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MATRIC No.: 17/MHS01/206

DEPARTMENT: MEDICINE AND SURGERY

COURSE: HISTOLOGY OF SPECIAL SENSES AND NEUROHISTOLOGY (ANA305)

DATE: 14TH APRIL, 2020.

ASSIGNMENT.

1. Write an essay on the histological importance of eye in relation to their cellular functions.

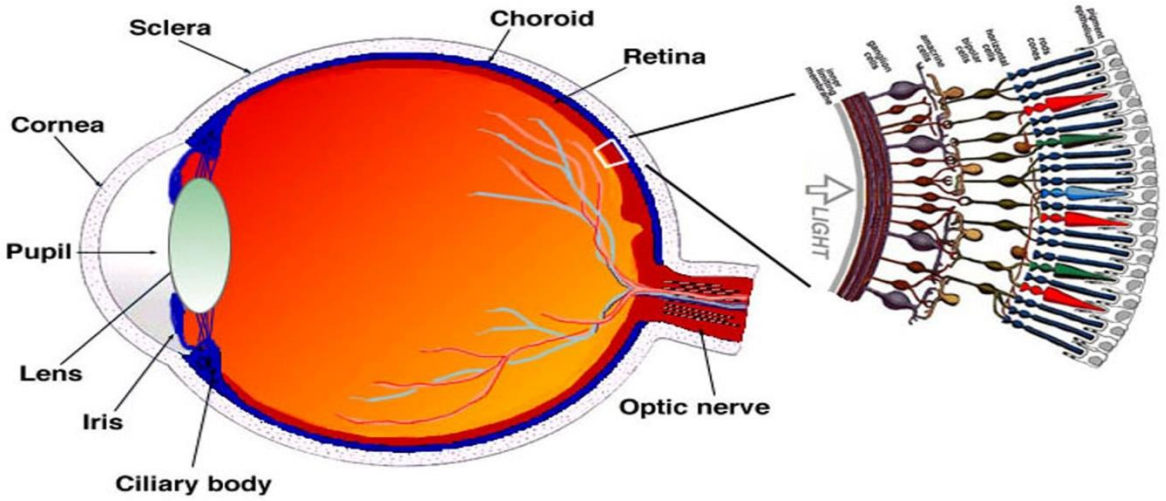
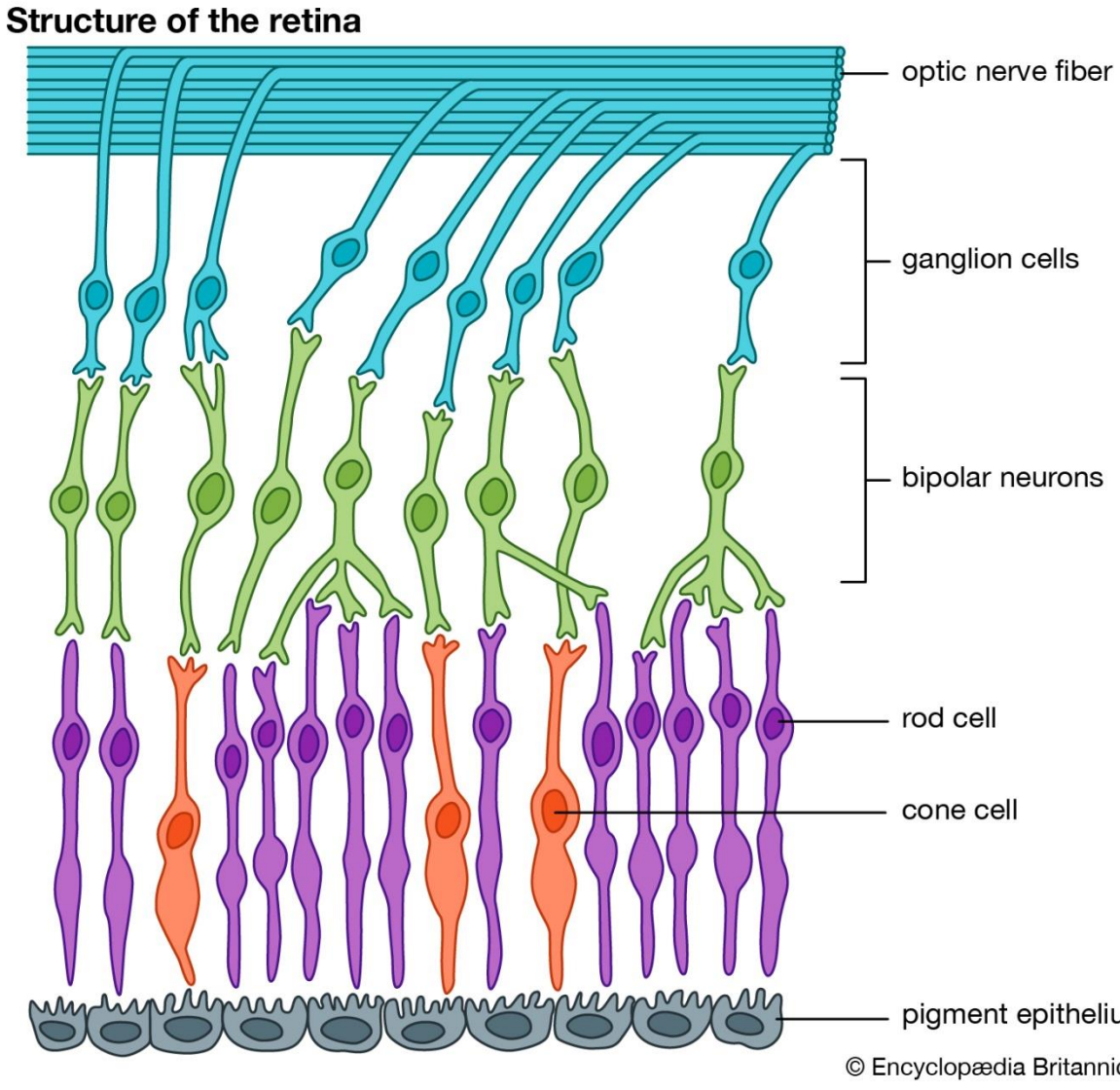


Fig. 1.1. A drawing of a section through the human eye with a schematic enlargement of the retina.

Ans; There are various cells in the eye and they have their various functions. These cells are found in different areas of the eye such as;

- **Retina**



Within the layers of the retina, there are specialized cells that respond to light and help transmit incoming photons into action potentials that the brain's cortices process into three-dimensional vision. There are five different cell types in the retina and they are;

a) **Photoreceptor Cells;** these are specialized cells that respond to light and they are of two types;

- **Rods;** the rods are located in concentrated amount in the outer retina and their density increases towards the periphery of the retina, there are zero rods in the central fovea. The human eye has over 100million rods, and they specialize in registering low-light

levels, thus helping to create a black and white vision known as **SCOTOPIC VISION**. The rods have interesting features which include [1)] low speed of response and spatial acuity which is as a result of wiring not any inherent inferiority in the rod cells, more rods converge onto a single retinal ganglion cell (RGC), [2)] contrast sensitivity are also very low, [3)] rods cannot function during the day time as they are photo-bleached, [4)] rods are more sensitive to a single photon of light than the cones. Rods use glutamate as their neurotransmitter.

- **Cones;** they are located in concentrated amount in the central area of the retina known as MACULA, which also contains fovea. The human eye has approximately 6 to 7million cones in total. Cones specialize in detecting red light (64%), green light (32%) or blue light (2%). Cones located in the fovea have a 2:1 ratio of red and green specific cone cells respectively, whereas cones in the peripheral surrounding the macula are responsible for blue light detection. Cone cells help the brain process **PHOTOPIC VISION**, which involves colour vision at varying light levels. Cones adapt to light rapidly and do not become saturated under constant light like rods do.

b) **Retinal Ganglion Cells;** these are the retina's main output neuron but also a third class of photoreceptors that are also photosensitive and help transmit both image-forming and non-image forming information that function in the physiological processes of the circadian rhythm, modulation of melatonin release and regulation of pupil size. There are approximately 20 different RGCs and 1% to 2% are photosensitive.

c) **Amacrine Cells;** these are intermediate neurons that release the inhibitory neurotransmitter GABA or glycine. There is great diversity among the amacrine cells and they fulfill variety of jobs. The amacrine cells form functional microcircuits that allow the retina to detect different shades and movement of light in particular directions. The glycine is released onto bipolar cells.

d) **Bipolar Cells;** these are second-order long-projection neurons, named after their axons 180-degree orientation, that receive visual inputs from photoreceptors (rods and cones) and project their axons onto retinal ganglion. There are 13 different types of bipolar cells which are further divided into two and they are Rod Bipolar Cells and Cone Bipolar Cells. Bipolar cells form circuits with other photoreceptors that provide the basic elementary blocks of vision such as chromatic composition, polarity, contrast and temporal profile of incoming visual stimuli. Bipolar cells link the inner and outer layers of the retina by forming a synaptic connection with rods and cones in the inner plexiform layer of the retina.

e) **Horizontal Cells;** these are involved in modulating information transfer between bipolar cells and photoreceptors and they are involved with helping the eyes adjust to both bright light and low light conditions. There are three types of horizontal cells in the retina with

their cell bodies concentrated toward the outer retina located mostly in the inner nuclear layer. Horizontal cells are GABAergic interneurons that provide inhibitory inputs to bipolar cells well as inhibitory feedback to both rods and cones.

- **Sclera**

  This is a dense connective tissue made up of mainly type 1 collagen fiber, oriented in different directions. The main connective tissue found in the sclera is the Scleral Fibroblasts which are involved in the remodeling of the sclera, this occurs during axial elongation in myopia. The sclera also contains pigment cells for absorption of excess light so photoreceptors can give clearer signal; they also move nutrients to and from the choroid.

- **Ciliary Body**

  This has ciliary epithelium cells which produce aqueous humor that fills the anterior compartment of the eye.

- **Cornea**

  This is the transparent front layer of the eye. It consists of type 1 collagen fibers oriented in a uniform parallel direction to maintain transparency

- **Corneal Epithelium;** these are non-keratinized stratified squamous epithelium which are fast growing, regenerating multicellular layer which interacts directly with the tear film.
- **Corneal Keratocytes;** these are found in the stroma layer of the cornea, they maintain integrity of this layer. It is also involved in the extracellular matrix production and inflammation regulation.
- **Corneal Endothelium;** this is a one cell thick layer made up of either simple squamous or cuboidal cells. The cells do not regenerate and they have pumps that maintain fluid balance and prevent swelling of the stroma.

2. Corona virus can penetrate the body through the eye and implicate the immune system; briefly discuss the layers of the retina for information penetration.

   Ans. The Retina is the innermost layer of the wall of the eye.

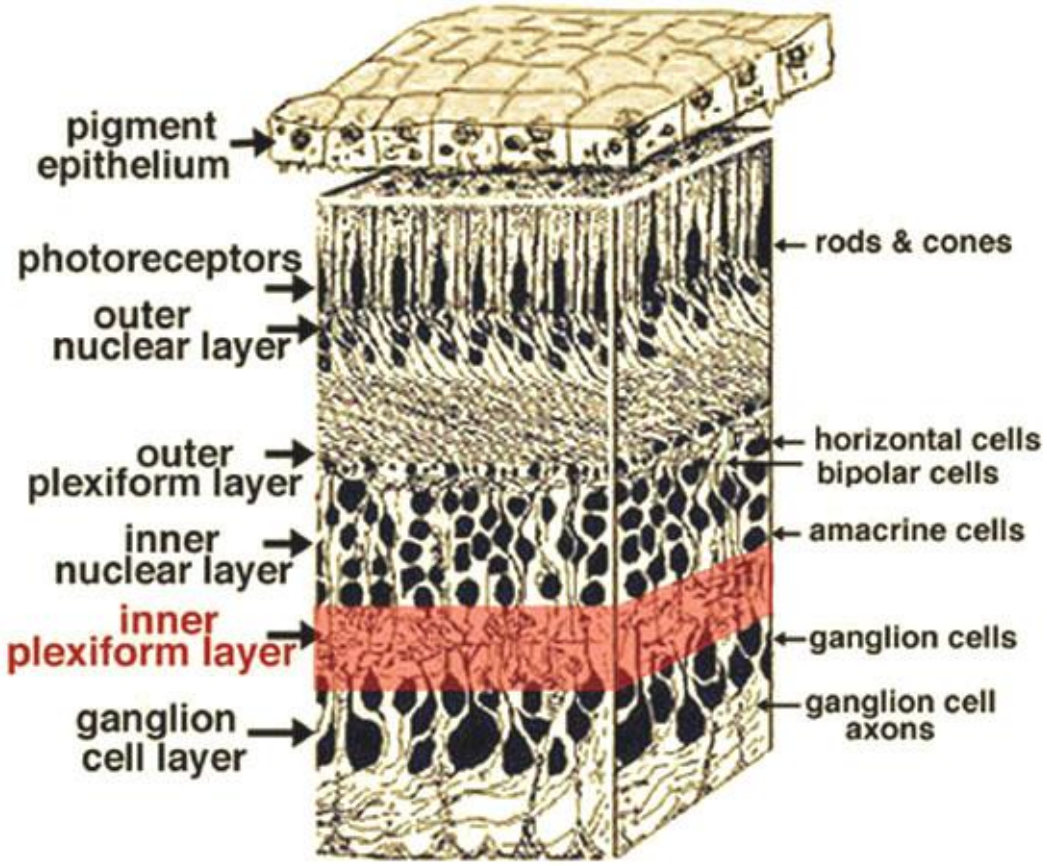


Fig. 7. 3-D block of retina with the inner plexiform layer highlighted (red).

The retina is a layered structure with distinct layers of neurons interconnected by synapses. These layers are:

a) **Inner Limiting Membrane**: this is the retina's inner surface bordering the vitreous humor and thereby forming a diffusion barrier between the neural retina and vitreous humor. It contains Muller cell synaptic buttons and other basement membrane parts.
b) **Nerve Fiber Layer (NFL):** the second innermost layer of the retina from the vitreous
c) **Ganglion Cell Layer:** this layer contains the Retinal Ganglion Cells (RGCs) and displaced Amacrine Cells. As a rule of thumb, smaller RGCs dendrites arborize in the inner plexiform layer while larger RGCs dendrites arborize in other layers.
d) **Inner Plexiform Layer:** is an area comprised of a dense reticulum of fibrils formed by interlaced dendrites of Retinal Ganglion Cells and cells of the inner nuclear layer.

e) **Inner Nuclear Layer:** this layer contains the cell bodies of bipolar cells, horizontal cells and amacrine cells.
f) **Outer Plexiform Layer:** this layer contains a neuronal synapse of between rods and cones with the footplate of horizontal cells. Capillaries are also found to be primarily running through the outer plexiform.
g) **Outer Nuclear Layer:** contains the rod and cone granules that sense photon, extensions from the rod and cone cell bodies.
h) **External Limiting Membrane:** contains the bases of the rod and cone photoreceptors cells bodies.
i) **Retinal Pigment Epithelium:** the retinal pigment epithelium (RPE), which has many functions including vitamin A metabolism, maintenance of the blood-retina barrier, phagocytosis of photoreceptors outer segments, production of mucopolysaccharide matrix surrounding the outer segments of the retina, and active transport of materials into and out of the RPE. They are made up of cuboidal cells containing melanin which absorbs light; these cells also establish a blood-retina barrier through tight junctions.