

Objectives:**The student should be able to:**

1. Describe the cell and tissue components of the 3 different layers of the eye (i.e., External layer, Vascular Layer, and Retinal Layer.)
2. Draw a sketch of the eye and label the cornea, iris, sclera, lens, choroid, anterior & posterior chambers, vitreous body, canal of Schlemm, ciliary body & processes, retina, retinal pigment epithelium, & macula lutea. Identify these structures in a slide or photomicrograph
3. Describe the functional significance of the following structures: cornea, corneal endothelium, iris, pupil, constrictor pupillae and dilator pupillae muscles, ciliary body, lens, optic disc, macula lutea and fovea.
4. Locate and identify the photoreceptor layer, bipolar cell layer, and ganglion cell layer, in a slide or photomicrograph of the eye.
5. Describe the respective roles of rods and cones in vision and their relative distribution within the retina

References: Wheater's Functional Histology 5th Ed. by B. Young & J.W. Heath, Churchill Livingstone, 2006; Pg. 402-413.

Overview

-the eyes function as the photosensitive organ responsible for vision. **They collect light waves and transmit them as nerve impulses along the visual pathways to the brain, which translates them to images.**

-it receives light through the cornea, which is subsequently focused on the retina via the lens. In the retina specialized photoreceptors (modified dendrite nerve cells-rods and cons) recognize various patterns of the image for transmission to the brain via the optic nerve.

-the eye is a spherical structure that measures about 2.5cm in diameter; it contains 70% of the body's sensory receptors.

-It is a complex structure composed of three layers of tissue and a lens: **The outer corneo-sclera layer, the intermediate uveal layer and the inner retinal layer**

-the eye possesses intrinsic muscles that adjust the aperture of the iris and alter the lens diameter, permitting accommodation for close vision. It possesses extrinsic muscles, attached to the external aspect of the orb (eyeball), which move the eyes in a coordinated manner to access the desired visual fields

- the conjunctiva is the thin vascular membrane that lines the inner surface of the eyelids and sclera; it is attached to the sclero-corneal junction but does not extend over cornea

-the orb is moistened on its anterior surface with lacrimal fluid (tears) secreted by the lacrimal gland

Structure/Function of the Eye

1. Outermost corneo-sclera layer-tunica fibrosa

- The **cornea**, the anterior one sixth of the eye, is **avascular, colorless, highly innervated and transparent**. It is composed of five layers. Light first passes cornea as it enters the eye. The air –cornea interface is the site of **greatest refraction** of light as it travels to retina
- The **sclera** is the posterior five sixths of the external layer of the eye. It consists of a tough fibrous connective tissue, which maintains the size and shape of the eye. Its exterior surface appears white and is the site of attachment for recti and oblique ocular muscles. Anteriorly the sclera is covered by the bulbar conjunctiva
- The **Limbus** is the transition between the cornea and sclera, which is highly **vascularized** and has numerous nerve fibres. Within its stroma layer, irregular, endothelium lined channels, the trabecular meshwork, merge to form the canal of **Schlemm**, which **drains aqueous humor** from the anterior chamber of the eye.

2. Uvea- middle layer-tunica vasculosa

This layer has three components, the iris, choroid and ciliary body

- The **iris** extends from the angle of the anterior chamber partially covering the lense, leaving a round opening in the centre called **the pupil**. It is responsible for controlling the amount of light that passes through the pupil and reaches the retina
 - It separates the anterior and posterior chambers of the eye.
 - The iris consist of an outer (anterior)layer composed of fibroblasts and **melanocytes** and an inner (posterior) double layer of pigmented epithelium.
 - Melanocytes of the iris function to keep stray light from onterfiring with image formation and are responsible for the color of the eye.
 - **Sphincter papillae muscle** causes constriction under parasympathetic control
 - dilator papillae muscle** causes relaxation under sympathetic control
- **The choroid** is the vascularized coat, with loose connective tissue. The inner most layer called the choriocappilaris, is rich in small blood vessels and provides nutrients to the retina
- **The ciliarybody** is an anterior expansion of the choroids and is immediately behind the iris. It is easily recognized by a series of pigmented finger-like processes (**ciliary processes**) on its surface (see attached figure . The ciliary body contains smooth muscle fibres and blood vessels. **Zonular fibres** project from the ciliary body to the **lens** and keep the lens suspended behind the iris. **Smooth muscle fibres within the ciliary body alter the tension of the zonular fibres which in turn alters the thickness of the lens** (i.e., changes its refractive properties).

3. Inner-retina layer = Retinal Pigmented Epithelium + Neural Retina.

- It is responsible for photoreception. Although it displays 10 distinctive layers, the two layers, the retina pigmented epithelium and the layer of rods and cones, bear the major responsibility for photoreception.
- The **Retinal Pigmented Epithelium (RPE)** forms the outer layer between the neural

retina and the choroid. The RPE is a single layer of pigmented cells; it absorbs light that has passed through the retina. The **neural retina** contains photoreceptor cells (i.e., **rods** and **cones**), horizontal cells, bipolar cells, amacrine cells and ganglion cells. The rods and cones are the cells of the neural retina which lie closest to the RPE. Therefore the light passes through much of the neural retina before it reaches the rods and cones. The **rod cells** are sensitive to low light intensities and produce images in shades of **gray**. The **cone cells** are sensitive to bright lights and produce **colour** perception. The greatest concentration of cone cells is at the optical posterior pole in a region called the **fovea** which is located in the middle of a larger area called the **macula lutea**. **The fovea is the site of greatest visual acuity.**

- The **ganglion cells** are the innermost cells of the neural retina and it is these cells that send axons to the CNS. The axons of the ganglion cells form the innermost layer of the retina and the axons exit the retina at the **optic disc** to become the **optic nerve**. The **optic disc** is devoid of photoreceptors and is also the site through which the central artery (and vein) of the retina enters (and leaves) the eye.

CHAMBERS OF THE EYE

Within the eye there are **3 chambers**. The **anterior chamber** is located immediately behind the cornea and anterior to the iris and lens. The **posterior chamber** is a smaller chamber located between the iris and the lens/zonula fibres. These 2 chambers are filled with **aqueous humour**. As the name suggests the aqueous humour is a watery medium and is similar to plasma (minus the proteins). It is formed by the processes of the ciliary body and the aqueous humour flows from the posterior chamber to the anterior chamber. The anterior chamber is drained by the **Canal of Schlemm**. The aqueous humour provides nutrients to the cornea and the lens (both are avascular).

The **vitreous chamber** is the largest chamber of the eye and is behind the lens and is encapsulated by the retina. The vitreous chamber is filled with a hydrated gel-like substance called the **vitreous body** or vitreous humour. The **vitreous body** supports the lens in its place as well as holding the retina in its place.

