



ANATOMY OF THE EYE

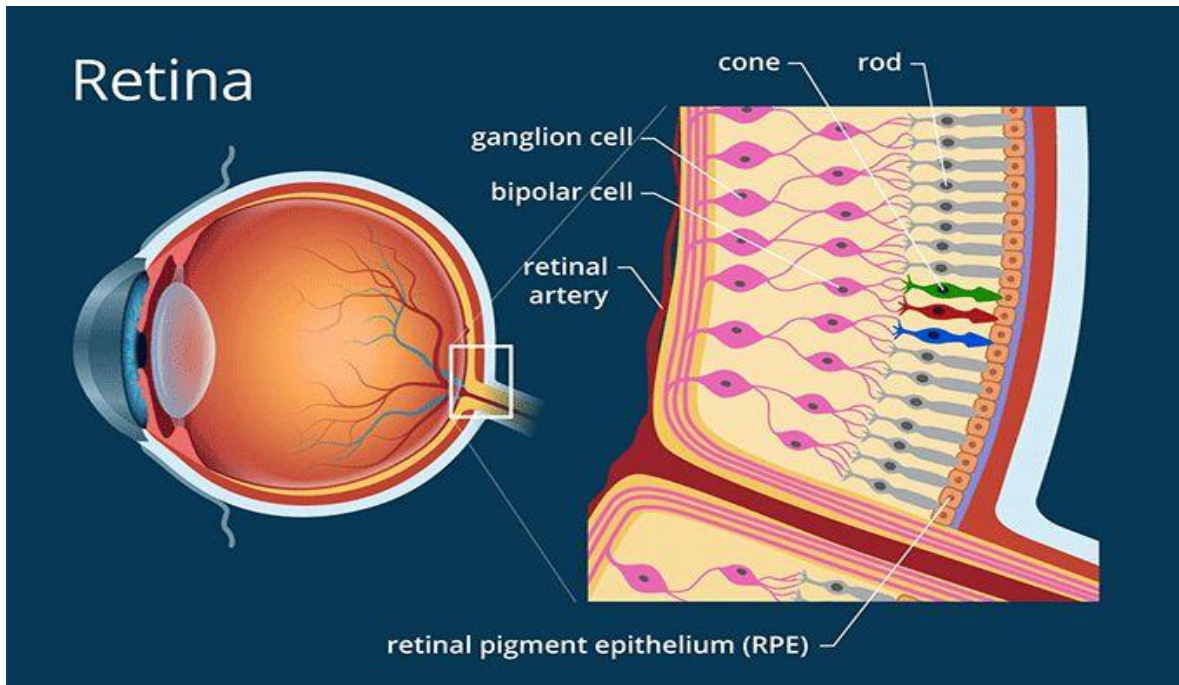
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قسم تقنيات فحص البصر

Lec5

Anatomy of Retina



The first step in the process of vision is the conversion of light into signals that can be interpreted in the brain. This takes place in the retina, which is located in the back of the eye.

Retina Definition

The retina is the sensory membrane that lines the inner surface of the back of the eyeball. It's composed of several layers, including one that contains specialized cells called [photoreceptors](#). There are two types of photoreceptor cells in the human eye — **rods and cones**.

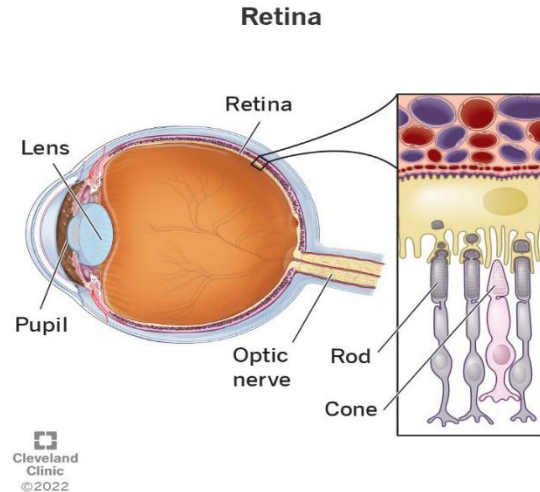
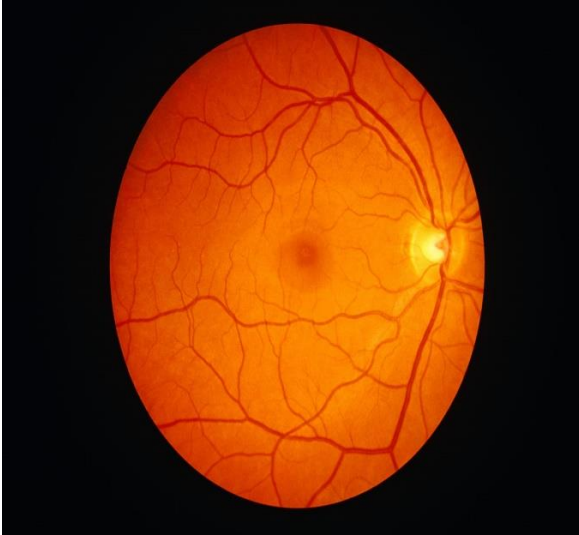
Rod photoreceptors detect motion, provide black-and-white vision and function well in low light. (mainly in dim light and provide monochromatic vision).

Cones are responsible for central vision and [color vision](#) and perform best in medium and bright light. (Cones function in well-lit conditions and are responsible for the perception of colour through the use of a range of opsins, as well as high-acuity vision used for tasks such as reading).

Rods are located throughout the retina; cones are concentrated in a small central area of the retina called the **macula**. At the center of the macula is a small depression called **the fovea**. The fovea contains only cone photoreceptors and is the point in the retina responsible for maximum [visual acuity](#) and color vision.

Retina Function

Photoreceptor cells take light focused by the [cornea](#) and lens and convert it into chemical and nervous signals which are transported to visual centers in the brain by way of the [optic nerve](#). In the visual cortex of the brain, these signals are converted into images and visual perceptions.



Retinal layers

• Retina consists of 10 distinct layers. from **outside** inwards of the following layers:

- 1) Retinal pigment epithelium (RPE):
- 2) Layer of the rods and cones (photoreceptor layer)
- 3) Outer/ external limiting membrane
- 4) Outer nuclear layer
- 5) Outer plexiform layer
- 6) Inner nuclear layer
- 7) Inner plexiform layer
- 8) Ganglion cell layer
- 9) Nerve fiber layer
- 10) Internal limiting membrane

1. Retinal pigment epithelium (RPE):

It is a single layer of flattened, mostly hexagonal cells which is firmly adherent to lamina vitrea of the choroid.

- On direct ophthalmoscopy the retina exhibits fine mottled appearance due to the following facts: –The RPE cells are not equally pigmented.– Pigments in each RPE cells are distributed at the periphery of the cells and the central nuclear area remains relatively pigment free.
- The taller and narrower pigment cells at the macula confer darker color to this region.
- RPE cells transport substances to the photoreceptor cells which are needed for metabolism.

2. Photoreceptor cells layer :

- Rods and cones with their nucleus and processes form the sensory receptor.
- arranged on the external limiting membrane like a palisade.
- The rods contain visual purple called rhodopsin which combines vitamin A with protein.
- Rhodopsin is responsible for vision in dim light (scotopic vision) and peripheral vision.
- The cones are responsible for acuity of vision, vision in strong light (photopic vision) and color vision.
- No. of rods— 125 million No. of cones— 7 million Each photoreceptor, i.e. rod and cone consist of 3 parts;
 - Outer and inner segment connected by a tubular connection called cilium in the layer of the rods and cones.
 - Cell body and nucleus in the outer nuclear layer.
 - Cell processes, i.e. axons that extend into the outer plexiform layer.

3. Outer limiting membrane:

The **external limiting membrane** (or **outer limiting membrane**) is one of the ten distinct layers of the retina of the eye. It has a network-like structure and is situated at the bases of the rods and cones.

It is a fenestrated membrane formed by fibers of Müller and pierced by the processes of the rods and cones.

4. Outer nuclear layer:

- The **outer nuclear layer** (or **layer of outer granules** or **external nuclear layer**), is one of the layers of the vertebrate retina, the light-detecting portion of the eye. Like the inner nuclear layer, the outer nuclear layer contains several strata of oval nuclear bodies; they are of two kinds, viz.: rod and cone granules

-This layer contains nuclei of the rods and cones

5. Outer plexiform/molecular layer:

- is a layer of neuronal synapses in the retina of the eye. It consists of a dense network of synapses between dendrites of horizontal cells from the inner nuclear layer, and photoreceptor cell inner segments from the outer nuclear layer. It consists of;

–Arborisation of the axons of the rod and cone nuclei with the dendrites of the bipolar cells

–Processes of the horizontal cells

–The fibers of Müller

1. Inner nuclear layer: • This layer consists of; a number of closely packed cells, of which there are five cells

- 1) Bipolar cells
- 2) Horizontal cells
- 3) Amacrine cells
- 4) Nuclei of the fibers of Müller
- 5) Capillaries of the central retinal artery and vein

∇.Inner plexiform/molecular layer • This layer contains;

–Mainly arborisation of the axons of the bipolar cells with the dendrites of the ganglion cells.

–Processes of the amacrine cells

–Fibers of Müller

–Branches of the retinal arteries and veins

∧.Ganglion cell layer

• Ganglion cells are multipolar nerve cells with clear oval nucleus and well developed Nissl granules. Ganglion cells form the second order of neurons.

is a layer of the retina that consists of retinal ganglion cells and displaced amacrine cells • There are at least 18 different morphological types of ganglion cell in the human retina • There are about a million ganglion cells.

∩.Nerve fiber layer:

• It consists of– Axons of the ganglion cells which pass through lamina cribrosa and form the optic nerve. is formed by the expansion of the fibers of the optic nerve; it is thickest near the optic disc, gradually diminishing toward the ora serrata .

– Fibers of Müller

– Retinal vessels

∩∩.Inner limiting membrane:

• It is a thin hyaloid membrane separating the retina from the vitreous.

• formed by astrocytes and the end feet of fibers of Müller cells are attached to it.

Blood supply of the retina

• The retina is highly metabolically active sheet of the neural tissue with the highest oxygen consumption of any human tissue.

• Like brain the retina has a highly selective blood tissue barrier, called Blood Retinal Barrier(BRB).

- BRB is formed by the junction of capillary endothelium with each other and tight junction of RPE.

BRB – has the following importance;

A. Primarily it regulates the optimal extracellular environment to facilitate neural transmission.

B. It also control the passage of pathogens and intravascular leucocytes.

C. Partly protect the neural environment from surveillance by immune.

The retina gets its blood supply from the following source:-1. The central retinal vessels (Artery and vein).2. The choroid capillaries.

Common retinal diseases and conditions include:

- 1. **Retinal tear.** occurs when the clear, gel-like substance in the center of eye (vitreous) shrinks and tugs on the thin layer of tissue lining the back of eye (retina) with enough traction to cause a break in the tissue. It's often accompanied by the sudden onset of symptoms such as floaters and flashing lights.
- 2. **Retinal detachment.** is defined by the presence of fluid under the retina. This usually occurs when fluid passes through a retinal tear, causing the retina to lift away from the underlying tissue layers.
- 3. **Diabetic retinopathy.** If you have diabetes, the tiny blood vessels (capillaries) in the back of your eye can deteriorate and leak fluid into and under the retina. This causes the retina to swell, which may blur or distort your vision. Or you may develop new, abnormal capillaries that break and bleed. This also worsens your vision.
- 4. **Epiretinal membrane.** Epiretinal membrane is a delicate tissue-like scar or membrane that looks like crinkled cellophane lying on top of the retina. This membrane pulls up on the retina, which distorts your vision. Objects may appear blurred or crooked.
- 5. **Macular hole.** A macular hole is a small defect in the center of the retina at the back of the eye (macula). The hole may develop from abnormal traction between the retina and the vitreous, or it may follow an injury to the eye.

- ٦.**Macular degeneration.** In macular degeneration, the center of retina begins to deteriorate. This causes symptoms such as blurred central vision or a blind spot in the center of the visual field. There are **two types** — **wet macular degeneration** and **dry macular degeneration**. Many people will first have the dry form, which can progress to the wet form in one or both eyes.
- ٧.**Retinitis pigmentosa.** Retinitis pigmentosa is an **inherited degenerative disease**. It slowly affects the retina and causes loss of night and side vision

Symptoms

Many retinal diseases share some common signs and symptoms. These may include:

- Seeing floating specks or cobwebs
- Blurred or distorted (straight lines look wavy) vision
- Defects in the side vision
- Lost vision

Risk factors

Risk factors for retinal diseases might include:

- Aging
- Smoking
- Being obese having obesity or overweight
- Having diabetes or other diseases
- Eye trauma
- A family history of retinal diseases



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LEARNING OBJECTIVES

At the end of this class students shall be able to:

Understand the components and functions of the different layers of the cornea.

- Identify various structures of the cornea.

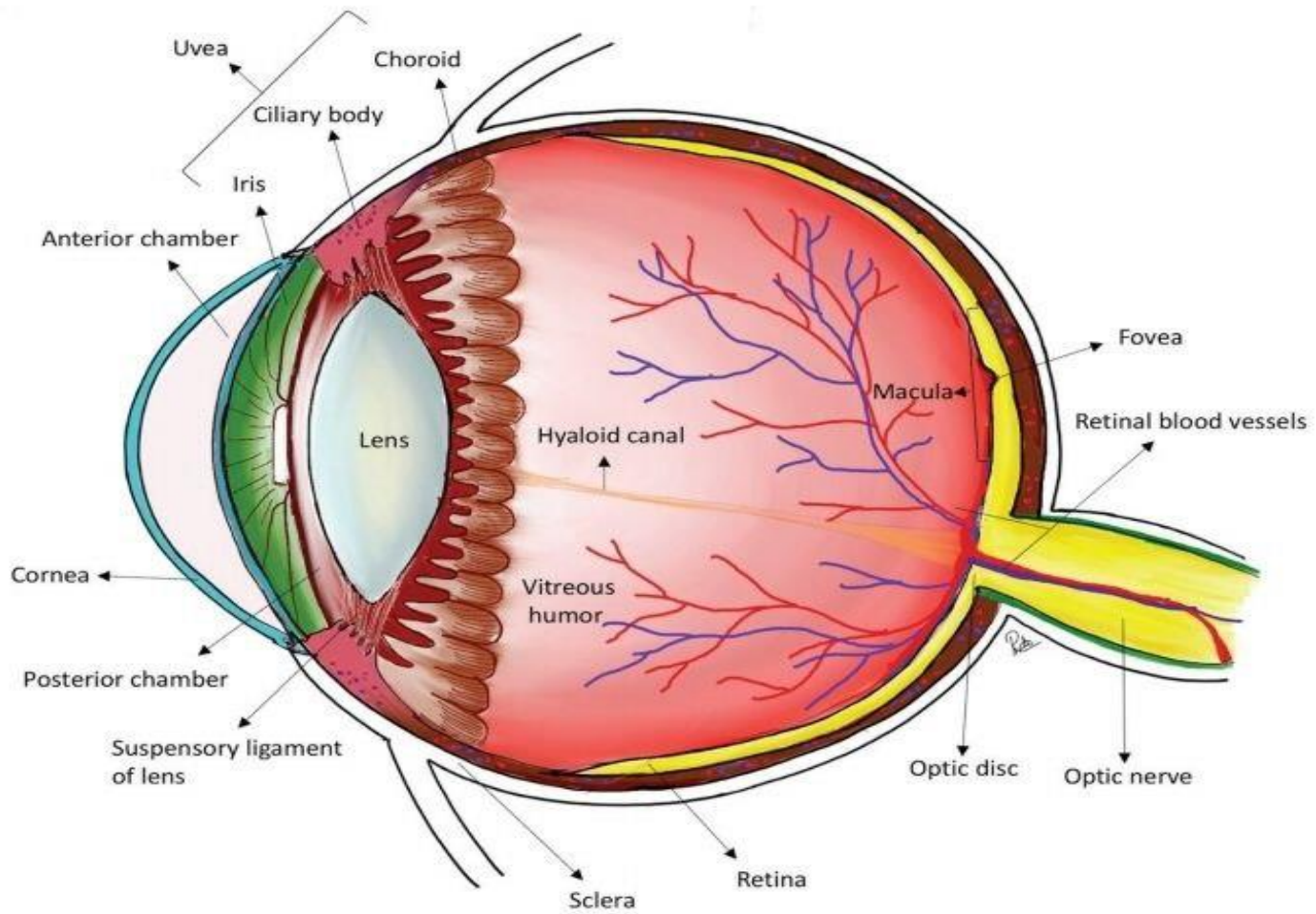
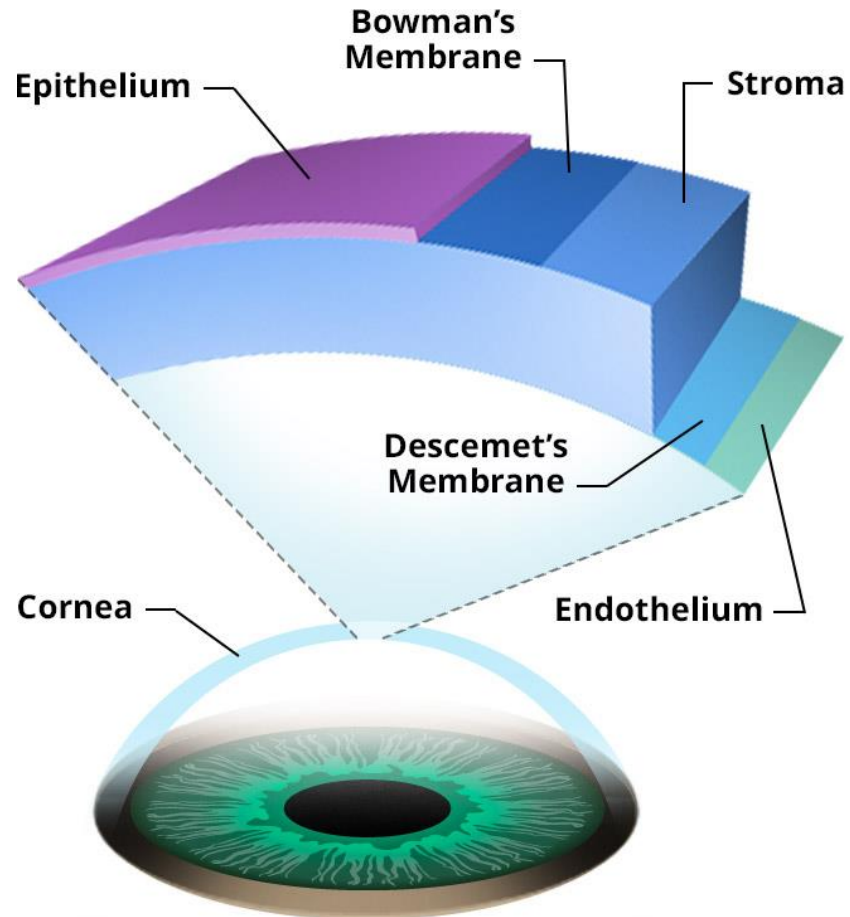


Fig. 1.1. Coronal section of the eyeball showing the various structures.



Cornea Definition

- The cornea is the transparent outermost covering of the eye and is the most important refractive medium of the eye
- The cornea is the transparent front part of the eye that covers the iris, pupil, and anterior chamber.

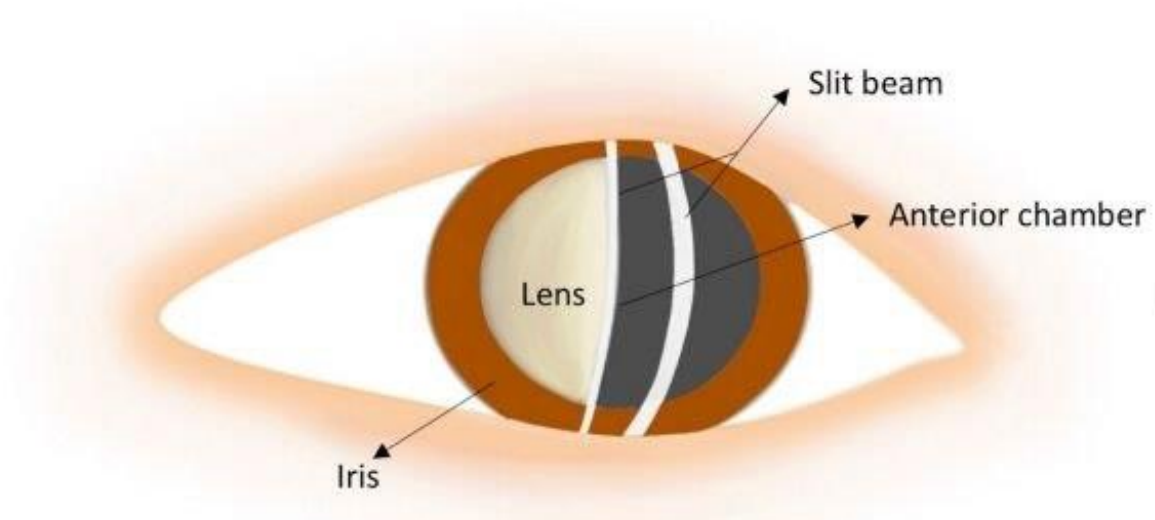
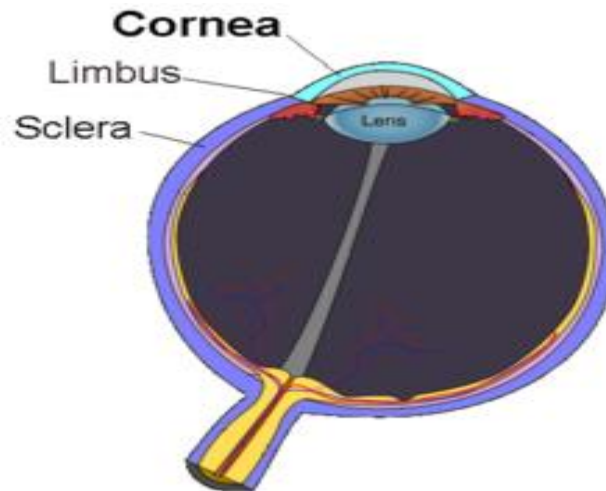


Fig. 1.2. Illustration of slit-lamp beam image of the anterior segment. The first broad slit beam corresponds to the cornea and the second narrow beam corresponds to the anterior surface of the lens.

Cornea

- Along with the anterior chamber and lens, the cornea refracts light, accounting for approximately two-thirds of the eye's total optical power.



Cornea Structure

- **The cornea has unmyelinated nerve endings** sensitive to touch, temperature and chemicals; a touch of the cornea causes an involuntary reflex to close the eyelid.

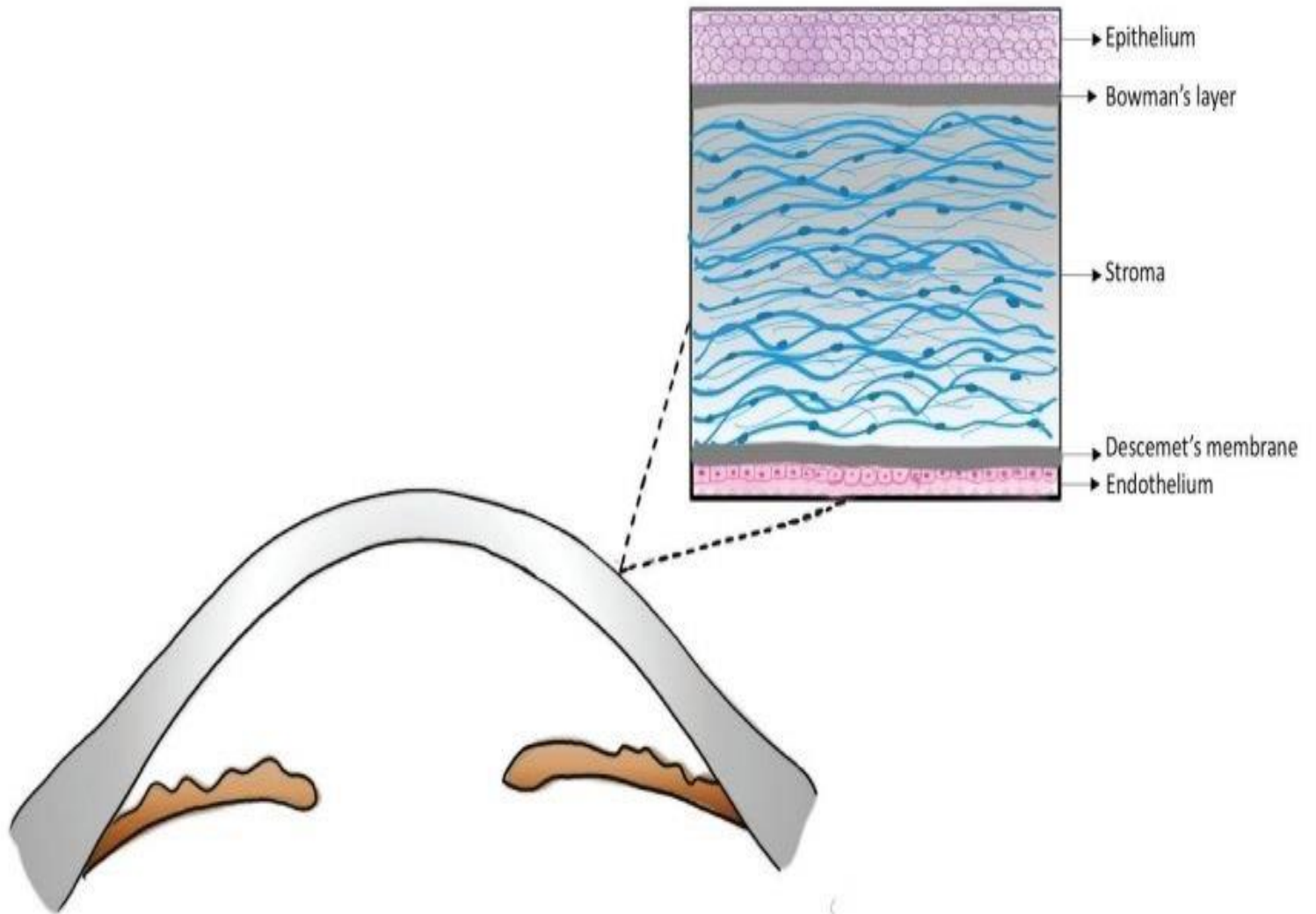
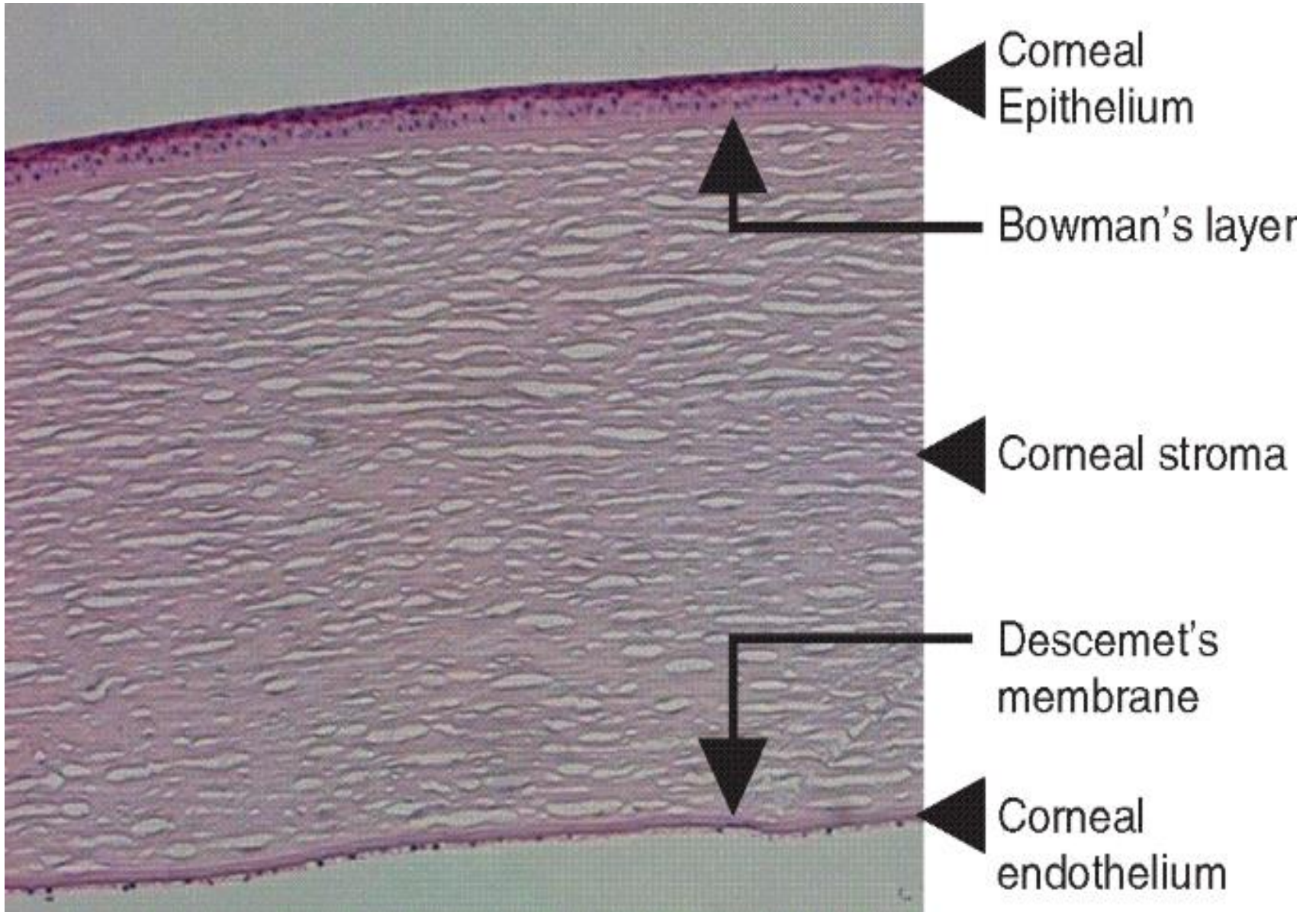


Fig. 1.3. Cross-section of the cornea and the 5 layers.

Cornea Microanatomy

- The 5 layers of the cornea are composed of:
- Corneal epithelium
- Bowman's layer
- Corneal stroma
- Descemet's membrane
- Corneal endothelium



1 - Corneal epithelium

- The corneal epithelium (epithelium cornea anterior layer) is made up of epithelial tissue and covers the front of the cornea. It **acts as a barrier** to protect the cornea, **resisting** the free flow of fluids from the tears, and **prevents bacteria** from entering the epithelium and corneal stroma .