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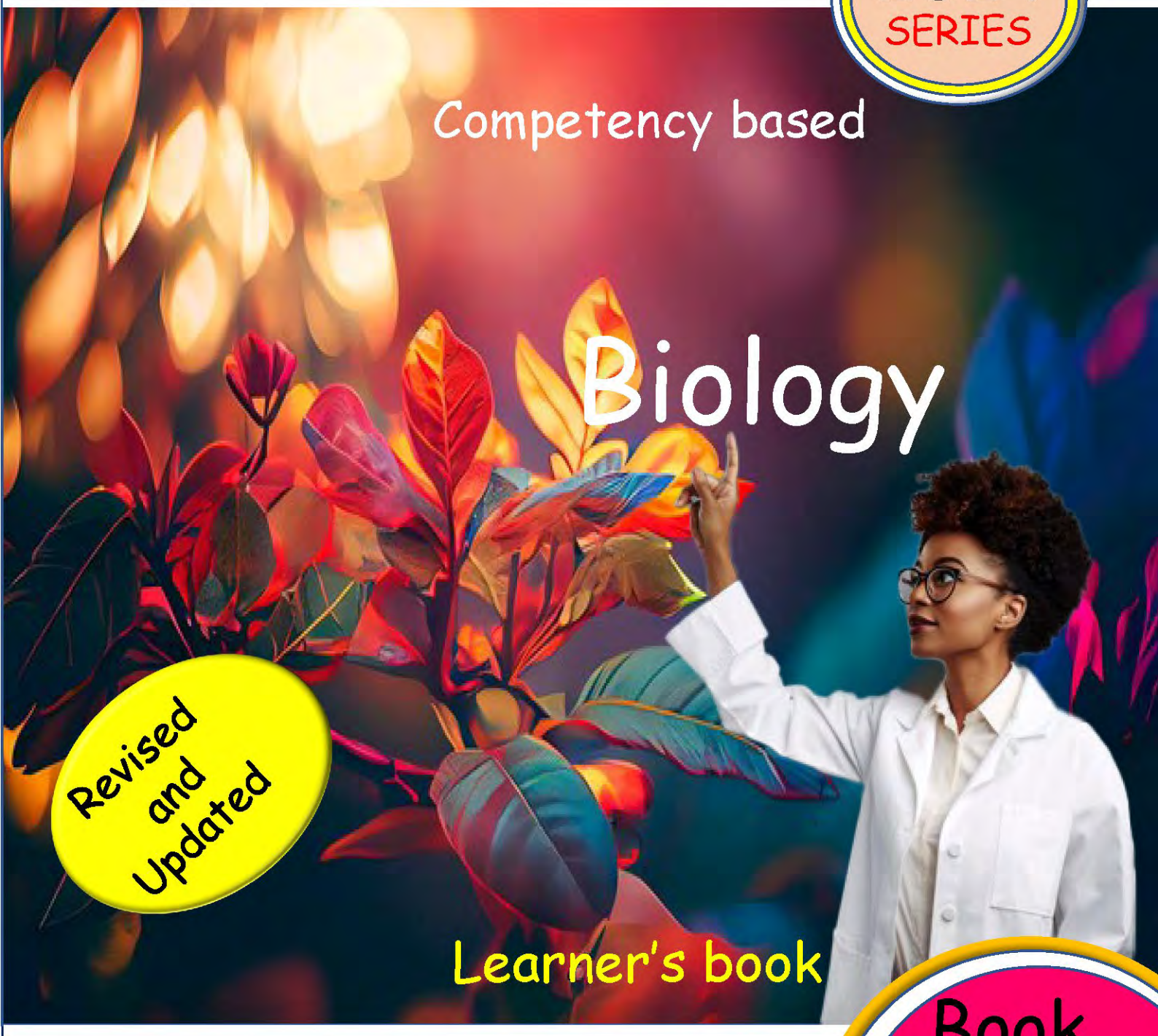

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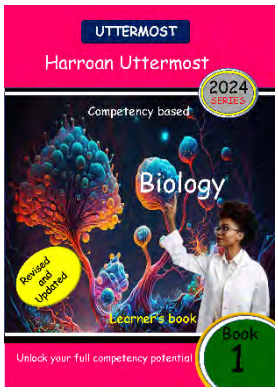

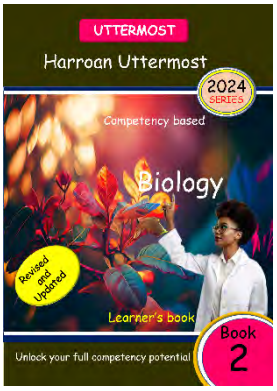

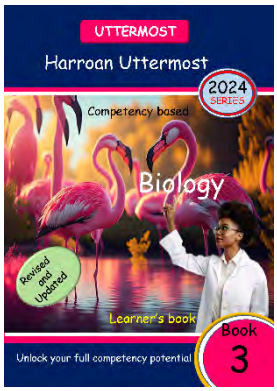

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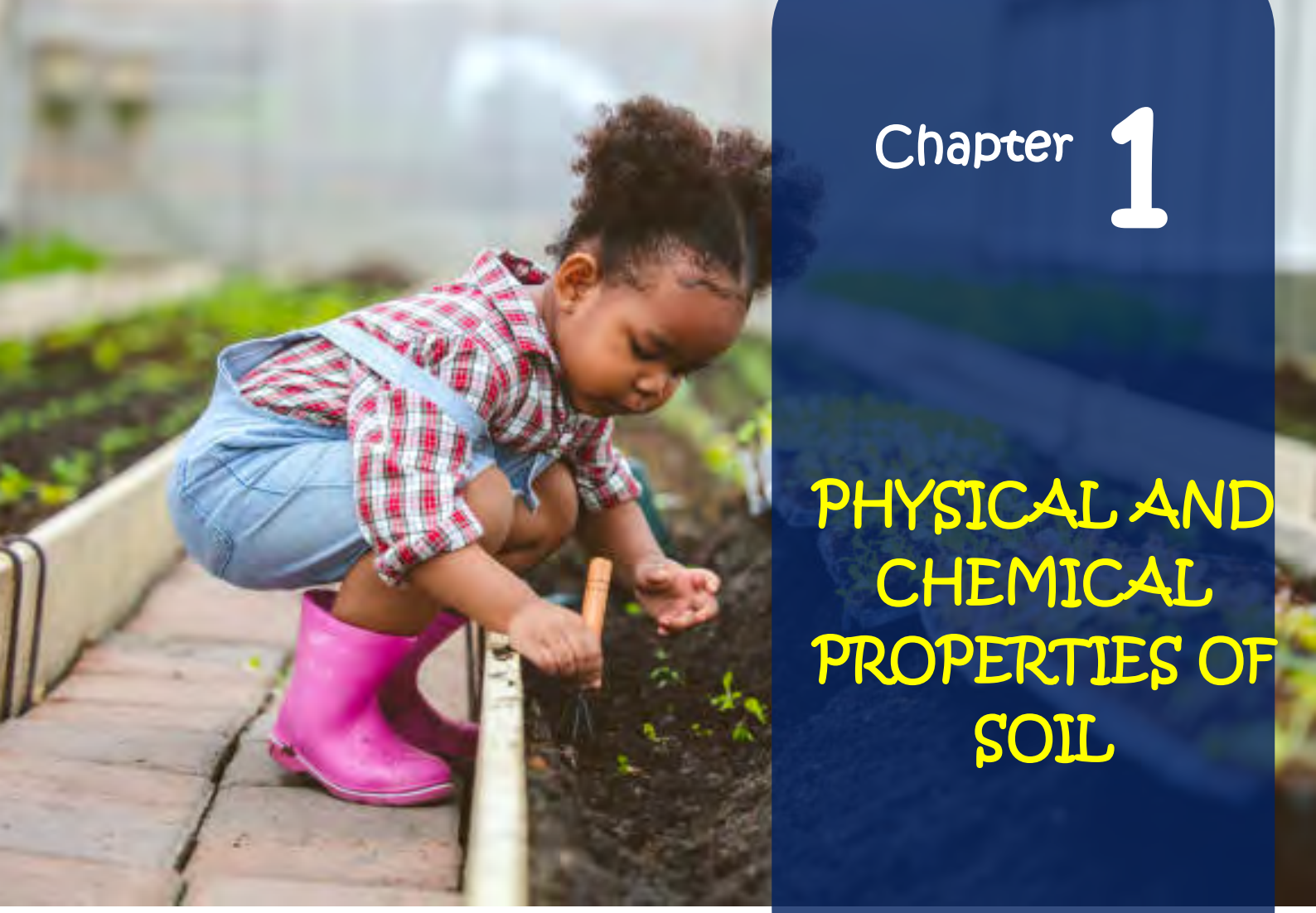


Chapter 1

PHYSICAL AND CHEMICAL PROPERTIES OF SOIL

By the end of this chapter, you should be able to;

- Identify the different types of soil
- Describe the constituents of soil.
- Describe the physical properties of soil
- Describe the chemical properties of soil.

1.1 Investigating characteristics of soil types

Key question: What are the characteristics of each type of soil?

Introduction to soil

Have you ever wondered about the fascinating world beneath our feet? Soil, the foundation of life on Earth, is a complex and vital component of our ecosystem. It is much more than just dirt; it plays a crucial role in supporting plant growth, providing habitats for numerous organisms, and even regulating our climate. Soil is a dynamic mixture of minerals, organic matter, water, air, and countless microorganisms. It forms through the gradual weathering of rocks over thousands or even millions of years which involves the physical breakdown of rocks.

Daily life connections

Soil serves as a reservoir for water, playing a vital role in the water cycle. It acts as a natural filter, purifying water as it percolates through the layers. Additionally, soil stores and releases water, helping to regulate the water supply and prevent flooding or drought conditions. One of the most crucial functions of soil is its role in supporting plant growth. Soil provides plants with essential nutrients, such as nitrogen, phosphorus, and potassium, which are necessary for their development. It also acts as a medium for roots to anchor themselves, allowing plants to access water and nutrients from the soil. Soil contains organisms, including bacteria, fungi, insects, worms, and small mammals. These organisms play vital roles in nutrient cycling, decomposition of organic matter, and the formation of soil structure. They contribute to the overall health and fertility of the soil, making it a thriving ecosystem in its own right.

Soil contains organisms

Soil acts as a medium to anchor roots

Soil supports plant growth

Types of soil.

Soil is divided into three types namely; Sand soil, clay soil and loam soil.

Sand soil

clay soil

loam soil.

Sand soil: Sand soil is a type of soil that has the largest particle size among the three types mentioned. It is characterized by its gritty texture and is composed predominantly of granules of sand. Sand particles are relatively large, ranging in size from 0.05 to 2.0 millimeters. Due to the larger particle size, sand soil has a high permeability, allowing water to drain quickly. This characteristic makes it prone to drought as the water-holding capacity is low. As a result, nutrients can easily leach out of the soil, which can affect plant growth. However, sand soil also has good aeration and drainage properties, preventing waterlogging and facilitating root development. Because of its loose structure, it does not hold much organic matter, making it less fertile. It is commonly found in coastal areas and deserts.

Clay Soil: Clay soil is composed of very fine particles, with a particle size smaller than 0.002 millimeters. It has a smooth and sticky texture when wet and becomes hard and compact when dry. Clay particles have a high surface area, which allows them to hold onto water and nutrients more effectively. Consequently, clay soil has a high water-holding capacity, but it can also retain excess water, leading to poor drainage and potential waterlogging. Due to its small particle size and compact nature, clay soil has low permeability, making it difficult for water and air to move through it. This can result in slow root growth and restricted aeration. However, clay soil is rich in nutrients and has a high cation exchange capacity, which means it can hold and release nutrients for plants. With proper management and amendments, clay soil can be improved for gardening and agriculture. It is commonly found in areas with high rainfall and in regions with sedimentary deposits.

Loam Soil: Loam soil is considered the ideal type of soil for plant growth and gardening. It is a balanced mixture of sand, silt, and clay particles, providing a combination of the positive qualities of each soil type. Loam soil has a crumbly texture that retains moisture well while allowing for good drainage and aeration. It holds onto nutrients effectively but does not become waterlogged. The sand particles provide good drainage, the silt particles improve water-holding capacity, and the clay particles contribute to nutrient retention. Loam soil is fertile and supports healthy root development, making it suitable for a wide range of plants. It is commonly found in areas with moderate rainfall and is often used in agriculture and gardening for its optimal properties.

How sand, silt and clay work together in loam soil

Loam soil is considered ideal for plant growth due to its balanced composition of sand, silt, and clay.

- The sand particles provide good drainage and aeration.
- The silt particles contribute to water-holding capacity and nutrient retention.
- The clay particles enhance nutrient retention and contribute to soil fertility.
- The combination of sand, silt, and clay in loam soil results in a well-structured soil with good water retention, drainage, and nutrient availability, promoting healthy plant growth

Group activity:

Group activity:

Investigating characteristics of different soil types

1. In groups of 3 to 5 students, carry out the following investigations and outline the characteristics of the given soil types

What you need: soil types: sand, clay and loam, Filter funnels, Measuring cylinders, Beakers, Filter papers and Water

What to do:

- Touch and feel the texture and size of the soil particles in each soil type
- Look carefully and observe the colour of the soil type.
- For each soil sample, place it in a filter funnel with a filter paper. Place the funnel on the measuring cylinder. Add water to the soil, observe and record the amount of water collected.

a) Complete the table below using your observations.

Feature	Sand soil	Clay soil	Loam soil
Size of particles			
Drainage			
Water retention			
Texture			
Colour			

b) Outline the characteristics of each soil type

Use your brain power!

2. A gardener is struggling with sandy soil that dries out quickly, resulting in poor water retention and nutrient deficiency in plants. Sandy soil does not hold water or nutrients effectively, leading to plant stress. How can the gardener address this issue?

3. A farmer wants to improve the drainage of his heavy clay soil to prevent waterlogged conditions. The clay soil retains too much water, which is detrimental to the crops. How can he achieve this?

1.2 importance of soil in daily life

Key question: How can we use soil to come out of poverty?

Uses of soil

Soil is a fundamental factor in supporting crop growth and agriculture, providing a medium for plant roots, water, nutrients, and support for the plant canopy. The physical, chemical, and biological properties of soil influence crop productivity, quality, and resilience to environmental stress. Soil supplies the essential nutrients, water, oxygen and root support that plants need to grow and flourish. The also serve as a buffer to protect delicate plant roots from drastic fluctuations in temperature. Agriculture and food production rely heavily on soil quality and health, impacting the availability and nutritional value of food for human consumption. Understanding the importance of soil in crop growth is essential for sustainable agriculture, food security, and environmental stewardship. Maintaining healthy soil promotes the sustainable production of diverse crops, preserves biodiversity, and supports ecosystem services such as water filtration and carbon sequestration.

Soil supplies nutrients to support plant growth

Agriculture relies on soil quality

Importance of soil in crop growth

Soil plays a vital role in crop growth, providing essential nutrients, water, and physical support for plants. Understanding the importance of soil in agriculture is essential for optimizing crop production and ensuring food security. Many people grow small vegetable gardens in their homes, utilizing the soil to grow fresh produce for daily consumption. The quality and health of the soil directly impact the growth and nutritional value of these crops. The majority of our food comes from agricultural practices that rely on soil for crop growth. Farmers and agricultural experts consider soil characteristics to make informed decisions about crop selection, fertilization, and irrigation.

Crops grown in loam soil: Loam soil is the best soil type for growing most crops though some crops can grow in clay and even some in sand. Loam favours the growth of most plants because it holds most of the moisture but also drains well so that sufficient air can reach the plant roots. It also contains humus providing fertility to the soil. Loam soil is a balanced mixture of sand, silt, and clay, providing good water retention, drainage, and fertility. Examples of crops grown in loam soil include; sugarcane, cotton, tomatoes, onions, green beans, cucumbers, banana


Sugarcanes growth in loam


Loam soil supports tomato growth


Banana growth in loam soil

Crops grown in sand soil: Though sand soil has a good drainage system, it is also warm, light, dry and tends to be acidic with low nutrients. Therefore, it favours crops which requires very few nutrients to grow. Organic matter can be added to sand soil to provide plants an additional boost of nutrients by improving the nutrient and water holding capacity of the soil. In countries of desert region or areas located near the coast, sand soil is used for crop growth but since it does not hold water and nutrients for long, it is mixed up with compost to boast organic matter which increases nutrients obtained by plants and also plants are watered by irrigation regularly. Crops that can grow in sandy soils include; potatoes, carrots, lettuce, corn etc.


Carrots growing in sand


Sweet potatoes growing in sand


Lettuce growth in sand

Crops grown in clay soil: Clay soils are considered to be one of the heaviest soils. They can hold nutrients and water for a long period of time. The good water storage quality makes it hard for air to penetrate into it and is compactness makes it hard for plant roots to easily penetrate and flourish. Poor drainage makes it wet with much water which could make plant roots to rot. However, clay soil can be improved over time; By adding a liming agent like calcium oxide which causes clay particles to clump thus improving its drainage (though this works in acidic soils), By adding organic matter. This will loosen the bulkiness and hardness of clay soil making it easy to work on and easy for penetration of plant roots. Crops grown in clay soil include; red cabbage, green cabbage, rice, broccoli, pea, potato

Rice growing in water logged clay soil

How can we improve clay and sand soil to support crop growth in them

Improving Clay Soil:

Drainage Improvement: Clay soil tends to have poor drainage, leading to waterlogging and root rot. To enhance drainage, consider incorporating organic matter such as compost or well-rotted manure into the soil. This improves the soil structure and promotes better water movement.

Organic Matter Addition: Adding organic matter helps break up compacted clay soil, making it more friable and easier for roots to penetrate. Apply compost, leaf litter, or straw to the soil surface and work it in using a garden fork or tiller.

Clay soil water logging

Mulching: Applying a layer of organic mulch, such as wood chips or straw, on the soil surface helps regulate soil temperature, reduce evaporation, and improve moisture retention. Mulching also adds organic matter as it breaks down over time.

Soil Amendments: Incorporating soil amendments like gypsum or lime helps to balance the pH levels of clay soil. Testing the soil's pH and following recommended guidelines will aid in creating an optimal growing environment for crops.

Improving Sand Soil:

Organic Matter Addition: Adding organic matter to sandy soil improves its water-holding capacity and nutrient retention. Incorporate well-decomposed compost, peat moss, or aged manure into the soil. This increases its ability to retain moisture and nutrients, supporting healthy crop growth.

Mulching: Applying a layer of organic mulch helps conserve moisture in sandy soil and prevents rapid evaporation. Mulch also adds organic matter to the soil as it breaks down, improving its fertility over time.

Irrigation Management: Sandy soil drains quickly and may require more frequent irrigation. Implementing efficient irrigation systems like drip irrigation can help provide a consistent water supply to crops grown in sandy soil.

Cover Crops: Planting cover crops, such as legumes or grasses, in fallow periods helps improve sandy soil. These plants add organic matter, fix nitrogen, and enhance soil structure, making it more suitable for crop growth.

Group activity:

Uses of soil in daily life

Group activity: 1. The pictures below show the different uses of soil in daily life

A

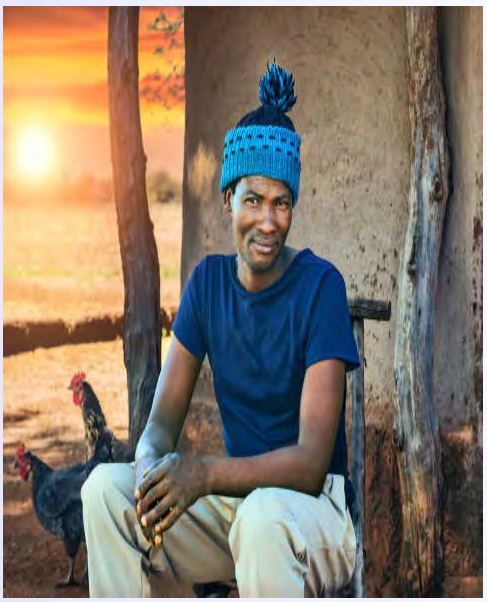
B

C

D

a) Identify how soil is used in each; A, B, C and D.
b) Identify the soil type used in each; A, B, C and D.
c) Briefly describe the importance of the uses of soil in the pictures to the environment and our society.
d) Describe other uses of soil.

Use your brain power!



2. Nsotoka is one of the remote areas in Uganda, most people living in the village are uneducated and they are so poor. There is reported increased crime rates which has resulted from poverty and lack of employment opportunities in the area. Write a sensitization message to the people living in the area describing to them ways they can use soil to come out of poverty.
3. A gardener wants to enhance crop growth in heavy clay soil and improve its workability. Clay soil has poor drainage, is prone to compaction, and can be challenging to work with. What actions can the gardener take to support healthy plant growth in clay soil?

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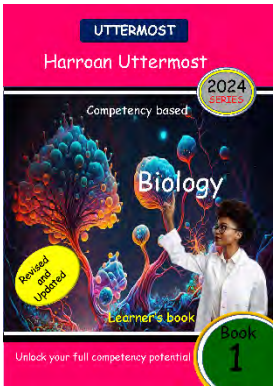

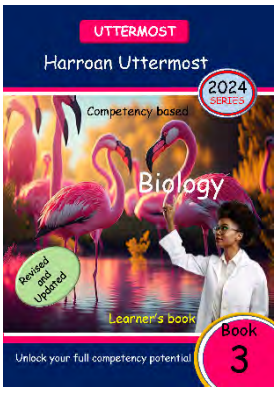

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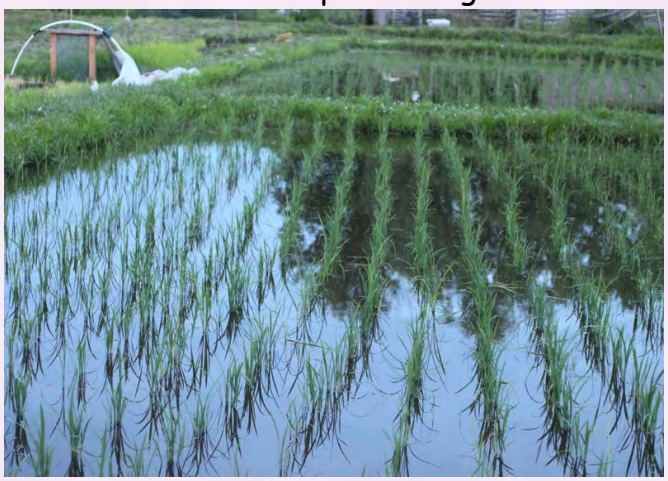
1.4 Soil drainage and soil water retention

Key question: Describe the importance of soil drainage to the growth of crops

Soil drainage

Soil drainage and soil water retention are important properties that influence the availability of water for plant growth and the overall health of the soil ecosystem. Understanding these properties helps in optimizing irrigation practices, preventing waterlogging, and promoting healthy plant growth. Soil drainage refers to the ability of soil to allow water to pass through it, while soil water retention refers to the ability of soil to retain water within its pores. Soil drainage and water retention are relevant in various aspects of daily life, such as gardening, agriculture, construction, and environmental management. For gardeners and farmers, understanding soil drainage and water retention helps in selecting suitable plants, determining irrigation frequency, and preventing water-related issues. In construction, knowledge of soil drainage is crucial to design foundations and drainage systems. In environmental management, it aids in managing water resources and preventing soil erosion.

Soil drainage and soil retention helps farmers to determine irrigation frequency.



Understanding soil drainage and soil retention prevents water logging.

Daily life connections

Crop production: Soil drainage and water retention determine the water availability and stress for crops, which affect their growth, yield, and quality. Crops need adequate but not excessive water for optimal performance. Different crops have different water requirements and tolerance to drought and flooding. For example, rice needs flooded soil, while wheat needs well-drained soil.

Soil erosion: Soil drainage and water retention influence the susceptibility of soil to erosion by water and wind. Erosion removes the topsoil, which is rich in organic matter and nutrients, and degrades the soil quality and productivity. Erosion also causes water pollution, sedimentation, and flooding. Well-drained and well-structured soils are less prone to erosion than poorly drained and compacted soils.

Soil health: Soil drainage and water retention affect the soil biological activity and diversity, which are essential for soil health and function. Soil organisms such as bacteria, fungi, earthworms, and insects decompose organic matter, recycle nutrients, improve soil structure, and suppress diseases. Soil drainage and water retention affect the oxygen and moisture levels in the soil, which influence the survival and activity of soil organisms. Well-aerated and moist soils support more soil life than waterlogged and dry soils.

Group activity:

Group activity: **An experiment to investigate the drainage of different soil types.**

1. Follow the given instruction to carry out a simple experiment to compare the drainage of sand, loam and clay soil samples.

Aim: To investigate drainage of the different soil types.

Hypothesis: Sand has the highest drainage rate, followed by loam, and then clay.

Variables:

Independent variable: Soil type (sand, loam, clay)

Dependent variable: Drainage rate (amount of water passing through in a given time)

Controlled variables: Soil volume, soil moisture, container size, container shape, drainage hole size, drainage hole number, drainage hole position, temperature, and pressure.

Materials: 3 funnels, 3 filter papers, Clay soil, Sand soil, Loam soil, 3 Measuring cylinders

Procedure:

- Place each of the filter funnels in the measuring cylinder.
- Fold the filter papers and place each in the filter funnels
- Put equal amounts of the three types of soil in the separate filter funnel.
- Pour equal amounts of water at the same time through all the three filter funnels
- Leave the experiment stand for some time.
- Observe carefully what happens in all the three-measuring cylinder.
- Discuss you observation with young group members.

Questions;

a) State your observations

b) Explain your observation for each soil sample

c) which conclusion can you make on that experiment?

d) Describe the importance of soil drainage to the growth of crops.

Use your brain power!

2. You are a farmer who grows maize on a sandy soil in a semi-arid region. You have noticed that your crop suffers from drought stress during the dry season, and your yield is low compared to other farmers who grow maize on clayey soils in the same region. Your soil has low water retention and high drainage, which means that it cannot store enough water for your crop during the dry season. Your crop experiences water deficit and wilts, reducing its photosynthesis, biomass, and yield. How can you improve your soil water retention and reduce your crop water stress? Suggest at least 3 possible solutions and explain how they work.

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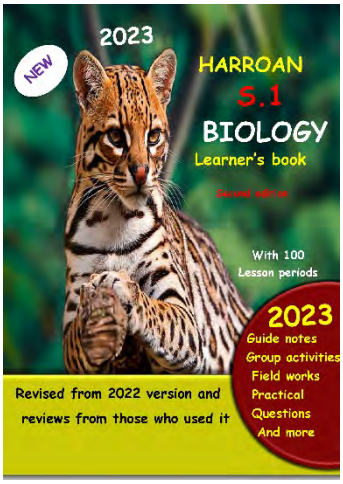

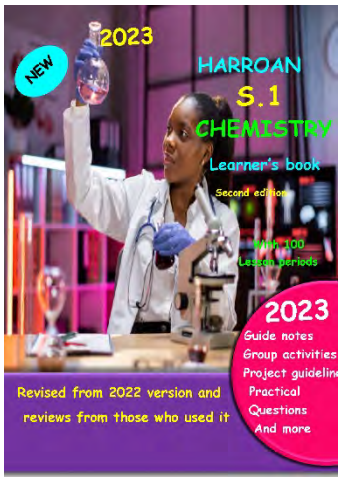

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Chapter 2

SOIL EROSION AND SOIL CONSERVATION

By the end of this chapter, you should be able to;

a) Know the features of a fertile soil

b) Understand the process of soil erosion and factors leading to it.

c) Understand the causes of reduced soil fertility

d) Outline the processes involved in the nitrogen cycle

2.3 Types of soil erosion

Key question: Describe how the different types of soil erosion occur.

Types of soil erosion

Soil erosion is a natural process that occurs when the top layer of soil is displaced or worn away by external factors such as wind, water, or human activities. There are several types of soil erosion, each with its own characteristics and impact on the environment. Understanding these types is crucial for developing effective soil conservation strategies.

Soil erosion occurs in various ways and it is divided in the following types;

Sheet erosion Gulley erosion Rill erosion Splash erosion

Gulley erosion

Gulley erosion is the massive removal of soil along drainage lines by surface water runoff creating deep channels. It consists of open unstable channels that have been cut more than 30cm deep into the ground. Gulley erosion is often triggered by intense or prolonged rainfall, inadequate vegetation cover, improper land management practices, and steep slopes.

How gulley erosion occurs:

- Gulley erosion occurs when water is channeled across unprotected land and washes away the soils across drainage lines.
- The washing away of soil is massive and is done by high velocity run off creating channels.
- Initially, small channels form as water concentrates and starts cutting into the soil surface. Over time, these channels merge and deepen, creating gullies that can be several meters deep and wide.
- Surface runoff increases and concentrates in drainage lines, allowing gulley erosion to develop.

Causes of soil erosion

Deforestation: Deforestation is the massive cutting down of trees from land. Trees protect soil from wind and rainfall. When they are cut, the land becomes exposed, leaving it vulnerable to being washed away by flowing water or being carried by wind. When trees are cut, the land is exposed to the sun's heat that dries the moisture inside the soil. Nutrients evaporate which affects the bacteria which helps in the breakdown of organic matter. The soil loses its compactness, becomes loose and can easily be carried by wind or flowing water.

Overgrazing: Overgrazing occurs when animals graze on vegetation for extended periods without giving it enough time to regrow. This leads to the removal of vegetation cover, exposing the soil surface to the erosive forces of wind and water. Without the protective cover of plants, the soil becomes more vulnerable to erosion, as rainwater can wash away the topsoil more easily.

Construction and urbanization: Construction and urbanization involve clearing land, removing vegetation, and altering the natural landscape. These activities often result in the removal of the topsoil, which is rich in organic matter and essential nutrients. Without the topsoil, the underlying soil is more prone to erosion by wind and water.

Mining: Mining operations can cause significant soil erosion. During mining activities, large areas of land are excavated, exposing the soil to erosion by wind and water. Moreover, the removal of vegetation cover and the disturbance of the soil structure further increase the susceptibility to erosion. Mining can also generate acidic or toxic runoff, which can contaminate nearby soil and water bodies.

Climate change: Climate change can exacerbate soil erosion through various means. Increased frequency and intensity of rainfall events can lead to greater runoff, which can erode the soil. Changes in temperature and precipitation patterns can also affect vegetation growth, leading to reduced plant cover and increased vulnerability to erosion. Additionally, climate change-induced droughts can dry out the soil, making it more susceptible to wind erosion.

Poor irrigation practices: Improper irrigation practices can contribute to soil erosion. When water is applied to crops or fields in excessive amounts or at high pressure, it can result in surface runoff. This runoff carries away the topsoil, nutrients, and sediment, causing erosion. Inadequate drainage systems and improper water management can also lead to waterlogging, which degrades the soil structure and increases erosion risks.

Natural disasters: Natural disasters such as floods, hurricanes, and landslides can cause severe soil erosion. Heavy rainfall associated with these events can result in massive runoff, which carries away large amounts of soil and sediment. The force of moving water can cut into the land, forming gullies and channels, and removing topsoil. Similarly, landslides can displace large volumes of soil downslope, causing extensive erosion in affected areas.

Floods can cause severe soil erosion

Mining operations cause soil erosion

Overgrazing removes vegetation cover exposing the land to soil erosion

Construction involves land clearing which removes the topsoil.

Group activity:

Group activity: 1. The pictures below show the types of soil erosion

A

B

C

For each, identify the type of soil erosion, state its causes and describe how it occurs. Present before the class

2. The pictures below show methods of preventing soil erosion. Use them to answer questions that follow

A

B

C

a) Identify the methods A, B and C
b) Describe briefly how each method is done;
c) How does each control soil erosion
d) Describe other methods of preventing soil erosion

Use your brain power!

4. You are a civil engineer responsible for a road construction project. The area is prone to gulley erosion, and you need to design effective measures to prevent soil erosion and protect the road infrastructure. Propose innovative engineering solutions that can effectively control gulley erosion and ensure the long-term stability of the road.

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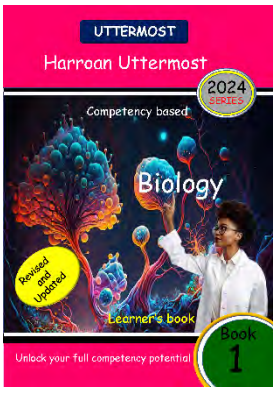
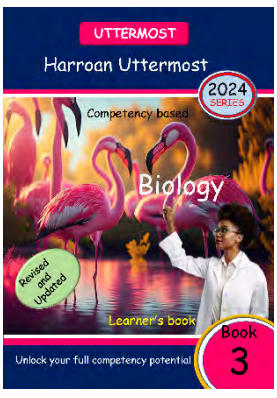




Chapter 3

NUTRITION TYPES & NUTRIENT COMPOUNDS

By the end of this chapter, you should be able to;

- Define nutrition
- Identify the food nutrients, their sources and importance to people
- Appreciate the importance of a balanced diet
- Appreciate the causes and effects of nutritional deficiency
- Calculate body mass index (BMI) and explain its implication.

3.1 Meaning of nutrition

Key question: Why do organisms carry out nutrition?

Introduction to nutrition

Living things require food substances that are necessary for sustaining their lives. Such food substances perform different functions in the body. Some types of food provide energy to carry out various body activities such as movement, growth, and development. Other types of food serve as raw materials used in building, repairing, and keeping the body in a healthy condition. By studying nutrition, we can gain a deeper understanding of the vital role that food and nutrients play in supporting our health and well-being. It empowers us to make informed decisions about our dietary choices, leading to improved nutritional outcomes and a better quality of life.

Meaning of nutrition

Nutrition is the process of feeding and utilisation of food for energy provision, growth, development, repair and maintenance of the overall body health. Nutrition also refers to the study of the relationship between diet, health, and diseases. It involves the study of the dietary needs of organisms, the ingestion and digestion of food, the absorption and utilization of nutrients, and the prevention and treatment of nutritional disorders

Types of nutrition: There are two main types of nutrition: autotrophic and heterotrophic.

Autotrophic nutrition is a type of nutrition whereby organisms manufacture their own food using energy sources available to them. An organism that manufactures its own food is called an autotroph. The term 'autotroph' comes from two Greek words 'autos' which means 'self' and 'trophy' which means 'feed'; hence 'autotrophy' means 'self-feeding'. This means that autotrophs are organisms that are capable of making their own food for their own use and for other organisms. They are very important because without them, no other organisms could exist or survive. Examples of autotrophic organisms include green plants, algae, and some bacteria such as cyanobacteria. Types of autotrophic nutrition include photosynthesis and chemosynthesis. The autotrophs can be divided into two groups based on how they obtain their energy. These are photoautotrophs and chemoautotrophs. Photoautotrophs are organisms that obtain their energy from sunlight in order to make their own food. They make their food using water and carbon dioxide in the presence of chlorophyll and sunlight through a process called photosynthesis. This is called photoautotrophic nutrition. Photoautotrophic nutrition is a type of nutrition in which organisms use light energy to make their own food. Examples of photoautotrophs include all green plants and some bacteria (cyanobacteria), euglena, and algae that carry out photosynthesis. These organisms produce food in the form of carbohydrates for themselves, which can also be used by heterotrophs like human beings. Chemoautotrophs are organisms that obtain their energy from chemical substances like hydrogen sulphide, iron, methane, and ammonia. They use such chemicals to make their own food in the form of carbohydrates through a process called chemosynthesis.

This is called chemoautotrophic nutrition. This is the type of nutrition in which organisms use chemical substances to make their own food. Examples of chemoautotrophs are some bacteria (archaebacteria) that live in harsh environments such as in the deep sea and around volcanic sites where there is no sunlight and where many other organisms cannot survive.

Heterotrophic nutrition

Heterotrophic nutrition is a mode of nutrition where organisms feed on already made food Heterotrophs are organisms that cannot make their own food and hence, are incapable of self-feeding. The term 'hetero' means different, and 'trophy' means feeding. Therefore, 'heterotroph' means 'different feeding'. Heterotrophs feed on either different food substances manufactured by other organisms or feed on other organisms directly. Examples of heterotrophs include all animals, fungi, most bacteria, and protoctists. The mode of feeding in which an organism is unable to make its own food, and instead depends on food already made by other organisms is called heterotrophic nutrition. There are various types of heterotrophic nutrition including phagocytosis, holozoic, saprophytic, and symbiotic nutrition.

Types of heterotrophic nutrition

1. **phagocytosis:** Phagocytosis is the type of heterotrophic nutrition where unicellular organisms engulf solid food particles. E.g. amoeba, white blood cells.
2. **Holozoic nutrition:** This mode of nutrition involves taking in complex food substances, digesting, absorbing, and assimilating the nutrients into the organisms' body. The undigested and indigestible food remains are finally egested as faeces. This type of nutrition is found in most animals. Holozoic nutrition is divided into three modes of feeding: carnivorous, herbivorous and omnivorous.

- **Carnivorous:** This is a mode of feeding in which an animal feeds on other animals. Examples of animals that practice this type of feeding are ground beetles, lions, tigers, and leopards. These animals are called carnivores because they eat other animals, usually of different species. In this kind of feeding relationship, animals that hunt other animals are called predators, while those that are hunted are called preys.
- **Herbivorous:** In this mode of feeding, an organism feeds on plants. Animals that undergo this type of feeding are called herbivores because they eat plants or parts of plants. Examples of plant eaters or herbivores include grasshoppers, cattle, rabbits, goats, antelopes, and giraffes.
- **Omnivorous:** This is a mode of feeding in which an organism feeds on both plant and animal food sources. They also feed on other organisms including fungi and algae. They are also known as opportunistic feeders because they feed on a variety of food sources. Examples of omnivorous animals include human beings, bears, chimpanzees, birds, pigs, turtles, lizards, and certain insects such as crickets, ants, and wasps.

A lion feeding on its prey

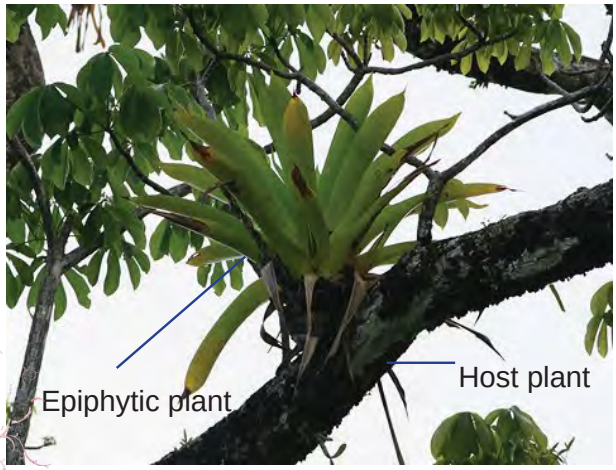
A cow feeding on grass

A venus fly trap feeding on an insect

3. Saprophytic nutrition: This is a mode of feeding in which an organism feeds on decaying organic matter. Such decaying matter may originate from plants, animals, and other decomposing materials. Organisms that obtain their food from dead and decaying organic matter are called saprophytes. In this mode of feeding, a saprophyte releases digestive enzyme externally on the substrate. The released enzymes convert complex organic molecules such as starch into simple molecules such as glucose. The glucose can be easily absorbed by body cells and used for various activities. Digestion which takes place by release of enzymes outside the cell is also called extracellular digestion. An example of a saprophyte is a mushroom growing on a log. The mushroom releases enzymes externally through their root-like structures called rhizoids. The enzymes cause decomposition and decay of the log from which the mushroom gets its nutrients. Another example of a saprophyte is bread mould that grows on the surface of decaying bread to obtain the nutrients.

3. Symbiosis: This is an association between two organisms of the different species. Symbiosis can be in the form of commensalism, mutualism, or parasitism.

- **Commensalism:** This is a feeding relationship between individuals of two different species in which one species benefits while the other is neither harmed nor benefiting. In most cases, the host individual is large in size compared to the commensal individual. The commensals benefit in various ways such as getting nutrients, shelter, support, or transport from the host. For example, small fishes like remora attach to the body of a large fish such as a shark. The shark enables remora to move in different areas without using its own energy but the shark is unaffected and it does not benefit from such a relationship.



Other examples are epiphytes which are small plants that grow on different trees but do not harm the trees. The epiphytes get access to nutrients, exposure to sunlight, and support from the trees while the trees are neither harmed nor benefit from the relationship.

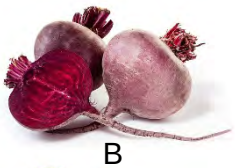
- **Mutualism:** This is a symbiotic relationship between two species in which both species benefit. For example, bacteria living in the gut of a goat, sheep, or cow get their nutrients from the food digested by the animals. The bacteria in turn help the animals to digest cellulose as the animals cannot produce the enzymes used to digest cellulose.
- **Parasitism:** This is a kind of feeding relationship between two species where one species benefits while the other is harmed. For example, the relationship between a tapeworm and a human being. The tapeworm lives in the human gut and gets nutrients from the human body while the human being is harmed by getting sick. The organism that benefits is called a parasite while the one that is harmed is called a host. In the human-tapeworm relationship, the human being is a host and the tapeworm is a parasite. In parasitic mode of nutrition, the parasites depend on nutrients that are found in the body of their hosts. There are two types of parasites, namely ecto-parasites, and endo-parasites. Ectoparasites live outside the body of the host. Examples of ectoparasites include ticks, lice, fleas, and bed bugs. Endo-parasites live and obtain their food inside the body of the host. *Plasmodium*, *Ascaris*, and tapeworms are examples of endoparasites.

Group activity:

Group activity:

1. Describe the importance of nutrition to organisms.
2. Outline the nutrients in the food we eat.
3. You are provided with pictures of food sources below for each, identify the name of the food source and the nutrients.

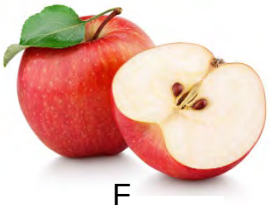

A


B


C

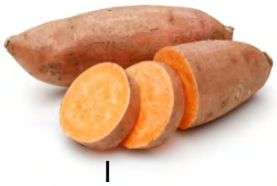

D


E


F


G


H


I


J


K


L


M


N


O


P

4. complete the table below

Food	Name of the source	nutrients
A	Avocado	Vitamins C, E, K, fats.
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		
L		
M		
N		
O		
P		

Use your brain power!

3. You are a student who wants to pass exams. You need to study hard and stay focused for long hours. You often feel tired, hungry, and distracted when you study. You wonder if your diet has anything to do with it. Outline the nutrients and their sources you need in order to boost your energy and concentration? Explain the reason behind each nutrient you have named.

4. You are a runner who wants to improve your performance and endurance. You train regularly and participate in marathons. You sometimes experience fatigue, cramps, and low blood sugar during your runs. You want to know how to prevent these issues and optimize your results. What are some strategies you can take before, during, and after your runs?

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3.3 Proteins and lipids

Key question: Describe the importance of proteins and lipids

Proteins

Proteins are organic compounds made of amino acids. There are two groups of amino acids: essential amino acids and non-essential amino acids. The essential amino acids are obtained from foods eaten, while non-essential amino acids can be made by the body. However, the body is not able to produce essential amino acids. Foods like beef, chicken, fish, termites, eggs, beans, peas, groundnuts, mushrooms, and milk and its products like cheese and butter are rich in proteins. Proteins are present in all living organisms and include essential biological compounds such as enzymes, hormones and anti-bodies. They are required for the structure, function and regulations of the body tissues and organs.

Classification of Proteins:

Proteins can be classified into several categories based on their structure, function, and composition. Here are some common classifications:

Structural Proteins: These proteins provide support and shape to cells and tissues. Examples include collagen, which gives strength to connective tissues, and keratin, which forms the structure of hair, nails, and skin.

Enzymes: Enzymes are proteins that catalyze biochemical reactions in the body. They act as biological catalysts, accelerating chemical reactions without being consumed in the process. Enzymes are involved in various metabolic processes, such as digestion, energy production, and DNA replication.

Transport Proteins: These proteins facilitate the transport of molecules across cell membranes or within the bloodstream. For example, hemoglobin is a transport protein that carries oxygen from the lungs to tissues throughout the body.

Hormones: Hormonal proteins act as chemical messengers, regulating various physiological processes in the body. Examples include insulin, which regulates glucose metabolism, and growth hormone, which influences growth and development.

Antibodies: Antibodies are proteins produced by the immune system in response to foreign substances called antigens. They recognize and bind to specific antigens, marking them for destruction by the immune system.

Properties of proteins

- They are denatured by high temperatures
- They are made up of amino acids
- They have a high molecular mass
- They resist PH change when small quantities of acids or alkaline are added.
- They are inactivated by low temperatures.

Lipids

They are compounds made of carbon, hydrogen, and oxygen. They are insoluble in water. The main forms of dietary lipids are fats and oils. Fats are solid at room temperature while oils are liquid at room temperature. Lipids are made up of fatty acids and glycerol. Fatty acids can be essential or non-essential. Essential fatty acids are obtained from foods eaten while non-essential fatty acids can be made by the body. The body is not able to produce essential fatty acids. It is therefore important to eat foods that contain essential fatty acids. Examples of such foods are oily fish, nuts, avocados, oil, and seeds such as sunflower and sesame

Types of fats

Fats are divided into two parts namely;

- Saturated fats
- Unsaturated fats

Saturated fats: are solids at room temperature and are found in animal products.

Unsaturated fats: are liquids at room temperature. They are found mainly in plant extracts

Unsaturated fats can be converted to saturated fats by adding hydrogen atoms.

Properties of Lipids

- They are inert substances
- They solidify when subjected to very high temperatures
- They also form emulsions with dilute alkalis
- They are greasy organic substances
- They are lighter than water and insoluble in it.
- They are soluble in organic solvents such as alcohol.
- They are bad conductors of heat.

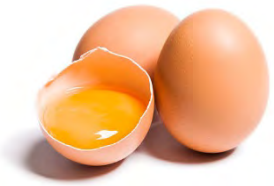
Group activity:

Group activity:

1. Write the names of the common food below the picture

b) From the above common food, identify the sources of proteins.
















2. The pictures below show various sources of lipids. Identify the name of the source

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

3. Describe the uses of:

i) lipids ii) proteins

Use your brain power!

4. Sarah, a 5-year-old child from a **rural** village, is diagnosed with severe malnutrition, specifically suffering from kwashiorkor. Her parents are seeking advice on how to treat her condition and improve her nutritional status. Sarah's current diet lacks essential proteins leading to the development of kwashiorkor characterized by swollen belly, hair loss, muscle wasting, and compromised immune function. Design a meal plan that focuses on incorporating protein-rich foods to help Sarah recover from kwashiorkor