TASTE/ GUSTATION

FLAVOUR

Complex sensation comprising

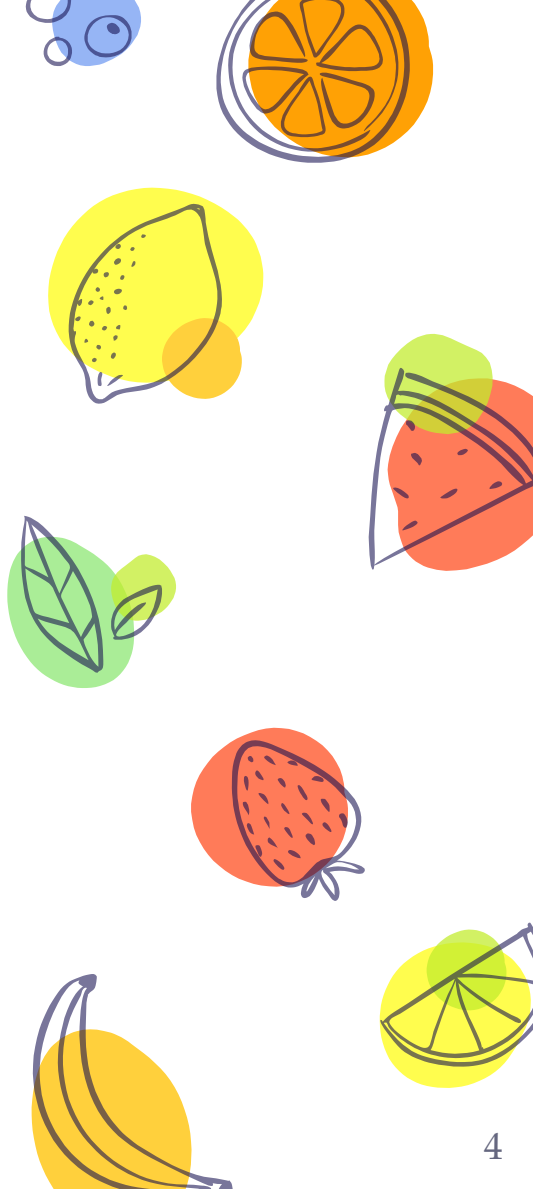
- Taste
- Odour
- Roughness or smoothness
- Hotness or coldness
- Pungent or non-irritating

Importance of **TASTE** : select food in accord to desires & body's metabolic need

Taste & smell :
chemical sensations with
differentiated chemoreceptors &
*f*unctionally related to each other

Perception of taste

- To sense chemicals -> **TASTANTs** (form of solution)
- Sense organ of taste : **TASTE BUDS**
- Carry chemoreceptors for taste.
- 2000 – 5000 taste buds in an individual
- 1 taste bud : 50 – 150 taste receptor cells.



Taste buds present in

TONGUE
abundant over
dorsal surface

PALATE

PHARYNX

CHEEK

UNDER SURFACE OF
TONGUE

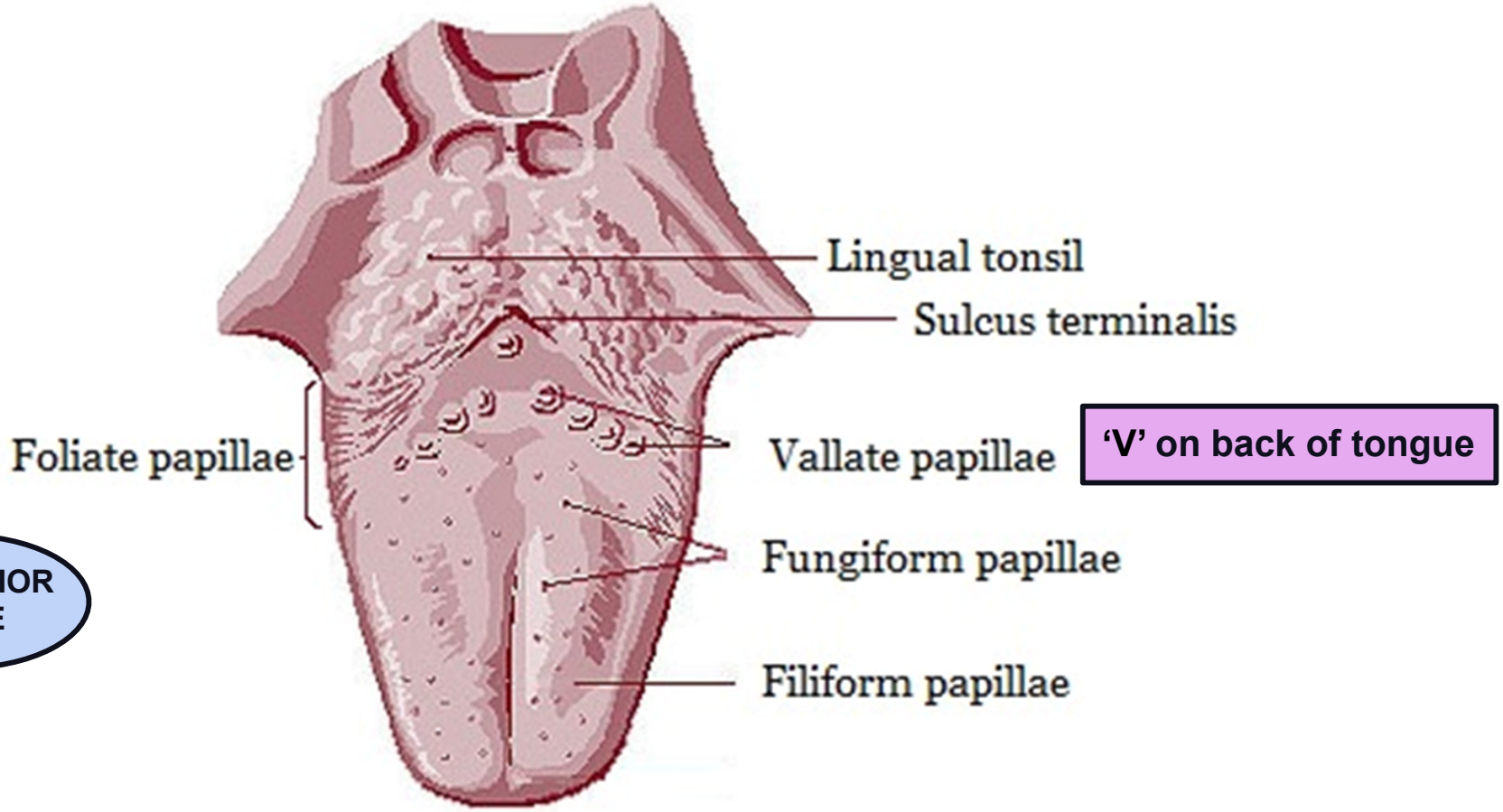
- TASTE receptors are concentrated within small but visible projections called PAPILLAE

CIRCUMVALLATE

FOLIATE

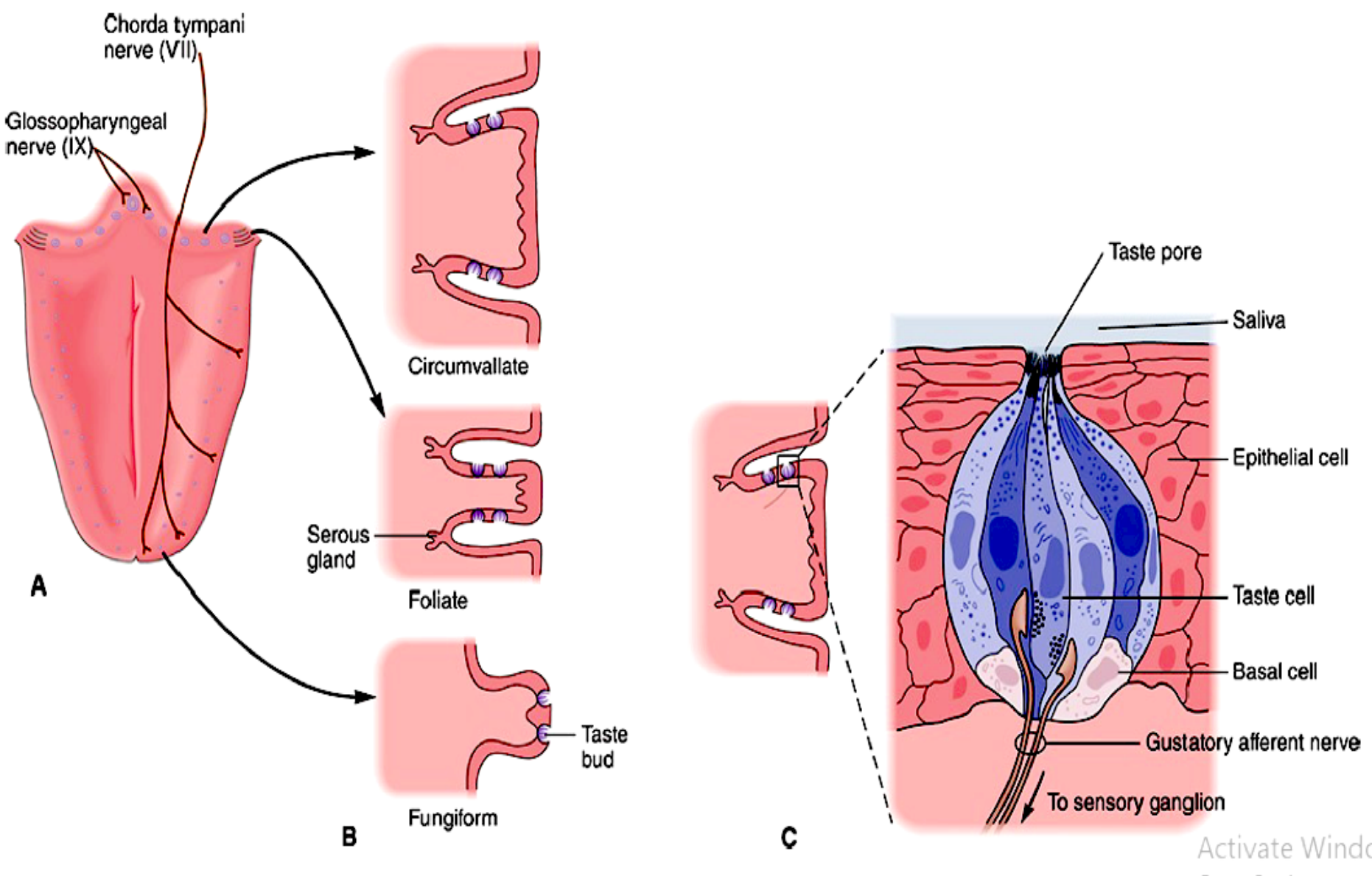
FUNGIFORM

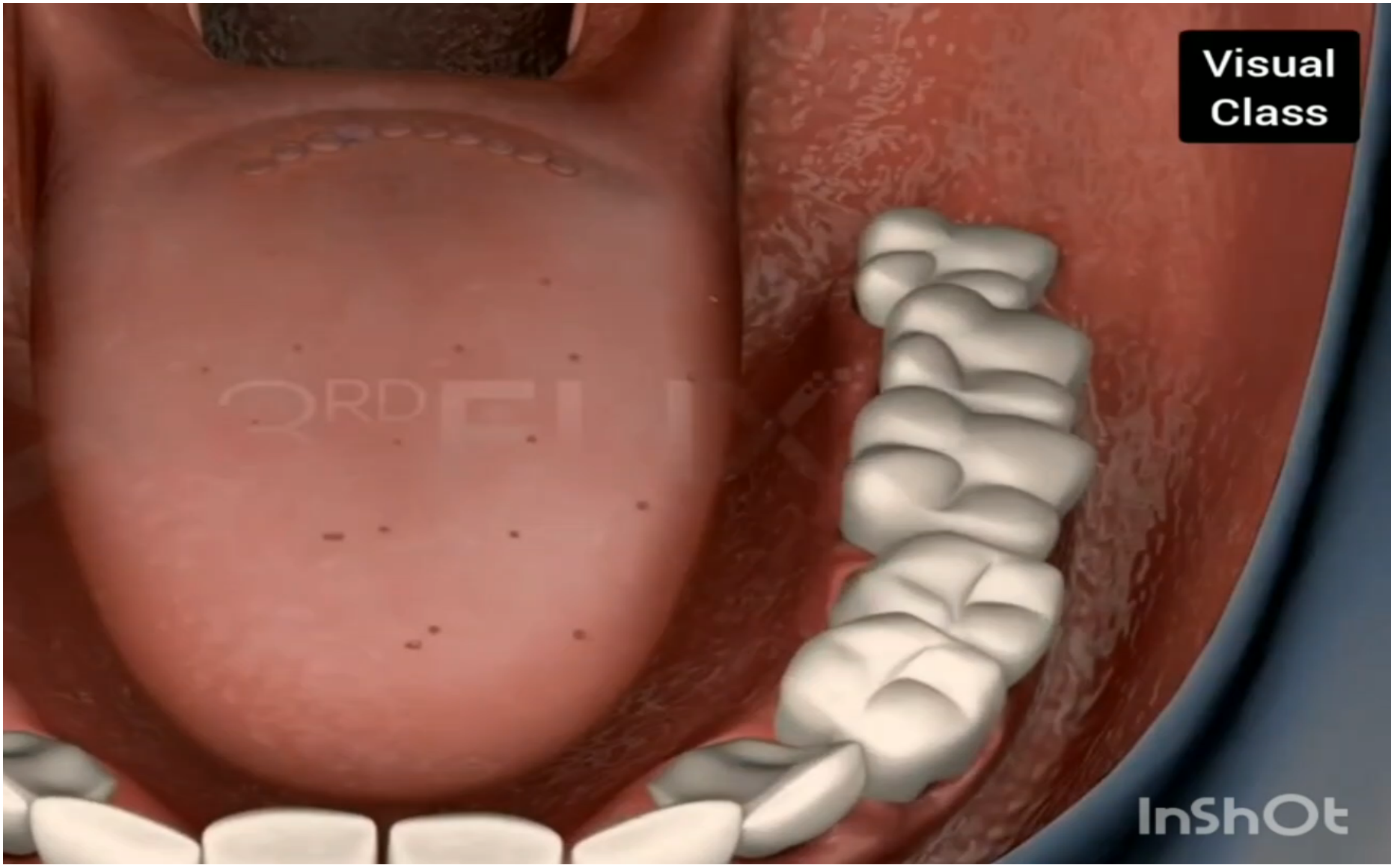
VON EBNER'S gland : secrete saliva into cleft around circumvallate & foliate papillae



'V' on back of tongue

POSTERIOR EDGE



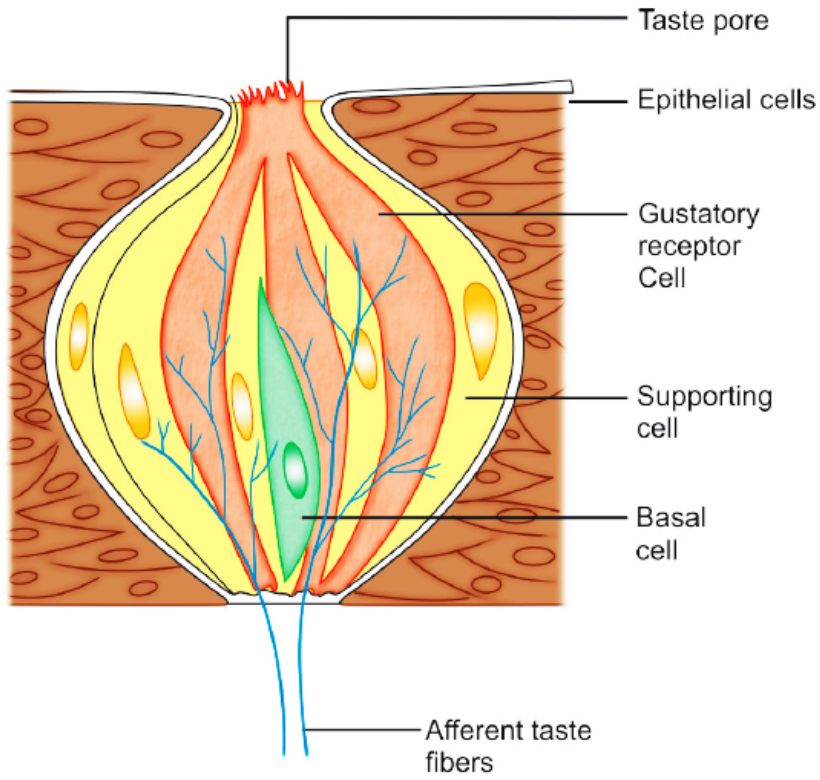

Visual
Class
InShOt

STRUCTURE

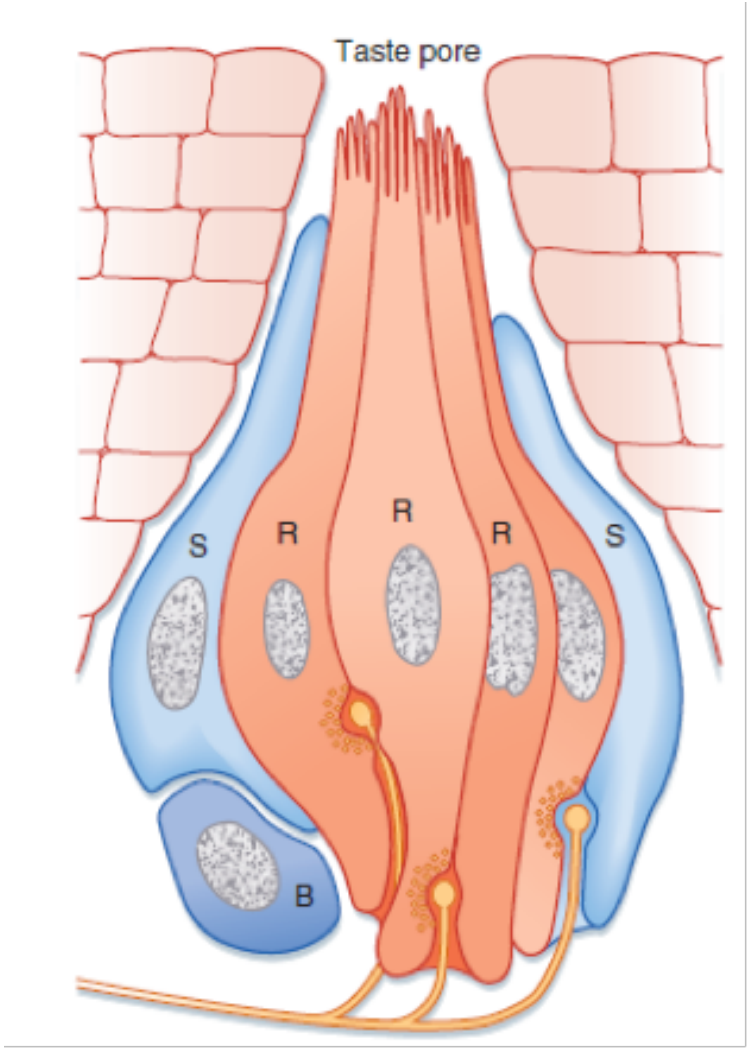
- Oval shaped clusters of cells in epithelial layer
- Small pores opening to surface
- 60- 80 µm length, 40 µm diameter

2 types of cells:-

1. Gustatory receptor cell
2. Supporting/ sustentacular cells
   - appears in 7-8 wks of IUL

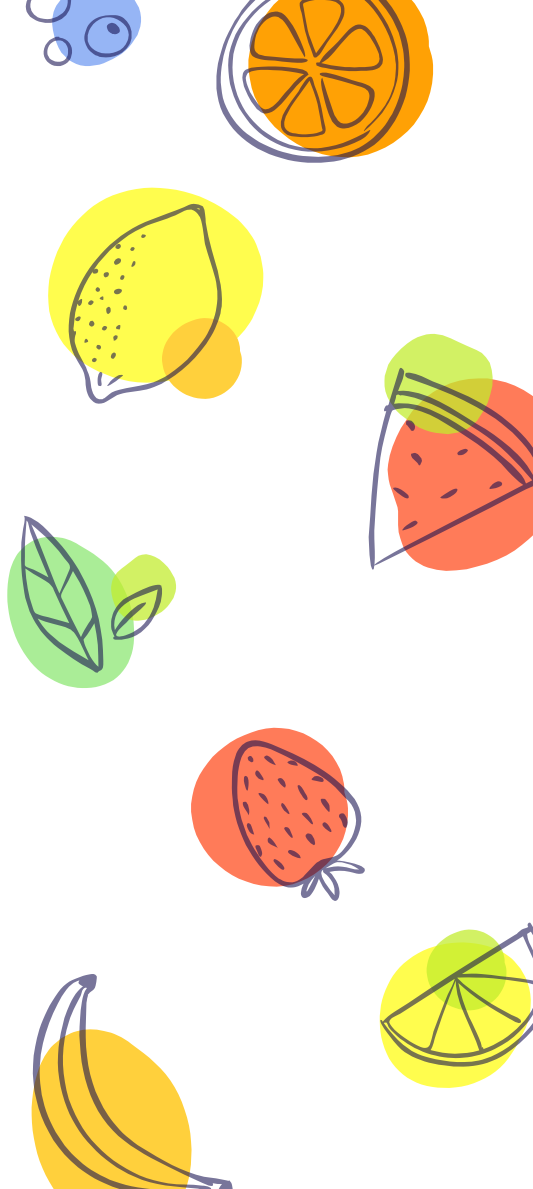


- Taste cells → epithelial cells surrounding taste buds.
- migrate towards centre as they mature.
- Dark, intermediate & light cells.
- Degenerate in about <u>10 days.</u>
- Each gustatory cell have microvilli at the top near the pore



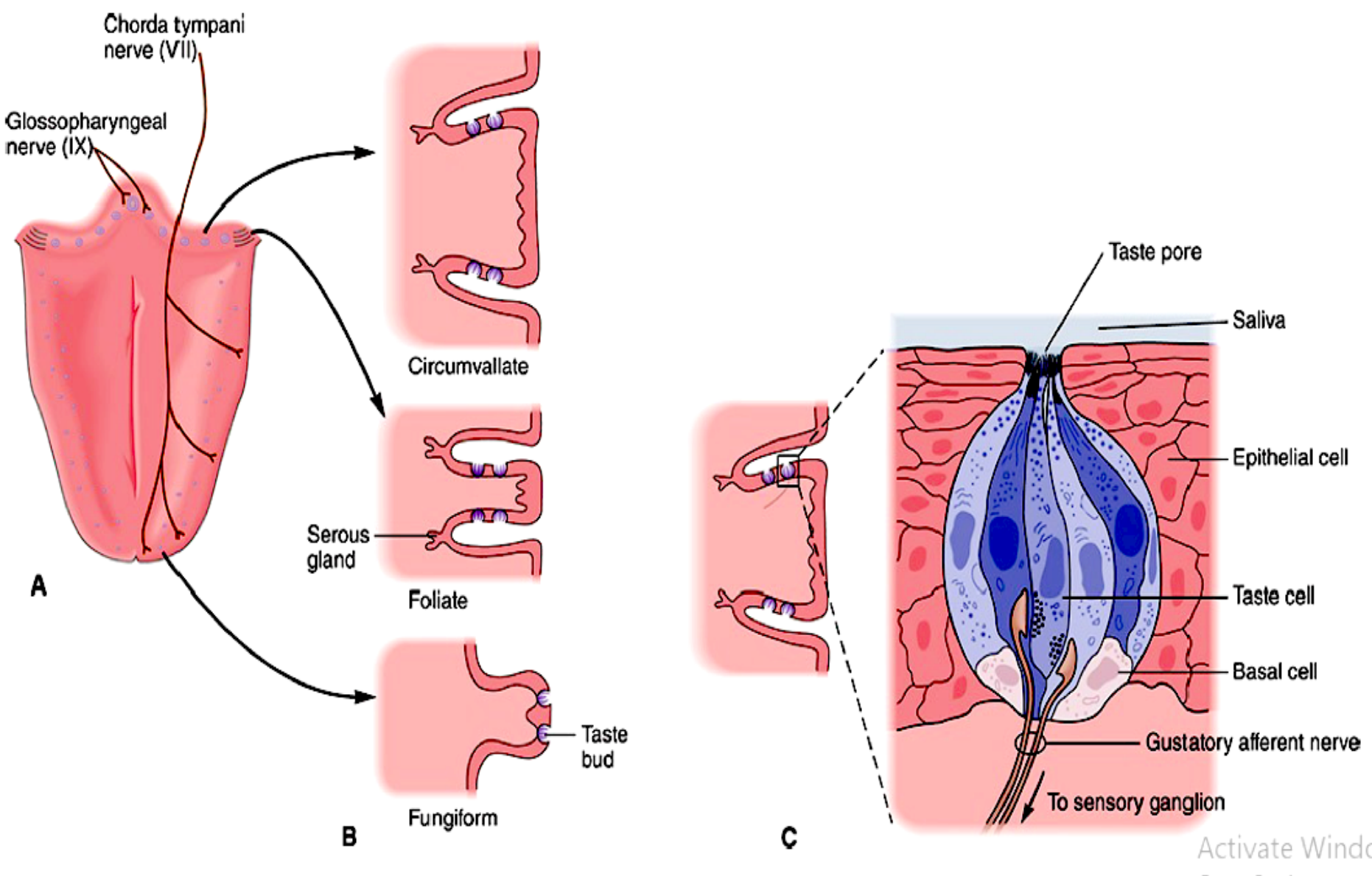
FUNCTION OF TASTE BUDS

- Selection of food
- Separate undesirable/ even lethal food & desirable food
- Stimulate secretion of saliva & gastric juice



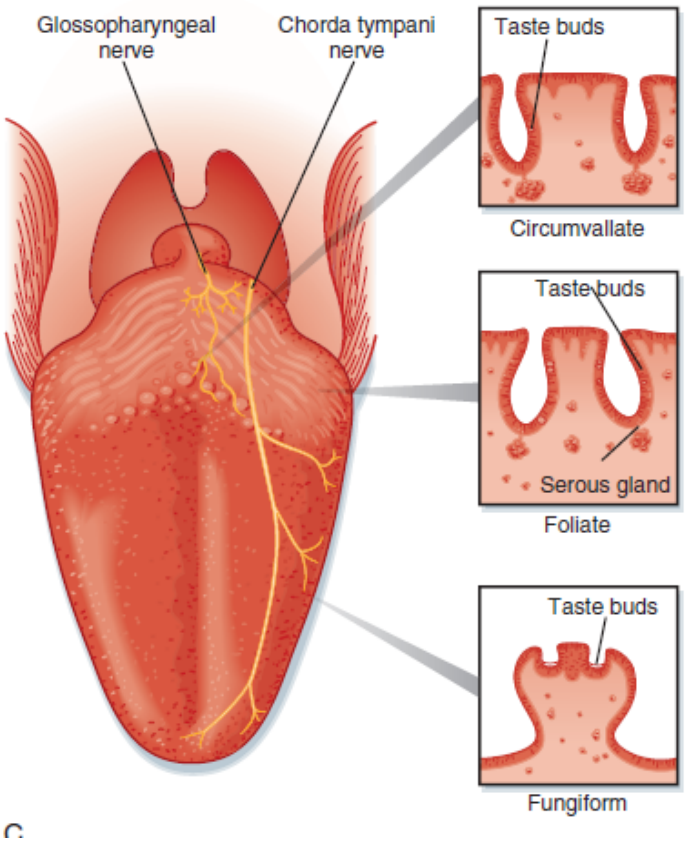
AFFERENT NERVES

- Begins as minute fibres
- join to form 2 or 3 large fibres
- Each taste bud innervated by about 50 nerve fibres



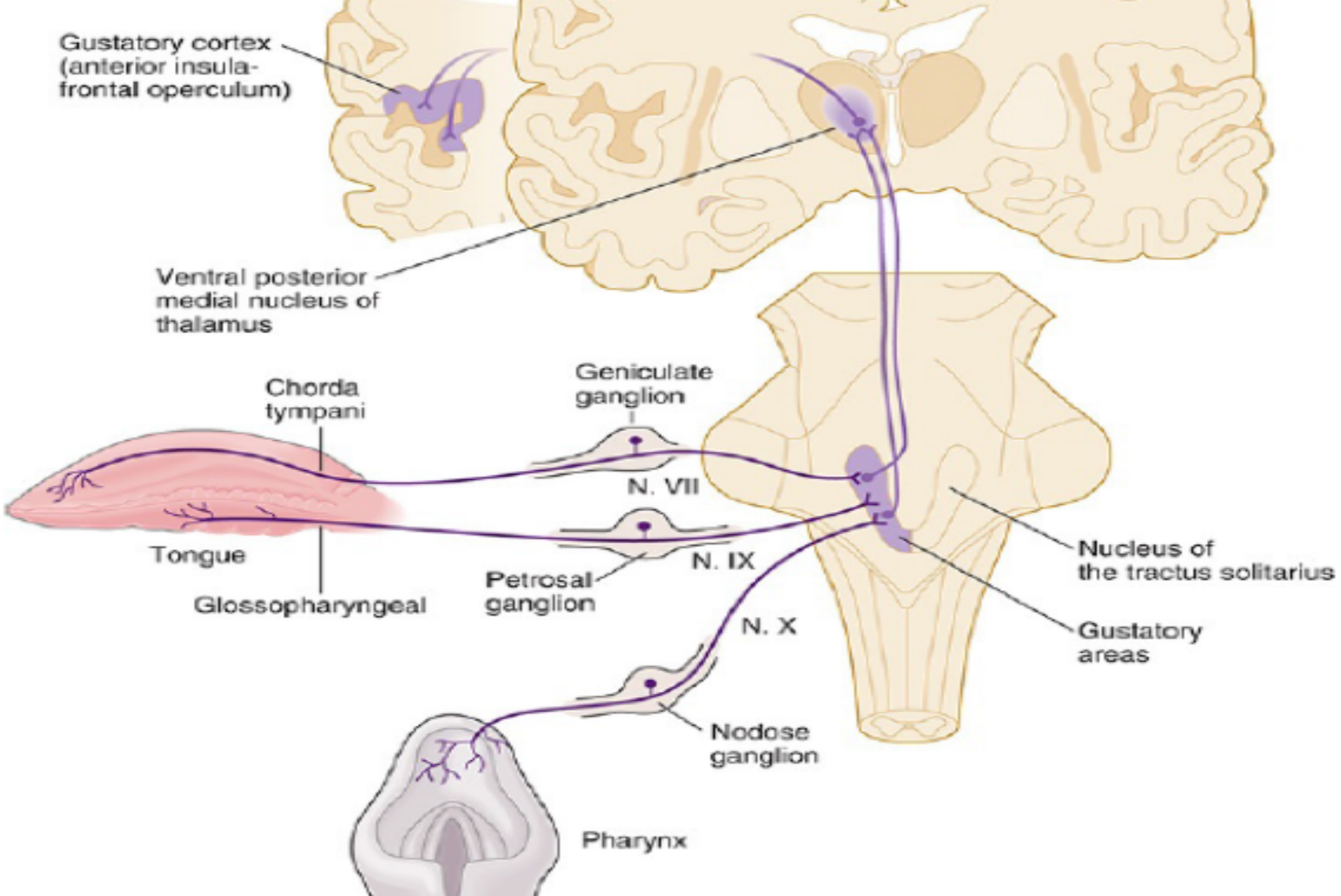
TASTE PATHWAY

- Sensation of taste :-
  - Ant 2/3rd of tongue : Chorda tympani (branch of facial nerve)
  - Post 1/3rd of tongue: Glossopharyngeal
  - Pharynx and epiglottis : Vagus nerve



- These fibers run to NTS in medulla
- 2nd order neurons located in NTS go through Medial lemniscus
- into Ipsilateral thalamus (ventral posteromedial nucleus)
- 3rd order neurons arise from here end in

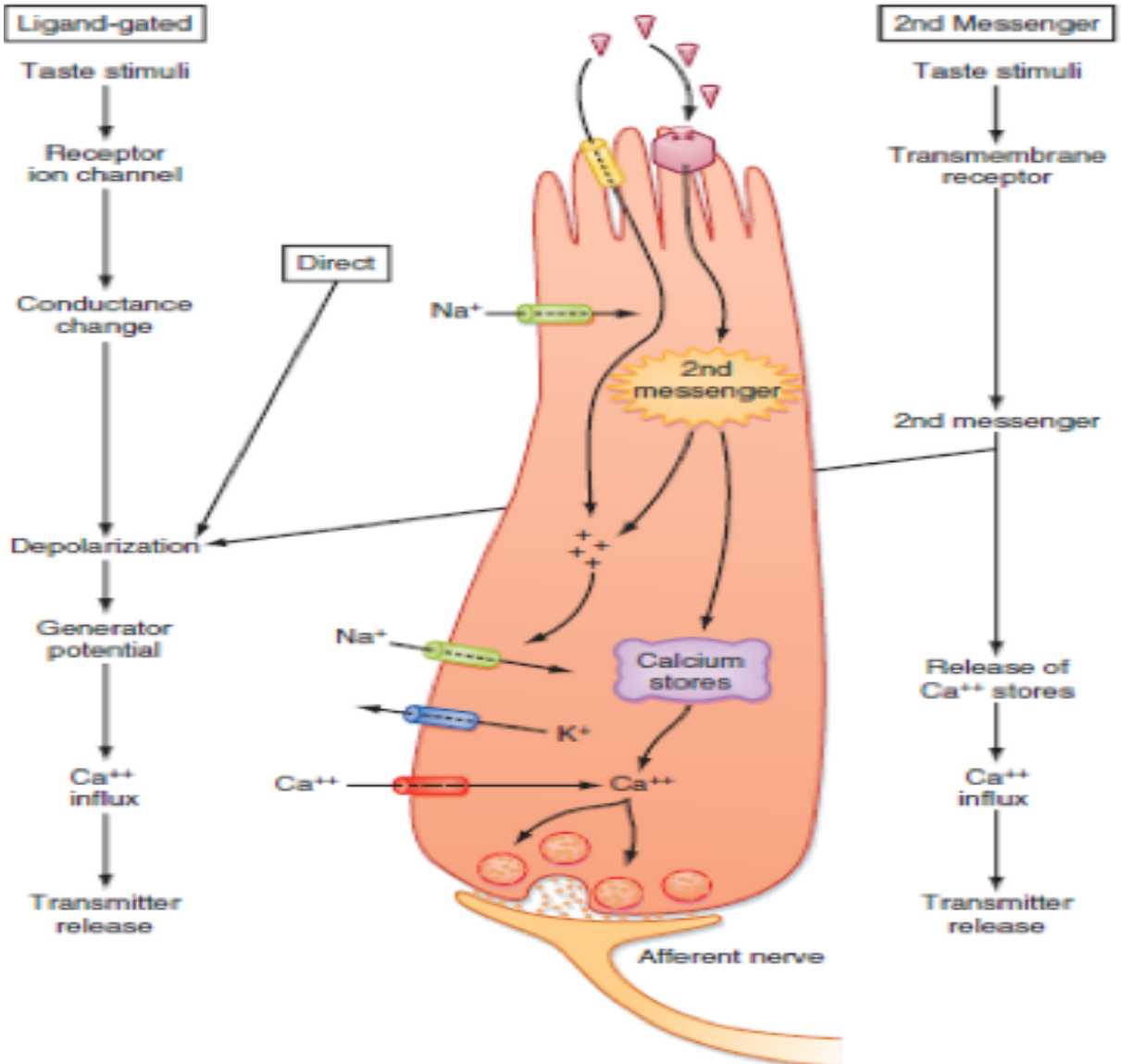
Anterior insula & frontal operculum in ipsilateral cerebral cortex


Gustatory cortex
(anterior insula-
frontal operculum)
Ventral posterior
medial nucleus of
thalamus
Chorda
tympani
Geniculate
ganglion
N. VII
Tongue
Glossopharyngeal
Petrosal
ganglion
N. IX
N. X
Nucleus of
the tractus solitarius
Gustatory
areas
Nodose
ganglion
Pharynx

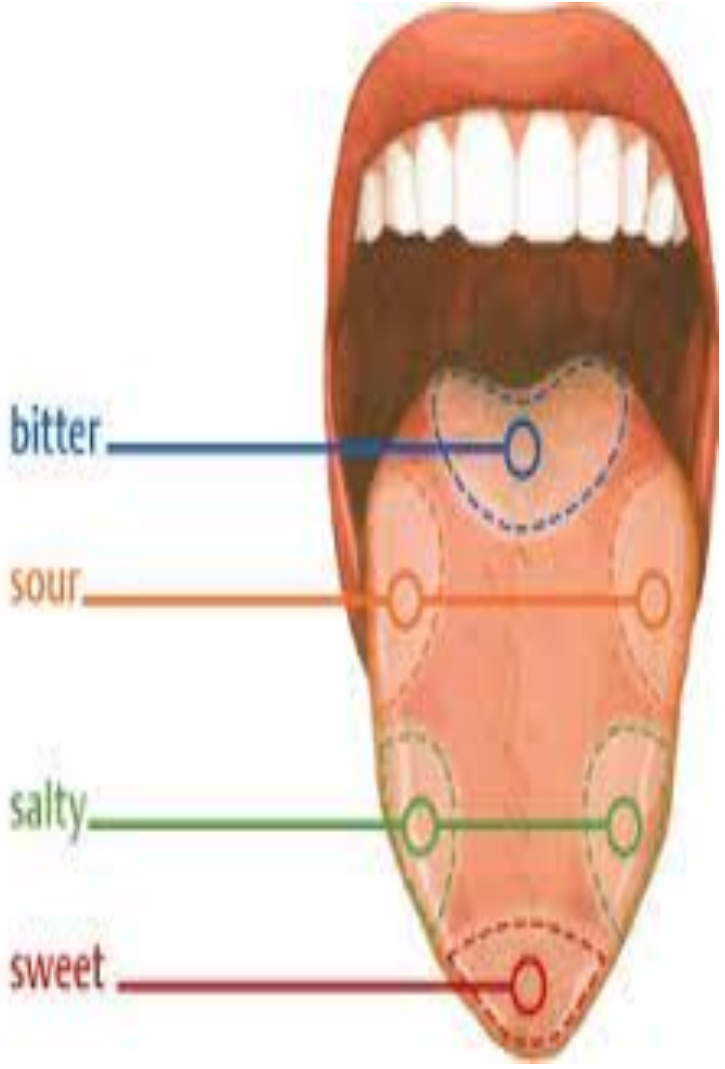
PHYSIOLOGY OF TASTE

RECEPTOR STIMULATION

- Taste producing substances: ***dissolved in oral fluid***
- **Weakly attach** to taste receptors
- **Evokes generator potential**
- Action potentials in sensory nerves
- This action potential is transmitted along the pathway to sensory cortex

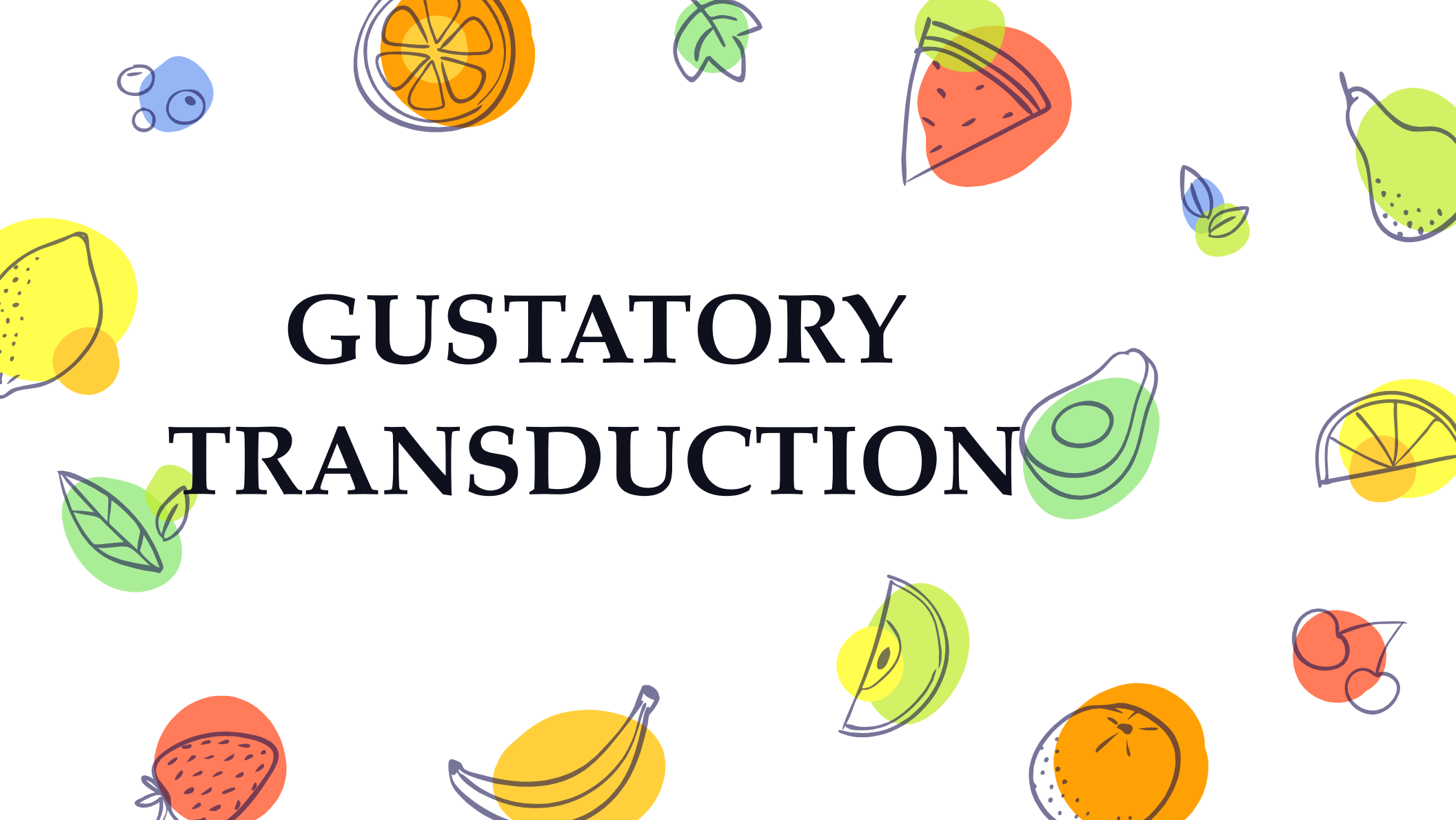

Ligand-gated
Taste stimuli
Receptor ion channel
Conductance change
Direct
Depolarization
Generator potential
Ca++ influx
Transmitter release
Na+
2nd messenger
Na+
Calcium stores
K+
Ca++
Ca++
Afferent nerve
2nd Messenger
Taste stimuli
Transmembrane receptor
2nd messenger
Release of Ca++ stores
Ca++ influx
Transmitter release

- Sweet and salt : greatest at tip
- Sour : side
- Bitter : back
- Mid dorsum : insensitive
- All four taste modalities can be sensed on palate, pharynx, and epiglottis

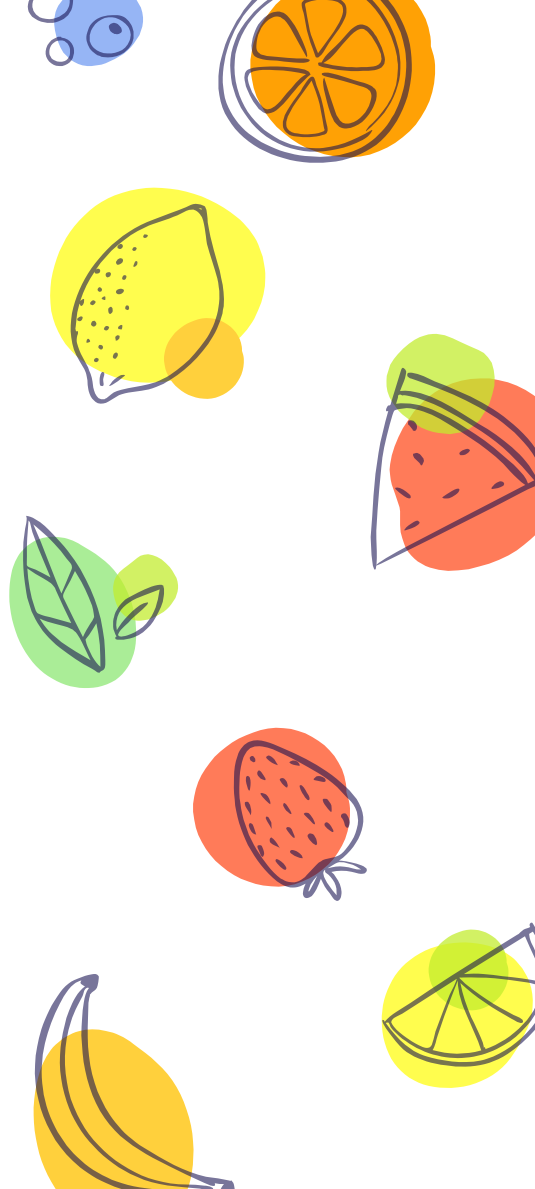

bitter
sour
salty
sweet


OUR TONGUES CAN DIFFERENTIATE BETWEEN THESE FLAVOURS
SWEET
SOUR
SALTY
BITTER
UMAMI

GUSTATORY TRANSDUCTION



- Salt and sour : Ionotropic receptors
- Sweet, Bitter & umami : GPCR



SOUR

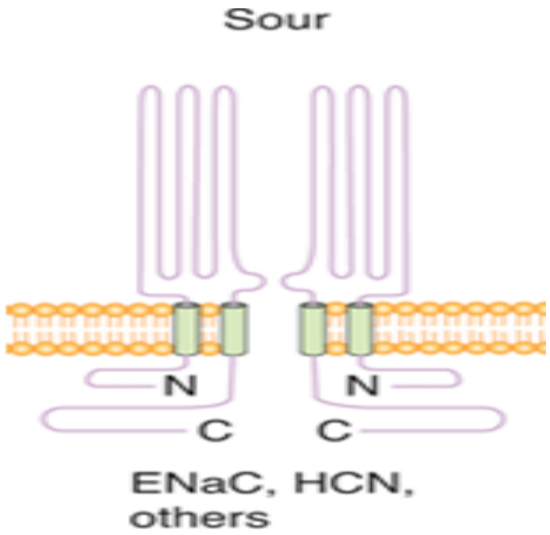
- Acidity of food (H+ ion concentration).
- Intensity of sensation :- proportional to logarithm of H+ ion concentration.

Mechanism of action

- Entry of protons via ENaC → depolarise receptor cell

  ↑

  Bind & block K+ sensitive channel
- Also HCN (hyperpolarisation activated cyclic nucleotide gated)



Sour

↓

increase entry of H+/Blocks K+ channels

↓

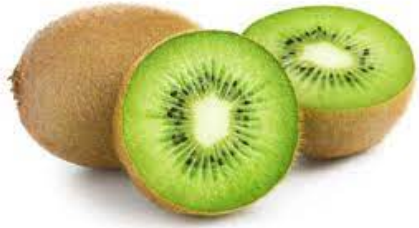
Depolarisation of receptor cell

↓

Neurotransmitter secretion

↓

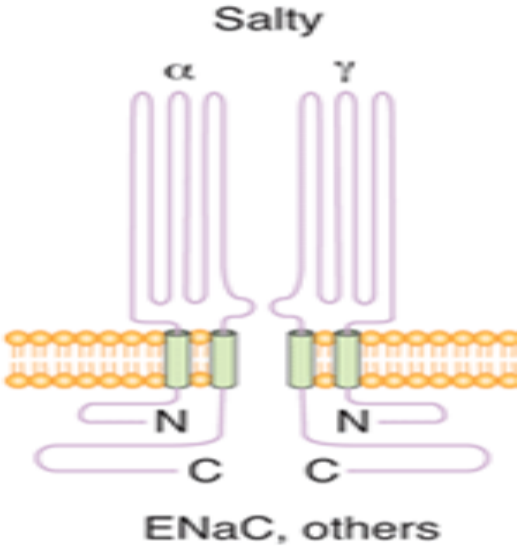
Stimulation of gustatory afferent nerve fibre



Citric acid: sweet and sour
Picric acid : bitter and sour

SALT

- Pure salt taste is Sodium Chloride
- Mediated by ENaC



salt

↓

Increase Sodium permeability

↓

Increase depolarisation of taste receptor cell

↓

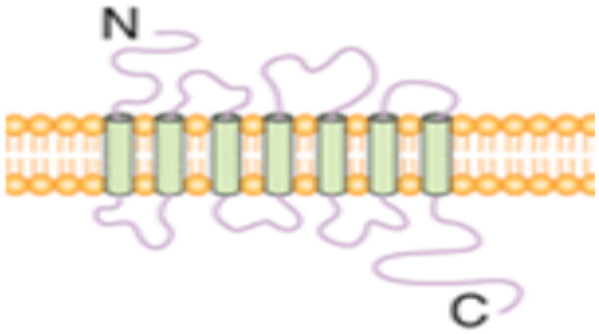
Neurotransmitter secretion

↓

Stimulation of gustatory afferent nerve fiber

BITTER

-
  - Quinine – bind & block K+ channel
  - Strychnine – bind to GPCR that couple with Gustducin
  - Nicotine
  - Caffeine
  - Phenylthiourea
- Deadly toxins are mostly bitter
- Causes rejection of food
- GPCR(T2R family)



T2R family, others

AFTER TASTE

- Many sweet substances have an accompanying bitter taste
- Eg. Saccharin
- Reason for double taste:
  - tip of tongue sweet taste is well appreciated
  - when going backwards bitter sensitivity is developed

Bitter

↓

Activation of receptor

↓

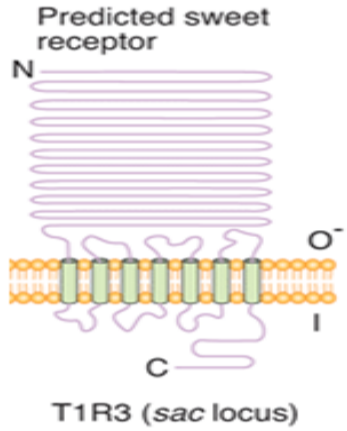
Dissociation of G protein

↓

Activation of phospholipase C → increase IP3 → increase intracellular Ca2+ → neurotransmitter secretion → stimulation of gustatory afferent fiber

SWEET

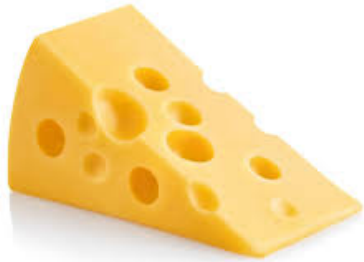
- Due to organic compounds
- ***Sucrose*** is the reference
- Synthetic sweeteners : saccharin (sweet substitutes)
- Act via Gustducin
- T1R2,T1R3 family of GPCR
- Lowers cAMP & increases IP3 → releases Ca++ → depolarization



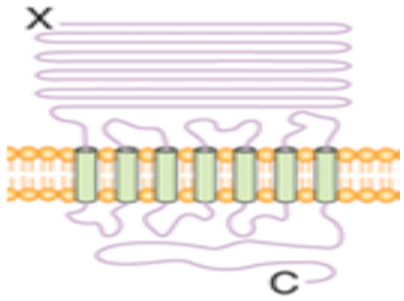
UMAMI TASTE

- Metabotropic glutamate receptor - mGluR4
- Also T1R1 , T1R3
- Triggered by MSG/L-glutamate

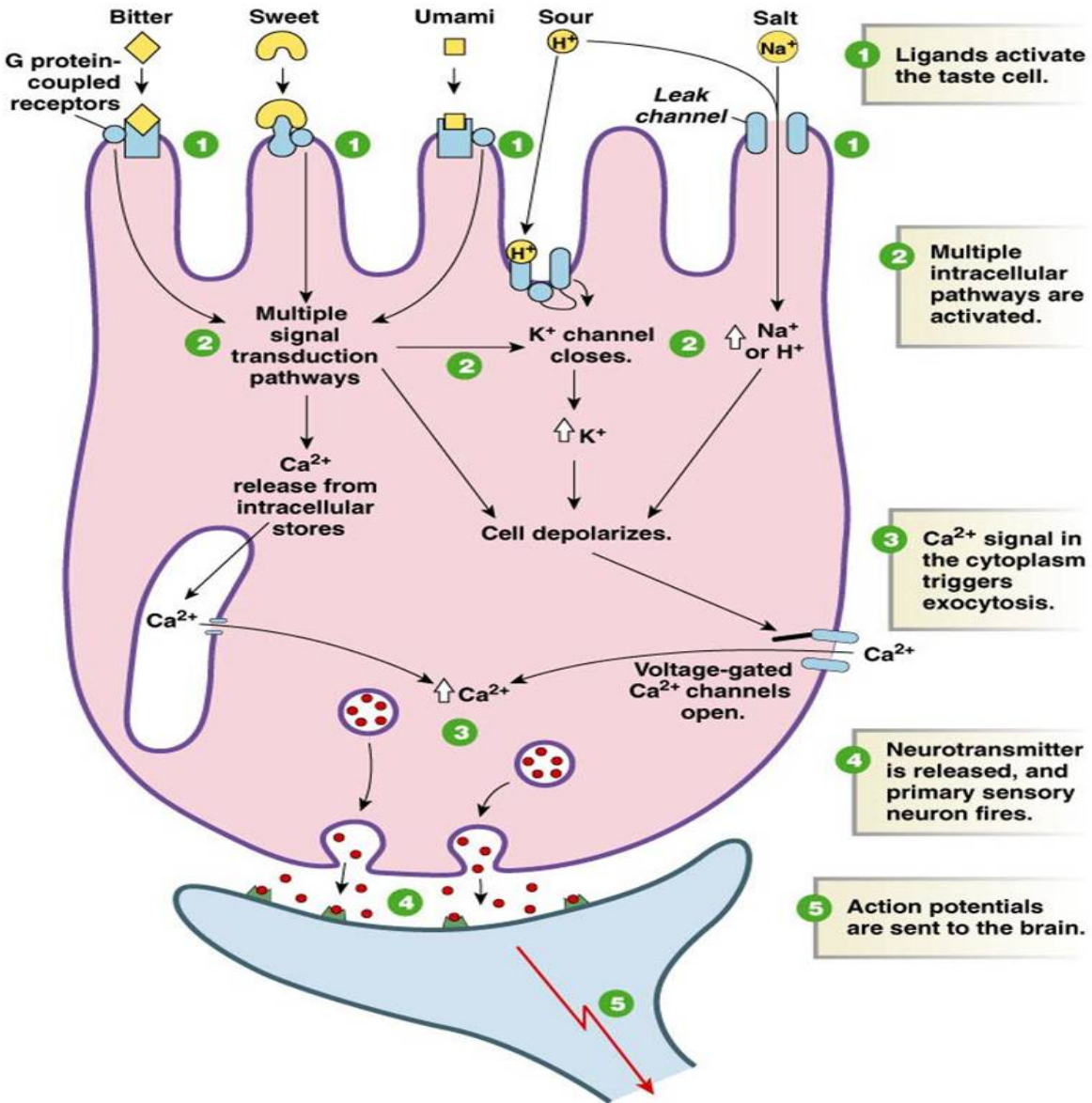
- Kikunae Ikeda in 1908
- Fish, mushrooms, ageing cheese, ripe tomatoes



Umami
(L-glutamate)



Taste mGluR4


Bitter
Sweet
Umami
Sour
Salt
G protein-coupled receptors
Leak channel
1 Ligands activate the taste cell.
2 Multiple intracellular pathways are activated.
Multiple signal transduction pathways
K+ channel closes.
Na+ or H+
K+
Ca2+ release from intracellular stores
Cell depolarizes.
3 Ca2+ signal in the cytoplasm triggers exocytosis.
Ca2+
Voltage-gated Ca2+ channels open.
4 Neurotransmitter is released, and primary sensory neuron fires.
5 Action potentials are sent to the brain.

TASTE THRESHOLD

- Different substances have different taste threshold

SUBSTANCE	THRESHOLD
SOUR	0.0001
SALT	0.2
BITTER	**0.000008(provides protection against poisoning)**
SWEET (GLUCOSE)	0.08
SWEET (SACCHARIN)	0.000023

- 30% change in concentration : intensity discrimination
- **Supertasters** : Increased number of fungiform papillae.

FACTORS INFLUENCING TASTE SENSATION

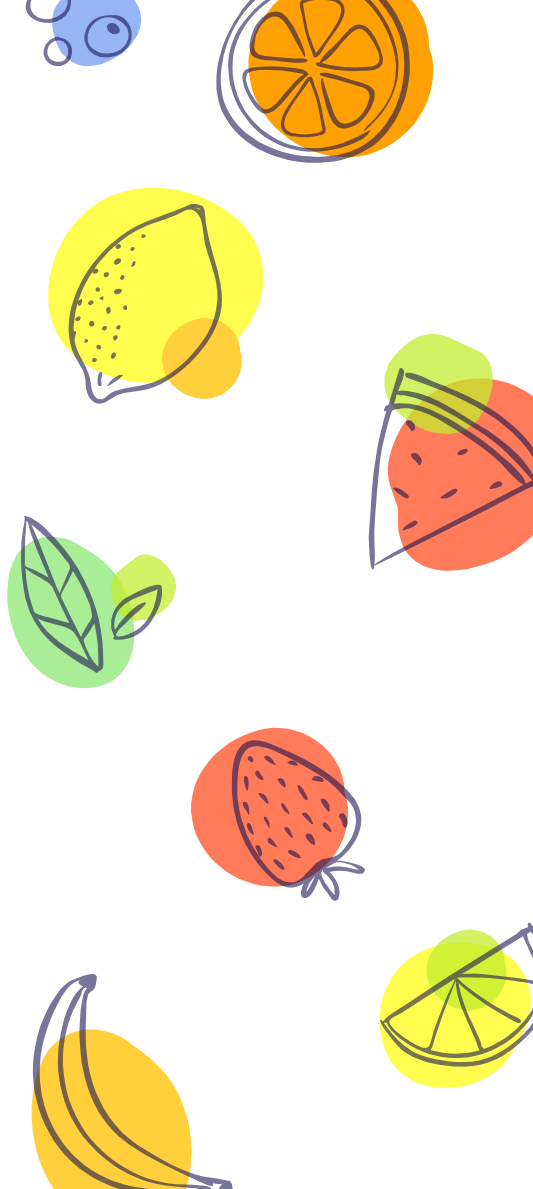
- Area of stimulation.
- Temperature of Tastants
- Age of the person
- Sex – female more sensitive to sweet & salt.
- Adaptation
- Interaction between taste producing substances.
- Effect of taste modifying proteins – Miraculin in west african plant, it makes acid taste sweet.
- Abnormalities of taste sensations.

ROLE OF SALIVA : Acts as solvent

- Essential for normal taste sensation
- Dry mouth : difficult to taste

REDUCED SALIVATION

- Head and neck irradiation
  - Affects taste sensation
  - Decrease turnover of taste buds
  - Damage to nerve terminals
- Xerostomia : altered taste perception
- Sjogren's syndrome : reduced taste perception



Applied aspects

- **AGEUSIA** : absence of taste sensation
  - Bell's palsy, vestibular schwannoma
  - Captopril and penicillamine : temporary loss of taste
- **HYPOGEUSIA** : diminished taste sensitivity
- **DYSGEUSIA** : disturbed taste sense
- **FAMILIAL DYSAUTONOMIA**: congenital, inability to recognise taste
- ***SELECTIVE TASTE BLINDNESS*** : inherited ,very marked rise in threshold to bitter taste of phenyl thiourea. But, other sensations normal

IMPORTANT QUESTIONS

- TASTE PATHWAY
- GUSTATORY TRANSDUCTION

Thanks!