Taste Physiology

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**taste buds** (sense organs for taste) see 1826 (2-4) p.

* total ≈ 10.000 taste buds.
* each taste bud is innervated by ≈ 50 nerve fibers; each nerve fiber receives input from ≈ 5 taste buds.
* if sensory nerve is cut, taste buds it innervates degenerate and eventually disappear;

if nerve regenerates, epithelial cells in neighborhood become organized into new taste buds.

Taste Pathways

Tongue:

anterior two-thirds → chorda tympani branch of **facial nerve**.

posterior third → **glossopharyngeal nerve**.

Areas other than tongue → **vagus nerve**.

* all taste fibers (myelinated but slowly conducting) unite in rostral third of **nucleus tractus solitarii** (in medulla oblongata); further way:
	1. axons *cross midline* and join **medial lemniscus** → specific sensory relay nuclei of **thalamus**.
	2. **gustatory lemniscus** - *uncrossed* ascending fibers; some switch in **parabrachial nuclei** (rostral pons) and continue to **thalamus**, **hypothalamus**, **amygdala**.
	3. some axons connect to adjacent **RF** and **dorsal motor nucleus n. vagi** – salivatory and lingual reflexes.
* taste projection area is in foot of **postcentral gyrus** (parietal operculum).

N.B. taste does not have separate cortical projection area and is represented in face area.



Basic Taste Modalities

* gustatory chemoreceptors (located on microvilli of taste cells) respond to sapid (taste-producing) substances dissolved in oral fluids bathing them.
* **concentrating & transporting protein** (delivers taste-producing molecules to receptors) is produced by *Ebner glands*.

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| **sweet** - at tongue ***tip***.* most sweet substances are organic: *sucrose, maltose, lactose, glucose, polysaccharides, glycerol, some alcohols and ketones, chloroform, beryllium salts, various amides of aspartic acid*.
* artificial sweeteners (*saccharin* and *aspartame*) produce satisfactory sweetening without calorie burden.
* *thaumatin* and *monellin* (proteins isolated from African berries) are 100,000 times as sweet as sucrose; structures of these two proteins are very different, yet antibodies to one cross-react with antibodies to other (some sort of common 3D structure).
* receptor activation: sweet substances act via GS protein → cAMP↑ → reduced K+ conductance → depolarization.
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**sour** - along ***posterior half of tongue side*** (also on palate).

* sourness is proportionate to H+ concentration.
* receptor activation: acids depolarize sour receptors by activating H+-gated cation channels.

**salt** - along ***anterior half of tongue side***.

* salty taste is produced by Na+ (and anions of ionizable salts).
* receptor activation: Na+ depolarizes salt receptors via Na+ channel related to amiloride-sensitive epithelial sodium channel (ENaC).
* some organic compounds also taste salty (e.g. dipeptides lysyltaurine & ornithyltaurine are more potent than NaCl).

**bitter** - mostly on tongue ***back*** (also on palate).

* no apparent common molecular feature of substances that taste bitter.
* organic compounds (esp. alkaloids): quinine sulfate, strychnine hydrochloride, morphine, nicotine, caffeine, urea.
* inorganic salts of magnesium, ammonium, calcium.
* receptor activation: bitter substances reduce cAMP (via G protein\*) and increase IP3 and DAG.

\*novel G protein (**α-gusducin**) has been cloned - it activates phosphodiesterase, but exact role remains unsettled.

* all four modalities can be sensed on pharynx and epiglottis.
* additional taste modality named **umami** has been postulated to exist - taste of (monosodium) glutamate.
* taste cells are not different histologically; each nerve fiber responds to more than one taste stimulus (but responds best to one of four primary taste qualities).
* intensity discrimination is relatively crude (like in olfaction) - 30% change in concentration of substance being tasted is necessary before intensity difference can be detected.
* taste threshold concentrations vary with particular substance:



**Flavor** components:

1. combinations of *four basic taste components*.
2. *smell* – nn. olfactorii
3. may include element of *pain stimulation* (e.g. "hot" sauces) – n. trigeminus
4. *consistency* (texture) – n. trigeminus
5. *temperature* – n. trigeminus

N.B. taste is component of flavor!

After-Effects

* taste exhibits after-reactions and contrast phenomena (similar to visual after-images and contrasts) - some are chemical "tricks," but others may be true central phenomena.
* **miraculin** - taste modifier protein discovered in plant - when applied to tongue, makes acids taste sweet.
* animals and humans form particularly *strong aversions to novel foods* if eating food is followed by illness (survival value of avoiding poisons).

Taste Abnormalities

**ageusia** (absence of taste sense); e.g. drugs which contain *sulfhydryl groups* (e.g. captopril, penicillamine) cause temporary ageusia.

**hypogeusia** (diminished taste sensitivity) - many different diseases.

**dysgeusia** (disturbed taste sense).

Bibliography for ch. “Taste” → follow this [link >>](http://www.neurosurgeryresident.net/A.%20Neuroscience%20Basics%5CA.%20Bibliography.pdf)

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