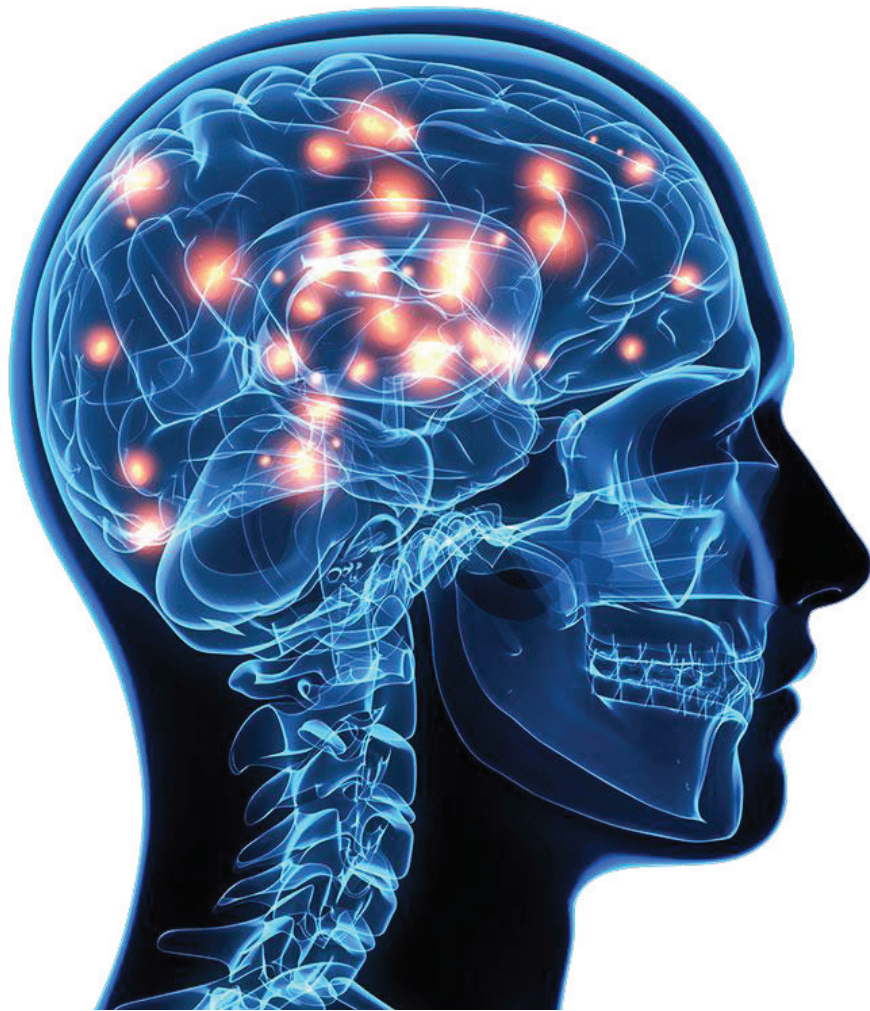


# NEURAL CONTROL AND COORDINATION



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# NEURAL CONTROL AND COORDINATION

## Human Nervous System

- Central Nervous System
- Peripheral Nervous System

**Coordination:** Coordination is the process through which two or more organs interact and complement the function of each other.

**The endocrine system:** Neural system provides an organized network of point-to-point connection for quick coordination. The endocrine system provides chemical integration through hormones.

**Neural system:** Neural system of animals is composed of specialized cells called neuron, which can detect, receive, and transmit different kinds of stimuli. In hydra neural system is composed of network of neuron. In insects it consists of brain and a number of ganglia. Vertebrates have highly developed neural system.

**Central nervous system (CNS):** Central nervous system (CNS) includes brain and spinal cord. It is the site for information processing and control.

**Peripheral nervous system:** Peripheral nervous system includes all nerves associated with CNS.

**There are two types of nerve fibers:**

**Afferent fibers:** Afferent fibers transmit impulses from tissue/ organ to CNS.

**Efferent fibers:** Efferent fibers transmit regulatory impulses from CNS to concerned peripheral organs.

**Peripheral nervous system are divided in two parts:**

- Somatic neural system
- Autonomic neural system

**Somatic neural system and Autonomic neural system:** Somatic neural systems relay impulses from CNS to skeletal muscles. Autonomic neural system transmits impulses from CNS to involuntary system and smooth muscles.

**Autonomic neural system:**

- Sympathetic
- Parasympathetic

## Neuron as Structural and Functional Unit of Neural System

Neuron is made up of three major parts- cell body, dendrite and axon.

Cell body contains cytoplasm, cell organelles and Nissl's granules. Short fibers projecting out from cell body is called dendrites. The axon is long fiber having branched structure at the end that terminates into knob like structure called

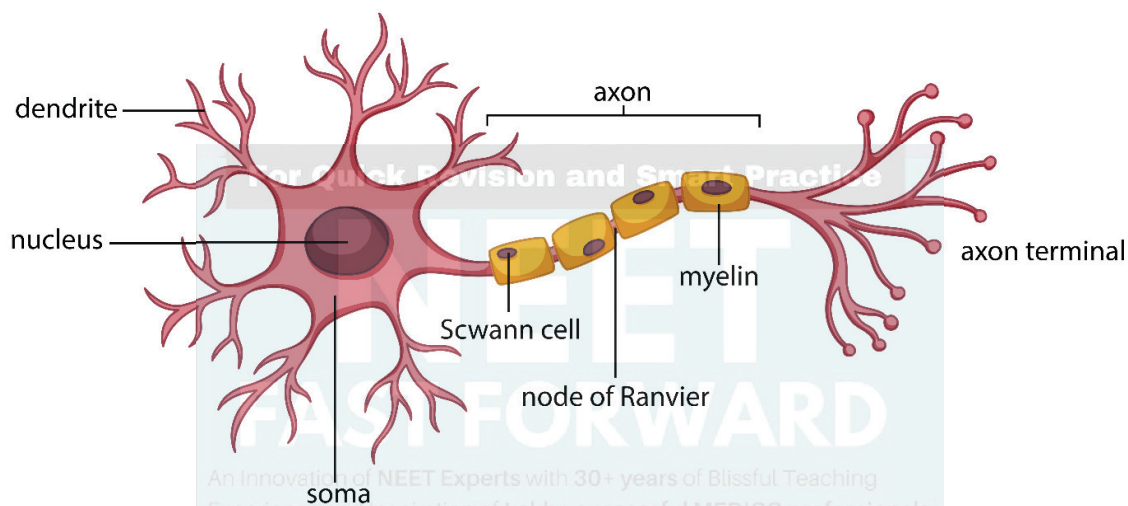
synaptic knob.

**Based on number of axon and dendrites neuron are of three types:**

- **Multipolar:** One axon and two or more dendrite found in cerebral cortex.
- **Bipolar:** One axon and one dendrite found in retina of eyes.
- **Unipolar:** Cell body with only one axon found in embryonic stage.

**There are two types of axon:**

- **Myelinated:** Fibers are enveloped with Schwann cells to form myelin sheath around the axon. The gap between two myelin sheaths is called nodes of Ranvier. Found in spinal and cranial nerves.
- **Unmyelinated:** Fiber is enclosed by Schwann cells that do not form myelin sheath around the axon. Found in autonomous and somatic neural system.



## Generation and Conduction of Nerve Impulse

- Ion channels are present in neural membrane which is selectively permeable to different ions. When neuron is not conducting impulse (resting), axonal membrane is more permeable to  $K^+$  ions and impermeable to  $Na^+$  ions.
- Ionic gradient across the resting membrane is maintained by active transport of ions by sodium-potassium pump. This will develop positive charge outside the axonal membrane and negative charge on inner side.
- The electrical potential difference across the resting membrane is called resting potential.
- When stimulus is applied at site A, the membrane becomes permeable to  $Na^+$  ions to make rapid influx of  $Na^+$  ions to create outer surface negatively charged and inner membrane positively charged that create Action Potential or nerve impulse.
- The nerve impulse from A moves to B in inner surface and B to A on outer surface. This process is repeated several times to transmit the impulse.
- Nerve impulse is transmitted from one neuron to another neuron through

synapse.

### There are two types of synapses:

- **Electrical synapse:** The membrane of pre and post synaptic neuron is very close to each other and current flow directly from one neuron to another.
- **Chemical synapse:** Pre and post synaptic neuron is separated by fluid filled space called synaptic cleft. Neurotransmitters are involved in transmission of impulses.

### Central Neural System:

Brain is the central information processing organ of our body and act as command-and-control center. Human brain is protected by skull (cranium) and three layers of cranial meninges- outer dura mater, middle arachnoid, and inner pia mater.

Brain can be divided 3 parts- forebrain, midbrain, and hindbrain. Forebrain consists of cerebrum, thalamus, and hypothalamus. Cerebrum is divided into left and right cerebral hemispheres which are covered by cerebral cortex (grey matter). Cerebral cortex contains sensory neuron, motor neuron and association area. Association area controls complex functions like intersensory associations, memory, and communication.

Thalamus- cerebrum wraps around a structure called thalamus. It is a major coordinating center for sensory and motor signaling. Hypothalamus controls the urge for eating, drinking and body temperature. They also release hypothalamic hormones. Limbic system is involved in controlling sexual behavior and expression of emotional reactions. Midbrain is located between hypothalamus and pons of hindbrain. Dorsal portion consists of four round lobes called corpora quadrigemina. They are involved in relay of impulses back and forth between cerebrum, cerebellum, pons, and medulla. Hind brain consists of pons, medulla oblongata and cerebellum.

The medulla contains centers which control respiration, cardiovascular reflexes, and gastric secretions. Cerebellum controls balance and posture. Reflex action is a spontaneous autonomic mechanical response to a stimulus without the will of the organism. It is controlled by spinal cord. The afferent neuron receives the signal from sensory organs and transmits the impulse to CNS. The efferent neuron carries the impulse from CNS to effector. Ex- knee-jerk reflex. The path followed by reflex action is called reflex arc.



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