SENSE ORGANS

A sense organ is a group of specialized cells or tissues or receptors which are able to receive/collect/perceive/direct stimulus and transmit the information/impulse/message to the central nervous system. While a sensory cell or sensory receptor is defined as a specialized cell which receive particular stimulus which they convert to impulse and transmit same to the brain or spinal cord or cells. Structures containing sensory receptors are of 3 types.

1. Free dendrites endings or nerve endings/primary sense cells E.g. touch receptors.

2. Higher animals have Secondary sense cells (synapse with sensory neurons e.g. taste receptors.
3. Sense organs e.g. skin, ears, eyes e.tc.

Need for sense organs

complex nature of existence e.g. activities of searching for food, escaping from enemies and attracting mates are very complex and hazardous and the environment where the live is also constantly changing, so there is need for sense organs which are specialized in one or a few of these stimuli-temperature, light, sound, gravity, chemicals.

Skin as a sense organ

There are five sense receptors in the skin. They are touch, pressure, pains, heat and cold. Their sensory nerve endings are unevenly distributed in the skin.

Touch

E.g. Pricking of skin with a needle. Sense of touch is greatly developed in the finger tips of blind people which help them to identify objects and for reading Braille.

Temperature

-Two temperature receptors in the skin- heat and cold receptors. Heat receptors detect heat while cold receptors detect cold. They make us aware of temperature changes especially detecting hot and cold food.

Pain

-When stimulated give rise to the sensation of pain.

Pressure

-Located deep inside the skin. They respond to very heavy touch. Due to its location pressure stimulus must be stronger than touch stimulus.

ORGAN OF SIGHT

The eye is hollow and spherical. It is situated in the cavity of the skull called **sockets**. It is attached to the socket by two **oblique muscles** and **four erectus muscles**. These muscles help to hold the eyes firmly to the socket and enable it to rotate freely without moving the head.

In front there are upper and lower eyelids. They are muscular and protect the eye from external dangers. On the eyelids, there are rows of hair called the **eye lashes**. These protect the eyeball from dust.

Inside, in the upper eyelid is the **tear gland or lachrymal gland**. It secretes a saline fluid called **tears**. Tear moistens the conjunctiva as well as washes away the dust particles and destroys bacteria. In front of the eyeball is a tough transparent skin, the conjunctiva.

The eyeball is divided into three layers.

1. Sclerotic
2. Choroid

3. Retina

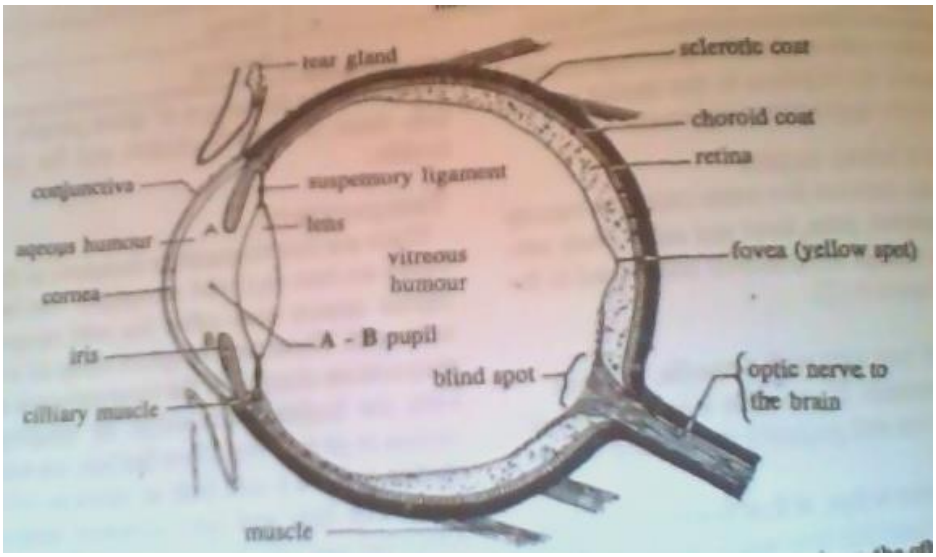


Diagram of the organ of sight/eye

1. **Sclerotic layer**- Outer layer of the eye maintain the spherical shape and internal structure of the eye. It is the white part of the eye. It bulges in front to form a convex transparent tissue called **cornea** which allows light into the eye and bends the light rays to bring them to focus on the innermost layer of the eye. At the back the sclera is perforated by the optic nerve. The conjunctiva lines the eyelids and covers the cornea protectively.
2. **Choroid-** Middle layer of the eye. It is coloured and richly supplied with blood capillaries. It supplies nourishment and oxygen to the cells of the eye. It also contains melanin which absorbs light within rays and prevents reflection of light within the eye. The choroid forms the **iris** which is muscular extension of the layer in front. An opening through the iris is called **pupil**. It allows light rays into the eyes. The iris controls the amount of light that enters through the pupils. It is made up of circular and radial muscles. In bright light the circular muscle contracts and radial muscle relax. This reduces the size of the pupil and so reduces the amount of light that enters the eye. In dim light, circular muscles relax, radial muscles contract as a result the pupil is widened and the eye can take in more.
3. **Retina**- It is the inner layer of the eyeball. It is pigmented elastic, vascularised and light sensitive. It is made up of light receptive cells called **rods** and **cones**. The rods contain sensitive pigment called **visual purple-Rhodopsin** made up of vitamin A and protein. Rods are more than the cones. They are sensitive to light intensity but cannot sense colour. They are used in dim light or low light intensity (night vision) . Cones are sensitive to colour and vision at high intensity. They have a photochemical substance called **Iodopsin**. The most sensitive part of retina is called **yellow spot or fovea centralis**. It contains a high concentration of cones and gives the most accurate interpretation of an image. Below the yellow spot is the blind spot which does not contain any rod or cone or photoreceptors. It is incapable of receiving light intensity.

Nerve fibres emerge to form the optic nerve at this spot and goes to the brain. The lense is a biconvex elastic transparent structure located behind the choroid by **suspensory ligament**. Its shape is capable of changing when muscles relax or contract.
Ciliary muscle- The ciliary body, pulls on the lense and varying its tension makes the lens thinner or thicker from back to front. This alters its focal length and results in proper accommodation.
Aquaeous and vitreous humours-They are solutions of salts, sugars and proteins in water. They help to refract light rays and produce image on the retina. These liquid also aid in keeping the eyeball firm thus preventing its collapse.

Functions of the eye

1. Image formation
2. Accomodation

Image formation

Light rays from an external object before reaching the retina is refracted four times by the cornea, the aquaeous humour, the lense and the vitreous humour. The greatest refraction takes place at the cornea and the least through the humours. The lens acts as fine adjustment bringing the rays to focus on the retina where an inverted image smaller than the object, is formed. The light sensitive cells in the retina are then stimulated and the nervous impulses generated are transmitted via the optic nerve fibres to the brain; it then interpretes the impulses so that the object appears to be in an upright position.

Accomodation

To give a clear image of both near and distant objects on the retina, the focal length of the lens is altered.

To focus a distant object

The ciliary muscle relaxes.
-The suspensory ligament exerts a pull on the lens causing it to flatten and become thinner.
-The focal length is longer and clear image of distant object is received by the retina.

To focus a near object

-They ciliary muscle contracts pulling the margin of the choroid nearer the lens and reducing the strain on the lens.
-The suspensory ligaments are slack and lens become thickened or more convex.
-The focal length is shortened and a sharp image of near object is placed on the retina.

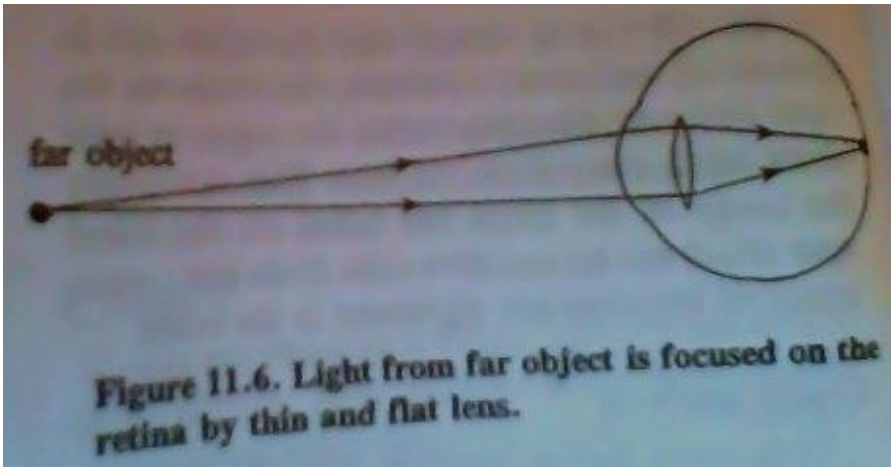
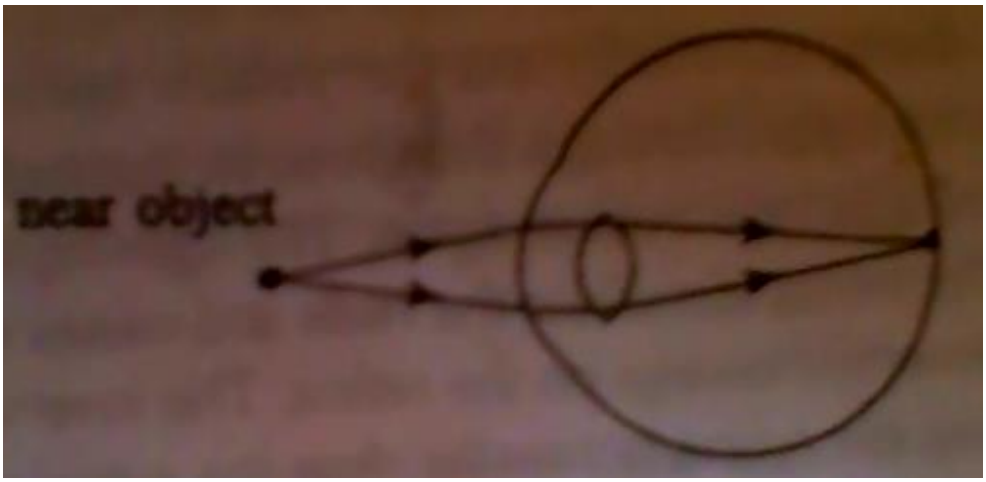


Figure 11.6. Light from far object is focused on the retina by thin and flat lens.



Near object-light from near object is focused by thick and fat lens

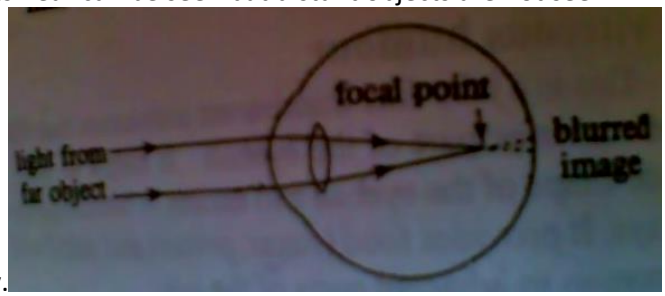
Eye defects

Shortsightedness (myopia)

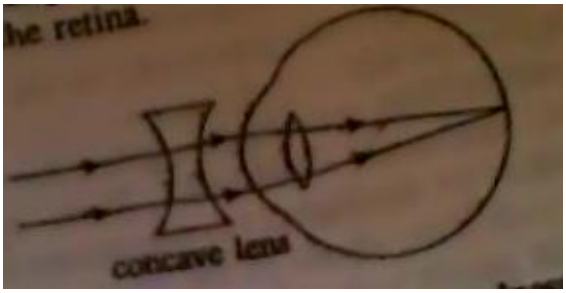
The eyeball is too long or cornea too curved.

-Parallel rays of light from a distant object are brought to focus by cornea and lens at a point in front of the retina.

Objects near can be seen but distant objects are not seen clearly.



shortsightedness

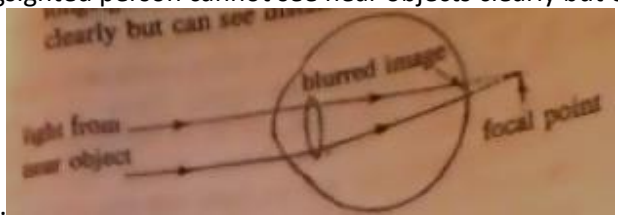


Correction of shortsightedness

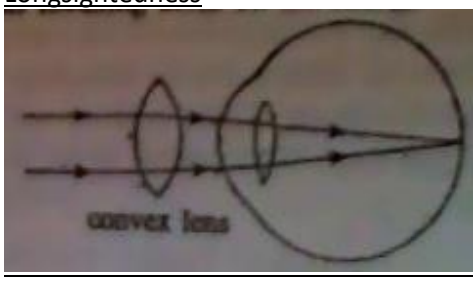
shortsightedness

Longsightedness (hypermetropia)

-The eyeball is too short or cornea is not sufficiently curved.
Parallel light from a near object are brought to focus at a point behind the retina.
-A longsighted person cannot see near objects clearly but can see distant objects clearly.



Longsightedness



Correction of longsightedness

`- Caused when the power of lense to accommodate becomes reduced due to less elasticity of ciliary muscle.

Correction

-Wearing bifocal glasses with one part for distant vision and the other part for near vision.
Astigmatim:-Caused by uneven curvature of the cornea/ lens or both. The person is unable to focus objects horizontally and vertically.

Cataract- This condition occurs only in old people. The lens becomes cloudy and sufficient light cannot pass through it so that the affected person cannot see clearly. It can be corrected by removing the affected lens and either replacing it with a plastic lens or providing spectacles with suitable lens.
Night blindness- People with night blindness cannot see clearly in dim light. It may be due to a deficiency of vitamin A the substance used to make rhodopsin.
Xerophtalmia-This is an eye disease caused by vitamin A deficiency. It can lead to blindness.
Conjuctivitis- This is an inflammation of the conjunctiva. It may be caused by irritants such as wind and glare or bacteria (a very contagious infection).

Organ of taste (tongue)

The sensory cells of taste are called the **taste buds**. They are mainly located on the upper surface of the tongue and few in the mucous membrane of the mouth cavity and pharynx. Four kinds of taste buds are sour, sweet, salt and bitter.
The taste buds are evenly distributed over the surface of the tongue.

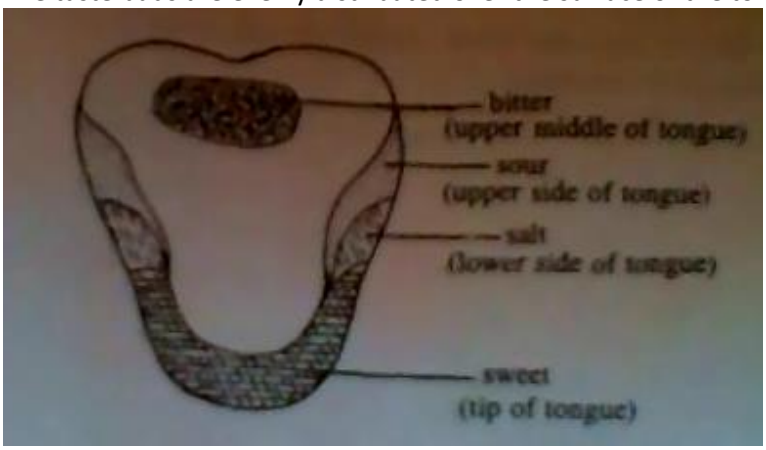
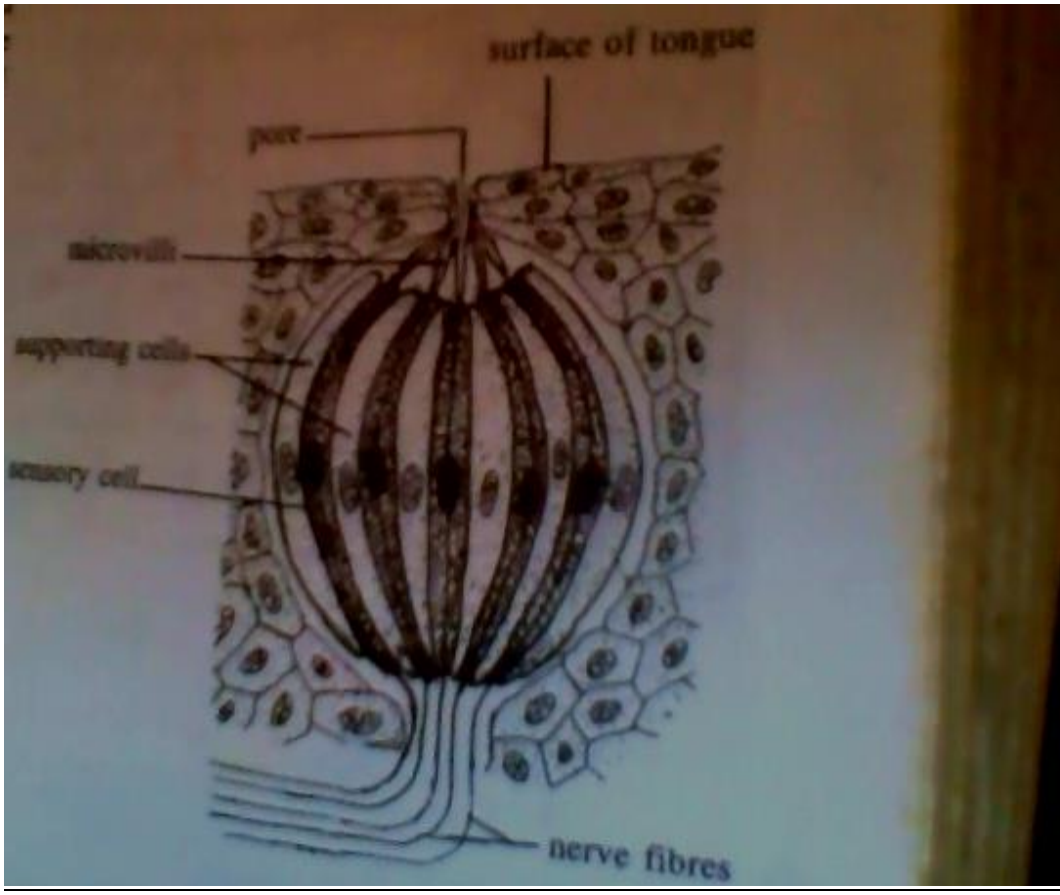


Diagram of organ of taste(tongue)

Process of taste



Diagram

The substance to be tasted dissolves in the solution in the tongue usually saliva. The molecules of the substance stimulate the sensory nerve endings which then pass impulses to the brain for interpretation.

Organ of smell(nose)

Inside the nasal cavity are covered with a moist membrane and well supplied with blood vessels. The upper portions of the nasal chamber contain many sensory nerve cells. The sensory nerve endings join together to form the olfactory lobe of the brain.

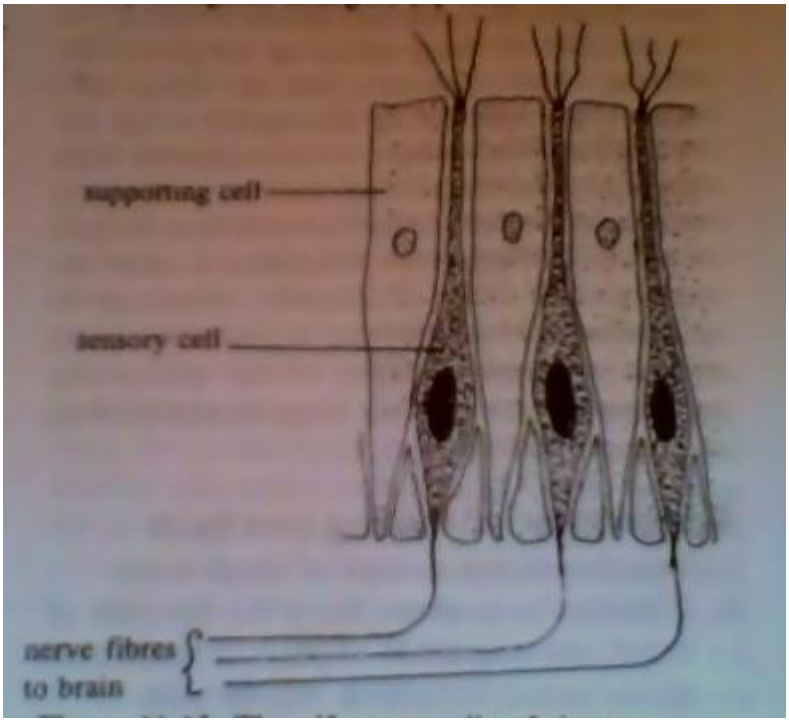


Diagram of organ of smell

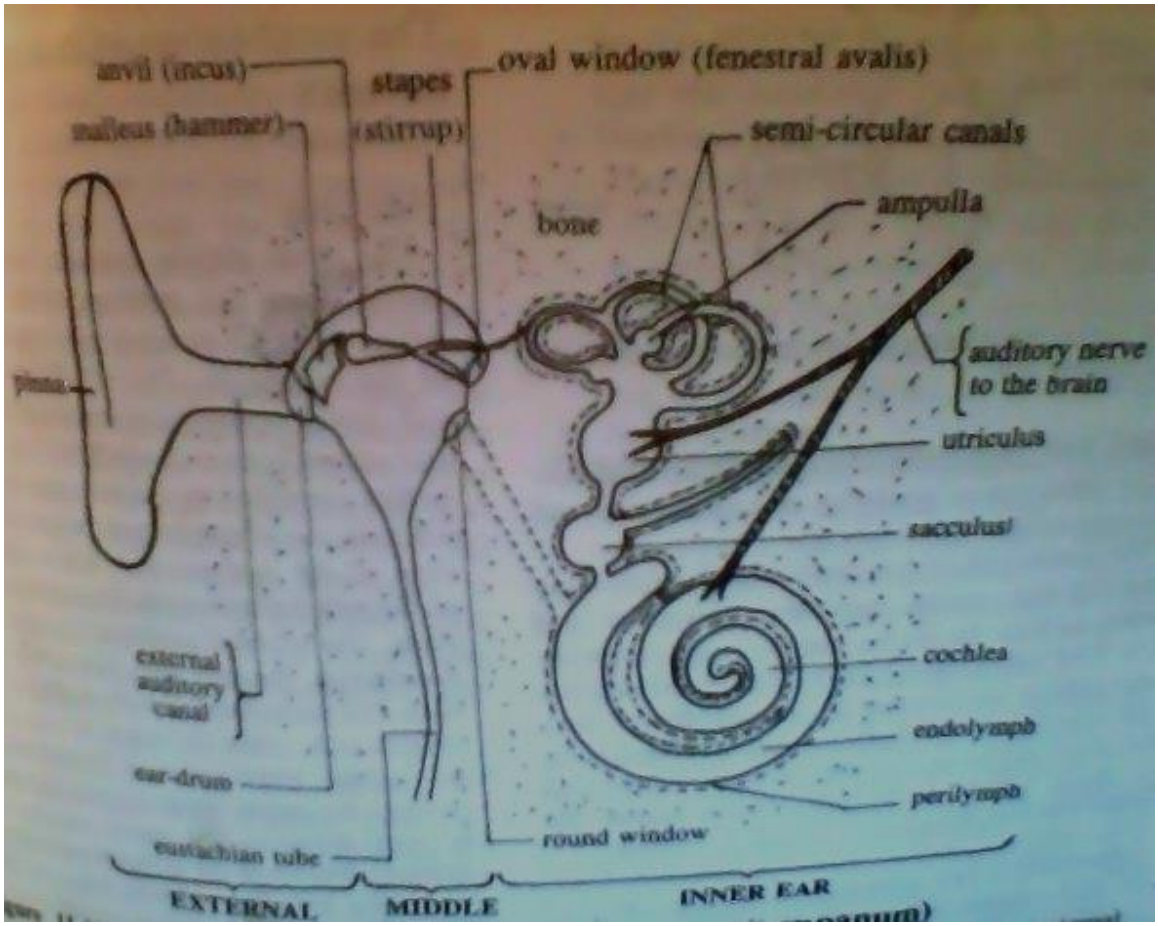
Process of smell

Chemical substances carried in the air pass through the nostrils and their molecules dissolve in the moist membrane and stimulate the sensory nerve endings which end in the olfactory nerves. The olfactory nerve carries this impulse so generated to the olfactory lobe of the cerebrum of the brain. Then the brain interpretes the impulse and a sensation of smell is produced.

The organ of hearing(the ear)

The ear consist of three parts

1. External ear (outer ear)
2. Middle ear (tympanum)
3. Inner ear (labyrinth)



Structure of the human ear

The external ear (outer ear)

-Made up of two parts, Pinna and auditory canal.

Pinna- Collects sound waves and directs them into the auditory canal.

-It also protects the external structures of the ear.

Auditory canal- Extends inwards in an oblique direction, so as to prevent hard objects from hitting the eardrum (tympanic membrane). Lined with hairs and contains glands that produce wax. It connects the external ear and the middle ear.

The middle ear (tympanum)

Consists of the eardrum and a chain of three **small bones** or **ossicles** called **malleus** (hammer), **incus** (anvil), and **stapes** (stirrup) all articulating together.

The cavity of the middle ear is connected to the pharynx (throat) by the **Eustachian tube** through which the pressure inside the middle ear is equalized with that of the atmosphere.

The inner ear

-Consists of **semicircular canals, utriculus, sacculus** and a spirally coiled canal called the **cochlea**. All these constitute the **membranous labyrinth** which is surrounded by a fluid called **perilymph** and **bony labyrinth.** Inside the membranous labyrinth is filled with another fluid called **endolymph**. At the base of the semicircular canals are swellings known as **ampullae** concerned mainly with balancing.

Functions of the ear

1. Hearing
2. Balancing

Mechanism of hearing

-Sound waves are collected by the pinna.
-They pass along the auditory canal/ meatus.
-The sound waves strike the eardrum/ tympanic membrane which vibrates as a result.
-The vibrations are sent along three ossicles, malleus, incus, stapes.
-The vibration of the ossicles is transmitted to the inner ear
-Through the oval window
-Which sets the liquid perilymph vibrating.
-The vibrated perilymph in turn excites the endolymph and thus stimulates the sensory cells (organ of corti) present in cochlea
-Impulses are set up by hair cells in the cochlea and transmitted through auditory nerve to the brain for interpretation/ resulting in hearing.

Balance and position

-The semi-circular canals, utriculus and sacculus are **the organs of balance and position** and contain endolymph fluid.
-The semicircular canals contain small granules called **otoliths (ear stones)**
-These otoliths rest on sensory hairs which are in abundance in the ampullae, utriculus and sacculus.
-When the head moves or changes position the endolymph fluid moves or changes position, the endolymph fluid moves in the canals and stimulates the nerve endings.
The movement of the otoliths also stimulates the sensory hairs.
The nerve endings then transmits the impulses through the **vestibula** (a branch of the auditory nerve) to the cerebellum of the brain, where the new position of the head is interpreted and the appriopriate responses sent to the muscular system to maintain the body balance.
The auditory nerve transmits two kinds of stimuli to the **acoustic (sound)** and **vestibula (balance and position)** nerve fibres respectively.
Spinning round in one direction for a long time causes the endolymph in the semicircular canals to pick up speed. On stopping suddenly the fluid continues to flow round.
This stimulates the sensory cells in the ampulla of semi-circular canals causing the ground to appear to spin round /motionless, thus giving a feeling of dizziness.

Advantages of having two ears

- It increases the range of sound waves.
- It enables us to detect faster the direction of sound, the magnitude of sound since the ear nearer the source will be more stimulated.

Disease of the ear

The diseases of the ear are mainly defects of the middle ear and inner ear. These defects lead to deafness which could be partial or permanent.

Types of deafness

-Conduction deafness- inability of the ear-ossicles (earbones) to conduct sound vibrations to the inner ear.
-**Nerve deafness:-** Is the inability of the auditory nerve to transmit sound vibrations from the ear ossicles to the auditory part of the brain.

Causes of deafness

1. **Wax in the ears**:- When large quantities of wax are produced by the wax glands. Partial deafness may result due to complete blockage of the canals. This can be corrected by seeing an experienced ear nose and throat doctor.
2. **Deafness due to otosclerosis:**- This deafness is due to replacement of the oval window by a spongy bone, thereby blocking the movement of the stapes. This disturbs the transmission of vibrations from the ear ossicles to the inner ear.
3. **Noise deafness**:- A loud noise such as explosion, high disco noise and gun shots may damage the eardrum and cochlea and may cause noise deafness.
4. **Deafness from arteriosclerosis:**- This type of deafness is due to old age. It is caused by the hardening of the arteries. The patient is unable to hear the ringing of a telephone and door bell. Hearing aid may also help.
5. **Deafness due to viral and bacterial infections**:- Diseases such as measles, polio, influenza, Diphteria and meningitis cause deafness. Prevention is by vaccination against such diseases.
6. **Deafness from syphilis**:- A mother who is infected with syphilis may pass the infection to her baby. The syphilis may affect the auditory nerve and cause deafness.
7. **Deafness from injuries** e.g. bad fall, hitting the head with stick or traffic accident may cause the fracture of the skull and affect the hearing organs due to internal bleeding and pressure.

Care of the ear

1. Sharp objects should not be used to clean the ear as they may damage the eardrum.
2. Regular washing and cleaning of the ears are necessary to avoid accumulation of wax dirts and growth of microorganisms which may cause diseases to the ear.
3. Chest colds, fever, discharge from the ear and head ailments should be reported to medical doctor for treatment.
4. Avoid places where there are loud noises or wear ear plugs.
5. Immunise children against deadly diseases e.g. polio, measles.
6. Avoid listening to radio by using ear phones.
7. Do not introduce any hot liquid into your ear as this may destroy the hearing organ.
8. See an ear specialist for any ear problem. Ear cleaning should be carried out at least twice a year by a medical doctor.