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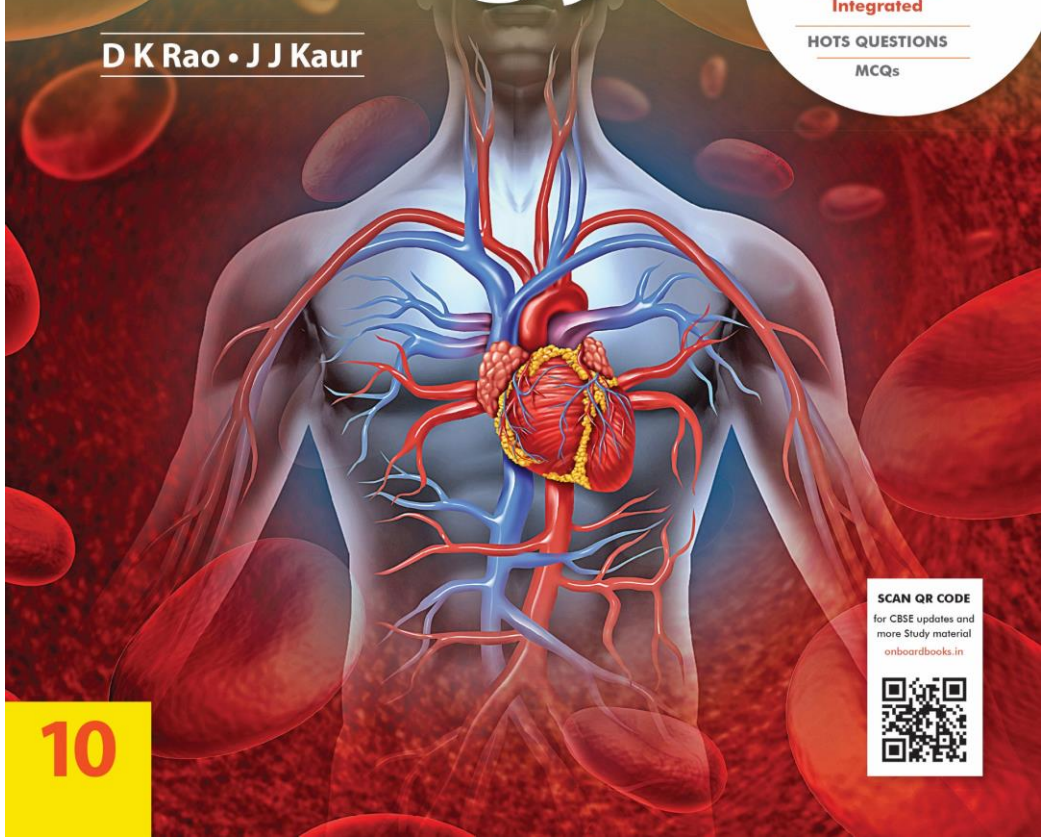

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CBSE
Living Science
Biology

Class 10

Chapter 2 Control and Coordination

LEARNING OBJECTIVES

Stimuli and Receptors

Control and Coordination in Plants

- Tropic Movements or Tropism
- Types of tropisms
- Nastic Movements or Nasties

Plant Hormones

- Types of plant hormones

Coordination in Animals – Nervous System

- Nervous System in Lower Animals
- Control and Coordination in Humans

Nervous System In Humans

- Neurons – The Unit of Nervous System
- Organs of Nervous system in Human Beings

Central Nervous System

- The human brain
- Spinal cord
- Reflex Action and Reflex Arc
- Components of a reflex arc
- Peripheral Nervous System
- Autonomic Nervous System

Endocrine System in Humans

What are Hormones?

- Endocrine and exocrine glands
- Characteristics of hormones
- Endocrine Glands
- Thyroid Gland
- Thyroxine
- Undersecretion
- Adrenal Glands
- Pancreas
- Pituitary – The Master Gland
- Hormones Secreted by Gonads

Stimuli and Receptors

Any change in the environment to which an organism responds and reacts is called a stimulus. Stimuli are detected by group of cells called receptors. The leaves of touch-me-not plant fold if we touch (stimulus) them. Stimuli are detected by group of cells called receptor

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

We have five types of receptors.

- Photoreceptors – sensitive to light
- Phonoreceptors – sensitive to sound
- Olfactoreceptors – sensitive to smell
- Thermoreceptors – sensitive to temperature
- Thigmoreceptors – sensitive to touch

Control and Coordination in Plants

Plants can detect changes in light, water, touch, chemicals, gravity and respond to these changes by the action of hormones. Since plants do not have nervous system, they use hormones for coordination and response. Therefore, the function of control and coordination in plants is performed by chemical substances called hormones.

Plant movements can be of two types:

- Tropic movements
- Nastic movements

Tropic Movements or Tropism

The environment has a great influence on a plant's shape. **A growth response that results in the movement of plant part towards or away from stimuli is called tropism.** In simpler terms, the movement of a plant in the direction of stimulus is known as **tropism**. When the growth movement of the plant part is towards the stimulus, it is called **positive tropism**. When the growth movement of the plant part is against or away from the stimulus, it is called **negative tropism**.

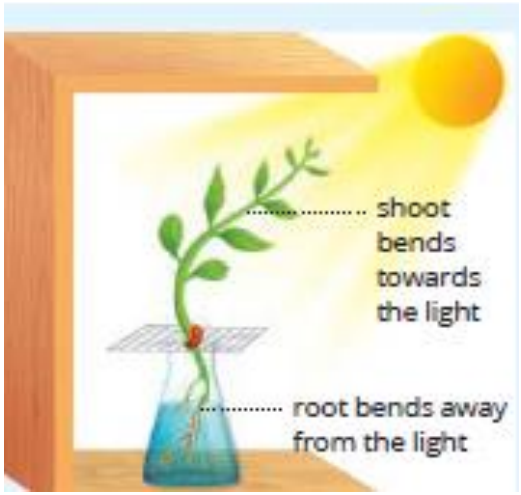
Types of tropisms

There are five types of tropisms found in the plants – **phototropism**, **geotropism**, **hydrotropism**, **chemotropism** and **thigmotropism**.

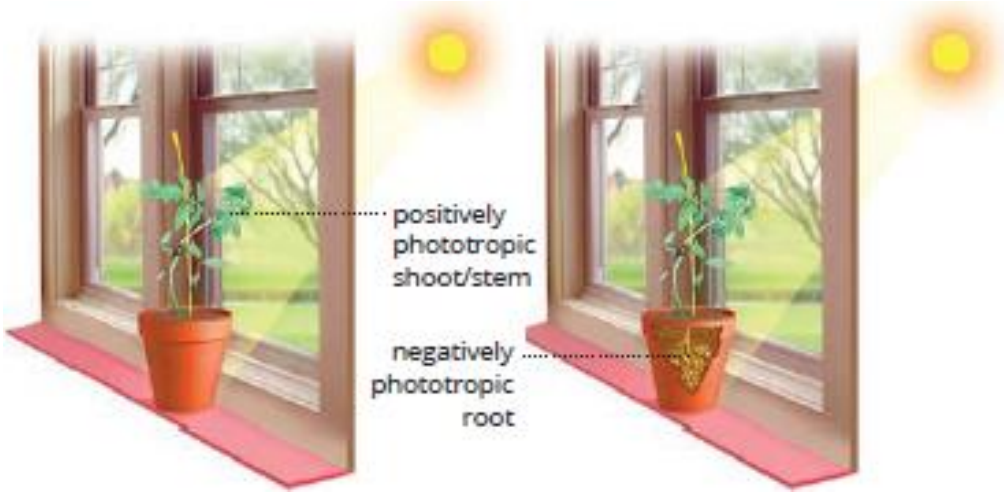
Phototropism – movement in response to light

The growth and movement of a plant part in response to the light is called phototropism. For example, movement of sunflower in the direction of sunlight is phototropism.

If the plant part (like shoot/stem) moves towards the light then it shows **positive phototropism**. If the plant part (like its roots) moves away from light then it shows **negative phototropism**.

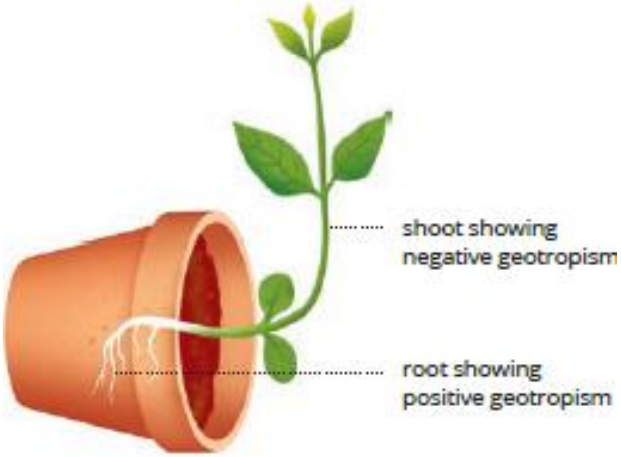


Positive and negative phototropism



Positive phototropism

Negative phototropism



Geotropism – movement in response to gravity

The downward movement of a plant part in response to gravitational force of the earth is called geotropism. Roots show positive geotropism while shoots show negative geotropism.

Hydrotropism – movement in response to water

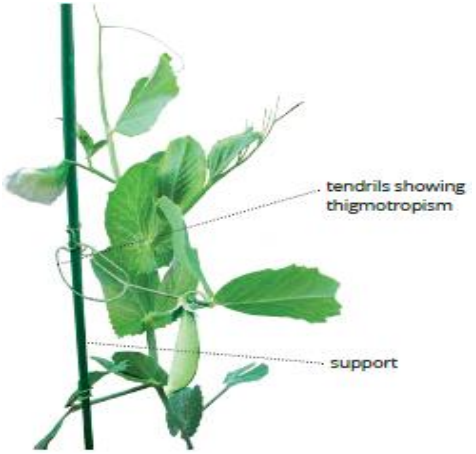
The movement of plant parts toward water or moisture is called hydrotropism**.** The roots always grow towards water, therefore **roots are positively hydrotropic.**

Chemotropism – movement in response to chemicals

The movement of a plant part due to chemical stimuli is called chemotropism. For example, pollen tube grows through the style towards ovules in response to certain chemical secretions from stigma.

Thigmotropism – movement in response to touch

The movement of a plant part in response to the touch of an object is called thigmotropism. For example, the tendrils of a plant grow towards a support, touch it and wind around that support.



Nastic Movements or Nasties

The movement of a plant part in response to an external stimulus when the direction of response is not based on the direction of stimulus is called **nastic movement.** When the non-directional movement of a plant part is in response to touch, it is called **thigmonasty.** For example, movement in touch-me-not plant (*Mimosa pudica*).

When the non-directional movement of a plant part (usually petals) is in response to light, it is called **photonasty.** For example, opening and closing of *Dandelion* flower in response to light intensity.

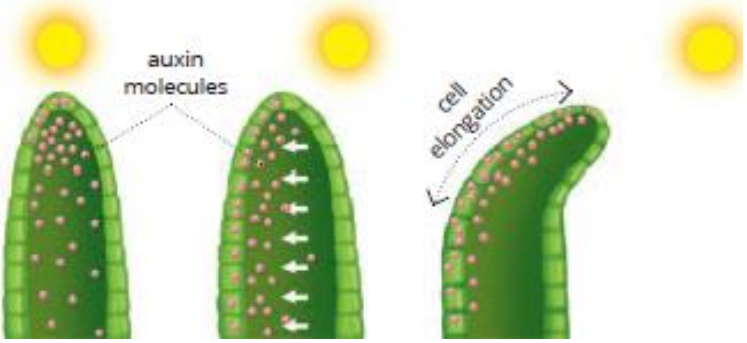
Plant Hormones

Plants produce certain chemical substances in their cells which regulate their growth. These chemicals are secreted in very minute quantity but have a marked effect on physiological processes in a plant. Some of these chemicals stimulate plant growth while others retard the rate of growth of plants. Therefore, these chemicals are known as **plant growth regulators** or **plant hormones** or **phytohormones**.

Types of plant hormones

There are five main types of naturally occurring plant hormones or plant growth regulators.

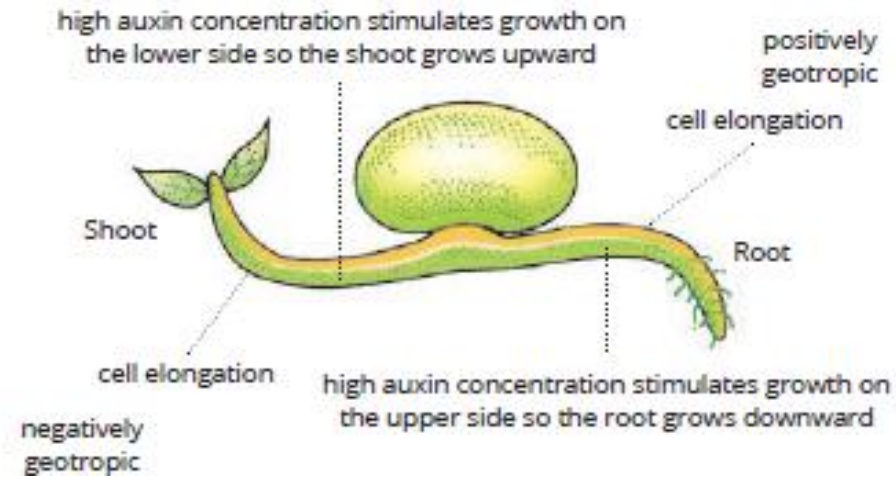
1. Auxins 2. Gibberellins 3. Cytokinins 4. Ethylene 5. Abscisic acid (ABA)



❖ **Auxin** is a growth hormone and helps the cells to grow longer. It is **synthesized at the shoot and root tip**.

❖ Auxin controls the phototrophic behaviour of a plant.

Auxins also **controls the geotropic behaviour** of a plant.



❖ **Gibberellin** promotes **cell enlargement** in the presence of auxins.

❖ It promotes **cell division** and stimulates **stem elongation**.

❖ It stimulates **seed germination** by breaking seed dormancy.

❖ **Cytokinin** promotes **cell division**. Therefore, it is present in high concentration in areas of rapid cell division like fruits and seeds.

❖ It controls **cell enlargement** and **cell differentiation**

❖ **Ethylene** is a **gaseous hormone** that has **inhibitory effect on growth**.

❖ It induces **ripening of fruits**

❖ Abscisic acid is a **growth inhibiting hormone**.

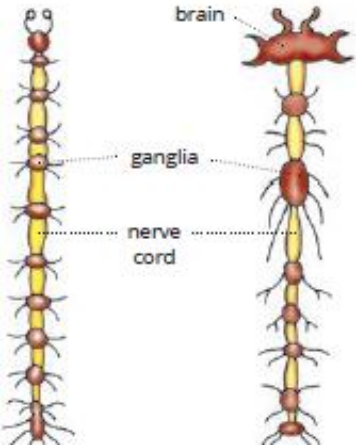
❖ It also **promotes wilting of leaves**.

Coordination in Animals – Nervous System

All multicellular animals (except sponges) have specialized cells called neurons or nerve cells for responding to external changes (i.e. stimuli) and coordinate their activities. This system made of nerve cells is called **nervous system**. In higher animals, including humans, **the nervous system works with the endocrine (hormonal) system to communicate**, **integrate** and **coordinate the functions of various organs and organ systems in the body.**

Nervous System in Lower Animals

The **cnidarians**, like *Hydra*, jelly fish and sea anemone, have the simplest form of nervous organisation amongst all animals. These animals have a **net of nerve cells and fibres** that helps in the conduction of impulses from one part of the body to another. These animals lack brain or any local cluster of neurons.



In case of other invertebrates such as **insects**, the organization is further advanced. In addition to a small **centralized**, **bilobed brain**, their bodies possess structures called **ganglia** and **nerve cord** arising from brain that help to coordinate the working of the animal's body. From each ganglion, many **small nerves** arise which go to different parts of the body.

Control and Coordination in Humans

In humans, control and coordination is brought about by two systems –
1. Nervous system and **2.** Endocrine (or hormonal) system.

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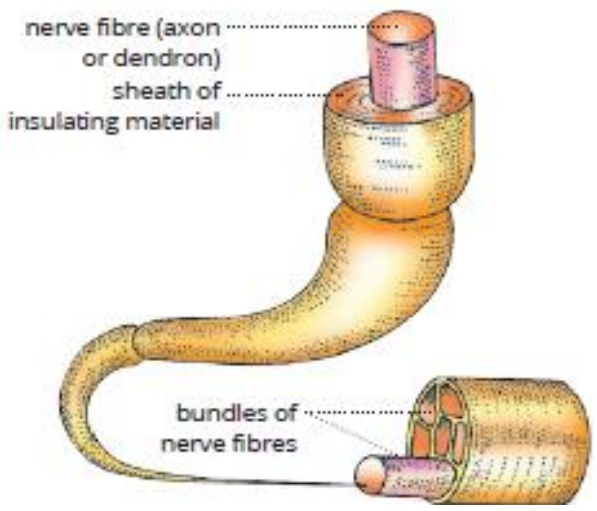
Nervous System in Humans

In humans, the nervous system is composed of **nerves** which connect the brain and the spinal cord to all parts of the body.

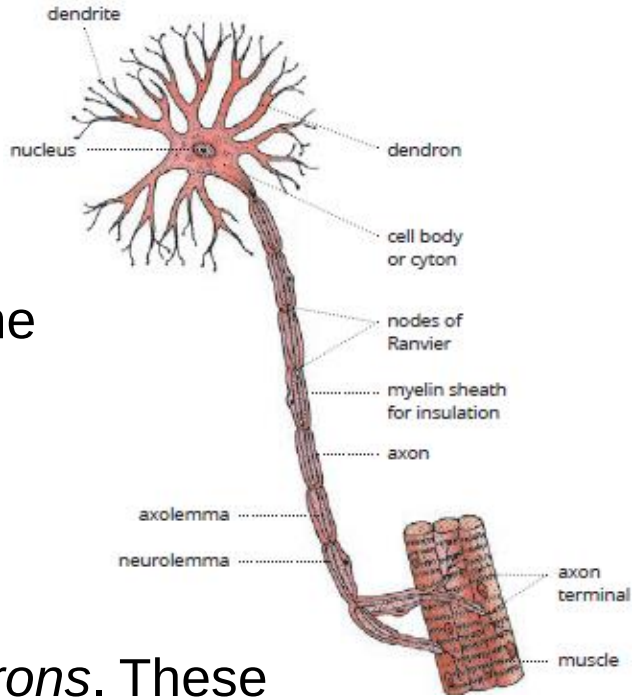


Neurons– The unit of Nervous system

Nerves are composed of nerve fibres bundled together like the strands of a telephone cable . **These nerve fibres or nerve cells are called neurons which form the basic units of the nervous system.** A neuron is the longest cell in the body. Messages are conducted by neurons in the form of electrical impulses or nerve impulses. Thus, neuron is the structural and functional unit of the nervous system.

Structure of a nerve cell (Neuron)

Each neuron consists of three principal parts.
1. Cell body or cyton 2. Axon, and 3. Dendrites



Types of neurons

There are three types of neurons depending upon the direction in which they transmit the nerve impulse.

Sensory neurons: These are also called **afferent neurons** . These neurons carry messages from receptors towards the brain or spinal cord.

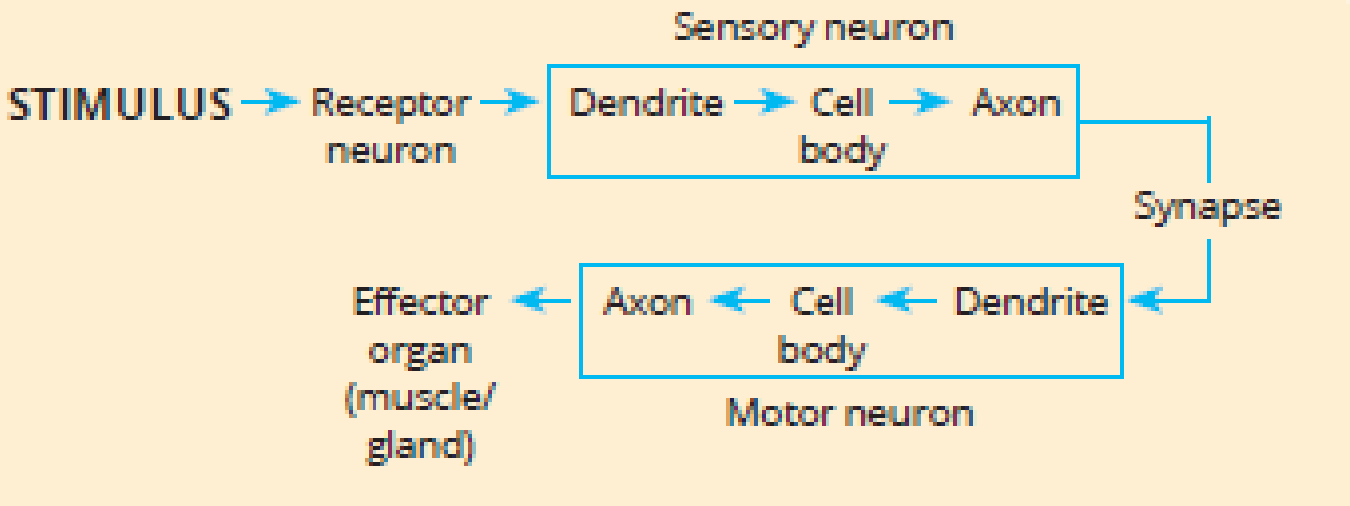
Motor neurons: These are also called *efferent neurons*. These neurons take messages away from the brain or spinal cord towards the effector organ, such as muscles and glands.

Relay neurons: The nerve cells that carry signals/ messages from the sensory neurons to the motor neurons are called **relay neurons**. These are found in the central nervous system.

Synapse – the gap between two neurons

Neurons are not attached to each other. There is a gap between them. The small gap between the axon endings of one nerve cell and cyton or dendrite of the next nerve cell is called synapse.

Flow chart showing direction of nerve impulse

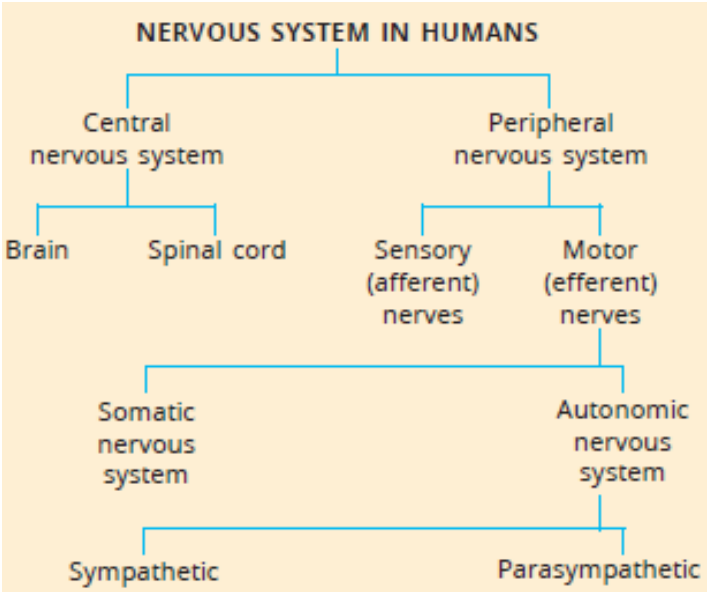


Organs of Nervous System in Human Beings

The nervous system in human beings is divided into two main parts.

1. The **central nervous system (CNS)** includes the brain and the spinal cord. It is the centre for control and coordination of all body functions.

2. The **peripheral nervous system (PNS)** consists of nerves that arise from the central nervous system (brain and spinal cord) and connects it to the rest of the body.

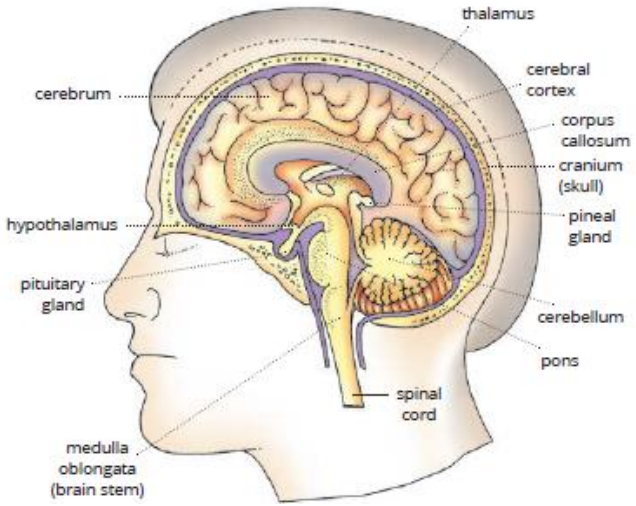


Central Nervous System

The central nervous system (CNS) consists of brain and spinal cord.

The human brain

The human brain is a highly developed organ and is situated in the **cranium** of the skull. In an adult, it weighs about 1200–1400 g. **The cerebrospinal fluid** fills the spaces between the meninges and also brain cavities or the ventricles. The fluid protects the brain from shock.



The human brain is divided into three major regions.
1. Forebrain 2. Midbrain 3. Hindbrain

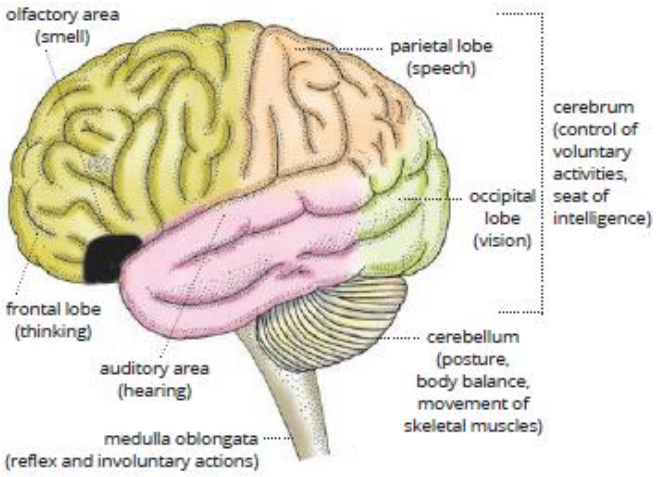
Forebrain

It is the anterior region of the brain. It has three main parts – the **olfactory lobes, the cerebrum** and **diencephalon**. **The olfactory lobes** are a pair of very small, club-shaped bodies which remain fully covered by the cerebrum. Thus, they are visible only in the ventral view of brain. They act as the centre of smell. **Cerebrum** is the largest, highly developed and most prominent part of the brain. The **diencephalon** mainly consists of the pineal gland, pituitary gland, thalamus and hypothalamus.

It possesses control units for body temperature, hunger, thirst, sleep, etc.

Midbrain

It is a thick-walled structure and constitutes a comparatively smaller portion of the brain. The midbrain connects the anterior region of the brain to the posterior region and therefore all nerve fibre tracts pass through this region. **It consists of four optic lobes concerned with vision.**



Hindbrain

The hindbrain has three main centres – cerebellum, pons and medulla oblongata.

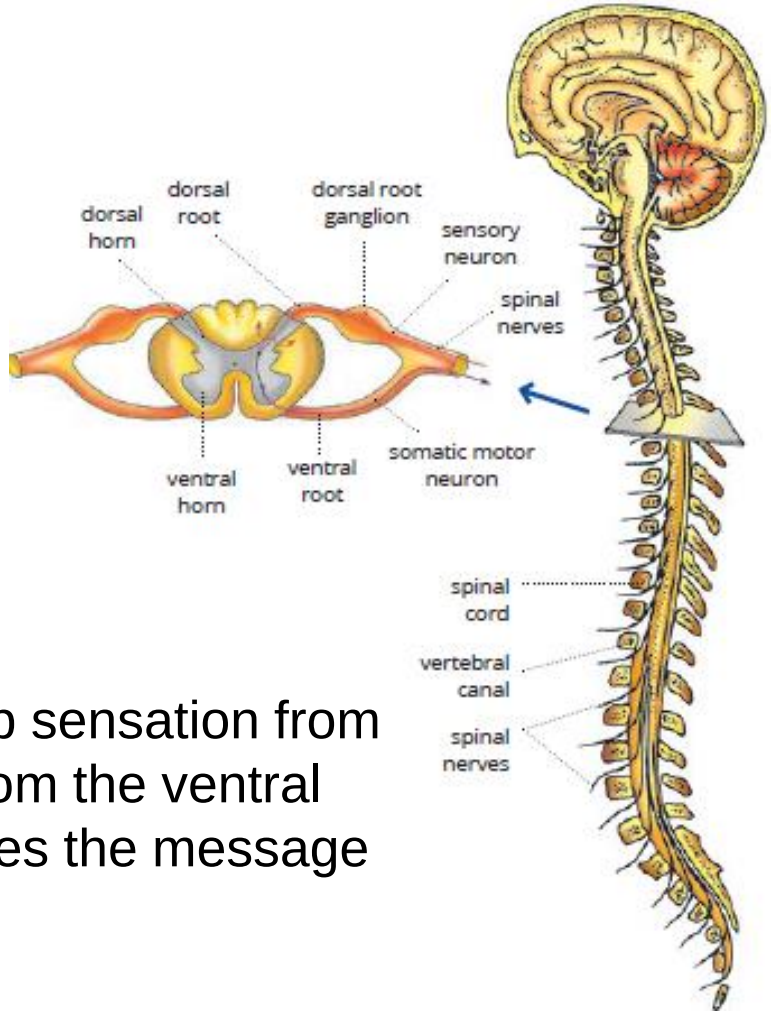
The **cerebellum** is situated in the dorsal region of hindbrain. It maintains equilibrium and controls postures. It makes the body movements smooth, steady and coordinated.

Pons is a bridge between the cerebrum and the cerebellum. It also connects the forebrain to the spinal cord. Pons helps in respiration.

The **medulla oblongata** is the lowermost part of the brain. This part of the brain extends into the spinal cord. It controls involuntary actions such as peristalsis, breathing, swallowing, heart beat, etc.

Spinal cord – structure and functions

The **spinal cord** is a cylindrical cord-like structure which arises from the medulla oblongata and passes through the **vertebral column** or backbone. The vertebral column is made up of small bones which protect the extremely delicate structure of the human body.



On each side of the spinal cord are two horns, the **dorsal horn** and the **ventral horn**.
To the dorsal horn joins a nerve which picks up sensation from various organs. It is called **sensory nerve**. From the ventral horn or root arises the **motor nerve** which takes the message from spinal cord to the concerned organ.

Functions of spinal cord

- It is the centre for reflex actions.
- It conducts impulses from and towards the brain.
- It also mediates most of the involuntary activities.

Reflex Action and Reflex Arc

There are certain body responses which are immediate and do not require any processing by the brain. These responses or actions are controlled by the spinal cord. These are called **reflex actions**.

A reflex action may be defined as a spontaneous, automatic and mechanical response to a stimulus controlled by the spinal cord without the involvement of brain. The pathway followed by sensory and motor nerves in a reflex action is called **reflex arc**

Peripheral Nervous System

Peripheral nervous system comprises the nerves that connect the central nervous system with different parts of body. The neurons of peripheral nervous system include both motor neurons and sensory neurons.

The fibres of motor and sensory neurons are bundled together into nerves, which are of two types.

- **Cranial nerves** arise directly from the brain, such as the optic nerve
- **Spinal nerves** arise from the spinal cord

Autonomic Nervous System

ANS is primarily a motor system consisting of neurons that control the functioning of many organs automatically even without our thinking

Endocrine System In Humans

What are Hormones?

The endocrine system is involved in coordinating various body activities. It affects body activities by releasing chemical messengers called hormones. Hormones are chemical messengers secreted by endocrine glands and carried by blood and lymph to the target organ elsewhere in the body to stimulate a specific activity that may be biochemical or physiological.

Endocrine and exocrine glands

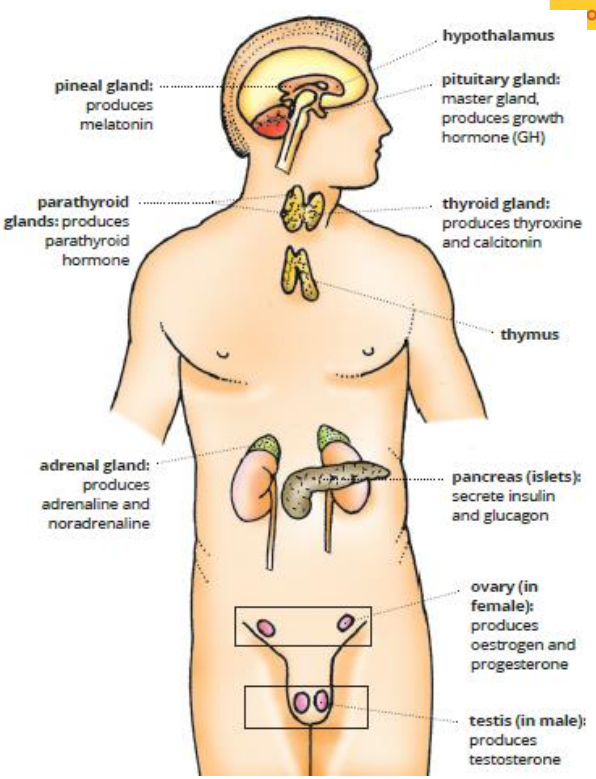
Hormones are secreted by **endocrine glands** These are also called **ductless glands** because they do not have their own ducts, and their secretions are directly released into the tissue space next to them. On the other hand, **exocrine glands** secrete substances directly into the duct. They have their own ducts which carry the secretions directly to the target organ.

Characteristics of hormones

Hormones are regulatory chemicals which are **secreted by endocrine glands directly into the blood**. They are **produced in very minute quantity**. They are **biologically very active** and their **action is very rapid**. They **act only on target organs or cells** located usually away from their sources.

Endocrine Glands

The major endocrine glands in our body are as follows: 1.Thyroid gland 2. Parathyroid glands 3. Thymus gland Hypothalamus gland 4. Pancreas 5. Pituitary gland 6. Pineal gland 7. Adrenals 8.Gonads



Thyroid Gland

The **thyroid gland** is a large endocrine gland located in the neck region just in front of the trachea or windpipe. The thyroid gland secretes two hormones – thyroxine and calcitonin.

Thyroxine: It regulates body temperature by energy production; growth and development of the body and mental development; activities of the nervous system and metabolism of carbohydrate, protein and fat.

Under secretion

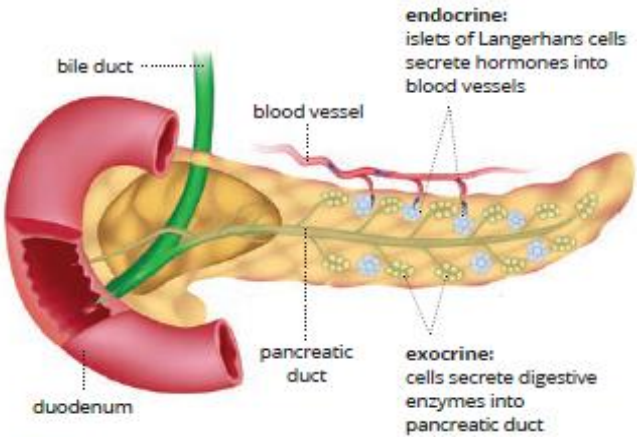
Undersecretion of thyroxine may cause, **Simple goitre:** In this condition, the **thyroid gland of adults enlarges** and becomes visible as a **swelling in the neck**. Insufficient secretion of thyroxine or insufficient amount of iodine in diet may cause simple goitre.

Adrenal Glands

In our body, two adrenal glands are present, one on top of each kidney. Adrenal glands secrete two major hormones – **adrenaline** (epinephrine) and **noradrenaline** (nor-epinephrine). Adrenaline accounts for almost 80 per cent of the total secretion of the adrenal gland.

Pancreas

Pancreas is a **compound gland** present in the abdominal region. It secretes both digestive juice as well as hormones. It has two parts namely an exocrine (duct) part, which produces digestive juices, and an endocrine (ductless) part, which secretes hormones. Its endocrine part contains hormone secreting cells called Islets of Langerhans.



Pancreas secretes insulin hormone

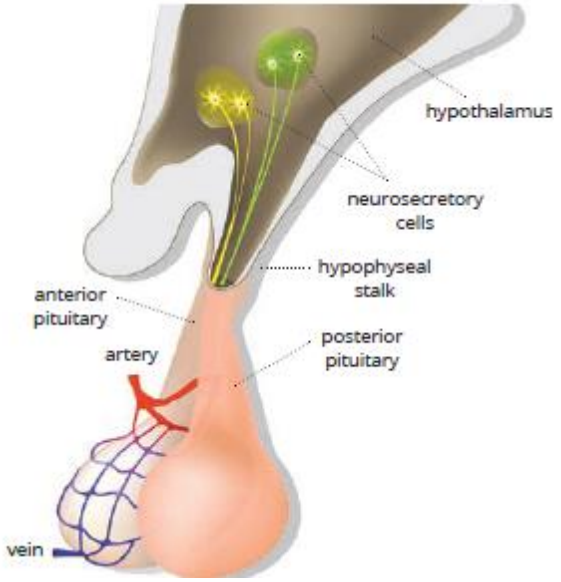
It **regulates blood sugar level** in two ways.

1. Whenever there is increase in blood glucose, insulin is secreted which induces uptake of glucose. This reduces the blood glucose level.

2. It stimulates deposition of extra glucose as glycogen in the liver and muscles.

Pituitary – The master gland

The pituitary is a small gland, about 1 cm in diameter. It lies just below the hypothalamus, (the midbrain) connected to it by a stalk-like structure called **hypophyseal stalk**. It is popularly known as **master gland** because **it controls the functioning of all other endocrine glands**. Since most hormones secreted by pituitary stimulate other glands to produce their hormones, they are called **tropic hormones**. The **pituitary releases growth hormone** (GH).



Hormones Secreted by Gonads

In males, there are a pair of testes that **secrete** male hormone, **testosterone**, which in turn influences the appearance of **secondary sexual characteristics** like development of male sex organs and male features like deeper voice, more body hair, beard, moustache, etc. These changes are associated with puberty and occur at an age of approximately 13–14 years.

Note: Refer to Table 2.3 for Major hormones secreted in the human body, their source glands and principal functions

SUMMARY...

❖Auxin is a growth hormone that controls the phototropic and geotropic behaviour of a plant.

❖Gibberellin promotes cell division and stem elongation.

❖ Cytokinin promotes cell enlargement and differentiation.

❖ Ethylene is a gaseous growth inhibiting hormone. It promotes fruit ripening.

❖ Abscisic acid is a growth inhibiting hormone. It promotes wilting of leaves.

❖ The functional unit of the nervous system is a highly specialized cell called the nerve cell or the neuron. Each neuron has three principal parts – the cell body or cyton, the axon and dendrites.

❖ The nervous system receives a stimulus through a receptor organ, integrates or coordinates it, and effects a response through the effector organ.

❖ The human brain has three main divisions – the forebrain, the midbrain and the hindbrain.

❖ Spinal cord is the centre for reflex actions.

❖ Reflex action is a spontaneous, automatic and mechanical response to a stimulus controlled by the spinal cord without the involvement of brain.

❖ Hormones are secreted by endocrine glands to stimulate a specific physiological change. They affect only their target cells in a particular organ.

❖ Hormones **1.** are secreted in minute quantity, **2.** they are specific chemical messengers, **3.** regulate physiological processes by chemical means, **4.** are secreted by ductless (endocrine) glands, **5.** are poured directly into blood stream, and **6.** act very rapidly and on a specific target away from the source.

❖ Thyroid gland is situated in the neck region. It secretes thyroxine. Thyroxine regulates body temperature by energy production. It regulates carbohydrate, protein and fat metabolism.

❖ Adrenal glands secrete adrenaline and noradrenaline hormones. Both these hormones together control emotions, fear, anger, blood pressure and heartbeat rate and are called emergency hormones.

❖ Pancreas produces insulin. Insulin regulates conversion of glucose to glycogen.

❖ Pituitary gland secretes growth hormone (GH). It controls the overall growth of the body. Its hyposecretion causes dwarfism and hypersecretion causes gigantism in children.

❖ Testes secrete testosterone, while ovaries secrete progesterone and oestrogen. These hormones help in the development of secondary sexual characteristics in boys and girls, respectively.

THANK YOU