

Chapter 3: Coordination and Control

Complete Sindh Textbook Board curriculum notes covering nervous system, human brain, spinal cord, reflex actions, endocrine glands, and feedback loops.

Introduction to Coordination



Nervous Coordination

Fast-acting electrochemical impulses transmitted via nerve cells (neurons) for rapid responses to environmental changes.



Chemical Coordination

Slower, long-lasting hormonal secretions transported through the bloodstream by endocrine glands to regulate body functions.



Components of Pathway

- **Stimulus:** Change in environment.
- **Receptors:** Detectors (sense organs).
- **Effectors:** Muscles or glands.

Structure of a Neuron

Functional Unit

● Cell Body (Soma)

Contains nucleus and cytoplasm. Directs metabolic activity and protein synthesis for the neuron.

└─ Dendrites

Short, branching cytoplasmic processes that receive electrochemical impulses from other neurons and convey them inward.

→ Axon

Long single fiber carrying nerve impulses away from the cell body toward effectors or neighboring neurons.

🛡️ Schwann Cells & Myelin

Insulating fatty sheath accelerating impulse transmission via Nodes of Ranvier.

Types of Neurons

Classification



Sensory Neurons

Transmit nerve impulses from sense organs (receptors) to the central nervous system (brain and spinal cord).



Interneurons (Relay)

Located entirely within the CNS. Process incoming sensory information and formulate appropriate motor responses.



Motor Neurons

Carry impulses away from the CNS to specific effectors (muscles or glands) to execute action.

Central vs. Peripheral Nervous System

Central Nervous System (CNS)

- **Brain:** Ultimate control center protected by skull and meninges.
- **Spinal Cord:** Tubular bundle of nervous tissue running through vertebral column.
- **Function:** Integration, processing, and coordination of neural signals.

Peripheral Nervous System (PNS)

- **Cranial Nerves:** 12 pairs originating directly from the brain.
- **Spinal Nerves:** 31 pairs branching out from the spinal cord.
- **Subdivisions:** Somatic (voluntary) and Autonomic (involuntary) systems.

Regions of the Human Brain

Forebrain, Midbrain, Hindbrain

FOREBRAIN

Cerebrum & Thalamus

Largest region. Controls thought, memory, reasoning, voluntary muscle movement, and sensory interpretation. Hypothalamus manages body temperature and hunger.

MIDBRAIN

Visual & Audio Relay

Small region acting as a relay station connecting forebrain with hindbrain, processing auditory and visual reflex information.

HINDBRAIN

Cerebellum, Pons, Medulla

Cerebellum maintains balance and posture. Medulla oblongata regulates vital involuntary actions like heartbeat, breathing, and blood pressure.

Reflex Action & Reflex Arc

Immediate Protection

⚡ Reflex Action Pathway

- **Receptor:** Detects stimulus (e.g., heat on finger).
- **Sensory Neuron:** Carries impulse to spinal cord.
- **Interneuron:** Relays signal inside grey matter.
- **Motor Neuron:** Transmits impulse to muscle.
- **Effector:** Muscle contracts instantly to withdraw hand.

🛡️ Significance of Reflexes

- Bypasses conscious brain processing for ultra-fast reaction.
- Prevents severe injury from sudden environmental hazards.
- Automatic and stereotyped response pattern.

Major Endocrine Glands & Hormones

Pituitary Gland

Master gland at base of brain. Secretes Growth Hormone (GH), TSH, and ADH controlling other endocrine organs.

Thyroid & Pancreas

Thyroid produces thyroxine for metabolism. Pancreas islets secrete insulin and glucagons to manage blood glucose levels.

Adrenal Glands

Located above kidneys. Secretes adrenaline during stress ("fight or flight" response) increasing heart rate and breathing.

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Chapter Review & Key Takeaways

Coordination and Control is achieved rapidly through neurons and electrochemical signals, and sustained longer-term through endocrine hormones and feedback loops.

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