15. Life Processes in Living Organisms

- **Transportation** is a life process where substances synthesized or absorbed in one part of the body are carried to other parts of the body**.**

- **Transportation in plants**
    - The transportation system in plants moves the energy stored in leaves to different parts. It also helps in moving raw materials absorbed from the roots to various organs of the plant.
    - **Xylem** conducts water and minerals obtained from soil (via roots) to the rest of the plant.
    - Transport of water occurs due to transpiration pull, root pressure and difference in pressure gradient.
    - **Phloem** transports food materials from the leaves to different parts of the plant body.
    - Transport of food (translocation) through phloem requires energy.

- **Water movement**
- **Root pressure**
    - It is the positive pressure that develops in the roots of plants by active absorption of nutrients from soil.
    - It pushes the water up to small heights.
    - Root pressure is linked to the phenomenon of guttation.
    - Guttation: It involves the loss of water in the form of liquid droplets through the vein endings of the leaves.
    - Guttation occurs early in the morning and late in the evening when evaporation is low and root pressure is high.
- **Transpiration Pull**
    - Water transport in tall trees occurs by transpiration pull.
    - Transpiration pull is generated by transpiration. It is also called cohesion - tension - transpiration pull model of water transport.
    - The ascent of xylem sap is dependent on three physical properties of water:
        - Cohesion
        - Surface tension
        - Adhesion

Transportation
It is a life process where substances synthesised or absorbed in one part of the organism's body are carried to other parts of the body.

Translocation in plants

- The translocation system in plants moves the synthesised food from leaves to remaining plant parts. It also helps in moving raw materials absorbed from the roots to various organs of the plant.
- **Phloem** transports food materials from the leaves to different parts of the plant body.
- The phloem consists of companion cells, sieve tubes, phloem parenchyma, and fibres.
- Transport of food (translocation) through phloem requires energy, which is obtained from respiration in the form of ATP.

Excretion in Plants

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    - Plants use a variety of techniques to remove waste materials.
    - Oxygen, a by-product of photosynthesis is removed through stomata.
    - The excess water absorbed from roots is also lost through stomata via **transpiration.**
    - Cell vacuoles, gum, resin etc. are stored in old xylem tissues.
    - Waste products may be stored in leaves that fall.
    - Plant roots also sometimes excrete wastes materials.

Excretion in Plants

- Plants get rid of the excess of water by transpiration.
- Transpiration is the evaporation of water from plants.
- The water evaporates through stomata. Stomata help in gaseous exchange and evaporation of water.

Excretory system- The organ system that performs the function of excretion is known as the excretory system

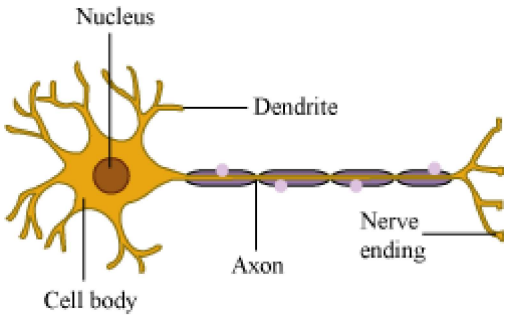
- **Excretion** – It is the process of removing harmful waste products produced in the cells of living organisms.
- The excretory system in humans includes – a pair of kidneys, a pair of ureters, a urinary bladder and a urethra.
- **Kidney-** It is the main excretory organ of the human body. It plays an important role in the formation of urine. Human kidney produces about 1 – 1.8L of urine in a day. The urine consists of 95% water, 2.5% urea and 2.5% other waste products.
- It is divided into two layers - outer cortex and inner medulla.
- Nephrons are the basic filtering units of the kidneys.
- The main components of a nephron are the **glomerulus**, **Bowman's capsule,** and a long **renal tube**.
- **Ureter** carries urine to the bladder.
- **Urinary bladder** collects and stores urine.
- **Urethra** carries urine out of the body.
- **Dialysis-** The process of removing wastes using an artificial kidney is called dialysis.

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.

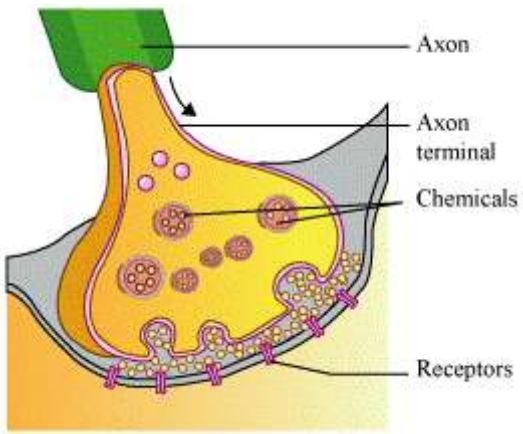


- **Types of neuron:-**
  - Sensory neuron
  - Motor neuron
  - Relaying or intermediate neuron

- **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



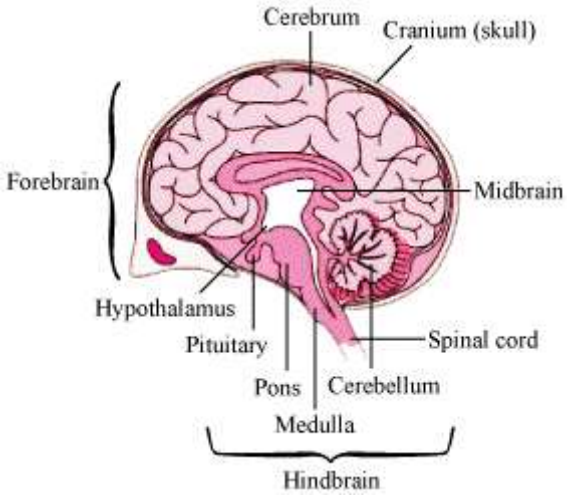
Parts of the nervous system

- 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**.

Reflex action –

- It is an automatic action or response provoked by a stimulus.
- **Reflex** pathway is comprised of the following.
  - **Afferent neuron** – Receives signal from sensory organ and transmits impulse into CNS(spinal cord level).
  - **Efferent neuron –** Carries signal from CNS to effectors

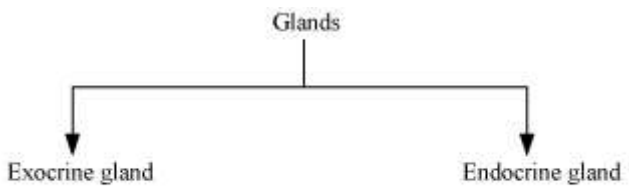
Hormones

- Hormones are chemical messengers that regulate the physiological processes in living organisms.
- These act upon specific target cells/tissues and organs.

Differences between Hormonal Control and Nervous Control

Hormonal Control	Nervous Control
Transmitted chemically through blood	Transmitted electro-chemically through nerve fibres
Transmitted slowly	Transmitted rapidly
Affects different organs	Affects specific organs
Is not affected by previous experience	Is affected by previous experience
Has both long lasting and short lasting effects	Has short lasting effect

Glands



- **Exocrine glands –** Glands that discharge their secretions into ducts

Examples: salivary gland in buccal cavity, sebaceous gland in skin

- **Endocrine gland–** Glands that do not discharge their secretions into ducts, but directly into blood

These are also called ductless glands. Examples: pituitary gland, thyroid gland, adrenal gland, etc.

Human Endocrine System

- Pituitary, pineal, thyroid, adrenal, pancreas, parathyroid, thymus, and gonads are the organised endocrine glands in our body.
- In addition, GI tract, liver, kidney, heart also produce hormones.

Human endocrine system

- **Hypothalamus:**
    - Contains neurosecretory cells that produce hormones
    - Hormones regulate the synthesis and secretion of pituitary glands.
    - Two types of hormones are released.
        - **Releasing hormones –** Stimulate pituitary gland to release hormones
        - **Inhibiting hormones –** Inhibit pituitary gland from releasing hormones
- **Pineal gland**
    - It secretes a hormone called melatonin.

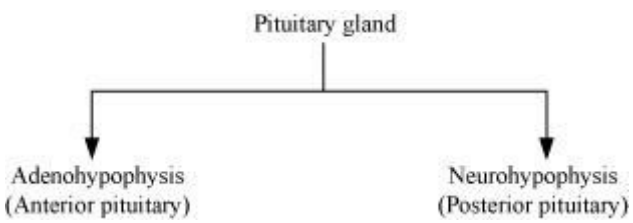
- It also regulates the rhythm of body.

- **Thyroid gland**
  - It secretes two hormones:
    - **Tetraiodothyronine or thyroxin (T4)**
    - **Triiodothyronine (T3)**

Deficiency of iodine results into

- **Hypothyroidism.** The disease is known as **goitre**
- **Creatinism**
- **Myxodema**
- High level of iodine results into **hyperthyroidism.**
- Thyroid hormone plays a role in carbohydrate, fat, and protein metabolism in the body.
- It also secretes thyrocalcitonin, which lowers the calcium level in blood plasma.
- **Parathyroid gland:** It regulates calcium level in body. It increases the reabsorption of calcium ions by renal tubules and digested food.

- **Pituitary gland**



- **(i). Adenohypophysis** is further divided into two regions:
- **Pars distalis (anterior pituitary):**
  - **Growth hormone –** It is involved in growth and development of the body. Low secretion of growth hormone results in dwarfism and acromegaly (extra growth of bones in jaws, hands or feet)
  - **Prolactin –** It helps in growth of mammary gland and milk formation.
  - **Thyroid stimulating hormone –** It helps in secretion of thyroxine from thyroid glands.
  - **Adreno-corticotrophic hormone –** It helps in secretion of glucocorticoid hormone from adrenal cortex.
  - **Gonadotrophic hormone –** It includes the following.
    - **Luteinizing hormone –** It helps in secretion of androgen from testis. It also induces ovulation from Graafian follicles.
    - **Follicle stimulating hormone –** It maintains the growth and development of Graafian follicle.

- **Pars intermedia:** It secretes melanocyte-stimulating hormone (MSH), which maintains skin pigmentation.

- **(ii). Neurohypophysis (posterior pituitary): –** It contains pars nervosa region. Pars nervosa region secretes two hormones:
    - **Oxytocin –** It helps in contraction of uterus and milk ejection.
    - **Vasopressin (Anti-diuretic hormone) –** It stimulates reabsorption of water by distal convoluted tubules.Deficiency causes Diabetes Insipidus.

- **Thymus**
    - This gland is degenerated with the age.
    - Thymus produces a hormone called **thymosins.**
    - Thymosins produce T-lymphocytes that protect the body against infectious agents. It provides cell-mediated immunity and also humoral immunity.

- **Adrenal gland**
    - It is divided into:
        - **Adrenal medulla –** It secretes adrenaline (epinephrine) and noradrenaline (norepinephrine). These are collectively called as catecholamines. These hormones are also called emergency hormones.
        - **Adrenal cortex –** It secretes hormone called corticoids.
            - Corticoid such as glucocorticoid regulates carbohydrate metabolism. Example includes cortisol.
            - Corticoid such as mineralocorticoid maintains the sodium potassium level in blood and tissue. Example includes aldosterone.
    - **Hyposecretion** : Less secretion from adrenal cortex.
    - Disease caused is called **Addison's disease.**
    -
    - **Hypersecretion:** Excess of secretion from adrenal cortex
    - Disease caused is called **Cushing's Syndrome.**
- **Pancreas**
- The islets of Langerhans have two types of cells:
    - **α – cells –** secrete glucagon
    1. **β – cells –** secrete insulin

- **Insufficient Secretion of Insulin**
- **Disease caused: Diabetes mellitus**
- **Over- Secretion of insulin**
- **Disease caused: Hypoglycemia**

- **Hyperglycemia –** Increased blood glucose level
    - Glucagon is a hyperglycaemic hormone.
    - **Hypoglycaemia –** Decreased blood glucose level
    - Insulin is a hypoglycaemic hormone.

    - Diabetes mellitus – Abnormal high glucose level in blood, which results in release of sugar in urine and formation of toxic ketone bodies

- **Testis**
    - **Leydig cells (Interstitial cells) –** Secrete androgens, mainly testosterone

    - Testosterone plays a role in spermatogenesis and development of male secondary sexual characters.

- **Ovary**
    - It secretes two hormones.

    - **Estrogen –** Secreted by Graafian follicle, it regulates the development of female secondary sexual characters.

    - **Progesterone –** Secreted by corpus luteum, it acts on mammary glands and helps in milk secretion.

- 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