Chemical senses

TASTE

Chemical Senses

- **Taste & smell**:

  Both determine the flavour of food

Taste and smell are closely linked even though they involve different receptors and receptive processes.

This suggests an overlap in central processing.

Chemical Senses

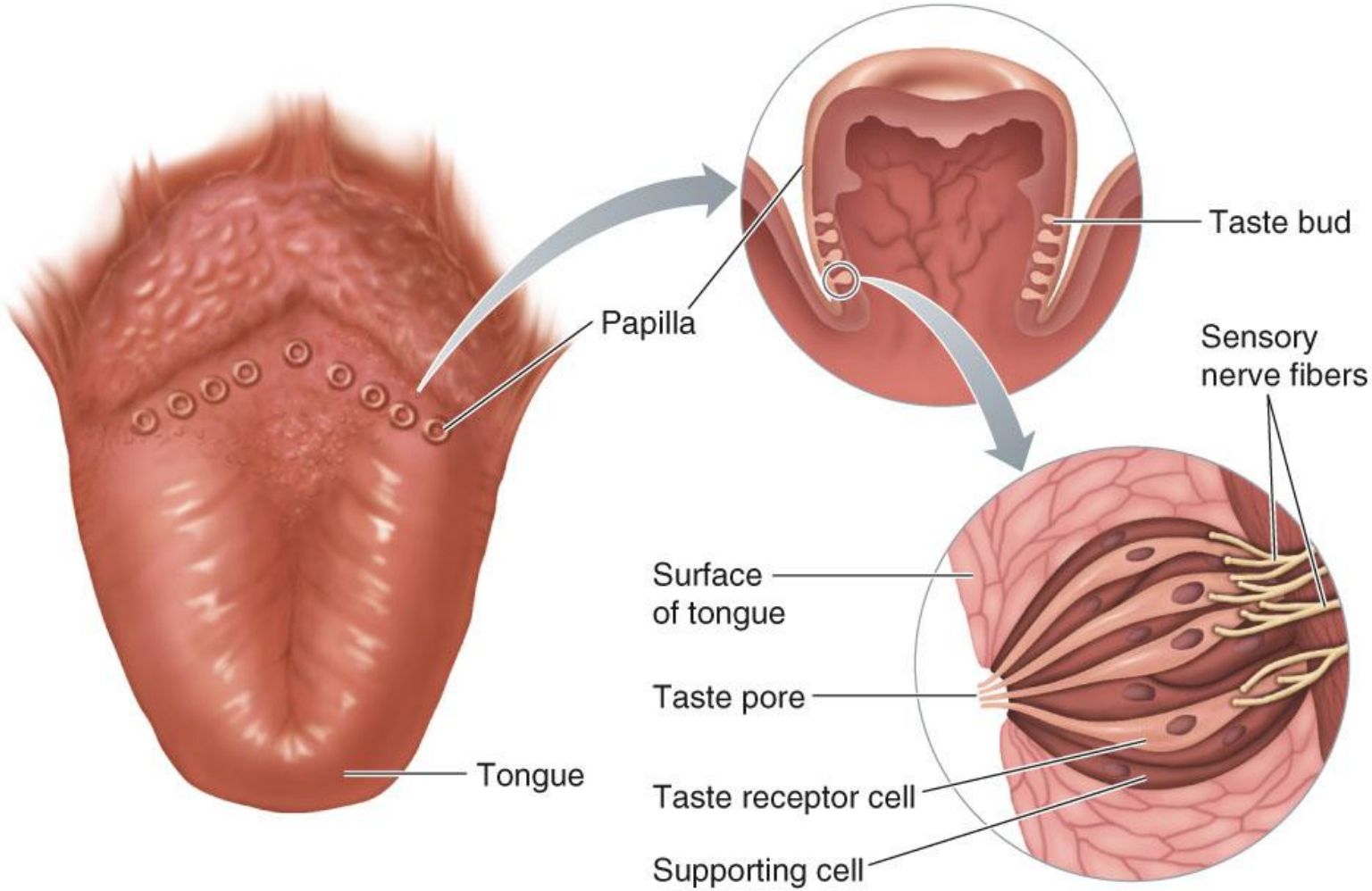
Taste and smell:

- Receptors are **chemoreceptors**
- In association with food intake, influence flow of digestive juices and affect appetite
- Stimulation of receptors induces pleasurable or objectionable sensations and signals presence of something to seek or to avoid

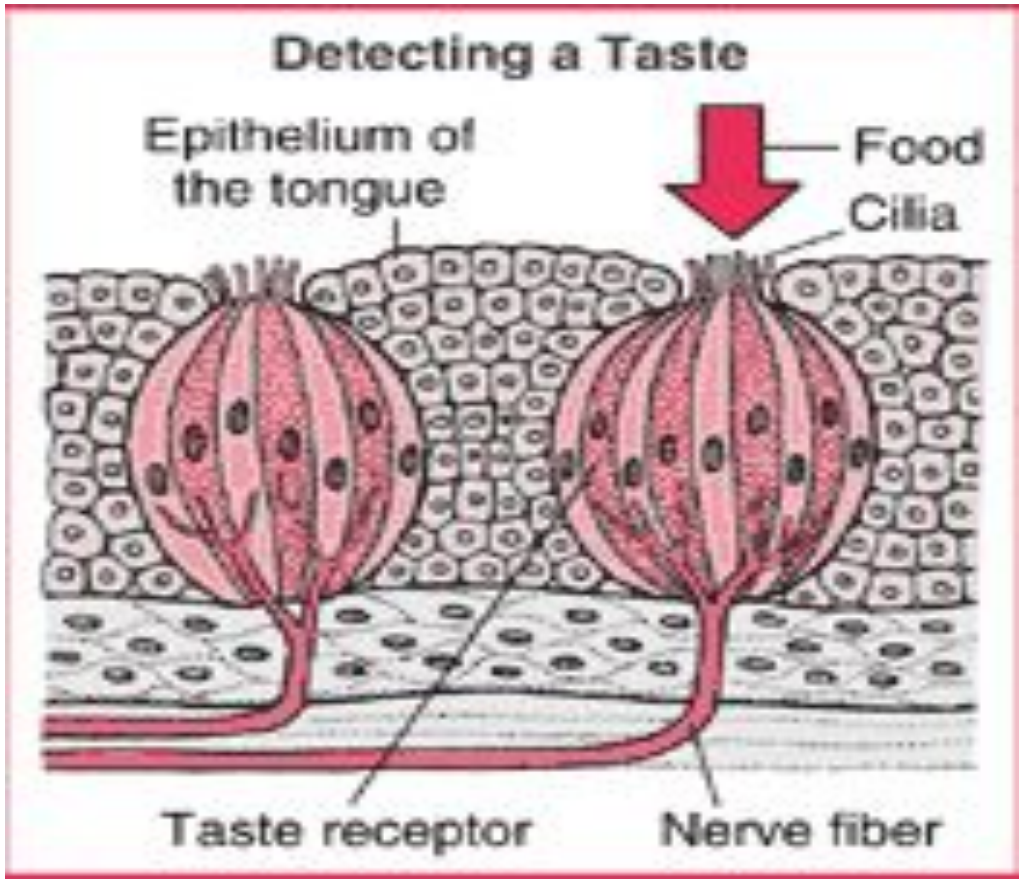
Taste (Gustation)

- Chemoreceptors housed in taste buds
- Present in oral cavity and throat
- Taste receptors have life span of about 10 days
- Taste bud consists of
  - **Taste pore**
    - Opening through which fluids in mouth come into contact with surface of receptor cells
  - **Taste receptor cells**
    - Modified epithelial cells with surface folds called microvilli
    - Plasma membrane of microvilli contain receptor sites that bind selectively with chemical molecules

Location and Structure of Taste Buds



Taste Buds

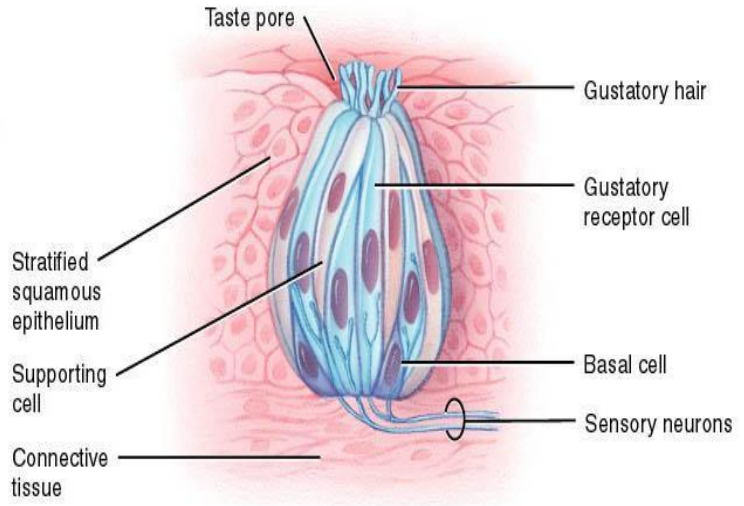

Detecting a Taste
Epithelium of the tongue
Food
Cilia
Taste receptor
Nerve fiber

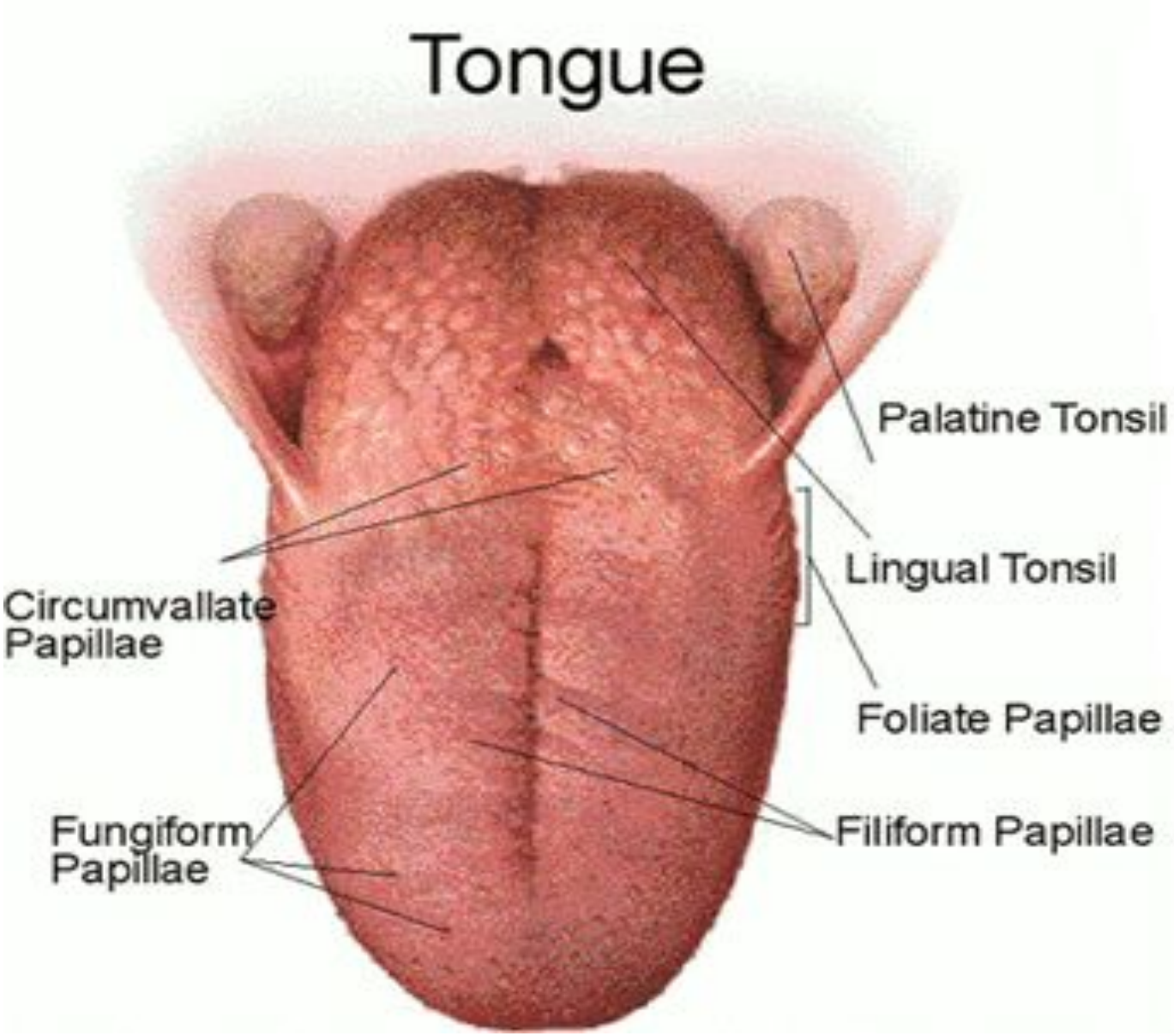
- Sensation of Taste

- **Located in taste buds in:**
  - Tongue
  - Epiglottis
  - Soft Palate
  - Pharynx

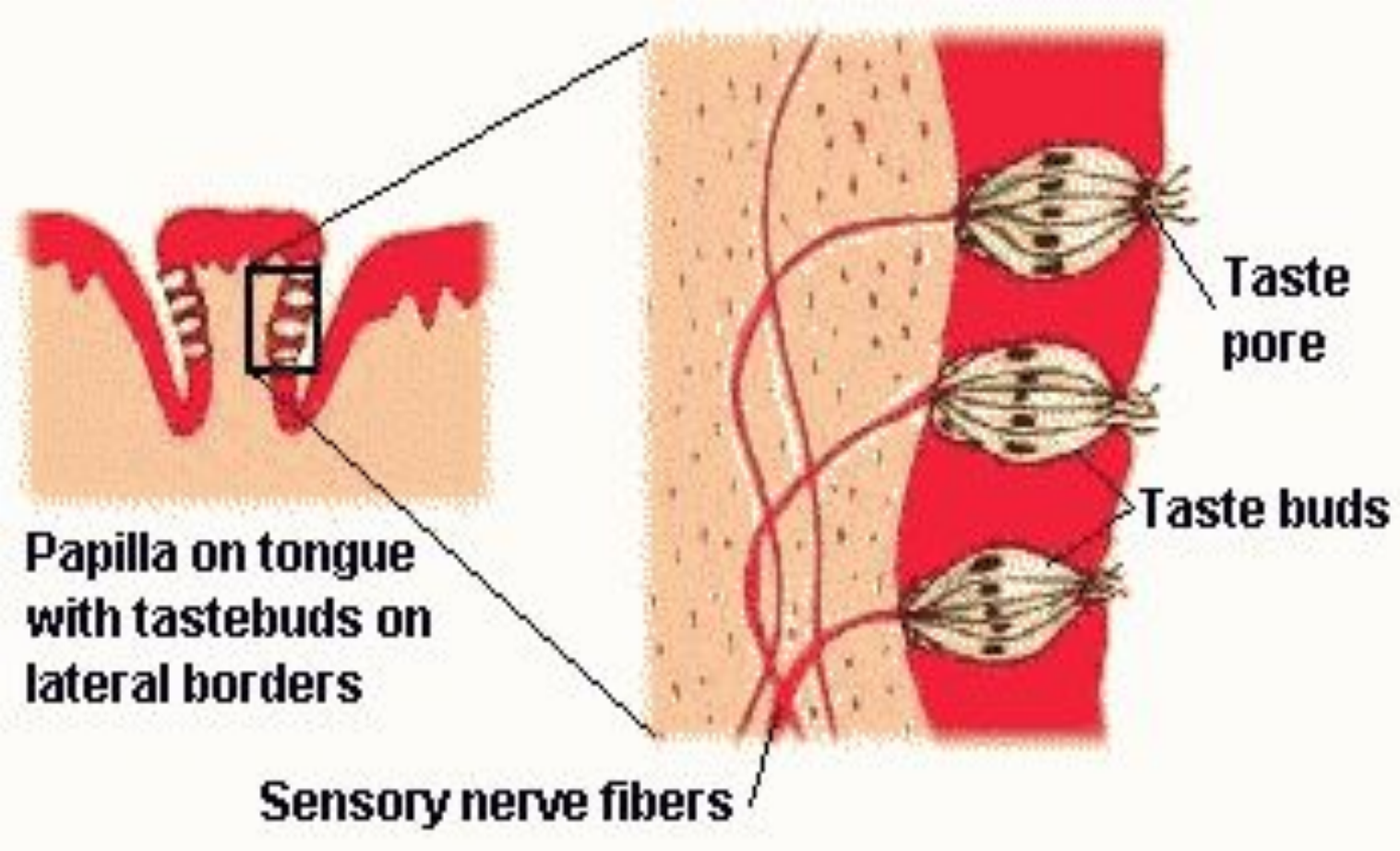
Anatomy of Taste Buds

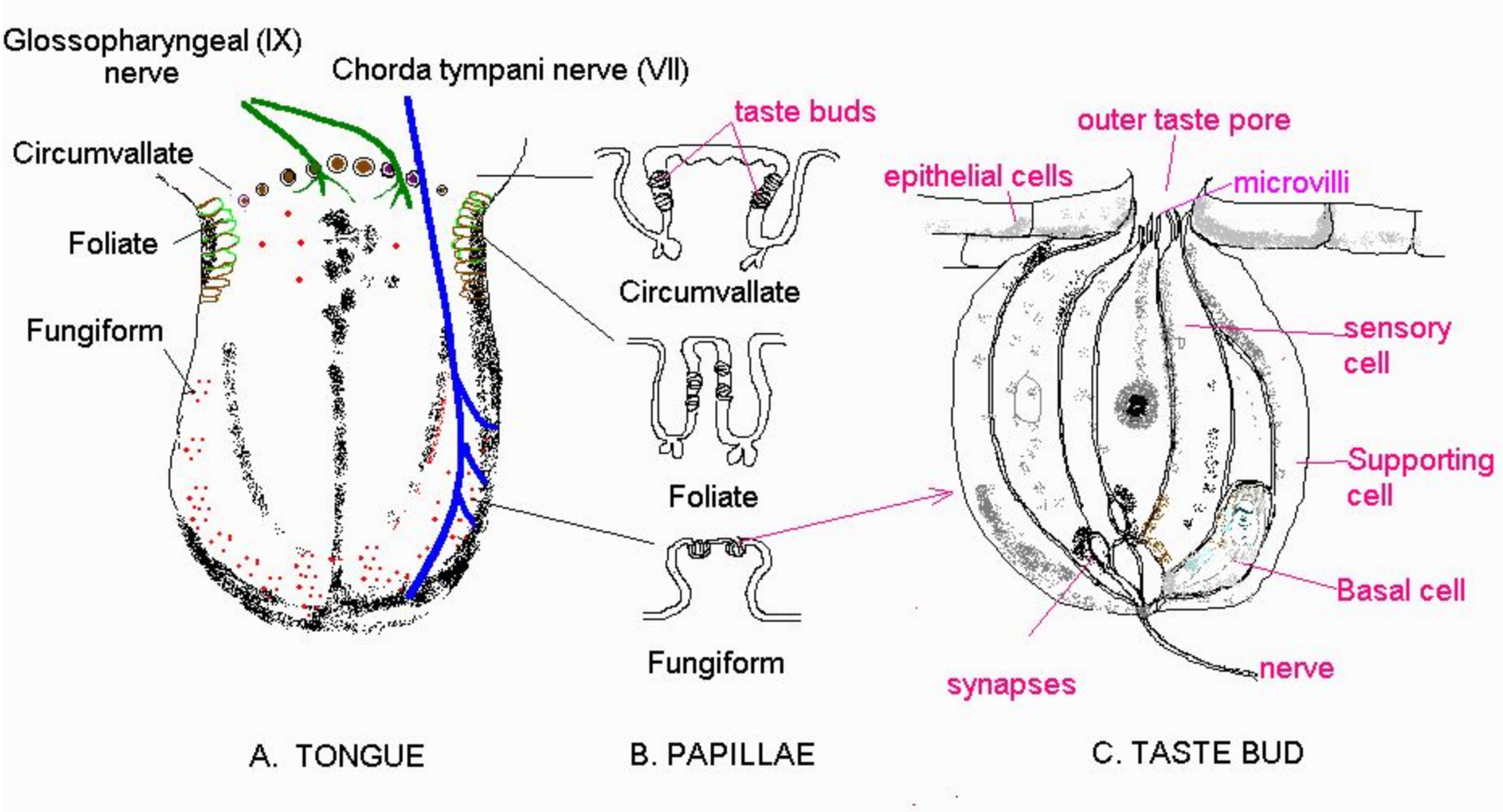
- **10,000 taste buds found on tongue, soft palate & pharynx**
- **Taste buds consist of:**
  - **~50 receptor cells** (type 3) **surrounded by supporting cells**
  - **Basal cells** (type 1 &2) **develop into supporting cells then receptor cells**
    - **Gustatory hairs project through the taste pore**
    - **Life span of 10 days**



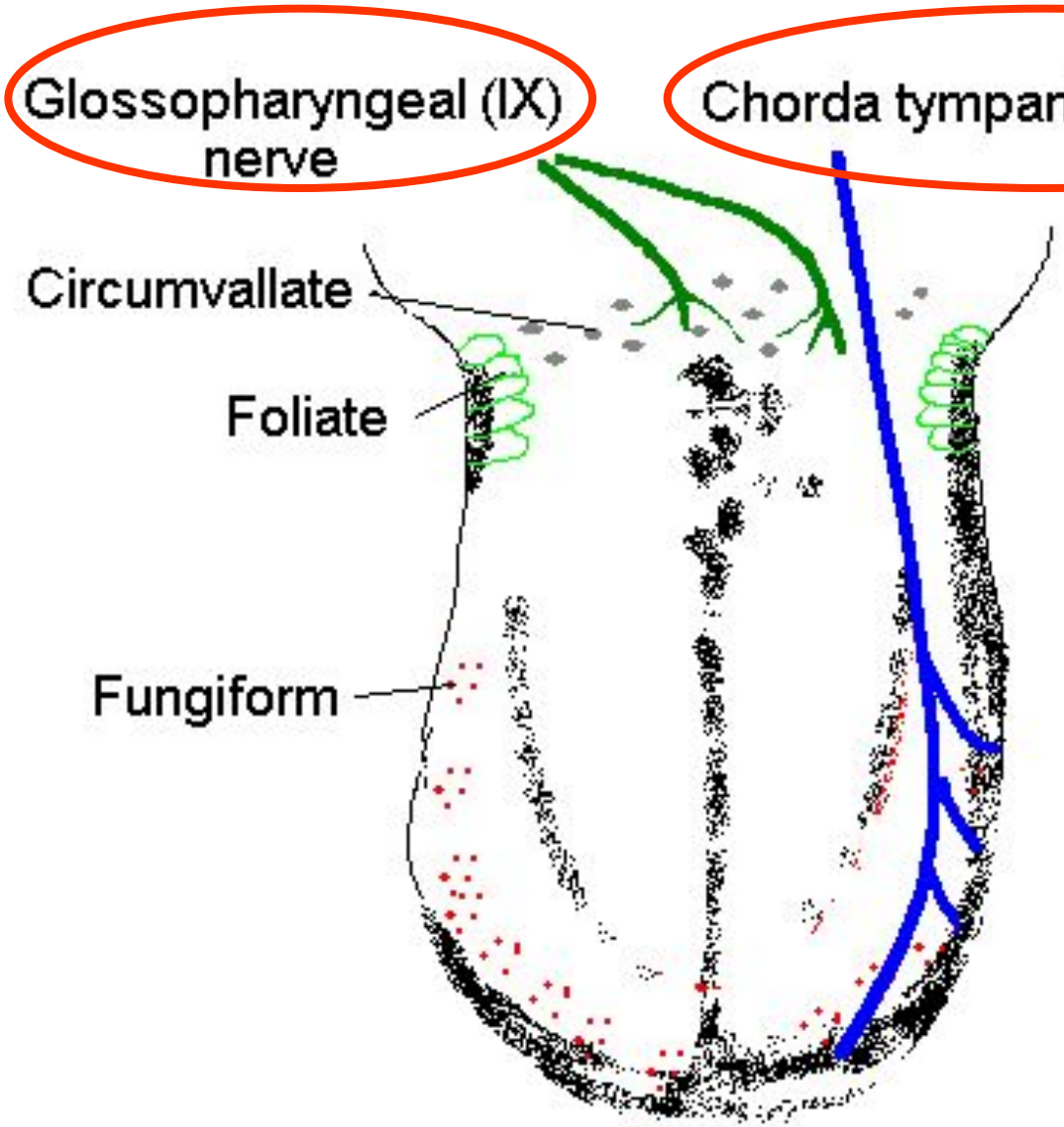

Tongue
Palatine Tonsil
Lingual Tonsil
Circumvallate Papillae
Foliate Papillae
Fungiform Papillae
Filiform Papillae

.Anatomy of Taste Buds - cont




Glossopharyngeal (IX) nerve
Chorda tympani nerve (VII)
Circumvallate
Foliate
Fungiform
taste buds
Circumvallate
Foliate
Fungiform
outer taste pore
epithelial cells
microvilli
sensory cell
Supporting cell
Basal cell
synapses
nerve
A. TONGUE
B. PAPILLAE
C. TASTE BUD

Nerve supply of tongue



:Fibres from

- Epiglottis
- Palate
- Pharynx

⇩

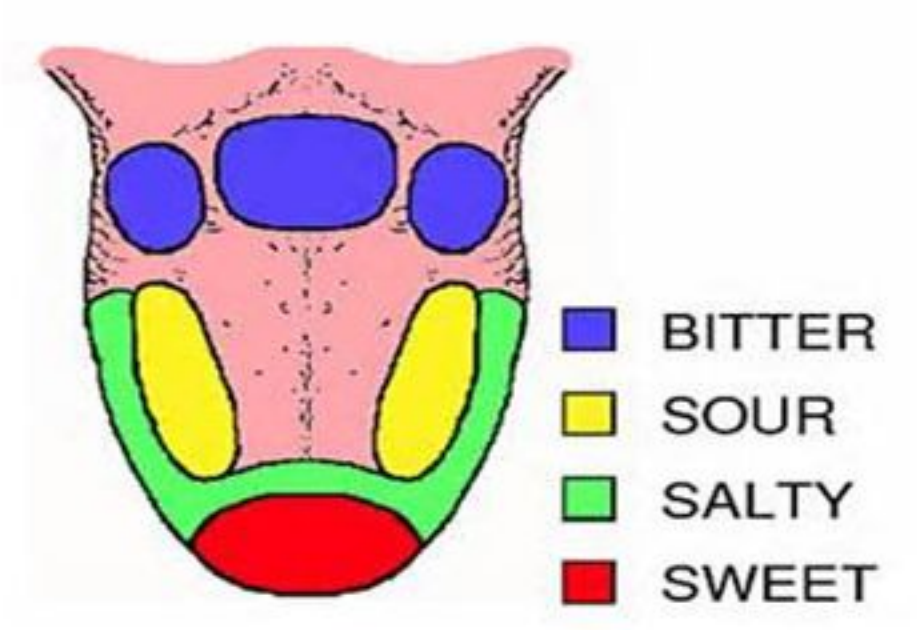
VAGUS(X)

Physiology of Taste :

Its not this simple

Sensitivity differs in different areas, but all tastes can be perceived at most areas of the tongue

Taste modalities over tongue

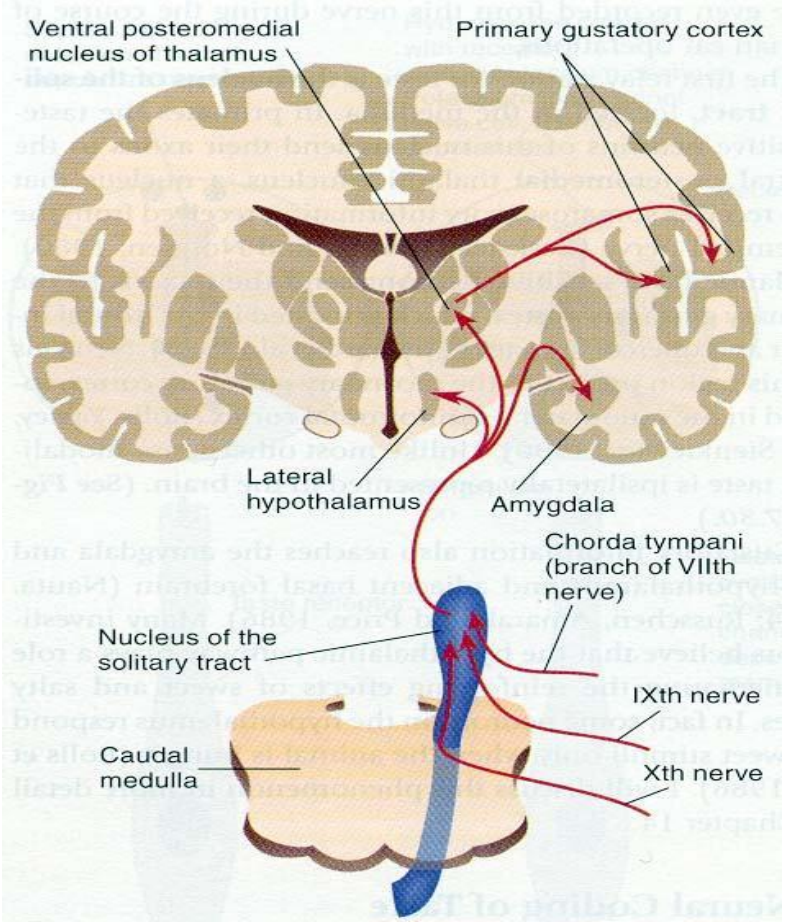


Taste

- **Tastant** (taste-provoking chemical)
- Binding of tastant with receptor cell alters cell's ionic channels to produce depolarizing receptor potential
- Receptor potential initiates action potentials within terminal endings of afferent nerve fibers with which receptor cell synapses
- Terminal afferent endings of several cranial nerves synapse with taste buds in various regions of mouth
- Signals conveyed via synaptic stops in brain stem and thalamus to cortical gustatory area

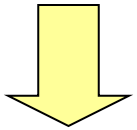
Taste Pathway

Taste information is send to the CNS by the cranial nerves # 7, 9 and 10 ➡ the taste nucleus (n. tractus solitarius) ➡thalamus ➡ primary gustatory cortex

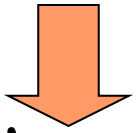


- Physiology of Taste

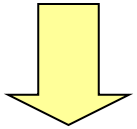
Dissolution in Saliva



Attachment to Receptors



Generator Potential



Action Potential

Taste Perception

- Influenced by information derived from other receptors, especially odor
- Temperature and texture of food influence taste
- Psychological experiences associated with past experiences with food influence taste
- How cortex accomplishes perceptual processing of taste sensation is currently unknown

Primary modalities of taste

Responses of Taste buds:

- Each taste bud responds strongly to one type of taste
- But they also respond to other tastes as well

Taste

- **5 primary tastes**
  - **Salty**
    - Stimulated by chemical salts, especially NaCl
  - **Sour**
    - Caused by acids which contain a free hydrogen ion, H^+
  - **Sweet**
    - Evoked by configuration of glucose
  - **Bitter**
    - Brought about by more chemically diverse group of taste substances
    - Examples – alkaloids, toxic plant derivatives, poisonous substances
  - **Umami**
    - Meaty or savory taste/ pleasant taste

Physiology of taste

- **Sour** ... Acidity by $\{H^+\}$ – HCL
- **Salt** ... Sodium chloride
- **Sweet** ..Sucrose
  glucose
  Saccharin
- **Bitter** ..Strychnine hydrochloride
  Quinine sulphate, alkaloids

Mechanism of stimulation of taste -:sensations

.By sodium and hydrogen ions respectively

The transduction process for sweetness and .bitterness involve second messengers

- Physiology of Taste

Mechanism of stimulation of taste sensation:

- Sour:
  - -Acids (H^+)
  - -Blocks K^+ channels
- Salt taste
  - $-Na^+$
  - -Depolarization

Mechanism of stimulation of taste sensation:

- **Sweet**

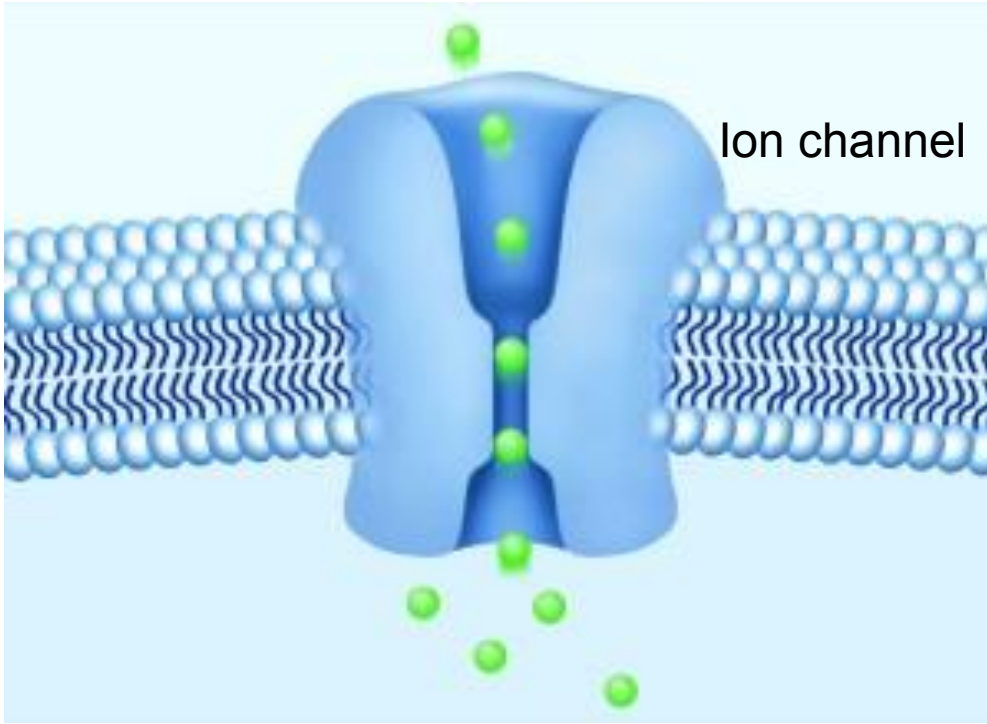
  G protein → activation of adenyl cyclase → c-AMP → ↑K conductance ↓

- **Bitter**

  G protein → Activatn. of Phospholipase C → ↑I.P-insitol$(PO_4)_3$ → Ca^{2} release

Ion channels

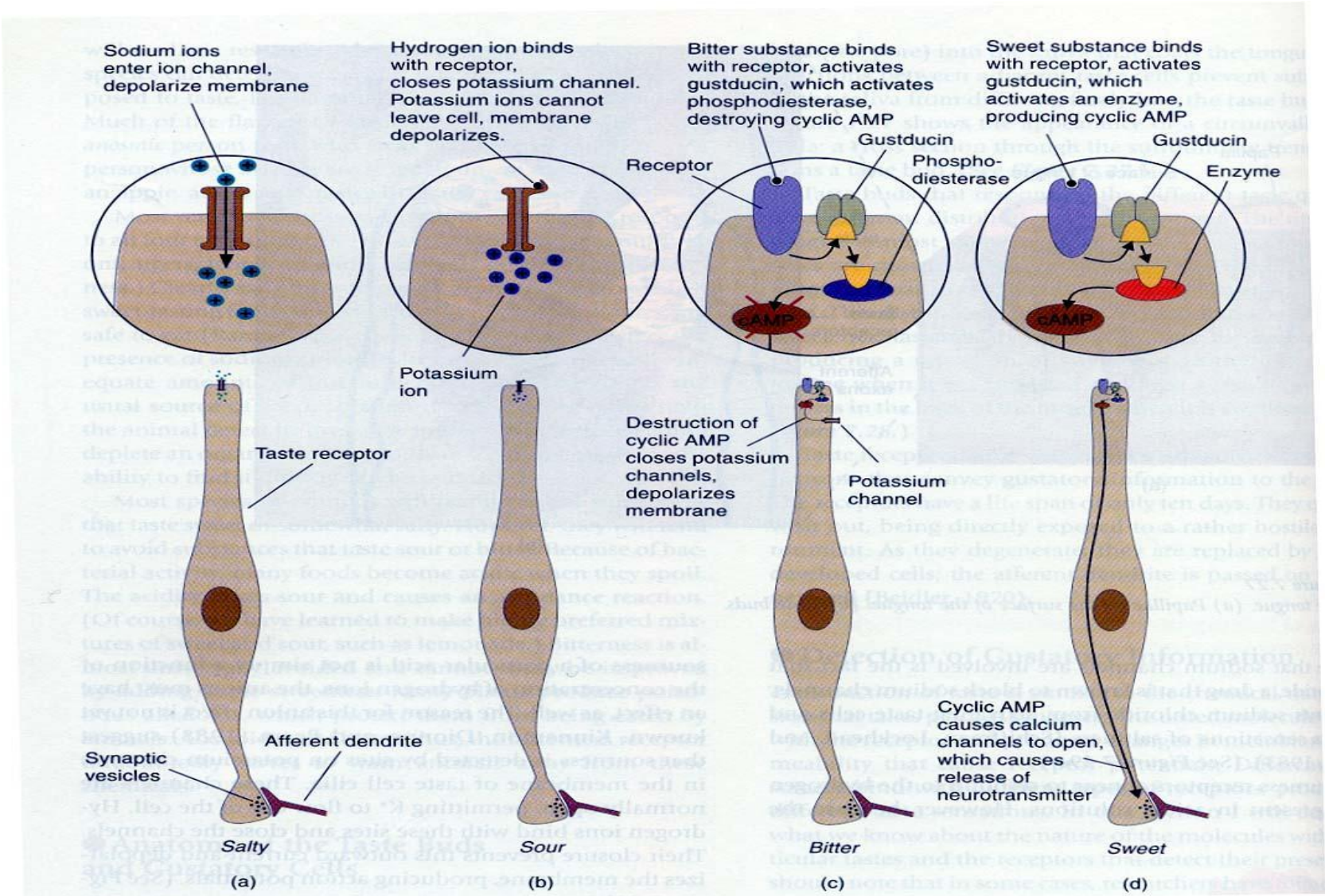
Saltiness or sodium receptors allow sodium ions to cross the membrane, thereby causing depolarization.



THE 4 "BASIC" TASTES ARE SALTY, SOUR, SWEET AND BITTER,

Also: UMAMI (MSG)?, METALLIC? FAT? AMINO ACID?

Different ions, different receptors for different tastes



Sensation of Taste – cont

Discrimination in intensity of taste:

- **Poor (like smell)**
- **Requires 30% change to allow discrimination of intensity**

Sensation of Taste – cont

Decreased sensation from repeated stimulus

Entirely peripheral at the receptors

Sensation of Taste – cont.

After-effects in taste sensation:

(Taste tricks):

- Taste modifier **Meraculin** (a glycoprotein extracxted from miracle fruit):
  - **When applied to tongue makes acids taste sweet**

The Miracle fruit-origin of miraculin

Sensation of Taste

Taste modifier **Miraculin** (a glycoprotein extracxted from miracle fruit):

- **When applied to tongue makes acids taste sweet**

The Miracle fruit-origin of miraculin

Clinical considerations

- Ageusia: Absence of sense of taste
- Dysgeusia: Disturbed sense of taste
- Hypogeusia: Diminshed sense of taste
- Hypergeusia: increased sense of taste