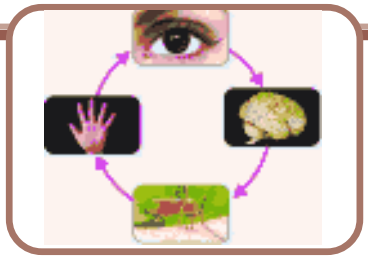
Chapter 6

Sense Organs



We enjoy the beauty of nature with our eyes, the melodious music with our ears, the fragrance of flowers with our nose, the taste of food with our tongue and feel the cool breeze on our skin. What do we do when suddenly bright light falls on our eyes or a hot utensil is touched by chance? All these situations show just how our senses pick up informations and react to them.

Our senses aren't just a part of us, they define us. This is because nothing that we experience in our life, from the most important to the most boring, would be possible without the intricate power of our senses.

Nothing in the entire universe of scientific exploration can even come close to matching the ability of our brain to use information sensed by our eyes, ears, skin, tongue, and nose to produce a rich sensory experience in a matter of milliseconds!

- But how much do we know about our senses?

What do our senses do?

Our senses have several roles to play. They aid our survival by directing us toward certain informations of our environment that are important for us and influence some activity (called as stimuli). As for example tasty foods draw us towards them and our mouth starts watering. Our senses also help us locate mates, seek shelter, and recognize our friends. Incidentally, our senses also give us the opportunity to find pleasure in music, art, athletics, etc.

There are yet other things that our senses do. You may have experienced feeling hurt to see someone in pain. Usually when we have strong emotional ties to someone and when he or she experiences pain, so do we(not just emotional ties we could be influenced by situations not directly related to us and yet feel the pain e.g. sympathising and feeling pain of drought affected people).

How do our senses accomplish all this? The complete answer is complex, but it involves one elegantly simple idea that applies across the sensory system. Our sensory impressions of the world involve nerve signals. These play a very important role in the way we react or respond to various stimuli or even to same stimuli in different situations.

For example generation of flavor preferences by our brain is usually based on what our body needs. Like cooked fish

may not smell good to some people. But if the person is very hungry and has no other option and particularly if the body has a need for protein, fish may suddenly smell good!

Stimuli from the environment around are received by our body through some sense organs. As we already know, they are the eyes, ears, nose, tongue and skin. Let's try to understand the path of receiving a stimulus to expressing a response (sensation).

Stimulation to Sensation

There are certain conditions, substances etc in nature that trigger the process of sensing them by our body. These are stimulants. Information carried by these stimulants are picked up by certain organs called as receptors present in our sense organs and converted into nerve signals. These are carried to the brain and processed to create a sensation. For example when reflected light (stimulus) from the surface of a green leaf and its surroundings reaches receptors in our eyes, it is converted into nerve signals. These signals reach the brain and are interpreted as green coloured shape against a background. We see this as the leaf.

Brain is the centre for all the sensitive activities. It receives information through sensory nerves that bring nerve signals from the sense organs and after interpretation sends off signals through another type of nerves called as motor nerves to parts that are to show the response. For example, you see a mosquito biting you on your leg through your eyes. The response works through motor nerves from the brain to your hands to strike and kill it.

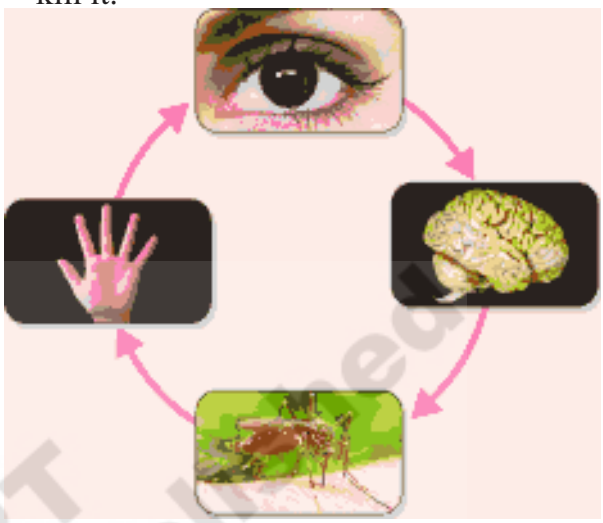


Fig-1 schematic representation of nerve stimulation to response.

Activity-1

Note down a few lines of any text in your book.

Write about the stimuli and responses and the sensory and motor functions with respect to the sense organs involved.

- Do you think our sense organs work together? Why, why not?

All stimuli may not lead to responses. Only a particular level of stimulus will give rise to a response. Moreover changes in stimulus also go unnoticed if they are not of a particular level.

Activity-2

Dissolve a pinch of sugar in a glass of water. Drink a little of this. Does it taste sugary? Why?

You could try this for different concentrations of sugar ,adding by proper

quantification, that is, weighing and preparing solutions to find out how much sugar in solution starts off your sensation. (you could take 1/4th teaspoonful sugar each time which would be nearly 2grams, for your convenience)

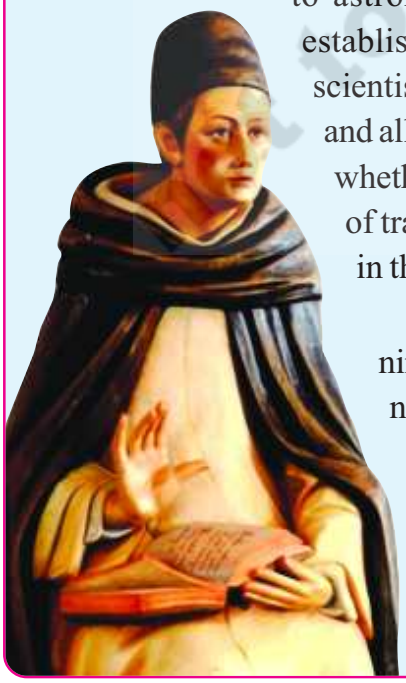
You may have often noticed while drinking tea or coffee that if you eat a very sweet substance in between, your tea or coffee appears to be less sweet as compared to the sips taken before eating the sweet (Thus, salty snacks go with tea or coffee!).

Looking back in History

Scientists from ancient times have wondered about the senses. Nearly 2300 years back Plato and then Aristotle mentioned the five senses of humans among which the sense of touch was considered the most important. In ancient Indian and Chinese medical documents also, mention of senses have been found. Thereafter for over a thousand years no documents regarding the role of senses had been found till Albertus Magnus' contributions (around 1220 AD).

He was a bishop in a church in Italy, a keen observer of nature and a lover of science who followed Aristotelian ideas, but commented on them for the first time making them accessible for wider academic debate. He mentioned the role of nerves for the first time in the sensation of touch.

Physiology of sensation could be studied in great detail only from the 17th century as this was the prime time when several instruments were being invented to aid the unaided eye to observe more closely. Johannes Kepler (1600 AD), well known for his contributions to astronomy regarding the rotation and revolution of earth, established the role of eye as a sense organ. In recent years, scientists have uncovered new insights into how our senses work and all the amazingly complex and fascinating things they can do, whether we are aware of them or not. The electrochemical basis of transmission of nerve signals and functions of specific areas in the brain involved in sensations are also better understood.



The number of senses from Aristotelian era to the nineteenth century stands at five, while in the modern era this number signifies the sense organs in our body.

Though it is classically considered that humans have five senses, but in fact, we may have many more. We have one sense of touch dedicated to pressure, another for heat and cold, and yet another for vibration and texture and that's just one of our traditional sense of touch!

This usually happens because a higher level of the same stimulus masks that of the lower level. Remember the poem "Tinaga Tinaga Vemu Thiyyanundu".

We should consider our sense organs to be change detectors. If you have ever jumped into a cool pool on a hot day, you know that sensation is critically influenced by change. In fact, a main role of our stimulus detectors is to announce changes in the external world—a flash of light, a splash of water, a clap of thunder, the prick of a pin etc. The receptors present in our sense organs specialize in gathering information about new and changing events.

Though our senses are change detectors, usually small changes or unchanging stimuli often go unnoticed. Our senses accommodate to unchanging stimulation and we become less and less aware of constant stimulation. For example the sounds in a printing press may be very uncomfortable for a worker landing there for the first time. Eventually as time passes, the person would not find the sounds so uncomfortable.

What does all this mean for our understanding of human sensation? The general principle is this: We are built to detect changes in stimulation and relationships among stimuli and often adapt to certain stimuli.

Our Sense Organs

As we all know, we have five main sense organs, the eyes, ears, skin, nose and tongue. These sense organs have sensory receptors. Each type of receptor is highly sensitive to specific stimulus types.

1. Eye

Vision helps us detect desired targets, threats, and changes in our physical environment and to adapt accordingly. So, how does the visual system accomplish this? We shall do a few activities and read the following section to find out about this.

Activity-3

1. Observe the external structure of your friend's eye, draw the diagram and label it (you can take the help of diagram given in this section).
2. Observe the eye ball of your friend in normal light. Then throw a beam of torchlight on your friend's eye.

- What is his or her reaction? Why is it so?

Fig-2(a) The Human Eye

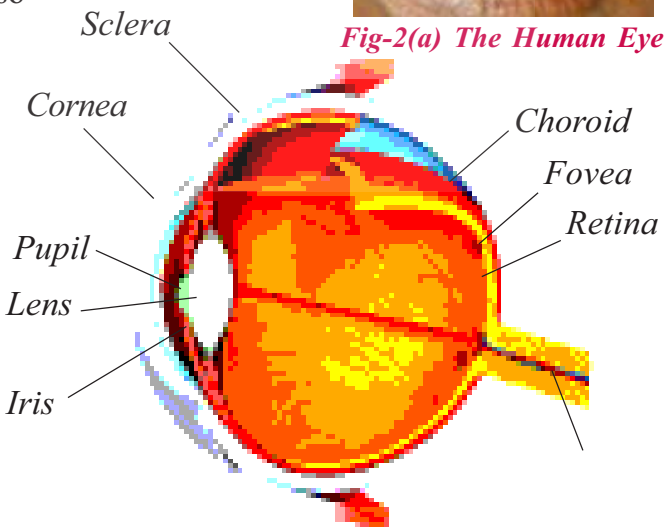


Fig 2(b) Human eye: schematic cross sectional view

Now ask your friend to keep the eye closed for around two minutes. Now let her/him open the eye. Observe the size of the small black portion in the centre. Ask your friend to keep her/his eye open forcibly as you throw the beam of torch light this time. Observe what happens to the small dark portion.

- What happened to the small dark portion called the pupil? Guess why.

Structure of the eye

Our eye contains eye lids, eye lashes, eyebrows and lachrymal glands. A thin layer, called conjunctiva covers the front portion of the eye. The eye ball is located in the eye socket. Only 1/6 portion of the eye ball is visible to us.

Eye has three main layers. They are sclerotic layer or sclera, choroid layer and retina. The outer most thick, tough, fibrous, non-elastic and white coloured layer is sclera. The sclera bulges and forms cornea. The end of sclera connects to the optic nerve. The second layer is choroid layer. This layer is black in colour and contains a lot of blood vessels. It encloses the eye except the part pupil. The part formed by the choroid layer around the pupil is iris. Radial and circular muscles are present in the iris. Biconvex Lens is present immediately behind the pupil is attached to the ciliary muscles and suspensory ligaments.

The lens divides the inner eye ball as aqueous chamber and Vitreous chamber. Aqueous chamber is filled with water like fluid whereas vitreous chamber is filled with jelly like fluid.

Retina contains the cells, called rods and cones. The area of no vision, called blind spot and the area of the best vision, called yellow spot are present in the retina. The yellow spot is also called Macula or Fovea.

Functioning of the eye:

The Visual Sensation

You might think of the eye as a sort of "video camera" that the brain uses to make motion pictures of the world. Like a camera, the eye gathers light through a convex lens, focuses it, and forms an image in the retina at the back of the eye. The lens, turns the image left to right and upside down (you may have studied in the chapter on light that we get an inverted /upside down image through a convex lens). This visual reversal may have influenced the very structure of the brain, which tends to maintain this reversal in its sensory processing regions. Thus, most information from the sense organs crosses over to the opposite side of the brain. Likewise, "maps" of the body in the brain's sensory areas are typically reversed and inverted. But while a digital camera simply forms an electronic image, the eye forms an image that gets extensive further processing in the brain.

The unique characteristic of the eye that makes it different from other sense organs, lies in its ability to take the information from light waves then transform the characteristics of light into neural signals that the brain can process.

This happens in the retina, the light-sensitive layer of cells at the back of the eye that acts much like the light-sensitive chip in a digital camera. As with a camera, things can go wrong. For example, the lenses of those who are "nearsighted" focus images short of (in front of) the retina; in those who are "farsighted,"the focal point extends behind the retina. Either way, images are not sharp without corrective lenses.

The real work in the retina is performed by light-sensitive cells known as photoreceptors. These photoreceptors consist of two different types of specialized cells the rods and cones that absorb light energy and respond by creating nerve impulses.

But why are there two sorts of photoreceptors? Our eyes function sometimes in near darkness and sometimes in bright light. These two types of processors involving distinct receptor cell types named for their shapes have evolved for this purpose.

Fig 5 a Fig 5 b Schematic Representation Rods and cones in the human retina

Nearly 125 million tiny rods containing the pigment rhodopsin "see in the dark" that is, they detect low intensities of light at night, though they cannot make the fine distinctions that give rise to our sensations of color.

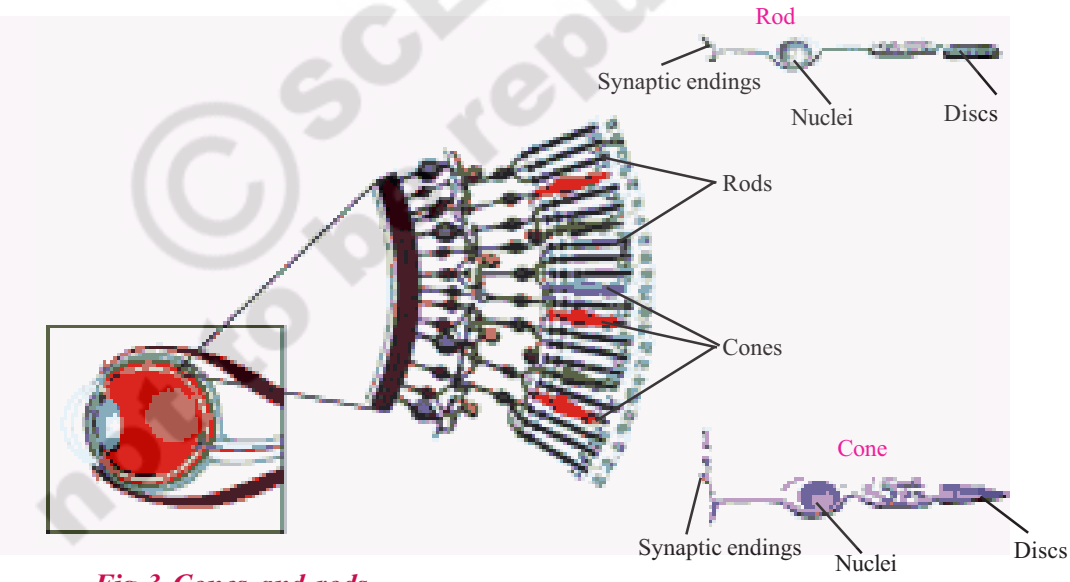


Fig-3 Cones and rods

Cells and tissues in the eye

Making the fine distinctions necessary for color vision is the job of the nearly seven million cones containing the pigment iodopsin that come into play in brighter light. Each cone is specialized to detect the light waves we sense either as blue, red, or yellow and the array of colours formed by their combinations. Thus the yellow field, the bright red morning sun, the blue sky and all other colours in nature are sensed. Let us observed the figure 5a, 5b.

The cones concentrate most in the very center of the retina, in a small region called

the fovea, which gives us our sharpest vision. With movements of our eyeballs, we use the fovea to scan whatever interests us visually, the features of a face or, perhaps, a flower.

There are other types of cells in the retina that do not respond directly to light. These handle the job of collecting impulses from many photoreceptors (rods and cones) and shuttling them on to the nerve cells. Presence of some other receptor cells sensitive to edges and boundaries of objects and those that respond to light and shadow and motion in the retina have also been reported recently.

Bundled together, the nerve cells make up the optic nerve, which transport visual information from the eye to the brain.

Again, it is important to understand that the optic nerve carries no light. Only patterns of nerve impulses conveying information derived from the incoming light is carried. Each of the eyes collects slightly different view of an object. The brain puts the two views together and a three dimensional picture is formed.

Just as strangely, there is a small area of the retina in each eye where everyone is blind, because that part of the retina has no photoreceptors. This blind spot is located at the point where the optic nerve exits each eye, and the result is a gap in the visual field. You do not experience blindness there because what one eye misses is registered by the other eye, and the brain "fills in" the spot with information that matches the background.

Activity-4

Hold the text at arm's length, close your right eye, and fix your left eye straight on the fig-4. Keep your right eye closed and bring the book slowly closer. When it is about 8 to 10 inches away the gap disappears as it is on the blind spot of your left eye. But you will not see a "hole" in your visual field. Instead, your visual system "fills in" the missing area with information from the blue line on either side.

Fig-4

Eye protection

Each eye is protected by eyelids, eye lashes, eye brows and lachrymal or tear glands. A thin membrane covers the front part of the eye. This membrane is called conjunctiva. The conjunctiva is made up of transparent epithelium. It is also a protective cover to the eye. Whenever unwanted substances come in contact with this layer the lachrymal glands are stimulated to wash the substance out of the eye. The fluids that are filled in the eyeball (vitreous and aqueous chambers) protect the lens and other parts of the eye from mechanical shocks. Cornea is the clean window in the sclera in front of the Iris. It protects the eye from direct exposure to light.

Think and Discuss

- What will happen if we have no eye lashes?
- Is tears good for us?

Eye: Some structures that bring about adjustments

The Iris is a muscular structure which adjusts the size of the pupil which is nothing but a gap between the iris in front of the lens. Adjustments are made depending on light intensity.

Cilliary muscles and suspensor ligaments are capable of adjusting the focal length of the eye lens.

Activity-5

1. Observe the Iris and its surroundings of your friend's eye. Can you find the pupil?
2. Observe the colours and patterns in the iris of your friend' s eyes.

Is there any difference from one another? Select a minimum of ten members and note the result. Use a hand lens for close observation. Record your observations in your notebook.

Do you know?

While issuing identity cards like AADHAR. They take photographs of your eyes. Do you know why did they take photo of your eye? Iris patterns are individual specific and can be used for identification just as our finger prints.

The lenses in our eyes are very special. They are biconvex and crystalline in nature. Their shape is adjustable to some extent that is their focal length can be changed with the help of cilliary muscles and suspensory ligaments. They can change the shape of the lens from a moderately to more convex form.

Activity-6

1. Enter into a dark room from a very bright place. What happens?
2. Sit in a dark room for some time. Then go into a bright light room. What happens?

Do you know the impression of an image stays in the retina for about 1/16 of a second. If the still images of an object are flashed at the rate faster than 16 per second. The eye receives it as moving. This is how we see movies.

Eye and Illusions

Activity-7

Take two pieces of white papers with same size. Draw the picture of a cage on one paper and the parrot on the other. Then insert a stick and attach the blank sides of the papers with gum see the adjacent figure. Let it dry then twist the stick rapidly.

What do you notice? Guess why.Let us observe the following figures.

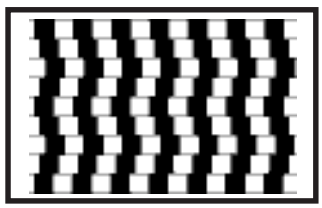


Fig-5(a)

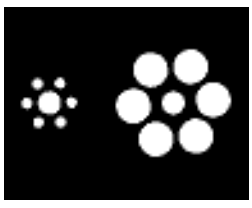


Fig-5(b)

fig-5a :are these lines straight or not

fig-5b: wich one is having big circle in the centre

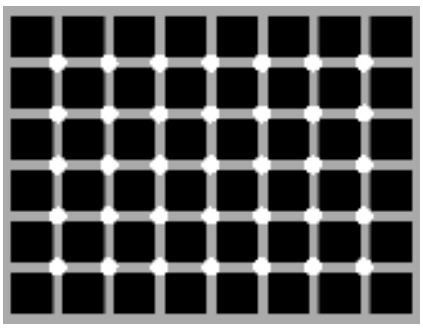


Fig-5(c)

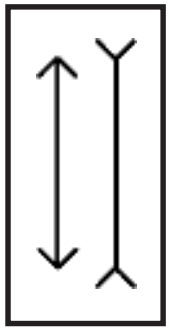


Fig-5(d)

fig-5c: Why do the dots, gray painted as appearing at the intersections of the grid?

fig-5d: which line is smaller

What illusions tell us about Sensation

When your mind deceives you by interpreting a stimulus pattern incorrectly, you are experiencing an illusion. Such illusions can help us understand some fundamental properties of sensation and particularly the discrepancy between what we see and external reality.

Let's first examine the black-and-white grid. As you stare at the center of the grid, note how dark, fuzzy spots appear at the intersections of the white bars. But when you focus on an intersection, the spot vanishes. Why? The answer lies in the way receptor cells in your visual pathways interact with each other. The functioning of certain cells that are sensitive to light–dark boundaries inhibits the activity of adjacent cells that would otherwise detect the white grid lines. This makes you see the grayish regions, even though you know that the squares are black and the lines are white, this knowledge cannot overcome the illusion.

Diseases and defects of the eye

The main diseases and defects of the eye are - Night blindness, Xeropthalmia, myopia (near sightedness), Hypermetropoia (far sightedness), glucoma, cataract and colour blindness. Some persons may have eye defects by birth due to various reasons. Ask your teacher about these eye defects and write one or two sentences for each in your notebook.

Taking care of our eyes

You know the saying Sarvendriyanam Nayanam Pradhanam. How you take care of your eyes? Let us observe the following check list as your teacher how to get points.

Wash eyes with fresh water atleast thrice or four times per day.	Yes/No
Keep the distance between the book and eyes about 25 cm while reading.	Yes/No
Don't give continuous stress and strain to the eyes. Stop the work for some time when ever your eyes feel stressed.	Yes/No
Eat food materials like green leafy vegetables carrots etc rich in Vitamin A.	Yes/No

Work under good lighting.	Yes/No
Don't rub your eyes if anything falls in them, just wash the eyes immediately.	Yes/No
Remove dust in eye by using tongue, ring, blowing air etc.	Yes/No
Consult the eye specialist immediately whenever you face any vision related problems.	Yes/No
Avoid to see lightening gas welding sporks, eclipse.	Yes/No

- How many points you got?
- Are you aware of your eyes?

Ear

Apart from hearing ear helps in maintaining the equilibrium of our body. Do you know by which bone your ears made of? Observe the following picture how inside your ear is?

1. Auditory canal
2. Ear drum
3,4,5. Semicircular canals
6. Cochlea
7. Vestibular nerve
8. Cochlear nerve
9. Eustacian tube
10. Ear Asslcles
11. Outer ear (Pinna)

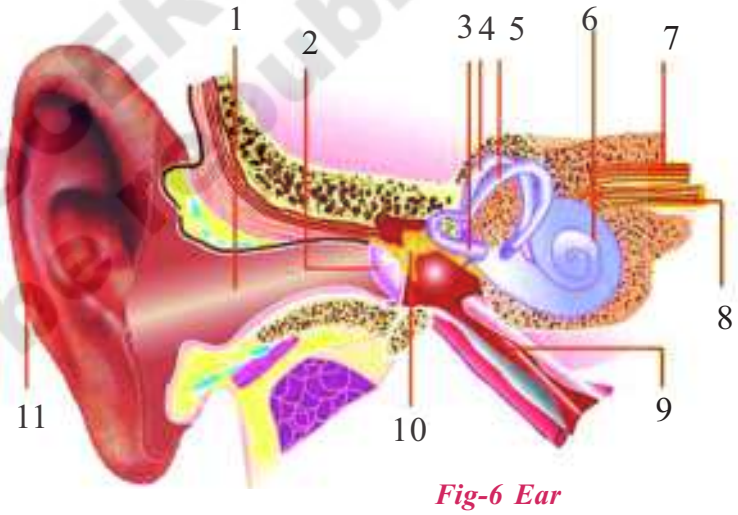


Fig-6 Ear

External ear:

It is the visible part of the ear on either side of our head. It is a flap like structure, called the Pinna. It leads to the ear canal. The pinna is crumpled and made up of cartilage.

- Have you ever observed wax like substance in your ear? Do you know where does it comes from.?

Pinna has ceruminous (wax producing) and sebaceous glands (oil producing). These help to keep the ear cannal lubricated prevent the dust and other particles from entering into the ear canal. The ear canal is also called Auditory Meatus. A thin layer, called tympanum or ear drum is present at the end of the auditory meatus. It is present in between the external and middle ear. It is in the shape of a cone. Its narrow area connects to the first bone malleus of the middle ear.

- If we have not our external ear what will happen to us?

Middle ear:

Middle ear plays an important role in amplifying the vibrations received on the tympanum membrane. The chain of three bones, malleus, incus and stapes helps to do the same. Oval window is a membrane, covered ending of the middle year it opens into the inner ear through round window.

Internal ear or Inner ear:

Internal ear consist of bony labyrinth enclosing the membranous labyrinth. The membranous labyrinth consists of vestibule, three semicircular canals and cochlea. The anterior part of the vestibule is sacculus and the posterior part is utriculus. Nerve fibers from them form vestibular nerve.

The semicircular canals are connected to the vestibule and filled with endolymph. Vestibule and semilunar circles together form vestibular apparatus. If maintains the equilibrium of the body, pertaining to the posture and balance of the body.

Cochlea is a spiral shaped structure. It has three parallel tubes called scala vestibuli, scala media and scala tympani.

The first two are separated by the vestibular membrane. The second and third are separated by the basilar membrane. Scala vestibli and scala tympani are filled with perilymph. Scala media is filled with endolymph. It contains organ of conrti and tiny cells called primary sensory cells. Cochlear nerve fibres form cochlear nerve.

The vestibular and cochlear nerves join together and form auditory nerve.

The Hearing/Auditory Sensation

External ear collects the sound waves. They enter into the auditorymeatus. Then they strike the tympanum. The vibrations from the tympanum reach the malleus, incus and stapes. They magnify the intensity of the sound vibrations. The stapes transmits the vibrations to the membrane of oval window. Then they transmit to the cochlea. The bacillary membrane is moved then the vibrations reach to the organ of carti. The impulses are sent to the brain through the auditory nerve. The hearing can be done according to the responses given by the brain.

Activity-8

- Take a plastic or Iron funnel. Stretch a piece of rubber balloon and cover the wide part of the funnel with it. Tie it with rubber band. Put four or five rice grains on the sheet. Ask your friend to shout 'Oh' at the narrow opening of the funnel.

Observe the movements of the rubber sheet while he is shouting. Observe the rice grains also. What happens to the rice grains? Why?

- Later remove the grains. Keep the wide part with balloon sheet on the chest of your friend. Put the narrow end at the opening of your ear. Could you hear any sound? What is it?

Functions of the ear:

- To collect and transform vibrations produced by sound to nerve impulses to be carried to the brain for processing.
- To maintain balance or equilibrium:
- Ask your teacher in what way ear maintain balance.

Caring for the ears

- Don't insert any sharp edged thing in the ears to clean the ear cannal.
- If any blockage occurs due to ear wax, use the ear drops, or a few drops of coconut oil to loosen it.
- A specialist may be consulted whenever needed.
- It is very danger to pore boiled oils, leafy juices in the ear. Sometimes it may cause deafness.

Ear – diseases:

Common ear-diseases like formation of pus, infection of ear drum etc may be caused by bacterial and fungal infections. If any infection occurs, one must consult the qualified doctors and use prescribed medicines.

Nose

Structure of the nose

Our external nose has two nostrils. They lead to the nasal cavity. Nasal septum divides the nasal cavity into two halves. The nasal cavity is lined with mucus membrane and small hairs. Olfactory receptors are present in the mucus membrane.

Smell and our Nose

Smell serves a protective function by sensing the odur of possibly dangerous food or, for some animals, the scent of a predator. We humans seem to use the sense of smell primarily in conjunction with taste to locate and identify foods, avoid spoiled foods etc. Humans use the sense of smell in much limited manner as compared to other animals.

Fig-7 Nose

The Smell or Olfactory sensation

Smell from flower like Artabotrys (Sampenga) and fruits like Jack fruit (Panasa) is good for some people but not for others. How we get smell either it is good or bad?

Biologically, the sense of smell, or olfaction, begins with chemical events in the nose. There, odurs (in the form of airborne chemical molecules) interact with receptor proteins associated with specialized nerve cells. These cells, incidentally, are the body's only nerve cells that come in direct contact with the outside environment. Receptors present at the base of the skin lining the inner walls of the

nose, are highly sensitive to odor chemicals. These odor chemicals can be complex and varied. For example, freshly brewed coffee owes its scent to as many as 600 volatile compounds (substances that reach gaseous state quickly as they have low boiling points.)

- List out how many odors did you able to smell?

More broadly, scientists have cataloged at least 1,500 different odor-producing chemicals. Exactly how the nose makes sense of so many odors is not completely understood, but we do know that nasal receptors sense the shape of odor molecules.

We also know that the nose's receptor cells (see figure11) transform information about the stimulus into nerve signals and convey it to the brain's smell centers located on the underside of the brain. There, our sensations of smell are initially processed and then passed on to many other parts of the brain. Unlike all the other senses, smell signals are not relayed through the hypothalamus an important part of brain that coordinates our nervous systems and endocrine or hormone secreting system.

- If you are suffering from cold did you smell things in the natural way?
- Do you find any relation between smell and taste?

The hairs and mucous in the nasal cavity keep dust, germs and other unwanted materials away from gaining entry into our bodies through the nose.

Activity-9

Blindfold your friend and ask him/her to identify different things by smell like lemon, tea, coffee, potato, tomato, tamarind, spinach, curd, brinjal, etc. Keep as many things but be careful in choosing them. They should not be in powdered form. Don't allow your friend to touch them.

How does the sense of smell work in identifying some substances mentioned above?

Taking care

Take proper care of your nose by washing it with water as you take bath and during nasal infection by washing them with lukewarm saltwater.

Tongue

Structure of the tongue

Our tongue is made up of voluntary muscles. It contains about 10 thousand taste buds. The taste buds are located in the walls of the papillae.

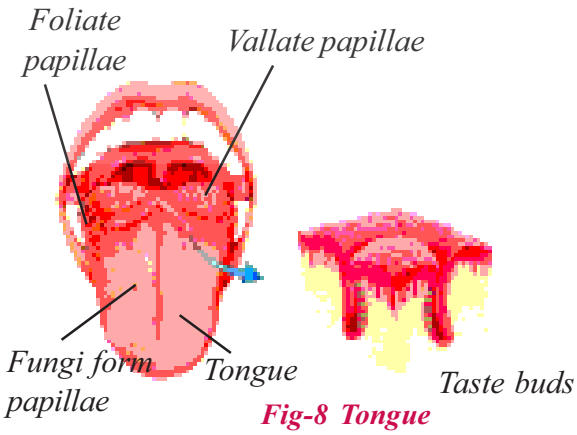


Fig-8 Tongue

Taste and our tongue

Like smell, taste is also a sense based on identifying chemicals in food and the

texture of it. But the similarity doesn't end there: The senses of taste and smell have a close and cooperative working relationship. So many of the subtle distinctions you may think of as flavors really come from odors. (Much of the "taste" of an onion is odor, not flavor. And when you have a cold, you'll notice that food seems tasteless because your nasal passages are blocked.)

Most people know that our sense of taste, or gustation, involves four primary qualities or dimensions: sweet, sour, bitter, and salty. Generally our Telugu people consider six types of tastes (Shadruchulu) which includes spicyness, Vagaru but actually they are tastes.

Less well known, however, is a fifth taste called umami . Umami is the savory flavor found in protein-rich foods, such as meat, seafood, and cheese. It is also associated with monosodium glutamate (MSG) also called as "huching", often used in Asian cuisine.

Metallic taste is the taste of some artificial processed food material.

The taste receptor cells, located in the taste buds on the top and side of the tongue, sample flavors from food and drink as they pass by on the way to the stomach. These taste receptors cluster in small mucous-membrane projections called papillae. Each is especially sensitive to molecules of a particular shape.

Moving beyond the receptors on the tongue, a specialized nerve "hotline" carries nothing but taste messages to specialized regions of the brain.

Developmental Changes in Taste

Infants have heightened taste sensitivity, which is why babies try to sense everything by taste. This super sensitivity, however, decreases with age. As a result, many elderly people complain that food has lost its taste.

Activity-9

Close the eyes of your friend with a piece of cloth. Give her/him a piece of ginger, garlic, tamarind, banana and jaggery one by one. Ask her/him to taste by just taking these one at a time on the tongue. Remember that your friend needs to rinse his /her mouth between each test.

Could your friend tell the taste by just putting the substances on the tongue?

Now repeat the above experiment by asking your friend to take a bite and press the food on the palate. What difference does he or she feel now?

As food enters our mouth, we bite and chew it and press it against the palate with our tongue. This releases the chemicals in food that trigger off our taste buds to act and carry stimulus to the brain to be processed for recognition of taste. The same taste bud is capable of producing different signals corresponding to the different chemicals in food.

Activity-10

Observe your tongue by standing in front of the mirror by sticking your tongue out.

See how many different kinds of structures you can see on your tongue.

Compare with the given diagram.

You can clearly see flake like structures that are the filiform papillae.

The roundish structures are fungiform papillae.

There are large roundish ones at the back of the tongue which are circumvallate papillae. On the sides of the tongue the bump like structures are foliate papillae.

Taste buds are present on all of these except the filiform papillae that are not the sites of taste sensation.

Do you know?

Each taste bud has a cavity with a pore. The pore is called taste pore. The epithelial cells, surrounding the taste buds form taste cells or the receptors. The receptor cells and the cells supporting them are situated in the cavity. Each receptor cell connects to a nerve fibre. All the nerve fibres connect to main nerves that carry messages to the brain and spinal cord for further processing.

Activity-11

Blindfold your friend and ask him/her to close his or her nose as well. Give a few cumin seeds to your friend and ask him/her to chew. Ask your friend to identify what you gave. You could try this with a small piece of potato as well.

- What do you observe? Why?

Taking care about the tongue

- Clean and wash the tongue before going to bed at night and after rising up in the morning.
- Wash the mouth cavity, after eating the food.
- If any problem arises consult the doctor immediately.

Think and Discuss

- Why we are suggested not to take too cool or too hot food material.
- If you are suffering from fever that time to your not able to enjoy the taste of food why?

Skin

The sense of touch had received supreme importance in the sphere of senses from ancient time. The organ involved is our skin.

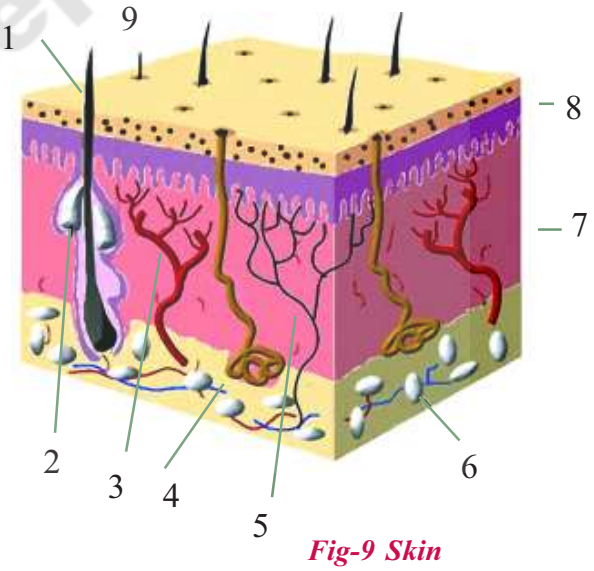


Fig-9 Skin

Structure of the skin

1. hair
2. Oil gland
3. blood vessel
4. sweat gland
5. nerve
6. fat lobules
7. endodermis
8. epidermis
9. pore

Our skin is the sense organ for touch. It contains cutaneous receptors for touch. The skin consists of two main layers, called epidermis and dermis.

Epidermis is the layer for protection. It has sweat pores and small hairs. It contains three layers. They are outer stratum corneum or cornified layer containing dead cells, middle granular layer containing living cells and inner malpighian layer containing the cells dividing constantly. Dermis lies below the epidermis. It is made up of elastic connective tissue. It contains sweat glands, sebaceous glands hair follicles, blood vessels and fats.

Skin and touch:

Skin is the outer most covering of our body. It regulates the body temperature and eliminates certain waste material through sweat. It is the sense organ of touch. The sense of touch is done by the cutaneous receptos. It is the largest organ of all. It provides the first level of protection to the body.

- How sensitive is our skin?

Activity-12

Make bundles of three toothpicks. See to it that their pointed ends are at the same level. Now ask your friend to make an outline of one of her/his palm. Ask you friend to close her/his eyes. Now starting from the tip of the thumb keep pricking lightly with your toothpick bundle all over the plam and keep asking your friend how many points she/he could identify each time. Remember to record with w cross if there is no sensation and with numbers depending on the number of points identified.

Repeat this with some of your friends.

- Where on the palm do you find maximum sensation?
- Where did you find minimum sensation?
- Are palm sense patterns same for all your friends?

The colour of the skin is due to the presence of the pigment, called "melanin". This pigment gets stimulation, when exposed to sun light. The skin becomes dark to protect other layers of the skin from harmful effects of light. Skin is sensitive to touch, temperature and pressure. It contains the separate receptors such as tactile receptors for touch, pacinian corpuscles for pressure, nociceptors for temperature etc.

Activity-13

Press your thumb gently on the tip of a sharpened pencil. Later press it on the blunt end of the pencil.

- How do you feel? Why?
- Do you know?

In Braille script, the letters are written in the form of elevations and depressions. So, the visually impaired students can read the script merely by touching.

Taking care about skin:

We should take bath regularly

- Use soap to clean the body
- If any redness, itching, decolouration and rashes appear on the skin immediately consult the doctor.

Some of the diseases, affecting the skin are.

- Viral diseases such as measles, chicken pox etc.
- Bacterial diseases such as leprosy
- Leucoderma, the disease due to the deficiency of melanin.
- Pellagra the disease due to the deficiency of vitamines.
- Fungal diseases such as ring worm.

Sense organs are the gate way of knowledge. We see, hear and feel the nature by these sense organs. Taking care of sense organs provide good health which leads to better lively hood.

Key words

Sensory receptors, lacrinal glands, conjunctiva, sclera, cornea, iris, pupil, choroid layer, suspensory ligaments, vitreous chamber, aqueous chamber, retina, blind spot, fovea, optic nerve, night blindness, myopia, hypermetropia, cataract colour blindness. pinna, ceruminous glands, sebaceous glands, auditory meatus, malleus, incus, stapes, tympanum, vestibule, semilnar canals, cochlea, basilar membrane, auditory nerve, chemoreceptors, olfactory sense fungiform papillae, filiform papillae, vallate papillae, foliate papillae. Melanin, ceruminous glands, sebaceous glands, cutaneous receptors, tactile receptors, leucoderma

What we have learnt

- Sense organs are five, sense organs work together for particular sensations.
- There is a particular level at which the process of sensation is triggered.
- Stronger sensation masks weaker ones.
- The lens in the eye is adjustable.
- Lachrnmal glands secrete lubricant for the eye aiding in movements of the eye.
- Retina contains mainly Rods for near dark (dim light) vision while Cones help in bright light colour vision.
- Blind spot is the area of "No vision" where the optic nerve leaves the eye.
- Fovea is the area of distinct vision.
- Each eye gets a slightly different view of an object.
- The image forms on retina.
- Our ear has three main parts. They are external ear, middle ear and internal ear.
- Ceruminous glands and sebaceons glands are present in the ear.
- Tympanum or ear drum is present at the end of the auditory meatus or ear cannal.Vibrations of this due to sound travelling through ear cannal, starts the process of hearing

- The middle ear contains three bones, called malleus, incus and stapes that amptify sound.
- Tongue contains nearly 10000 taste buds present on the papillae.
- Skin has cutaneous receptors. It is the sense organ of touch.
- Sense organs send messages through sensory pathways to the brain where they are processed and sent to required sense organs to function through motor pathways.

Improve your learning

I. Give reasons for: (AS 1)

1. We usually do not see bright colours in dim light
2. Removal of wax layer too often will raise incidence of ear infection
3. During severe cough and cold we lose taste of food.
4. While cutting onions our tears start flowing.

II.Find out the false statements and rewrite them as correct ones. (AS 1)

1. The rationale behind seeing is just the impression of the image in the retina.
2. Ear functions only to hear.
3. Iris patterns are like finger prints used in identifying individuals.
4. Saliva helps the taste buds in taste sensation.
5. We are not able to adapt to sensations.

III.State the difference between the two (AS 1)

1. Rods and cones
2. Iris and Pupil
3. Pinna and Tympanum
4. Nasal cavity and ear canal

IV. How do the following processes occur? (AS 1)

1. When we see an object, a real inverted image is formed on the retina.
2. The sound waves, collected by the pinna are changed as vibrations.
3. We move our hand away from a hot object.
4. A pungent odour, makes us close our nose.

V. Fill in the blanks with suitable words. Then give reasons why the words are suitable. (AS 1)

1. Chroid layer provides …… to the eye.
2. The relationship between the tongue and …… is more.

3. Iris pattern is used for individual ……
4. Area where optic nerve leaves the eye is called the ……
5. The ear drum is the …….

VI Choose the correct option (AS 1)

1. This vitamin is essential for the health of eye.
   a) Vitamin 'A' b) Vitamin 'B' c) Vitamin 'C' d) Vitamin 'D'
2. Sensation is a complex pathway involving -
   a) Sense organs b) Sense organs and nerve impulses
   c) Sense organs,nerve impulses, brain
   d)Brain and nerve impulses
3. The sound waves if not focused by external pinna and ear cannal will result in
   a) Hearing several types of sound loudly b) Not hearing anything
   c) Slight hearing d) Not being able to make out the type and origin of sound
4. The muscles of the eyeball of a person becomes non functional, the invariable effect would be-
   a) The person fails to close eyes
   b) Fails to move eye and see colours clearly
   c) Feels pain in the eye
   d) The nerves reaching the muscles become nonfunctional.
5. The tongue of a person is exposed to a high salty taste then:
   a) The person learns to taste salty things better
   b) Loves tasting salty things
   c) Hates tasting salty things
   d) Fails to taste a less salty thing just after the exposure.

VII Draw and label the diagrams, showing the structure of the (AS 5)

1. Eye 2. Ear 3. Tongue

VIII How would you pay concern towards disabled people who is lacking sensory organs?

IX How do you appreciate the functions of sensory organs which helps us to enjoy the beauty of nature? (AS 6)

X Form a group with five students in your class and collect eye diseases and its characteristics by talking with ophthalmic assistant. (AS 4)

XI What happens if our skin loss its sensory nature? (AS 2)

XII Sagar is not able to listen things properly. Guess what would happen to him. What suggestions you would like give to him? (AS 7)