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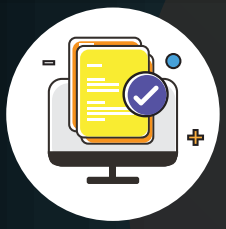

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Chapter 7 - Control and Coordination

Animals- Nervous System:

Nervous system is the organ system present in the animals to control and coordinate different activities of the body. Nervous system comprises of the brain, the spinal cord, and a huge network of nerves that are spread throughout the body.
The nervous system is responsible for sending, receiving and processing messages in the form of chemical signals called as impulses.

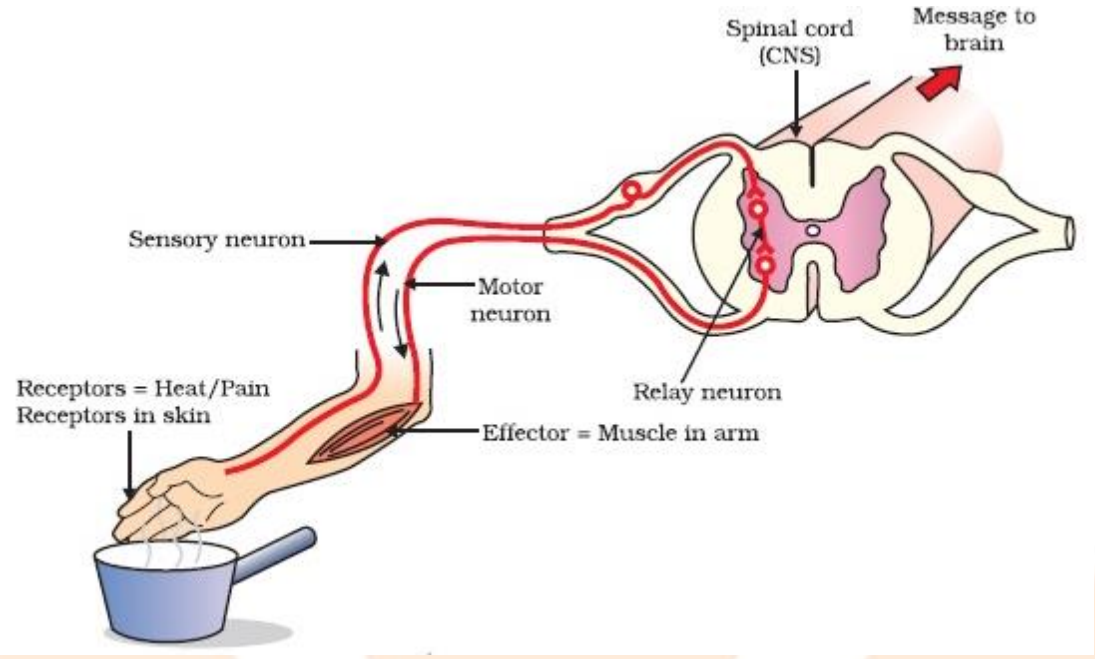
Nervous tissue is made up of an organized network of nerve cells or neurons. It is specialized for conducting information via electrical impulses from one part of the body to another. A neuron is the basic unit of the nervous system. Each neuron consists of three parts, namely, the cell body or cyton, branched projections called the dendrites, and the long process from the cell body, called the axon.
Synapse is a gap between two neurons.
Nerves are thread like structures emerging out of the brain and spinal cord. Nerves branch out to all parts of the body and are responsible of carrying messages in the body.
Types of nerve cells or neurons:

- Sensory nerves send messages from the sense organs to the brain or spinal cord.
- Motor nerves carry messages back from the brain or spinal cord to all the muscles and glands in the body.
- Interneuron or relay neuron connects neuron within specific regions of the central nervous system. These are neither motor nor sensory.

What happens in reflex actions?

Reflex action: A **reflex action**, differently known as a **reflex**, is an involuntary and nearly instantaneous movement in response to a stimulus. Reflex is an action generated by the body in response to the environment.
The process of detecting signal or the input and responding to it by an output action might be completed quickly. Such a connection is commonly called a reflex arc. Reflex arcs are formed in the spinal cord itself; although the information input goes on to reach the brain. In higher animals, most sensory neurons do not pass directly into the brain, but synapse in the spinal cord. Reflex arc continue to be more efficient for quick response.

Study Materials



Human brain:

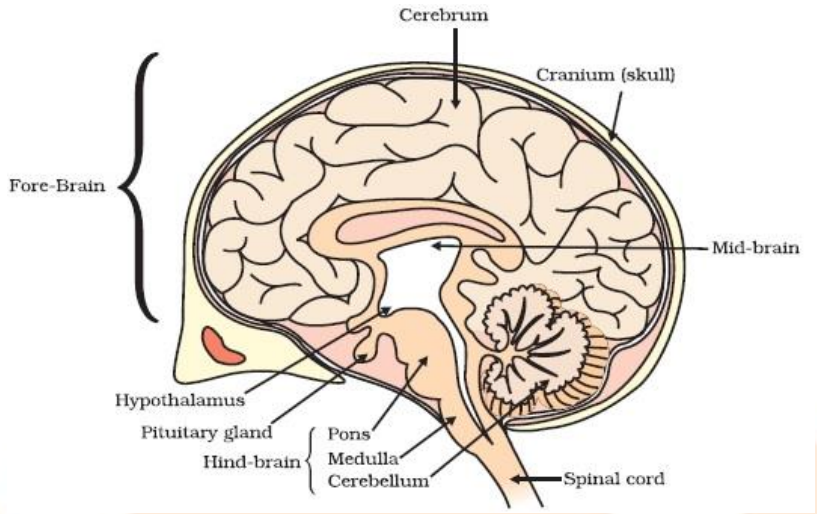
Types of nervous system

The nervous system is divided into two systems – the central nervous system and the peripheral nervous system.

Central nervous system: It includes the brain and the spinal cord. It receives information from the body and sends out instructions to particular organs. The brain has three such major parts or regions namely the fore brain, mid brain and hind brain.

- The forebrain is the main thinking part of the brain. It consists of the cerebrum and diencephalon. The cerebrum is the seat of memory and intelligence, and of sensory centres like hearing, smell and sight. The diencephalon is the seat for pressure and pain.
- The midbrain connects the forebrain to the hindbrain and controls the reflexes for sight and hearing.
- The hindbrain consists of the cerebellum, pons and medulla. The cerebellum coordinates muscular activities and maintains balance and posture. The medulla controls involuntary activities like blood pressure, salivation, vomiting and heart beat.
- The spinal cord extends from the medulla of the brain through the whole length of the vertebral column and is protected by the vertebral column or backbone.

Peripheral nervous system: It consists of the cranial and spinal nerves arises from the brain and spinal cord respectively.



How are the tissues protected?

Human brain is protected by the thick bones of the skull and a fluid called cerebrospinal fluid which provides further shock absorption.

How does the nervous tissue cause action?

When a nerve impulse reaches the muscle the muscle fibre must move. The muscle cells will move by changing their shape so that they shorten. Muscle cells have special proteins that change both their shape and their arrangement in the cell in response to nervous electrical impulses. When this happens new arrangements of these proteins give the muscle cells a shorter form.

Coordination in plants:

All living things respond to environmental stimuli. Plants also respond to stimuli with the help of chemical compounds secreted by the cells. Plants being living organisms, exhibit some movements. Plants show two different types of movement- one dependent on growth and the other independent of growth.

The plants also use electrical chemical means to convey this information from cell to cell but there is no specialized tissue in plants for the conduction of information. Plants respond to stimuli slowly by growing in a particular direction. Because this growth is directional it appears as if the plant is moving.

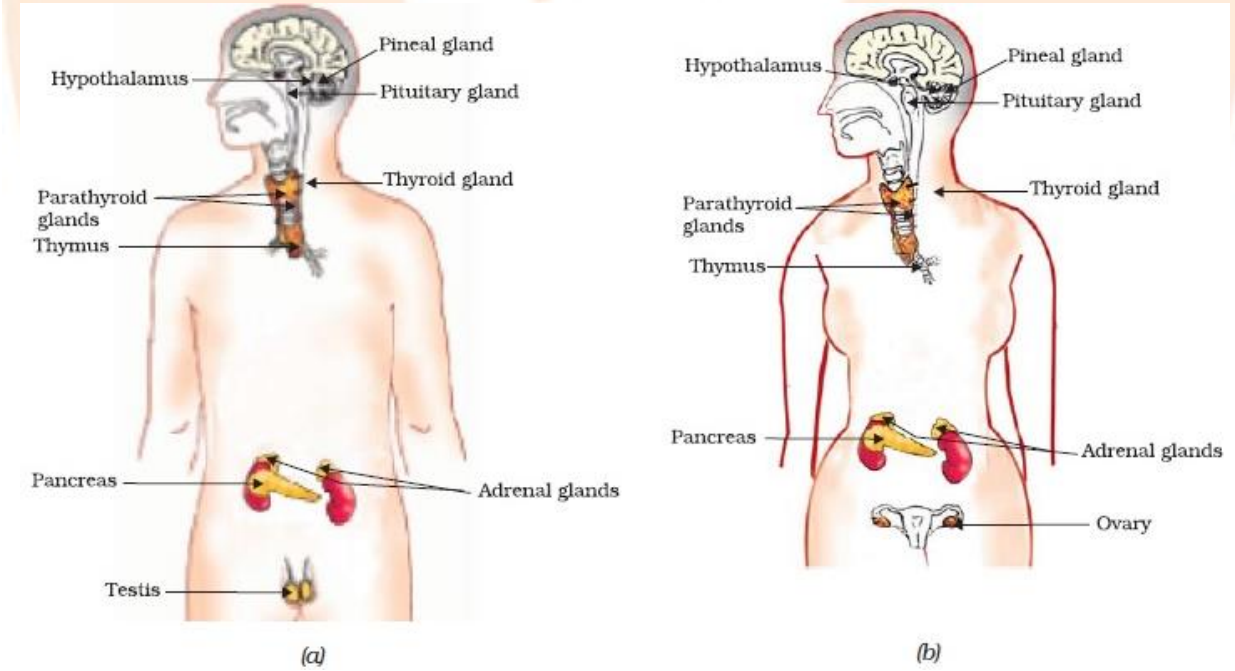
Directional movements: These are also called as tropic movements. These movements can be either towards the stimulus or away from it.

- Positive phototropism is seen in shoots which respond by bending towards light. Negative geotropism is seen in shoots by growing away from the ground.
- Roots bend away from light exhibiting negative phototropism. They grow towards the ground exhibiting positive geotropism.
- Hydrotropism is a growth response in which the direction is determined by the stimuli of water.

- Chemotropism is a growth movement of a plant part in response to chemical stimulus. e.g. Growth of pollen tubes towards ovules.
  Hormones are the chemical compounds released by stimulated cells. Hormones diffuse all around the cell. They are synthesised at places away from where they act and simply diffuse to the area of action. Different plant hormones help to coordinate growth, development and responses to the environment. Different hormones secreted by the plant are auxins, gibberellins, cytokinins, abscisic acid.
- Auxins are the hormones synthesised at the tip of the stem. These help the plant in growth by cell elongation. Auxin induces shoot apical dominance.
- Gibberellins are hormones that help in the growth of the stem, seed germination, bolting, and flowering.
- Cytokinins are hormones present in the areas of rapid cell division, such as fruits and seeds. They also promote the opening of the stomata.
- Abscisic acid is a hormone that inhibits the growth in various parts. It is also responsible for the closure of stomata. Its effects include wilting of leaves.

Hormones in Animals:

Endocrine system is the system formed by ductless glands which secrete chemical substances called as hormones. Endocrine glands release hormones directly into the blood.
Hormones are minute, chemical messengers thrown into blood to act on target organs.



Endocrine glands

Different types of endocrine glands present in our body are the pituitary gland, the pineal gland, the hypothalamus, the thyroid, the parathyroid, the thymus, the adrenal gland, the pancreas, the testes and the ovary.

The adrenal glands:

These are located above the kidneys.

Two regions of the adrenal gland are adrenal cortex and adrenal medulla.

- Adrenal cortex secretes the hormones like cortisol, aldosterone and androgens.
- Adrenal medulla secretes the hormones like adrenaline and noradrenaline. Adrenaline is also called the "hormone of fight or flight," or the emergency hormone. It prepares the body to face an emergency condition of physical stress, like danger, anger and excitement.

The thyroid gland:

- It is located in the neck, ventral to the larynx.
- It is the one of the largest endocrine glands.
- The principal hormones produced by this gland are triiodothyronine and thyroxine.
- Thyroxine is a hormone that regulates the metabolism of carbohydrates, proteins and fats in the body. Iodine is essential for the synthesis of thyroxin. Deficiency of iodine in food causes goiter. One of the symptoms in this disease is a swollen neck.

The pituitary gland:

- **It is located at the base of the brain.**
- It is considered to be master gland as it secretes many hormones to regulate the organs as well as the other glands.
- Different hormones secreted by this gland include Growth hormone, TSH, FSH, LH, ACTH, MSH, Vasopressin and Oxytocin. Growth hormone regulates growth and development of the body. If there is a deficiency of this hormone in childhood, it leads to dwarfism. Excess secretion of this hormone leads to gigantism.

Gonads:

Two types of gonads present in human beings are female gonads and male gonads.

Female gonads

- A pair of ovaries forms the gonads in female.
- Ovaries are the female sex organs that lie one on either side of the abdominal cavity. Ovaries produce two hormones, namely, oestrogen and progesterone.
- Oestrogen controls the changes that occur during puberty, like feminine voice, soft skin and development in mammary glands.
- Progesterone controls the uterine changes in the menstrual cycle, and helps in the maintenance of pregnancy.

Male gonads

- A pair of testes forms the gonads in males.
- A pair of testes is the male sex organ located in the scrotum, which is outside the abdomen.

- Testes produce the hormone testosterone.
- Testosterone controls the changes, which occur during puberty, like deeper voice, development of penis, facial and body hair.

The pancreas:

It is located just below the stomach within the curve of the duodenum. It is both exocrine and endocrine in function.

- It secretes hormones such as insulin, glucagon, somatostatin and pancreatic polypeptide.
- Insulin regulates the sugar level in our blood. Insulin secreted in small amounts increases the sugar level in our blood which in turn causes a disease called diabetes mellitus.

The pineal gland:

- It is located near the centre of the brain, dorsal to the diencephalon.
- It produces the hormone melatonin.
- Melatonin affects reproductive development, modulation of wake and sleep patterns, and seasonal functions.

The hypothalamus:

- It is a neuro-endocrine part of the brain.
- It links the nervous system and the endocrine system through the pituitary gland.
- Hormones like Stomatostatin, Dopamine are secreted by this gland.

Parathyroid glands:

- These are two pairs of small, oval-shaped glands embedded on the dorsal surface of the thyroid gland present in the neck.
- They secrete parathormone. It helps in regulation of calcium and phosphate ions in the bones and blood.
- Hyposecretion leads to tetany and hypersecretion causes osteoporosis.

The thymus gland:

- It is located in front of the heart, in the upper part of the sternum.
- It produces the hormone thymosine.
- It helps in the maturation of T-lymphocytes.

The timing and amount of hormones released are regulated by feedback mechanisms. For example, if the sugar levels in blood rise, they are detected by the cells of pancreas which respond by producing more insulin. As the blood sugar level falls, insulin secretion is reduced.