

## LESSON 4

### BECOMING AWARE OF THE WORLD AROUND US

#### SUMMARY

Human beings and animals are able to know the world around them. The most remarkable characteristic of an organism is its possession of different sense organs. Sense organs are our windows to collect information from the external world. Each of these sense organs is selectively sensitive to different kinds of stimuli. Human beings depend primarily on visual, auditory, and cutaneous senses to gather most of the information from the world around them.

#### Vision, Audition and Other Senses

We have **ten sense organs** in total. Eight of them gather information from the external world and two help in maintaining body equilibrium and provide important information about body position.

**Human Senses** – Vision, Audition, Smell, Taste, Touch, cold, warmth, pain, Vestibular sense and Kinesthetics sense

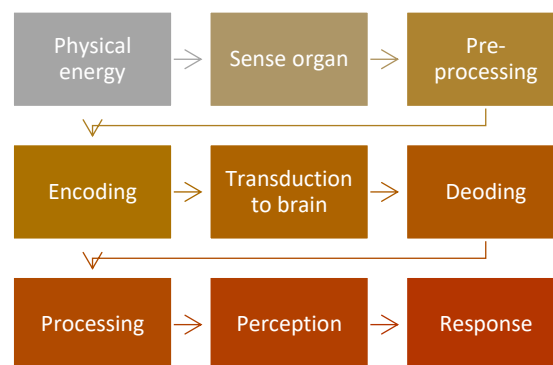
**Cutaneous Sense** – pressure, touch, temperature (cold and warmth) and pain

**Deep Senses**- Vestibular sense, kinesthetics sense

Any external stimulus is received by a specific sense organ. Sense

organs have specialized receptors that **transform the physical energy into neural signals (transduction)** which are then transmitted to brain. The pattern of neural activity is recognized by the brain.

Given below is a diagrammatic representation of **sequence of processing of stimulus information** –



#### Vision

We make the use of vision much more than all the senses combined, about 90 percent of the time. More of the brain is devoted to mechanisms for vision than to any other sense.

#### Physical Nature of Visual stimuli

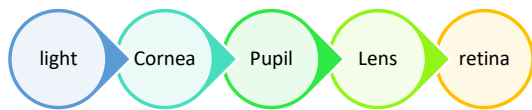
Each of the different sense organs is sensitive to specific physical stimulus called **adequate stimulus**. For eyes adequate stimulus is **photopic stimulation** i.e., light waves. The light waves activate the visual receptors- **rods** and **cones**.

The eyes receive light reflected from objects in the world and from this we perceive colour, shape, depth, texture, etc.

The **visible spectrum range** for human eye is – **400 nm to 750 nm** (approx.).

### Structure of the Eye

A human eye weighs about 7 gm and its diameter is 25mm. It has four major parts – **cornea, iris, lens, retina.**



**Cornea** – Light rays enter the eye through cornea. It is transparent, sharply curved and focuses light on the retina.

**Pupil** – behind cornea is pupil. It appears black. The amount of light that enters pupil is regulated by **iris.**

**Iris** – it's a ring of muscle whose pigmentation gives the eye its colour (brown, blue, etc.). It contracts and dilates reflexively and regulates the amount of light. It allows the eye to adapt as light levels change.

**Lens** – after passing through pupil, light pass through the transparent lens. The **ciliary muscles** attached to the lens modify its curvature to focus light (**accommodation**) on the retina.

Cornea and **sclera** (surround the retina) serve to protect eye

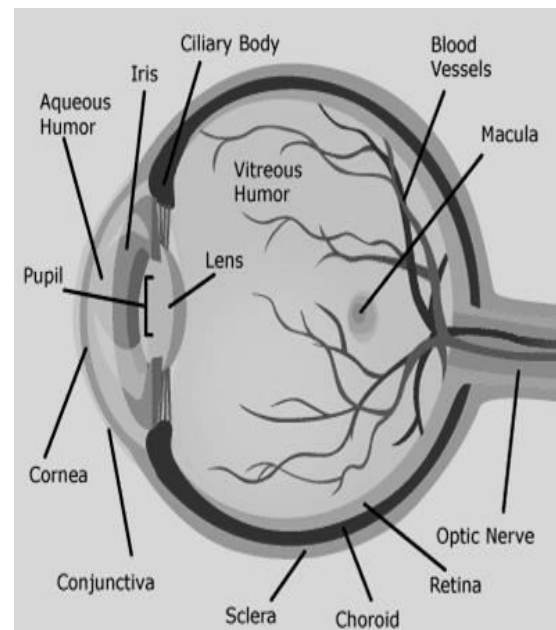
from injury and maintain its shape. **Choroid** is the middle layer of dark material richly supplied with blood vessels.

### The Retina

**Retina** is a thin and delicate inner layer containing the photo-receptors and an elaborate network of interconnecting nerve tissues. Retina is the most important part of the eye.

The light reaches the retina by passing through the **anterior (front)** and **posterior chambers** containing watery fluid (called **aqueous** and **vitreous humor**) and the various retinal layers.

Finally, it reaches the visual receptors, the rods and the cones, located near the back of the retina. These specialized cells (receptors) convert light energy into electrical potential (electrical signals). Here is the diagram representing structure of human eye -



## Sensory Processes other than Vision

After vision, audition is used more often than any other sense.

### Audition

Auditory receptors in the ears respond to sound waves to produce neural signals.

The **eardrum** is pushed and pulled by the **compressions** and **expansions**. It vibrates in a pattern that corresponds to the sound.

Sound waves are produced by pressure changes in the atmosphere. They have two important physical aspects: **frequency** and **amplitude**.

**Frequency** - pitch of a sound depends on its frequency; higher the frequency, higher the pitch. Its unit is **Hertz (Hz)**.

**Amplitude** - The intensity depends upon the amplitude. Its unit is **decibels (dB)**.

**Noise** - if the sound is produced by great number of unrelated sound waves, it is perceived as noise.

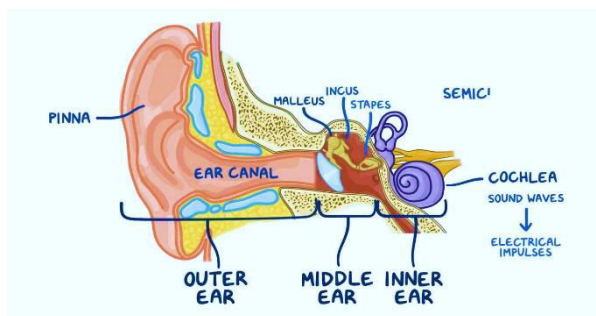
### Structure of Ear

The ear has three major divisions:

- (i) **Outer ear** - consists of pinna and auditory canal  
**Pinna** collects the external energy  
This energy travel through an air-filled **auditory canal**.

- (ii) **Middle ear**—consists of ear drum (tympanic membrane)  
It is stretched on the inner end of auditory canal. Any alteration in the presence of sound wave makes this move back and forth.

- (iii) **Inner ear** - formed by three small bones called **ossicles (MIS)** - **Malleus** (hammer), **Incus** (anvil), and the **Stapes** (stirrup).



The vibration of the oval window creates waves in the fluid that fills the cochlea. As the waves travel through the cochlear fluid the hair cells bend to and fro. At this point, mechanical energy of waves is transduced into electro-chemical impulses that are carried by the auditory nerve to the brain.

The auditory nerve fibres convey the auditory information through series of relay stations to the auditory cortex, located in the temporal lobe of the brain.

### The Cutaneous Sense

The **skin** or cutaneous senses give us information about the surface of our body. Skin is the largest sense organ of the body. It is also called **somaesthetic system**. It consists of –

**Pressure and touch**—The amount of pressure required to produce the experience of pressure varies for different body parts.

**Meissner Corpuscles** serves the pressure sense in the hairless regions of the body. The **nerve endings** do the same for the roots of the hair. Free nerve endings convey touch impulses.

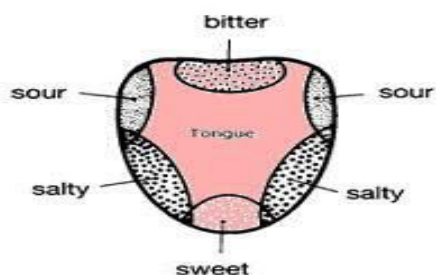
**Temperature sensation: Cold and warmth** – Experiences of cold and warmth are felt by the changes in normal **gradient** of skin temperature i.e., difference (gradient) between skin surface temperature and blood temperature.

It is believed that free nerve endings appear to be responsible for signalling information about temperature.

**Pain**— it has immense biological importance because it signals that something is wrong within the body. Evidence suggests that free nerve endings are the receptors stimulated by tissue damage.

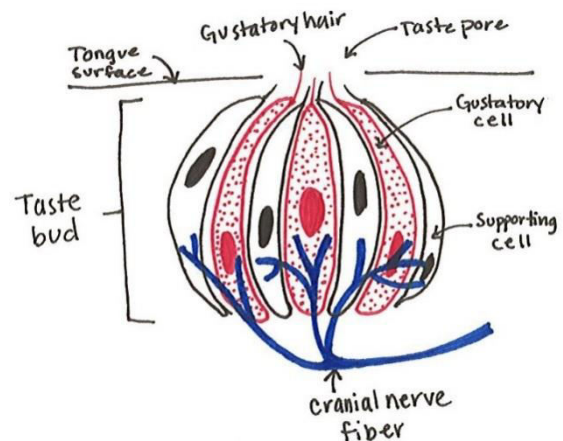
### The sense of taste

Sense of taste or **gustatory system** has four basic tastes—**salty, sweet, sour and bitter**. The tongue is not uniformly sensitive to all stimuli.



Taste buds contain hair cells that are the taste receptors. They are mostly found clumped together on the tongue and are called papillae.

Most of the papillae have **grooves** (moats) around their sides and when we eat or drink something, the liquid in the mouth fills up these grooves around the papillae and stimulate the hair cells chemically. The cells on their part send sensory message to the brain and results in the sensation of taste.



### The Sense of Smell

Smell Sense/**Olfactory system** - provides information about chemical compounds suspended in the air.

Olfactory receptors are located high up in the nasal passage, from the nostrils to the throat. These receptors lie in two small patches, one on the left and other on the right in the roofs of nasal passage. They are embedded in a mucus-coated membrane called - **olfactory epithelium**. Chemicals suspended in the air pass through the nasal passages and stimulate

the olfactory receptors which connect with the olfactory nerve.



### Deep Senses

**kinesthetics System-** Skeletal movement of the body is sensed through kinesthesia, a collective term for all the information that we get from receptors in the muscles, tendons, and joints. It provides us information about the movement of the body as well as information about bodily posture and orientation.

**Vestibular System** - A group of receptors, located in the inner ear, signal the rotation of the head. The three canals in the ear contain viscous liquid that moves when the head is rotated. It provides information about the position of the head-straight up and down or tilted. The system responds to gravity and keeps us informed about our body's location in space.



## Mind, Brain and Consciousness

The sensory experience that we get from stimulus through our receptors is a process and a product the end outcome is what we call perception. Our conscious experience (perception) is a result of processing of information that we receive from different sense modalities (e.g., vision, audition, touch, etc.).

### Consciousness

Consciousness is a state of awareness of external and internal events experienced by an individual. The state of consciousness, keeps on changing even during the waking state. Though, we can perform one action at a time where allocation of attention is required, we can simultaneously carry on the other task if it is highly learnt (it becomes automatic and no conscious control is required).

### Computers and Human Beings

In certain aspects, Computer may be considered to be superior to human brain, e.g., large memory of a computer. Its large and parallel processing capacity. On the other hand, brain is basically capable of serial processing (one task at a time).

But no computer can perform the function of thinking. It has no emotions, imagery, insight, desires, motives, creativity, consciousness.

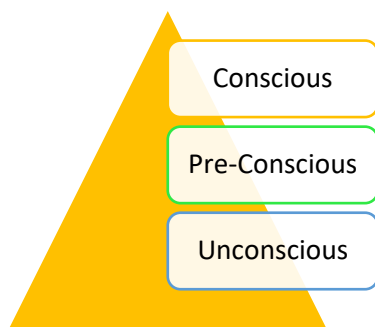


Human brain is capable of performing various cognitive and affective functions.

**Mind** is often considered a functional correlate of brain. Our thoughts, memory, mental images, reasoning, decision making, and so on are all aspects of the human mind.

### Level of Consciousness

Sigmund Freud, the founder of psychoanalysis, believed that human mind has three distinct levels. These three levels include –



**Conscious** – current thoughts and feelings

**Pre-conscious** – contains memories that are not part of current thought but can be readily brought to mind (conscious) if need arises.

**Unconscious** – contains thoughts, desires, and impulses of which we remain largely unaware

### Do you know?

The process of adjusting the lens in accordance with distance, so that the image of the external object is focussed on the retina, is called **accommodation**.

Each retina contains approximately 120 million rods and 6 million cones.

Humans can detect sounds in a frequency range from about 20 Hz to 20,000 Hz.

Sounds above 120 dB are likely to be painful to the human ear.

Females are somewhat more sensitive and accurate than males in odour recognition.

### Evaluate yourself

1. Explain how we process any stimulus.
2. Describe the structure of human eye and ear.
3. How do we feel touch, pressure or temperature? Explain.
4. Elucidate upon the taste and smell senses?
5. What is consciousness? Explain Freud's Level of consciousness model.