Unit 2 World Of Living

Chapter 6:

Control And Coordination

➡ Control and Coordination In Animals

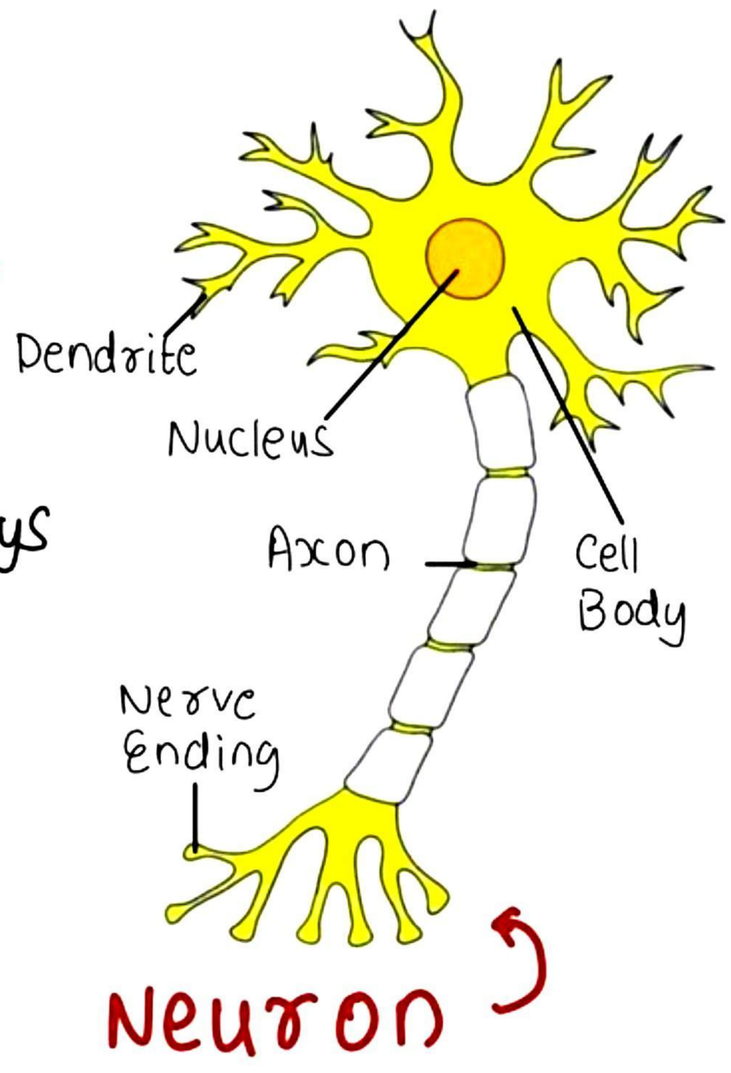
In invertebrates, excluding Sponges, basic nervous systems facilitates control and coordination. Sponges rely on cilia for coordination due to the absence of a nervous system. Conversely, vertebrates possess well developed nervous and endocrine systems, managing control and coordination comprehensively.

➡ Nervous System

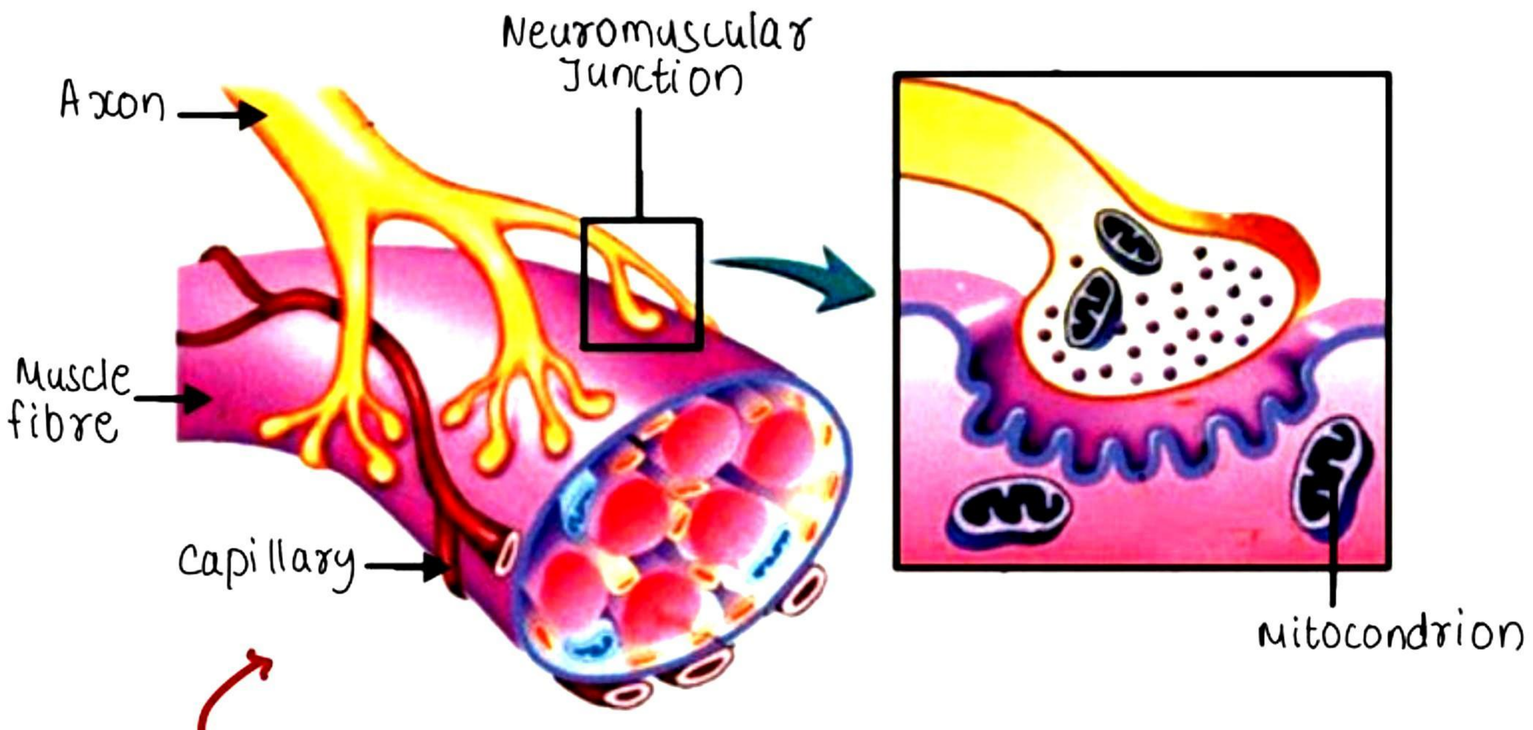
The nervous system of all animals is made up of specialized cells called nerve cell or neurons. These specialized cells are responsible for responding to stimuli and then coordinating the body's actions. This is why nerve cells are called the "structural and functional" unit of the nervous system.

Neuron

The Neuron serves as the fundamental unit of the nervous system.
Comprising dendrites, cyton/soma/cell body, and axon, each neuron has three primary components. Dentrites accept impulses from neighboring neurons, while the cyton/soma processes these impulses. The axon then conveys the impulses, either to another neuron or to muscles / glands



Neuron



Neuromuscular Junction

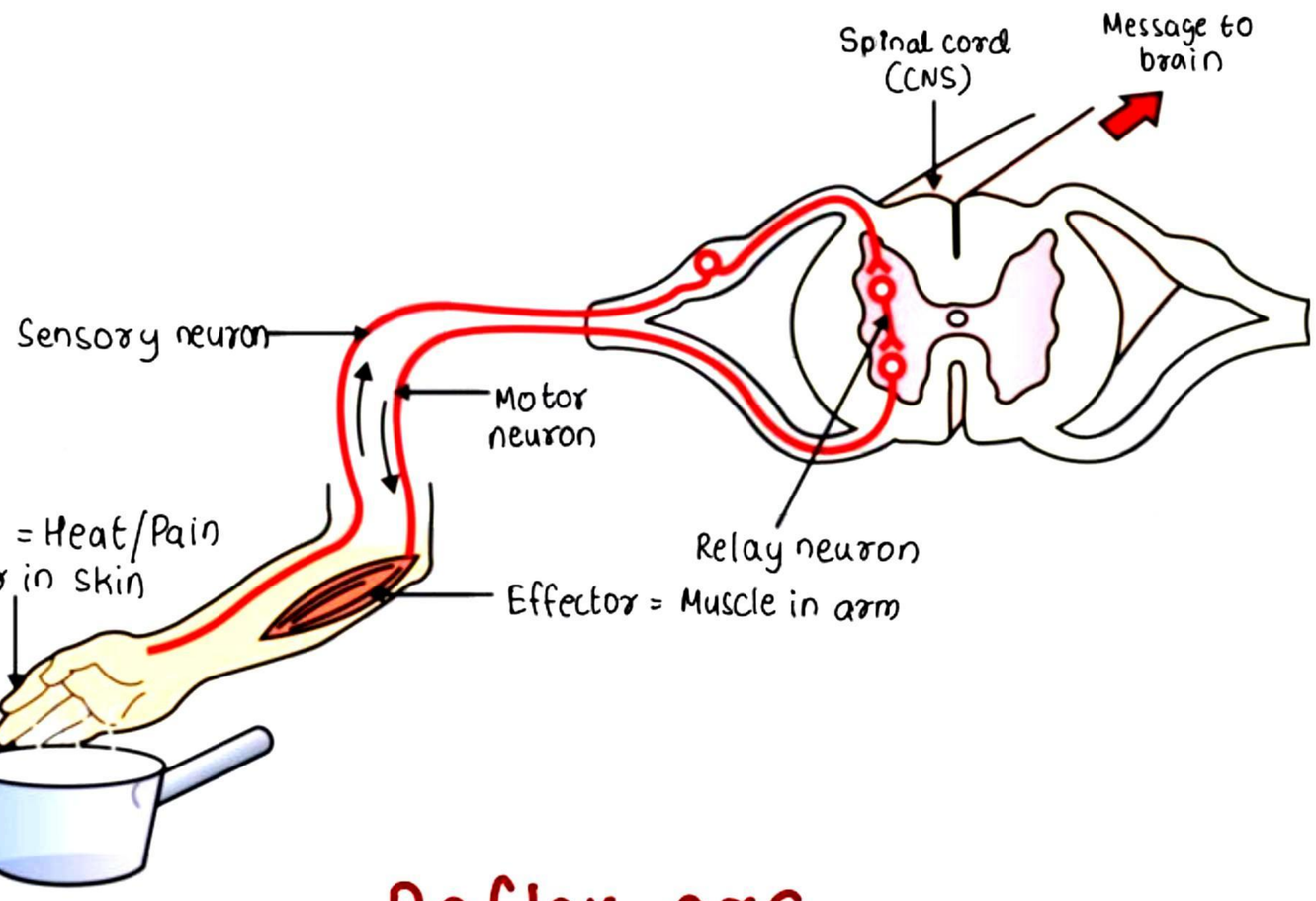
Axon may be myelinated or non-myelinated with myelinated neurons facilating faster impulses transmission. The cell body or cyton, houses the nucleus and cytoplasm. Dendrites receive signals, while the axon transmits them away, protected by the neuron's terminations, emit electrical signals to other neurons.

Synapse

It is the gap between the nerve ending of one neuron and dendrite of the other neuron. Here, electrical signal is converted into chemical signal for onward transmission.

Reflex Actions

Reflex action refers to a swift, sudden and automatic bodily reaction to a stimulus. Examples include the knee-jerk reflex and the intensive withdrawal of the hand upon contact with an object.

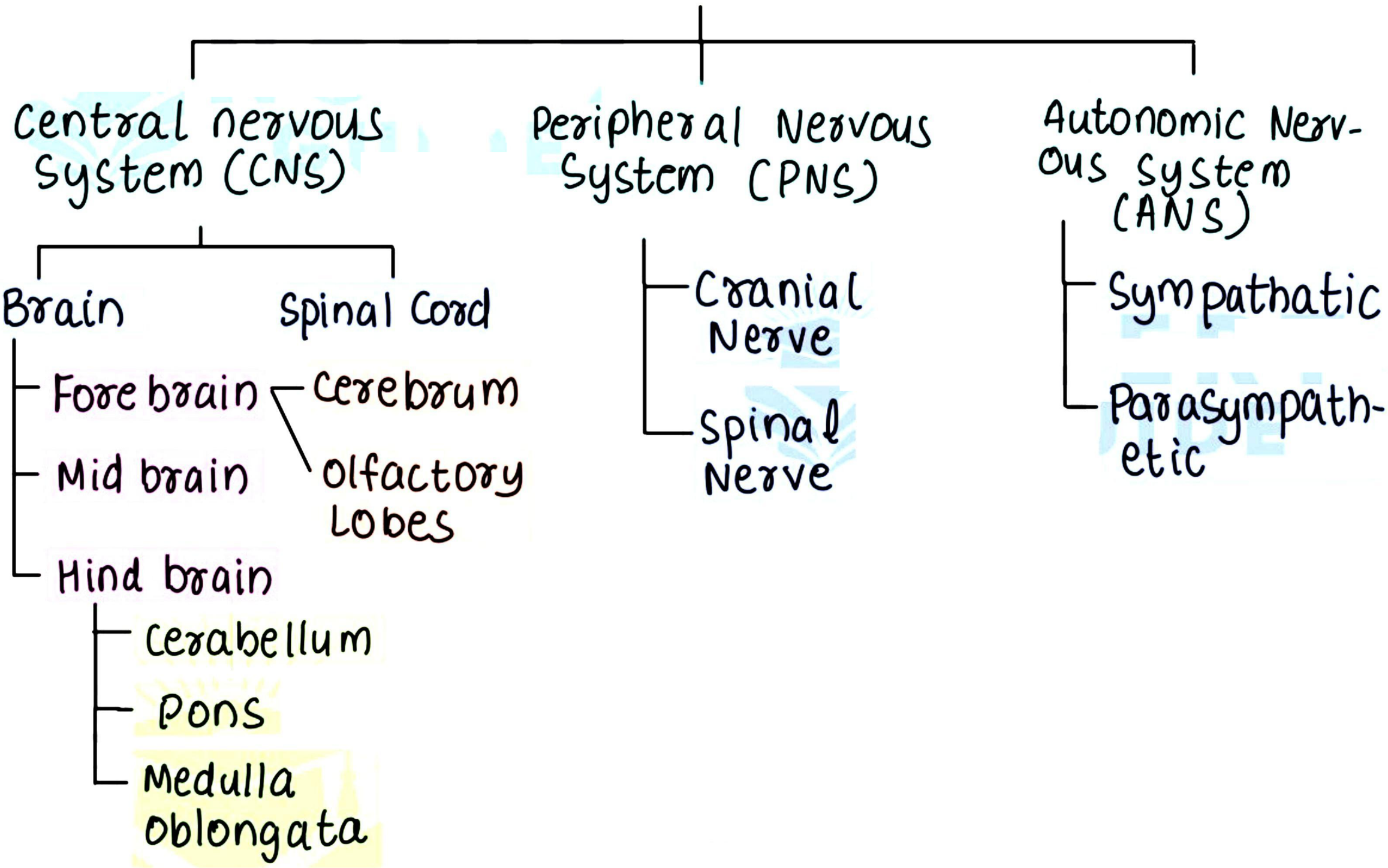


Reflex arc

The Central Nervous System (CNS)

- The cerebrum governs reasoning, logic, emotions, speech, memory, visual processing and recognition of auditory and taste stimuli.
- The cerebellum coordinates and regulates body movements, posture and balance.
- The pons acts as a relay station, transmitting signals from hindbrain to the forebrain.
- The cerebrum handles complex functions and sensory processing.
- The cerebrum ensures smooth, coordinated physical movements and maintain equilibrium.

HUMAN NERVOUS SYSTEM



Peripheral Nervous System (PNS)

The collection of nerves emanating from both the brain and Spinal Cord forms the peripheral nervous system. This system comprises 12 cranial nerves and 31 spinal nerves in humans.

Autonomic Nervous System.

- The Autonomic nervous System controls involuntary bodily functions like breathing, heart rate and digestion.
- It consists of two divisions : the sympathetic and parasympathetic nervous systems.
- The Sympathetic System triggers the fight-or-flight response, preparing the body for physical excretion
- In contrast, the parasympathetic system promotes relaxation and slows down high-energy processes.

➡ Human Brain

Forebrain

The predominant cognitive area of the brain, tasked with receiving sensory inputs. Its constituents comprise:

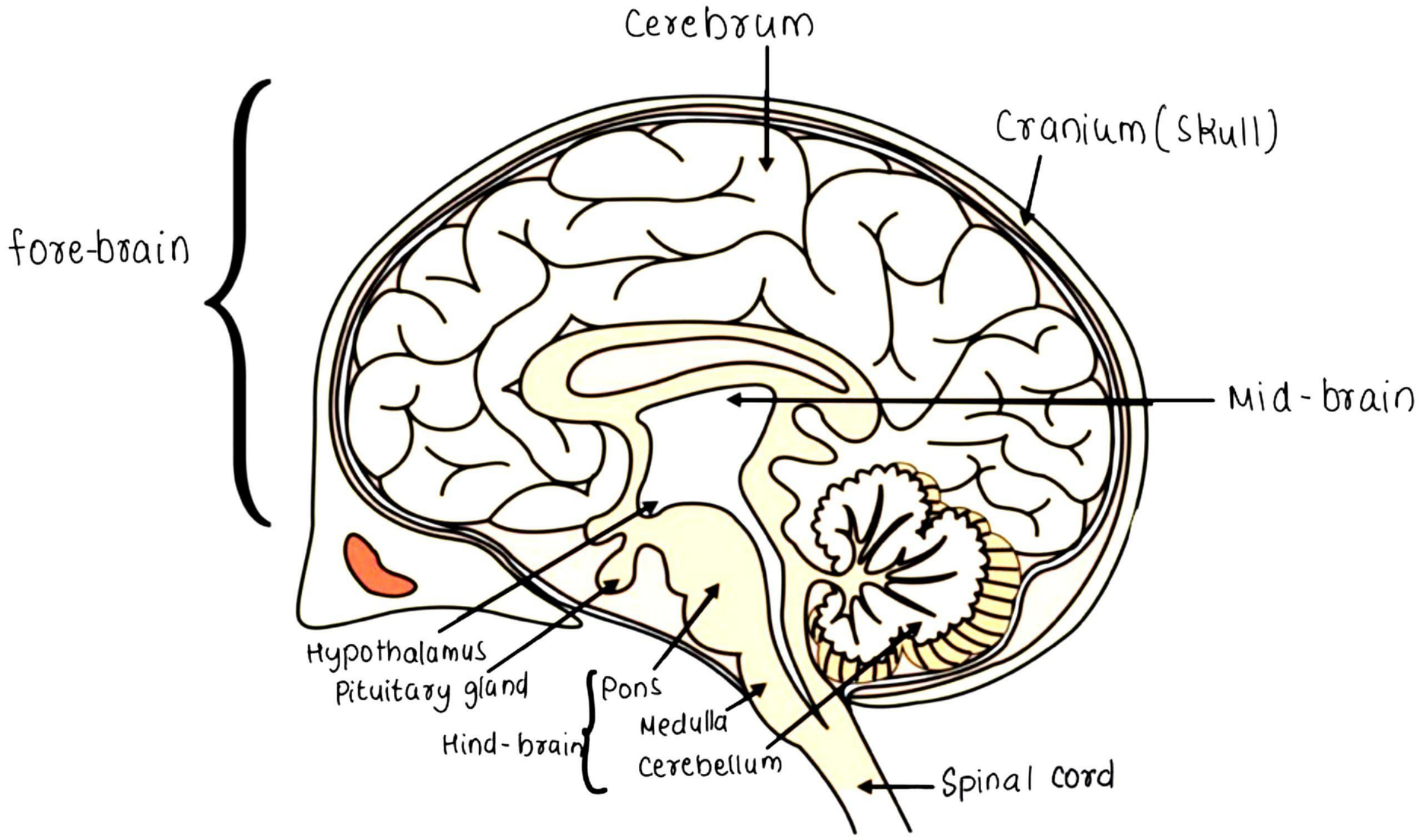
- Cerebrum - Shaped like a dome, it serves as the uppermost structure of the forebrain and acts as the primary thinking center. Responsible for functions such as reasoning, speech and information processing. It controls voluntary motor actions, processes sensory perceptions like touch and hearing and is crucial for learning and memory

- Lobes
  - frontal: Governs voluntary muscle movements, memory and speech.
  - Parietal: Responsible for tactile and taste sensations.
  - Temporal: Regulates smell and hearing.
  - Occipital: Manages vision.

Midbrain

Characterized by the presence of the hypothalamus, which forms an integral part of its composition.

- Hypothalamus - Positioned at the base of the cerebrum, the hypothalamus oversees urges for eating and drinking. Additionally, it Regulates the body's sleep and wake cycle



Human Brain

Hindbrain

Situated in the lower brain region adjacent to the beginning of

the Spinal cord, it comprises three components : the cerebellum, pons and medulla.

- Cerebellum - Positioned at the hindrain's roof, it is the brain's second-largest part after the cerebrum. Responsible for maintaining posture, balance and coordinating body movements during activities like walking, swimming and dancing.
- Pons - Located just above the medulla, it regulates respiration
- Medulla - Situated at the hindbrain's base and extending into the Spinal cord, it controls essential functions such as breathing movements, heart rate, blood pressure, swallowing, coughing, vomitting and sneezing.

➡ Types of Actions

- Voluntary Actions - controlled by the forebrain, such as speaking and writing.
- Involuntary actions - managed by the mid and hind brain, including heartbeat, vomiting and respiration.
- Reflex actions - Coordinated by the Spinal cord, such as the instinctive withdrawal of a hand from a hot object.

➡ Coordination In plants

- Animals use their nervous system and muscles to respond to Stimuli, while plants lack these structures.
- Plants still react to their environment, such as sensitive plants folding their leaves when touched, a response not involving growth.
- Seedling movement during germination, like Stem and root direction is driven by growth.
- Plants exhibit two types of movement: one involving growth and one not.

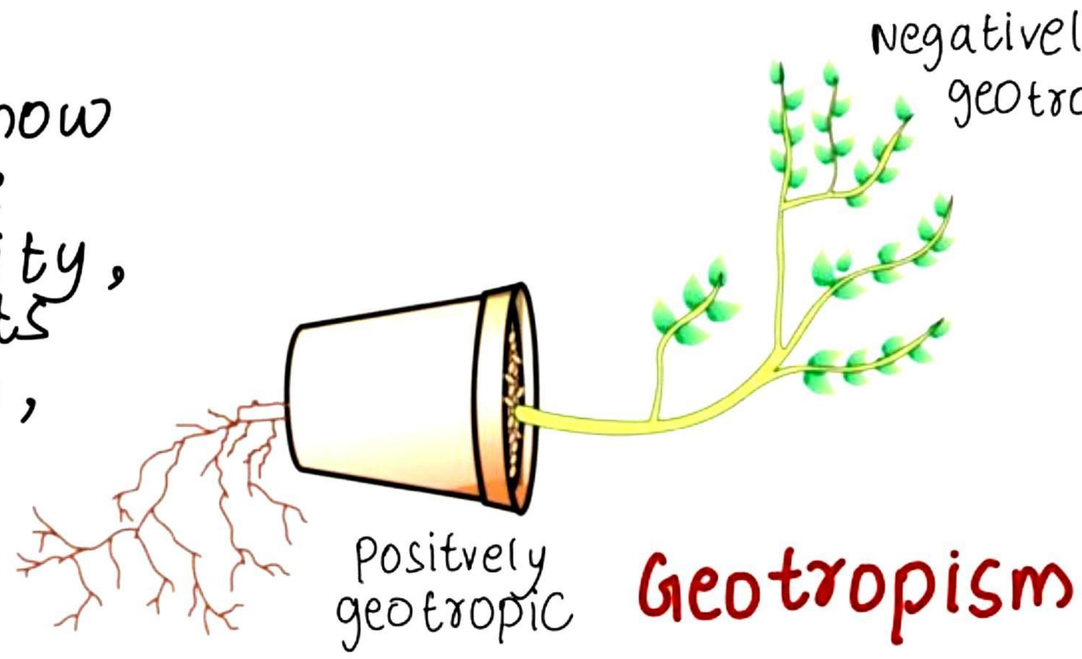
📌 Growth Independent Movements

Non-growth-related movements are referred to as nastic movements. These reactions are triggered by environmental stimuli, but their direction is not dictated by the direction of the stimulus.

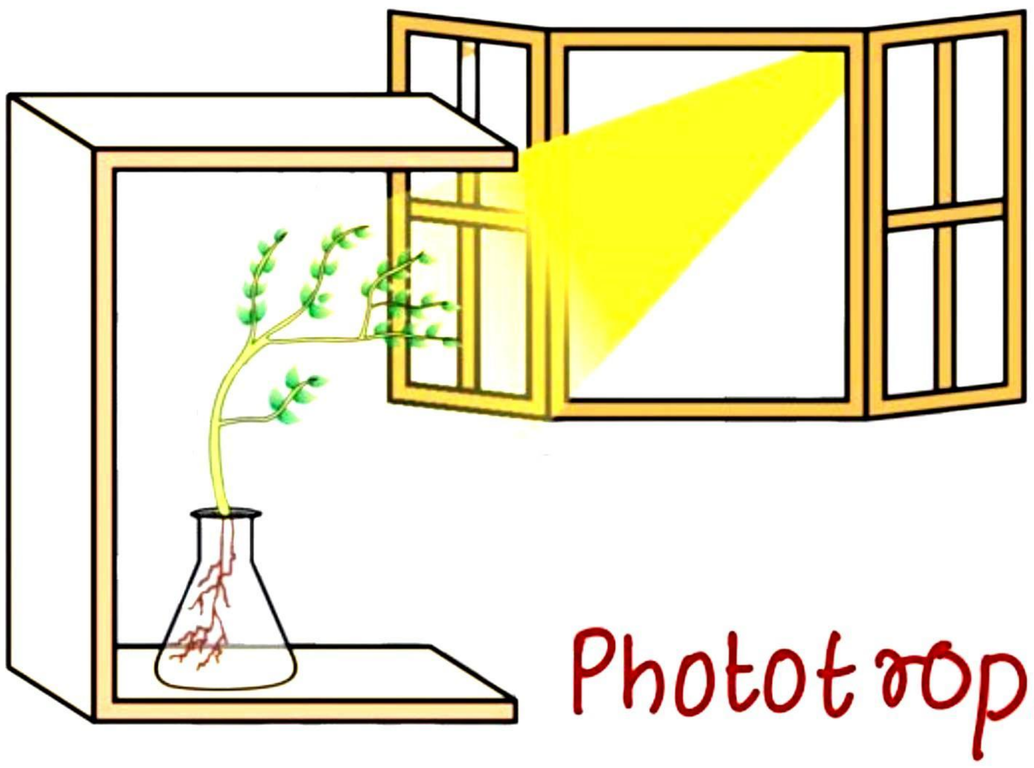
📌 Plant Growth Movements

Tropic movements, categorized by their dependency on growth, include phototrophic (light-induced), geotropic (gravity-induced) chemotrophic (chemical-induced, hydrotrophic (water-induced and thigmotropic (touch-induced) movements. These responses are triggered by environmental stimuli, with the direction of the response determined by the direction of the stimulus.

- Geotropism or gravitropism is how plants react to gravity. positive geotropism grows towards gravity, while negative grows away. Roots show positive by growing down, shoots show negative by growing up.

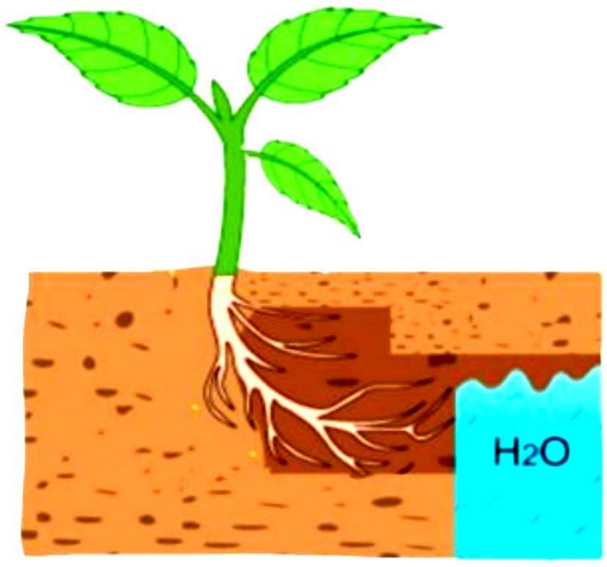


Geotropism

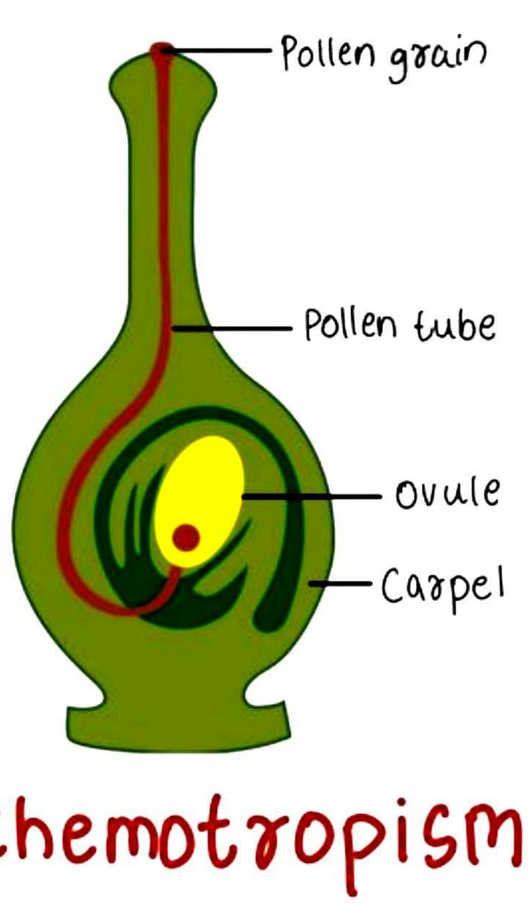


Phototropism

- Plants respond to light with phototropism. Positive bends toward the light, seen in stems, negative moves away, shown by roots

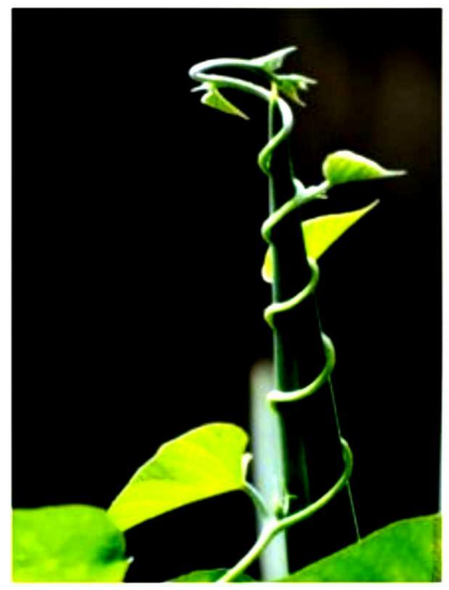


- Hydrotropism plants response to water. Positive moves towards the water, negative moves away. Roots show positive by growing towards moisture.



chemotropism

- Chemotropism plant response to chemicals. Positive move towards, negative moves away. Pollen tube grows towards ovule, showing positive chemotropism.



- Thigmotropism plant response to touch. Positive moves away. Tendrils wrapping around support show positive thigmotropism.

→ Hormones are chemicals released by cells, diffusing to areas of action. They coordinate plant growth and response to the environment. Key hormones include,

Auxins : Synthesized at stem tips, promoting cell elongation and shoot apical dominance.

Gibberellins : Aid stem growth, seed germination and flowering.

Cytokinins : found in areas of rapid cell division like fruits and seeds, promoting stomatal opening.

Abscisic acid : Inhibits growth, closes stomata, leading to leaf wilting.

➡ Hormones In Animals

Pineal Gland

- Hormone : Melatonin
- Location : In the brain (dincephalon)
- Function : Control day and night cycle rhythm

Hypothalamus

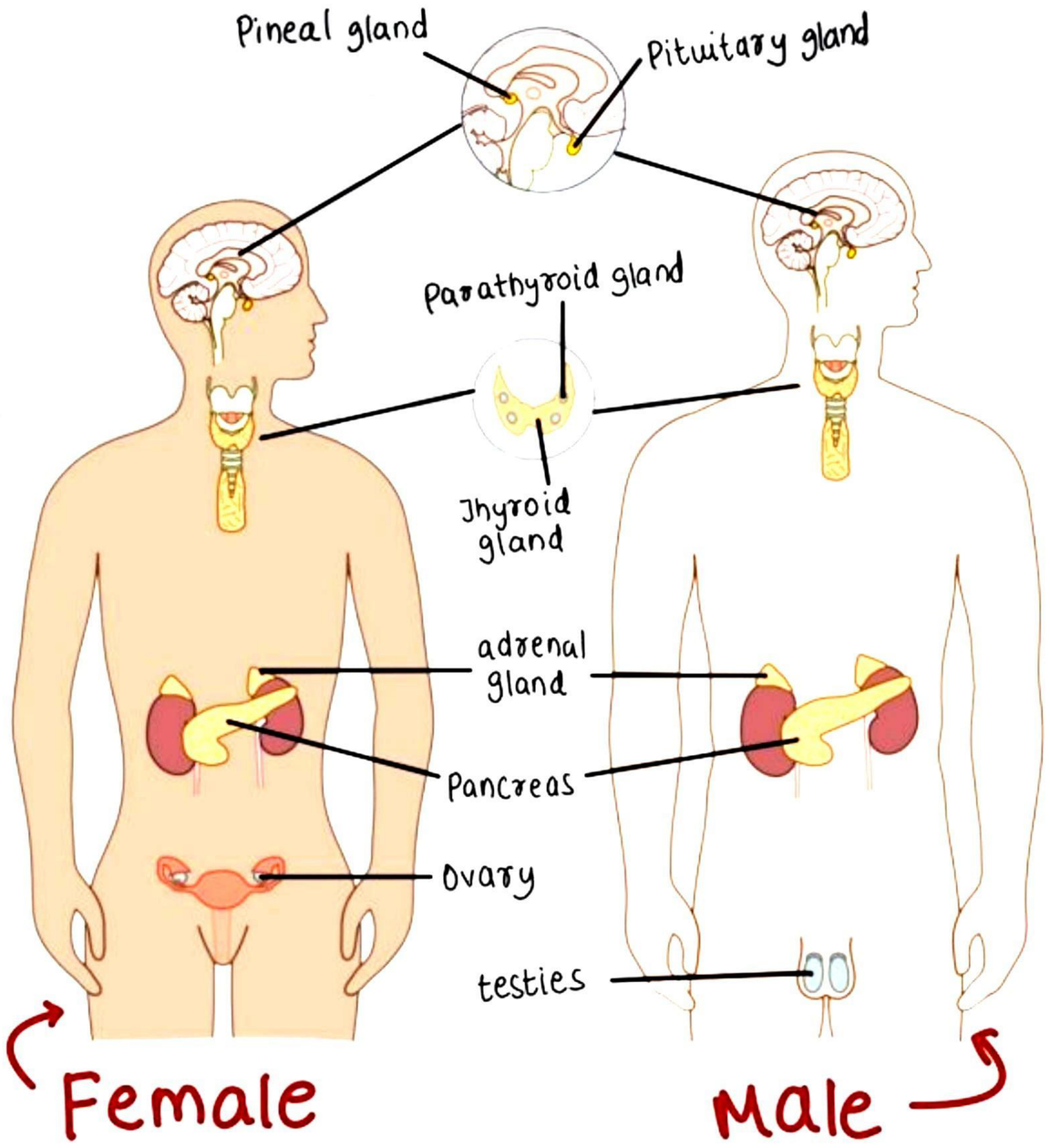
- Hormone : Neuron
- Location : In the brain
- Function: Regulate the secretion of pituitary gland regulatory inhibitory hormone

Pituitary gland

- Hormone : Growth hormone
- Location : Just below the brain
- Function : Maintain growth
- Deficiency: Dwarfish / excess tallness

Thyroid gland

- Hormone : Thyroxine
- Location: Attached to the windpipe of the body



- Function: Control the rate of metabolism of carbohydrate fat and protein Iodine is required by the thyroid gland to make thyroxine.
- Deficiency: Goitre/excess mental retardation

Parathyroid

- Hormone : Parathormone
- Location : Embedded in thyroid gland
- Function: Regulate calcium and phosphate levels in blood

Thymus gland

- Hormone : Thymous
- Location: lie in the lower part of the neck and upper part of the chest.
- Function: Development of the immune system. This gland is large in small children but shrinks after puberty.

Pancreas

- Hormone : Insulin
- Location : Just below the stomach
- Function : lower blood sugar level
- Deficiency: Diabetes, millitus/excess - coma.

Adrenal gland

- Hormone : Andrenil
- Location : located on the top of the Kidney
- Function : Also known a fright/fight emergency. It controls emotions. Target organ is heart.

Testies

- Hormone : Testosterone
- Location : In male
- Function: Control development of male sex organs and male features, such as beard and deeper voice.

Ovaries

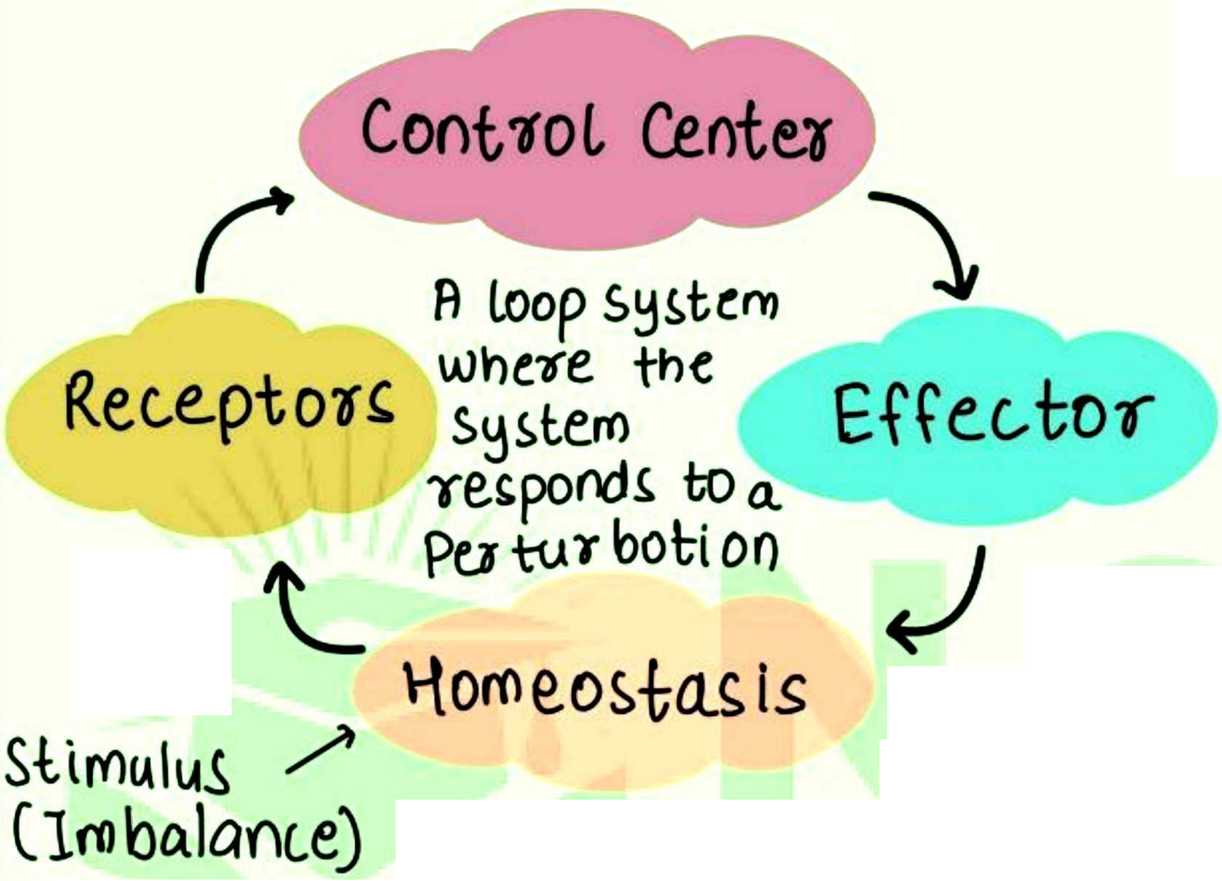
- Hormone : Oestrogen and Progesterone
- Location: In female
- Function: control development of female sex organ and female feature such as famine voice, mammary gland etc.

Functions of Animal Hormones - Animal hormones serve various purpose such as regulating growth, metabolism, while growth hormone controls how tall we grow. Hormones

like testosterone and estrogen cause changes during puberty and insulin helps regulate blood sugar levels.

Feedback Mechanisms - To ensure hormones are released in the right amount at the right times, the body uses feedback mechanisms. For example, if blood sugar levels rise, cells in the pancreas release more insulin to bring them back to normal. This feedback loop helps maintain balance in the body.

Feed back Mechanism



The response may be in the same direction (positive feedback) or in the opposite direction (negative feedback)