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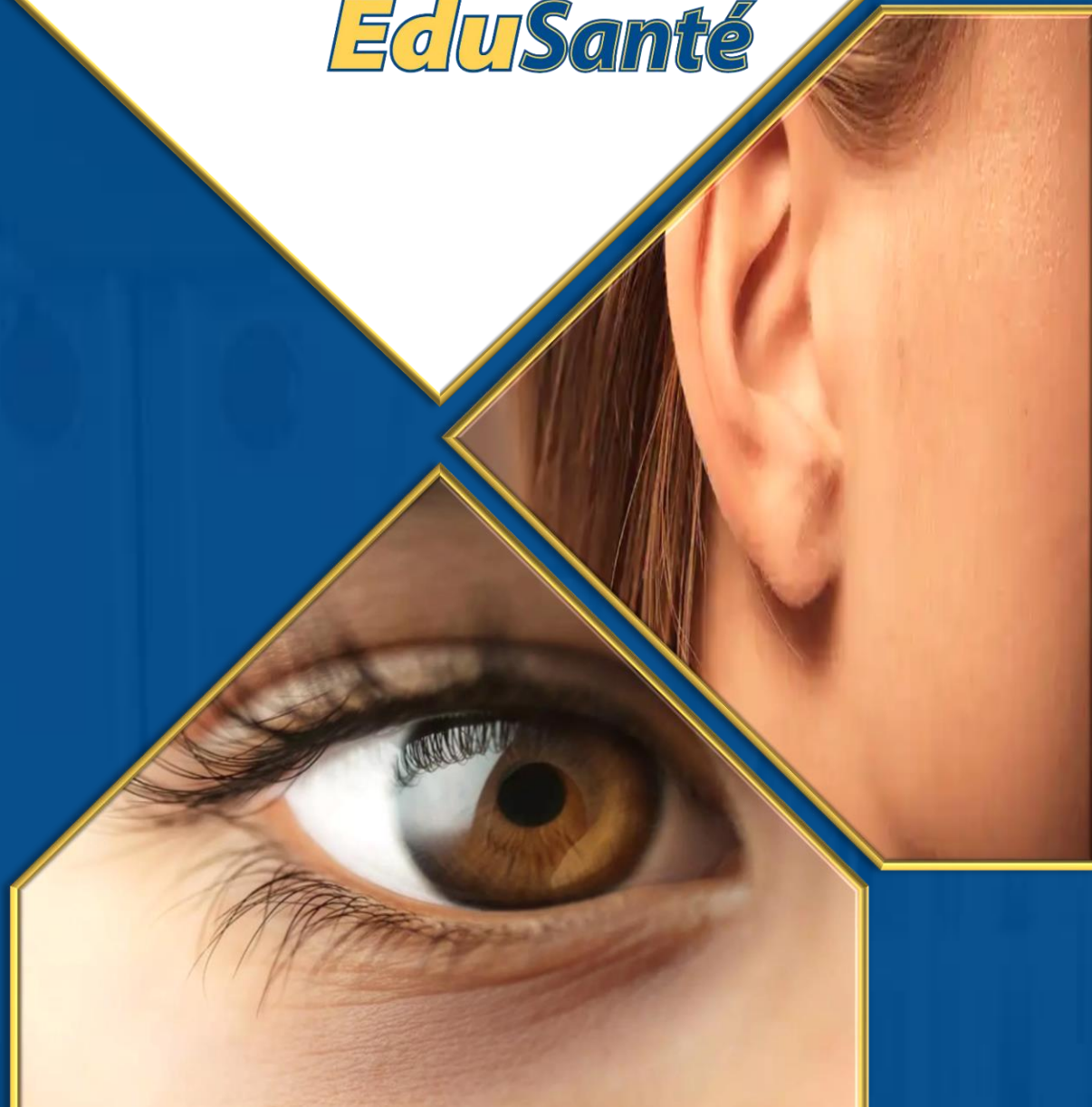
Sensory Anatomy

Primary Care Paramedicine



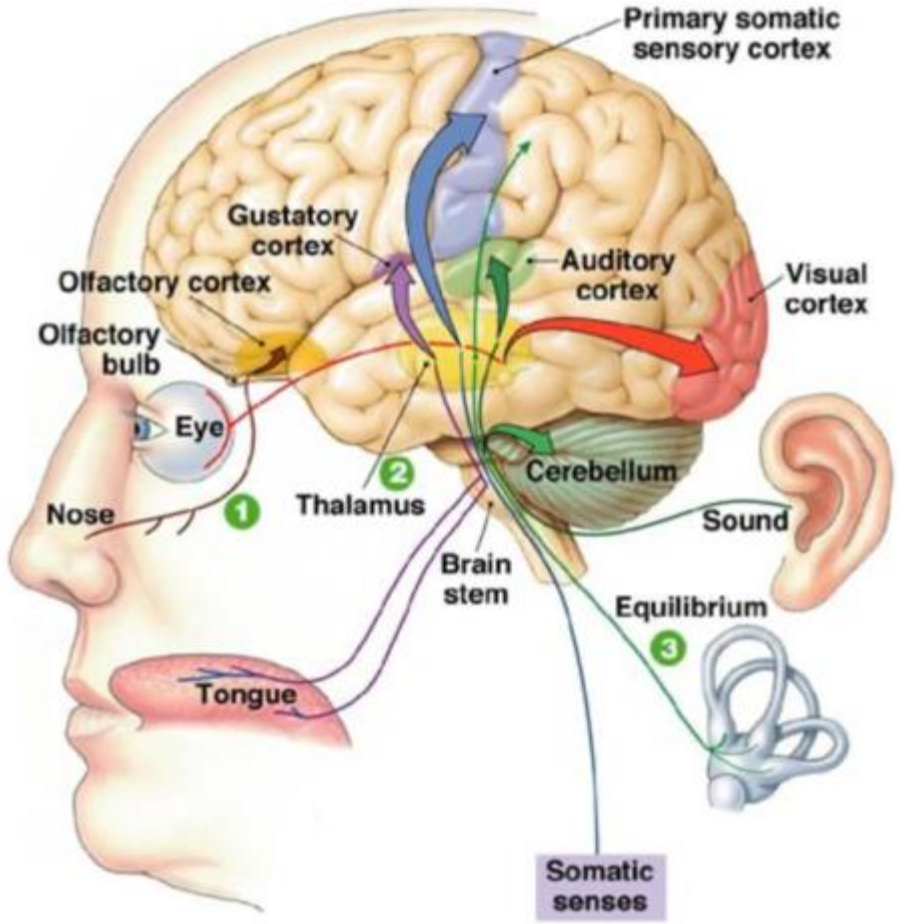
Module: 13

Section: 02

Sensory System

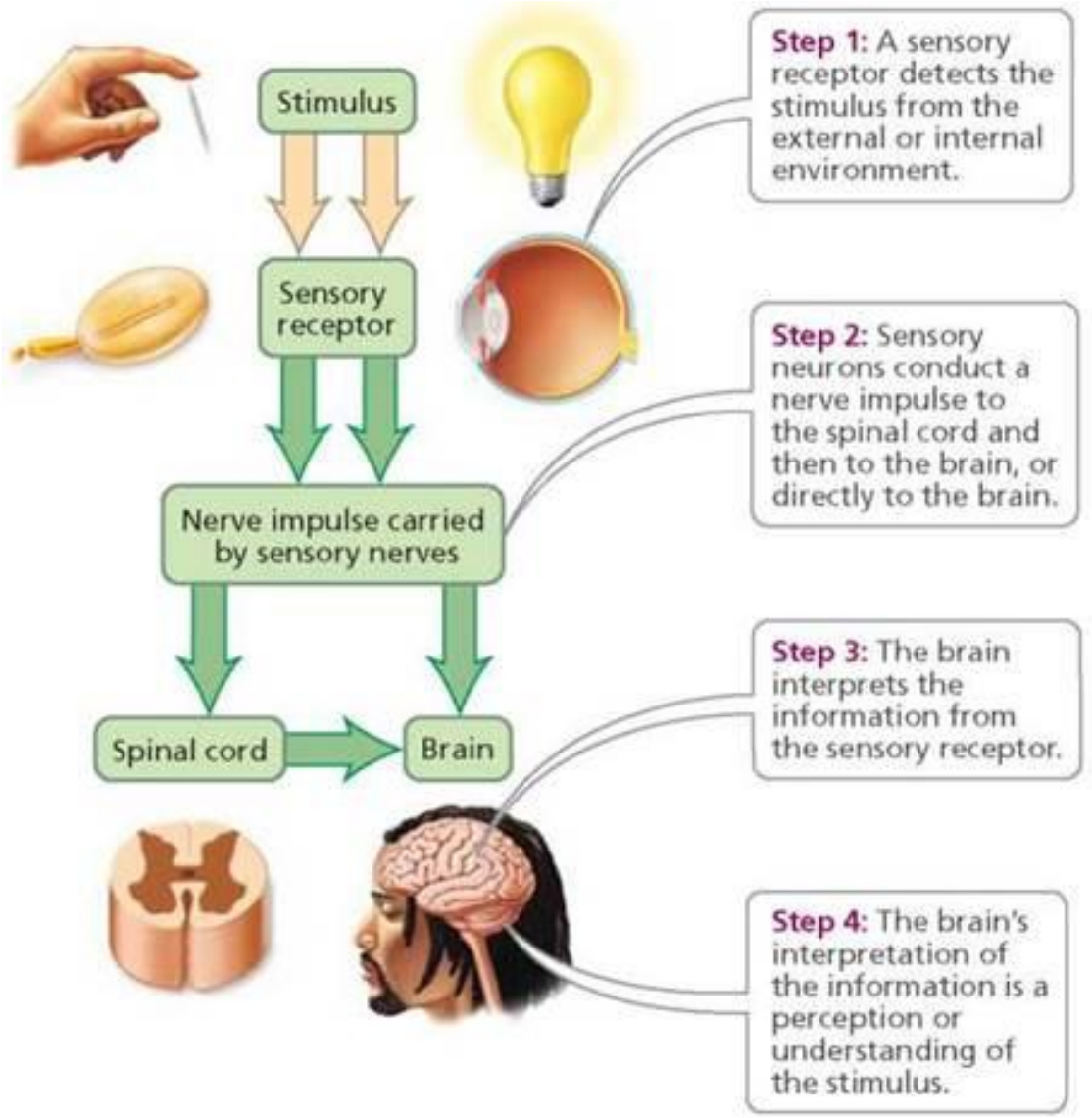
- Is dependant on sense receptors responding to stimulation

General senses	Specialized senses
Widely distributed	Localized
• Pain • Touch • Temp • Pressure • Proprioception	• Smell • Taste • Hearing • Sight



Receptors and Sensations

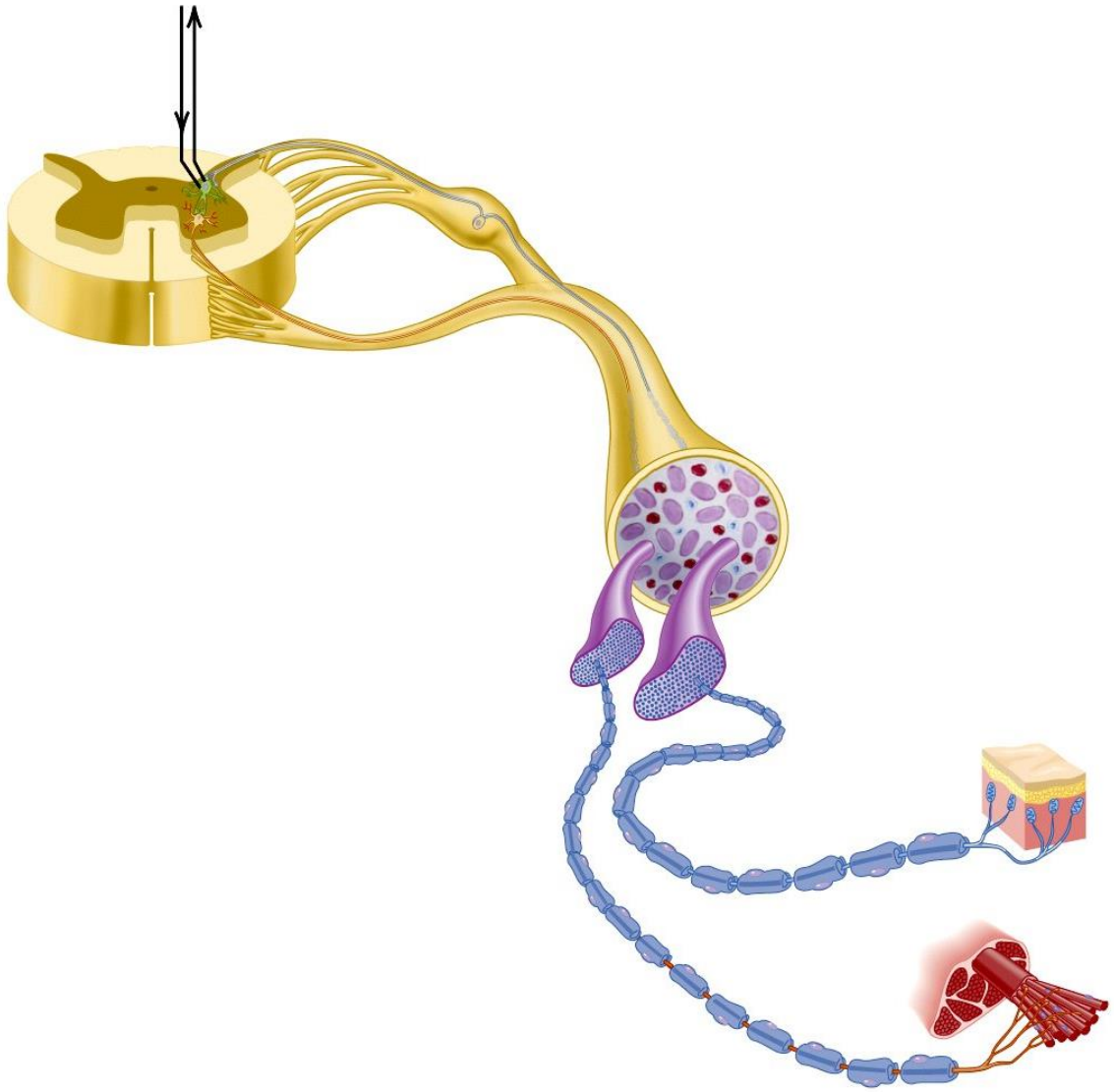
- Steps involved in perceived sensation



Sensory Anatomy

GENERALIZED SENSES

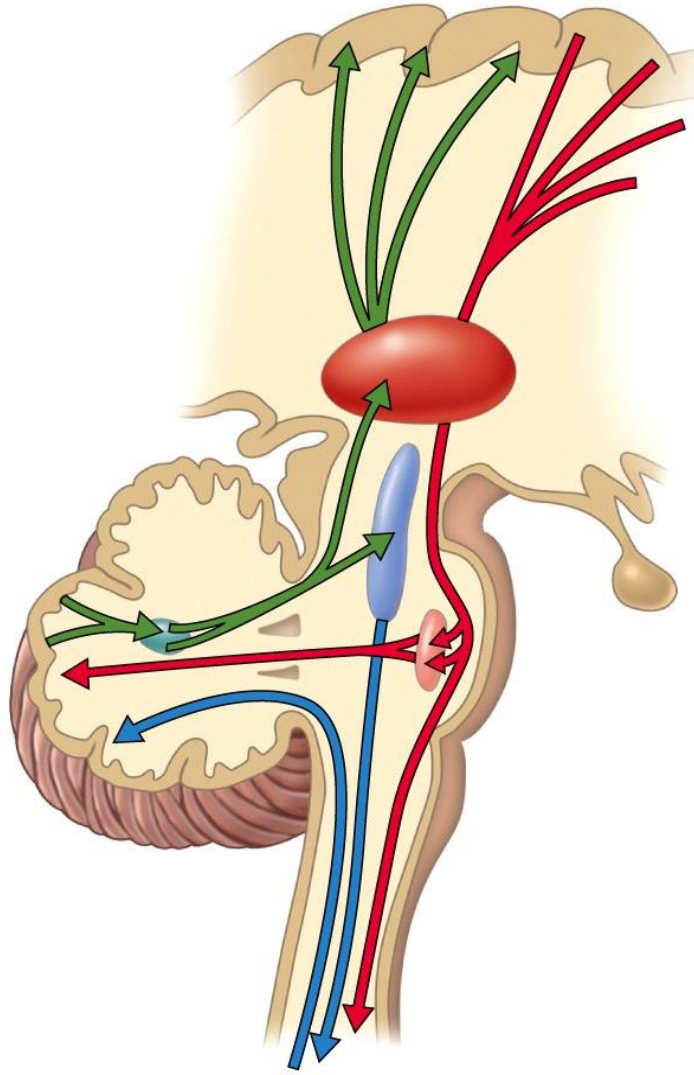
General Sensations



- As sensory impulses reach the CNS, they become part of a large pool of sensory input (though not every one will elicit a response)
- Each piece of incoming information is combined with other arriving and previously stored information in a process called integration

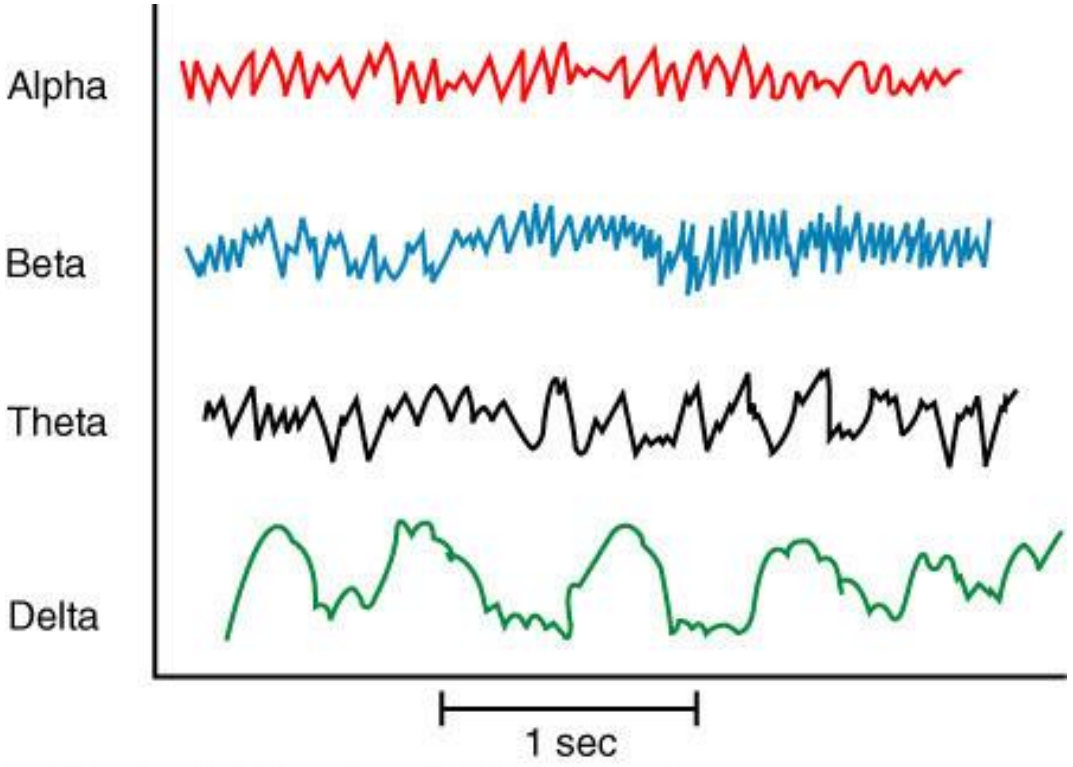
General Sensations

- Integration occurs at many places along pathways in the spinal cord, brain stem, cerebellum, basal nuclei and cerebral cortex.
- Sensations result in and evoke a conscious perception or subconscious awareness that changes have occurred in the external or internal environment.
- The motor responses are also modified at several of these levels.



General Sensations

- Examples of complex integrative functions of the brain include wakefulness and sleep, and learning and memory



James D'Addio/Corbis Stock Market

Sensory Modalities

- Each unique type of sensation is called a sensory modality, and a given sensory neuron carries information for only one modality, be it somatic, visceral, or “special”

Somatic Senses

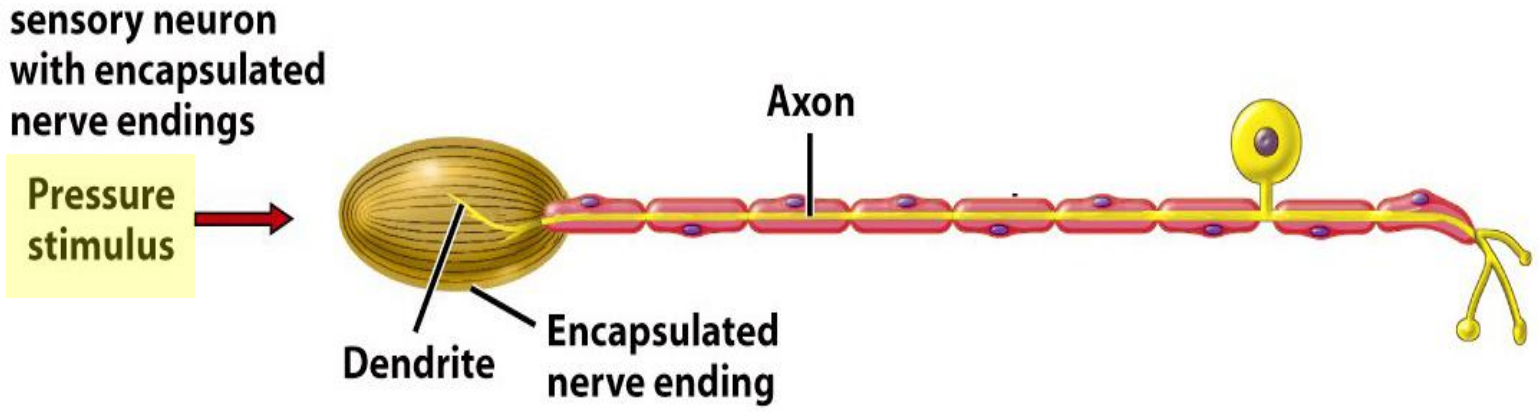
- Tactile sensations (touch, pressure, vibration, itch, and tickle)
- Thermal sensations (warm and cold)
- Pain sensations
- Proprioception

Visceral Senses

- Provide information about conditions within internal organs

Sensory Modalities

- The process of sensation begins in a sensory receptor, which can be either a specialized cell or the dendrites of a sensory neuron
  - A particular kind of stimulus (a change in the environment) activates certain sensory receptors, while other sensory receptors respond only weakly or not at all – a characteristic known as selectivity



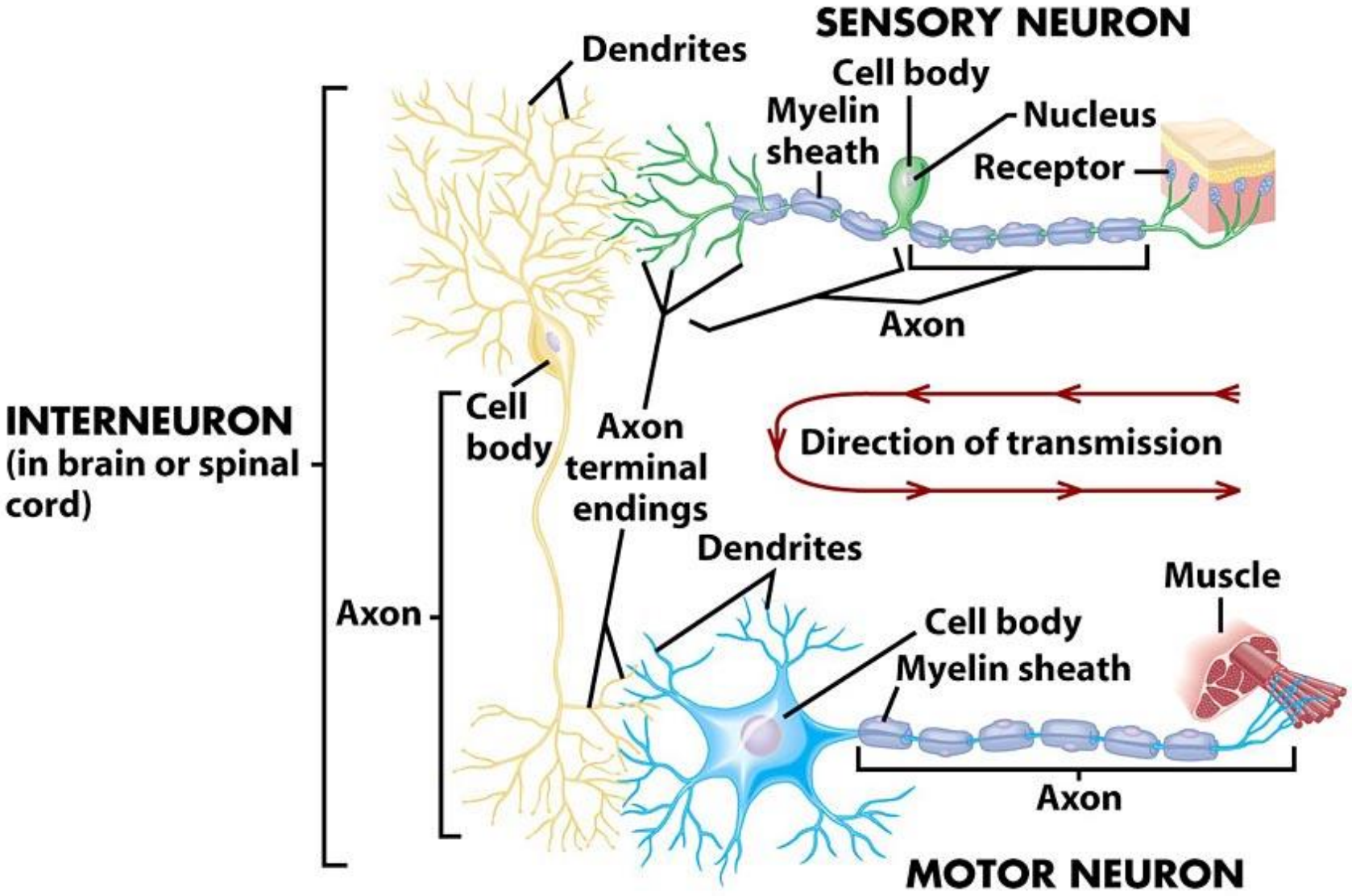
Sensory Modalities

- For a sensation to arise, four events typically occur:
  - Stimulation of the sensory receptor
    - An appropriate stimulus must occur within the receptor's receptive field
  - Transduction of the stimulus
    - A sensory receptor converts energy in a stimulus into a graded potential. Recall that graded potentials (but not APs) vary in amplitude depending on the strength of the stimulus that causes them, and are not propagated

Sensory Modalities

- Generation of nerve impulses
  - Occurs when the sum of graded potentials reach threshold in first-order neurons (the first neuron in a specific tract – in this case from the PNS into the CNS)
- Integration of sensory input
  - Occurs when a particular region of the CNS integrates a number (and even a variety) of sensory nerve impulses and results in a conscious sensations or perceptions

Sensory Modalities



Sensory Receptors

- Sensory receptors can be grouped into several classes based on structural and functional characteristics:
  - Microscopic structure – free nerve endings vs encapsulated endings
  - Location - Receptors and the origin of the stimuli that activate them
  - The type of stimulus detected (nociceptors for pain, mechanoreceptors for pressure, etc.)

Sensory Receptors

- Receptors named according to their location include:
  - Exteroceptors
    - Located at or near the external surface of the body and respond to external stimuli
  - Interoceptors (viscероceptors)
    - Located in blood vessels, organs, and muscles and produce impulses which usually are not consciously perceived
  - Proprioceptors
    - Located in muscles, tendons, joints, and the inner ear. They provide information about body position and movement of joints

Sensory Receptors

- Receptors can also denote the type of stimulus that excites them

Types of Environmental Stimuli

Mechanical	Thermal	Chemical	Electromagnetic
• Pressure • Touch • Motion • Sound • Vibration • Gravity	• Heat • Cold • Infrared radiation	• Individual types of molecules	• Visible light • Electricity • Magnetism

Sensory Receptors

- Receptors named according to mode of activation are:
  - Mechanoreceptors
    - Which are sensitive to deformation
  - Thermoreceptors
    - Which detect changes in temperature
  - Nociceptors
    - Which respond to painful stimuli
  - Photoreceptors
    - Which are activated by photons of light
  - Chemoreceptors
    - Which detect chemicals in the mouth (taste), nose (smell) and body fluids
  - Osmoreceptors
    - Which detect the osmotic pressure of body fluids

Sensory Receptors

- A characteristic feature of most sensory receptors is adaptation, in which the generator potential or receptor potential decreases in amplitude during a sustained or constant stimulus
  - Because there is an accommodation response at the receptor level, the frequency of nerve impulses traveling to the cerebral cortex decreases and the perception of the sensation fades even though the stimulus persists
    - Receptors vary in how quickly they adapt (rapidly adapting and slowly adapting receptors)

Sensory System

Sensory Adaption

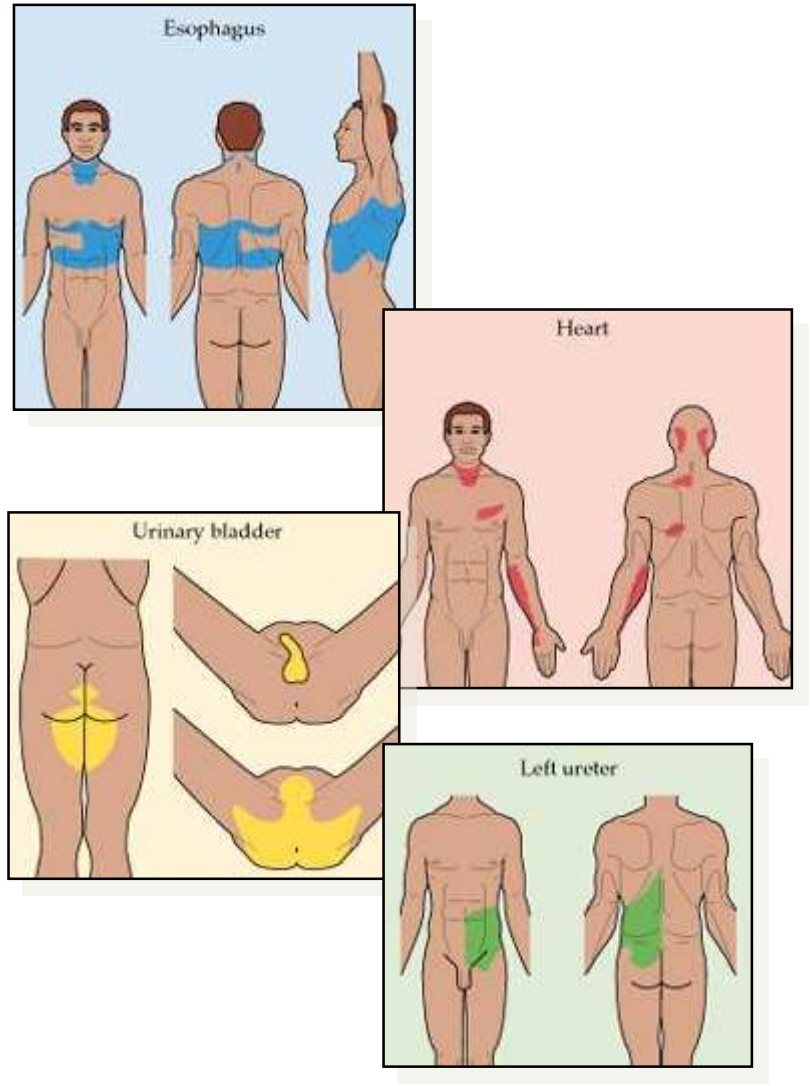
- Neural or sensory receptors change/reduce their sensitivity to a continuous, unchanging stimuli
- Occurs in the brain
- Examples:
  - Adapting to hot or cold water after a brief time in it
  - Eyes adjusting to a darker room
  - The smell of your home

Habituation

- Pattern of decreased response to a stimulus after frequent repeated exposure
- Occurs in the body
- A reduced response to something that used to elicit a stronger response
- Examples:
  - Response to drugs
  - No longer respond to favorite food as when we first loved it

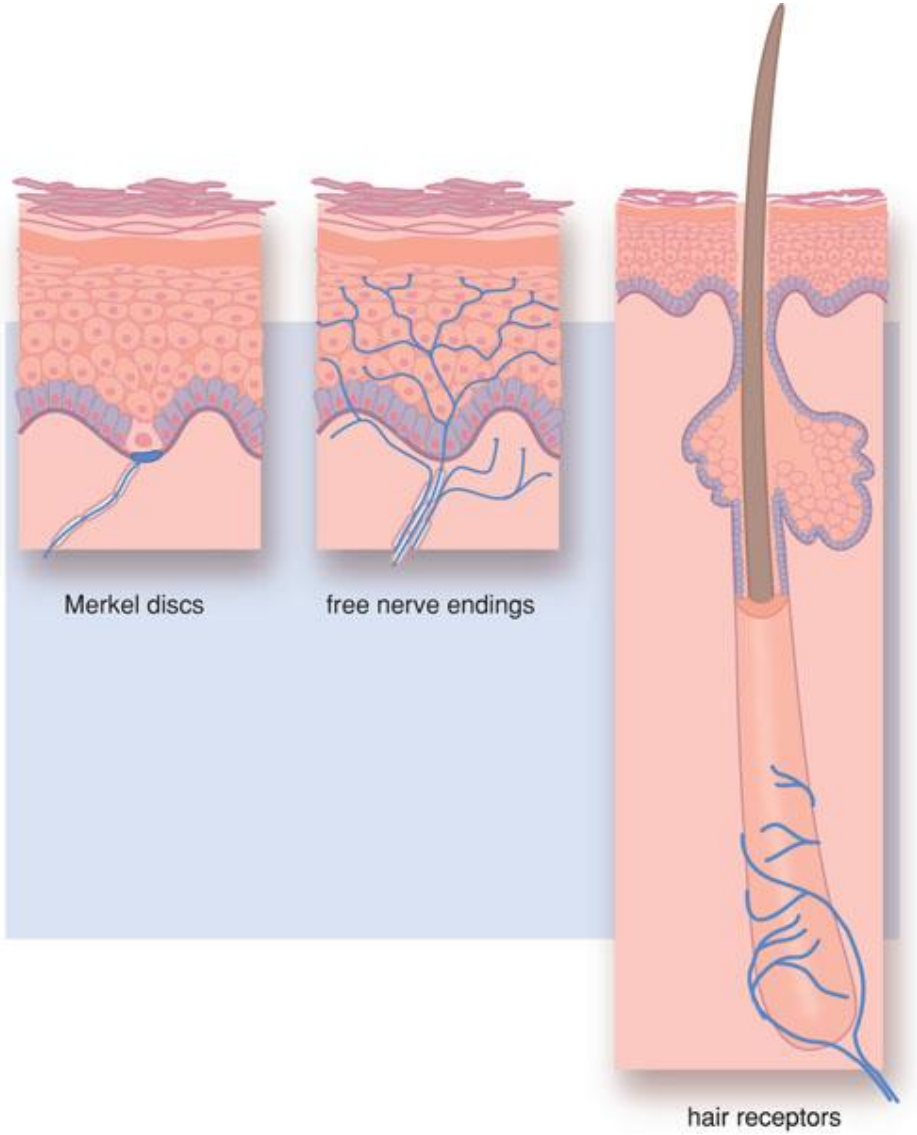
Pain

- Somatic
  - Point of pain
- Referred
  - Stimulation of deep nociceptors referred to surface areas
  - Due to sensory interpretation of visceral senses that enter the same segment of the spinal cord as the sensory fibers of the skin



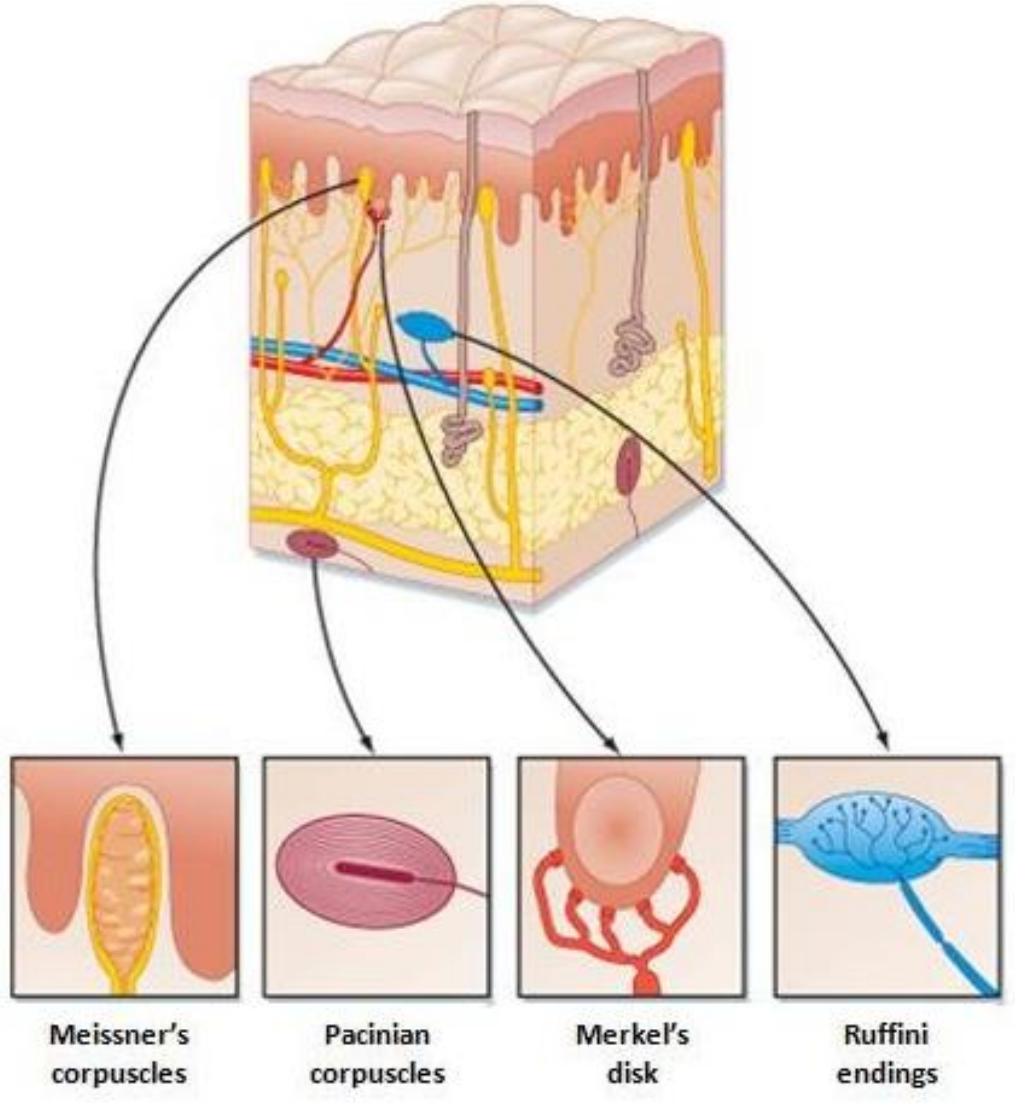
Structure

- Free nerve endings
  - Simplest most common form
  - Nociceptors
  - Root hair plexus
  - Merkel endings



Structure

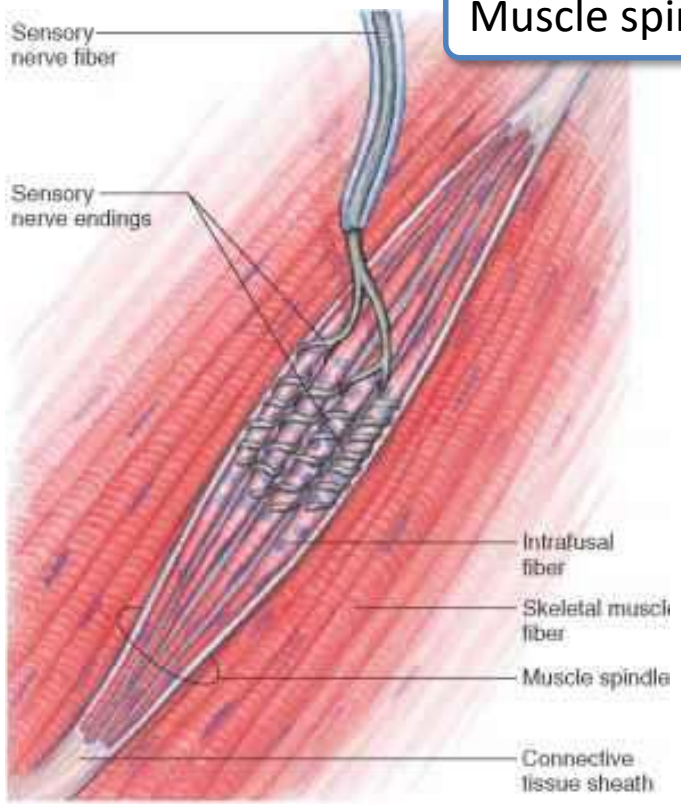
- Encapsulated nerve endings
  - Touch and Pressure
    - Meissner's corpuscles
    - Krause's end bulbs
    - Ruffini's corpuscles
    - Pacinian corpuscles



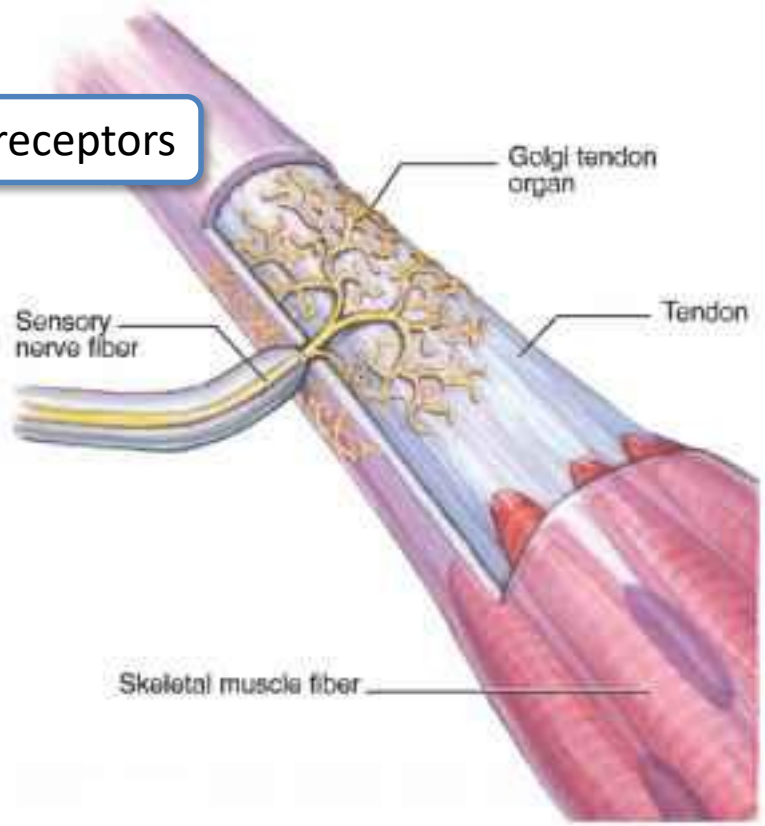
Structure

- Encapsulated nerve endings
  - Stretch Receptors

Muscle spindles



Golgi tendon receptors



Sensory Anatomy

SPECIALIZED SENSES

Special Senses

Smell

Taste

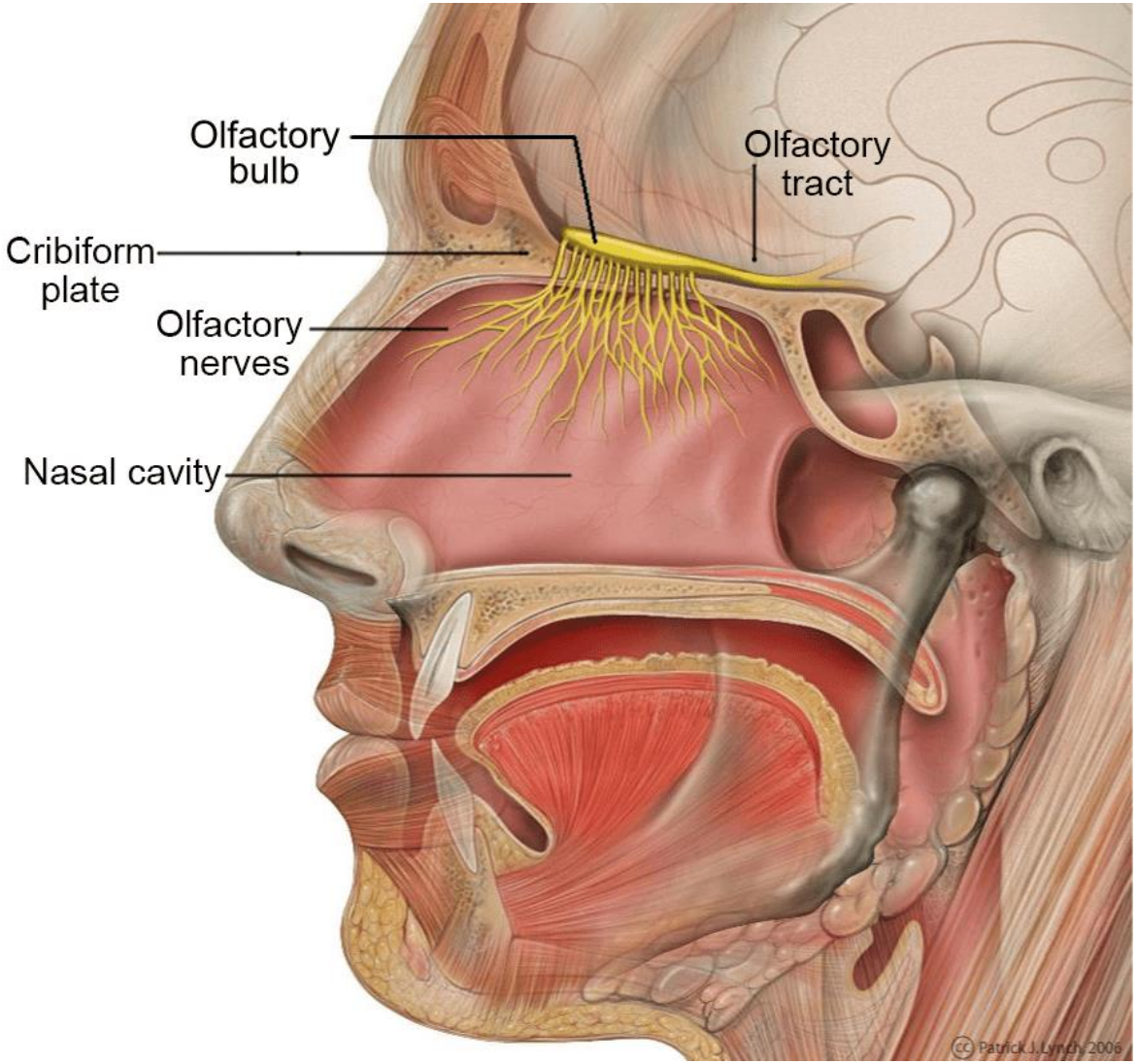
Hearing

Vision

- Receptors are anatomically distinct from one another
- Concentrated in specific locations in the head

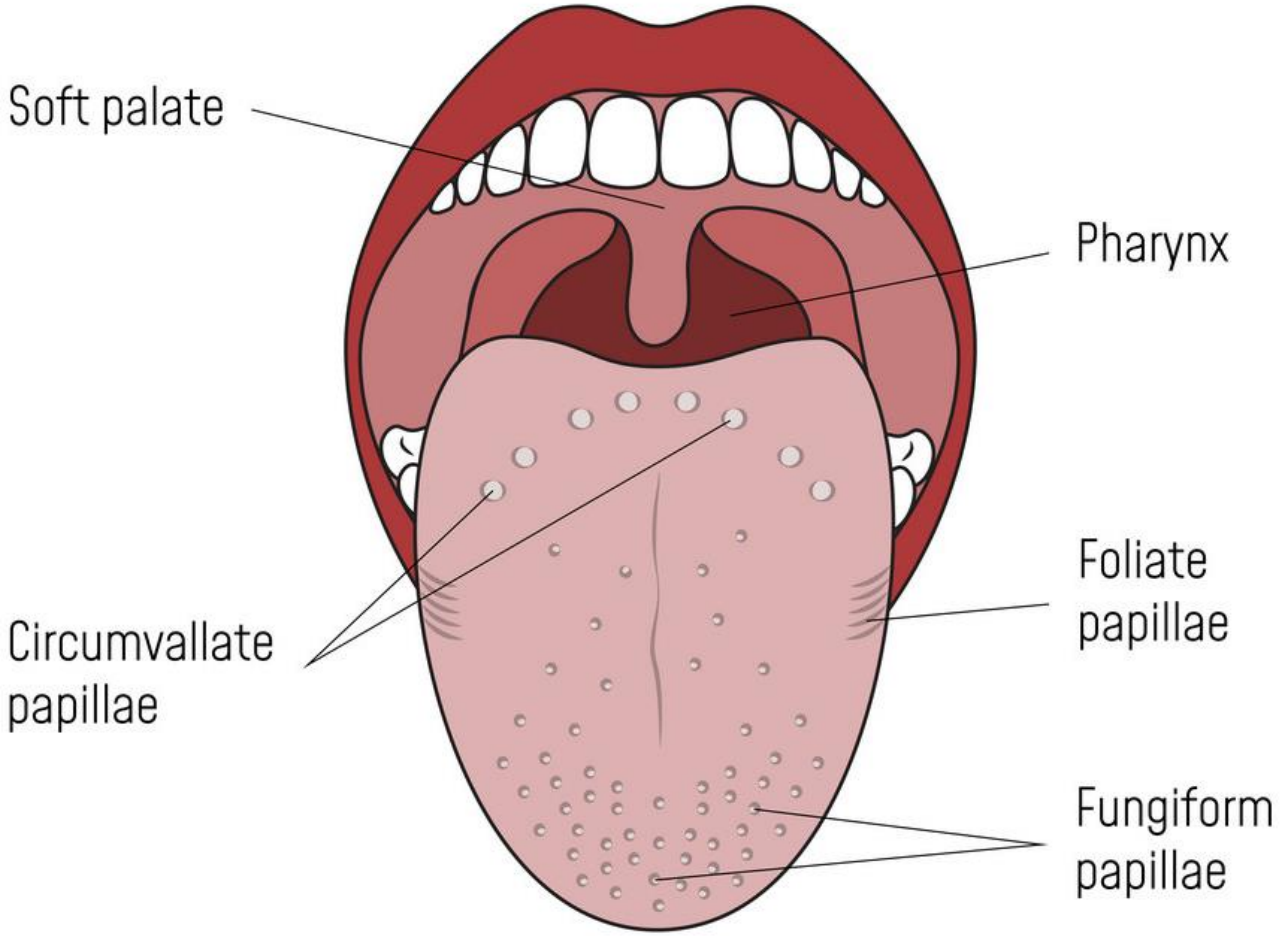
Smell (Olfaction)

- Olfaction is the process of perceiving smells
- Cranial nerve I



Taste (Gustatory)

- Most taste buds found on the tongue in elevated projections called papillae
  - Sour, sweet, bitter (most sensitive) or salty

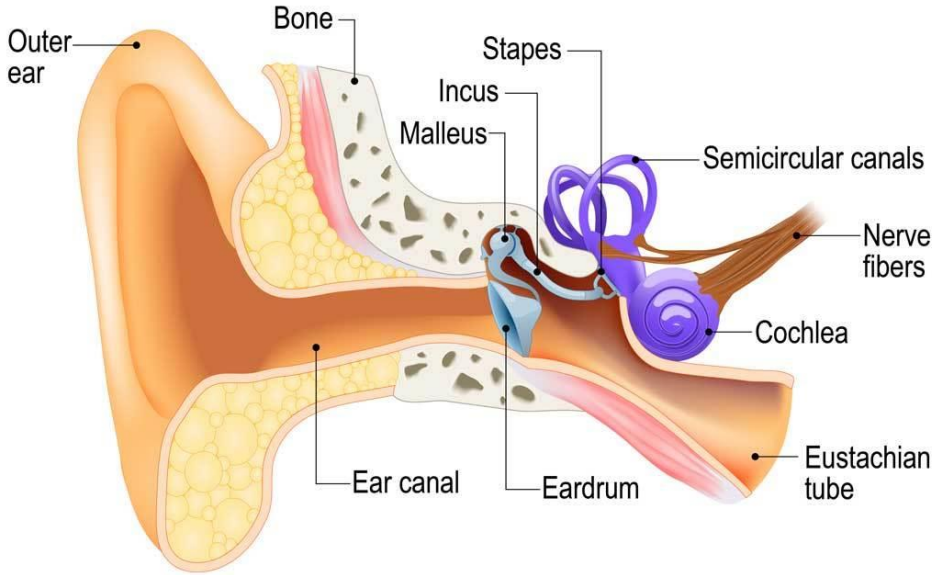


Olfaction and Taste

- Olfaction is the process of perceiving smells. Smell and taste are brought about through the interpretation of chemicals present in the environment
  - Olfactory and gustatory (taste) impulses travel not only to the cerebral cortex, but also to the limbic system
    - This is why we can have emotional responses and trigger strong memories to certain smells and tastes
    - Gustation and olfaction work together but olfaction is much stronger/more sensitive (when someone has a cold it is difficult to taste food)

Hearing

- Dual function
  - Hearing
  - Sense of Balance or equilibrium
    - Static equilibrium
      - Position of head relative to gravity
    - Dynamic equilibrium
      - During rotation or movement



Vision

- Includes:
  - Eyes
  - Accessory structures (lids, lashes and brows, lacrimal glands)
  - Optic nerve, tract and pathways
- Second cranial nerve (optic nerve)
- Third cranial nerve (oculomotor nerve)