OptiHealth Institute

Med-Fit Tech Assistant Course

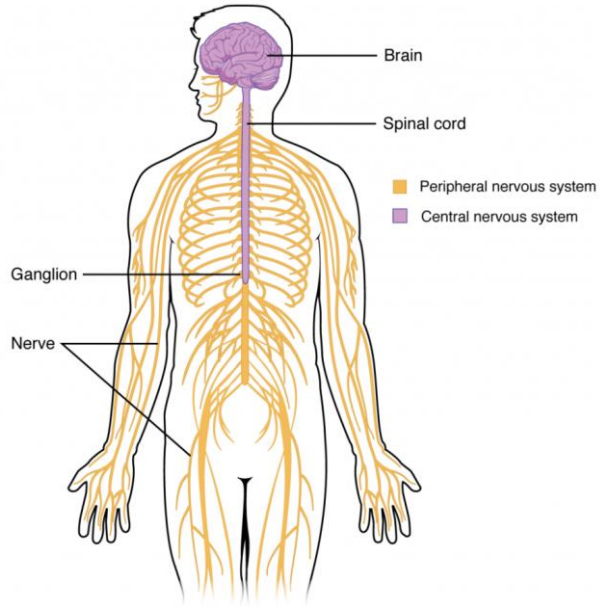
Learning Module #3

The Neuro-Muscular System

Part A: The Nervous System

The Nervous System can be divided **anatomically** into 2 major sub-systems:

- **Central Nervous System** (CNS) includes the **brain** (the nervous tissue contained within the cranium), and the **spinal cord** (an extension of that nervous tissue within the vertebral column).
- The **Peripheral Nervous System** (PNS) includes all the **nerves** (the nervous tissue that extends out from the brain and spinal cord to the rest of the body) distal to the cranium and vertebral column.

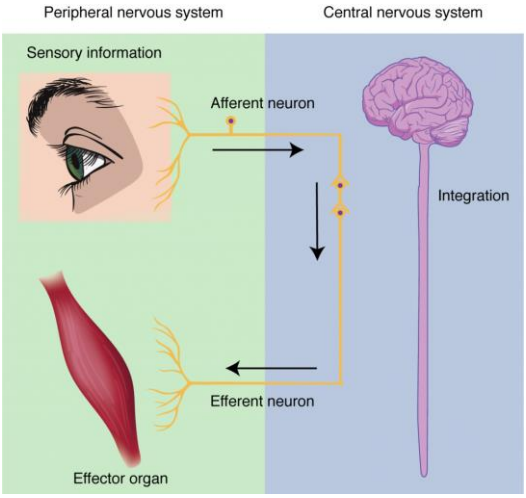


The CNS includes the brain and spinal cord.
The PNS includes all the nerves nerves.

The Nervous System can also be divided **functionally** into 3 major sub-systems:

- **Sensory Function** involves the receiving of sensory information, which is detected and transmitted by the **Afferent** (sensory) branch of the **PNS** to the CNS.
    - Specific and often highly specialized sensory receptors are responsible for detecting **different stimuli**, such as: sight, sound, touch, taste, smell, balance, movement, temperature, pain, and body position (proprioception).
    - Sensory signals from the skin, skeletal muscles, and joints are transmitted by the PNS to the CNS using **somatic sensory neurons**.
    - Sensory signals in the blood vessels, smooth muscle, and internal organs are transmitted by the PNS to the CNS using **visceral sensory neuron**s.
- **Response Function** involves the sending of motor information, which is generated by the CNS and transmitted by the **Efferent** (motor) branch of the PNS to the effector organs (skeletal and smooth muscles and glandular tissues).
    - Effector signals to skeletal muscles are transmitted by **somatic motor neurons**.
    - Effector signals to cardiac, smooth muscles, and glandular tissues are transmitted by **autonomic motor neurons**.
    - Voluntary responses are transmitted by **somatic** motor neurons, and involuntary responses are transmitted by **autonomic** motor neurons.

- **Integration Function** takes place in the CNS and involves the **interpretation** of the sensory signals received by way of the **afferent** branch of the PNS and the **generation** of an appropriate response signal activated by motor neurons and transmitted to the effector organ by way of the **efferent** branch of the PNS.

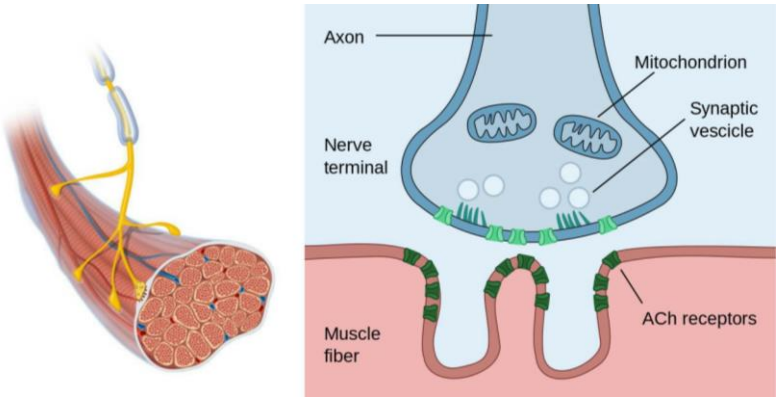


Sensory signals from the periphery are transmitted by afferent neurons to the CNS for integration. The CNS then generates a response and transmits **motor** signals by efferent neurons to the effector organs.

The Neuro-Muscular Junction

The process of muscle contraction begins at the site where a **motor neuron**'s terminal meets the **muscle fiber** - called the **neuromuscular junction** (NMJ). Every skeletal muscle fiber in every skeletal muscle is innervated by a motor neuron at a NMJ. Excitation signals from the motor neuron are the only way to functionally activate skeletal muscle fibers to contract.

- The axon terminal of a somatic motor neuron has vesicles containing a neurotransmitter called **acetylcholine** (ACh).
- The nerve signal releases the ACh into the synaptic cleft (the microscopic space between the somatic motor neuron and the muscle cell membrane (sarcolemma).
- The released ACh diffuses across the synaptic cleft and occupies cholinergic receptors on the membrane (sarcolemma) of the muscle fiber, which triggers the fiber to contract.
- ACh is eliminated by a degrading enzyme called acetylcholinesterase.



The Neuromuscular Junction

Motor Units - The contraction of skeletal muscle fibers is triggered by signaling from a motor neuron. Each muscle fiber is innervated by only one motor neuron, but a single motor neuron can innervate multiple muscle fibers. A **motor unit** consists of a single motor neuron and all of the muscle fibers that are innervated by it.