

Control and Coordination

- **Endocrine glands**

- Hormones are secreted by endocrine glands such as the pituitary gland, thyroid gland, adrenal gland, pancreas etc.
- Major endocrine glands in humans are
 - Pituitary
 - Hypothalamus
 - Pineal
 - Thyroid
 - Parathyroid
 - Thymus
 - Pancreas
 - Adrenal
 - Testis in men /ovary in women
- A feedback mechanism (positive and negative) regulates the action of the hormones

- **Hormones**

- Hormones are chemical secretions that bring about various changes in the body
- They are produced by **endocrine glands**.
- These glands release hormones into blood to reach specific **target site**.
- Production of hormones is under the control of hormones produced from **pituitary gland**.

- **Characteristics of hormones:**

- Hormones act as chemical messengers.
- They are secreted by living cells/tissues or organs called glands.
- They are secreted in very small quantities by glands.
- They act upon specific cells, tissues, or organs called the target sites.
- They are generally slow in action, but have long lasting effects.
- They either accelerate or inhibit a reaction.

- **Various Glands**

- **Pituitary gland**

- It is a pea sized gland situated at the base of the brain. It secretes a **growth hormone (GH)**.
- It is required for proper body growth.
- The hyposecretion of growth hormone causes a condition called **dwarfism**.
- The hypersecretion causes **gigantism** in children and **acromegaly** in adults.

- **Thyroid gland**

- It is located close to trachea in the neck. It produces a hormone called **thyroxine**.
- It is required for regulating metabolism in the body.
- The hyposecretion of thyroxine causes **hypothyroidism**. This condition causes abnormalities like **simple goitre**, **myxoedema** and **cretinism**. Lack of iodine leads to deficiency of thyroxine, which results in a disease called goitre.
- The excess secretion of thyroxine causes **hyperthyroidism**. It results in high metabolism, protrusion of the eye balls, high BP, nervous tension, etc.

- **Parathyroid Gland**

- There are four parathyroid glands present on back side of thyroid glands that secrete parathyroid hormone or parathormone (PTH).
- This hormone regulates the level of calcium ions in the bloodstream.
- Excess of parathyroid hormone removes calcium from bones and makes them soft.

- **Pancreas**

- It produces two hormones- Insulin and Glucagon.
- These hormones maintain blood sugar level.
- Deficiency of insulin results in diabetes.

- **Adrenal Gland**

- There are two adrenal glands located one on upper part of each kidney.
- It has two parts- **cortex** and **medulla**.
- Cortex secretes the hormones like **cortisol** that regulates the rate of metabolism.
- The medulla secretes a hormone like **adrenaline** that prepares the body to face various stressful situations.

- **Gonads**

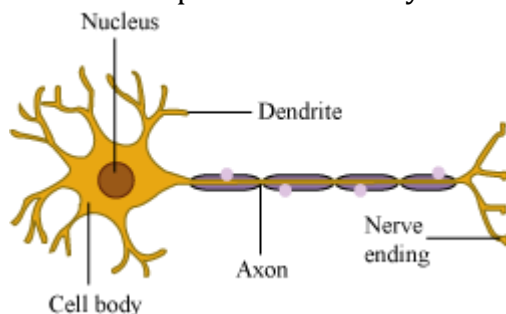
- It includes testes in males and ovaries in females.
- Male sex hormone is **testosterone**. It is produced by the testes on the onset of puberty.
- Female sex hormones produced by ovaries are **estrogen** and **progesterone**.
- Deficiency of estrogen causes **infertility**.

Control and coordination

- Working together of various integrated body systems in response to changes in the surrounding for the maintenance of bodily functions is known as **control and coordination**
- **Nervous system and endocrine system** provide control and coordination in animals.

Nervous system

- **Neurons** -functional units of the nervous system, conduct messages in the form of electrical and chemical impulses
- Neuron composed of cell body and dendrite, axon and nerve endings.



- **Types of neuron:-**

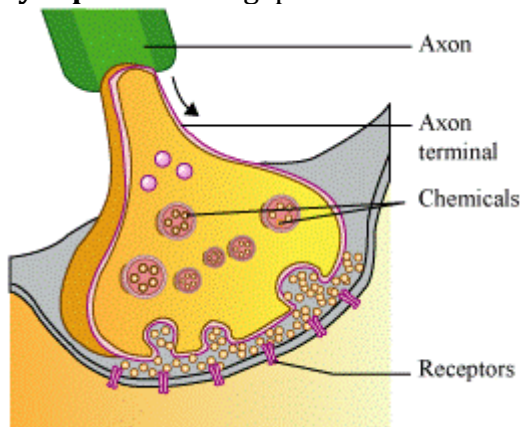
- Sensory neuron
- Motor neuron
- Relaying or intermediate neuron

- **Nerve:** A nerve is a collection of nerve fibres (or axons) enclosed in a tubular medullary sheath. This sheath acts as an insulation and prevents mixing of impulses in the adjacent fibres.

- **Transmission of nerve impulse:**

Under normal conditions, the outer side of the nerve fibre consists of positive charge as more Na^+ ions are present outside axon membrane. The neuron is then said to be in polarised state. On stimulation, the membrane becomes more permeable and Na^+ ions move inside causing depolarisation. Such a region is known as excited region. The point of depolarisation behaves as stimulus for the neighbouring area and this goes on. In the mean time, the previous area becomes repolarised due to active transport (using ATP) of Na^+ ions with the help of **sodium pump**.

- **Synapse-** a small gap between the axon of one neuron and the dendrite of the next neuron



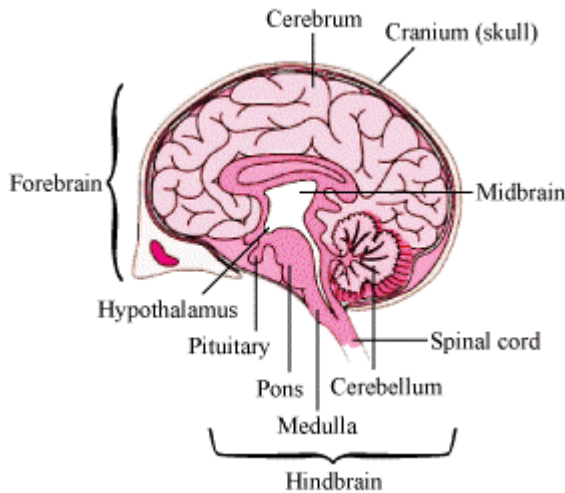
Parts of the nervous system

- Human nervous system divided into- central nervous system (CNS) and peripheral nervous system (PNS)
- CNS consists of the brain and spinal cord
- PNS consists of the nerves that connects the CNS to different parts of the body
- The Brain, spinal cord, and nerves are the important parts of the nervous system

Brain

- The brain is enclosed in a bony box called the **cranium** and spinal cord is protected by **vertebral column**.
- The brain and spinal cord are externally covered by protective covering called **meninges**.
- It is made up of three layers namely **duramater (outer layer)**, **arachnoid (middle layer)**, **piamater (inner layer)**.

- The space between meninges is filled by a watery fluid called **cerebro- spinal fluid (CSF)**.



Human brain is classified into- forebrain, midbrain, and hindbrain.

- **Forebrain-** It consists of cerebrum, thalamus, and hypothalamus.
- It has following functions:
 - It is the thinking part of the brain.
 - The forebrain has sensory regions that receive sensory impulses from various receptors.
 - It has motor regions that control the movement of various muscles (such as the leg muscles).
 - Cerebrum controls intelligence, learning, memory, thinking, and speech.
 - Hypothalamus contains many areas that control things such as body temperature, urge for eating and drinking, etc.
- **Midbrain-** It is mainly concerned with the sense of sight and hearing.
- **Hindbrain-** It consists of pons, medulla, and cerebellum.
- It has following functions:
 - Most of the involuntary actions such as heartbeat, blood pressure, movement of food in the alimentary canal, salivation, etc., are controlled by the midbrain and medulla of the hindbrain.
 - Cerebellum is responsible for voluntary actions and maintaining the posture and equilibrium of the body.

Spinal Cord

- It is the continuation of the medulla oblongata and runs through the vertebral column.
- The spinal cord is made up of two similar halves fused together to form a central canal containing the cerebrospinal fluid.
- The outer portion of the spinal cord is known as the **white matter**, which consists of nerve fibres.
- The inner portion contains the cell bodies of neurons and is known as the **grey matter**.

- Three types of responses of the nervous system are- **reflex action, voluntary action and involuntary action**

- **Reflex action**

- Sudden movement or response to a stimulus
- Occurs in very short duration of time
- Does not involve will or any thinking of brain
- E.g. If we touch hot plate, we immediately pull our hand back.

- **Voluntary action**

- Actions such as writing, talking etc. that can be controlled consciously.

- **Involuntary action**

- Actions such as breathing, digestion etc. that cannot be controlled consciously.

- **Reflex action -**

- It is an automatic action or response provoked by a stimulus.
- Reflex pathway is comprised of the following:
 - **Receptor:** It includes sense organs that receive stimulus.
 - **Sensory or afferent neuron:** It conducts the nerve impulse from receptor to the spinal cord or brain.
 - **Association neuron:** It helps to transmit nerve impulse from sensory neuron to motor neuron.
 - **Motor or efferent neuron:** It transmits nerve impulse to the effector organs like muscles or glands.
 - **Effector:** It includes muscles or glands where action takes place in response to stimulus.

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- Plants respond to stimuli by showing movement.
- Examples of movements in plants
 - When you touch a sensitive plant such as *touch-me-not (Mimosa pudica)*, the plant folds its leaves and droops.
 - When a seed germinates, the root grows down in the soil and the stem grows up in the air.
- In the first example, the plant shows movement by folding its leaves and there is no growth involved. So, it is a **Growth-independent movement**.
- In the second example, the seed germinates and shows directional movement. The movement of the seedling is caused by growth. If the seedling is prevented from growing, then it will not show any movement. Thus, it is a **Growth-dependent movement**
- **Movement in Plants**
- Plants show tropic movement and nastic movement.
- In tropic movement plant either moves towards or away from the stimulus. The movement could be phototropic (towards/away from light), geotropism (gravity stimulated), thigmotropism (touch stimulated) or hydrotropism (moisture stimulated)
- Nastic movements occur in response to environment stimulus but they are different from the tropic movements since the direction of response is not dependent on the direction of stimulus.
- Nastic movements may be classified as thigmonastic, thermonastic and photonastic.

Tropic movement

- Directional movement of a specific part of the plant in response to an external stimulus
- Phototropism- response to light
- Geotropism- response to gravity
- Hydrotropism- response to water
- Chemotropism- response to chemicals
- Thigmotropism- response to touch

Hormones in plants

- Growth and development in plants is possible because of plants hormones or phytohormones
- Auxin- growth of stem
- Gibberellin- promote stem elongation
- Cytokinin- promote cell division
- Abscisic acid- promotes seed dormancy
- Ethylene- regulates fruit ripening