Sense Organs

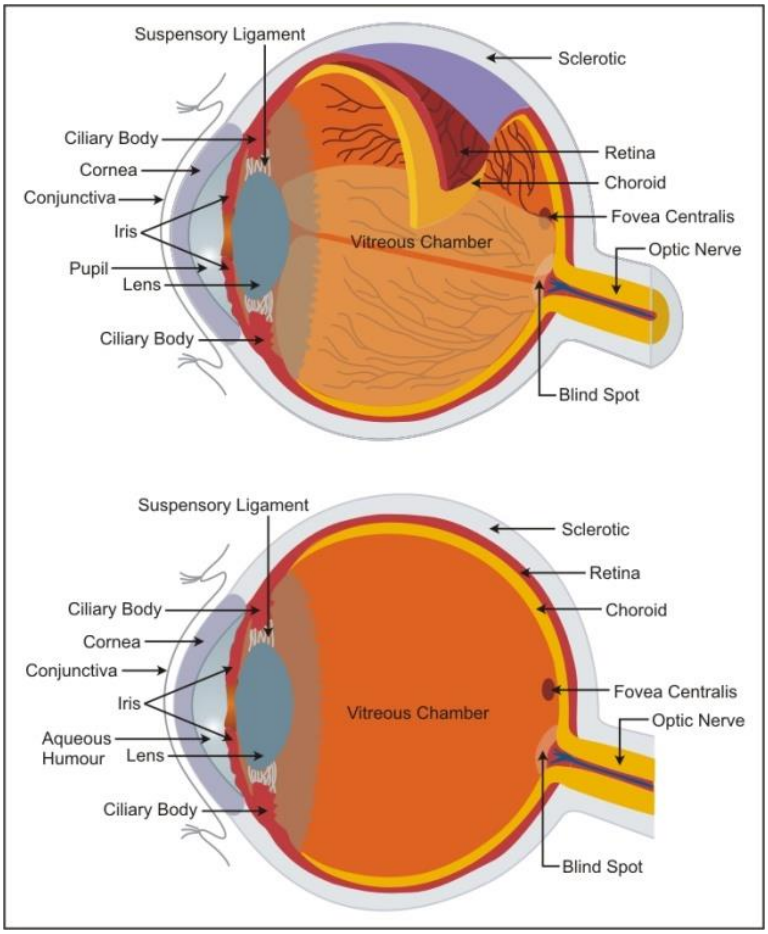
The **sense organs** enable us to be aware of the condition of the environment.
A **receptor** is any specialised tissue or cell sensitive to a specific stimulus.

Mechanoreceptors	Receptors of touch, i.e. pressure on the skin due to mechanical change.
Chemoreceptors	Receptors of taste of the tongue and smell of the nose due to chemical influence.
Photoreceptors	Receptors of light present in rods and cones of the retina of eyes.
Thermoreceptors	Heat and cold receptors in the skin due to change in temperature.

The Eyes

- The two eyes are located in deep sockets called orbits.
- The upper and lower moveable eyelids protect the front surface of the eyes.
- There are 6–12 tear glands.
- Functions of the tear glands are
  - Lubricate the surface of the eye
  - Wash away the dust particles
- A thin membrane which covers the entire front part of the eyes is called conjunctiva.
- Due to viral infection of the conjunctiva, we suffer from eye disease called **conjunctivitis**.

Structure of the Eyeball



The wall of the eyeball is composed of the folowing three concentric layers:

1. Sclerotic Layer (Outer Layer)
    - The white visible portion of the eyeball is nothing but the sclera.
    - The sclera covers the coloured part of the eye, i.e. the cornea.

2. Choroid Layer (Middle Layer)
    - Richly supplied with blood vessels to provide proper nourishment.
    - Choroid expands in the front to form a **ciliary body**.
    - Iris is also a part of the choroid.
    - The iris partially covers the lens. It leaves a circular opening in the centre called a **pupil**.
    - The muscles of the iris regulate the size of the pupil. Thus, the pupil regulates the amount of light entering the eye.

3. Retina (Inner Layer)
    - It has two types of sense cells—rods and cones.
    - The rod cells are sensitive to dim light and do not respond to colour.
    - The cone cells are sensitive to bright light and are responsible for colour vision.

Comparison between Rods and Cones

Rods	Cones
• More in number.	• Less in number.
• Located at the periphery of the retina.	• Located in the centre of the retina.
• Rapid generation of light-sensitive pigment **rhodopsin**.	• Slow generation of light-sensitive pigment **iodopsin**.

Yellow Spot and Blind Spot

Yellow Spot	Blind Spot
• Contains maximum number of sensory cells, particularly cones.	• It does not contain any sensory cells.
• This is the region of colour vision and the brightest vision.	• This is the region of no vision.

Lens

- It is transparent, biconvex and crystalline.
- It is held by a suspensory ligament which attaches the lens to the ciliary body.

Aqueous and Vitreous Chambers

The lens divides the inner cavity of the eye ball into two chambers:

Aqueous Chamber	Vitreous Chamber
• Front chamber between the lens and the cornea.	• Larger chamber behind the lens.
• Filled with clear, watery liquid called **aqueous humour.**	• Filled with transparent, jelly-like fluid called **vitreous humour**.
• It refracts light.	• It protects the retina and its nerve endings.

Four Major Steps in Seeing an Object

Light rays reflected from the object enter the eyes through transparent structures.

↓

First, the curvature of the cornea converges the rays to some extent, and then the lens converges them further.

The image on the retina is inverted and real.

↓

The light energy produces chemical changes in rods and cones which send the nerve impulse. This nerve impulse is sent to the cerebrum through the optic nerve. The cerebrum gives the sensation of sight.

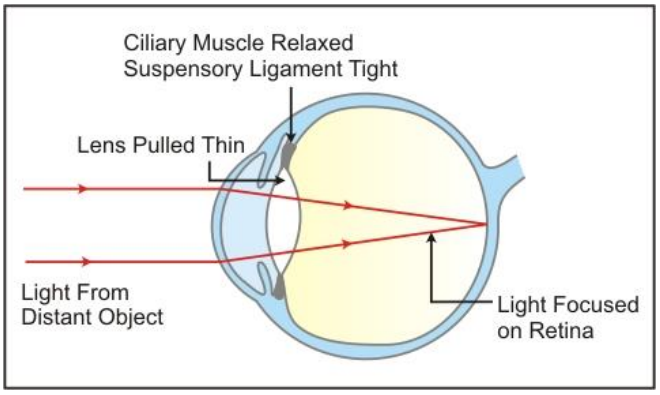
↓

The brain interprets the inverted image on the retina, and the obect is seen upright.

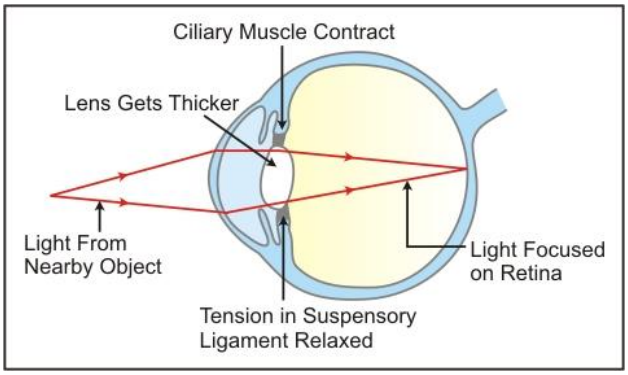
Accommodation Vision

The process of focusing the eyes at different distances is called **accommodation**.
This is brought about by change in the curvature of the lens.

- For distant vision, the lens is more flattened.
  The lens remains stretched by the suspensory ligaments.



- For near vision, the lens becomes convex and rounded.
  The ciliary muscles contract and pull the ciliary body forward. This releases the tension of suspensory ligaments, making the lens convex and rounded.



Light and Dark Adaptation

Dark Adaptation

When we pass from a brightly lit area to a dark area, we experience difficulty in seeing the objects for a short while. This is called **dark adaptation**

Light Adaptation

When we pass from a dark area to a brightly lit area, we experience a dazzling effect for a short period. This is called **light adaptation**.

Common Defects of the Eyes

	Defects of the Eyes	
1.	**Myopia (Short-sightedness)**	• Near objects are seen clearly, but distant objects appear blurred. • The lens is too curved. • Myopia is corrected by suitable concave lens
2.	**Hyperopia (Hypermetropia/long-sightedness)**	• Difficulty in seeing nearer objects. • The lens is too flat.
3.	**Astigmatism**	• Some parts of the object are seen in focus, while others appear blurred.
4.	**Presbyopia**	• Observed in older people. Near objects cannot be seen clearly.
5.	**Cataract**	• The lens turns opaque and the vision is reduced.
6.	**Colour blindness**	• Colour blind people cannot distinguish between certain colours such as red and green.
7.	**Night blindness**	• Difficulty in seeing in dim light. • Due to non-formation of rhodopsin in rod cells.
8.	**Squint**	• The eyes converge leading to cross eyes.
9.	**Corneal opacities**	• The cornea of patients gets scarred and turns opaque and non-functional • Can cause minor irritation, vision problems and even blindness.

Stereoscopic Vision

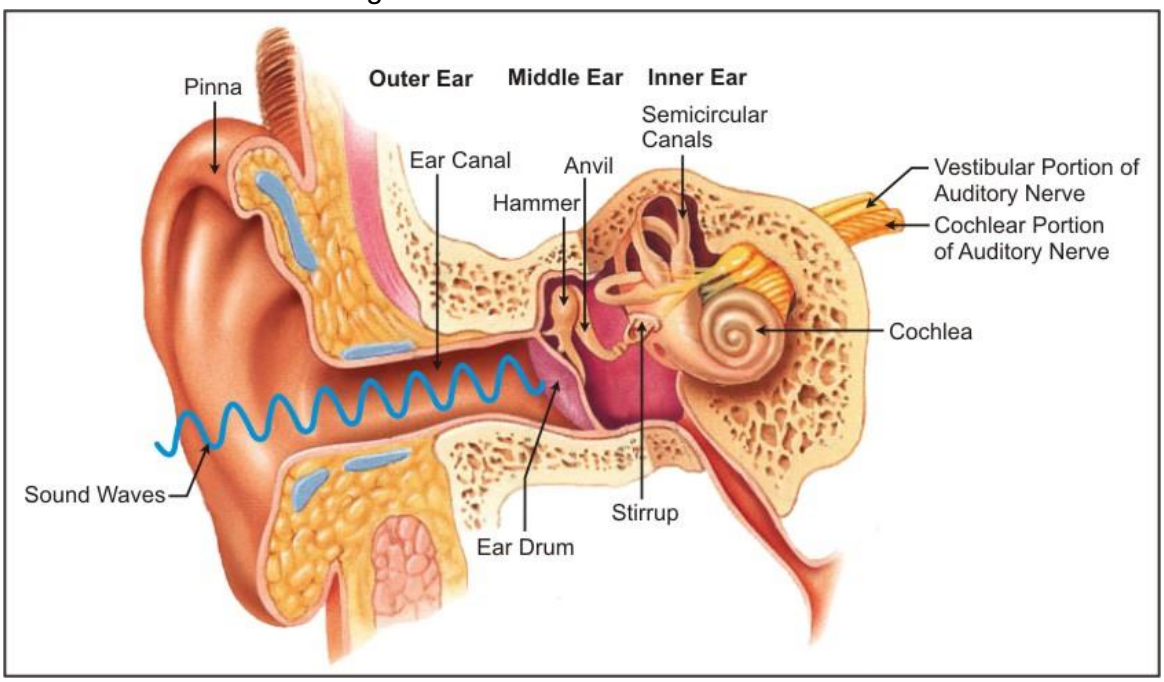
Humans, monkeys and apes can perceive depth or the relative distance of objects. This is due to simultaneous focusing of an object in both eyes. The images of both eyes are overlapping and give a 3-dimensional effect.

After-images

When one looks at a brightly coloured object and then looks at a dark surface, an image of the object in the same colour will persist. This is known as **persistence image** or **after-image**.

The Ear

The human ear has the three following main divisions:



1. Outer Ear
    - Consists of pinna/auricle and auditory canal.
2. Middle Ear
    - Contains three ear ossicles—malleus (hammer), incus (anvil) and stapes (stirrup)—and the eustachian tube.
    - The eustachian tube connects the cavity of the middle ear with the throat.

3. Inner Ear
    - Also known as **membranous labyrinth**.
    - Contains cochlea and the semicircular canals.
    - The cavity of cochlea is divided into three parallel canals. The middle canal consists of the **organ of corti** which is responsible for hearing.
    - Ends of the semicircular canals widen to form an **ampulla**.
    - The ampulla contains sensory cells.
    - The short stem joining the bases of semicircular canals to the cochlea is called the **vestibule**.
    - The vestibule contains two sacs—utriculus and sacculus.

Functions of the Ear

Two functions of the ears are **hearing** and **body balance**.

1. Hearing

The pinna collects sound waves and conducts them through the external auditory canal. They finally strike on the ear drum and the vibration is set.

Eustachian Tube	• Equalises the air pressure on either side of the ear drum.
Ear Drum	• Sets the three ear ossicles into vibration.
Vibration of Stapes	• Transmits vibration to the membrane of the oval window.
Oval Window	• Sets the fluid in the cochlear canal into vibration.
Cochlea	• Sensory cells of cochlea transmit impulses to the auditory nerve.

2. Body Balance

- The sensory cells in the semicircular canals are concerned with dynamic equilibrium, i.e. when the body is in motion.
- The sensory cells in utriculus and sacculus are concerned with static equilibrium, i.e. when the body is stationary.

Hearing Impairment