

Neural Control and Coordination

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- To maintain **homeostasis**, the functions of various organs and organ systems in the human body must be **well-coordinated**.

What is Coordination?

- Coordination** is the process through which two or more organs interact and complement each other's functions.
- This ensures that the internal environment of the body remains stable even when external conditions change.

Example of Coordination in the Body

During physical exercise:

- The energy demand increases due to enhanced **muscular activity**.
- To meet this demand, the **supply of oxygen** must increase.
- This leads to:
 - Increased respiratory rate,
 - Increased heartbeat,
 - Increased blood flow through blood vessels.

After the exercise ends:

- The activity of various systems such as the nervous system, lungs, heart, and kidneys gradually returns to normal.
- This demonstrates how different organs like **muscles, lungs, heart, blood vessels**, and **kidneys** work together in a coordinated way.

Systems Involved in Coordination

1. Neural System

- Provides a **rapid**, point-to-point connection between organs through a network of nerves
- Responsible for immediate coordination and response

2. Endocrine System

- Uses hormones for chemical coordination
- Enables slower but sustained regulation of physiological processes

Together, the **neural and endocrine systems** ensure that all organs function in a synchronised and integrated manner.

Neural System

- The **neural system** in animals is responsible for detecting, receiving, and transmitting various types of stimuli.
- It is made up of highly specialized cells called **neurons**, which are the functional and structural units of the nervous system.

Neural System across Animal Kingdom

1. Lower Invertebrates

- Neural organization is **simple**.
- Example: In **Hydra**, the system consists of a diffused network of neurons without a centralized control.

2. Higher Invertebrates (e.g., Insects)

- Neural system is **more organized**.
- Presence of a brain, ganglia, and neural tissues.
- These structures allow for better control and coordination of body functions.

3. Vertebrates

- Possess a highly developed and complex neural system.
- It includes a well-defined central nervous system (**CNS**) and peripheral nervous system (**PNS**), enabling precise regulation and integration of physiological activities.

Human Neural System

- The **human neural system** is responsible for coordinating and regulating bodily functions by transmitting signals between various parts of the body and the brain.
- It is divided into **two** main parts:
 1. Central Neural System (**CNS**)
 2. Peripheral Neural System (**PNS**)

Central Neural System (CNS)

Components:

- Brain
- Spinal cord

Function:

- Acts as the **control center** of the body.
- The CNS receives sensory information, processes it, and initiates appropriate responses.

Peripheral Neural System (PNS)

Components:

- All **nerves** arising from or associated with the **CNS** (brain and spinal cord).

Function:

- Connects the CNS to the **rest of the body** (organs, limbs, and skin).

Types of Nerve Fibres in the PNS

1. Afferent Fibres (Sensory Fibres):

- Carry impulses from tissues/organs to the **CNS**.

2. Efferent Fibres (Motor Fibres):

- Transmit regulatory impulses from the CNS to peripheral tissues/organs.

Divisions of the Peripheral Neural System

1. Somatic Neural System

- Relays impulses from the CNS to skeletal muscles.
- Controls voluntary movements.

2. Autonomic Neural System (ANS)

- Transmits impulses from the CNS to involuntary organs (e.g., heart, lungs, digestive tract) and **smooth muscles**.
- Controls involuntary functions such as heartbeat, digestion, and respiration.
- **ANS** is further divided into:

A. Sympathetic Neural System (SNS)

- Prepares the body for '**fight or flight**' responses (e.g., increases heart rate).

B. Parasympathetic Neural System (PNS)

- Promotes '**rest and digest**' activities (e.g., slows down heart rate).

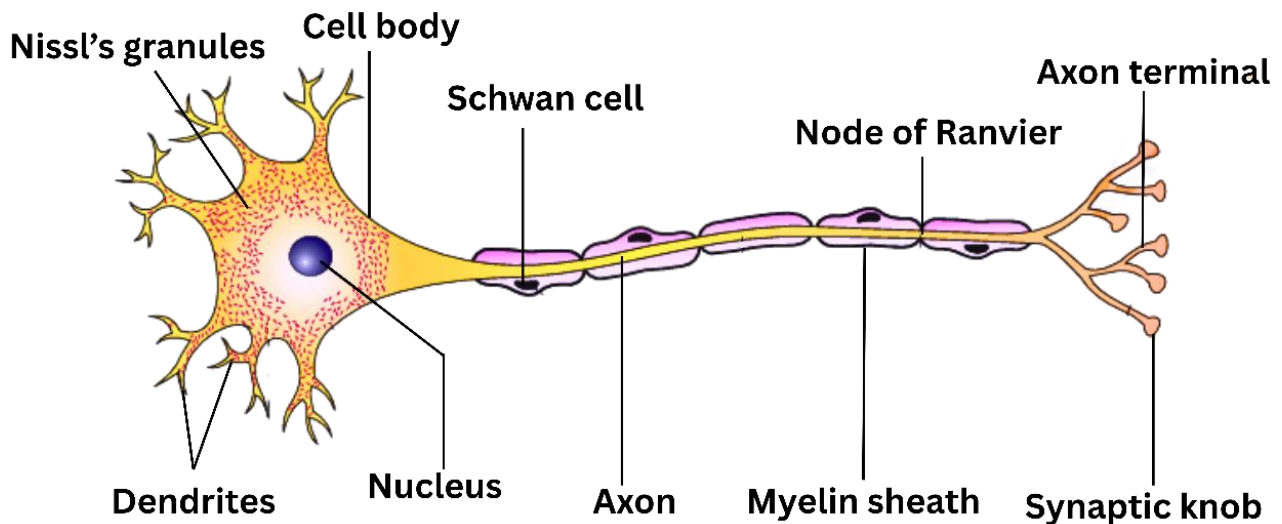
Visceral Nervous System

- A part of the **PNS** involved in:
 - Carrying signals **from the CNS** to visceral (internal) organs.
 - Returning sensory information from the viscera to the CNS.

- It includes:
 - Nerves
 - Fibres
 - Ganglia
 - Plexuses
- This system ensures the communication and coordination between the **internal organs** (viscera) and the **central nervous system**.

Neuron as the Structural and Functional Unit of the Neural System

- A **neuron** is the basic structural and functional unit of the neural system.
- It is a microscopic, specialized cell designed to **receive, process, and transmit** nerve impulses.



Structure of a neuron

Each Neuron is Composed of Three Major Parts

1. Cell Body (Soma)

- Contains **cytoplasm, cell organelles**, and unique granular structures known as **Nissl's granules**.
- The cell body performs the basic metabolic functions of the neuron.

2. Dendrites

- These are short, branched extensions projecting from the cell body.
- They also contain **Nissl's granules**.
- Dendrites receive impulses from other neurons and transmit them toward the cell body.

3. Axon

- A **long, cylindrical fibre** that extends from the cell body.
- The distal end of the axon is branched, and each branch ends in a bulb-like structure called a **synaptic knob**.
- Synaptic knobs contain synaptic vesicles filled with **neurotransmitters** (chemicals that help in signal transmission).
- The axon transmits nerve impulses away from the cell body to either another neuron (**synapse**) or to an effector such as a muscle (**neuro-muscular junction**).



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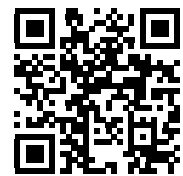


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