

# RECEPTORS

***SENSATION*** – conscious or subconscious awareness of external or internal stimuli.

***RECEPTORS*** – sensory nerve terminals that receives stimuli & relays them to the CNS (brain & spinal cord).

- any structure specialized to detect a stimulus.

## ○ ***General Properties of Receptors:***

- All sensory receptors are transducers.
- Transducer – is any device that converts one form of energy to another.

- Sensory transducers – converts stimulus energy into electrochemical energy = ***action potential***
- Action potentials – a meaningful pattern of electrochemical energy from the converted stimulus.

- Sensory transduction – process of conversion.
- Receptor potential – a type of local potential produced as an effect of a stimulus.
  - a graded voltage change across the plasma membrane of the receptor cell.

- The receptor potential causes a receptor cell to release a neurotransmitter that stimulates an adjacent neuron.
- When the voltage of the neuron reaches threshold, the neuron fires impulses to the CNS.
- Sensation

STIMULUS



SENSORY TRANSDUCTION



RECEPTOR POTENTIAL



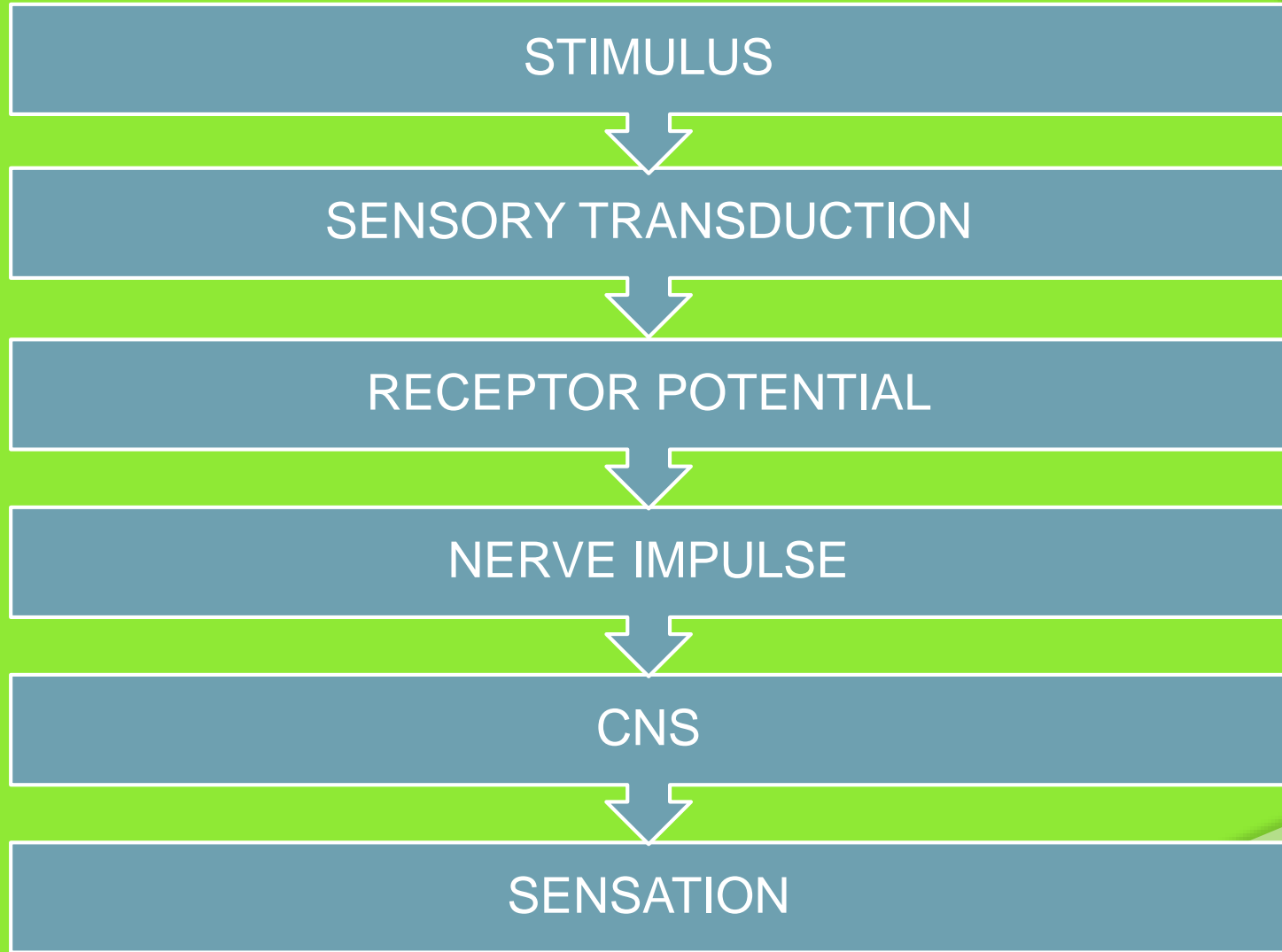
NERVE IMPULSE

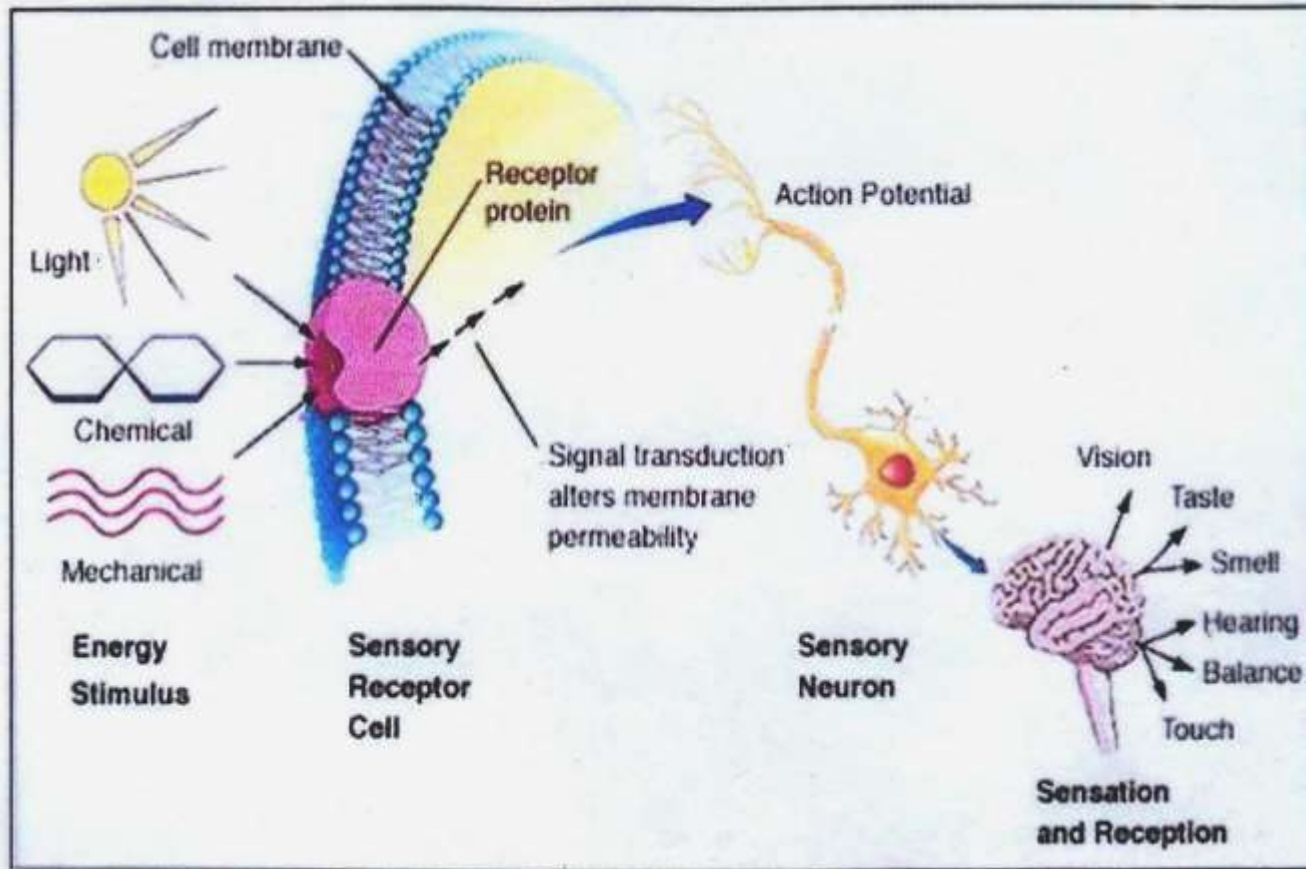


CNS



SENSATION







○ ***Events for Sensation to Occur:***

- 1. Stimulation of sensory receptor.
- 2. Transduction – stimulus converted to graded potential.

- 3. Impulse Generation & Conduction
  - if the graded potential reaches threshold strength, a nerve impulse results.
  - This impulse travels to the CNS.
- 4. Integration – CNS translates the impulse into a sensation.

○ ***Kinds of Information Transmitted  
by the Sensory Receptor:***

1. Modality
2. Location
3. Intensity
4. Duration

## ● ***Classification of Receptors:***

- can be classified by several overlapping systems:

### 1. By stimulus modality:

- a. Chemoreceptors
- b. Thermoreceptors
- c. Nociceptors
- d. Mechanoreceptors
- e. Photoceptors

2. By the origin of the stimuli:

- a. Exteroceptors
- b. Interoceptors
- c. Proprioceptors

3. By the distribution of receptors in the body:

- a. General (Somesthetic) senses
- b. Special senses

## General Senses:

- Types according to structure & physiology:

### A. Unencapsulated Nerve Endings

1. Free Nerve Endings
2. Tactile (Merkel) Discs
3. Hair (Peritrichial Endings)

## B. Encapsulated Nerve Endings

1. Tactile (Meissner) Corpuscles

2. Krause End Bulb

3. Lamellated (Pacinian) Corpuscles

4. Ruffini Corpuscles

# **PAIN RECEPTORS**



# ***PAIN RECEPTORS***

**Pain** – is a discomfort caused by tissue injury or noxious stimulation & typically leading to evasive action.

**Nociceptors** – specialized nerve fibers that mediate pain.

## **Types:**

1. Myelinated
2. Unmyelinated

**Somatic Pain** – pain from the skin, muscles & joints.

**Visceral Pain** – pain from the viscera (internal organs of the 3 great body cavities-thoracic, abdominal & pelvis).

**Referred Pain** – perception of pain coming from parts of the body that are not actually stimulated.

## ○ **Classification of Pain Receptors** *(Origin of Stimulus)*

- 1. *Exteroceptors*** – stimulated by immediate external environment with most of the impulses being sensed at conscious levels.

- a) ***Free nerve endings*** – tactile & superficial pain
- b) ***Krause's corpuscles*** – cold receptors
- c) ***Meissner's corpuscles*** – tactile skin receptors
- d) ***Merkel's corpuscles*** – tactile receptors in the oral mucosa & submucosa of the tongue
- e) ***Ruffini's corpuscles*** – pressure & warmth receptors

**2. Interoceptors** – located in body cavities; these serves involuntary bodily functions below conscious levels.

- a) **Free nerve endings** – perception of visceral pain
- b) **Pacinian corpuscles** – perception of pressure

**3. Proprioceptors** – chiefly involved in automatic functioning & perceive movement, pressure & position.

a) **Free nerve endings** – perception of deep somatic pain & other sensations

b) **Golgi tendon organs** – mechanoreceptors between muscle tendons relaying data concerning muscle length & tension

c) ***Muscle spindles*** –

mechanoreceptors between muscle fibers responsive to passive muscle stretch

d) ***Pacinian corpuscles*** – perception of pressure

e) ***Periodontal receptors*** – perception of tooth movement

# **SKIN RECEPTORS**



# ***SKIN RECEPTORS***

## **Types According to Function/ Stimulus Modality:**

- 1. Thermoreceptors*** – for temperature changes

**2. Mechanoreceptors** – for mechanical stimulation.

a) **Tactile receptors** – touch

b) **Baroreceptors** – pressure

c) **Proprioceptors** – distortion

**3. Nociceptors** – for injuries leading to pain sensation.

## Types According to Morphology:

### 1. *Free nerve endings* –

nonmyelinated fibers that enters the epidermis, extending as far as the stratum granulosum.

- a) *Merkel's ending* – free nerve ending attached to modified epidermal cells, found in the stratum germinativum layer.

## ***2. Encapsulated nerve endings***

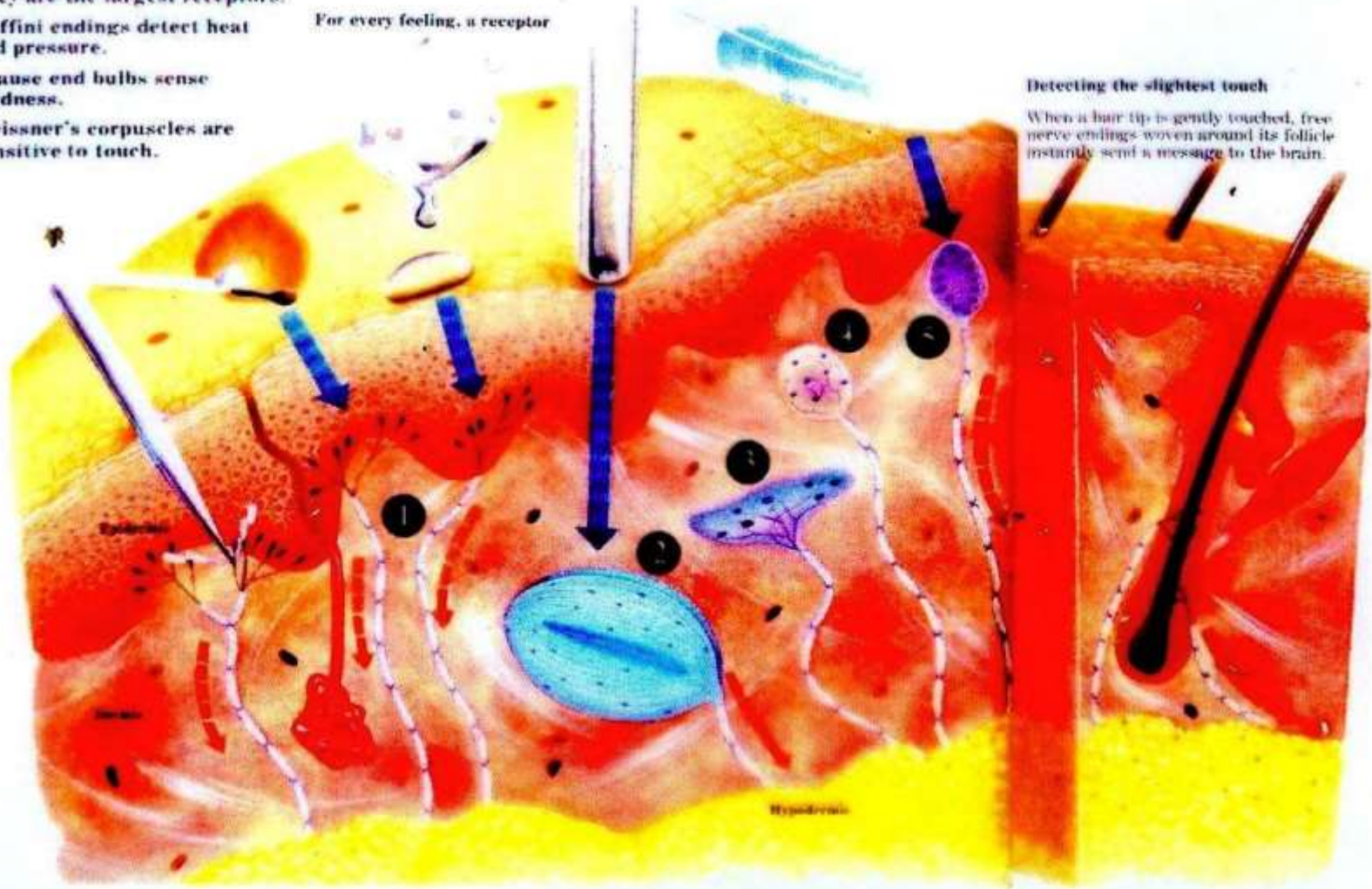
- a) ***Pacinian corpuscles*** – deep pressure
- b) ***Meissner's corpuscles*** – touch
- c) ***Ruffini's corpuscles*** – heat/warmth
- d) ***Krause's corpuscles*** - cold

- 1 Near the skin's surface, free nerve endings sense pain and heat.
- 2 The onion-shaped Pacinian corpuscles sense pressure. They are the largest receptors.
- 3 Ruffini endings detect heat and pressure.
- 4 Krause end bulbs sense coldness.
- 5 Meissner's corpuscles are sensitive to touch.

For every feeling, a receptor

#### Detecting the slightest touch

When a hair tip is gently touched, free nerve endings woven around its follicle instantly send a message to the brain.



# **TASTE RECEPTORS**

# ***TASTE RECEPTORS***

## **Taste (Gustation)**

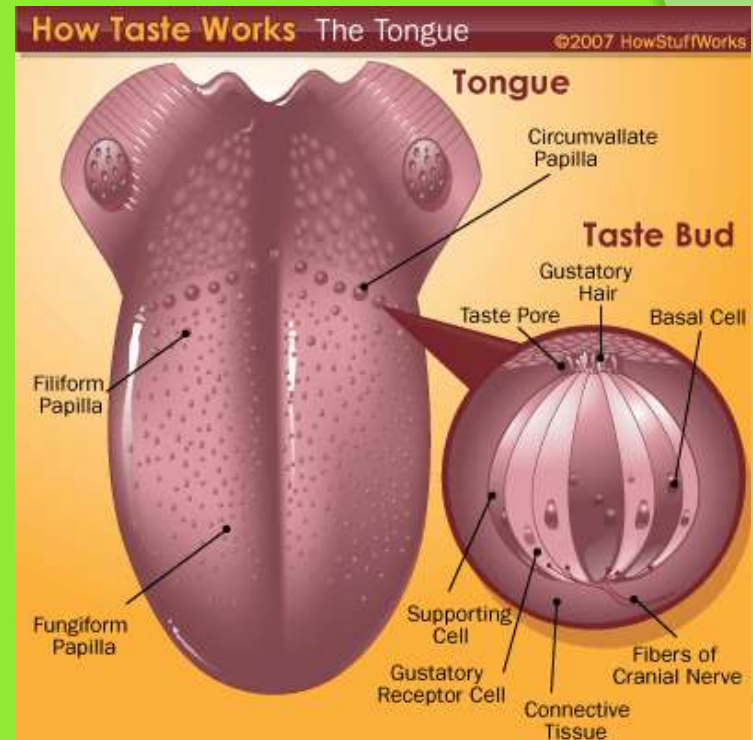
- > a sensation that results from the action of chemicals on the taste buds.
- > the detection & recognition of liquid phase stimuli.
- > a sensation developed well before birth.

- ***\* Taste is detected only when food is dissolved in saliva.***
- ***\* Mouth that is dry affects sense of taste.***



# Taste buds

- > taste receptors
- > goblet-shaped epithelial cells with small pore opening to the mucosal surface.
- > lemon shaped



- > measures to about 70 microns in length & 40 microns in diameter.
- > approximately 10,000 buds in man

> located on the edges & dorsum of the tongue, epiglottis, soft palate, pharynx & inside the cheeks

> life span is 10-12 days & are constantly replaced by cell division (taste cell-mitotic division).

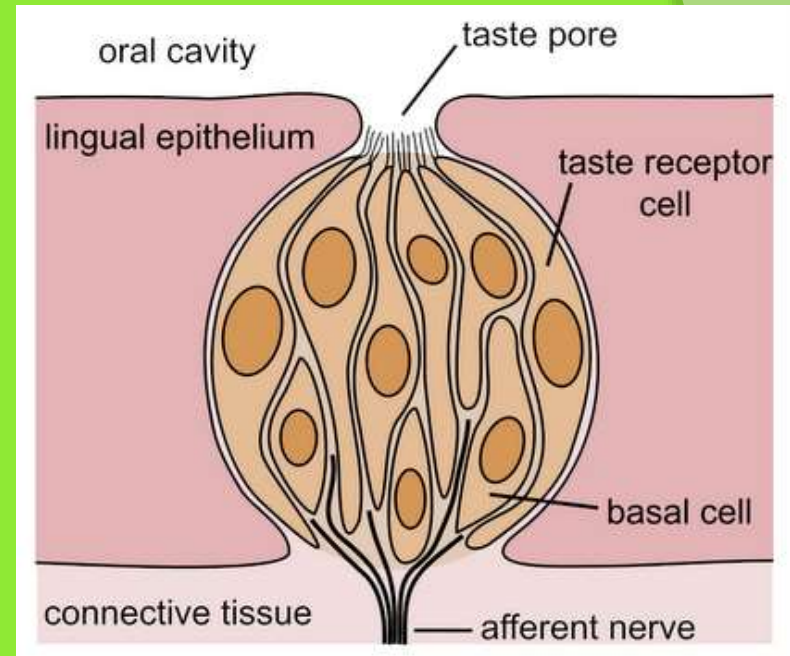
> composed of 40-60 cells  
of three kinds:

a. Taste/ Receptor/  
Gustatory cell

- sensory cell  
(banana shaped)

b. Supporting/  
Sustentacular cell

c. Basal cell

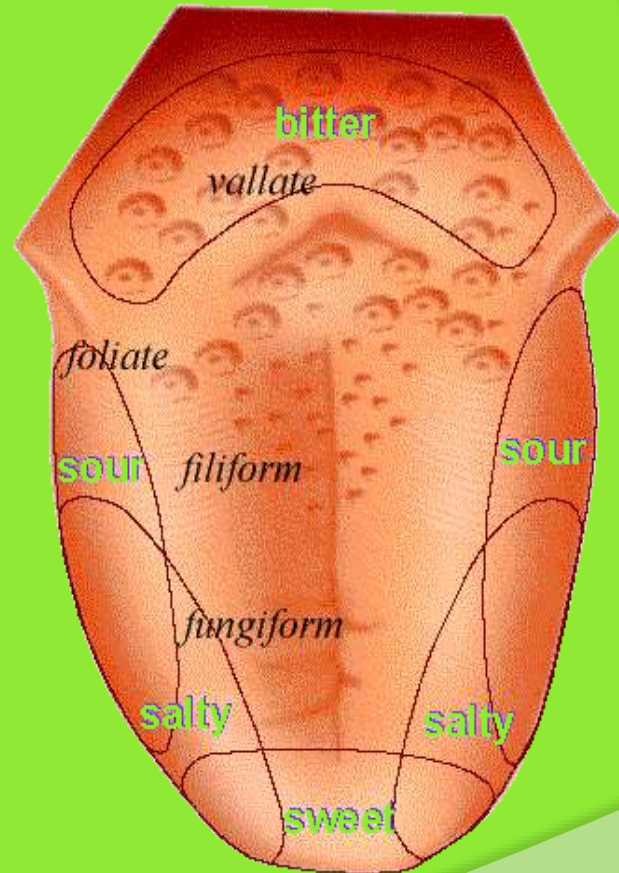


> taste hair – slender microvilli extension of the taste cell.

> taste pore – narrow opening from where taste hairs are projected.

> *Geographic distribution:*

1. tip of the tongue
  - sweet
2. side near the tip
  - salty
3. side near the back
  - sour
4. back/rear of the tongue
  - bitter



> *Primary taste sensation:*

*(Taste Modalities)*

1. Sweet
2. Salty
3. Sour
4. Bitter
5. Umami

Generally, each taste modality is associated with organic compounds such as:

### ***1. SWEET***

- associated with organic compounds such as polysaccharide like sugar, glycerol, dulcin, chloroform & amino acid.



## **2. SOUR**

- associated with hydrogen ions as acid & acid salts.
- not all acids are sour
  - e.g. amino acid – sweet

### **3. SALTY**

- associated with positive & negative ions, inorganic compounds such as, chlorides of sodium, ammonium & iodine.

## ***4. BITTER***

- associated with inorganic salts of increasing molecular weight like alkaloids (nicotine & caffeine).

## ***5. UMAMI***

- “meaty” taste produced by amino acids such as aspartic & glutamic acids.
- the taste is best known from the salt of glutamic acid, monosodium glutamate (MSG).

- pronounced as “ooh-mommy”
- the word is Japanese slang for “delicious” or “yummy”
- specific area on the tongue sensitive to umami is not yet known.

>Taste buds present in papillae:

1. Fungiform papillae
2. Circumvallate papillae
3. Palatal papillae

4. Other papillae and taste buds may occur in other oral & pharyngeal locations, including the lips, inner surface of the lingual mucosa, epiglottis, various pharyngeal regions of the upper 1/3 of the esophagus as well as the pharynx.

\* Filiform papillae – do not contain taste buds

> Taste buds are capable of responding to each quality, but their response characteristics are concentration dependent:

1. Taste buds in Fungiform papillae – respond in uniform manner to low concentration of both sweet and salty taste substance.



2. Taste buds in Circumvallate papillae - respond in uniform manner to low concentration of sweet substances and only to higher concentrations of salt, sour & bitter stimuli.

3. Taste buds in Palatal papillae – respond in uniform manner to both sour & bitter substances, although they respond to salt in relatively high concentrations.

# ***PHYSIOLOGIC PROPERTIES OF TASTE RECEPTORS:***

## **1. ADAPTATION**

- diminution in the intensity or sensation or even disappearance of sensation even with continued stimulation of receptors
- reduction in sensitivity in the presence of a constant stimulus.

## **2. AFTER TASTE/**

### **AFTER DISCHARGE OF**

### **TASTE RECEPTORS**

- taste still lingers even if the stimulus has been removed.

### **3. CONTRAST**

#### **a. Successive contrast**

- eat sweet then sour food, sourness is intensified

#### **b. Simultaneous contrast**

- if one border of the tongue is rubbed with sugar, the other border will enhance the sweet taste.

## **4. DUAL TASTE**

- some substances can elicit 2 tastes or they can stimulate 2 different types of receptors.

## 5. EFFECT OF CERTAIN DRUGS

- when cocaine, an anesthetic solution is applied to the tongue the sensation is abolished.

- sequence of disappearance:

a. pain

d. salty

b. bitter

e. sour

c. sweet

# **OLFACTORY RECEPTORS**



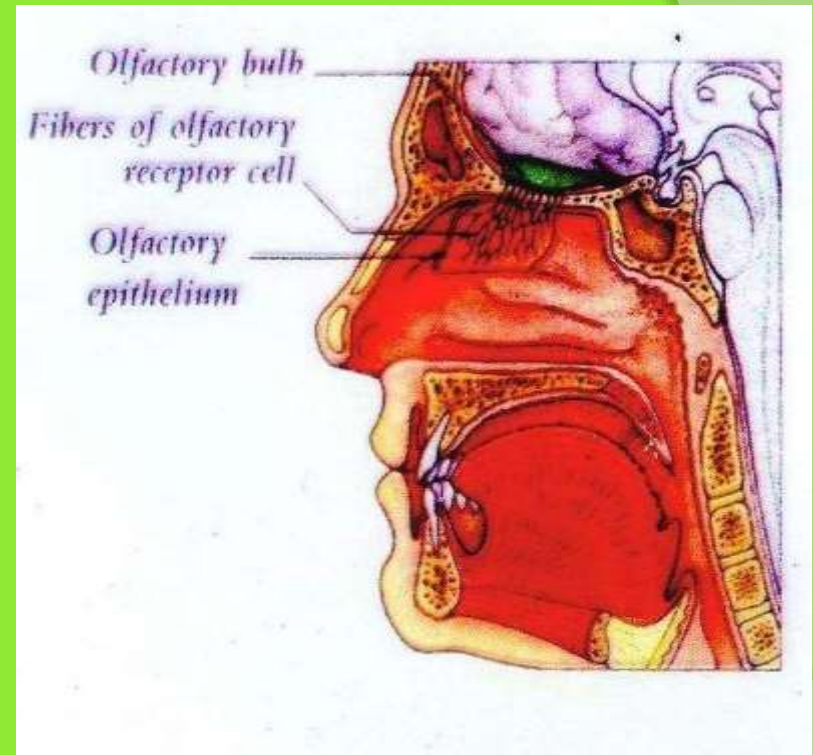
# ***OLFACTORY RECEPTORS***

## **Olfaction**

- > closely related to taste
- > flavors of various food are largely due to the combination of taste & smell.

# Olfactory receptors

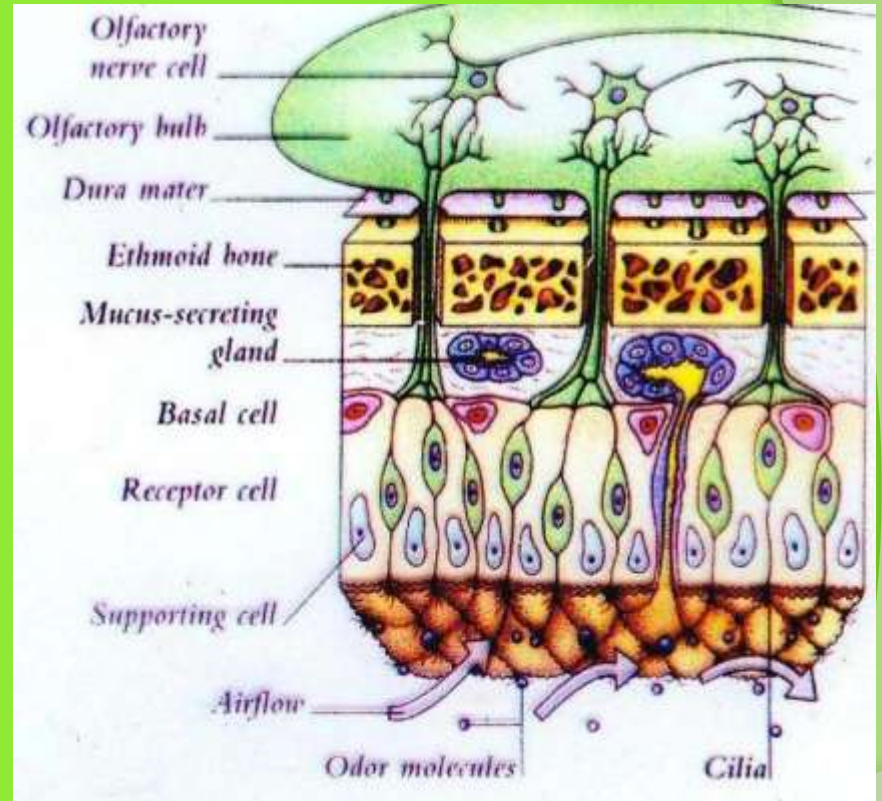
> located on the *olfactory mucous* which lies on the posterodorsal part of the nasal cavity. It has an area of about  $2.5 \text{ cm}^2$ . It includes the upper 3<sup>rd</sup> nostril, septum & superior conchae.



> composed of:

a. Olfactory cell

b. Supporting cell



## *Primary Odors:*

### **1. CAMPHORACEOUS**

- tough volatile fragrant compound from the wood & bark of camphor tree used in medicine as plasticizer and insect repellent.

## **2. MUSKY**

- substance with a penetrating odor obtained from a sac beneath the abdominal skin of male musk deer & used as perfume fixation.

### **3. FLORAL**

- flower

### **4. PEPPERMINTY**

- minty aroma/ fresh

## **5. ETHEREAL**

- ether is a light volatile inflammable liquid obtained by the distillation of alcohol with sulfuric acid & used chiefly as solvents and anesthetic.

## **6. PUNGENT**

- stinging or biting quality

## **7. PUTRID**

- rotten, foul odor
- decomposing organic matter



# ***PHYSIOLOGIC PROPERTIES OF OLFACTORY RECEPTORS:***

## **1. ADAPTATION**

- it is well known experience that an odor which at first seems to be quite strong or even noxious, after a few minutes is hardly noticed.

## **2. EFFECT OF ONE ODOR ON THE OTHER ODOR**

- strong odors tend to mask weaker ones. If appropriate amount is applied, one odor antagonizes the other odor.

## ***Anomalies in Olfaction:***

1. Excessive smoking.
2. Temporary loss of sense of smell may be the result of inflammation of the nasal mucosa.
3. Disease of the nervous system may affect olfaction either unilaterally/ bilaterally.
4. Hypernosmia – acute sensitivity of the sense of smell due to some diseases of the CNS.

