CHAPTER-6
CONTROL AND CO-ORDINATION

Topic-1 Control and Co-ordination in Plants

Concepts Covered • Tropic movements in plants, • Plants hormones- Auxins, Gibberellins, Cytokinins, Abscisic acid and Ethylene.

Revision Notes

Introduction

- All the living organisms respond and react to the changes that happen in the environment around them.
- The changes in the environment to which the organisms respond and react are called stimuli such as light, heat, cold, smell, touch, etc.
- Both plants and animals respond to stimuli but in a different manner.
- **Plant Movements:** The movements of the individual plant parts or organs of a plant like shoot, root, etc, are due to some external stimuli like light, force of gravity, chemical substance, water, etc.
- **Tropic Movement:** It is the directional growth movement of a plant organ in response to an external stimulus. Growth towards the stimulus is positive tropism and growth away from the stimulus is negative tropism.
- Plants show two different types of movement:

  (A) Movement dependent on growth: It is of four types:

  (i) Phototropism: Growth movements of plants towards light e.g., shoots bend toward light (positively phototropic) and roots move away from light (negatively phototropic).

  (ii) Geotropism: Movement towards gravity. e.g., Roots of a plant are positively geotropic while shoots of a plant are negatively geotropic.

  (iii) Chemotropism: Movement towards chemicals. e.g., Growth of pollen tube towards ovule.

(iv) **Hydrotropism:**
Movement towards water.

(B) Movement independent of growth: These are immediate response to stimulus. e.g., Drooping of leaves of "Touch me not plant" on touching it. This is known as thigmotropism.

Key Fact

Thermotropism is a type of growth movement in plants in response to temperature, e.g., seedlings curve towards warm side.

- **Plant Hormones:** They are the chemical compounds produced naturally in plants which control the growth and other physiological functions' at a site, far away from the place of secretion are called plant **hormones** or phytohormones.. They are required in very small amount and help to coordinate growth, development and responses to the environment.

Key Word

Hormones: They are the chemical substances which co-ordinate and control the activities of living organisms and also their growth. They are functional in small concentration at the remote site from their production.

- **Main plant hormones are:**

(a)	**Auxins**	Synthesized at shoot tip. Helps the cells to grow longer. Involved in tropic movements of plants.
(b)	**Gibberellin**	Helps in the growth of the stem.
(c)	**Cytokinins**	Promotes cell division. Present in greater concentration in fruits and seeds.
(d)	**Abscisic Acid**	Inhibits growth. Cause wilting of leaves. Also called as Stress hormone.
(e)	**Ethylene ($H_2C=CH_2$)**	A gaseous hormone which helps in artificial ripening of fruits. Promotes senescence and abscission of leaves.

Concept: Plant Hormone

Mnemonics: A CAGE
Interpretations:

A - Auxins
C - Cytokinins
A - ABA (Abscisic Acid)
G - Gibberellins
E - Ethylene

Topic-2 Control and Co-ordination in Animals

Concepts Covered • Nervous System, • Voluntary and involuntary action, • Reflex action, • Animal hormones.

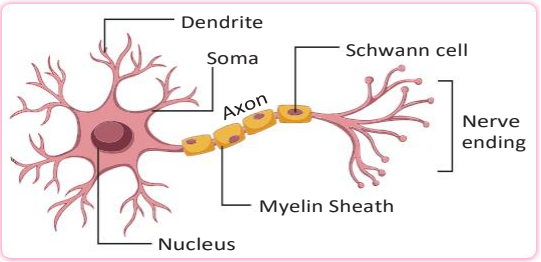
Revision Notes

- Control and coordination is brought about in all animals with the help of two main systems: Nervous system and Endocrine system.
- **Nervous system:** It is the system of conducting tissues that receives the stimulus and transmits it to other parts of the body forming a network of nerves. It is involved in receiving information (sensation) and generating responses to that information (motor response).
- A typical **neuron** consists of following parts:
(i) Cyton or Cell body: It is star shaped which contains nucleus with abundant cytoplasm called neuroplasm. The information acquired by it travels as an electrical impulse.
(ii) Dendrite: The hair like structure protruding out from margins of cell body is called dendrite. It receives the nerve impulses.

(iii) Axon: It is the longest fiber on the cell body. It ends in several hairs like structures called axon terminals, which transmits electrical impulse from cell body to dendrite of next neuron.

(iv) Myelin sheath: It is an insulator covered around the axon.

(v) Synapse: It is the point of contact between the nerve ending of one neuron and dendrite of other neuron. It is the part where electrical signal is converted into chemical signal for onward transmission to next neuron.



Structure of a Neuron

Important term:

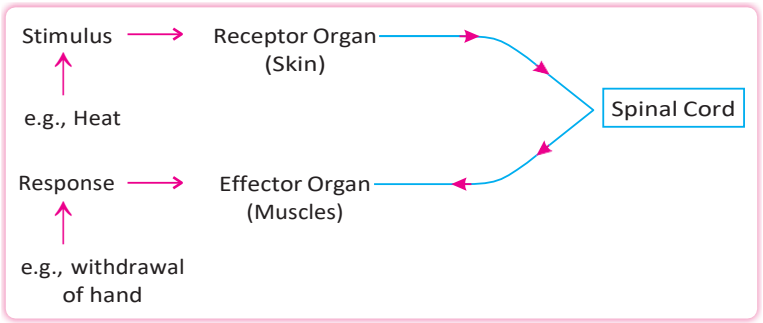
A chemical synapse formed by the contact between a motor neuron and a muscle fiber is called a neuromuscular junction.

- **Functioning of neuron:** Dendrites → Cell body → Axon → Nerve endings at the tip of axon → Synapse → Dendrite of next neuron
- The units which make up the nervous system are called **nerve cells or neurons**.
- The **receptors** pass the information to the brain through a type of nerve cells called **sensory neurons**.
- Motor neurons transmits the information from the brain to the effector organs, mainly muscles and glands.
- **Nerve Impulse:** It is the information in the form of chemical and electrical signals passing through neurons. These impulses are carried by dendrites towards the cell body.

Key Words

Neurons are structural and functional unit of nervous system.
Receptors are the chemical structures made up of proteins that receive signals from both external and internal environment.
Sensory neurons: The neurons which transmit impulses towards central nervous system.

- **Synapse:** The point of contact between the terminal branches of axon of one neuron with the dendrite of another neuron is called synapse.
- **Voluntary Action:** These are the actions which need thinking and are performed knowingly i.e., these are controlled by conscious thought. e.g.,**:** speaking to a friend, writing a letter etc.
- **Involuntary Action:** These are not under the control of the will of an individual and are automatic response to a stimulus which is not under the voluntary control of the brain. It occurs without the conscious choice of an organism. e.g.,**:** Touching a hot plate unknowingly.
- **Reflex action:** It is quick, sudden and immediate response of the body to a stimulus. e.g., Knee jerk, withdrawal of hand on touching hot object.
- **Reflex arc:** The pathway through which nerve impulse passes during reflex action is called reflex arc. i.e., it is a pathway through which the reflex action occurs.

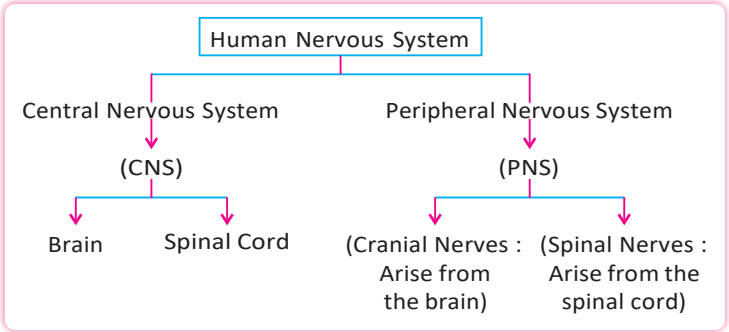


- **Stimulus and Response:** Stimulus is an observable or detectable change in the external or internal environment to which an organism reacts while response is the final reaction after reflex action.

Mnemonics

Concept: Reflex Arc
Mnemonics: RACEE
Interpretations:
R: Receptor
A: Afferent or Sensory Nerve
C: Centre (Brain or Spinal cord)
E: Efferent or Motor Nerve
E: Effector

- Responses are of three main types:
  - **(a) Voluntary:** Controlled by fore brain for e.g., talking, writing.
  - **(b) Involuntary:** Controlled by mid and hind brain for e.g., heartbeat, vomiting, respiration.
  - **(c) Reflex action:** Controlled by spinal cord for e.g., withdrawal of hand on touching a hot object.
- **Need of Reflex Actions:** In some situations such as touching a hot object, pinching, etc., we need to act quickly, otherwise our body would be harmed. Hence, this response is generated from spinal cord instead of brain.
- **Human nervous system:** The nervous system of vertebrates (including humans) is divided into the central nervous system (CNS) and the peripheral nervous system (PNS).



- Human brain is the main coordinating centre of the body. It has three major parts: Forebrain, midbrain and hind brain.
  - **(a) Fore-brain:** It is the most complex or specialized part of the brain. It consists of cerebrum. The main functions of forebrain are as follows:
    - **(i)** Main thinking part of the brain.
    - **(ii)** Controls the voluntary actions.
    - **(iii)** Stores information (memory).
    - **(iv)** Receives sensory impulses from various parts of the body and integrate it.
    - **(v)** It is the centre associated with hunger.

    The brain is protected by the skull called the cranium and is surrounded by three membranes called the meninges.

Key Fact

The space between meninges is filled with a fluid called Cerebro-Spinal Fluid (CSF). The brain floats in CSF, which acts as a cushion and shock absorber, making the brain neutrally buoyant.

Medulla oblongata, pons varolii and mid brain are collectively called the brain stem.

Pituitary gland is the master gland which controls all other endocrine glands.

  - **(b) Mid-brain:** Controls involuntary actions.
  - **(c) Hind-brain:** It has three parts:
    - **(i) Cerebellum:** Controls posture and balance, precision of voluntary actions. e.g., picking pen.
    - **(ii) Medulla:** Controls involuntary actions. e.g., blood pressure, salivation, vomiting.
    - **(iii) Pons:** Controls voluntary actions and helps in regulation of respiration.
- There are 31 pairs of spinal nerves and 12 pairs of cranial nerves in humans.
- Spinal cord is a cylindrical structure and a part of the central nervous system. It is made up of nervous tissue that extends from medulla oblongata in the brain stem to the lumbar region of vertebral column. It functions primarily in the transmission of nerve signals.

- **Endocrine system:** Endocrine system comprises endocrine glands and its secretion is called hormones.
- Hormones are chemical messengers secreted in very small amounts by specialized tissue called ductless glands. They act on target tissues/organs usually away from their source.
- Hormones assist the nervous system in control and coordination.
- **Endocrine glands with the hormones names and their secretions in humans are:**

No.	Gland	Hormones	Functions	Target Site
1.	Hypothalamus	(i) Releasing hormones (RH) (ii) Growth inhibiting hormones	Regulates secretion of pituitary hormones.	Pituitary gland
2.	Pituitary Gland	(i) Growth hormone (GH)	Controls growth-dwarfism and gigantism.	Various body cells which undergo growth
3.	Thyroid Gland	(i) Thyroxin (ii) Triiodothyronine (iii) Thyrocalcitonin (TCT)	Regulate basal metabolic rate, RBC formation. Regulate Calcium level.	Body tissues
4.	Adrenal Gland	(i) Adrenaline (ii) Nor adrenaline (iii) Corticoids	Increase alertness, pupillary dilation, piloerection, sweating and heart beat.	Body tissues
5.	Pancreas	(i) Insulin	Regulates glucose homeostasis, stimulates glycogenesis, controls carbohydrate metabolism.	Tissues
		(ii) Glucagon	Maintains glucose levels, stimulates gluconeogenesis.	
6.	Testis	(i) Testosterone (ii) Androgens	Plays a role in development of male reproductive tissues and promotes secondary sexual characters in male.	Male body tissues
7.	Ovary	(i) Estrogen (ii) Progesterone	Helps in development of female secondary sexual characters. Support pregnancy.	Female body tissues

- **Hormonal Disorders:** All hormones are secreted in precise quantities. Its hypo (less) or hyper (more) secretion may lead to different disorders. For example:
  - **(a) Dwarfism:** Hyposecretion (Deficiency) of growth hormone causes a disease called dwarfism.
  - **(b) Gigantism:** Hypersecretion of growth hormone causes a disease called gigantism or excessive growth.
  - **(c) Goitre:** Deficiency of iodine causes a disease called goitre.

  Importance of iodine: Thyroid gland needs iodine to make thyroxine, which helps in regulating the metabolism of carbohydrates, fats and proteins.
  - **(d) Diabetes:** Deficiency of insulin hormone causes diabetes. Diabetes can be treated by injecting insulin hormone in the patient's body.
- **Feedback mechanisms:** The excess or deficiency of hormones have a harmful effect on our body. Feedback mechanism makes sure that hormones are secreted in precise quantities and at the right time.

  For example, blood is detected by the cells of the pancreas which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.