

# Senior 2: Term 1

Theme: Soil

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## TOPIC 2.1: PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

**Competency:** The learner appreciates the importance of soil as a resource and understands how its properties affect the growth of plants.

### 2.1.1 Composition of Soil

Soil is composed of four main components in roughly equal proportions (excluding mineral content):

1. **Mineral Matter (45%):** Sand, silt, and clay (inorganic).
2. **Organic Matter (5%):** Decomposed remains of organisms (**Humus**). Improves water holding capacity.
3. **Soil Water (25%):** Contains dissolved mineral salts (**soil solution**).
4. **Soil Air (25%):** Provides **oxygen** for root and microbial respiration.

### 2.1.2 Physical Properties of Soil

#### A. Soil Texture

- **Definition:** The relative proportion of different-sized mineral particles (sand, silt, clay).
- **Particle Size (Largest to Smallest):** Sand → Silt → Clay.
- **Loam Soil:** A desirable mixture of sand, silt, and clay, offering the best balance of aeration and water retention.

#### B. Water Retention and Drainage

| Soil Type  | Particle Size | Water Retention | Drainage (Permeability) | Aeration |
|------------|---------------|-----------------|-------------------------|----------|
| Sandy Soil | Large         | Poor            | Excellent (Fast)        | Good     |
| Clay Soil  | Small         | Very High       | Poor (Slow/Waterlogged) | Poor     |
| Loam Soil  | Mixed         | Good            | Moderate                | Good     |

## 2.1.3 Chemical Properties of Soil

### A. Soil pH

- **Definition:** A measure of the acidity or alkalinity of the soil (pH scale 1-14).
- **Importance:** pH affects the **solubility** and hence the **availability** of essential mineral nutrients to plants. Most plants grow best in slightly acidic to neutral soil (pH 6.0–7.0).
- **Correction:** Add **Lime** (calcium carbonate) to raise the pH (reduce acidity).

### B. Mineral Nutrient Content

- **Macronutrients:** Needed in large amounts.
  - **Nitrogen (N):** Essential for protein and leaf growth.
  - **Phosphorus (P):** Essential for root growth, flowering, and fruiting.
  - **Kalium (Potassium, K):** Essential for plant health and fruit ripening.
- **Micronutrients:** Needed in trace amounts (e.g., Iron, Zinc, Copper).

**Summary:** Soil is a mix of mineral matter, organic matter, water, and air. **Texture** determines water and air capacity. **Loam** is the best soil. **Soil pH** is vital for nutrient availability. Plants require key **N-P-K** macronutrients.

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## TOPIC 2.2: SOIL EROSION AND CONSERVATION

**Competency:** The learner understands how soil is degraded by erosion and proposes sustainable methods for conservation.

### 2.2.1 Soil Erosion: Causes and Effects

- **Definition:** The removal and transportation of the top fertile layer of soil.
- **Causes:**
  - **Water:** High-intensity rainfall (splash erosion) and rapid surface runoff (sheet, rill, and gully erosion).
  - **Wind:** Strong winds carry away fine, dry topsoil.
  - **Human Activities:** **Deforestation** (removes roots), **Overgrazing** (removes vegetation cover), and poor farming practices (ploughing up and down slopes).
- **Effects:**
  - Loss of **topsoil fertility**, leading to reduced crop yields.
  - **Siltation** of rivers and dams.
  - Formation of deep channels (**gullies**), making land unusable.

## 2.2.2 Soil Conservation Methods

**Soil Conservation** aims to prevent soil loss and degradation.

| Method                   | Description                                                                                               | Principle                                                                          |
|--------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Afforestation</b>     | Planting trees on bare land.                                                                              | Roots bind the soil; canopy reduces the force of rainfall.                         |
| <b>Contour Ploughing</b> | Plowing or tilling <i>across</i> the slope (along contour lines).                                         | Furrows act as small dams, slowing down runoff water and increasing absorption.    |
| <b>Terracing</b>         | Creating flat steps on very steep slopes.                                                                 | Eliminates rapid runoff and converts steep slopes into level ground.               |
| <b>Strip Cropping</b>    | Planting alternating strips of different crops (e.g., a row crop followed by a close-growing cover crop). | The close-growing crop traps soil washed from the open crop.                       |
| <b>Mulching</b>          | Covering the soil surface with crop residue, plastic, or dry grass.                                       | Protects the soil surface from direct rain/wind impact; reduces water evaporation. |

**Summary: Soil Erosion** is the loss of topsoil, mainly caused by water, wind, and human activities like **deforestation**. **Conservation** involves methods like **Contour Ploughing**, **Terracing**, and **Afforestation** to stabilize the soil and control the flow of water.

# Term 2 Study Notes

Theme: Nutrition in Plants and Animals

## TOPIC 3.1: NUTRITION TYPES AND NUTRIENT COMPOUNDS

**Competency:** The learner understands the various ways organisms obtain food and the chemical composition and importance of the major nutrient compounds.

### 3.1.1 Types of Nutrition

| Type                 | Definition                                                                                                               | Example Organisms                                              |
|----------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|
| <b>Autotrophic</b>   | Organisms synthesize complex organic food from simple inorganic substances (e.g., CO <sub>2</sub> and H <sub>2</sub> O). | Green Plants (Photosynthesis), some Bacteria (Chemosynthesis). |
| <b>Heterotrophic</b> | Organisms obtain pre-formed organic food by feeding on other organisms.                                                  | Animals, Fungi, most Bacteria.                                 |

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#### Sub-types of Heterotrophic:

- **Holozoic:** Ingestion of solid food (e.g., Humans).
- **Saprotrophic:** Feeding on dead/decaying matter (external digestion) (e.g., Fungi).
- **Parasitic:** Obtaining nutrients from a living host, causing harm (e.g., Tapeworm).

### 3.1.2 Major Nutrient Compounds (Classes of Food)

Nutrients are used by the body in a process called **assimilation**.

| Nutrient Class       | Main Elements                     | Importance/Function (Assimilation)                                             | Food Source                      |
|----------------------|-----------------------------------|--------------------------------------------------------------------------------|----------------------------------|
| Carbohydrates        | C, H, O (1:2:1 ratio)             | Primary source of energy for cellular respiration.                             | Cereals, Cassava, Sugar.         |
| Proteins             | C, H, O, N (often S/P)            | Essential for Growth and Repair of tissues; structure of enzymes and hormones. | Meat, Eggs, Fish, Beans.         |
| Lipids (Fats & Oils) | C, H, O (low O <sub>2</sub> )     | Energy storage; insulation; components of cell membranes.                      | Butter, Groundnuts, Cooking Oil. |
| Vitamins             | Diverse organic compounds         | Act as co-factors for metabolism; vital for maintaining health.                | Fruits, Vegetables.              |
| Mineral Salts        | Inorganic elements (e.g., Ca, Fe) | Bone/teeth formation; part of haemoglobin (Fe).                                | Vegetables, Dairy.               |
| Water                | H <sub>2</sub> O                  | Solvent, transport medium, temperature regulation.                             | Drinking water, Fruits.          |
| Fibre/Roughage       | Cellulose                         | Provides bulk to faeces to prevent constipation.                               | Vegetables, Whole Grains.        |

**Summary:** Nutrition is either **Autotrophic** (self-made) or **Heterotrophic** (obtained externally).

The main nutrients are **Carbohydrates** (Energy), **Proteins** (Growth/Repair), **Lipids** (Storage/Insulation), and supporting compounds like Vitamins and Minerals.

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## TOPIC 3.2: NUTRITION IN GREEN PLANTS

**Competency:** The learner understands the mechanism of photosynthesis in plants and its role in maintaining life on earth.

### 3.2.1 Photosynthesis

- **Definition:** The process by which green plants manufacture their own food (glucose) using **sunlight** energy,  $\text{CO}_2$ , and  $\text{H}_2\text{O}$ .
- **Site: Chloroplasts** (contain chlorophyll) in the leaves.
- **Equation:**  
Carbon Dioxide + Water  $\rightarrow$  Chlorophyll Light Energy Glucose + Oxygen  
 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{Chlorophyll Light Energy } \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
- **Raw Materials:**  $\text{CO}_2$  (from air, via stomata) and  $\text{H}_2\text{O}$  (from soil, via roots).
- **Products: Glucose** (stored as starch) and **Oxygen** (released to atmosphere).

### 3.2.2 Adaptations of the Leaf

1. **Large Surface Area:** To capture maximum sunlight.
2. **Thin Lamina:** To minimize the distance for gas and water transport.
3. **Stomata:** Pores to regulate gas exchange ( $\text{CO}_2$  intake,  $\text{O}_2/\text{H}_2\text{O}$  release).
4. **Veins (Xylem & Phloem):** Transport water and manufactured food.

### 3.2.3 Importance of Photosynthesis

1. **Food Source:** It is the ultimate source of food/energy for almost all life on Earth.
2. **Oxygen Supply:** Releases the oxygen necessary for aerobic respiration by most organisms.

**Summary: Photosynthesis** uses light energy to convert  $\text{CO}_2$  and  $\text{H}_2\text{O}$  into **glucose** (food) and **oxygen**. It is the vital process that maintains the food chain and the Earth's atmosphere.

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## TOPIC 3.3: NUTRITION IN MAMMALS

**Competency:** The learner understands the processes of digestion and absorption in mammals, and appreciates the importance of a balanced diet.

### 3.3.1 Human Digestive System (Holozoic Nutrition)

| Organ/Gland     | Function                                                                                      |
|-----------------|-----------------------------------------------------------------------------------------------|
| Mouth           | Ingestion; Mechanical (chewing) and Chemical (saliva amylase starts starch digestion).        |
| Oesophagus      | Muscular tube that pushes food down by peristalsis.                                           |
| Stomach         | Stores and churns food; chemical digestion of Protein begins (by Pepsin).                     |
| Small Intestine | Main site of chemical digestion (by Pancreatic/Intestinal Juice) and Absorption.              |
| Liver/Pancreas  | Accessory organs: Liver produces Bile (emulsifies fats); Pancreas produces digestive enzymes. |
| Large Intestine | Water absorption; formation of faeces.                                                        |
| Anus            | Egestion (removal of undigested waste/faeces).                                                |

### 3.3.2 Digestion and Absorption

- **Digestion:** The breakdown of large, insoluble food into small, soluble molecules by **enzymes**.
- **Absorption:** The passing of small, soluble molecules (e.g., glucose, amino acids) through the wall of the small intestine into the bloodstream.
- **Adaptation of Small Intestine:** The inner lining is folded into **villi** and **microvilli** to vastly increase the **surface area** for efficient absorption.

### 3.3.3 Balanced Diet

- **Definition:** A diet containing the correct proportions and quantities of all the six essential nutrients (Carbohydrates, Proteins, Lipids, Vitamins, Mineral Salts, Water) to maintain health.
- **Malnutrition:** A state resulting from an unbalanced diet.
  - **Protein Deficiency:** Causes **Kwashiorkor** (swollen belly) and **Marasmus** (severe wasting).
  - **Vitamin C Deficiency:** Causes **Scurvy** (bleeding gums).
  - **Iron Deficiency:** Causes **Anaemia** (low red blood cell count).

**Summary:** Mammalian nutrition involves the entire digestive tract to facilitate **digestion** and **absorption**. The **small intestine** is optimized for absorption with **villi**. A **balanced diet** of all six nutrients is essential to prevent deficiency diseases.

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# Term 3 Study Notes

## Theme: Transport in Plants and Animals

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### TOPIC 4.1: TRANSPORT IN PLANTS

**Competency:** The learner understands the processes of absorption, transpiration, and translocation in plants and their significance.

#### 4.1.1 Absorption

- **Root Hair Cells:** Specialized cells that greatly increase the **surface area** for absorption.
- **Water Uptake:** By **Osmosis** (movement from a region of high water potential to low water potential).
- **Mineral Salt Uptake:** Mainly by **Active Transport** (requires **ATP** energy, against a concentration gradient).

#### 4.1.2 Transpiration

- **Definition:** The loss of **water vapor** from the plant surface, primarily through the **stomata**.
- **Mechanism:** Water loss creates a negative pressure (**Transpiration Pull**) that draws water up the **Xylem** vessels from the roots.
- **Significance:** Moves water/minerals up the plant; provides a **cooling effect**.
- **Factors Affecting Rate:**
  - **Temperature:** Higher temp → faster evaporation → **Increased rate**.
  - **Wind/Air Movement:** Blows away humid air → maintains concentration gradient → **Increased rate**.
  - **Light Intensity:** Causes stomata to open → **Increased rate**.

#### 4.1.3 Translocation

- **Definition:** The transport of manufactured food (**sugars/sucrose**) from the site of production (**source** - usually leaves) to the site of use/storage (**sink** - e.g., roots, fruits).
- **Tissue Responsible:** The **Phloem** vessels. (The movement can be up or down, unlike water in the Xylem).

**Summary:** Water and minerals are absorbed by root hairs. **Transpiration** (water loss via stomata) creates the pull for transport in the **Xylem**. **Translocation** is the movement of food (**sucrose**) in the **Phloem**.

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## TOPIC 4.2: TRANSPORT IN ANIMALS

**Competency:** The learner understands the structure and function of the circulatory system in mammals and the role of blood in transport.

### 4.2.1 The Circulatory System

- **Function:** To circulate substances ( $O_2$ , nutrients, hormones) to body cells and remove waste ( $CO_2$ , urea).
- **Components:** **Heart** (pump), **Blood Vessels** (tubes), and **Blood** (medium).
- **Double Circulation:** Blood passes through the heart **twice** per circuit (Pulmonary → Lungs; Systemic → Body).

### 4.2.2 Blood Vessels

| Vessel    | Direction                 | Wall Characteristics                  | Pressure | Exchange Site?               |
|-----------|---------------------------|---------------------------------------|----------|------------------------------|
| Artery    | Away from the heart.      | Thick, muscular, elastic.             | High.    | No.                          |
| Vein      | Towards the heart.        | Thin, less muscular; contains valves. | Low.     | No.                          |
| Capillary | Links arteries and veins. | One cell thick.                       | Low.     | Yes (main site of exchange). |

### 4.2.3 Components and Function of Blood

| Component         | Function                                                                     |
|-------------------|------------------------------------------------------------------------------|
| Plasma            | Transport medium (water, digested food, waste, hormones).                    |
| Red Blood Cells   | Transport Oxygen (due to haemoglobin).                                       |
| White Blood Cells | Immunity: Fight disease (Phagocytes engulf, Lymphocytes produce antibodies). |
| Platelets         | Essential for Blood Clotting to prevent blood loss.                          |

**Summary:** Mammalian transport is via a **double circulation** system driven by the **heart**. **Arteries** carry blood away, **veins** return it, and **capillaries** facilitate exchange. **Blood** performs key transport ( $O_2$ ), defense (White Blood Cells), and clotting (Platelets) functions.