

Chemical Senses

Required reading: Ganong-Review of Medical Physiology 23 ed. Ch.14

Objectives:

This lecture concerns the two main chemical senses, taste and smell. We will also briefly discuss the putative pheromonal chemical sense.

- Understand the link between chemical senses and overall health, nutrition, and dietary choices
- Recognize that abnormalities in taste and smell perception can indicate underlying health conditions
- Describe the role of taste testing in the diagnosis and monitoring of neurologic and nutritional disorders
- Recognize the impact of age, gender, and genetics on taste and smell perception.

Taste: You should know:

- the structure and function of taste buds
- taste buds are modified epithelial cells with neuron-like properties
- the different types of taste buds in the oral cavity and their structure
- the molecular mechanisms by which sweet, salty, sour, and bitter substances depolarize taste receptors.
- taste information is coded by the pattern of activity in the population of neurons
- the cranial nerves involved and their pathways:
 - CN 7,9,10 project to...
 - the nucleus of the Solitary tract, where 2nd order neurons are located which project to...
 - the medial part of the ventral posteromedial nucleus (VPM), whose neurons project to...
 - gustatory cortex in the insula and medial surface of frontal operculum by the base of the central sulcus, which in turn projects to...
 - orbital cortex of the frontal lobe and amygdala
- CN 5 provides innervation of the anterior 2/3 of the tongue and the soft palate, and carries general somatic information, including pain (e.g., capsaicin)
 - carries information to spinal nucleus of V and on to the VPM of the thalamus adjacent to inputs from CN 7,9 and 10

Smell: You should know:

- the structure and function of olfactory receptor cells
- olfactory receptor cells are neuronal (unlike taste buds)
- olfactory receptors cells regenerate throughout adult life, and their high rate of turnover is unique amongst neurons.

- individual olfactory receptor cells each express a single class of G-protein coupled receptors which have been implicated in the response to odorant (olfactant) molecules.
- there are thousands of different kinds of olfactory receptor cells, each of which binds a unique array of odorants.
- the chemical and physical properties that substances must have to be detected by the olfactory system
- the neuronal pathways involved in smell
 - olfactory receptor cells project through cribriform plate (via olfactory nerve) to innervate mitral cells in the olfactory bulb
 - olfactory bulb projects directly to olfactory cortex
 - primary olfactory cortex sends information to olfactory association cortex either directly or through a relay at the dorsomedial nucleus in the thalamus
- how deficits in olfaction can be either conductive or sensorineural

Pheromonal communication: You should know:

- this sense, which has been widely studied in insects and lower mammals, has not been convincingly shown to exist in primates.
- the vomeronasal organ, where pheromonal receptors are located, is absent in most primates after gestation
- in cases in which a vomeronasal-like structure persists into adulthood, it is thought to be non-functional (vestigial)
- this is still a very hotly debated scientific issue