

# The sense of taste essay sample



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Taste is the ability to respond to dissolved molecules and ions called tastants. Humans detect taste with taste receptor cells. These are clustered in taste buds. Each taste bud has a pore that opens out to the surface of the tongue enabling molecules and ions taken into the mouth to reach the receptor cells inside. There are five primary taste sensations:

- salty
- sour
- sweet
- bitter
- umami

Properties of the taste system.

- A single taste bud contains 50–100 taste cells representing all 5 taste sensations (so the classic textbook pictures showing separate taste areas on the tongue are wrong).
- Each taste cell has receptors on its apical surface. These are transmembrane proteins which admit the ions that give rise to the sensations of salty and sour; bind to the molecules that give rise to the sensations of sweet, bitter, and umami.
- A single taste cell seems to be restricted to expressing only a single type of receptor (except for bitter receptors).
- Taste receptor cells are connected, through an ATP-releasing synapse, to a sensory neuron leading back to the brain.
- However, a single sensory neuron can be connected to several taste cells in each of several different taste buds.
- The sensation of taste — like all sensations — resides in the brain

[evidence]. •And in mice, at least, the sensory neurons for four of the tastes (not sour) transmit their information to four discrete areas of the brain.

### Salty

In mice, perhaps humans, the receptors for table salt (NaCl) is an ion channel that allows sodium ions (Na<sup>+</sup>) to enter directly into the cell. This depolarizes it allowing calcium ions (Ca<sup>2+</sup>) to enter [Link] triggering the release of ATP at the synapse to the attached sensory neuron and generating an action potential in it. In lab animals, and perhaps in humans, the hormone aldosterone increases the number of these salt receptors. This makes good biological sense:

- The main function of aldosterone is to maintain normal sodium levels in the body.
- An increased sensitivity to sodium in its food would help an animal suffering from sodium deficiency (often a problem for ungulates, like cattle and deer).

Sour

Sour receptors are transmembrane ion channels that admit the protons (H<sup>+</sup>) liberated by sour substances (acids) into the cell.

### Sweet

Sweet substances (like table sugar — sucrose) bind to G-protein-coupled receptors (GPCRs) at the cell surface. •Each receptor contains 2 subunits designated T1R2 and T1R3 and is •coupled to G proteins.

- The complex of G proteins has been named gustducin because of its similarity in structure and action to the transducin that plays such an

essential role in rod vision. •Activation of gustducin triggers a cascade of intracellular reactions: oactivation of adenylyl cyclase

formation of cyclic AMP (cAMP) the closing of K<sup>+</sup> channels that leads to depolarization of the cell. •The mechanism is similar to that used by our odor receptors [View]. The hormone leptin inhibits sweet cells by opening their K<sup>+</sup> channels. This hyperpolarizes the cell making the generation of action potentials more difficult. Could leptin, which is secreted by fat cells, be a signal to cut down on sweets? Bitter

The binding of substances with a bitter taste, e. g., quinine, phenylthiocarbamide [PTC], also takes place on G-protein-coupled receptors that are coupled to gustducin. In this case, however, cyclic AMP acts to release calcium ions from the endoplasmic reticulum [Link], which triggers the release of neurotransmitter at the synapse to the sensory neuron. Humans have genes encoding 25 different bitter receptors (“ T2Rs”). However, each taste cell responsive to bitter expresses many of these genes. (This is in sharp contrast to the system in olfaction where a single odor-detecting cell expresses only a single type of odor receptor.)

Despite this — and still unexplained — a single taste cell seems to respond to certain bitter-tasting molecules in preference to others. The sensation of taste — like all sensations — resides in the brain. Transgenic mice that •express T2Rs in cells that normally express T1Rs (sweet) respond to bitter substances as though they were sweet; •express a receptor for a tasteless substance in cells that normally express T2Rs (bitter) are repelled by the tasteless compound. So it is the activation of hard-wired neurons that

determines the sensation of taste, not the molecules nor the receptors themselves.

## Umami

Umami is the response to salts of glutamic acid — like monosodium glutamate (MSG) a flavor enhancer used in many processed foods and in many Asian dishes. Processed meats and cheeses (proteins) also contain glutamate. The binding of amino acids, including glutamic acid, takes place on G-protein-coupled receptors that are coupled to heterodimers of the protein subunits T1R1 and T1R3. Another umami receptor (at least in the rat's tongue) is a modified version of the glutamate receptors found at excitatory synapses in the brain.