

## The eye

Eye is the sense organ which helps us most to gain knowledge. Eyes are situated in the **eye sockets** of the skull. Images are formed in the **retina**. Let us examine through which parts light passes before reaching the retina. **Cornea**, which is convex in shape and transparent as glass, is found in the front of the eye. The continuation of cornea seen in white colour is called **sclera** and it is the outermost layer of the eye. It is the strong layer that gives shape to the **eye ball**.

The **aqueous chamber** is seen just behind the cornea. The fluid filled in that chamber is called the **aqueous humour**. This fluid, which gets separated from the blood, gets absorbed back into the blood in the same quantity. This fluid provides nourishment and oxygen to the cells around it.

**Melanin** is the pigment which gives dark colouration to the **choroid**. It absorbs the excess light which enters into the eye. Numerous capillaries are present in the choroid. They bring oxygen and nutrients required for the eye. The **iris** serves as a screen in front of the lens and it is the continuation of the choroid. The colour of iris vary in people, have you ever thought why? The function of the iris is to limit the amount of light that passes through the **lens** to the retina. To make the iris **opaque**, it is coated with the pigment melanin, in varying degrees for each of us. Melanin makes the eyes dark brown and 10,000 years ago, everyone's eyes were this colour. Then a mutation turned off the pigmentation on the front of the iris. This allows light to reach the fibres of the stromal cells beneath, and they reflect light back as blue. Green, grey and olive eyes are just half-way colours. Note the portion where the iris joins the **sclerotic layer**. Ciliary muscles are seen in this thickened area.

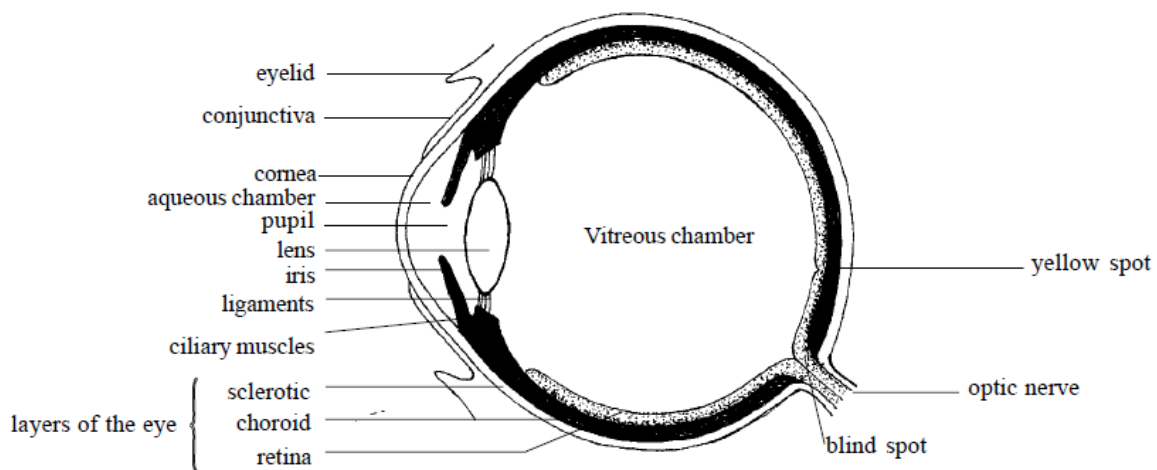


Figure 4.1

Cross section of the eye

### Light and the pupil

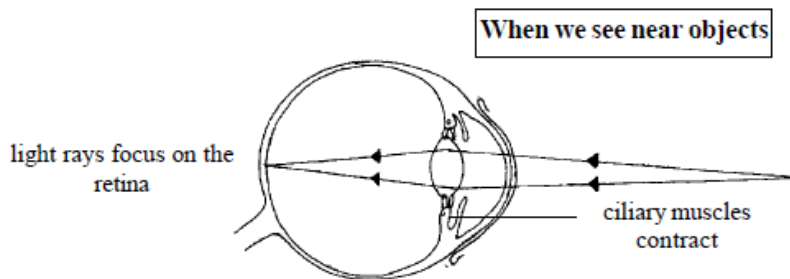
Observe the position of the **pupil**. This is the only way through which light can reach the retina. The pupil **constricts** in bright light and **dilates** in dim light. When the **circular muscles** contract, the size of the pupil decreases.

The lens is made of a substance which has elasticity and it is connected to the **ciliary muscles** with the help of **ligaments**. The **curvature** of the **lens** changes with the contraction of ciliary muscles. Light passes through the lens into this large chamber behind it. The semisolid transparent substance filled in this chamber is called **vitreous humour**. It gives shape to the **eyeball**.

### How is image formed?

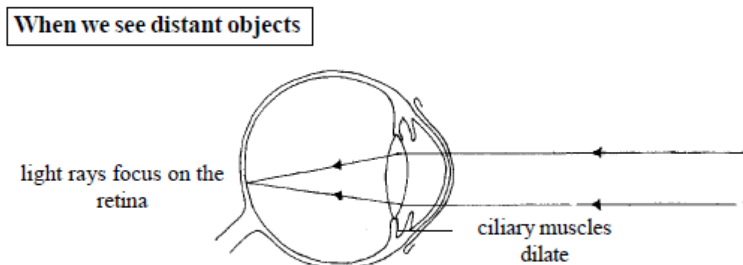
The image formed when light passes through a convex lens is inverted. It is the image of a distant object which is formed in the focus. The lens in the eye is convex. Then what are the characteristics of image formed. The light gets refracted when it passes through cornea, aqueous humour, lens and vitreous humour. As a result of this the image falls on the retina

But when we look at a near object its image will be formed behind the retina. Here the curvature of the lens is increased by the contraction of the ciliary muscles, so that the image is



formed on the retina.

Thus depending upon the distance of the object from the eye, its ability to focus the image on the retina by altering the convexity of the lens is called the power of accommodation. In addition to the contractions of the ciliary muscles, the curvature of the cornea, shape of the pupil and the fluids in the eye also help in this process.



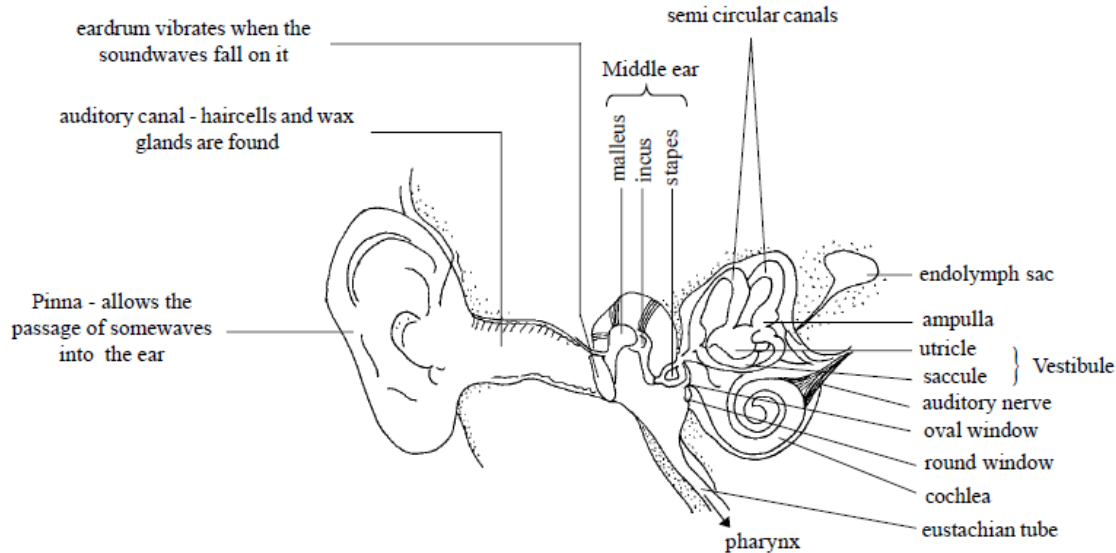
### Lens and vision

As we grow old the elasticity of the lens decreases. This state is known as **presbyopia**. What type of lens is used in the spectacles of such people?

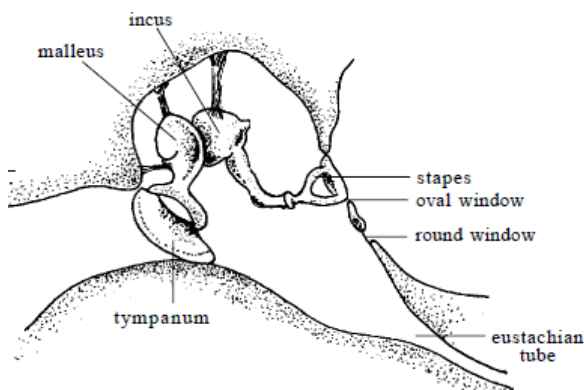
The transparency of the lens is lost in many aged people and in some persons affected by diseases. This disorder is known as **cataract**. The lens incapable of functioning is replaced by an artificial lens.

## The ear

Hearing is as important as vision. We know that ear is the sense organ which helps us in hearing. It also helps us to maintain the balance or equilibrium of our body. From the picture, it is clear that the ear has three main parts: external ear, middle ear, internal ear.



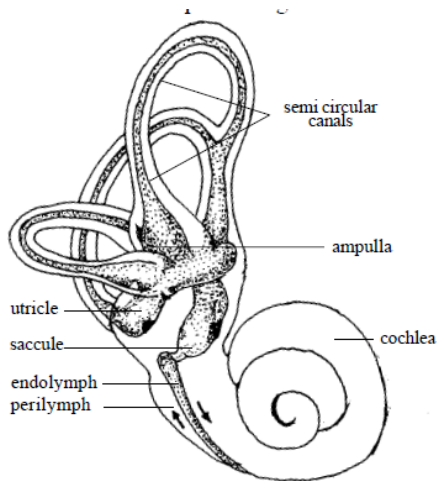
**The external ear** consists of pinna, auditory canal and ear drum. **Pinna** helps to direct the sound waves into the **auditory canal**. Ceruminous glands are special glands which are found in the walls of the auditory canal which is the continuation of the pinna. The **wax** produced by these glands and the hairs in the auditory canal together protect the ear from small insects, germs and dust. In addition to this, they help to maintain the temperature and dampness of the auditory canal. The auditory canal ends in the **ear drum**, which is a thin membrane separating the external ear from the middle ear. This membrane capable of vibration is connected to the **ossicles** of the middle ear.



**The middle ear** is a chamber with air circulation. Observe figure and try to understand the shape and arrangement of the bones in the middle ear. You know that **stapes** (or stirrup) is the smallest bone of the human body found in this chain of bones which are movable. The oval window which separates the middle ear from the inner ear is connected to the stapes followed by incus (anvil) and malleus (hammer). The bones of the middle

ear are connected to each other by ligaments and are capable of vibrating in a peculiar way.

**The eustachian tube** connects the middle ear to pharynx. This tube helps to regulate the air pressure on both sides of the ear drum (tympanum).



**The inner ear:** The semicircular canals, vestibule, cochlea etc. are made of membranes. These are filled with a fluid called endolymph and are surrounded by another fluid called perilymph.

### How is hearing made possible?

Cochlea is the part of the inner ear which helps in hearing. There are three chambers of cochlea. They are located on the basilar membrane which separates the median canal and the lower tympanic canal. They are connected to the auditory nerve.

The upper chamber is connected with the oval window and lower chamber with the round window. Both these membranes are capable of vibration. We recognise the sound when the auditory nerve carries this stimulus to the brain.

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### The role of the ear in maintaining the balance of the body

The semicircular canals and vestibule together help to maintain the balance of the body. Observe the figure and examine how this is effected. The swollen end of the semicircular canal is called **ampulla**. **Cupula** containing sensory nerves found inside the ampulla can detect any movement of the head. The **semicircular canal** begins from the vestibule, goes around and rejoins in the vestibule. Small particles of calcium carbonate called otoliths are found near the hair cells of the ampullae and vestibule. The movement of the head in any direction can be detected by the receptor hair cells. The nerve fibres coming from these two types of receptors reach the cerebellum through the auditory nerve.

