ADEBAYO BLESSING OMOLOLA

17/MHS01/013

MEDICINE AND SURGERY

300 LEVEL

NEUROHISTOLOGY

1. Write an essay on the histological importance of eye in relation to their cellular functions.
2. Corona virus can penetrate the body through eye and implicate the immune system, briefly discuss the layers of the retina for information penetration.

ANSWERS

1. **HISTOLOGICAL IMPORTANCE OF EYE**

Eyes are organs of the visual system. They provide animals with vision, the ability to receive and process visual detail, as well as enabling several photo response functions that are independent of vision. Eyes detect light and convert it into electro-chemical impulses in neurons.

External structures of the eye include the eyelashes, lids, muscles, accessory glands, and conjunctiva.

The internal structures of the eye consist of three layers of tissue arranged concentrically:

A. The sclera and cornea make up the exterior layers.
B. The uvea is the vascular layer in the middle, subdivided into the iris, ciliary body, and choroid.
C. The retina constitutes the innermost layer and is made up of nervous tissue.

OUTERMOST LAYER: SCLERA AND CORNEA:

- **The sclera (White of the eye):** The sclera is dense connective tissue made of mainly type 1 collagen fibers, oriented in different directions. The lack of parallel orientation of collagen fibers gives the sclera its white appearance, as opposed to the transparent nature of the cornea. However, the collagen of the sclera and cornea are continuous.

The four layers of the sclera from external to internal are Episclera, Stroma, Lamina fusca, Endothelium.

The episclera is the external surface of the sclera. It is connected to the Tenon capsule by thin collagen fibers. At the corneoscleral junction, also known as the limbus, the Tenon capsule contacts stroma of the conjunctiva.

- **Cornea (Transparent front layer of the eye):** The cornea serves a protective role and is responsible for two-thirds of the refractive properties of the eye.

  Consists of type I collagen fibers oriented in a uniform parallel direction to maintain transparency

  Consists of five layers: epithelium (non-keratinized, stratified squamous epithelium), Bowman layer, stroma (also called substantia propria), Descemet's membrane, corneal endothelium.

  Corneal epithelium: Fast growing, regenerating multicellular layer which interacts directly with the tear film.

  Bowman layer: This is a layer of subepithelial basement membrane protecting the underlying stroma. It is composed of type 1 collagen, laminin, and several other heparan sulfate proteoglycans.

  Stroma: The largest layer of the cornea, the stroma has collagen fibers arranged in a regular pattern. Keratocytes maintain the integrity of this layer. The function of this layer is to maintain transparency, which occurs by the regular arrangement, and lattice structure of the fibrils, whereby scatter from individual fibrils gets canceled by destructive interference, and the spacing of less than 200 nm allows for transparency.

  Descemet's membrane: An acellular layer made of type IV collagen that serves as a modified basement membrane of the corneal endothelium

  Corneal endothelium: A one cell thick layer made of either simple squamous or cuboidal cells. Cells in this region do not regenerate and have pumps that maintain fluid balance and prevent swelling of the stroma. When corneal endothelial cells are lost, neighboring cells stretch to attempt to compensate these losses.

MIDDLE LAYER: UVEA (IRIS, CILIARY BODY, CHOROID): The middle layer, the uveal tract, includes the iris, ciliary body and choroid. The uvea of the eye is a crucial mediator of nutrition and gas exchange, as blood

vessels course through the ciliary body and iris, while the choriocapillaris in the posterior eye help support the retina.

- **Iris:** Consists of Stromal layer with pigmented fibrovascular tissue and Pigmented epithelial cells beneath the stroma.
  The sphincter pupillae and dilator pupillae muscles connect to the stroma
  The pigmented layer of cells blocks rays of light and ensures that light must move through the pupil to reach the retina
  The angle formed by the iris and cornea contains connective tissue with endothelial channels called the trabecular meshwork, which drains aqueous humor in the anterior chamber into the venous canal of Schlemm; from here, fluid drains into episcleral veins.
- **Ciliary Body:** The tissue that divides the posterior chamber and vitreous body
  Consists of the ciliary muscle and the ciliary epithelium
  The ciliary muscle, via the lens zonules, controls the structure of the lens, which is vital for accommodation. Zonules are connective tissue fibers that connect the ciliary muscle and lens.
  The ciliary epithelium produces aqueous humor which fills the anterior compartment of the eye.
- **Choroid:** Consists of a dense network of blood vessels supplying nourishment to structures of the eye, housed in loose connective tissue.
  The choriocapillary layer is located in the innermost part of the choroid and supplies the retina
  The Bruch membrane is an extracellular matrix layer situated between the retina and choroid and has significance in age-related macular degeneration, where an accumulation of lipid deposits prevent diffusion of nutrients to the retina.

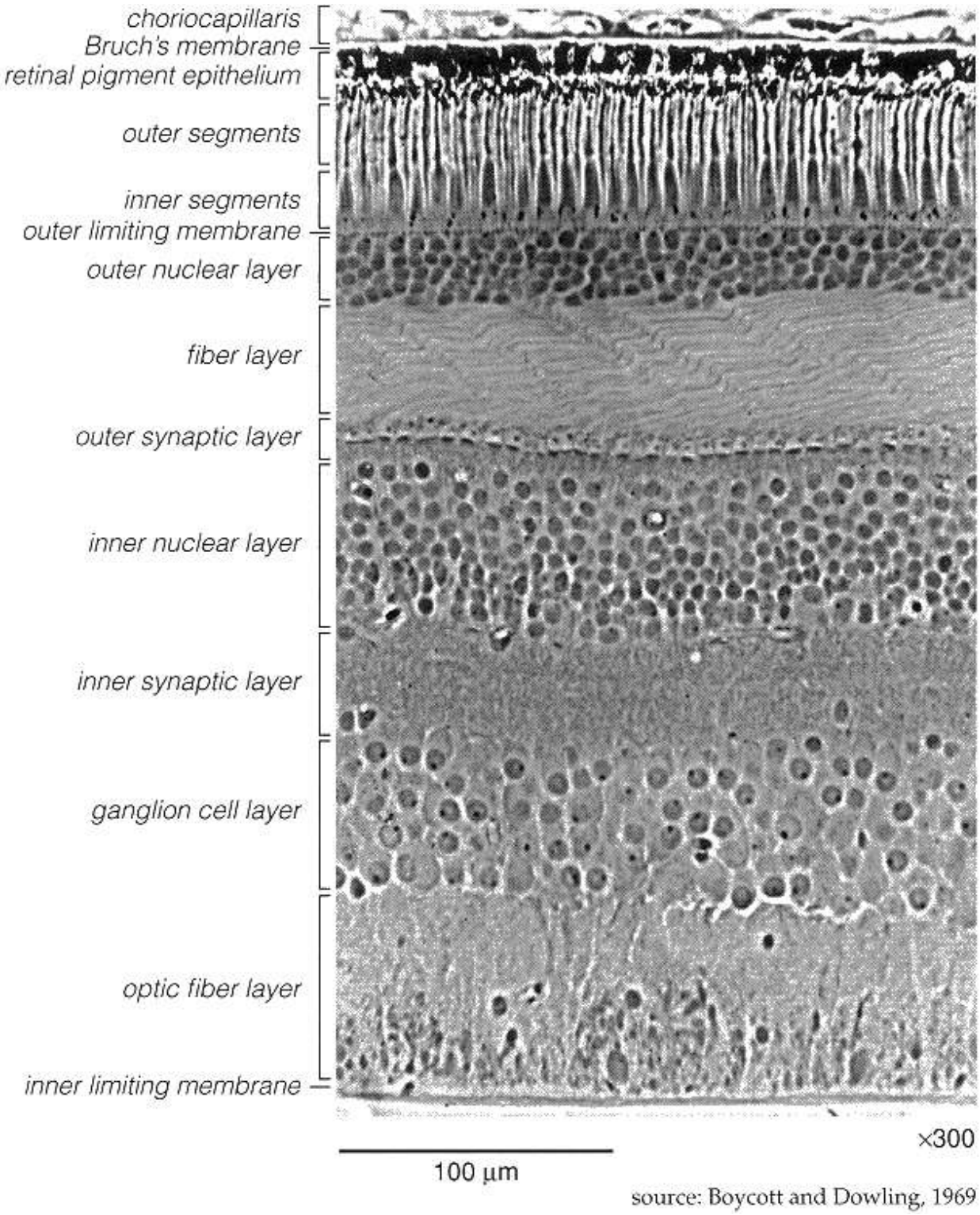
INNERMOST LAYER: LENS, VITREOUS, RETINA:

- **Lens:** Separates the aqueous and vitreous chambers
  Consists of an outer capsule, a middle layer called cortex, and an inner layer called the nucleus.
  The capsule is the basement membrane of the lens epithelium which lies below

New lens cells differentiate from the lens epithelium and are incorporated peripherally, pushing older lens cells towards the middle.

- **Vitreous:** A jelly-like space made of type II collagen separating the retina and the lens
- **Retina:** Nervous tissue of the eye where photons of light convert to neurochemical energy via action potentials
  Retina itself is divided into various layers as follows
  Retinal pigment epithelium: Made of cuboidal cells containing melanin which absorbs light. These cells also establish a blood-retina barrier through tight junctions.
  Rod and cone cells: The layer of cells with photoreceptors and glial cells. Rods are located peripherally and are more sensitive to light and motion than cones. Cones have higher visual acuity and specificity for color vision.
  Outer limiting membrane: A layer of Muller cells and rod/cone junctions which serves to separate the photosensitive regions of the retina from the areas that transmit the electrical signals.
  Outer nuclear layer: This layer consists of nuclei of rod and cone cells.
  Outer plexiform layer: This layer contains synaptic processes of rod and cone cells.
  Inner nuclear layer: This layer contains the cell body of glial, amacrine, bipolar, and horizontal cells
  Inner plexiform layer: This layer relays information from cells of the inner nuclear layer. Thus, this layer has axons of amacrine, bipolar, and glial cells and dendrites of retinal ganglion cells.
  Ganglion cell layer: This layer contains nuclei of retinal ganglion cells.
  Nerve fiber layer: This layer contains axons of retinal ganglion cells and the astroglia which support them. Collectively, these axons constitute the optic nerve.
  Internal limiting membrane: A thin layer of Muller glial cells and basement membrane which demarcates the vitreous anteriorly from the retina posteriorly.

2. THE LAYERS OF THE RETINA



The layers of the retina:

1. Inner limiting membrane – Basement membrane elaborated by Müller cells.
2. Nerve fibre layer – Axons of the ganglion cell bodies. A thin layer of Müller cell footplates exists between this layer and the inner limiting membrane.
3. Ganglion cell layer – Contains nuclei of ganglion cells, the axons of which become the optic nerve fibres, and some displaced amacrine cells.
4. Inner plexiform layer – Contains the synapse between the bipolar cell axons and the dendrites of the ganglion and amacrine cells.
5. Inner nuclear layer – Contains the nuclei and surrounding cell bodies (perikarya) of the amacrine cells, bipolar cells, and horizontal cells.
6. Outer plexiform layer – Projections of rods and cones ending in the rod spherule and cone pedicle, respectively. These make synapses with dendrites of bipolar cells and horizontal cells. In the macular region, this is known as the Fiber layer of Henle.
7. Outer nuclear layer – Cell bodies of rods and cones.
8. External limiting membrane – Layer that separates the inner segment portions of the photoreceptors from their cell nuclei.
9. Inner segment / outer segment layer – Inner segments and outer segments of rods and cones. The outer segments contain a highly specialized light-sensing apparatus.
10. Retinal pigment epithelium – Single layer of cuboidal epithelial cells (with extrusions not shown in diagram). This layer is closest to the choroid, and provides nourishment and supportive functions to the neural retina. The black pigment melanin in the pigment layer prevents light reflection throughout the globe of the eyeball; this is extremely important for clear vision.