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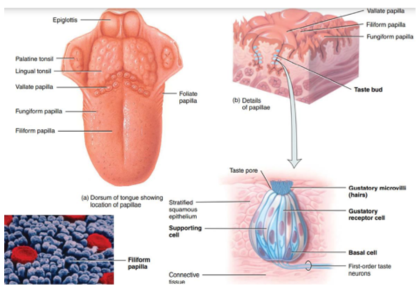
Gustation

Taste



- The **sense** of **tase** is a **chemical sense** which means that the **chemicals** that we **ingest** in our mouth has to **dissolve** in our **saliva** to be **detected** by the **receptor proteins located** in **the taste buds** in the **oral cavity**
- The **experience** of the **tasting food** is very **complex** and **doesn't only involve** the **activation** of the **taste receptors**
- There are **many other sensory receptor involved** like the **olfactory receptors** – when u taste food we will smell it to that's why some people with the flu they wont taste well
- Also there will be **activation** of **tactile receptors** because you wanna **feel** the **texture** and **movement** of the **food** in the **oral cavity**
- **Thermoreceptor** will get **activated** that's **why we** have this **feeling** if **its hot food** or **cold** or **warm**
- **Pain receptors** may also be **activated** like when **eating chili pepper**

Sense of taste

- **Taste** is **mainly** a **function** of the **taste buds** in the **mouth**, but it is **common experience** that **one's sense** of **smell** also **contributes strongly** to **taste perception**. In **addition**, the **texture of food**, as **detected** by **tactual senses of the mouth**, and the **presence** of **substances** in the **food that stimulate pain endings**, such as **pepper**, **greatly alter** the **taste experience**. The **importance** of **taste lies** in the **fact** that it **allows a person to select food** in **accord with desires** and **often** in **accord with the body tissues' metabolic need** for **specific** substances.

Primary sensations of taste

- They are **sour**, **salty**, **sweet**, **bitter**, and "**umami**."
- A **person** can **perceive hundreds** of different tastes. They are **all thought to be combinations** of the **elementary taste sensations**, just as all the colors we can see are combinations of the three primary colors.

Sense of taste

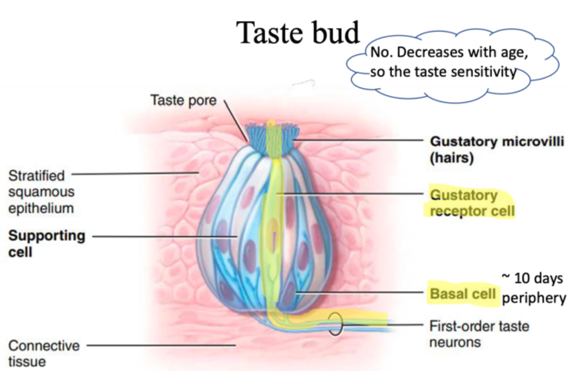
- **5 primary taste sensation**
  - **Sour** Taste.
    - The sour taste is **caused** by **acids**–that is, by the **hydrogen ion concentration**–and the **intensity** of this **taste sensation** is **approximately proportional** to the **logarithm of the hydrogen ion concentration**.
  - **Salty** Taste.
    - The salty taste is **elicited by ionized salts**, mainly by the **sodium ion concentration.**
    - The **quality** of the **taste varies somewhat** from **one salt to another because some salts elicit other taste sensations in addition** to **saltiness**.
    - The **cations of the salts**, **especially sodium cations**, are **mainly responsible** for the **salty taste**, but the **anions also contribute** to a **lesser extent.**
  - **Umami** Taste.
    - Umami, a Japanese word meaning "delicious," designates a **pleasant taste** sensation that is **qualitatively different from sour**, **salty**, **sweet**, or bitter.
    - Umami is the **dominant taste of food containing L-glutamate**, such as **meat extracts** and **aging cheese**.
    - New sensation added
  - **Sweet** Taste.
    - The sweet taste is **not caused** by **any single class of chemicals**.
    - **Some** of the **types** of **chemicals** that **cause** this taste include **sugars**, **glycols**, **alcohols**, **aldehydes**, **ketones**, **amides**, **esters**, some **amino acids**, some **small proteins**, **sulfonic acids**, **halogenated acids**, and **inorganic salts** of **lead** and **beryllium**.
    - Note specifically that **most** of the **substances** that **cause** a **sweet taste** are **organic chemicals**.
  - **Bitter** Taste.
    - like the sweet taste, is **not caused** by a **single type of chemical agent**.

- They are **mostly organic substances**, such as **long-chain organic substances** that **contain nitrogen** and **alkaloids**, which include many of the **drugs used** in **medicines**, such as **quinine**, **caffeine**, **strychnine**, and **nicotine**.
- **Some substances** that **initially taste sweet have a bitter aftertaste**, such as **saccharin**.
- The **bitter taste**, when it **occurs in high intensity**, usually causes the **person** or **animal** to **reject the food**.
- This reaction is **important because** many **deadly toxins found** in **poisonous plants** are **alkaloids**, and **virtually all of these alkaloids** cause an **intensely bitter taste**.
- Has the **lowest threshold** which is an **important mechanism** so **you need only very** few **molecules** of this **bitter tasting component** to **have** this **sensation**

Threshold for taste

- In **general tase** has **low thereshold** but **varies** with the **different categories**
- The **threshold** for **stimulation** of the **sour taste by hydrochloric** acid **averages 0.0009 M**; for **stimulation** of the **salty taste by sodium chloride**, **0.01 M**; for the **sweet taste** by **sucrose, 0.01 M**; and for **the bitter taste by quinine, 0.000008 M.**
- **Note** especially **how much more sensitive the bitter taste sense** is **than all the others**, which **would be expected**, because this **sensation provides an important protective function against many dangerous toxins** in **food**.

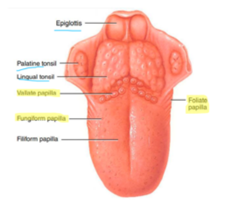
Taste Bud



- **Taste buds** are a **collection of epithelial cells** that has **taste receptor cells** and **supporting cells** and **basal cells(for regeneration, avg time** of **regeneration** is **about 10 days**)
- a **new taste receptor** cell **will be** on the **periphery then** it will **go all the way** to **center** so as **you move** from the **periphery** to the **center** the **cells** are **getting** older (the ones in the

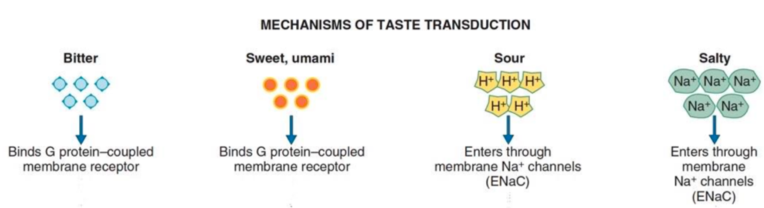
center are **older**) the **ones** in the **center** will **shed off** and **break off** and **dissolve** in the **saliva**

- The **number** of **taste buds changes** with **age**, they **decrease with age that's** why **taste sensitivity** in older **people is much less than young ones and children**
- The **average life span** of **each taste cell** is **about 10 days.**
- The **outer tips** of the **taste cells** are **arranged around** a **minute taste pore**. **From** the **tip of each taste cell**, **several microvilli protrude outward** into the **taste pore to approach** the **cavity of the mouth.**
- These **microvilli provide** the **receptor surface for taste**.
- **Interwoven around** the **bodies** of the **taste cells is a branching terminal network of taste nerve fibers that** are **stimulated** by the **taste receptor cells.**
- **Many vesicles form beneath** the **cell membrane near the fibers**. It is **believed** that **these vesicles contain** a **neurotransmitter substance** that is **released through the cell membrane** to **excite** the **nerve fiber endings** in **response** to **taste stimulation**



Location of taste buds

- The **taste buds** are **found** on **three types** of **papillae** of the **tongue**, as follows:
  - (1) **Circumvallate papillae**: a **large number** of **taste buds** are on the walls of the troughs that **surround** the **circumvallate** papillae, which **form** a **V line** on the **surface** of the **posterior tongue.**
  - (2) **Fungiform papillae**: **moderate numbers** of **taste buds** are on the **fungiform papillae** over the **flat anterior surface** of the **tongue**.
  - (3) **Foliate papillae**: **moderate numbers** are on the **foliate papillae located** in the **folds along** the **lateral surfaces of the tongue.**
  - **Additional taste buds** are **located** on the **palate**, and a **few are found** on the **tonsillar pillars** on the **epiglottis** and **even** in the **proximal epiglottis**



- The **mechanism** of **taste transduction differs** for **each taste** so **when** the taste **substance goes** to the **oral cavity** and **dissolves** in the **saliva** it will **then go** to the **taste bud** where the **receptors** are **present** on the **microvilli** of the **receptor cells**, so if the **substance** is

        - **bitter**, **sweet** or **umami** it will **bind** to **g coupled receptor** of **different types**
        - **sour** and **salty substance sodium ion will bind** to sodium **channels like** the **ENaC**
    - **all of these** will **cause depolarization** in the **receptor cells** so the **more** the **concentration of** the **substance** the **higher** the **amplitude** of the **depolarization receptor potential** in **these cells**
    - the **taste substance will then be washed away by** the **saliva that's why** the **concentration** will **decrease rapidly**

Taste transduction

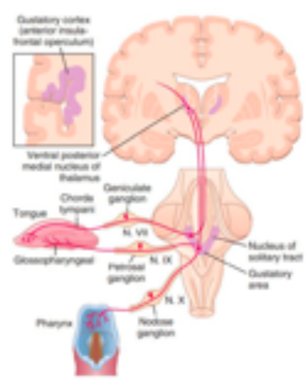
- The **mechanism** by **which most stimulating substances react** with the **taste villi** to **initiate** the **receptor potential** is by **binding** of the **taste chemical** to a **protein receptor molecule** that **lies** on the **outer surface** of the **taste receptor cell near** to or **protruding through** a **villus membrane**.
- This **action**, in **turn**, **opens ion channels**, which **allows positively charged sodium ions** or **hydrogen ions** to **enter** and **depolarize the cell**. **Then the taste chemical** is **gradually washed away** from the **taste villus** by the **saliva**, **which removes** the **stimulus**.
- The **type** of **receptor protein** in **each taste villus determines** the **type** of **taste that will** be **perceived**. For **sodium ions** and **hydrogen ions**, which **elicit salty** and **sour taste sensations**, **respectively**, the **receptor proteins open specific ion channels** in the **apical membranes** of the **taste cells**, **thereby activating** the **receptors**.
- **However**, for the **sweet** and **bitter taste sensations**, the **portions** of the **receptor protein molecules** that **protrude through the apical membranes** (**GPCR**) **activate second messenger transmitter substances inside** the **taste cells**, and **those second messengers cause intracellular chemical changes** that **elicit the taste signals**

Taste pathway

- **After signal transduction receptor potential develops** at the **taste receptor cells** and this will **activate first order neuron** which if it **reaches** the **threshold** it will **regenerate** an **action potential** to **reach** up to the **CNS** but **unlike** what we **previously learned** in special senses that for example in **vision** there is **only one cranial** nerve to **transmit** the **information** (optic nerve) and the **olfaction** its **one cranial nerve again** (olfactory) **however** here in **taste there are 3 cranial nerves to transmit the sensation** from **different areas of the oral cavity**
    - **Signal** form the **anterior 23/of the tongue** : **lingual nerve** then **chorda tympani through** the **facial** nerve

- **Posterior 1/3 of the tongue** : **glossopharyngeal nerve**
- **Base of** the **tongue**: **vagus nerve**
    - **All of them will terminate** in the **nucleus tractus solitarius** in the **brain stem**

- **Second order neuron start** form the **nucleus tractus solitaries** in the **brain stem** up to the **thalamus** to **the VPL** just **near the somatosensory posterior column signal**
- The **third order neuron will go from** the **thalamus** to the **gustatory cortex located** in the **postcentral gyrus near** the **somatosensory tactile area** for the **tongue**
- **Taste impulses** from the **anterior two thirds** of the **tongue pass first** into the **lingual nerve**, **then through** the **chorda tympani into** the **facial nerve**, and **finally into** the **tractus solitarius in the brain stem.**
- **Taste sensations** from the **circumvallate papillae** on the **back** of the **tongue** and **from other posterior regions** of the **mouth** and **throat are transmitted through the glossopharyngeal nerve** also into the **tractus solitarius**, but at a **slightly more posterior level**.
- **Finally**, a **few taste signals are transmitted** into **the tractus solitarius from** the **base** of **the tongue** and **other parts of the pharyngeal region** by **way of the vagus nerve**
- **All taste fibers synapse** in the **posterior brain stem** in the **nuclei of the tractus solitarius**. **These nuclei send second-order neurons** to a **small area of the ventral posterior medial nucleus** of the **thalamus**.
- **From** the **thalamus**, **third-order neurons are transmitted** to the **lower** tip of the **postcentral gyrus** in the **parietal cerebral cortex**, where it **curls deep** into the **sylvian fissure, and into the adjacent opercular insular area.** This **area lies slightly lateral**, **ventral**, and **rostral** to the **area for tongue tactile signals** in **cerebral somatic area I.**
- From this **description** of the **taste pathways**, it is **evident that they closely parallel the somatosensory pathways from the tongue**



Taste reflexes

- From the **tractus solitarius**, **many taste signals** are **transmitted within the brain stem itself directly into** the **superior and inferior salivatory nuclei**, and **these areas transmit signals** to the **submandibular**, **sublingual**, and **parotid glands** to **help control** the **secretion** of **saliva during** the **ingestion** and **digestion** of **food**