

Gustatory and Olfactory Sensations (Taste and Smell)



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Objectives

- ❑ Describe taste receptors and list its types
- ❑ Follow the taste pathway to the cerebral cortex
- ❑ Compare and contrast Olfactory and Gustatory sensations
- ❑ Describe olfactory sensation
- ❑ Outline the olfactory pathways
- ❑ Describe Gustatory and Olfactory abnormalities

Taste and Smell

- ❑ allows one to separate undesirable or lethal foods from those that are nutritious
- ❑ recognize the proximity of other individuals or animals
- ❑ tied to primitive emotional and behavioral functions of the nervous system

Taste is a Function of the Taste Bud

- 13 possible chemical receptors in taste buds
 - 2 for sodium
 - 2 for potassium
 - chloride
 - adenosine
 - inosine
 - 2 sweet
 - 2 bitter
 - glutamate
 - hydrogen ion

Primary Sensation of Taste

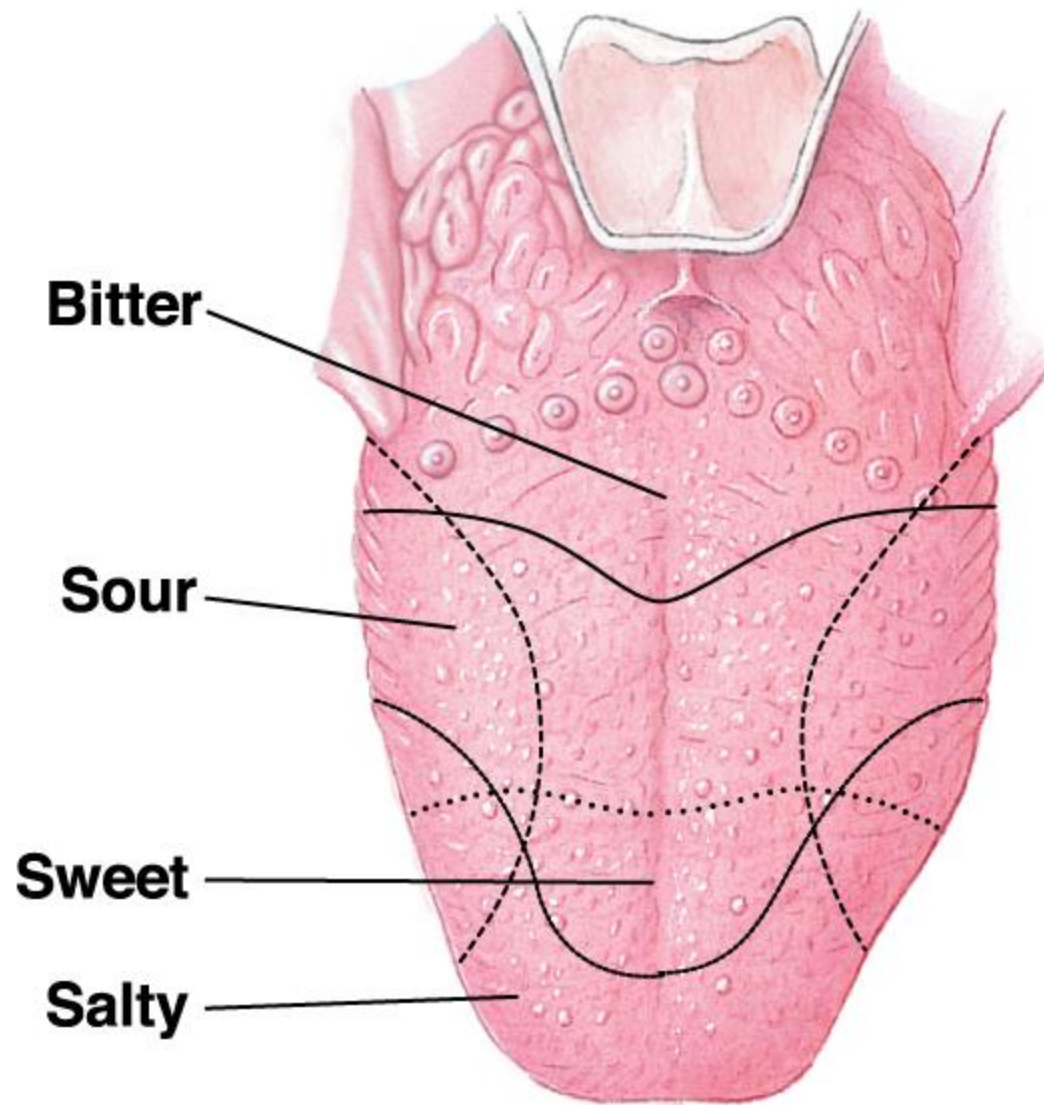
- can perceive hundreds of different tastes
- all are various combinations of the four primary taste sensations
 - sour
 - salty
 - sweet
 - bitter
- similar to the perception of color

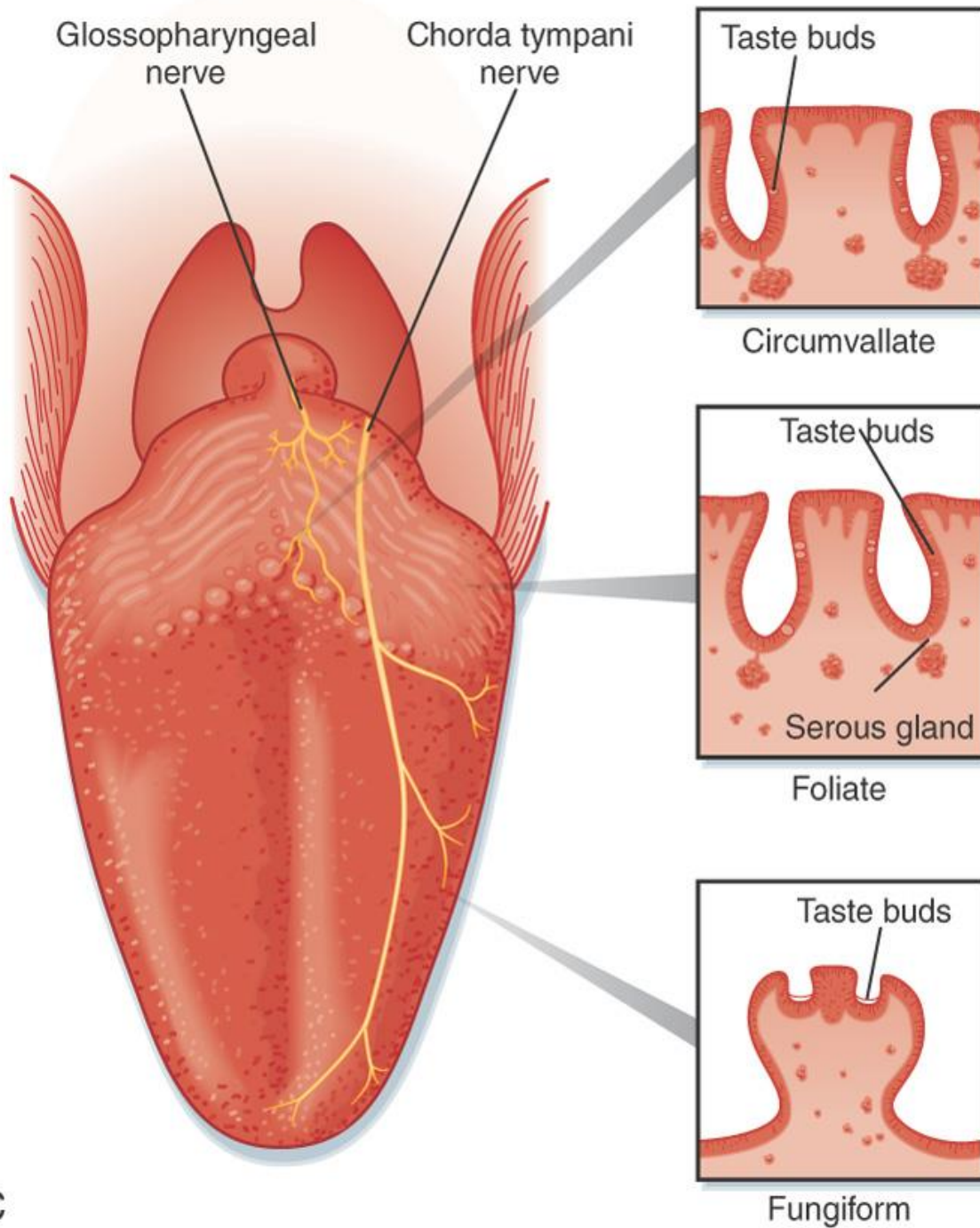
Taste Perception

- Sour
 - caused by acid concentration
- Salty
 - caused by ionized salts (e.g Na^+)
- Sweet
 - many chemicals mostly organic compounds
- Bitter
 - long chain organic substances containing nitrogen
 - Alkaloids
- Umami
 - Not familiar, a distinctive and delicious taste associated with certain amino acids such as glutamate and arginin

Location of Taste Buds

- ❑ found on three types of papillae of the tongue
- ❑ circumvallate
 - form a V on the posterior surface of the tongue
- ❑ foliate
 - located along the lateral surfaces of the tongue
- ❑ fungiform
 - located over the flat surface of the tongue
- ❑ extraglossal taste buds
 - on the tonsillar pillars, palate, epiglottis, and proximal esophagus





C

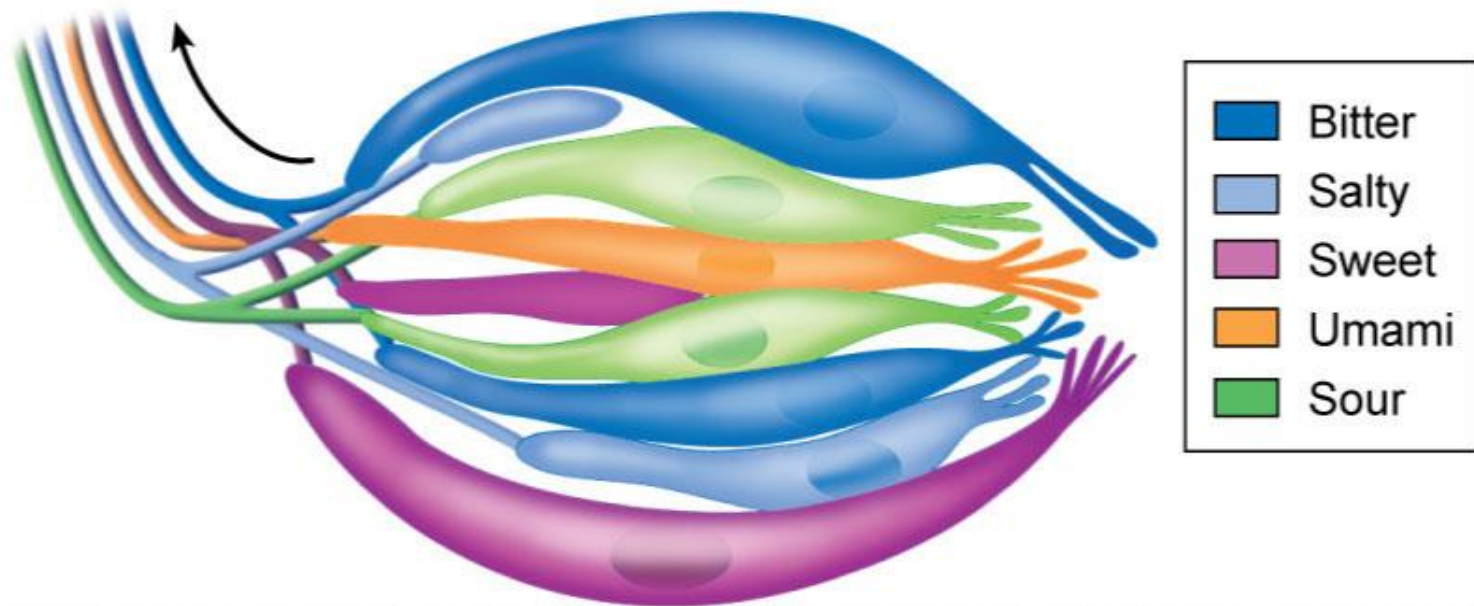
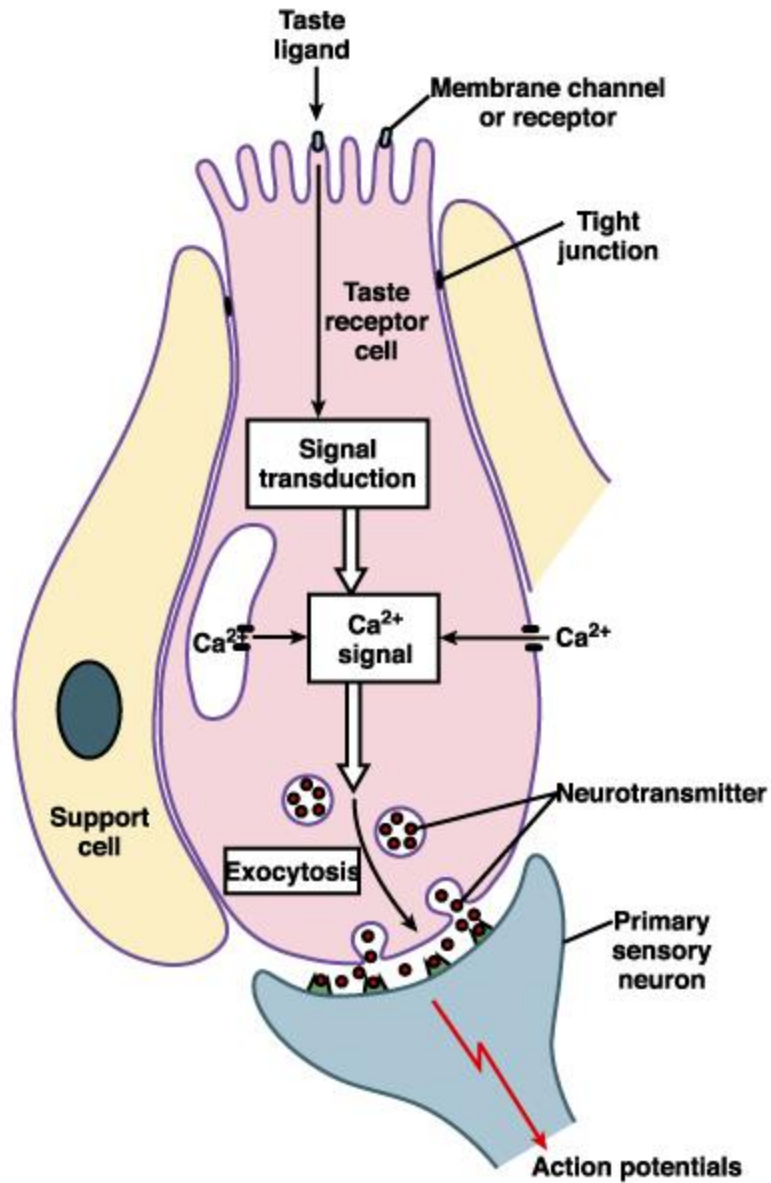


Fig. 15-9. **Taste receptors.** The labeled-line model of gustation (taste) holds that each distinct taste has a separate group of taste receptors, with each group sending its impulses along a distinct "line" or neural pathway.

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Ligand-gated

Taste stimuli

Receptor ion channel

Conductance change

Depolarization

Generator potential

Ca⁺⁺ influx

Transmitter release

Direct

Na⁺

2nd messenger

Na⁺

K⁺

Ca⁺⁺

Afferent nerve

2nd Messenger

Taste stimuli

Transmembrane receptor

2nd messenger

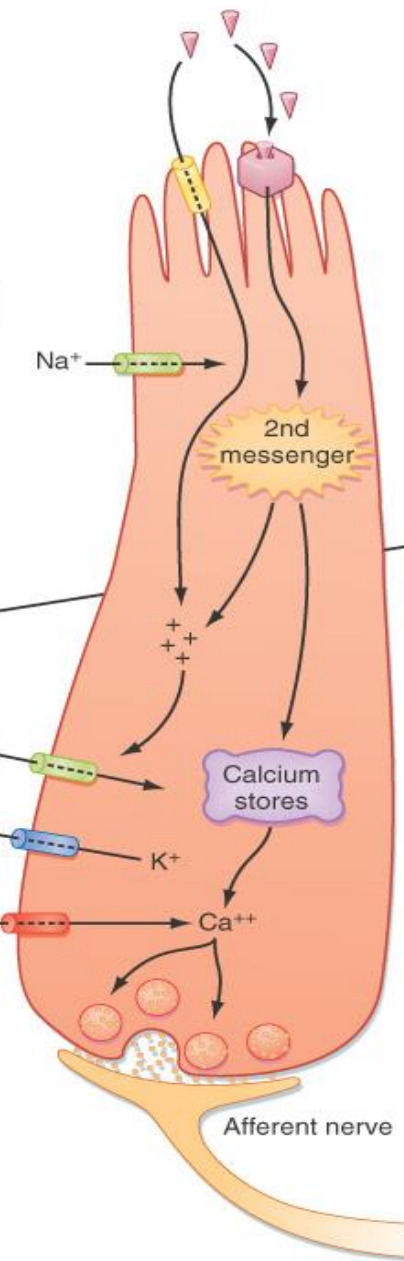
Release of Ca⁺⁺ stores

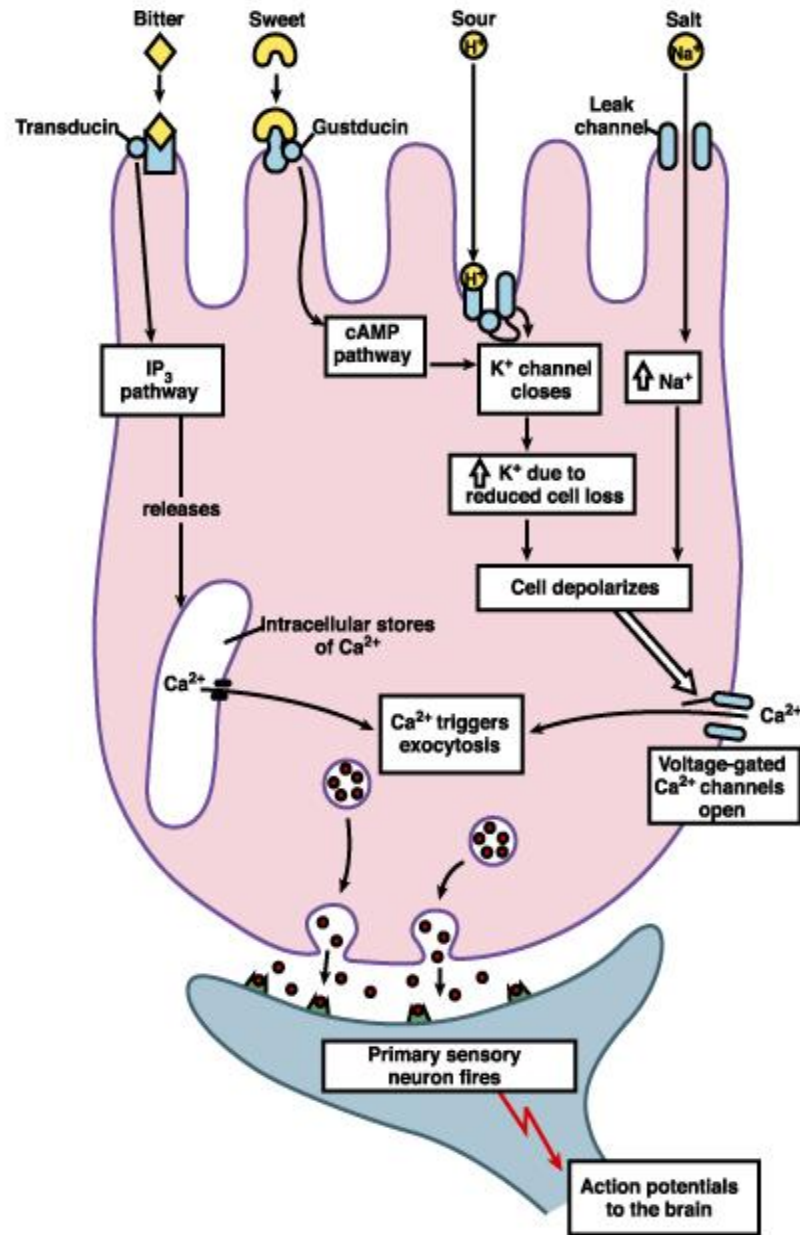
Ca⁺⁺ influx

Transmitter release

B

(Redrawn from Squire LR et al [eds]: Fundamental Neuroscience. San Diego, CA, Academic Press, 2002.)



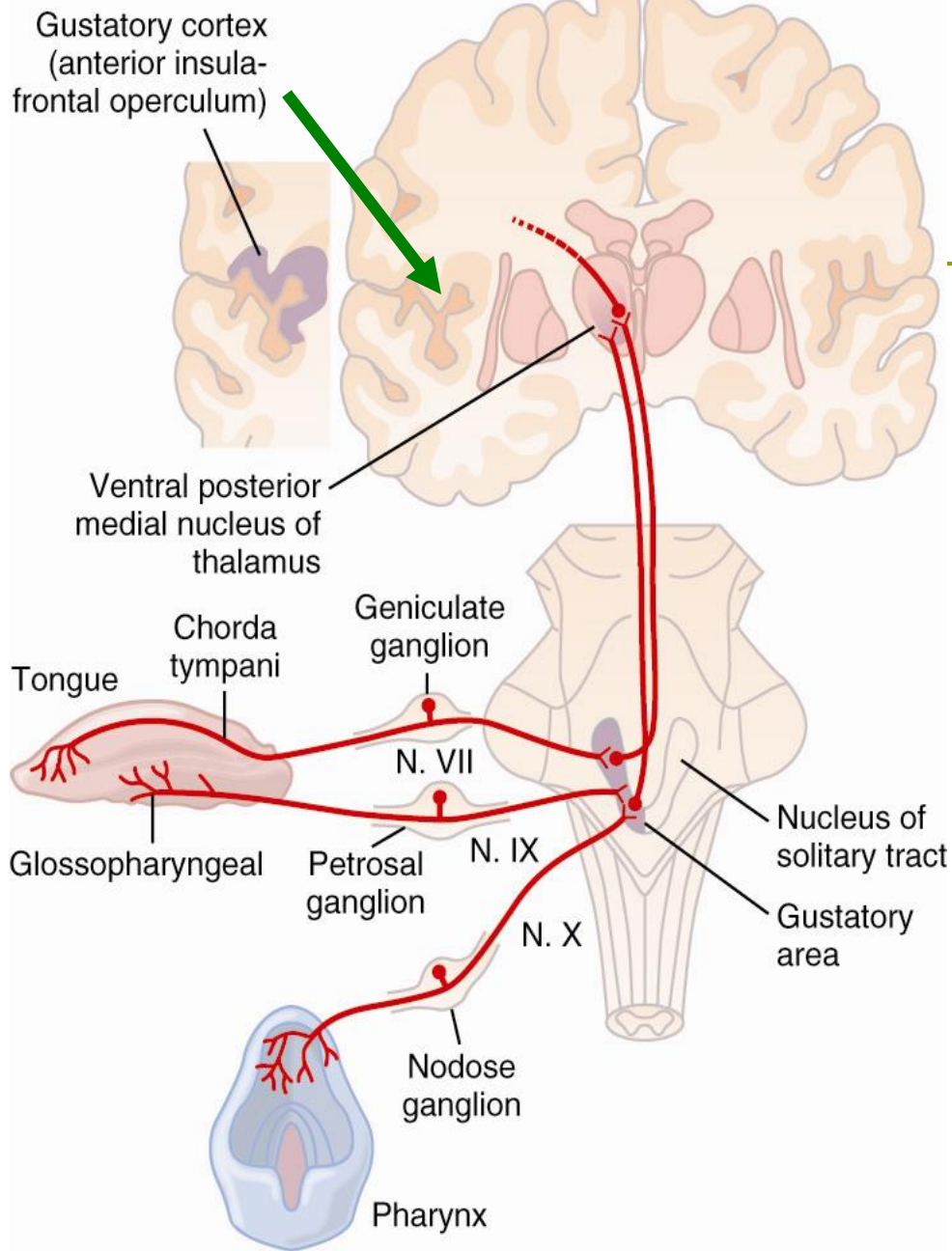


Taste Bud Facts

- ❑ Adults have 3-10,000 buds
- ❑ Children have more
- ❑ Taste receptors are epithelial cells able to regenerate every 10-15 days
- ❑ Beyond age 45 taste buds start to degenerate, taste becomes less critical
- ❑ Sweet and salty buds located on the tip of the tongue
- ❑ Sour on the lateral sides of the tongue
- ❑ Bitter on the posterior tongue and soft palate

Transmission of Taste Sensations

- ❑ activation of taste buds excite taste fibers
- ❑ anterior 2/3 of tongue through facial nerve
- ❑ posterior 1/3 of tongue through glossopharyngeal nerve
- ❑ posterior aspects of the mouth through vagus nerve
- ❑ transmitted to solitary nucleus
- ❑ from solitary nucleus to thalamus
- ❑ from thalamus to cortex



Taste Pathways:
It is Bilateral but
predominantly
uncrossed

Adaptation of Taste

- ❑ taste sensations adapt rapidly
- ❑ adaptation of the taste buds themselves accounts for only about 50% of the adaptation
- ❑ central adaptation must occur but the mechanism for this is not known

Olfaction (Smell)

- ❑ least understood of all senses
- ❑ poorly developed in humans
- ❑ olfactory membrane located on the superior part of each nostril
- ❑ contains olfactory cells which contain cilia
- ❑ Olfactory receptors are actual neurons (Bipolar) but they can regenerate every around 30-45 days
- ❑ on the cilia are odorant-binding proteins
- ❑ binding of chemical to protein induces the G-protein transduced formation of cAMP which opens ion channels

Characteristics of substance to be Smelled

- ❑ substance must be **volatile** so that it can be sniffed into the nostrils
- ❑ substance must be at **least slightly water soluble** to penetrate the mucus to reach the olfactory cells
- ❑ substance must **be at least slightly lipid soluble** to interact with the membrane
- ❑ olfactory receptors adapt very slowly
- ❑ olfactory sensation itself adapts rather rapidly
- ❑ must involve a central mechanism

Primary Sensations of Smell

- camphoraceous
- musky
- floral
- pepperminty
- ethereal
- pungent
- putrid

Olfactory transduction

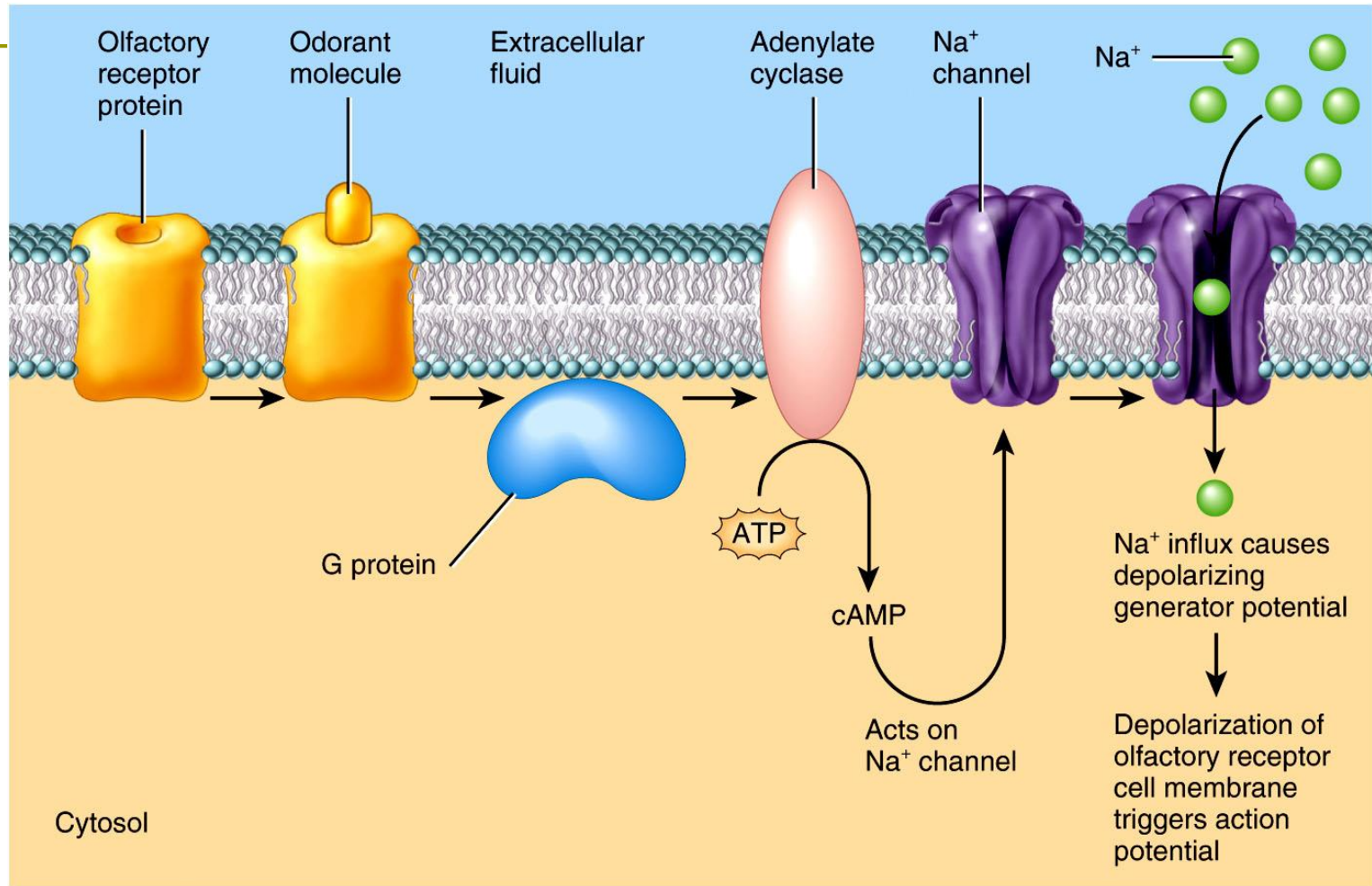
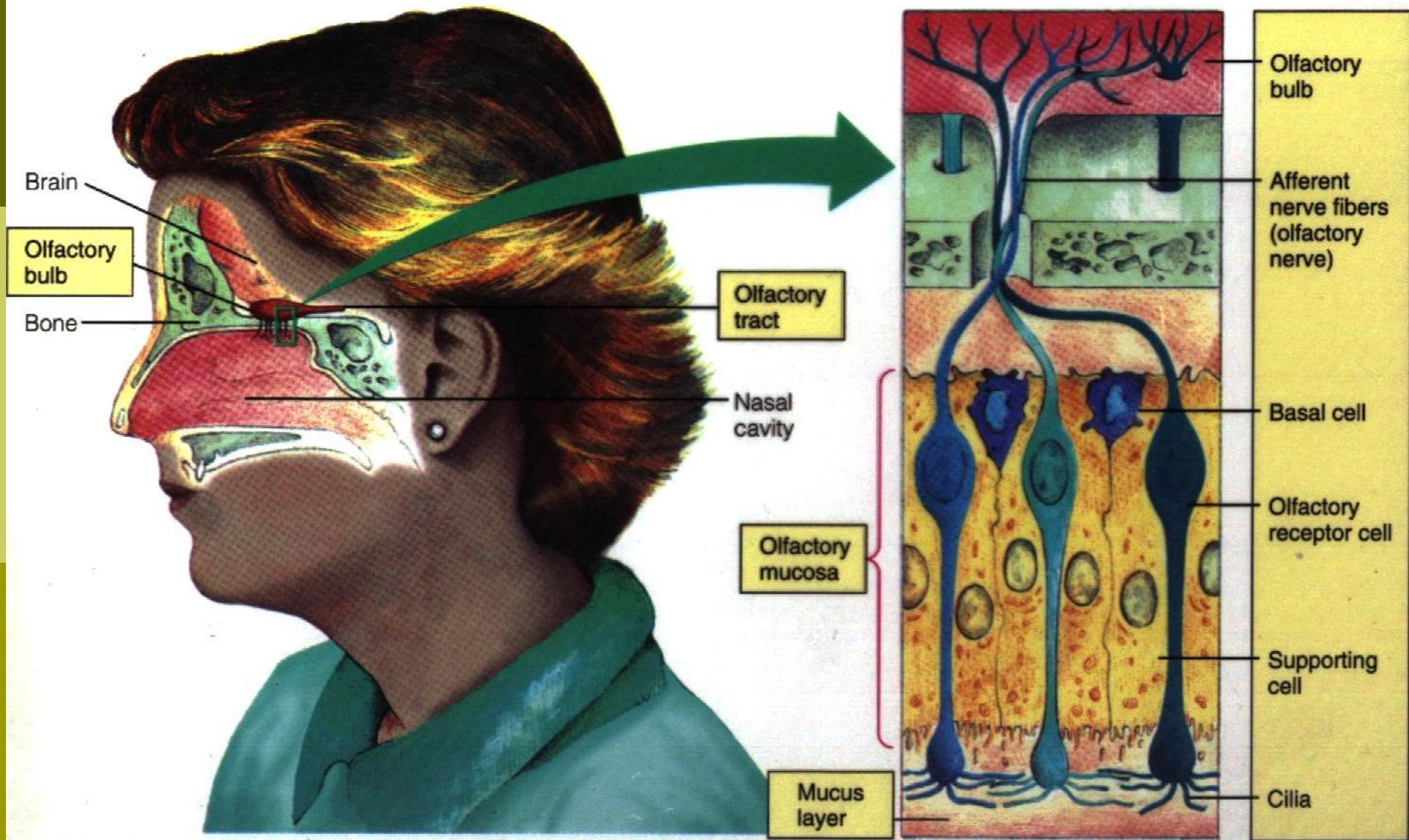
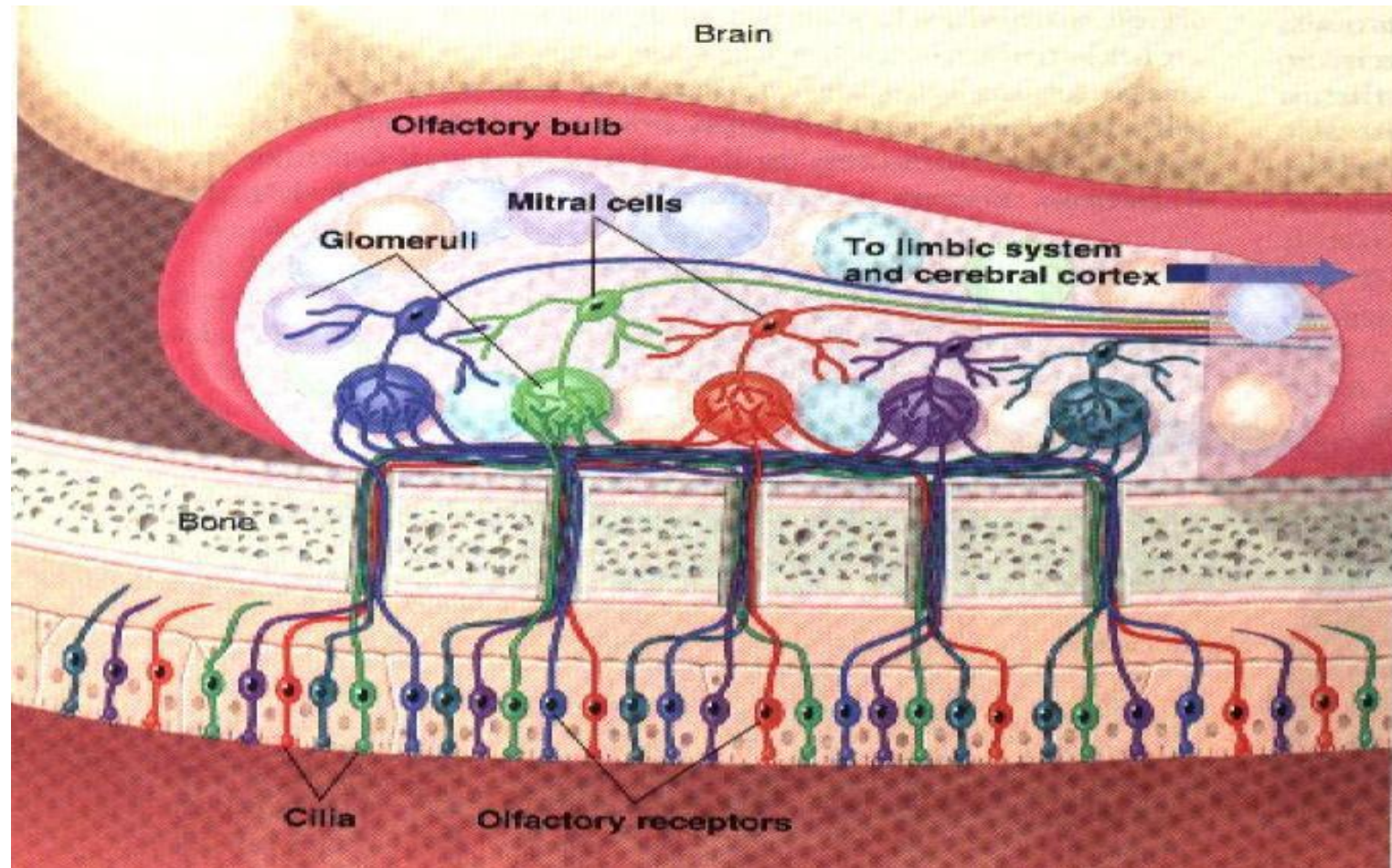


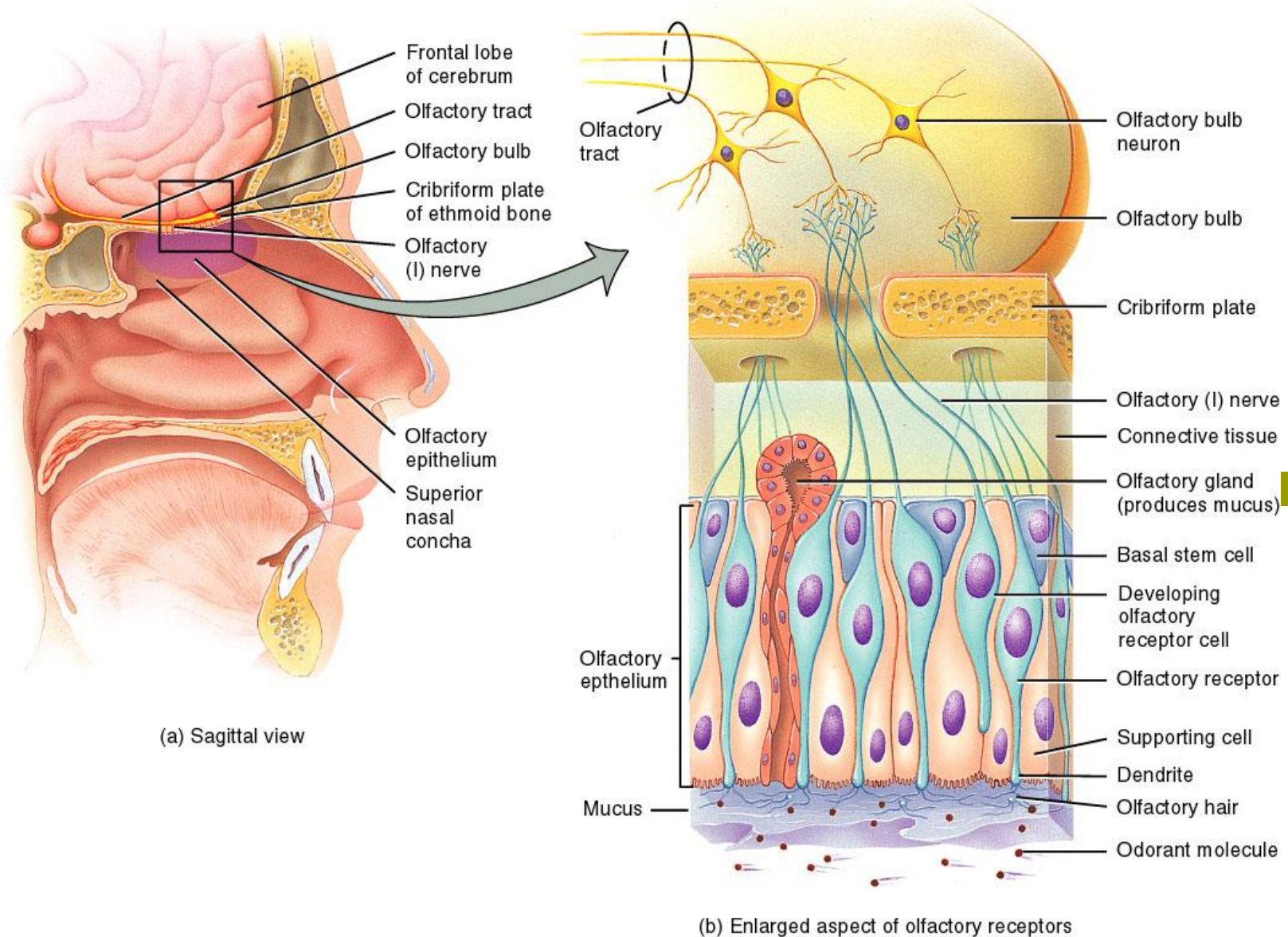
Figure 17.02 Tortora - PAP 12/e
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Location and Structure of the Olfactory Receptors



Olfactory bulb





Olfactory receptors

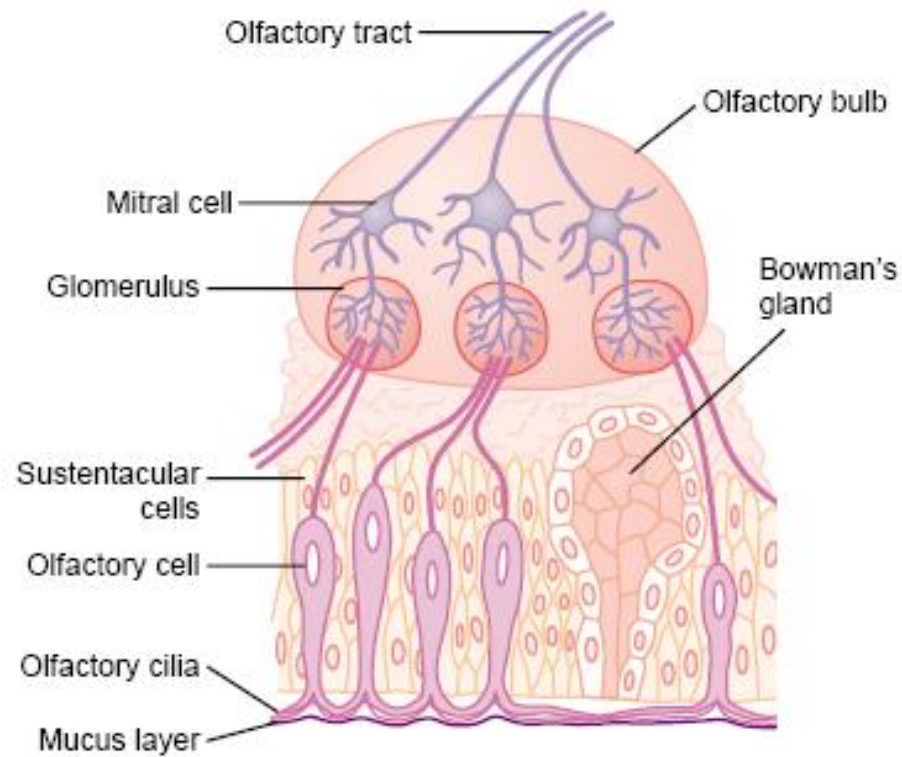
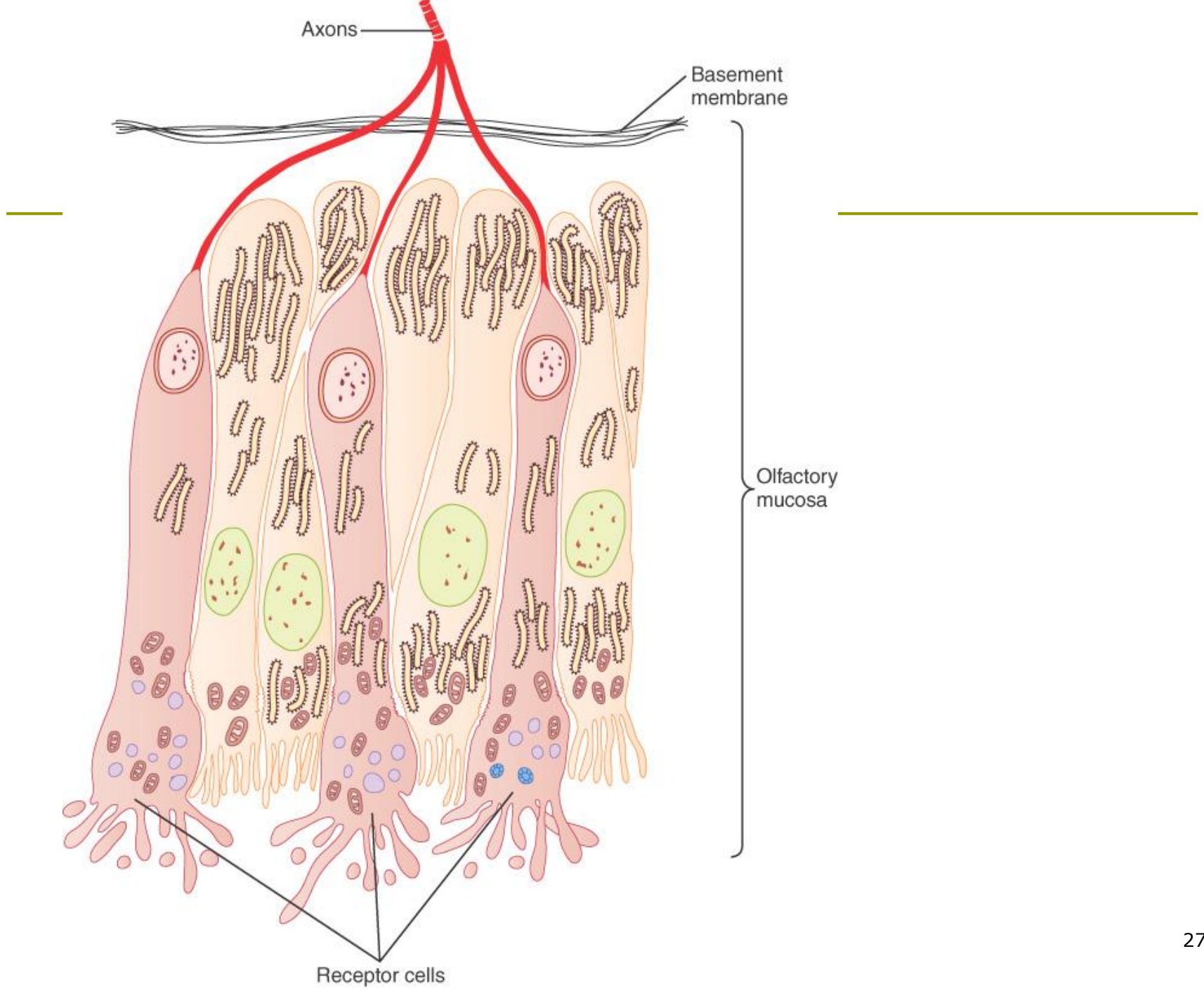
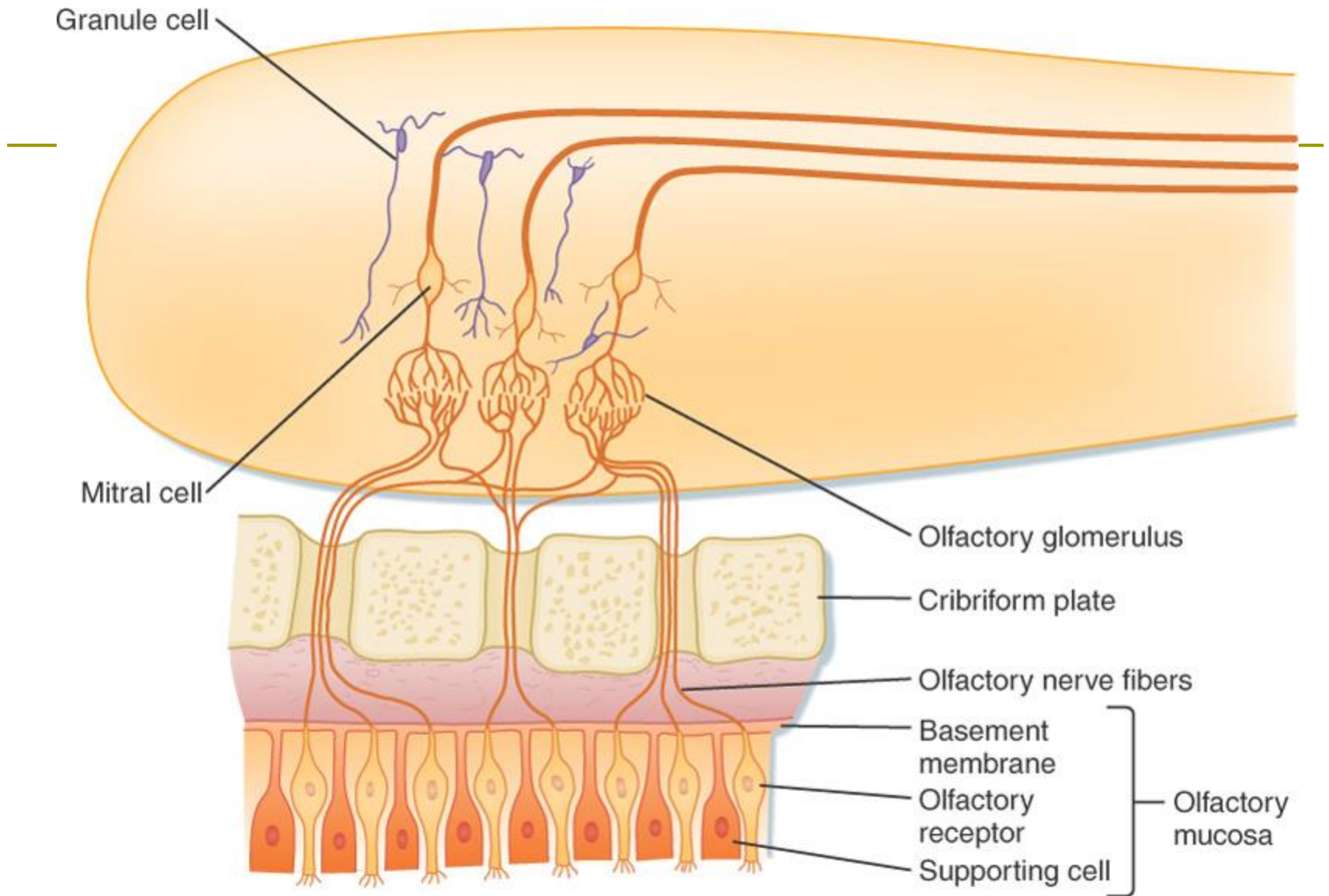


Figure 53-3

Organization of the olfactory membrane and olfactory bulb, and connections to the olfactory tract.



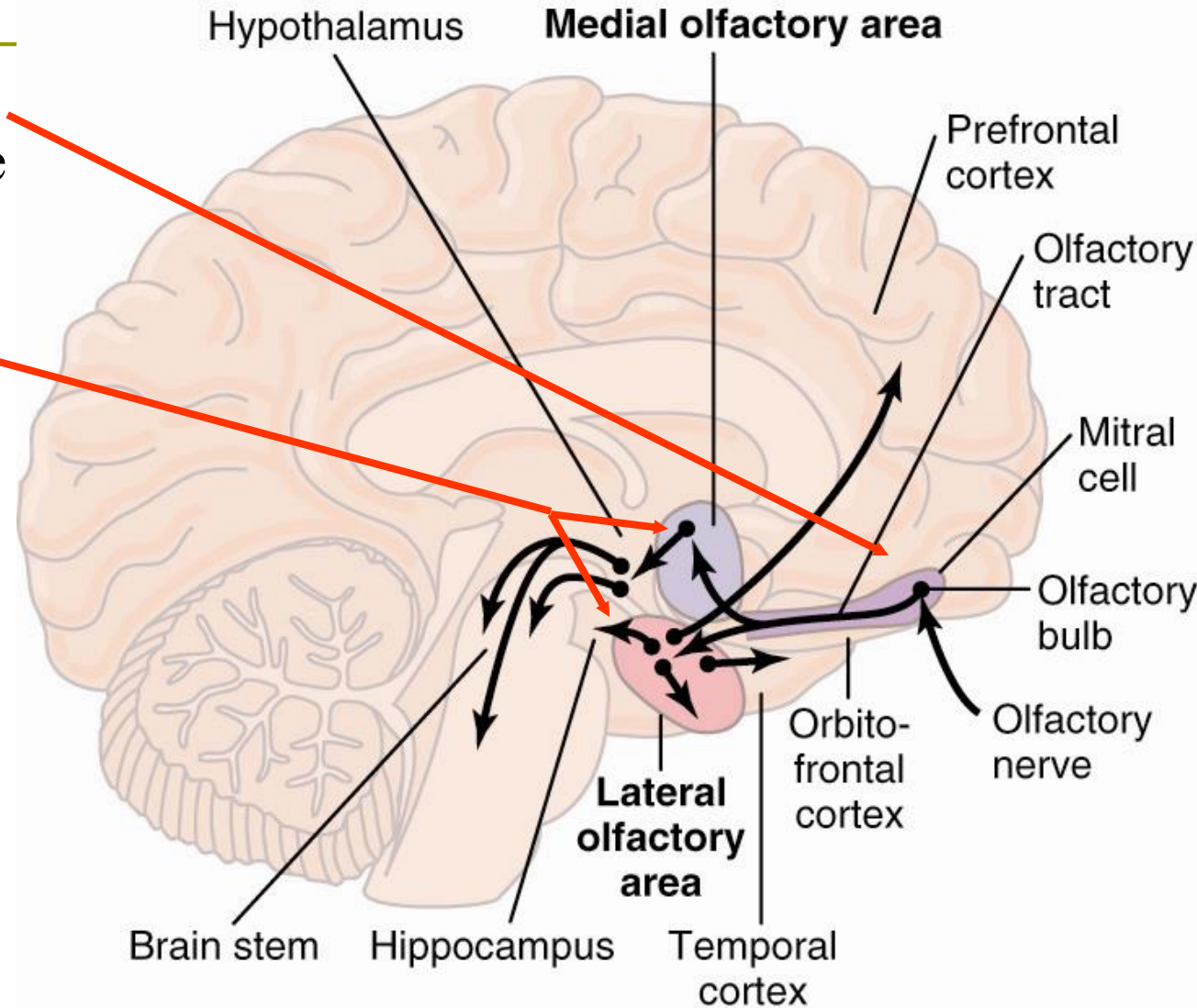


(Modified from House EL, Pansky B: A Functional Approach to Neuroanatomy, 2nd ed. New York, McGraw-Hill, 1967.)

Transmission of Smell Sensation to CNS

olfactory nerve is the first cranial nerve

medial (old) and lateral (new) olfactory area



Olfactory pathway

- ❑ The olfactory tract enters the brain at the anterior junction between the mesencephalon and cerebrum
- ❑ Old tract passes medially → medial olfactory area of the brain stem (very old tract)- septal nuclei to hypothalamus and limbic system (licking lips, salivation, and other feeding responses caused by smell of food or by primitive emotional drive associated with smell)

Olfactory pathway ...cont

- Another passes laterally to the lateral olfactory area
 - Less old- prepyriform, pyriform cortex and cortical portion of amygdaloid nuclei. Paleocortex and anteromedial portion of the temporal lobe, Limbic system and hippocampus. For learning to like or dislike certain food depending on past experiences with them and also food aversion to nauseated food.
 - The newer pathway: passes through the thalamus, dorsomedial nucleus of the thalamus and then to the lateroposterior quadrant of the orbitofrontal cortex, for conscious analysis of odor

Smell and Taste Abnormalities

- ❑ Anosmia: loss of smell sensation
- ❑ Loss of taste sensation due to nerve damage

Thank You

