1.2. sense organs

- **sensory organ** an organ that receives and relays information about the body's senses to the brain.

- In the human body there are many different types of sensory receptors that respond to different stimuli. Some of the most important include:

Receptor	Energy
Eye (retina, provides vision)	Light
Ear (cochlea, organ of hearing)	Sound
Ear (semi-circular canals, organ of balance)	Movement (kinetic)
Tongue (taste buds, enable us to taste)	Chemical
Nose (olfactory organ or organ of smell)	Chemical
Skin (touch, pressure and pain)	Movement (kinetic)
Skin (temperature receptors)	Heat
Muscles (stretch receptors)	Movement (kinetic)
Arteries and brain (chemoreceptors responding to pH and carbon dioxide levels)	Chemical

1. The human eye

- The eye is a spherical shaped ,which provide to see in clear focus, in three dimensions and in colour
- They are set in eye sockets in the skull that protect them. eye.pptx

Human eye is protected by:

- Eyelids: to protect from the entry of material like dust, sand and insects, which might injure or irritate them.
- Eyelashes: trap particles and keep them out of the eye
- Conjunctiva: a thin transparent membrane on the surface of the eye.eye.pptx

❑ Parts of the eye and their functions

- **Eye ball is composed of 3 separate layers**

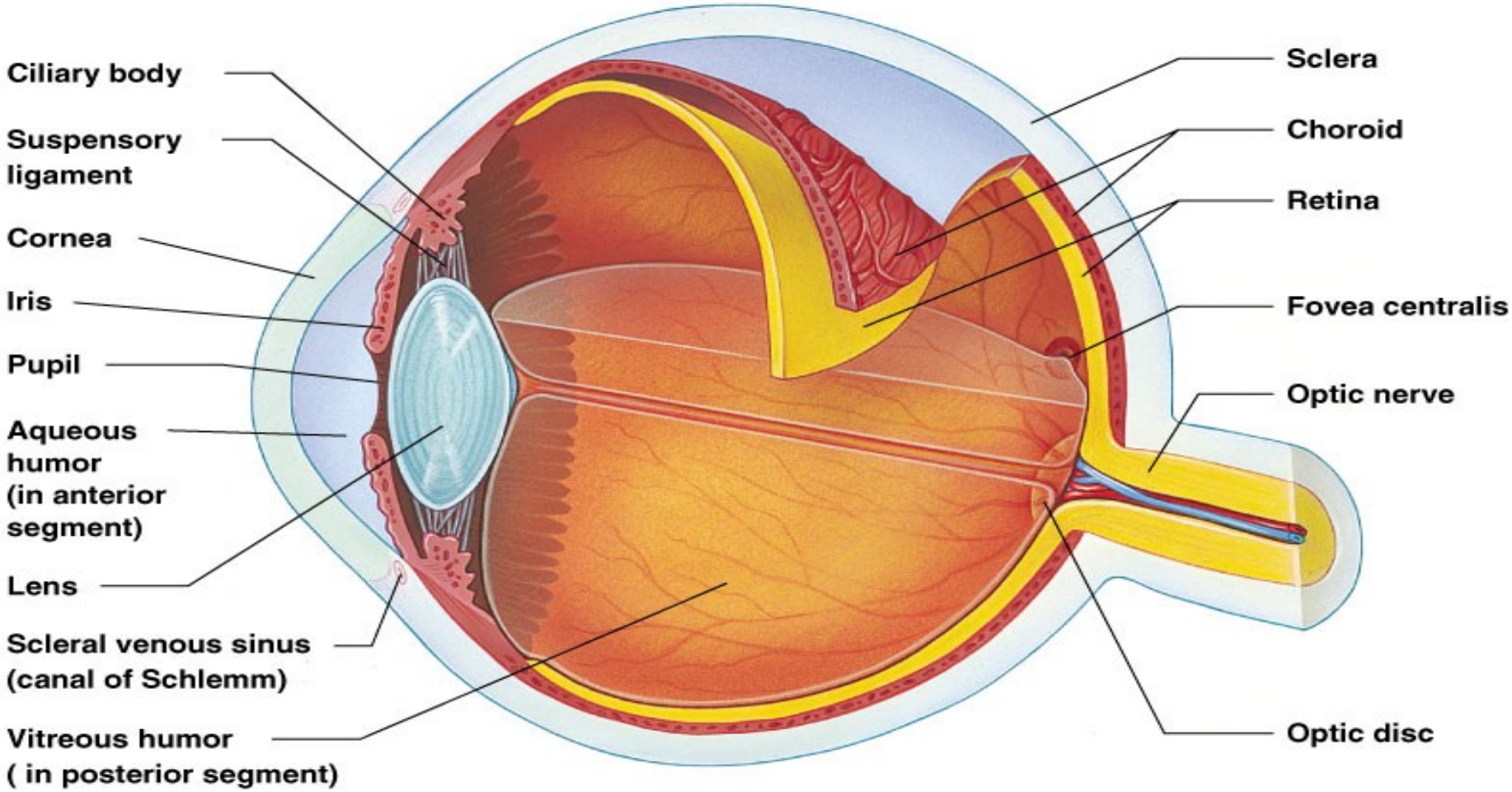
i. The sclera(the white outer layer):

- ✓ is very tough and strong so the eyeball is not easy to damage.eye.pptx
- ✓ It has a transparent area at the front known as the cornea, which lets light into the eye.
- ✓ The curved surface of the cornea is also very important for bending the light coming into the eye.

- ✓ The rest of the sclera has many blood vessels, which supply the retina with food and oxygen, and a dark layer underneath.

II. The choroid (middle layer of eye).

- ✓ This layer is dark because it contains pigmented cells that absorb light and stop it being reflected around inside of the eye.
- ❖ **Aqueous humor:** is a fluid that fills the anterior chamber of the eyeball
- ✓ Provides nutrients for the lens and cornea
- ❖ **Vitreous humor**: is a jelly-like fluid fills posterior that helps to hold shape eyeball.


Ciliary body
Suspensory ligament
Cornea
Iris
Pupil
Aqueous humor (in anterior segment)
Lens
Scleral venous sinus (canal of Schlemm)
Vitreous humor (in posterior segment)
Sclera
Choroid
Retina
Fovea centralis
Optic nerve
Optic disc

(a)

- Once the light has travelled through the cornea it has to pass through the **pupil** in the centre of the **iris.**
- **Iris**: the coloured part of the eye
- It is made up of muscles that control the size of the pupil and so to control the amount of light reaching the retina.
- The circular muscles run around the iris, while the radial muscles run across it

circular muscles contract





radial muscles contract





When the light is relatively dim:

- ✓ The radial muscles contract
- ✓ The circular muscles relax and
- ✓ The pupil is pulled open wide (it dilates).

In bright light

- ✓ The circular muscles of the iris contract
- ✓ The radial muscles relax
- ✓ The pupil very small (it constricts).

- ✓ The change in the size of the pupil in response to light is a reflex.
- ✓ Once light has entered the inner eye through the pupil it passes through the lens.
- ✓ Lens a flexible disc that helps focus light on the retina.
- ✓ It is held and attached to the ciliary muscle of the eyeball by suspensory ligaments.
  - ❖ **Suspensory ligaments:** elastic-like structures that suspend the lens and pull it into shape for focusing distant objects onto the retina.

- **Ciliary muscles** eye muscles that automatically contract or relax the shape of the lens of the eye to help focus light on the retina.

III. Retina(the Inner layer):

- **Retina**: a light-sensitive tissue lining the inner surface of the eye
- ✓ The light sensitive cells that make up the retina are **cones** and **rods** cells.
- ✓ **Rods** cells in the retina that perceive light and movement and work well in dim light.

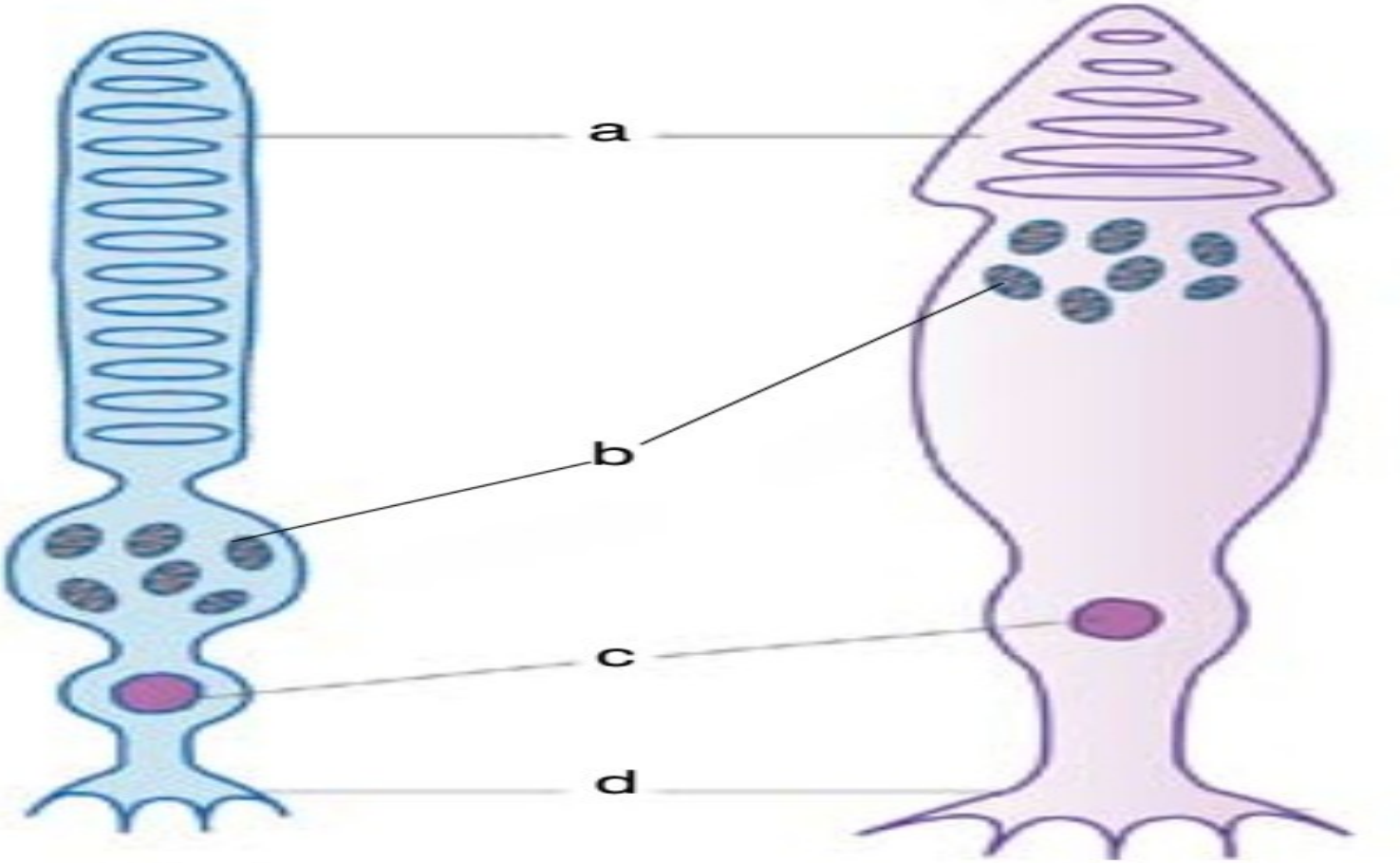
- ✓ Do not give a very clear image and they do not respond to different colours.
- ✓ Rods are spread across the retina except over the fovea

Fovea: parts of retina where the cone cells are concentrated

Cones cells in the retina that perceive light and movement and only work in bright light.

There are fewer conesthan rods

a light-sensitive pigments
b mitochondria to supply energy
c nucleus
d dentrites synapse with optic nerve



The colours of image formed is depend on which combination of cones is stimulated
Each cone responds to red, green or blue light

Some people cannot see all the colours because they are missing one or more type of cones .this is known as colour blindness.

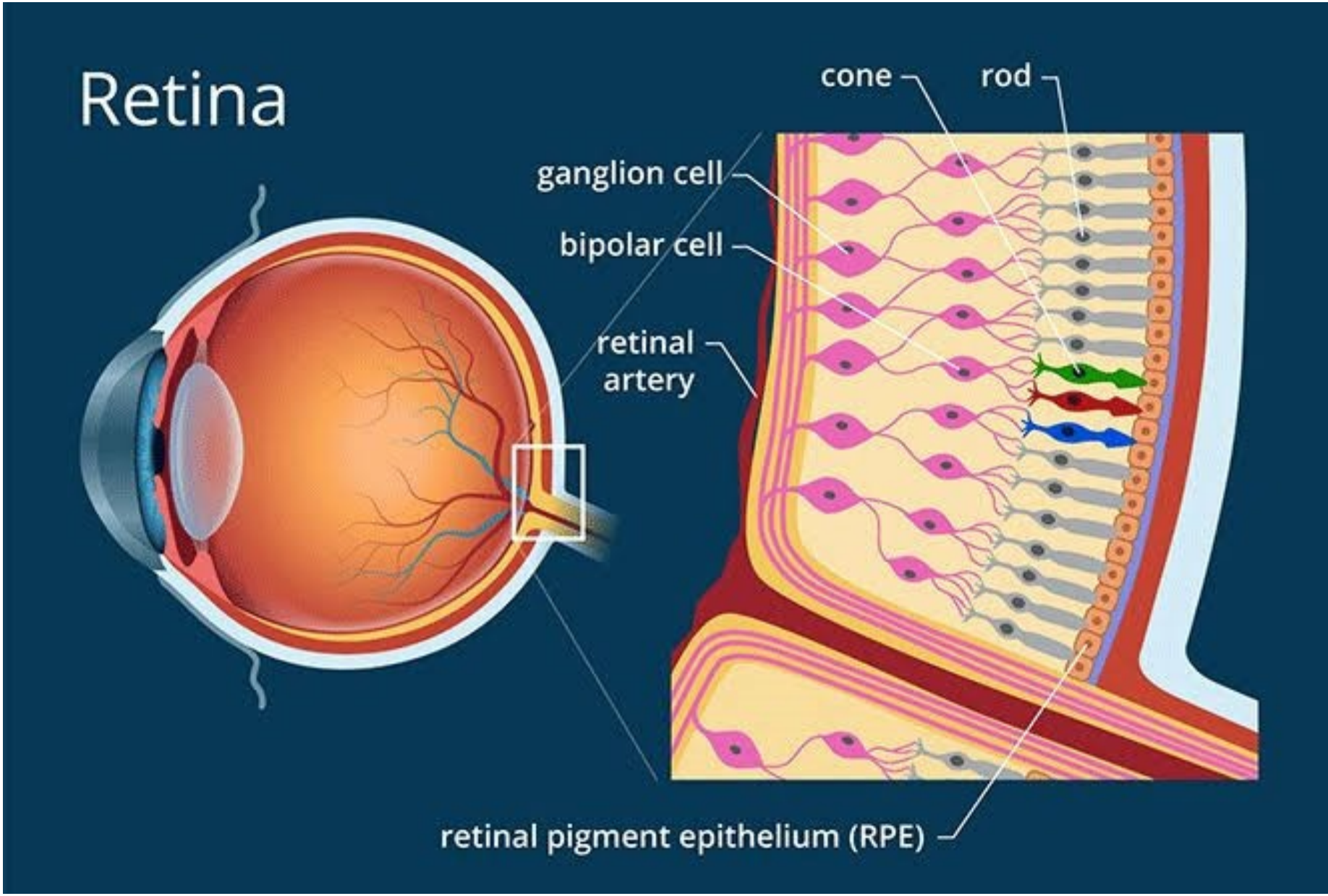
- At the point where the optic nerve leaves the eye there is no retina .this point is called blind spot

❖ How the retina works?

- ✓ The light energy that falls on the retina is changed into electrical energy by the light-sensitive cells.

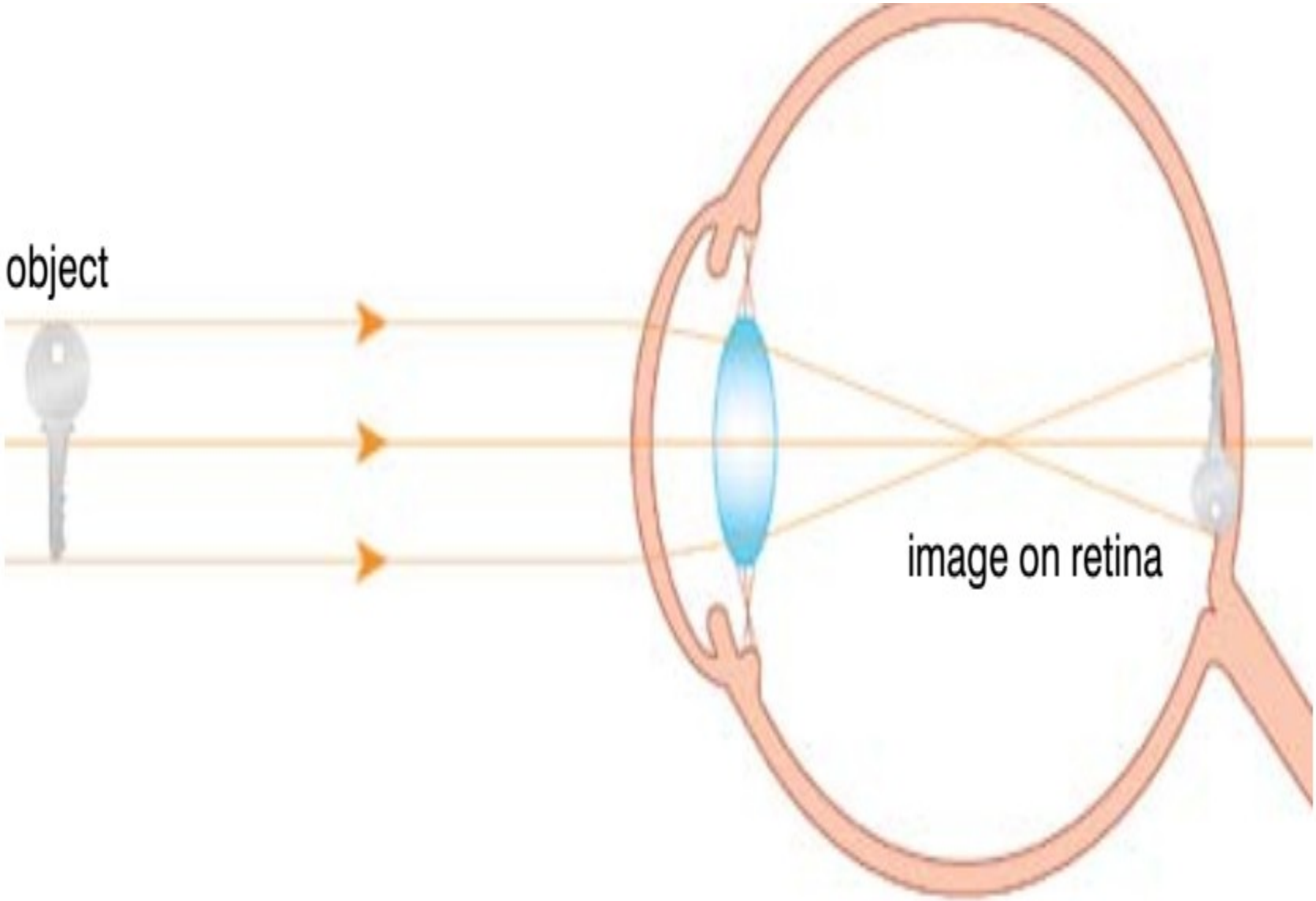
- ✓ Rods and cones contain chemicals that change when light falls on them. This change triggers an impulse in the affector neurons that make up the optic nerve.

- ✓ The impulses travel along the optic nerve to the visual areas of the brain.


Retina
cone
rod
ganglion cell
bipolar cell
retinal artery
retinal pigment epithelium (RPE)

- **Focusing the light**

- Light rays are refracted when they pass from one medium to another e.g. from air to water
- In the eye, the light coming in is bent (refracted) twice –As a result of this refraction the image is focused onto the retina is inverted and real.
- This corrected by vision center in the brain called optic lobe.
- The lens of the eye helps to focus both near and distant object equally through contraction and relaxation of ciliary muscles. This is known as accommodation


object
image on retina

◊ **Accommodation :**ability of the eye to see near and distant object

✓ **Focusing on nearby object**

- lens more rounded
- ciliary muscles contract
- Suspensory ligaments pulled tight-

Focusing on distant object:

- Lens is stretched (less convex)-
- ciliary muscles relax
- suspensory ligaments slack

❖ **Common eye defects.**

- ✓ There are a number of common eye defects that can and do affect many people of all ages
- ✓ There are a number of ways in which these problems can be treated – but they all involve the use of extra lenses to bend the light.

I. Short sight

- A short-sighted person can focus clearly on things that are close to them but has much more difficulty with objects in the distance, which appear blurred.
- This may be as a result of a lens that is effectively ‘too strong or eyeball too long
- Image focused in front of retina
- It can be corrected using concave (diverging) lenses that spread the light out more before it gets into the eye.

II. Long sight

- A long-sighted person can focus clearly on things that are at a distance but has much more difficulty with objects close to them, which appear blurred
- This may be as a result of a lens that is effectively ‘too weak’ it is too flat or eyeball too short
- It can be corrected using convex (converging) lenses that bring the light rays together more before they reach the eye and bring the rays of light into perfect focus on the retina.

III. Astigmatism:

- ✓ is a condition when the shape of the eye is irregular – more egg-shaped than round
- ✓ So the cornea is curved asymmetrically and this affect the way light is focused on the retina.
- ✓ The blurred image is focused at the different point on the retina.
- ✓ It can be corrected by the use of eyeglasses with cylindrical and equally curved.

2. The ear as a sense organ.

- ✓ The ear is an organ for hearing it also concerned with balance and position of the body
- ✓ The ear is divided into three regions: the **outer ear**, **middle ear** and **inner ear**

i. The outer ear

Consists of:

- ✓ **Pinna:** is flap like structure helps to trap and funnel sound into the ear.
- ✓ **Earcanal**: is a tube that carries the sound from pinna in wards & it is about 2 cm long.

- At the entrance of the ear canal are a number of small hairs. These filter out dust particles from the air entering the ear canal.

- The cells lining the ear canal produce waxy material which traps dust and germs, and lubricates the eardrum.

- **Eardrum or tympanum**: is a sheet of very thin membrane at the end of the ear canal that vibrates the incoming sound.

II. The middle ear

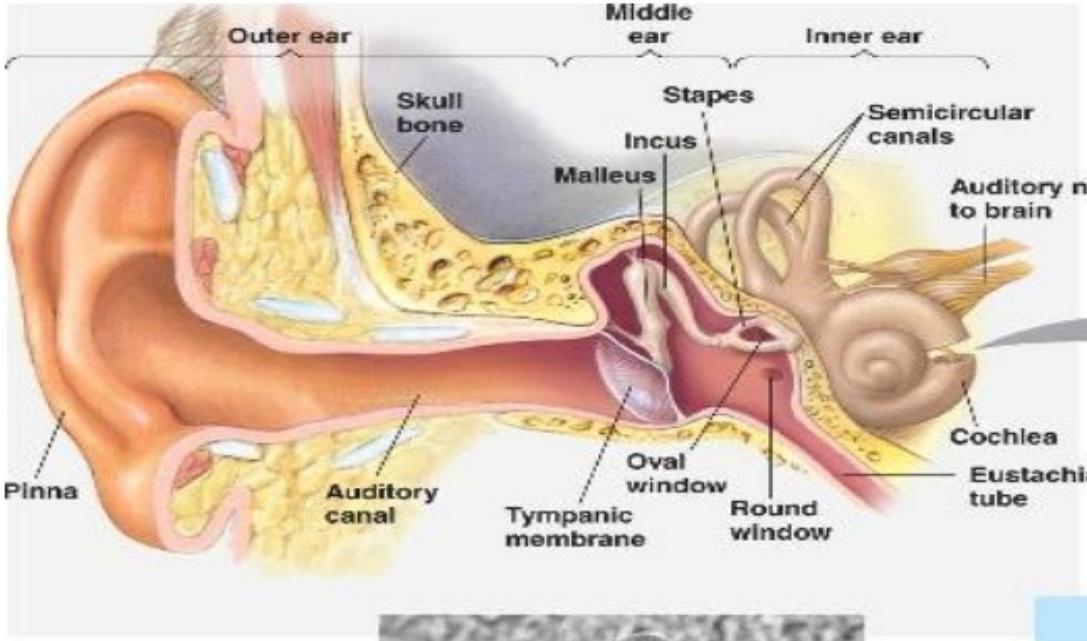
- ✓ The cavity contains three tiny bones called the **malleus** (**hammer**), the **incus** (**anvil**) and the **stapes**(**stirrup**) because of their shape – are the smallest bones in the body.
- ✓ They form joints with one another, with the malleus attached to the eardrum and the stapes to the oval window.
- ✓ The cavity of the middle ear is connected to the throat by a tube called the **Eustachian tube**. This is usually closed but when the pressure in the middle ear increases – while flying.

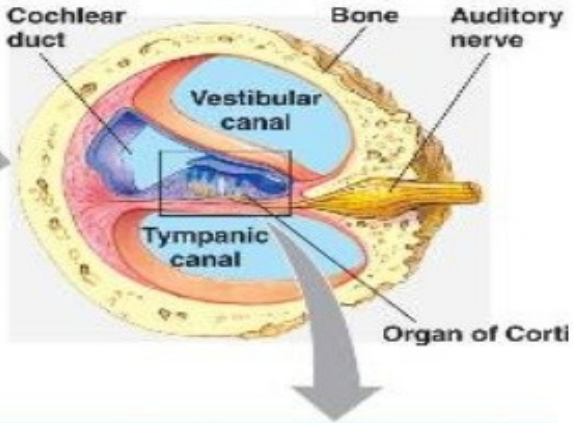
For example – the tube opens until the air pressure in the middle ear is equal to that in the throat and therefore to the atmosphere.

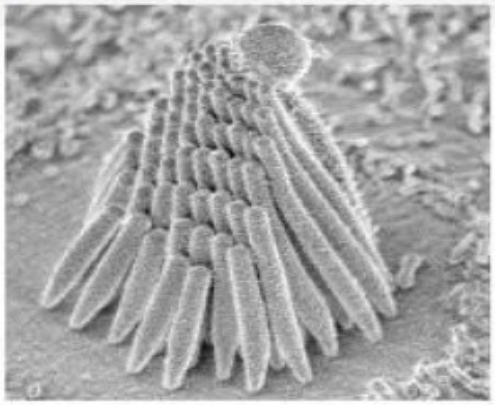
- ✓ At one end of the middle ear, opposite to the eardrum, there are two openings: one of them is oval in shape (oval window).
- ✓ The other is round (round window). The openings are covered by very thin membranes.

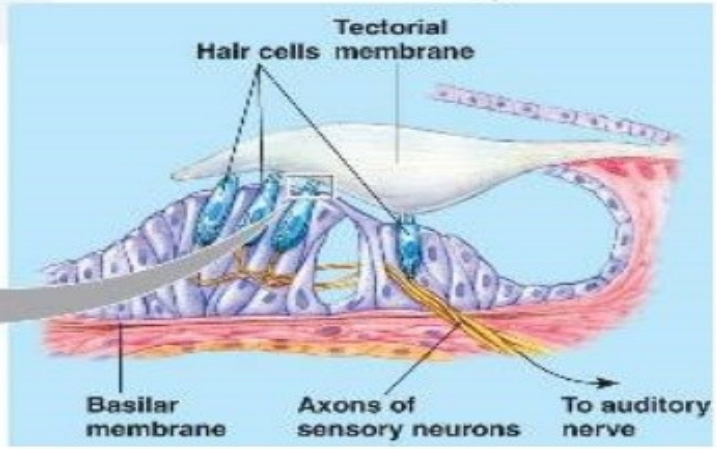
III. The inner ear

- ✓ Consists of a cavity filled with a fluid, two sac-like structures called the sacculus and utriculus, three semicircular canals and a coiled tube called the cochlea.
- ✓ A cross section of the cochlea reveals that it is made up of three tubes in one.


Outer ear
Middle ear
Inner ear
Skull bone
Stapes
Semicircular canals
Incus
Malleus
Auditory nerve to brain
Pinna
Auditory canal
Tympanic membrane
Oval window
Round window
Cochlea
Eustachian tube


Cochlear duct
Bone
Auditory nerve
Vestibular canal
Tympanic canal
Organ of Corti




Hair cells
Tectorial membrane
Basilar membrane
Axons of sensory neurons
To auditory nerve

❖ The mechanism of hearing

- ✓ The pinna collects sound waves and directs them to the eardrum through the ear canal. When sound waves hit the eardrum, it vibrates. This magnifies the vibrations.
- ✓ Which are then transmitted through the ear ossicles (the small bones) to the oval window.
- ✓ The ear ossicles also amplify the vibrations (make them bigger).

- ✓ The vibrations of the stapes make the membrane at the oval window vibrate.
- ✓ The vibrations of the oval window are transmitted to the fluid and then spread to the cochlea.
- ✓ Vibrations of the fluid cause the hair-like sensory cells to move. These movements in turn cause production of nerve impulses in the affector nerve fibres.
- ✓ These impulses are transmitted to the brain for interpretation through **auditory nerve**

❖ The senses of balance and movement

- ✓ The semicircular canals in the inner ear are concerned with the detection of motion.
- ✓ The swellings on each of the semicircular canals (the **ampullae**) contain sensory cells attached to sensory nerve endings.
- ✓ The sensory cells have hairs which are enclosed in a core of jelly substance called **a cupula**.
- ✓ Whenever the body or the head moves, the semicircular canals move with the head.

- The fluid in the semicircular canals also starts to move but it lags behind in its motion and so it apparently moves in the opposite direction.
- The moving fluid causes the cupula to tilt, thus pressing the hairs of the sensory cells. Which creates nerve impulses in the sensory nerve endings.
- The nerve impulses are transmitted to the brain through vestibular nerve. The brain then interprets the direction and speed of motion of the body or head.

- **The utriculus and sacculus** are concerned with the sense of balance and posture.
- The inner surfaces of these structures contain sensory cells with protruding hairs embedded in a jelly-like substance containing tiny particles of chalk called **otoliths**.
- When the head is tilted on one side, the otoliths move in the opposite direction, pulling or pressing the sensory hairs.

- This initiates nerve impulses which are transmitted to the brain.
- The brain then detects the angle of tilt and Return the body to its normal posture.

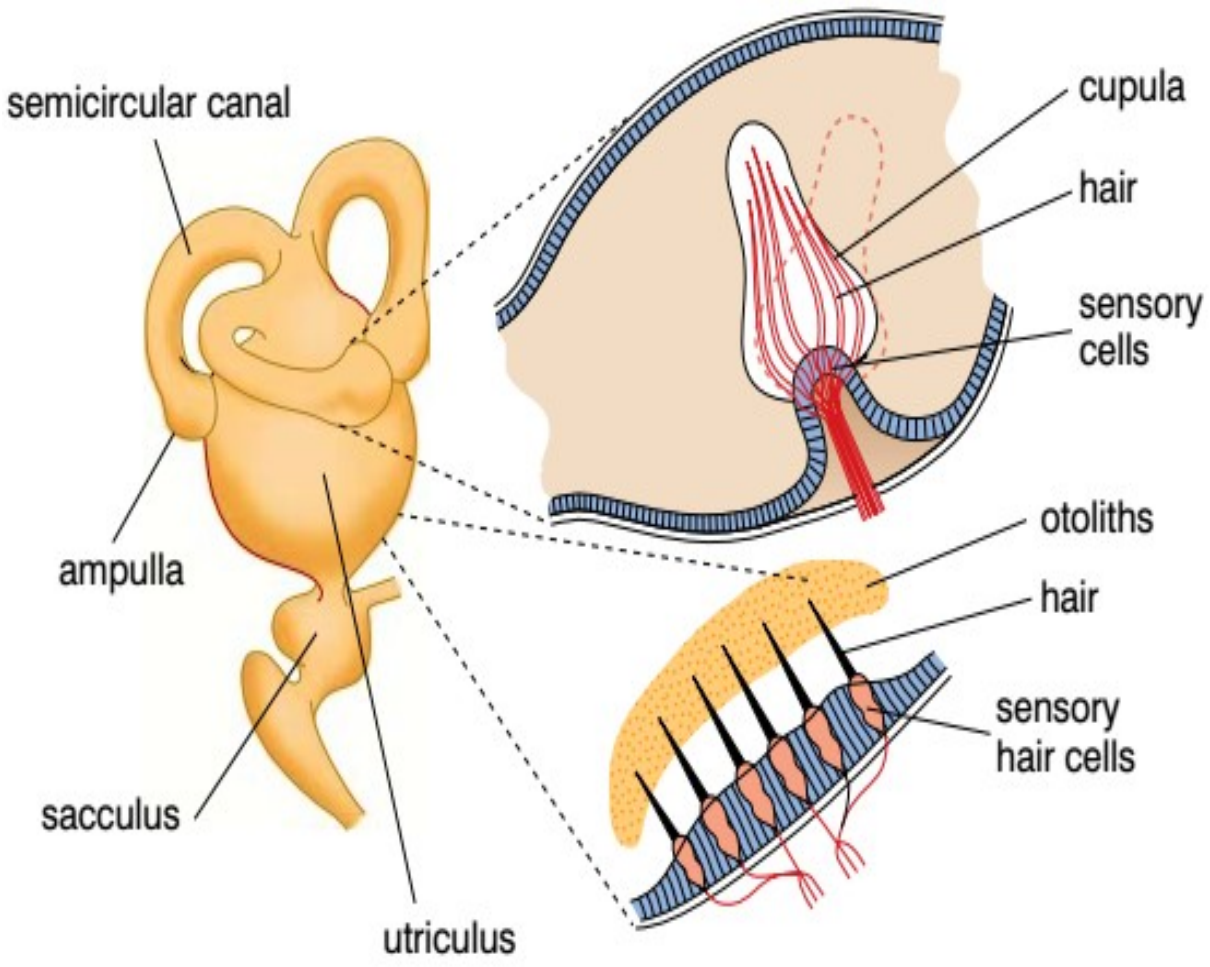


Figure 3.29 *The balance organs of the ear.*

Common disorders of the ear

- **Deafness or the inability to hear:** may be temporary or permanent. It can be caused in many ways.
- If the eardrum is damaged, by a blow or by a very loud noise, deafness will result. This may be temporary or, if the eardrum fails to heal, it can be permanent.
- If the tiny bones of the middle ear become damaged or fused by infection, or crumble away with age or disease, This will be permanently deaf.

- ✓ Damage to the auditory nerve ,once the nerve is damaged it cannot be restored.

- ✓ It can also be the result of infection, when the middle ear becomes full of thick infected mucus. It can be reversed if the infection is cleared with antibiotics. However, if the infection lasts too long, permanent hearing loss may result.

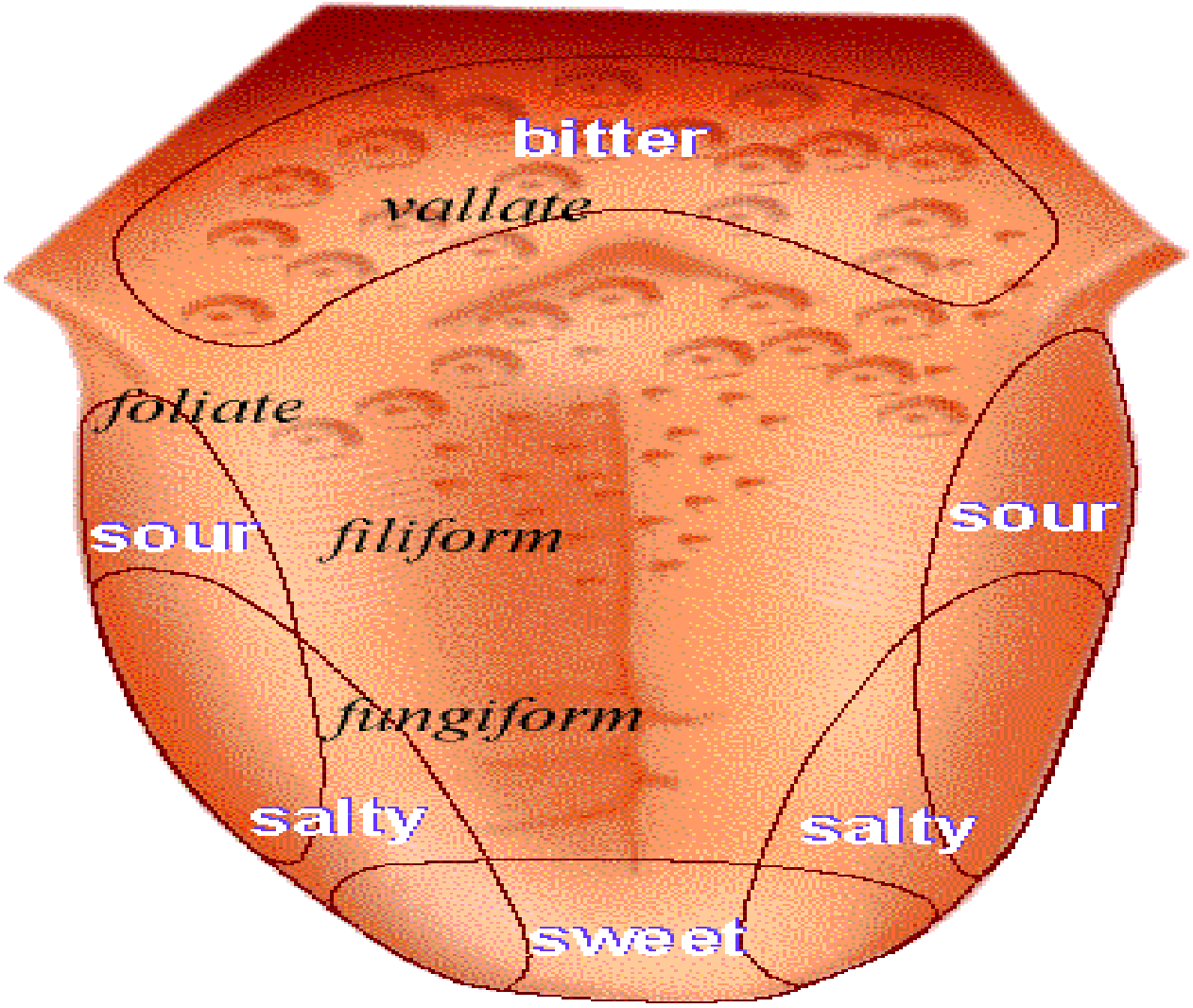
3. Taste and smell

- ✓ The sensory receptors of the tongue and those found in the nostrils are sensitive to solutions of certain chemical substances.

- ✓ The sensory receptors of taste(taste buds) are located on the upper surface of the tongue, and to a lesser extent on the surface of the throat.

- ✓ The receptors for smell(olfactory receptors) are located in the upper parts of the nasal passages

- There are five basic taste sensations: The first four are sweet, sour, bitter and salt and Very recently scientists have discovered a fifth taste called umami (a very savoury flavour found in foods such as meat, cheese, broth and mushroom).
- All of the five different taste organs are spread out all over the tongue, although some of them may seem to be in a greater concentration in certain places.


bitter
vallate
foliate
sour
filiform
sour
fungiform
salty
salty
sweet

The tongue is covered with projections called papillae

- Filiform papillae – sharp with no taste buds
- Fungiform papillae – rounded with taste buds
- Circumvallate papillae – large papillae with taste buds

Taste buds are found on the sides of papillae

A few substances stimulate only one of the five types of receptors ,but most stimulate two, three, four or five types to varying degrees.

4. The skin as a sense organ

- ✓ The skin is a remarkably complex organ which carries out a number of important functions in the body.
- ✓ It contains a huge variety of sense organs (touch, temperature, pressure, pain).
- ✓ It forms a waterproof layer around the body tissues, which protects against the loss of water

Through evaporation and prevents gaining water by osmosis

- ✓ It protects from the entry of bacteria and other pathogens.

- ✓ It protects from damage by UV light from the sun.
- ✓ It is an excretory organ (nitrogenous wastes are lost in sweat).
- ✓ It is vital in controlling the body temperature

❖ **Layers of skin**

The skin has three main layers.

A. The lower layer, the hypodermis

- ➢ Contains fatty tissue which is both an energy store and acts as an insulation layer, protecting against heat loss.

B. The middle layer or dermis

- ✓ Contains the blood vessels, the sweat glands, the sensory receptors and the hair follicles.
- ✓ This layer is closely involved in temperature control in homeostasis and in the sense of touch.

C. The upper layer or epidermis

- ✓ Is made up of dead cells. These stop water loss and also protect against the entry of pathogens.
- ✓ It is the dermis which is particularly involved in the homeostatic mechanisms of the skin.