

What is the endocrine system?

The endocrine system uses hormones and glands to control the body's functions. Hormones are chemical messengers that travel through the bloodstream to target organs and tissues.

The endocrine system includes the hypothalamus, pituitary gland, thyroid gland, parathyroid glands, adrenal glands, and the reproductive glands.

The hypothalamus and pituitary gland are the primary glands of the endocrine system.

Doctor 022



The hypothalamus and pituitary gland

The hypothalamus is a small region of the brain that controls the body's internal organs and functions. It is the master gland of the endocrine system.

The pituitary gland is a small gland located below the hypothalamus. It is the master gland of the endocrine system and controls the function of the thyroid gland, the adrenal glands, and the reproductive glands.

Thyroid

The thyroid gland is a butterfly-shaped gland located in the neck. It produces hormones that regulate the body's metabolism.

Heart

The heart is a muscular organ that pumps blood throughout the body. It is controlled by the autonomic nervous system.

Pineal gland

The pineal gland is a small gland located in the brain. It produces melatonin, a hormone that regulates the body's sleep-wake cycle.

Thyroid and parathyroids

The thyroid gland is a butterfly-shaped gland located in the neck. It produces hormones that regulate the body's metabolism. The parathyroid glands are four small glands located on the thyroid gland. They produce parathyroid hormone, which regulates the body's calcium levels.

Digestive system

The digestive system is the system of organs that break down food into nutrients that the body can use. It includes the mouth, esophagus, stomach, and intestines.

Physiology

Sheet no.17

The endocrine system and hormones

The endocrine system is a network of glands that produce and secrete hormones. These hormones travel through the bloodstream to target organs and tissues, where they regulate various physiological processes.



Action of hormones

Hormones act on target organs by binding to specific receptors on the cell surface or entering the cell and binding to intracellular receptors.



Function of insulin

Insulin is a hormone that regulates the body's blood sugar levels. It is produced by the beta cells of the pancreas. Insulin allows glucose to enter the cells, where it is used for energy.

Reproductive organs

The reproductive system is responsible for the production and development of offspring. It includes the testes in males and the ovaries in females.

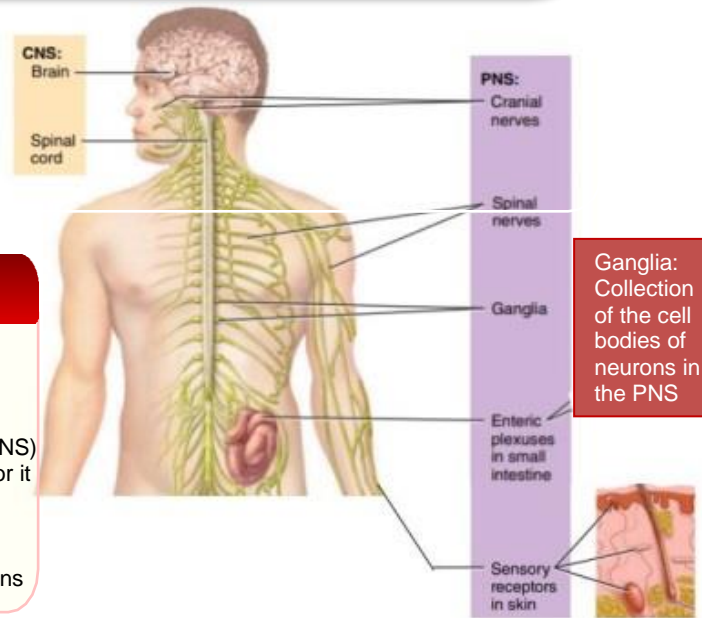


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INTRODUCTION TO NEUROPHYSIOLOGY

OUTLINE:

- i. Organization, subdivisions and functions of the nervous system (NS)
- ii. Sensations and different sensory modalities
- iii. Types of sensory receptors



i. Organization of the nervous system

The Nervous System is divided into:

- i. Central nervous system (CNS):
 - includes the brain and the spinal cord
- ii. Peripheral nervous system (PNS):
 - includes sensory receptors, nerves and ganglia (anything outside CNS)
 - can be subdivided into 3 peripheral systems according to the effector it affects:
 - a) somatic nervous system: affects skeletal muscles
 - b) enteric nervous system: affects GI system
 - c) autonomic nervous system: affects any other internal organs

Functions of the nervous system

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

1. Sensory function

- Sensory receptors detect internal or external stimuli
- The sensory information is carried to the CNS through cranial and spinal nerves
- Most activities of the nervous system are initiated by the sensory experiences that excite sensory receptors
- These sensory experiences can either:
 - cause immediate reactions from the brain

or

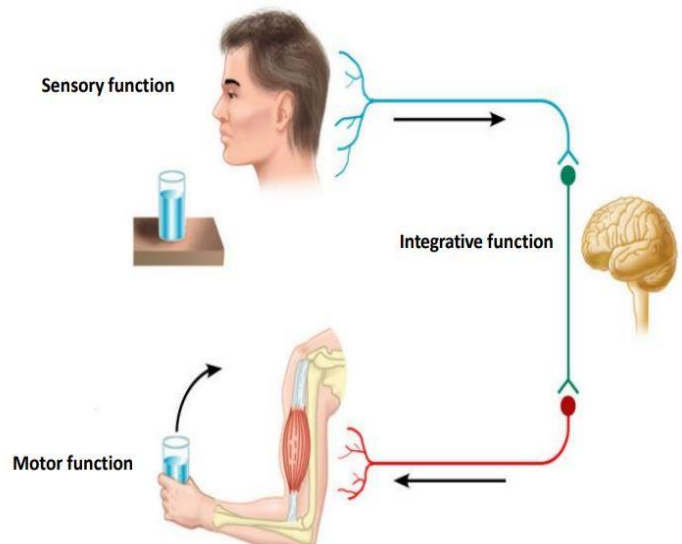
 - memories of the experiences can be stored in the brain for minutes, weeks or years and determine bodily reactions at some future date

2. Integrative function

- Process sensory information by analyzing it and making decision for appropriate responses
- More than 99% of the sensory information is discarded by the brain as irrelevant and unimportant
- When important sensory information excites the mind, it is immediately channeled into proper integrative and motor regions of the brain to cause desired responses
- This channeling and processing of information is called integrative function of the nervous system

3. Motor function

- Activation of effectors (muscles and glands) through cranial and spinal nerves
- The most important eventual role of the nervous system is to **control the various bodily activities**
- This task is achieved by controlling:
 - a. contraction of appropriate skeletal muscles throughout the body
 - b. contraction of cardiac muscles
 - c. contraction of smooth muscle in the internal organs
 - d. secretion of active chemical substances by both exocrine and endocrine glands in many parts of the body
- These activities are collectively called motor functions of the nervous system
- The muscles and glands are called effectors because they are the actual anatomical structures that perform the functions dictated by the nerve signals



STORAGE OF INFORMATION: MEMORY

- Only a small fraction of even the most important sensory information usually causes immediate motor response
- Much of the information is stored for future control of motor activities and for use in the thinking processes
- Most storage occurs in the **cerebral cortex**, but even the basal regions of the brain and the spinal cord can store small amounts of information
- Once memories have been stored in the nervous system, they become part of the brain processing mechanism for future “thinking”
- The thinking processes of the brain compare new sensory experiences with stored memories; the memories then help to select the important new sensory information and to channel this into appropriate memory storage areas for future use or into motor areas to cause immediate bodily responses

MAJOR LEVELS OF CNS FUNCTION

- **Three major levels of the central nervous system have specific functional characteristics:**
 1. The spinal cord level
 2. The lower brain or the subcortical level
 3. The higher brain or the cerebral cortex

1. Spinal Cord

The spinal cord has two main functions:

- Nerve impulse “Action Potential” propagation (sensory and motor tracts):** transmits signals from the periphery of the body to the brain, or in the opposite direction from the brain back to the body.
- Integration of information** (such as in spinal reflexes)

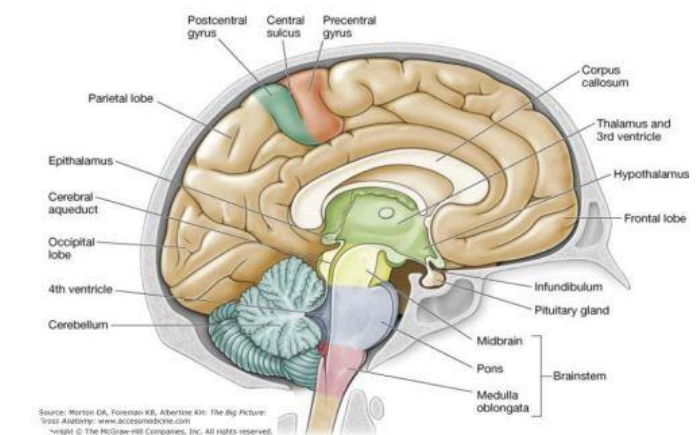
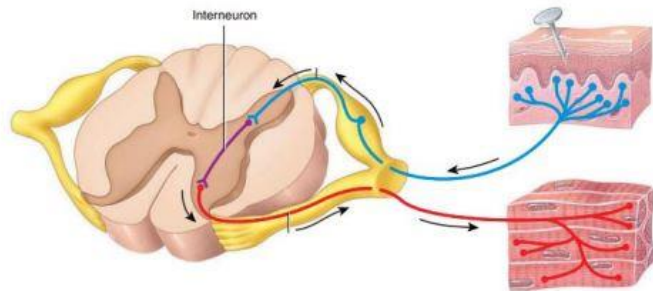
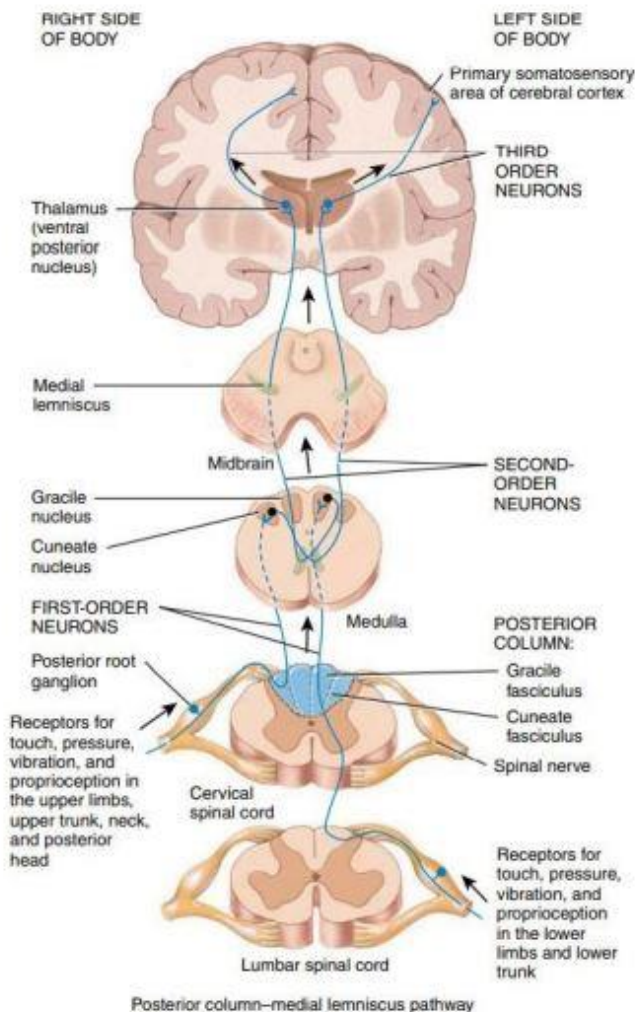


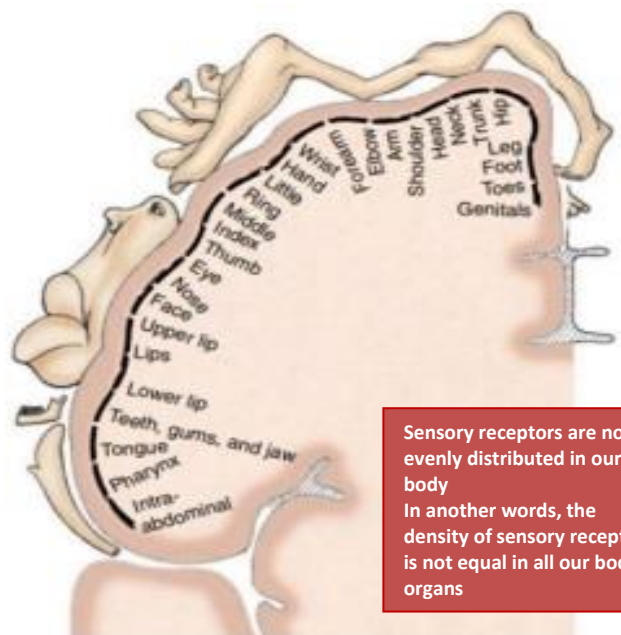
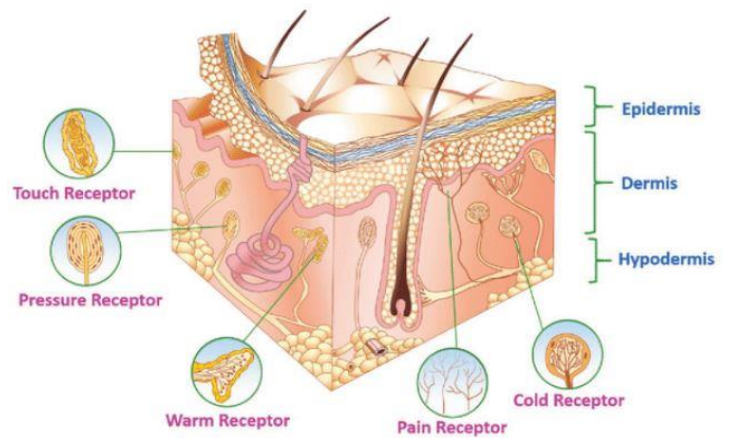
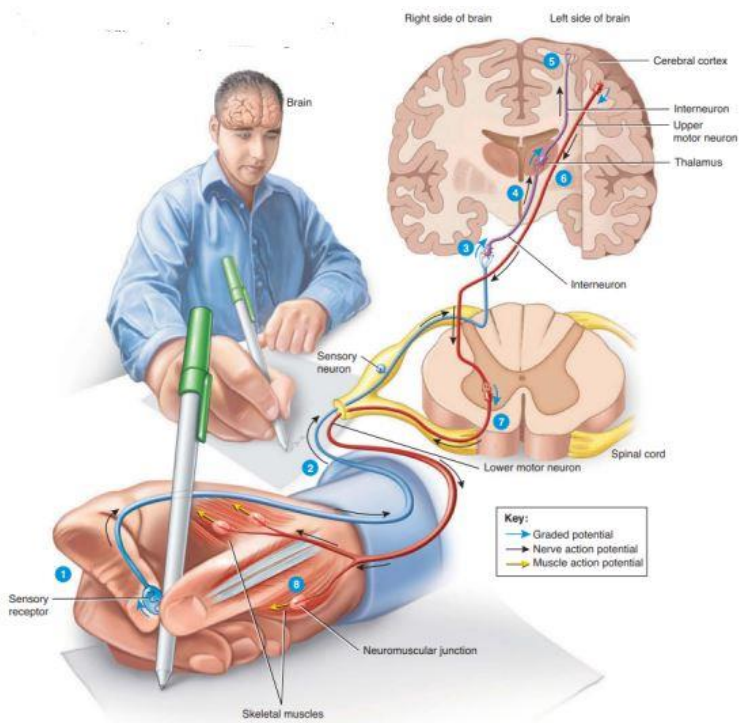
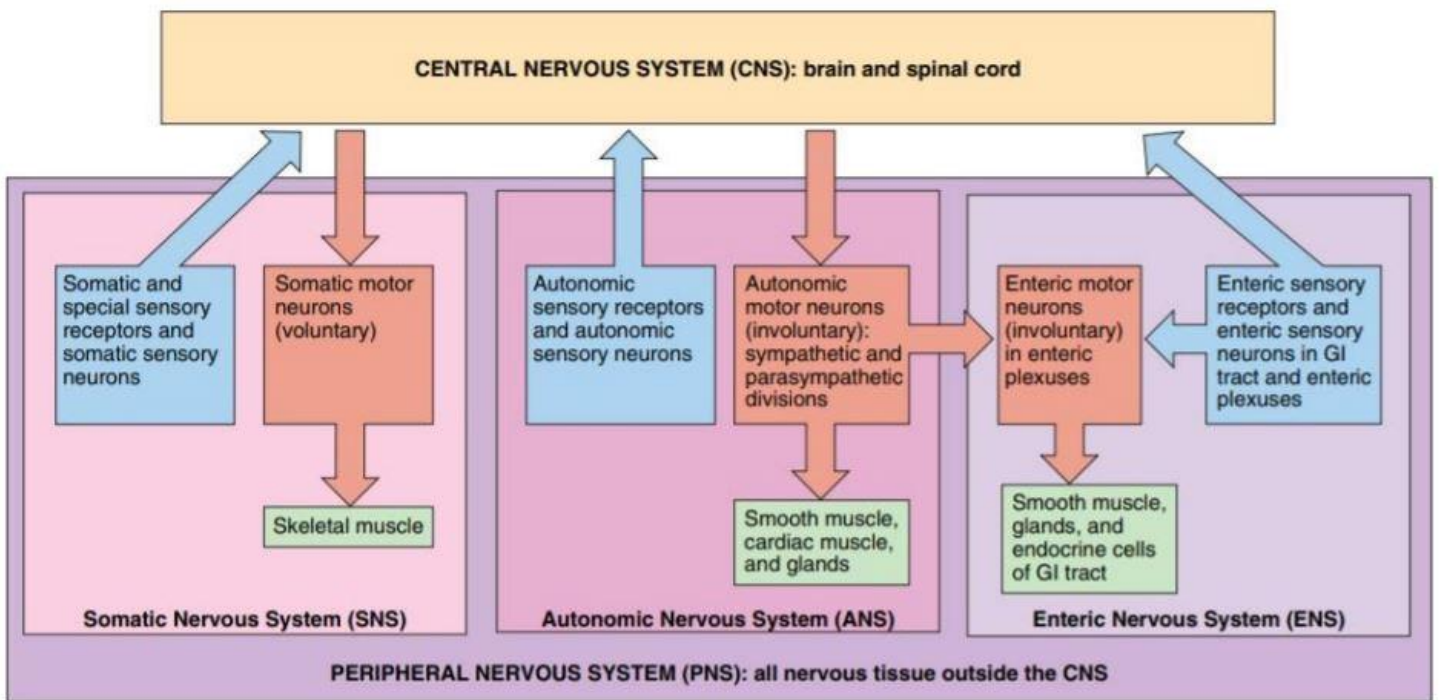
FIGURE: BRAIN (Different locations have different functions)

2. Lower Brain (subcortical regions)

- Many, if not most, of the subconscious activities of the body are controlled in the lower areas of the brain
- Examples of subcortical structures are brain stem, cerebellum, diencephalon, basal nuclei, hippocampus, and amygdala

3. Higher Brain (cerebral cortex)

- Cerebral cortex is an extremely large **memory storehouse**
- Without the cerebral cortex, the functions of the lower brain centers are often imprecise. Cortical information usually converts these functions to determinative and precise operations
- The cerebral cortex is essential for most of our **thought processes**

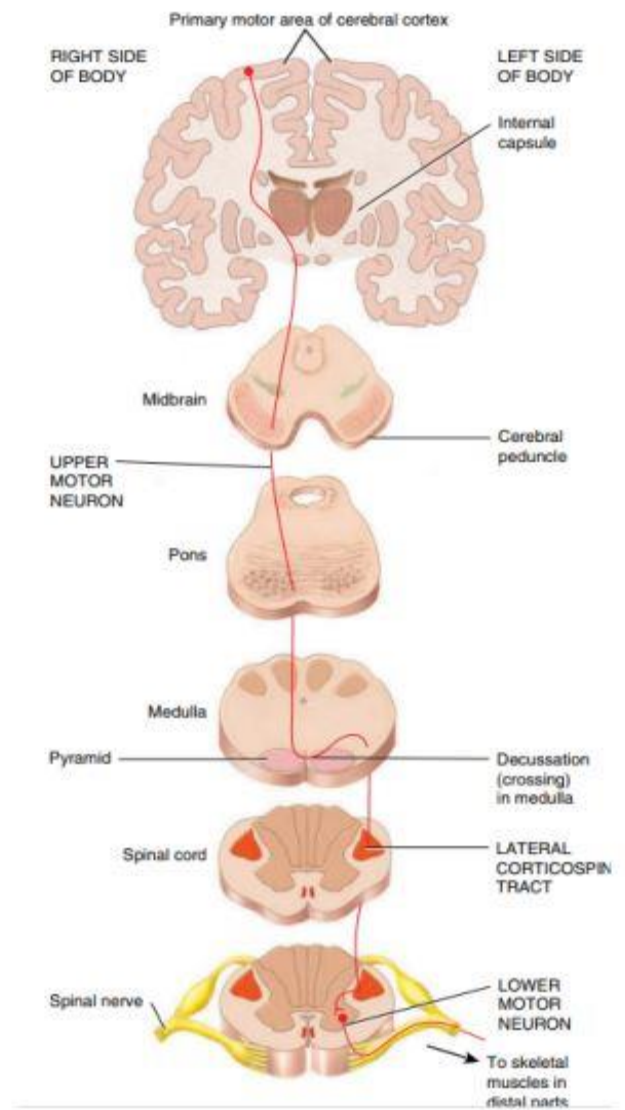
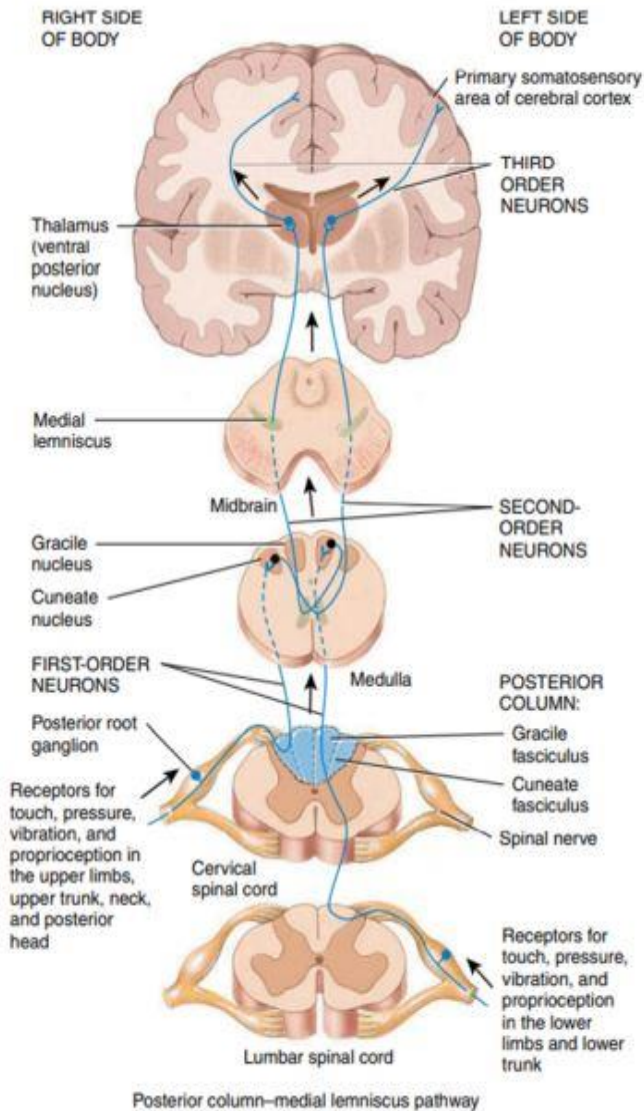


(a) Frontal section of primary somatosensory area in right cerebral hemisphere

REMEMBER:

The functional unit in the nervous system is the **Neuron (=Nerve fiber=Nerve cell)**
 The neuron is stimulated by certain stimuli which will cause an action potential (electricity) and communicates with other neurons **chemically** by **neurotransmitters**

Sensory receptors are not evenly distributed in our body
 In another words, the density of sensory receptors is not equal in all our body organs

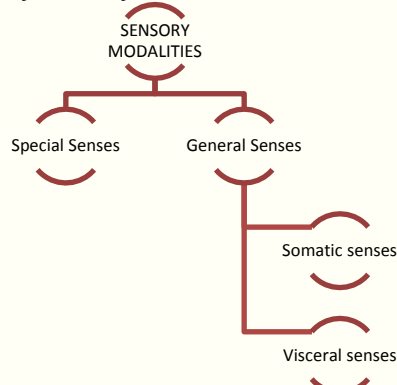


ii. Sensations and different sensory modalities

- **Sensation** is the conscious or subconscious awareness of changes in the external or internal environment
- When sensory impulses reach the cerebral cortex, we become consciously aware of the sensory stimuli and can precisely locate and identify specific sensations such as touch, pain, hearing, or taste
- **Perception** is the conscious interpretation of sensations and is primarily a function of the **cerebral cortex**

SENSORY MODALITIES

- Each type of sensation that we can experience, such as touch, pain, vision, or hearing, is called a **sensory modality**



1. Special Senses

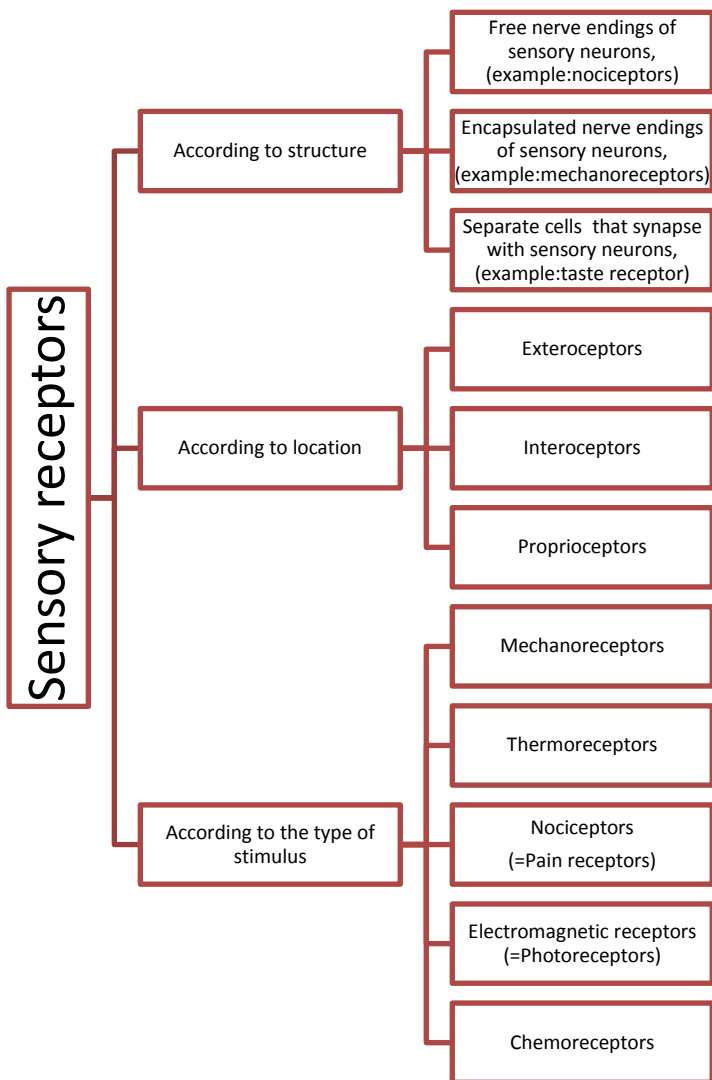
- The special senses include the sensory modalities of smell, taste, vision, hearing, and balance

2. General Senses

- **Somatic senses:**
 - transmit sensory information from the receptors of the entire body surface and from some deep structures
 - They include tactile sensations (touch, pressure, vibration, itch, and tickle), thermal sensations (warm and cold), pain sensations, and proprioceptive sensations (for position and movement)
- **Visceral senses:**
 - provide information about conditions within internal organs such as: pressure, stretch, and temperature

iii. Types of sensory receptors

- Sensory receptors can be grouped into different classes according to:
 - The microscopic structure
 - The location of the receptors and the origin of stimuli that activate the
 - The type of stimulus detected



According to the location

1. Exteroceptors:

- Are located at or near the external surface of the body; they provide information about the external environment
- Examples are the sensations of hearing, vision, smell, taste, touch, pressure, vibration, temperature, and pain

2. Interoceptors (visceroceptors):

- Monitor conditions in the internal environment

3. Proprioceptors:

- Are located in muscles, tendons, joints, and the inner ear
- They provide information about body position, muscle length and tension, and the position and movement of the joints

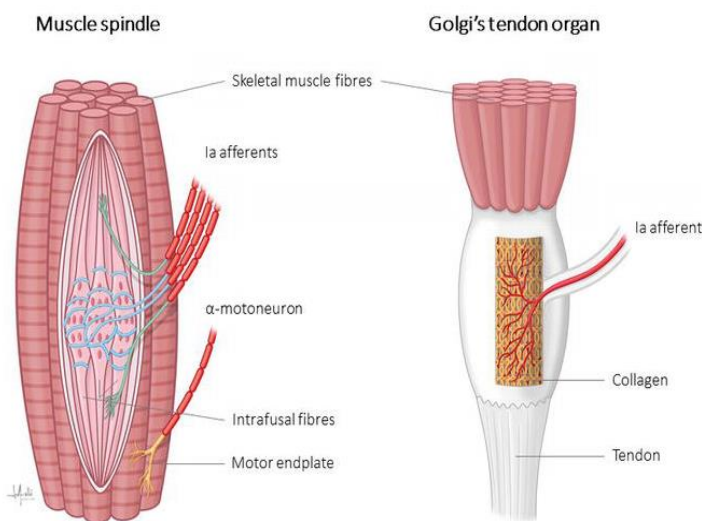
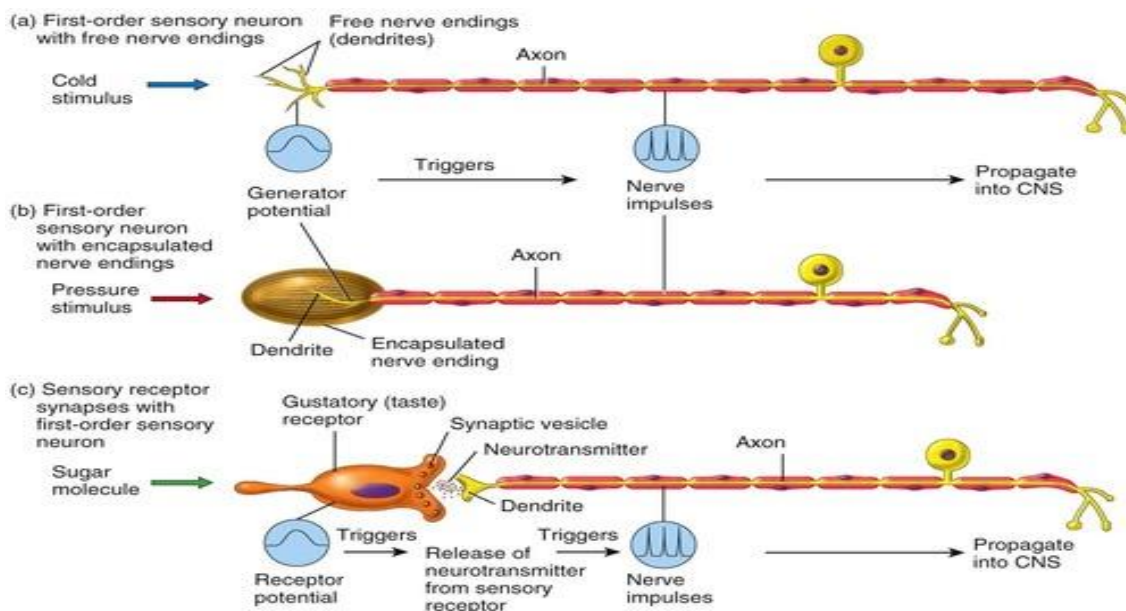


FIGURE: PROPRIOCEPTORS LOCATED IN MUSCLES AND TENDONS

According to the structure



Review Questions

- 1) **What is the function of sensory receptors?**
 - a) To analyze sensory information
 - b) To initiate motor responses
 - c) To detect internal or external stimuli
 - d) To control skeletal muscle contraction
- 2) **How is sensory information carried to the CNS?**
 - a) Through smooth muscles in the internal organs
 - b) Through cranial and spinal nerves
 - c) Through sensory receptors
 - d) Through exocrine and endocrine glands
- 3) **What percentage of sensory information is discarded by the brain?**
 - a) 99%
 - b) 90%
 - c) 50%
 - d) 10%
- 4) **What happens to important sensory information that excites the mind?**
 - a) It is discarded by the brain
 - b) It is stored in the brain for future use
 - c) It is immediately channeled into proper integrative and motor regions of the brain
 - d) It is processed by endocrine and exocrine glands
- 5) **Which of the following is not part of the motor function of the nervous system?**
 - a) Contraction of smooth muscles in the internal organs
 - b) Contraction of appropriate skeletal muscles throughout the body
 - c) Secretion of active chemical substances by glands
 - d) Sensory receptors detecting internal or external stimuli
- 6) **What are the actual anatomical structures that perform the functions dictated by nerve signals?**
 - a) Sensory receptors
 - b) Integrative regions of the brain
 - c) Effectors
 - d) None of the above
- 7) **What is the eventual role of the nervous system?**
 - a) To control bodily activities
 - b) To process sensory information
 - c) To detect internal or external stimuli
 - d) None of the above
- 8) **What is the role of sensory experiences in the nervous system?**
 - a) They cause immediate reactions from the brain
 - b) They are stored in the brain for future bodily reactions
 - c) Both a and b
 - d) None of the above
- 9) **Which of the following is not an effector in the nervous system?**
 - a) Muscles
 - b) Glands
 - c) Sensory receptors
 - d) None of the above
- 10) **Which part of the brain is responsible for the storage of most information?**
 - a) The brain stem
 - b) The cerebellum
 - c) The hippocampus
 - d) The cerebral cortex

- 11) What is the function of the basal nuclei?**
- To control subconscious activities of the body
 - To help select important new sensory information
 - To process new sensory experiences with stored memories
 - None of the above
- 12) Which of the following is true about the functions of the lower brain centers without the cerebral cortex?**
- They become more precise and determinative
 - They control all conscious thinking processes
 - They are unable to control any subconscious activities of the body
 - They are often imprecise
- 13) What is the purpose of storing sensory information in the nervous system?**
- Immediate motor response
 - Future control of motor activities and thinking processes
 - To forget irrelevant information
 - To block new sensory experiences
- 14) One of the major functions of the spinal cord is nerve impulse propagation which means:**
- To control most of our thought processes
 - To store memories
 - To transmit signals from the brain to the body only
 - To transmit signals from the periphery of the body to the brain or vice versa
- 15) Which of the following is not a role of the cerebral cortex?**
- To control subconscious activities of the body
 - To store information for future use
 - To convert imprecise functions of the lower brain into precise operations
 - None of the above
- 16) What is the difference between sensation and perception?**
- Sensation is the interpretation of sensory stimuli, while perception is the response to internal stimuli
 - Sensation is the response to internal stimuli, while perception is the interpretation of sensory stimuli
 - Sensation is the transmission of sensory information to the brain, while perception is the conscious or subconscious awareness of changes in the environment
 - Sensation is the conscious or subconscious awareness of changes in the environment, while perception is the conscious interpretation of sensations
- 17) Which part of the brain is primarily responsible for the conscious interpretation of sensations?**
- Cerebellum
 - Medulla oblongata
 - Cerebral cortex
 - Thalamus
- 18) Which type of sensation provides information about conditions within internal organs?**
- Tactile sensations
 - Thermal sensations
 - Proprioceptive sensations
 - Visceral sensations
- 19) Which type of general sense transmits sensory information from the receptors of the entire body surface and some deep structures?**
- Somatic senses
 - Visceral senses
 - Special senses
 - None of the above
- 20) Which of the following is not a type of sensory receptor according to their structure?**
- Free nerve endings of sensory neurons
 - Encapsulated nerve endings of sensory neurons
 - Separate cells that synapse sensory neurons
 - Interstitial receptor

ANSWERS: 11-A|12-D|13-B|14-D|15-A|16-D|17-C|18-D|19-A|20-D

21) What kind of information do interoceptors provide?

- a) Information about the external environment
- b) Information about body position, muscle length and tension, and the position and the movement of the joints
- c) Information about the conditions in the internal environment
- d) Information about the sense of smell and taste

22) Proprioceptors are located in:

- a) Muscles and tendons
- b) Skin and hair follicles
- c) Bones and cartilage
- d) None of the above

23) Which of the following is an example of separate cells that synapse sensory neurons?

- a) Gustatory(taste) receptors
- b) Interoceptors
- c) Nociceptors
- d) Mechanoreceptors

24) Which of the following is not a type of receptor based on location?

- a) Exteroceptors
- b) Interoceptors
- c) Proprioceptors
- d) Mechanoreceptors

25) Pain receptors are of which type of receptors based on structure?

- a) Exteroceptors
- b) Free nerve endings of sensory neurons
- c) Mechanoreceptors
- d) Encapsulated nerve endings of sensory neurons

ANSWERS: 21-C|22-A|23-A|24-D|25-B