

Control and Coordination

The Nervous System

Movement in organisms

The ability of organisms to move certain body parts is **movement**.

When they move from one place to another, it is called **locomotion**.

Organisms show movements in response to stimuli.

Introduction to control & coordination

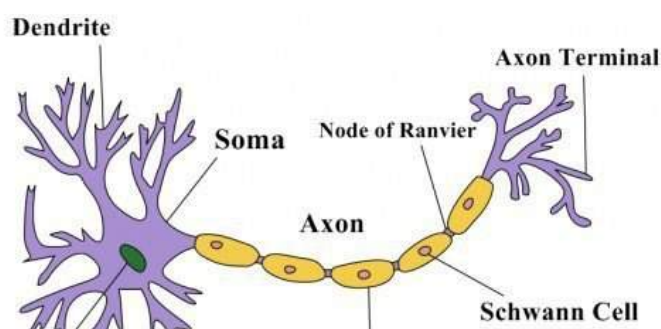
- Organisms move in response to various kinds of stimuli like light, heat, nutrients/food, mate etc.
- All the activities in animals is controlled and coordinated by the nervous and endocrine system.
- Hormones are chemical messengers which assist the nervous system in carrying out various functions. They are secreted by endocrine glands.
- Hormones in plants coordinate the movements.

THE NERVOUS SYSTEM

Neuron

Neuron is the structural and functional unit of the nervous system.

- Each neuron has three main parts: dendrites, cyton/soma/cell body and axon.
- Dendrites receive impulses from other neurons.
- Cyton/soma processes the impulse.
- Axon transmits the impulse, either to another neuron or to muscles/glands etc.
- Axon may be myelinated or non-myelinated.
- The impulse transmission is faster in myelinated neurons.





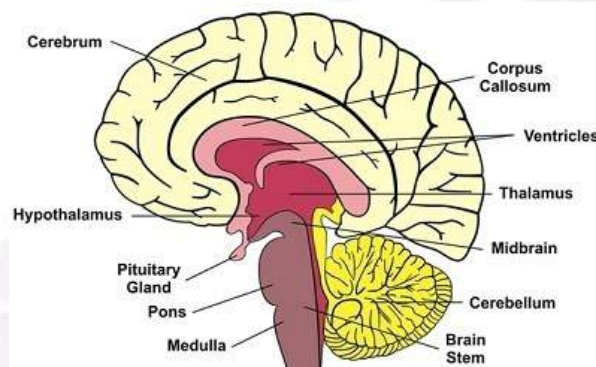
Myelin Sheath

Structure of Neuron

Central nervous system

The central nervous system (CNS) is made up of the brain and the spinal cord. Functions of different parts of the brain are:

- Cerebrum is responsible for reasoning, logic, emotions, speech, memory, visual processing, recognition of auditory and taste stimuli, etc.
- Cerebellum regulates and coordinates body movements, posture and balance.
- Pons relays signals from hindbrain to forebrain.
- Medulla Oblongata controls all involuntary movements like vomiting, sneezing, yawning, heartbeat, breathing, blood pressure, etc.
- Medulla oblongata continues as the spinal cord which runs through the vertebral column and it controls reflex actions.



Peripheral nervous system

- The nerves given out by the brain and the spinal cord form the peripheral nervous system (PNS).
- There are 12 cranial nerves and 31 spinal nerves in humans.

Somatic nervous system

- It forms a part of the PNS.
- The nerves of PNS that control the voluntary actions of the body form the somatic nervous system.

Autonomic nervous system

- All the nerves of the PNS that control the involuntary actions in the body form the autonomic nervous system.

Two divisions of autonomic nervous system are: sympathetic and parasympathetic nervous system

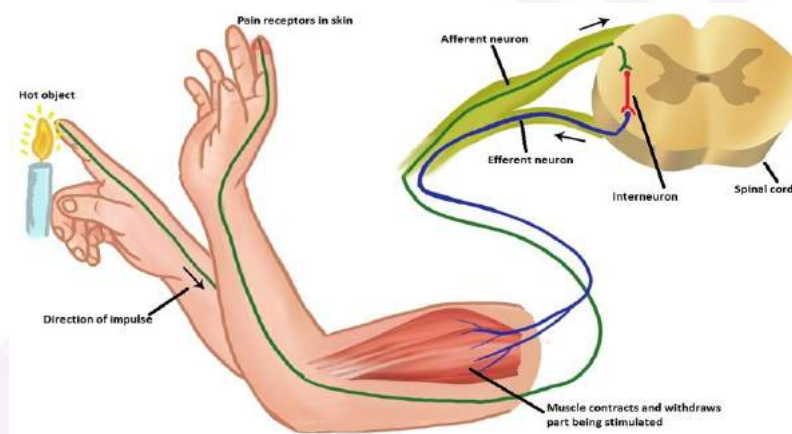
- The sympathetic nervous system prepares the body for intense physical activity and is often referred to as the fight-or-flight response while the parasympathetic nervous system has almost the exact opposite effect and relaxes the body and inhibits or slows many high energy functions.

Reflex action

Reflex action is a sudden, involuntary reaction of the body in response to stimuli.

Reflex arc

- It is the path followed by electrical impulse during a reflex action.
- The impulse travels from the receptor organ to the spinal cord/brain; is processed there and the information is brought back to the concerned muscle to carry out the action.
- Thus, receptor organ, sensory/afferent neuron, interneuron, motor/efferent neuron and effector organ are the components of a reflex arc.



Mechanism of Reflex Action

Protection of CNS

The brain is protected by 3 main layers -

- The bony skull (cranium),
- The cerebrospinal fluid and
- The meninges (Dura mater, Arachnoid and Pia mater).

Plant Hormones and Movements

Plant hormones

Control and coordination in plants is carried out by hormones.

<i>P l a n t H o r m o n e</i>	<i>Function</i>
<i>A u. x i n</i>	<i>Helps in growth of plant tissue.</i>
<i>C y t o k i n i n</i>	<i>Promotes cell division, delays ageing of cells</i>
<i>G i b b e r e l l i n</i>	<i>Helps in growth of stem, initiates seed germination, promotes flowering, cell division and seed growth after germination.</i>
<i>A b s c i s i c a. c i d</i>	<i>Inhibits growth and causes wilting of leaves, promotes dormancy of buds and seeds.</i>
<i>E t h y l e n e</i>	<i>This is a gaseous hormone which causes ripening of fruits.</i>

Growth independent movements

The movements which are not growth related are called nastic movements. These movements occur in response to environmental stimuli but the direction of response is not dependent on the direction of the stimulus.

- The movement in touch-me-not plant is thigmonastic movement (movement in response to touch).

Growth-related movements in plants

The movements which are growth related are called tropic movements. These movements occur in response to environmental stimuli and the direction of the response is dependent on the direction of the stimulus.

Examples:

- Phototropic movement (light dependent),
- Geotropic movement (gravity dependent),

- Chemotropic movement (chemical dependent),
- Hydrotropic movement (water dependent) and
 - Thigmotropic movement (touch dependent).

Geotropism

Movement of plant parts in response to earth's gravitational force is known as geotropism/gravitropism.

- Towards gravity - positive geotropism
- Away from gravity - negative geotropism
- Root grows towards gravity and shoot grows away from gravity

Phototropism

Movement of plant parts in response to light is known as phototropism.

- Towards light - positive phototropism
- Away from light - negative phototropism
- Stems move towards light and roots move away from light.

Hydrotropism

Movement of plant parts in response to water or moisture.

- Towards water - positive hydrotropism
- Away from water - negative hydrotropism
- Again, root movement in search of water is positive hydrotropism.

Chemotropism

Movement of plant parts in response to chemical stimuli is known as chemotropism.

- Towards chemical - positive chemotropism
- Away from chemical - negative chemotropism
- The growth of pollen tube towards the ovule is positive chemotropism.

Thigmotropism

Movement of plant parts in response to touch is called as thigmotropism.

- Towards touch - Positive thigmotropism
- Away from touch - negative thigmotropism
- Movement of tendrils around the support is positive thigmotropism.

The Endocrine System

Exocrine glands

Exocrine glands are glands that discharge secretions by means of ducts, which open onto an epithelial surface.

Endocrine glands

Endocrine glands are the ductless glands which secrete hormones into the bloodstream in humans.

Pituitary gland

- It is a pea-sized gland located at the base of the brain.
- It is the master gland as it controls the secretions of all the other endocrine glands.
- It also secretes Growth Hormone (GH). Under-secretion of GH causes 'Dwarfism' and over-secretion causes 'Gigantism' in children and 'Acromegaly' in adults.

Thyroid gland

- It is a butterfly-shaped gland located in the throat.
- It secretes the hormone 'Thyroxine' which regulates the metabolism of the body.
- Iodine is required to synthesize thyroxine in the body.
- In case of iodine deficiency, under-secretion of thyroxine leads to goitre.

Pancreas

- It is a leaf-like gland present behind the stomach in the abdomen.
- It is an endocrine as well an exocrine gland.
- As an endocrine gland, it manufactures two hormones - Insulin and glucagon. Both these hormones act antagonistically and regulate the sugar level in the blood.
- As an exocrine gland, it secretes enzymes to break down the proteins, lipids, carbohydrates, and nucleic acids in food.
- Insufficient amount of insulin from pancreas leads to diabetes.

Adrenal gland

- Occurs in pair above each kidney.

It decreases in size with age.

- Secretes the hormone adrenaline which helps in flight and fight response.
- Also secretes nor adrenaline

Gonads

- Gonads are the gamete-producing organs - testes in males and ovaries in females.
- The testes produce the male hormone testosterone and ovaries produce the female hormones oestrogen and progesterone.
- Testosterone and oestrogen help in producing gametes and are responsible for the sexual characteristics in males and females respectively.
- Progesterone is the pregnancy hormone.

Other endocrine organs

- The other endocrine organs include the hypothalamus, parathyroid, pineal and thymus glands.

