SENSE ORGANS

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Sense organs are special structures which provide us the ability of perceiving the environment. We have 5 sense organs which include eyes, ears, skin, tongue and nose. We see with our eyes, we hear with our ears, we smell with our nose, we taste with our tongue, we feel with our skin. We also have some receptors to perceive stimuli like heat, cold, touch, temperature, pain, thirst and hunger. These stimuli stimulate the sense organs and make them generate a response from the body. This response is termed as sensation.

Sensation

The response generated by the body against certain stimuli is called as sensation.
e.g. On touching a hot pan we quickly draw your hand away. Similarly, when bright light is flashed into our eyes, we immediately close our eyes and cover them with our hands.

Stimulus

the impulse which stimulates the body of an organism to respond is called as stimulus. Stimulus can be external stimulus or internal stimulus. Stimuli which come from outside environment to an organism are called as external stimuli. e.g. Light, sound, smell and heat. Stimuli which originate from inside of an organism are termed to be internal stimuli. e.g. Hunger, pain and thirst.

Response to stimulus

Every sense organ responds to only a specific type of stimulus. Ears only sense sound, Nose can detect smell, Eyes can see light etc. Sense organs are in turn made up of many types of cells. These cells are called as receptors.

Receptors

A group of cells which are capable of receiving stimuli are known as receptor cells or receptors. The name of the receptors cells depends on the stimuli they receive.
e.g. Receptors of the tongue are termed to be taste receptors or gustatory receptors. Receptors of the eyes are termed to be photoreceptors. Receptors that lie inside the
nose are known as olfactory receptors. Receptors located under the skin are known as tango receptors. Receptors located inside the ears are called auditory receptors or phono receptors.

Mechanism of receptors

Mechanism of hearing - Ear

As soon as sound waves reach the ear, these are taken to the auditory receptors. Auditory receptors convert the waves into electrical impulses. Impulses are transmitted to the brain. As the impulses are received by the brain, it analyses and interprets their meaning. The response is exhibited accordingly.
If the sound is loud the person will immediately cover his ears. If the sound is too low, human beings cannot respond as the sensory capability of the human ear is
low.

Sensory capability

This is the ability of an organ to respond to stimuli of particular intensity. Sensory capability differs from one animal to the other.
e.g. The ears of a dog have a higher sensory capability than that of human ears. Hence, they are able to hear even sound generated by tiptoe.

Sense organs in other animals

Lizards and snakes do not have ears to hear. They make use of their tongue to detect the sound. They also use their tongue in smelling and touching also.
Amphibians, such as the frog do not use their tongues for hearing or smelling. They use their tongue to capture their prey. Thus, different animals use the same sense organ for different purposes.

Sense organs, which have different uses, thus enable living organisms to become aware of their environment.

THE EAR

The ear is an important organ for hearing and to maintain balance. It is divided into– the outer ear, the middle ear and the inner ear. The outer and middle ear assist only in hearing, while the inner ear also helps in equilibrium.
The outer ear has pinna and external auditory meatus. Very fine hairs and wax-secreting sebaceous glands are present on the skin of the pinna and the meatus, which prevent dust and small insects. The pinna directs the sound into the meatus.

The tympanic cavity is bound externally by the tympanic membrane and internally by an auditory capsule. The auditory capsule has two

membrane bound apertures called the oval window and the round window. The middle ear has three ossicles called the malleus, incus and stapes, these are attached like a chain. They increase the efficiency of transmission.
Air pressure maintained by the Eustachian tube.

The inner ear consists of labyrinth, which consists of two functional parts – the cochlea, for hearing and the vestibular apparatus, for balance. The labyrinth is of two types – bony and membranous.

The cochlea, has two membranes, namely Reissner's membrane and the basilar membrane which divide the bony labyrinth into scala vestibuli and scala tympani. The fluids in the labyrinth cushion the soft structures and conduct waves from the middle ear to the organ of Corti. Which, is the actual receptor of sound. It is composed of hair cells, which are in contact with tectorial membrane.

The inner ear contains vestibular apparatus that helps maintain the body's balance. It consists of three semi-circular canals and the otolith organ which consists of the saccule and utricle, responsible for maintaining the body's balance and posture.

The external ear receives sound waves and directs them to the eardrum. The eardrum vibrates and transmits them through the malleus, incus and stapes – to the oval window. The ossicles, in turn, amplify the sound and pass the vibrations through the oval window to the fluid of the cochlea. This generates waves which induces a ripple in the basilar membrane, then bend the hair cells, pressing them against the tectorial membrane. This in turn stimulates the hair cells, to generate nerve impulses, which are transmitted to the auditory cortex of the brain. The brain then interprets these nerve impulses and sound is recognised.

THE EYE

Eye is the organ of sight which detect changes and give signals to the central neural system. It is located in eye sockets of the skull, and adapted for binocular vision, these are protected by the eyebrows, eyelids and lachrymal glands. The wall of the human eye is composed of three layers. Sclera, choroid and retina. The anterior portion of the sclera is the cornea. choroid forms the ciliary body which forms the iris, the eyeball contains a transparent crystalline lens held in place by the ligaments of the ciliary body. In front of the lens, the iris, which regulate the diameter of the pupil. The inner layer is the retina which contains three layers of cells consisting of ganglion cells, bipolar cells and the photoreceptor cells. – Photoreceptor cells are of two types rods and cones. Rhodopsin of rods, is sensitive to dim light, these do not play any role in colour vision. Iodopsin of cones, is sensitive to bright daylight. Cones are of three types and contain different photo pigments and respond to red, green and blue light radiations. The optical part of the retina contains two spots known as the blind spot and the fovea.

The aqueous chamber lies between the cornea and lens called, an aqueous humour that provides nutrition to the lens and cornea. The vitreous chamber lies between the lens and retina. It is filled with vitreous humour that gives shape to the eye, supports the retina and lens, refracts light rays and maintains intra-ocular pressure. The human eye works like a camera. The cornea, aqueous humour, lens and vitreous humour, all act as small lenses and refract light rays to focus on the retina. The light rays in the visible wavelength focus on the retina to generate impulses in the rods and cones. The photo pigments of the photoreceptors opsin and retinal. Light dissociates retinal from opsin, which results in changing the structure of opsin. The structural change in opsin changes membrane permeability, which in turn, results in potential differences in the photoreceptor

cells. This results in the generation of action potential which is transmitted to the visual area of the cerebrum by the optic nerve. These nerve impulses are analysed in the visual area and help to recognise the image formed.

THE NOSE

Nose is one among five sense organs present in human beings. It helps us to smell different odours in the environment. The human nose can detect approximately 10,000 different odours. Nose also helps in the process of respiration.

Structure of nose

The human nose has two nasal cavities that are separated from each other by a wall of cartilage called the nasal septum. The two external openings are called the nares or nostrils.

- Atmospheric air enters through the nostrils, passes through the nasal cavity and then through the pharynx, trachea and bronchi before it finally reaches the lungs.

Nasal cavity

The forward section of the nasal cavity within and above each nostril, is called the vestibule.

- At the back of the vestibule and along each outer wall are three elevations, each of which is called a nasal concha or a turbinate.
- These three conchae subdivide the nasal cavity into a series of groove-like passages. These serve as airways.
- Above the uppermost concha is the olfactory bulb. It processes information about odours.

- The entire nasal cavity is lined by a moist mucous membrane supplied with a large number of blood vessels.
- The mucous membrane also has fine hair-like projections called the cilia which collect any debris entering the nasal cavity.
- Apart from the cilia, the mucous membrane also has several cells. Some of these cells, called the secretory cells, secrete a thick, viscous fluid called the mucous.
- Mucous traps any dust, carbon or soot particles or any bacteria entering the nasal cavity.
- The mucous membrane above the uppermost concha also has several olfactory receptor cells that process odour input signals directly to the olfactory bulb.
- These olfactory receptor cells have nerve fibres extending from their bases. Nerve fibres pass through the holes present on the cribriform plate. Cribriform plate is a bony structure that separates the nasal cavity from
- the rest of the skull.
- All the nerve fibres emerging from the receptor cells join to form a larger nerve called the olfactory nerve Olfactory nerve carries the impulses for the sense of smell to the brain.

Information processing by the brain

- When air enters the nose, the odours of the chemicals or the odour molecules present in it dissolve in the moisture of the mucous membrane.
- Chemicals are then detected by the olfactory receptor cells which give out a small electrical current that travels through the nerve fibres to the olfactory nerve which carries the signal to the brain, where the
- information is processed.

Nose is one of the most important sense organs that help you to smell and breathe.

THE TONGUE

Tongue is one among the five sense organs. The tongue is the only muscle in the human body that has taste sensors.

Functions of tongue

- Tongue helps in the special sense of taste.
- Tongue also helps you speak.
- Tongue helps in movement of the food around in the mouth. It also helps in swallowing the food.

Structure of tongue

- The human tongue is covered with a moist, pink tissue, called the mucosa or the mucous membrane. On this membrane are present tiny bumps, called papillae.
- Papillae give the tongue its rough texture. The surface of the papillae is covered by thousands of taste buds.
- Taste buds have the taste sensors or the taste receptors inside them.
- Each taste bud has a cavity with a pore called as the taste pore.
- Inside each cavity are taste receptor cells or gustatory receptor cells, bathed in saliva.
- Each receptor cell has a free hair-like cilium also called the taste hair which projects into the outer taste pore.
- Additionally, each receptor cell has a nerve fibre called the gustatory nerve extending from its base to the taste centre of the brain.

Taste buds

Taste buds recognise different tastes like salt, sweet, bitter and sour. These taste buds are located at different parts of the tongue. Taste buds that are sensitive to salt and sweet tastes are located largely in the front portion of the tongue. The taste buds sensitive to sour taste are located along the sides. Taste buds sensitive to bitter taste are located at the back of the tongue.

Tongue and its receptors

- Tongue also has receptors that sense the temperature and texture of food.
- Tongue also has receptors for sensations like the burning or irritation caused by chillies and the coolness of mint.

Sense of taste

- When food enters the mouth chemical substances such as salt and sugar that provide taste to the food, dissolve in the saliva.
- This saliva enters the cavity of the taste buds through the taste pores and bathes the receptor cells inside.
- When the chemicals in the saliva come in contact with these cells they give out a small electrical potential that travels through the gustatory nerves to the brain.
- The brain decodes the information about the taste of the food and gives us the sense of that taste.

Thus, the tongue is an important sense organ in human beings that helps you taste food, speak and move food around in the mouth.

THE SKIN

Skin acts as a sense organ. It is with the help of skin that we are able to feel things. A pin feels sharp, a silk cloth feels smooth while ice feels cold.
The touch or sensitivity is due to the free nerve endings in your skin. These free nerves endings spread in the dermis layer of the skin making it the largest sense organ.
There are different nerve endings or receptor corpuscles for various sensations.
The tactile receptors are for touch, pressure and vibrations
The thermoreceptors are for temperature
The nociceptors are for pain.

1) Touch receptors:
The touch or tactile receptors on your skin are also called tango receptors. These are further classified into six types which include free nerve endings, root hair plexus, Merkel's discs, Meissner's corpuscles, Pacinian corpuscles and Ruffini corpuscles.

a) The free nerve endings are situated between epidermal cells. These are sensitive to both touch and pressure. The root hair plexus is made up of free nerve endings to detect touch and hair movement.

b) Merkel's discs are located in the lower epidermal layer of the glabrous or hairless skin. These receptors respond to fine touch and pressure.

c) Meissner's corpuscles are sensitive to light touch and vibrations. These are located in the eyelids, lips, fingertips, nipples and external genitalia.

d) Pacinian corpuscles are large receptors located in external genitalia. These receptors are sensitive to deep pressure and high frequency vibrations. They are also found in the fingers and breasts.

e) Ruffini corpuscles are located deep in the dermis, and are sensitive to pressure and distortions of the skin.

Receptors - Their adaptation

Adaptation is a special property possessed by some tactile receptors like free nerve endings, Meissner's corpuscles, Merkel's discs and root hair plexus. According to this property, the receptors respond to a stimulus only for a period of time, after which they no longer respond even if the same stimulus is applied continuously. e.g. After wearing earrings for a long period of time, you don’t feel them even though they constantly touch your body.

Thermoreceptors:

The receptors which respond to the changes in the temperature are called as thermoreceptors. These are of two types namely, heat and cold receptors. These are widely distributed in the skin. There is no structural difference between cold and heat receptors.
Cold receptors also called as frigid receptors respond to low temperatures ranging from 10oC to 20oC. The cold receptors are stimulated in a person working in an air-conditioned room. The number of cold receptors is three to four times more than that of heat receptors.
Heat receptors also as called coreceptors respond to high temperatures ranging from 25oC to 40oC. The heat receptors are stimulated in a person working in the sun.

Nociceptors:

These are free nerve endings below the surface of the skin which respond to pain caused by touch, temperature, pressure and chemicals. Nociceptors produce fast pain, as felt during a prickling sensation, or slow pain, as felt during an ache or a burn.
Nociceptors warn you about dangers. This is why you don't touch sharp or hot object as they hurt and may be even be dangerous to you.

Cutaneous receptors

All the skin receptors, that is nociceptors, thermoreceptors and tactile receptors are collectively called as cutaneous receptors. These are widely distributed throughout the body. Cutaneous distribution is uneven. They are more concentrated on the cheeks, lips and finger tips.
The intensity of feeling a stimulus depends on the area of your skin. If a pin or thorn pricks your finger tip or heel, the intensity of the pain would be more in your finger than in your heel. This is because the epidermis is thicker in the heel than in the finger. The free nerve endings are closely arranged and are sensitive to very weak stimulus making the fingers 'good feelers'.

Braille system

Braille system used by visually challenged people is devised with the letters in the form of elevations and depressions. As fingers are good feelers with more free nerve endings, they help visually impaired persons to read and write in the Braille system.

Skin - Its coordination

Skin does not function alone. Skin being a sense organ works in co-ordination with the brain and the spinal cord.
When a receptor in the skin is stimulated by a stimulus, it generates an electrical impulse.
This impulse travels to the brain via the spinal cord.
The brain analyses and processes the stimulus and the body reacts accordingly.
The presence of skin receptors, thus, helps you feel various sensations like touch, temperature, pressure, vibrations and pain.