



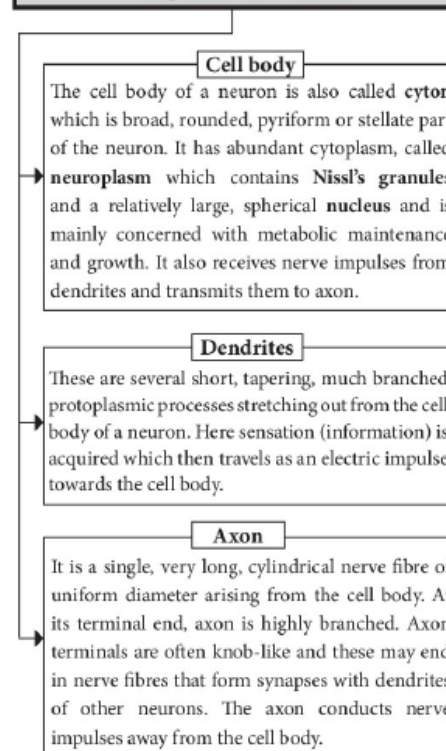
- ▶▶ All movements in living organisms occur in response to changes in the environmental factors. All living organisms respond and react to environmental factors (stimuli) such as light, heat, cold, sound, smell, taste, pressure, etc., and this response involves **coordination** of many organs in our body.
- ▶▶ **Coordination in animals:** Unicellular organisms respond to environmental stimuli by moving towards or away from it. Such response is termed as **taxis**. Movement

towards the source of stimulus is positive taxis and movement away from stimulus is negative taxis. In lower multicellular organisms, coordination takes place through nervous system.

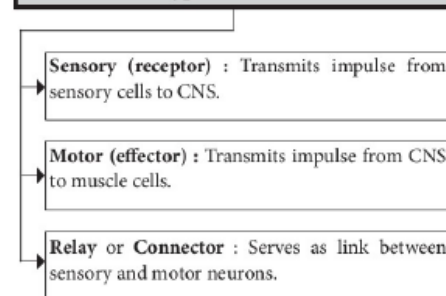
- ▶ **Annelids** – Central nervous system (CNS) is present which comprises of circumpharyngeal nerve ring and a nerve cord.
- ▶ **Insects** - CNS consist of circum-oesophageal nerve ring and nerve cord.
- ▶ In **higher animals**, control and coordination is provided by **nervous** and **endocrine** system.
- ▶▶ **Control and coordination in humans:** There are two systems of coordination of activities in humans : nervous system and endocrine system.
- ▶ Both the systems of coordination, consist of a number of organs working together in a systematic way.
- ▶▶ **Human Nervous System:** Human nervous system is the most complex system. The main parts of the nervous system are: **brain**, **spinal cord** and **nerves**. The sense organs can be considered to be other organs of the nervous system because they help in the functioning of the nervous system. We receive a variety of information from the environment around us through the sense organs. There are five sense organs in our body : eyes, ears, nose, tongue and skin. The sense organs contain receptors. A **receptor** is a cell (or a group of cells) in a sense organ which is sensitive to a particular type of stimulus. Different sense organs contain receptors for detecting different stimuli.
- ▶ The common types of receptor are photoreceptors (detect light, present in eyes), phonoreceptors (detect sound, present in ears), olfactory receptors detect smell, present in nose), gustatory receptors (detect taste, present in tongue) and thermoreceptors (detect heat or cold, present in skin).
- ▶ **Neurons** are the structural and functional unit of nervous system. Neuron is the longest cell in human body.

- ▶ **Coelenterates** – diffused nervous system is present which is made up of epidermal and gastrodermal nerve net of nerve cells.
- ▶ **Flatworms** – ladder type nervous system is present which is made up of ganglionated nerve ring and nerve cords.

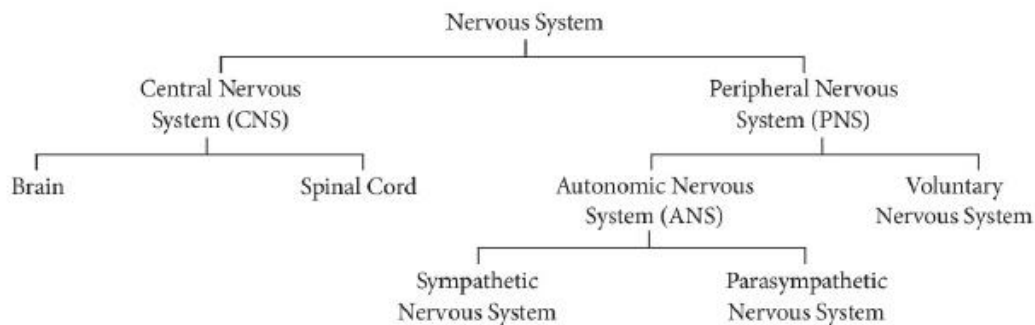
Components of Neuron



Types of neuron

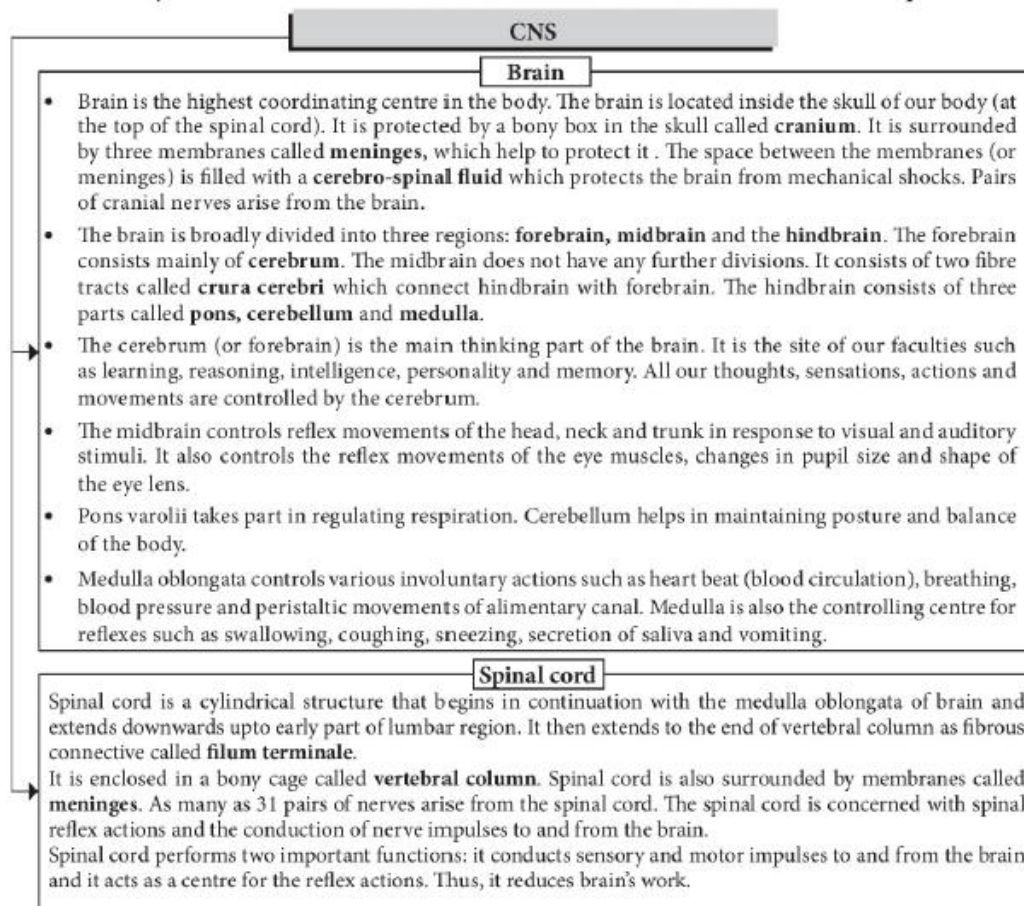


- ▶ The classification of human nervous system into various parts is given in the following chart:



Flow Chart : Main parts of human nervous system

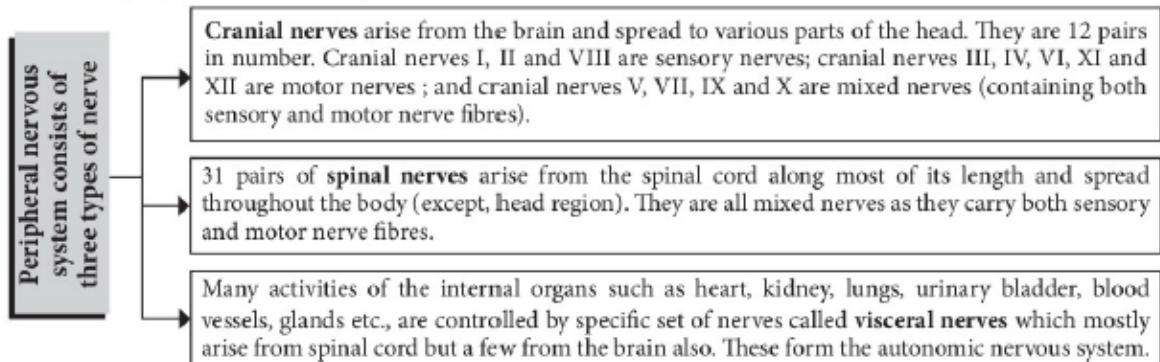
- ▶ **Central nervous system** : The central nervous system (CNS) consists of the brain and the spinal cord.
- ▶ **Peripheral nervous system** : All the nerves of the body together make up the peripheral nervous system (PNS). **Voluntary peripheral nervous system** is under the control of will. It consists of nerves that arise directly from CNS connecting different body parts for voluntary (conscious) control of the brain. **Autonomic nervous system** or **involuntary peripheral nervous system** on the other hand, is not under the control of human will. It develops from branches of some cranial and spinal nerves



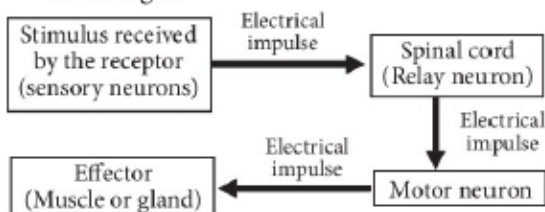
called **visceral nerves**. The autonomic nervous system (ANS) is subdivided into two parts:

(i) Sympathetic nervous system

(ii) Parasympathetic nervous system



- ▶ **Reflex action and reflex arcs :** The simplest form of response in the nervous system is reflex action. This is a rapid, automatic response to a stimulus which is not under the voluntary control of the brain. It is described as an involuntary action which aims to protect ourselves. A knee jerk, movement of diaphragm (during respiration), coughing, yawning, blinking of eyes and sneezing are all reflex actions. Coughing is a reflex action which clears our windpipe. The pupils of our eyes get smaller in bright light. This protects the retina of our eyes from damage due to too much light.



Flow chart : Depicting a reflex action

- ▶▶ The pathway taken by nerve impulses in a reflex action is called the **reflex arc**. Reflex arcs allow rapid response.

- ▶▶ **Human Endocrine System :** Endocrine system is comprised of endocrine glands and the hormones released by them.

- ▶ **Hormones :** These are the chemical substances which coordinate the activities of living organisms and also their growth. The various characteristics of hormones are:
 - ▶ They are secreted in small amounts by the endocrine glands.
 - ▶ They are poured directly into the blood and carried throughout the body by circulatory system.
 - ▶ They have their effects at the sites different from the sites where they are made. So, they are also called chemical messengers.
 - ▶ They act on specific tissues or organs (called target organs).
 - ▶ They coordinate the activities of the body and also its growth.
- ▶ **Endocrine glands :** A gland is a structure (cell, tissue or organ) which secretes certain useful chemicals or substances in the body. There are two types of gland in the body: **exocrine gland** and **endocrine gland**. Exocrine glands are the glands having ducts whereas endocrine glands are ductless glands.

Table: Endocrine glands – Their hormones and functions

Endocrine glands	Hormones secreted	Principal functions
1. Hypothalamus	(a) Releasing hormones (RH)	Stimulate anterior/ intermediate pituitary to secrete hormones.
	(b) Inhibiting hormones (IH)	Inhibit the secretion of hormones from anterior / intermediate pituitary gland.



<p>2. Pituitary gland</p> <ul style="list-style-type: none"> It has three lobes. It is attached to the lower surface of the brain. 		
<p>(i) Anterior lobe</p> <ul style="list-style-type: none"> It produces six hormones. 	<p>(a) Growth hormone (GH) or Somatotrophic hormone (STH)</p>	<p>Controls the overall development or growth of the body, muscles, bones and tissues. Lack of this hormone (hypoactivity) causes dwarfness. Its excessive secretion (hyperactivity) causes excessive growth of bones making the person very tall (gigantism).</p>
	<p>(b) Thyroid stimulating hormone (TSH)</p>	<p>Controls the growth and functioning of the thyroid gland. Stimulates the thyroid gland to produce thyroxine.</p>
	<p>(c) Adrenocorticotrophic hormone (ACTH)</p>	<p>Stimulates the adrenal cortex to secrete cortisol hormone.</p>
	<p>(d) Gonadotropic hormone</p> <p>(i) Follicle stimulating hormone (FSH)</p> <p>(ii) Luteinising hormone (LH)</p>	<p>In males, it stimulates the process of spermatogenesis (sperm formation). In females, it stimulates the follicle cells in the ovaries to develop into mature eggs.</p> <p>In males, it stimulates the secretion of male hormone, testosterone (sex hormone in males). In females, it stimulates the secretion of oestrogen and progesterone (sex hormones in females).</p>
	<p>(e) Prolactin hormone (PRL)</p>	<p>Stimulates mammary gland development during pregnancy and milk production after child birth in females.</p>
<p>(ii) Intermediate lobe</p>	<p>Melanocyte stimulating hormone (MSH)</p>	<p>Stimulates the synthesis of melanin in the skin.</p>
<p>(iii) Posterior lobe</p>	<p>(a) Oxytocin</p>	<p>Stimulates contraction of smooth muscles at the time of child birth. It also helps in milk ejection (lactation) from the mammary glands.</p>
	<p>(b) Vasopressin or Antidiuretic hormone (ADH)</p>	<p>Regulates water and electrolyte balance in body.</p>
<p>3. Pineal gland</p> <ul style="list-style-type: none"> It lies between the two cerebral hemispheres of the brain. 	<p>Melatonin</p>	<p>Regulates circadian rhythm.</p>



<p>4. Thyroid gland</p> <ul style="list-style-type: none"> It is situated in the neck region on the ventral side of the body. It has two lateral lobes, one on either side of the trachea. 	<p>(a) Thyroxine or T_4 and Triiodothyronine or T_3</p>	<p>T_3 and T_4 stimulate the rate of cellular oxidation and metabolism.</p>
	<p>(b) Calcitonin</p>	<p>Calcitonin lowers calcium level by suppressing release of calcium ions from the bones, when calcium level is high in blood.</p>
<p>5. Parathyroid gland</p> <ul style="list-style-type: none"> These are four small oval bodies which lie embedded in the lobes of the thyroid gland. 	<p>Parathyroid hormone (PTH) or parathormone.</p>	<p>Regulates calcium and phosphate levels in the blood. When blood calcium level is below normal, it mobilises the release of calcium into the blood from bones. It has an action opposite to that of calcitonin on calcium metabolism.</p>
<p>6. Thymus gland</p> <ul style="list-style-type: none"> It is situated in the upper chest near the front side of the heart. It undergoes gradual atrophy in the adult. 	<p>Thymosin</p>	<p>Stimulates the development and differentiation of lymphocytes (white blood cells).</p>
<p>7. Adrenal gland</p> <ul style="list-style-type: none"> In human beings, a pair of adrenal glands are present, one on top of each kidney, so, also called suprarenals. Each adrenal gland has an outer part called the cortex and an inner part, medulla. 		
<p>(i) Adrenal cortex</p> <ul style="list-style-type: none"> It secretes 3 groups of steroid hormones. 	<p>(a) Glucocorticoids</p>	<p>Regulate the metabolism of protein, fats and carbohydrates in the body and the level of blood sugar.</p>
	<p>(b) Mineralocorticoids (Aldosterone)</p>	<p>Regulate water and mineral balance in body.</p>
	<p>(c) Sexcorticoids</p>	<p>Stimulate the development of secondary sexual characters both in males and females.</p>
<p>(ii) Adrenal medulla</p> <ul style="list-style-type: none"> It secretes 2 hormones. 	<p>Adrenaline (Epinephrine) and Noradrenaline (Nor-epinephrine)</p>	<p>Both these hormones together control emotions, fear, anger, blood pressure, heart beat, respiration and relaxation of smooth muscles.</p>



<p>8. Pancreas</p> <ul style="list-style-type: none"> It is a compound gland in the abdominal region located posterior to the stomach. Its endocrine part is Islets of Langerhans, which secretes 2 hormones. 	(a) Insulin	Regulates the conversion of glucose to glycogen, <i>i.e.</i> , it lowers blood glucose level.
	(b) Glucagon	Regulates the conversion of glycogen back to glucose, <i>i.e.</i> , it increases blood glucose level.
<p>9. Ovaries</p> <ul style="list-style-type: none"> These are a pair of glands present in the lower abdominal region in females. 	(a) Oestrogen	Plays an important role in ovulation. It is responsible for development of secondary sexual characteristics in females like mammary glands, voice, hair pattern, etc.
	(b) Progesterone	Helps in the preparation of uterus for the reception of fertilised ovum. Also helps in the maintenance of pregnancy.
<p>10. Testes</p> <ul style="list-style-type: none"> These are extra-abdominal in position. The interstitial or Leydig's cells present in testes produce the male hormone. 	Testosterone	Stimulates spermatogenesis, regulates the growth, development and functioning of accessory sex organs and controls the secondary sexual characteristics in males, such as enlargement of penis and scrotum, growth of facial and pubic hair and enlargement of larynx that causes deepening of voice.

► **Feedback mechanism:** The timing and amount of hormones released by various glands are controlled by the 'feedback mechanism' which is in-built in our body. For example, if the sugar level in the blood rises too much, they are detected by the cells of pancreas which respond by producing and secreting more insulin into blood. And as the blood sugar falls to a certain level, the secretion of insulin is reduced automatically.

► **Control and coordination in plants:** Plants coordinate their behaviour against environmental changes by using hormones. The hormones in plants coordinate their

behaviour by affecting their growth. And the effect on growth of the plant can result in the movement of its part like shoot (stem) or root, etc. The plants respond to various stimuli very slowly by growing. Hence, in most of the cases, the response of a plant to a stimulus cannot be observed immediately. It usually takes a considerable time to observe the effect of a stimulus on a plant.

► **Plant hormones (or Phytohormones):** The plant hormones coordinate the activities of the plant by controlling one or the other aspect of the growth of the plant. So, they are also known as plant growth substances. The growth of a plant can be divided into three stages: **cell division**, **cell enlargement** and



cell differentiation (or cell specialisation), and these stages have particular locations in a plant. There are 5 major types of

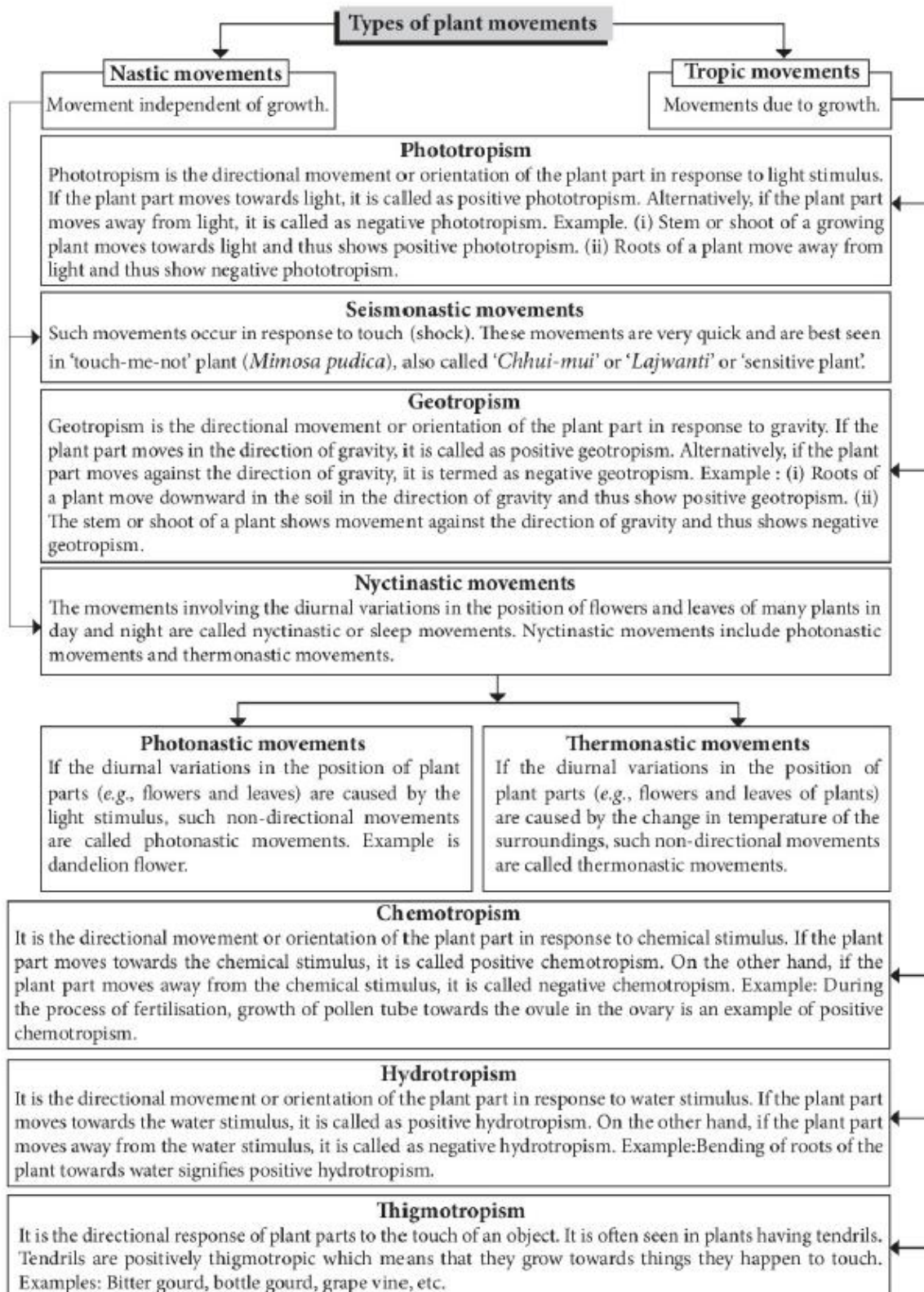
phytohormone. These phytohormones with their functions are discussed in the given table:

Table: Plant hormones and their functions

Plant hormones	Functions
Auxins	These promote cell enlargement and cell differentiation in plants. These promote stem and fruit growth. These regulate important plant growth movements, <i>i.e.</i> , tropisms. These induce parthenocarpy (<i>i.e.</i> , the formation of seedless fruits without fertilisation) in number of plants.
Gibberellins	These promote cell enlargement and cell differentiation in plants in the presence of auxins. These also promote growth in stems and fruits. Rossette plants (<i>i.e.</i> , plants that show profuse leaf development but reduced internode growth) show bolting and flowering when treated with gibberellins. These also induce parthenocarpy in many plants.
Cytokinins	These promote cell division in plants. These play vital role in the morphogenesis in plants. These help in breaking the dormancy of seeds and buds. These delay the ageing in leaves. These promote the opening of stomata. These also promote fruit growth.
Ethylene	It promotes growth and ripening of fruits. It helps in breaking the dormancy in buds and seeds. It stimulates the formation of separation layer (abscission zone) in leaves, flowers and fruits. It promotes yellowing and senescence of leaves.
Abscisic acid (ABA)	It promotes the dormancy in seeds and buds and thus inhibits growth. It also promotes the closing of stomata and thus affects wilting of leaves. It also promotes the falling of leaves (abscission) and senescence in leaves.

►► **Plant movements** : Plants do not show locomotion (movement of the entire body). However, movements of the individual parts or organs of a plant (like shoot, root, leaves, etc.) are possible when they are subjected to some external stimuli like light, force of gravity, chemical substances, water and

touch, etc. These movements of the plant parts are usually caused by an unequal growth in their two regions by the action of plant hormones, under the influence of the stimulus. When a plant part shows movement, it remains attached to the main body of the plant.



Flow chart : Types of plant movement



Previous Years' CBSE Board Questions

7.1 Animals-Nervous System

VSA (1 mark)

1. How is the spinal cord protected in the human body? *(Delhi 2010)*
2. Name two tissues that provide control and coordination in multicellular animals. *(Delhi 2009)*

SA II (3 marks)

3. What is reflex action? Describe the steps involved in a reflex action. *(Foreign 2009)*

LA (5 marks)

4. (a) Draw the structure of a neuron and label the following on it :
nucleus, dendrite, cell body and axon.
(b) Name the part of neuron :
(i) Where information is acquired
(ii) Through which information travels as an electrical impulse. *(AI 2008)*

7.2 Coordination in Plants

VSA (1 mark)

5. Name the two types of tropism. *(Foreign 2010)*
6. Which one of the following actions on touch is an example of chemical control?
Movement of the touch-sensitive plant
Movement in human leg *(Foreign 2009)*

SA I (2 marks)

7. What are 'nastic' and 'curvature' movements? Give one example of each. *(Delhi 2009)*

SA II (3 marks)

8. Design an experiment to demonstrate that the roots bend in the direction of water stimulus. *(Foreign 2010)*
9. What is 'phototropism'? How does it occur in plants? Describe an activity to demonstrate phototropism. *(AI 2009)*

LA (5 marks)

10. (a) What is (i) phototropism and (ii) geotropism? With labelled diagrams describe an activity to show that light and gravity change the direction that plant parts grow in.
(b) Mention the role of each of the following plant hormones:
(i) Auxin (ii) Abscisic acid *(AI 2008)*

7.3 Hormones in Animals

VSA (1 mark)

11. Which endocrine gland secretes the growth hormone? *(Foreign 2009)*

SA I (2 marks)

12. What are hormones? Name the hormone secreted by thyroid and state its function. *(Delhi 2010)*

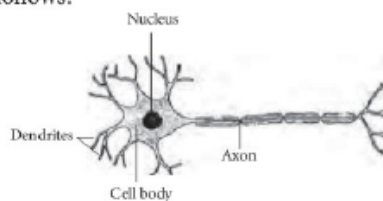
SA II (3 marks)

13. Define "hormones". Name the hormone secreted by thyroid. Write its function. *(Delhi 2008)*



Detailed Solutions

1. In the human body, spinal cord is enclosed within bony cage called the vertebral column which protects it from injury.
2. In multicellular animals, control and coordination, takes place through two types of tissues *i.e.*, nervous tissue and muscular tissue.
3. Reflex action is a spontaneous, automatic and mechanical response to a stimulus acting on a specific receptor without the will of the animal. In reflex action, fine tips (dendrites) of receptors (sensory neurons) quickly relay a message (electric impulse) *via* sensory nerves to the spinal cord. The spinal cord then sends information (impulse) *via* motor nerves to effectors (muscles or glands) which show response. The path taken by nerve impulses in a reflex action is called as reflex arc.
4. (a) : Diagrammatic representation of a neuron is as follows:



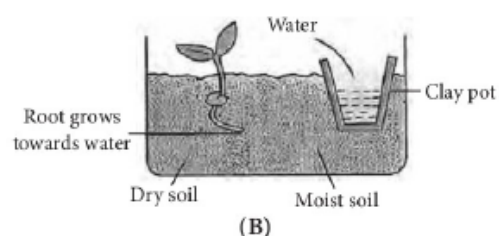
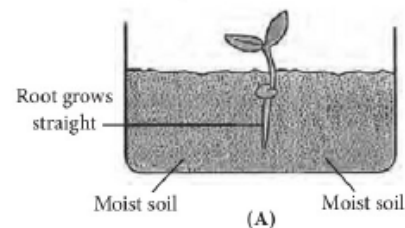
- (b) (i) Dendrites or dendrons acquires the information and sets off a chemical reaction that creates an electrical impulse.
 - (ii) The electrical impulse travels from the dendrite to cell body and then along the axon to its nerve ending. At the end of the axon, the electrical impulse sets off the release of chemicals which cross the synapse (gap) and start a similar electrical impulse in a dendrite to the next neuron. This is a general scheme how nervous impulse travel in the body.
5. The two types of tropism are phototropism and geotropism.
 6. Movement of the touch-sensitive plant.
 7. Nastic movements are non-directional induced variation movements that occur due to turgor changes. These are induced by external stimuli such as light, temperature, touch, etc. For example,

if we touch the leaves of *Mimosa pudica* we find that its leaves immediately fold up and droop. This occurs due to turgor changes in cells of plant.

Curvature movements are directional movements that occur in response to external stimuli such as light, force of gravity, etc. This stimuli cause differential growth in specific plant part *via* action of phytohormones. For example, roots of a plant grow downward in the soil in the direction of gravity showing positive geotropism.

8. The given experiment demonstrates the response of roots in the direction of water stimulus.

Take two glass troughs A and B and fill each one of them two-third with soil. In trough A, plant a tiny seedling and water it daily whereas in trough B, plant a similar seedling and also place a small 'clay pot' inside the soil. Do not water the soil (in trough B) but put some water in the clay pot and bury it in the soil and leave it for a few days.



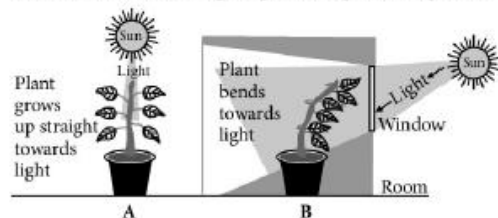
Now, dig up the soil carefully from both the troughs without damaging the roots of seedlings. Result : The roots of seedling in trough A will be straight because it gets water from all sides as soil is watered uniformly. On the other hand, the roots of seedling in trough B will be bent towards the right side because roots get water oozing out from the clay pot which is kept on the right side.

This experiment proves that the roots of a plant grow towards water *i.e.*, positively hydrotropic.



9. Phototropism is the directional movement or orientation of the plant part in response to light stimulus. If the plant part moves towards light, it is called positive phototropism. Alternatively, if the plant part moves away from light, it is called negative phototropism. For example, (i) Stem or shoot of a growing plant moves towards light and thus shows positive phototropism. (ii) Roots of a plant move away from light thus show negative phototropism. Phototropic movement in plant is caused due to the action of auxin hormone. Phototropism can be demonstrated by the following activity.

Take two potted plants and place one plant in the open so that it receives the sunlight coming from above. On the other hand, place the other plant in a room near the window in such a way that it receives sunlight from one side, i.e., through the window. After some days, observe both the plants. You will notice that the first plant (A) (which was kept in the open) has grown up straight towards light. However, the second plant (B) (which was kept in the room and receiving light from one side) has grown by bending towards the light. Thus, we can conclude from this experiment that the stem of plant responds to light by showing growth movement towards light (positive phototropism).



10. (a) (i) For definition of phototropism and its activity refer to answer 9.

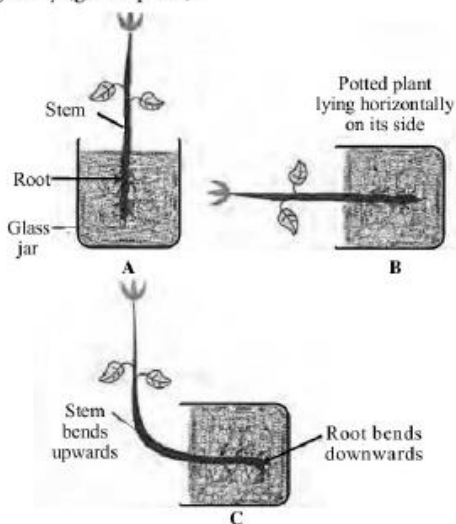
(ii) Geotropism is the directional movement or orientation of the plant part in response to gravity. If the plant part moves in the direction of gravity, it is called positive geotropism. Alternatively, if the plant part moves against the direction of gravity, it is termed as negative geotropism. For example. Roots of a plant move downward in the soil (in the direction of gravity) showing positive geotropism whereas the stem of a plant shows movement against the direction of gravity and thus showing negative geotropism.

The given activity demonstrates geotropism:

Take a potted plant growing in a transparent glass jar. Keep the potted plant growing in a transparent glass jar straight on the ground. Observe that its stem is growing upward and its roots are growing downward. (Fig. A).

Now place this potted plant horizontally on its side on the ground and observe the position of the growing stem and the root. Keep the plant in this position for a few days.

After few days, you will observe that when the potted plant is kept horizontally on its side on the ground, the growing stem and the growing root are parallel to the ground (Fig. B). After few days, you will find that the stem of this plant has bent upward away from earth (negative geotropism) and the root of the plant has bent downward towards earth, (positive geotropism Fig. C). This experiment confirms response of plants towards gravity (geotropism).



(b) (i) Auxin is a phytohormone which is basically growth promoter. It plays many important roles such as :

(I) Promotes cell enlargement and cell differentiation in plants.

(II) These induces tropism.

(III) Induces parthenocarpy, i.e., formation of seedless fruits without fertilisation, in number of plants.



(IV) Auxin promotes apical dominance, a phenomenon in which presence of apical bud does not allow nearby lateral buds to grow. This is because apical bud inhibits the growth of lateral buds by releasing auxins.

(ii) Abscisic acid is a phytohormone which is basically growth inhibitor. It is also called stress hormone because its production is stimulated by drought, water logging and other adverse conditions. It performs the following functions:

(I) It promotes dormancy in seeds and buds and thus inhibits growth.

(II) It promotes abscission of flower and fruits.

(III) It promotes falling and senescence in leaves.

(IV) It promotes closing of stomata and thus affects transpiration and wilting in leaves.

11. Growth hormone (GH) also called somatotropin, is a peptide hormone secreted by anterior lobe of the pituitary gland.

12. Hormones are the chemical substances secreted by endocrine glands. They regulate biological

processes in living organisms. Thyroid gland secrete three hormones : thyroxine (T_4), tri-iodothyronine (T_3) and calcitonin.

Both thyroxine and tri-iodothyronine are iodinated forms of the amino acid tyrosine. These two hormones have four functions:

(i) They maintain the basal metabolic rate (BMR) of the body by regulating the rate of oxidation of carbohydrates, fats and proteins and production of energy in our body.

(ii) They promote growth of body tissues and development of mental faculties.

(iii) They stimulate tissue differentiation therefore, they affect metamorphosis of a tadpole into an adult frog.

(iv) As they increase heat production, thus they maintain body temperature.

Calcitonin regulates the concentration of calcium and phosphorus in the blood.

13. Refer to answer 12.

