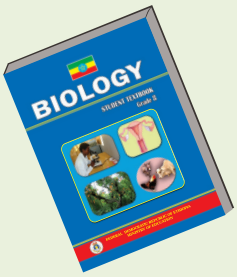
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BIOLOGY

STUDENT TEXTBOOK

GRADE 8

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FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

MINISTRY OF EDUCATION



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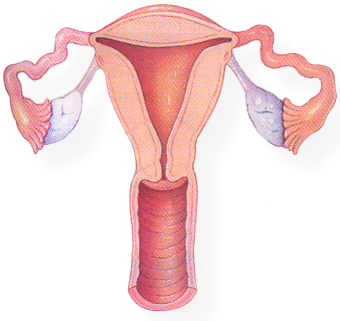


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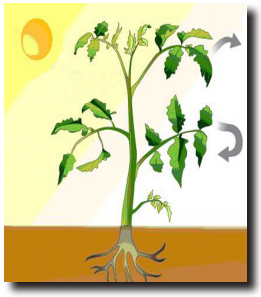
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Unit 1

Biology and Technology

Unit Outcomes

By the end of this unit, you will be able to:

- *explain how biology contributes to country's development;*
- *explain the role of technology for the progress of biology;*
- *list at least seven technological products used in biology; and*
- *tell the functions of some technological products used in biology.*



Main Contents

1.1 Biology for Development

1.2 Technological Products used in Biology

- Unit Review

Introduction

In your previous grade of biology lessons, you were able to explore the meaning and branches of biology, industries that utilize biological knowledge and its relevance to society. Furthermore, you have studied biology and technological innovations and values in biology education. In this unit you will identify, discuss and explain how biology contributes directly or indirectly in the development of Ethiopia. Biology uses several technological products. You will explore some of the technological products used in biology.

1.1 Biology for Development

By the end of this section, you will be able to:

- explain how biology contributes to the country's development.

Biological studies in general contribute for the development of a country in many aspects. Biology plays a role in the following areas of developmental activity in Ethiopia.

Health Care

What is the contribution of biology for community health?

In a community where health conditions are better, people live, safer and longer, reduce incidence of diseases, and produce more.

Biology is the basis for all health care activities. In all health care facilities, skilled professionals work in diagnosis, treatment, prevention and control of diseases. A wide variety of health care practitioners work in health care including, medical doctors, nurses, laboratory technicians, etc.

Relationship of Biology and development

Biological knowledge
↓
Health Care-Professionals
↓
Healthy People
↓
Work and Produce more
↓
Increased income and standard of living
↓
DEVELOPMENT

All physicians, nurses, laboratory technicians and other health professionals are trained in the field of biology. These professionals serve in several hospitals, clinics, and other health care centers in Ethiopia.



Activity 1.1

Discussion on the application of biology in health

Procedure: in group, discuss how the services of clinical laboratory and vaccination in your community require biological knowledge.

- ☑ Present the out comes of your discussion to your class

Agriculture

What is the role of biology in Agriculture?

Agriculture plays an important role in the Ethiopian Economy. Our country generates its income by exporting a number of agricultural products such as coffee, grains, flowers and fruits. Agriculture is an activity of producing crops and raising animals. Improving quality of crops and animals needs knowledge of biology so that to increase their productivity (See Figure 1.1).

Key Terms

- **Agrochemcials:** chemicals used for agriculture as fertilizers, weed and pest killers.
- **Selective breeding:** a practice during which selected two individuals mate and produce offspring with improved qualities.
- **Hybrid:** an individual that has superior qualities than that found in either of selected parent.

What is the use of Agro-chemicals?

Increasing productivity using Agro-chemicals like fertilizers, herbicides (weed-killers), and pesticides is made possible by using biological principles. However, agro - chemicals can be accumulated in the body of plants. As plants are consumed by other animals the concentration of these chemicals increase by many folds. The accumulation of these chemicals in the body of animals including humans causes more serious health problems. Agro-chemical residue is the agricultural chemical found in the food to be consumed.



Figure 1.1 Improved crop plantation by the use of agrochemicals

What is selective breeding?

Selective breeding of animals is an important practice in which biological knowledge is used in animal husbandry. Animals with the desired characteristics such as giving more milk, resistance to disease, giving more meat etc. Can be selected and reproduced in large numbers. Selective breeding practices are also conducted to produce plants with desired qualities.

Breeding is a practice of selective controlled mating in plants and animals to produce organisms that better serve human needs for food, work, sport, or aesthetics. Breeding involves crossing distinct strains or even species to produce hybrids that contain a combination of traits that is superior to that found in either parent. Hybrid varieties have many superior qualities, especially in yield and vigor.

Genetically modified crops (GM crops) are crops produced by means of genetic engineering in order to get desired characteristics of crops such as high yield from small plot of land.

Activity 1.2



Investigating the role of biology in agricultural products

Procedure:

- ☑ in group discuss how agricultural products (egg, milk, crops, hens, cattle) require biological knowledge to increase productivity.
- ☑ Present the outcomes of your discussion to the class.

Food Production



What is the contribution of biology in food production?

The food that we consume is produced by living things; plants and animals. Biology studies the living things and the processes in the production of nutritional substances (See Figure 1.2). Biology provides the means for keeping quality of foods during processing, transport and storage.

Then industrial process, transport and storage of food require biological knowledge to keep quality of foods.

Biological studies are essential in determining nutritional requirements and provision of nutrition for people.

Biologists study the nutritional content of food, as well as the interaction of food components with each other, with air, and with packaging materials, and the preservation of quality during processing, transporting and storage.



Figure 1.2 some nutritional foods

Activity 1.3



Discussion on the contribution of biology in food processing

Procedure:

- ☑ in group, discuss the contribution of biological knowledge in making, transporting and storing biscuits.
- ☑ present the outcomes of your discussion to the class.

Improvemenet of our Environment

What is the importance of biology for the improvement of our environment?

The conservation of natural environment, vegetation, and wildlife is important for our survival. The study of biology contributes to the improvement of the environment and how humans can live in harmony with the environment.

Did You Know?

* Effective conservation of wildlife and vegetation is important for tourism industry.

Good or friendly environmental practices are important to reduce the impact of negative human activities on the environment. Good environment is suitable for living. It is a practice through which consumption of natural resources is reduced and introduction of harmful chemicals to the environment is minimized.



Activity 1.4

Discussion on the role of biological knowledge in wildlife.

Procedure:

- ☑ in group, discuss the contribution of biological knowledge to wildlife conservation
- ☑ Role of biological knowledge in tree planting campaign during Ethiopian millennium.

Natural Products

W is the importance of biology in using natural products (remedies and cosmetics?)

Biological knowledge and techniques are also important for production of medicinal substances and cosmetics from natural resources. For example, Kosso is used as medicine for tape worm infection (see Figure 1.3).



Activity 1.5

Discussion on remedies and cosmetics

Procedure:

- ☑ in group, discuss on the economic and biological importance of remedies and cosmetics.

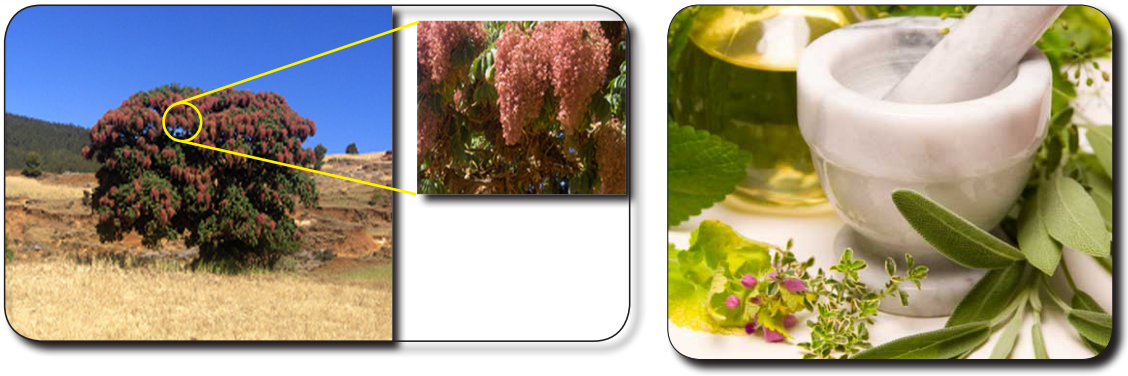


Figure 1.3 ***Hagenia abyssinica*** **(Kosso) tree (left) and its preparation for use as remedy for tape worm disease (Right).**

What are natural products and their uses?

Cosmetic is a general term applied to all preparations used externally to condition and beautify the body. It is done by cleaning, coloring, softening; and used for protecting the skin, hair, nails, lips and eyes.

Did You Know?

More than 80% of modern medicines are prepared from natural products, mainly from plants.

Natural products used for beauty include:

- ☑ "Hinna" used to stain hair
- ☑ "Ensosilla" used to stain skin

Local herbal medicines include:

- ☑ "Kosso" used to treat Tapeworm.
- ☑ "Enkoko" used to treat Tapeworm.
- ☑ "Meterae" used to treat Tapeworm and Ascaris.
- ☑ "Dingetegna" used to treat sudden illnesses
- ☑ "Yemitch medehanit" used to treat common cold and related diseases.

Several modern drugs are prepared from plants and other natural products produced from plants include:

- ☑ Rubber
- ☑ Gum
- ☑ Incense- "Itan"
- ☑ Dyes

Key Terms

- ☑ **Natural products:** are products that are obtained in nature.
- ☑ **Cosmetics:** substances used for body beauty.
- ☑ **Remedies:** substances used for treatments.

Exercise 1.1

I *Choose the best answers for the following questions*

1 Biology is used in agriculture to produce

A Pests attacking plants
B High yielding animals
C Disease causing plants
D Weeds

2 Biological knowledge is needed to improve

A Food qualities
B Food packaging
C Food storage
D All of the above

3 Which of the following biological knowledge is useful to improve the environment?

A Protection of vegetation
B Destruction of wildlife
C Damaging natural things
D B and C

4 The desirable characteristics of plants or animals can be developed for Ethiopian farmers through

A Selective breeding
B Natural breeding
C Conservation
D All of the above

5 Biological knowledge enables us to know all, but not

A The use of agrochemicals
B The destruction of natural products
C The method of pest control.
D The method of used control

1.2 Technological Products used in Biology



At the end of this section, you will be able to:

- ☑ explain the role of technology for the progress of biology;
- ☑ list at least seven technological products used in biology; and
- ☑ tell the functions of some technological products used in biology.

Biological studies use various technological products. These equipment are products of other sciences such as Mechanical, Electrical, and Electronic technologies.

Some Technological products used in biological studies:

- ❒ Microscope and hand lens
- ❒ Thermometer
- ❒ Binoculars
- ❒ Stethoscope
- ❒ Sphygmomanometer
- ❒ Incubator
- ❒ Refrigerator and freezer
- ❒ Balances
- ❒ Centrifuges

Microscope

What is Microscope?

A microscope is an instrument which is used to study smaller objects. It magnifies and revolves the object under study. Biologists study smaller organisms and cells using microscope (Figure 1.4).



Figure 1.4 A Binocular microscope

Activity 1.6

Labelling parts of a microscope

1. Refer to Grade 7 Biology Unit 1 and label the parts of Figure 1.5.
2. What is the difference between a microscope and a hand lens?

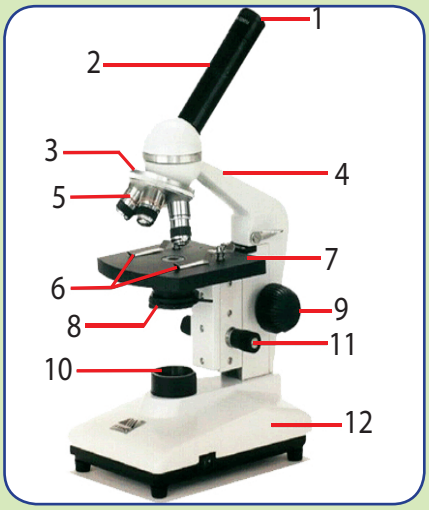


Figure 1.5 A microscope

What is the use of microscope?

Microscopes are tools used to enlarge images of small objects so as they can be studied. Microscopes allow us to look at things that are too small to be seen with our eyes. The microscope Figure 1.5 above is the most common type of microscope, the compound microscope. Compound microscopes can magnify objects up to about 1,000 times.

Word Roots and Origins

The word microscope is derived from two Greek words "Micro" meaning tiny and "scope" meaning to view or look at.

Activity 1.7

Observing samples under a Microscope

Materials you require:

- ☑ Microscope
- ☑ A small cup of yogurt (sample)
- ☑ Slide and cover slip
- ☑ Droppers with teat



Figure 1.6 Using the microscope

Procedure:

Observation under compound light microscope

1. Place a drop of thin yogurt at the center of the microscope slide and cover it with a cover slip. Avoid trapping of air bubbles.
2. Place the slide at the center over the stage opening on the stage of the microscope and fix it with clippers.
3. Adjust the amount of light using the iris diaphragm on the condenser (Figure 1.6).
4. Focus with the coarse adjustment knob using first the low power objective, and then with medium power objective using the fine adjustment knob to get a clear view.
5. Observe and search for organisms by moving the slide in all directions, left to right, and back to forth.
6. Draw and label what you observe.

Binocular

What is a Binocular?

Field glasses or binocular telescopes are instruments used to observe distant or far objects. Binocular is a pair of field glass which is made up of two small telescopes joined with a single focusing device. It is designed for simultaneous use by both eyes. It allows viewer to use both eyes when viewing distant objects (Figure 1.7).

Key Term

☑ **Prism:** a block of clear glass which separates light in to different color

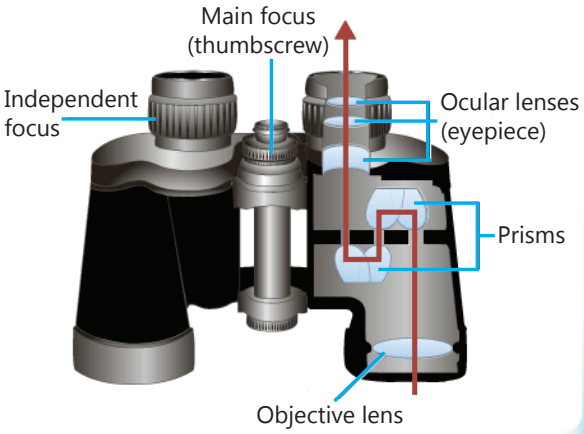


Figure 1.7: A binocular



Activity 1.8

Observing distant objects through binocular

Materials you require:

- ☑ Binocular

Procedure:

- ☑ Look first with your naked eyes at the distant object (bird or other animal)
- ☑ Use the binocular and look at the same bird or animal you see with your naked eyes.
- ☑ Using the binocular look at sites where you were not able to see clearly with your eyes.

Question:

What is the difference between naked eye and binocular observation?

Many different abbreviations are used for binoculars, including glasses, binos and bins.

Thermometer



What is a thermometer?

It is an instrument used to measure and indicate temperature. It typically consists of a graduated glass tube that contains mercury or alcohol which expands when heated(Figure 1.8).

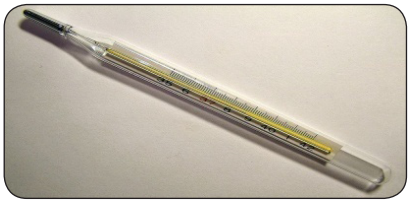


Figure 1.8: Thermometer



Activity 1.9

Measuring temperature using thermometer

Material you require:

- ☑ Thermometer, 70 % alcohol, cotton, stove, beaker, water.

Procedure:

- ☑ Add water to a beaker.
- ☑ Insert a thermometer and measure the temperature.
- ☑ Heat the water on a stove for 10 minutes.
- ☑ Insert a thermometer and read the thermometer.

Question:

1. What was the temperature before and after heating?
2. What is the difference in temperature between the two?

Stethoscope

What is the use of stethoscope?

A stethoscope is a medical instrument used to listen to sounds produced in the body, especially from the heart and lungs. It is designed to be used with both ears. It contains two flexible rubber tubes running from a valve to the ear pieces. The valve is connected to the chest piece. The chest piece is either a bell-shaped piece to pick up low sounds or a flat disk for higher frequencies. Most stethoscopes have Y-shape (Figure 1.9).

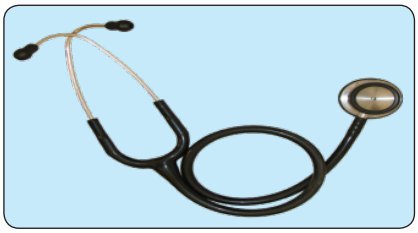


Figure 1.9 Stethoscope

Key Terms

- **Heart beat:** the rhythmic contraction and relaxation of the heart to pump blood through out the body of an animal.
- **Blood pressure:** the pressure of circulating blood from the heart to the rest of the body.

Sphygmomanometer

What is sphygmomanometer?

A sphygmomanometer or blood pressure meter is a device used to measure blood pressure. It is always used in combination with a means to determine at what pressure blood flow start and at what pressure it is unimpeded. Manual sphygmomanometers are used together with a stethoscope (Figure 1.10).



Figure 1.10 Sphygmomanometer

Activity 1.10



Measuring heart beat and blood pressure.

Material you require:

- Stethoscope, Sphygmomanometer

Procedures:

- With your teacher go to the nearby clinic and observe how a stethoscope and Sphygmomanometer are used. Or invite a health worker to your classroom and ask him/her to demonstrate the use of these instruments to you, and
- Record and compare heart beat and blood pressure of the group member.

Did You Know?

* The human heart beats 70 times in average every minute.

Incubator

What is an incubator?

Incubator is a device for maintaining an organism in an environment that encourages its growth (Figure 1.11). The instrument commonly maintain a constant temperature and, a constant humidity level in poultry (chicken farm). Incubators are used to keep eggs warm until they hatch and to warm the young chicks after hatching.



Figure 1.11 Incubator

Did You Know?

An infant incubator is used to keep pre mature newborns in a controlled temperature.

Refrigerator

What is a refrigerator?

A *refrigerator* (often called a "*fridge*") is a cooling instrument. It contains a thermally insulated compartment and a heat pump to transfer heat from it to the external environment. Then it cools the contents kept in to a temperature below the room temperature.

Refrigerators are extensively used to store foods, and prevent bacterial spoilage if this device maintains a temperature a few degrees above the freezing point of water. A similar device which maintains a temperature below the freezing point of water is called a "*freezer*". Most freezers operate around −18°C (Figure 1.12).



Figure 1.12 Refrigerator

Activity 1.11



Examing food items kept at different incubation conditions.

Materials you require:

- ☑ Three pieces of meat (fresh),
- ☑ Three small plastic containers,
- ☑ Freezer refrigerator.

Procedure:

- ☑ Smell each piece of meat and make sure it is not spoiled (Or they can be cooked).
- ☑ Place one piece in each plastic container.

Label: 1 Freezer 2 Refrigerator 3 Room

- ☑ Place label 1, in freezer, label 2 in refrigerator label 3 in one corner of the laboratory.
- ☑ Each day, smell all of them and return to their places.
- ☑ Continue smelling until one of them smells bad.
- ☑ Note the day, and continue until the second smells bad.

Question:

1. Which sample goes bad first and after how many days?
2. Which sample was spoiled next, and after how many days?
3. Which sample stayed long-unspoiled?
4. What is your conclusion?

Balance

What is a balance?

A weighing scale (balance) is a measuring instrument for determining the weight or mass of an object. The balances are used in many industries and laboratories to measure the weight or mass of an object or a substance (Figure 1.13).

Specialized medical scales and bathroom scales are used to measure the body weight of human beings.



Figure 1.13 Balance

Activity 1.12



Measuring weight

Materials you require:

- ☑ Bathroom balance

Procedure:

- ☑ Place the balance on a leveled surface.
- ☑ Adjust the weight indicator to zero by positioning your eyes in 90o line.
- ☑ Without shoe and heavy clothes, mount yourself on the balance.
- ☑ Let other students take the reading (look as above).
- ☑ Compare your weight with the weight of other students.

Question:

Reading from the side is not correct, why?

Activity 1.13



Field Visit

Visit the nearby health care facility and do the following.

1. Identify the type of instruments used?
2. Identify the purpose of each instrument?
3. Explain how each instrument is used?

Present a report of your visit in table format using the following template.

Type of Instrument	Purpose	How it is used

Centrifuge



What is centrifuge?

A centrifuge is a device used to separate two or more substance of different mass by rotating at a central axis. It is able to separate different substances from each other because the materials with heavier mass moving faster to the bottom of the tube than the lighter one.

It is used in industries and scientific laboratories to separate different substances with different weight or mass (Figure 1.14).

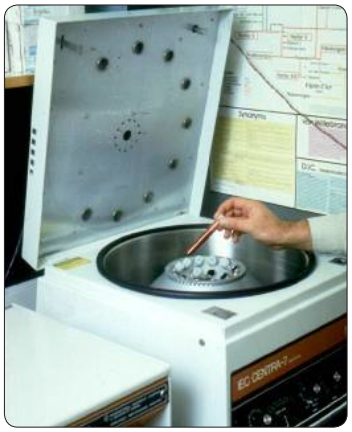


Figure 1.14 Centrifuge

Exercise 1.2

Choose the best answers for the following questions.

1 Stethoscope is used by physicians

A To listen blood pressure
B To listen heart beat
C To measure temprature
D To measure weight

2 What instrument is used by physicians to measure blood pressure?

A Centrifuge
B Incubator
C Sphygmomanometer
D Thermometer

3 A centrifuge separates contents from a solution by

A Heating
B Spinning
C Pressurizing
D Cooling

4 What do you use to measure your body temperature?

A An incubator
B A thermometer
C Beam balance
D Sphyg momanometer

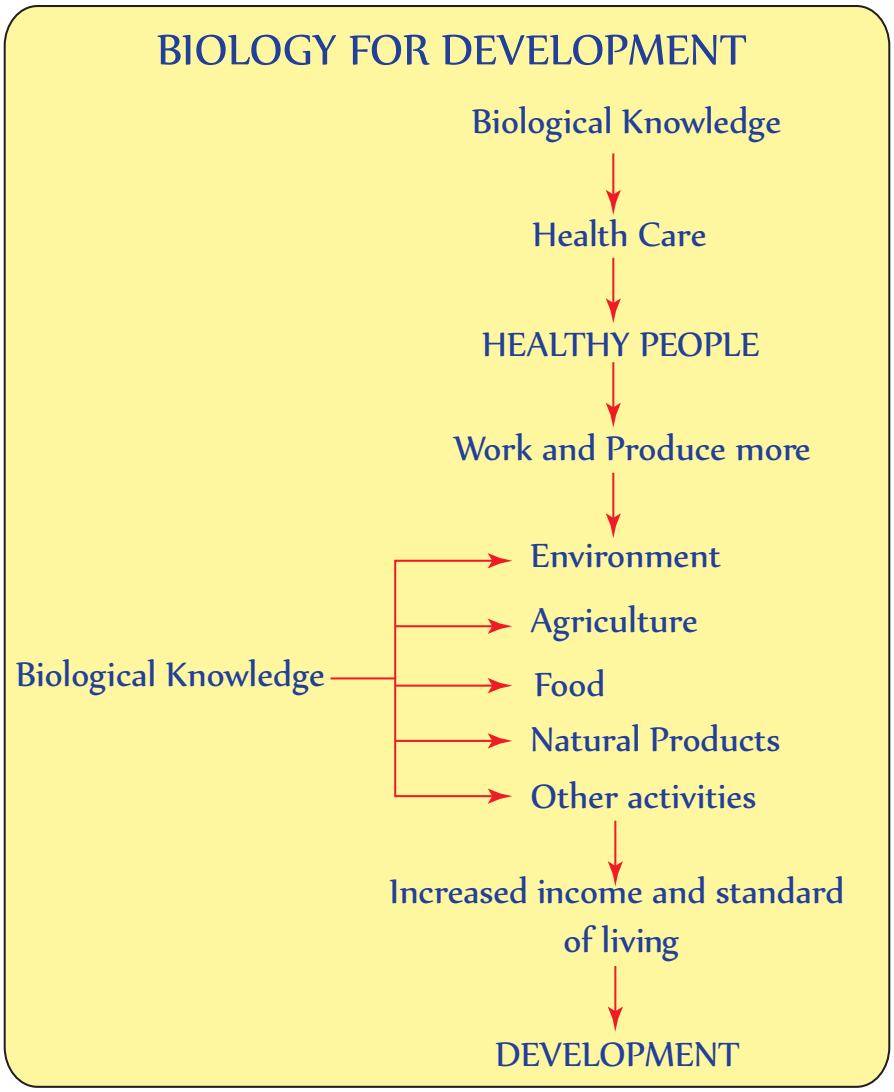
5 An incubator is used to control

A Temperature
B Pressure
C Light
D Gravity

Unit Summary

- Biology plays an important role and contributes for development of our country in community health, agriculture, food production and other useful aspects.
- Health professionals that diagnose, treat and cure diseases are trained in biology.
- Biological knowledge is needed to increase productivity of crops and animals.
- Biology plays role in improving the nutritional values of foods.
- Biology is important to safe guard the environment by providing the ways of conservation.

The following flowchart shows how biological knowledge is related to development



- Technological products have played a significant role in the progress of biology as science.
- Microscope is the most important tool used in biology.
- Other technological products used in biology include centrifuge, thermometer, refrigerator and incubator.

Some technological products used in biology are summarized in the following table

Technological Product	Use in Biology
Microscope and hand lens	To enlarge and see objects
Thermometer	To measure temperature
Binoculars	To see far objects
Stethoscope	To listen internal body sound
Sphygmomanometer	To measure blood pressure
Incubator	To grow or keep at a required temperature
Refrigerator	To keep materials cold (0-5°C)
Freezer	To keep materials cool (below 0°C)
Balances	To measure weight
Centrifuges	To separate components in a solution



Review Excises for unit 1

Part I: ***For the following questions choose the best answer among the choices given.***

1 Which one of the following is not the contribution of biology for community health

A Tracing of health professionals

B Production of fertilizers

C Prevention of disease

D Knowing causes of diseases

2 Herbicides are agrochemicals used

A To kill insects attacking crops

B To fertilize the soil

C To inhibit growth of weeds

D To inhibit growth of crops

3 The agriculture sector develops more when biology plays role in

A Keeping soil fertility

B Increasing plant and animal productivity

C the use of agrochemical production

D All of the above

4 Food production requires biological knowledge to

A Determine nutrient content

B Improve food storage

C Increase food production

D All of the above

5 Which of the following is not a natural product?

A Plastic

B Oil

C Silk

D Rubber

6 Consciousness in biology and its application makes environment

A Safe to humans

B Harmful to humans

C Unhealthy to live

D All of the above

7 Reproducing plants and animals which have desirable traits is called

A Genetic modification

B Fertilization

C Selective breeding

D Agrochemical using

8 A natural product used for colouring hair in Ethiopia is

A Kosso

B Ensosilla

C Hinna

D Metere

Part II: *Match descriptions in column B with the items in column A lased on function*

	Column A		Column B
9	Centrifuge	A	used to observe far objects
10	Incubator	B	used to measure blood pressure
11	Stethoscope	C	used for growing bacteria
12	Sphygmomanometer	D	used to heart beat
13	Binocular	E	used for spinning materials at high speed

Part III: *Fill in the blank*

14 The instrument used to know the weight of materials is called _____

15 Body temperature is measured by_____

16 Health care providers such as_____ and _____are trained in biology

17 Products used for beauty care are called _____

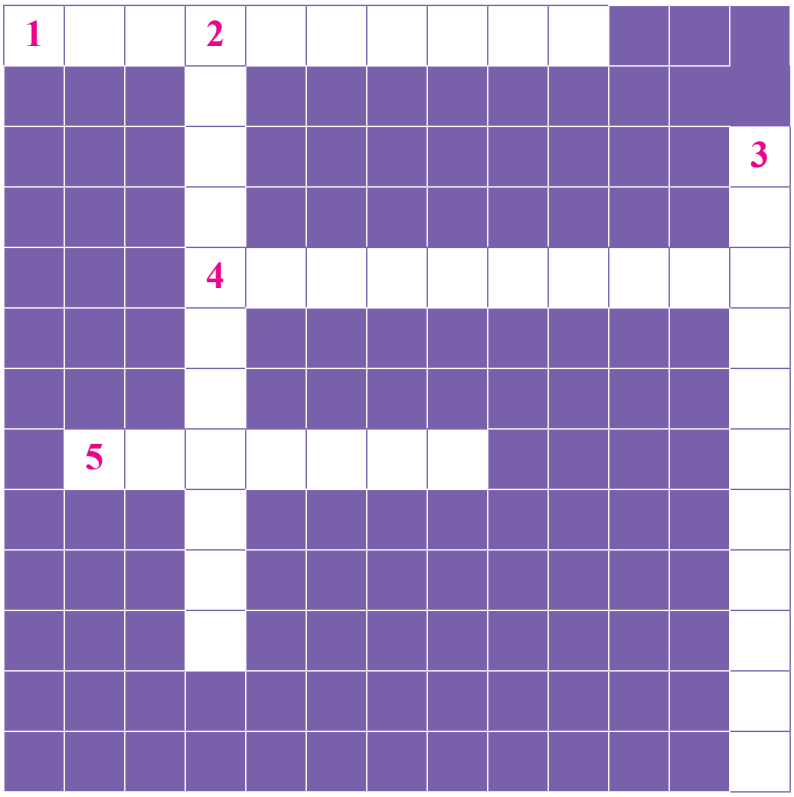
18 Analysis of the Nutrient of food needs _____ knowledge .

Part IV: *Give short Answer*

19 What are the development areas in which biological knowledge is used?

20 How can biology contribute to the safety of our environment?

Part V: ***Copy the crossword puzzle and use the numbered clues to complete and solve the puzzle.***



The numbers in bracket indicates the number of letters in each word.

Across

1 An instrument used for spinning solutions (10)

4 An instrument used to see very small objects (10)

5 An instrument used to keep temperature below zero degree centigrade (7)

Down ward

2 An instrument used to measure temperature (11)

3 An instrument used to listen heart beat (11)

Unit 2

Cell Biology

Unit Outcomes

By the end of this unit, you will be able to:

- *use hand lenses and microscopes to observe unicellular organisms and name some unicellular organisms;*
- *describe the structure, habitat, locomotion, nutrition, reproduction and importance of some unicellular organisms;*
- *name different types of cells, tissues, organs, and systems and state their functions;*
- *describe organism as the highest level of organization;*
- *demonstrate scientific enquiry skills: observing, comparing and contrasting, drawing conclusions, communicating, inferring, problem solving, comparing and contrasting.*



Main Contents

2.1 Looking at Unicellular Organisms

2.2 Single Celled Organisms

2.3 Levels of Organization in Multicellular Organisms

- Unit Review

Introduction

In Unit 1, you have discussed the contribution of biology to development by its role in community health, agriculture, food production, use and conservation of the environment. These contributions of biology for societal development are the outcomes of studying and understanding living things or life. Every living thing from the tiniest bacterium to the largest whale is made of one or more cells. Many of the chemical reactions that keep organisms alive (metabolic functions) take place in cells.

All organisms are made of cells. A cell is the basic unit of structure and function of living things. The cell is the smallest unit that carries on all life processes.

Unicellular organisms like bacteria, protozoa, algae, and yeasts are organisms that are made up of one cell. Living organisms such as some algae, most fungi, plants and animals are made up of many cells and are called multicellular organisms. In multicellular organisms all cells work together and make the organism alive.

Did You Know?

- Unicellular organisms perform the same life processes as multicellular organisms.
- Scientists estimate that our bodies contain from 75 to 100 trillion (1012= 106 X 106) cells.

Some of these cells are of the same type and collectively form a *tissue*. These cells of a tissue do the same job. For example, muscle tissues in animals effect movement and vascular tissues in higher plants transport materials.

In the following sections you will learn more about different unicellular organisms, which are very small to be seen with the naked human eye. Thus, you need to use a hand lens or microscope to study these organisms.

2.1 Looking at Unicellular Organisms



By the end of this section, you will be able to:

- use hand lenses and microscopes to observe unicellular organisms;
- name amoeba, paramecium, euglena, bacteria and yeast as unicellular organisms.

Can you see unicellular organisms with your naked eyes?

The term unicellular organism indicates that the organism is made of a single cell. These single celled organisms carry out the functions like feeding, locomotion, expelling wastes, reproduction, and so on by the single cell. These unicellular organisms include amoeba, euglena, paramecium, bacteria and yeasts. Many of these organisms are commonly found in water bodies like lakes, ponds, and river water. In most cases, they are ***minute*** sized or ***microscopic*** and require microscopes to observe them.

Did You Know?

* Unicellular organisms that are neither animals, plants, bacteria nor fungi are called 'Protists'.

Key Terms

- **Unicellular organism:** an organism which is made up of only one cell.
- **Multicellular organism:** an organism which is made up of many cells that work together.
- **Tissue:** a group of similar or different cells that perform the same function (blood tissue consists of red blood cells, white blood cells and platelets).

Because of their movement, unicellular organisms like amoeba and paramacium are generally known as animal-like single celled organisms. Because they are photosynthetic, unicellular algae like chlorella are known as single-celled plants. Whereas unicellular organisms, like euglena, which moves and feeds like animals and also prepares its own food like plants can neither be a plant nor an animal. All these microorganisms are known as ***Protists***.

The diversity of single-celled organisms is surprising. These differences are apparent for both the structure and function of the organisms. Single-celled organisms range greatly in their size, from less than 1 micron (one-millionth of a meter) in diameter for the smallest bacteria, to more than 100 microns for some protozoans.



Activity 2.1

Examining different water samples and prepared slides for the presence of organisms

In the first part of this activity, you will examine prepared slides of unicellular organisms under a compound microscope (Figure 2.1). In the second part of this activity, you will prepare a wet mount of amoeba culture.

Materials you will require:

- Hand lens,
- Water samples from pond, river, lake, well or standing water,
- Compound light microscope,
- Prepared slides of amoeba, euglena, paramecium, bacteria, yeast, and unicellular algae.

Procedures:

I Observation using a hand lens

1. Collect water samples in open mouth container (beakers).
2. Observe the surface of each sample with a hand lens for the presence of living organisms.
3. Can you observe anything moving? Please, draw it.

II Observation of prepared slides

1. Place a prepared slide of amoeba on the stage of the microscope.
2. With your microscope on low power, observe the slide.
3. Move the slide around on the stage until you find some cells.
4. Now, using the medium- or high-power objective lens, focus on one cell and observe and draw what you see.
5. Label all visible structures.
6. Repeat steps 1 – 5 for prepared slides of Paramecium, euglena, yeast and bacteria.
7. For each organism you view, be sure to include the name of the organism and the total magnification used.

N.B: Total magnification = Magnification of ocular lens × Magnification of objective lens

After completing these practical activities, compare your drawings with the figures given below (Figure 2.2).



Figure 2.1 Student making an observation using microscope

Key Terms

- ☑ **Mounting:** Placing a sample on glass slides and preparing it for observation under a microscope.
- ☑ **Wet mount:** A process during which water is used as a mounting medium.
- ☑ **Prepared slide:** (also known as permanent slide)**:** a sample prepared without water to be used for longer and many times.
- ☑ **Budding:** reproduction by forming a side growth from the mother cell.
- ☑ **Algae:** photosynthesizing unicellular organisms.

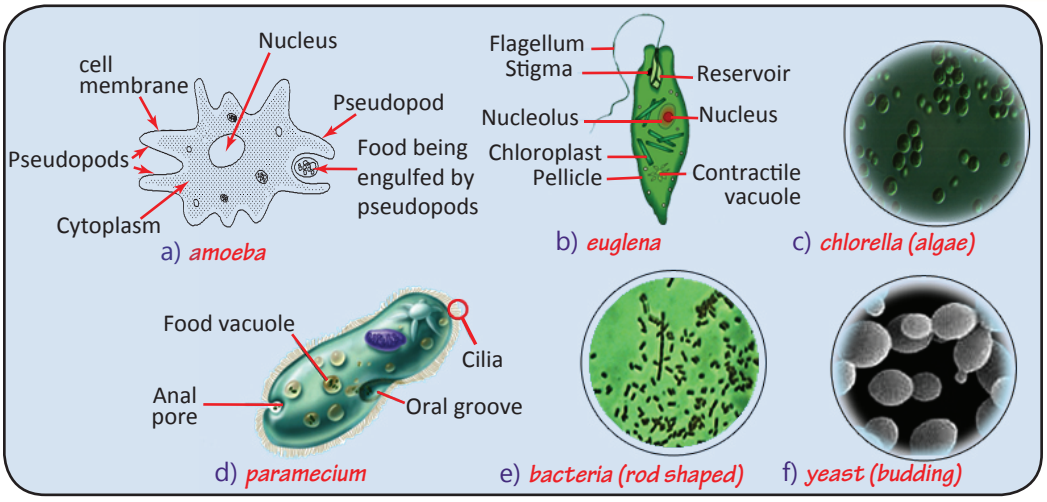


Figure 2.2: Pictures of different unicellular organisms

Exercise 2.1

I ***Give short answers for the following questions.***

1 Explain why organisms are called unicellular.

2 Based on your examination discuss the similarity and differences between each unicellular organisms.

3 Name unicellular organisms.

2.2 Single Celled Organisms

By the end of this section, you will be able to:

- describe the structure, habitat, locomotion, nutrition, reproduction and importance of amoeba, paramecium, euglena, bacteria and yeast.

In the previous section, you have observed different types of organisms which are made up of one cell only: those organisms are commonly known as single-celled organisms. Some microscopic organisms, such as bacteria, amoeba, euglena, paramecium, yeast or unicellular and some algae are unicellular. Plants, animals, and most fungi are multicellular; that is, they are composed of many cells working together. But whether it makes up an entire bacterium or is just one of trillions in a human being, the cell is an amazing thing of plan and efficiency. A closer study of single celled organisms shows how they are organized to perform various ***life activities***. Generally, a cell consists of different parts, commonly known as sub-cellular structures.

Amoeba

What does a cell of amoeba look-like?

Amoeba is a unicellular organism, which is found in nearly all freshwater habitats. It does not have a definite shape. Its shape depends on the condition.

Word Roots and Origins

Protozoa: made up of two Greek words proto, which means 'first' and, zoa, meaning 'animals'. Protozoa or protozoan for singular.

This animal-like unicellular organism is commonly known as protozoan. Amoeba can be identified with its unique mode of locomotion. It moves by means of extension of the plasma membrane known as pseudopodia. The amoeba consists of cellular parts like *cell membrane, cytoplasm, nucleus, food vacuole* and *contractile vacuole*.

Where do amoeba live?

A habitat is a place where an organism lives. Amoebas (sometimes spelled amoebas or amoeba) are either free living or parasitic organisms. The free living amoeba live in fresh water (ponds, rivers and lakes), mud including ditches, salty water and soil. Certain amoebae are parasites that are living inside other organisms.

How do amoebae move?

Amoeba moves by pushing its cytoplasm out to the direction of movement and by extending the cell membrane outwards. This outward projection (finger like projection) of the cytoplasm is called *pseudopodia* meaning false feet. By a flowing motion of the cytoplasm within the cell and the pseudopodia, the whole cell moves forward on the surface.

What do amoebae feed?

Amoeba commonly feed on bacteria, microscopic algae and other protozoa, which are enqulfed by pseudopodia

How do amoebae feed?

Amoeba uses its pseudopodia to engulf food particles and takes it into the food vacuole (Figure 2.3). The process of engulfing solid food is called *Phagocytosis*. When an amoeba approaches a food particle, it extends its pseudopodia forward on either side of the food particle and then by flowing around the food particle; the pseudopodia engulf it within a food vacuole.

Key Terms

- ☑ **Pseudopodia:** extended cell membrane for movement.
- ☑ **Habitat:** a place where an organism lives.
- ☑ **Life activities:** activities like growth, movement, reproduction, metabolism, response to stimuli which characterize living things.
- ☑ **Parasitic:** an organism that lives on or in the host and harms it.
- ☑ **Free living:** an organism which is not dependent on another organism to survive.
- ☑ **Cell membrane:** cellular structures serving as boundary of the cell to move materials in and out.
- ☑ **Cytoplasm:** jelly like substances enclosed by cell membrane.
- ☑ **Nucleus:** used to control all life activities. Can be one or more nuclei.
- ☑ **Food vacuole or granule:** used to contain food for digestion.
- ☑ **Contractile vacuole:** used to remove excess water.

Did You Know?

* The pseudopodia of amoeba can form at any point on the cell membrane so that it can move in any direction.

Word Roots and Origins

Pseudopodia: made up of two Greek words from. pseudo, meaning 'false' and, podia, meaning 'feet'.

The food vacuole containing the food particle receives digestive enzymes from the cell cytoplasm. Then the food digested is broken down into small nutrient molecules that can pass out of the vacuole into the cytoplasm of the organism. Unused parts are removed out through the cell membrane.

Key Terms

- ☑ **Sub-cellular structures:** cellular parts that perform the many physiological functions needed to maintain the life of the organism.
- ☑ **Engulf:** take in solid food by cell.

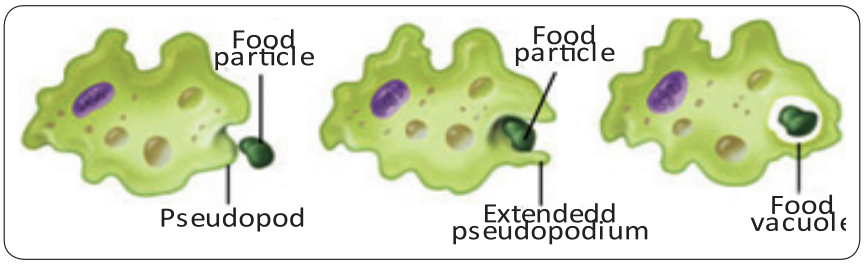


Figure 2.3: The feeding of amoeba using its pseudopodia

How do amoebae reproduce?

Amoeba reproduces and produces new amoebae (daughter amoebas) asexually (see Figure 2.4). Depending on the condition of living as good (favourable) or bad (unfavourable) an amoeba passes through two major stages. During its life period, the passing of an amoeba through good and bad living conditions forms its life cycle. The life cycle of amoeba includes two phases, the *active* (moving and feeding) and *cyst* (inactive and protected) phase.

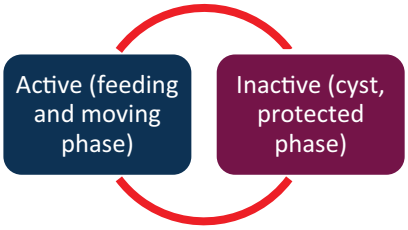


Figure 2.4: The life cycle of amoeba

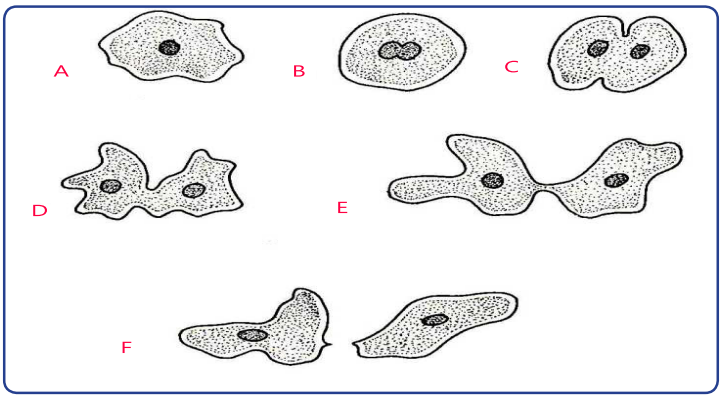


Figure 2.5: Binary fission in amoeba: a) *Amoeba stops moving and rounds off.* b) *The nucleus begins to divide.* c) *The nucleus has divided and the cytoplasm starts to constrict.* d) and e) *The construction continues to divide the cytoplasm.* f) *The daughter amoebae separate. This is a form of asexual reproduction called binary fission. There is no evidence of sexual reproduction in this species of Amoeba.*

During favorable condition an amoeba exists and lives in an active state. While in its active phase an amoeba reproduces by a type of asexual reproduction, known as binary fission (Figure 2.4). Binary fission means a process in which a cell divides into two equal parts and forms two daughter cells. The formed structure, the cyst, is resistant to dessication, low temperatures, and process of binary fission continues as long as the condition is suitable or favourable.

Did You Know?

* During sporulation an amoeba cyst forms as many as 500-600 spores, those which develop into active amoebae when condition is favorable for an active life.

Key Terms

- ☑ **Sporulation:** asexual reproduction by forming spore
- ☑ **Cyst:** a hard cover enclosing an inactive cell in unfavourable conditions.

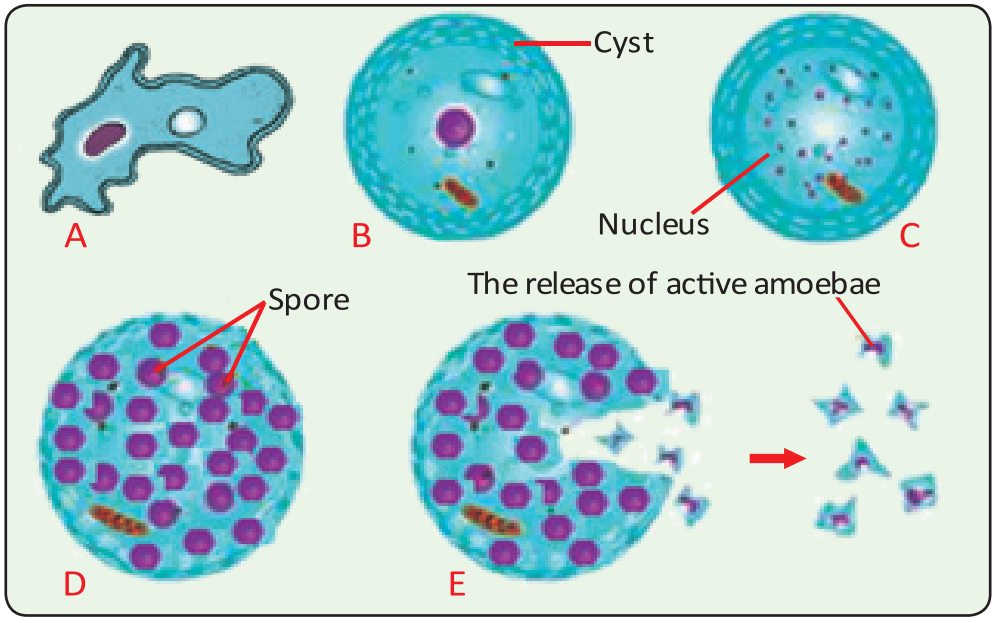


Figure 2.6 Sporulation of amoeba: a) *Active amoeba;* b) *cyst;* c) *nucular division in the cyst;* d) *the covering of each nucleus with a spore membrane and the formation of spore;* e) *breaking of the cyst and the release of active amoebae.*

Is Amoeba important?

There are several species of amoeba, both free living and parasitic. The fresh water species of amoeba is a useful experimental animal. However, *Entamoeba histolytica* is a parasitic species of amoeba that negatively impacts the human body, resulting in the infectious disease known as amebiasis. It is most common in developing countries that have poor sanitary conditions.

Activity 2.2



Examining different water samples for the presence of living organisms

In the previous section you have observed prepared slide of amoeba, now you will bring water sample from places nearby your school and you will observe live samples.

Materials you will require

- ☑ Compound light microscope,
- ☑ Slides and cover slip,
- ☑ Dropper,
- ☑ Pond, river, lake water, standing water or hay infusion.

Procedures:

1. Using a clean eyedropper place a drop of sample at the center of microscope slide and cover it with a cover slip. Avoid trapping of air bubbles by tapping the slide gently to remove any air bubbles.
2. Place the slide at the center of the hole on the stage of the microscope and fix it with clippers.
3. Adjust the amount of light using the iris diaphragm on the condenser.

   N.B: Since amoeba will be inactivated when exposed to light, either adjust the light so that it will not be much for them or take a few minutes till they get activated.
4. Use the coarse-adjustment knob to focus on the cells under the low power.
5. Switch to medium power and use the fine adjustment knob to bring the cells into focus once more.
6. Draw what you observe and compare it with picture of amoeba in Figure 2.3.
   - ☑ Have you seen amoebae?
   - ☑ How are they moving?

Paramecium



What does a cell of paramecium look-like?

Paramecium is a unicellular organism with a shape of a print of shoes. This colorless and slipper-like protozoan consists of cellular parts such as, cell membrane, cytoplasm, macro and micro-nuclei, food vacuole, contractile vacuoles, anal pore, gullet and oral groove and cilia (Figure 2.7).

Key Terms

- ☑ **Conjugation:** a process in which unicellular organisms are temporarily united and exchange genetic material.
- ☑ **Binary fission:** a type of cell division during which the cell divides into two equal cells.

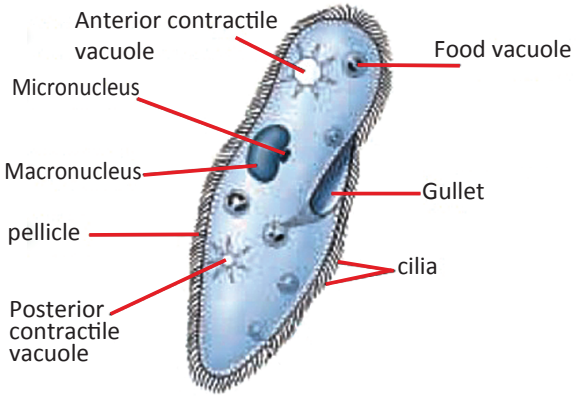


Figure 2.7: **Paramecium and its cellular parts**

Where does paramecium live?

Paramecium is living in fresh water habitats including ditches, rivers and lakes as free living organism.

How does a paramecium move?

Paramecium uses its cilia for movement. The whole surface of a Paramecium is covered with cilia that beat and create water currents and then move it towards a food source. The oral groove of the Paramecium also contains cilia that create currents and which draw the food into an oral cavity.

How does a paramecium feed?

Paramecium is able to feed on bacteria and algae which are brought into the oral groove and carried to the cytoplasm by the beating action of the cilia. The food from the oral groove is moved down a gullet and enters the food vacuoles for digestion. Following digestion, the soluble nutrients are absorbed by the cytoplasm, and the undigested food is eliminated at the anal pore.

Key Terms

- **Macro nucleus:** large nucleus which is related to metabolism and development of Paramecium.
- **Micro nucleus:** smaller nucleus which is responsible for the reproduction of Paramecium.
- **Oral groove:** a mouth-pore, through which a Paramecium feeds.
- **Anal pore:** an opening through which a Paramecium removes waste material.
- **Gullet:** the passage through which food passes from mouth (oral groove) into the cytoplasm.
- **Cilia:** fine hair-like extensions that beat and move the organism through liquid.
- **Pellicle:** a thin protective membrane that covers the whole surface of the cell membrane of a Paramecium.

How does paramecium reproduce?

Paramecium is capable of reproducing both asexually and sexually (Figure 2.8a and b). During asexual reproduction, *Paramecium* first divides its micronuclei. Then, it divides its cytoplasm and divides into two paramecia through binary fission.

Sexual reproduction in *Paramecium* involves conjugation. During conjugation, each of the two paramecia divide their micronuclei and form four micronuclei. In each paramecium three of the micronuclei disappear and only one survives. Then, each nucleus in each paramecium divides and forms two nuclei. The macronuclei brake down and disappear. Then after, the two paramecia join together and exchange one of the two nuclei. The new and the old nuclei in each paramecium fuse (unit) and form a zygote. The paramecia separate and the nucleus in each paramecium divides into eight. Afterwards, each paramecium undergoes binary fission twice to form four new individuals.

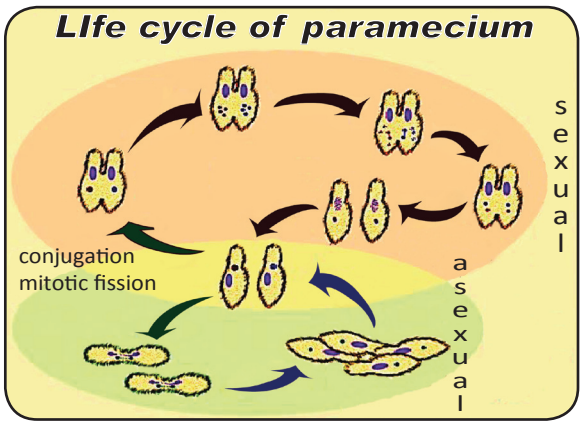


Figure 2.8: Reproduction in paramecia.

Activity 2.3



Examining the reproduction of Paramecium.

In groups discuss the types of reproduction in Paramecium. Draw the sequence of events that occurs during the reproduction of the species.

Is paramecium important?

Paramecium feeds on bacteria and algae; thereby they play significant role in the carbon cycle. These free living protists are in turn eaten by other protozoan and invertebrates, which in turn are eaten by other higher animals. As a result they are part of the food relationship among organisms in the ecosystem.

Euglena

What does a cell of euglena look–like?

Euglena is an oval-shaped unicellular organism. It shows both plant and animal like features. The cell of euglena consists of cell membrane, nucleus, contractile vacuole, flagellum, eye spot (stigma) and chloroplast.

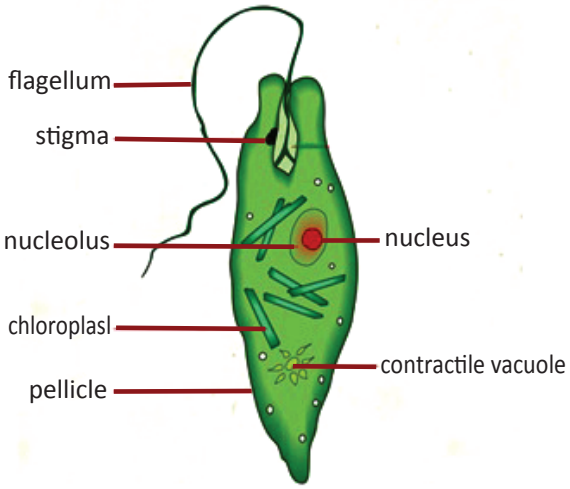


Figure 2.9: Euglena and its cellular parts

Key Terms

- **Flagellum:** slender whip-like structure used for movement in water, to swim.
- **Eye spot (stigma):** light sensitive structure usually found behind the flagellum.
- **Chloroplast:** part of a plant cell that contains chlorophyll and in which photosynthesis takes place.
- **Preying:** a process of hunting and feeding.

Where does an euglena live?

Euglena is living in freshwater habitats such as ditches and ponds, especially those contaminated by urine and feces.

How does an euglena move?

Euglena moves by propelling its flagellum. When the long flagellum rotates, the euglena is able to move in a wave- like motion in the direction it wants to go.

How does an euglena feed?

Because of the presence of chloroplast, euglena can prepare its own food using sun light. In the absence of light it can feed by preying.

How does an euglena reproduce?

Euglena are capable of reproducing asexually only. The type of asexual reproduction is binary fission that involves the division of the nucleus and the length wise division of the cytoplasm to produce new daughters of Euglena.

Is an euglena important?

Euglena lives in freshwater habitats especially in those contaminated by urine and feces. In the absence of light euglena feed on bacteria; and in the presence of light they photosynthesize. These characteristic give them especial place in the ecosystem. They serve as primary producers in the presence of light and as heterotrophs in the absence of light. As a result they play important role in the food relationship among organisms in the ecosystem.

Did You Know?

- Euglena like an animal ingests its food and like plants it photosynthesizes.
- Euglenas are unique unicellular or single-celled organisms with both plant and animal features.

Activity 2.4



Examining the movement of Euglena under the microscope.

Materials you will require

- ☑ Compound light microscope
- ☑ Slides and cover slip,
- ☑ Dropper,
- ☑ Standing water or hay infusion.

Procedures

1. On a clean slide add a drop of hay infusion and cover it with a cover slip.
2. Observe your sample first under the lower power and then observe it under the medium power.
3. Draw what you observe and compare it with the picture of amoeba in Figure 2.9.
   - ☑ Have you seen Euglena?
   - ☑ How do you differentiate Euglena from Paramecium?

Bacteria

What are bacteria?

Bacteria are very small, unicellular organisms that have nuclear material, but without distinct nucleus. They have cellular structure such as cell wall, cell membrane, nuclear material (nucleoid), cytoplasm, slime envelope and flagellum (see Figure 2.10).

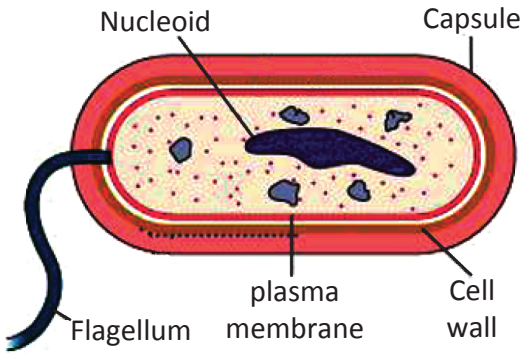


Figure 2.10: A generalized bacterial cell.

Did You Know?

- Bacteria are prokaryotic organisms. Prokaryotes are organisms in which their nuclear material is not enclosed within a nuclear membrane.
- Since bacteria are very small, 1 μm (0.001 mm), it takes more than one million of them to cover a pinhead.

Activity 2.5



Library research in different shapes of bacteria.

Go to the library and investigate the major shapes of bacteria. Together with the major shapes among bacteria give one or two representative examples for each shape. Submit your report to your teacher.

Where do bacteria live?

Bacteria are found in a wide variety of habitat, almost everywhere. They are found in air, water, soil, and in or on the body of other living things. Bacteria can exist in single, in pairs or in chains. Bacteria are so small that they can normally be seen only through a powerful microscope by experts working in a laboratory. Because bacteria are so small, the experts grow them in the laboratory until there are many of them. These groups or pile of bacteria are called colonies (Figure 2.11).

What do bacteria feed on?

Because of their existence in a wide range of habitats, they show different types of feeding. Some bacteria are photosynthetic and are able to make their own food using sun light or inorganic substances. Other types of bacteria feed by decomposing organic matters. The remaining others absorb materials from their hosts being parasites.



Figure 2.11: Bacterial colonies on a plate.

How do bacteria reproduce?

Bacteria reproduce asexually by binary fission which involves the division of the nuclear materials within the nucleoid. During binary fission the cell stops moving, and then the genetic material divides. Following this, the cytoplasm divide and finally two bacterial daughter cells will be formed.

How do bacteria move?

Some bacteria are able to move by means of their flagella. These flagella when they rotate cause the bacteria to move forward.

Are bacteria important to us?

Bacteria are important in many aspects. Some bacteria are useful to us like in making food (yoghurt [ergo] and cheese [ayib]) and to make medicine. As photosynthetic organisms they provide food for other organisms. Being decomposers they supply nutrients in a cyclic way.

Some bacteria are harmful and spoil our food. They make it go rotten hence taste and smell bad. Moreover they cause diseases to plants and animals. For instance, they can cause diseases such as cholera, pneumonia, typhoid, and syphilis in humans.

Activity 2.6



Library study on some human bacterial diseases.

Go to the library and investigate the bacterial agents responsible to cholera, pneumonia, tuberculosis, typhoid, and syphilis. In your investigation include the ways of transmission and major control methods.

Yeast

What does a yeast cell look-like?

Yeast is an oval unicellular microscopic fungus. The yeast cell is composed of cell membrane, nucleus and cytoplasm (Figure 2.12).

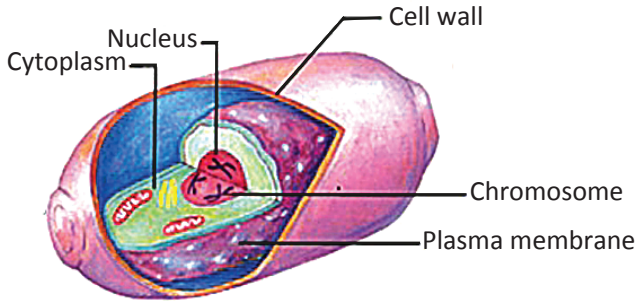


Figure 2.12: A yeast cell.

Key Terms

- **Fungi:** organisms that include yeasts and moulds. They have cell wall like plants, but unlike plants and animals they obtain their foods through absorption.
- **Fermentation:** biochemical process during which raw food material (like teff flour and water) is converted into fermented products (like fermented teff dough, beer, wine, tella).
- **Fermented dough:** biochemical conversion of thick malleable mixture of flour and liquid , which is going to be baked into bread, pastry or enjerra

Where do yeasts live?

Yeasts are found normally on the skin surface of fruits such as grapes and also in fermented dough (enjerra dough) and other local fermented products like tella and tej. Yeasts are also found on the skin surfaces and in the intestinal tracts of warm-blooded animals.

What do yeasts feed on?

Yeasts commonly feed on sugary materials present in fruits and grains. When they feed on sugar or glucose, in the absence of oxygen they convert it into alcohol (ethanol) and carbon dioxide (Figure 2.13). This process is known as fermentation.



Figure 2.13: Equation showing ethanol and CO2 production from glucose.

How do yeasts reproduce?

A yeast cell reproduces asexually by budding (Figure. 2.14). When a yeast cell reaches full size and matures, its nucleus divides into two nuclei. Then an outgrowth starts forming on one side as a bud. Then one of the nuclei migrates into the growing bud. Finally the bud detaches itself from the parent cell and becomes a new yeast cell.

Key Terms

- **Budding:** an asexual process of reproduction in yeasts by forming an outgrowth, a bud.
- **Bud:** an outgrowth from a mother yeast that finally separate and form a new individual.
- **Biofuel:** fuel directly produced from living things.

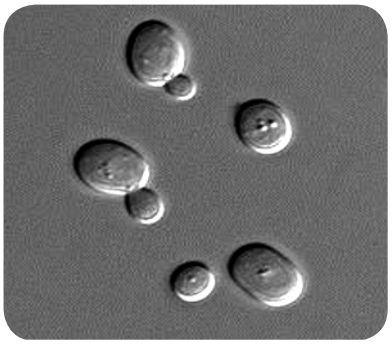


Figure 2.14: Budding yeast

Activity 2.7



Looking at yeast cells under the microscope.

Materials you require:

- ☑ overnight grown yeast culture
- ☑ compound microscopes
- ☑ eye droppers
- ☑ clean slides and cover slips

Procedures:

1. To a clean slide add a drop of yeast and cover it with a cover slip.
2. Observe your sample first under the low power and then observe it under the medium power.
3. Draw what you observe and compare it with picture of budding yeast in Figure 2.13.
   - ☑ Have you observed a budding yeast?

Are yeasts important?

Yeasts are the most important members of Fungi that are used for industrial production of food and alcohol drinks. The ethanol produced during yeast fermentation (Figure 2.14) is important for the alcohol and taste beer, wine, tella and tej. Moreover, the ethanol produced serves as a biofuel. The CO_2 produced by yeast cells during fermentation of dough is important for the rising of bread (including Diffo dabo) and enjerra.

Activity 2.8



Discussion on unicellular organisms.

In groups compare and contrast the unicellular organisms you have discussed so far. Present your report to the class.

Exercise 2.2

Choose the best answer for each of the following questions.

1 Amoeba does not have a definite
- A nucleus
- B shape
- C contractile vacuole
- D A and B

2 Paramecium is identified by its
- A macro and micronuclei
- B flagellum and oral groove
- C slipper-like shape
- D A and C

3 Like a plant cell, euglena has
- A chloroplast
- B flagellum
- C eye spot
- D A and B

4 All bacterial cells are without
- A cell walls
- B nucleus
- C cell membranes
- D flagella

5 A yeast cell does not
- A make its own food
- B feed sugar
- C have nucleus
- D reproduce

2.3 Levels of Cellular Organization in Multicellular Organisms

By the end of this section, you will be able to:

- name different types of cells;
- state the functions of different types of cells;
- name some plant and animal tissues;
- state the functions of some plant and animal tissues;
- name some plant and animal organs;
- state the functions of some plant and animal organs;
- name some plant and animal systems;
- state the functions of some plant and animal systems;
- describe organism as the highest level of organization in multi-cellular organisms.

What are the different types of cells in multicellular organisms?

In the previous section you have learnt that all organisms are made up of small structural and functional units known as cells. All cells have basic similarities. On the basis of number of cells they are made from, organisms are categorized as unicellular and multicellular organisms. Organisms that are composed of one cell are known as unicellular organisms. These organisms are usually smaller in size, and are simple types. Multicellular organisms are composed of many cells. Plants, animals and some fungi are multicellular organisms. In these organisms, there are different types of cells that vary in their shapes, sizes and functions.

Did You Know?

* All multicellular organisms start as a single cell in their life cycle..

Key Terms

- **Unicellular organisms:** organisms that are made up of one cells that include organisms like amoeba, paramecium, euglena and others.
- **Multicellular organisms:** organisms that are made up of many cells that include organisms like plants and animals.

What types of cells are found in plants?

Plants are *multicellular organisms*. A plant body is made up of many and different types of cells. For example, types of cells in different parts of a plant body include leaf epidermal cells; leaf palisade cells; and root tip cells. These different types of cells have different functions. Leaf epidermal cells cover the upper and lower surfaces of a leaf (Figure 2.15).

The leaf epidermis protects the internal part of the leaf from any mechanical damage. The leaf palisade cells are found below the upper epidermal layer. As their name is indicating, the root tips cells are found at the tip of plant roots.

Key Terms

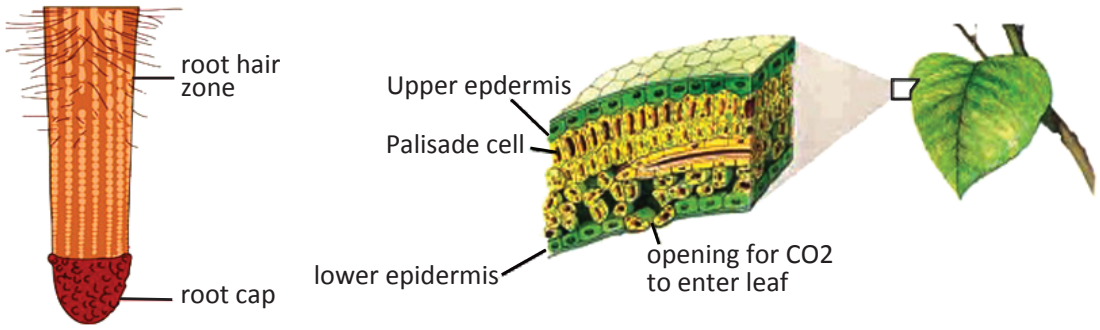
- ☑ **Leaf epidermal cells:** are flat cells that are found on the upper and lower surface of leaves.
- ☑ **Leaf palisade cells:** type of cells that are located just below the upper epidermis and contain large number of chloroplast. Due to the presence of chloroplast they are sites at which photosynthesis is taking place in plants.
- ☑ **Root tip cells:** these are cells that are found at the tip of roots.

Activity 2.9



Identifying different types of plant cells

In groups, list down different types of plant cells and give their possible functions to the plant. Present your report to the class.



a. Root tips b. Leaf cross section

Figure 2.15: Different types of plant cells



What types of cells are present in the body of animals?

Animals including humans are made up of many cells, and are known as multicellular organisms. There are different types of cells in human body. The cells that form our body include skin cells, nerve cells, muscle cells, blood cells, sperm cells, ova (egg cells) and others (Figure 2.16). These cells vary in their shapes and sizes. In addition to variations of these cells in their shapes and sizes, they also differ in their functions.

Activity 2.10



Observing prepared slides under microscope

Material you will require:

- prepared slides of different animal cells (skin cells, nerve cells, blood cells, muscle cells, and others)
- compound light microscope

Procedures:

1. Observe each prepared slide first under low power and then under medium power.
2. Draw what you have observed and compare it with pictures in Figure 2.16.
   - Have you observed differences among the cells?
   - What type of variations have you observed?
   - What do you think is the reason for these variations among cells of multicellular organisms?

Key Terms

- **Muscle cells:** cells that are pointed at both ends and form the muscles of the body. Due to their ability to contract and relax, they play role in moving body parts or the whole body.
- **Nerve cells:** long and branched cells that are involved in transmitting nerve message in the body.
- **Blood cells:** circular cells that are involved in transporting oxygen and carbon dioxide; and defending the body from disease causing organisms.
- **Skin cells:** flat and thin cells that cover our body.
- **Sperm cells:** male reproductive cells that are involved in fertilizing female reproductive cells and initiate the process of reproduction.
- **Egg cells (ova):** female reproductive cells that are fertilized by male reproductive cells during the process of reproduction.

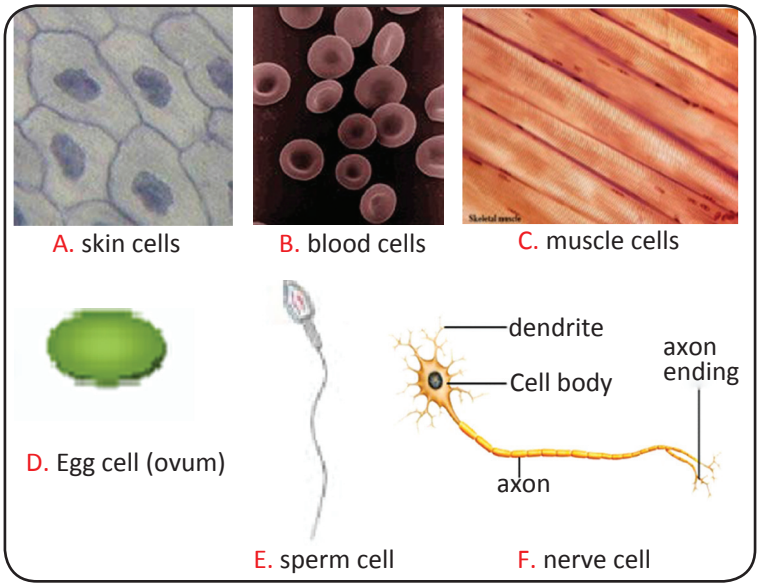


Figure 2.16: Different types of human body cells

Tissues

What are tissues?

Multicellular organisms are made up of many cells and have different type of cells that are specialized to perform various functions. In fact, they are not simply a collection of many cells. Rather, cells in the body of multicellular organisms are organized at different levels of functional groups. A group of cells that is similar in shape, size and that carries out the same function is called a tissue.

Key Terms

- **Tissue:** a group of cells that have the same shape and size which carry out the same function.
- **Epithelial tissue:** a tissue made up of cells that cover the external surfaces of the body (the skin) and lining the surfaces of the structures like mouth, heart, liver and eyes.
- **Muscle tissue:** a tissue made up of a group of muscle cells and forms the muscle that are found at different parts of the body.
- **Blood tissue:** a tissue which is made of blood cells and fluid that fills the space in blood vessels tub.
- **Nervous tissue:** a tissue which is made of a group of nerve cells that form the brain, spinal chord, and the peripheral nervous system.

What are the types of plant tissue?

Plants are one group of multicellular organisms. In plants, cells with the same structure and performing similar function are organized as tissue. Tissues in plants include epidermal tissue, conducting tissue, photosynthetic tissue (mesophyll tissue) and strengthen tissue (Figure 2.17).



Activity 2.11

Identify tissues in plants

In groups, identify tissues that are found in plants, specify their locations and give their functions. Submit a written summary of your discussion to your teacher.

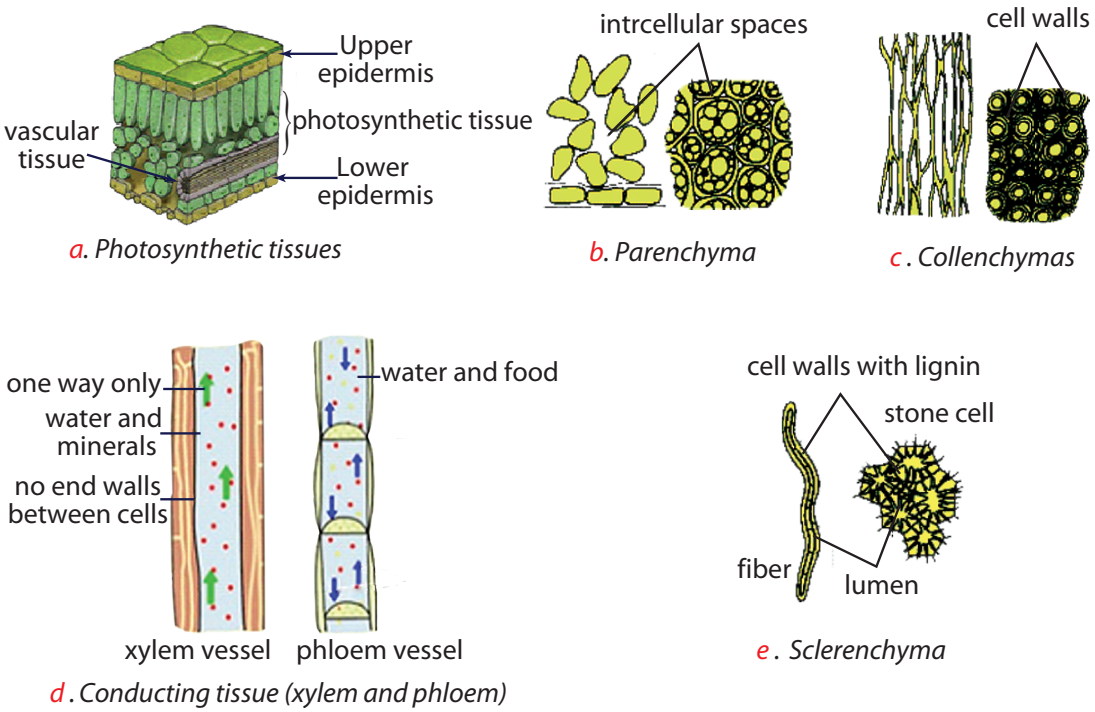


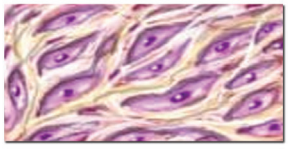
Figure 2.17: Different types of tissues in plants.

What are the types of animal tissues?

Similar to plants, in animals including humans a group of similar cells that performs the same function is organized as a tissue. Generally, there are four basic types of tissue in the body of human. The four basic tissue types of a human body are epithelial tissue, muscle tissue, connective tissue, and nervous tissue. Blood is an example of connective tissue. Connective tissue is a type of tissue characterized by few cells separated by space and large amount of extracellular material (Figure 2.18).

Key Terms

- **Epidermal tissue:** a tissue found at the external surfaces of plant bodies. The tissue is involved in protecting the plant surface from external damage, it involves in gas exchange, and reducing water loss from the body of the plant.
- **Conducting tissue:** a tissue made up of cells that transport water, photosynthetic product and mineral in the plant body. It is made up of mainly from xylem (water and mineral transporting cells) and phloem (food transporting cells).
- **Photosynthetic tissue (mesophyll tissue):** a tissue found in plant leaves that contains chloroplasts and is involved in the process of photosynthesis.
- **Strengthen tissue:** a tissue which is made up of cells with thick-wall and is involved in providing mechanical strength to the body of a plant.


a . connective tissue


c . epithelial tissue


b .muscle tissue

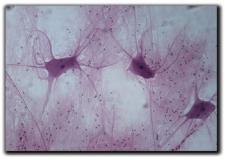

d .nervous tissue

Figure 2.18: Different types of tissues found in the body of animals including human.



Activity 2.12

Discussion on types of tissues in human body

In groups, identify different types of tissues that are found in human body and specify their functions. Present the summary of your discussion to your class.

Organs

What are Organs?

In the body of multicellular organisms different tissues are grouped together to form structural and functional unit known as an organ. An organ is made up of different types of tissue that work together to achieve one or more functions within the organism.

What organs are there in plants?

A plant body is made up of different tissues that are organized into functional units known as organs. In plants stems, leaves, flowers, and roots are all organs (Figure 2.19). These organs are made of different types of tissues and perform specified function or functions. For instance, leaf is an organ which is made of tissues like epidermal, photosynthetic, and conducting tissues.

Key Terms

- **Organ:** a functional unit which is made up of different types of tissues that work together.
- **Leaf:** an organ found in the body of plants. It is made up of different tissues and mainly carries out photosynthesis, transpiration and gaseous exchange.
- **Stem:** an organ found in the body of plants. It consists of different tissues and mainly involved in supporting the aboveground part of the plant. It is also involved in transporting photosynthetic product, water and mineral in the plant body.
- **Root:** an organ found in the body of plants. It contains different tissues and mainly anchors the plant into the soil. It absorbs water and minerals from the soil and transports them up to the aboveground part of the plant.
- **Flower:** an organ found in the body of flowering plants. It is made up of different tissues and is involved in sexual reproduction of flowering plants.

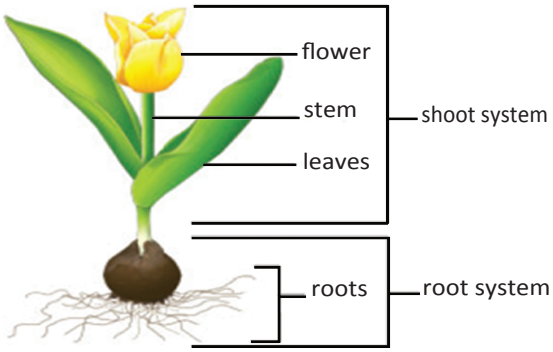
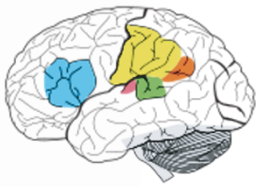
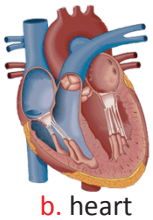


Figure 2.19: The major organs and organ systems of plants

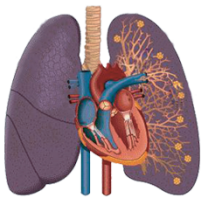
What organs are there in animals?

Different tissues are organized to form larger structures, such as the skin, stomach, eye, lung, ear and heart in the body of animals including humans (Figure 2.20). These structures are called organs. For example the heart is an organ, which contains cardiac muscle, connective tissue, epithelial tissue and nerve tissue. Other organs found in a human body include the skin, stomach, brain, lungs, intestines, eyes, liver and others.


a. Brain


b. heart


c. Stomach


d. Lung


e. Eye


f. Ear

Figure 2.20: Some of the organs of our body

Key Terms

- ☑ **Brain:** an organ found in the body of animals. It is made up of different types of tissues. It coordinates and controls overall activities of the animal body.
- ☑ **Heart:** an organ found in the body of animals. It contains different types of tissues and pumps blood to different parts of the body.
- ☑ **Stomach:** an organ found in the body of animals. It consists of different types of tissues and is involved in the digestion of food substances ingested by the animal.
- ☑ **Lung:** an organ found commonly in animals. It is made up of different types of tissues and mainly involved in breathing process.
- ☑ **Eye:** an organ found in the body of animals. It is made up of different types of tissues and involved in visual process.
- ☑ **Ear:** an organ found commonly in animals. It contains different types of tissues and mainly involved in hearing process.

Activity 2.13



Observing plant and animal organs.

In groups,

- ☑ collect plants (small-sized) identify their organs, and specify the types of the tissues that each organ is made from.
- ☑ jot down different organs of the human body and specify their major functions.
- ☑ present your summary to the class.

Organ System

What are systems?

Organs never work alone. Two or more organs work together to perform certain task and form an organ system or a biological system. An organ system is a biological system in which different organs are coordinated to perform major activities of the body.

What are the types of systems in plants?

In plants the functions of the different organs are coordinated in the form of organ system. Generally, plants have two major organ systems: the root system and the shoot system (Figure 2.19). The root system includes the underground body parts of plants, namely the main root, lateral roost, and root tips. The aboveground parts of the plant form the shoot system. It includes the stem, branches, leaves and flowers in flowering plants.

Did You Know?

* The vertebrate body contains 11 principal organ systems

What are the types of system in animals?

In the body of animals including humans different organs are organized, coordinated and function as organ system. For instance, the digestive system is an organ system which is made up of several organs including the mouth, esophagus, stomach, liver, pancreas, small and large intestines, and anus. Other organ systems that are found in the bodies of animals include the circulatory system, respiratory system, digestive system, musculoskeletal system, and nervous system (Figure. 2.21).

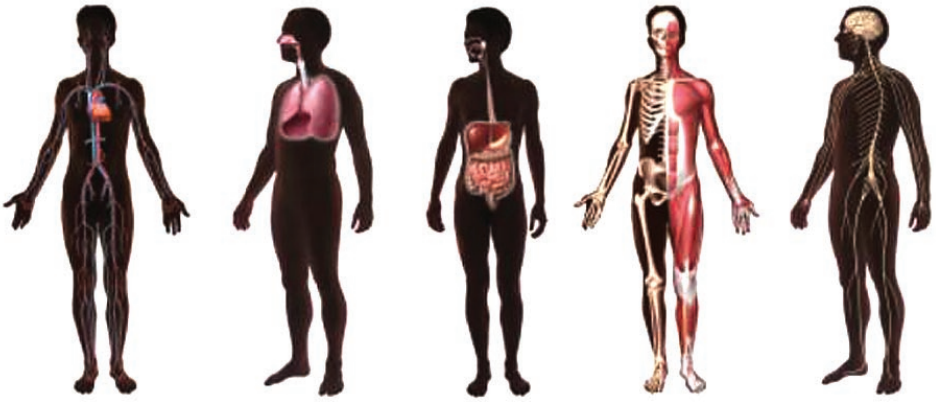


Figure 2.21: Major organ systems of the human body.

organism

What is an organism?

The body of multicellular organism like yourself is the result of coordinated hierarchical organization of all five levels of organizations. The five levels of organization include cells, tissues, organs, organ system and organism (Figure 2.22). Therefore, an organism is the outcome of coordinated functions of different organ systems, which included all lower levels of organization. For instance, the human body is made up of different organ systems (digestive, circulatory, nervous, and others), in turn each organ system is composed of different organs. Each organ that forms an organ system in turn is made up of different tissues (epithelial, muscle, connective and nervous). Each tissue in the body that forms an organ in sequence is composed of many cells (Figure 2.23).

Similarly, a plant as an organism is a result of a hierarchical organization of all levels of organizations. A plant is an organism which is organized from cells, tissues, organs, and organ system (Figure 2.22). For example, a rose plant is composed of the shoot and root systems. The shoot system in turn is made up of organs of like

Key Terms

- **Organ system:** a biological system in which two or more organs are coordinated together to perform certain major activity in the body of an organism.
- **Digestive system:** a system made up of mouth, esophagus, stomach, intestines, liver, and pancreas. It digests ingested food and absorbs digested nutrients..
- **Circulatory system:** a system which contains the heart, blood vessels, blood, lymph, and lymph structures. It transports useful and wasteful materials throughout the body.
- **Nervous system:** a system which is composed of nerves, sense organs, brain, and spinal cord. It receives stimuli, integrates information and directs the body.
- **Respiratory system:** a system which consist of the lung, trachea, pharynx, and other air passages. It carries out gas exchange between the organism and the environment.
- **Musculoskeletal system:** a biological system that contains muscles, bones, cartilage, and ligaments. It protects the internal body parts, move parts or the whole body and provides support for organs.

the root, stem, leaves and flowers. Each organ of a plant body like the leaf consists of different tissues like epidermal, mesophyll and conducting tissues. Each tissue that makes the leaf in turn contains many similar cells.

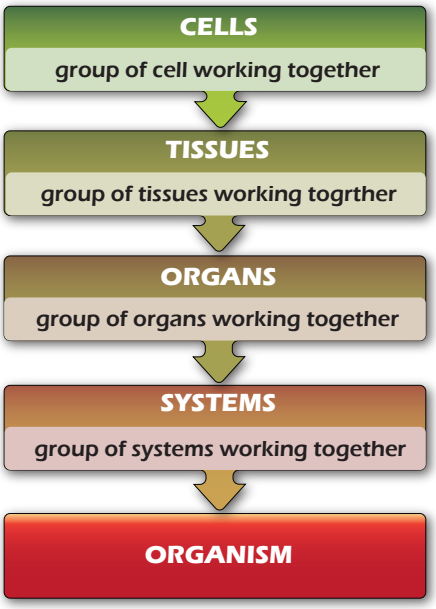


Figure 2.22: Sequences of level of organization in an organism

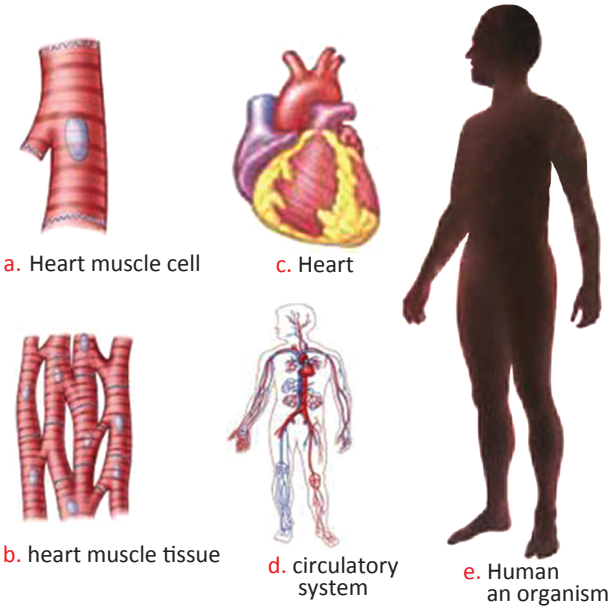


Figure 2.23: Example of level of organization within human body

Activity 2.14



Discussion on organ system in human, human as an organism and comparing with other organisms.

Go to the library and look at diagrams and other pieces of information on an amoeba, a plant and an animal in a biology book, and put a tick mark as 'a' where it is appropriate, in the table below (by coping on to your excercise book).

Diagram	Unicellular	Multicellular	Have				Is an organism
			Cells	Tissues	Organ	Organ system	
Amoeba							
Plant							
Animal							

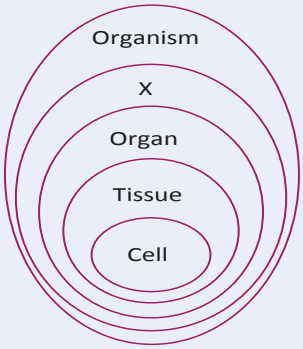
Exercise 2.3

Choose the correct answers for the following questions

1 One of the followings is not found in plants.

A Organ
B Organ system
C Tissue
D Blood cells.

2 The diagram below shows levels of organization in living things. Which level is best represented by X?



A Tissue
B Body
C System
D A and B

3 Which sequence demonstrates the increasing complexity of levels of organization in multicellular organisms?

A organelle → cell → tissue → organ → organ system → organism
B cell → organelle → tissue → organ → organ system → organism
C organelle → tissue → cell → organ → organ system → organism
D cell → organism → organ system → organ → tissue → organelle

4 Which of the following is different from the others?

A Epithelial tissue
B Palisade tissue
C Muscle tissue
D Nerve tissue

5 One of the following is different from the others?

A Root
B Shoot
C heart
D leaf

Unit Summary

- Many Unicellular organisms are seen using a hand lens or a microscope.
- Amoeba, Paramecium, Euglena, Yeast, and Bacteria are the common unicellular organisms.
- Amoeba is a single celled organism found in mud at the bottom of ditches and ponds.
- The cell of amoeba consists of Nucleus, Cytoplasm, Contractile vacuoles, and Food granules.
- Amoeba is able to move by forming pseudopodia because of the flow of cytoplasm.

- Amoeba feeds on bacteria and microscopic algae, which are engulfed by pseudopodia, and digested in food vacuole.
- Amoeba reproduces asexually by binary fission and Sporulation. The mechanisms of binary fission: Occurs when conditions are favourable involving its nucleus divides to form two daughter amoebae cells.
- Sporulation: reproduction by producing spores.
- Occurs when conditions are unfavourable by which the amoeba form a cyst and divides many times within.
- When conditions become favourable the cyst ruptures and many amoebae are released
- Paramecium is a single celled organism, shaped like a shoe print, which is found in fresh water ditches and ponds.
- The cell of paramecium is composed of Nucleus, Cytoplasm, Contractile vacuoles, and Oral groove.
- Paramecium feeds on bacteria.
- Paramecium reproduces both asexually and sexually. Asexual reproduction by binary fission while sexually by conjugation.
- Sexual reproduction by conjugation involves the fusion of two strains of paramecia for rapid binary fission.
- Euglena is a single celled organism, is oval shaped and has a single flagellum. It is found in fresh water ditches and ponds.
- The cell of euglena consists of Nucleus, Cytoplasm, Contractile vacuoles, Chloroplast, and Flagellum.
- Euglena has a chloroplast and produces its own food by photosynthesis.
- Euglena reproduces only asexually by binary fission only.
- The movement of euglena is by the whipping of the flagellum.
- Bacteria differ in their kinds but have cell wall, nucleotide and cytoplasm.
- There are many different kinds of bacteria but they have certain generalised features.
- Some bacteria exist as individuals while others group together.
- Bacteria are found in a variety of habitats both outside and inside other organisms.
- The cellular parts of a bacterium are Nuclear material, Cell wall, Cytoplasm, Slime envelope, and Flagellum.
- Bacteria have no nucleus but a knot of nuclear material.
- Bacteria are able to move due to the motion of flagella.
- Bacteria reproduce asexually by binary fission,
- The different bacterial forms are Cocci, Bacilli, Vibrios, and Spirilla.
- Some bacteria can cause diseases in people including Cholera, Pneumonia, Typhoid, and Syphilis.
- Yeast is a single-celled fungus found naturally on the skins of fruit such as grapes and in fermented dough.
- Nutrition in yeast involves the breakdown of glucose in the absence of air. This is called alcoholic fermentation since alcohol (ethanol) is one of the products: glucose → ethanol + carbon dioxide + energy.
- Fermentation in yeast is commercially important for
- The formation of alcoholic drinks like beers and wines.
- The making of ethanol used as a biofuel.

- baking by providing carbon dioxide to make bread rise.
- Yeast reproduces asexually by budding.
- In a multicellular organism, there are different types of cells, each having a particular function.
- Some of the different types of cells found in plants include Leaf epidermal cells; Leaf palisade cells; and Root tip cells.
- The different types of cells found in the human body include Skin cells, Blood cells, Muscle cells, Nerve cells, Sperm and ova.
- Cells of a particular type are usually grouped together to form a tissue. Tissue consists of cells of the same shape and size, which carry out the same function.
- Some of the tissues present in plants are Photosynthetic tissue, epidermal tissue, conducting tissue, and strengthening tissue.
- Some of the tissues present in animals are Epithelial tissue, Blood tissue, Nerve tissue, Muscle tissue, and Skeletal tissue.
- Tissues may be grouped together to form a functional unit called an organ.
- An organ consists of a number of different tissues, which combine to enable the organ to perform specific functions.
- Some of the organs present in plants are Leaf, Stem, Root, and Flower.
- Some of the organs present in animals are Heart, Lungs, Liver, and Stomach.
- Organs may be grouped together to form a system.
- A system consists of several organs whose functions are coordinated.
- Some of the systems present in plants, are Root system, and Shoot system.
- Some of the systems present in animals are Digestive system; Circulatory system; and Reproductive system.
- Systems combine together to form an organism. The five levels of organisation in a multicellular organism: cells → tissues → organs → systems → organism



Review Excises for unit 2

Part I: *Choose the best answers for the following questions*

1 The common shapes of bacteria include:-

A cocci
B spiral
C bacilli
D all of these

2 Making injera requires the activity of:-

A Amoeba
B Yeast
C Algae
D Paramecium

3 Binary fission is observed in:-

A Euglena
B Amoeba
C Bacteria
D all of the above

4 Which of the following can be parasites?

A Bacteria
B Green plants
C Amoeba
D A and C

5 Contractile vacuole is not observed in:-

A amoeba
B yeast
C paramecium
D A and B

6 Amoeba obtain its food by

A photosynthesis
B engulfing
C absorption
D chemosynthesis

7 Identify an organism that is not unicellular.

A Insect
B Bacterium
C Chlorella
D Amoeba

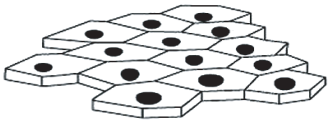
8 One of the following is a harmful aspect of bacteria.

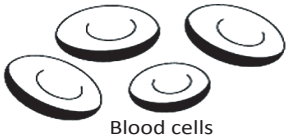
A Involvement in compost making
B Decomposition of dead body of plants
C Spoilage of human food
D Removal of hair from animal skin in tanneries.

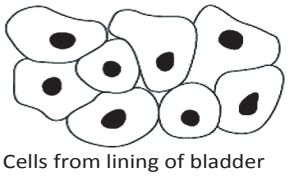
9 Brewing is the fermentative effect caused by

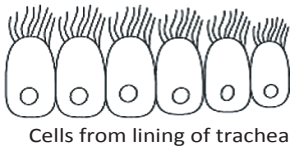
A euglena
B amoeba
C paramecium
D yeast

10 Some human body cells are shown in the diagrams below. What do these groups of cells show?


Cells from skin


Blood cells


Cells from lining of bladder


Cells from lining of trachea

A tissues in which similar cells function together
B organs that help to carry out a specific life activity
C systems that are responsible for a specific life activity
D organelles that carry out different functions

Part II: ***Match correct terms/meaning given in column 'B' with their correct levels given in column 'A'***

Column A		Column B	
11	Cell	A	Organism
12	Plant	B	Group of similar cells
13	Tissue	C	Heart
14	Nose	D	Ova
15	Organelle	E	Organ
		F	Group of different cells
		G	Nucleus

Part III: ***Fill in the blank spaces with appropriate terms.***

16 The movement of amoeba is achieved by forming _____

17 Paramecium use _____ for movement.

18 Bacterial cells have _____, _____ and _____Shape.

19 The structure that removes water from cell of euglena is _____.

20 In multicellular organisms organ system is organized by various _____.

Part IV: ***Give short answers for the following questions.***

21 What is the difference between unicellular and multicelular organisms?

22 Give examples of unicellular and multicellular organisms.

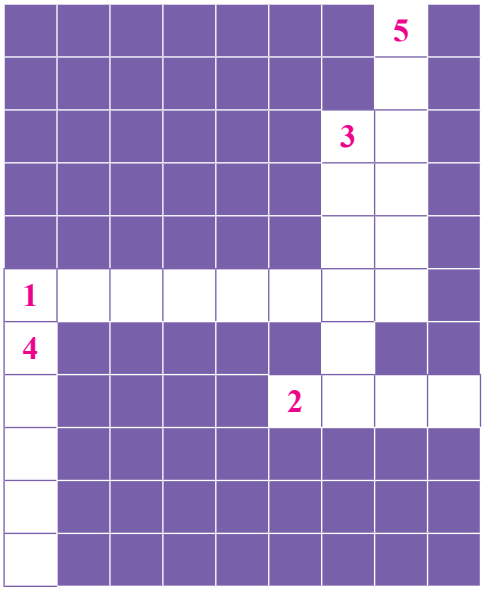
23 Define a tissue and give example of animal tissues.

24 Define an organ and give example of organs in plants.

25 How do you define a cell?

Part V: ***Copy the crossword puzzle and use the numbered clues to complete and solve the puzzle.***

The numbers in bracket indicates the number of letters in each word.



Across

1 Group of systems working together. (8)

2 The basic unit of living things. (4)

Down ward

4 A group of tissues working together.(5)

3 A group of cells working together. (6)

5 A group of organs working together. (6)

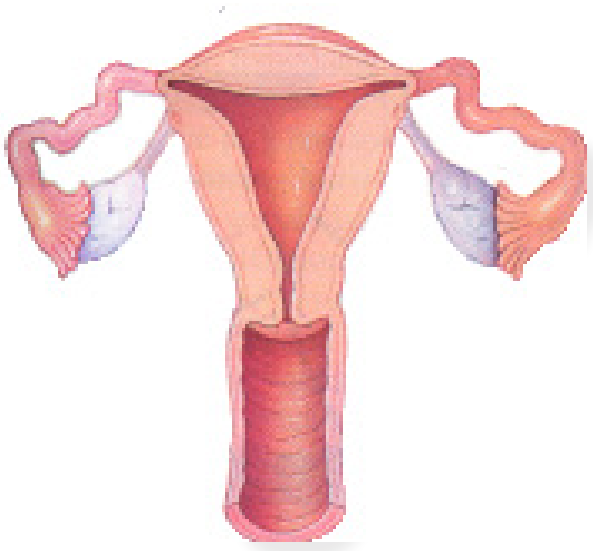
Unit 3

Human Biology and Health

Unit Outcomes

By the end of this unit, you will be able to:

- *explain the primary and secondary sexual characteristics of males and females;*
- *label the reproductive structures and give their functions;*
- *explain the menstrual cycle and the cares that girls should take before and during menstruation;*
- *define fertilization and explain its process;*
- *mention pills and condoms as birth control methods and explain how they are used;*
- *trace some common reproductive health problems, describe how they affect humans and how they could be prevented,*
- *show the local, national and global distribution of HIV and AIDS, explain its impacts in the society and express willingness to give care and support to people living with it,*
- *demonstrate assertiveness, decision making, and problem solving skills as life skills that help to prevent HIV.*



Main Contents

3.1 The Reproductive System

3.2 HIV and AIDS

- Unit Review

Introduction

In the previous unit of this biology lesson you have studied how single-celled organisms such as bacteria, amoeba, paramecium and yeast reproduce for their survival. These unicellular organisms have no reproductive organs as they are made up of one cell. However, most multi-cellular organisms that reproduce sexually have distinct male and female reproductive organs. So do humans and other mammals.

A human body is the result of coordinated activities of different systems. These systems include, circulatory, breathing, skeletal, reproductive and other systems.

In this unit emphasis will be given to human reproductive system and its function. Moreover, the unit will introduce you on how to keep the reproductive structures healthy. The unit will also deal with the distribution and impacts of HIV and how to take care for people living with HIV/ AIDS (PLWHA); and the skills that help to prevent HIV infection and distribution.

3.1 The Reproductive System



By the end of this section, you will be able to:

- state the primary and secondary sexual characteristics;
- label the reproductive structures of males and females on a diagram;
- describe the functions of the reproductive structure of males and females;
- explain the menstrual cycle using a simplified diagram;
- explain the cares that girls should take before and during menstruation;
- define fertilization;
- Explain the process of fertilization;
- mention pills and condoms as birth control methods;
- explain how pills and condoms are used for birth control;
- describe how FGM, early marriage, STI, rape and illegal abortion affect reproductive health;
- explain how FGM, early marriage, STI, rape and illegal abortion could be prevented.

Primary and Secondary Sexual Characteristics

What are primary sexual characteristics ?

Humans and all other mammals are born with sex already determined. The male individuals are born with the penis, testes, and scrotum. Similarly, the females are borne with vagina, ovaries and uterus. In both sexes, these sex organs make the primary sexual characteristics.

These are the body reproductive structures that distinguish one sex from the other, males from females. These features may render reproduction impossible since the reproductive organs are immature.

What are the secondary sexual characteristics?

Reproduction is possible when one attains sexual maturity and this is shown by what we call secondary sexual characteristics. This occurs at puberty or adolescence and is displayed on the average, at the age of 10-15. The secondary sexual characteristics display distinct changes in males and females. These changes are brought about by sex hormones produced by matured reproductive organs. As a result boys develop into adult men, whereas girls into adult women (See Table 3.1).

Key Terms

- **Reproductive system:** a system consisting of reproductive organs for production of offspring.
- **Secondary sexual characteristics:** features that show the immaturity of reproductive organs.
- **Sex organs:** are organs of reproduction.
- **Gonads:** sex glands to produce gametes (sex cells), and sex hormones.
- **Testes :** male gonads to produce sperm cells.
- **Ovaries:** female gonads to produce egg cells.

Can you list the major secondary sexual characteristics in males and females?



Activity 3.1

Discussion on the primary and secondary sexual characteristics.

- In groups, identify the primary and secondary sexual characteristics.
- Compare your lists of the secondary sexual characteristics of males and females with the lists in Table 3.1 below.

Table 3.1: Secondary sexual characteristics of males and females.

In Males	In Females
Deepening of voices	Enlargement of breast
Fast body growth	Fast body growth
Broadening and widening of chest and shoulder	Widening of hips
Growing pubic hair (in armpits and groin)	Growing pubic hair (in armpits and groin)
Enlargement of genital organs	Enlargement of genital organs
Production of sperm cells and sex hormones	Production of egg cells and sex hormones
Nocturnal emission of sperm cells	Menstruation
Development of desire to the opposite sex	Development of desire to the opposite sex

The Male and Female Reproductive Organs

The human reproductive organs produce reproductive cells within gonads. These reproductive cells produced by male and female gonads, respectively, are sperm cells and egg cells. When these sperm cells and egg cells unite together during sexual intercourse they produce offspring.

What are the male reproductive organs?

Because the male reproductive organs are simple to understand, we better begin with them.

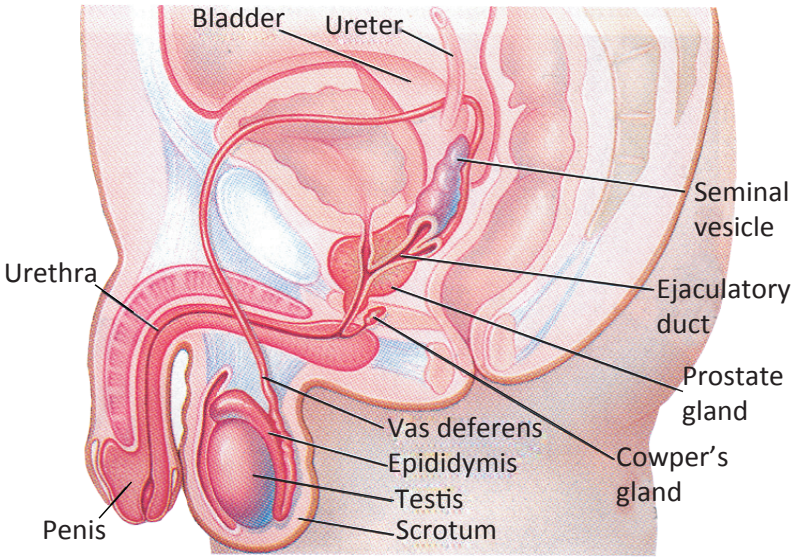


Figure 3.1: The male reproductive system

What are the functions of the male reproductive structures?

The human male reproductive system (Figure 3.1) consists of the testes and other sex organs like penis, scrotum, vas deferens, urethra, prostate glands, and Cowper's glands.

Did You Know?

Semen contains sperm cells and fluid secretions.

Between 2 and 5 ml semen are produced in a normal ejaculate.

- ***Testes:*** are two male reproductive glands made up of mass of tubules called seminiferous tubules. These tubules lined with germinal epithelium cells that produce sperm cells while they divide. In addition to sperm cells, testes produce the sex hormone, testosterone, at puberty to maintain secondary sexual characteristics. Testes are stimulated to produce sex hormones by follicle stimulating hormone coming from the pituitary gland.
- ***Penis:*** is an erectile cylindrical organ for sexual intercourse during which it ejaculates semen (sperm cells and fluid).
- ***Scrotum:*** a sac-like structure on the lower end of the penis. It ventilates the testes to have lower temperature than the other body parts that favours the maturation of sperm cells.
- ***Epididymis:*** is a coiled tubule situated at the outside surface of each testis. It stores sperm cells for maturation.
- ***Vas deferens or (sperm ducts):*** is a long tube extending from each epididymis to the urethra for transportation of sperm cells mixed with a fluid.
- ***Prostate glands:*** are small glands at the base of the urinary bladder that produce alkaline fluid for sperm cells' motility through the vagina.
- ***Cowper's gland:*** very small gland below the prostate. It secretes mucus to lubricate the end of penis and urethra.
- ***Seminal vesicles:*** are two small pouches behind the bladder. They expel stored nutrients during ejaculation that help sperm cells movement.
- ***Urethra:*** is a tube inside the penis to discharge sperm cells as semen during sexual intercourse, and also pass out urine during urination.
- ***Sperm:*** is a mass of male reproductive cells produced by the testis.
- ***Semen:*** is a mixture of sperm cells and a watery secretion of prostate glands and seminal vesicles.

Activity 3.2



Looking at the male reproductive system

You will require:

- ☑ a model or drawing of male reproductive system

Method

- ☑ identify the parts of the male reproductive system.
- ☑ label the parts and give their functions.

What are the female reproductive organs?

The human female reproductive system (Figure 3.2) is so complex when compared to the males. It consists of ovary and other structures such as vagina, uterus, fallopian tube, cervix, clitoris, and vulva.

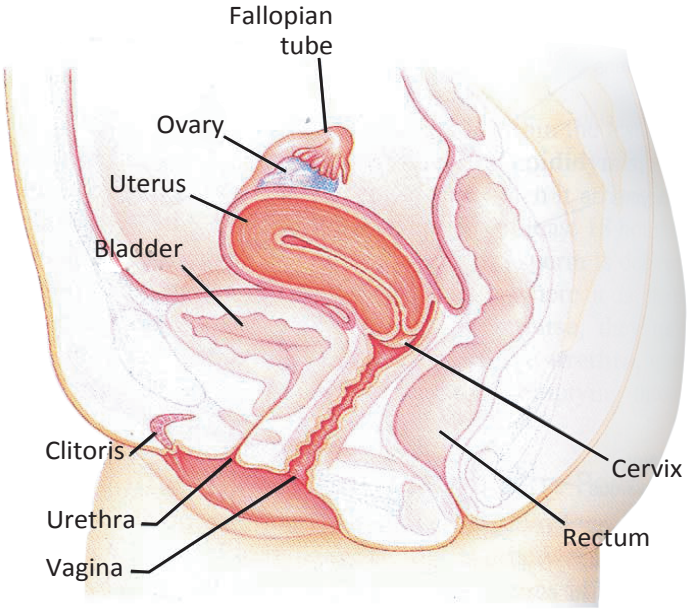


Figure 3.2: The female reproductive system

What are the functions of the female reproductive structures?

- ☑ ***Ovaries*:** are two female reproductive glands made up of follice cells, called graafian follicle to produce ova or egg cells. They also produce the sex hormones (estrogen and progesterone) at puberty for secondary sexual characteristics. The ovaries are stimulated to produce sex hormones by the folicle stimulating hormone (FSH) and luteinizing hormones (LH) secreted by pituitary gland.

- ☑ ***Vagina*:** is a muscular tube for intercourse and serves as birth canal.
- ☑ ***Fallopian tube (oviduct)*:** is a narrow tube from the ovary to uterus for movement of an egg cell or ovulation and fertilization. It is a site for fertilization.
- ☑ ***Uterus (womb)*:** is wide muscular tube for implantation of the fertilized egg and development of an embryo. It is a site for pregnancy.
- ☑ ***Cervix*:** is a ring of muscles at the lower end of the uterus. It opens at the time of menstruation and child birth.
- ☑ ***Clitoris*:** an erectile and sensitive tissue like a penis. It is found in the upper front part of the vagina.
- ☑ ***Vulva*:** is the external genital of the female reproductive system.

Activity 3.3



Looking at the female reproductive structures.

You will require:

- ☑ a model or drawing of the female reproductive system.
- ☑ identify parts of the female reproductive structures.
- ☑ label the parts and write their functions.

The Menstrual Cycle



What is menstrual cycle?

Menstrual cycle is a monthly cyclic change that normally takes place in a woman reproductive system. The cycle occurs normally unless the woman gets pregnant or reaches the stage of menopause (45-50 years of age). It takes place from the time of puberty to menopause. Generally this cycle involves the two processes, ovulation and menstruation. ***Ovulation:*** is the process of releasing an ova every month from ovaries of the female. This occurs after 14 days of the last menstruation.

Did You Know?

Sperm cells are produced throughout adult life of a man.

Menstruation: is the out flow of blood through the vagina.

What are the sequence of events during menstrual cycle?

The menstrual cycle occurs in three phases: namely, the menstrual phase, the proliferative phase, and the secretory phase.

What happens during the menstrual phase?

The **menstrual phase** is characterized by the breaking down of the wall of the uterus and the loss of blood through the vagina. It lasts 3 to 5 days.

Key Terms

- **Ejaculation** is expulsion of semen through the penis.
- **Hormones** are chemicals from ductless glands to coordinate body activities.
- **Sex hormones** are secreted from sex glands.
- **Ovulation** is movement of an egg cell from the ovary to fallopian tube.
- **Menstruation** is removal of unfertilized dead eggs with blood through the vagina.
- **Menopause** is the age when menstrual cycle stops and marks the end of giving birth.

What happens during the proliferative phase?

The **proliferative phase (follicular phase)** is mainly characterized by the release of egg from the ovary, which is ovulation. This usually happens after 9-10 days of the last days of menstruation. The process of ovulation induces a number of changes on the wall of the uterus and in the ovary as well. In the ovary, ovulation causes the release of estrogen hormone and changes in the uterus. In the uterus, the wall starts thickening and development of blood vessels.

What happens during secretory phase?

The **secretory phase (Luteal phase)** is characterized by what happens in the ovary and its consequences on the uterus wall. It happens from the 14^{th} to 28^{th} day of the beginning of menstruation day. The ovary releases a hormone known as progesterone which further thickens the wall of the uterus and reduces its movement. This makes the uterus to accept the fertilized egg. However, if the egg is not fertilized, the ovary stops producing estrogen and progesterone. At about the 28^{th} day the level of progesterone drops and the wall of the uterus starts breaking down and the menstrual phase begins.

The average length of the menstrual cycle is about 28 days. By convention the days of the cycle are counted from the beginning of the **menstruation** or the period of bleeding which usually lasts for 3 to 5 days. This is followed by the **critical period** (about 10 days), then by the **safe period** (about 14 days). The chance of **pregnancy is high** if there is sexual intercourse within the **critcal period** i.e. **(10 - 18)th** day of the beginning of menstruation. However, the chance of pregnancy is low in menstrual and safe periods. Therefore, limiting sexual intercourse to the safe period minimizes the chance of unwanted pregnancy.

Menstrual characteristics: in many women, various symptoms are shown by the combined effect of hormones and the contraction of uterus after menstruation. These symptoms may include significant menstrual pain, abdominal pain, emotional sensitivity, nausea and so on.

Activity 3.4



I. Preparing a simple diagram of menstrual cycle

- ☑ in groups, draw a simple diagram of the menstrual cycle.
- ☑ Discuss the major events during menstrual cycle.

II. Discussion on menstruation

- ☑ in groups, discuss that menstrual cycle is a natural process.
- ☑ discuss the personal hygiene needed by females and sanitation skills in using towels and other products.

Fertilization

What is fertilization?

Fertilization is the union of a male sex cell or sperm cell and a female sex cell or egg cell. Fertilization takes place in the fallopian tube if there is sexual intercourse just a few days before or after ovulation.

During fertilization, a single sperm cell fuses with the egg cell and penetrates its wall. Then it combines its nucleus with the nucleus of the egg cell. The fusion of the two nuclei forms a zygote. Then the fertilized ovum or zygote in the fallopian tube finds its way to the uterus for implantation. After fertilization, the ovary keeps on producing progesterone for the first 3-4 months of pregnancy. Later on, the placenta starts producing additional progesterone until the birth of the child to avoid overlapping of pregnancy.

Did You Know?

- ✶ A fertilized egg is implanted in the wall of the uterus after 9 days.

Key Terms

- ☑ **Fertilization** is the union of a sperm cell and an egg cell.
- ☑ **Zygote** is a one celled stage formed by the fusion of a sperm cell and egg cell nuclei.
- ☑ **Placenta** is a tissue that produces additional progesterone during pregnancy.

Birth Control Methods

What are birth control methods?

Birth control methods are methods used to prevent fertilization by avoiding the union of an egg cell and sperm cell.

Did You Know?

* During one ejaculation about 1.5 cm 3 of semen containing 300 million sperms, is released, of which of which one sperm cell fertilizes the egg.

Birth control methods are used to prevent unwanted pregnancy using various family planning methods. The process of avoiding conception (pregnancy) is called contraception. There are various methods of contraception. The most effective method of avoiding fertilization for youngsters, like you, is abstinence from sexual activity.

Pills and Condoms

Have you ever seen contraceptive pills?



Figure 3.3: Pills

Contraceptive Pills

Contraceptive pills are tablets, taken orally by a woman for 21 days between menstruation to avoid fertilization. These tablets contain progesterone that prevents ovulation. In the absence of ovulation the egg will not be produced and reach fallopian tube. So there is no chance of fertilization even if there is sexual intercourse.



Figure 3.4: Condom

Condom

Condom is a thin rubber tube used to collect and retain sperm cells not to enter the female reproductive system though there is sexual intercourse. diagram of condom.



Activity 3.5

I. Discussion on the birth control methods.

- ☑ in groups, discuss, cost, availability, and side effects of contraceptive pills and condoms.
- ☑ decide which one is the most reliable.

II. Discussion on the need for birth control methods and its role in family planning

- ☑ in groups, examine the role of birth control methods in family planning.
- ☑ present your findings to the class.

III. Discussing the problem of over population

- ☑ in groups, discuss the impacts of over population on the individual, country, and the world.
- ☑ present your summary to the class.

Reproductive Health



What is reproductive health?

Reproductive health is the physical, mental, and social health status of an individual related to reproductive system at all stages of life. Therefore, reproductive health is related to the health condition and maintenance of the reproductive system of an individual. It helps an individual to be able to have

- ☑ a responsible, satisfying and safe life
- ☑ the capability to reproduce, and
- ☑ the freedom to decide when and how often to reproduce.

Due to lack of knowledge, there are a number of reproductive health problems in our country. These problems mainly affect the reproductive health of women. The problems include female genital mutilation, early marriage, rape, illegal abortion and sexually transmitted infections.

Female Genital Mutilation (Fgm)



What is FGM?

FGM is known by different names like **female genital cutting** and **female circumcision**. It is a bad tradition, in which partial or total removal of the external female genitalia is practiced. It is practiced in many parts of the world, and most often in Africa. It is a harmful traditional practice which violates the right of girls and women.

Did You Know?

- ✶ The prevalence of female genital mutilation in Ethiopia is reported to be 62, 78 and 81% between ages of 15-19, 25-29 and 45-49, respectively.
- ✶ In Ethiopia, 19 % of girls were married by age 15.

In fact in many parts of the world, the practice of FGM is most commonly practiced at any age from infancy to adolescence, particularly at the ages of 4 to 8 years.

The procedure is done in most cases by individuals who had no medical training, without anesthesia, without sterilization and/or in the absence of proper medical instruments. Generally, the practice can possibly result in infection and/or death through shock from excessive bleeding or as a result of infections. It is generally linked to adverse health effects to women, especially during mating, pregnancy and childbirth.

Activity 3.6



Discussing the effects of FGM

- ☑ in groups, discuss the effects of FGM on the reproductive health of a woman and
- ☑ present your findings to the class

Early Marriage

How does early marriage affect the reproductive health of a girl?

Early marriage is marriage of children, mostly females, under 18 years of age which is practiced in some communities. This practice is commonly a forced marriage in many parts of the world, including Africa. It is also a widespread harmful traditional practice in Ethiopia. During this practice, many girls (and a smaller number of boys) are married without their free will or consent being under 18 years of age. By international conventions, age 18 has been established as the legal age of consent or agreement to marriage. However, what is practiced in the Ethiopian society shows that the median age of marriage is 16 years. Generally, it is considered as one of the violations of basic human rights for children.

The negative consequences of early marriage on women's and girls' reproductive health include maternal deaths, fistula, infections with HIV and the consequences thereof and other negative psychological and social problems.

Activity 3.7



Discussion on the effects of early marriage

- ☑ in groups, discuss the effect of early marriage on the reproductive health of girls.
- ☑ present your summary to the class.

Rape

What is rape?

***Rape*: is** a practice in which human beings, most commonly females, are forced, intimidated or deceived into the act of sexual intercourse. The act of rape is done without the will of the other partner. It is no more a secret that large number of children, men and women are raped daily. Rape and the fear of rape has significantly affected the lives of the victims. First, rape may affect the mental condition by causing depression and secondly may cause infections or physical damage.

Activity 3.8



Examining the effects of rape

- ☑ in groups, discuss on how rape affects reproductive health.
- ☑ forward your suggestions to the class

Illegal and Unsafe Abortions

What are the effects of illegal and unsafe abortions?

Illegal and unsafe abortions are procedures in which pregnant women terminate unwanted pregnancy. Unsafe abortion can be done either by persons lacking the necessary skills or the minimum medical standards or both. Generally, women around the world have been trying to terminate their unwanted pregnancies legally under proper medical care or illegally in unsafe conditions (lack of proper sanitation, facilities, know how, etc.). To the worst, women are sometimes involved in self-induced dangerous abortion practices. Illegal and unsafe abortions result in various infections including HIV; and physical damage to women. In some instances, they may cause death of the victim woman.

Activity 3.9



Examining the effects of illegal abortion

- ☑ in groups, discuss on the effects of unsafe abortions on a woman.
- ☑ forward your suggestions to the class.

Sexually Transmitted Infections (STIs)

What are STIs?

Sexually transmitted infections are infections due to adultery and prostitution; that is by having a number of sexual partners. These infections can be gonorrhea, syphilis, and chancroids which are commonly seen among youngsters. If STIs are not treated early they can cause serious reproductive health and other body problems.

Activity 3.10



Examining STIs

Method

- ☑ in groups, discuss STIs and their effects on reproductive health.
- ☑ present your summary to the class.

Table 3.2: Common sexually transmitted infections.

Disease and causative agent	Symptoms
Gonorrhea: Caused by the bacterium called *Nisseria gonorrhea*.	***Men:*** inflammation and discharge from the penis; pain while urinating. ***Women:*** inflammation of the vagina and urethritis; may be present without noticeable symptoms.
Syphilis: caused by the Bactrian treponema palladium	***First stage:*** appearance of a chancrae
	Second stage: appearance of a rash all over the body
	Tertiary stage: affects the heart and/or brain.

Activity 3.11



A project work on how to educate people against harmful traditional practices.

Method

- ☑ set your objectives.
- ☑ organize activities that you are going to do.
- ☑ decide methods of education: poster, public talk, drama.
- ☑ in groups design a project on how to educate the public about the negative effects of bad traditional practices.
- ☑ go to the library and refer to brochures/leaflets on reproductive health.
- ☑ How can you reduce the effects of harmful traditional practices?
- ☑ How can you educate the people against these practices?
- ☑ Suggest and forward your solutions

Key Terms

- ☑ **Female Genital Mutilation (FGM)** is a harmful practice of cutting the female external genitalia.
- ☑ **Early marriage** is a harmful practice of coupling before attaining sexual maturity.
- ☑ **Unsafe abortion** is a harmful practice of avoiding pregnancy.
- ☑ **Sexually Transmtited Infections (STIs)** are infections transmitted by multiple sexual partner.
- ☑ **Rape** is a harmful practice of sexual intercourse without the will of the other partner.
- ☑ **Fistula** is a rupture and pus discharge that commonly occurs in the rectum and urinary structures due to an injury or disease. It can result in mixing of the two structures following chronic abscess with an infected open tube.

Therefore, when we come to young citizens like you, reproductive health is very essential to enable you decide responsibly.

- ☑ When to have a partner?
- ☑ How to choose a partner?
- ☑ Why to have a partner?

In order to achieve these, you must develop the habit of free discussion with parents, teachers and peer group on the structures and functions of the reproductive system; and the skills in keeping your reproductive structures healthy. Besides, you must protect yourself and others from harmful traditional practices that affect the health of reproductive organs.

Exercise 3.1

Choose the best answers for each of the following questions

1 Primary sexual characteristics of males do not include the presence of
A Testes B Scrotum C Penis D Sperm cells

2 Secondary sexual characteristics of females do not include the presence of
A breast enlargement
B voice deepening
C ovum production
D Pubic hair

3 Which parts of the male and female reproductive system are equivalent?
A Testes and ovaries
B Penis and cervix
C Vas deferens and uterus
D Urethra and clitoris

4 Which of the following parts of reproductive structure are concerned with sex cells' transport?
A Vagina and epididymis
B Fallopian tube and vas deferens
C Uterus and urethra
D All of the above

5 Menstrual cycle involves the processes of
A Ovulation
B Menstruation
C Ejaculation
D A and B

6 In humans, menstrual cycle normally takes place:
A in all adult females
B every 28 days
C during pregnancy
D during menopause

7 During fertilization,
A zygote is formed
B embryo is formed
C egg cell disintegrates
D all of the above.

8 All birth control methods are
A equally efficient to prevent fertilization
B used to kill sperm cell
C designed to prevent unwanted pregnancy
D without side effects.

9 The factor for reproductive health problem that involves cutting female genitals is:
A FGM
B STI
C Rape
D Illegal abortion

10 Reproductive health is essential for youngs to decide the right time for :
A marriage
B giving birth
C having a partner
D all of the above

3.2 HIV /AIDS

By the end of this section, you will be able to:

- show the local, national and global distribution of HIV/AIDS, explain its impacts in the society and express willingness to give care and support to PLWHA;
- demonstrate assertiveness, decision making, and problem solving skills to prevent HIV.

Distribution Of Hiv /Aids (Local, National And Global Levels)

What is HIV?

HIV (Human Immunodeficiency Virus) is the virus that causes the disease AIDS or Acquired Immune Deficiency Syndrome. AIDS is mainly transmitted by sexual intercourse. So far, for this disease, caused by HIV and that damages the immune system, there is no cure or vaccine. The **incidence** of AIDS has increased in epidemic proportions in the last decades. Basically, the high-risk groups include homosexual men, intravenous drug users, sex workers, and hemophiliacs; as well as the sexual partners of persons in these groups.

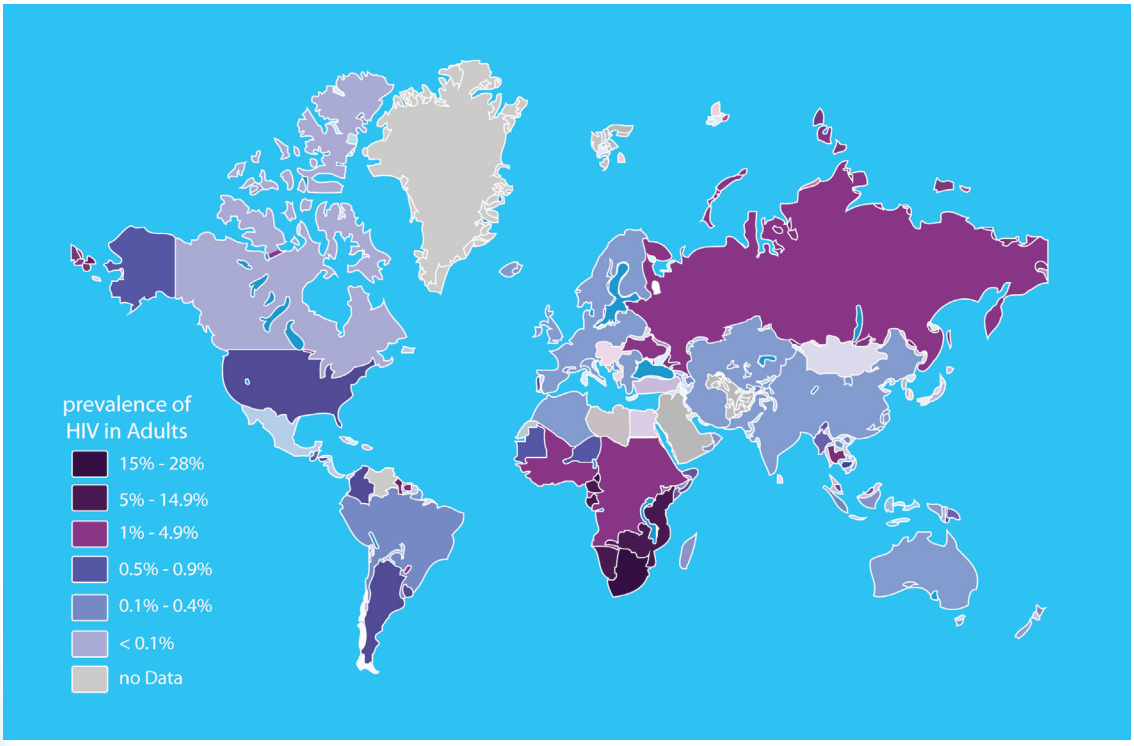


Figure 3.5: Map of global distribution of HIV/AIDS (2010)

How is HIV transmitted?

Infection with HIV occurs by the transfer of blood, semen, vaginal fluid, pre ejaculate fluid, or breast-milk. These are body fluids in which both free HIV particles and virus infected immune cells are present quite in good numbers. The four major routes of transmission are:

- ☑ unsafe sex,
- ☑ contaminated needles,
- ☑ breast-milk, and
- ☑ transmission from an infected mother to her baby at birth.

Table 3.3: People with HIV/AIDS in different regions of the world(UNAIDS,WHO & UNICEF Nov. 2011)

Region	Percent infected	Numbers
Oceania	1	59 000
North America	4	1 400 000
Caribbean and Latin America	6	2 240 000
Western and Central Europe	2.5	850 000
Middle East and North Africa	1	310 000
Sub-Saharan Africa	67	22 000 000
Eastern Europe and Central Asia	4.5	1 500 000
East, south and South-East Asia	14	4 650 000

Table 3.4: Prevalence of HIV/AIDS in Ethiopia(UNAIDS, WHO & UNICEF Nov. 2011)

HIV/AIDS	Number in millions
Prevalence in adults of 15 - 49 years	4.4
Women living with HIV of 15-49 years	0.77
Children living with HIV	0.23
Children orphaned by HIV and AIDS	0.23

Activity 3.12



Asking the regional prevalence of HIV/AIDS

- ☑ In groups, go to the nearly health center and ask about the prevalence of HIV/AIDS in your area or region.
- ☑ Then present your findings to class mate.

Impacts Of Hiv And Aids On Society

What are the effects of HIV/AIDS on society?

HIV/AIDS epidemic is causing serious illness, and premature deaths among the young and productive ages of society. It has devastated countless families and communities. In developing countries like ours, it has seriously affected the nation's efforts to fight poverty, improve food security and health care effects.

Key Terms

- **HIV:** a virus that causes AIDS.
- **AIDS:** a disease of that destroys body's defense system.
- **High risk groups:** groups of highly venerable to HIV/ AIDS.
- **Route of transmission:** means or ways of transmission of diseases.

Generally, HIV/ AIDS reduces productivity by reducing a person's ability to work, reduces incomes and the ability to support one's family because of extra expenses for treatments. Moreover, it may end up with family separation including orphanage and widows. This can increase the risk of women to HIV/AIDS infections.

It disrupts socioeconomic orders (more orphans, widows, etc.) and gender disparities, by increasing the risk of women to HIV and AIDS infections.

It also strains the resources of communities by diverting its efforts to fighting the epidemics rather than concentrating on development.

Activity 3.13



Discussion on the impact of HIV and AIDS

- in groups, discuss the impacts of HIV/ AIDS on a person, a person's family and the country.
- present your summary to the class.

Care And Support To People Living With Hiv/Aids

People living with HIV/AIDS (PLWHA) are found to be living without the knowledge of their health status or medical care. If such people have access to information, treatment, care and support within their own communities, they can live healthy and productive life. This will be good as it initiates others to be tested for HIV after counseling. So, giving care and support for PLWHA and their families is helpful for safety of others and ourselves. When care and support is based on our own willingness and concern, the effect gives us strength for better achievement. As a result, better care and support improves the quality of life of PLWHA, their families and communities. Moreover, care and support is also important to help efforts to prevent the spread of HIV/AIDS.

Activity 3.14



Examining institutions working on PLWHA .

- ☑ in groups, find out if there are government and non-government institutions working on care and support to PLWHA.
- ☑ If there are, arrange a visit to learn more about what they do.
- ☑ report to the class the services rendered by these institutions.

Life Skills

Life skills provide you with skills such as self assertiveness, decision making and problem solving. You can use these skills to translate information about HIV/AIDS into protective behaviors.

It is essential to be assertive in describing your ideas, plans and stands in a polite and convincing ways to others. At the same time, making decision about sex or marriage involves negotiation skills. Above all solving problems wisely to identify and handle uncomfortable situations like unprotected dating conditions or sex; is important for one's life.

You can develop and practice life skills when you participate in school clubs and community based activities. Remember! The main goal of youth oriented HIV/AIDS prevention is to inform youngsters about HIV/AIDS. This enables the use to develop skills like the ability to analyze situations and behaviors and their possible effects before making decisions. It also enables them to have skills to refuse or avoid risky behavior.

Activity 3.15



Practicing life skills (assertiveness and decision making).

Work in a groups to discus the following case study.

Abay has been upset with Mohammed. When she see him, she says "Mohammed I need to talk to you right now". Could we talk where no one is around? Moving to another room, Abay sits straight with her hands on the table and looks Mohammed in the eye. She says in a calm but firm voice, "I have thought your suggestion for our date" but I feel uncomfortable about it. I think we need more time to be close friends before being alone, but I am not ready for that yet. "Is that ok with you?"

Discuss the point below

- ☑ Was Abays's behavior assertive?
- ☑ If you say yes, why?
- ☑ What were her decision making words?

Activity 3.16



Plan two role plays to the following situation.

Awash has been in the hospital for the last month but he wants to go home. His family members think that he should stay in the hospital as they do not have time and do not know how to take care of him. Awash is becoming hopeless and restless.

Act out the situation to show how you can support "Awash" to be tested for HIV. Also act out the situation as if Awash is positive after he made HIV test. Then suggest and debate on the ways to solve the problems of Awash. Try to make the right decision as much as you can.

Act the role plays in front of your classmates. Allow others to forward suggestion.

Exercise 3.2

Choose the best answers for the following questions.

1 HIV can be transmitted by:

A sexual intercourse
B mosquito bite
C sleeping together
D kissing

2 Which group of people are at high risk of HIV / AIDS?

A Drug users
B Homosexuals
C Prostitutes
D All of the above

3 Which part of the globe has high HIV/AIDS prevalence?

A Central Europe
B North America
C Sub-Saharan Africa
D Middle East

4 Which age group is the most vulnerable to HIV?

A Olders
B Youngs
C Children
D Babies

5 HIV /AIDS affect a person's family by causing:

A income reduction
B children drop out from school
C family separation
D All of the above

6 You can help PLWHA by showing them:

A discrimination
B disregard
C no respect
D willingness to help

7 The best way to prevent yourself from HIV is
- A using condoms
- B abstinence from sex
- C avoiding peer
- D marriage

8 Life skill is essential for you:-
- A to be self-assertive
- B to be influenced by friends
- C to maximize risk in life situation
- D to be able create problems

9 HIV/AIDS
- A is curable
- B affects only youngs
- C is treatable
- D affects only adults.

10 Practicing like skill is helpful for you in:-
- A decision making
- B self assertiveness
- C problem solving
- D all of the above



Unit Summary

- Primary sexual characteristics are features that can be seen soon after birth.
- Primary sexual characteristics in males include the presence of the penis, scrotum, and testes.
- Primary sexual characteristics in females include the reproductive organs vagina, uterus, fallopian tube and ovaries.
- Secondary sexual characteristics are features that appear during puberty age, and make males and females more distinct.
- Secondary sexual characteristics in males include deepening of voice, appearance of pubic hair and beard, and production of sperm cells.
- Secondary sexual characteristics in females include enlargement of breast, appearance of pubic hair, widening of hip, appearance of menstrual cycle and production of egg cells.
- The male reproductive system consists of testes or male gonads that produce sperm and sex hormone.
- Scrotum is a sac-like structure to enclose the testes.
- Epididymis are tubules on testes to store sperm cells.
- Vas deferens is a long tube to transport semen during ejaculation.
- Urethra is a tube in the penis to discharge semen or urine.
- The female reproductive system includes ovaries or female gonads that produce egg cells and sex hormones.
- Fallopian tubes or oviducts are tubes that pass egg cells through for fertilization.
- Uterus or womb is a wide muscular tube to implant and develop the fertilzed egg. It is for pregnancy.
- Cervix is an opening at the lower side of the uterus.
- The menstrual cycle is a regular and normal cycle in a woman's reproductive system involving ovulation and menstruation.
- Ovulation is movement of an egg cell from the ovary to the oviduct.
- Menstruation is the removal of unfertilized dead egg with blood through the vagina.

- Mensuration occurs when the blood vessels on the uterine wall break due to low progesterone.
- Ovulation occurs half way between two menstruation and vice versa.
- Menstruation normally occurs unless there is pregnancy or menopause.
- Fertilization is the the union of sperm and egg cell nuclei to form zygote.
- Fertilization normally occurs in the fallopian tube when there is sexual intercourse within a few days of ovulation.
- Birth control methods or contraceptives are ways of preventing fertilization. Birth control methods are achieved by natural or artificial ways. The natural ones are coitus interrupts and rhythm methods. The artificial ones can be the physical barriers (condom, diaphragm, IUD and sterilization), the chemical barriers (pills, foam and nor plant)
- Birth control methods are needed for family planning to limit the number of children within a family, individuals living in a country and the world.
- Practising birth control methods is essential to avoid the problems of food, shelter and resources to the ever increasing human population.
- Reproductive health is a condition by which people have a responsible, satisfying and safe life, capability to reproduce, freedom to decide when and how often to reproduce.
- Reproductive health of a woman can be affected by the harmful traditional practices such as FGM, STIs, early marriage, illegal abortion and rape.
- These harmful practices can be prevented by educating people and creating awareness about the impacts of the factors, and develop skills against these practices.
- HIV/AIDS is widely distributed all over the world.
- HIV/AIDS shows a high prevalence in the developing world specially in Sub-Saharan African countries where Ethiopia is located.
- HIV/AIDS affects the livelihood of a person, a victim's family, and the country.
- As part of the community every one is expected to care and support PLWHA in reducing the impacts of HIV/AIDS.
- Life skills are so essential to prevent HIV/AIDS and also solve other problems in real life situation.



Review Excises for Unit 3

Part I: ***Choose the best answers for the following questions.***

1 One of the following is true concerning secondary sexual characteristics?

A Appear during childhood
B Begin at puberty age
C Similar in males and females
D begin at old age

2 As penis is an erectile tissue in males,_____is erectile in females.

A Uterus
B Cervix
C Clitoris
D Oviduct

3 The part of the male reproductive system that stores sperm cells is

A epididymis
B scotrum
C penis
D urethra

4 The part of the female reproductive system found at lower end of the uterus is

A vagina C cervix

B oviduct D ovary

5 Menstrual cycle occurs during

A menopause C old age

B pregnancy D Puberty

6 Fertilization most likely occurs if there is sexual intercourse

A during menstruation C any time

B during ovulution D A and B

7 A birth control method that is done with surgery is:-

A IUD C sterilization

B diaphram D abstinence

8 A bad traditinal practice of having many sexual partners can cause:-

A rape C abortion

B STI D FGM

9 Currently, HIV/AIDS is an issue of

A the globe C poor countries

B a family D the victims

10 Life skills are needed for :-

A youngs C babies

B adults D A and B

PART II: *Match items in column A with items in column B*

Column A		Column B	
11	Sperm cells	A	a contraceptive rubber bag
12	Egg cells	B	need care and support
13	Prostate glands	C	female circumcision
14	Cowper's gland	D	alkalinesolution production
15	Pills	E	male gametes
16	An example of FGM	F	assertiveness
17	Condom	G	gonorrhea
18	An example of STI	H	contraceptive tablets
19	Life skill	I	lubricant production
20	PLWHA	J	female gametes

Part III: *Fill in the blanks with the appropriate terms*

21 An enforced act for sexual intercourse is known as_____.

22 Normally ovulation occurs on the _____day of the beginning of menstruation.

23 Population growth of a country can be controlled by practicing_____methods.

24 The prevalence of HIV/AIDS can be reduced by helping_____

25 Practicing life_____help you to keep yourself from HIV.

Part IV: *Give short answers for the following questions.*

26 Why do secondary sexual characteristics bring about changes?

27 What do you suspect if menstruation stops in a young woman?

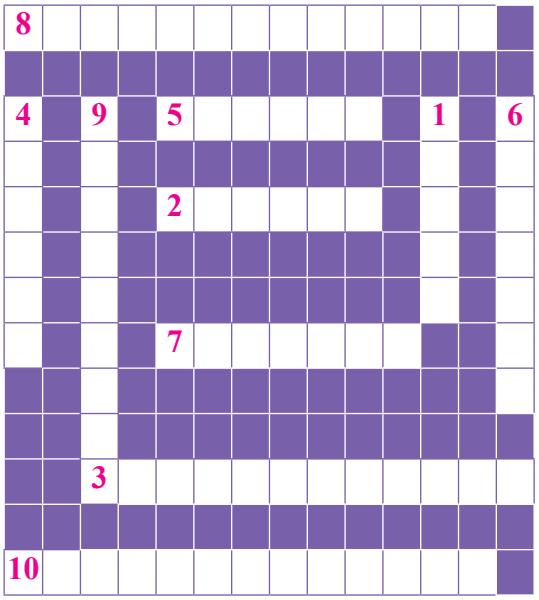
28 What is the use of contraceptives for couples?

29 Who are the most affected age group by HIV/AIDS?

30 How can you develop your life skills?

Part V: *Copy the crossword puzzle and use the numbered clues to complete and solve the puzzle.*

The numbers in bracket indicates the number of letters in each word to be inserted in a box



Across

2 A muscular tube for embryonic development (6)

3 A long tube to transport semen (12)

5 A muscular opening at the lower side of the uterus (6)

7 A sac-like structure that contains the testes (7)

8 A tube to transport egg for fertilization (13)

10 Produces alkaline fluid for sperm motility (13)

Down ward

1 Ejaculation of semen into the vagina (5)

4 Produces sperm cells and sex hormone (6)

6 Produces egg and sex hormone (6)

9 An erectile tissue at the upper front of the vagina (8)

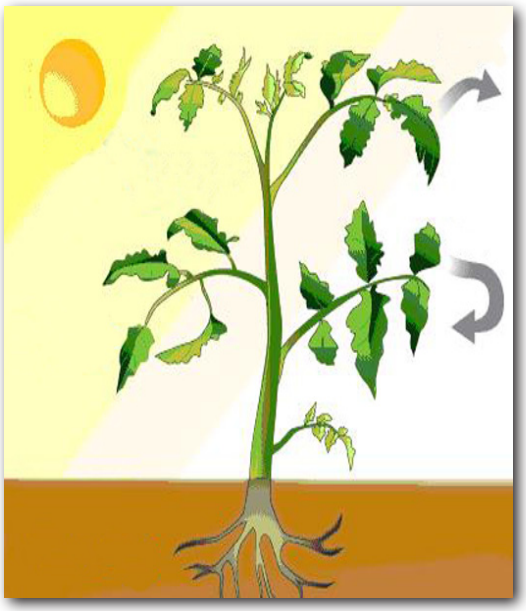
Unit 4

PLANTS

Unit Outcomes

By the end of this unit, you will be able to:

- *define photosynthesis, explain its light and dark phases and give a summary equation of photosynthesis;*
- *conduct a simple experiment to confirm that plants produce food by photosynthesis;*
- *demonstrate the steps followed in growing trees and in caring for them as they grow;*
- *explain the advantages of indigenous trees over exotic trees and show willingness to participate in tree growing projects.*



Main Contents

4.1 Food Manufacturing in Green Plants

4.2 Growing Trees

- Unit Review

Introduction

The sun gives light to Earth. Plant cells use light energy to help them make food by *photosynthesis*. *Photosynthesis* is the process of food making using *sunlight energy*, *water*, *carbon dioxide* and *chlorophyll*. This process occurs in plants, algae and some bacteria. During *photosynthesis* these organisms produce their own food in the form of simple sugars (carbohydrates).

Word Roots and Origins

Photosynthesis: From two Greek words photo means light and synthesis means putting together or composition.

Photosynthesis is a metabolic process in which food is produced by plants and other photosynthetic organisms. All life forms depend on photosynthesis as a source of energy. The basic difference between *plants* and *animals* is that plants make their own food, whereas *animals* do not. In *plants* it is primarily done in *leaves*, particularly in the *mesophyll tissue*, where *chloroplasts* are found in large number.

Did You Know?

* Photosynthesis is the master chemical reaction on Earth through which light energy is converted by green pigment, chlorophyll, into chemical bonds of food substances (sugars).

Plants use atmospheric *carbon dioxide* and release oxygen during the process of *photosynthesis* (Figure 4.1). They are very important group of organisms that are involved in balancing between the levels of *carbon dioxide* and *oxygen* in *our environment*. *Plants* in the form of trees also provide *shade*, *shelter*, *wooden materials*, *food sources* for animals, and *beautify* the environment. Hence, it is necessary to grow trees in our surroundings (Figure 4.2). It is important to consider the stages of growing trees and selection of the appropriate types while planning to grow trees in a given locality. In addition to growing the right types of trees, it is equally necessary to give care until they properly establish themselves in the soil.

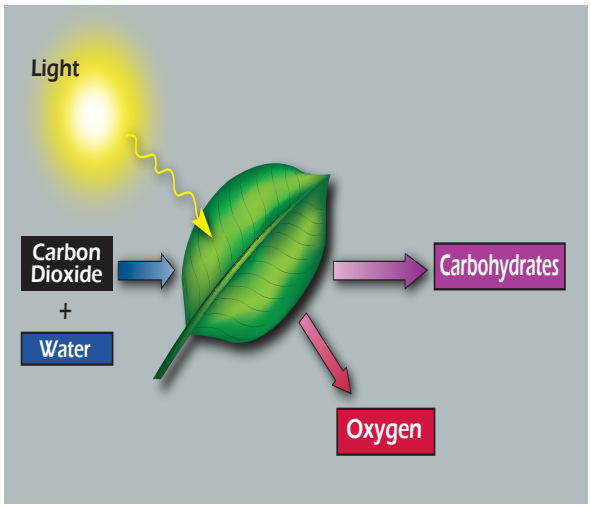


Figure 4.1: Summary of photosynthesis



Figure 4.2: Students planting tree

In this unit, you will start studying the process of photosynthesis. You will be able to describe how plants convert sunlight energy into organic molecules, sugars. You will also evaluate the importance of tree growing in your locality, and moreover start participating in tree growing projects in your surroundings.

Key Terms

- ☑ **Photosynthesis:** the process by which green plants use sunlight to synthesize sugars from carbon dioxide and water.
- ☑ **Photosynthetic organisms:** organisms that have the ability to carry out the process of photosynthesis, like plants.
- ☑ **Tree:** a woody perennial plant typically with a single stem growing to a considerable height and bearing lateral branches.

4.1 FOOD MANUFACTURING IN GREEN PLANTS

By the end of this section, you will be able to:

- Define photosynthesis as the production of food by leaves using sunlight, water and chlorophyll;
- Give a summary equation of photosynthesis;
- Explain the major events in the process of photosynthesis;
- Confirm that plants produce food by photosynthesis by conducting a simple experiment.

Key Terms

- ☑ **Chloroplast:** sub-cellular structures found in cells and where chlorophyll pigments are located in and are organized.
- ☑ **Chlorophyll:** a green pigment which is responsible for the absorption of light by plants to provide energy for photosynthesis.

What is photosynthesis?

Photosynthesis is a cellular process during which light energy is absorbed by green pigments, *chlorophyll* and used for making *organic compounds* (sugar molecules).

Did You Know?

* A very small proportion of sunlight energy is trapped and transformed by the chlorophyll of plants and algae during the processes of photosynthesis.

How is the reaction of photosynthesis summarized?

The chemical reaction during which inorganic compounds (carbondioxide and water), are converted into high *energy, organic compounds* by *plant cells using light energy* and the release of oxygen can be summarized as in Figure 4.3.

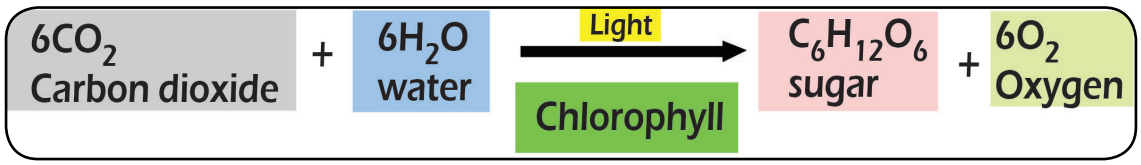


Figure 4.3: Summary equation for photosynthesis

Is sunlight necessary for the process of photosynthesis?

Plant cells have *chloroplasts* that contain *chlorophyll pigments*. The pigment absorbs sunlight and converts carbon dioxide and water into sugar molecules.

Photosynthesis takes place primarily in plant leaves, in the green part of the plant. The parts of a typical *leaf* include the **upper and lower** *epidermis*, the *mesophyll*, the **vascular bundle(s)** (*veins*), and the *stomata*. The *upper* and *lower epidermal cells* do not have *chloroplasts*, thus *photosynthesis* does not occur there (Figure 4.4). They serve primarily as protection for the *leaf*. The *stomata* are openings that are commonly found in the *lower epidermis* and are used for gas exchange: they let CO_2 in and O_2 out. The *vascular bundles* or *veins* in a *leaf* are part of a plant's transportation system, moving water and nutrients through plant body. The *mesophyll cells* have *chloroplasts* and this is where *photosynthesis* occurs.

Did You Know?

* The O2 we breath in comes as a byproduct of photosynthesis from H2O molecules.

Key Terms

- **Mesophyll:** tissue in the internal part of the leaf that contain large number of chloroplasts.
- **Stomata:** minute pores in the epidermis of the leaf and allow gas in and out.

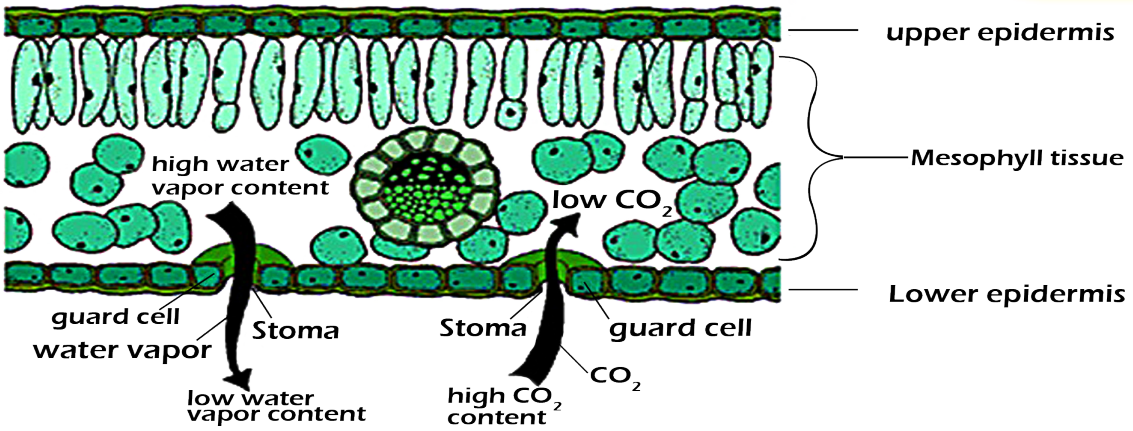


Figure 4.4: The internal parts of leaf.



Activity 4.1

Testing for starch in green leaves from plants kept in the dark

Matarials you will require:

- ☑ Boxes (which do not allow the entrance of light)
- ☑ Plants (beans) growing in pots
- ☑ Bunsen burner/sprit lamp/heat source
- ☑ Ethanol
- ☑ Beakers
- ☑ Water
- ☑ Iodine solution
- ☑ Forceps
- ☑ Shallow dish/petridish

Procedures:

1. In groups, keep growing bean plants in four pots for about two weeks.
2. After two weeks transfer two of the plants growing in pots to a complete darkness in box/boxes and leave the other two bean plants growing in a pot exposed to sunlight. Keep them for a week.
3. After a week remove leaves from the plants and boil them in water for a few (five) minutes. (Do not forget to properly label them as 'grown in complete darkness/ exposed to light'.)
4. Transfer the leaves into ethanol and heat them in a water bath for a few minutes.
5. Wash the leaves in cold water and stretch them on shallow dish.

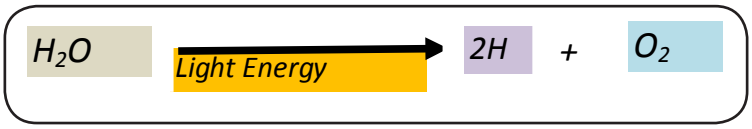
6 Add drops of iodine solution to the leaves (cover it completely).

7 A blue-black colour indicates the presence of starch.

- ☑ Which of the leaves turned blue-black?
- ☑ What do you conclude from this experiment?

How is glucose formed during photosynthesis?

During *photosynthesis,* CO_2 from the atmosphere is used to make the *organic molecule* of the cell in the form of *glucose.* Part of the light energy absorbed by *chlorophyll pigments* splits H_2O molecules. The light energy is used to generate energy that powers the conversion of CO_2 into *glucose* in the *chloroplast*. The splitting of H_2O molecules results in the formation of O_2 as a byproduct in the process (see the equation below).



The *glucose* formed in the *leaf cells* is temporarily stored there in the form of *starch*. Then after, the starch is converted into glucose and transported to different parts of the plant and stored in the form of insoluble sugar, *starch*.

Key Terms

- ☑ **Glucose:** simple sugar which is formed during the process of photosynthesis, and the main energy source in living organisms.
- ☑ **Starch:** an insoluble complex sugar, and the form in which plants store their foods.

Activity 4.2



Discussion on why plants store glucose in the form of starch

- ☑ Discuss in groups why plants store their photosynthetic products in the form of starch rather than in the form of glucose.

Did You Know?

* The mass of the plant (think of a huge plant) is made up of organic compounds, which is formed from carbon of atmospheric CO_2.

How do you confirm the occurrence of photosynthesis?

During *photosynthesis*, *glucose* formed in the *leaf cells* is temporarily stored in the form of *starch*. As a result, the presence of starch indicates that the process of photosynthesis has taken place in *leaf cells*. The process of *photosynthesis* requires the energy from *sunlight* and *chlorophyll* pigments. Therefore, starch cannot be formed by *leaf cells* if a plant is kept in *complete darkness* for more that 48 hours.

Do all parts of variegated leaves carry out photosynthesis?

Generally, the *green pigments* are distributed uniformly in leaves. A *variegated leaf* is a leaf with partial green and some non-green parts. Thus, in *variegated leaf* the green pigment is reduced or lacking altogether in certain parts of the leaf, as indicated by the yellow colour (Figure 4.5). The non-green parts of *variegated leaves* is associated with failure of the parts to carry out *photosynthesis*. *Variegated leaves* generally do not survive in the wild due to this pigment deficiency and inability to carry out enough *photosynthesis*.

Key Terms

- **Variegated leaf:** a leaf that has reduced or lack completely the green pigment in some of its parts.

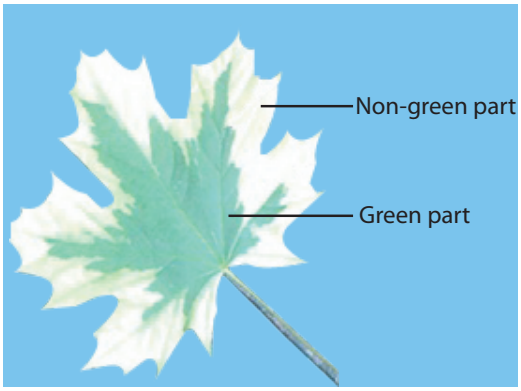


Figure 4.5: A Variegated leaf



Activity 4.3

Testing for starch in variegated leaves

Materials you require:

- Variegated leaves
- Bunsen burner/spirit lamp/heat source
- Ethanol
- Beakers
- Water
- Iodine solution
- Forceps
- Shallow dish/petridish

Procdure

1. In groups, obtain variegated leaves from plants of your school compound.
2. Place the variegated leaves in boiling water for a few (five) minutes.
3. Transfer the leaves into ethanol and heat them in a water bath for a few minutes.
4. Wash the leaves in cold water and stretch them on shallow dish.
5. Add drops of iodine solution to the leaves (cover it completely).
6. A blue-black colour indicates the presence of starch.
   - ☑ Which part of the leaves turned blue-black?
   - ☑ What do you conclude from this experiment?

Is oxygen a byproduct of photosynthesis?

During the process of *photosynthesis*, H_2O and CO_2 are used as raw materials to form carbohydrate ($C_6H_{12}O_6$, glucose) and O_2 as products. The production of O_2 during the process of plant *photosynthesis* can be studied using a pondweed, *Elodea* (or water plant, Figure 4.6) . The rate of *photosynthesis* in *Elodea* can be indirectly measured by observing the amount of O_2 bubbles given off by the leaves. As the *rate of photosynthesis* increases, so does the rate of bubbles given off and conversely, a decreased rate will produce less bubbles.



Figure 4.6: Elodea

Key Terms

- ☑ **Elodea:** a pondweed.
- ☑ **Rate of photosynthesis:** the extent at which the process of photosynthesis is done.

Activity 4.4



Testing for the formation of oxygen during photosynthesis using pondweed, *Elodea (or any small water plant)*

Materials you require:

- ☑ Two beakers
- ☑ Water
- ☑ Sodium bicarbonate
- ☑ Two funnels
- ☑ Pondweed (Elodea) or water plants
- ☑ Two measuring cylinders

Procedure:

1. Add water into a beaker.
2. Place small amount of sodium bicarbonate, which serves as a source of carbon dioxide into water in a beaker.
3. Put the pondweed in the beaker.
4. Cover the weed with an inverted funnel, which is rested on a support (two small rectangular plastic rods can be used) (Figure 4.7), to keep the funnel away from the bottom of the beaker.
5. Fill a test tube to the brim with water, place your thumb over the mouth of the test tube and invert the tube. Place the mouth of the test tube under the water surface in the beaker and then remove your thumb, make sure that little or no air enters the tube during this operation.
6. Move the test tube over the funnel stem and lower it gently to rest on the funnel as shown in Figure 4.7.
7. Place the apparatus in a position where it can receive maximum sunlight.
8. Leave the apparatus until the test tube is half full with gas.
9. Carefully lift the test tube from the funnel and place your thumb over the open end before taking it out of the water.
10. Remove the test tube from the water and invert it keeping the thumb in place so that no gas escapes.
11. Remove your thumb from the test tube and quickly insert a glowing splint into the gas in the tube.
    - ☑ Observe what happens? What gas causes this?

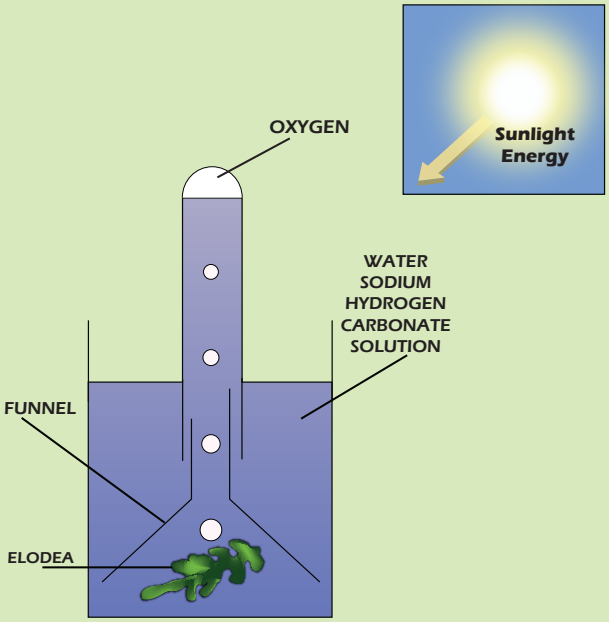


Figure 4.7: Collecting oxygen released by Elodea during photosynthesis

Does the intensity of light affect the rate of photosynthesis?

The *rate of photosynthesis* can be affected by different factors like the raw materials (H_2O, CO_2), light, temperature, minerals, and *photosynthetic pigments*. Generally, light is an important source of energy for *photosynthesis*. Regarding light, not only its presence or absence; but the amount of light (intensity) that falls on the leaves affect the *rate of photosynthesis*.

Key Terms

- **Intensity of light:** the amount of light that falls on the surface of the leaf. It is one of the factors that affect the rate of photosynthesis.

Activity 4.5



Analyzing the effect of light intensity on rate of photosynthesis

Experiments similar to activity 4.4 were conducted with 100 and 40 watt light bulbs as sources of light. The test tubes used in these experiments were clear. The distances of the light bulbs were 10cm and 20cm away from the test tubes. Then the oxygen bubbles made by the Elodea were counted for 4 minutes and 10 minutes. In which set up do you expect small number of oxygen bubble to be

given off and in which one do you expect large number? What is the reason for these results? Can you explain the effect of the distance from light source and the effect of measuring time on the result of these experiments? In groups analyze the results using the following table and present your analysis to the class.

Experiment No	Size of bulb	Distance	Oxygen bubbles per time	Oxygen bubbles per minute
1	100w	10cm	39 bubbles/10min.	3.9 bubbles/min.
	100w	20cm	24 bubbles/10min.	2.4 bubbles/min.
2	100w	10cm	20 bubbles/4min.	5 bubbles/min
	40w	10cm	6 bubbles/4min.	1.5 bubbles/min.
3	100w	20cm	80 bubbles/4min.	20 bubbles/min
	40w	20cm	46 bubbles/4min.	11.5 bubbles/min.

Exercise 4.1

Choose the answer from the alternatives given for the following questions.

1 Photosynthesis is a process:

A Done by some plants and algae

B Done by few plants

C Done by all plants

D That can be done in the absence of light

2 One of the following is a raw material for photosynthesis

A O_2

B H_2O

C Sunlight

D Chlorophyll

3 One of the following is the immediate product of photosynthesis

A CO_2

B Starch

C Glucose

D Protein

4 Variegated leaves are leaves:

A That contain chlorophyll all over their parts

B With less number of stomata

C With reduced amount of chlorophyll in some of their parts

D That can not carry out photosynthesis at all

5 Sunlight is:

A Raw material for photosynthesis

B An energy used to power the process of photosynthesis

C a product of photosynthesis

D None of the above

4.2 Growing Trees

By the end of this section, you will be able to;

- demonstrate the steps followed in growing trees;
- demonstrate the steps followed in caring for trees as they grow;
- show willingness to participate in tree growing projects;
- explain the advantages of indigenous trees over exotic trees.

What is a tree?

Prior to *tree planting* it is useful to be familiar with what a *tree* is. A *tree* is defined as a *large*, *perennial*, *woody plant*. Even if it is difficult to set minimum size, the term *tree* generally refers to plants at least 6 m high at maturity and, with branches supported on a single main *stem* or trunk. Compared with most other plant forms, *trees* are long-lived.

Trees are important part of the *natural landscape* of a country and significant in *landscaping* and *agriculture*, *shade* (Figure 4.8a), *fence* (Figure 4.8b), *timber*, *fire wood*, supplying fruit crops (such as apples), etc.

Key Terms

- **Tree:** a woody perennial plant commonly with a single stem or trunk growing above 6 m.
- **Trunk:** the main woody stem of a tree as distinct from its branches.
- **Twig:** a slender woody shoot growing from a branch or stem of a tree or shrub.
- **Wood:** the hard fibrous material forming the main substance of the trunk or branches of a tree.
- **Perennial:** a plant living for several years.
- **Landscaping:** enhancing the appearance of an area of land by planting trees.



a. Shade



b. Fence

Figure 4.8: Some uses of trees

Steps of Growing Trees

How are trees grown from seeds?

It is possible to *grow trees* either from *seeds* or *seedlings*. The important point to be considered while developing *seedlings* is to take into

Did You Know?

* The ground nutrients are essential for the growth of a tree, but the majority of its biomass comes from carbon dioxide absorbed from the atmosphere (see photosynthesis).

consideration that different types of *seeds* have different requirements. In general there are steps that you need to follow up while *growing trees* starting from *seeds*. In addition to identifying the purpose of *tree planting*, *selecting* the type of tree to be planted and choosing the *site of tree planting*; and some more steps are required in tree growing project. The steps are summarized as follows.

1 In groups, obtain seeds of trees (preferably of indigenous trees).

2 Fill the pot/plastic bags to 0.5 cm of the rim with soil and moisten it.

3 Carefully distribute your seeds into the small holes made in the soil; be careful not to crowd them.

4 Cover them with plastic bags or put them in a shade (Figure 4.9). Never allow the soil to dry out completely.

5 Place your pots/bags in a warm area where they can get good light but not direct sun. Germination can take anytime from a few days to several months, depending on the type of seed you are growing.

6 Remove the cover when seeds start germinating and *gradually* move them into brighter light or full sun. At this moment the seedlings will be quite soft, so a radical lighting or temperature change can be disastrous.

7 Keep the soil moistened all the time; the seedlings are at their critical time of development.

8 When the plants developed four *true* leaves, it is time to thin. Transplant them into pots or thinned down to 2.5 cm or more apart. The seedlings can be kept with this condition until they are ready to be planted in their permanent sites.

9 Protect the seedlings by keeping them in the shade and moist. Watch out for pests that can damage the seedlings.

Did You Know?

* Trees form forest ecosystem, which serves as reservoir for different plants, animals, and microbes living in it.

Key Terms

- ☑ **Greenhouse:** a glass building in which plants are protected while growing.
- ☑ **Germination:** the process of growing of shoot and root from the seed.
- ☑ **Sprouting:** producing shoot.
- ☑ **Thinning:** reducing the member of seedling in order to improve the growth of those remaining.



a. A pot filled with soil, moisten and into which seeds are planted.



b. Emerging seedling in a pot.



c. Shade for developing seedlings

Figure 4.9: Growing seedlings in pots and shade

Did You Know?

* Always water plants thoroughly prior to any thinning, repotting or transplanting; and handle seedlings by their leaves never by their stems

Key Terms

- ☑ **Thinning:** it is a process of reducing the number of seedlings in order to lessen competition among themselves.

Activity 4.6



Discussion on steps required to grow trees

- ☑ In groups, discuss the major steps needed to grow trees in your school compound.
- ☑ Consider if there is any possibility of growing trees rather than directly from seeds.

Key Terms

- ☑ **Root ball:** tightly packed mass of roots and soil produced by a plant especially when grown in a container.
- ☑ **Mulch:** a mass of leaves, bark or compost spread around a plant for protection or to enrich the soil.

Did You Know?

* After planting trees, be careful not to pack the soil too tightly to avoid water to either pooling or running off.

When the seedlings are transferred to their permanent sites, there are some more important steps to be followed. These are also summarized as:

1 Prepare a hole as deep as the *root ball* (Figure 4.10a), and three times wider than the diameter of the *root ball* (Figure 4.10b). The top of the *root ball* should be even with the height of the original soil (Figure 4.10c).

2 Mix the soil in the pot with the excess soil from the ground to create a 50/50 mix.

3 Place the tree in the hole and fill the space with the potting soil until it reaches the top of the *root ball*.

4 If necessary, pack a layer of *mulch* around the entire tree (making sure not to put the mulch right up against the trunk), with some overhang down the hill. Water the tree thoroughly.

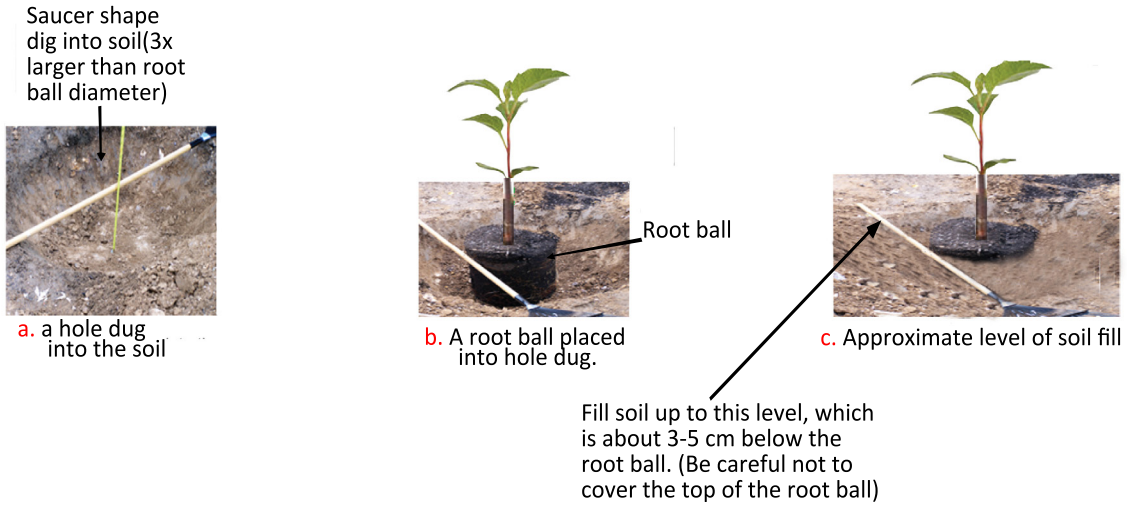


Figure 4.10: Preparation of holes for a developing tree and the root ball.



Activity 4.7

Developing seedlings for Wanza

Interview an agricultural extension worker and find out the necessary steps required for developing seedlings for Wanza (Cordia africana). Find out how the seedlings are transferred to their permanent site?

What cares should be exercised when growing trees?

After the development of *seeds* into *tiny plants* (Figure 4.11), *seedlings* will be placed in the open air with careful follow up. It is necessary to give care for these baby plants until they establish themselves as trees in their permanent sites.



Figure 4.11: Emerging seedlings

What are the areas in Ethiopia forestelin the 1900 and now?

The land of Ethiopia was covered by 30% forest in late 1900. Due to clearing of land for agriculture, cutting trees for fuel, timber and other activities the forest coverage was reduced to 4% today (Figure 4.12). The clearing process, together with a worldwide climate change, a high increase in population and overgrazing causes deforestation. The only dense forest that exists today in Ethiopia is found in the southern and southwestern sections of the highlands. The northern parts of the highlands of the country are almost devoid of trees.

Key Terms

- **Forest coverage:** plant community which is predominantly of trees or other woody vegetation, and that occupy or cover a given area of land.
- **Forest clearing:** removing or destroying forest cover from a given land as a result of different activities.
- **Reforestation:** replanting trees in a given area of land to cover again with forest.

Since the early 1980s, the *reforestation program* in Ethiopia is launched by planting millions of seedlings in community forests throughout the country. About 700 million

trees were planted in 2007 alone. Together with the Ministry of Agriculture, different Non-Governmental Organizations are involved in organizing the activities. Different sectors of the community including students are largely involved in the *reforestation program* all over the country.



a. Tree cutting for timber



b. Charcoal



c. Transportation of logs





Figure 4.12: Different activities that contribute to deforestation.

Activity 4.8



Researching on areas of forest cover in Ethiopia in 1900s and now

☑ In groups, go to the library and carry out research by making comparison between the forest coverage of the country by 1900s to what is existing now. Present your findings to the class.

A Tree Growing Project



Can you plan a tree growing project?

In Ethiopia *tree planting* has different purposes like *timber production*, *erosion control* and *growing* of edible fruits, *livestock forage*, *medicinal plants* and *wood for fuel*. Moreover, *trees* are grown for *aesthetic* purposes (the natural beauty of the area). Thus, *planning* to grow *trees* will be an exciting moment to you (Figure 4.13). If performed properly *tree planting* can ensure the successful restoration of a deforested area, hence creating an ecologically sustainable resource.

Did You Know?

* About 2 billion tons of top soil is lost every year into the River Nile (Abay) system.



Figure 4.13: Students planting trees.

Activity 4.9



Tree growing project

Materials you require:

- ☑ A project plan
- ☑ (Plant) seedlings
- ☑ Appropriate holes
- ☑ Spades
- ☑ Water containers

Procedure:

In groups, design a project to grow indigenous trees at your locality or school compound. You may go and discuss on how to get the necessary materials and support with the school administration and local representative office of the Ministry of Agriculture. But, you are expected to do the followings ahead of time.

1. Develop your project:
   - ☑ Specify your objective why you are planning to grow trees at your locality or school compound,
   - ☑ Select the type of trees you plan to grow (well adapted to your locality),
   - ☑ Specify the site where you are going to plant them,
   - ☑ Decide the numbers (important to work out cost breakdown and later caring) of trees, and
   - ☑ Fix the time as when you are going to do it.
2. Workout how you are going to obtain the seedlings like (raising funds to buy) and other necessary equipment for growing selected trees.

3 Include in your plan, how you are going to care for the seedlings till they develop sufficient root to absorb water by themselves.

4 Your project design should also include how you are going to educate the immediate community to care for the trees planted; otherwise it is going to be a failure.

☑ After completing your project submit a report to your teacher.

Indigenous Trees

What are indigenous trees?

Indigenous plants are those plants native to a given locality. These include plants that have *developed*, *occur naturally*, or *existed for many years* in an area (e.g. *trees*, *grasses* and other *plants*). These plants are well adapted to the *soil* and the *climate* of a given region. Large numbers of trees are *indigenous* to Ethiopia. Some of the common *indigenous* trees in Ethiopia are given in Table 4.1 and Figure 4.14.

Did You Know?

* Each of us inhales 16 kg of oxygen daily, which all come from plants. Every day, we need seven trees to remove the carbon dioxide we breath out and to give us back the oxygen we breath in.

Table 4.1: Some common indigenous trees in Ethiopia

Trees (Amharic and English Names)
Sholla (ficus)
Yabesha tid (Juniperous)
Zigba (Podocarpus)
Grar (Accacia)
Wanza (Cordia)
Kosso (Hagenia)



Figure 4.14: Examples of Indigenous plants

What are the benefits of growing indigenous trees?

Indigenous trees are trees that exist naturally at a given place for long time. These trees provide different benefits for the local people. The indigenous trees serve as sources of:

- ☑ building materials
- ☑ firewood and charcoal
- ☑ medicine (cultural)
- ☑ shade
- ☑ scenes
- ☑ fruits
- ☑ fence
- ☑ furniture (domestic items)
- ☑ fodder
- ☑ to keep hives
- ☑ increases water availability in the soil
- ☑ Prevents soil erosion

Activity 4.10



Researching indigenous trees in a given locality.

In groups, identify the indigenous trees in your locality. Present Your findings to your class.

Exercise 4.2

Choose the best answer for each of the following questions.

1 A tree is characterized as:

A Small and soft woody plant
B Small and annual plant
C Large and soft woody plant
D Large and perennial plant

2 One of the following is not included among the stages of a developing tree.

A Seed
B Seedling
C Young plant
D Flower

3 Seedling is:

A A small and fully developed plant.
B A large annual plant
C a baby plant
D Grown up flowering plant

4 One of the following is not included among care for a seedling.

A Providing shade
B Watering
C Cutting
D None of the above

5 One of the following is not an indigenous plant.

A Chat
B Eucalyptus
C Zigba
D Warka

Unit Summary

- Photosynthesis is a process during which light energy is absorbed by green pigments, chlorophyll and used for making organic compounds (sugar molecules).
- Photosynthesis takes place primarily in plant leaves.
- Plant cells absorb sunlight energy and use it to convert carbon dioxide (CO_2) from atmosphere and water (H_2O) from the soil into sugars, food molecules.
- During photosynthesis CO_2 from the atmosphere is used to make the organic molecule of the cell in the form of glucose.
- The glucose formed in the leaf cells is temporarily stored in the form of starch.
- The presence of starch indicates that the process of photosynthesis has taken place in leaf cells.
- During plant photosynthesis O_2 is evolved as a byproduct.
- A tree is defined as a large, perennial, woody plant.
- Trees are important part of the natural landscape of a country.
- Trees are important to us in many aspects; for instance in agriculture, as shade, fence, timber, fire wood, supplying fruit crops (such as apples) and traditional medicine.
- The basic parts of a tree are the roots, trunk(s), branches, twigs (slender woody shoot growing from the stem) and leaves.
- Generally, the life cycles of trees, are divided into different stages in forestry.
- Seeds or seedlings are used to grow trees.
- It is necessary to give care for these baby plants until they establish themselves as trees in their permanent sites.
- Due to clearing of land for agriculture, cutting trees for fuel, timber and other activities the forest coverage of Ethiopia is reduced to 4% today.
- In Ethiopia tree planting has multipurpose.
- Indigenous plants are those plants native to a given locality.
- Growing indigenous plants is the most important practice in tree growing project at a given area.

Review Exercise for Unit 4

Part I: ***Choose the best answer for each of the following questions.***

1 Stomata are:

A Pores in plant cells
B Pores on the leaves of a plant
C Photosynthetic sites
D None of the above

2 The use of CO_2 during the process of photosynthesis is for:

A The formation of O_2
B The absorption of light
C The formation of organic compound
D Respiration

3 Blue black coloration on leaves during test for photosynthesis is

A Confirmation of release of O_2
B Confirmation of carbohydrate formation
C Confirmation of the formation of H_2O molecules
D None of the above

4 One of the following is not included in the summary equation of photosynthesis.

A CO_2
B H_2O
C O_2
D Darkness

5 One of the following is true about the test of formation of O_2 as a by-product during photosynthesis.

A Blue black coloration on leaves
B Keeping plants in complete darkness results in no blue black coloration
C Keeping pondweed in inverted funnel and the release of air bubble
D None of the above

6 One of the following is not included among the list of importance of trees to the environment.

A Providing shade
B Providing wood fire
C Absorbing CO_2 from the environment
D Causing erosion

7 The first step in tree growing project is:

A Planting trees
B Transferring the seedlings
C Giving care to seedlings
D Identifying the purpose

8 Deforestation is:

A Clearing forest for timber
B cutting trees for construction
C cutting trees for agriculture
D all of the above

9 Care for a tree is:

A cutting a tree
B removing leaves from a tree
C pruning
D not given

10 Indigenous tree is:

A a tree introduced from outside of the locality
B a tree not adapted to a given locality
C a tree known growing at a given locality
D an exotic tree

Part II: *Match items in column 'B' with items in column 'A'*

Column A		Column B	
11	Choroplast	A	Product of photosynthesis
12	Chlorophyll	B	Cellular part
13	CO_2	C	Pigment
14	Glucose	D	Energy
15	Sunlight	E	Raw material of photosynthesis
16	Seed	F	Perennial wody plant
17	Seedling	G	*Wanza*
18	Pole	H	Young plant
19	Tree	I	Embryo plant
20	Indigenous	J	Baby plant

Part III: *Fill in the blank spaces with appropriate terms.*

21 The process of food making in plants is _____.

22 The product of photosynthesis are _____ _____and _____.

23 Standing dead wood is _____.

Part IV: *Give short answer for the following questions.*

24 Write the equation of photosynthesis.

25 Explain the importance of indigenous plants.

Part V: *Under each category, list down that begins with each letter. For example, one raw material required during photosynthesis that begins with letter 'C' is carbon dioxide.*

Photosynthesis		
Raw material	energy source and site where it is done	Products
C __Carbon dioxide	C _____	G _____
W _____	S _____	O _____

Unit 5

ANIMALS

Unit Outcomes

By the end of this unit, you will be able to:

- *Explain the importance of caring for farm animals, list down their products, and state the methods of preparing and storing food and sheltering for farm animals;*
- *Compare the ruminant stomach with the human stomach and explain why farm animals regurgitate;*
- *List the pregnancy periods of some farm animals and describe the special care given to their young; and*
- *Explain the causes, symptoms, transmission and prevention of some common diseases of farm animals.*



Main Contents

5.1 KEEPING FARM ANIMALS

- UNIT REVIEW

Introduction

There are many kinds of animals. Animals differ in their mode of reproduction, their way of locomotion, their food type and feeding habit, their body cover, shape etc. Animals also differ in their use. Animals are grouped as wild animals and domestic animals based on their relation with humans. Wild animals are animals living in the wild while domestic animals are animals tamed and reared by human beings. Domestic animals live around houses and farms. Animals domesticated and reared by farmers as part of the agricultural system are called farm animals. Examples of farm animals include poultry, cattle, sheep, goats, camels, horses and donkeys. Farm animals are useful for farmers in Ethiopia in many ways.

5.1 Keeping Farm Animals

By the end of this section, you will be able to:

- explain the reasons for caring for farm animals
- list down the products of farm animals
- compare the ruminant stomach with the human stomach
- explain why farm animals regurgitate
- state the methods of preparing and storing food for farm animals
- state the methods of sheltering farm animals
- list the pregnancy periods of some farm animals
- describe the special care given to young farm animals
- state some of the symptoms seen on sick farm animals
- name some common diseases of farm animals
- explain the causes, symptoms, transmission and prevention of some common diseases of farm animals

Uses of Farm Animals

What is livestock?

Livestock refers to one or more domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labor. The term "**livestock**" as used in many books does not include poultry or farmed fish; however, the inclusion of these, especially poultry, within the meaning of "livestock" is common.

Did You Know?

* Livestock production plays an important role in Ethiopia's economy. Estimates for 1987 indicated that livestock production contributed one-third of agriculture's share, or nearly 15 percent of total.

Why Farmers Keep Farm Animals?

Farmers in Ethiopia keep farm animals. The reasons for keeping farm animals by farmers include the following:

- ☑ Farm animals are an essential support for crop farming. They are used for ploughing, thrashing crop, and transporting yield.
- ☑ Farm animals are direct source of food. Meat is obtained from cattle, sheep, goat, camel and poultry; Egg is obtained from poultry; Milk and milk products (butter, cheese, and yoghurt) are obtained from cows, goats and camels.
- ☑ Farm animals are a source of income; Farmers sell live farm animals and their products such as hides and skins and hair/fur to get money. They use the money to buy other necessities such as clothes, industrial products, medicines, etc.

Farm animals are used as a means of drag power and transportation in addition. Their dung serve as fuel and manure.

DID YOU KNOW?

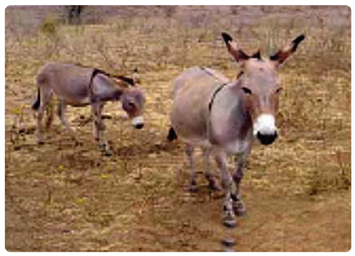
Numbers of Farm animals in Ethiopia in 2008.

✶ Cattle	49,297,898
✶ Sheep	25,017,218
✶ Goats	21,884,222
✶ Horses	1,787,211
✶ Donkeys	5,421,895
✶ Mules	373,519
✶ Camels	759,696
✶ Poultry	38,127,504

Activity 5.1



1. Look at the Figure 5.1,5.2, and 5.3, and tell their uses.
2. What farm animals are kept in your community? What are they used for?
3. Name some abuses made by people when using farm animals in your community and suggest what should be done.



Donkey



Horse

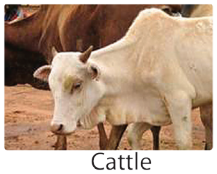


Mule


Camel


Goats


Sheep


Cattle


Poultry

Key Terms

- ☑ **Livestock:** farm animals.
- ☑ **Manure:** animal dung used for fertilizing land.
- ☑ **Ploughing:** cutting or turning over the soil.

Figure 5.1: Farm animals

Table 5.1: Summary of uses of farm animals

Type of animal	Uses
Cattle	Crop farming, milk and milk products, meat, manure, fuel, skin hides, hornets, whips, strings
Sheep, Goat	Milk and milk products (goats), meat, skin, manure, wool (sheep), fuel
Horse,mule, donkey	Mainly materials and human transport, manure, fuel
Camel	Milk and milk products, meat transport
Poultry	Meat, egg, feather

Cattle are raised as livestock for meat, as dairy animals for milk and other dairy products, and as drag animals (pulling carts, ploughs and the like). Other products include leather and dung for manure or fuel.








Figure 5.2: The use of farm animals in Ethiopia

Table 5.2: Summary of farm animal products and uses

Products	Uses
Skin/hide	Clothes, shoe, bags, wallet, belt, mask, baby carriage, caps tying materials, writing (parchment), grain container bag,
Hair	Musical strings, insect prevention
Fur	Wool-clothes, mats, blankets
Horn	Drinking cup, home ground, buttons
Feather	Pillows, cushions
Dung	Fuel, manure, house pasting (floor and wall)
Meat, Egg, Milk, Butter, Cheese,Yoghurt	Food – protein and fat sources

Feeding Farm Animals

Farm animals should be given the right kind of feed.

How Should We Feed Farm Animals?

Animals are divided into three groups based on who eats what?

- ☑ Carnivores that eat meat, e.g. dog, lion
- ☑ Omnivores that eat meat and plants,-e.g. pig
- ☑ Herbivores that eat plants, e.g. Cow, horse

In herbivores, the digestive system is very large because they eat large amounts of grass.

What are Ruminant Animals?

The word "**ruminant**" comes from the Latin *ruminare*, which means, "to chew over again.

The horse, donkey, camel and mule are herbivores but do not chew the cud. They are non-ruminants.

Cattle, goats, sheep and buffalo chew the cud. They are ruminants (Figure 5.4).

Key Terms

- ☑ **Carnivores:** animals, which eat meat.
- ☑ **Herbivores:** animals, which eat plants.
- ☑ **Omnivores:** animals, which eat plants and meat.

A ruminant is an animal that digests plant-based food by initially softening it within the animal's first stomach, then regurgitating the semi-digested mass, now known as cud, and chewing it again. The process of re-chewing the cud to further break down plant matter and stimulate digestion is called "ruminating".

The stomach of ruminants is adapted to their plant based food (Figure 5.5 and 5.6).

- ☑ The stomach of a ruminant, like a cow, has four chambers.
- ☑ The first chamber is called the **rumen.**

Key Terms

- ☑ **Abomasum:** the fourth stomach of ruminants, the true stomach.
- ☑ **Omasum:** one of the four stomachs of ruminants also called the book.
- ☑ **Cud:** partially digested food brought up from the rumen and chewed.
- ☑ **Reticulum:** one of the four stomachs of the ruminant also known as the honeycomb.
- ☑ **Ruminant:** animal, which has a rumen and chews the cud.
- ☑ **Rumen:** the first stomach of ruminants.

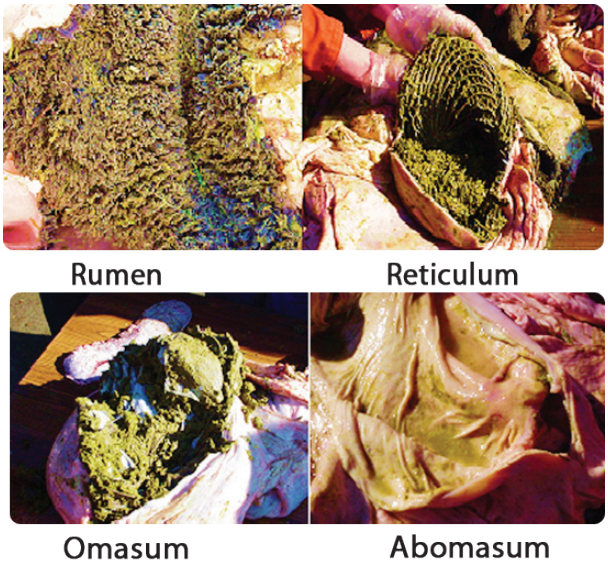
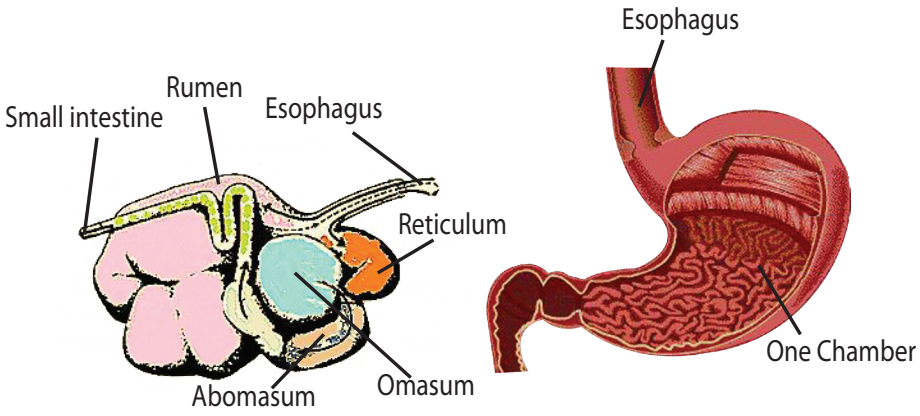


Figure 5.3: The four parts of ruminant stomach

- ☑ Food enters the first chamber when it is swallowed and is fermented by anaerobic bacteria which break down the cellulose.
- ☑ The food then passes to the second chamber of the stomach, the **reticulum** where it becomes a **cud**.
- ☑ The cud is regurgitated into the mouth where it is chewed again.
- ☑ The chewed cud passes to the third chamber of the stomach, the **omasum** where much of the water it contains is reabsorbed.
- ☑ The food then passes to the last chamber of the stomach, the **abomasum**, where normal gastric secretions digest the protein in the food.



a. Ruminanat Stomach b. Human Stomach

Figure 5.4: Ruminant stomach and human stomach

The ruminant chews grass and swallows and it goes into the rumen. When the ruminant has finished eating, the food is brought back up and re-chewed. This is called chewing the cud or rumination.

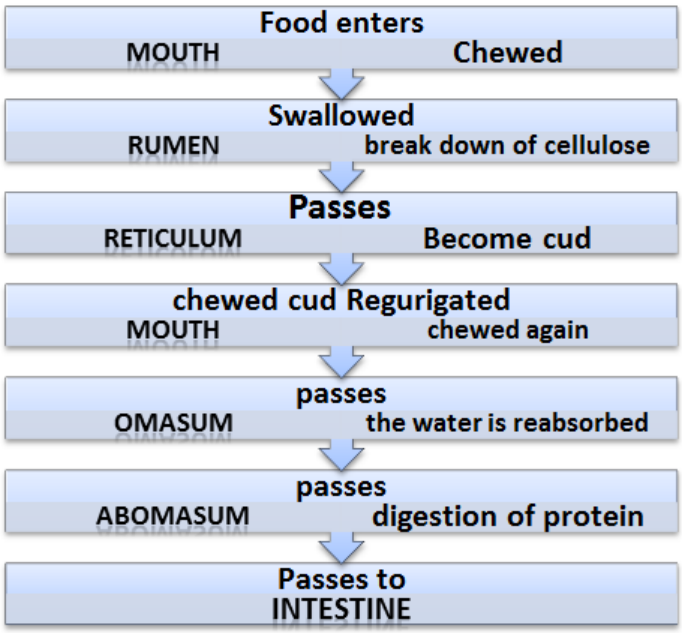


Figure 5.5: The process of digestion in ruminant stomach

Activity 5.2



Group work

1. Compare the ruminant stomach, type of food and way of chewing with humans. Make a table to compare the two.
2. Obtain the stomach of cattle, sheep or goat if possible, and identify parts of the stomach, the appearance of each part and the material you see inside each part (see Figure 5.4 and 5.5).

Food and Water Need of Ruminants

What is the food and water need of ruminants?

In order to get the most out of livestock you must always give animals enough, good feed and clean water. Good feed is high in nutrients and provides everything that the body needs in order for the animal to grow and reproduce. A daily ration is the amount of feed an animal needs every day. A good ration will contain all of the nutrients. Some nutrients are found in large amounts in some plants. Farm animals need clean water everyday. Their water need vary according to the weather condition.

What is forage?

Do you know forage? Forage is plant material (mainly plant leaves and stems) eaten by grazing livestock. The term forage include plants eaten by the animals directly as pasture, crop residue, or immature cereal crops, but it is also used more loosely to include similar plants cut for fodder and carried to the animals.

What are fodder trees?

Fodder trees are those trees used for feeding animals. Some trees are better feed than other. The best trees are leguminous trees. These trees can be grown in rows 4 m apart.

Other crops can be grown between the rows of trees (alley farming). The leaves and branches of the trees can be cut through the year and used as animal feed. Using these trees for feed is beneficial because:

- ☑ The leaves of the trees provide good feed for animals all through the year.
- ☑ The rotting leaves provide mineral rich mulch (natural fertilizer) for other crops.
- ☑ The trees provide fuel wood, timber and shelter from the wind.
- ☑ The trees stop soil erosion and improve the fertility of the soil.

Key Terms

- ☑ **Silage:** grass and plants cut green and stored in an airtight container for feed.
- ☑ **Silo:** airtight pit in which silage is made and stored.
- ☑ **Forage:** plant material, mainly plant leaves and stems eaten by grazing livestock.
- ☑ **Herd:** large group of animals.
- ☑ **Pasture:** area of grassland used for grazing.
- ☑ **Fodder:** food for farm animals.
- ☑ **Hey:** dried animal food.
- ☑ **Overgrazing:** when pasture grasses have provided feed for too many animals for too long and becomes damaged or destroyed by loss of grass and soil.

What is hay and how is it prepared?

Hay is grass, legumes or other herbaceous plants that have been cut, dried, and stored for use as animal fodder, particularly for grazing livestock such as cattle, horses, goats, and sheep. The best hay is prepared from young grasses. Cut the grass and leave it to dry in the sun for several days turning it over to make sure it is completely dry when it can be stored until needed. Do not try to make hay in the rainy season.



Figure 5.6: Grass hay and stacked hay; Horses eating hay

Hay is fed when or where there is not enough pasture or rangeland on which to graze. It is used when grazing is unavailable due to weather or when lush pasture by itself is too rich for the health of the animal(Figure 5.6 and 5.7).



Figure 5.7: Stored hay

What is silage?

Silage is fermented, high-moisture fodder that can be fed to ruminants (cud-chewing animals like cattle and sheep). It is usually made from grass crops, including corn (maize) or sorghum or other cereals, using the entire green plant (not just the grain). Silage can be made either by placing cut green vegetation in a silo, or by piling it in a large heap covered with plastic sheet, or by wrapping large bales in plastic film.

How is silage prepared?

Silage must be made from plant material with suitable moisture content, about 50% to 60%, depending on the means of storage, the degree of compression, and the amount of water that will be lost in storage. Major steps in making silage are as follows:

- ☑ Chopping and compacting the crop within a few days of cutting to exclude air.
- ☑ Sealing the compacted material with soil and covering with a (water proof covering) to exclude air and protect it from the sun and rain.
- ☑ Leaving the silage to ferment.
- ☑ Well-prepared silage turns green, and
- ☑ It is free from moulds and unpleasant odours

Did You Know?

Managing the grazing of pastures by herds and flocks will:

- ✶ Prevent overgrazing of pasture and loss of soil through erosion.
- ✶ Ensure maximum production of animal feed from the land.
- ✶ Help in the control of internal and external parasites.

Key Terms

- ☑ **Stable:** a bulding where horses are kept.
- ☑ **Pen:** an enclosure for animals.
- ☑ **Barn:** a bulding on a farm used to store grain, grass, hey, etc.
- ☑ **Paddock:** a small field to keep farm animals.



Cattle feeding in a meadow



Cattle sheltered in a barn



Cattle watering in a river



Cattle watering in a trough

Figure 5.8: Some Ways of feeding and sheltering farm animals

How do we shelter farm animals?

Farm animals are kept in various shelters. The shelters include stables, barns(Figure 5.8), paddocks, and pens.

Farm animals need shelter to pass the night, and to protect they from bad weather during the day.

Horse, donkeys, and mules can be kept in stables when not working.

Activity 5.3



1. Ask an agriculture officer about using fodder trees.
2. Talk to the people in your community and record what they feed their animals (See Figure 5.6).
3. Ask the local agriculture extension worker what the best types of feed that you can get locally are and how they can be used for the livestock in your community.
4. You could encourage your community to make hay or silage for use in the dry season.

Pregnant and Young Farm Animal

What is pregnancy?

When the male mates with the female, he deposits sperm in the vagina. The sperm joins with the egg and forms the embryo, which becomes attached to the wall of the womb. The embryo grows within a bag of fluid (water bag) and is attached to the wall of the womb by a navel cord.

Key Terms

- **Browse:** to eat plants and leaves.
- **Pregnancy:** the development of the young inside the mother.
- **Pregnant:** having developing young in the womb.
- **Poultry:** domesticated birds.

What are the signs of pregnancy?

- The animal becomes quieter and the belly grows bigger.
- In milk animals the production of milk will gradually stop.

How long is pregnancy?

- ☑ If male and female animals have been allowed to run together in a large herd it will be difficult to determine the expected time for birth (parturition).
- ☑ If however you do know when a female was mated you can determine when she will give birth.

Activity 5.4



Class Discussion

1 Mule is a farm animal. Have you ever seen a pregnant mule? or have you ever seen a new born mule? Discuss how a mule is born.

Table 5.3: The length of pregnancy for different animals.

Animal	Length of pregnancy
Cow	280 days
Sheep	150 days
Goat	150 days
Horses	336 days
Camel (One humped)	390 days
Camel (Two humped)	406 days

Remember!

- ♣ *Take care not to spread disease through feed and water.*
- ♣ *Keep water and feed troughs clean, and do not allow animals to eat old or musty feed.*
- ♣ *Change feeds slowly.*

What care should be taken for a pregnant animal?

- ☑ A pregnant animal will need more feed and will benefit from the addition of some grain to the feed towards the end of pregnancy.
- ☑ Pregnant animals should be kept close to home towards the end of the pregnancy and some form of shelter should be provided.
- ☑ They should be watched twice a day for signs that **parturition** is close. In particular, cattle need a clean, well ventilated place, preferably with a sand or grit floor on which suitable bedding is placed.
- ☑ Do not keep a pregnant animal constantly tied up or with little room to exercise to allow her some freedom in a field or yard each day.

What care should be taken for the newborn?

From birth, the young animal is vulnerable to disease. It is completely dependent on the mother for food and if the mother dies the orphan will need a foster mother if it is to survive. Young farm animals should be sheltered and kept separately in a clean place.

How are young farm animals fed?

- ☑ The stomach of the calf needs time to develop fully and become able to digest plants. At first, it can only digest milk and a 2-months-old calf will drink 4 to 6 liters of milk daily.
- ☑ The calf should be allowed to take all the milk it needs from his mother for the first two months of its life.
- ☑ From 3 weeks of age a calf will begin to eat a little grass and by 3 months of age a calf can eat plants and ruminate. At this age the calf can be weaned. It is allowed to take less milk and is given solid food which is increased until drinking milk is stopped.

Lambs and kids will suckle from the mother until they are 4 months old, but they will start to show an interest in green plants from 3 weeks of age (Figure 5.9).

Young camels start to eat grass at 2 to 3 months of age and can be weaned by 4 months of age.


Young chicken


Goat and kids


Young donkey


Sheep and lamb

Figure 5.9: Farm animals which needs special care

Activity 5.5



Visit and answer the following questions

1. What is the type of feed given to young farm animals?
2. What kind of shelter is used for young farm animals?
3. Until what age are calf allowed to suck milk?

Poultry

What is Poultry?

Poultry is the category of domesticated birds that people keep for the purpose of collecting their eggs, or killing for their meat and/or feathers.

How do we keep polutry?

Providing shelter, food and clean water to chickens will result in more meat and eggs. Chickens can easily become sick and some diseases kill many chickens. If chickens are allowed to wander around freely, disease can spread quickly through all the birds kept in the community. Keeping chickens in a closed area and providing them with shelter is the first step towards improving them (Figure: 5.10).



Figure 5.10: Modern poultry

There must be enough space to hold all the *chickens* plus the feed and water containers (troughs). Young chickens will need less space than older *chickens* and perches must be provided for chickens to roost on at night. Every house will need a run for the chickens to be able to exercise in, pick up grass, insects etc.

What is the importance of keeping chickens in houses?

Keeping chickens in houses is important for the following reasons.

- ☑ They will be protected from the sun, rain, cold and snow.
- ☑ They will be protected from other animals such as foxes and birds of prey, from theft and from being killed on the streets.
- ☑ Chickens can be prevented from eating bad food or drinking dirty water.
- ☑ Nest boxes can be provided to make it easy to collect eggs.
- ☑ The spread of disease can be stopped.

Activity 5.6



Visit a nearby poultry farm, observe and investigate the answer for the following questions.

1. How are poultry sheltered? Young and adult?
2. How are poultry fed-young and adult?
3. How is egg collected?

After your visit discuss in small groups and write a report answering the questions.

Diseases of Farm Animals

What are farm animal diseases?

Farm animal diseases reduce productivity, and, in some cases, can infect humans. Diseases of farm animals are disorders that influence an animal's health and ability to function. Animal diseases are of great concern to humans for several reasons.

- ☑ Diseases can reduce the productivity of animals used to produce food, such as hens and dairy cows.
- ☑ Animals that are raised as food, that become ill may affect the economic well-being of many industries.

- Some animal diseases can be transmitted to humans, and control of these types of diseases, is vital to public health.

Many microscopic organisms, known as **pathogens**, cause diseases in animals. Common farm animal diseases in Ethiopia include Liver fluke, Trypanosomiasis and Anthrax.

What is liver fluke?

Liver fluke is a Parasite which affects cattle, but it is more serious in sheep. It causes general weakness and debilitation. It is transmitted by animals eating spores attached to grass. The parasite lodges in the body and eggs pass out in the animal dung. The eggs infect a snail, the secondary host, and more spores are laid (Figure 5.11).

The prevention method liver fluke includes removing infected animals and preventing animal dung coming into contact with water sources to break the cycle of re-infection.

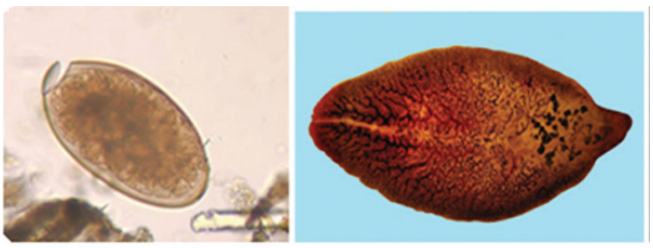
Key Terms

- **Anthrax:** disease of cattle and sheep caused by bacteria, which can be passed to humans.
- **Liver flukes:** an enclosure for animals.
- **Infection:** disease caused by a germ.
- **Parasite:** animal or plant which lives in or on another.
- **Pathogen:** disease causing germs.
- **Appetite:** a desire for something especially for food.
- **Carcass:** dead body of an animal.
- **Coma:** a state of unconsciousness.
- **Disinfectant:** a chemical used to destroy germs, the process is called disinfecting.

Did You Know?

Aware that an animal is unwell when.

- Loss of appetite
- Unusual behavior
- Lack of strength or energy



Egg Fluke

Figure 5.11: Liver fluke

What is anthrax?

- Antrax is caused by a bacterium and affects all livestock (Figure 5.12).
- Symptoms include a high fever, swollen neck, lower abdomen and sexual organs, and in the latter stages, staggering.

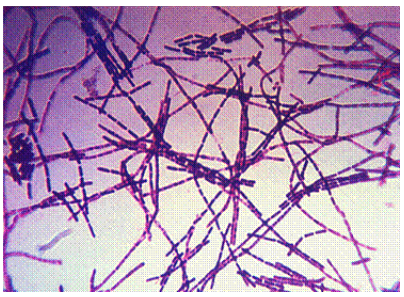


Figure 5.12: The Anthrax bacteria

- ☑ The disease is transmitted through contaminated water but may also be licked up from the soil, particularly where the skin is broken due to injury.
- ☑ Isolating infected animals and vaccinating them; burning the carcasses of dead animals and disinfecting all equipment and the area where the animal has been.

What is Trypansosomiasis?

- ☑ Trypanosomiasis is a disease caused by a parasite called trypanosome which is carried by tsetse fly.
- ☑ Symptoms include fever followed by a **coma** which is often fatal.
- ☑ The disease is transmitted by tsetse fly when the victim is bitten by a fly carrying the parasite.(Figure 5.13)
- ☑ Removing bushes and under growth along streams where the tsetse fly is found; spraying infected areas with insecticides; spraying animals with insect **repellents**.

Remember!

- ♣ *Take care not to spread disease through feed and water.*
- ♣ *Keep water and feed troughs clean, and do not allow animals to eat old or musty feed.*
- ♣ *Change feeds slowly.*
- ♣ *Your local veterinarian or extension worker can advise you on the best types of feed that you can get locally and how they can be used for the livestock in your community.*
- ♣ *You could encourage your community to make hay or silage for use in the dry season.*

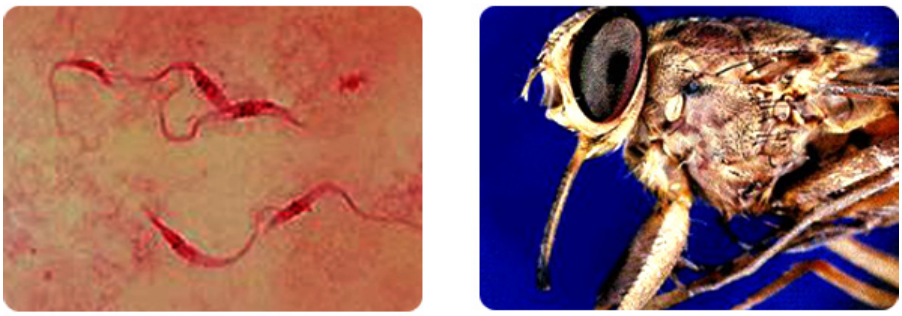


Figure 5.13: Trypanosome parasites in blood and tsetse fly

Controlling the spread of infectious animal diseases begins with isolating, or put in quarantine the animals with threatening infections, to prevent further transmission.

Activity 5.7



Your teacher and the libererian will help you to get books on Liver fluke, Anthrax, and Trypanosomiasis. Read about the transmission of the diseases and the method of control and prevention by taking notes. Present your notes using the following table format.

Type of diseases	Transmission of diseases	Methods of prevention and control
Liver fluke Anthrax Trypanosomiasis		

Unit Summary

- Farm animals are animals kept by farmers and include poultry, cattle, sheep, goats, camels, horses and donkeys.
- The reasons why farm animals are kept include to provide food; to provide skins; to be sold for profit; to do work; and to breed.
- Farm animals should be fed and sheltered properly.
- Cattle are herbivores and therefore their diet is very different from humans. Mammals cannot digest cellulose. A ruminant's stomach is significantly different from a human stomach.
- The stomach of a ruminant like a cow has four chambers. The first chamber is called the rumen, food enters the first chamber when it is swallowed and is fermented by anaerobic bacteria, which break down the cellulose.
- The food then passes to the second chamber of the stomach, the reticulum were it becomes known as cud. The cud is regurgitated into the mouth where it is chewed again.
- The chewed cud passes to the third chamber of the stomach, the omasum where much of the water it contains is reabsorbed.
- The food then passes to the last chamber of the stomach, the abmasum, where normal gastric secretions digest the protein in the food.
- Forage crops are grown to feed livestock and that it is necessary to harvest and store the crop to feed animals when natural food is in short supply.
- Hay is composed mainly of legumes and grasses, including cereal crops. Hay is best made in the dry season when there is sufficient sun to dry the cut material.
- The properties of well-prepared hay includes slight green colour, high leaf to stem ratio, low fibre so easily digestible, low moisture content (15-25%), no mould or dust, free from weeds and stones, and able to be stored for long periods without deteriorating.
- Making silage involves the preservation of forage crop by acids produced by the fermentation of sugars present in the fodder.
- The steps in the formation of silage include chopping and compacting the crop within a few days of cutting to exclude air, sealing the compacted material with soil and covering with a tarpaulin to exclude air and protect it from the sun and rain.
- The properties of a well-prepared silage include green colour, free from moulds and unpleasant odours.
- Special caring for pregnant and young animals is needed.after they are born.
- Animals can be sick due to various reasons. Signs of knowing sickness in farm animals include loss of appetite, unusual behaviour, and lack of strength or energy.
- Liver fluke is a disease of farm animals caused by a parasitic fluke, Fasciola hepatica and affects cattle,
- Anthrax is a disease of farm animals caused by a bacterium and affects all livestock.
- Trypanosomiasis is caused by a parasite called trypanosome which is carried by the tsetse fly.



Review Exercise for Unit 5

Part I: ***Choose the best answer among the choices given for each question.***

1 Farm animals are kept for
- A Tourist attraction
- B Increasing income
- C Entertainment purpose only
- D All of the above

2 Which one of the following is not a farm animal
- A Camel
- B Donkey
- C Rat
- D Hen

3 A farm animal very useful in desert environment is
- A Camel
- B Horse
- C Sheep
- D Donkey

4 Lamb is from sheep as kid is from
- A Cow
- B Goat
- C Horse
- D Mule

5 An animal that is not used for ploughing is
- A Camel
- B Ox
- C Sheep
- D All of the above

6 Dung is used for
- A Fertilizing soil
- B Food
- C Cloth making
- D Music

7 Cattle are
- A Omnivore
- B Carnivore
- C Herbivore
- D All of the above

8 Partially chewed food by cattle is stored in the
- A Rumen
- B Reticulum
- C Omasuni
- D Abomasum

9 In ruminant animals, digestion of proteins is done in the
- A Rumen
- B Reticulum
- C Abomasum
- D Omasum

10 Which one of the following animals is not a ruminant
- A Cow
- B Sheep
- C Donkey
- D Goat

11 A bad quality hay is
- A Green in colour
- B With high moisture
- C Not too coarse
- D With no mold

12 A farm animal with 280 days of pregnancy period is
- A Sheep
- B Goat
- C Horse
- D Cow

13 Which one of the following is not required by all farm animals
- A Housing
- B Water and food
- C Health care
- D Cloth

14 An insect transmitted animal disease is
- A Trypanosomiasis
- B Liver fluke
- C Anthrax
- D All of the above

15 Ethiopia is best known for its
- A Donkeys
- B Camels
- C Cattle
- D None of the above

Part II: *Give short answers.*

16 What are the useful products obtained from cattle?

17 What is silage?

18 What is anthrax?

19 What are the signs of sick animals?

20 For what type of farming activities are farm animals used?

Part III: *Match animals given in column A with appropriate products given in Column B. An animal can be matched with more than one product from Column B.*

	Column A		Column B
21	Sheep	A	Meat
22	Camel	B	Manure
23	Poultry	C	Egg
24	Horse	D	Milk
25	Cattle	E	Hides/skins

Part IV: *Fill in the blank with appropriate word*

26 The farm animal which is useful in desert areas is _____.

27 The first part of ruminant stomach is_____.

28 Special care is needed for farm animals during _____period.

29 The two types of farm animal feed prepared by farmers are _____ and_____.

Part V: *Copy the cross word puzzle and use the numbered clues to complete and solve the puzzle.*

The numbers in bracket indicate the number of letters in each word to be inserted in a box.

Across

1 Bacteria causing disease in animals and humans (7)

3 Group of domesticated birds and chicken (7)

6 Feed of cattle (5)

8 Last part of stomach in cattle (9)

10 Second part of stomach in cattle (9)

Down ward

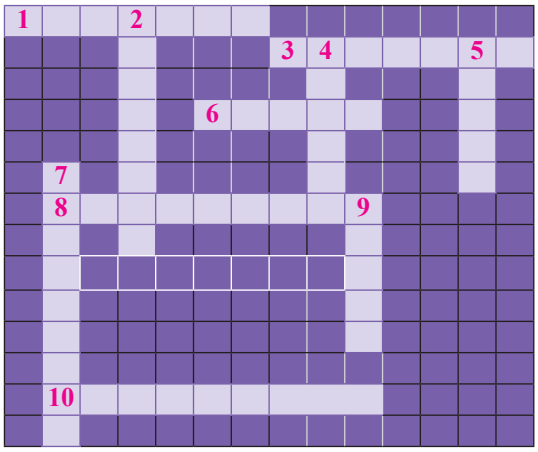
2 Group of animals feeding on plants (8)

4 Third part of stomach in cattle (6)

5 First part of cattle stomach (5)

7 Group of animals eating meat (9)

9 Farm Animal adapted to desert (5)



Unit 6

ENVIRONMENT

Unit Outcomes

By the end of this unit, you will be able to:

- *Define ecosystem, give examples of ecosystems, distinguish between them, and explain the adaptations of plants and animals to each ecosystem;*
- *List some types of biological association, explain them and give examples of organisms for each type;*
- *Describe soil as a physical factor of the ecosystem, explain how it is formed, and explain its different types;*
- *Describe the causes and methods of prevention of soil erosion;*
- *Investigate the water humus and air contents of soil and particle size and water retention through simple experiments;*
- *Describe water as a physical factor of the ecosystem; and*
- *State the importance of water, explain the water cycle and describe the methods of conservation.*



Main Contents

6.1 Ecosystem

6.2 Biological Associations

6.3 The Physical Factors of the Ecosystem

- Unit Review

Introduction

Ecology is study of the interaction of organisms with each other and with non-living parts of the Earth. Each of the variety of organisms depends, in some way, on the other living and non-living parts of the environment. Part of the Earth that supports life is known as the *biosphere*. The *biosphere* is divided into many units known as the ***ecosystem.***

Different types of *biological associations* are observed between *biotic factors* in an *ecosystem*, which all together is known as *symbiosis*. During *symbiotic* interaction two different organisms live and interact in various manners. Similarly, the *abiotic factors* of the *ecosystem* can be classified as non-living *chemical* and *physical factors* of the *ecosystem*. The major *physical factors* of a given *ecosystem* include features of *soil* and *water*. Soil and water affect the *biotic factors* of the *ecosystem* and in turn are being affected by them.

Key Terms

- ☑ **Ecology:** branch of biology that studies all life forms and their interactions with their environment.
- ☑ **Ecologist:** a person who studies the relationship between organisms and their environment.
- ☑ **Biosphere:** the surface and atmosphere of the earth which is occupied by living things.
- ☑ **Ecosystem:** all of the living organisms and non-living part of a specific area and their interaction.

Word Roots and Origins

Ecology: Comes from two Greek words oikos means house and logos means study or knowledge. It refers to the study of organisms at their natural homes.

In this unit you will start studying how biological and non biological factors are interrelated within an ecosystem. Moreover, you will explore parts of the ecosystem and their interaction. In the second sub unit, you will discover different types of *biological association* or *symbiotic relationship* that exists between organisms of two different species. You will also evaluate the significance and characteristics of the two *physical factors* of the *ecosystem*, namely *soil* and *water*.

6.1 Ecosystem

By the end of this section, you will be able to:

- define ecosystem;
- distinguish between forest, grassland, desert and aquatic ecosystems; and
- explain the adaptations of plants and animals to each ecosystem.

What is an ecosystem?

An ecosystem is a given area where biotic factors interact with abiotic factors. The biotic factors refer to all living things in the ecosystem, which is a community of living things (different plants, animals and microorganisms). The abiotic factors refer to all non-living things of the ecosystem including climatic and soil factors, which includes temperature, light, water, and nutrients. In any ecosystem, biotic factors interact with abiotic factors, biotic factors interact with biotic factors and abiotic factors interact with abiotic factors. (See Figure 6.1).

An *ecosystem* is a given area in which living things (*biotic factors*) and non-living things (*abiotic factors*) are found and interact in different ways.

Key Terms

- **Community:** a grouping of populations of different species living together in a particular area at a particular time.
- **Climatic factors:** the general weather conditions of a given area over a long period and include the temperature, rain, humidity, wind.
- **Soil factors:** factors related to soil type, water content, temperature, pH, humus content, and nutrient content.
- **Biotic factors:** the living parts of an ecosystem.
- **Abiotic factors:** the non-living components of an ecosystem.

Activity 6.1



Discussion on ecosystem

- In groups, take one example of ecosystem, identify its parts and then discuss the type of interaction that possibly exists within an ecosystem.

How big is an ecosystem?

An ecosystem can be as small as a single tree, an aquarium, a pond, a forest or as big as a desert, a sea or the whole planet earth. We consider here a tree as an ecosystem. For instance, the tree in Figure 6.1 could be considered as a complete ecosystem. It contains a community of living things and abiotic components such as air, radiation from the sun, water, and nutrients. This ecosystem interacts with, and is part of, a larger ecosystem containing the community of organisms living in the forest.



Figure 6.1: A tree as an example of an ecosystem.

Where does one ecosystem end and another begin?

Ecosystem boundaries are not always clearly defined. In areas where two ecosystems meet, there may be a large area of transition. It is the area where physical and biological elements from both ecosystem types can be found. Ecosystems vary greatly in size and the elements that make them up, but each is a functioning unit of nature.

There are many ways of defining and classifying ecosystems. In general, however, ecosystems are defined based on the dominant plants, animals, land forms, and climatic conditions found within a particular geographic area.

Generally, all *ecosystems* on earth can be categorized into two main types, as the *aquatic (water) ecosystem* and the *terrestrial (land) ecosystems*. Each ecosystem has its own climate, soil, plants, animals and microorganisms. Examples of ecosystems include *Forest ecosystem*; *Grassland ecosystem*; *Desert ecosystem*; and *Freshwater ecosystem* (See Figure 6.2). The type of plants and animals, the climate and the availability of food and water of each of these ecosystems is summarized in Table 6.1.

Did You Know?

All of these ecosystems and their interactions make up the biosphere, which includes all portions of Earth (all land surfaces and bodies of water) inhabitable by some types of life.

Key Terms

Types of ecosystems

- ☑ **Terrestrial ecosystems:** all ecosystems found on land, and include Forest ecosystem, grassland ecosystem and desert ecosystem.
- ☑ **Aquatic ecosystems:** all ecosystems found in water bodies, and include marine ecosystem (salty water) and freshwater (non-salty water) ecosystem.
- ☑ **Forest ecosystem:** an ecosystem dominated by forest.
- ☑ **Grassland ecosystem:** an ecosystem dominated by long grasses and scattered trees and shrubs.
- ☑ **Desert ecosystem:** an ecosystem found in hot, with less rain fall and dry places.
- ☑ **Freshwater ecosystem:** an ecosystems found in standing water (lakes, ponds), running water (springs, streams, river and wetlands (marshes and swamps) .

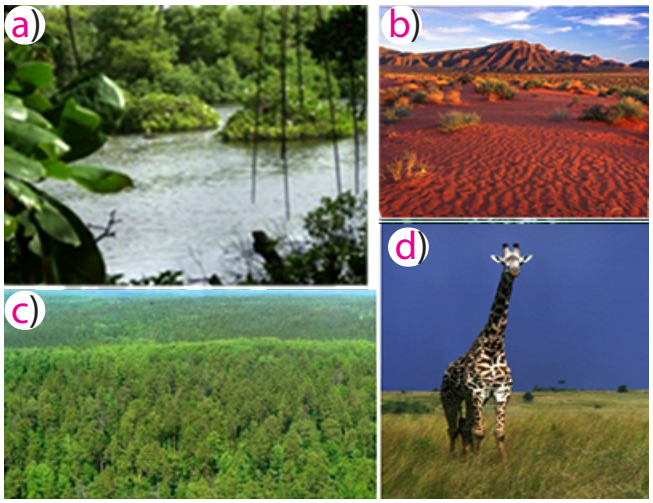


Figure 6.2: Different types of major ecosystems a) aquatic, b) desert, c) rain forest d) grassland ecosystems

Activity 6.2



Looking at aquarium or a pond

Materials you require:

- ☑ Aquarium

Proecedure:

1 In groups, carefully observe the aquarium (Figure 6.3 below) or consider a pond; and identify the interacting biotic and abiotic factors. Categorize the biotic factors into different groups of living things. And categorize the abiotic factors into chemical and physical factors.



Figure 6.3: Aquarium

Table 6.1: Some examples of ecosystems and summarized features

Ecosystem	Climate, availability of food and water	Organisms present
Rain forest (tropical rain forest)	• Stable temperature (20-30°C), abundant rain (200-400 cm), continuous growing season • Rich in food and water; and support diverse types of organisms	Animals • Different insects (termites, beetles, ants, moths and others) and spiders, lizards, snakes, birds, mammals (including rabbit, deer, arboreal (living in trees) animals, tiger, hyena) Plants • Shrubs, epiphytes and climbers, evergreen and deciduous broad-leaved trees, bamboo

Ecosystem	Climate, availability of food and water	Organisms present
Desert	• High temperature (7-38°C), dry (less rain, <25 cm) • Less amount of water and food	Animals • Desert rats (rats burrow in the ground), snakes, lizards, birds, camel and other nocturnal (night) or burrowing animals. Plants • Xerophytes like different cacti, desert rose, euphorbia, acacia, thorny bushes, and succulents like Welwitschia
Grassland (African savannas)	• Warm (16-34°C), low seasonal rain (75-150 cm) • Between the forest and the desert • Food and water (not like forest's) are available (but not as much as in forest ecosystems).	Animals • Zebra, wild beest, giraffes, and gazelles, lion and tigers. Plants • Grasses, scattered small deciduous or broad-leaved trees
Freshwater (non-salty water bodies like lakes, ponds and rivers)	• Features depend on location and type • Food and water is available	Animals • Fish, frogs, birds, crocodiles, insects, worms and protozoa Plants • Aquatic plants and algae

Exercise 6.1

Choose the correct answer for each of the following questions

1 An *ecosystem* is:.

A where only biotic community exists.

B where both biotic community and abiotic factors exist.

C where only abiotic factors exist.

D where both biotic community and abiotic factors exist and interact.

2 *Abiotic* factors are:

A living organisms in an ecosystem.

B soil and water of an ecosystem.

C all non-living factors that surround the living things in an ecosystem.

D the climate of an ecosystem.

3 Interactions between *biotic* and *abiotic* factors of an *ecosystem* can be summarized as:

A biotic-biotic and abiotic-abiotic.

B biotic-abiotic.

C abiotic-abiotic, and biotic-biotic.

D biotic-abiotic, biotic-biotic and abiotic-abiotic.

4 One of the following is not an example of *terrestrial ecosystem?*

A A tree.

B A forest.

C A lake.

D A grassland.

5 One of the following is not true about *biotic community* of a given ecosystem.

A Refers only to plants and animals.

B Refers to plants, animals and abiotic factors of the environment.

C Refers to plants, animals and microorganisms.

D Refers to animals only.

6.2 Biological Associations

By the end of this section, you will be able to:

- list some types of biological association;
- explain the types of biological association listed; and
- give examples of organisms for each type of biological association.

What are biological associations?

All living organisms are directly or indirectly related for survival. Some relationships are helpful and some are harmful. In some relationships one organism provides food and/or a habitat for another. The general biological term of living together in a close association of two or more organisms of different species is called **symbiosis**. It is a term to describe a wide range of interaction among plants, animals and microorganisms that occur in nature.

Sometimes a symbiotic relationship benefits both species, sometimes one species benefits at the other's expense, and in other cases neither species benefit. Some of these biological associations are described as *parasitism*, *predation*, *mutualism* and *commensalism*.

Key Terms

☑ **Symbiosis:** any type of biological association between two organisms that interact. The association could be beneficial to both, beneficial to one without benefiting or harming the other or beneficial to one and harmful to the other.

Did You Know?

✶ Tuberculosis, Malaria, HIV/AIDS and intestinal parasites are among the most known top diseases in Ethiopia.

A. Parasitism

What is parasitism?

It is a symbiotic relationship between organisms of different species in which one organism benefits (the parasite) while the other is harmed (the host). In such relationship the host is the victim of the relationship by providing food and shelter to the parasite.

Key Terms

- **Ectoparasite** is parasite that lives on the outer body of its host.
- **Endoparasite** is parasite that lives within the body of its host.
- **Symbiosis** is a close ecological relationship between the individuals of two (or more) deferent species .

There are two types of parasites depending where they live either in or on the host's body. These are ectoparasites and endoparasites. Parasites that live on the outer body of its host are known as **ectoparasites** (Example: fleas, bugs, ticks etc) (See Figure 6.7). Parasites that live within the body of its host are called **endoparasites** (Example: ascaris, tapeworm, amoeba, hookworm etc). (See Figure 6.4 and 6.5).



Hook worms, endoparasites enter the body through the feet and circulates in the blood. In such a way they get both food and shelter.

Figure 6.4: hookworm on the lining of an intestine



Figure 6.5: Tapeworm, an endoparasite with people and cattles

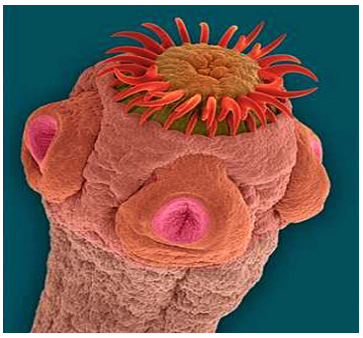


Figure 6.6: The tape worm, scolex



Ticks are pinhead-sized arachnids that form parasitic relationships with birds, reptiles, and sometimes humans. Ticks attach to their host's skin and feed off its blood. In this way it gets both food and home (shelter).

Figure 6.7: Tick, an ecotoparasite

Activity 6.3



Parasitism mode of association

Discuss in groups;

1. How do parasites enter into human body?
2. What advantages do the parasites get from their host?
3. How can you control parasites?
4. What are the measures that should be taken when a person is attacked by a parasite?

B. PREDATION

What is predation?

Predation is a feeding relationship between two animals, in which one is a killer (predator) and the other is a killed (prey). Predators are skillful and strong. (See Figure 6.8). Some of these predators are strictly carnivores such as lions, tigers and some others are omnivores such as bears, and the like.

Key Terms

- **Predation:** A form of symbiotic relationship between two organisms of different species in which one of them acts as predator that captures and feeds on the other organism that is prey.
- **Predator:** An animal that naturally attack and kill others for food.
- **Prey:** An animal hunted and killed by another for food.



Figure 6.8: A group of lion (pride) attacking a buffalo

Characteristics of predators

Predators usually possess excellent senses to find their prey and special abilities to capture the prey. Predatory birds, for example, possess outstanding eyesight and often hearing, as in the case of owls. Other predators, such as many species of mammals, have a very keen sense of smell that helps them locate their prey. Many predators are very fast, and use their speed to help them catch prey.

Activity 6.4



Identify Predator-prey relationship

Discuss in group

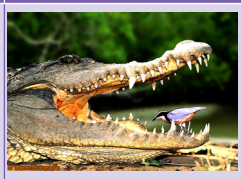
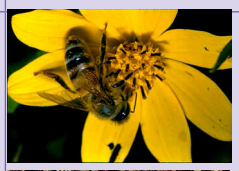
1. Give examples of predator-prey relationship.
2. What are the characteristics of predator-prey relationship?
3. Does population size matter for predator-prey relationship?
4. What kind of natural adaptation do you observe between the predator and prey?

C. MUTUALISM

What is Mutualism?

Mutualism is a form of symbiosis where two organisms mutually benefit from each other. The Table 6.2 describes the types of mutual relationship among different types of living organisms with examples.

Table 6.2: Some examples of mutual relationship

Types of mutual Relationship	Examples
Animal-animal relationship	 Crocodile and bird; the Egyptian Plover bird and the crocodile have a mutual relationship.
Animal-plant relationship	 Mutual relationship between insects (Bees) and flowers
Plant - plant relationship	 Growing Lichens (association between algae and fungi on a bark of a tree
Microorganisms and animals or plants	e.g. termites and protozoan that inhabits their gut, Nitrogen-fixing bacteria which live in root nodules of leguminous plants.

D. COMMENSALISM

What is commensalism?

Commensalism is a form of symbiotic relationship between organisms of different species in which one organism benefits but the other neither benefits nor is harmed. The Figure 6.9 shown below describes how commensalism works.



Figure 6.9: Birds following cattle

As large grazers move through the grass, They stir up insects. Cattle Egrets follow them and get their food from insects. The large grazers are neither helped nor harmed by the presence of the birds.

Key Terms

- **Parasitism:** The symbiotic relationship between two organisms where one species, the parasite, benefits, but the other, the host, is harmed.
- **Mutualism:** A symbiotic relationship between organisms of different species in which both organisms benefit.
- **Commensalism:** one of the forms of symbiosis. In which, one species lives attached to another but does not harm the other.



The remora fish which attaches itself to the underside of a shark and travels with it, the remora fish takes advantage of protection from other predators by attaching its self to the shark.

Figure 6.10: Commensalism between a shark and remora fish

There are also some other modes of survival which are considered as mode of nutrition. This includes **decomposers**, which are microorganisms, mainly fungi and bacteria that live on a dead organic matter. They secrete digestive enzymes on to a dead body and absorb the product of digestion.

Scavengers are animals that are dependent on the remnants of the primary predators. e.g voltures, hyena, etc.

Activity 6.5



Discussion on biological associations

Discuss in groups

- ☑ the above mentioned biological associations that you observe in your surroundings

1 Sort out if it is between
   - ☑ Animals,
   - ☑ Plants
   - ☑ Plants and animals

2 Describe the type of biological association that you observe?

Exercise 6.2

Choose the correct answer for each of the following questions

1 The biological term of living together in a close association of two or more organisms of different species is called -----

A Parasitism
B Commensalism
C Symbiosis
D Predation

2 Parasitism is an association where

A one benefits while the other is harmed
B both benefits
C neither benefits nor is harmed
D none of the above

3 Ectoparasites are parasites that live
- A within the host's body
- B on the outer body
- C both on the outer and within the host's body
- D none of the above

4 One of the following is an example of mutual association between plants and plants
- A lichens
- B insects and bees
- C crocodiles and birds
- D none of the above

5 In a commensalism association
- A one benefits while the other is harmed
- B one benefits but the other neither benefits nor harmed
- C both benefits
- D none of the above

6.3 Physical Factors of the Ecosystem

By the end of this section, you will be able to:

- describe soil as a physical factor of the ecosystem;
- explain how soil is formed;
- explain the different types of soil;
- describe the causes of soil erosion;
- describe the methods of prevention of soil erosion;
- Investigate different characteristics of soil using simple experiments;
- describe water as a physical factor of the ecosystem;
- state the importance of water;
- explain the water cycle with the help of a diagram; and
- describe the methods of conservation of water.

A. Soil

What is Soil?

Soil is an important abiotic (physical) factor of the ecosystem. Soil is the basis for the sustenance of life. Soil consists of a matrix of tiny particles of rock which result from the erosion and weathering of rocks. Soil contains air, water, organic materials and mineral salts that accumulated over time. These together provide a habitat for plants and small animals.

How is Soil formed?

The formation of soil takes place over a very long period of time. It can take several years before it becomes a soil. Soil is formed from the weathering of rocks and minerals. (see Figure 6.12)

The surface rocks break down into smaller pieces through a process of weathering and are then mixed with moss and organic matter. Over time this creates a thin layer of soil.

What are the contributing factors of soil formation?

Key Terms

- **Soil:** can be defined as the solid material on the Earth's surface that results from the interaction of weathering and biological activity on the parent material or underlying hard rock.

Soil is formed as a result of the interaction of the following five factors; parent materials, climate, organisms, relief (topography), and time (See Figure 6.11).

1 ***Parent materials*:** determine the type of soil produced such as its texture, drainage characteristics, mineral content and color. It is the material from which the soil is originated and varies from place to place.

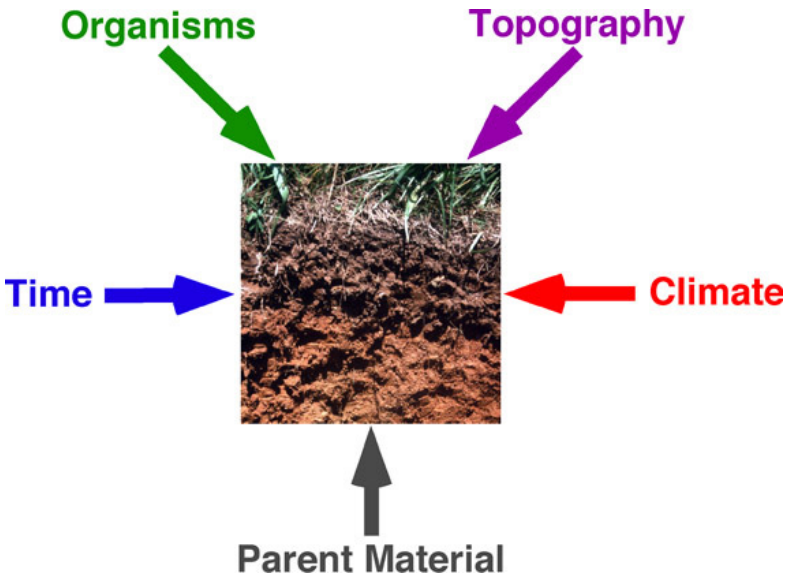


Figure 6.11: Factors affecting formation of soil.

2 ***Climate*** determines important environmental conditions, including the temperature and moisture (precipitation) and the length of the growing season. These affect a number of processes in the soil.

3 ***Biotic factors (living organisms)*:** different organisms starting from a microscopic bacterium to large animals contribute in the formation of soil. Micro organisms such as bacteria and fungi assist in the decomposition of plant litter (waste). Humus, dead parts of plants decompose and contribute to the texture of the soil.

4 ***Time*:** a newly formed soil retains the basic characteristics of the parent soil but through time it acquires other features resulting from the addition of organic matter and the activity of organisms.

5 ***Relief (landforms and topography)*:** it is a dynamic system that influences the formation of soil in several ways such as effect on soil profile thickness, on climate and the like.

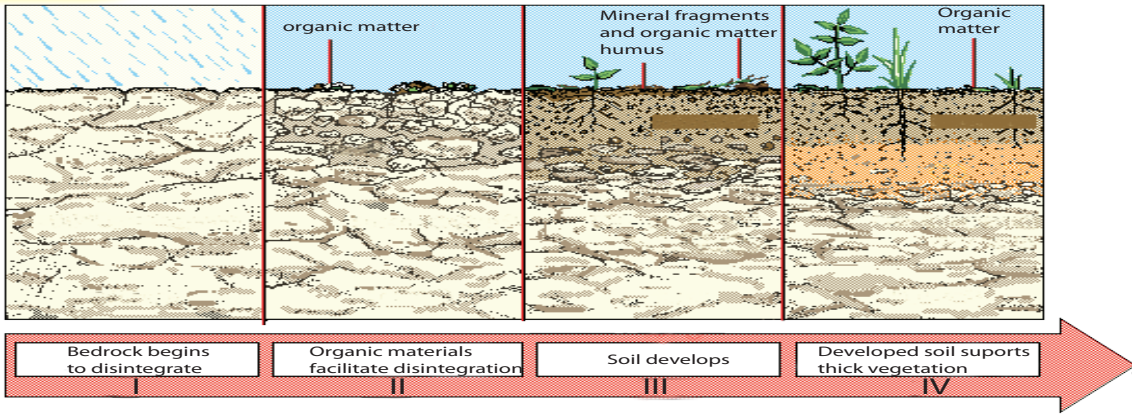


Figure 6.12: Steps of soil formation



Activity 6.6

Formation of soil

Procedure:

In groups, visit different places in your environment and discuss together:

- ☑ How the soil is formed?
- ☑ What factors are involved in the formation of soil?
- ☑ Can we use all types of soil for agriculture? and
- ☑ Classify the type of soils used for various purposes in your environment?

What are the processes in soil formation?

Soil formation process is a complex process and does not merely consist of random collection of particles. This complex system requires various processes such as weathering, decomposition and humification.

1. ***Weathering*:** refers to the breakdown and decomposition of rocks and minerals by factors including air, water, sun and frost. There are two types of weathering. These are:
   - a. Physical weathering that results in a continual breakdown of rocks into smaller and smaller particles and
   - b. Chemical weathering that results in a chemical composition of rock minerals.
2. ***Decomposition*:** is the process of breakdown of organic matters such as plant derived materials into its simpler organic constituents. This process is supported by the enzymes and chemicals of earthworms, termites and other organisms (See Figure 6.13).
3. **Humification** is the breakdown of plant remains leading to the formation of different types of humus.



Figure 6.13: Earthworms play an important part in decomposition

Key Terms

- **Decomposition:** the process of breakdown of organic matters.
- **Humiliation:** is the breakdown of plant remains leading to the formation of different types of humus.

Activity 6.7



Identify types of soil

1. Can you identify the types of soil formed in your habitat?
2. Try to differentiate the different types of soil in your habitat and bring a sample of soil for discussion.
3. Try to classify the soil type by color, size, and moisture content.
4. What are the advantages and disadvantages of each type of soil?
5. Which type of soil is more important for growing plants?

What are the types of soil?

There are three basic types of soil: **Loam (silt), sand, and clay**.

1. ***Clay soil*:** Clay soil is very fine particle which is less than 0.002 mm in diameter. It is difficult for cultivation during the rainy season due to its sticky nature of holding highest water capacity. Clay soil would be good for making pottery (see Figure 6.14a).

Key Terms

- **Clay soil:** Clay soil is very fine with a particle size of less than 0.002 mm in diameter.
- **Sandy soil:** It is light and dry soil and its particle size is between 0.002 mm and 2.00 mm in diameter.
- **Loam soil:** It is an ideal blend of sand and clay soil.

Its water retention capacity is valuable in a dry season and it is rich in nutrients. To improve the quality, lime should be applied to clay soils regularly as lime prevents clay soil from becoming too "sticky," and "opens" it up.



a. b. c.

Figure 6.14: Types of Soil (a, Clay soil; b, Sandy soil; c, Loam soil)

2 ***Sandy soil*:** It is light and dry soil and its particle size is between 0.002 mm and 2.00 mm in diameter. It contains less than 10 percent of clay and consists of very small particles of silica and quartz. The amount of humus present will alter the colour and the texture. Comparatively, it is easy to cultivate but poor in plant nutrients, coarse-grained, and does not retain moisture (See Figure 6.14b).

3 ***Loam soil***: It is an ideal blend of sand and clay soil. It is considered as the best soil for large number of plants because it is formed from dead and decayed bodies of organisms. This is called humus. The ideal loam has all the advantages of sandy and clay soils, and none of their disadvantages. The sand property allows the plant roots to work easily throughout it; the clay present helps to look after the plant nutrients, and prevents rapid drying out. In wet weather the water can percolate through quite quickly, and so the soil does not become water logged and in dry weather it does not become too hard for the roots to work through. (See Figure 6.14c).

Exercise 6.3

What are the characteristics of each type of soil? Try to identify each based on the table given below

Fill in the table below

Table 6.3: Soil types and their characteristics

	Soil Type		
Characteristics	**Clay**	**Sandy**	**Loam**
Humus content			
Particle size			
Moisture content			
Nutrient for plants			
Air content			
Draining			

Soil composition: In order to analyze the composition of soil in a particular sample, let's collect the different types of soil. Soil is composed of many different sized particles.

Activity 6.8



Soil composition

Materials you will require:

- ☑ Soil of different type,
- ☑ water, rocks, and
- ☑ water glass.

Procedures:

1 Go to your surroundings and collect a sample of soil. Put a sample of it in a jar of water. Stir it well and let it settle. Observe and describe the different layers of materials, as illustrated in the Figure 6.15.

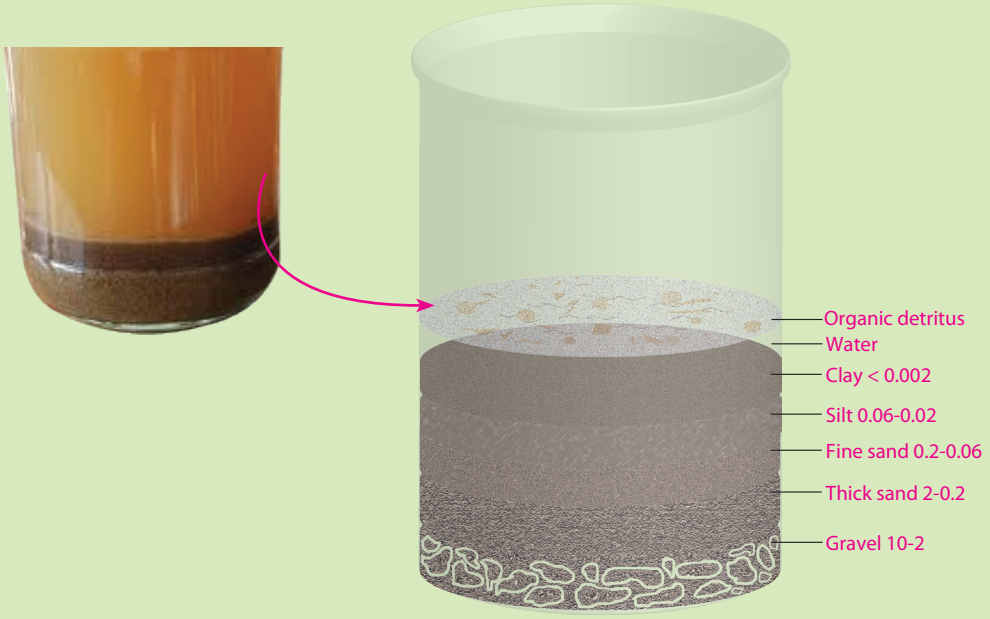


Figure 6.15: Test for the composition of soil (the sizes are in mm)

2 In water, bigger particles settle more quickly than smaller ones. It is possible to use this property to determine the amount of each component of the soil. Put 3 parts of water and 1 part of soil in the container (try 1 cup soil and three cups of water in a quart jar); shake the container for 5 minutes and let the material settle?

3 Evaluate

- ☑ The water content- by drying a known mass in an over at 100°c.
- ☑ Humus content- by heating a known mass of dry soil on a tin lid wich a Bunsen burner.
- ☑ Air content- by mixing 50cm^3 of soil with 50cm^3 of water and measuring the total
- ☑ Particle size distribution- by passing a known volume of dry powderd soilthrough a series of sives.
- ☑ Water retention- by timing how long it takes to pass down a column of soil.

4 Compare the results for each types of soil based on the Figure 6.15.

B. Soil Erosion

What is Soil Erosion?

Soil is one of the important aspects of an ecosystem. Green plants that are the source of food production take up minerals and water from the soil. A plant that grows in a favorable soil texture brings much fruit or production. One of the main reasons for poor quality of soil is a natural cause of soil degradation due to erosion.

Key Terms

- **Soil Erosion:** is the process by which soil and rock are removed from the land surface by physical forces such as rainfall, flowing water and wind.

Soil erosion is a naturally occurring process on all land. The agents of soil erosion are water and wind, each contributing a significant amount of soil eroding from one part of land to another or sea. Soil erosion may be a slow process that continues relatively unnoticed, or it may occur at an alarming rate causing serious loss of topsoil.

What happens when heavy rainfall and wind constantly blows over soil?

What happens when rain erodes the top parts of the soil?

Erosion is a natural process that occurs over time and affects location and design of each land. There are different types of erosion: splash, rill gully and sheet erosion, tunnel and wind erosion. Erosion which is created due to rain starts as a splash off and grows into sheet, rill and gully. (See Figure 6.16).



Figure 6.16: Severe rill and gully erosion due to improper land use.

The loss of soil from farmland results in reduced crop production potential, lower surface water quality and damaged drainage networks. Soil erosion is one form of soil degradation that results in soil compaction, low organic matter, loss of soil structure, poor internal drainage, salinisation, and soil acidity problems. These other forms of soil degradation, serious in themselves, usually contribute to accelerated soil erosion.

Causes of Soil Erosion: the causes of soil erosion can be grouped as natural and man-made.

1 **Natural factors** for soil erosion such as rainfall, wind and gravity are the main natural reasons for soil erosion.

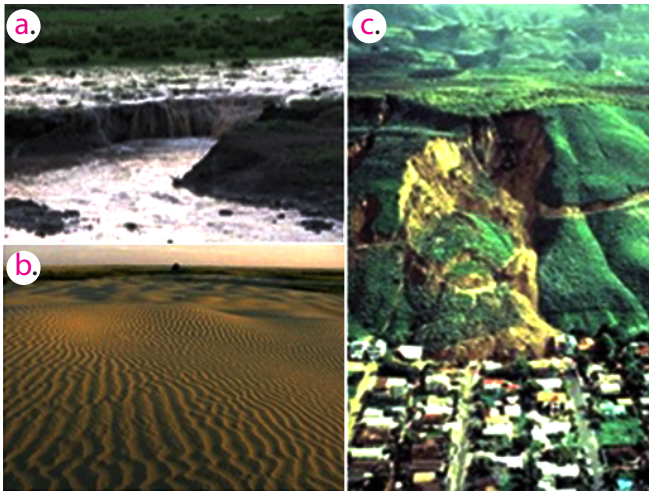


Figure 6.17: Factors contributing for soil erosion; (a) flood due to heavy rain, (b) wind power and (c)mass slide due to gravity.

2 ***Man made factors*:** inappropriate land use; deforestation, overgrazing, faulty farming systems, high crop intensity, housing construction and mining are some of the major cause of soil erosion. (See Figure 6.17).



Activity 6.9

Demonstration on how soil erosion works

Materials you will require:

- ☑ Soil,
- ☑ Water,
- ☑ Rocks,
- ☑ Disposable,
- ☑ Aluminum Trays,
- ☑ Containers of Water,
- ☑ Newspapers,
- ☑ Books and
- ☑ Pencil/Pen.

1 Tray filled with soil and rocks



2 Water being poured on it

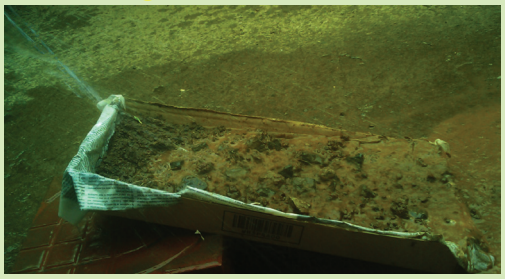


Figure 6.18: A model for demonstration of soil erosion

Procedures:

1. Cover the tray with newspaper.
2. Fill your tray with soil, putting it down firm into place.
3. Position rocks in the soil so they cannot move about freely.
4. Place the narrow side of the tray on a book or pice of stone, so the tray is on a slant.
5. Pour little drops of water starting at the highest part of the tray, so water can run down the soil.
6. Write down changes taking place in your tray. Are the soil and rocks moving out of position?
7. Pour larger amounts of water at the highest part of the tray.
   - ☑ Now describe the changes that are taking place. Of course, you can observe such signs of erosion in your localities now onwards.

C. CONSERVATION



What is Soil Conservation? What are the means to protect soil erosion?

For an effective soil erosion controls

- ☑ Maintain good soil structure,
- ☑ Protect the soil surface by adequate crop and residue cover, and
- ☑ Use special structural erosion control practices where necessary.

These factors often control both water and wind erosion. Not all erosion control practices will fit into every land structure. However, each erosion problem can be improved by choosing one or more of the remedial practices appropriate to the problem.

Key Terms

- ☑ **Deforestation:** the removal of trees for timber and other reasons.
- ☑ **Overgrazing:** the loss of ground cover, grass by too much consumption of cattles.

Soil erosion can be improved by several ways. Some of these are

1. ***Plant and crop residue cover***
2. ***Afforestation*:** it is to plant trees on a land which has been faced with deforestation. (See Figure 6.19a).

Key Terms

- ☑ **Conservation:** it is the care and management of the natural environment.

3 ***Terracing*:** Making slopes into steps so that rain cannot run down a hill carrying soil off. When building terraces, it is important to stabilize the slope. The easiest way to do this is to plant grass. If there is enough rock around it may be possible to construct a wall out of them. (See Figure 6.19b).

4 ***Contour plowing*:** Similar to terracing except that it follows the contours of a hill more closely than terracing, possibly even encircling a top hill. The contours are not wide like terraces. It is more like planting along the contours, so the hill slope remains gentle or less steep. (See Figure 6.19c).



Figure 6.19: Soil conservation method. a) afforestation, b) Terracing and c) contour plowing.

D. WATER

What is the importance of water?

Water is an important abiotic (physical) factor in any ecosystem. It is a precondition for existence of human, animal and plant life. Water also plays a fundamental role in the climate regulation cycle and a country's economic growth. Water that lands or falls on high ground has potential energy that can be converted into electric energy by a hydroelectric power. Productivity in agriculture is directly related to the availability of water.

Key Terms

☑ **Water:** a clear, colorless, odorless, and tasteless liquid, H_2O, essential for most plant and animal life.

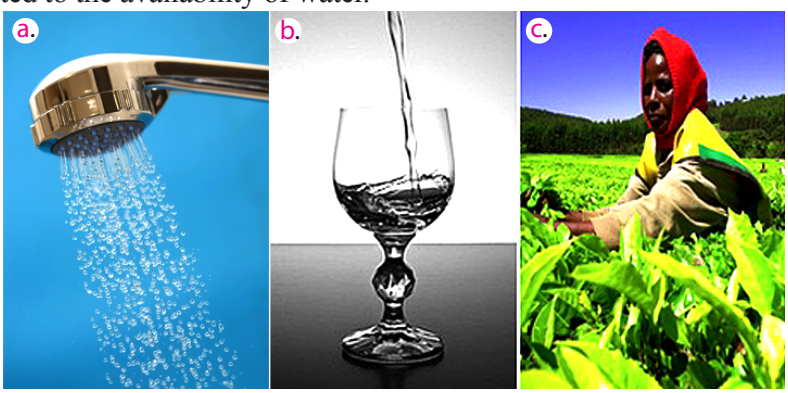


Figure 6.20: Some common uses of water a. Showering and bathing b. Drinking c. Agriculture

Water Cycle

Activity 6.10

How water cycle works in an ecosystem

- ☑ Draw and label the water cycle to identify the different processes and stages of recycling water

Use the information given below in developing the water cycle

- ☑ The sun provides the energy needed to convert liquid water to water vapour.
- ☑ In warm climates water evaporates from the surface of the oceans into the air.
- ☑ Water vapour forms clouds that could turn to rain.
- ☑ Clouds pass to colder parts of the world.
- ☑ At some point water vapour condenses and falls to the ground as rain, or sometimes as rain or snow (See Figure 6.21).

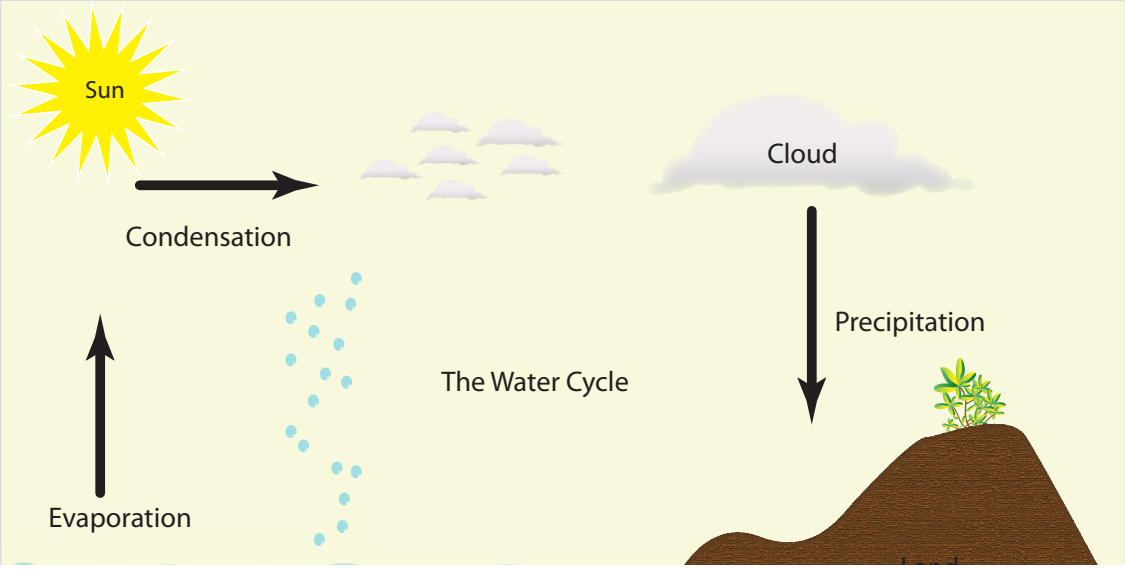


Figure 6.21: The water Cycle

The proportion of the rain differs from one part of the world to another. In some parts of the world it rains a lot and may result in flooding while in other parts of the world it rains very little and water is a scarce commodity.

Did You Know?

* ¾ of our world surface is covered by water but only 2.5% is consumable including the glaciers and polar ice.
* Water makes up 70 - 75% of our total body weight. We need 6-8 glasses of water per day for normal metabolism

The main processes involved in water cycle are: evaporation, transpiration, condensation and precipitation.



Activity 6.11

Factors affecting the water flow

Procedure:

Discuss in groups

1. Which parts of the world get much amount of rainfall and which parts of the world don't get enough rain? What is the reason for that?
2. Which parts of our country get enough rainfall and which parts frequently experience drought?
3. Build a rain gauge from an empty 2 liter water bottle and use it to measure the rainfall in your locality over a period of time.

What is Water Conservation?

The amount of water within any environment varies from season to season. During rainy season there is enough or excess amount of water available and provides moisture to the ground and also flows into streams or rivers and joins into pools, lakes or seas.

It is so important in an area where rainfall is scarce to conserve water using various conservation methods. (See Figure 6.22).

Key Terms

- **Evaporation:** the process of becoming a vapour or gas .
- **Transpiration:** loss of water vapour from plants.
- **Condensation:** a change of water vapour to liquid water.
- **Precipitation:** Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.



Figure 6.22: The Grand Millennium Dam which is being built on the river Blue Nile is one of the strategies to conserve water and soil

Activity 6.12



Water conservation

☑ Discuss in groups,

1 What are the means to reserve water during rainy seasons?

2 How can we use water economically?

3 How can we keep the water we use in our environment clean?

4 What are the good steps that you appreciate that are currently taken by the local government in your regions and at national level on water conservation?

5 What practical plan do you have to conserve water in all seasons?



What are the different methods of water conservation?

Some of the methods used on water conservation include:

☑ Building dams and reservoirs on the rivers

☑ During the rainy season collecting as much of the rain as possible in reservoirs and store ponds.

☑ Eliminating leakage from the pipes used to transport water from storage to the user.

☑ As individuals, reducing ways in which water is wasted at home such as leaking taps due to damaged washers, washing under running water rather than in a bowl of water, leaving taps on unnecessarily.

☑ In times of shortage eliminating unnecessary uses such as car washing and garden watering.



Figure 6.23: Water reservior a means for water conservation

Unit Summary

- Ecosystem – is the system formed by the interaction of living and non-living components of the environment.
- Ecosphere is the part of the earth where radiant energy (sun light) reaches. It includes all ecosystems of the world.
- Biome – is a specific life zone with a particular environmental condition (climatically defined).
- Biosphere – is the area of the earth where there is life.
- Symbiosis: is a biological association between two organisms or species within a habitat. The relationship could be helpful or harmful.
- Some of the major types of biological associations are parasitism, predation, mutualism, commensalism.

Type of association	Characteristics
Mutualism (++)	both species benefit
Commensalism (0 +)	one species benefits, the other is unaffected
Parasitism (- +)	one species benefits, the other is harmed
Competition (- -)	neither species benefits
Neutralism (0 0)	both species are unaffected

- Soil is one of the abiotic factors of an ecosystem. Its formation depends on various factors such as parent materials, climate, biotic factors, time and relief. It passes through a complex process of weathering, decomposition and humification.
- Soil has different profiles based on the depth of the ground, classified as top soil, subsoils and parent material.
- Soil type classified in to three types as Clay, Sandy and Loam soil. Other types of soils such as Calcareous or chalky soil, peat soil
- Soil is composed of organic detritus, water, clay, silt, sand, and gravel.
- Erosion is a natural process that occurs over time and affects location and design of each land. It is mainly caused by natural and man-made problems. It can be protected using techniques like covering with green plants, terracing, contour ploughing, etc …
- Water is another abiotic factor that plays important roles in maintaining living things within an ecosystem. It has a cyclical movement within ecosystem and needs caring and conservation as it is becoming one of the scarce resources in different seasons.

Review Exercise for Unit 6

Part I: ***Choose the best answer for each of the following questions***

1 An ecosystem is an interaction among

A living things only

B nonliving things only

C both living things and nonliving things

D none of the above

2 The relationship between tapeworms and humans is an example of

A Commensalism

B Mutualism

C Parasitism

D Symbiosis

3 A relationship is called commensalism if

A both organisms are benefited

B one organism is benefited and the other not harmed

C one organism is benefited and the other is harmed

D neither of the organisms are benefited

4 Identify the correct match between type of soil and diameter

A Clay – less than 0.002 mm

B Sand – 0.002 mm – 0.02 mm

C Gravel – less than 0.02 mm

D All are correct

5 Which of the following is not involved in water cycle?

A Condensation

B Precipitation

C Evaporation

D Crop rotation

6 Which of the following methods does not conserve soils?

A Dam-building and reservoirs

B Deforestation

C Making terraces

D Crop rotation



A sample of soil is mixed with water in a sedimentation tube and shaked thoroughly and allowed to settle down. Finally the result, as shown in the figure, is obtained. Based on this, answer questions 7 to 10.

7 Which type of soil particle is heavier?

A A C F

B E D B

8 Which layer contains high amount of remenants of decayed organisms?

A A C C

B F D B

9 Which soil layer is the least to retain water?

A F C C

B A D B

10 One of the following is not correctly matched

A A=Humus

B C= Gravel

C D= Sand

D F=Clay

PART II: *Match the following*

	Column A		Column B
11	Biomes	A	Good type of soil for making pottery
12	Aquatic ecosystem	B	Best soil for large number of plants
13	Symbiosis	C	(+, -) Relationship
14	Commensalism	D	(+, +) Relationship
15	Mutualism	E	(0, +) relationship
16	Parasitism	F	is a close ecological relationship between the individuals of two (or more) different species.
17	Loam soil	G	is a complex relationship of living organisms and their habitat within a water area.
18	Clay soil	H	Large area of the earth that have similar weather, types of plants and animals

PART III: *Fill in the blank space*

19 The non-living component of an ecosystem is known as _____.

20 Biological term of living together in a close association of two or more organisms of different species is called _____.

21 Soil is composed of _____, _____, _____, _____, sand and gravel.

PART IV: *Give short answer*

22 Define briefly the following terms

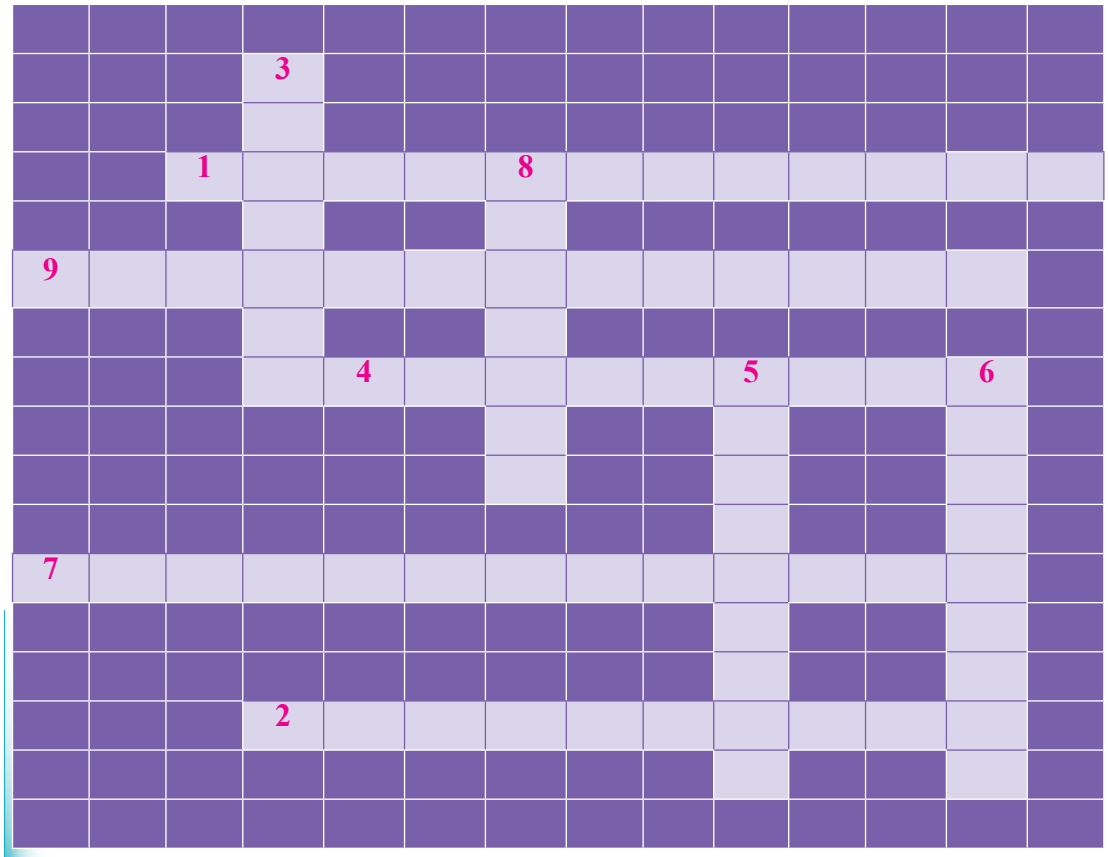
a Ecosystem

b Ecology

23 Mention at least three types of biological relationships and give examples for each types of association.

24 What are the physical factors of ecosystem

PART V: *Copy the cross word puzzle and use the numbered clues to complete and solve the puzzle.*



The numbers in bracket indicate the number of letters in each word to be inserted in a box.

Across

1 The care and management of the natural environment (12)

2 A person who studies the relationship between organisms and their environments. (9)

4 All of the living organisms and non-living parts of a specific area and their interaction. (9)

7 One of the forms of symbiosis in which, one species lives attached to another but does not harm the other. (12)

9 The process of break down of organic matters into simpler organic constituents (13)

Down ward

3 The scientific study of the life and structure of plants and animals (7)

5 Is a close ecological relationship between the individuals of two (or more) different species. (9)

6 A symbiotic relationship between organisms of different species in which both organisms benefit. (9)

8 Branch of biology that studies all life forms and their interactions with their environment. (7)