Neurophysiology of smell and taste (gustation)

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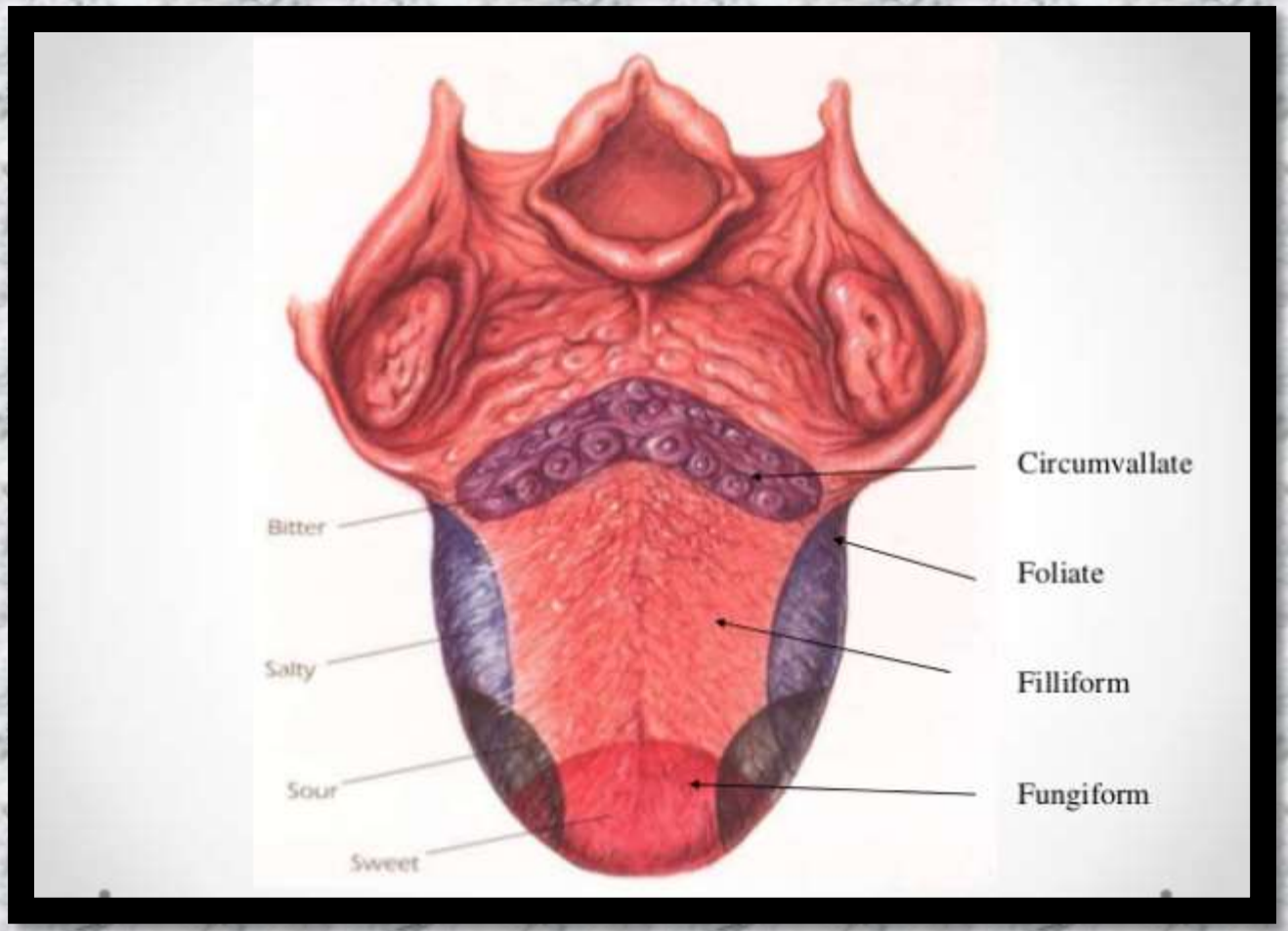
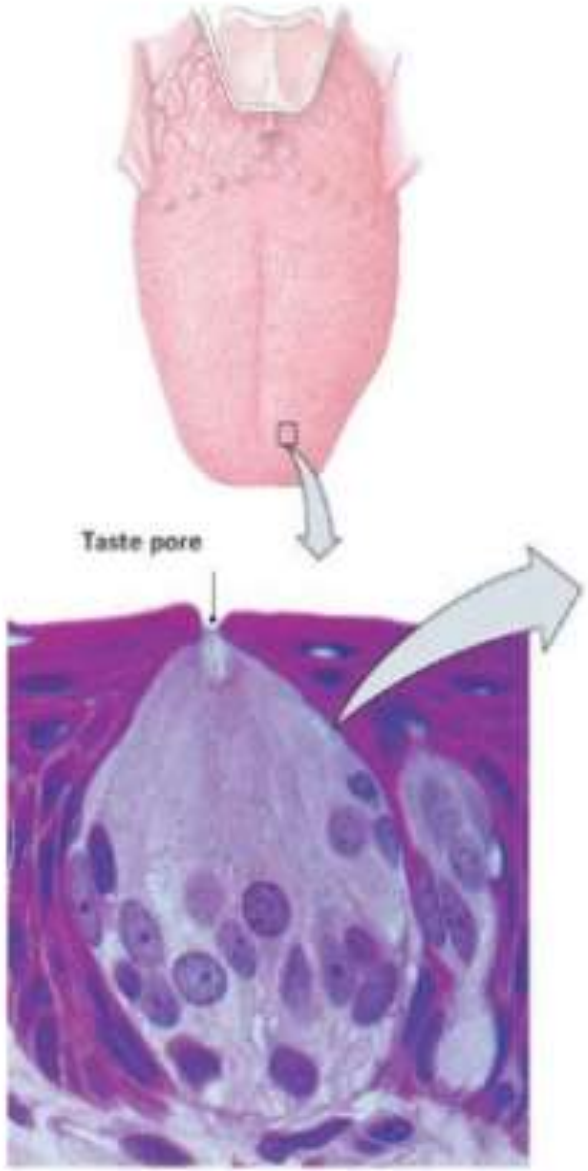
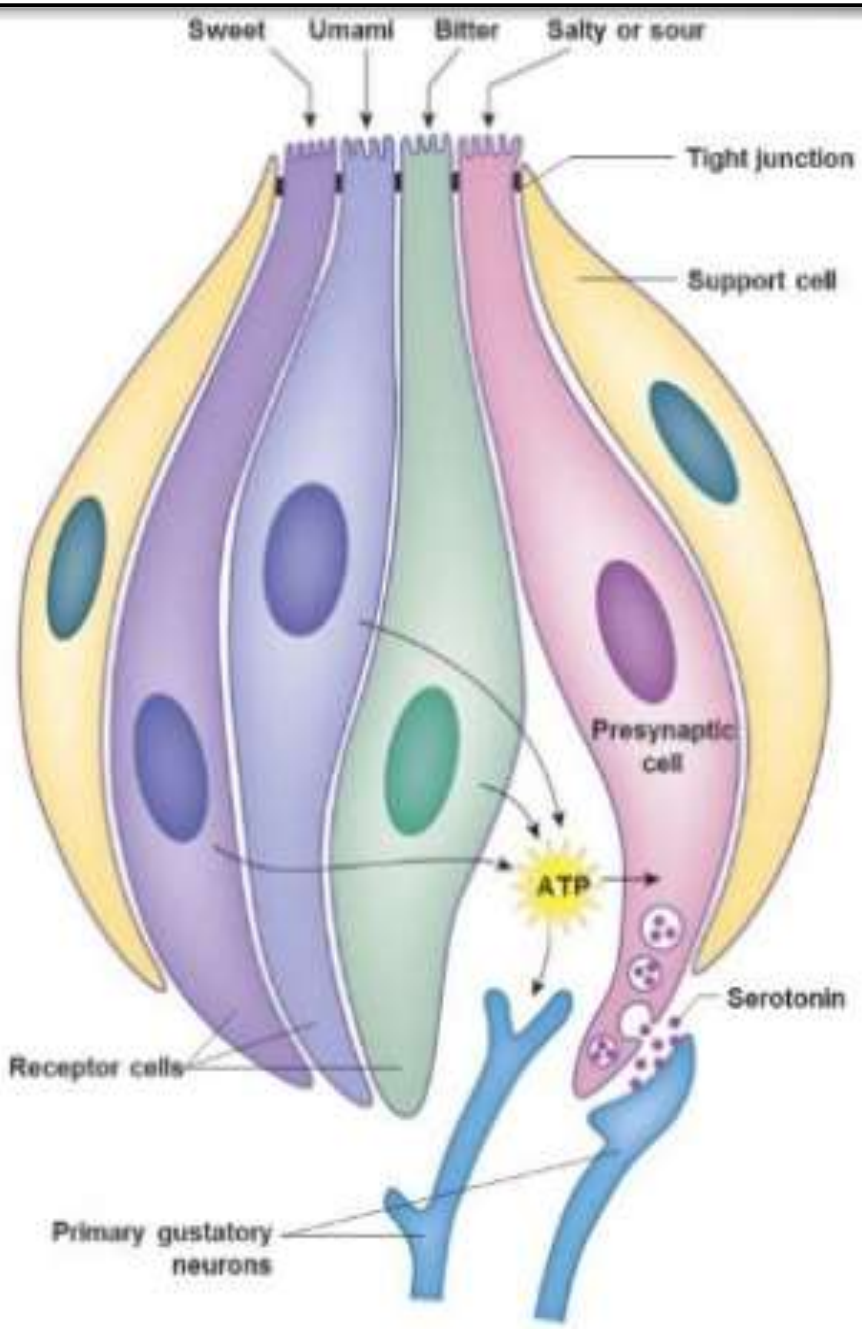
Physiology of taste

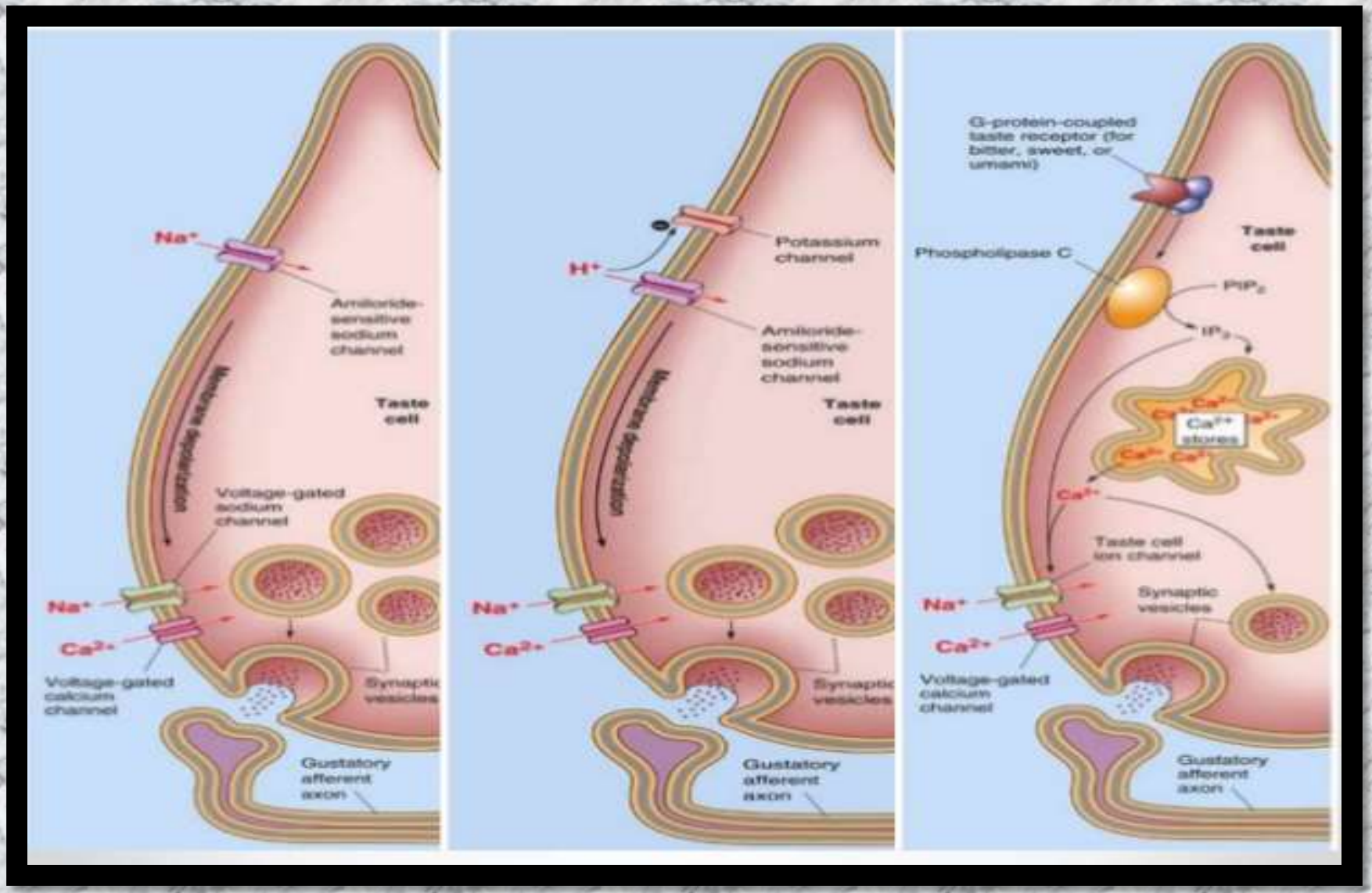



Taste pore

Taste Bud


Sweet
Umami
Bitter
Salty or sour
Tight junction
Support cell
Presynaptic cell
ATP
Serotonin
Receptor cells
Primary gustatory neurons

Mechanism of stimulation

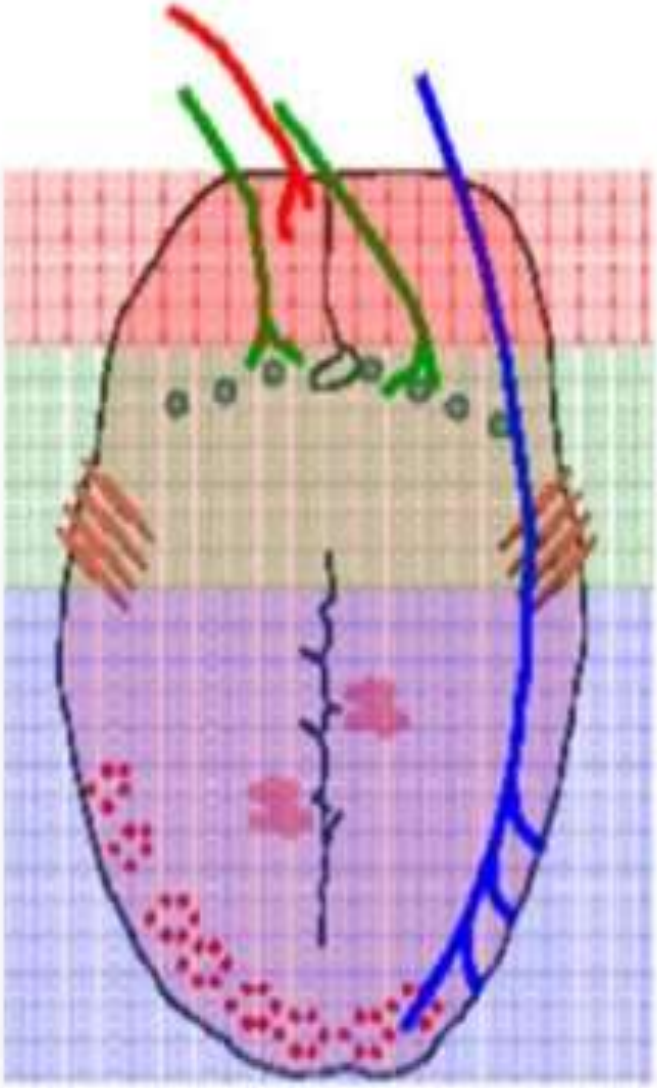


Gustatory Nerves

Pharynx, Epiglottis, Esophagus

1/3 of anterior tongue innervated by glossophryngeal nerve

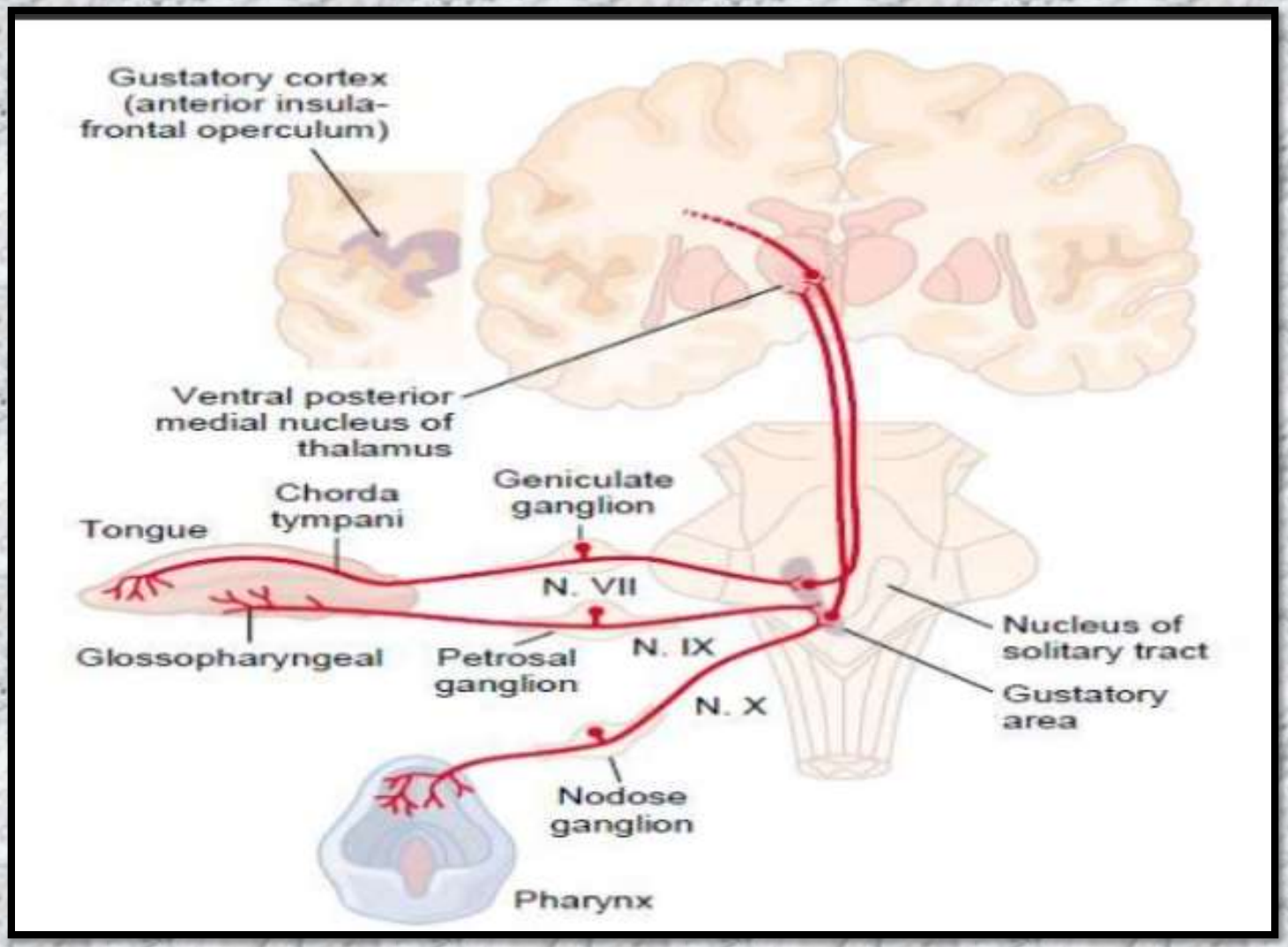
2/3 of anterior tongue innervated by tympanic nerve



Vagus Nerve (X)

Glossophryngeal Nerve (IX)

Facial Nerve (VII)

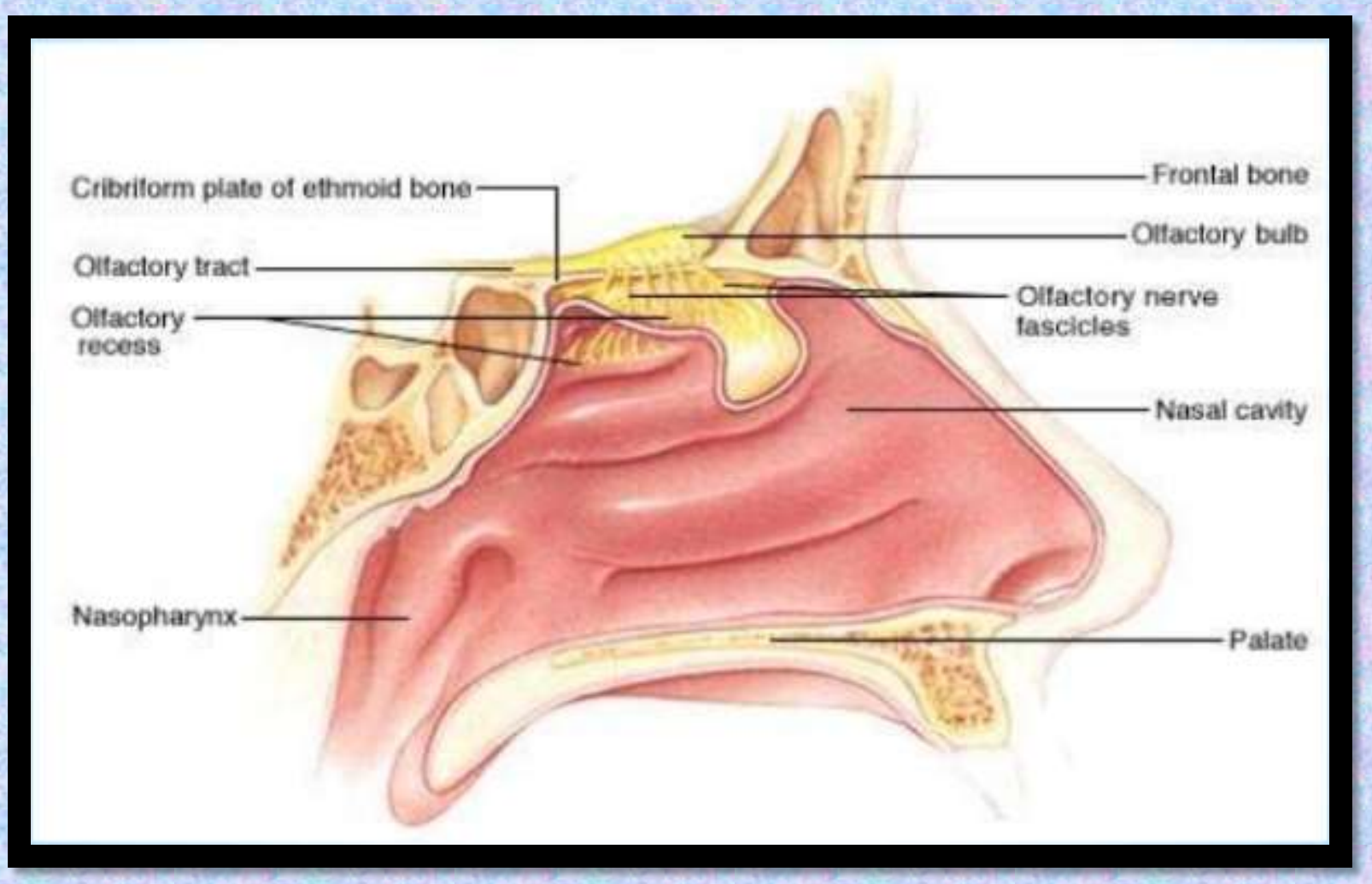

Gustatory cortex
(anterior insula-
frontal operculum)
Ventral posterior
medial nucleus of
thalamus
Geniculate
ganglion
Chorda
tympani
Tongue
N. VII
Nucleus of
solitary tract
Glossopharyngeal
Petrosal
ganglion
N. IX
Gustatory
area
N. X
Nodose
ganglion
Pharynx

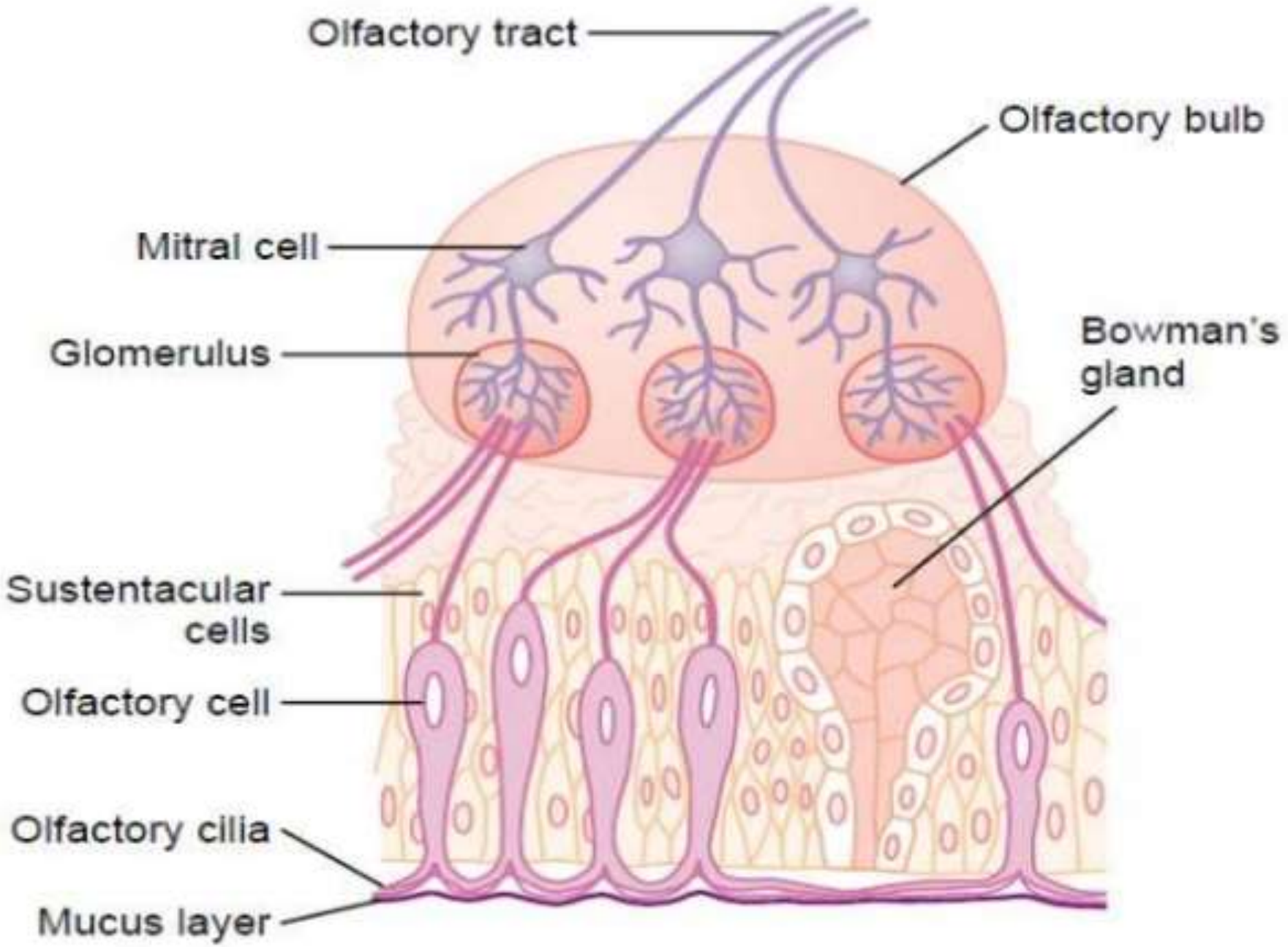
- Geniculate ganglion

Herpes zoster, also known as shingles, is caused by the reactivation of the varicella-zoster virus (VZV), the same virus that causes varicella (chickenpox)

- Bell's palsy is an unexplained episode of facial muscle weakness or paralysis. This condition results from damage to the facial nerve (the 7th cranial nerve)

Physiology of olfaction




Olfactory tract
Olfactory bulb
Mitral cell
Glomerulus
Bowman's gland
Sustentacular cells
Olfactory cell
Olfactory cilia
Mucus layer

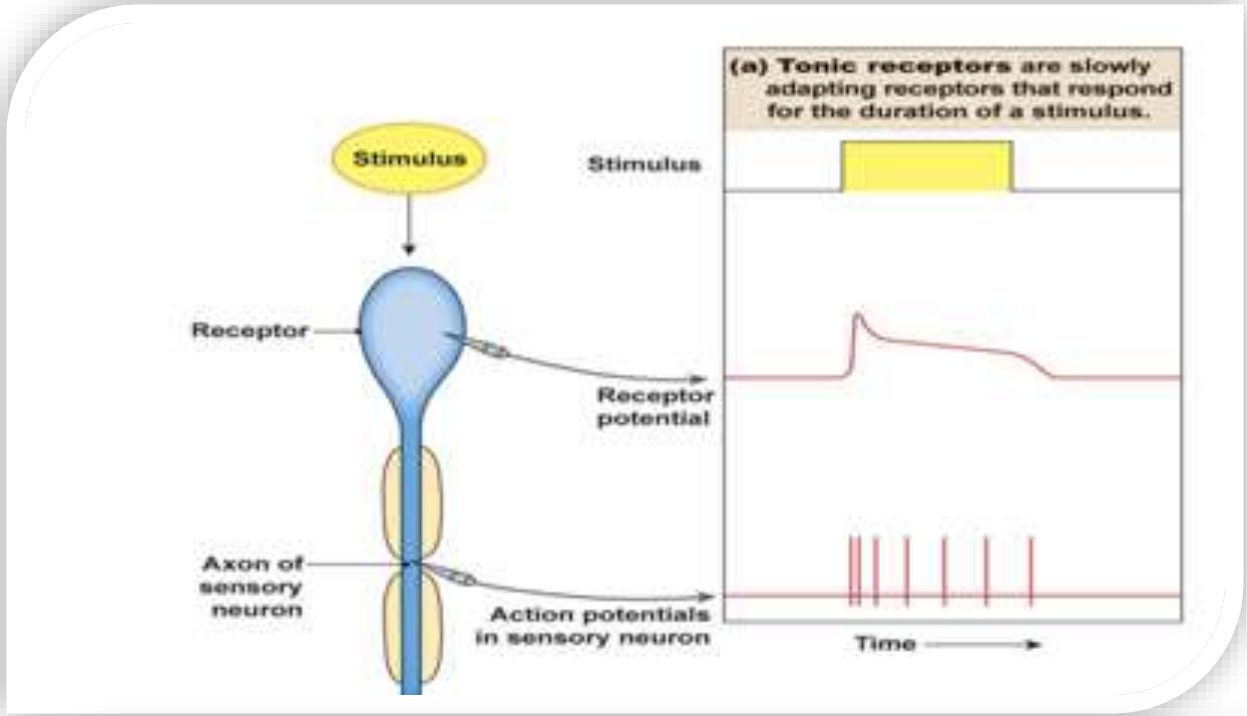
- **Only volatile substances** that can be sniffed into the nostrils can be smelled

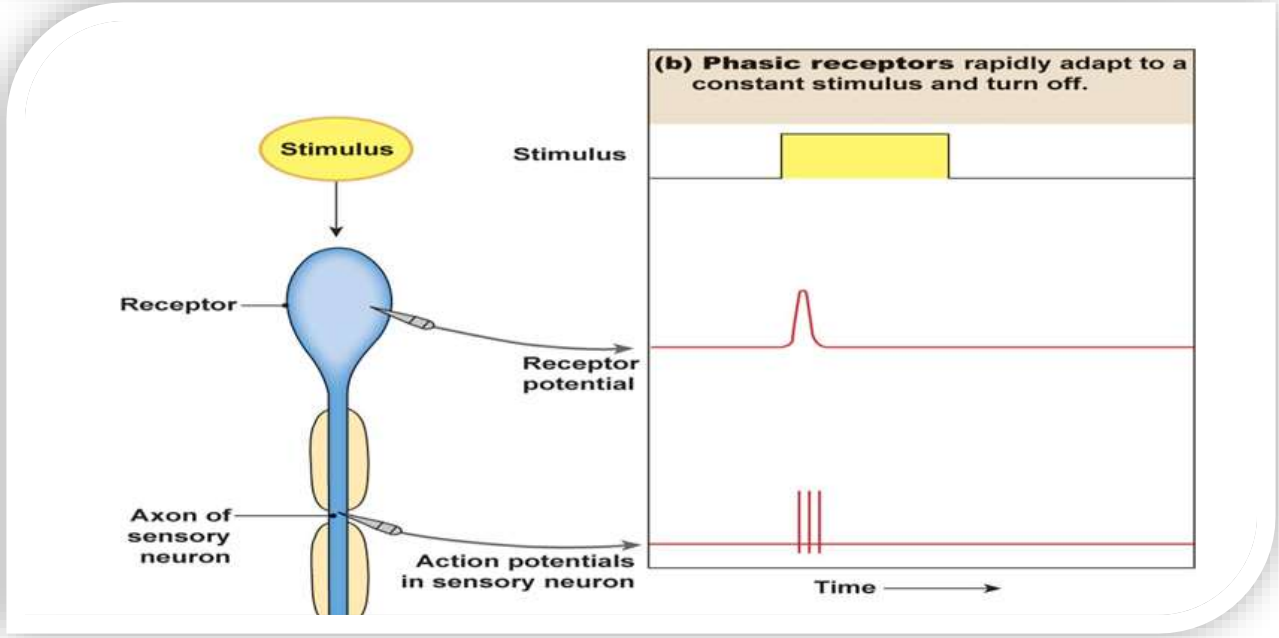
- Substance must be at least **slightly water soluble** so that it can pass through the mucus to reach the olfactory cilia.

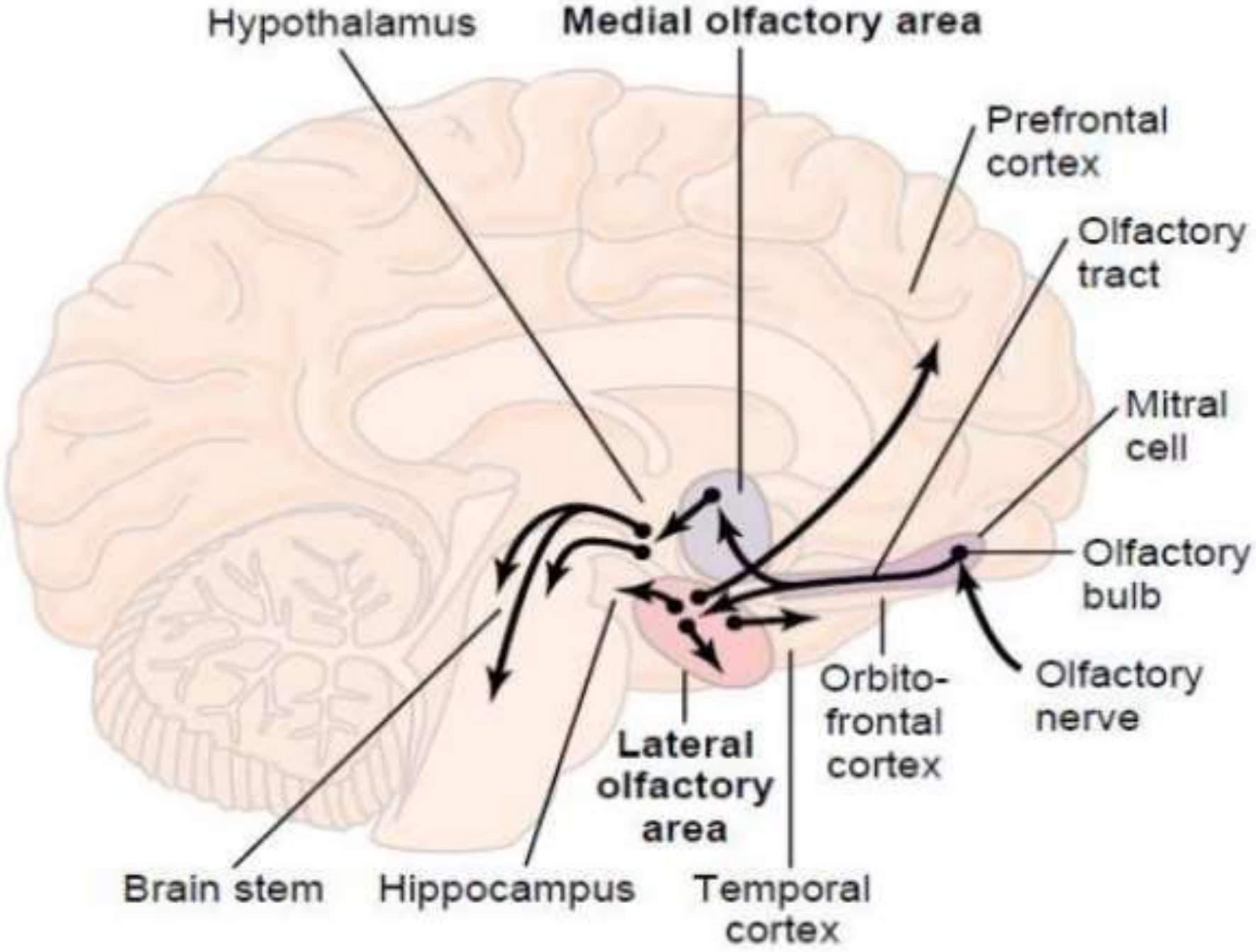
- substance to be at least **slightly lipid soluble**, presumably because lipid constituents of the **cilium** itself are a weak barrier to non-lipid-soluble odorants.

Granule cells connected glomerular with mitral and when they get excited, they releasing GABA inhibitory neurotransmitter .Granule cells neurons are interneurons that are thought to be involved with fine-tuning the processing of olfactory information by doing things like helping to sharpen the contrast between different odorants.

- A cilia of specific cilia express a specific protein receptors which can respond to different odorants
- One odor can bind to many different types of olfactory receptors protein
- G olfactory protein bind to GDP . But gets rid of GDP and binds with ATP and become very active
- Bind with AC that makes ATP converts into c AMP and bind to sodium channels and flow in sodium and calcium (adaptation response) and leaving chloride (component of mucus layer)


(a) Tonic receptors are slowly adapting receptors that respond for the duration of a stimulus.
Stimulus
Stimulus
Receptor
Receptor potential
Axon of sensory neuron
Action potentials in sensory neuron
Time


(b) Phasic receptors rapidly adapt to a constant stimulus and turn off.
Stimulus
Stimulus
Receptor
Receptor potential
Axon of sensory neuron
Action potentials in sensory neuron
Time


Hypothalamus
Medial olfactory area
Prefrontal cortex
Olfactory tract
Mitral cell
Olfactory bulb
Olfactory nerve
Orbito-frontal cortex
Lateral olfactory area
Brain stem
Hippocampus
Temporal cortex

Lateral olfactory area gives branches to :

1. Deep part in the temporal lobe ; the incus and supply the piriform cortex

2. Limbic system

Entorhinal cortex (EC) , Hippocampus (memories)

Amygdale (emotion)

Medial olfactory area gives branches to :
Subcallosal gyrus
Orbital frontal cortex

Some small fibers can cross over
Other fibers are ipsilateral

So smell can be bilateral

All the olfactory nerves and taste nerves are intermingled
Taste is 80% smell

Receptors adaptation

- The duration of a stimulus is coded by duration of action potentials.
- A longer stimulus generates longer series of APs.
- If a stimulus persists, some receptors adapt or stop responding
- There are 2 classes of receptors according to how they adapt:
  - Tonic receptors – slowly adapting – they fire rapidly when first activated, then they slow and maintain firing as long as the stimulus is present (Mechanoreceptors)
  - Phasic receptors – rapidly adapting receptors – rapidly firing when first activated but stop firing if the strength of stimulus remains constant
    - This type of reaction allows the body to ignore information that was evaluated and found not to be a threat to homeostasis (smell)

Anosmia

Nasal infection

Paranasal sinus infection

Olfactory groove meningiomas

trauma

(sign of neurodegenerative disease)