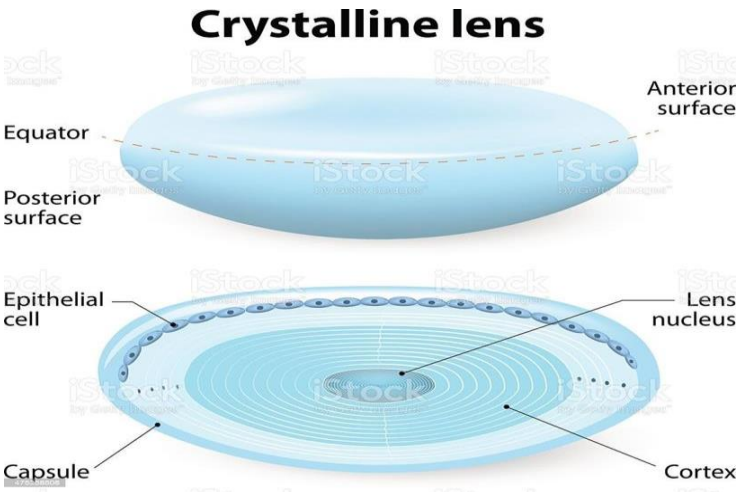
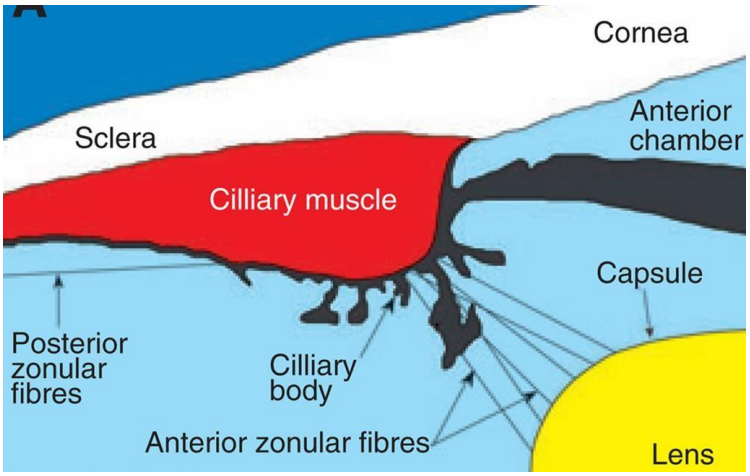
- The lens or crystalline lens is It is biconvex structure that along with the cornea, helps to refract light to be focused on the retina.

- Its a transparent, avascular organ surrounded by an elastic capsule.

- It lies behind the pupil and is suspended from the ciliary body by a series of fine ligaments called zonular fibres.

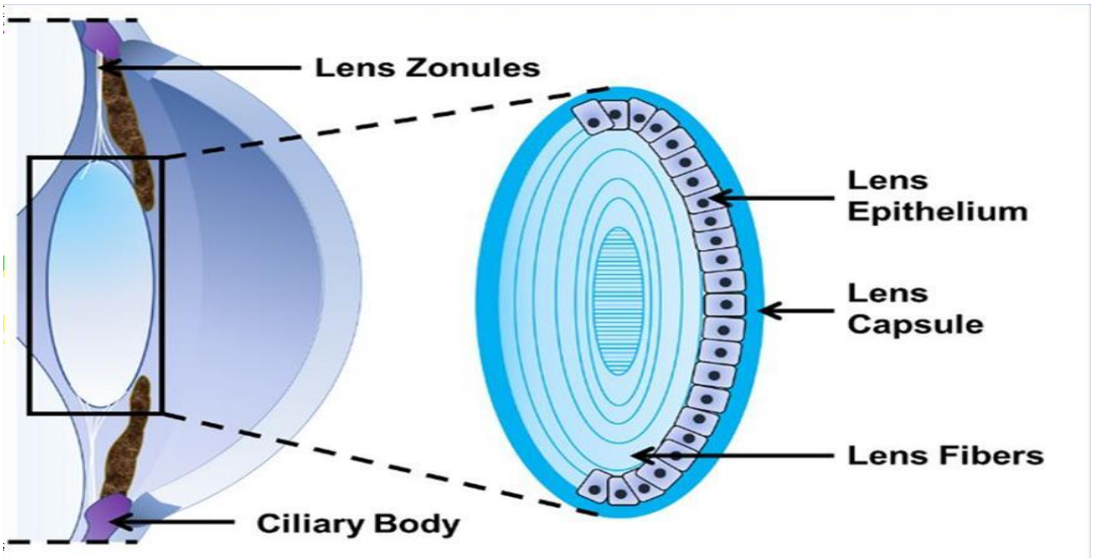


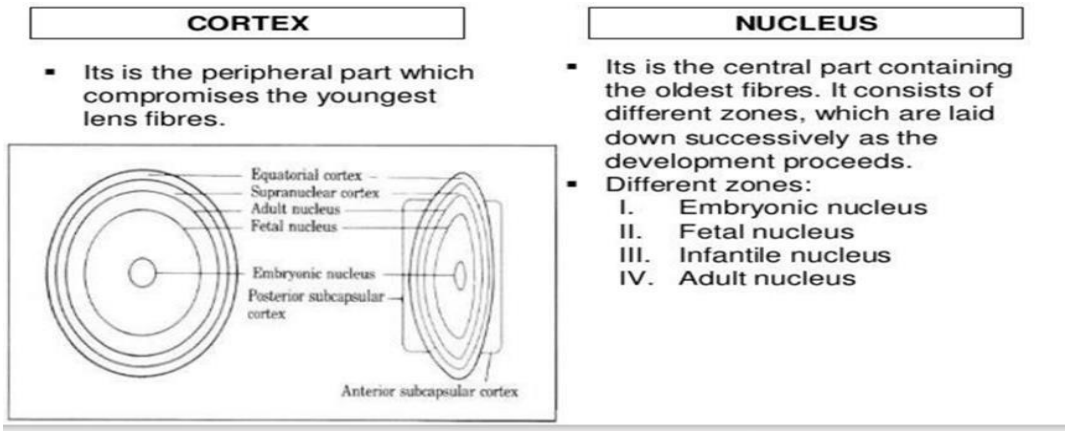


- The lens has three main parts: The lens capsule, the lens epithelium, and the lens fibers.

1- The lens **capsule** forms the outermost layer of the lens.
2- The lens **epithelium**, located only in the anterior part, between capsule and fibers.

3- Lens fibers form the bulk of the interior of the lens.
- The lens itself lacks nerves, blood vessels, or connective tissue.





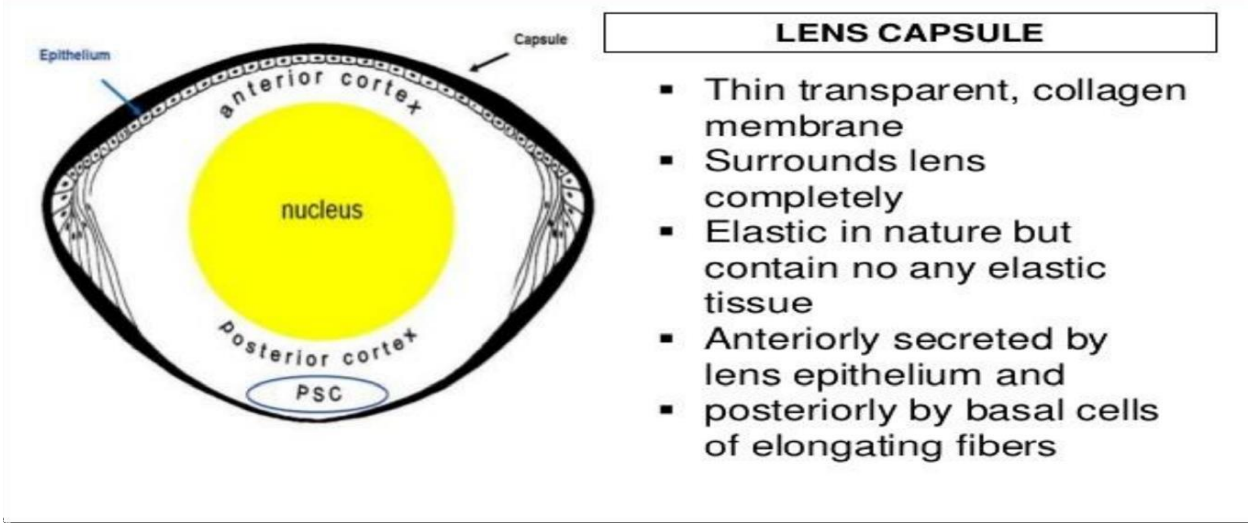
CORTEX

Its is the peripheral part which compromises the youngest lens fibres.

NUCLEUS

Its is the central part containing the oldest fibres. It consists of different zones, which are laid down successively as the development proceeds. Different zones:

1.Embryonic nucleus
2.Fetal nucleus
3- Infantile nucleus
4. Adult nucleus

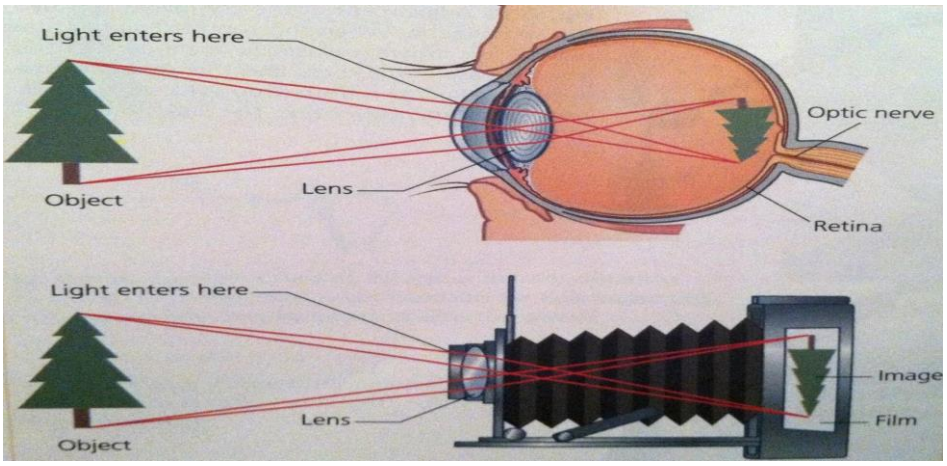


LENS CAPSULE

- Thin transparent, collagen membrane
- Surrounds lens completely
- Elastic in nature but contain no any elastic tissue
- Anteriorly secreted by lens epithelium and posteriorly by basal cells of elongating fibers

- Like the lens in a camera, the basic function of the eye lens is to transmit and focus light onto the retina. To facilitate this, it contains one of the highest concentrations of proteins of any tissue.

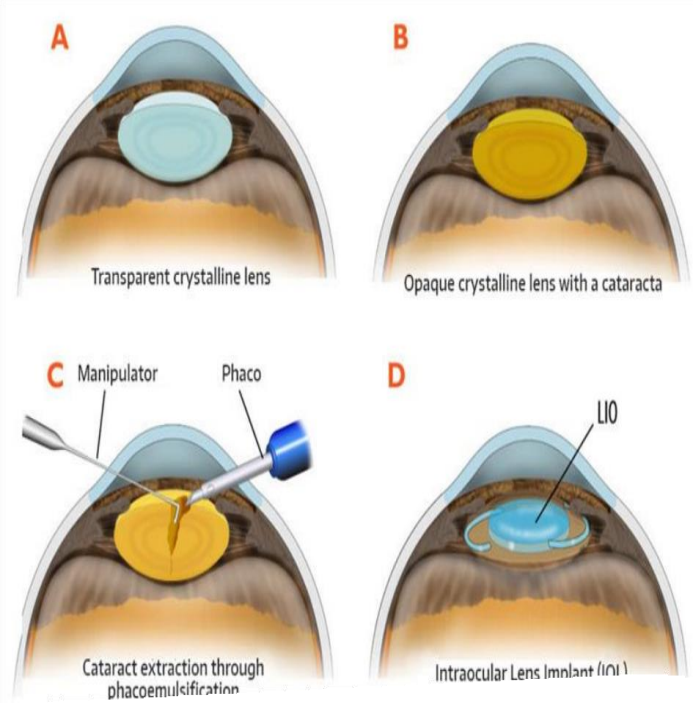
- The main optical function of the lens is to transmit light, focusing it on the retina. The cornea contributes about 80% of total refraction, while the lens fine-tunes the focusing of light onto the retina.

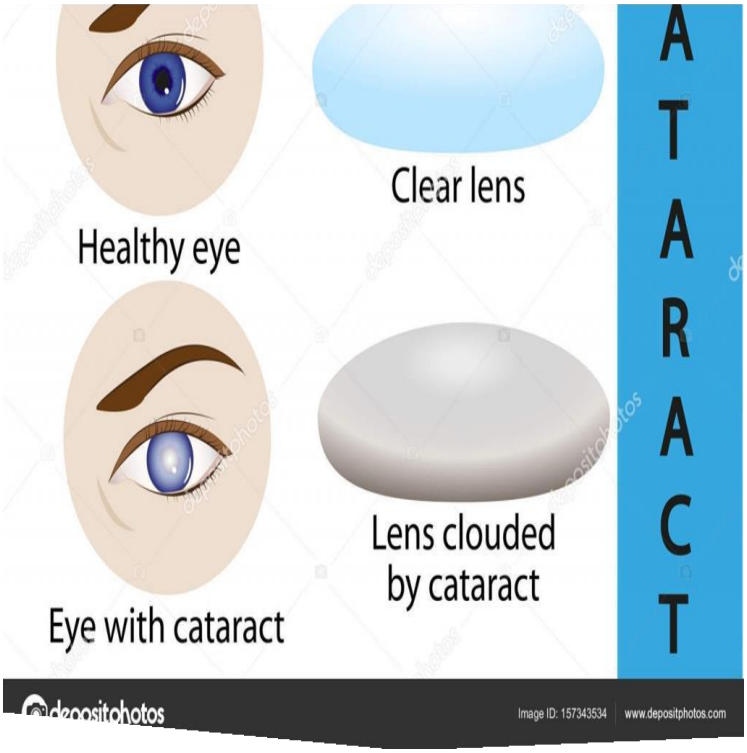


- In front of the lens is the **iris**, which regulates the amount of light entering the eye.

- Posterior to the lens is the **vitreous body**, which, along with the aqueous humor on the anterior surface, bathes the lens.

- The anterior surface is less curved than the posterior. In the adult, the lens is typically 10 mm in diameter and has an axial length of about 4 mm, though it is important to note that the size and shape can change due to accommodation and because the lens continues to grow throughout a person's lifetime.





- Interference with the growth or maintenance of lens fibres can result in the formation of abnormal fibres or fibres arrangements that cannot transmit light as well as the normal lens fibres. An opacity is thus seen in the lens.

- Minor irregularities are common in otherwise perfectly normal eyes. If the opacity is severe enough .to affect vision, it is called a cataract

- •The lens functions : By changing its shape, the lens changes the focal distance of the eye. In otherwords, it focuses the light rays that pass through it (and onto the retina) in order to create clearimages of objects that are positioned at various distances. It also works together with the cornea torefract, or bend, light.

- •The main function of the lens is to transmit and focus the light onto the retina in order to createclear images of observed objects at various distances.

Accommodation: The Mechanism of Accommodation

Accommodation: is how the eye adjusts its optical power to maintain a clear image as the viewing distance changes. This ability is crucial for seeing objects at different distances, especially for near vision.

Anatomy Involved in Accommodation

1. **Lens:** The lens is a transparent, flexible structure that changes shape to focus light on the retina.
2. **Ciliary Muscle:** A circular muscle that controls the shape of the lens.
3. **Zonular Fibers:** Fibers that connect the ciliary muscle to the lens and help adjust the shape.
4. **Retina:** The light-sensitive layer at the back of the eye where the focused image is formed.

Function

The function of the accommodation reflex is to coordinate visual attention to near objects. Proper convergence prevents diplopia

Mechanism of Accommodation

Accommodation occurs through the contraction and relaxation of the ciliary muscle, which leads to changes in the shape of the lens:

- **For Near Vision:**
  - The ciliary muscle contracts.
  - Zonular fibers relax.
  - The lens becomes more convex (thicker), increasing its refractive power.
  - Light is focused correctly on the retina for close objects.
- **For Distance Vision:**
  - The ciliary muscle relaxes.
  - Zonular fibers tighten.
  - The lens becomes flatter, reducing its refractive power.
  - Light is focused correctly on the retina for distant objects.

Neural Control of Accommodation

The autonomic nervous system controls the process of accommodation:

- **Parasympathetic Stimulation:** Activates the ciliary muscle contraction for near vision.
- **Sympathetic Stimulation:** Helps to relax the ciliary muscle for distant vision.

Age-Related Changes in Accommodation

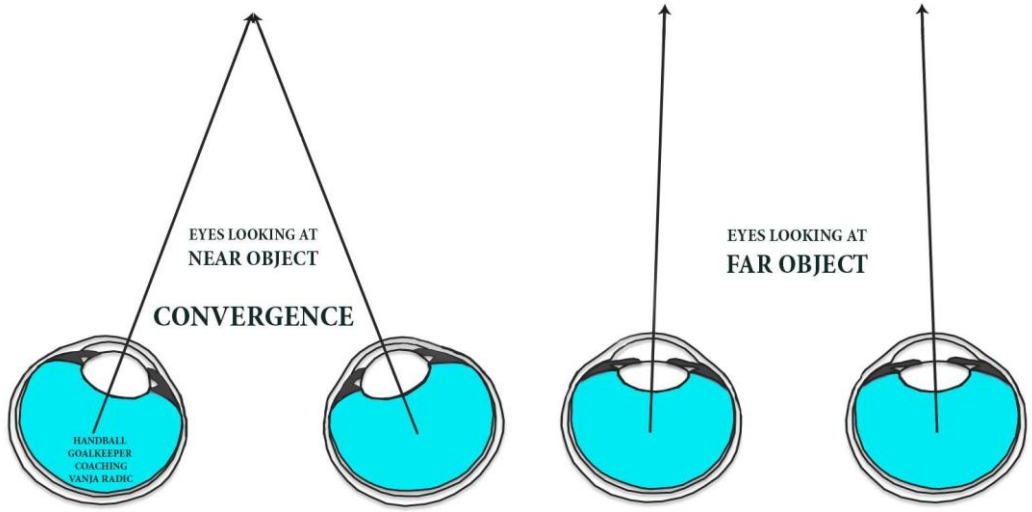
With aging, the ability of the lens to change shape declines, a condition known as **presbyopia**. This occurs due to:

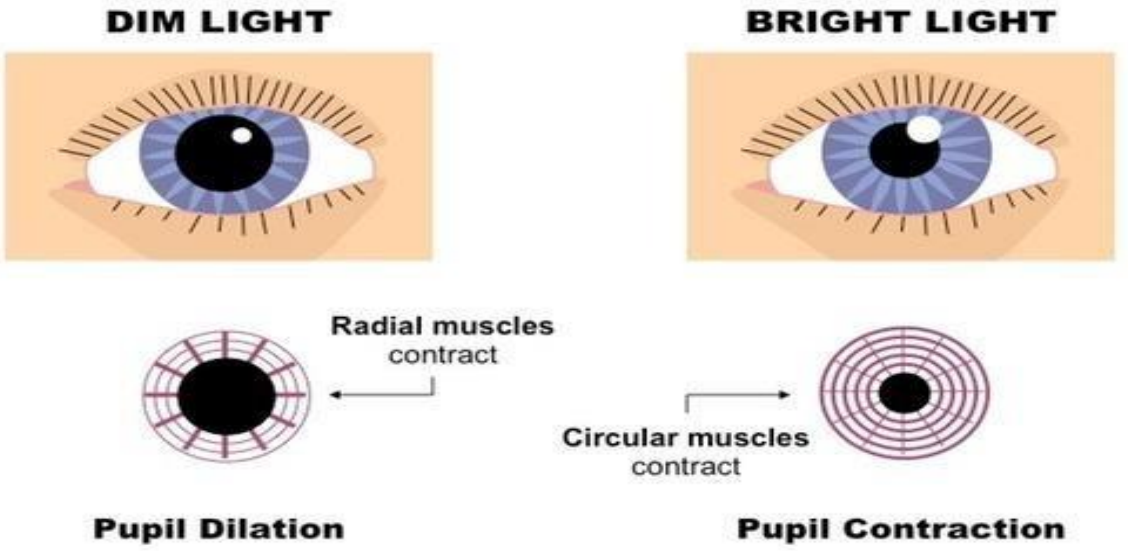
- Decreased elasticity of the lens.
- Weakening of the ciliary muscles.
- Reduced flexibility of the zonular fibers.

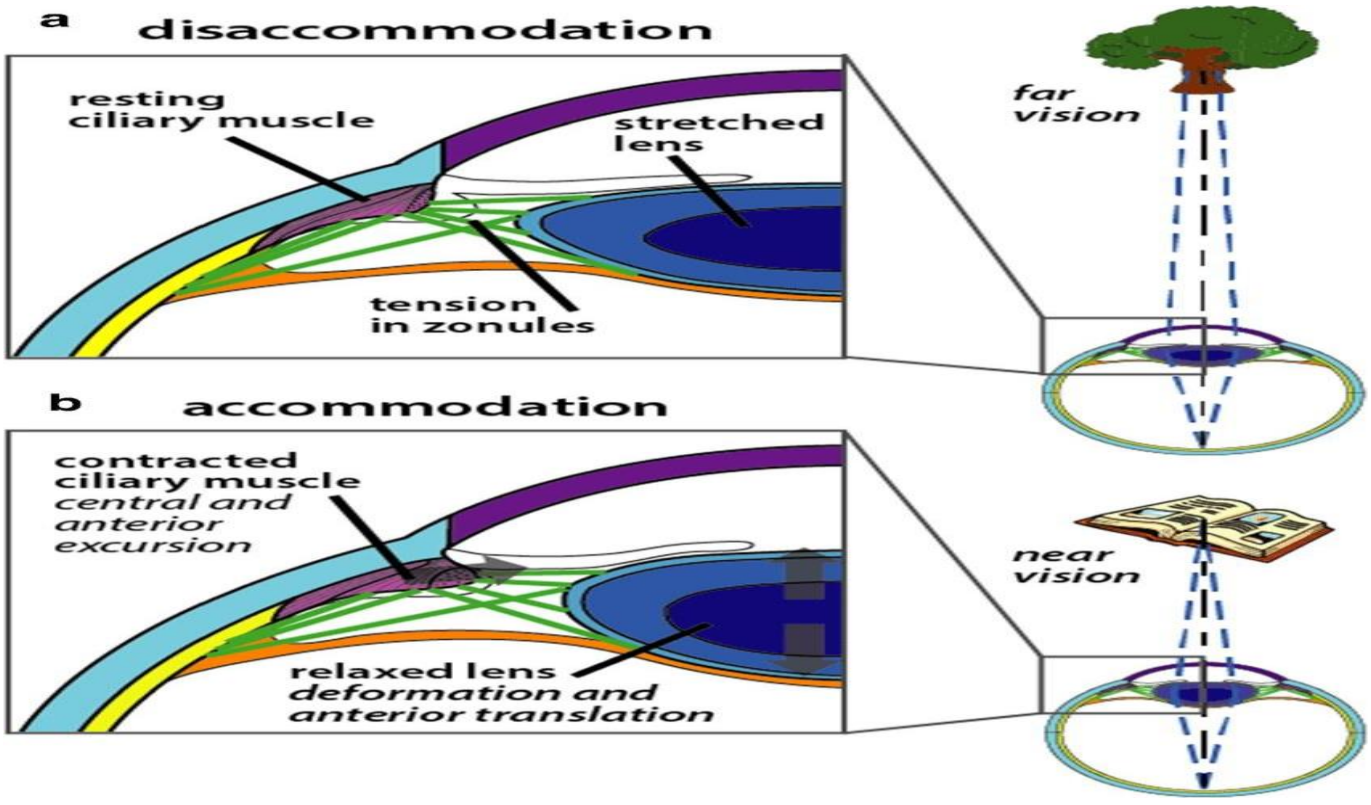
Clinical Importance of Accommodation

1. **Presbyopia:** Age-related loss of near vision requiring reading glasses.
2. **Hypermetropia (Farsightedness):** Difficulty in seeing near objects.
3. **Myopia (Nearsightedness):** Difficulty in seeing distant objects.
4. **Astigmatism:** Uneven curvature of the lens or cornea affecting focus.
5. **Testing Accommodation:** This includes near-point accommodation (NPA) and accommodative amplitude tests.

Accommodation is an essential eye function that allows clear vision at different distances. Understanding its mechanism is crucial for diagnosing and managing vision-related disorders, especially in aging individuals.


EYES LOOKING AT
NEAR OBJECT
CONVERGENCE
EYES LOOKING AT
FAR OBJECT
HANDBALL
GOALKEEPER
COACHING
VANJA RADIC


DIM LIGHT
BRIGHT LIGHT
Radial muscles
contract
Circular muscles
contract
Pupil Dilation
Pupil Contraction


a
disaccommodation
resting
ciliary muscle
stretched
lens
tension
in zonules
far
vision
b
accommodation
contracted
ciliary muscle
central and
anterior
excursion
relaxed lens
deformation and
anterior translation
near
vision

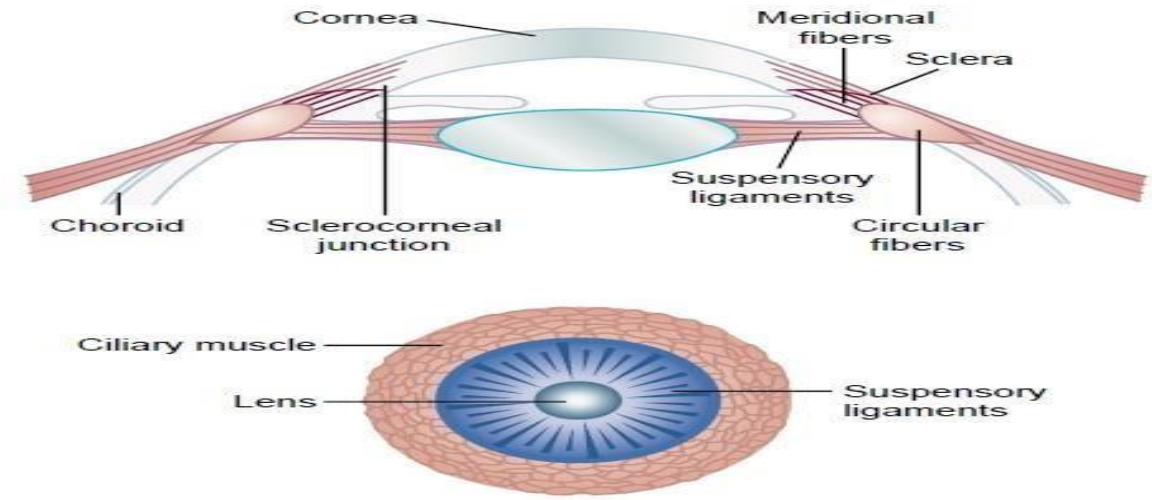
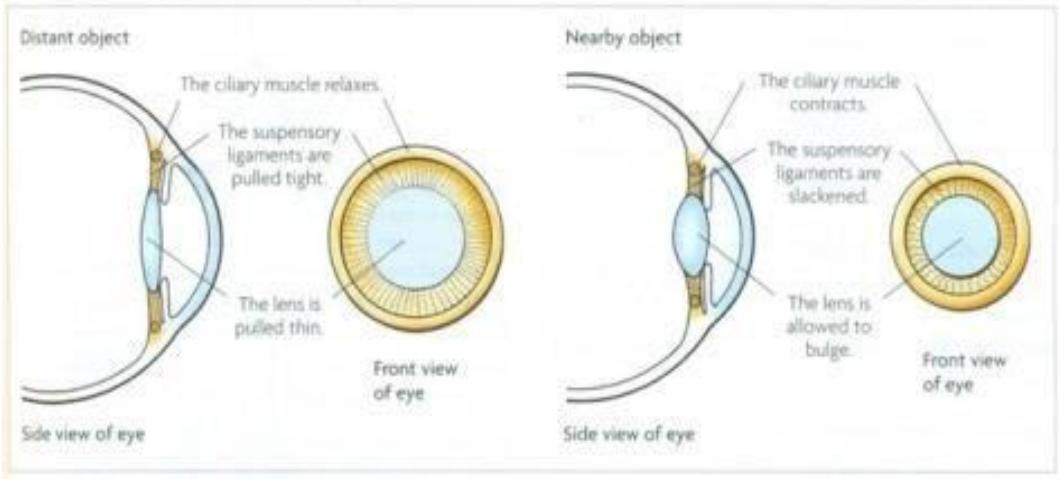
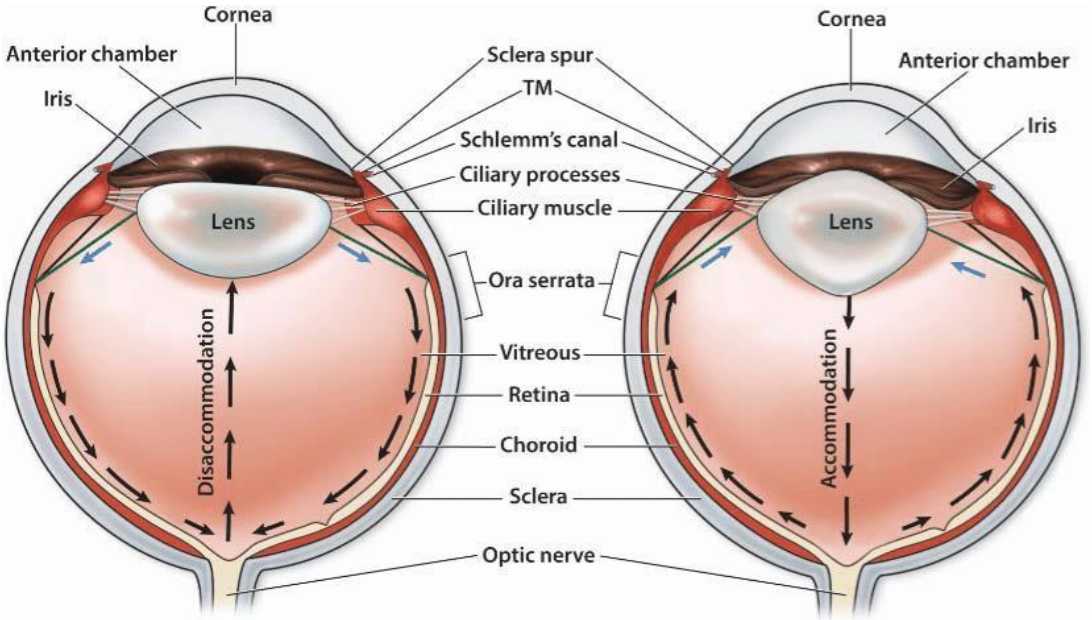


Figure 49–10

Mechanism of accommodation (focusing).





Physiology of the eye and vision

The Lacrimal System and Tears

lecture
3

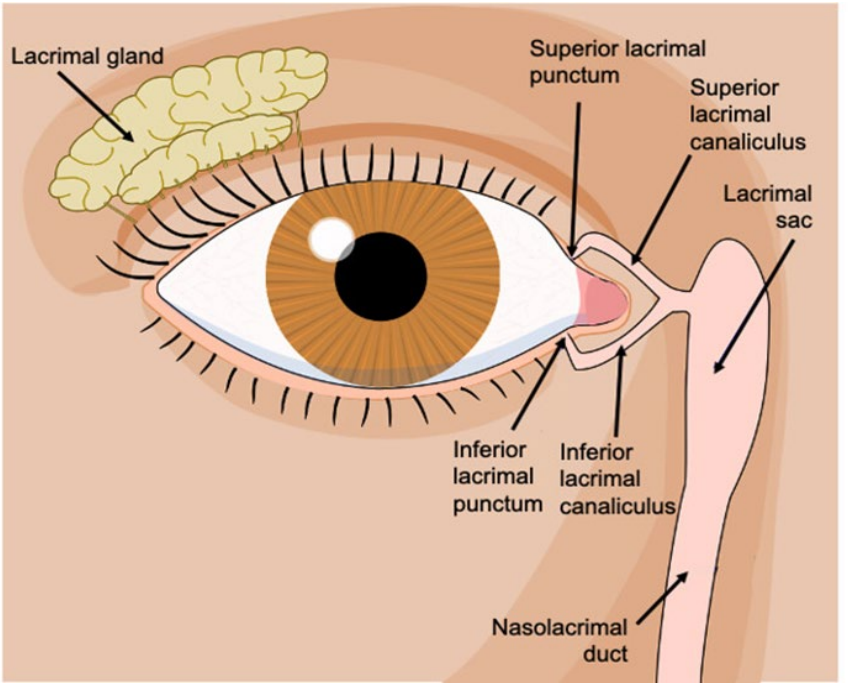
The Lacrimal Gland

The lacrimal glands

- Are exocrine glands that secrete lacrimal fluid **(tears)** onto the surfaces of the conjunctiva and cornea of the eye.

- It is located anteriorly in the superolateral aspect of the orbit.

- **Lacrimal fluid** acts to the clean, nourish and lubricate the eyes.

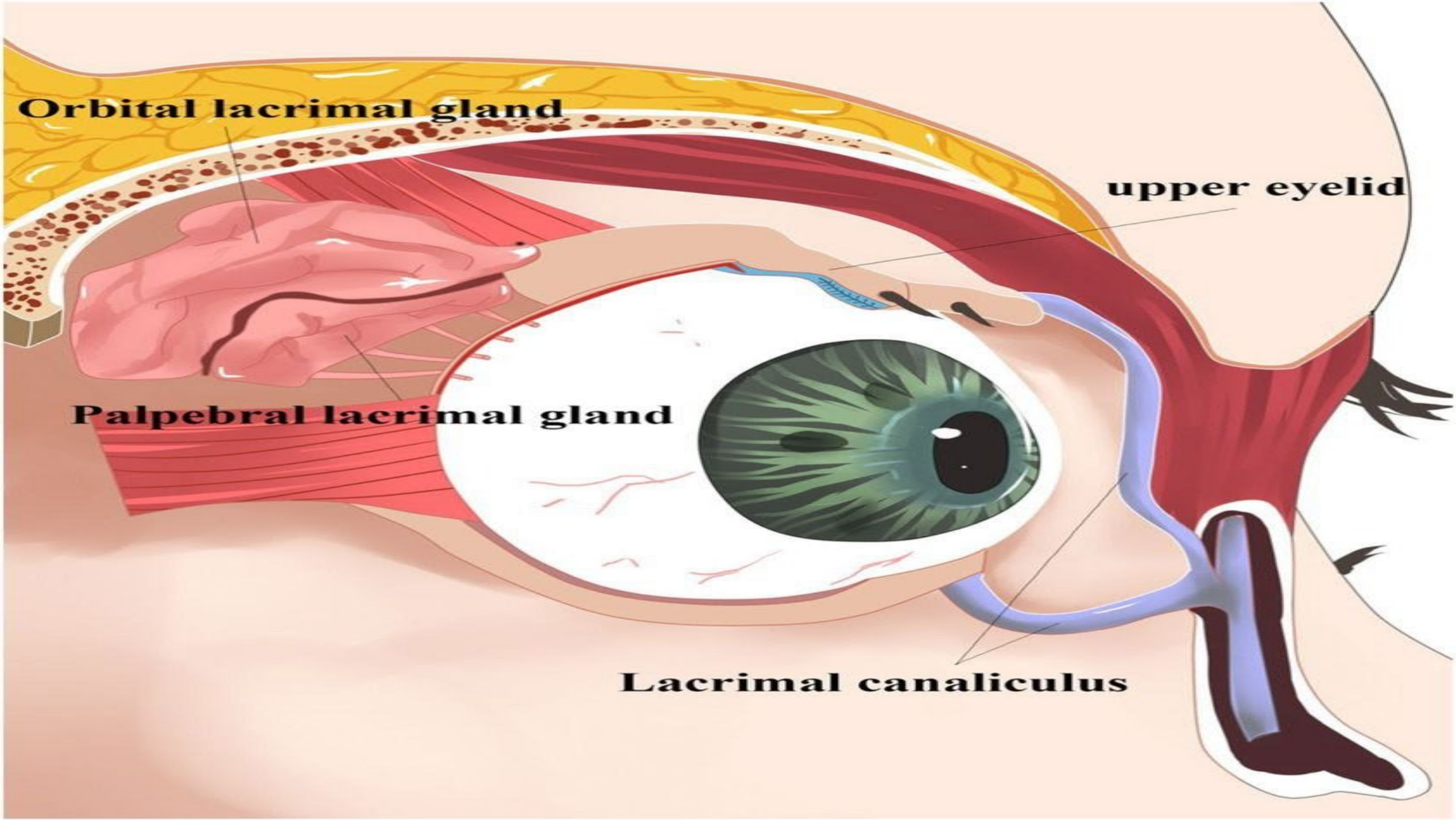


Anatomical Structure:

- The lacrimal gland is approximately 2cm long.
- It can be divided into two main parts:

1- Orbital: larger and sits on the lateral margin of the levator palpabrae superioris muscle.

2- Palprebral: smaller and is located along the inner surface of the eyelid.

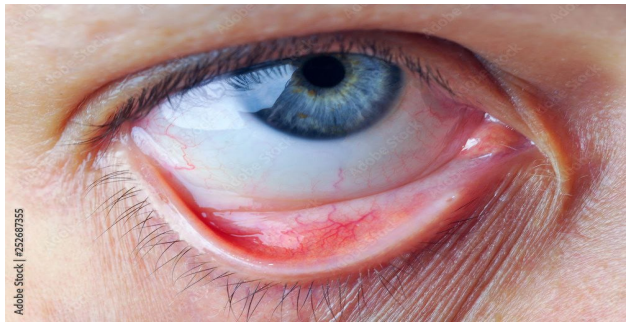

Orbital lacrimal gland
upper eyelid
Palpebral lacrimal gland
Lacrimal canaliculus

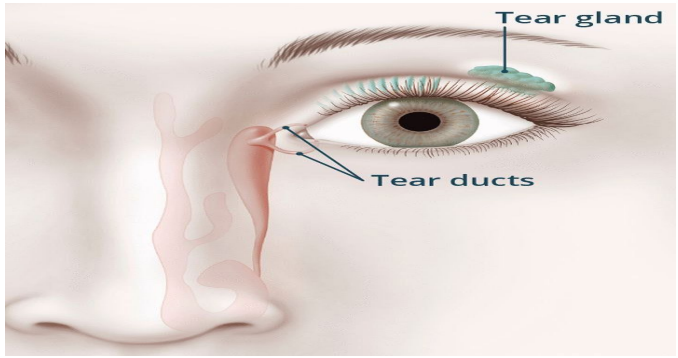
Lacrimal Gland

Tear Ducts

- Also known as **lacrimal ducts**, are small channels that drain tears from the eyes into the nasal cavity.

- They play a crucial role in maintaining the proper drainage and regulation of tear fluid





Conjunctival Sac

- is a space between the eyelids and the eyeball.

- It serves as a reservoir for tears and facilitates their distribution over the ocular surface

Vasculature: The main arterial supply to the lacrimal gland is from the **lacrimal artery**.

Function of the lacrimal gland

- Secrete lacrimal fluid, which consists of **water**, **electrolytes**, and **proteins**, contributing to the necessary lubrication and nourishment of the ocular surface.

- Its continuous secretion and drainage help maintain the health and clarity of the cornea.

Tear

Steps

- Involves a coordinated process, starting with the lacrimal gland secreting tears, Followed by their distribution across the ocular surface during blinking.

Function

- Tears are essential for maintaining ocular health by nourishing the cornea.

- Safe the eyes against foreign particles and pathogens.

Types of Tears

Basal Tears

- Are continually released to keep the ocular surface moist and nourished, contributing to the regular lubrication of the eyes,

Emotional Tears

- Are triggered by intense emotions, stress, or pain.
- They contain additional proteins and hormones
- Not found in basal or reflex tears

Reflex Tears

- Are produced in response to irritants, environmental factors, or emotions, such as **wind**, **smoke**, or **emotional stress**.

Common Lacrimal System Disorders

Blocked Tear Ducts

- Blockages in the tear drainage system can cause **excessive tearing**, **discharge**, and **recurrent eye infections.**

Dry Eye Syndrome

- Dry eye syndrome results from **inadequate tear production** or **poor tear quality**, leading to ocular discomfort, visual disturbances.

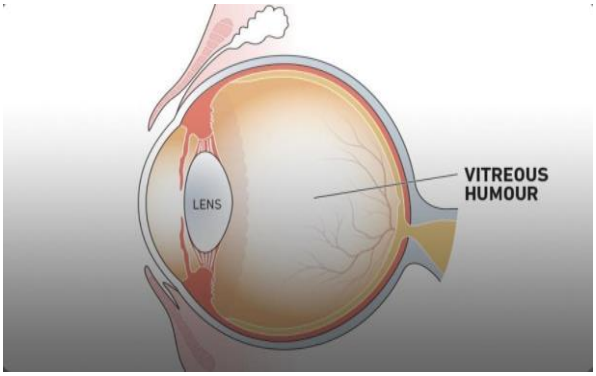
Conjunctivitis

- Conjunctivitis, or **pink eye**, is an inflammation of the conjunctiva due to **infection**, **allergies**, or **irritants**. It can cause **excessive tearing**, **discharge**, **redness**, and **discomfort**


Thank You!

What is vitreous humor?

The vitreous humor (also known as vitreous fluid) is a transparent, colorless, gel-like substance that fills the space between the lens and the retina within the eye. The vitreous humor is composed of mostly water, along with a small percentage of collagen, glycosaminoglycans (sugars), electrolytes (salts), and proteins.



The vitreous humor is located in the posterior segment and fills the vitreous chamber, which takes up about 80% of the eye. The vitreous humor is not to be confused with the aqueous humor, which is a clear watery fluid that fills the anterior segment.

Anatomy

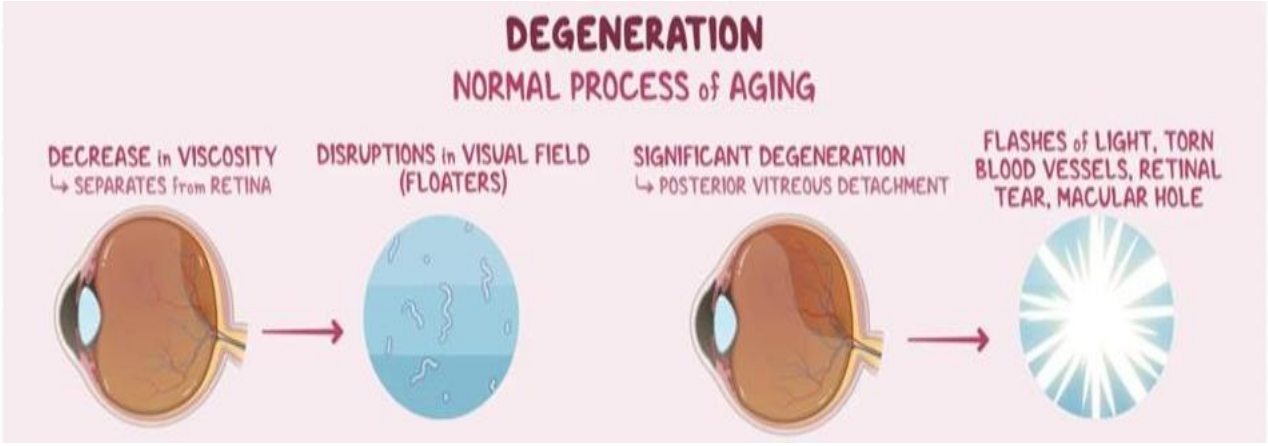
The human eye is divided into two segments, the anterior (front) segment and the posterior (back) segment.The vitreous humor is located in the posterior segment and fills the vitreous chamber, which takes up about 80% of the eye.The vitreous humor is not to be confused with the aqueous humor, which is a clear watery fluid that fills the anterior segment.

Function :

The vitreous humor's main role is to maintain the round shape of the eye. The size and shape of the vitreous humor also ensures that it remains attached to the retina, which is the layer at the back of the eye that is sensitive to light.

The vitreous humor is also a part of the eye that can help with vision clarity. Because the vitreous humor is a clear substance, light is able to pass through and reach the retina. can be helpful in absorbing any unexpected disturbances to the eye, such as a thump to the side of head.

With the normal process of aging, the vitreous humor may begin to shrink due to a decrease in viscosity or thickness. This process is called vitreous degeneration.



Vitreous Humour vs. Aqueous Humour

- The aqueous humour is a thin, watery fluid that exists in the aqueous chamber. It is a cavity between the lens and the cornea.

- The aqueous humour is responsible for providing necessary nutrition to the lens and cornea, while vitreous humour is a transparent jelly-like substance that exists in a much larger chamber as compared to the aqueous chamber.

- The vitreous humour holding chamber is known as the vitreous chamber which is responsible for supporting the retina and lens. The pressure of vitreous humour helps in providing the proper shape to the eye.

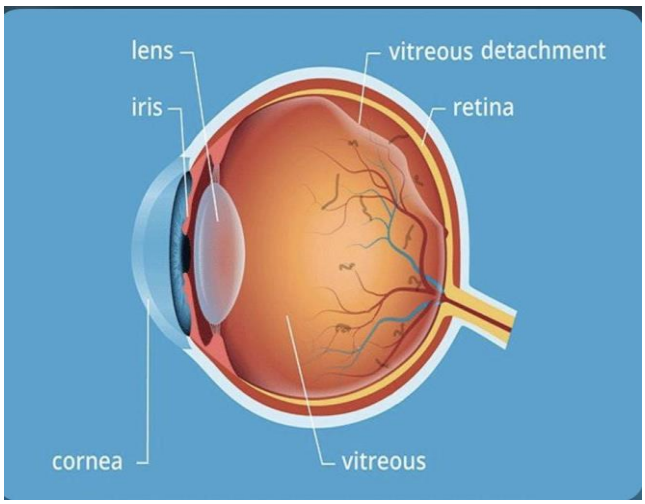
- The vitreous humour absorbs the shock waves and prevents the retina from getting detached. In addition to this, it absorbs the light rays which enter the eye and directs them to the retina.

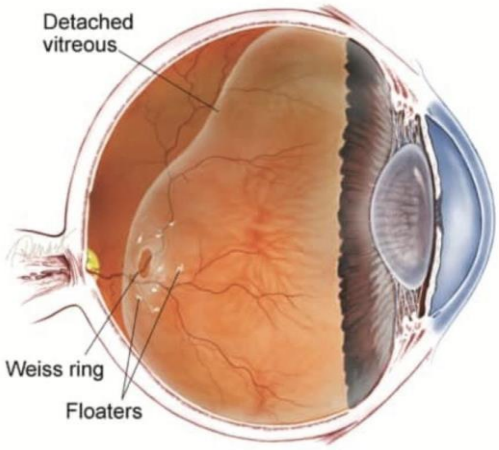
Vitreous Detachment

The vitreous is naturally attached to the retina with the help of millions of fine fibres. However, as a person grows older, the vitreous begins to shrink and achieves a fluid-like consistency, and gets detached from the retina.

This problem is common among people ageing around 65. People having the age of 85 are at an even higher risk of developing this condition.

The major cause of vitreous detachment may include various conditions such as myopia (short-sightedness), eye inflammation (uveitis), eye injury.





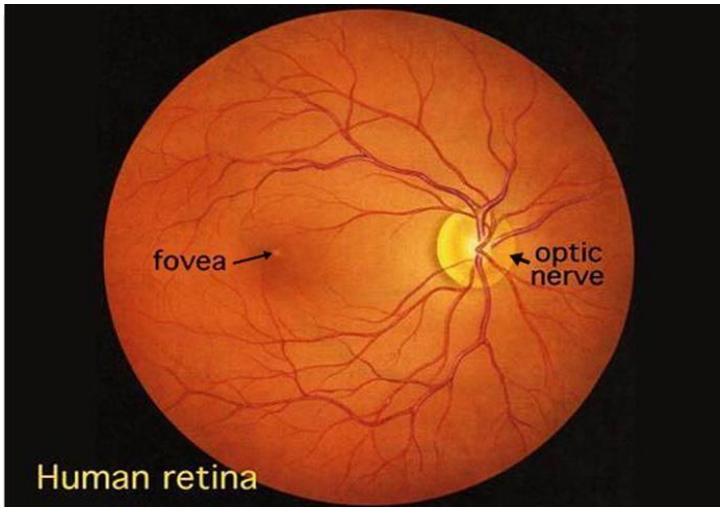
Retina

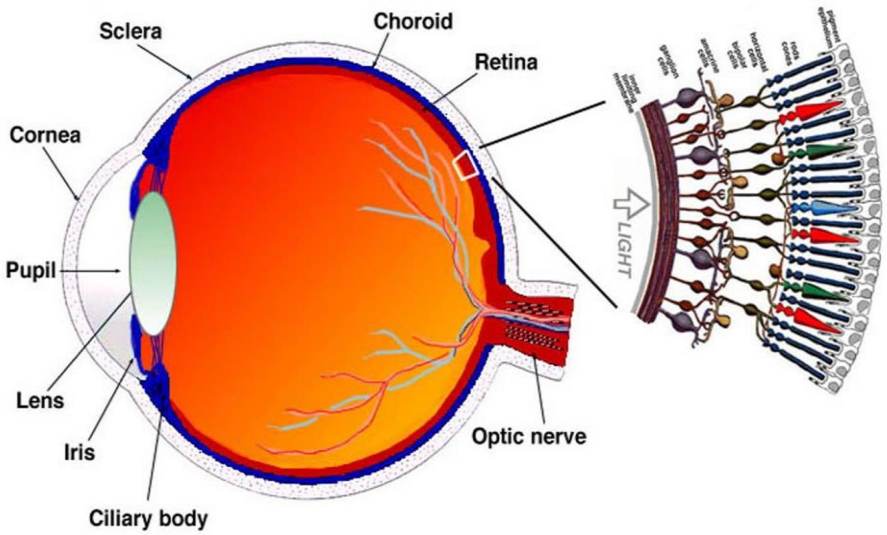
- The retina is the innermost layer in the eye that is responsible for the visual processing that turns light energy from photons into three-dimensional images.

- 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.

- In the center of the retina is the optic nerve, a circular to oval white area . From the center of the optic nerve radiates the major blood vessels of the retina.

- the left of the disc, can be seen the slightly oval-shaped, blood vessel-free reddish spot, the fovea, which is at the center of the area known as the macula .





Retina Anatomy, Function & Histology

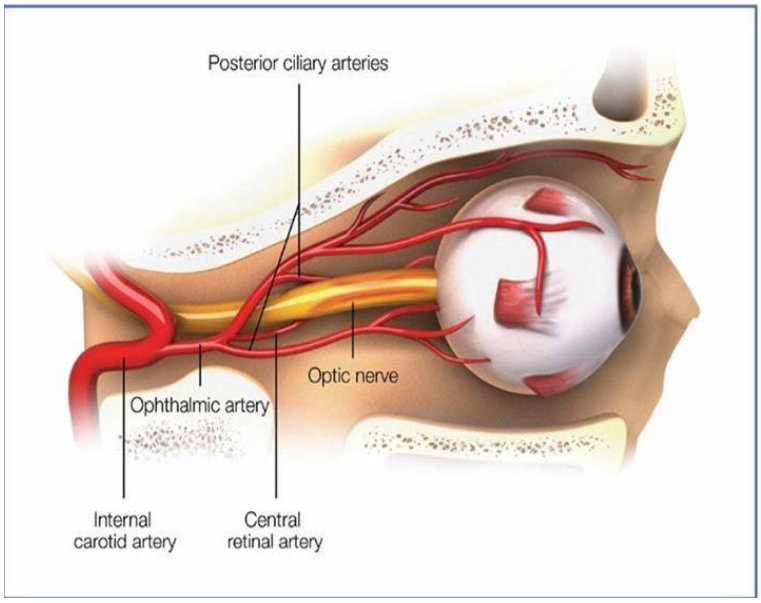
The retina is a thin layer of tissue that lines the back of the eye on the inside. It is located near **optic nerve**.

The human retina is located on the inner surface of the posterior two-thirds to three-quarters of the eye. The eye itself is a mostly hollow organ, roughly spherical in shape. The purpose of the retina is to receive light that the lens has focused, convert the light into neural signals, and send these signals on to the brain for visual recognition.

Due to the retina's vital role in vision, damage to it can cause permanent blindness. Conditions such as retinal detachment, where the retina is abnormally detached from its usual position, can prevent the retina from receiving or processing light. This prevents the brain from receiving this information, thus leading to blindness.

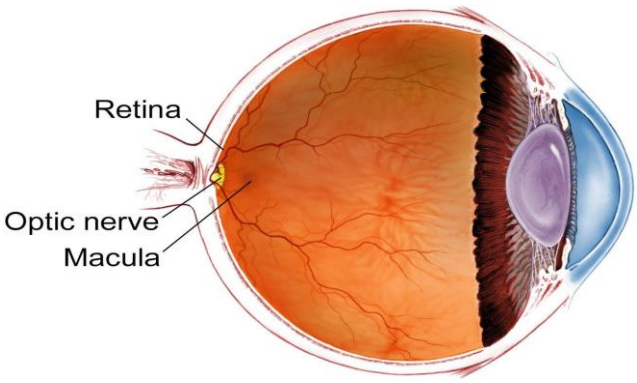
Central retinal artery

The central retinal artery is a blood vessel inside the eye. It provides essential nutrients to the retina. The retina lines at the back of the eye and is full of **cone** cells and **rods**, which transmit messages to the occipital lobe in the brain's cerebral cortex. These messages give individuals the ability to tell the difference between light and dark, as well as colors.



Retina Nerve Supply

optic nerve, second cranial nerve, which carries sensory nerve impulses from the more than one million ganglion cells of the retina toward the visual centres in the brain. Each human optic nerve contains between 770,000 and 1.7 million nerve fibers, which are axons of the retinal ganglion cells of one retina.

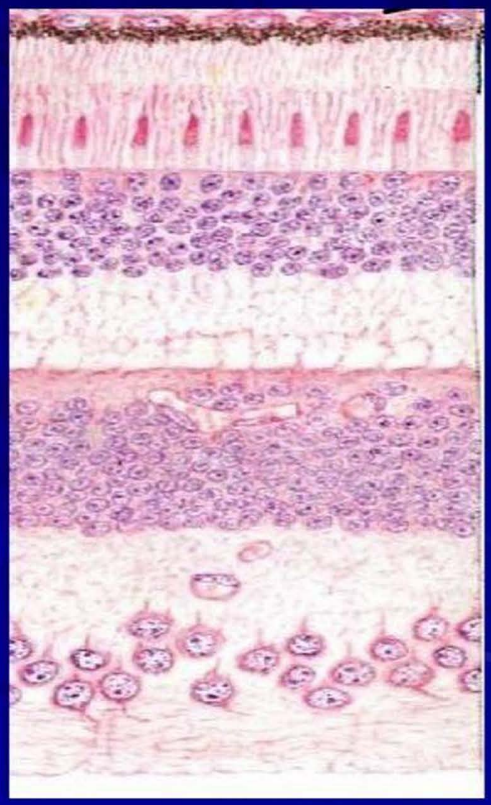


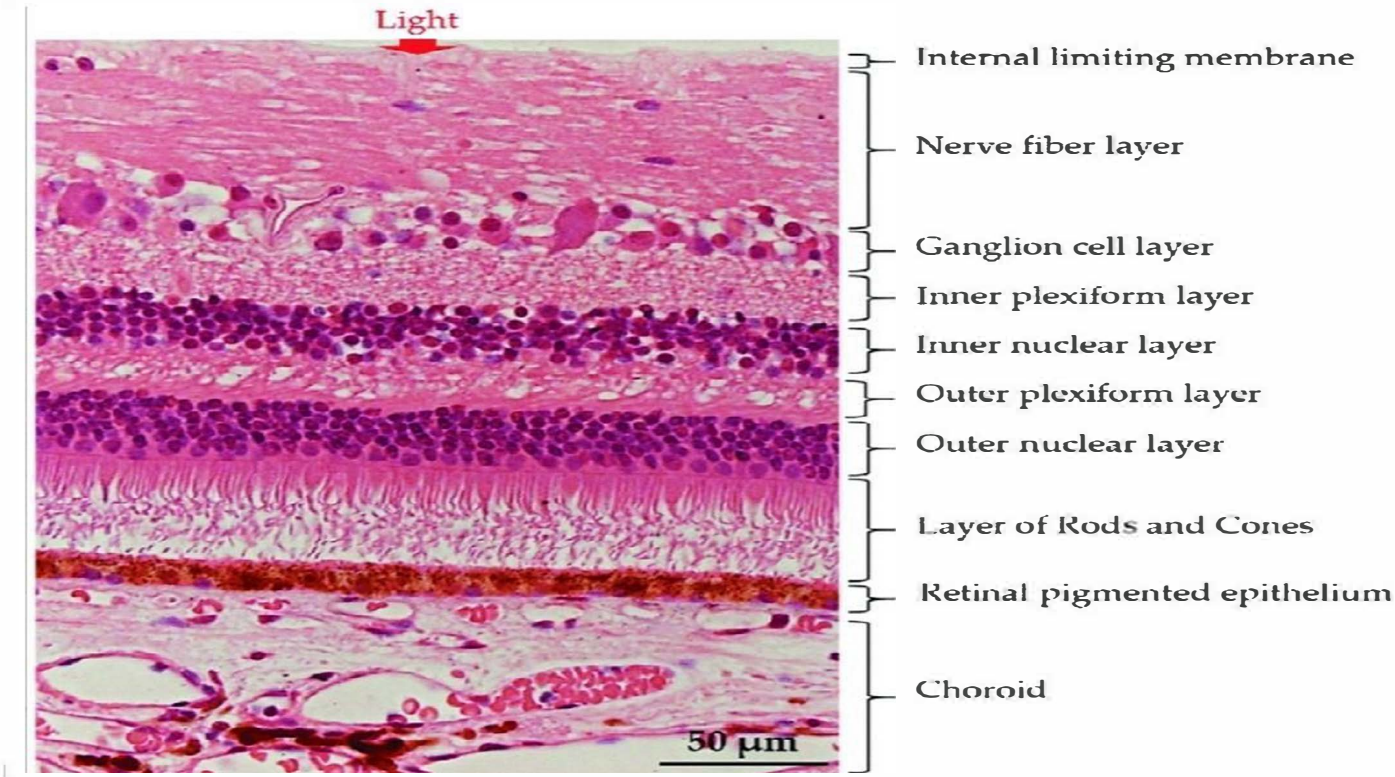
The retina processes the information gathered by the photoreceptor cells and sends this information to the brain via the **optic nerve.**

Basically, the retina processes a picture from the focused light, and the brain is left to decide what the picture is.

LAYERS OF RETINA

1. Pigment cell layer
2. Layer of rods & cones
3. 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





Structure and function

- The retina captures the light that enters your eye and helps translate it into the images you see

1- Photoreceptors (rods and cones): The detection of light begins at the deepest cell layer in the retina, the photoreceptors, located in the outer nuclear layer. Rods are very light sensitive and are responsible for dim-light vision. Cones, on the other hand, are not very light sensitive but are specific for a particular wavelength of light. Thus, cones are responsible for high acuity color vision.

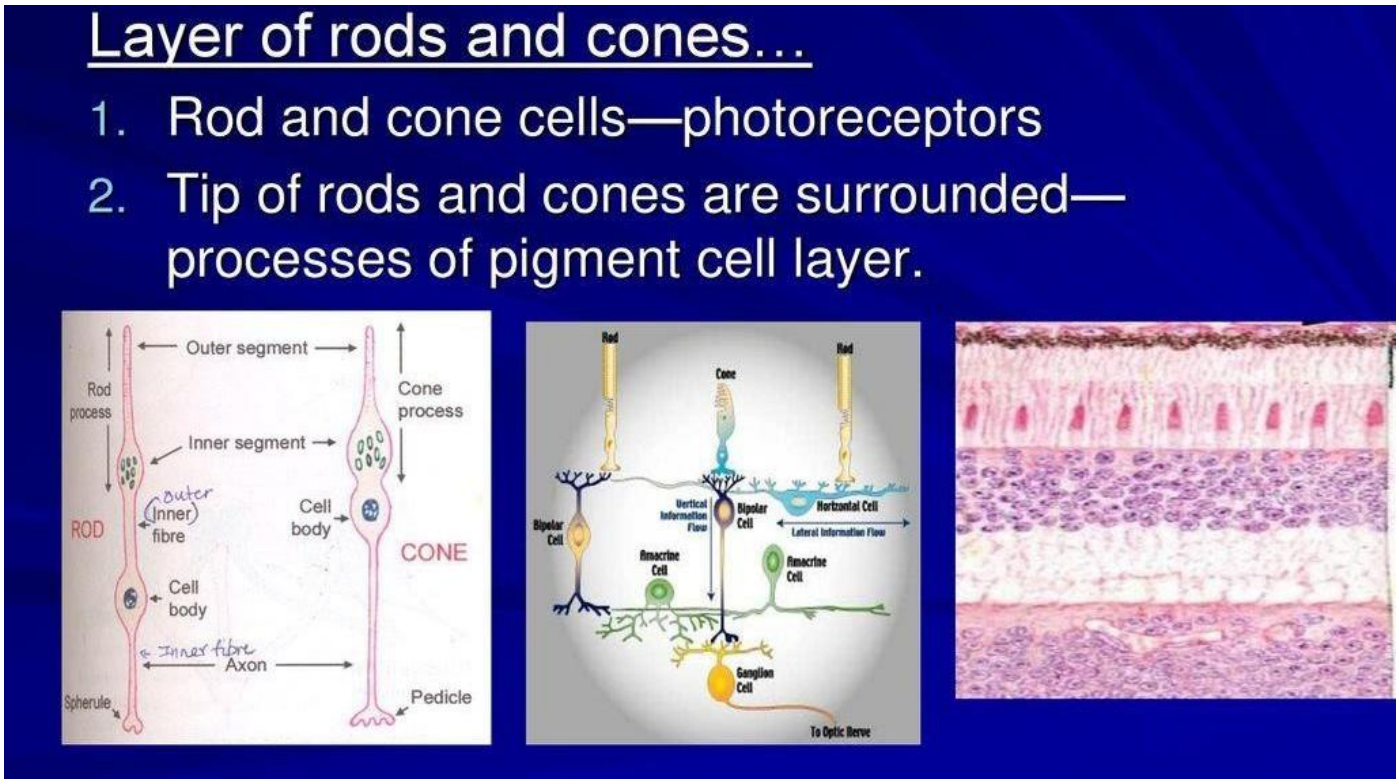
2- Bipolar cells: Photoreceptors use the neurotransmitter, glutamate, to communicate at the synapse with bipolar cells within the outer plexiform layer. Bipolar cell bodies are just shallow to this layer at the inner nuclear layer. At the inner plexiform layer, bipolar cells are responsible for transmitting an impulse to retinal ganglion cells.

3- Retinal ganglion cells: These are the final receivers and transmitters of the initial stimulus. They send the information they receive down their axons, which eventually form the optic nerve and project to higher brain centers.

4- Amacrine cells: Amacrine cells modulate the excitation of the retinal ganglion cells through contact with ganglion cell dendrites or bipolar cell axon terminal bulbs, using the neurotransmitters GABA and glycine.

5- Horizontal cells: These cells function to modulate the communication between photoreceptors and bipolar cells. Bipolar cells contact ganglion and amacrine cells at the inner plexiform layer.

6- Muller cells: These are cells are of glial origin and are essential for proper retinal function. They contact almost every cell type in the retina, spanning the entire width from the photoreceptors to the inner retina. They serve to recycle neurotransmitters, prevent glutamate toxicity, and regulate nutrient homeostasis in the retina.



Rods & Cones: The retina processes light through a layer of **photoreceptor cells** (Rods & Cones). These are essentially light-sensitive cells, responsible for detecting qualities such as color and light- intensity.

Rods are responsible for vision at low light levels (scotopic vision). *They do not mediate color vision*, and have a low spatial acuity.

Cones are active at higher light levels (photopic vision), are *capable of color vision* and are responsible for *high spatial acuity.*