

# Control & Coordination



## Lecture Notes on Control and Coordination in Animals (Class 10, NCERT)

### Nervous System

The nervous system in animals is responsible for receiving, processing, and transmitting information throughout the body. It enables coordination between different body parts and allows animals to respond to their environment.

### Structure and Function of Neurons

- **Neurons:** Neurons are the basic functional units of the nervous system. They are specialized cells that transmit nerve impulses.
  - **Cell Body (Soma):** Contains the nucleus and cytoplasm. It maintains the cell's health and carries out metabolic activities.
  - **Dendrites:** Branch-like structures that receive signals from other neurons and convey this information to the cell body.
  - **Axon:** A long, thread-like structure that transmits impulses away from the cell body to other neurons or muscles. The axon may be covered with a myelin sheath, which insulates and speeds up signal transmission.
  - **Axon Terminals:** The endpoints of an axon where the transmission of signals to the next neuron or muscle cell occurs.

### Mechanism of Nerve Impulse Transmission

- **Resting Potential:** A neuron at rest has a voltage across its membrane called the resting potential, typically around  $-70\text{mV}$ . This is due to the differential distribution of ions, with more sodium ions ( $\text{Na}^+$ ) outside the cell and more potassium ions ( $\text{K}^+$ ) inside.
- **Action Potential:** When a neuron is stimulated, sodium channels open, allowing  $\text{Na}^+$  to rush into the cell, causing depolarization. If the depolarization reaches a threshold, an action potential is generated, propagating along the axon.
- **Repolarization:** Following depolarization, potassium channels open, allowing  $\text{K}^+$  to flow out of the cell, restoring the negative charge inside (repolarization).
- **Refractory Period:** After an action potential, the neuron undergoes a brief refractory period during which it cannot generate another action potential, ensuring the unidirectional flow of nerve impulses.

### Synapse and Neuromuscular Junction

- **Synapse:** The junction between two neurons where information transfer occurs. It consists of:
  - **Presynaptic Neuron:** The neuron sending the signal.
  - **Synaptic Cleft:** The small gap between the neurons.
  - **Postsynaptic Neuron:** The neuron receiving the signal.
- **Transmission Process:** When an action potential reaches the axon terminal, it triggers the release of neurotransmitters into the synaptic cleft. These chemicals bind to receptors on the

postsynaptic neuron, generating a new action potential in that neuron.

- **Neuromuscular Junction:** A specific type of synapse where a motor neuron communicates with a muscle fiber, causing muscle contraction.

## Central Nervous System (CNS)

The CNS includes the brain and spinal cord, responsible for processing and sending out signals to the body.

### Structure and Function of the Brain

- **Brain:** The control center of the body, responsible for processing sensory information, regulating bodily functions, and facilitating thought and memory.
  - **Fore-brain:** Includes the cerebrum, thalamus, and hypothalamus.
    - **Cerebrum:** The largest part of the brain, divided into two hemispheres. It controls voluntary activities, sensory perception, and higher mental functions like thinking and memory.
    - **Thalamus:** Acts as a relay station for sensory information.
    - **Hypothalamus:** Regulates homeostasis, including temperature, hunger, and thirst.
  - **Mid-brain:** Involved in vision, hearing, motor control, sleep/wake cycles, and arousal.
  - **Hind-brain:** Includes the cerebellum, pons, and medulla oblongata.
    - **Cerebellum:** Coordinates voluntary movements and maintains posture and balance.
    - **Pons:** Connects different parts of the brain and is involved in facial expressions and sleep regulation.
    - **Medulla Oblongata:** Controls vital involuntary functions like heart rate, breathing, and blood pressure.

### Role of Spinal Cord

- **Spinal Cord:** A long, cylindrical structure extending from the brainstem down the vertebral column.
  - **Functions:** Transmits signals between the brain and the rest of the body. It also coordinates reflex actions through reflex arcs.
  - **Structure:** Composed of white matter (myelinated nerve fibers) and gray matter (nerve cell bodies and dendrites).

### Key Points

- The nervous system enables animals to detect and respond to environmental changes.
- Neurons are the basic units, transmitting electrical impulses.
- Nerve impulses are generated and propagated through action potentials and synaptic transmission.
- The CNS, comprising the brain and spinal cord, processes information and coordinates responses.
- The brain's regions (fore-brain, mid-brain, hind-brain) have distinct functions essential for overall body regulation.
- The spinal cord plays a critical role in signal transmission and reflex actions.