# Chapter 7
# Control and Coordination

- All living organisms **respond** and **react** to changes in their environment.
- These changes in their environment are known as **stimuli**, and they include light, heat, cold, sound, smell, touch, and so on.
- **Plants** and **animals** both respond to stimuli, but in different ways.
- Control and coordination in **animals** involve two major systems: Nervous system & Endocrine system (or Hormonal System)
- Plants do not have nervous system. Control and coordination take place in plants through the use of **hormones**.

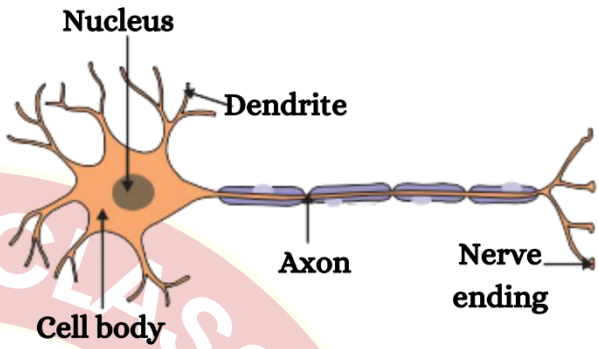
## Nervous System

Nervous system is the organ system present in the animals to **control and coordinate** different activities of the body.

- Nervous tissue is made up of nerve cells or neurons
- Nerve cells transmit the information from one part of the body to another using **electrical signals.**

**Receptors**: Receptors are **specialized tips** of nerve cells that **detect information** from their surroundings. These are found in our sensory organs.
(i) Ear has **phonoreceptors** (detects sound).
(ii) Eyes have **photoreceptors** (detects light).
(iii) Skin has **thermoreceptors** (detects temperature or touch).
(iv) Nose has **olfactory receptors** (detects smell).
(v) Tongue has **gustatory receptors** (detects taste)

**Neuron**: It is the structural and functional unit of nervous system.




## Parts of Neuron

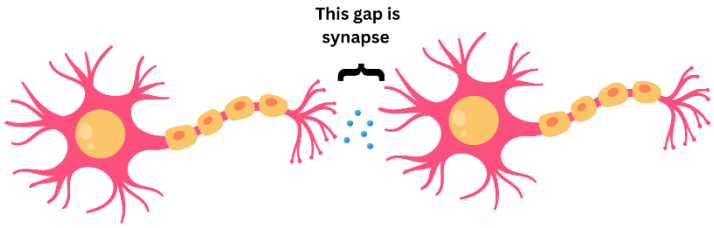
(i) **Dendrite**: branch-like structures that **receives** incoming information.

(ii) **Cell body**: receives the signal from the dendrites.
(iii) **Axon**: a long fibre like structure which passes the electrical impulse (or signal) from cell body to the dendrite of next neuron.

## Functioning of Neuron

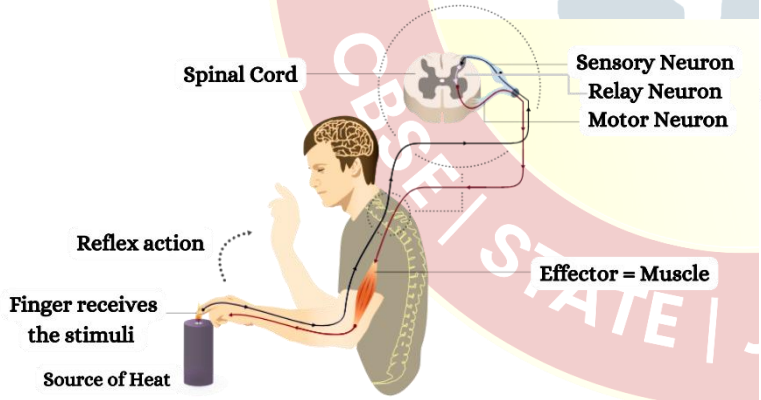
- The information from **receptors** is received at the end of the **dendritic tip** of a nerve cell as chemical reaction that creates an electrical impulse.
- This impulse travels from the dendrite to the cell body and then at the **end of the axon.**
- Chemicals are released at the end of the axon by the effect of **electrical impulse**.
- These chemicals cross the gap (**synapse**) and start a similar electrical impulse in a dendrite of the next neuron.
- Finally, the similar synapse allows the delivery of signals **from neurons** to other cells, such as **muscle cells or glands**.

**Synapse:** It is the **gap** between the **nerve ending** of one neuron and **dendrite** of the other neuron.




## Reflex Action

Reflex action is quick, sudden and immediate response of the body to a stimulus.
Example: *Withdrawal of hand on touching hot object*, *the change in size of pupil when intensity of light changes*, etc.
**Stimulus**: It is any change in surrounding which is detected by the body of an organism.
**Reflex arc**: The pathway through which nerve impulse passes during reflex action is called reflex arc.




**What is the need for reflex actions?**
In some situations, such as touching a hot object or pinching, we must react quickly to avoid harm to our body. So, in such cases, the response is generated from **spinal cord** instead of **brain**. Hence, reflex action takes less amount of time, so our body reacts quickly and protects us from harm.

## Human Nervous System

**Parts of human nervous system**

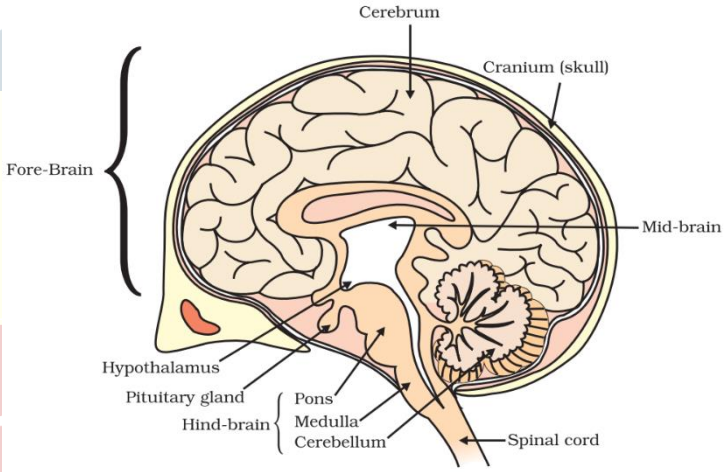
1. **Central nervous system (CNS)**
   - Brain
   - Spinal Cord

2. **Peripheral nervous system (PNS)**.
   - **Cranial Nerves** (nerves which arise from the brain)
   - **Spinal Nerves (**nerves which arise from the spinal cord)

The peripheral nervous system helps in communication between the central nervous system and the other parts of the body.

## Human Brain

Brain is of the most important and central organ of the human nervous system. It has three major parts: **fore-brain**, **mid-brain** and **hind-brain.**




**Fore-brain**: It is the **largest** and most complex part of the brain. It consists of **cerebrum**.
Functions of fore-brain:
- Thinking.
- Controls the voluntary actions.
- Stores information (Memory).
- Receives and integrates sensory impulses from various parts of the body.
- Centre associated with **hunger**.

**Mid-brain**: Function of mid-brain is to control the involuntary actions such as change in pupil size and reflex actions in head, neck and trunk region.

**Hind-brain**: It is divided into three parts:

1. **Cerebellum:** Controls the posture and balance, precision of voluntary actions. For example: picking up a pen.
2. **Medulla:** Controls involuntary actions such as heartbeat, blood pressure, salivation, vomiting, etc.
3. **Pons**: Controls involuntary actions and regulation of respiration.

**Protection of Brain and Spinal Cord**: Brain is protected by a fluid-filled balloon which acts as shock absorber and is enclosed in skull (bony box). Spinal cord is protected inside vertebral column (backbone).

**How does the Nervous Tissue cause Action?** During voluntary actions, the brain sends messages to muscles. The communication between the **central nervous system** and the other parts of the body is facilitated by **the peripheral nervous system**. Thus, the brain enables us to think and act on that thinking. This is achieved through a complex design, with the help of various parts of the brain responsible for integrating various inputs and outputs.

When a nerve impulse reaches a muscle, the muscle must move. The most basic concept of movement at the cellular level is that muscle cells move by changing their shape and shortening. Muscle cells contain proteins that change shape and arrangement within the cell in response to nervous electrical impulses. When this happens, new protein arrangements give the muscle cells a shorter shape.

## Limitations of Nervous system

1. Electric impulse can reach **only** to those cells that are connected by nervous tissue. *(Neurons cannot reach to each and every cell in the body*)
2. Cells cannot continuously create and transmit electrical impulses. (*Once an electrical impulse is generated and transmitted, the cell takes some time to reset its mechanism and create a new electrical impulse*.)

## Hormones in Animals

Hormones are chemicals that are released within our body and control different functions. They are produced by **endocrine glands**. These glands secrete the hormone directly into the blood.

**Important hormones and their functions:**

| Hormone | Secreted by gland | Functions |
|---|---|---|
| **Thyroxine** | Thyroid *located in Neck/Throat region* | regulates the metabolism of carbohydrates, fats and proteins |
| **Growth hormone** | Pituitary (master gland) *located in Mid-brain* | regulates growth and development |
| **Adrenaline** | Adrenal *located above both kidneys* | increases blood pressure and heart-beat, carbohydrate metabolism |
| **Insulin** | Pancreas *located below stomach* | regulates blood sugar level |
| **Testosterone (in males)** | Testes *located in scrotal sacs outside the body in the lower abdomen* | develops secondary sexual characters in males |
| **Oestrogen (in females)** | Ovaries *located in lower abdomen area* | develops secondary sexual characters in females |

**Why do we need iodine?**

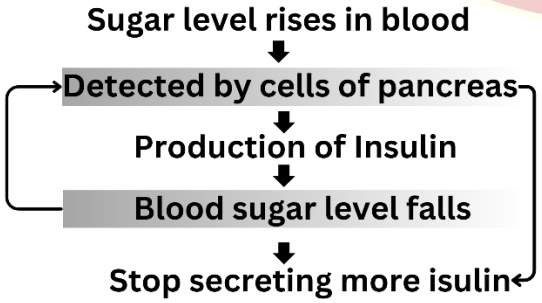
- Iodine is necessary for the thyroid gland to make **thyroxin** hormone.
- Thyroxin regulates carbohydrate, protein and fat metabolism in the body.
- Deficiency of iodine causes **goitre**. One of the symptoms in this disease is a **swollen neck**.

**Diabetes**

- It is a disease in which blood sugar(glucose) level rises.
- **Cause**
  The disease is caused due to the **deficiency of insulin hormone** secreted by pancreas. Insulin hormone is responsible for controlling blood sugar levels.
- **Treatment**
  Injections of insulin hormone can help in the treatment of diabetes.

**Feedback Mechanism**

- The excess or deficiency of hormones has a harmful effect on our body.
- Feedback Mechanism controls the timing and amount of hormones released by various glands in our body.
- Example: When blood sugar levels rise too high, pancreatic cells detect it and respond by producing and secreting more insulin into the blood. When blood sugar falls below a certain level, insulin secretion is reduced automatically.




## Coordination in Plants

There are two types of movements in plants.

1. **Tropic Movements** (Dependent on growth/direction)
2. **Nastic Movement**s (Independent of growth/direction)

## Tropic Movements

These movements are **directional movements** in response to stimulus. Tropic movements involve the **growth of plant** parts toward or away from a specific stimulus in a particular direction.

Types of tropic movements:

- **Phototropism**: Movement towards/away from light. For example, if the stem of a growing plant moves or bends towards light, it is *positive phototropism* and if the root of a plant moves away from light, this means the roots of a plant shows *negative phototropism*.

- **Geotropism:** Movement towards/away from gravity. For example, root of a plant moves in a downward direction, so they show *positive geotropism* and stem moves in the upward direction, so it shows *negative geotropism*.

- **Chemotropism:** Movement in response to chemical stimulus. For example, the growth of pollen tube towards the ovule during fertilization in a flower is called *positive chemotropism*.

- **Hydrotropism:** Movement towards/away from water. For example, root of a plant moves towards water, so they show positive hydrotropism.

- **Thigmotropism**: Movement in response to touch. For example, tendrils of a plant climb towards any support which they touch.

## Plant Hormones

1. **Auxins**
   - present at the tip of a stem and roots.
   - controls a plant response to light and gravity *(involved in phototropism and geotropism*)
   - speeds up the growth of stem and slows down the growth of roots.
   - promote cell enlargement, cell differentiation and fruit growth.

2. **Gibberellins**
   - works in the presence of auxin hormone
   - promotes cell enlargement and cell differentiation
   - promotes fruit growth and elongation of shoots
   - breaks the **dormancy** (inactive condition of part of plant) in seeds and buds

3. **Cytokinins**
   - promotes **cell division**.
   - present in greater concentration in areas of rapid cell division, such as in fruits and seeds.
   - breaks the **dormancy** (inactive condition of part of plant) in seeds and buds
   - delay **ageing** in leaves
   - promotes the **opening** of stomata.

4. **Abscisic Acid (ABA) (also known as stress hormone)**
   - Inhibits (slows) growth and **promotes** dormancy in seeds and buds.
   - promotes **closing** of stomata
   - promotes **wilting and falling** of leaves and detachment of fruit and flower from the plant

**Importance of tropic movements**: It helps the plant to survive. For example, roots of the plant are positively geotropic hence they will always go downward into the earth even if they are planted upside down.

## Nastic Movements

When the direction of response is independent of the direction of stimulus, it is called **nastic movement**. These movements are non-directional movements.
For example:

- Folding of leaves of 'Touch-me-not' *(mimosa pudica)* plant on touching it.
- Petals of dandelion flower open in the morning and close in the evening
- Petals of moonflower close in the morning and open in dark at night.