

# Chapter 45

## Making Sense of the World

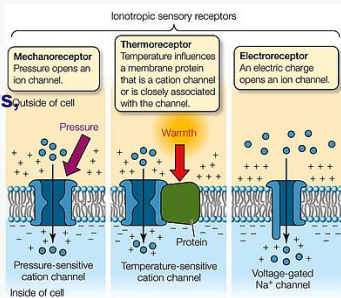


### Sensory Receptors

- sensory cells **transduce** physical and chemical stimuli into neuronal signals.
- the receptor protein detects a stimulus then opens or closes ion channels in the membrane, changing the resting potential

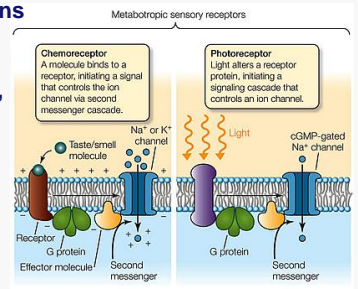
### Sensory Receptors

- **Ionotropic:** ion channels themselves or directly affect ion channels—**mechanoreceptors, thermoreceptors, electrosensors**



### Sensory Receptors

- **Metabotropic:** affect ion channels through G proteins and second messengers—**chemoreceptors, photoreceptors**

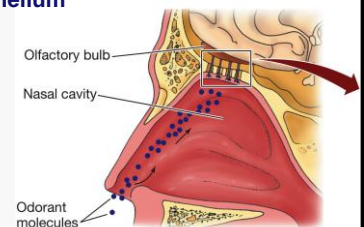


### Sensation

- sensation depends on which part of the **CNS** receives the sensory messages
  - ◆ Intensity of sensation is coded as the frequency of action potentials
- some sensory cells transmit information to the brain about internal conditions, but there is no conscious sensation
- sensory systems include sensory cells, associated structures, and neuronal networks that process the information

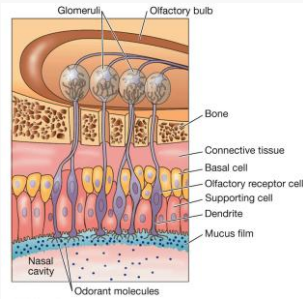
### Sense of Smell

- **olfaction** is the sense of smell
- axons extend to the olfactory bulb in the brain, dendrites end in olfactory hairs on the nasal epithelium



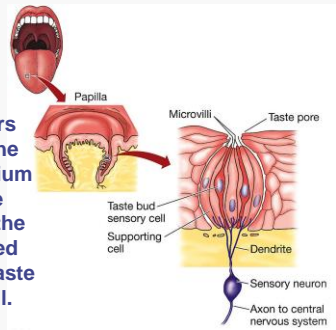
### Sense of Smell

- **odorant**: a molecule that binds to a receptor protein on the olfactory cilia.
  - ♦ olfactory receptor proteins are specific for particular odorants.



### Sense of Taste

- **gustation** is the sense of taste.
  - ♦ taste buds: clusters of chemoreceptors
  - ♦ embedded in the tongue epithelium
  - ♦ some fish have taste buds on the skin; duck-billed platypus has taste buds on the bill.



### Sense of Taste

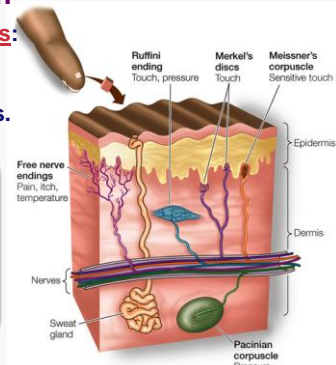
- humans taste salty, sour, sweet, bitter, and **umami**
  - ♦ savory, meaty taste from receptors for amino acids
- full complexity of taste involves both gustatory and olfactory receptors



### Sense of Touch

- **mechanoreceptors**: sensory cells that respond to mechanical forces.

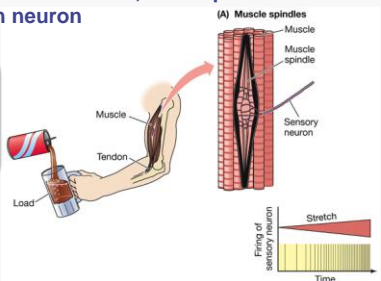
physical distortion of the plasma membrane causes ion channels to open, this changes membrane potential and leads to action potentials



### Sense of Touch

- muscle spindles: **mechanoreceptors** in muscle cells → **stretch receptors**
  - ♦ when muscle is stretched, action potentials are generated in neuron

CNS adjusts strength of contraction to match load on muscle

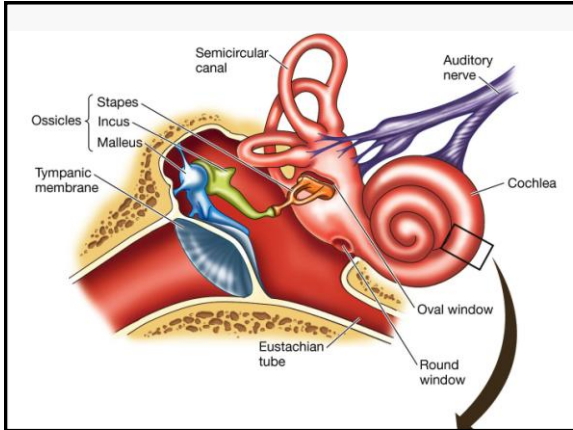


### Sense of Hearing

- Auditory systems use mechanoreceptors to convert pressure waves to receptor potentials.

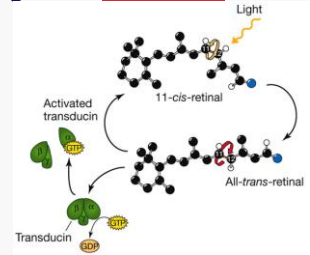
- ♦ human ears use pinnae to collect sound waves and direct them to the auditory canal
- ♦ the tympanic membrane (eardrum) covers the end of the auditory canal and vibrates in response to pressure waves.





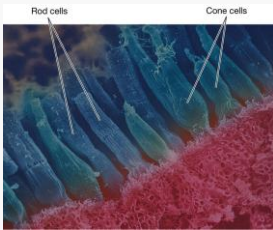
### Sense of Sight

- **photosensitivity**: sensitivity to light
- a range of animal species from simple to complex can sense and respond to light.
- all use the same pigments: **rhodopsins**.



### Sense of Sight

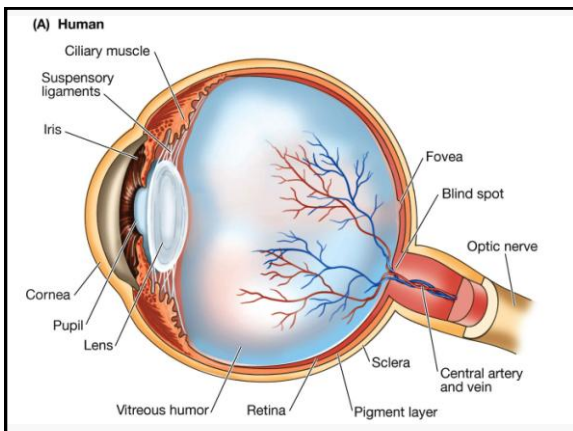
- **rods**: one type of vertebrate photoreceptor
  - ◆ detects light
- **cones**: one type of vertebrate photoreceptor
  - ◆ detects colors



humans have three types of cone cells with slightly different opsin molecules; they absorb different wavelengths of light

### Sense of Sight

- **sclera**: tough connective tissue, becomes transparent cornea on front
- **iris** (pigmented): controls amount of light reaching photoreceptors; opening is the pupil
- **lens**: crystalline protein; focuses image – allows accommodation; changes shape
- **retina**: photoreceptor layer
- **fovea**: area where cone cell density is highest



### Sense of Sight

- light must pass through all five layers of before it is captured by rhodopsin.

