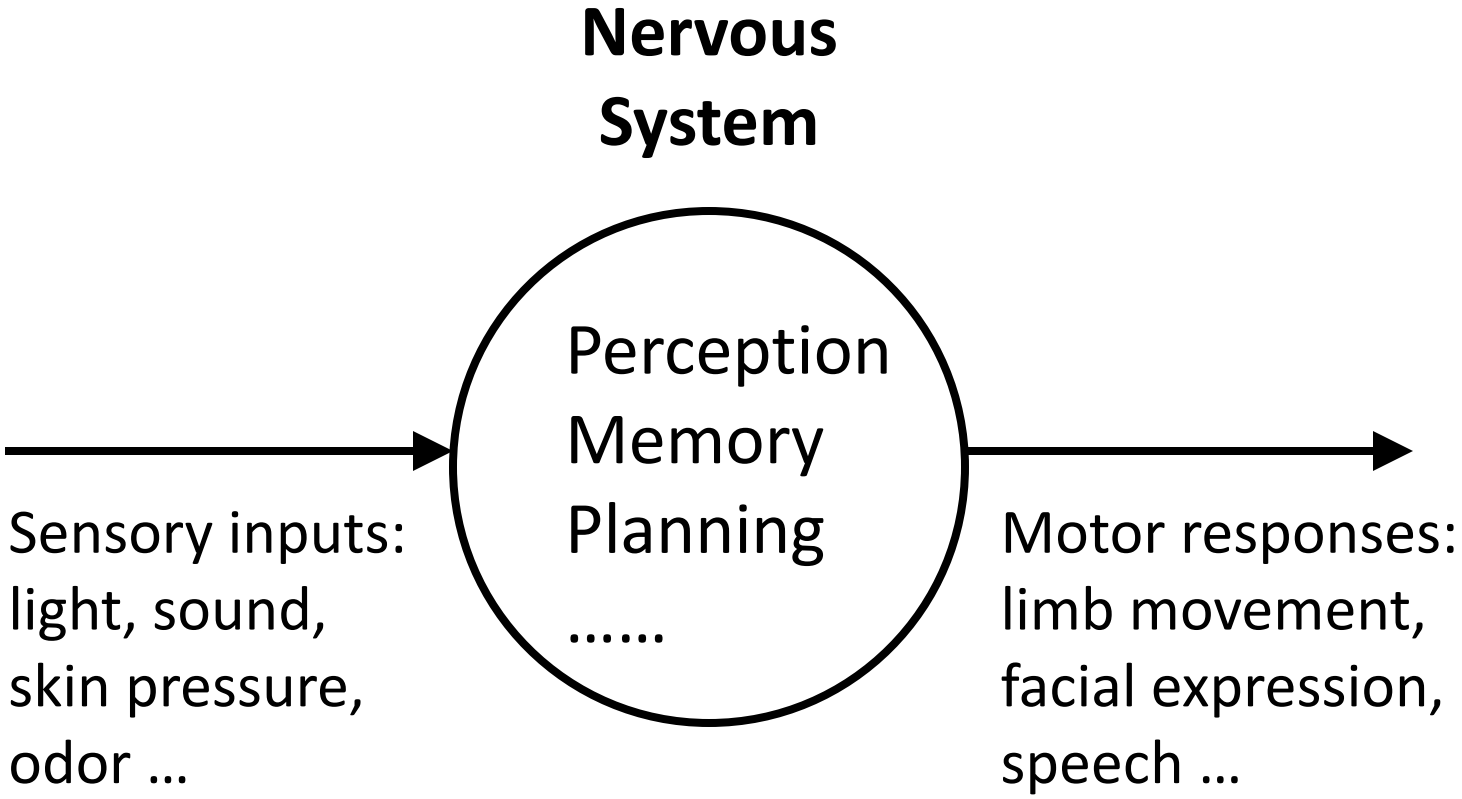
Sensory coding

Sensory receptors detect a stimulus and transduce it into information, which is transmitted to the CNS.

This process involves four basic steps:

1. Filtering
2. Detection of the filtered information
3. Amplification
4. Encoding of the information into action potential


Nervous System
Perception
Memory
Planning
……
Sensory inputs: light, sound, skin pressure, odor …
Motor responses: limb movement, facial expression, speech …

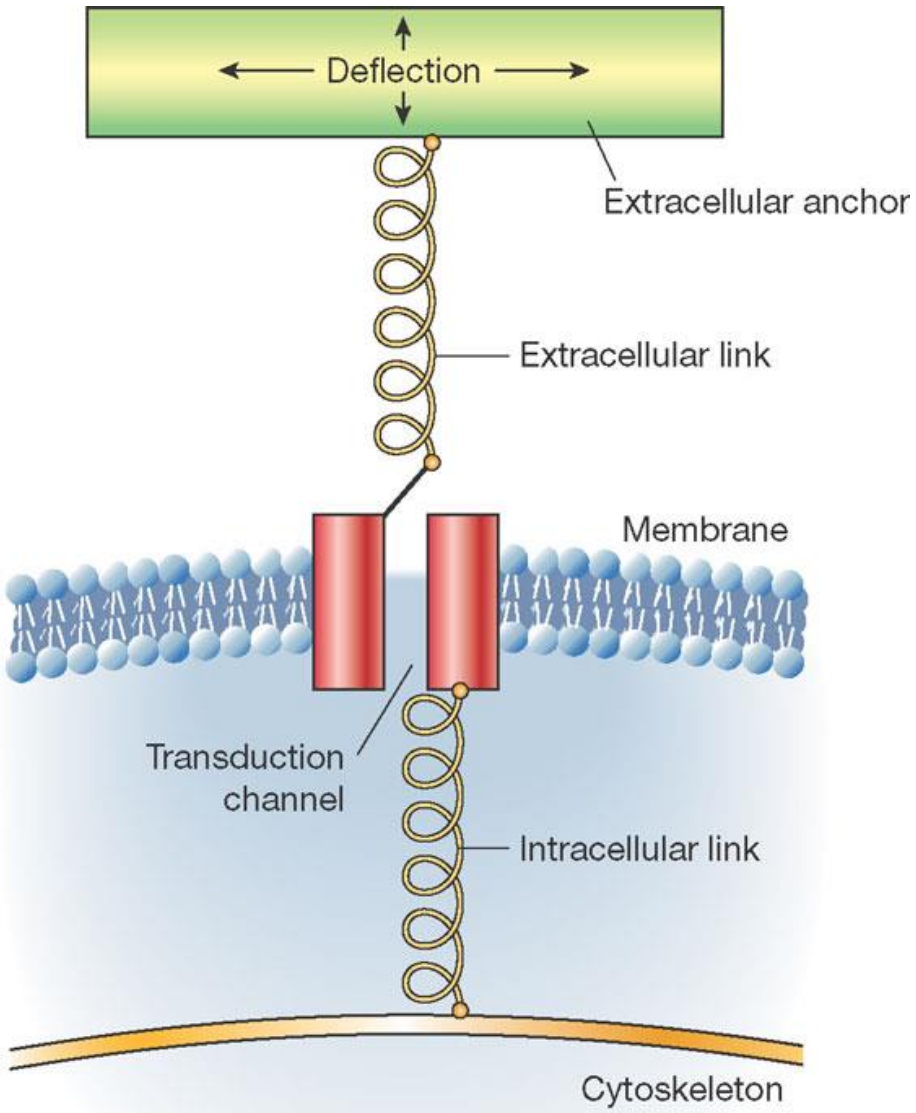
Sensory Systems

Modality	Stimulus	Receptor Class	Receptors
Vision	Light	Photoreceptors	Rods, cones
Audition	Sound	Mechanoreceptor	Hair cells (cochlea)
Vestibular	Gravity, acceleration	Mechanoreceptors	Hair cells (vestibular labyrinth)
Somatic			Dorsal root ganglion neurons
Touch	Pressure	Mechanoreceptor	Cutaneous mechanoreceptors
Proprioception	Displacement	Mechanoreceptor	Muscle and joint receptors
Temperature	Thermal	Thermoreceptor	Cold and warm receptors
Pain	Chemical, thermal, or mechanical	Chemoreceptor, themoreceptor, or mechanoreceptor	Chemical, thermal, and mechanical nociceptors
Itch	Chemical	Chemoreceptor	Chemical nociceptor
Taste	Chemical	Chemoreceptor	Taste buds
Smell	Chemical	Chemoreceptor	Olfactory sensory neurons

Transduction

- Sensory receptors are continuously exposed to stimulus (temperature, pressure, light, chemicals, movement, and chemical gradients) but it respond to only a specific stimulus
- Receptor sensitivity is due to its molecular structure.
- For e.g. mechanoreceptor cell has specialized cilium which is sensitive to stretch.

Transduction



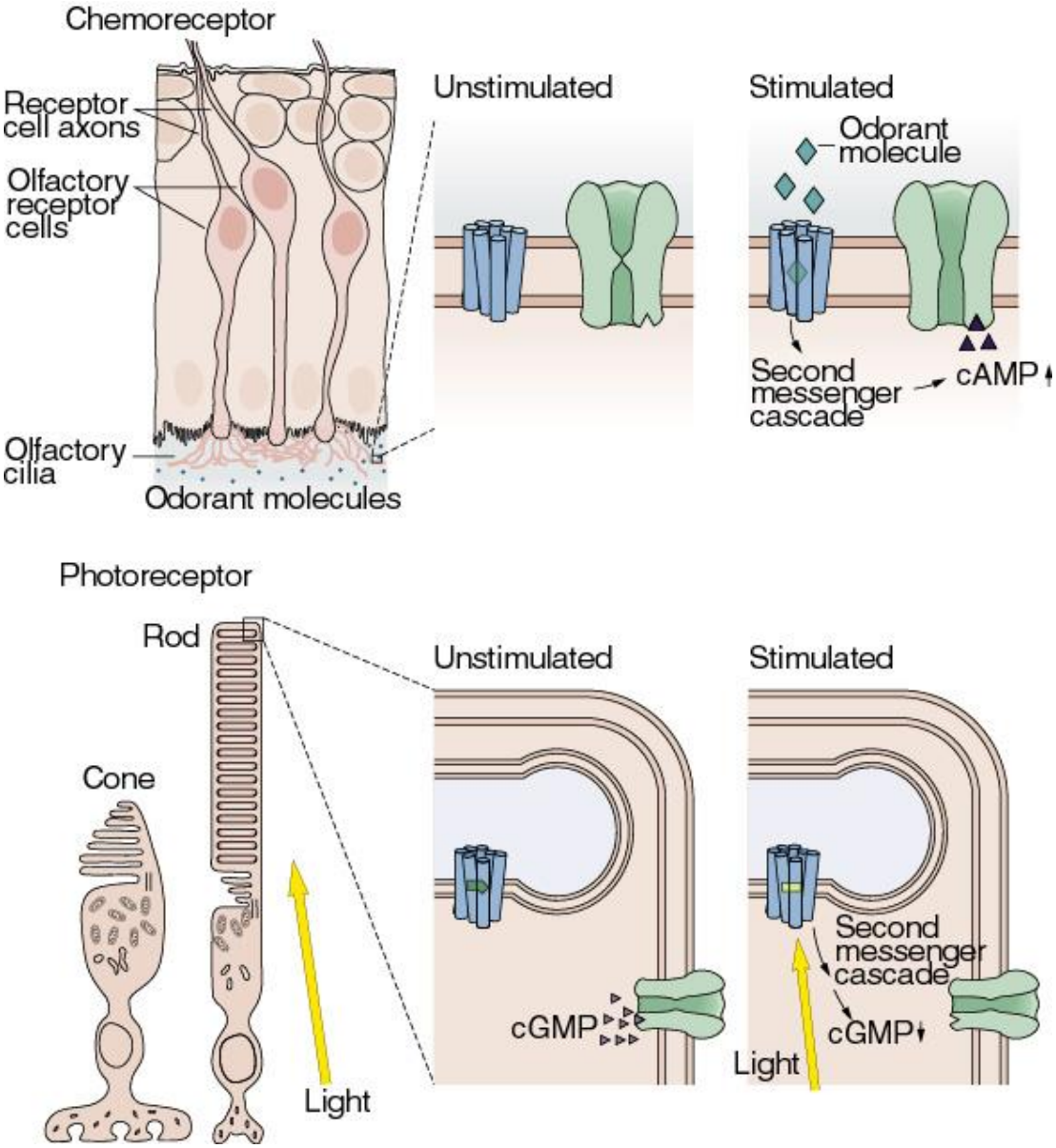
- Stimulation of the receptor membrane changes its permeability and ionic conductance
- Mechanoreceptors – physically deform ion channels and change ionic permeability
- Thermoreceptors – temperature depending changes in ion channel permeability
- Chemoreceptors- regulate the ion channel permeability through G proteins, adenyl cyclase, and cyclic AMP.

- Photoreceptors – absorbs photon of light by rhodopsin, and alters Na+ permeability.
- Electroreceptors- voltage dependent ion channels.
- Stimulation of sensory receptors temporarily opens ion channels
- RECEPTOR POTENTIAL: receptor membrane is transiently depolarize and hyperpolarize by the change in conductance, this is called *receptor potential*.

- **Invertebrates photoreceptors**
- Absorption of light → INCREASES → Na+ conductance of photoreceptors → DEPOLARIZES → membrane.
- **Vertebrates photoreceptors**

Absorption of light → DECREASES → Na+ conductance → HYPERPOLARIZES → membrane

Transduction



- **Generator potential:**

- The electrical depolarization that is electronically propagated to the myelinated nerve fiber is the stimulus that initiates (or generates) an action potential , this is called *generator potential.*

Sensory adaptation

- If the stimulus intensity is maintained constant then the action potential frequency of most sensory receptors declines, this is called as *Adaptation.*
- Receptors adapt either *Rapidly* or *Slowly*
- *Tonic receptors:* has a slow or no decline in response to maintained stimulus
- *Phasic receptors:* rapidly adapts and has a faster decline in action potential discharge