

NAME: AWOJANA ANUOLUWAPO JOSEPH

MATRIC NUMBER: 17/MHS01/069

COLLEGE/DEPARTMENT: M.H.S./ M.B.B.S.

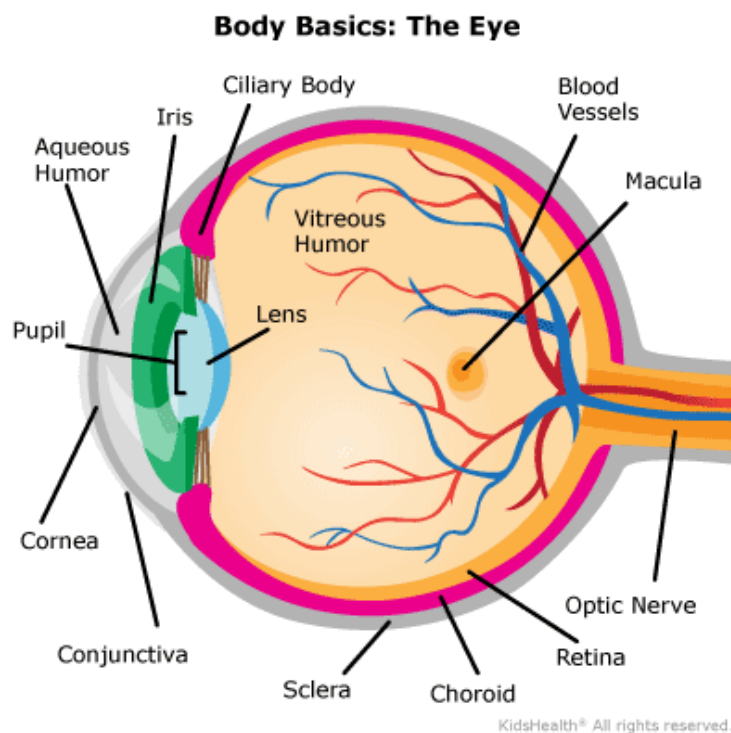
ASSIGNMENT TITLE: SPECIAL SENSES ASSIGNMENT

COURSE TITLE: HISTOLOGY OF SPECIAL SENSES AND NEUROHISTOLOGY

COURSE CODE: ANA 305

DATE: 09/04/2020

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



The eye can be viewed as a series of overlapping layers of tissue. 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:

-The sclera and cornea make up the exterior layers.

-The uvea is the vascular layer in the middle, subdivided into the iris, ciliary body, and choroid.

-The retina constitutes the innermost layer and is made up of nervous tissue.

The layers of the eye perform distinct functions which coalesce to create a unified, perceptual experience. The essential role of the external eye structures is to protect the delicate tissue of the internal eye. The eyelid prevents foreign bodies from entering the inner eye and helps refresh and distribute the tear film by blinking. Eyelashes are finely sensitive to touch and warn the eye of possible debris and particles that may cause injury.

Internal parts of the eye have primarily structural and visual functions. The cornea serves a protective role and is responsible for two-thirds of the refractive properties of the eye. The remaining one-third of refraction is performed by the lens, which is functionally adjustable through the action of the zonular fibers and ciliary muscles. At the end of the visual process, as rays of light bend through the cornea and lens, photon energy is converted to neurochemical action potentials by cells of the retina, which then send these impulses to the brain, via the optic nerve. 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.

The tissues of the eye can be split into three types:

-refracting tissues that focus light

-light-sensitive tissues

-support tissues

Refracting tissues

Refracting tissues focus incoming light onto the light-sensitive tissues, to give us a clear, sharp image. If they are the wrong shape, misaligned, or damaged, vision can be blurry. The refracting tissues include:

-The pupil: This is the dark spot in the center of the colored part of your eye, which, in turn, is called the iris. The pupil expands and shrinks in response to light, acting similarly to the aperture on a camera. In very bright conditions, the pupil constricts or shrinks to around 1mm in diameter to protect the sensitive retina from damage. When it is dark, the pupil can dilate or widen up to 10 mm in diameter. This dilation allows the eye to take in as much light as possible.

-Iris: This is the colored portion of the eye. The iris is a muscle that controls the size of the pupil and, therefore, the amount of light reaching the retina. It consists of stromal layer with pigmented, fibrovascular tissue and pigmented epithelial cells beneath the stroma. The pigmented layer of cells blocks rays of light and ensures that light must move through the pupil to reach the retina.

-Lens: Once light has traveled through the pupil, it reaches the lens, which is a transparent convex structure. The lens can change shape, helping the eye to focus light accurately onto the retina. With age, the lens becomes stiffer and less flexible, making focusing more difficult. The lens consists of an outer capsule, a middle layer called cortex, and an inner layer called the nucleus.

-Ciliary muscle: This muscular ring is attached to the lens via the lens zonules, as it contracts or relaxes, it changes the shape of the lens. This process is called accommodation.

-Cornea: This is a clear, dome-like layer that covers the pupil, iris, and anterior chamber or fluid-filled area between the cornea and the iris. It is responsible for the majority of the eye's focusing power. However, it has a fixed focus so cannot adjust to different distances. The cornea is densely populated with nerve endings and incredibly sensitive. It is the eye's first defense against foreign objects and injury. Because the cornea must remain clear to refract light, it has no blood vessels. It consists of type I collagen fibers oriented in a uniform parallel direction to maintain transparency. It is made up of five layers: epithelium (non-keratinized, stratified squamous epithelium), Bowman layer, stroma (also called substantia propria), Descemet's membrane, corneal endothelium.

Two fluids circulate throughout the eyes to provide structure and nutrients. These fluids are:

-Vitreous fluid: Found in the back section of the eye, vitreous fluid is thick and gel-like. It makes up the majority of the eye's mass.

-Aqueous fluid: This is more watery than vitreous fluid and circulates through the front of the eye.

Light-sensitive tissues

-Retina: The retina is the innermost layer of the eye, it has layers as shown in question 2. It houses more than 120 million light-sensitive photoreceptor cells that detect light and convert it into electrical signals. These signals are sent on to the brain for processing. Photoreceptor cells in the retina contain protein molecules called opsins that are sensitive to light. The two primary photoreceptor cells are called rods and cones. In response to particles of light, the rods and cones send out electrical signals to the brain.

-Cones: These are found in the central region of the retina called the macula, and they are particularly dense in a small pit at the center of the macula known as the fovea. Cones are essential for detailed, color vision. There are three types of cones, normally called:

-short or blue

-middle or green

-long or red

Cones are used to see in normal light conditions and allow us to distinguish colors.

-Rods: These are mostly found around the edges of the retina and are used for seeing in low light levels. Although they cannot distinguish colors, they are extremely sensitive and can detect the lowest amounts of light.

-Optic nerve: This thick bundle of nerve fibers transmits signals from the retina to the brain. In all, there are around 1 million thin, retinal fibers called ganglion cells that carry light information from the retina to the brain. The ganglion cells leave the eye at a point called the optic disc. Because there are no rods and cones, it is also referred to as the blind spot. Different subsets of ganglion cells register different types of visual information. For instance, some ganglion cells are sensitive to contrast and movement, others to shape and details. Together, they carry all the necessary information from our visual field. The brain allows us to see in 3-D, giving us depth perception, by comparing the signals from both eyes. The signals generated in the retina end up in the visual cortex, a part of the brain that is specialized for processing visual information. Here, the impulses are stitched together to create images.

Support tissues

-Sclera: This is commonly referred to as the white of the eye. It is fibrous and provides support for the eyeball, helping it keep its shape. It consists of dense connective tissue filled with the protein collagen to both protect the inner components of the eye and maintain its shape.

-Conjunctiva: A thin, transparent membrane that covers most of the white of the eye, and the inside of the eyelids. It helps lubricate the eye and protect it from microbes. The tarsal plate lies beneath the conjunctiva and contains meibomian glands, which secrete an oily substance to decrease the evaporation of the tear film

-Choroid: A layer of connective tissue between the retina and sclera. It contains a high concentration of blood vessels. It is just 0.5 mm thick and contains light-absorbing pigment cells that help reduce reflections in the retina.

Clinical Significance

-Astigmatism: The cornea or lens is incorrectly curved so that light is not focused properly on the retina.

-Cataracts: Clouding of the lens causes cataracts. They lead to blurred vision and, if untreated, blindness.

-Colorblindness: This occurs when cone cells are absent or do not work correctly. Someone who is colorblind finds it difficult to distinguish between certain colors.

-Conjunctivitis or pink eye: This is a common infection of the conjunctiva, which covers the front of the eyeball.

-Detached retina: A condition when the retina comes loose. It requires urgent treatment.

-Diplopia or double vision: This can be caused by several conditions that are often serious and should be checked by a doctor, as soon as possible.

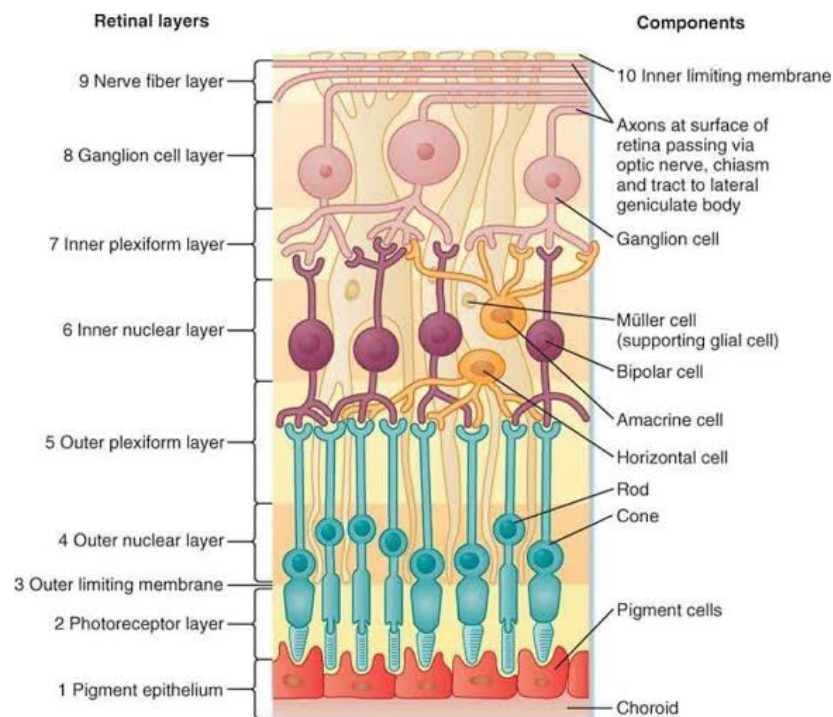
-Floater: These are specks that drift across a person's visual field. They are normal but can also be the sign of something more serious, such as retinal detachment.

-Glaucoma: Pressure builds up inside the eye and can eventually damage the optic nerve. It can eventually lead to loss of sight.

-Myopia: This is otherwise known as nearsightedness. With myopia, it is difficult to see things that are far away.

-Optic neuritis: The optic nerve becomes inflamed, often due to an overactive immune system.

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



The retina is the innermost layer in the eye that is responsible for the visual processing that turns light energy from photons into three-dimensional image. Located in the posterior portion of the eyeball, the retina is the only extension of the brain that can be viewed from the outside world and gives ophthalmologists a rare window into real-time pathology affecting the retina. The retina itself consists of six different cell lines divided into ten different layers, each playing a specific role in creating and transmitting vision. The different cell types perform a particular role and form functional circuits that specialize in detecting specific variations and movements of light.

The ten distinct layers of neurons are interconnected by synapses. The cells subdivide into three basic cell types: photoreceptor cells, neuronal cells, and glial cells. The layers from the closest to the front anterior of the head towards the posterior of the head are as follows:

- Inner limiting membrane
- Nerve fiber layer (NFL)
- Ganglion cell layer
- Inner plexiform layer
- Inner nuclear layer
- Middle limiting membrane
- Outer plexiform layer
- Outer nuclear layer
- External limiting membrane
- The layer of rods and cones

Within these layers of the retina, we find multiple different types of cells with specific jobs that help transmit incoming photons into action potentials that the brain's cortices process into three-dimensional vision. The six different cell types in the retina include:

- Rods
- Cones
- Retinal Ganglion cells
- Amacrine cells

-Bipolar cells

-Horizontal cells

CELLS OF THE RETINA

-Rods: In humans, approximately 95% of the photoreceptors in our retina are rods, and they specialize in registering low-light levels, thus helping to create a black and white vision- known as scotopic vision. Rods are concentrated in the outer retina and their density increases as one moves outward towards the periphery of the retina, with there being zero rods in the central fovea.

-Cones: Unlike rods, cones are less sensitive to photons in general but are better at responding to one of three specific (colors) wavelengths of light. Cone cells specialize in detecting either red light (64%), green light (32%), or blue light (2%) and concentrate primarily in the central area of the retina referred to as the macula- which also contains fovea. The central fovea contains neither rods nor even synapses, but only 100% cones which have an unobstructed view of the incoming light from the outside world.

-Retinal Ganglion Cells: Retinal ganglion cells (RGC) 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 functions in the physiological processes of the circadian rhythm, modulation of melatonin release, and regulation of pupil size.

-Amacrine Cells: Amacrine cells are intermediate neurons that release the inhibitory neurotransmitter GABA or glycine. However, given their unique gap junction physiology, they can be both inhibitory or excitatory. There is great diversity among amacrine cells, and they fulfill a variety of jobs and functions within the retina; serving as the ultimate utility cell of the retina. This diversity among amacrine cells allows them to form dedicated functional microcircuits that allow the retina to detect different shades and movements of light in particular directions.

-Bipolar cells : These 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.

-Horizontal Cells: Horizontal cells are involved in modulating information transfer between bipolar cells and photoreceptors and are involved with helping eyes adjust to both bright light and low light conditions

LAYERS OF THE RETINA

-Inner limiting membrane: The ILM is the retina's inner surface bordering the vitreous humor and thereby forming a diffusion barrier between the neural retina and vitreous humor. The ILM contains laterally contacting Muller cell synaptic boutons and other basement membrane parts.

-Nerve fiber layer (NFL): The nerve fiber layer is the second innermost layer of the retina from the vitreous. Patients with retinitis pigmentosa may have a measurable degree of RNFL thinning.

-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.

-Inner plexiform layer: The inner plexiform layer is an area comprised of a dense reticulum of fibrils formed by interlaced dendrites of RGCs and cells of the inner nuclear layer.

-Inner nuclear layer: This layer of the retina contains the cell bodies of bipolar cells, horizontal cells, and amacrine cells.

-Outer plexiform layer: This layer of the retina 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 layer.

-Outer nuclear layer: This layer contains the rod and cone granules that sense photon, extensions from the rod, and cone cell bodies.

-External limiting membrane: This layer contains the bases of the rod and cone photoreceptors cell bodies. The ELM forms a barrier between the subretinal space, into which the inner and outer segments of rods and cones project to be in close association with the pigment epithelial layer behind the retina, and the neural retina proper.

-Retinal pigment epithelium: The retina is supported by the retinal pigment epithelium (RPE), which has many functions including vitamin A metabolism, maintenance of the blood-retina barrier, phagocytosis of photoreceptor outer segments, production of mucopolysaccharide matrix surrounding the outer segments of the retina, and active transport of materials into and out of the RPE.

Clinical Significance

In a retinal detachment, layers of rods and cones become detached from the RPE. The separation of the neurosensory layer of the retina from the outermost pigmented epithelium leads to the degeneration of photoreceptors and subsequent vision loss. Symptoms of early retinal detachment include flashes and floaters in the affected eye or a veil/curtain type of vision loss that is constant (vs. transient loss due to amaurosis fugax). Treatment includes lasering around the detached area to re-adhere the retina to the underlying RPE or doing a vitrectomy and filling the eye with oil to press the retina back onto the RPE. Common causes of retinal detachment include trauma, hypertension, and diabetic retinopathy.