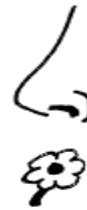
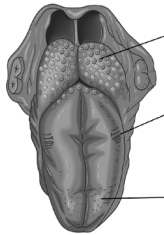


TASTE & SMELL

GUSTATION & OLFACTION



DR SYED SHAHID HABIB
MBBS DSDM FCPS
Assistant Professor
Dept. of Physiology
College of Medicine & KKHU

OBJECTIVES

At the end of this lecture you should be able to:

- Describe the basic features of the neural elements in the olfactory epithelium and olfactory bulb.
- Describe signal transduction in odorant receptors and olfactory pathway.
- Describe the location and cellular composition of taste buds.
- Name the five major taste receptors and signal transduction mechanisms in these receptors.
- Outline the pathways by which impulses generated in taste receptors reach the insular cortex.



SMELL (OLFACTION)



- Least Understood Sense
- It is mainly subjective
- Poorly developed in humans
- Olfactory membrane
 - Receptor Cells Olfactory Cells (Bipolar Cells)
 - Mucus

PRIMARY SENSATIONS OF SMELL

- Camphoraceous
- Musky
- Floral
- Pepperminty
- Ehtereal
- Pungent
- Putrid

Some Olfactory Thresholds

| Substance | mg/L of Air |
|-------------------|-------------|
| Ethyl ether | 5.83 |
| Chloroform | 3.30 |
| Pyridine | 0.03 |
| Oil of peppermint | 0.02 |
| Iodoform | 0.02 |
| Butyric acid | 0.009 |
| Propyl mercaptan | 0.006 |
| Artificial musk | 0.00004 |
| Methyl mercaptan | 0.000004 |

Garlic

There may be 100-1000 Primary Sensations of taste

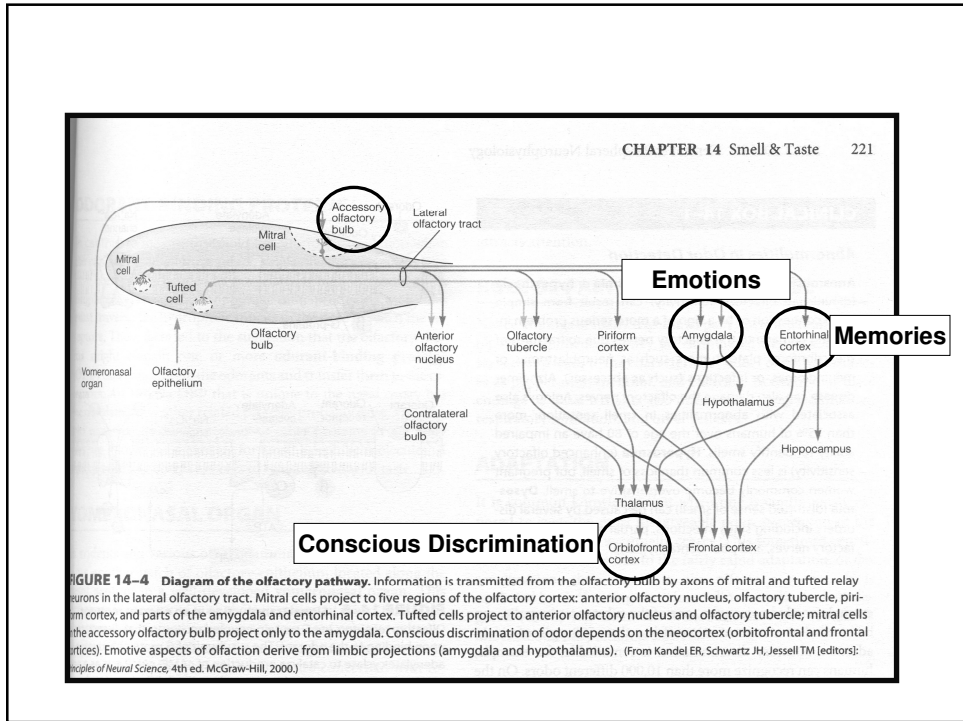
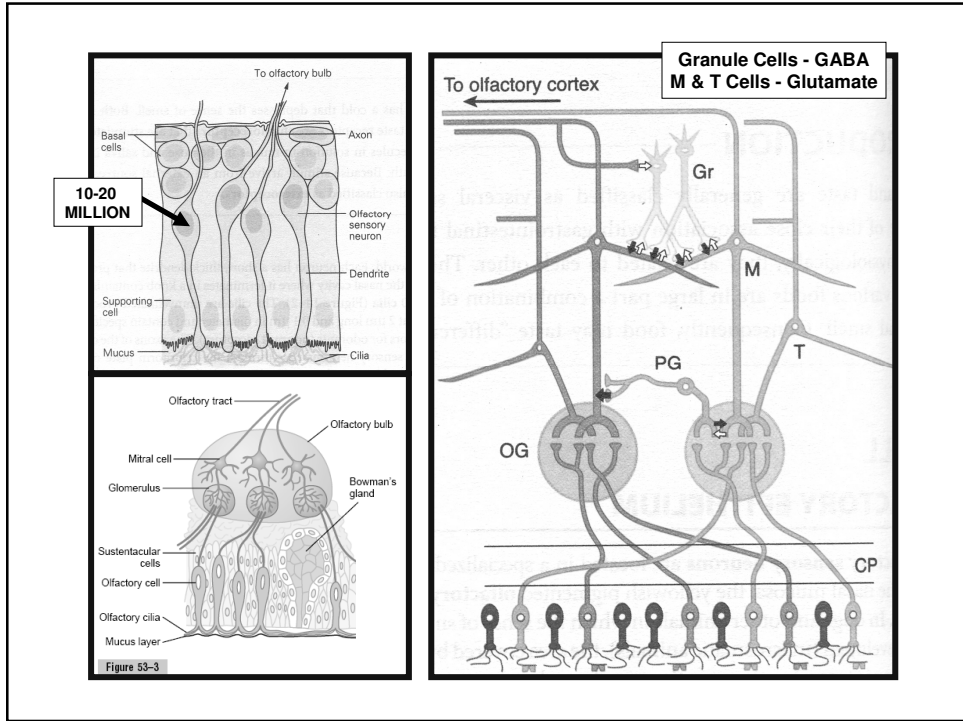
SMELL PATHWAY

The olfactory tract transmits the signals to the brain to areas such as the olfactory cortex, hippocampus, amygdala, and hypothalamus [Limbic System].

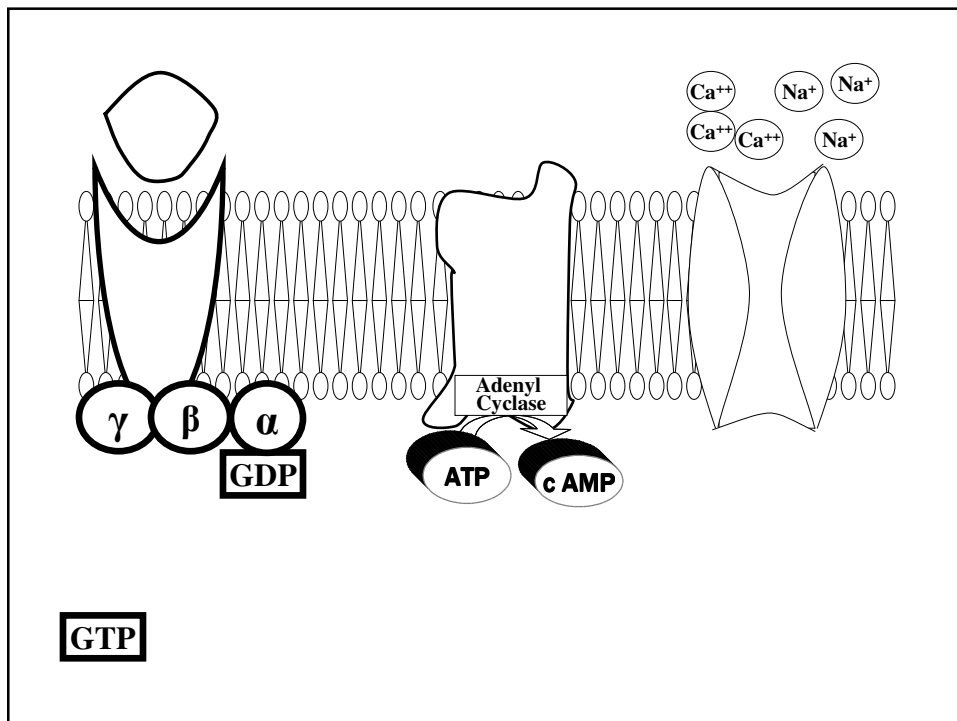
The limbic system is involved with emotional behavior and memory

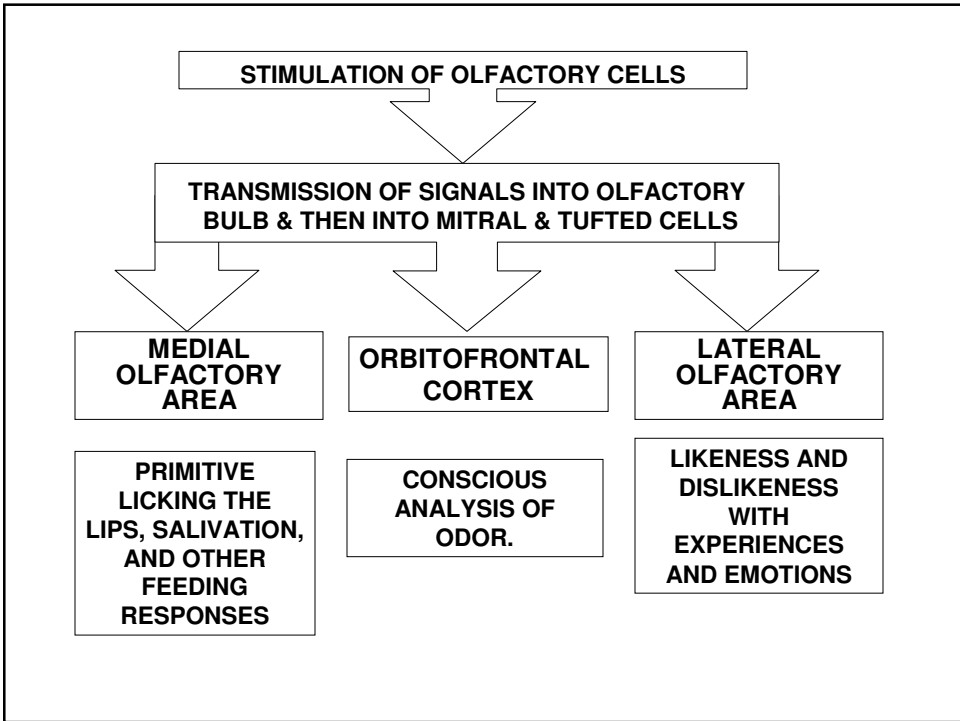
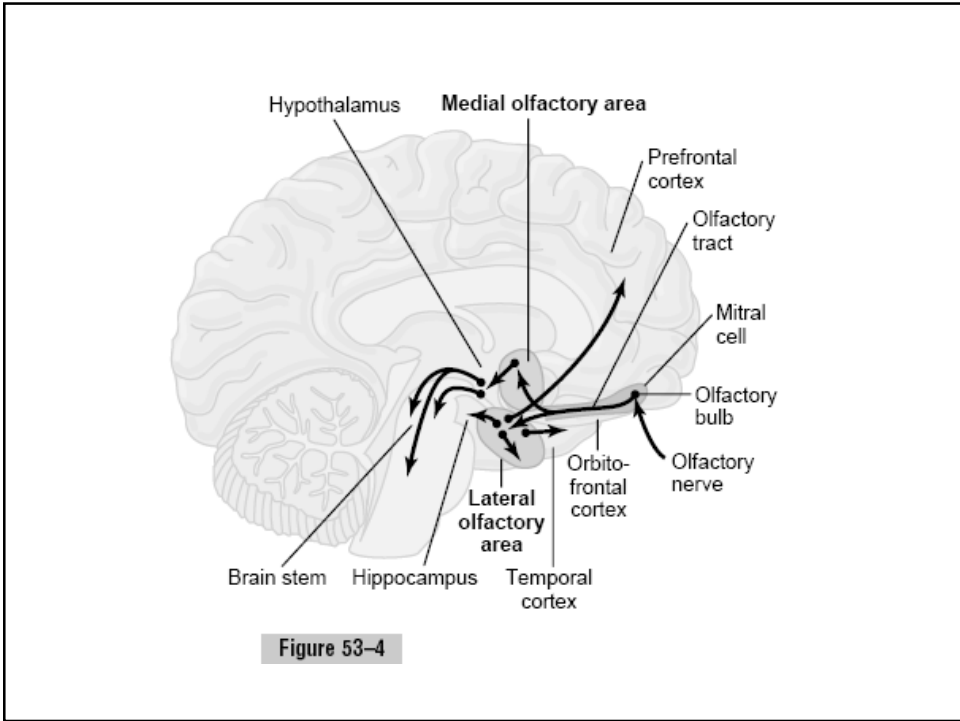
OLFACTORY SENSORY CELLS

These are not epithelial cells as are taste cells, but neurons, which until recently were not known to be generated in adults. (Recent evidence shows that this can happen, even in the brain). The olfactory sensory neurons are not only replaced every 60 days or so, but each must also grow an axon to the correct place in the brain.



MECHANISM OF SMELL RECEPTORS STIMULATION





Vomeronasal Sensation and Pheromones

- Pheromones are chemicals released by an animal that affect the behavior of other members of the same species
- Human body secretions have subtle pheromone effects

Abnormalities of Odor Detection

1. Anosmia and Hyposmia- Nerve Damage & Nasal Congestion
2. Hyperosmia - Pregnancy
3. Dysosmia- Sinusitis & Dental Hygiene

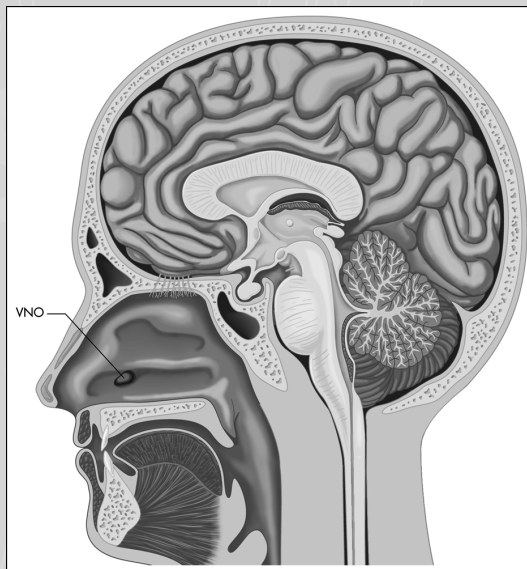


Figure 7.23 The human vomeronasal organ

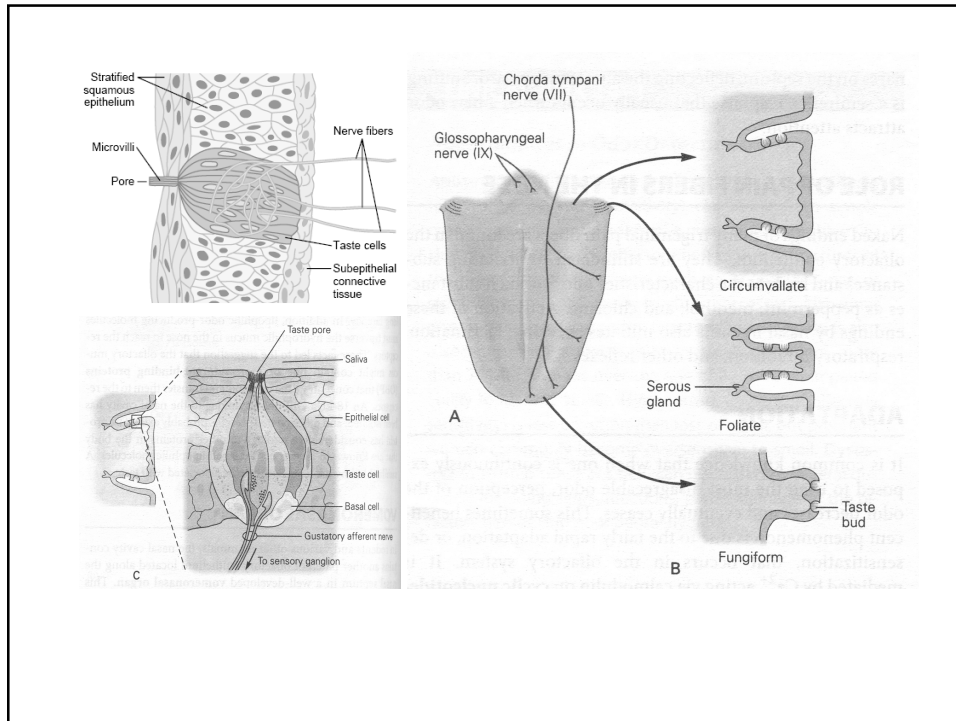
This organ detects certain chemicals, especially those found on the human skin, but produces no conscious experience. Perhaps for that reason, researchers were slow to discover this organ.

TASTE (GUSTATION)

- Sense of taste is important in the selection and enjoyment of food
- Taste is mainly a function of **TASTE BUDS**
- Other inputs
 - Olfactory input
 - Tactile input
 - Visual input
 - Pain input
 - Thermal input
 - Metabolic need of tissues for specific nutritive substances

TASTE BUDS

- Taste buds are Spindle shaped structures with an opening known as taste pore.
- 3000 to 10000
- 50-70 micro meter in diameter.
- 4 type of cells....basal, dark, light (most mature) and intermediate cells.
- Taste cells....half life 10 -14 days, and have taste hair or microvilli (sensitive part of receptor cell).



LOCATION

- **ON TONGUE...**
 - Vallate papillae
 - Fungiform papillae
 - Foliate papillae
- **On Tonsillar pillars, palate, pharynx, epiglottis, proximal esophagus.**



**Delicious, scrumptious, delectable,
mouth-watering, yummy.
Stale, awful, terrible, unsavory,
bland, unpalatable.**

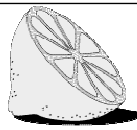
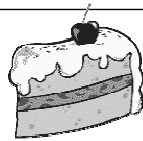
PRIMARY SENSATIONS OF TASTE

- **4 BASIC TASTE MODALITIES.**
 - SOUR [Acids]
 - SALTY [Ionized Salts]
 - SWEET [Organic Chemicals]
 - BITTER [Organic Chemicals]
 - FIFTH ADDITIONAL.... UMAMI.
 - **SPECIFICITY IN SITE AND SENSITIVITY.**
 - **THRESHOLD.....bitter taste most sensitive**
- HCl 0.0009 N
 - NaCl 0.01 M
 - Sucrose 0.01 M
 - Quinine 0.000008 M

RELATIVE TASTE INDICES OF DIFFERENT SUBSTANCES

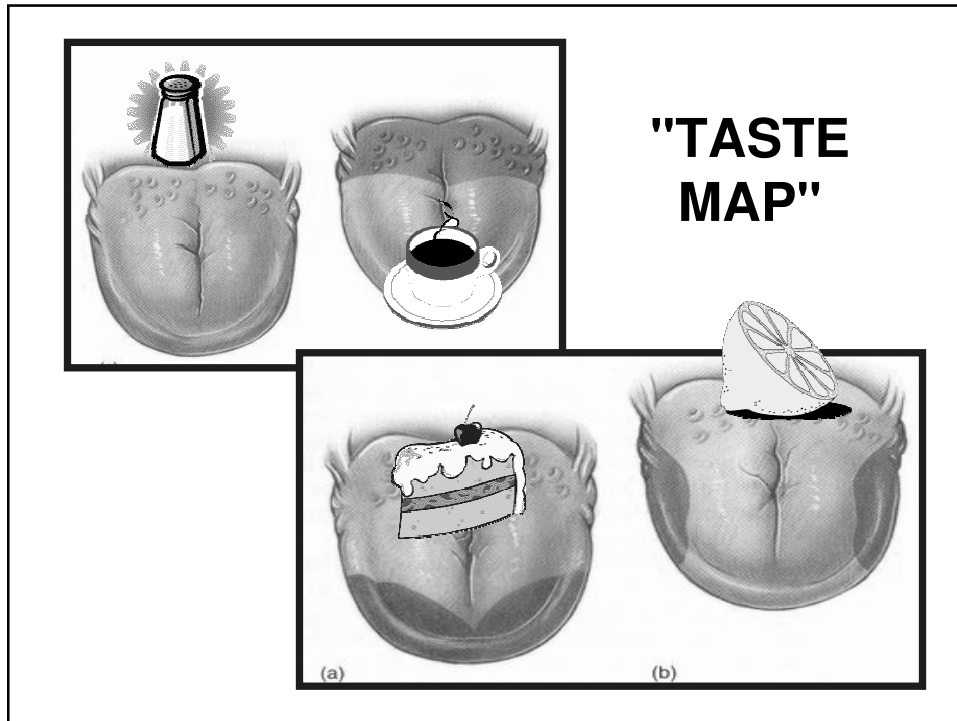
| Sour Substances | Index | Bitter Substances | Index |
|----------------------|-------|-------------------|-------|
| Hydrochloric acid | 1 | Quinine | 1 |
| Formic acid | 1.1 | Brucine | 11 |
| Chloroacetic acid | 0.9 | Strychnine | 3.1 |
| Acetylacetic acid | 0.85 | Nicotine | 1.3 |
| Lactic acid | 0.85 | Phenylthiourea | 0.9 |
| Tartaric acid | 0.7 | Caffeine | 0.4 |
| Malic acid | 0.6 | Veratrine | 0.2 |
| Potassium H tartrate | 0.58 | Pilocarpine | 0.16 |
| Acetic acid | 0.55 | Atropine | 0.13 |
| Citric acid | 0.46 | Cocaine | 0.02 |
| Carbonic acid | 0.06 | Morphine | 0.02 |

For food to have a taste, it must be dissolved in water. Five basic tastes:



| SWEET | SOUR | SALTY | BITTER |
|----------------------|--------------|--------------|--------------------------|
| Like a piece of cake | Like a lemon | Like salt! | Like a cup of bad coffee |

A fifth basic taste called "UMAMI" has recently been discovered. Umami is a taste that occurs when foods with glutamate are eaten.



OPENING OF ION CHANNELS OF TASTE CELLS BY DIFFERENT GUSTATORY MODALITIES

- **ACIDS** ----- depolarize sour receptor cells by activating H⁺-gated cations channels
- **Na⁺ SALTS**----- depolarize salt receptor cells via Na⁺ channels (EnaC)
- **SUGARS & BITTER SUBSTANCES** ----- depolarize their receptors by binding to G-protein & 2nd messengers (camp, IP3/DAG) that gate ion channels

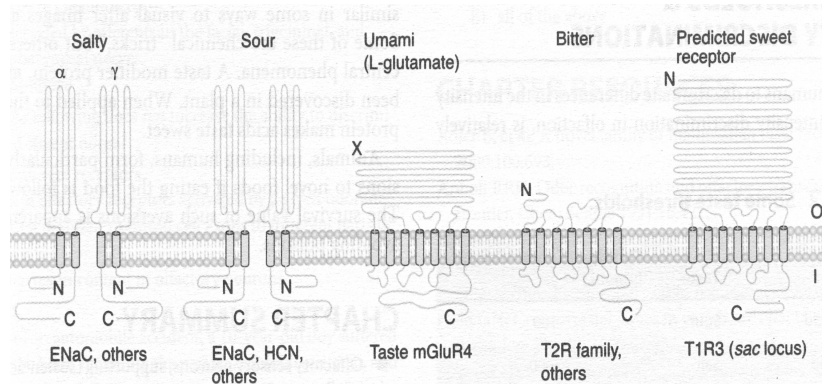
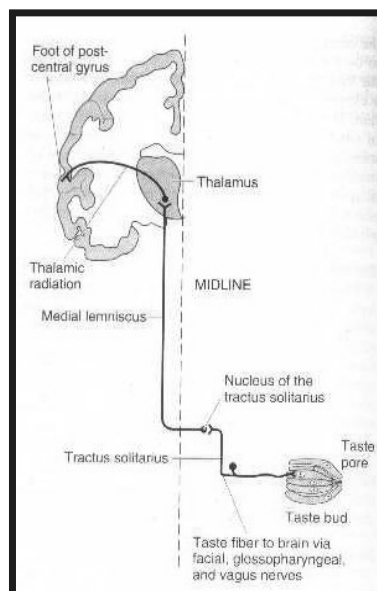
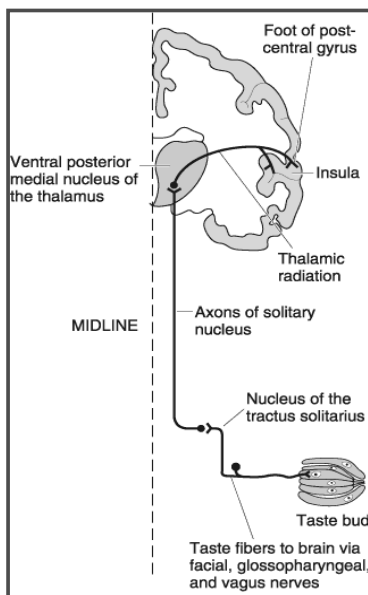
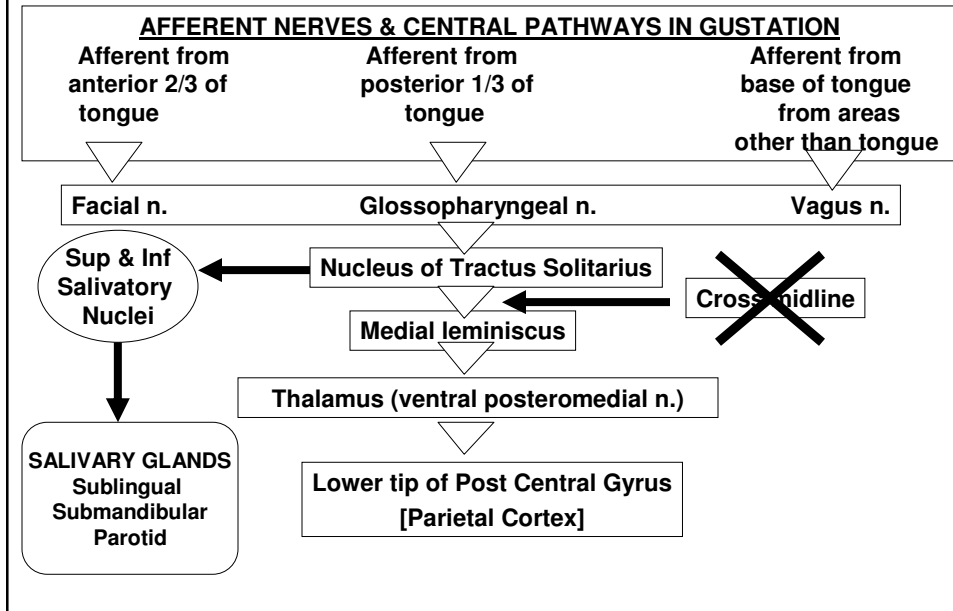


FIGURE 14-8 Signal transduction in taste receptors. Salt-sensitive taste is mediated by a Na⁺-selective channel (ENaC); sour taste is mediated by H⁺ ions permeable to ENaCs; umami taste is mediated by glutamate acting on a metabotropic receptor, mGluR4; bitter taste is mediated by the T2R family of G protein-coupled receptors; sweet taste may be dependent on the T1R3 family of G protein-coupled receptors which couple to the G protein gustducin. (Modified from Lindemann B. Receptors and transduction in taste. *Nature* 2001;413:219.)



TASTE PATHWAY



TASTE PATHWAY

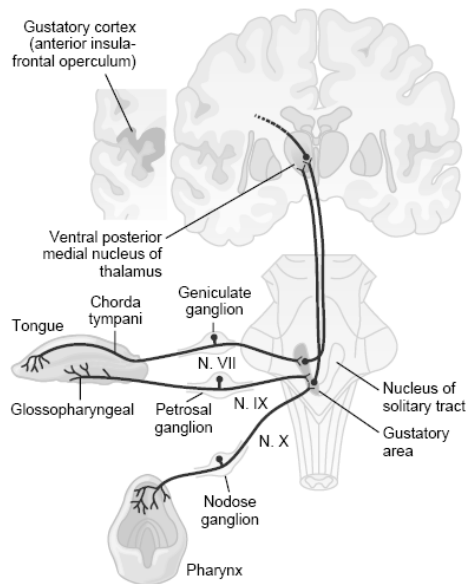
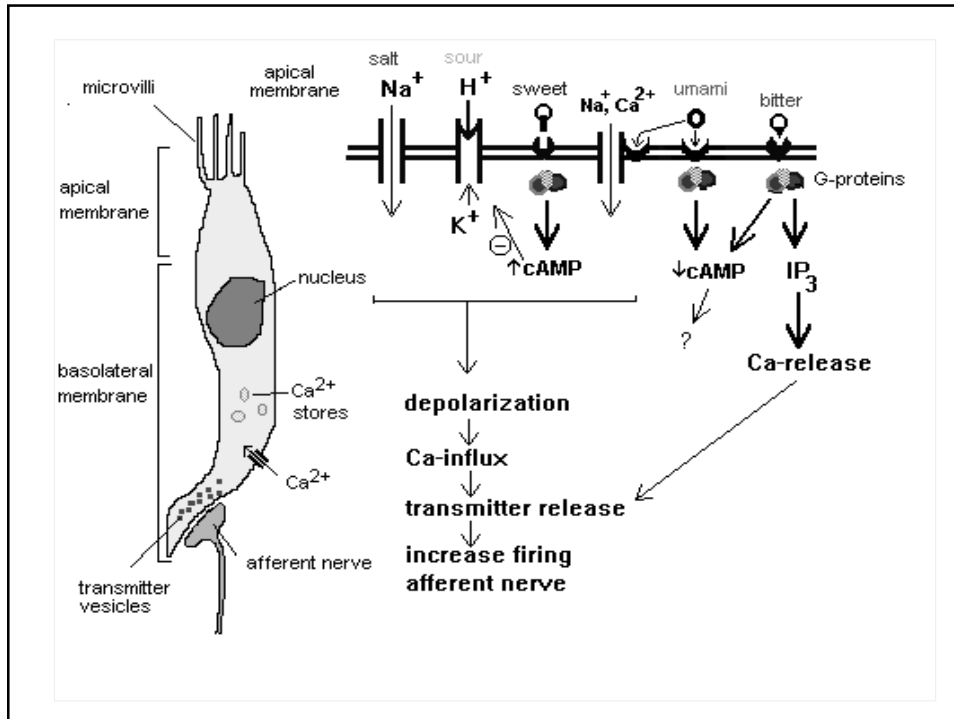


Figure 53-2



ADAPTATION OF TASTE

Some occur at level of taste buds
Mostly occur at CNS

APPLIED GUSTATORY PHYSIOLOGY

AGEUSIA & HYPOGEUSIA - Nerve Damage,
Drugs, Aging & Tobacco use

DYSGEUSIA - unpleasant taste

PSEUDOGEUSIA - Psychological