

# CHAPTER - 12

## SENSE ORGAN

### Points to be covered in this topic

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# CHAPTER - 12

## SENSE ORGAN

### Points to be covered in this topic

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12.5.2 Parts of tongue

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12.5.4 Sensation of taste

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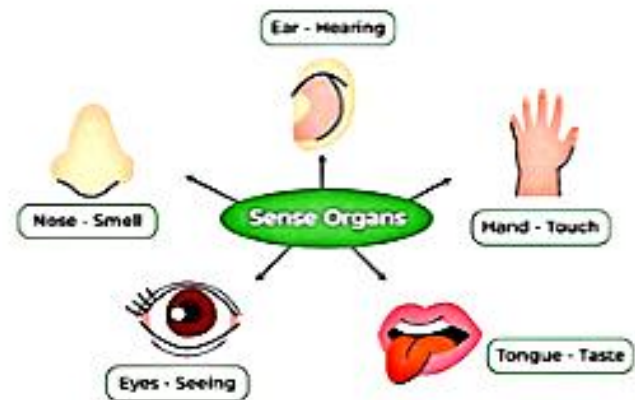
12.6.3 Functions of nose

12.6.4 Disorder of nose

# SENSE ORGAN

## 12.1 INTRODUCTION

- The sensory organs are primarily responsible for the reception of stimuli and pass them on to the neuro-muscular system, resulting in the varied behavior patterns of insects.



- An organ of the body which responds to external stimuli by conveying impulses to the sensory nervous system. Sensory organs have special receptors that allow us to **smell, taste, see, hear and maintain equilibrium or balance.**
- Information conveyed from these receptors to the central nervous system is used to help to maintain homeostasis.
- There are five sense organs – **Eyes, Ears, Nose, Tongue, and Skin.**

## 12.2 EYE

- Vision is extremely important for the human survival.
- More than half of the sensory receptors are located in the eyes.
- Eye is situated in the orbital cavity and is supplied by the optic nerves.
- It is spherical in shape and about **2.5 cm in diameter.**
- The eye is located in bony socket called as **orbit.**
- The space between the eye and the orbital cavity is occupied by adipose tissue.
- The bony walls of the orbit help to protect the eye from injury.

### 12.2.1 Accessory structures of the Eye

1. **Eyelids**
2. **Eyelashes**
3. **Eye brows**
4. **Lacrimal apparatus**
5. **Extrinsic eye muscle**

## 1. Eyelids

- Eyelids are the two movable folds of tissue situated above and below the front of each eye.
- Various layers of tissue forming the eyelids are
  - ✓ A thin covering of skin.
  - ✓ A thin sheet of subcutaneous connective tissue.
  - ✓ Lining of conjunctiva.

### ➤ **Function**

- The eyelids and eyelashes protect the eye from injury.
- The eyelids protect the front surface of eyes from excessive wind, small particles in the air and from minor mechanical injury.

### ➤ **Conjunctiva**

- It is a thin, transparent membrane that lines the eyelids and the front of eyeball.
- The corneal conjunctiva consists of a vascular stratified epithelium i.e. epithelium without blood vessels.
- When the eyelids are closed, the conjunctiva becomes a closed sac.
- It protects the delicate cornea and the front of eye.

## 2. Eyelashes

- In humans, there are 75 to 80 lashes on the lower eyelid., and the upper eyelid has 90 to 160 lashes.
- The eyelashes grow from the edges of the eyelid. They also help protect the eye from dust and debris.

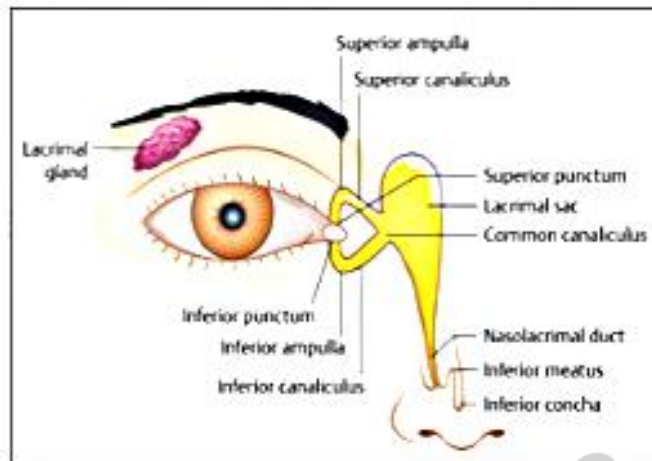
## 3. Eye brows

- They are two arches of thick skin over the eyes.
- They contain thick hairs.
- Prevent dripping of sweat, dust or other foreign particles into the eyes.

## 4. Lacrimal apparatus

- It is concerned with the production of tears and it consists of Lacrimal glands and its Duct system.
- This gland secretes "Tears". Tears have antibacterial function.

- Tears lubricate the front part of the eye.
- Tears pass through the lacrimal ducts and enter into the conjunctival sac.
- It consists of:
  - ✓ 1 Lacrimal gland and its ducts
  - ✓ 2 Lacrimal canaliculi
  - ✓ 1 Lacrimal sac
  - ✓ 1 Nasolacrimal duct
- The fluid protects, clean lubricates and moisture the eyeball.

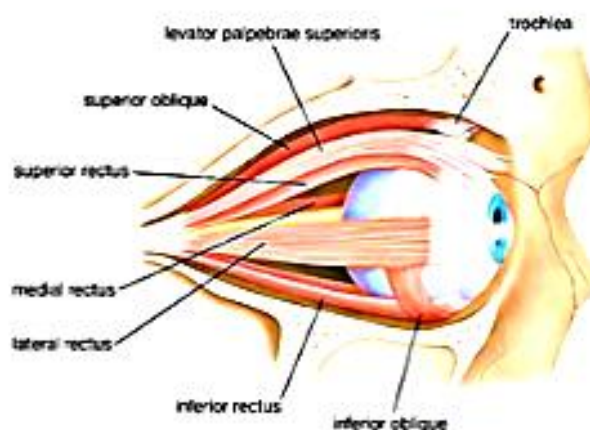


**Fig.12.1: Lacrimal apparatus**

## 5. Extrinsic eye muscles

The eye ball is moved by six muscles.

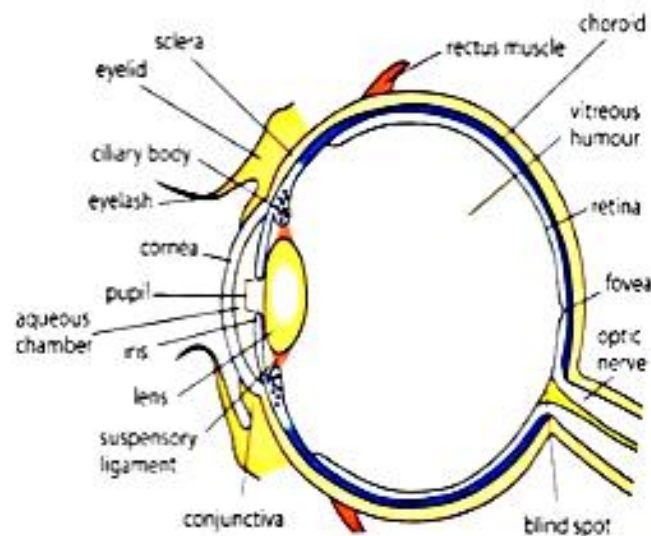
- **Superior rectus:** Moves the eye upwards.
- **Inferior rectus:** Moves the eye downwards.
- **Medial rectus:** Moves the eye inwards.
- **Lateral rectus:** Moves the eye outwards.
- **Inferior oblique:** Moves the eye up and outwards.
- **Superior oblique:** Moves the eye down and outwards.



**Fig. 12.2- Extrinsic eye muscles**

## 12.2.2 Anatomy of the Eyeball

- The eye ball is almost spherical in shape and it is situated in the anterior part of orbital cavity.
- The adult eyeball measures about 2.5 cm in diameter.
- The eye ball contains:



**Fig. 12.4- Internal structure of the eyeball**

1. **Three coats**
2. **Light transmitting structures**

### 1. Three coats

- A. **Outer fibrous coat** - Sclera and Cornea.
- B. **Middle vascular coat** - Choroid, Ciliary body and Iris
- C. **Inner nervous coat** - Retina

### A. Outer fibrous coat

#### i. Cornea

- The cornea is transparent coat that covered the coloured iris.
- The cornea helps to focus the light onto the retina.
- The cornea is about 0.5 to 1 mm thick and consists mainly of the following structure:
  - Corneal epithelium
  - Substantia propria
  - Corneal endothelium

#### ii. Sclera

- The white of the eye is a layer of dense connective tissue made up of collagen fibres and fibroblasts.

- The sclera covers the entire eyeball except the cornea.
- It gives shapes to the eyeball, makes it more rigid and protects its inner parts.
- At the junction of sclera and cornea is an opening known as canal of Schlemm.
- A fluid called as aqueous humour drains into the sinus.
- The muscles of the eye ball are attached to the surface of the sclera.
- The sclera is covered by a thin mucous membrane called Conjunctiva.

## **B. Middle vascular coat**

### **i. Choroid**

- The choroid also contains melanocytes that produce the pigment melanin which appear dark brown in colour.
- In the anterior portion of the vascular tunic, the choroid becomes the ciliary body.
- It is a thin, pigmented and highly vascular membrane. It lines the posterior compartment of the eye and lies between the inner surface of sclera and retina.

### **ii. Ciliary Body**

- It is the anterior continuation of choroid and it lies between choroid and iris. The ciliary body contain "Ciliary muscles".
- The suspensory ligament of lens is attached to ciliary muscles.
- The ciliary body also houses secretory epithelial cells, forming the ciliary gland, responsible for the secretion of the "aqueous humour."

### **iii. Iris**

- It is anterior continuation of the ciliary body.
- The iris is a pigmented membrane and the colour of eye (iris) is dependent on the number of pigment cells present.
- Iris has a central opening called "Pupil". Two sets of iris muscles control the size of the pupil.
- It is a visible coloured portion.

## C. Inner nervous coat

### i. Retina

- The third and inner coat of the eyeball is the retina.
- It is extremely thin and transparent.
- The optic disc is the site where the optic (II) nerve exits the eyeball.
- It consists of:
  - Central retinal artery
  - Central retinal vein
- The retina consists of a pigmented layer and neural layer.

### ii. Rods

- Rods are very sensitive to dim light and its function is in night vision.
- Rod consists of a photosensitive chemical known as rhodopsin.
- Rhodopsin is a combination of vitamin 'A' (retinol) and a protein called pepsin. But when the retina is exposed to bright light rhodopsin vanishes.

### iii. Cones

- Cones are essential for day light vision and colour vision.
- There are three types of cones, having different pigments, mostly sensitive to red, blue or green light. When there is stimulation in correct proportion in the three types of cones, sensation is white.

## 2. Light Transmitting Structures

### A. Aqueous humour

- It is a fluid present in the both the anterior and posterior chambers of eye.
- The aqueous humour is a transparent water-like fluid similar to plasma, but containing low protein concentrations.
- It is secreted from the ciliary body, a structure supporting the lens of the eyeball.

### B. Lens

- It is present behind the pupil and iris within the cavity of the eyeball.
- A crystalline protein, arranged like the layers of an onion, make up the lenses transparent and lacks blood vessels.
- The lens helps to focus images on the retina to facilitate clear vision.



- It is a nearly transparent biconvex structure suspended behind the iris of the eye, the sole function of which is to focus light rays onto the retina.

### **C. Vitreous humour**

- It is a clear gel like substance that occupies the space behind the lens and in front of the retina at the back of the eye.

### **12.2.3 Physiology of vision**

- Light enters the eye through the cornea. Light crosses the aqueous humour and passes through pupil and lens.
- Iris and the pupil regulate the amount of light entering the eye.
- The image is then focused through the lens on the retina, after passing through vitreous humour.
- The pigmented choroid darkens the interior of the eye. This reduces scattering and reflection of light.
- The image then stimulates the photoreceptors present in the rod and cones of retina. The rods are concerned with dim light vision and not colour vision. The cones are concerned with bright light vision and colour vision.
- These impulses are then carried through optic nerve. The optic nerves of both sides cross at optic chiasma. From the optic chiasma, the impulses are carried by optic tract to visual cortex present in the occipital lobe of the brain.

### **12.2.4 Disorders of eye**

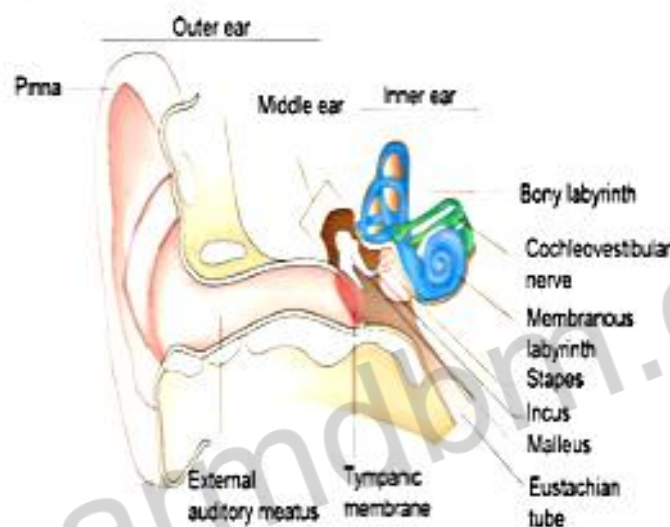
- i. **Myopia (short sight)**
- ii. **Hypermetropia (long sight)**
- iii. **Presbyopia**
- iv. **Glaucoma**
- v. **Colour blindness**
- vi. **Night blindness (Nyctalopia)**
- vii. **Cataract**
- vi. **Xerophthalmia**
- vii. **Keratomalacia**

## 12.3 EAR

- Ear is concerned with the functions of hearing and equilibrium.
- It is supplied by 8<sup>th</sup> cranial nerve i.e. the cochlear part of the vestibulocochlear nerve which is stimulated by vibrations caused by sound waves.

### 12.3.1 Anatomy of Ear

1. **External ear**
2. **Middle ear**
3. **Internal ear**



**Fig. 12.5- Internal structure of ear**

#### 1. External Ear

- It is the only part which lies outside the skull.
- It contains the following structures -

- a) **Pinna or Auricle** which is a funnel shaped organ made of elastic fibrocartilage. It helps to collect the sound waves.
- b) **External auditory meatus** which is a small channel lined by skin and wax secreting glands. It conveys the vibrations of sound to the tympanic membrane.

#### 2. Middle Ear

- It is a small cavity in the temporal bone.
- It conveys the sound vibrations to the oval window.
- It is also called as tympanic cavity.

- It contains the following structures-
  - i. "Tympanic membrane" or "Ear drum" which forms the lateral wall.
  - ii. Tensor tympani muscle and stapedius muscle.
  - iii. Two foramina in the inner or medial wall called Fenestra ovalis or oval window and "Fenestra rotundum" or round window.
  - iv. Eustachian tube through which middle ear communicates anteriorly with nasopharynx. There are two canals opening into the anterior wall namely canal for tensor tympani and the eustachian tube.
  - v. "Auditus" is a narrow channel which connects the middle ear posteriorly with Mastoid antrum.
  - vi. The Auditory ossicles which are three small bones arranged across the middle ear. The three ossicles are Malleus, Incus and Stapes. The head of malleus is connected to incus which in turn is connected to stapes.

### 3. Internal Ear

- Inner ear, also called labyrinth of the ear, part of the ear that contains organs of the senses of hearing and equilibrium.
  - i. Bony labyrinth which consists of a series of channels (present in the petrous portion of temporal bone lined with periosteum). The bony labyrinth contains a fluid called "Perilymph". It is longer than membranous labyrinth, which fits into it, like a tube within a tube.
  - ii. "Membranous labyrinth" which lies within the bony labyrinth. The membranous labyrinth is filled with a fluid called "Endolymph".

#### ✓ The bony labyrinth contains three structures

##### a) Vestibule

- It is the central part. It lies between cochlea in front and semicircular canals behind.
- It contains Utricle and Saccule which are the parts of the membranous labyrinth.

##### b) Cochlea

- It is a spiral canal which looks like the shell of a snail.
- Modiolus is a central column of spongy bone around which the spiral canal twines.

- Basilar membrane is a membranous septum which divides the cochlea into two parts. The upper part is called Scala vestibuli and the lower part is called Scala media.
- Organ of Corti is the auditory receptor which rests on the basilar membrane.

### c) Semicircular Canals

- Each ear has three semicircular canals which are placed at right angles to each other.
- They are posterior, superior and lateral semicircular canals.
- Each semicircular canal has an enlarged end called "Ampulla".
- The ampulla has endings of vestibular nerve and also some hair like projections.

### 12.3.2 Physiology of ear

#### ➤ Mechanism of hearing

- Sound waves in air are collected by pinna.
- The external auditory meatus directs these waves to the tympanic membrane which then vibrates.
- The vibrations are transmitted by malleus, incus and stapes to the membrane covering fenestra ovalis.
- From the inner surface of this membrane, vibrations are transmitted to organ of Corti through perilymph and endolymph.
- From the organ of Corti, the impulse is carried to the brain stem through the cochlear portion of the 8th cranial nerve.
- The fibers are then carried to auditory center of brain which is present in the temporal lobe of the opposite side.

#### ➤ Mechanism of equilibrium

- Head movement or changes in its position result in the displacement of the endolymph within the semicircular canals.
- The movement of endolymph stimulates the nerve endings in the ampullae.
- The impulses are carried to brain through the vestibular portion of the 8th cranial nerve.

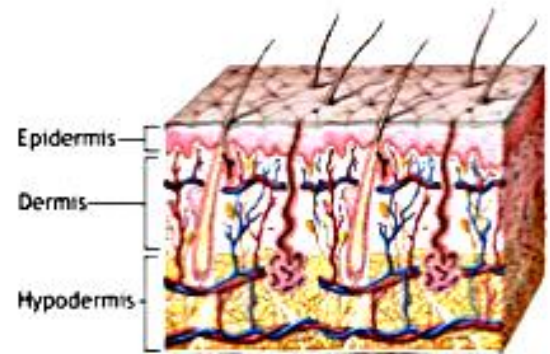
- These impulses produce sensations which make us conscious about the position of the head.
- When the head position is disturbed, we can make adjustments to restore balance and equilibrium.

### 12.3.3 Disorder of ear

1. **Meniere's syndrome**
2. **Earache**
3. **Otitis media**
4. **Deafness**

## 12.4 SKIN

- Skin is the largest organ in the body.
- It forms a protective covering for the body which is in contact with the external environment.
- Skin plays an important role in the regulation of body temperature.
- The normal pH value of healthy human skin typically falls within the range of 4.7 to 5.75.
- Skin consists of three layers
  1. The **epidermis**, the outermost layer of skin, provides a waterproof barrier and creates our skin tone.
  2. The **dermis**, beneath the epidermis, contains tough connective tissue, hair follicles, and sweat glands.
  3. The **hypodermis** is the deeper subcutaneous tissue and is made of fat and connective tissue.



### 14. 1.4 Structure of skin

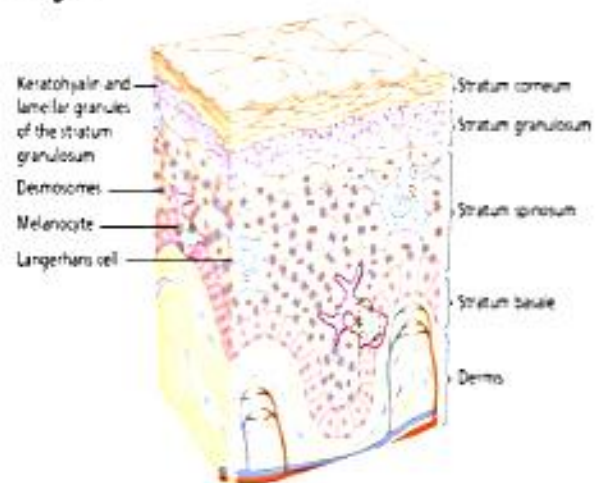
#### 12.4.1 Structure of Skin

##### 1. Epidermis

- It is the outer layer of the skin.
- It is composed of stratified squamous epithelium.

- Epidermis is divided into five layers, namely:

- i. **Stratum corneum**
- ii. **Stratum lucidum**
- iii. **Stratum granulosum**
- iv. **Stratum spinosum**
- v. **Stratum germinativum**



**Fig. 12.6- Layers of skin**

### ***i. Stratum corneum***

- This is the most superficial layer.
- 20-30 cell layers, is the uppermost layer, made up of keratin and horny scales made up of dead keratinocytes, known as anucleate squamous cells.
- This is the layer which varies most in thickness, especially in called skin.
- The nuclei are absent.

### ***ii. Stratum lucidum***

- This is a thin, more or less transparent, glistening layer
- The cell contains cytoplasm.
- 2-3 cell layers, present in thicker skin found in the palms and soles, is a thin clear layer consisting of eleidin which is a transformation product of keratohyalin.

### ***iii. Stratum granulosum***

- This layer contains spindle-shaped cells.
- 3-5 cell layers, contains diamond shaped cells with keratohyalin granules and lamellar granules. Keratohyalin granules contain keratin precursors that eventually aggregate, crosslink, and form bundles.
- The cytoplasm and nucleus are present in these cells.

### ***iv. Stratum spinosum***

- This is the broad layer. It contains polyhedral cells.
- 8-10 cell layers, also known as the prickle cell layer contains irregular, polyhedral cells with cytoplasmic processes, sometimes called "spines", that extend outward and contact neighbouring cells by desmosomes. Dendritic cells can be found in this layer.

## v. *Stratum germinativum*

- This layer is composed of single layer of columnar epithelium or cuboidal cells.
- This layer is connected to the dermis.
- Melanin pigments are present in this layer.

## 2. Dermis

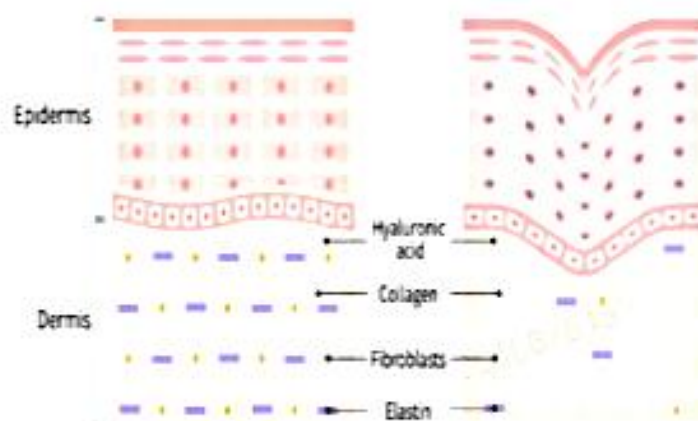
- The dermis is the middle layer of skin in your body. It has many different purposes, including protecting your body from harm, supporting your epidermis, feeling different sensations and producing sweat and hair.
- It is composed of connective tissue and is highly vascular.
- It is made up of fibroelastic tissue which maintains the texture of the skin.
- The dermis consists of two layers:
  - Reticular dermis-** The reticular layer is the bottom layer of your dermis. It's thick, and it contains blood vessels, glands, hair follicles, lymphatics, nerves and fat cells. A net-like structure of elastin fibers and collagen fibers surrounds the reticular dermis.
  - Papillary dermis-** The papillary layer is the top layer of your dermis. It's much thinner than the reticular dermis. It consists of collagen fibers, fibroblast cells, fat cells, blood vessels (capillary loops), nerve fibers, touch receptors (Meissner corpuscles) and cells that fight bacteria (phagocytes). The papillary dermis extends to the basement layer of the epidermis layer.

### ➤ Gland of the dermis

- Sebacous gland**
- Sweat gland**
- Ceruminous gland**

### A. Sebaceous gland

- It is located in dermis, which open into the hair follicles.



**Fig. 12.7- Structure of dermis**

- They are flask shaped glands.
- They secrete an oil like material called sebum.
- They have a duct which opens into a hair follicle.
- It prevents excess evaporation of water from the skin and prevents drying of skin.
- Sebaceous glands are present in the skin of many parts of the body except skin of palms of hands soles of feet.

### **B. Sweat gland**

- There are two types of sweat glands "Eccrine glands and Apocrine glands".
- Eccrine glands are present all over the body. Apocrine glands are present in axilla, female genitalia and round the nipples.
- Eccrine glands secrete watery sweat and apocrine glands secrete milky sweat.

### **C. Ceruminous gland**

- They are modified sweat glands. They secrete wax in the external ear.

## **3. Hypodermis**

- This layer also called as Subcutaneous Tissue
- The hypodermis is the bottom layer of skin in your body. It has many functions, including insulating your body, protecting your body from harm, storing energy and connecting your skin to your muscles and bones.

### **12.4.2 Function of skin**

- The skin protects the body against injury and bacterial invasion.
- It regulates body temperature.
- The skin serves as a medium for receiving the sensations like touch, pressure and temperature.

### **12.4.3 Regulation of body temperature**

- The normal body temperature is 98.4°C (37°C).
- The normal body temperature is maintained by a balance between heat production and heat loss.



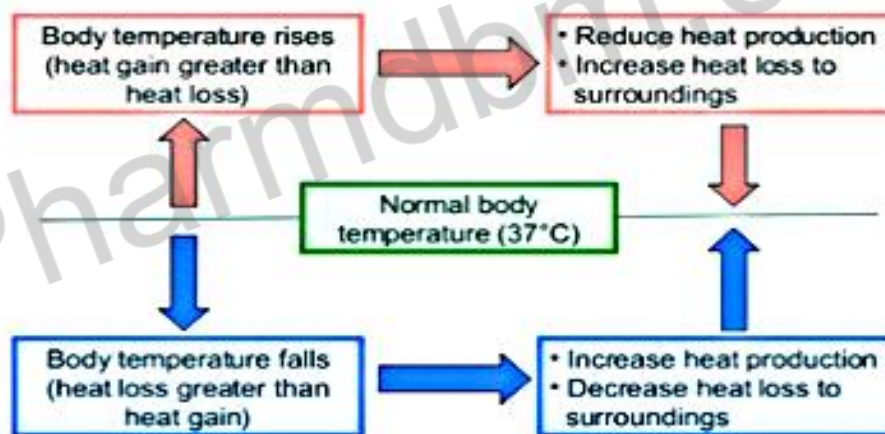
- Body temperature is controlled by Heat regulating center present in the hypothalamus.

### ➤ Heat production

- During severe exercise, by the increased activity of muscles.
- By the increased activity of liver and other glands in the body.
- Increased intake of food (proteins).
- Increased metabolism, like oxidation of food stuffs and combustion of fat.
- Endocrine secretions like adrenaline and noradrenaline.

### ➤ Heat loss

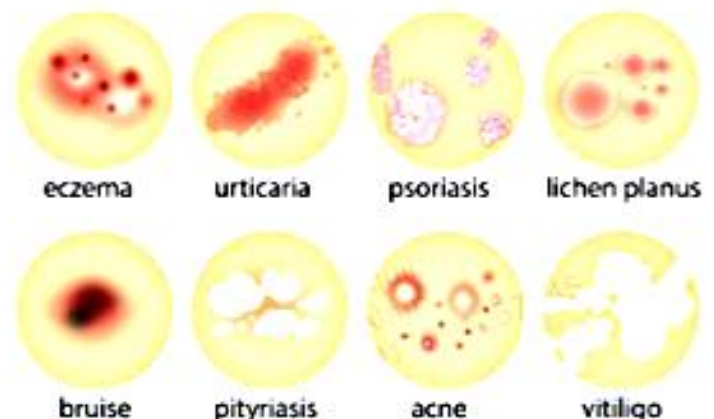
- Conduction, body heat is lost through clothing, bedding etc.
- Convection, the hot air around the body moves up and it is replaced by cool air, and thus body heat is lost.
- Sweating, the skin becomes cool and this leads to heat loss.
- Evaporation of water from the skin, mucous membranes and respiratory passages, the body heat is lost.



**Fig.12.8: Regulation of body temperature**

### 12.4.4 Disorders of skin

- i. Acne
- ii. Alopecia areata
- iii. Atopic dermatitis (eczema)
- iv. Psoriasis
- v. Raynaud's phenomenon
- vi. Rosacea, flushed
- vii. Vitiligo



**Fig. 12.9: Disorders of skin**

## 12.5 TONGUE

- The tongue is a muscular organ in the mouth covered with a moist, pink tissue called the mucosa.
- It is involved in licking, tasting, breathing, swallowing, and speaking.
- The papillae present on the tongue gives it a rough texture. It is covered by a number of taste buds.
- **Location** - Tongue is a mobile organ, situated within the mouth.

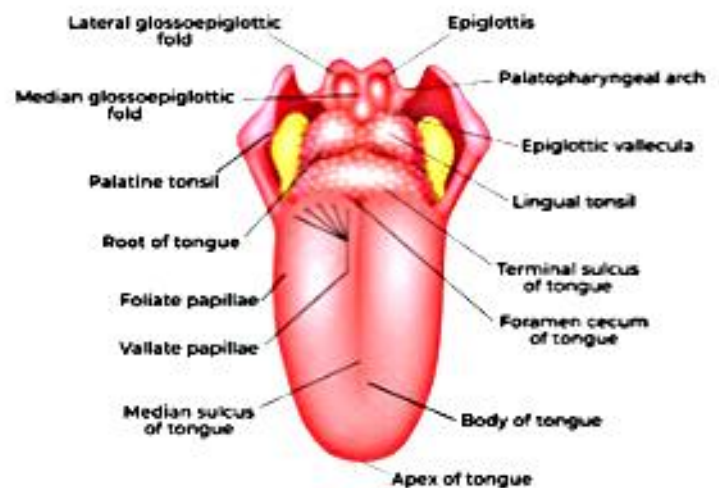
### 12.5.1 Anatomy

- The central surface of the tongue is connected to the floor of the mouth by frenulum linguae.
- The dorsal surface of the tongue is facing the palate.
- The dorsal surface is divided into anterior 2/3<sup>rd</sup> portion and posterior 1/3<sup>rd</sup> portion by the sulcus terminalis.
- The anterior 2/3<sup>rd</sup> portion has taste papillae.
- There are three types of taste papillae

- ✓ **Circumvallate papillae or vallate papillae**
- ✓ **Fungiform papillae**
- ✓ **Foliate papillae**

### 12.5.2 Parts of the tongue

1. **Tip** - This highly agile part houses taste buds for sweet. Also called the apex, the tip of the tongue is the point at the front of the mouth.
2. **Root** - The root connects the tongue to the floor of the mouth. It's attached to the hyoid bone and the lower jaw, keeping it in place.
3. **Body** - The body is the portion of the tongue between the root and the tip. It's very mobile and performs many different functions, including assisting in eating and speaking.



**Fig. 12.10: Structure of tongue**

- 3. Dorsum** - It refers to the top surface of the tongue. It's covered in hairlike projections known as lingual papillae, which contain numerous taste buds and glands.
- 4. Ventral surface** - The underside of the tongue is smooth and has no papillae. It contains many blood vessels that may make it purple.

### 12.5.3 Functions of the Tongue

- It is an organ of taste. The tongue tastes sweet, salt, bitter and sour.
- It helps in mastication (chewing) of food.
- It helps in swallowing.
- It helps in cleaning the lips.
- It helps in speech.

### 12.5.4 Sensation of taste

- Tongue is mainly concerned with taste sensation.
- On the dorsum of the anterior 2/3<sup>rd</sup> of the tongue, there are taste papillae, these papillae are called taste buds.
- Taste buds are the end organs of taste.
- The following tastes are felt in the tongue from the front portion to the back portion of the tongue. They are.

1. Sweet (at the tip of the tongue)
2. Salt (at the back of the tongue)
3. Sour (at the back edge of the tongue)
4. Bitter (at the front edge of the tongue)
5. Umami or Savory



- The taste from the anterior 2/3<sup>rd</sup> of the tongue is carried by the chorda tympani branch of the facial nerve.
- The taste from the posterior 1/3<sup>rd</sup> of the tongue is carried by the glossopharyngeal nerve.
- The impulses travel to the taste center in the medulla, from where they proceed to the thalamus and then on to the motor cortex.
- The impulses are interpreted in the cerebral cortex as the sensation of taste.

## 12.5.5 Disorder of tongue

- i. Aglossia
- ii. Ankyloglossia
- iii. Hypoglossia

## 12.6 NOSE

- The nose is an olfactory organ.
- Our olfactory system helps us to perceive different smells. This sense of organ also aids our sense of taste. The sense of smell is also known as olfaction.
- The olfactory cells tend to line the top of the nasal cavity. On one end, olfactory cells have cilia that project into the nasal cavity and on the other end of the cell, are the olfactory nerve fibres.
- Your nose gives you a sense of smell and helps shape your appearance.

### 1. Parts of nose

1. **Bone-** The hard bridge at the top of your nose is made of bone.
2. **Hair and cilia-** Hair and cilia inside your nose trap dirt and particles.
3. **Lateral walls (outer walls)-** The outer walls of your nose are made of cartilage and covered in skin. The walls form your nasal cavities and your nostrils.
4. **Nasal cavities-** Your nose has two nasal cavities, hollow spaces where air flows in and out. They are lined with mucous membranes.
5. **Nerve cells-** These cells communicate with your brain to provide a sense of smell.
6. **Nostrils (nares)-** These are the openings to the nasal cavities that are on the face.
7. **Septum-** The septum is made of bone and firm cartilage. It runs down the center of your nose and separates the two nasal cavities.
8. **Sinuses-** You have four pairs of sinuses. These air-filled pockets are connected to your nasal cavities. They produce the mucus that keeps your



**Fig.12.11: Structure of nose**

nose moist.

- 9. Turbinate(conchae)-** There are three pairs located along the sides of both nasal cavities. These folds inside your nose help warm and moisten air after you breathe it in and help with nasal drainage.

### **12.6.1 Sensation of smell**

- The receptors for smell are the olfactory cells.
- They are present in the mucous membrane of upper part of nasal cavity.
- The ends of the olfactory rods collect to form the olfactory nerve.
- This nerve passes through the root of nose and ends in the olfactory bulb.
- The sensations are carried through olfactory tract to olfactory area in the temporal lobe of cerebral cortex.
- The perception of smell occurs in this area.

### **12.6.2 Functions of nose**

- i. Air Filtration**
- ii. Moistening of Air**
- iii. Temperature Regulation**
- iv. Olfaction (Sense of Smell)**
- v. Respiration**
- vi. Speech and Phonation**
- vii. Immune Defence**
- viii. Nitric Oxide Production**

### **12.6.3 Disorders of nose**

- i. Allergic rhinitis**
- ii. Nasal Polyps**
- iii. Fungal sinusitis**
- iv. Inverting papilloma**
- v. Olfactory Disorders**
- vi. Nasal Fractures**