CHAPTER 6: CONTROL AND COORDINATION

Introduction

Living organisms continuously interact with their environment. Any change in the environment is called a **stimulus**, and the reaction of an organism to the stimulus is called a **response**.

Example:

- Pulling the hand away from a hot object
- Plants bending toward sunlight
- Mouth watering when we see food

These responses must be **controlled and coordinated** so that the body reacts correctly. In multicellular organisms, specialized systems carry out this function.

Control and Coordination Systems:

1. **Nervous System** – fast responses through electrical impulses
2. **Endocrine System** – slower responses through hormones

Animals- Nervous System

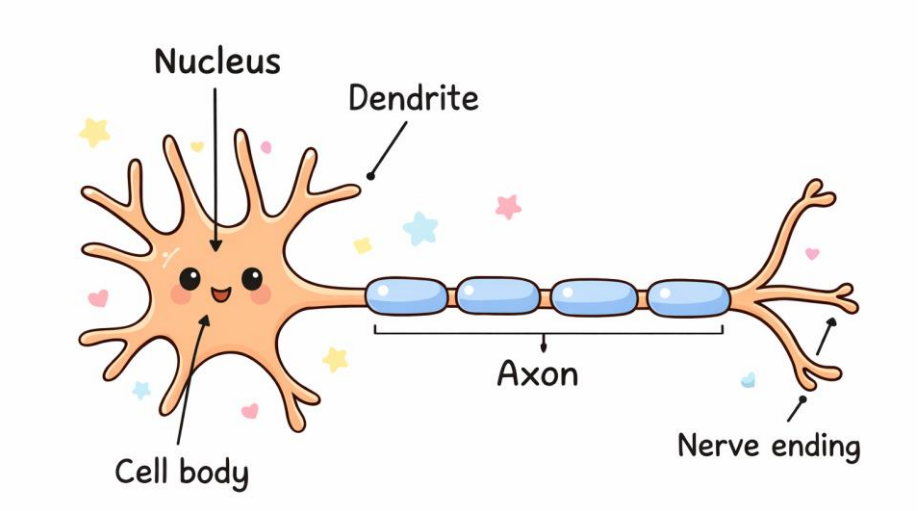
In animals, control and coordination are provided by **nervous tissue** and **muscular tissue**.

The nervous system:

- Receives information from surroundings
- Processes the information
- Sends instructions to different body parts

Example:
When we touch a hot object, the nervous system quickly detects the heat and instructs muscles to pull the hand away.

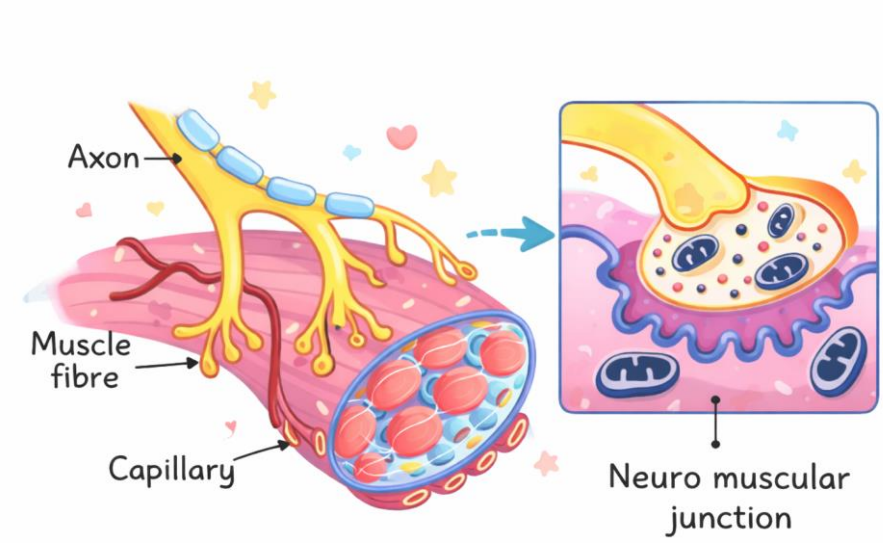
Structure of Neuron (Nerve Cell)



The **neuron** is the basic unit of the nervous system.

Parts of a Neuron

1. **Dendrites**
   - Receive information from receptors or other neurons.
2. **Cell Body (Cyton)**
   - Contains nucleus and processes information.
3. **Axon**
   - Carries impulses away from the cell body.



Neuromuscular junction

Transmission of Nerve Impulse

Steps:

1. Stimulus is detected by **receptors**.
2. Electrical impulse is generated.
3. Impulse travels:
   - Dendrite → Cell body → Axon
4. At the end of the axon, **chemicals (neurotransmitters)** are released.
5. These chemicals cross the **synapse** and start a new impulse in the next neuron.

Receptors
Specialized cells that detect stimuli such as light, smell, taste, touch.

Examples:

- Gustatory receptors – detect taste
- Olfactory receptors – detect smell

Synapse
The tiny gap between two neurons where chemical transmission occurs.

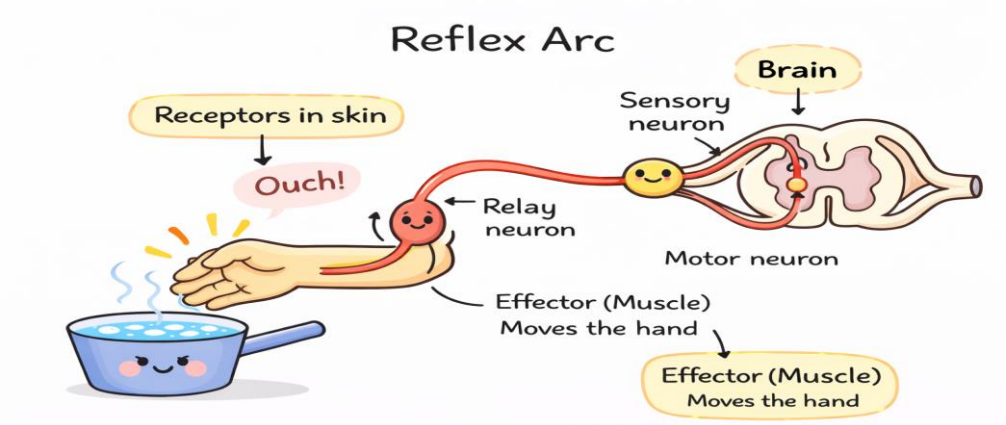
Reflex Action

A **reflex action** is a sudden, automatic response to a stimulus without conscious thinking.

Example:

- Pulling hand from fire
- Blinking of eyes
- Sneezing

These responses are **very quick** because they do not require thinking.



A **reflex arc** is the pathway followed by nerve impulses during a reflex action.

Steps of Reflex Arc

1. Stimulus (heat) detected by **receptors**
2. Impulse travels through **sensory neuron**
3. Reaches **spinal cord**
4. Spinal cord sends signal through **motor neuron**
5. Muscle (effector) responds

Example:
Touching a hot object → Hand quickly pulled back.

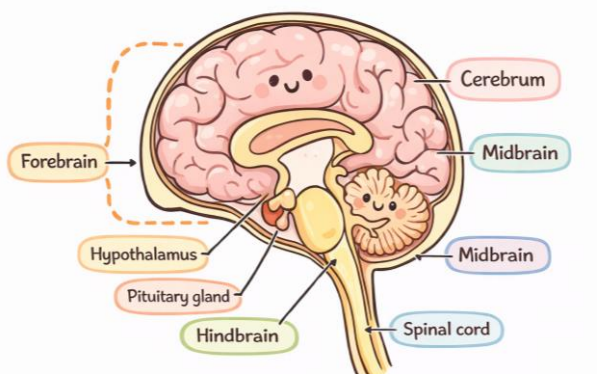
The reflex action is controlled by the **spinal cord**, though the brain also receives the information later.

Human Brain

The **brain** is the main coordinating centre of the b

It performs functions such as:

- Thinking
- Memory
- Decision making
- Control of voluntary and involuntary actions



Parts of Brain

The brain has three major parts:

1. Forebrain

Functions:

- Main thinking part
- Controls voluntary actions
- Receives sensory information

Activities controlled:

- Thinking
- Memory

- Intelligence
- Hunger and thirst

2. Midbrain

Functions:

- Controls reflex movements related to vision and hearing.

3. Hindbrain

Includes:

- Cerebellum
- Pons
- Medulla

Functions:

Cerebellum

- Maintains balance
- Coordinates muscle movement

Medulla

- Controls involuntary actions such as:
  - Heartbeat
  - Breathing
  - Blood pressure
  - Vomiting
  - Salivation

Protection of Brain and Spinal Cord

The nervous system is delicate and needs protection.

Protection of Brain

1. **Skull (Cranium)** – bony box protecting brain
2. **Cerebrospinal Fluid (CSF)** – fluid that acts as shock absorber

Protection of Spinal Cord

The spinal cord is protected by the **vertebral column (backbone)**.

How Nervous Tissue Causes Action

When nerve impulses reach muscles, they cause muscles to **contract or relax**.

Muscle cells contain **special proteins** that change shape when stimulated.

This causes the muscle to shorten and produce movement.

Types of Muscles

1. **Voluntary Muscles**
   - Controlled consciously
   - Example: arm and leg muscles
2. **Involuntary Muscles**
   - Not controlled consciously
   - Example: stomach muscles, heart muscles

CONTROL AND COORDINATION IN PLANTS

Plants do not have:

- Nervous system
- Muscles

Yet they respond to stimuli such as:

- Light
- Gravity
- Water
- Touch

Plants show **two types of movements**:

1. **Growth-dependent movement**
2. **Growth-independent movement**

Immediate Response to Stimulus

Example: **Touch-me-not plant (Mimosa pudica)**

When touched:

- Leaves fold quickly
- Movement occurs without growth

Mechanism:

- Electrical and chemical signals travel from cell to cell.
- Cells lose water and shrink, causing leaf movement.

Movement Due to Growth

Some plant movements are caused by **unequal growth** of plant parts.

Example:

- Tendrils of pea plant wrap around support.

The part touching support grows slower, causing bending.

Tropic Movements

Directional growth movements in response to stimuli are called **tropisms**.

Types of Tropism

1. **Phototropism**
   - Growth in response to light
   - Shoots grow towards light
2. **Geotropism**
   - Growth in response to gravity
   - Roots grow downward
3. **Hydrotropism**
   - Growth toward water
4. **Chemotropism**
   - Growth in response to chemicals
   - Example: pollen tube growing toward ovule

Plant Hormones

Plants use **chemical substances called hormones** to control growth and development.

Major Plant Hormones

1. Auxins

- Promote cell elongation
- Help in phototropism

2. Gibberellins

- Promote stem growth

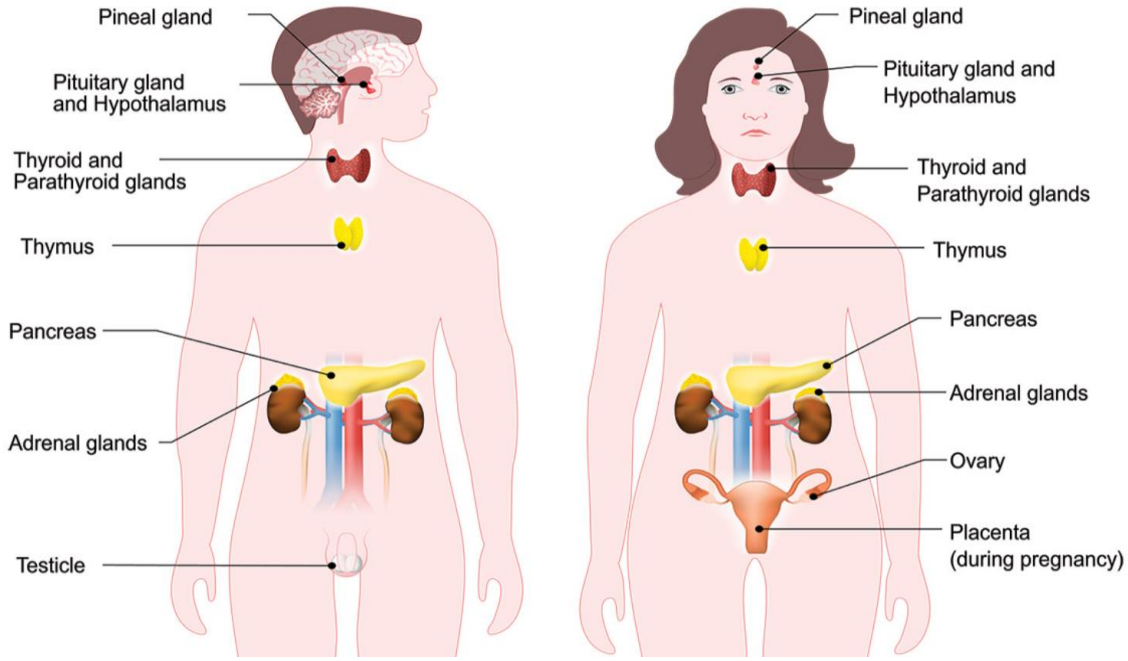
3. Cytokinins

- Promote cell division
- Present in growing tissues

4. Abscisic Acid

- Inhibits growth
- Causes wilting and dormancy

HORMONES IN ANIMALS



Animals also use chemical signals called **hormones** for control and coordination.

Hormones are secreted by **endocrine glands**.

Characteristics:

- Secreted directly into blood
- Travel to target organs
- Produce specific effects

Adrenaline Hormone

In dangerous situations, the body prepares for **fight or flight** response.

This is caused by **adrenaline** secreted by **adrenal glands**.

Effects of adrenaline:

- Heartbeat increases
- Breathing rate increases
- Blood flows more to muscles
- Digestive activity slows down

This prepares the body to react quickly.

Major Endocrine Glands

1. Pituitary Gland

- Known as **master gland**
- Controls other endocrine glands
- Produces growth hormone

Deficiency: dwarfism
Excess: gigantism

2. Thyroid Gland

Produces **thyroxine**.

Functions:

- Regulates metabolism
- Controls growth and development

Requires **iodine**.

Deficiency causes **goitre** (swollen neck).

3. Pancreas

Produces **insulin**.

Function:

- Controls blood sugar level

Deficiency leads to **diabetes**.

4. Adrenal Glands

Produce **adrenaline**.

Function:

- Prepares body for emergencies.

5. Testes (Male)

Produce **testosterone**.

Functions:

- Development of male reproductive organs
- Secondary sexual characters

6. Ovaries (Female)

Produce **oestrogen**.

Functions:

- Development of female reproductive organs
- Secondary sexual characters