18/mhs07/18

Phs 212 Assignment

June 20, 2020

Elucidate the pathway involved in taste.

The **gustatory system** or **sense of taste** is the [sensory system](/wiki/Sensory_system%22%20%5Co%20%22Sensory%20system) that is partially responsible for the [perception](/wiki/Perception%22%20%5Co%20%22Perception) of [taste (flavor)](/wiki/Flavor%22%20%5Co%20%22Flavor). Taste is the perception produced or stimulated when a substance in the mouth [reacts chemically](/wiki/Biochemistry%22%20%5Co%20%22Biochemistry) with [taste receptor](/wiki/Taste_receptor%22%20%5Co%20%22Taste%20receptor) cells located on [taste buds](/wiki/Taste_bud%22%20%5Co%20%22Taste%20bud) in the [oral cavity](/wiki/Oral_cavity%22%20%5Co%20%22Oral%20cavity), mostly on the [tongue](/wiki/Tongue%22%20%5Co%20%22Tongue). Taste, along with smell ([olfaction](/wiki/Olfaction%22%20%5Co%20%22Olfaction)) and [trigeminal nerve](/wiki/Trigeminal_nerve%22%20%5Co%20%22Trigeminal%20nerve) stimulation (registering texture, pain, and temperature), determines [flavors](/wiki/Flavor%22%20%5Co%20%22Flavor) of [food](/wiki/Food%22%20%5Co%20%22Food) and other substances. Humans have taste receptors on taste buds and other areas including the upper surface of the [tongue](/wiki/Tongue%22%20%5Co%20%22Tongue) and the [epiglottis](/wiki/Epiglottis%22%20%5Co%20%22Epiglottis). The [gustatory cortex](/wiki/Gustatory_cortex%22%20%5Co%20%22Gustatory%20cortex) is responsible for the perception of taste.

The tongue is covered with thousands of small bumps called [papillae](/wiki/Lingual_papillae%22%20%5Co%20%22Lingual%20papillae), which are visible to the naked eye. Within each papilla are hundreds of taste buds. The exception to this is the [filiform papillae](/wiki/Filiform_papillae%22%20%5Co%20%22Filiform%20papillae) that do not contain taste buds. There are between 2000 and 5000 taste buds that are located on the back and front of the tongue. Others are located on the roof, sides and back of the mouth, and in the throat. Each taste bud contains 50 to 100 taste receptor cells.

Taste receptors in the mouth sense the five taste modalities: [sweetness](/wiki/Taste%22%20%5Cl%20%22Sweetness%22%20%5Co%20%22Taste), [sourness](/wiki/Taste%22%20%5Cl%20%22Sourness%22%20%5Co%20%22Taste), [saltiness](/wiki/Taste%22%20%5Cl%20%22Saltiness%22%20%5Co%20%22Taste),  [bitterness](/wiki/Bitter_%28taste%29%22%20%5Cl%20%22Bitterness%22%20%5Co%20%22Bitter%20%28taste%29), and [savoriness](/wiki/Taste%22%20%5Cl%20%22Heartiness%22%20%5Co%20%22Taste) (also known as *savory* or *umami*). Scientific experiments have demonstrated that these five tastes exist and are distinct from one another. Taste buds are able to distinguish between different tastes through detecting interaction with different molecules or ions. Sweet, savoriness, and bitter tastes are triggered by the binding of molecules to [G protein-coupled receptors](/wiki/G_protein-coupled_receptors%22%20%5Co%20%22G%20protein-coupled%20receptors) on the [cell membranes](/wiki/Cell_membrane%22%20%5Co%20%22Cell%20membrane) of taste buds. Saltiness and sourness are perceived when [alkali metal](/wiki/Alkali_metal%22%20%5Co%20%22Alkali%20metal) or [hydrogen](/wiki/Hydrogen%22%20%5Co%20%22Hydrogen) [ions](/wiki/Ions%22%20%5Co%20%22Ions) enter taste buds, respectively.

The basic taste modalities contribute only partially to the sensation and flavor of food in the mouth—other factors include [smell](/wiki/Odor%22%20%5Co%20%22Odor), detected by the [olfactory epithelium](/wiki/Olfactory_epithelium%22%20%5Co%20%22Olfactory%20epithelium) of the nose; [texture](/wiki/Texture_%28food%29%22%20%5Co%20%22Texture%20%28food%29), detected through a variety of [mechanoreceptors](/wiki/Mechanoreceptor%22%20%5Co%20%22Mechanoreceptor), muscle nerves, etc.; temperature, detected by [thermoreceptors](/wiki/Thermoreceptor%22%20%5Co%20%22Thermoreceptor); and "coolness" (such as of [menthol](/wiki/Menthol%22%20%5Co%20%22Menthol)) and "hotness" ([pungency](/wiki/Pungency%22%20%5Co%20%22Pungency)), through [chemesthesis](/wiki/Chemesthesis%22%20%5Co%20%22Chemesthesis).

As the gustatory system senses both harmful and beneficial things, all basic taste modalities are classified as either aversive or appetitive, depending upon the effect the things they sense have on our bodies. weetness helps to identify energy-rich foods, while bitterness serves as a warning sign of poisons.

Among [humans](/wiki/Human%22%20%5Co%20%22Human), taste perception begins to fade around 50 years of age because of loss of tongue papillae and a general decrease in [saliva](/wiki/Saliva%22%20%5Co%20%22Saliva) production. Humans can also have distortion of tastes through [dysgeusia](/wiki/Dysgeusia%22%20%5Co%20%22Dysgeusia). Not all [mammals](/wiki/Mammal%22%20%5Co%20%22Mammal) share the same taste modalities: some [rodents](/wiki/Rodent%22%20%5Co%20%22Rodent) can taste [starch](/wiki/Starch%22%20%5Co%20%22Starch) (which humans cannot), [cats](/wiki/Cat%22%20%5Co%20%22Cat) cannot taste sweetness, and several other [carnivores](/wiki/Carnivores%22%20%5Co%20%22Carnivores) including [hyenas](/wiki/Hyena%22%20%5Co%20%22Hyena), [dolphins](/wiki/Dolphin%22%20%5Co%20%22Dolphin), and [sea lions](/wiki/Sea_lion%22%20%5Co%20%22Sea%20lion), have lost the ability to sense up to four of their ancestral five taste modalities.

In the human body a [stimulus](/wiki/Stimulus_%28physiology%29%22%20%5Co%20%22Stimulus%20%28physiology%29) refers to a form of energy which elicits a physiological or psychological action or response. [Sensory receptors](/wiki/Sensory_receptors%22%20%5Co%20%22Sensory%20receptors) are the structures in the body which change the stimulus from one form of energy to another. This can mean changing the presence of a chemical, sound wave, source of heat, or touch to the skin into an electrical [action potential](/wiki/Action_potential%22%20%5Co%20%22Action%20potential) which can be understood by the brain, the body's control center. Sensory receptors are modified ends of sensory [neurons](/wiki/Neurons%22%20%5Co%20%22Neurons) modified to deal with specific types of stimulus, thus there are many different types of sensory receptors in the body. The neuron is the primary component of the nervous system, which transmits messages from sensory receptors all over the body.

Taste is a form of [chemoreception](/wiki/Chemoreception%22%20%5Co%20%22Chemoreception) which occurs in the specialised [taste receptors](/wiki/Taste_receptor%22%20%5Co%20%22Taste%20receptor) in the mouth. To date, there are five different types of taste these receptors can detect which are recognized: salt, sweet, sour, bitter, and umami. Each type of receptor has a different manner of [sensory transduction](/wiki/Sensory_transduction%22%20%5Co%20%22Sensory%20transduction): that is, of detecting the presence of a certain compound and starting an action potential which alerts the brain. It is a matter of debate whether each taste cell is tuned to one specific tastant or to several; Smith and Margolskee claim that "gustatory neurons typically respond to more than one kind of stimulus, [a]lthough each neuron responds most strongly to one tastant". Researchers[*[who?](/wiki/Wikipedia%3AManual_of_Style/Words_to_watch%22%20%5Cl%20%22Unsupported_attributions%22%20%5Co%20%22Wikipedia%3AManual%20of%20Style/Words%20to%20watch)*] believe that the brain interprets complex tastes by examining patterns from a large set of neuron responses. This enables the body to make "keep or spit out" decisions when there is more than one tastant present. "No single neuron type alone is capable of discriminating among stimuli or different qualities, because a given cell can respond the same way to disparate stimuli."[*[citation needed](/wiki/Wikipedia%3ACitation_needed%22%20%5Co%20%22Wikipedia%3ACitation%20needed)*] As well, [serotonin](/wiki/Serotonin%22%20%5Co%20%22Serotonin) is thought to act as an intermediary hormone which communicates with taste cells within a taste bud, mediating the signals being sent to the brain. Receptor molecules are found on the top of [microvilli](/wiki/Microvilli%22%20%5Co%20%22Microvilli) of the taste cells.

**Sweetness**

Sweetness is produced by the presence of [sugars](/wiki/Sugar%22%20%5Co%20%22Sugar), some proteins, and other substances such as alcohols like [anethol](/wiki/Anethol%22%20%5Co%20%22Anethol), [glycerol](/wiki/Glycerol%22%20%5Co%20%22Glycerol) and [propylene glycol](/wiki/Propylene_glycol%22%20%5Co%20%22Propylene%20glycol), [saponins](/wiki/Saponins%22%20%5Co%20%22Saponins) such as [glycyrrhizin](/wiki/Glycyrrhizin%22%20%5Co%20%22Glycyrrhizin), [artificial sweeteners](/wiki/Artificial_sweetener%22%20%5Co%20%22Artificial%20sweetener) (organic compounds with a variety of structures), and [lead](/wiki/Lead%22%20%5Co%20%22Lead) compounds such as [lead acetate](/wiki/Lead%28II%29_acetate%22%20%5Co%20%22Lead%28II%29%20acetate).[*[citation needed](/wiki/Wikipedia%3ACitation_needed%22%20%5Co%20%22Wikipedia%3ACitation%20needed)*] It is often connected to [aldehydes](/wiki/Aldehyde%22%20%5Co%20%22Aldehyde) and [ketones](/wiki/Ketone%22%20%5Co%20%22Ketone), which contain a [carbonyl group](/wiki/Carbonyl_group%22%20%5Co%20%22Carbonyl%20group).[*[citation needed](/wiki/Wikipedia%3ACitation_needed%22%20%5Co%20%22Wikipedia%3ACitation%20needed)*] Many foods can be perceived as sweet despite of the sugar content, alcoholic drinks can taste sweet despite of having sugar or not, some plants such as [liquorice](/wiki/Liquorice%22%20%5Co%20%22Liquorice), [anise](/wiki/Anise%22%20%5Co%20%22Anise) or [stevia](/wiki/Stevia%22%20%5Co%20%22Stevia) are sometimes used as sweeteners. [Rebaudioside A](/wiki/Rebaudioside_A%22%20%5Co%20%22Rebaudioside%20A) is a [steviol glycoside](/wiki/Steviol_glycoside%22%20%5Co%20%22Steviol%20glycoside) coming from stevia that is 200 times sweeter than sugar. Lead acetate and other lead compounds were used as sweeteners, mostly for wine, until [lead poisoning](/wiki/Lead_poisoning%22%20%5Co%20%22Lead%20poisoning) became known. Romans used to deliberately boil the must inside of lead vessels to make a sweeter wine. Sweetness is detected by a variety of [G protein-coupled receptors](/wiki/G_protein-coupled_receptor%22%20%5Co%20%22G%20protein-coupled%20receptor)coupled to a [G protein](/wiki/G_protein%22%20%5Co%20%22G%20protein) that acts as an intermediary in the communication between taste bud and brain, [gustducin](/wiki/Gustducin%22%20%5Co%20%22Gustducin). These receptors are T1R2+3 (heterodimer) and T1R3 (homodimer), which account for sweet sensing in humans and other animals.

**Saltiness**

Saltiness is a taste produced best by the presence of [cations](/wiki/Ion%22%20%5Co%20%22Ion) (such as Na+
, K+
 or Li+
and is directly detected by cation influx into glial like cells via leak channels causing depolarisation of the cell.

Other [monovalent](/wiki/Valence_%28chemistry%29%22%20%5Co%20%22Valence%20%28chemistry%29) [cations](/wiki/Cations%22%20%5Co%20%22Cations), e.g., [ammonium](/wiki/Ammonium%22%20%5Co%20%22Ammonium), NH+
4, and [divalent](/wiki/Divalent%22%20%5Co%20%22Divalent) cations of the [alkali earth metal](/wiki/Alkali_earth_metal%22%20%5Co%20%22Alkali%20earth%20metal) group of the [periodic table](/wiki/Periodic_table%22%20%5Co%20%22Periodic%20table), e.g., calcium, Ca2+
, ions, in general, elicit a bitter rather than a salty taste even though they, too, can pass directly through [ion channels](/wiki/Ion_channel%22%20%5Co%20%22Ion%20channel) in the tongue.[*[citation needed](/wiki/Wikipedia%3ACitation_needed%22%20%5Co%20%22Wikipedia%3ACitation%20needed)*]

**Sourness**

Sourness is [acidity](/wiki/Acid%22%20%5Co%20%22Acid), and, like salt, it is a taste sensed using [ion channels](/wiki/Ion_channel%22%20%5Co%20%22Ion%20channel). Undissociated acid diffuses across the plasma membrane of a presynaptic cell, where it dissociates in accordance with [Le Chatelier's principle](/wiki/Le_Chatelier%27s_principle%22%20%5Co%20%22Le%20Chatelier%27s%20principle). The protons that are released then block potassium channels, which depolarise the cell and cause calcium influx. In addition, the taste receptor PKD2L1 has been found to be involved in tasting sour.

**Bitterness**

Research has shown that TAS2Rs (taste receptors, type 2, also known as T2Rs) such as [TAS2R38](/wiki/TAS2R38%22%20%5Co%20%22TAS2R38) are responsible for the human ability to taste bitter substances. They are identified not only by their ability to taste certain bitter ligands, but also by the morphology of the receptor itself (surface bound, monomeric).

**Savoriness**

The [amino acid](/wiki/Amino_acid%22%20%5Co%20%22Amino%20acid) [glutamic acid](/wiki/Glutamic_acid%22%20%5Co%20%22Glutamic%20acid) is responsible for savoriness, but some [nucleotides](/wiki/Nucleotide%22%20%5Co%20%22Nucleotide)([inosinic acid](/wiki/Inosinic_acid%22%20%5Co%20%22Inosinic%20acid) and [guanylic acid](/wiki/Guanylic_acid%22%20%5Co%20%22Guanylic%20acid) can act as complements, enhancing the taste.

Glutamic acid binds to a variant of the G protein-coupled receptor, producing a [savory](/wiki/Umami%22%20%5Co%20%22Umami)taste.