Senses: What would we do without them?

**Introduction:**

Well to start off, our lives would be extremely dull without them! There is a total of five major categories for the sensations that we experience on a daily basis. These senses include such things as taste, smell, hearing, touch, and sight, as you probably already know. Although we experience these sensations every day, most people don’t know HOW such environmental and superficial stimuli actually get processed in our body. Such knowledge would allow us to know that we are SMELLING something fishy, SEEING that it is a fish, and possibly TOUCHING it and sensing the scales, again, proving that it is a fish. Another example would be TASTING something like iron with our HEARING being static and distant, and knowing that you just got hit in the mouth because you FELT someone’s hand touch your face. As you can now see and will continue to learn in the upcoming chapter, some of our senses are very interconnected, and all senses are important to understand because they aid in everyday processes.

**Taste and Smell:**

Taste and smell will be discussed together because they are two of the most interconnected senses, as you will soon find out.

Both tasting and smelling systems have three main distinctive characteristics from the other three senses. They are (1) utilized to provide information about our chemical surroundings. Smelling or tasting different things can stimulate a certain feeling such as happiness or sadness depending on the association of that sense to stored memories. (2) They use chemoreceptors to detect molecules that are entering either system. Smelling is a sensation that is stimulated by molecules from the air entering the nose and dissolving in the mucus present. Taste, however, is determined when molecules are dissolved in the saliva in the mouth. And (3) these two senses are not entirely independent from one another. There have been numerous studies done where one of these sensations is blocked, and there is a resulting decrease in the ability to distinguish what the stimulus is. This is an experiment that you have probably done on your own, but you may not have been aware of exactly what was going on. Take, for instance, a strong food such as garlic. Because of its strong taste and smell, it would seem that no matter what sense was limited, garlic would still be identified as garlic. However, if smell is cut off from the decision making, it has been found that just by using taste, garlic is very rarely correctly identified. So, both taste and smell are very closely linked in order to piece together a chemical in the air as a certain food or substance.

The taste sensation is also known as gustation. As previously stated, taste is sensed when molecules are dissolved in saliva. Well, then what? In the mouth there are about 10,000 taste buds, some are more concentrated in certain areas and cluster together to form fungiform papilla. And the taste buds themselves contain about 100 receptor cells each! These receptor cells are not only located on the tongue, they are found on the roof of the mouth, in the throat, and as far down in the digestive tract as the stomach and intestines, all utilized for one sense: taste.

Taste is organized into 5 categories: sweet, salty, bitter, sour, and umami. There have been 3 identified types of receptor cells within the taste bud, but these functions are still not completely clear. Type 1 is used to detect the sodium ion (Na+) which helps discern the salty taste, and it is assumed this is accomplished through Na+ channels. Originally this receptor cell was only thought to aid in support. Type 2 is a receptor cell which means that it doesn’t synapse with a dendrite, instead it releases ATP in order to induce an interaction between cells which stimulates or inhibits the stimulus. This, unlike receptor 1, does not only sense one taste, but is stimulated by multiple. Finally, type 3 cells, unlike type 2 cells, do pass on a stimulus through synapses of neurons in the form of the serotonin neurotransmitter. These cells are also called “presynaptic cells” and “specialized sensory cells.” These are similar to type 1 cells because they only detect H+ which distinguishes the sour taste. All of these tastes are transduced through Ca^2++ signaling in the respective cell leading from the chemical stimuli to an electrical message that goes to the brain for interpretation. These stimuli pass through the tongue into the brain stem (specifically the medulla oblongata) to the thalamus, and then to the gustatory cortex (taste area of the brain).

**Interesting Fact:** The one taste not mentioned is spicy. Spiciness is not recognized by taste receptor cells because it is recognized by pain receptors, also known as nociceptors. So, if you don’t like spicy food that might be due to your body not liking self-induced pain!

Olfaction is another name for the sense of smell. These smells are recognized by about 10,000,000 receptor cells found in the epithelium of the olfactory within the nose. The specific type of chemical detected depends on the receptor type (one of thousands) stimulated. The olfactory neurons are the only cranial nerves that do not go through the brain stem or thalamus to enter the brain. These neurons transmit from the olfactory epithelium (located internally to the nasal cavity) to the Olfactory bulb and eventually end up in the olfactory cortex, then the limbic system and cerebral cortex in the brain. To begin this process, however, free nerve endings located in the mucus of the nose sense the signals and the process is initiated in order to smell a certain smell.

The last three senses sight, hearing, and touch are more widely known topics so discussion will consist of more of an overview.

**Sight:**

Vision is the result of the distinction of an image in the brain due to reflection of light from the environmental objects in the field of vision entering the eye. The light goes through the cornea and pupil and hits the lens where it focuses that incoming light on the retina. Photoreceptors housed in the retina transform this light energy into electrical signals which can travel through the optic nerve to the brain. Rods and cones are two of these photoreceptors. Cones sense colors by light absorption and rods can operate in lower light and are used for peripheral vision. Once the electrical signals pass through the visual cortex in the brain, neural processing takes place creating the actual image that we “see.”

**Hearing:**

 Sound is a mechanical pressure wave that passes through the air and into your ear. Most of sound transduction is the result of vibrations all originating from the mechanical pressure wave reaching the tympanic membrane, or eardrum, then a chain of events within the ear occurs. The energy from the sound wave is passed through the 3 middle ear bones and results in vibration of those bones to amplify the sound to reach the inner ear. Then these vibrations continue further into the inner ear reaching the fluid in the cochlea and results in waves. The cochlear nerves attach the cochlea to the brain, and action potentials travel through those nerves and the sound energy is reintroduced into the cochlea. It’s amazing to think that all of these steps have to occur in order to create a simple sound!

**Touch:**

Touch is the result of a stimulus on the surface of the skin, or superficial part of the body, that is characteristic of a pressure change. This pressure change stimulates neurons to fire through the body into the spinal cord and brain in order to determine where that pressure is originating from. This response can be a result of a painful stimuli. In this case, the neuron firing goes directly to the spinal cord and immediately initiates a reaction. An example would be placing your hand on a hot stove, the moment your hand touches that stove, you remove it because there is an immediate interpretation of the heat and pain. Once this initial reaction is initiated then the action potentials reach the brain where the sensation is further interpreted through synapsing with neurons throughout the peripheral nervous system. Ultimately, these signals travel into the central nervous system and end up in the thalamus.

**Conclusion:**

 Each of these senses have their own pathways and processes in order to produce the sensations that we are familiar with. The one thing each of these senses has in common is that a nerve of some kind is used in getting the initial stimulus to the brain for interpretation. These are complex pathways to produce something that is used every day, but it is incredible because these are events that happen without our knowing. Our only real knowledge stems from the product, the sound, image, taste, smell, or touch that affects us and that we are well aware of.

**References:**

Dee Unglaub Silverthorn. 2018. Human Physiology. An Integrated Approach, 8th ed. San Francisco: Pearson Education, Inc.

Dr. Mathew Lovern Physiology Lecture.