

CONTROL AND COORDINATION

KEY POINTS

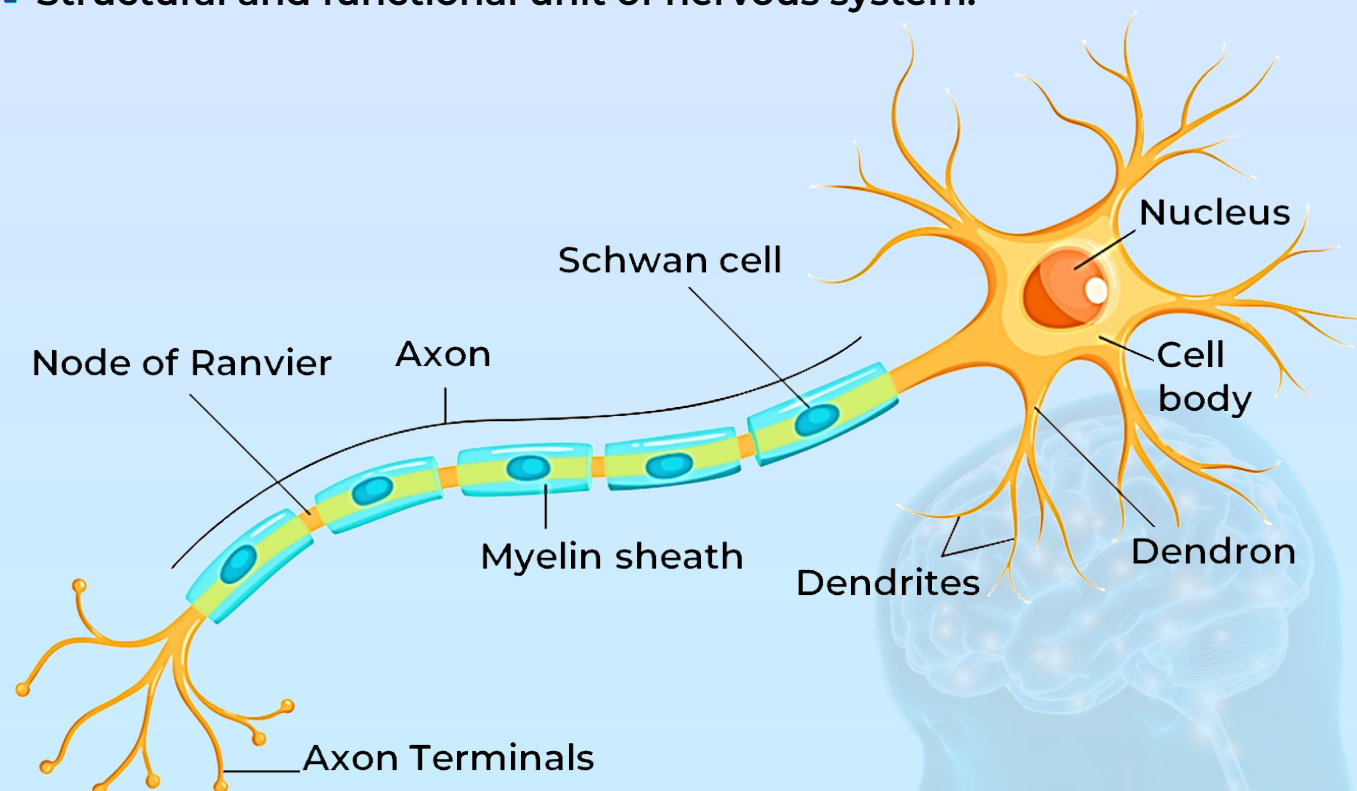
“The nervous system, in coordination with the endocrine system communicates, integrates and coordinates the various organs and organ system in the body.”

Nervous system

- ◆ The nervous system in vertebrates is highly evolved which is the control system for all our actions, thinking and behaviour.

Neuron

- ◆ Structural and functional unit of nervous system.



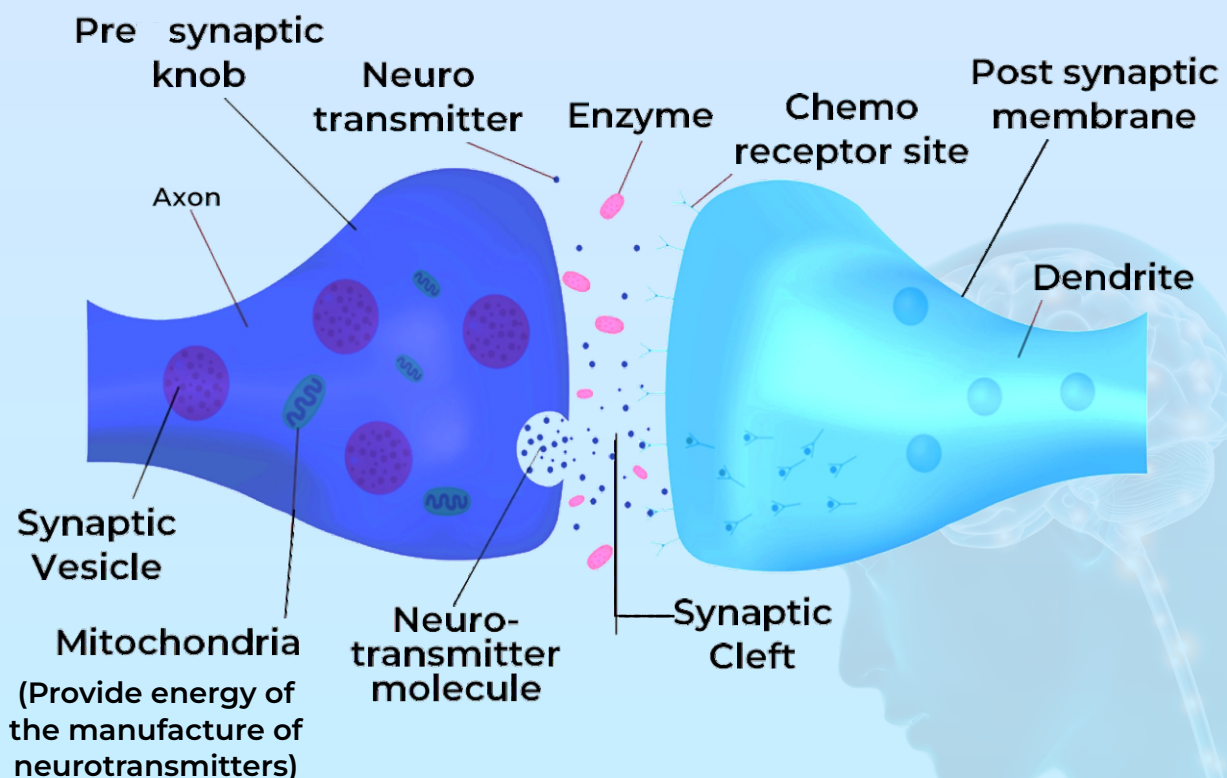
Note

Nissl's granules : Clumps of ribosomes.
Deeply stained particles in cyton.

- ◆ **Telodendria** : Axon has uniform thickness but it has terminal thin branches called telodendria.
- ◆ **Terminal end buttons or synaptic knobs** : It occurs at the end of telodendria.
- ◆ **Stimulus** : An agent or a change in external or internal environment that induces reaction in the body.
- ◆ **Response** : A change in activity in the body of an organism due to stimulus.
- ◆ Axon conducts impulse away from cyton to other neuron.
- ◆ Dendrites receive impulse from receptor or other neuron and bring it to cyton.

Electrochemical Mechanism of Transfer of Nerve Impulse

- ◆ Any two neurons in the nervous system do not join to one another completely, there is always a very small gap between the two neurons. This gap is called synapse.

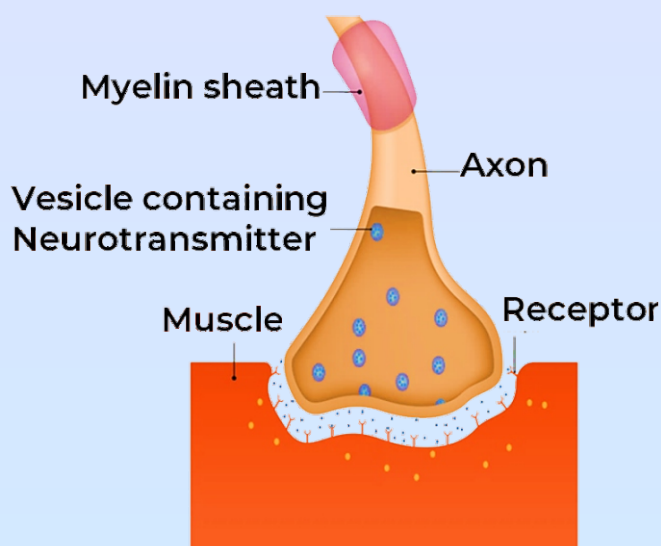


Note

Neurotransmitter : It is a chemical secreted by axon terminal for transmission of impulse to the next neuron, muscle, gland or organ e.g. acetylcholine, nor adrenaline, glutamic acid.

Neuromuscular junction

- ◆ A neuromuscular junction is a place in the body where the axons of motor nerves meet the muscle, thus transmitting messages from the brain which cause the muscle to contract and relax.



Reflex Action

A reflex action is a quick, involuntary action in response to an external or internal stimulus, generally without involvement of the brain.

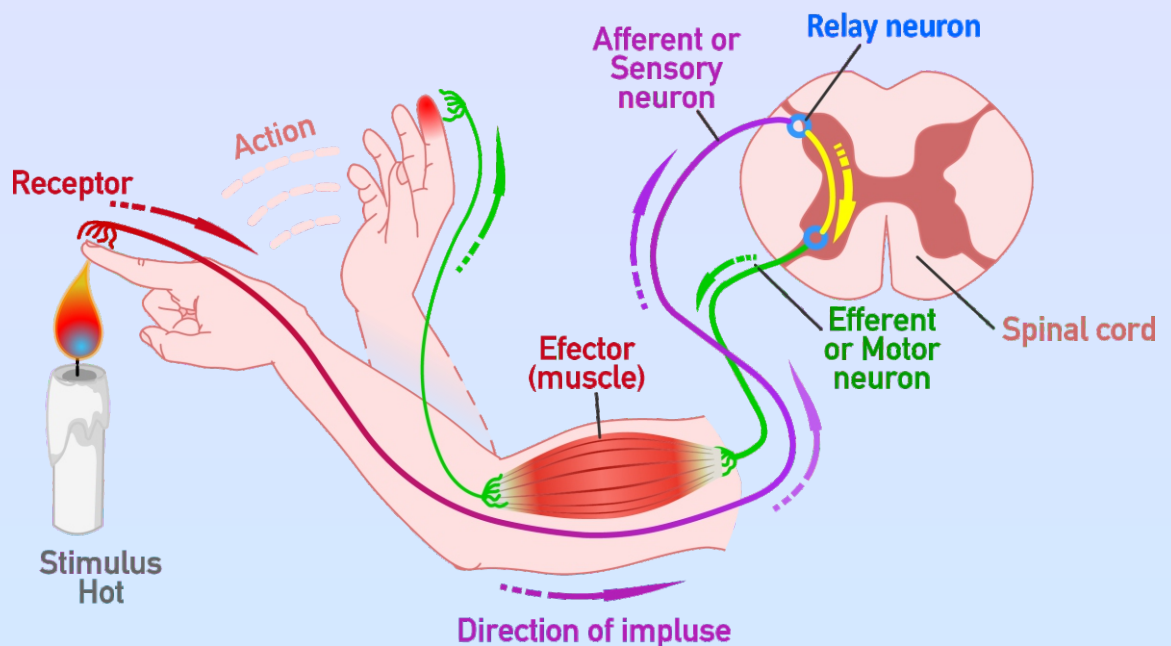
Example : A tap below the knee result in sudden kicking movement of lower leg (a knee-jerk reflex). Similarly, when we touch a hot object we spontaneously withdraw our hand.

Reflex action are of two types

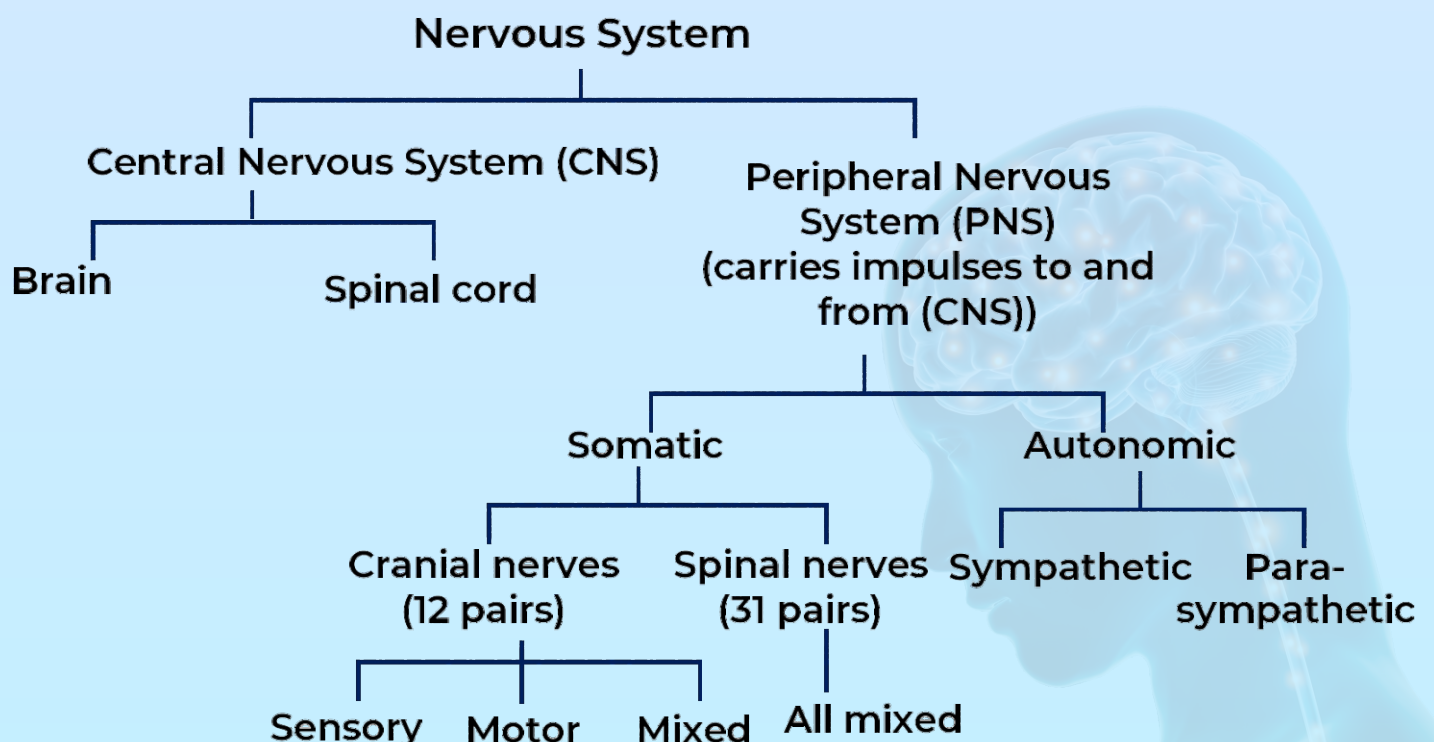
- ◆ **Unconditioned reflex** : Which are inborn and inherited. e.g. sneezing and coughing.
- ◆ **Conditioned reflex** : Which are learned reflexes. e.g. cycling and salivation on smelling one's favourite food.

A reflex arc is the shortest route that can be taken by an impulse from a receptor to an effector. The basic components of reflex arc are a receptor, a sensory neuron, a relay centre, a motor neuron and an effector (muscles or gland).

Stimulus → Receptor organs → Sensory neurons → CNS (Brain/Spinal cord) → Motor neuron → Effector organ → Response.



Nervous System

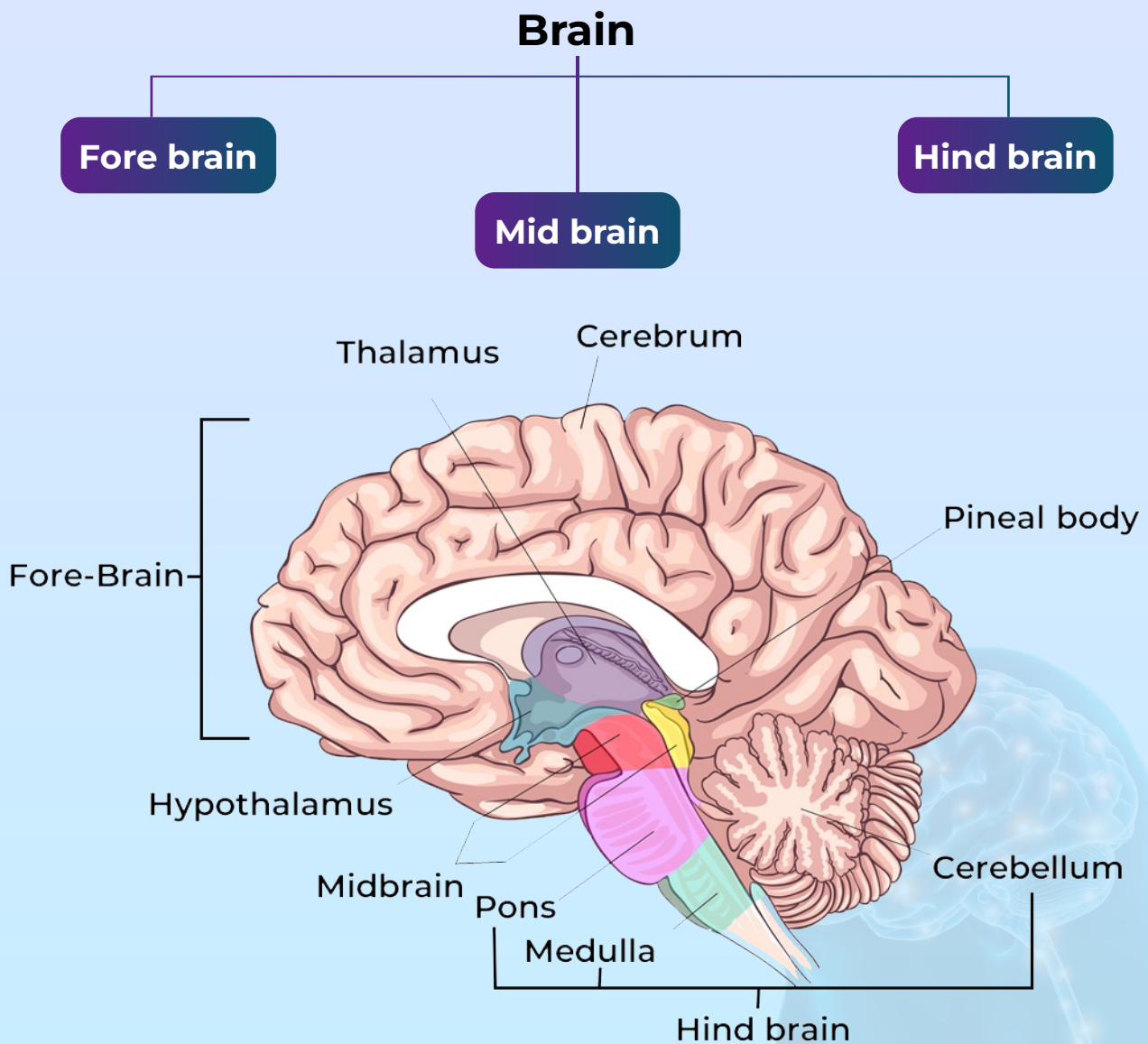


Central nervous system

- ◆ The central nervous system is made up of the brain and spinal cord which is the continuation of the brain.

Brain

- ◆ Part of the central nervous system which is present in the head and protected by the cranium.



Fore brain

Cerebrum

- Largest and main thinking part of the brain and is made up of two hemispheres called the cerebral hemispheres.
- Controls action of the voluntary muscles and have specialised area for hearing, smelling, sight etc.
- Has sensory, association and motor areas.
- Responsible for the intelligence, memory, consciousness and will power.

- Has centres that control emotions, hunger, thirst, fatigue, sleep, body temperature and sweating.
- Secretes neurohormones which regulate the secretion of anterior lobe of pituitary which is the main link between nervous and endocrine system.

Hypothalamus

Mid brain

- ◆ It is a small portion of the brain that serves as a relay centre for sensory
- ◆ information from the eyes and ears to the cerebrum. It also controls the reflex movements of the ears and eyes muscles. It provides a passage for the different neurons going in and coming out of the cerebrum.

Hind brain

Cerebellum

- Second largest part of the brain.
- Responsible for maintaining the balance while walking, swimming, riding, etc.
- Responsible for precision and the fine control of the voluntary movements.



Pons

- Pons means bridge. It is hidden as it is well protected because of its importance.
- Has the breathing centre.

- Posterior main part of the brain which lie below the cerebellum.
- Controls involuntary activities such as sneezing, coughing, swallowing, salivation and vomiting.
- Contains centres which controls respiration and cardiovascular reflexes.
- Controls rate of heart beat and expansion & contraction of blood vessels to regulate blood pressure.

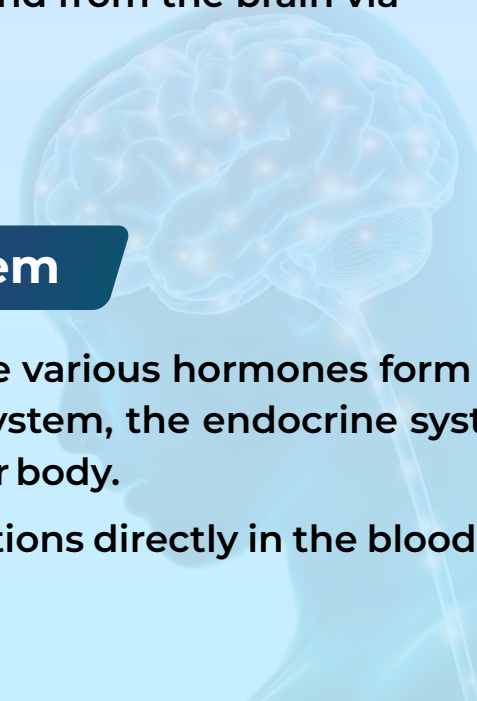
Medulla oblongata

Spinal cord

- ◆ Collection of nervous tissue running along the back bone. It is protected by the vertebral column. It is a continuation of the medulla oblongata and extends downwards.
- ◆ Coordinating spinal reflexes.
- ◆ Conducts sensory and motor impulses to and from the brain via sensory and motor nerve fibres.

Endocrine system

- ◆ A group of endocrine glands which produce various hormones form the endocrine system. In addition to nervous system, the endocrine system also helps in coordinating the activities of our body.
- ◆ The duct less glands which pour their secretions directly in the blood are called endocrine glands.



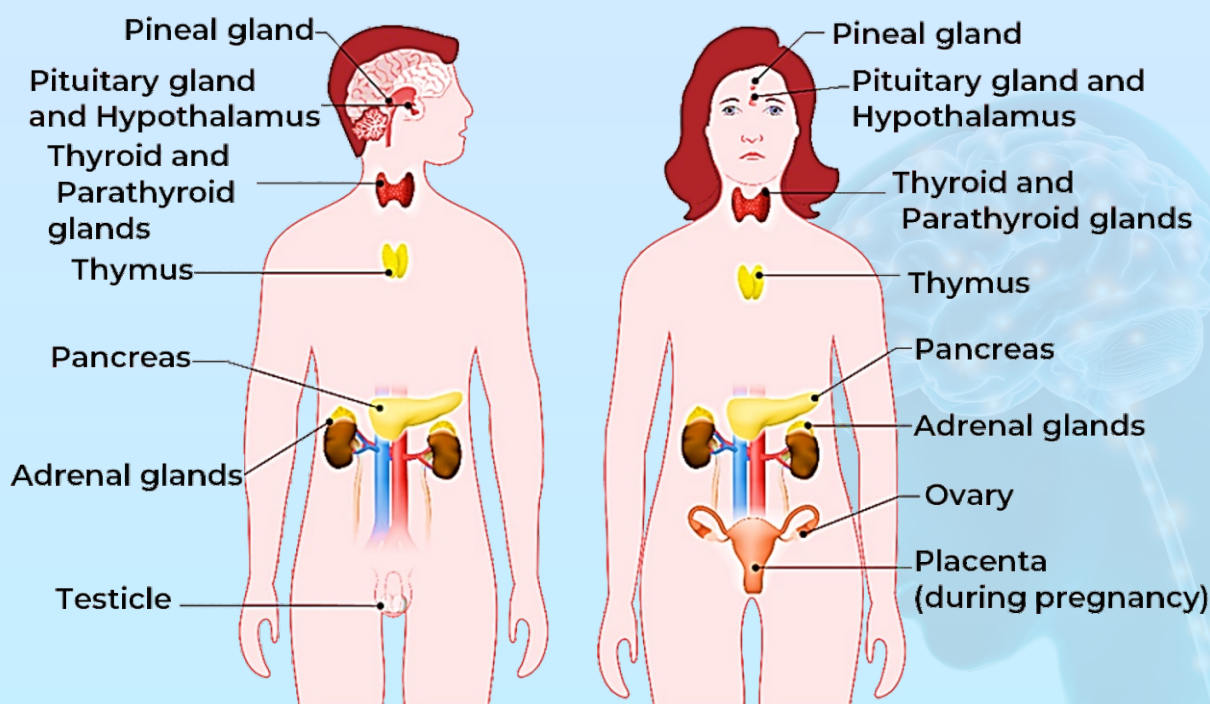
- They are secretions of the endocrine glands and one of the important substances that controls the body chemistry. Also known as "Chemical messengers."

First hormone, secretin, was discovered by Bayliss and Starling (1902). The term hormone was coined by Starling (1905).

Characteristics of hormones

- These are secreted by endocrine glands.
- Hormones are secreted only when required.
- Their secretion is regulated by feedback mechanisms.
- These are generally released in the blood stream.
- The molecules of most of the hormones are small.
- The secretion of hormone is always in very small quantity.
- Hormones are destroyed after use i.e. hormones cannot be stored in the body. Thyroxine is an exception.

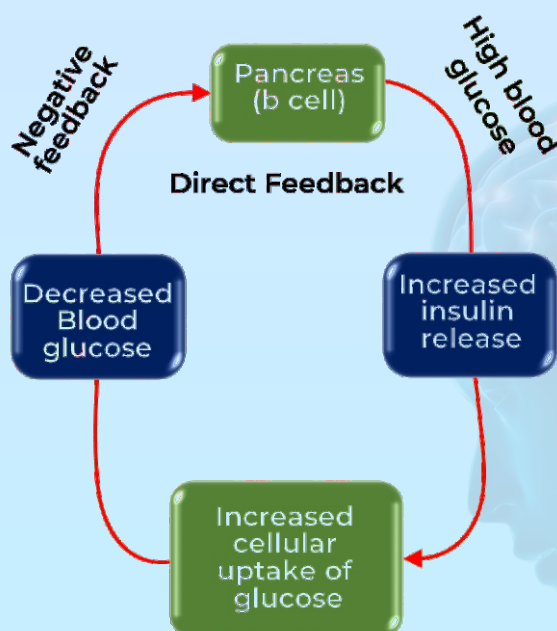
Endocrine glands



Endocrine Gland	Hormone	Function	Deficiency may cause
Pituitary	Growth Hormone	Regulates growth and development of body	Dwarfism
	ADH	Regulates the concentration of urine	Diabetes insipidus
Thyroid Gland (Largest endocrine gland)	Thyroxine	Controls carbohydrate, protein and fat metabolism. It regulate BMR [Basal metabolic rate]	Goitre
	Calcitonin	Regulates blood calcium levels	
Adrenal gland	Adrenaline	Prepares the body to deal with emergency situations	–
Pancreas	Insulin	Decrease blood sugar levels	Diabetes mellitus
	Glucagon	Increase blood sugar levels	
Testes	Testosterone	Causes development of sexual organs and secondary sexual characteristics in males	–
Ovary	Oestrogen	Causes development of sexual organs and secondary sexual characteristics in females	–
	Progesterone	Maintains pregnancy	–

Feedback mechanism

- A regulatory mechanism in which presence of certain level of substance promotes or inhibits its further formation.



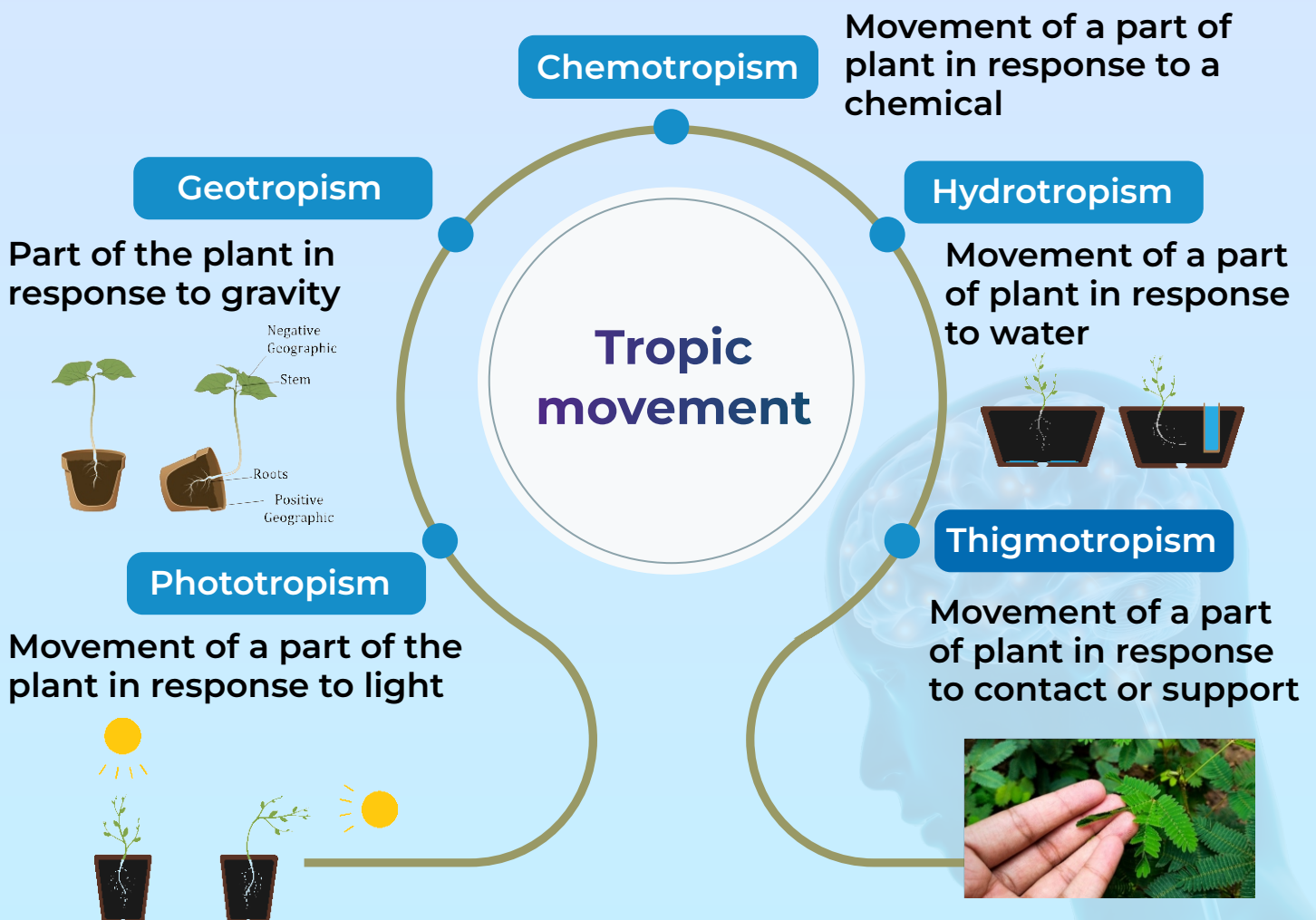
Coordination in plants

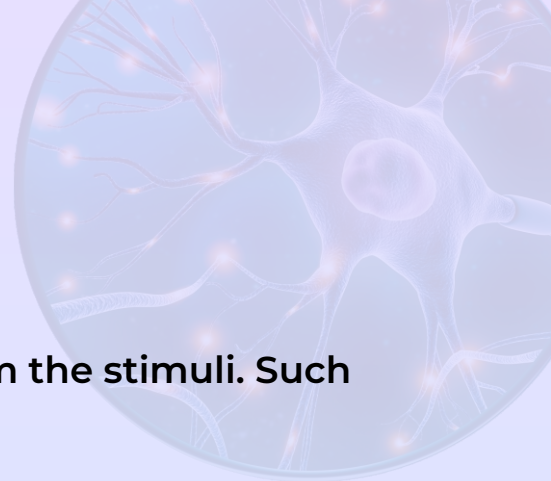
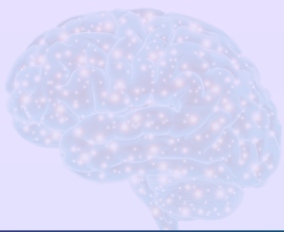
- Plant have neither a nervous system nor muscles. But they give response to stimuli. The higher plants are fixed to the substratum by means of roots. They cannot move from one place to another. They therefore show movement of their organs only.



Tropic movement

- The directional movement of the part of a plant caused by its growth.
- The growth of a plant part in response to the stimulus can be towards the stimulus (positive tropism) or away from the stimulus (negative tropism).





Nastic / Non directional

Movement which is neither towards nor away from the stimuli. Such movements are reversible.

Photonasty

E.g., Flowers close up when light fades in the evening and re-open the next day when light appears

Seismonasty (Thigmonasty)

Movements occur in response to touch (shock).
E.g., 'touch-me-not' plant (*Mimosa pudica*).

Tropic movements	Nastic movements
Direction of movement is in the direction of the stimulus or against it.	Movement are non-directional.
Growth takes place.	Growth does not take place.
Movements are slow.	Movements are fast.
e.g. Growth movement of shoot towards light.	E.g. The folding up and drooping of leaves in the sensitive plants.

Chemical coordination in plants

Help to coordinate growth, development and response to the environment.

Takes place by the plant hormones or phytohormones.

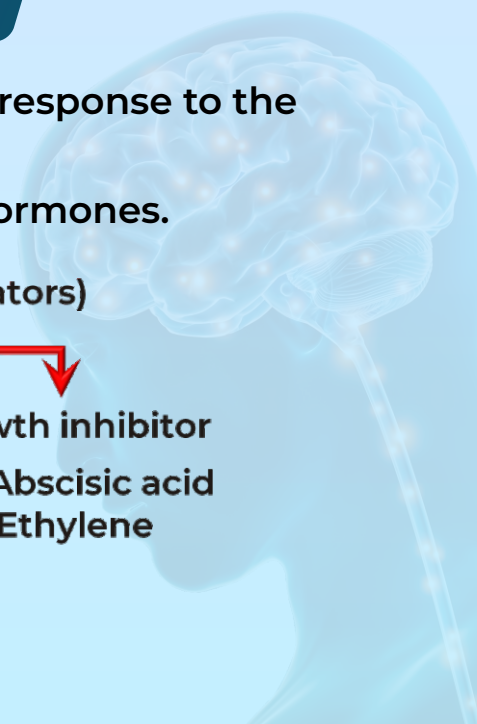
Phytohormones (growth regulators)

Growth promoter

1. Auxins
2. Gibberellins
3. Cytokinins

Growth inhibitor

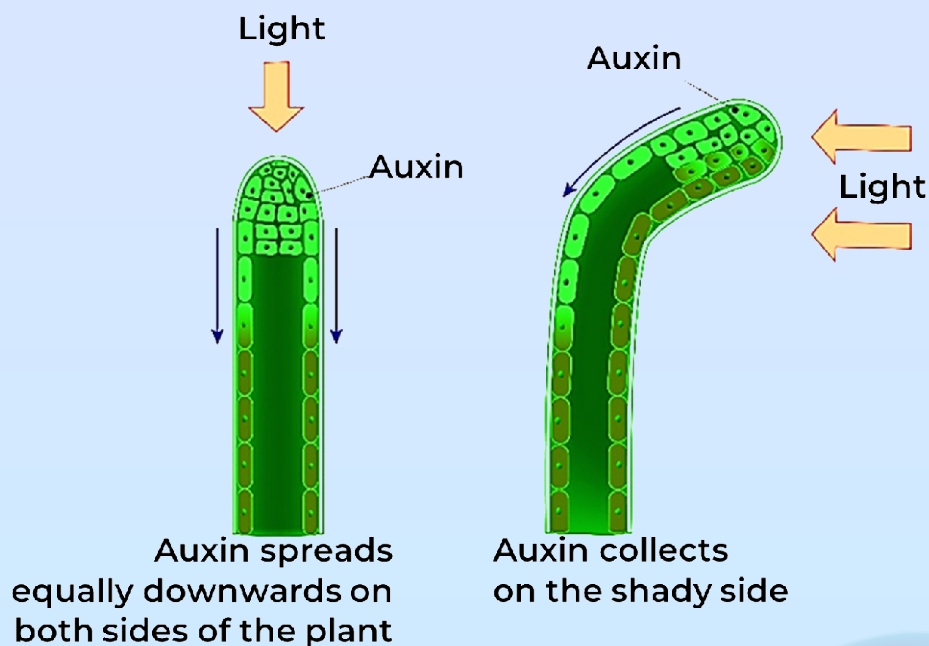
1. Abscissic acid
2. Ethylene



Growth promoters

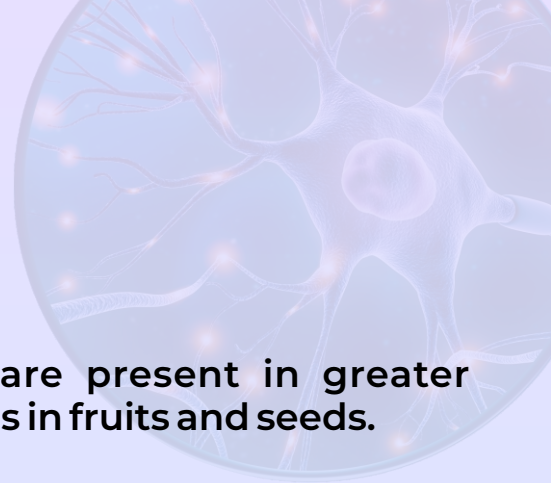
Auxins

- Auxin was the first plant hormone discovered by Went which is synthesised at shoot tip.
- Promotes cell elongation, apical dominance and help in root initiation in cutting or in callus differentiation.
- When growing plants detect light, a hormone called auxin, synthesized at shoot tip, helps the cells to grow longer. When light is coming from one side of the plant, auxin diffuses towards the shady side of the shoot. This concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from light. Thus, the plant appears to bend towards light.



Gibberellins (G.A.)

- Stimulate stem elongation by stimulating internodal elongation or help in growth of the stem.
- Helps in breaking dormancy in seeds and buds.
- Promotes growth in fruits.
- Increases size and number of fruits.



Cytokinins (CK)

- Cytokinins promote cell division, and they are present in greater concentration in areas of rapid cell division such as in fruits and seeds.
- Promotes opening of stomata.
- Suppresses apical dominance.
- Helps in breaking the dormancy of seeds and buds.

Growth inhibitors

Abscisic acid (ABA)

- Called stress hormone which inhibit the growth.
- Promotes the closing of stomata thus effects wilting of leaves.
- Cause dormancy of seeds and promotes falling of leaves.

Ethylene

- Gaseous hormone which promotes fruit growth and ripening.
- Prevents elongation of stem and roots.
- Promotes the yellowing and senescence of leaves.

