Lecture Review: Chemical Senses

The **chemical senses** encompass a variety of systems including **unconscious senses** like osmosensation (sense of body fluid concentration), and **conscious senses** like **gustation** and **olfaction**. In the lecture, after a brief summary, I focused on the later two sensory systems.

Gustation is the sense of taste. In mammals the sense of taste is provided by taste receptors that are distributed for the most part on the tongue, but are also found in the pharynx. On the tongue the taste receptors are grouped together into what are called **papillae** (little bumps). There are three types of papillae: **fungiform**, **foliate**, and **vallate** papillae. You should know where each of these types of papillae is found on the tongue. The papillae have anywhere from one to several hundred **taste buds** on their surface. The taste buds are composed of 50-150 **taste receptor cells**, which are arranged so that their apical end is exposed to the surface of the tongue, and their basal end makes synaptic contact with an afferent sensory axon. In addition to receptors, taste buds also consist of **basal cells**. The taste receptor cells usually last about 2 weeks before they are die and need to be replaced. The basal cells serve a variety of functions including dividing and giving rise to new taste receptor cells.

When taste receptor cells are stimulated by their taste stimulus, they generate a **receptor potential** that causes the release of neurotransmitter onto the post-synaptic membrane of the afferent sensory axon. In mammals, **five basic taste sensations, sweet, sour, salty, bitter, and umami,** are recognized**.** Umami is a taste sensation associated with amino acids like glutamate. Most taste receptor cells are not specifically sensitive to a single taste stimulus, they may be tuned to respond most strongly to a specific taste stimulus, but they also respond to some degree to more than one of the five basic tastes. So, when you experience a taste sensation, your brain distinguishes a taste by comparing the inputs from all the taste receptors and distinguishes which is responding most strongly. This type of sensory processing is common and is referred to as **population coding**.

The process by which a sensory signal is converted into an electrical signal is called **transduction.** And in the gustatory receptors the different tastes stimuli are transduced differently. You should know in detail how each of the taste stimuli is transduced by the taste receptors as described in lecture.

The taste receptors are innervated by **cranial nerves VII, IX, and X**. I described which taste receptors are innervated by each of these cranial nerves. The sensory afferents from these nerves have their cell bodies in ganglia that are associated with each of these nerves. The sensory afferents enter the medulla oblongata, and synapse in the **gustatory nucleus (a.k.a. nucleus solitarius)**. The neurons in the gustatory nucleus send axons to several parts of the brain. For the conscious sensation of taste, the gustatory nucleus sends axons to synapse on cells in a nucleus in the ipsilateral thalamus called the **ventral posterior medial nucleus** (**VPM**). The neurons in VPM send their axons up to **primary gustatory cortex,** which is also known as **Brodmann area 43.** The gustatory nucleus also makes synaptic connections with **other nuclei in the medulla** that are responsible for **reflex acts** like salivating, swallowing, and vomiting. Connections are also made with the **hypothalamus** which mediate behaviors like food specific hungers and other food related drives.

Olfaction is the sense of smell. The receptors responsible for olfaction are located in the **olfactory epithelium**, and are called olfactory receptor cells, which possess an axon and are considered neurons. Olfactory receptors survive about 4-8 weeks before they die and are replaced by basal cell division in the olfactory epithelium. I discussed transduction in olfactory receptors and you should know this process in detail. The olfactory axons come together to form several bundles, which penetrate the cribriform plate of the skull. The bundles of olfactory axons constitute the **olfactory nerve**. After entering the cranial cavity, the axons of the olfactory nerve penetrate the **olfactory bulb** and enter into glomeruli where they form synapses on dendrites of olfactory bulb neurons. The olfactory bulb neurons give rise to axons that form the **olfactory tract.** I reviewed the connections of the olfactory tract and you should know these connections for the exam.