

Class 10– Control and Coordination

The changes in the environment to which living organisms respond are called stimuli. Eg :- heat, cold, sound, smell, taste, touch, pressure, gravity, water etc.

Living organisms respond to stimuli in the form of body movements.

Coordination :- For a proper response to a stimulus many organs in the body should work together. The working together of various organs in an organism to produce a proper response to a stimulus is called coordination.

- i) In animals control and co ordination is done by the nervous system and endocrine system.
- ii) In plants control and co ordination is done by chemical substances called plant hormones or phytohormones.

Coordination in animals: - In animals control and co ordination is done by the nervous system and endocrine system.

The nervous system consists of the brain, spinal cord and nerves.

a) Receptors :- These are the sense organs which receive the stimuli and pass the message to the brain or spinal cord through the sensory nerves. Eg :- Photoreceptors in the eyes to detect light. Phonoreceptors in the ears to detect sound. Olfactory receptors in the nose to detect smell. Gustatory receptors in the tongue to detect taste. Tangoreceptors in the skin to detect touch.

b) Effectors: - These are the muscles and glands which respond to the information from the brain and spinal cord through the motor nerves.

c) Sensory nerves :- are nerves which carry information from the receptors (sense organs) to the brain and spinal cord.

d) Motor nerves :- are nerves which carry information from the brain and spinal cord to the effectors (muscles and glands).

e) Mixed Nerves: These nerves contain both sensory and motor nerve fibres and perform a mixed function.

Human nervous system:-

The nervous system functions in a coordinated manner. It receives a stimulus through a receptor organ like eye, ear, tongue, etc. The stimulus through sensory nerves reaches the brain and spinal cord, which integrates it and give action. The motor nerves pass on the action to the required organ (muscle or gland) and this way a response is generated.

a) Parts of the nervous system:-

The human nervous system consists of the Central Nervous System and Peripheral Nervous System.

- i) The central nervous system: - consists of the brain, and spinal cord.
- ii) The peripheral nervous system:- consists of cranial nerves arising from the brain and spinal nerves arising from the spinal cord.

b) Nerve cell (Neuron) :-

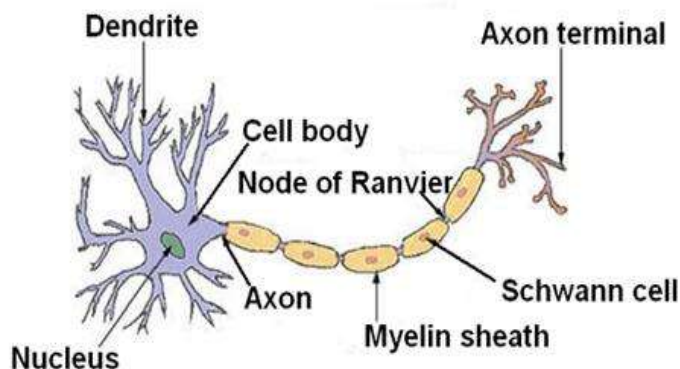
Neuron is the structural and functional unit of the nervous system. It has a cell body called cyton containing a nucleus and cytoplasm. It has several branched structures called dendrites. It has a long nerve fibre called axon which is covered by a protective covering called Myelin sheath.

Structure of a Typical Neuron

The junction between two neurons is called synapse. There is a space at the synapse between the end of axon of first neuron and cell body or dendrite of the next neuron. This is called synaptic cleft.

Messages pass through the nerve cell in the form of chemical and electrical signals called nerve impulse. The dendrites receive the information and starts a chemical reaction which produce electrical impulse which passes through the axon.

When the impulse reaches the end of axon of first neuron, a neurotransmitter (a chemical substance) is released in the synaptic cleft of the synapse, which helps in passage of nerve impulse from one neuron to the next neuron.



What does a synapse do?

- It allows the information to pass from one neuron to another.
- It ensures the passage of nerve impulse in one direction only.
- It helps in information processing by combining the effects of all impulses received.
- It filters out low-level stimuli.

CENTRAL NERVOUS SYSTEM- BRAIN AND SPINAL CORD

Brain: The human brain weighs about 1200-1400g in an adult.

It is protected by the cranium. It is covered by three membranes called meninges filled with a fluid called cerebrospinal fluid which protects the brain from shocks.

The spinal cord is by vertebral column.

The brain has three main parts. They are fore brain, mid brain and hind brain.

i) Fore brain: - It consists of the cerebrum and olfactory lobes. It is the thinking part of the brain and controls voluntary actions. It controls mental activities like thinking, learning, memory, emotions etc(cerebrum). and touch, smell, hearing, taste, sight(olfactory lobes).

ii) Mid brain :- It connects Fore brain and Hind brain. it controls involuntary actions and reflex movements of head, neck, eyes and ear etc.

iii) Hind brain :- it connects the Fore brain & Hind brain . it consists of cerebellum, pons and medulla.

Cerebellum :- controls body muscular movements , balance and posture

Pons :- it acts as a bridge between brain & spinal cord. controls respiration.

Medulla :- it controls involuntary action like heart beat, blood pressure, swallowing, coughing, sneezing, vomiting etc.

d) Spinal cord: - The spinal cord starts from the brain and extends through the vertebral column. It has 31 pairs of spinal nerves. It carries messages to and from the brain.

It also controls reflex actions. Cylindrical or tubular structure extending downwards from the Medulla oblongata.

PERIPHERAL NERVOUS SYSTEM

There are two types of cells in the peripheral nervous system. These cells carry information to (sensory nervous cells) and from (motor nervous cells) the central nervous system (CNS). Cells of the sensory nervous system send information to the CNS from internal organs or from external stimuli.

Motor nervous system cells carry information from the CNS to organs, muscles, and glands.

The motor nervous system is divided into the somatic nervous system and the autonomic nervous system.

The somatic nervous system and the autonomic nervous system

The somatic nervous system controls skeletal muscle as well as external sensory organs such as the skin. This system is said to be voluntary because the responses can be controlled consciously. Reflex reactions of skeletal muscle however are an exception. These are involuntary reactions to external stimuli.

The autonomic nervous system controls involuntary muscles, such as smooth and cardiac muscle. This system is also called the involuntary nervous system.

Reflex action:-

Reflex action is a sudden response of the effectors to a stimulus. Eg :- We suddenly withdraw our hand if we suddenly touch a hot object.

In this reflex action, the nerves in the skin (receptor) detects the heat and passes the message through the sensory nerves to the spinal cord. Then the information passes through the motor nerves to the muscles (effector) of the hand and we withdraw our hand.

Reflex arc :- The pathway of a reflex action is called reflex arc. In a reflex arc the stimulus is received by the receptors (sense organs) and it passes through the sensory nerves to the spinal cord. From the spinal cord the information passes through the motor nerves to the effectors (muscles/glands) for the response.

ENDOCRINE SYSTEM

Our body has a number of organs called endocrine glands that produce chemical secretions called hormones.

Hormones play an important role in control, coordination and regulation of the functioning of tissues and organs in the body.

Hormones are secreted by ductless glands or endocrine glands regulate chemical coordination in the animals including man.

The endocrine glands in our body are :- pineal, hypothalamus, pituitary, thyroid, parathyroid, thymus, adrenal, pancreas, testes and ovary.

Examples of coordination by endocrine glands :-

i) When we are frightened or angry, the adrenal glands produce more adrenalin hormone which is sent through the blood to the heart, rib muscles and diaphragm. This increases breathing rate to supply more oxygen to the muscles to prepare the body to either run away or fight with the enemy.

ii) Iodine is needed by the thyroid gland to produce the hormone thyroxin. Thyroxin controls the metabolism of carbohydrates, fats and proteins and helps in proper growth. If the diet is deficient in iodine it causes goitre.

iii) The pituitary gland produce growth hormones.

Deficiency of this hormone in childhood causes dwarfism. Excess of this hormone causes tall growth.

iv) The pancreas produces the hormone insulin which controls the blood sugar level. Increase in blood sugar level causes diabetes. A diabetic patient has to take insulin injections to control his blood sugar level.

v) The testes in males produces the hormone testosterone which controls the production of sperms and changes during puberty.

The ovary in females produces the hormone oestrogen which controls the production of eggs and changes during puberty.

Action caused by Nervous tissue

Information → Nervous tissue → Brain Muscles → Causes action

Path or action-

Nerve impulse → Muscle cell → Changes shape due to special proteins



Action caused ← Shorter form of muscles ← Change shape & arrangement of cell

Chemical communication by hormones- (advantages)

- (i) Electrical impulses have their limitations because they reach only those cells connected to the nervous tissue.
- (ii) Also the nerve cells cannot generate & transmit impulses continuously.
- (iii) Electrical communication is slower.

Hormones –

- (i) are chemical messengers secreted by endocrine glands
- (ii) Are secreted in small amounts & may act in nearby places or distant places.
- (iii) Do not take part in the reaction & are destroyed immediately.

Hormones are secreted by- Endocrine glands & Exocrine glands

S.No.	Endocrine glands	Exocrine glands
1.	Ducts absent	Ducts present
2.	Secrete hormones	Secrete enzymes
3.	Secreted in blood	Secreted in ducts of glands
4.	Situated away from the site of action	Situated near the site of action

Some glands which act as both endocrine & exocrine

Gland	Endocrine function	Exocrine function
Pancreas	Produces insulin & Glucagon hormone.	Produces digestive enzyme. (pancreatic amylase)
Testes	Produces hormone Testosterone	Produces male gametes (reproductive cells)
Ovaries	Produces hormone Oestrogen	Produces female gametes (reproductive cells)

Important Endocrine glands, the hormone they secrete & their function

Endocrine gland	Hormone	Function
Pituitary gland	Growth hormone	Body growth, development of bones & muscles (If excess- Gigantism) (If less- Dwarfism)
Thyroid gland	Thyroxine	Regulates carbohydrate, protein & fat metabolism(If less- Goitre)
Pancreas	Produces insulin & Glucagon hormone	Regulates blood sugar levels (if less diabetes is caused)
Testes in males	Produces hormone Testosterone	Development of secondary male characters like deep voice, beard, etc.
Ovaries in females	Produces hormone Oestrogen	Development of secondary female characters like mammary glands, menstrual cycle, maintenance of pregnancy.

Coordination in plants:-

In plants control and coordination is done by chemical substances called plant hormones or phytohormones.

There are five main types of plant hormones. They are :- Auxins, Gibberillins, Cytokinins, Absciscic acid and Ethylene.

- i) Auxins :- help in cell division, cell elongation and growth.
- ii) Gibberillins :- help in growth of stem and branches.
- iii) Cytokinins:- help in cell division, formation of fruits and seeds.
- iv) Absciscic acid :- inhibits growth and affects wilting of leaves.
- vi) Ethylene :- helps in flowering and ripening of fruits.

Movements in plants:- Movements in plants are of two main types. They are:-Tropic movements and Nastic movements.

a) Tropic movements :- are directional movements towards or away from the stimulus and it depends on growth. They are of different types like Phototropism, Geotropism, Chemotropism, Hydrotropism etc.

i) Phototropism :- is movement of plants in response to light. If it is towards light, it is called positive phototropism. Eg:- Bending of shoot towards light. If it is away from light, it is called negative phototropism. Eg:- Bending of root away from light.

ii) Geotropism :- is the movement of plants in response to gravity. If it is towards gravity it is called positive geotropism. Eg:- Downward growth of roots. If it is away from gravity it is called negative geotropism. Eg:- Upward growth of shoot.

iii) Chemotropism :- is movement of plant in response to chemical stimuli. Eg:- Growth of pollen tube towards the ovule.

b) Nastic movements :- are non directional movements which are neither towards or away from the stimulus and it does not depend on growth. Eg :- If we touch the leaves of touch me not plant, its leaves fold up and droops down immediately due to the change in the amount of water in the leaves. Depending upon the amount of water in the leaves, it swells or shrinks.