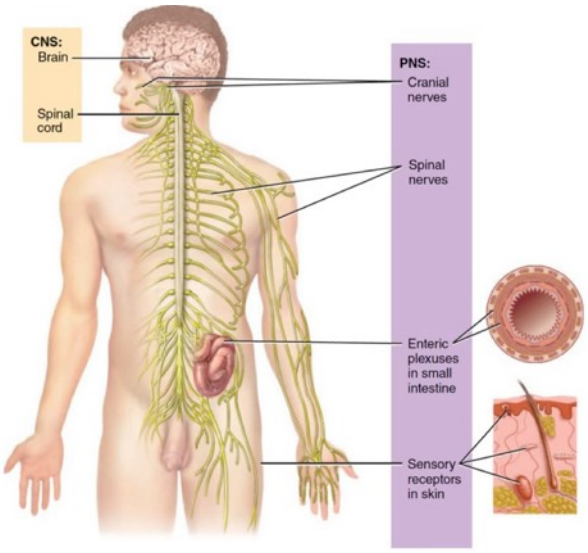
# Neurophysiology Introduction

## Functions of the nervous system :

- **Sensory function:** sensory receptors detect internal or external stimuli. The sensory information is carried to the CNS through cranial and spinal nerves.
- **Integrative function**: process sensory information by analyzing it and making decision for appropriate responses.
- **Motor function:** activation of effectors (muscles and glands) through cranial and spinal nerves.

## Divisions of nervous system




Sensation

- **Sensation** is the conscious or subconscious awareness of changes in the external or internal environment.
- **Perception** is the conscious interpretation of sensations and is primarily a function of the cerebral cortex

Perception

- Is the world, as we perceive it, reality? 🙂

## The process of sensation :

Stimulation of the sensory receptor.

A receptor may be either

(1) a specialized ending of the afferent neuron or

(2) a separate receptor cell closely associated with the peripheral ending of the neuron.

Each type of receptor is specialized to respond to

## Sensory modalities

- Sensory modalities are divided into general senses and special senses.

* General senses are further divided into:

- Somatic senses: include tactile, thermal and pain sensations.
- Visceral senses: provide information about conditions within internal organs.

* Special senses include smell, taste, vision, hearing, and balance.

## Receptor potential

Because the only way afferent neurons can transmit information to the CNS about stimuli is via action potential propagation, receptors must convert these other forms of energy into electrical signals.
Stimulation of a receptor alters its membrane permeability, producing a receptor potential

## The process of sensation

- 1. Stimulation of the sensory receptor.
- 2. Transduction of the stimulus. A sensory receptor converts the energy in the stimulus into a graded potential
- 3. Generation of nerve impulses. When a graded potential in a sensory neuron reaches threshold, it triggers one or more nerve impulses, which then propagate toward the CNS.
- 4. Integration of sensory input. A particular region of the CNS receives and processes the sensory nerve impulses

## Receptive Field

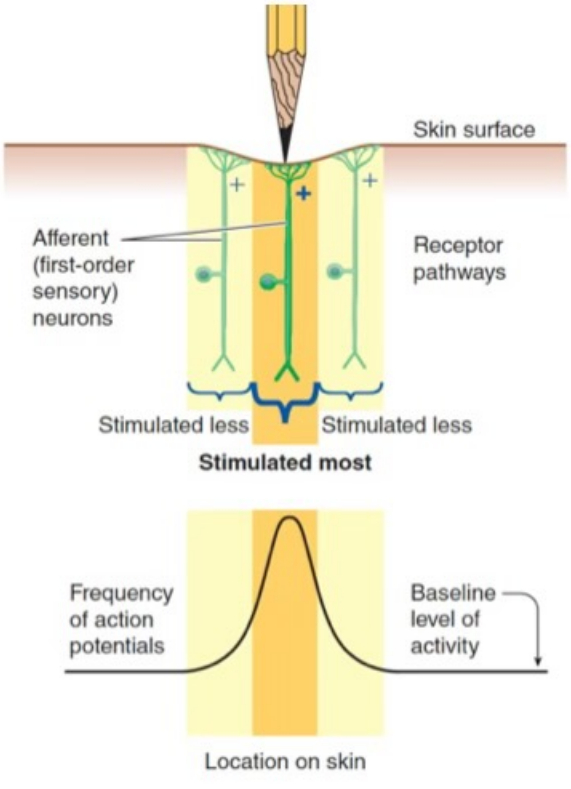
- Each sensory neuron responds to a stimulus only within a specific region surrounding it, this region is called its receptive field.
- The size of a receptive field varies inversely with the density of receptors in the region.
- The smaller the receptive field is in a region, the greater its acuity or discriminative ability: 2 point discrimination

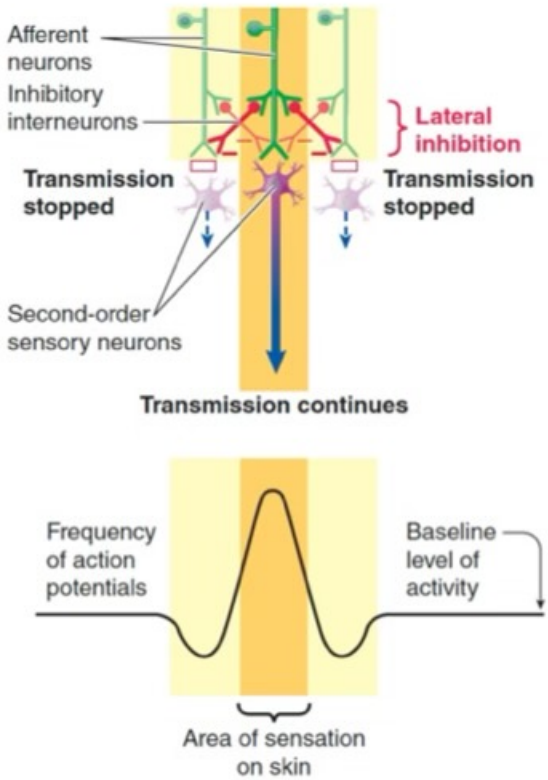
## Somatic sensory receptors distribution

- Receptors are distributed unevenly.
- The areas with the highest density of somatic sensory receptors are the tip of the tongue, the lips, and the fingertips

## Lateral Inhibition

- To facilitate localization and sharpen contrast, lateral inhibition occurs within the CNS.
- With lateral inhibition, each activated signal pathway inhibits the pathways next to it by stimulating inhibitory interneurons that pass laterally between ascending fibers serving neighboring receptive fields.
- The most strongly activated pathway originating from the center of the stimulus area inhibits the less excited pathways to a greater extent than the weakly activated pathways inhibit the more excited central pathway
- Blockage of further transmission in the weaker inputs increases the contrast between wanted and unwanted information so that the stimulus precisely localized.
- The extent of lateral inhibitory connections within sensory pathways varies for different modalities. Those with the most lateral inhibition: touch and vision



## Stimulus intensity

- The intensity of the stimulus is reflected by the magnitude of the receptor potential.
- The larger the receptor potential, the greater the frequency of action potentials generated in the afferent neuron.
- A larger receptor potential cannot bring about a larger action potential but it can induce more rapid firing of action potentials
- Stimulus strength is also reflected by the size of the area stimulated: Stronger stimuli usually affect larger areas, so correspondingly more receptors respond.
- Temporal and spatial summation.

### True or false

- Stimuli of the same intensity always result in receptor potentials of the same magnitude in the same receptor

## Adaptation in sensory receptors

- A characteristic of most sensory receptors is adaptation, in which the receptor potential decreases in amplitude during a maintained, constant stimulus.
- Because of adaptation, the perception of a sensation may fade or disappear even though the stimulus persists.
- Receptors vary in how they adapt and how quickly they adapt (tonic vs phasic).

## Labeled Line Principle

- Even though all information is propagated to the CNS via the same type of signal (action potentials), the brain can decode the type and location of the stimulus.
- A particular sensory modality detected by a specialized receptor type is sent over a specific afferent and ascending pathway to excite a defined area in the somatosensory cortex.
- Thus, different types of incoming information are kept separated within specific labeled lines between the periphery and the cortex.