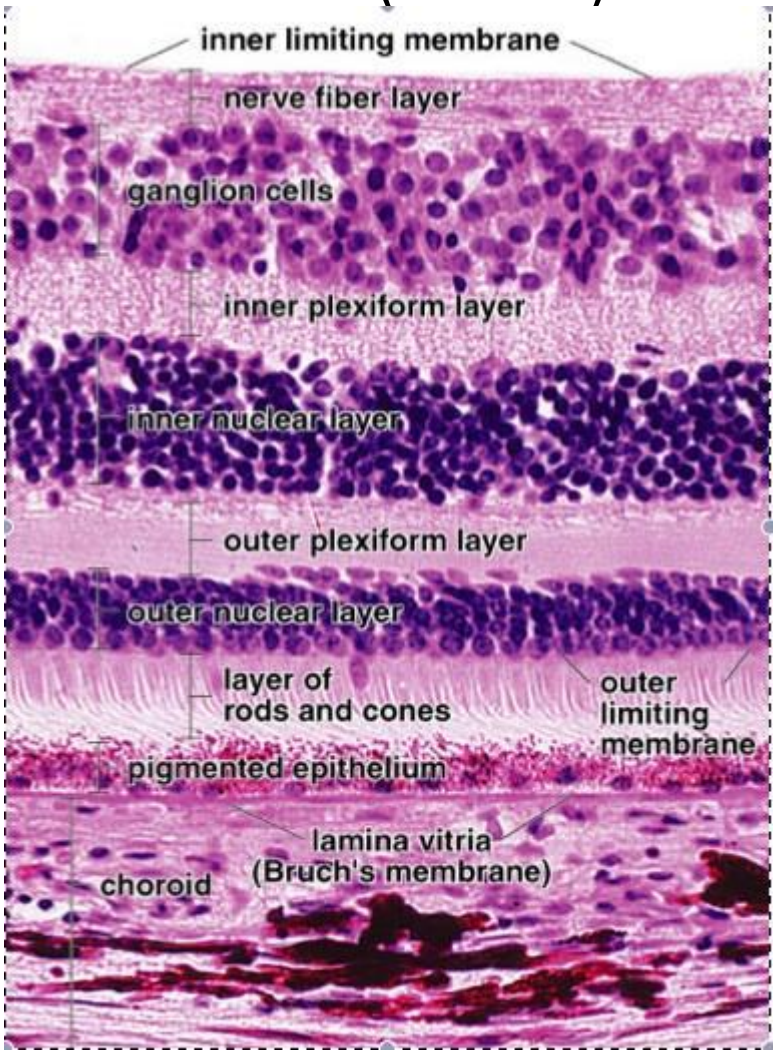
It is composed of **10 distinct layers** (from outside to inside):

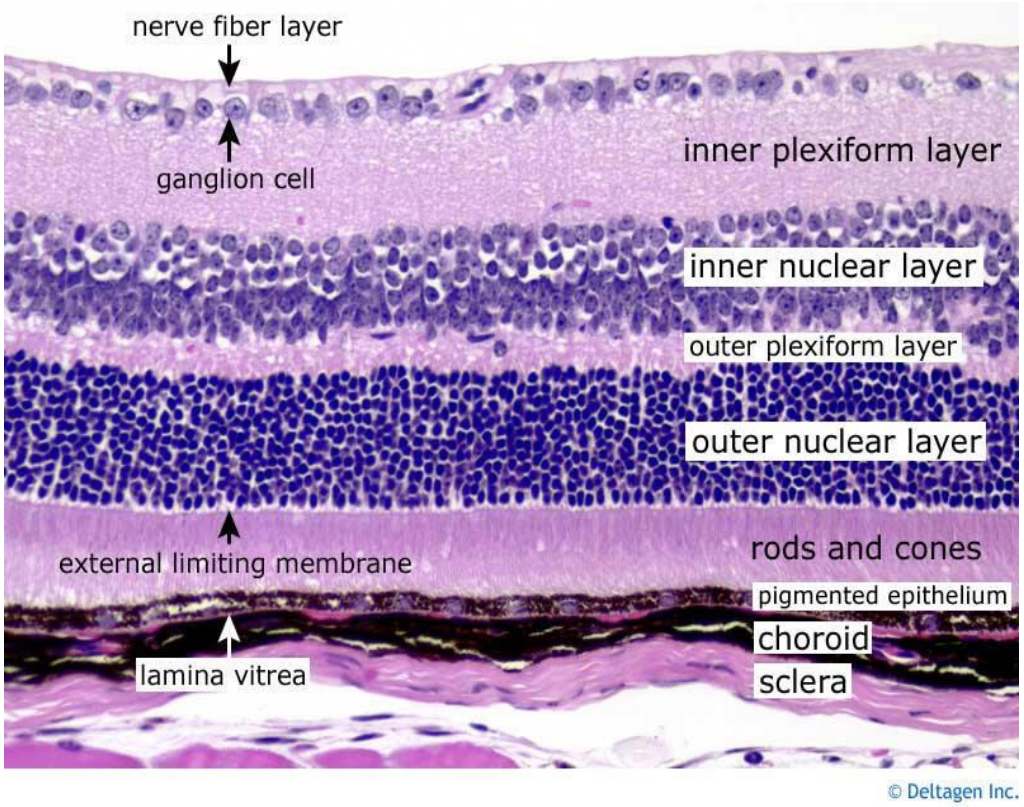
- 1- Pigmented epithelium.
- 2- Rods and cones layer.
- 3- Outer limiting membrane.
- 4- Outer nuclear layer.
- 5- Outer plexiform layer.
- 6- Inner nuclear layer.
- 7- Inner plexiform layer.
- 8- Ganglion cell layer.
- 9- Optic nerve fiber layer.
- 10- Inner limiting layer.





RETINA (Cont.)


inner limiting membrane
nerve fiber layer
ganglion cells
inner plexiform layer
inner nuclear layer
outer plexiform layer
outer nuclear layer
layer of rods and cones
outer limiting membrane
pigmented epithelium
lamina vitria (Bruch's membrane)
choroid


nerve fiber layer
ganglion cell
inner plexiform layer
inner nuclear layer
outer plexiform layer
outer nuclear layer
external limiting membrane
rods and cones
pigmented epithelium
choroid
lamina vitrea
sclera
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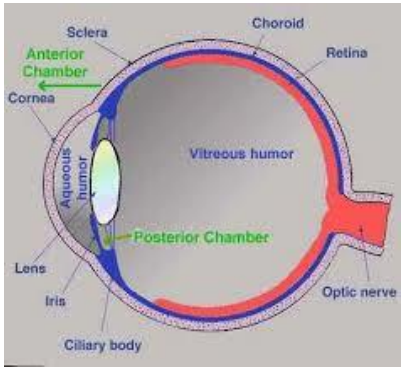

Sclera
Choroid
Anterior Chamber
Retina
Cornea
Vitreous humor
Aqueous humor
Posterior Chamber
Lens
Iris
Optic nerve
Ciliary body

RETINA (Cont.)

- **Pigmented Epithelium:**
- Cuboidal to columnar cells (single layer).
- Apical microvilli.
- Abundance of melanin granules.

- Functions:
  1- Absorb light.
  2- Phagocytosis of membranous discs from tips of rods.
  3- Esterification of Vitamin A (in SER).

RODS AND CONES LAYER (Cont.)

- Are photoreceptor cells.
- Each has:

1. Dendrite formed of:

   -Outer segment (OS): contains membranous discs containing rhodopsin (in rods) and iodopsin (in cones).

   - Connecting Stalk: with modified cilium.

   -Inner segment (IS).

2. Cell body.

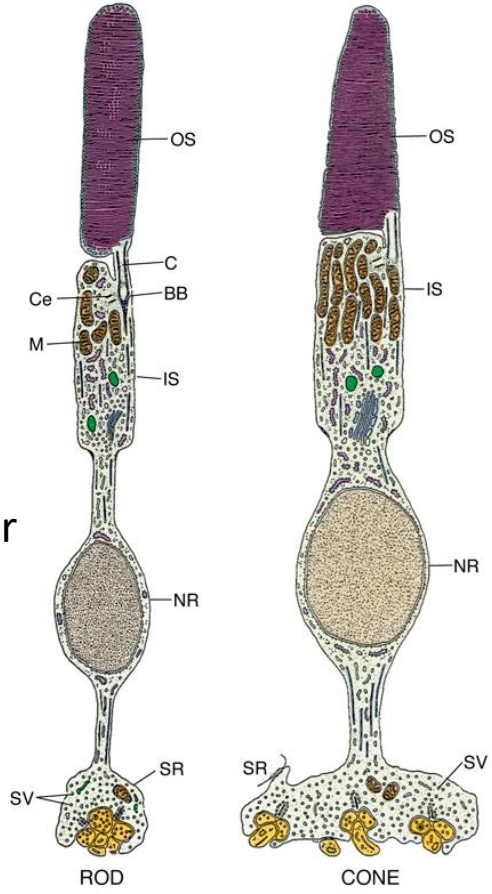
3. Axon: synapses with dendrite of bipolar neuron of inner nuclear layer.

- **Functions:**

  Rods are receptors for dim light (low intensity light).

  Cones are receptors for bright light and color vision

  (red, green & blue).



RETINA (Cont.)

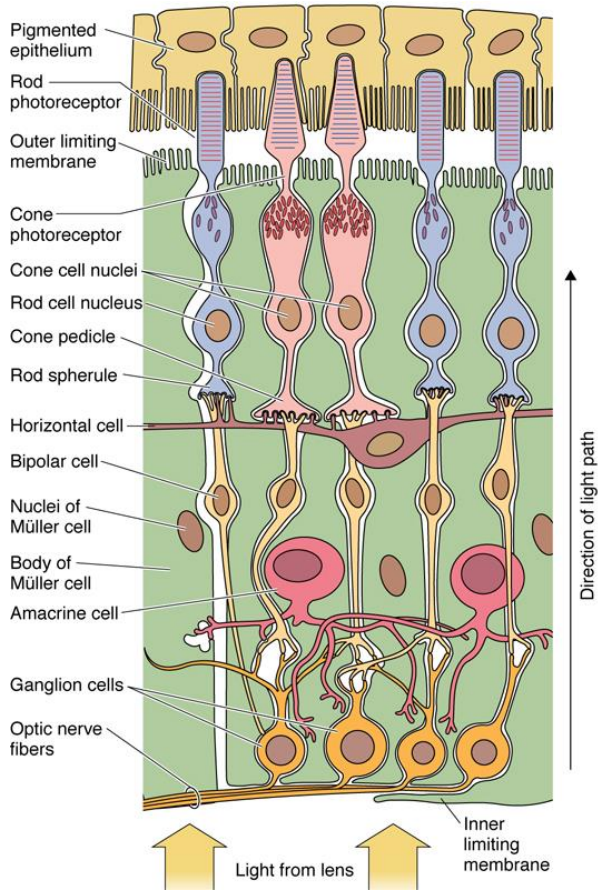
- **Outer limiting membrane:**
  - A region of zonulae adherents junctions between Muller cells and the photoreceptors.
- **Outer nuclear layer:**
  - Contains nuclei of the rods & cones.
- **Outer plexiform layer:**
  - Contains axodendritic synapses between the photoreceptor cells and dendrites of bipolar and horizontal cells.
- **Inner nuclear layer:**
  - **Contains the nuclei of:**

  1- Bipolar neurons.

  2- Horizontal neurons.

  3- Amacrine neurons (unipolar neurons):

  4- Neuroglial cells (Muller cells) that extend between the vitreous body and the inner segments of rods and cones.



RETINA (Cont.)

- **Inner plexiform layer:**

  Contains axodendritic synapses between axons of bipolar neurons and dendrites of ganglion cells and amacrine cells.

- **Ganglion cell layer:**

  Contains cell bodies of large multipolar neurons of the ganglion cells.

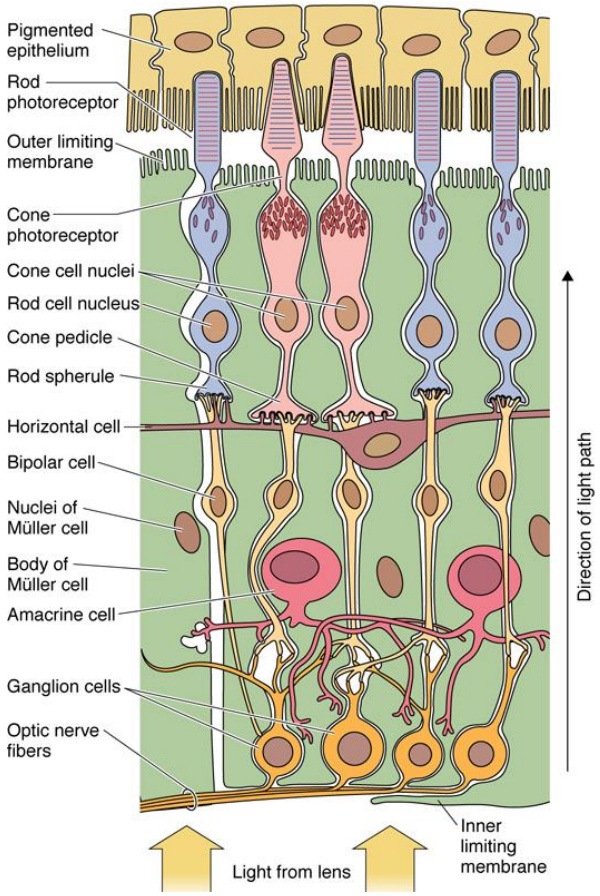
- **Optic nerve fiber layer:**

  Contains unmyelinated axons of the ganglion cells.

  N.B. These axons become myelinated as the nerve pierces the sclera.

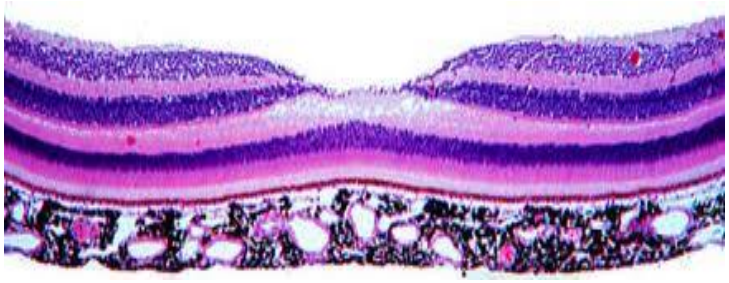
- **The inner limiting membrane:**

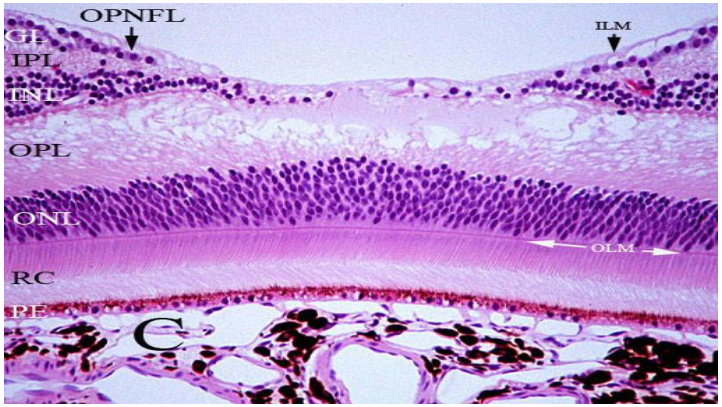
  It is formed by the basal laminae of the Muller cells.

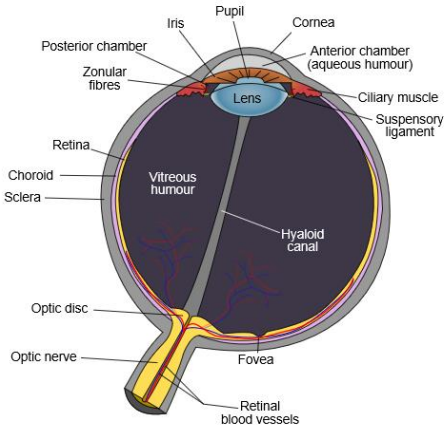


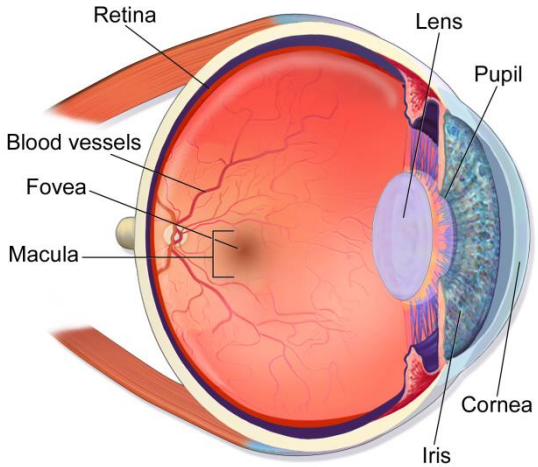
RETINA (Cont.)

- **Fovea centralis:**
- It lies in the center of macula lutea.
- Cones are highly concentrated in the fovea.
- It is responsible for visual acuity.









Eye Anatomy

RETINA (Cont.)

- **Types of cells in the retina:**

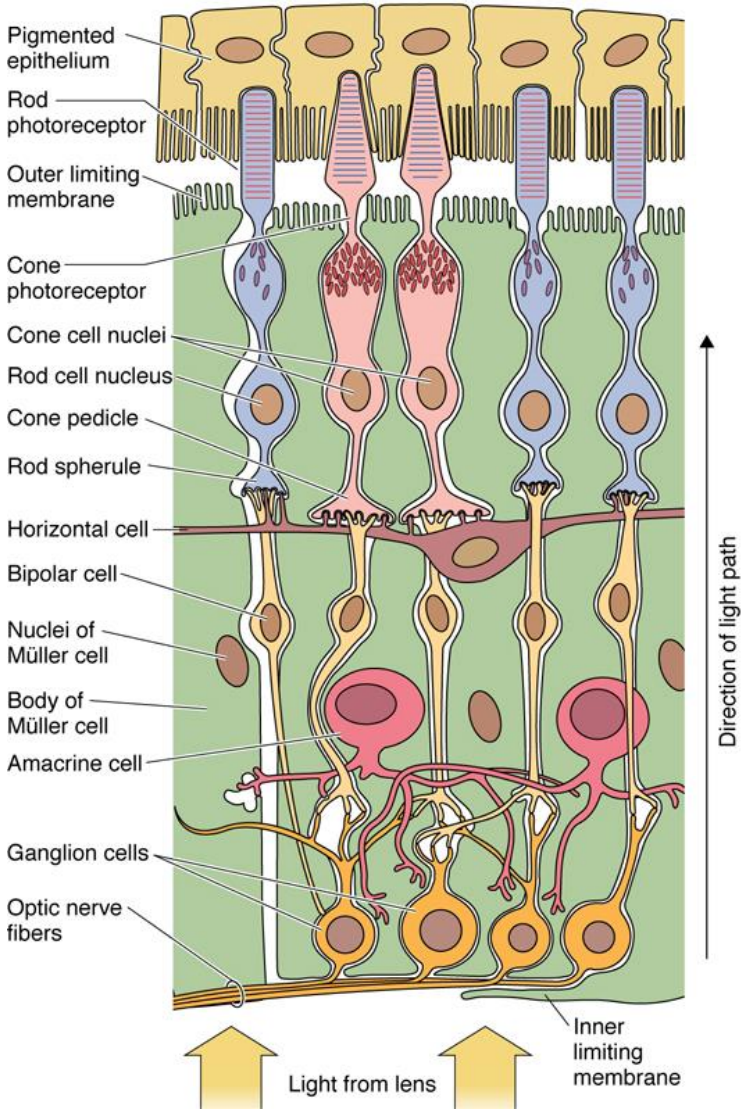
1- Pigmented epithelium.

2- Nerve cells:

- Photoreceptor cells (rods & cones)
- Bipolar neurons.
- Ganglion cells.
- Association neurons:
  - i. Horizontal cells.
  - ii. Amacrine cells.

3- Neuroglial cells:

- Muller's cells.
- Astrocytes.

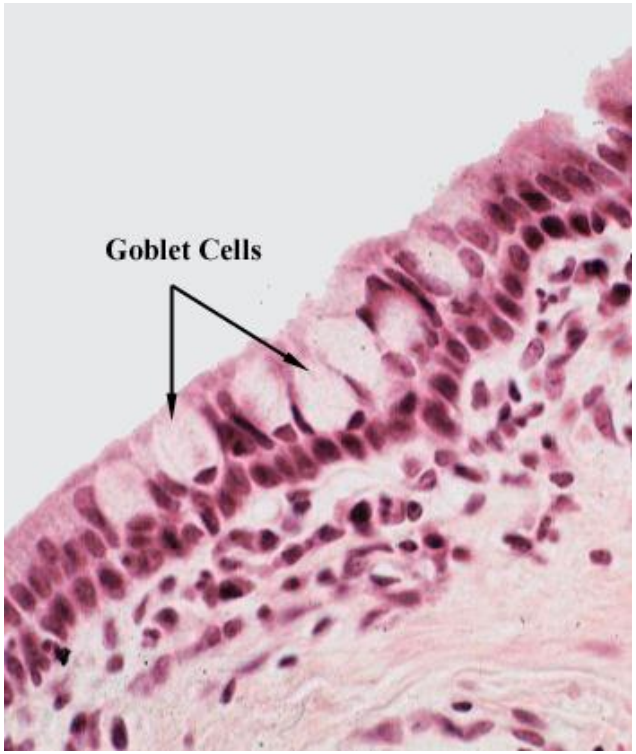


CONJUNCTIVA

- It is the transparent mucous membrane lining the inner surfaces of the eyelids (palpebral conjunctiva) and reflecting onto the sclera of the anterior surface of the eye (bulbar conjunctiva).
- **L/M:**
- **1- Epithelium:**

  Stratified columnar epithelium with numerous goblet cells.
- **2- Lamina propria:**

  Loose C.T.



GOOD LUCK