

Human Physiology
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Hello everyone, welcome to another new class on human physiology. We are almost at the end of our course. In this class, we will discuss different types of sensory organs and also see how they function. So, let us stick with it. So, what different concepts will be covered in this class? So, this week you remember we discussed neural transmission, we also discussed different types of glial cells, and now we are almost at the end of our course and the end of our week as well. So, finally, we will discuss in this class different sensory organs, and we will see how the sensory organs, such as vision, hearing, smell, taste, and touch, eventually function.

So, what is it basically like the sensory system? The sensory system integrates the specialized sensory receptors. that detect stimuli from both the external and internal environments. So, from the external or internal environment, the sensory system eventually detects different types of responses, and it transmits those sensory responses to the brain and the spinal cord. And once those responses get processed inside our brain or through the motor neuron or the motor nerve, it generates different types of stimulation or responses.

So, what are the different types of key functions for the sensory system? Basically, the main function is receiving sensory input. So, basically, specialized receptors detect stimuli such as light, sound, chemicals, pressure, and temperature. Then it also helps in transmitting information to the brain. So, as we said, once the sensory applications are received, this sensory system transmits the signals from the spinal cord to the brain and finally processes and interprets the sensory information. So, once the sensory signals have been transmitted to the brain, They get processed in the different areas of the brain.

For example, the sensory cortex area interprets the signals, giving rise to different types of perceptions and, eventually, to consciousness and awareness related to the stimuli. This type of process basically involves a lot of complicated neuronal pathways and integration with memory and other cognitive functions. What are the different types of senses? Basically, we mostly have five types of senses, as we all know. It is like vision, right? So, in cases of vision, it helps in terms of detecting light and allows us to perceive the world visually. Also, it helps to understand the color, shape, and movement.

Then, in the case of hearing or the auditory sense, it detects basically different types of sounds, enabling us to perceive auditory information such as speech, music, and other environmental sounds. Then, olfaction, in terms of smell, detects airborne chemicals. It also allows us to perceive odors. Then in terms of taste or gustation, it detects chemicals in the mouth, allowing us to perceive different types of flavor. Finally, in terms of touch, it detects pressure, temperature, pain, texture, etc.

through different receptors of skin. Apart from that, other senses, like balance, body posture, body position, and movement, as well as some internal sensations, can also be present through the use of sensory organs or the sensory system. The first one we will discuss is the vision, in which the eye is the most important component. So, let us see the different components of the

eye through which we basically see the world; along with that, we can also understand color, and we can also see the shape and structure of an object. So, let us see what the different components of our eye are.

The first thing we will discuss is the cornea. You can see it is basically the transparent dome-shaped outer layer of the eye composed of several layers of specialized cells, and it basically lacks blood vessels. And what is the cornea's function? It basically refracts or bends light. So, you can see that from the cornea, the light gets basically refracted or bent. When it enters the eye in this way, it plays a very crucial role in terms of focusing images on the retina.

So from the cornea, the light gets bent and eventually focuses those images in the retina. Then the sclera you can see is like this part, which is the sclera; this is a white, tough layer mostly made of collagen and elastic fibers, and it basically serves as a structural component or protection; this is the function of the sclera. So, this is a collagen layer mostly meant to provide structural support. In the choroid, this part just inside the sclera is the vascular layer of the eye; it is located between the retina. So, between the retina and the sclera, the vascular layer, which is called the choroid, is present, and its function is basically to provide oxygen and nutrients to the eye.

Then the lens you can see this part, which is one of the most crucial components of the eye, which is a lens. It is a flexible crystalline structure, right? This is a crystalline and flexible structure that is located behind the pupil. So, just behind the pupil, you can see that the lens is located. And what is the function? Basically, it fine-tunes the focus by changing its shape to a process called accommodation. So, in this way, it allows us to see objects clearly at varying distances.

So, by changing the shape of the lens, it helps us see objects at varying distances. Then you can see the iris. Basically, it is a colored, circular part of the eye surrounding the pupil. As you know, the function of the iris is basically to regulate the diameter of the pupil, thereby controlling the amount of light that can enter. Then the pupil, which is basically a circular opening in the center of the iris, functions to control how much light can enter the eye.

So, the pupil and the iris both have a role in controlling the movement of light and the entry of light into our eye. Then the retina is one of the most important parts; right, the retina is this. This yellow part, which is the retina, you can see right. So, basically, it is a light-sensitive layer lining the inner surface of the back of the eye, and as you all know, the function of the retina is to convert the light signal into an electrical signal that is then transmitted to the brain. So, in the retina, this is such an important area where the light signal gets converted to the electrical signal and then it kind of gets transmitted to the brain.

Then, if you can see this part, this part of the fovea is basically a small central pit, and its function is that it provides the sharpest central vision. So, it is just like a small pit, and it contains a higher concentration of cone cells; in this way, these cone cells provide the sharpest central vision. Then there is the ciliary muscle; you can see this muscle like ciliary muscles. It is a ring of smooth muscle in the eye's middle layer, and the function of these ciliary muscles is to help control accommodation, the process by which the lens changes its curvature. So, basically, with the help of the ciliary muscle, it controls the accommodation process.

And then there are other components you can go through; for example, the aqueous humor is important in terms of maintaining the eye shape, while the vitreous humor helps in maintaining

the eye's spherical shape and also supports the retina. Another important component is the optic nerve. So, you can see there is the optic nerve, which is present to see the bunch of optic nerves that come out of the eye, and why these are important is because, as we said, in the retina it kind of changes the light signal to the electrical signal, and these electrical signals basically transmit via the optic nerve to the brain. So, via the optic nerve, the electrical signal eventually transmits to the brain for further processing. Then, very importantly in our eyes, there are two types of receptors: one is the rod receptor, and the second is the cone receptor; these are basically photoreceptors.

So, in terms of rods, these are highly sensitive photoreceptors that are mostly present in the retina, and they enable vision in low light conditions. So, this type of rod photoreceptor improves a person's night vision. And more like the cones concentrated in the periphery of the retina, it is thus responsible for black and white vision. And cones, you can see, these are another type of photoreceptor; these are less sensitive, not as sensitive as the rods, and mostly they enable color vision. So, in the case of the rods, they can help with black and white vision, as well as with low light conditions or night vision, but in terms of the cones, they enable color vision.

Apart from that, they are less numerous than rods and are concentrated mostly in the fovea area. and it requires a brighter light to function. So, in the case of cones, it requires brighter light to function; in the case of rods, it can even work in darker conditions or at night. And let's see, like the human visual pathway. So, basically, initially light enters the eye and is focused in the cornea and falls onto the retina.

So, you can see how light enters and eventually is focused on the cornea and the lens, and then the light gets inverted right onto the retina, where it is converted from light to an electrical signal. And now these electrical signals are eventually transmitted. So, basically, who eventually kind of converts this light into electrical signals? So, these photoreceptors, which are mostly the rods and the cones, are present. So, these rods and cones eventually convert the light into an electrical signal, and then through the optic nerve, these signals basically go to our brain, but an interesting thing happens here in the optical area; you can see this crossover, which is where the signals received from the right eye eventually go and are transmitted to the left part of the brain and the signals received in the left eye crossover and go to the right side of the brain. So, this kind of crossover happens, and eventually, in the brain cortex, there is the occipital lobe.

So, in the visual cortex, we have already discussed the presence of the occipital lobe. The occipital lobe of the brain processes electrical signals and tries to understand or process the size, shape, color of the object, or even distance. Then the ear, which is the important organ for hearing, is. So, basically, as we all know, the ear contributes to hearing, right? It eventually allows us to listen to different types of music, sounds, or environmental noises. So, the ear has different components; you can see that it can be divided into the external component, middle part, and inner ear.

So, in the outer ear, it has this funnel-type shape, which is called the external auditory canal. So, you have these two components: one is this canal area, which is also called the external auditory canal, and then you also have this funnel-shaped structure, which is the pinna or auricle. So, basically from here we first perceive the voice or different types of sounds, and once we perceive the sounds, it goes via this external auditory canal or the ear canal. There in

the middle layer, you can see that there are different kinds of compositions; mostly, we will see that the tympanic membrane, or the eardrum, is present.

Right. So, this tympanic membrane, or the eardrum, is present here. This is a thin cone-shaped membrane that vibrates in response to the sound wave. Now, we will see different types of bones; three tiny bones are generally present, which, as a combination, are called ossicles: the malleus, incus, and stapes. Right, it helps in terms of transmitting the vibration from the eardrum to the inner ear. So, what it does basically is whenever this initial sound response comes, it vibrates and eventually transmits the vibration from the middle layer to the inner layer.

In the inner ear, what we can see is that it is also made of different compositions, where a spiral-shaped fluid-filled structure is observed that basically converts sound vibrations into electrical signals. It also contains hair-like cells that have sensory receptors within the cochlea. Okay, that basically transduces mechanical vibration to electrical signals. So, initially, when those three tiny bones were vibrated, they sent some mechanical vibration signals, which eventually converted to electrical signals inside the hair cells in the inner ear. And finally, the vestibular system, which is like a series of interconnected chambers and canals, is responsible for balance and spatial orientation.

And you can see that in the vestibular system, we can observe the semicircular canals, which are three fluid-filled canals that detect rotational movement of the head. We can also see the utricle and saccule, which are basically used to detect linear acceleration and position relative to gravity. Then the next one is the olfactory kind of organ, which is the nose, and it is also important for taking in or perceiving different types of smells. It is made with different components. For example, the external nose, nasal cavity, nostrils, nasal conchae, olfactory epithelium, olfactory receptor cells, and mucous membrane.

And what are the olfactory pathways basically like? So, basically, initially, the odor molecules or the chemical molecules in the air get dissolved in the mucus lining of the olfactory epithelium. So, basically, these are the olfactory epithelium cells. So, different types of chemical molecules that are present in the air get dissolved in this olfactory epithelium. And the olfactory receptor cells in the epithelium detect the odor molecules and generate electrical signals. So, once it kind of dissolves here in the olfactory epithelium cells, it creates electrical signals, and via this olfactory nerve, these electrical signals basically get transmitted to the brain area of the olfactory bulb.

So, where in the olfactory bulb are the electrical signals transmitted, and eventually, based on the kind of responses, are these signals transmitted to different parts of the brain, including the olfactory cortex, which is mostly responsible for the perception of different types of odors? Then finally, the fourth major sense is the sense of taste. And the responsible organ for that is the tongue. So, the tongue is a muscular organ that is present inside our mouth and aids in speech, chewing, swallowing, etc. So in terms of the tongue, it can be seen that it has a lot of taste buds. Basically, these are the sensory structures that contain the taste receptor cells.

So basically, taste buds contain the taste receptor cells. And the taste receptor cells are the specialized cells that are present in the taste bud and can detect different types of taste molecules. A different type of taste can be sensed, and the location of the tongue basically controls or directs which type of taste can be detected in which area of the tongue. So basically,

in cases of sweet taste, different types of sweet taste can be sensed on the tip of the tongue. So on the tip of the tongue, a sweet taste can be sensed.

In cases of a sour taste, it is basically detected on the side. So, all types of sour tastes can basically be perceived on the sides. Then the salty taste can basically be detected in the front. So, all these frontages can detect the salty taste. So, the salty taste can be detected at the front edges, while the bitter taste can mostly be detected at the back.

So, basically, a bitter taste can be detected on the backside, and in terms of umami, it is detected across the middle of the tongue. Basically, the savory taste is primarily detected by the receptors that respond to glutamate and other amino acids. So, basically, the test molecules in the food that you initially get dissolved in the saliva interact with the test receptor cells, which generate the electrical signals, and these electrical signals, as you all know, like we discussed, will be transmitted to the different sensory nerves, for example, the facial, glossopharyngeal, and vagus nerves of the brainstem, and then those signals will be relayed to the thalamus. Finally, those signals will reach the gustatory cortex of the brain where they will be processed in terms of the perception of taste. Lastly, the touch signal is being processed by the skin, which is one of the largest organs of our body.

It has different layers; for example, the epidermis, which is the outermost layer of the cells where Merkel cells are present. Then the middle layer, which is called the dermis, is a cell. It is just beneath the epidermis, and it contains different types of collagen, blood vessels, sweat glands, and different types of nerve endings. And lastly, the hypodermis, which is the deepest layer of the inner layer of the skin, is located beneath the dermis, and its components include adipose tissue, blood vessels, and nerves. And basically, a lot of mechanoreceptors are present, right? You can see all these mechanopresent or mechanoreceptors.

Apart from that, thermoreceptors are also present. This helps in terms of understanding conditions like cold or warm. Apart from that, a lot of nociceptors, or pain receptors, are also present in the skin. This helps us understand in cases where we sense any type of pain or not. And immediately, if we sense any pain, warm or cold condition, this will get processed initially through the sensory nerve; the signals will be transmitted to our brain, and after the perception, the process will resemble a reflex action. So, do you know the human nose can detect trillions of different odors, the skin is the largest sensory organ, and the stapes is the smallest bone present in the middle ear? So, which part of the brain controls the activity on the right side of the brain? So, can you say which part of the brain controls the right side of our vision? So, we already discussed the crossover thing, right? So, if you have any further questions, please discuss them with us during the live session.

You can also send us your question in an email. So, we are almost at the end of our physiology class. Today we thoroughly discussed different types of sensory organs, and we also saw what the different types of cells that process sensory organs are and how they generate different types of perceptions or responses. So, thank you again for attending today's class on human physiology. We will meet with you very soon regarding another new class. Basically, we are leaving with one more class where we will discuss neurological disorders.

So, let us meet with you very soon for the last class, which will be on neurological disorders, and then we will end our human physiology course. Thank you again for staying with us.