Biology

For Distance Education
Module 2
Grade 9

Federal Democratic Republic of Ethiopia
Ministry of Education

Biology

For Distance Education

Grade 9

FDRE
MOE

Biology

For Distance Education
Module 2

Grade 9

Federal Democratic Republic of Ethiopia
Ministry of Education

Biology

For Distance Education

Module 2

Grade 9

Writers:

Zufan Bedewi, PhD

Zelalem G/mariam, PhD

Editors:

Girma Moti, PhD (**Curriculum Editor**)

Temesgen Daniel, PhD (**Language Editor**)

Designer:

Tesfamichael Getu, PhD

Evaluators:

Berhanu Tesfaye, MA, MEd

Gebrehana Zeleke, MSc

FDRE Ministry of Education

Hawassa University

First Published xxxxx 2023 by the Federal Democratic Republic of Ethiopia, Ministry of Education, under the General Education Quality Improvement Program for Equity (GEQIP-E) supported by the World Bank, UK's Department for International Development/ DFID-now merged with the Foreign, Common wealth and Development Office/FCDO, Finland Ministry for Foreign Affairs, the Royal Norwegian Embassy, United Nations Children's Fund/UNICEF), the Global Partnership for Education (GPE), and Danish Ministry of Foreign Affairs, through a Multi Donor Trust Fund.

The Ministry of Education wishes to thank the many individuals, groups and other bodies involved – directly or indirectly – in publishing this Textbook. Special thanks are due to Hawassa University for their huge contribution in the development of this textbook in collaboration with Addis Ababa University, Bahir Dar University and Jimma University.

Photo credit: cover page, p.1,, 19, 44, 74, 103, 137 Unsplash, 2022

Printed by:
xxxxxxxx PRINTING
P.O.Box xxxxxx
xxxxxxx, ETHIOPIA
Under Ministry of Education Contract no. xxxxxxxxxxx

ISBN: XXXXXXXXXXXX

Contents

Module Two: Introduction

This is the second module of grade 9 Biology. It is a material designed for distance learner. The module consists of three units, namely **Reproduction; Human Health, Nutrition and Diseases; and Ecology.** Each unit is organized into sections that include introduction, minimum learning competencies, subtopics followed by self – assessment exercises and checklist. At the end of each unit, there are unit summary, feedback to activity and answer key for self–assessment exercises. Moreover, there are references, largely available as free book pdf on the internet, for each unit of the module for further reading.

Even though there are different specific learning strategies / learning methods for the different sections, the following general learning strategies are suggested, but not limited, to study this module:

- Rehearsal /Retrieval practices – Constructing mind or mental map, preparing short notes, checking course materials to fill gaps in memory
- Elaboration practices_ paraphrasing, creating analogies, question and answering
- Self-evaluation practices – Using checklist, rereading /reviewing , generating self-test questions
- Self-regulating practices : allocate specific study time (prepare daily time table or weekly pattern or some other types of arrangement), designate defined, quiet and organized area to study, adjust learning rate, Respect schedule and finish activities and exercises in time

In this module, you will find the following icons or graphic symbols with the description they represent throughout the module.

 This tells you there is an overview of the unit and what the unit is about.

 This tells you there is an in-text question to answer or think about in the text.

 This tells you to take note of or to remember an important point.

 This tells you there is a self-test for you to do

 This tells you there is an activity for you to do

√ This tells you there is a checklist.

 This tells you there is a written assignment

 This tells you that this is the key to the answers for the self-tests.

Be sure that as a student enrolled distance education, you are expected to take the roles of a student and a teacher to ensure the quality of your learning. As a student, you are responsible for mastering the lessons and completing the learning activities and assignments. As a teacher, you are responsible for checking your work carefully, noting areas in which you need to improve and motivate yourself to succeed.

Dear distance learner, if you encounter difficulty in understanding some topics in the module, do not get frustrated or discouraged. Take it as a challenge. Do not give up! Keep in mind that you are self – learner practicing individual learning. Do not forget that other distance learners too may experience similar difficulties as you encountered.

When some topics are difficult to understand, first go through the module over and over again until you get things clearer. If you are not able to succeed, do not hesitate to get the support of teachers in the nearby school or knowledgeable experts from other sectors or exchanging information with another distance learner and regular students. Additionally, you should be aware that tutors will be assigned to you in each tutorial center. As a result, you can get in touch with your tutors if you run into any problems. You can ask your instructors about the module's sections that you do not understand and even the activities that, in your opinion, are unclear or difficult to answer. You can also bring your module, your responses to the module's activities, and any challenging topics you think your tutor should hear about and help you.

As final advice, you should do all the activities and self-assessments exercises by yourself before proceeding to the feedback or answer key for self-test exercises.

General Objective of Module II

Dear learner! This module contains three units. After completing studying the units in this module, you will be able to:

- Appreciate that life perpetuates from generation to generation through reproduction (transfer of genetic material from parents to offspring)
- Compare and contrast the advantages and disadvantages of asexual and sexual reproduction
- Differentiate between male and female reproductive structures
- Discuss what are puberty and primary and secondary sexual characteristics
- Describe menstrual cycle, fertilization, pregnancy and sex determination
- Tell methods of birth control
- Describe what are nutrition and nutrients
- Recognize the importance of a balanced diet for a healthy lifestyle
- Describe the effects of malnutrition on the development of infectious and non-infectious diseases
- Reproduce a cost-effective plan for healthy diet in everyday life
- Appreciate renowned nutritionists in Ethiopia
- Explain ecological terms
- Differentiate between the biotic and abiotic components of an ecosystem
- Describe the major terrestrial and aquatic ecosystems and the fauna and flora of each biome
- Discuss the ecological levels
- Differentiate between terrestrial and aquatic ecosystems
- Describe what is ecological succession
- Tell ecological relationships in ecosystems

Assessment Techniques

Dear learner! One or more of the following assessment methods can be used while are studying this module to see if you have done so successfully:

1) After each section in the module, there is a self-evaluation checklist to which you have to respond.
2) Self-testing exercise are provided after each lesson that you are required to complete. Do not rush to look at the answers provided at the end of the units when you are completing the self-test exercise. Answer the questions first, then review your answers on the answer sheet.
3) You complete the activities in your tutorial centres, which will support your module study with practical activities. You must answer questions following your practical activity. However, do not rush to the answers provided at the end of the unit. First test on yourself.
4) You will have "Assignment for Submission" at the end of the module. You are required to complete assignments questions and submit it to your tutorial centre so that it can be corrected.
5) Try to respond to each every in-text and leading questions throughout your study session. Before moving on to the next section, these questions will assist you in reading additional materials – books, internet and other potential resources.
6) Final examination: Following successful completions the module, you will take a final examination at your tutorial centre.

UNIT ONE: REPRODUCTION

Dear learner! Welcome to unit one which deals with reproduction. This chapter will re-introduce you to the topic reproduction and several key concepts that you may have covered in primary school science education. We will start this chapter with definition of the concept of reproduction and the role of reproduction in the continuity of life. You will learn about types of reproductive modes in unicellular (e.g., bacteria, protozoa) and multicellular organisms (e.g., fungi, animal and plants). You will also learn about sexual reproduction humans', menstrual cycle, ovulation, fertilization, development and birth, contraceptive methods and sexually transmitted infections.

LEARNING OUTCOMES

Upon successful completion of this unit, you will be able to:

- Appreciate how life perpetuates from generation to generation through reproduction
- Compare and contrast the advantages and disadvantages of asexual and sexual reproduction
- Differentiate between male and female reproductive structures of human beings
- Discuss about puberty, and primary and secondary sexual characteristics
- Describe menstrual cycle, fertilization, and pregnancy
- Discuss methods of birth control
- Discuss about sexually transmitted infections (transmission ad preventions)

UNIT CONTENTS

This unit includes the following four major contents organized in sections.

Section 1.1. Introduction to reproduction

Section 1.2. Asexual reproduction

- Section 1.2.1. Fission
- Section 1.2.2. Fragmentation
- Section 1.2.3. Budding
- Section 1.2.4. Vegetative reproduction
- Section 1.2.5. Parthenogenesis

Section 1.3. Sexual reproduction (Humans as example)

- Section 1.3.1. Primary and secondary sexual characteristics
- Section 1.3.2. Male reproductive structures
- Section 1.3.3. Female reproductive structures
- Section 1.3.4. The Menstrual cycle
- Section 1.3.5. Fertilization and pregnancy
- Section 1.3.6. Methods of birth control

Section 1.4. Sexually transmitted infections: transmission and prevention

REQUIRED STUDY TIME

You are expected to spend 29 hours of the semester to learn this unit. You should use the allocated study time properly and efficiently to cover the lessons included in this unit.

LEARNING STRATEGIES

For your successful distance learning process, you can use the following learning strategies wherever they are appropriate to the topics/subtopics of your lesson. These are mind mapping, mentally rehearsing, short visits/onsite observation, comparing and contrasting, drawing and taking pictures, creating analogies, paraphrasing, summarizing (outlining and preparing flow chart summaries), taking short notes, underlining or highlighting key points.

SECTION 1.1. INTRODUCTION TO REPRODUCTION


Dear learner! In unit three of module one, you have learned about cells and their characteristic features. Go back to your notes in unit three to refresh your memory about cell structure and function. In this subsection, you will be using your knowledge about cell and applying it to the reproduction of organisms.

COMPETENCIES

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

- appreciate that life perpetuates from generation to generation through reproduction

Activity 1

Dear learner, as you know, there were people living in Ethiopia or elsewhere thousand years ago and all were passed away but still there are people living there. Why? Though individuals of a species are mortal, life continues from generation to generation. Which biological process is responsible for this? Prepare a short report on the biological process and present it at a tutorial center.


What is reproduction?

Dear learner, reproduction is one of the unique characteristics of life. The ability of organisms to reproduce to form their own kind is the one characteristic that best distinguishes living things from nonliving matter. Two modes of reproduction are recognized: **asexual** and **sexual**. In **asexual reproduction**, there is only one parent and with no special reproductive organs or cells. Each organism is capable of producing identical copies of it as soon as it becomes an adult. **Sexual reproduction** as a rule involves two parents, each of which contributes special germ cells (egg or sperm) that in union (fertilization) develop into a new individual.

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- appreciate that life perpetuates from generation to generation through reproduction _____ ☐

SECTION 1.2. ASEXUAL REPRODUCTION

 Dear learner! In the previous section, you have defined reproduction and studied the role of reproduction on the continuity of life. You have also defined asexual and sexual reproduction. Next, you will study in detail about the asexual reproduction and types of asexual reproduction.

COMPETENCIES

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

- define asexual reproduction
- differentiate the process of asexual reproduction
- tell the advantages and disadvantages of asexual reproduction
- explain the mechanism of fission
- discuss the mechanism of fragmentation
- describe the mechanism of budding
- investigate the mechanism of vegetative propagation
- describe the mechanism of parthenogenesis

Activity 2

Dear learner! Understand that no organism can live forever, but part of it lives in its offspring. As you knew offspring are produced by the process of reproduction. This process may be sexual or asexual, but in either case, it results in the continuation of the species. State the differences and similarities among the different types of asexual reproduction and present it at a tutorial center.

What is common to all types of asexual reproduction?

Dear learner, **asexual reproduction** is the production of individuals without gametes (eggs or sperm). It includes a number of distinct processes, all without involving sex or a second parent. Asexual reproduction appears in bacteria and unicellular eukaryotes and in many invertebrates, fungi and plants. However, asexual reproduction is absent among vertebrates. The basic forms of asexual reproduction are fission (binary and multiple), budding, and fragmentation. For example, a small piece of stem planted in the soil may form roots and grow into a complete plant as shown in Fig. 1.1.

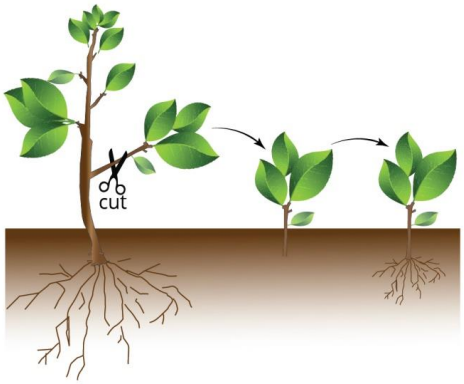


Figure 1.1. Vegetative propagation in plants.

Advantages and disadvantages of asexual reproduction

Advantages:

- no mate is needed;
- no gametes are needed;
- all the good characteristics of the parent are passed on to the offspring;
- offspring will grow in the same favorable environment as the parent.
- Plants that reproduce asexually usually store large amounts of food that allow survival.

Disadvantages:

- There is little variation created, so adaptation to a changing environment (evolution) is unlikely.
- If the parent has no resistance to a particular disease, none of the offspring will have resistance.
- Lack of dispersal can lead to competition for nutrients, water and light.

Section 1.2.1. Fission

Dear learner! Now you are familiar with the mechanism of asexual reproduction and its advantages and disadvantages. In this section, you will learn about the modes of reproduction commonly used by bacteria and protozoa. Have you ever asked yourself how unicellular organisms such as bacteria or protozoa reproduce? If you already know, it is fine! Otherwise, I will briefly present the mode of reproduction used by some unicellular organisms – bacteria and protozoa.

In **fission**, the organism divides into two (binary fission) or more (multiple fission) equal parts. Binary fission is common among unicellular organisms. In **binary fission,** the body of the unicellular parent divides by mitosis into two approximately equal parts, each of which grows into an individual similar to the parent.

What are the steps of fission?

Dear learner, bacteria are one-celled organisms that do not have a true nucleus. Bacteria reproduce through a process of asexual reproduction called **binary fission**. In binary fission, the organism splits into two equal-sized offspring each containing a single chromosome carrying a complete set of DNA identical to the parent as shown in Fig. 1.2 below.

Steps of binary fission are:

1. the cell is preparing for reproduction
2. cell makes a copy of a single chromosome
3. the original chromosome and its copy separate as the cell grows larger
4. the cell membrane begins to pinch inward near the middle of the cell, creating two new parts and
5. a new cell wall forms around the two new cells.

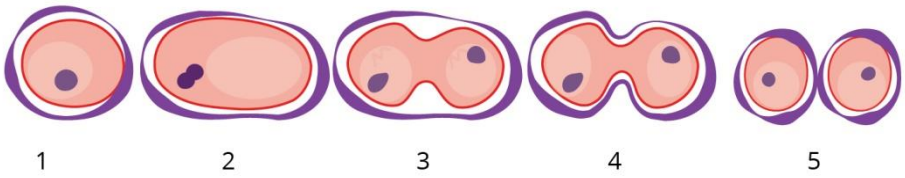


Figure 1.2. Binary fission in bacteria

ATTENTION: FOOD SPOILAGE

Dear learner, the cells of some species, such as bacteria, can divide every 20-30 minutes. When placed on a solid growth medium in a petri dish, a bacterial cell and its daughter cells undergo repeated cellular divisions and form a group of identical cells called a bacterial colony. Such rapid rate of bacterial cell reproduction is one reason why a small number of bacteria can seriously contaminate our food products.

Section 1.2.2. Fragmentation

Dear learner! In the previous section, you learned about the common reproduction mechanism in bacteria. It is stated that the products (daughter cells) of fission are identical to their parent. However, other organisms such as algae, fungi and some invertebrate species use other mechanism to propagate themselves. Did you know the reproductive mechanisms that algal cells use to multiply?

What is fragmentation?

Dear learner! Comprehend that fragmentation is one of the most common modes of asexual reproduction involving the breakdown of a parent organism into parts that develop into whole organism. Fragmentation is observed in fungi, plants, animals and algae. For example, Spirogyra, the filamentous green-algae undergoes fragmentation which results in many filaments. Each filament grows into matured filament (Fig. 1.3).

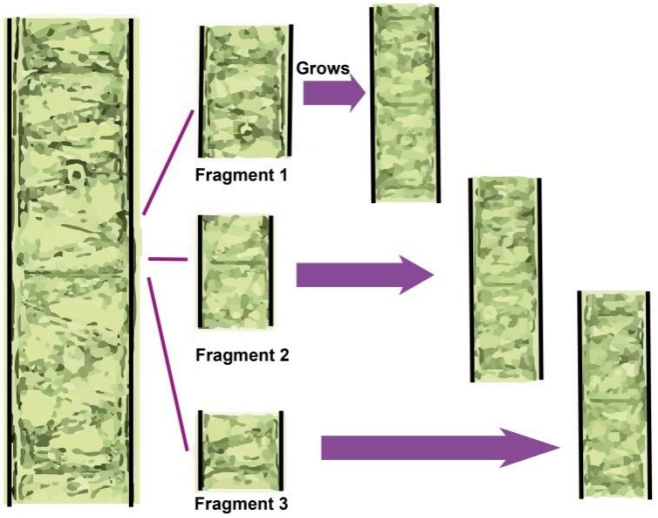


Figure 1.3. Fragmentation in filamentous green-algae

How do planarians reproduce?

Dear learner, a planaria reproduce by **fragmentation**. If a planaria is cut into two parts, it will create two new whole planaria. If a single planaria is cut into three parts, three new whole planaria will result. If part of a planaria is cut but remains attached, it will regenerate the cut part. For example, if the head of the planaria is cut, two new heads will result. Regeneration is the ability of an animal to regrow a tissue, organ, or part of the body.

Section 1.2.3. Budding

Dear learner! In last section, you learned about mode of reproduction algae and planarian use to perpetuate themselves. In fragmentation, if an organism is cut into parts the pieces will grow into a full organism as seen in planarian, for example. In this section you study mode of reproduction yeasts and invertebrates usually uses to propagate themselves.

What is budding?

Dear learner, the other common type of asexual reproduction is **budding**. In this mode of reproduction, the organism divides into two unequal parts. It is common in fugal species and invertebrates (e.g., hydra). During the process,

a bulge forms on the side of the cell, the nucleus divides mitotically, and the bud ultimately detaches itself from the mother cell.

Yeasts are well known for their ability to reproduce by budding. Yeast is an important part of bread production. When a yeast cell buds, it makes a copy of its nucleus. A tiny bud begins to form on the cell wall. The bud grows larger and eventually breaks off the cell wall to become a new yeast cell, taking along the new nucleus as shown in Fig. 1.4 below.

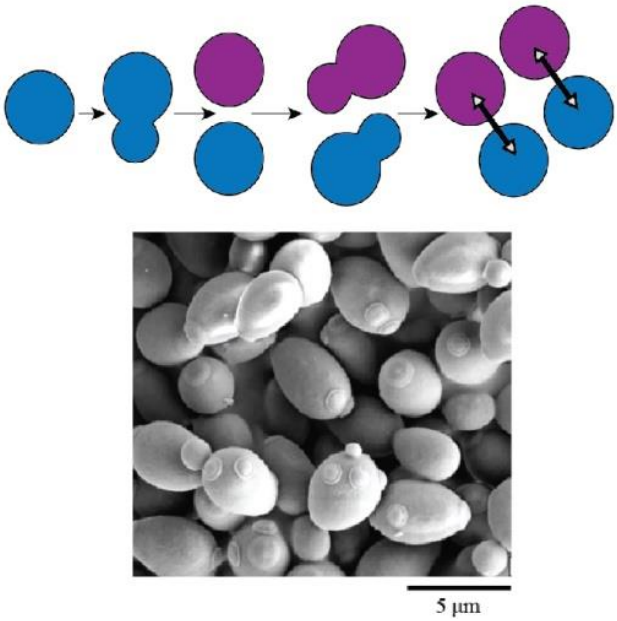


Figure 1.4. Budding in yeast

Sporulation

Why sporulation is an ideal means of asexual reproduction in colonizing the different habitat?

Dear learner, the majority of fungi, however, reproduces asexually by the formation of spores (i.e., sporulation). Spores are dispersed often by air currents and if they reach a suitable situation, they grow new **hyphae.** The hyphae develop into a mycelium (Fig. 1.5; left). At the tip of the hyphae, a swelling or sporangium – spore case forms. **Penicillium** and **Mucor** are examples of mould fungi that grow on decaying food or vegetable matter as indicated in Fig. 1.5; right below.

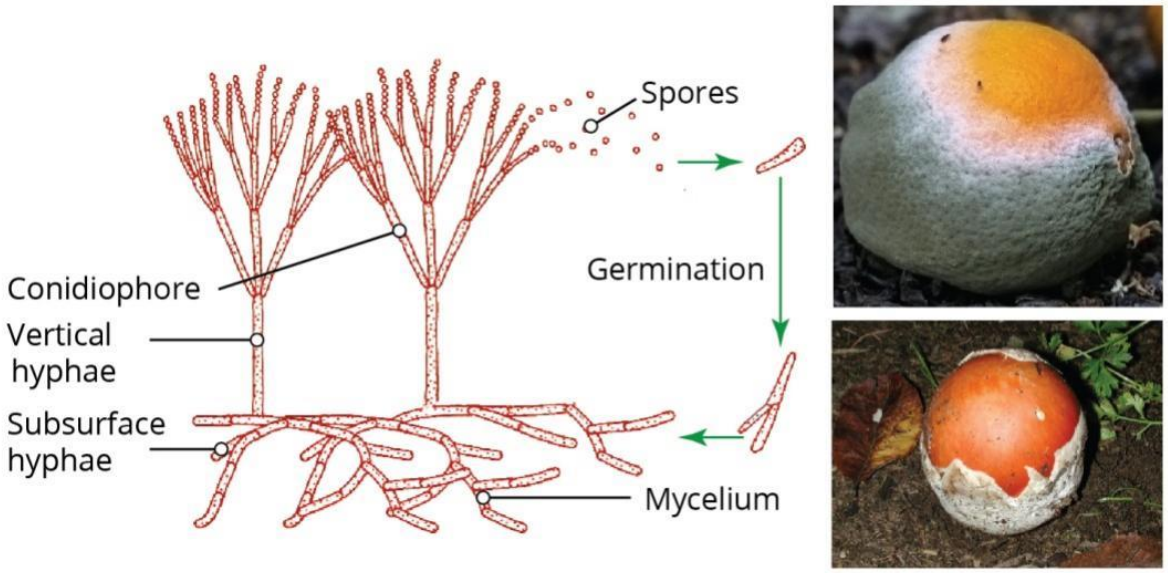


Figure 1.5. Asexual reproductions in fungi

Activity 3: Experiment on budding and fragmentation

Dear learner! Make a field visit in your village and collect specimens of organisms that reproduce with budding/fragmentation and take a picture of the habitat. Do experimentation on budding/fragmentation, if you have access to a resources. Material required 10% glucose solution, yeast, microscope, slide, cover slip, dropper and test tube. Write the outcome of your experimentation and present it at a tutorial center.

Key terms

Chromosome: the hereditary material that carry the biological information

Hypha (pl. hyphae): the long filamentous branches found in fungi

Mitosis: type of cell division that produce two identical daughter cells

Mycelium: the vegetative part of a fungus, consisting of a network of fine white filaments (hyphae)

Spore: reproductive cell

Section 1.2.4. Vegetative Propagation

Dear learner! Now that you are familiar with the mechanisms of fission, budding and fragmentation. Next, you will see the mode of reproduction many plant species use to propagate themselves. Did you know how some plant species such as Potato, Enset, Onion, Ginger propagate themselves? Could you name some of the application vegetative propagation in agriculture? Do not bother! Next, we will explore in detail the different types of vegetative propagation and their application turn by turn.

What is vegetative propagation?

Dear learner**!** Be aware that vegetative propagation is the process by which a new plant is created from the roots, stems, or leaves of plants. For example, willow branches can develop roots and grow into a new tree and runners in strawberry plants can sprout roots and develop into a new plant. Several types of vegetative asexual reproduction include grafting, bulbs, tissue culture, runners, cloning, and tubers. Vegetative propagation could occur a in nature or artificially. The following are types of vegetative reproduction.

NATURAL VEGETATIVE PROPAGATION

- **Stolons (runners)**

Dear learner! Now we have defined vegetative propagation and our survey of the vegetative propagation start with the discussion of stolon. Did you know the mechanism that strawberry plant use to reproduce?

What is a stolon?

Dear learner**,** runners originate from auxiliary bud in a lower portion of plant and grow along the surface of the soil. In the cultivated strawberry, for example, leaves, flowers, and roots are produced at every other node on the runner. Just beyond each second node, the tip of the runner turns up and becomes thickened. This thickened portion produces first adventitious roots and then a new shoot that continues the runner. Thus, a complete plant may

develop and take root at the node, nourished for a time by food sent from the parent plant through the stolon. Eventually, the stolon dries up and withers, leaving an independent daughter plant growing a short distance away from the parent.

- **Rhizome**

Dear learner! In the previous section you studied the mode of reproduction a strawberry plant use to perpetuate itself. Next, you will explore the mode reproduction used by some grass species like couch grass to propagate themselves.

What is a rhizome?

Dear learner, in many plants, horizontal shoots arise from lateral buds near the stem base and grow under the ground. Such underground horizontal stems are called **rhizomes**. At the nodes of the rhizome are buds, which may develop to produce shoots above the ground. The shoots become independent plants when the connecting rhizome dies. Many grasses propagate by rhizomes; the couch grass (Fig. 1.6) is a good example.

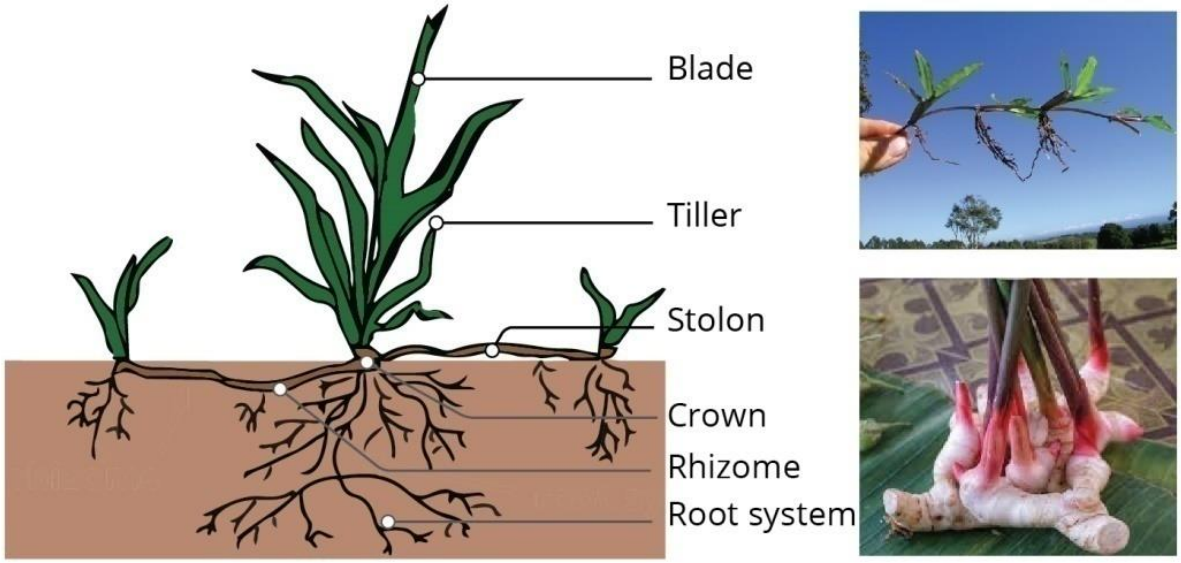


Figure 1.6. Reproduction using stolon and rhizomes

- **Corms**

Dear learner! Did you know the mechanism that Enset plant use to reproduce? In this section you see the mode of reproduction some plant species use to propagate themselves.

What is a corm?

Corms are similar to rhizomes, except they are more rounded and fleshy (such as in gladiolus). Corms contain stored food that enables some plants to survive the winter.

- **Tubers**

Dear learner! Did you know the mechanism that potato plant use to reproduce? Next, you will see the mode of reproduction plants like potato use to propagate themselves.

What is a tuber?

Tubers are modified stems that may store starch, as seen in the potato (*Solanum* sp.). Tubers arise as swollen ends of stolons, and contain many adventitious or unusual buds. If the tubers are left in the ground or transplanted, the buds will produce shoots, using food stored in the tuber as demonstrated in Fig. 1.7 below.

Activity 4: Experimentation on growing potato plants from tuber.

Dear learner! Make a field visit to your locality and collect specimens of potato tuber. Materials required include potato tubers, razor blade, iodine solution, microscope, slide, cover slip, and large pot. Do experimentation on the growth of potato, if you have access to a resources. Take a note on the morphological features and growth of potato plants from tubers. Prepare a short report on the results of experiment and present it to at a tutorial center.

- **Bulb**

Dear learner! Did you know the mechanism the onion plant use to reproduce? Now, you will see the mode of reproduction plants like garlic use to propagate themselves.

What is a bulb?

A bulb, which functions as an underground storage unit, is a modification of a stem that has the appearance of enlarged fleshy leaves emerging from the stem or surrounding the base of the stem (Fig. 1.7).

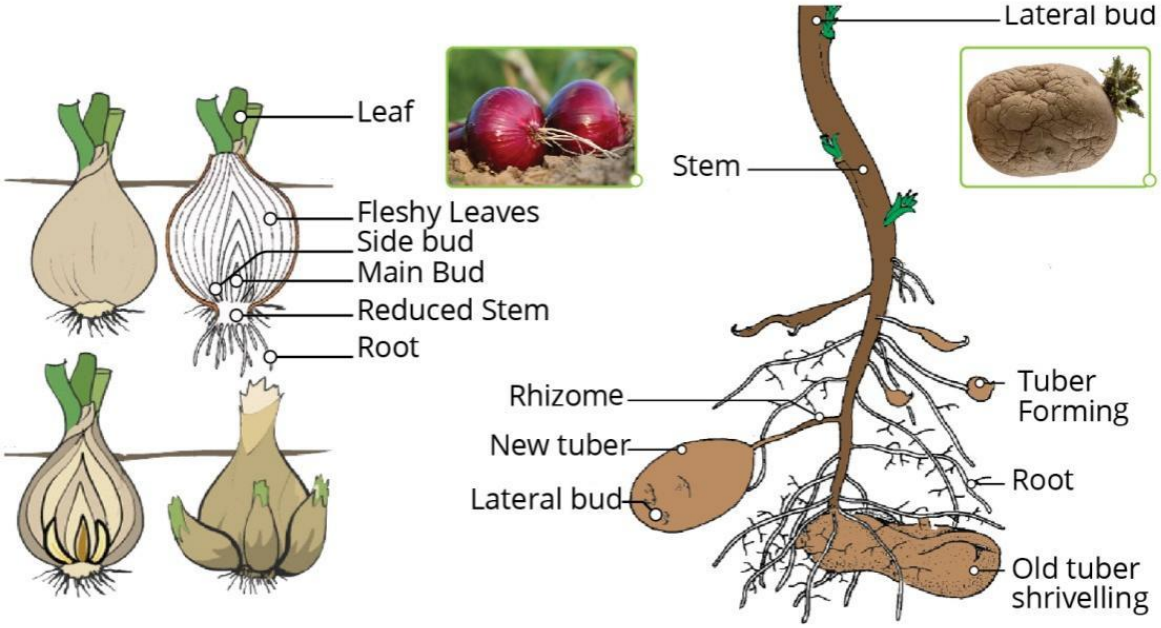


Figure 1.7. Asexual reproduction with tuber and bulb

Activity 5: Experimentation on growing onion plants from bulbs.

Dear learner! Make a field visit in your village and collect specimens of onion plants. Material required bulb and pot containing soil mixed with compost. Do experimentation onion plant growth, if you have access to a resource. Take a note on the morphological features and grow onion plants from bulbs. Prepare a short report on the results of your observation and present it at a tutorial center.

ARTIFICIAL VEGETATIVE REPRODUCTION

Dear learner! You are now familiar with the natural mode of vegetative propagation used by various plant species. In the remaining part of this section, you will explore artificial vegetative propagation method applied to multiply cultivated/domesticated plants.

Have you ever asked yourself how humans multiple some cultivated plants? If you know it is fine! Otherwise, I will briefly present the various artificial mode of plat propagation humans use to multiply different crops – sugar cane.

Artificial methods of asexual reproduction are frequently used to give rise to new and sometimes novel, plants. They include grafting, cutting, layering, macro-cutting and micro propagation.

- **Grafting**

We will start the survey of artificial vegetative propagation method with grafting. Grafting is an artificial method of asexual reproduction used to produce plants combining favorable stem and root characteristics. The stem of the plant to be grafted is known as the scion. The root is called the stock.

- **Cutting**

Dear learner! You are familiar with mechanism and application of grafting. Did you know the mechanism hibiscus and Aibika use to reproduce? Now, you will you study see the mode of reproduction hibiscus and Aibika use to propagate themselves.

Plants such as hibiscus and Aibika are propagated through stem cuttings where a portion of the stem containing nodes and internodes is placed in moist soil and allowed to root. In some species, stems can start producing a root even when placed only in water. For example, leaves of crotons or tanget will root if kept undisturbed in water for several weeks.

- **Layering or runner**

Dear learner! We will complete our discussion of artificial propagation method with the exploration of **layering or runner.** A method in which a stem attached

to the plant is bent and covered with soil. Young stems that can be bent easily without any injury are the preferred plant for this method.

Activity 6

Dear learner! Farmers and gardeners typically make use of asexual reproduction when growing crops and plants. Select two of the asexual reproduction techniques you have learnt in this section and write a report describing how these techniques work, what plants use the technique, and how the technique benefits agriculture or gardening and present your report at a tutorial center.

Section 1.2.5. Parthenogenesis

Dear learner! We will complete our discussion of asexual reproduction with the exploration parthenogenesis. Did you know how some animal species like insects and reptiles reproduce? Next, we will discuss about the mode of reproduction used by species like honey bee.

 Why offspring produced by parthenogenesis is commonly called "virgin birth"?

 Dear learner! Understand that some species of animals (e.g.,bees) are able to reproduce asexually. Among common honeybees (*Apis mellifera*), a queen bee might lay 2,000 eggs per day. Nearly all of these eggs are fertilized by sperm the queen has received during one of her nuptial fights, and each one of these eggs will develop into one of the worker bees of the colony every one of them a female. A queen can, however, choose to let some of her eggs go **unfertilized**; no sperm from a male ever fuses with these eggs, yet bees develop within them and hatch from them. Since egg and sperm do not come together in this process, this is not sexual reproduction. All the bees derived through parthenogenesis are males these are the few drones of a bee colony. Also, salamanders, ticks, aphids, mites, cicadas, some reptiles and fish are capable of reproducing in this manner.

Exercise 1.1: Self-assessment questions

Part One: Match items under column A with the appropriate items under **column** B.

A	B
1. An unfertilized egg develops into an adult organism	A. Tuber
2. Asexual reproduction by the formation of spores	B. Budding
3. Roots are produced at every other node on the runner	C. Parthenogenesis
4. Contain stored food that enables some plants to survive the winter	D. Stolon's
5. The organism divides into two or more equal parts	E. Bulbs
6. Are modified stems that may store starch, as seen in the potato	F. Corm
7. Horizontal shoots arise from lateral buds near the stem base.	G. Rhizome
8. A modification of a stem that has the appearance of enlarged fleshy leaves	H. Sporulation
9. The organism divides into two unequal parts	I. Fission

Part Two: Critical thinking questions

1. Write the steps of binary fission in bacteria.
2. Name two ways that fungi reproduce.
3. What name is given to the reproduction of bacteria?
4. Compare and contrast the way that humans and bacteria use mitosis.
5. When a food is left open for two or three days, one observes a fruiting body on the food and the taste of food changes. Why?
6. Discuss the mechanisms of multiple fission.

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s), which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task. I can:

- define asexual reproduction _____ ☐
- differentiate the process of asexual reproduction _____ ☐
- tell the advantages and disadvantages of asexual reproduction ____ ☐
- explain the mechanism of fission _____ ☐
- discuss the mechanism of fragmentation _____ ☐
- describe the mechanism of budding _____ ☐
- investigate the mechanism of vegetative propagation_____ ☐
- describe the mechanism of parthenogenesis _____ ☐

SECTION 1.3. SEXUAL REPRODUCTION (HUMANS AS EXAMPLE)

 Dear learner! In the previous section, you learned about how plants, fungi, and animals reproduce asexually. Unicellular and some multicellular organisms use mitosis for asexual reproduction, whereas complex organisms use it for growth and the repair of body cells. You also learned that asexual reproduction requires only one parent, and that offspring are identical to the parent. However, you have noticed that complex organisms such as plants, animals and humans require two parents to produce offspring. Next, you will learn the processes of sexual reproduction (taking humans as model), and how it is used to create unique offspring by combining genetic material. As you know questions regarding human reproduction are relevant. What do sex cells in humans look like, how are they produced, and where do they come from?

COMPETENCIES

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

- describe the mechanism of sexual reproduction
- compare and contrast asexual and sexual reproduction
- enumerate advantage of sexual reproduction over asexual reproduction.

Activity 7

Dear learner! Ask biologist about the advantages and disadvantages of sexual reproduction. Write a brief note about your discussion with the biologist and present it at a tutorial center.

What is sexual reproduction?

Dear learner! You will invest the rest of your time studying reproduction in humans. First you will see the male and female reproductive organ anatomy, sperm and egg production, the process fertilization, birth and development.

S**exual reproduction** involves the production of **sex cells**. It almost always involves two parent organisms. These sex cells are called **gametes** and they are made in **reproductive organs**. The gametes are produced through **meiosis**. The female gametes are always larger than the male gametes and are not mobile. Sexual reproduction starts with the union of sperm and an egg in a process called fertilization. This can occur either inside (**internal fertilization**) or outside (**external fertilization**) the body of the female. Fertilization results in the formation of a single cell called a **zygote**. The zygote then grows into a new individual.

Advantages and disadvantages of sexual reproduction

Advantages:

- Sexual reproduction produces a new organism that results from a combination of traits of two parents.
- Sexual reproduction increases viability in organisms of the same species and even within the offspring of one couple.
- Sexual reproduction allows the best adaptations to be widespread within a species, especially in changing circumstances.
- The variability of the offspring within a species guarantees that a higher proportion will survive in perilous circumstances.
- Two parents can watch over offspring.

Disadvantages:

- Finding a reproductive partner and producing gametes requires the output of a lot of energy
- The genetic results of meiosis, and often fertilization, are unpredictable.
- Offspring are not necessarily as well adapted to their environment as the parents.
- Many organisms never become parents because they can't find a partner; many gametes are lost because they are not fertilized.

Key terms

Egg: female gamete
Fuse: union(fertilization) of egg and sperm
Gametes: reproductive cell (sex cells_ egg or sperm)
Meiosis: type of cell division whereby gametes are produced
Sperm: male gamete
Zygote: fertilized egg

Exercise 1.2: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. These sex cells are called gametes and they are made in reproductive organs.
2. The female gametes are always larger than the male gametes and are not mobile.
3. Fertilization always occurs outside the female body.
4. The gametes are produced through mitosis.

Part Two: Critical thinking questions

1. State the difference between internal and external fertilization.
2. A male gamete is called a _____ and a female gamete is called a _____
3. When two gametes unite, they form a _____
4. Name the male and female sex cells in animals.
5. Where are the male and female sex cells produced in animals?
6. What are the advantages of asexual reproduction as compared to sexual reproduction?

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task. I can:

- Describe the mechanism of sexual reproduction_____ ☐
- Compare and contrast asexual and sexual reproduction _____ ☐
- Enumerate advantages of sexual reproduction over asexual _____ ☐

Section 1.3.1. Primary and Secondary Sexual Characteristics

Dear learner! In previous section, you have defined sexual reproduction and discussed its advantage and disadvantage. Here, you will learn about primary and secondary sexual characteristics. You will differentiate between the primary and secondary sexual characteristics of males and females in humans. Furthermore, you will get detailed understanding of the major biological, psychological, and social changes during the stage of puberty.

COMPETENCIES

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

- Describe the biological, psychological, and social changes during puberty stage
- Differentiate between the primary and secondary sexual characteristics of males and females in humans

Activity 8

Dear learner, during puberty, humans mature physically and become able to reproduce. State the major biological, psychological and sociological changes that occur during puberty. At what ages do you think males and females go through puberty? Write a brief report about these changes and present it at a tutorial center.

What are primary sexual characteristics?

Dear learner, the human males are born with the **penis**, **scrotum and testicle** whereas females are born with **vagina**, **uterus and ovaries**. These are the

primary sexual characteristics in males and females, respectively. At puberty or adolescence these characteristics change markedly.


What are secondary sexual characteristics?

Dear learner, puberty begins in the early teen years. **Puberty or adolescence** is the time when **secondary sex characteristics** begin to develop. Secondary sexual characteristics begin to develop so that sexual maturity is reached. Sexual maturity means that the potential for sexual reproduction exists. Secondary sexual characteristics in males include:

- growth and maintenance of the male sex organs,
- an increase in body hair, an increase in muscle mass,
- increased growth of the long bones of the arms and legs, and
- deepening of the voice.


What roles do hormones play in puberty?

Dear learner, the glands of the endocrine system release hormones (chemical substances) which control the development and activity of the reproductive system. The changes that occur during puberty are controlled by sex hormones. These hormones are secreted by the endocrine system. For example, the onset of puberty in males causes the hypothalamus to produce several kinds of hormones. These hormones interact with the pituitary gland.

ATTENTION: HORMONES

The hypothalamus secretes a hormone that causes the pituitary gland to release two other hormones. The hormones are follicle-stimulating hormone (FSH) and luteinizing hormone (LH). When **FSH** and **LH are** released into the bloodstream, are carried to the testes. In the testes, FSH causes the production of sperm cells. LH causes the endocrine cells that are in the testes to produce the male hormone **testosterone**. Testosterone influences the production of sperm cells. Testosterone is responsible for the growth and development **of secondary sex characteristics** in the male. The **FSH** and **LH** are also secreted in females and influence the development of secondary sex characteristics.

Key terms

Hormones: Are chemical messenger secreted by endocrine glands.

Puberty: the time when secondary sex characteristics begin to develop; as secondary sexual characteristics begin to develop, so does sexual maturity, the potential for sexual reproduction.

Secondary sex characters: characteristics that are not primarily involved in formation and delivery of egg/sperm, but that are essential for behavioral and functional success of reproduction.

Dear learner, puberty in females begins in the early teen years. In females, LH causes eggs to be released into the **oviduct** whereas FSH stimulates the development of **follicles** in the ovary. A **follicle** is a group of epithelial cells. These epithelial cells surround a developing egg cell. FSH also causes a hormone called **estrogen** to be released from the ovary. It is responsible for the secondary sex characteristics of females. Secondary sexual characteristics in females include:

- Increase in growth rates of the long bones of the arms and legs.
- Develop more hair, especially under the arms and in the pubic area.
- The hips broaden, and more fat is deposited in the breasts, buttocks, and thighs.
- The menstrual cycle begins.

What are the psychological and social changes occur during puberty? How do they affect life of the youth?

Dear learner! Remember from life experiences that young people must adjust to remarkable **physiological, anatomical, and psychological** transformations during the process of puberty. Their bodies change rapidly, and thus their body image also changes. Any deviations of their bodies from what they or their peers consider "normal" can lead to low self-esteem.

- Girls will worry about the size of their **breasts** and other aspects of their figures and will not feel feminine if these are not in line with the norm of their peers.

- Boys may worry about the size of his **penis** or his **physique**; and if these are not within the norm, he will feel that something is wrong with him.
- There is considerable variation in the timing of the stages of puberty among different individuals, and that most people develop into "normal" adults in the course of their sexual and physical maturation.
- An individual who reaches puberty later or earlier than his or her peers can suffer **psychological pain**.
- Early or late puberty could lead to **poor self-esteem** and problems in sexual and other areas of life.
- Late-developing males may suffer from a poor self-image, and this can influence them in later life. They tend to have a lower **occupational attainment, get paid less, marry later**, and have fewer children than other men of the same adult height.
- Early maturing males, on the other hand, can have an easier time of it. They tend to be held in higher esteem by their peers because of their broad shoulders and masculine physiques.
- Early-maturing females suffer more than early-maturing males. Because of their mature bodies (large breasts), their peers make the assumption that they are sexually experienced and sexually "easy," whereas in actuality, early maturing females tend to be submissive, socially indifferent, and low in popularity.
- Therefore, such individual should get medical or psychological advice to cope up with problems related early or late puberty.

Adolescence is the period between puberty and adulthood, when a good deal of social learning takes place. The length of this period of youth is socially determined. Its length could be influenced by nature, culture, and civilization.

Biologically, teenagers are adult after they have reached puberty, when they are capable of having children.

Economically, they are adult when they can support themselves and possibly a family.

Morally, they are adult when they are responsible for their actions, can express love in a mature manner, and can have productive and meaningful relationships. During adolescence, teenagers must achieve economic and moral adulthood; deal with separation from family.

Exercise 1.3: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. The length of adolescence could be influenced by nature, culture, and civilization.
2. FSH causes eggs to be released into the oviduct whereas LH stimulates the development of follicles in the ovary.
3. Biologically, teenagers are adult after they have reached puberty, when they are capable of having children.
4. The onset of puberty in males causes the hypothalamus to produce several kinds of hormones.
5. Early-maturing females suffer more than early-maturing males.
6. The primary sexual characteristics in human males are the penis, scrotum and testicle.

Part Two: Critical thinking questions

1. Define adolescence.
2. What are the two hormones involved in male puberty released by the pituitary gland?
3. What are the secondary sex characteristics in females?

☑ Self-evaluation checklist

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Describe the biological, psychological, and social changes during puberty stage_____ □
- Differentiate between the primary and secondary sexual characteristics of males and females in humans _____ □

Section 1.3.2. Male Reproductive Structures

Dear learner! Now, you are familiar with primary and secondary sexual properties in males and females. And also you have studies about the biological psychological, and sociological changes during puberty. Next, you are going to describe the function of the various parts of the male reproductive system. You will recall that sexual reproduction requires gametes from both parents. The male gamete is called **sperm**. In order for **fertilization** to occur, sperm must unite with the female gamete called the **egg**. As you complete the task, keep in mind the two main functions of the male reproductive system.

COMPETENCIES

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

- Identify the structure and functions of the male reproductive organs.

Activity 9

Dear learner! As you might know, the main function of the organs, glands and hormones of the male reproductive system is to produce sperm and deliver them to the female. Try to draw and label parts of the male reproductive organ along with their function. Also, write a brief note about these structures and their functions; submit it to a tutorial center.

What are the functions of the male reproductive organs?

Figure 1.8 below illustrates the male reproductive system in humans. Each labeled part has an important function in the process of reproduction.

Epididymis: a long, crooked duct on the testis where sperm are stored

Prostate gland: a gland that is located near and that empties into the urethra, which produces a **secretion** that improves sperm viability

Scrotum: a pouch of skin that regulates the temperature of the testes by raising or lowering them

Seminal vesicle: glands that contribute fructose to sperm—the fructose serves as an energy source

Testes (*singular* testis): the male gonads that produce sperm and male sex hormones—they are paired organs that contain seminiferous tubules in which sperm are produced

Urethra: a narrow tube that transports urine from the bladder to the outside of the body—in males, it also conducts sperm and semen to the outside

Vas deferens: the duct that carries sperm from the epididymis to the ejaculatory duct and urethra; the tube connecting the testes to the urethra

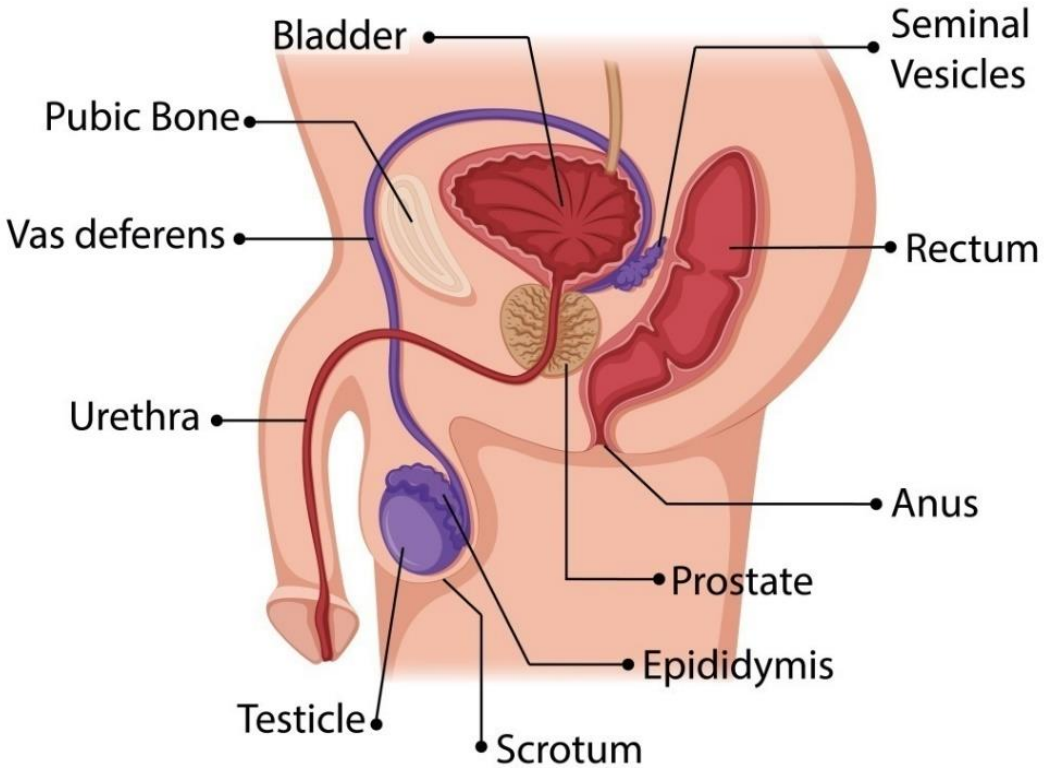


Figure 1.8. Parts of male reproductive systems

How does the structure of a sperm relate to its function?

The sperm travels from the seminiferous tubules to **epididymis**, where sperm maturation occurs and then to a **vas deferens**, the ejaculatory duct. The vas deferens joins the urethra, a duct that carries both sperm and urinary products through the penis. Three sets of accessory glands open into the reproductive channels: a pair of **seminal vesicles**, a single **prostate gland**, and the pair of

bulbourethral glands. Fluid secreted by these glands furnishes food to the sperm, lubricates the female reproductive tract for sperm, and counteracts the acidity of the vagina so that the sperm retain their viability longer after being deposited in the female. Semen is a mix of sperm, proteins, nutrients, ions, and signaling molecules. Sperm constitute less than 5 percent of semen volume.

Male Hormones in reproduction

LH travels to the testes and stimulates cells to produce testosterone. Testosterone is the most abundant male sex hormone and is responsible for the male characteristics listed below. These characteristics begin to show at puberty.

- Onset of sperm production
- Sexual organs grow and develop.
- Voice changes, muscle and bone grow.

FSH combines with testosterone to stimulate the production of sperm. The sperm has a "head" that is packed full of genetic material and covered by an enzyme. The enzymes help the sperm penetrate an egg. At its other end, the sperm has a flagellum that it uses to swim toward an egg. In the midsection contains many mitochondria that supply the energy required for flagella movement as shown in Fig. 1.9:

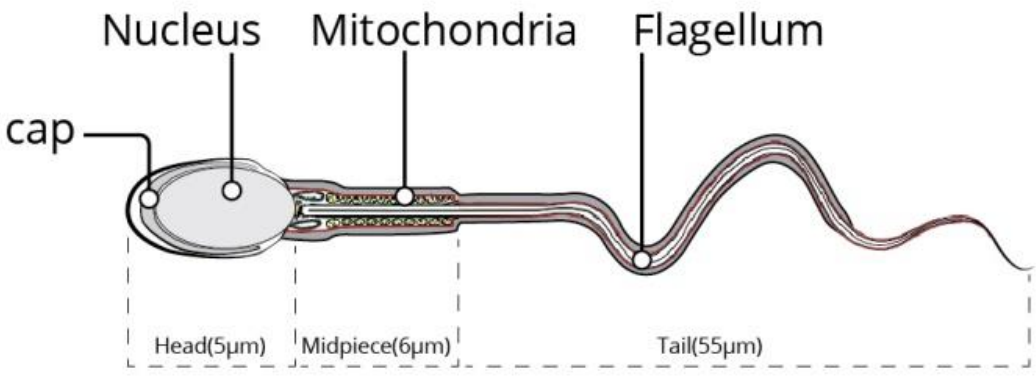


Figure 1.9 Parts of a sperm cell

Key terms

Bulbourethral glands: secrete a lubricating mucus into the urethra which helps clear the urethra of residual urine.

Penis: male organ of intercourse.

Semen: sperm mixed with secretions from seminal vesicles and the prostate gland.

Seminiferous tubules: inside a testis, coiled tubules that contain male germ cells and produce sperm.

Exercise 1.4: Self-assessment questions

Part One: Match items under column A with the appropriate items under **column** B.

A	B
1. The duct that carries sperm from the epididymis	A. Vas deferens
2. Secrete a lubricating mucus into the urethra	B. Prostate gland
3. Male organ of intercourse	C. Epididymis
4. A pouch of skin that regulates the temperature of the testes	D. Urethra
5. The male gonads that produce sperm and male sex hormones	E. Bulbourethral glands
6. Sperm mixed with secretions from seminal vesicles and the prostate gland.	F. Testes
7. Produces a secretion that improves sperm viability	G. Scrotum
8. Glands that contribute fructose to sperm	H. Semen
9. A narrow tube conducts urine, sperm and semen to the outside	I. Penis
10A long, crooked duct on the testis where sperm are stored	J. Seminal vesicles

Part Two: Critical thinking question

1. Draw and label parts of human sperm cells.
2. Write the two hormones are produced in the pituitary gland.
3. State the functions testosterone.

4. Where is the hormone testosterone produced?
5. Write part of the brain is responsible for the production of hormones.
6. State the main functions of the male reproductive system.

☑ Self-evaluation checklist

Put a tick ☑ against each of the following task(s), which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task. I can:

- Identify the structure and functions of the male reproductive organs_____ ☐

Section 1.3.3. Female Reproductive Structures

Dear learner! In the previous section, you have learned about structure and functions of the male reproductive system. Next, you will explore about the female reproductive structures, and explaining their roles in fertilization, development of the embryo, and birth. In addition, you will also see the role of hormones in the female reproductive system.

COMPETENCIES

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

- Identify female reproductive structures and their functions.

Activity 10

Dear learner! Draw and label the various parts of the female reproductive systems along with their functions. Also, write a brief note about the structure and their functions; submit it to a tutorial center.

What are the functions of female reproductive organs?

Dear learner, figure 1.10 below illustrates the female reproductive system in humans. Each labeled part has an important function in the process of reproduction.

Cervix: narrow part of uterus that connects to the vagina.

Corpus luteum: hormone-secreting structure that forms from follicle cells left behind after ovulation.

Estrogens: hormones secreted by ovaries; cause development of secondary sexual traits and maintain the reproductive tract's lining.

Ovarian follicle: immature animal egg and the surrounding cells.

Oviduct: duct that conveys eggs away from an animal ovary.

Ovulation: release of a secondary oocyte from an ovary.

Progesterone: hormone secreted by ovaries; prepares the reproductive tract for pregnancy.

Uterus: muscular chamber where offspring develop; womb.

Vagina: female organ of intercourse and birth canal.

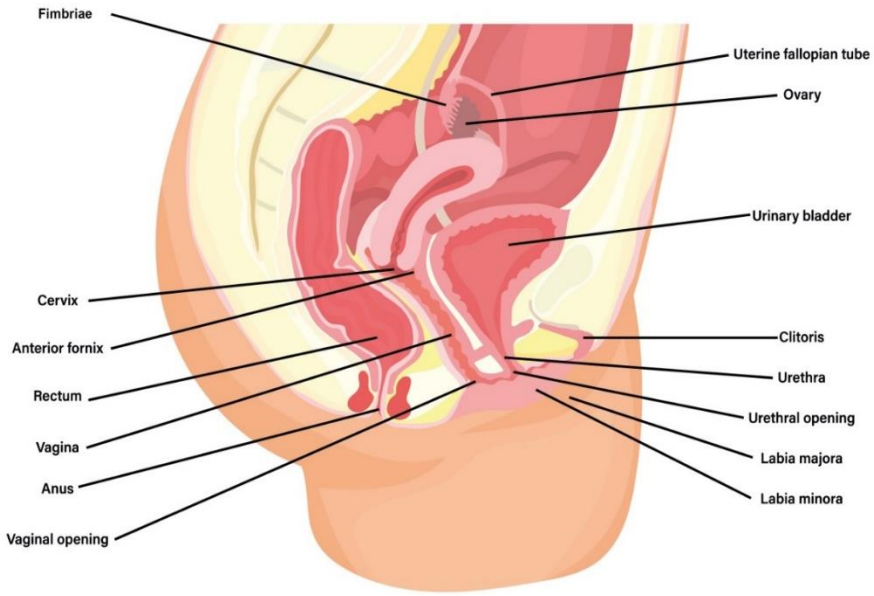


Figure 1.10 Female reproductive systems

Ovulation

What is ovulation? Dear learner, in humans, egg production occurs before birth. A girl is born with about 2 million eggs. At puberty hormonal changes prompt eggs to mature, one at a time, in an approximately twenty eight-day ovarian cycle. As the cycle begins, the follicle enlarges and a fluid filled cavity forms around it. About two weeks after the follicle began to

mature, its wall ruptures and ovulation occurs. The egg and surrounding follicle cells are ejected into the adjacent oviduct. After ovulation, cells of the ruptured follicle develop into a hormone-secreting corpus luteum. If pregnancy does not occur, the corpus luteum breaks down, and a new follicle will begin to mature shown in Fig.1.11 below.

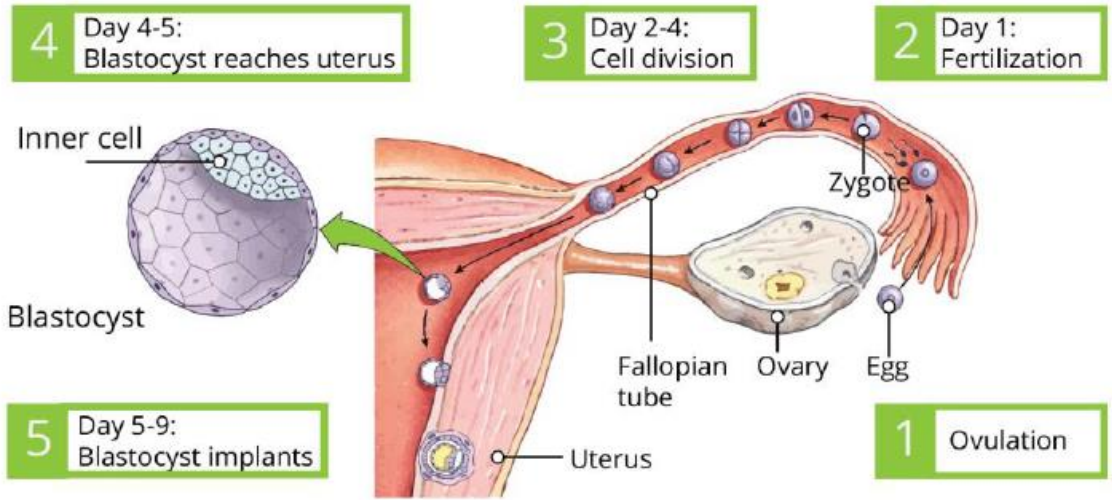


Figure 1.11 Ovulation

Exercise 1.5: Self-assessment question

Part One: Match items under column A with the appropriate item under **column** B.

A	B
1. The tube connecting the ovaries to the uterus	A. Follicle
2. Structure that receives sperm from the male	B. Uterus
3. The primary female reproductive organ	C. Vagina
4. Connects the vagina to the uterus	D. Estrogens
5. The location where the fertilized egg will travel	E. Corpus luteum
6. The process of egg production	F. Oviduct
7. Prepares the reproductive tract for pregnancy	G. Cervix
8. Hormone-secreting structure that forms from follicle cells	H. Ovulation
9. Composed of a developing egg surrounded by an outer layer	I. Ovary
10. cause development of secondary sexual traits	J. Progesterone

Part Two: Critical thinking questions

1. What will happen corpus luteum if pregnancy does not occur.
2. Write the two hormones are present in both males and females?
3. What type of cell reproduction takes place in the zygote once fertilization occurs?
4. What is the main sex organ in females?

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Identify female reproductive structures and their functions_____ ☐

Section 1.3.4. The Menstrual Cycle

 Dear learner! Now, you have completed the discussion of male and female reproductive structure and functions. Next, you will explore about the menstrual cycle – phases of menstrual cycles, the hormones involved, and menstrual cycle hygiene. Understand that the female has a cycle called the **menstrual cycle** in which her body prepares the endometrium in four ways.

COMPETENCIES

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

- Outline the phases of the menstrual cycle

Activity 11

Dear learner! State the major changes that happen during the menstrual cycle. Also explain the about importance menstrual hygiene and its health benefits. Preparations of menstrual hygiene materials from locally available resources (for examples reusable pads). Develop a short report and bring it to a center.

What cyclic changes occur in the ovary and uterus?

- building up the endometrium (follicular phase)
- ovulation
- preparing hormonally for pregnancy (luteal phase)
- shedding the endometrium if no pregnancy occurs (menstrual phase)

The menstrual cycle is approximately 28 days in length. If there is no fertilization and no pregnancy is taking place, the egg cell and the endometrium are discarded through **menstruation**. Menstruation is a flow of liquids that flush out the **egg and endometrium** that have not been used for embryo development. If a pregnancy has taken place, there is no menstrual flow as the egg is developing into an embryo and the endometrium is needed to sustain the embryo.

Dear learner, the interaction of hormones in the reproductive cycle for females is described below.

- The pituitary gland secretes FSH into the blood and stimulates follicles to develop in the ovary.
- Follicle cells surrounding the developing oocyte secrete **estrogen**, which is responsible for the thickening of the uterine lining.
- Estrogen travels to the pituitary and causes it to release LH. LH triggers **ovulation**.
- Following ovulation, follicle cells produce a **corpus luteum** that secretes increasing amounts of **estrogen** and **progesterone**.
- As the level of progesterone increases, it travels to the pituitary and signals the pituitary to decrease the production of LH and FSH. The decreasing levels of LH and FSH prevent the production of egg cells until the next cycle when levels of LH and FSH increase again (Fig.1.12).

Dear learner, a woman enters **menopause** when all the follicles in her ovaries have either been released during menstrual cycles or have disintegrated as a result of aging. With no follicles left to mature, production of estrogen and

progesterone is diminished and menstrual cycles cease. Menopause is known only in humans and two species of whales.

ATTENTION: WEEKLY IRON FOLIC AND ACID SUPPLEMENTATION (WIFAS)

Do you know that WIFAS is provided to prevent the anemia? Does your school provide the supplement for prevention of Anemia? (Please get information from the local nearby health facility).

Activity 12

Dear learner! Ask a midwife nurse (Gynecologist) in your village (clinic) about menstrual cycle and the three phases of the cycle; prepare a brief note about your discussion with the health professional and present it at a tutorial center.

Key terms

Corpus luteum: a structure that secretes the hormones estrogen and progesterone; progesterone causes changes to occur in the lining of the uterus that prepare it to receive a fertilized egg.

Menstrual cycle: the series of changes in the female reproductive cycle that occur each month, which include producing an egg and preparing the uterus for receiving the egg.

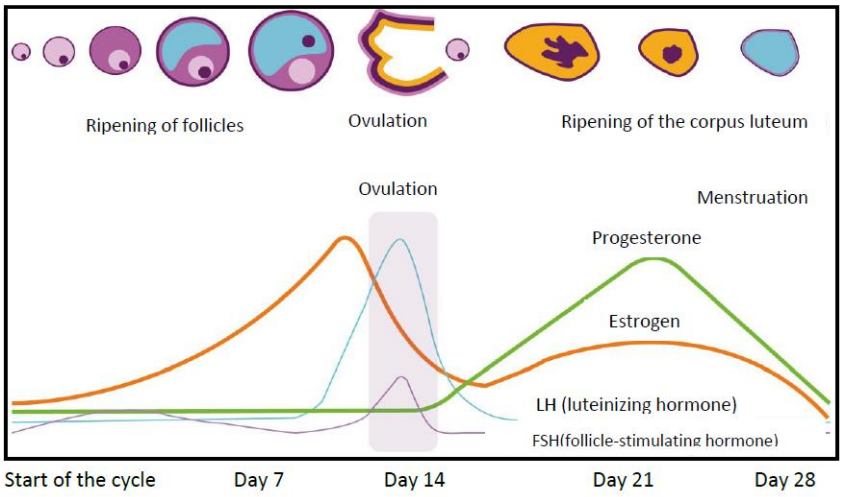


Figure 1.12. Menstrual cycle

Menstrual hygiene and health benefits

These hygiene practices can help females stay healthy and comfortable during period:

- **Wear lightweight, breathable clothing** (such as cotton underwear). Tight fabrics can trap moisture and heat, allowing germs to thrive.
- **Change menstrual products regularly**. Trapped moisture provides a breeding ground for bacteria and fungi. Wearing a pad or period underwear for too long can lead to a rash or an infection.
- **Keep genital area clean**. Wash the outside of vagina every day. In the bathroom, good to wipe from the front toward the back, not the other way. Use only water to rinse vulva. The vagina is a self-cleaning organ.
- **Use unscented toilet paper, tampons, or pads**. Scented hygiene products can irritate the skin and impact natural pH balance.
- **Drink enough liquids**. This can help wash out female urinary tract and help prevent infections, like vaginal candidiasis.
- **Track and monitor period**. Menstrual cycle is a valuable marker for female overall health. Irregular periods can be a sign of conditions like diabetes, thyroid dysfunction, and celiac disease.
- **Visit a healthcare provider for annual check-up**. An annual full check-up includes a pap smear, a pelvic exam, and a breast exam. These exams are essential for good reproductive health as they can catch early signs of cancer or other health issues.

Exercise 1.6: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. The pituitary gland secretes FSH into the blood and stimulates follicles to develop in the ovary.
2. Menopause is known only in humans and two species of whales.
3. Menstruation occurs if there is fertilization and pregnancy.
4. As the level of progesterone increases, it travels to the pituitary and

signals the pituitary to decrease the production of LH and FSH.

5. The vagina is a self-cleaning organ.

Part Two: Critical thinking questions

1. What are the health benefits of menstrual hygiene?
2. Define a menopause.
3. What is shed during menstrual flow?
4. Write the two female hormones secreted by the corpus luteum.
5. State the cyclic changes that occur in the ovary and uterus.

Self-evaluation checklist

Put a tick ☑ against each of the following task(s), which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Describe the phases menstrual cycle _____ ☐

Section 1.3.5. Fertilization and Pregnancy

Dear learner! Now you are familiar with both male and female reproductive systems, menstrual cycle, and menstrual cycle hygiene. Next, you will investigate the stages of development between the initial formation of a zygote and the birth of a new-born baby.

COMPETENCIES

- define mating, fertilization and pregnancy
- describe process of twin formation and types

Activity 13

Dear learner! The union of an egg and a sperm result in a fertilized egg. This single cell must undergo many changes before it develops into a fetus. State the changes that you know occur in the developing embryo and fetus. Write a brief note about these changes and submit it to a tutorial center.

Mating and fertilization

What is mating?

Dear learner! Understand that sexual arousal in the male results in an erection. That is, the penis becomes firm and erects as a result of blood flowing into the erectile tissue. Arousal in the female stimulates the lining of the vagina to produce mucus. This lubricates the vagina and makes it easy for the erect penis to enter. In the act of copulation, the male inserts the penis into the female's vagina. The sensory stimulus in the male results in the ejaculation of semen into the top of the vagina.

What is fertilization?

Dear learner, **fertilization** of the egg takes place in the oviduct. Once sperm have been released in the vagina, they travel by moving their tails (flagella) back and forth. Sperm move through the vagina, cervix, uterus, and into the oviduct where they can meet a single egg. Of the several thousand sperm that reach the oviduct, only one will fertilize the egg as shown in figure Fig. 1.13.

Dear learner! Comprehend that the released egg is thought to survive for about 24 hours; the sperm might be able to fertilize an ovum for about 2 or 3 days. So there is only a short period of about 4 days each month when fertilization might occur. If this fertile period can be estimated accurately, it can be used either to achieve or to avoid fertilization (conception).

Twins (Multiple births)

How are twins formed?

Many mammals give birth to more than one offspring at a time, each member of which has come from a separate egg.

Dear learner, be clear that human twins may come from one zygote (**identical,** or **monozygotic** twins) or two zygotes (**non-identical, dizygotic,** or **fraternal**

twins). Fraternal twins do not resemble each other anymore than other children born separately in the same family, but identical twins are, of course, strikingly alike and always of the same sex. Triplets, quadruplets, and quintuplets may include a pair of identical twins.

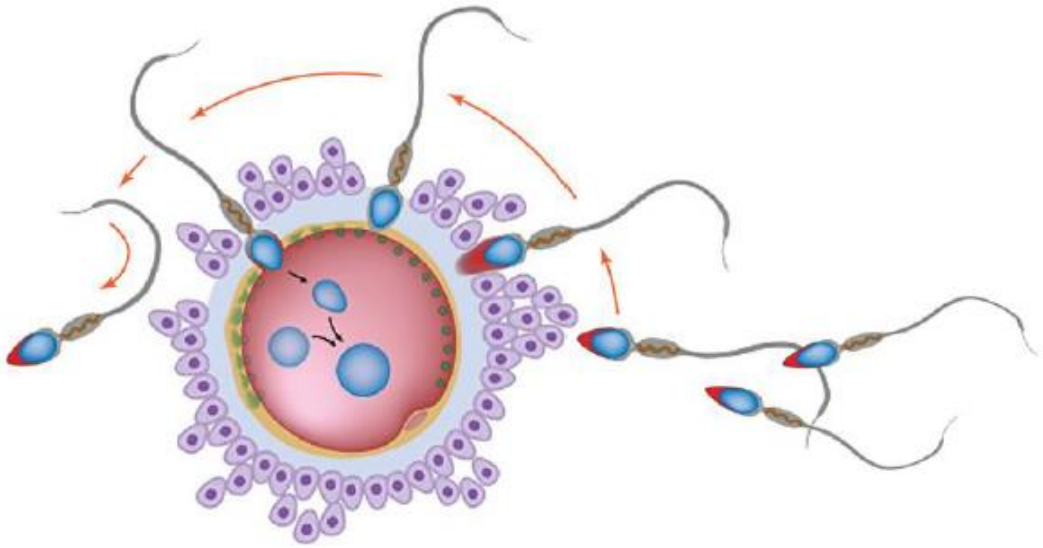


Figure 1.13. Fertilization

Pregnancy and development

What is implantation?

Dear learner, if the egg has been fertilized as it moves from the oviduct to the uterus, it will attach to the thick lining called the endometrium in the uterus. If the egg is not fertilized, the endometrium is shed in a process called **menstruation**. Fertilization of the egg takes place in the oviduct. The egg and sperm join nuclei to produce a single diploid cell called a **zygote**.

Once the egg has been fertilized and the zygote is formed, there are two stages of development from fertilization to birth.

The Embryo stage takes place over the first eight weeks.

Fetus stage takes place from eight weeks to birth.

Embryo Stage: Once fertilization has taken place in the oviduct, the zygote is moved into the uterus and attaches to the endometrium_ a process called **implantation.**

Fetus Stage

The developing child will begin to form bone cells around the ninth week of pregnancy or approximately at the end of the first trimester (Fig. 1.14). Once this stage is reached, the child is called a fetus until it is born.

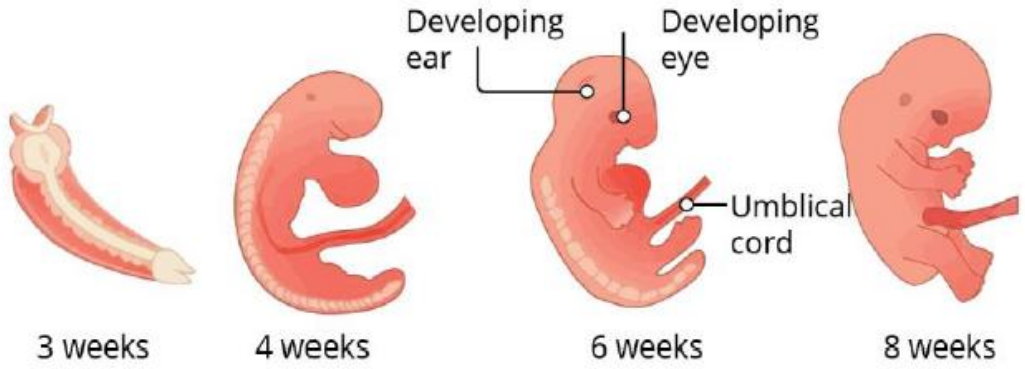


Figure 1.14 Human embryo developmental stages until week eight

The oxygen and food needed to keep the embryo alive and growing are obtained from the mother's blood by means of a structure called the **placenta**.

Placenta

Dear learner, the placenta becomes closely attached to the lining of the uterus and is attached to the embryo by a tube called the **umbilical cord**. Oxygen and nutrients such as glucose and amino acids pass across the placenta to the embryo's bloodstream. Carbon dioxide passes from the embryo's blood to that of the mother. Blood entering the placenta from the mother does not mix with the embryo's blood. Figure 1.15 shows the human embryo from 5 to 35 weeks surrounded by the amnion and placenta.

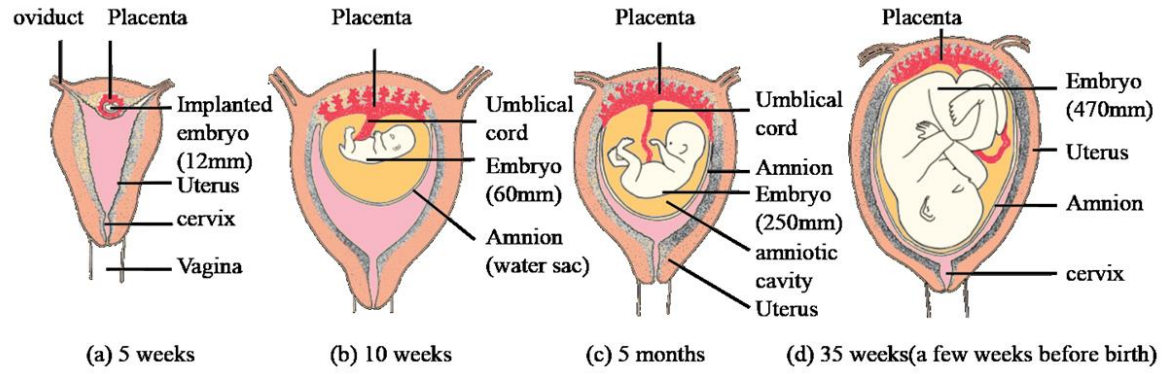


Figure 1.15 Growth and development in the uterus (5 to 35 weeks)

ATTENTION: NEURAL TUBE DEFECTS (NTDS)

NTDs are birth defects of the brain, spine, or spinal cord. It occurs when the neural tube does not close properly in very early within the first month of pregnancy. Women should take folic acid rich foods before and during pregnancy. Folic acid supplementation is recommended at least three months before pregnancy to prevent NTDs. Recommended to take folic acid rich foods, including folate supplement prior to pregnancy.

Exercise 1.7: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. Human twins may come from one zygote or two zygotes.
2. Egg could survive for about 24 hours; the sperm might be able to fertilize an ovum for about 2 or 3 days.
3. Arousal in the female stimulates the lining of the vagina to produce mucus.
4. Amniotic fluid protects the fetus from damage and prevents unequal pressures from acting on it.
5. Fraternal twins resemble each other more than other children born separately in the same family.

☑ **Self-evaluation checklist**

Put a tick☑against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Define mating, fertilization and pregnancy_____ ☐
- Describe the process of twin formation and types _____ ☐

Section 1.3.6. Methods of Birth Control

 Dear learner! In the last section, you have learnt about fertilization, pregnancy, twin formation, implantation and embryonic development. Next, you will learn about the various birth control methods – natural as well as artificial. Furthermore, you will discuss about the mechanisms of action; advantages and disadvantages; degree of effectiveness of different birth control methods.

COMPETENCIES

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

- Discuss the methods of prevention of unwanted pregnancy
- Explain the advantages and disadvantages of different birth control methods.

Activity 14

Dear learner, contraception, the deliberate prevention of unwanted pregnancy, can be achieved in a number of ways. Some contraceptive methods prevent gamete development or release from female or male gonads; others prevent fertilization by keeping sperm and egg apart; and still, others prevent implantation of an embryo. State methods of use, the mechanisms of action; advantages and disadvantages; degree of effectiveness of different birth control methods you knew. Prepare a short note about the various interceptive methods and submit it at a tutorial center.

What can prevent pregnancy?

Dear learner! As little as 4 weeks after giving birth, it is possible, though unlikely, that a woman may conceive again. Frequent breastfeeding may reduce the chances of conception. Nevertheless, it would be possible to have children at about 1-year intervals. Most people do not want, or cannot afford, to have as many children as this. All human communities, therefore, practice some form of birth control to space out births and limit the size of the family. Family planning methods could be natural or artificial.

- Some family planning methods such as condoms can help prevent the transmission of HIV and other sexually transmitted infections.
- Family planning /contraception reduce the need for abortion, especially unsafe abortion.
- Family planning reinforces people's rights to determine the number and spacing of their children.
- By preventing unintended pregnancy, family planning /contraception prevents deaths of mothers and children.

Benefits of family planning / contraception

- Preventing pregnancy-related health risks in women
- Reducing infant mortality
- Empowering people and enhancing education
- Reducing adolescent pregnancies
- Slowing population growth

Natural methods of family planning

- **Abstinence**

Dear learner! Now, we will explore natural methods of unwanted pregnancy control method – abstinence. It is the most obvious way of preventing a pregnancy. This involves a couple avoiding sexual intercourse. In this way, sperm cannot come into contact with an egg and fertilization cannot

happen. It is the effective method with added advantage of preventing exposure to sexually transmissible pathogens.

- **Fertility Awareness/Natural Family Planning**

Fertility awareness methods rely on understanding the most likely time that ovulation will take place during the monthly cycle, so that intercourse is avoided, or a barrier method is used.

Fertility awareness methods include:

- Standard Days Methods
- Calendar Rhythm Method
- Symptothermal Method
- Ovulation Method

The effectiveness of fertility awareness methods range from 98% with perfect use to 78% with typical use. Although an important option for women worldwide, fertility awareness methods overall are less effective than other methods. Male partners must be continuously cooperative. Physiologic changes (that is recent childbirth, current breast-feeding, early menstruation, discontinuation of other hormonal methods, approaching menopause) can affect reliability.

Withdrawal (Coitus Interruptus)

- The withdrawal method for pregnancy prevention refers to the moment a man pulls his penis out of his partner's vagina before ejaculation to avoid ejaculating the sperm.
- Preventing sperm from entering the vagina (and thus the uterus and fallopian tubes) and fertilizing an ovum.

Effectiveness

- In terms of pregnancy prevention, withdrawal effectiveness is similar to that of the male condom. Effectiveness is ninety six percent (96%) with perfect use and eighty percent (82%) with typical use.
- Consider back-up method such as emergency contraception if

ejaculation begins before withdrawal.

Advantages

- Withdrawal requires no money, devices, hormones, or medical provider, making it available to anyone.

Disadvantages

- Provides no protection against sexually transmitted infections and HIV.
- Requires a great degree of self-control. For some men, it may be difficult to ensure that they withdraw before ejaculation has started.
- For some people, pleasure may be diminished by the interruption of sexual intercourse.

Monitoring body temperature

Dear learner, if it were possible to know exactly when ovulation occurred, intercourse could be avoided for 3–4 days before and 1 day after ovulation. At the moment, however, there is no simple, reliable way to recognize ovulation, though it is usually 12–16 days before the onset of the next menstrual period. By keeping careful records of the intervals between menstrual periods, it is possible to calculate a potentially fertile period of about 10 days in mid-cycle, when sexual intercourse should be avoided if children are not wanted. On its own, this method is not very reliable but there are some physiological clues that help to make it more accurate. During or soon after ovulation, a woman's temperature rises by about 0.5 °C. It is reasonable to assume that 1 day after the temperature returns to normal, a woman will be infertile. There is 25% chance of pregnancy per year.

- **Cervical mucus**

Dear learner, another clue comes from the type of mucus secreted by the cervix and lining of the vagina. As the time for ovulation approaches, the mucus becomes more fluid. Women can learn to detect these changes and so calculate their fertile period. By combining the 'calendar', 'temperature' and 'mucus' methods, it is possible to achieve about 80% 'success', i.e. only 20% unplanned pregnancies.

Dear learner, natural methods have no side effects and this method is permitted by most religions. Carried out with care and scientific precision about recording techniques it can be very effective. Depends on full co-operation of both partners and it is not always easy to pinpoint ovulation so pregnancy can result. There is a chance of 10 pregnancies per 100 women per year.

Artificial methods of family planning (barrier methods)

 Dear learner! Now, you are familiar with the natural method of control of unwanted pregnancy such as abstinence, fertility awareness and cervical mucus. Next, you will study about the different artificial method family planning – female condom, male condom, diaphragm, spermicides, contraceptive pill, intra-uterine system, contraceptive implant, and contraceptive injection. Furthermore, you will discuss about the mechanism use, effectiveness, advantages and disadvantages of the various methods.

Activity 15

Dear learner! Ask a midwife nurse (Gynecologist) in your village about artificial methods of family planning methods. Do not forget to mention, methods of use, the mechanisms of action; advantages and disadvantages; degree of effectiveness of different methods. Write a brief note about your discussion with the health professional and submit it at a tutorial center.

- **Female Condom**

The female condom is a polyurethane sheath_ one end is inserted into the vagina while the other remains outside of the vagina and provides some protection to the external genitalia. It contains a silicone lubricant. Additional lubricant is provided with each condom.

Effectiveness: Female condom effectiveness is ninety five percent (95%) with perfect use, and eighty percent (80%) with typical use.

Advantages: Dual protection against pregnancy, and STI/HIV, accessible without prescription, causes few medical side effects, some people find

female condoms to be more comfortable and less constricting than male condoms, as they are wider.

Disadvantages: Coitus dependent, more expensive than male condoms, challenge to use in relationships with weak partner cooperation and/or intimate partner violence

- **Male Condom**

Dear learner! Male condoms are available in latex, lambskin, and polyurethane. All three materials effectively prevent pregnancy. Lambskin contains small pores that may permit the passage of bacteria and viruses. Thus they are not recommended for infection prevention.

Effectiveness: Male condom effectiveness is ninety eight percent (98%) with perfect use, and eighty five (85%) with typical use.

Advantages: Provides protection against both pregnancy and STI/HIV, widely accessible without a prescription, causes almost no medical side effects.

Disadvantages: Coitus dependent, reduced sensitivity for men however, this may be an advantage for preventing premature ejaculation, some men have difficulty maintaining erections, especially when they are inexperienced condom users, challenge to use in relationships where there is weak partner cooperation and/or intimate partner violence or coercion and latex allergy.

- **Diaphragm**

Dear learner! A thin rubber disc, placed in the vagina before intercourse, covers the cervix and stops sperm entering the uterus. Condoms and diaphragms, used in conjunction with chemicals that immobilize sperm, are about 95% effective. However, a diaphragm does not prevent the risk of transmission of sexually transmitted infections (STIs) (Fig. 1.16). There are no side effects, offers some protection against cervical cancer. It must be initially fitted by a doctor. May be incorrectly positioned or damaged and allow sperm past. Gives better protection against pregnancy when combined with spermicide. There is a chance of 2.5 pregnancies per 100 woman years.

- **Spermicides**

Dear learner! Spermicides are chemicals which, though harmless to the tissues, can kill or immobilize sperm. The spermicide, in the form of a cream, gel or foam, is placed in the vagina. On their own, spermicides are not very reliable but, in conjunction with condoms or diaphragms, they are effective.

- **Intra-uterine device (IUD)**

Dear learner! A small T-shaped plastic and copper device, also known as a coil, can be inserted by a doctor or nurse into the wall of the uterus, where it probably prevents implantation of a fertilized ovum. It is about 98% effective but there is a small risk of developing uterine infections, and it does not protect against STIs. Once inserted, no further steps need to be taken. It is relatively effective at preventing implantation and pregnancy. It can cause pain and heavy periods; can cause uterine infections which may lead to infertility. If pregnancy does occur, it has a high chance of being in the Fallopian tubes (ectopic pregnancy). There is a chance 2.5 pregnancy per 100 woman years

- **Intra-uterine system (IUS)**

Dear learner! This is similar to an IUD; is T-shaped and releases the hormone progesterone slowly over a long period of time (up to 5 years). The hormone prevents ovulation. An IUS does not protect against STIs.

- **Contraceptive pill**

Dear learner! The pill contains chemicals, which have the same effect on the body as the hormones oestrogen and progesterone. When mixed in suitable proportions these hormones suppress ovulation and so prevent conception. The pills need to be taken each day for the 21 days between menstrual periods.

There are many varieties of contraceptive pill in which the relative proportions of oestrogen and progesterone-like chemicals vary. They are 99% effective, but long-term use of some types may increase the risk of cancer of the breast and cervix. The pill does not protect against STIs.

- **Contraceptive implant**

Dear learner! This is a small plastic tube of about 4 cm long which is inserted under the skin of the upper arm of a woman by a doctor or nurse. Once in place, it slowly releases the hormone progesterone, preventing pregnancy. It lasts for about 3 years. It does not protect against STIs, but has more than a 99% success rate in preventing pregnancy.

- **Contraceptive injection**

Dear learner! This injection, given to women, contains progesterone and stays effective for between 8 and 12 weeks. It works by thickening the mucus in the cervix, stopping sperm reaching an egg. It also thins the lining of the uterus, making it unsuitable for implantation of an embryo. It does not protect against STIs.

Surgical methods


Dear learner! Now, you will study about the two surgical methods – vasectomy and laparotomy. Furthermore, you will discuss about the mechanism use, effectiveness, advantages and disadvantages of the various methods

- **Male sterilization – vasectomy**

Dear learner, this is a simple and safe surgical operation in which the man's sperm ducts are cut and the ends sealed. This means that his semen contains the secretions of the prostate gland and seminal vesicle but no sperm so cannot fertilize an ovum. Sexual desire, erection, copulation and ejaculation are quite unaffected. The testis continues to produce sperm and testosterone. The sperm are removed by white cells as fast as they form. The testosterone ensures that there is no loss of masculinity. The sperm ducts can be rejoined by surgery but this is not always successful.

- **Female sterilization– laparotomy**

Dear learner, a woman may be sterilized by an operation in which her oviducts are tied, blocked or cut. The ovaries are unaffected. Sexual desire and

menstruation continue as before, but sperm can no longer reach the ova. Ova are released, but break down in the upper part of the oviduct. The operation cannot usually be reversed. Both vasectomy and laparotomy are almost 100% guaranteed to prevent pregnancy and permanent control of fertility. Remove the problem of human error in contraception. For women in particular it involves a general an aesthetic. Not easily reversible. There a chance of 0.05 pregnancies per 100 woman years.

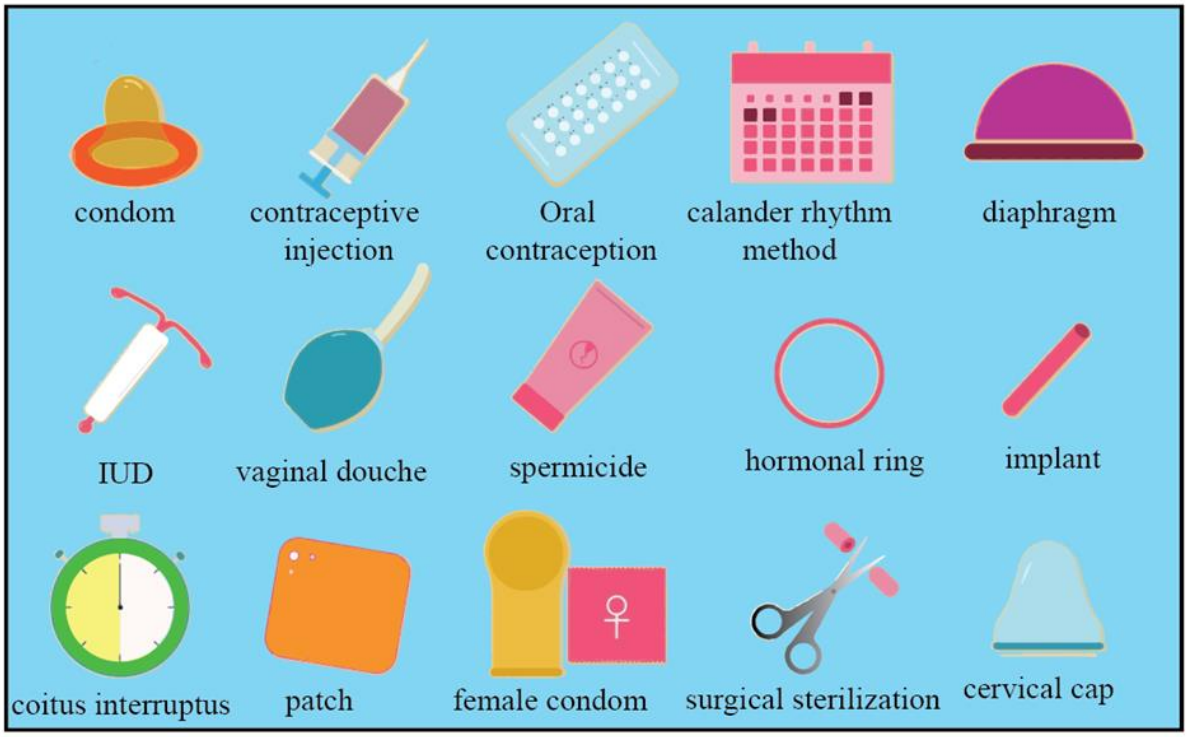


Figure 1.16 The different Contraceptive methods used by females and males

Dear distance learner, sterilization is the permanent prevention of gamete production or release. For women, the most common method is **tubal ligation**, the sealing shut or tying off (ligating) of a section of each oviduct to prevent eggs from traveling into the uterus. Similarly, **vasectomy** in men is the cutting and tying of each vas deferens to prevent sperm from entering the urethra. Sex hormone secretion and sexual function are unaffected by both procedures, with no change in menstrual cycles in females or ejaculate volume in males. Although tubal ligation and vasectomy are considered permanent, both procedures can in many cases be reversed by microsurgery.

Exercise 1.8: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

A	B
1. Chemicals can that kill or immobilize sperm	A. Vasectomy
2, One end is inserted into the vagina while the other remains outside of the vagina	B. Diaphragms
3. A couple avoiding sexual intercourse	C. Intra-uterine system
4, Have the same effect on the body as the hormones oestrogen and progesterone	D. Female condom
5. Inserted onto male penis	E. Contraceptive pill
6. A thin rubber disc, placed in the vagina before intercourse	F. Cervical mucus
6. Surgical operation in which the man's sperm ducts are cut and the ends sealed	G. Spermicides
7. Secreted by the cervix and lining of the vagina	H. Abstinence
8. T-shaped and releases the hormone progesterone	I. Laparotomy
8. Sterilization of woman by an operation	J. Male Condom

Part Two: Critical thinking question

1. Write the major fertility awareness methods.
2. State advantages and disadvantages of male condom.
3. Describe the mechanisms of coitus interrupts.
4. Write the disadvantages of diaphragm.
5. Write the disadvantages of vasectomy and laparotomy.
6. Abstinence important for the youth like you. Explain.

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s), which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task

I can

- Discuss the methods of prevention of unwanted pregnancy_____ ☐
- Explain the advantages and disadvantages of different birth control methods_____ ☐

SECTION 1.4. SEXUALLY TRANSMITTED INFECTIONS (STIs): TRANSMISSION AND PREVENTION

Dear learner! In the previous section, you have learnt about the various birth control methods – natural as well as artificial. You have also learnt about the mechanisms of action; advantages and disadvantages; degree of effectiveness of different birth control methods. Here you will learn about sexually transmitted infections (STIs): transmission and prevention. Sexually transmitted infections are infections which spread through sexual contact. Trichomoniasis, Syphilis, Gonorrhea, Chaceriod and HIV/AIDS are the common STIs in Ethiopia.

COMPETENCIES

- Describe the types, modes of transmission and preventive mechanisms of sexually transmitted diseases

Activity 16

Dear learner, ask a clinical nurse in your village about the most common sexually transmitted infectious in Ethiopia (e.g., HIV/AIDS, syphilis, gonorrhea, trichomoniasis and chancroid). Your discussion should focus on the causes, the modes transmission and methods of preventions. Write a brief note about your discussion with the health professional and submit it to a tutorial center.

- **Trichomoniasis**

Dear learner, **trichomoniasis** is caused by the flagellated protozoan *Trichomonas vaginalis*. Many infected people do not have symptoms, but some infected women have a yellowish discharge, and a sore, itchy vagina. In both sexes, an untreated infection can cause infertility. Some epidemiological studies suggest that, in men, untreated trichomoniasis may increase the risk of benign prostate enlargement and aggressive prostate cancer. A single dose of an antiprotozoal drug can quickly cure the infection. Both partners should be treated.

- **Chlamydia**

Dear learner, it is caused by *Chlamydia trachomatis*. Chlamydias are small bacteria. In women, an infection of the reproductive tract by bacteria most often goes undetected. Some women and most men experience painful urination; most infected men have a clear or yellow discharge from the penis. Left untreated, a Chlamydia infection can scar the reproductive tract and lead to infertility in both sexes. An infection can be passed from a mother to child during birth, causing pneumonia and conjunctivitis in the newborn. Chlamydia can be cured with antibiotics.

- **Gonorrhea**

Dear learner! Gonorrhea is the second most common bacterial STI is caused by *Neisseria gonorrhoeae*. Men usually develop symptoms within one week of becoming infected; yellow pus oozes from the penis and urination becomes frequent and painful. By contrast, most women have no early symptoms. In both sexes an infection can damage reproductive ducts and cause sterility. Gonorrhea is treated with antibiotics, but strains resistant to the most widely used antibiotics are increasingly common. Gonorrhea could harms the joints and skin, but can also affect the heart and liver.

- **Syphilis**

Is caused by *Treponema pallidum*, a spiral shaped bacterium. During sex with an infected partner, these bacteria get onto the genitals or into the cervix, or vagina. They slip into the body through tiny cuts. If untreated, the infection can

become systemic. Skin chancres appear and the liver, bones, and eventually the brain can be damaged. Like gonorrhea, syphilis is treated with antibiotics.

- **HIV/AIDS**

The disease is now known as Human Immunodeficiency Virus, or HIV. HIV kills immune cells in the body. HIV leads to Acquired Immune Deficiency Syndrome, or AIDS. Once attached, the virus can penetrate the immune cell. The virus may remain inactive for months.

Spread of HIV

Dear learner! The disease HIV is spread from an infected person through blood or body fluids. This can occur through direct contact with the infected blood or body fluids. It also can occur through contact with objects that have been contaminated by infected blood or body fluids. Intimate sexual contact and use of contaminated intravenous needles are known methods of disease transmission. HIV also can be transmitted by blood transfusion if the blood is contaminated. A pregnant woman who has HIV can transmit it to her fetus. The virus also can be transmitted through breast milk.

What are the symptoms of AIDS?

The first symptoms of AIDS may not appear for as many as ten years after a person is infected. During this time, the **AIDS** virus reproduces, infecting more and more immune cells. People infected with HIV may develop AIDS. Early symptoms of AIDS may include swollen lymph nodes, loss of appetite, weight loss, fever, rashes, night sweats, and fatigue. It is not known how many people who are infected with HIV will develop AIDS. AIDS weakens the body's immune system and the body cannot fight off other infectious diseases or certain forms of cancer.

Prevention and control of HIV

Dear learner! Abstinence from intimate sexual contact protects against HIV and other sexually transmitted diseases. HIV transmission can be prevented among users of illegal drugs if they do not share needles. When AIDS first appeared, there were no effective drugs. Today, there is a range of drugs that

can be given separately or as a 'cocktail', which slow the progress of the disease. Research to find a vaccine and more effective drugs is ongoing. There is a range of blood tests designed to detect HIV infection. These tests do not detect the virus but do indicate whether antibodies to the virus are in the blood. If HIV antibodies are present, the person is said to be **HIV positive**. The tests vary in their reliability and some are too expensive for widespread use.

Mechanisms of reducing the risk of HIV infection

- Abstinence (not having sex) is always an option.
- Be loyal to your partner.
- Use condoms the right way every time you have sex.
- Get tested and treated for other sexually transmitted infection (STIs). Having other STIs increases your chances of getting or transmitting HIV.
- If you are HIV positive, take HIV treatment as prescribed. HIV treatment can make your viral load (amount of virus in your blood) undetectable. If you stay undetectable, you will not transmit HIV to your sex partner.
- Voluntary Male Circumcision (VMC): prevents HIV infection, sexually transmitted infections (STIs), and other health outcomes. Male circumcision can reduce a male's chances of acquiring HIV by 50% to 60% during heterosexual contact with female partners with HIV, according to data from three clinical trials. Circumcised men compared with uncircumcised men have also been shown in clinical trials to be less likely to acquire new infections with syphilis (by 42%), genital ulcer disease (by 48%), genital herpes (by 28% to 45%), and high-risk strains of human papillomavirus associated with cancer (by 24% to 47% percent). While male circumcision has not been shown to reduce the chances of HIV transmission to female partners, it does reduce the chance that a female partner will acquire a new syphilis infection by 59%.

- **Control of the spread of STIs**

The best way to avoid sexually transmitted infections is to avoid having sexual intercourse with an infected person. However, the symptoms of the disease are often not obvious and it is difficult to recognize an infected individual. So

the STI is avoided by not having sexual intercourse with a person who might have the infection. Such persons are:

- prostitutes who offer sexual intercourse for money.
- people who are known to have had sexual relationships with many others.
- Casual acquaintances whose background and past sexual activities are not known.

These are good reasons, among many others, for being faithful to one partner. The risk of catching a sexually transmitted infection can be greatly reduced if the man uses a condom or if a woman uses a female condom. These act as barriers to bacteria or viruses. If a person suspects that he or she has caught a sexually transmitted infection, treatment must be sought at once. Treatment is always confidential. The patients must, however, ensure that anyone they have had sexual contact with also gets treatment. There is no point in one partner being cured if the other is still infected. STIs that are caused by a bacterium, such as syphilis and gonorrhea, can be treated with antibiotics if the symptoms are recognized early enough. However, HIV is viral so antibiotics are not effective.

Activity 17

Dear leaner, ask a health professional about AIDS: **Acquired Immune Deficiency Syndrome**. As you might know, the virus that causes AIDS is the **human immunodeficiency virus** (HIV). Focus your discussion on the transmission mechanisms of HIV; the different control method of the spread of AIDS and responsible sexual behavior and HIV/AIDS. Write a brief note about your discussion with the health professional and present it at a tutorial center.

Exercise 1.9: Self-assessment questions

Part One: Say true if the statement is correct false if the statement is wrong.

1. Gonorrhea infection can damage reproductive ducts and cause sterility both in male and female.
2. Women infected with *Trichomonas vaginalis,* could have a yellowish discharge, and a sore, itchy vagina.

3. Male circumcision can reduce a male's chances of acquiring HIV by 50% to 60% during heterosexual contact with female partners with HIV.
4. Chlamydia infection of the reproductive tract in women can easily be detected.
5. HIV transmission can be prevented among users of illegal drugs if they do not share needles.
6. The best way to avoid sexually transmitted infections is to avoid having sexual intercourse with an infected person.
7. Treatment to sexually transmitted infections is always not confidential.
8. Treatment of one partner is sufficient for the control and prevention of STIs.
9. Syphilis is caused by *Treponema pallidum*, a spiral shaped protozoa.
10. HIV can also be transmitted by blood transfusion if the blood is contaminated.

Part Two: Critical thinking question

1. Which types of persons will increase your chance of catching STIs via sexual intercourse?

2. State the effect of untreated trichomoniasis in males.

3. Write the scientific names the pathogens that cause the common STIs in Ethiopia.

4. Describe the methods we use to reduce the risk of HIV infection.

☑ Self-evaluation checklist

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task

I can:

- Describe the types, modes of transmission and preventive mechanisms of sexually transmitted diseases_____ ☐

Unit Summary

- Reproduction is one of the ubiquitous properties of life. The ability of organisms to reproduce to form their own kind is the one characteristic that best distinguishes living things from nonliving matter.
- Asexual reproduction is the process resulting in the production of genetically identical offspring from one parent. It occurs without gametes or fertilization.
- The basic forms of asexual reproduction are fission (binary and multiple), budding, fragmentation, and parthenogenesis.
- Many flowering plants reproduce asexually by vegetative propagation. The stolon of the strawberry plant is a horizontal stem that grows above the ground, takes root at the nodes and produces new plants. Rhizomes, corms, bulbs and tap root may store food, which is used to accelerate early growth.
- Sexual reproduction is the process involving the fusion of the nuclei of two gametes to form a zygote and the production of offspring that are different from each other. The male gamete is small and mobile. The female gamete is larger and not often mobile. The female gamete of an animal is an egg.
- Fertilization is the fusion of gamete nuclei. Fertilization happens when a sperm enters an ovum and the sperm and egg nuclei join up (fuse). The fertilized egg (zygote) divides into many cells and becomes embedded in the lining of the uterus. Here it grows into an embryo.
- The human males are born with the penis, scrotum and testicle whereas females are born with vagina, uterus, and ovaries. These are the primary sexual characteristics in males and females, respectively.
- Secondary sexual characteristics in males include: growth and maintenance of the male sex organs, an increase in body hair, an increase in muscle mass, increased growth of the long bones of the arms and legs, and deepening of the voice.
- Secondary sexual characteristics in females include: increase in growth rates of the long bones of the arms and legs, develop more hair, especially under the arms and in the pubic area, the hips broaden, and more fat is deposited in the breasts, buttocks, and thighs, the menstrual cycle begins.
- Young people must adjust to remarkable physiological, anatomical, and psychological transformations during the process of puberty.

- Young people should realize that there is considerable variation in the timing of the stages of puberty among different individuals, and that most people develop into "normal" adults in the course of their sexual and physical maturation.
- Adolescence is the period between puberty and adulthood, when a good deal of social learning takes place.
- Biologically, teenagers are adult after they have reached puberty, when they are capable of having children.
- Economically, they are adult when they can support themselves and possibly a family.
- Morally, they are adult when they are responsible for their actions, can express love in a mature manner, and can have productive and meaningful relationships.
- During adolescence, teenagers must achieve economic and moral adulthood; deal with separation from family.
- Human testes reside within a scrotum. They produce sperm and testosterone. Sperm form continually from germ cells inside the testes' seminiferous tubules. The sperm mature in an epididymis that opens into a vas deferens.
- Secretions from the seminal vesicles and prostate gland join with sperm to form semen. Semen is expelled from the body through the urethra that runs through the penis.
- Human ovaries produce eggs and sex hormones. An oviduct conveys an egg to the uterus. The cervix of the uterus opens into the vagina, which serves as the organ of intercourse and the birth canal.
- Pituitary release follicle stimulating hormone (FSH) and luteinizing hormone (LH).
- FSH causes an ovarian follicle to begin maturing. Follicle cells around an egg, which formed before birth, proliferate and secrete estrogens and progesterone.
- LH triggers ovulation of the egg. After ovulation, the corpus luteum secretes progesterone that primes the uterus for pregnancy. When the corpus luteum breaks down, menstruation occurs.

- The ovarian cycle is coordinated with cyclic changes in the uterus. We refer to the approximately monthly changes in the uterus as the menstrual cycle.
- Sperm enters the cytoplasm of the egg and the male nucleus of the sperm fuses with the female nucleus. This is the moment of fertilization.
- Human twins may come from one zygote (identical, or monozygotic twins) or two zygotes (non-identical, dizygotic, or fraternal twins).
- Fraternal twins do not resemble each other any more than other children born separately in the same family, but identical twins are, of course, strikingly alike and always of the same sex.
- Soon after the ball of cells reaches the uterus, some of the cells, instead of forming the organs of the embryo, grow into a disc-like structure, the placenta. The placenta becomes closely attached to the lining of the uterus and is attached to the embryo by a tube called the umbilical cord.
- There are natural and artificial methods birth control methods. Abstaining from sex is the effective method with added advantage of preventing exposure to sexually transmissible pathogens.
- Artificial methods of family planning barrier methods includes sheath or condom, diaphragm, femidom, spermicides, intra-uterine device (IUD), intra-uterine system (IUS),contraceptive pill, contraceptive implant, contraceptive injection, vasectomy and laparotomy.
- Sexual intercourse can pass protozoan, bacterial and viral pathogens between partners. The consequences of a STIs range from mild discomfort to sterility and systemic disease.
- Protozoan and bacterial STIs can be cured with antibiotics, but there are no drugs to cure viral STIs.

UNIT REVIEW QUESTIONS

Part One: Match items under column A with the appropriate item under **column** B.

A		B
1.	Conveys sperm out of body	A. Labia majora
2.	Produces testosterone	B. Endometrium
3.	Usual site of fertilization	C. Seminal vesicles
4.	Lining of uterus	D. Ovary
5.	Fat-padded skin folds	E. Oviduct
6.	Stores sperm	F. Vagina
7.	Birth canal	G. Urethra
8.	Secrete fructose rich fluid	H. Labia minora
9.	Secret estrogens and progesterone	I. FSH and LH
10.	Thin inner folds	J. Prostate gland
11.	Pituitary gland	K. Testis
12.	Secretes semen components	L. Epididymis

Part Two: Choose the correct answer among the given alterative

1. The cervix is the entrance to the _____
   A. Scrotum B. Fallopian tube
   C. Vagina D. Uterus
2. Morally, teenagers are adult after they have reached puberty, when they are capable of having children.
   A. False B. True
3. A male attains an erection when _____
   A. Spongy tissue inside the penis fills with blood
   B. Muscles running the length of the penis contract
   C. Leydig cells release a surge of testosterone
   D. The posterior pituitary releases oxytocin
4. Sexual reproduction_____
   A. Requires formation of sex cells by mitosis
   B. Results offspring identical in their traits
   C. Occurs only in non- flowering plants
   D. Requires formation of sex cells by meiosis

5. Sperm in an epididymis passes next into the _____
   A. Seminiferous tubules
   B. Vas deferens
   C. Pituitary gland
   D. Urethra
6. Semen contains secretions from the _____
   A. Prostate gland
   B. Pituitary gland
   C. Corpus luteum
   D. Adrenal gland
7. Birth control pills deliver synthetic.
   A. Oxytocin and prostaglandins
   B. LH and FSH
   C. Testosterone
   D. Estrogens and progesterone
8. Which one of the following is not the advantage of asexual reproduction
   A. No mate is needed
   B. No gametes are needed
   C. All the good characteristics of the parent are passed on to the offspring
   D. Little variation created

Part Three: Critical thinking question

1. One of the first signs of pregnancy is that the menstrual periods stop. Explain.
2. Several endocrine events occur after the fertilization of ovulated egg. Why?
3. State the functions of male sex hormones.
4. Sperm differ from egg in their structure. Explain
5. Discuss the causes, effects and treatments of common STIs.
6. Describe, and distinguish among, the birth control methods: vasectomy, diaphragm, contraceptive pill, spermicides and laparotomy.
7. Name the general location and give the function of the following reproductive structures: seminiferous tubules, vas deferens, urethra,

seminal vesicles, prostate gland, bulbourethral glands, mature follicle, oviducts, uterus, vagina.

8. Define, and distinguish among, the terms fission, fragmentation, parthenogenesis, budding and vegetative propagation.
9. From the list of changes at puberty in girls, write those that are related to childbearing and say what part you think they play.
10. Is fertilization likely to occur if mating takes place:

    A. 2 days before ovulation B. 2 days after ovulation

Feedback to Activitie, Self-Test $ Modules

🗝Feedback to Exercise 1.1: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1.C	2.H	3.D	4.F	5.I	6.A	7.G	8. E	9. B

Part Two: Critical thinking question

1. **Answer:** Steps of binary fission in bacteria
    a. The cell is preparing for reproduction
    b. Cell makes a copy of a single chromosome
    c. The original chromosome and its copy separate as the cell grows larger
    d. The cell membrane begins to pinch inward near the middle of the cell, creating two new parts and
    e. A new cellwall forms around the two new cells.
2. **Answer:** Budding and sporulation.
3. **Answer:** Binary Fission
4. **Answer:** Bacteria use mitosis for reproduction but humans use for growth and repair.
5. **Answer:** It is due to the decomposing effect of fungi
6. **Answer**: The nucleus of the orgasms divides repeatedly and each daughter nucleus breaks away together with a small portion of the cytoplasm, resulting in the production of many daughter cells.

🗝**FEEDBACK TO** Activity 7. Advantages and disadvantages of sexual reproduction

Advantages	Disadvantages
• Sexual reproduction produces a new organism that results from a combination of traits of two parents. • Sexual reproduction increases the genetic viability in organisms of the same species and even within the offspring of one couple. • In the long run, sexual reproduction allows the best adaptations to be widespread within a species, especially in changing circumstances. • The variability of the offspring within a species guarantees that a higher proportion will survive in perilous circumstances. • Two parents can watch over offspring.	• Finding a reproductive partner and producing gametes requires the output of a lot of energy. • Mechanisms for the transport of gametes for fertilization, for the attraction of the opposite sex, and for competition within a species must be put in place. • Not only are two gametes needed for fertilization, one must be male and the other is female. • The genetic results of meiosis, and often fertilization, are unpredictable. • Genetic "errors" happen more frequently because meiosis is more complex than mitosis and diploid organisms have more chromosomes to double. • Offspring are not necessarily as well adapted to their environment as the parents. • Many organisms never become parents because they cannot find a partner; many gametes are lost because they are not fertilized.

🗝**FEEDBACK TO Exercise 1.2: Self-assessment questions**

Part One: Say true if the statement is correct false if the statement is wrong.

1. True 2. True 3. False 4. False

Part Two: Critical thinking question

1. **Answer:**

   a. Internal fertilization: Fertilization occurs inside the female body.

   b. External fertilization: Fertilization occurs outside the female body.

2. **Answer**: Sperm & egg
3. **Answer**: Zygote
4. **Answer**: Sperm & egg
5. **Answer**: Tests & Ovary
6. **Answer**: does not need the involvement of males and female partners, faster, uniformity.

🗝FEEDBACK TO Activity 8

- Puberty begins in the early teen years. **Puberty** is the time when **secondary sex characteristics** begin to develop.
- Secondary sex characteristics begin to develop so that sexual maturity is reached.

🗝FEEDBACK TO Exercise 1.3: Self-assessment questions

Part One: Say true if the statement is correct false if the statement is wrong.

1. True	2. True	3. True
4. True	5. True	6. true

Part Two: Critical thinking question

1. Answer: Adolescence is the period between puberty and adulthood, when a good deal of social learning takes place**.**

2. Answer: follicle-stimulating hormone (FSH) and luteinizing hormone (LH).

3. Answer: secondary sex characteristics in females are:

- Develop more hair, especially under the arms and in the pubic area.

- The hips broaden, and
- More fat is deposited in the breasts, buttocks, and thighs.
- The menstrual cycle begins.

🗝FEEDBACK TO Activity 9.

Male reproductive structures and function

Structure	Function
Epididymis	a single, coiled tube in which sperm finish their maturation process fluid into the vas deferens
Prostate gland	a doughnut-shaped gland that lies below the urinary bladder and surrounds
Scrotum	a sac that contains the testes; suspended directly behind the base of the penis
Seminal vesicle	a gland located at the base of the urinary bladder that secretes a fructose rich the top portion of the urethra; secretes an alkaline fluid that helps the sperm move
Vas deferens	a duct that carries sperm from the epididymis toward the ducts that will force the sperm out of the body; sperm can stay in the vas deferens for two or three months

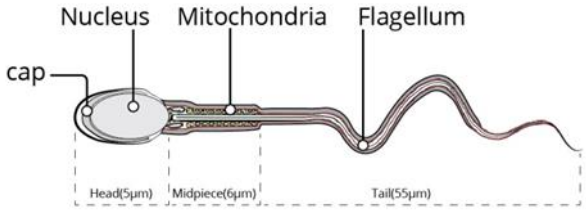
🗝FEEDBACK TO Exercise 1.4: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1.A	2.E	3. I	4.G	5.F
6.H	7. B	8.J	9.D	10. C

Part Two: Critical thinking question

1. **Answer:** Parts sperm cells are: head, mid piece and tail.



2. **Answer: F**ollicle-stimulating hormone (FSH) and luteinizing hormone (LH)
3. **Answer:** Sperm cell production
4. **Answer:** In the tests.
5. **Answer:** Hypothalamus
6. **Answer:** Sperm production & transport**/delivery**

🗝FEEDBACK TO Activity 10

Female reproductive structures and function

Structure	Function
Cervix:	the lower end of the uterus that leads into a narrow opening in the vagina
Corpus luteum:	a structure that secretes the hormones estrogen and progesterone; progesterone causes changes to occur in the lining of the uterus that prepares it to receive a fertilized egg **oviduct:** a tube that transports eggs from the ovary to the uterus
Follicle:	a group of epithelial cells that surround a developing egg cell
Ovaries	Egg production
Oviduct	Site of fertilization

🗝FEEDBACK TO Exercise 1.5: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1. F	**2. C**	**3. I**	**4. G**	**5. B**
6. H	**7. J**	**8. E**	**9. A**	**10. D**

Part Two: Critical thinking question

1. **Answer:** the corpus luteum breaks down, and a new follicle will begin to mature.

2. **Answer: F**ollicle-stimulating hormone (FSH) and luteinizing hormone (LH)
3. **Answer:** Mitosis.
4. **Answer:** Ovary

🗝FEEDBACK TO Activity 11:

- The **menstrual cycle** is the series of changes that the female body experiences each month. These changes include producing an egg and preparing the uterus for receiving the egg. Once an egg has been released during ovulation, the part of the follicle that remains in the ovary develops into the corpus luteum. The **corpus luteum** is a structure that secretes the two female hormones estrogen and progesterone. Progesterone causes changes to occur in the lining of the uterus. These changes prepare the uterus to receive a fertilized egg. The menstrual cycle begins during puberty. It will continue for 30 to 40 years. It stops at **menopause**. At menopause, the female stops releasing eggs and the secretion of the female hormones estrogen and progesterone decreases.

🗝FEEDBACK TO Activity 12:

1. Flow phase,
2. Follicular phase
3. Luteal phase

🗝FEEDBACK TO Exercise 1.6: Self-assessment questions

Part One: Say true if the statement is correct false if the statement is wrong.

1. True	**2. True**	**3. False**	**4. True**	**5. True**

Part Two: Critical thinking question

1. **Answer**: the health benefits are
    a. Keeping the genitalia clean
    b. Avoid infection
    c. Maintain natural pH balance
    d. Good reproductive health

2. **Answer: Menopause**: occur when all the follicles in a woman's ovaries have either been released during menstrual cycles or have disintegrated as a result of aging.
3. **Answer:** The endometrium is shed during menstrual flow
4. **Answer:**It secretes the hormones estrogen and progesterone
5. **Answer:**
    - building up the endometrium (follicular phase)
    - ovulation
    - preparing hormonally for pregnancy (luteal phase)
    - shedding the endometrium if no pregnancy occurs (menstrual phase)

🗝FEEDBACK TO Activity 13:

- The sperm enters the cytoplasm of the ovum and the male nucleus of the sperm fuses with the female nucleus. This is the moment of fertilization. The released ovum is thought to survive for about 24 hours; the sperm might be able to fertilize an ovum for about 2 or 3 days. So there is only a short period of about 4 days each month when fertilization might occur. If this fertile period can be estimated accurately, it can be used either to achieve or to avoid fertilization (conception).
- The fertilized ovum (zygote) first divides into two cells. Each of these divides again, so producing four cells. The cells continue to divide in this way to produce a solid ball of cells, an early stage in the development of the embryo. This early embryo travels down the oviduct to the uterus. Here it sinks into the lining of the uterus, a process called **implantation**. The embryo continues to grow and produces new cells that form tissues and organs. After 8 weeks, when all the organs are formed, the embryo is called a **fetus**.

🗝FEEDBACK TO Exercise 1.7: Self-assessment questions

Part One: Say true if the statement is correct false if the statement is wrong.

1. True	2. True	3. True	4. True	5. False

🗝FEEDBACK TO Activity 14:

No.	Birth control method	Advantage	disadvantage
1	Abstinence	• Sperm cannot come into contact with an egg and fertilization cannot happen.	• no
2	Monitoring body temperature	• Reduce the side effect some contraceptive methods	• no simple, reliable way to recognize ovulation • not very reliable
3	Cervical mucus	• Could e combined with other methods 'calendar', 'temperature'	• Not 100% effective
4	Sheath or condom	• Traps the sperm and prevents them from reaching the uterus. • Prevents the transmission of sexually transmitted infections (STIs).	• Not 100% effective
5	Diaphragm	• covers the cervix and stops sperm entering the uterus	• Does not prevent the risk of transmission of STIs.
6	Femidom	• semen is trapped inside the femidom. • reduces the risk of infection by STIs.	
7	Spermicides	• conjunction with condoms or diaphragms, they are effective.	• spermicides are not very reliable
8	Intra-uterine device (IUD)	• prevents implantation of a fertilized ovum	• a small risk of developing uterine infections, and it does not protect against STIs.
9.	intra-uterine system (IUS)	• prevents ovulation	• IUS does not protect against STIs.
10.	Contraceptive pill	• suppress ovulation and so prevent conception	• Long-term use of some types may increase the risk of cancer of the breast and cervix. • The pill does not protect against STIs.

🗝 FEEDBACK TO Exercise 1.8: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1. G	2. B	3. H	4. E	5. J
6. D	7. A	8. F	9. C	10. I

Part Two: Critical thinking question

1. **Answer:**

   a. Standard Days Methods
   b. Calendar Rhythm Method
   c. Symptothermal Method
   d. Ovulation Method

2. **Answer:** Advantages: Provides protection against both pregnancy and STI/HIV, widely accessible without a prescription, causes almost no medical side effects. **Disadvantages**: Coitus dependent, reduced sensitivity for men however, this may be an advantage for preventing premature ejaculation, difficulty maintaining erections, especially when they are inexperienced condom users, challenge to use in relationships where there is weak partner cooperation and/or intimate partner violence or coercion and latex allergy.

3. **Answer:** A man pulls his penis out of his partner's vagina before ejaculation to avoid ejaculating the sperm.

4. **Answer:** Does not prevent the risk of transmission of STIs

5. **Answer:** The operation cannot usually be reversed.

6. **Answer:** Avoid the chance of unwanted pregnancy & to make the chance contracting sensually transmitted infections low

🗝 FEEDBACK TO Activity 16:

- AIDS, syphilis and gonorrhoea
- Abstinence sexual intercourse
- use condom during sexual intercourse

🗝**FEEDBACK TO** Activity 17:

- HIV is transmitted by direct infection of the blood. Drug users who share needles contaminated with infected blood run a high risk of the disease. It can also be transmitted sexually, both between men and women and, especially, between homosexual men. Prostitutes, who have many sexual partners, are at risk of being infected if they have sex without using condoms and are, therefore, a potential source of HIV to others.
- When AIDS first appeared, there were no effective drugs. Today, there is a range of drugs that can be given separately or as a 'cocktail', which slow the progress of the disease. Research to find a vaccine and more effective drugs is ongoing.

🗝**FEEDBACK TO Exercise 1.9: Self-assessment questions**

Part One: Say true if the statement is correct false if the statement is wrong.

1.True	2.True	3.True	4. False	5.True
6.True	7.False	8. False	9. False	10.True

Part Two: Critical thinking question

1. **Answer:**
   a. Prostitutes who offer sexual intercourse for money.
   b. People who are known to have had sexual relationships with many others.
   c. Casual acquaintances whose background and past sexual activities are not known.
2. **Answer:** Untreated trichomoniasis may increase the risk of benign prostate enlargement and aggressive prostate cancer.
3. **Answer:** *Trichomonas vaginalis*, *Chlamydia trachomatis, Neisseria gonorrhoeae, Treponema pallidum*
4. **Answer:** Abstinence, be loyal to your partner, use condoms the right way every time you have sex, etc.

🗝FEEDBACK TO REVIEW QUESTIONS

Part One: Match items under column A with the appropriate item under **column** B.

1. G	2. K	3. E	4. B	5. A	6. L
7. F	8. C	9. D	10. H	11. I	12. J

Part Two: Choose the correct answer among the given alterative

1. D	2. A	3. A	4. D
5. B	6. A	7. D	8. D

Part Two: Critical thinking question

1. **Answer** The hormones cause the uterine lining to thicken and encourage blood vessels to grow through it. The uterus is now ready for pregnancy.
2. **Answer:** Progesterone causes changes to occur in the lining of the uterus. These changes prepare the uterus to receive a fertilized egg.
3. **Answer:** Testosterone: Is main hormone produced by testes; required for sperm production and development of male secondary sexual traits**.**
4. **Answer:** Sperms are smaller in size compared to the egg, as the egg contains reserved food for the developing embryo.
5. **Answer:**

STIs	Cause	Treatment
• Chlamydial infection	Bacteria	Antibiotics
• AIDS	Virus	ART/vaccine
• Syphilis	Bacteria	Antibiotics
• Gonorrhea	Bacteria	Antibiotics
• Trichomoniasis	Protozoa	Antibiotics

6. **Answer:**

A. **Vasectomy**: This is a simple and safe surgical operation in which the man's sperm ducts are cut and the ends sealed. This means that his semen contains the secretions of the prostate gland and seminal vesicle but no

sperm so cannot fertilize an ovum. Sexual desire, erection, copulation and ejaculation are quite unaffected. The testis continues to produce sperm and testosterone. The sperm are removed by white cells as fast as they form. The testosterone ensures that there is no loss of masculinity. The sperm ducts can be rejoined by surgery but this is not always successful.

B. **Diaphragm**: A thin rubber disc, placed in the vagina before intercourse, covers the cervix and stops sperm entering the uterus. Condoms and diaphragms, used in conjunction with chemicals that immobilize sperm, are about 95% effective. However, a diaphragm does not prevent the risk of transmission of STIs (Fig. 1.16). There are no side effects, offers some protection against cervical cancer. It must be initially fitted by a doctor. May be incorrectly positioned or damaged and allow sperm past. Gives better protection against pregnancy when combined with spermicide. There is a chance of 2.5 pregnancies per 100 woman years.

C. **contraceptive pill**: The pill contains chemicals, which have the same effect on the body as the hormones oestrogen and progesterone. When mixed in suitable proportions these hormones suppress ovulation and so prevent conception. The pills need to be taken each day for the 21 days between menstrual periods. There are many varieties of contraceptive pill in which the relative proportions of oestrogen_and progesterone-like chemicals vary. They are 99% effective, but long-term use of some types may increase the risk of cancer of the breast and cervix. The pill does not protect against STIs.

D. **Spermicides**: Spermicides are chemicals which, though harmless to the tissues, can kill or immobilize sperm. The spermicide, in the form of a cream, gel or foam, is placed in the vagina. On their own, spermicides are not very reliable but, in conjunction with condoms or diaphragms, they are effective.

E. **Laparotomy**: A woman may be sterilized by an operation in which her oviducts are tied, blocked or cut. The ovaries are unaffected. Sexual desire and menstruation continue as before, but sperm can no longer reach the ova. Ova are released, but break down in the upper part of the oviduct.

The operation cannot usually be reversed. Both vasectomy and laparotomy are almost 100% guaranteed to prevent pregnancy and permanent control of fertility. Remove the problem of human error in contraception. For women in particular it involves a general an aesthetic. Not easily reversible. There a chance of 0.05 pregnancies per 100 woman years

7. Answer

Male Reproductive System		**Female Reproductive System**	
Structure	Role	Structure	Role
Semen	the combination of sperm and the fluids produced in glands to either protect the sperm or move them through and out of the male body	oviduct	the tube down which the ova pass when released from the ovary
seminal vesicle	a gland located at the base of the urinary bladder that secretes a fructose rich the top portion of the urethra; secretes an alkaline fluid that helps the sperm move	follicle	a group of epithelial cells that surround a developing egg cell
prostate gland	a doughnut-shaped gland that lies below the urinary bladder and surrounds	cervix	the lower end of the uterus that leads into a narrow opening in the vagina
Epididymis	a single, coiled tube in which sperm finish their maturation process fluid into the vas deferens	corpus luteum	a structure that secretes the hormones estrogen and progesterone; progesterone causes changes to occur in the lining of the uterus that prepares it to receive a fertilized egg
scrotum,	a sac that contains the testes; suspended directly behind the base of the penis	vagina	muscular tube that receives erect penis during sexual intercourse
vas deferens	a duct that carries sperm from the epididymis toward the ducts that will force the sperm out of the body; sperm can stay in the vas deferens for two or three months		
Bulbourethral gland	secrete a clear, sticky alkaline fluid		

8. Answer:

A. **Fission**: In binary fission the body of the unicellular parent divides by mitosis into two approximately equal parts, each of which grows into an individual similar to the parent. Alternatively, the nucleus of the orgasms divide repeatedly and each daughter nucleus breaks away together with a small portion of the cytoplasm, resulting in the production of many daughter cells.

B. **Fragmentation**: Fragmentation is one of the most common modes of asexual reproduction involving the breakdown of a parent organism into parts that develop into whole organism

C. **Parthenogenesis**: a form of asexual reproduction in which an unfertilized egg develops into an adult organism.

D. **Budding**: During the process a bulge forms on the side of the cell, the nucleus divides mitotically, and the bud ultimately detaches itself from the mother cell.

E. **Vegetative propagation:** Is a method of asexual reproduction in plants where structures with lateral meristems such as roots, stems, buds, and leaves give rise to new self-supporting individual. The following are types of vegetative reproduction.

9. Answer: Estrogen is responsible for the secondary sex characteristics of females. These characteristics include the growth and maintenance of female sex organs. In females, the hips broaden, and more fat is deposited in the breasts, buttocks, and thighs. The menstrual cycle begins.

10. Answer: yes

References

Jane , B. et al (2016). *Campbell Biology*. 11th Ed. Pearson higher education Ltd.

Mackean, D. G., & Hayward, D. (2014). *Cambridge IGCSE Biology*. 3rd Ed. Hodder Education.

Starr, C., Taggart, R., Evers, C., & Starr, L. (2015). *Biology: The unity and diversity of life*. Cengage.

UNIT 2: HUMAN HEALTH, NUTRITION, AND DISEASE

INTRODUCTION

Dear learner! In this unit, you will learn about nutrition and health. This unit has nine sections: section one deals about the meaning of food. Section two and three are about nutrition and nutrients. Nutrition is the process of taking of food and converting to energy. Nutrients are important chemical substances that are found in foods, which include carbohydrates, proteins, lipids (fats and oil), vitamins, minerals and water.

In section four, you will study about balanced diet. Section five deals about deficiency diseases which is occurred if food intake in human body is inadequate in carbohydrate, proteins, minerals or vitamins and the sixth section deals about malnutrition which is defined as the insufficient, excessive or imbalanced consumption of nutrients.

Section seven is about substance abuse, the meaning of drugs and types of drugs. Section eight is about types of diseases and their mode of transmission and prevention. The last section of this unit deals about renowned nutritionists of Ethiopia.

Learning competences

- Define nutrition
- List the types of nutrients
- Describe the role of a balanced diet especially for children, nursing mothers, athletes, and people with HIV/AIDS
- Describe with examples the sources and deficiency diseases of vitamins and minerals.
- Define malnutrition
- Discuss the feeding habits that may lead to obesity
- Examine the effects of smoking, alcohol use, chewing khat, cannabis, and other drug use, on the health, social, economic, cultural, and

psychological wellbeing

- Explain the modes of transmission and prevention of infectious and non infectious diseases
- List and appreciate renowned nutritionists in Ethiopia

Contents

The Required Study Time

This section should take Approximately 22 hours of learning time.

LEARNING STRATEGIES

Dear learner! For your successful distance learning process, you can use different learning strategies wherever they are appropriate to the topics/ subtopics of your lesson. These learning strategies might be mind mapping, mentally rehearsing, short visits/onsite observation, using microscope in the nearby schools, hospitals and clinics, and research sites, comparing and contrasting, drawing and taking pictures of real plants, creating analogies, paraphrasing, summarizing (outlining and preparing flow chart summaries), taking short notes, underlining or highlighting key points.

Module Assessment

When you complete unit 1, you will submit your assignments, to the Distance Learning Unit either by mail or electronically through the learning management system (LMS). The staff will forward your work to your tutor/marker.

SECTION 2.1. WHAT IS FOOD?

Overview

Dear learner! In this section, you will study about food. Food is any beneficial substance that is eaten, drunk, or otherwise taken into the body to sustain life, provide energy, promote growth, etc. It is consumed to provide nutritional support for an organism. Food is usually of plant, animal, or fungal origin, and contains essential nutrients, such as carbohydrates, fats, proteins, vitamins, or minerals

Learning competences

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

- Explain what food is

The importance of food in living things:

Activity 2:1

Explain the importance of food with the particular type of food we eat. For example eating rice for breakfast.

Growth: Food is the source substances necessary for making new cells, tissues and organs.

Energy: living things undergo different biological and chemical reaction in their bodies. These reactions in living things produce at the same time require energy.

Food is the sources of energy that fuel all the biological activities. Running, jumping, moving, growing, reproducing, and all other activities require energy.

Replacement of damaged tissues: Food is required for making new cell and used to replace damaged cells of the body.

Protect from diseases: There are different types of diseases caused by the shortage of specific groups of foods. Our body requires these food groups to

protect our body from deficiency diseases and to become healthy.

Self-test exercise

1. What is food?
2. List the importance of food in living things

☑ Checklist

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again. I can:

- Explain about food and its importance for growth, for repairing damaged tissue as a source of energy and for protecting our body from different diseases ……..……..…. □

SECTION 2.2 NUTRITION

☸Overview

Dear learner! In the previous section, you have studied well about the meaning of food and the importance of food. Then you should go to the next section which about nutrition. The food that we eat needs some process in order to convert into energy.

Learning competences

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

- Explain about nutrition.

Dear learner! We hope you enjoyed reading the previous section and in the next two section, you will learn about nutrition and nutrient. Nutrition is the process of taking in food and converting it into energy and other vital nutrients required for life.

Energy obtained from food is important for different activities of the body. The food we eat keeps us alive and provides the nourishment for growth, repairs of our body cells and maintain good health.

Self-test exercise

1. What is nutrition?

☑ Checklist

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again.

I can:

- Define nutrition……..…..□

SECTION 2.3. NUTRIENTS

Overview

Dear learner! In the previous two sections, you have learned about the meaning of food and nutrition. In this section, you will learn about nutrients and types of nutrients.

Nutrients are important chemical substances that are found in foods. In human body, we need nutrients for growth, source of energy and stay healthy.

We obtain these nutrients from the foods we eat. The five important classes of nutrients are: carbohydrates, proteins, lipids (Fats and oil), vitamins, minerals and water.

Dear learner! Be aware about the difference between nutrition and nutrients.

Learning competences

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

- List important nutrients
- Explain the importance nutrients and their deficiency

Activity 2.2

Explain the meaning of nutrients by giving example

Macronutrients and Micronutrients

Dear learner! Be aware that the three nutrients, carbohydrate, protein and fats are required in large quantities. Such nutrients are called macronutrients. In contrast, minerals and vitamins are needed in very small quantities and are called micronutrients.

Dear learner! Vitamins and minerals do not supply energy but they play an important role in the regulation of the metabolic activity in the body and help in the utilization of proteins, fats and carbohydrates. Minerals are also used for the formation of body structure and skeleton.

Carbohydrates

Dear learner! We hope you will enjoy the following lesson which is about carbohydrates. It is the type of nutrient that is used as a source of energy.

Carbohydrates are types of nutrients that provide energy for the human body. They are composed of three elements, carbon, oxygen and hydrogen.

Dear learner! Do you know that the human body gets carbohydrate from green plants?

Green plants prepare carbohydrate in the form of starch by the process of Photosynthesis. They combine carbon dioxide and water using energy from the sun in order to produce carbohydrate. Such carbohydrates are the major sources of energy in our diet. Starch is abundant in potatoes, bread, maize, rice and other cereals.

Sugar appears in our diet mainly as **sucrose** (table sugar) and is added to drinks and many prepared foods such as biscuits and cakes. Sugars also occur naturally in many fruits and some vegetables.

Dear learner! Be aware that one gram of carbohydrate can provide, on average, 16 kilojoules (kJ) of energy.

Dear learner! Read the following attention box to know about how energy is measured in calorie and joule. Be aware about the relation of calorie and joule.

Attention

The energy produced from the raw materials is usually measured in units known as calories; one calorie is the amount of energy needed to raise the temperature of 1 g or cubic centimeter (cc) of water in 1°C. The calorie units usually referred to in biology and nutrition are kilogram-calories (Kcal); each is 1,000 gram-calories.

1 kilojoule is equal to 0.2 kilocalorie

1 calorie is equal to 4.2 kilojoule

Dear learner! We hope you enjoyed reading about carbohydrate. If you did, then you should go on to the about indigestible carbohydrate which provides dietary fiber that does not serve as a source of energy.

This indigestible part is a product of plant's cell walls that consists mainly of cellulose. Human body does not have any enzymes for the digestion of this cellulose.

Therefore, the plant cell walls reach the large intestine (colon) without being digested. This undigested part of the diet is called fiber or roughage. The colon contains many bacteria that can digest some of the substances in the plant cell walls to form fatty acids.

The fiber and the bacteria, which multiply from feeding on it, add bulk to the contents of the colon and help it to recollect water. This softens the feces and reduces the time needed for the undigested residues to pass out of the body.

Both effects help to prevent constipation and keep the colon healthy and increase bowel movement. It is found in vegetables, fruits, and grains.

Dear learner! Be aware that there are three types of carbohydrates.

Monosaccharide: The simplest carbohydrate is simple sugar or monosaccharide which include glucose, fructose and galactose.

These three monosaccharide each have six carbon atoms, so they are also known as hexose sugars. Their molecular formula is $C_6H_{12}O_6$.

Disaccharide: Similar to other carbohydrates, disaccharides are comprised of hydrogen, carbon, and oxygen.

It is the combination of two simple sugars to form a complex sugar called disaccharide. These are:

- maltose(Glucose+ Glucose),
- sucrose (Glucose +Fructose and
- lactose (Glucose+ Galactose).

The general chemical formula of disaccharides is $\mathbf{C_{12}H_{22}O_{11}}$.

Polysaccharide: which is formed when many simple sugar join together. They are substances whose molecules contain hundreds or thousands of monosaccharaides linked together into long chains. Polysaccharides are found in plant cell as cellulose and starch. In addition it stored in animals as glycogen. The general formula of (C6H10O5)n.

Activity 2. 3: Homework

Refer to biology books or search from the internet in order to list example of food that belong to fructose, sucrose and starch.

Fats and Oils

Dear learner! We hope you did well in the carbohydrates? If you did, then you should go on to fats and oils. Fats and oils are high-energy nutrients that provide 35 to 45% of caloric intake. One gram of lipid gives 37kJ of energy. Like carbohydrates, fats and oils are composed of three elements, carbon, oxygen and hydrogen.

Dear learner! Fats are obtained from animal source and are solid at room temperature while oils are from plant source and liquid at room temperature. The major sources of fat are meat, milk, cheese, butter and egg-yolk. We obtain oils from fruits, seeds (e.g. sunflower seed).

In human body, lipid is used to make fatty tissue, **adipose tissue**, under the skin forms a layer that can reduce heat losses from the body. Besides satisfying metabolic energy needs, dietary fat, also serve as a vehicle for the absorption of the fat soluble vitamins (A, D, E and K).

Activity 2.4

What is the amount of energy obtained from one gram of carbohydrate?

Proteins

Dear learner! In the next part, you will learn about proteins. Proteins are nutrients, which provide growth of the body and build a new cell. It is made up of amino acid composed of carbon, hydrogen, oxygen and nitrogen. In all living things, the structural part of the cell is composed of protein.

Dear learner! The major sources of dietary proteins from animals are meat, fish, eggs, milk and cheese. Plants such as beans, chickpea, soya beans and nuts are also important protein sources. Dear learner! Read the following table to summarize about the macro-nutrients.

Table 2.1: Source and function carbohydrate, protein and fats.

Nutrient	Good food sources	Use in the body
Carbohydrate	Barley, wheat, potato, bread, sugary foods like honey	Storage; source of energy, An unavailable or indigestible carbohydrate provides dietary fiber that does not serve as a source of energy.
Lipids (Fat/oil) oils are liquid at room temperature, but fats are solid)	Butter, cheese, animal fat, groundnuts (peanuts)	Source of energy(twice as much as carbohydrate); insulation against heat loss; some hormones; cell membranes; insulation of nerve fiber
Protein	Meat, fish, eggs, soya, groundnuts, milk	Growth; tissue repair; enzymes; some hormones; cell membranes; hair; nails; can be broken down to provide energy

Vitamins (Types)

Dear learner! In next you will learn about vitamins and minerals (micronutrients). Vitamins are nutrients, which are essential in small quantities for human body. They are organic substances needed for chemical reactions of human cells. Plants can make these vitamins in their leaves, but animals as well as human have to obtain many of them ready-made either from plants or from other animals.

Dear learner! Be aware that if any one of the vitamins is missing or deficient in the diet, the vitamin deficiency disease may develop.

Examples of vitamins: are vitamin A, vitamin E, thiamine (vitamin B1) and riboflavin (vitamin B2), and vitamin C.

Minerals

Minerals are inorganic substances, which are essential in small quantities for human body. The major minerals, which are necessary for human body, are Calcium, Iron, phosphorous and Iron.

Dear learner! Please read the following about types of minerals and identify their function.

Calcium is used to build teeth and bones, it make muscles to contract and help for the transmission of nerve impulses. The important sources of calcium are milk, cheese etc.

Iron is a mineral which synthesizes the hemoglobin of red blood cells. Hemoglobin is a molecule, which carries oxygen in blood. The sources of iron in the diet are red meat, liver, kidney, eggs, groundnuts, Tikur teff etc.

Iodine is a mineral, which makes thyroid gland to work properly. The source iodine is iodized salt and seafood.

Phosphorus is a mineral required to build bones in animal as well as humans body.

Water Dear learner! Body fluids such as blood, lymph and tissue fluid are mainly composed of water. The transportation of digested food into the body cell

and excretion of excess salt and urea out of the body is possible because of water. Thus, water acts as a solvent and as a transport medium for substances throughout the body.

Activity 2.5

Think about the types of food you ate in the past 12 hours, construct a table similar to that of table 5.1. and classify the foods you ate accordingly. Was it a balanced diet? If not, What do you propose it should be?

Key Words

Nutrients: are chemical substance found in food and used by the human body for growth, or to provide energy.

Carbohydrates: are types of nutrients that provide energy for the human body. One gram of carbohydrate can provide, on average, 16 kilojoules (kJ) of energy while

Fats and oils: types of nutrients divided into fats(solid at room temperature)and oil (liquid at room temperature). One gram of lipid gives 37 kJ of energy.

Proteins: are nutrients used for growth of the body and build a new cell. It can also provide energy. One gram of protein can provide 17 kJ of energy.

Vitamins: are nutrients that are essential in small quantities for human body. They are organic substances needed for chemical reactions inhuman cells. The major vitamins are: **Vitamin A, vitamin B, Vitamin D, Vitamin C**

Minerals: are inorganic substances, which are essential in small quantities. The major minerals are Calcium, Iron, phosphorous and Iron.

Fiber: is the indigestible part of the vegetables and other plant material, prevent constipation and keep the colon healthy.

Activity 2.6

Construct a table about minerals and vitamins by including their sources, their function and their deficiency disease

Self-test exercise

Match column A with column B

A	B
1. carbohydrate, protein and lipids are required in large quantities	A. Micro-nutrients
2. minerals and vitamins are needed in very small quantities	B. Macro-nutrients
3. Green plants prepare carbohydrate in the form of	C. Starch
4. The simplest carbohydrate	D. Disaccharide
5. it is the combination of two simple sugars	E. Monosaccharide

II. Choose the correct answer for the following questions.

1. Which of the following is true about disaccrides?
   A. maltose(Glucose+ Glucose),
   B. sucrose (Glucose +Fructose)
   C. lactose (Glucose+ Galactose)
   D. All
2. Which of the following is true about **Proteins?**
   A. Proteins are nutrients, which provide growth of the body.
   B. build a new cell.
   C. It is made up of amino acid.
   D. all

☑ **Checklist**

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform may one of these tasks, you need to read once again. I can

- List important nutrients.....□

SECTION 2.4. BALANCED DIETS

Overview

Dear learner! We hope you have studied well about nutrients and their important function for human body? If you have done so, then you should go

on to the next section which is the study about the correct combination of these nutrients called balanced diet.

Ethiopia has multicultural societies. These diverse societies have different types of cultural foods. All these foods are different in their preparation, flavor and ingredients.

In addition, different people prefer different food types. Some may prefer to feed on vegetables; others may carbohydrate, animal protein etc.

Different food or diet may contain important composition of the above important nutrients. In contrast, some diet may result in health problem because it may contain high amount of fat or high amount of animal protein etc.

Learning competences

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

- Explain the meaning of balanced diet
- list types of food which make a balanced diet

Figure 2.1. Ethiopian cultural foods

Dear learner! Be aware that the diet that contains all of the nutrients in the correct amount and proportion is termed as a balanced diet.

A balanced diet must contain enough proportion of carbohydrates and fats to meet our energy requirement. It should also contain enough protein of the right kind to provide the amino acids to make new cells and produce tissues growth.

The diet must also contain vitamins and mineral salts, plant fiber and water for normal functioning of the body. Therefore, a balanced diet gives us all the essential substances that we need in the right quantities.

Activity 2.7

Do you think that that our body needs energy only when we are doing some activity, such as riding a bicycle or walking to school?

If your answer is yes or no, Explain it

Figure 2.2. Balanced diet

Keywords

Diet: the food that you eat

Balanced diet: the diet that contains all of the nutrients in the correct amount and proportion **Deficiency disease**: disease occurs when a person does not have enough amount of one particular nutrient and suffers health problems.

Balanced diet depends on age, sex, activities and life styles

Dear learner! We hope you have enjoyed reading about balanced diet. Be aware that the feeding habit of people depends on where they live, their social issues, their age, their sex their personal activity and physiological conditions etc.

For example, a pregnant woman should eat more food for the development and growth of her baby. She should get more minerals like calcium for the development of bone and teeth of her baby.

Children have a greater energy requirement than adults because they are still in the process of growth. Young children also need more protein than adult does because they are constantly developing and making new cells.

Elderly people generally have lower energy and protein needs. However, they need to eat a balanced diet in order to stay healthy. Naturally, female have a relatively higher fat content in their bodies than male. Fat in female body is stored in fat tissue, such as under the skin.

These fatty tissues have a lower metabolic rate than muscular tissue, so women generally have a lower energy requirement than men. Therefore, men should eat relatively more energy food than women should.

Some jobs that involve physical activity require more energy than less active jobs. People who are usually work physical exercise such as athletes also require high energy and high protein diets. The extra protein is required for muscle development.

Activity 2.8

Read daily energy requirements of the people shown in the above table 2.2 and explain why adult manual worker requires more energy than the adult office worker or Teen ager

Table 2.2: Energy requirement by the body depends on age, sex, activities and lifestyles

Different groups of human	Energy used in a day/ kilocalories	
	Male	Female
8-year-oldchild	2031	2031
Teenager,aged14	2987	2318
Adult office worker	2653	2342
Adult manual worker	3585	2987
Pregnant woman		2390
Breast-feeding mother		2748

Self-test exercise

1. What is a balanced diet?
2. List types of food to make one balanced diet meal (It can be your lunch or dinner)

☑ Checklist

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again.

I can

- Explain about the balanced diet……..…□
- list types of food which make a balanced diet……..……..□

SECTION 2.5. DEFICIENCY DISEASES

Overview

Dear learner! We hope you did well in the previous section. If you did, then in this section, you will study about deficiency diseases. Human body requires a balanced diet for normal functioning of the body. If food intake in human body is inadequate in carbohydrate, proteins, minerals or vitamins, it causes deficiency diseases.

Learning competences

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

- explain the meaning of deficiency disease
- list the main deficiency diseases caused by different diets
- identify different diet as a source of balanced diet

Dear learner! Be aware that a deficiency disease occurs when a person does not have enough amount of one particular nutrient and suffers health problems as a result. Examples of deficiency diseases are Kwashiorkor, Marasmus, Anemia, Rickets and Scurvy etc.

Dear learner! Do you have any information about deficiency disease? If you did, write some of them in your note book. Next you will learn about the important types of deficiency diseases.

Marasmus

Marasmus is a deficiency disease caused by inadequate carbohydrate content in the human body. The incidence of marasmus increases in children. The symptoms of marasmus are thin arm and leg, little muscle, old-looking face. Peoples with this disease are extremely thin with reduced fat and muscle tissue.

Their skin is thin and hangs in folds. Treatment involves delivery of an energy rich, balance diet.

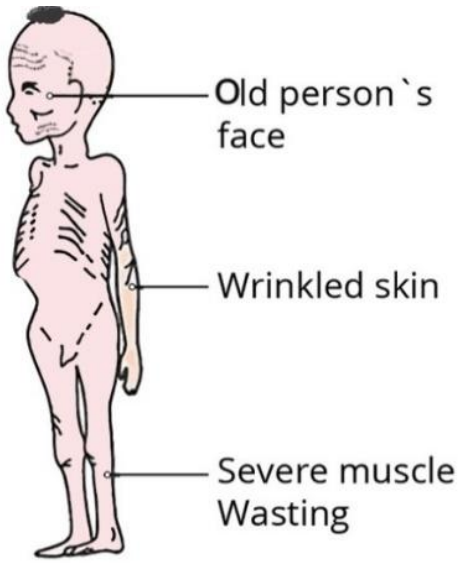


Figure 2.3. Child suffering from Marasmus

Attention

The term ‘marasmus’ is a Greek word, meaning decay.

Kwashiorkor

Kwashiorkor is a deficiency disease caused by inadequate protein content in human body especially in children. .Some symptoms of kwashiorkor are dry or flaky skin, swelling of leg and abdomen, and changes of the hair color, weakness and irritability. Protein deficiency can often be cured or prevented by an intake of protein.

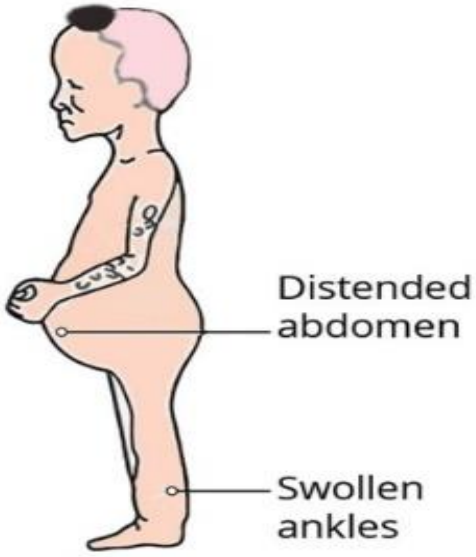


Figure 2.4. Child suffering from kwashiorkor

Diseases caused by deficiency of minerals and vitamins.

Anemia

Anemia is a deficiency disease caused by the lack of iron. A human adult should take enough amount of iron, which is important for then or malfunctioning of the body.

A human body could not produce enough hemoglobin if the amount of iron in the blood is insufficient. Less hemoglobin in the body results in less oxygen transportation. If the oxygen level of blood became less, it results in less respiration producing less energy.

The symptom of anemia includes feeling weak, tired and irritable. It can treat or protect by using iron capsules and by consuming iron rich food.

Activity 2. 9

1. Which vitamin is important to strengthen bone and teeth?
2. What is the main source of the above vitamin ?

Rickets

Dear learner! Be aware that deficiency disease caused by the shortage of vitamin D is called Rickets. It results in deformed bones in the legs of children. Vitamin D is the only vitamin that the human body can make upon exposure of the skin to morning and evening sunlight.

In addition, oily fish, butter, milk, cheese and egg-yolk are some foods that provide vitamin D. Vitamin D help in the absorption of calcium and phosphorus through the gut wall, which is important to build bone and teeth.

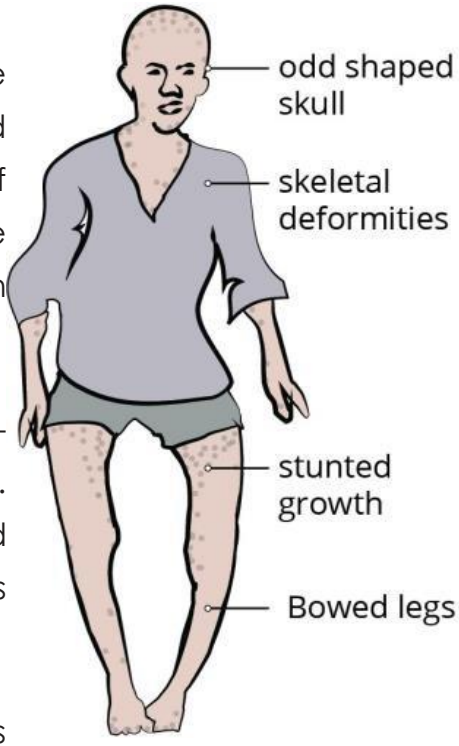


Figure 2.5. Child suffering from rickets

Scurvy

Scurvy is a deficiency disease caused by a lack of vitamin C (ascorbic acid).

This deficiency disease occurs when fibers in the connective tissue of skin and blood vessels do not form properly.

Figure 2.6. An individual suffering from scurvy

This disease causes bleeding under the skin, particularly at the joints, bleeding gums and poor healing of wounds.

Vitamin C can't be stored in the body therefore, it is important to take it daily. The good sources of vitamin C are oranges, lemons, grapefruit, tomatoes, fresh green vegetables.

Dear learner! Read the note in the following table to summarize the major nutrients and their deficiency diseases.

Table 5.3: Summary of the major nutrients and their deficiency diseases.

Name	Rich food sources	Use in body	Deficiency disease
Protein	Meat, fish, eggs, soya, ground nuts, milk	To build cell structure, growth and repair.	Kwashiorkor
Carbohy-drate	Barley, wheat, potato, bread, sugary foods like honey	Provide energy	Marasmus
Vitamin C	oranges, lemons, other citrus fruits	Tissue repair, resistance to disease	Bleeding gums (scurvy)
Vitamin D	Fish oil, milk, butter (also made By skin in the Sun)	Strengthens bones and teeth	Soft bones, legs bow outwards (rickets)
Iron	liver, meat, cocoa, eggs	Used in formation of hemoglobin in red blood cells for transport of oxygen	tiredness, lack of energy (anemia)
Calcium	milk, fish, green vegetables	Strengthens bones and teeth	weak, brittle bones and teeth(rickets), muscle weakness and cramps

Self-test exercise

1. List the deficiency disease caused by shortage of protein and carbohydrate
2. What is the deficiency disease caused by shortage iron?

☑ Checklist

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again.

I can:

- Describe the deficiency diseases caused by different nutrients…….☐
- Define deficiency diseases……..……☐
- Identify different diet as a source of balanced diet……..☐

SECTION 2.6. MALNUTRITION

Overview

Dear learner! In this unit you will study malnutrition. In the previous lesson you learnt the deficiency diseases caused by shortage of different nutrients.

Malnutrition is defined as the insufficient, excessive or imbalanced consumption of nutrients, which leads to health problems. The causes of malnutrition can be poverty, famine due to drought or flood, soil erosion, wars, too little land for too many people, ignorance of proper nutrition al requirements.

Learning competences

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

- Explain the meaning of malnutrition
- Differentiate problems relating to malnutrition
- Discus show stunting, wasting, underweight and micronutrient deficiency
- explain what cause obesity
- explain about body mass index(BMI)

Activity 2.10

Do you thing that, eating a lot of food cause malnutrition? If your answer is yes explain how it causes malnutrition

Dear learner! The dual burden of malnutrition consists of both under nutrition and overweight and obesity, as well as diet-related non communicable diseases.

Malnutrition causes tissue damage, growth retardation, disorderly differentiation, reduce developing of children's brain including negative behavioral issues which can cause poor intellectual capacity, class repetition, reduce productivity.

Dear learner! Under nutrition, the most common form of malnutrition is caused by under nutrition of protein and dietary energy (Carbohydrate, lipids).If the total intake of food is not sufficient to meet the body's need for energy, it leads to loss of weight, muscle wastage, weakness and ultimately starvation.

Dear learner! Be aware that extreme reduction of diets, such as carbohydrate foods can result in the deficiency disease like marasmus.

The victims of malnutrition due to food deficiencies have reduced resistance to different types of diseases. Under nutrition addresses the following four broad groups of conditions:

Wasting (low weight-for-height) is defined as low weight-for-height. It often indicates recent and severe weight loss, although it can also persist for a long time.

It usually occurs when a person has not had food of adequate quality and quantity and/or they have had frequent or prolonged illnesses. Wasting in children is associated with a higher risk of death if not treated properly.

Stunting (low height-for-age), is defined as low height for age. It is the result of chronic or recurrent under nutrition, usually associated with poverty, poor maternal health and nutrition, frequent illness and/or inappropriate feeding and care in early life. Stunting prevents children from reaching their physical and cognitive potential.

Underweight (low weight-for-age) is defined as low weight-for-age.

Micronutrient deficiencies are a lack of vitamins and minerals that are essential for body functions such as producing enzymes, hormones and other substances needed for growth and development.

In contrast, when the diet contains too much fat it causes diseases like coronary heart disease. If fatty substance builds up in the arteries, it reduces the diameter of these blood vessels which results in blood clots and leads to heart attack.

Dear learner! Have you heard about obesity, here you are going to learn about it.

Obesity: If you eat more food than you want, your body stores the extra food as fat. Then the stored fat results in obesity (overweight). People with

overweight may use diet contains fattening foods, such as high fat foods and foods with a lot of sugar.

Obesity is caused because of an imbalance between the energy store in human body and the energy released.

An increase in consumption of high-energy foods, without an equal increase in physical activity leads to an unhealthy increase in weight .In other way, decreased levels of physical activity can also result in an energy imbalance and lead to weight gain.

People who are overweight and obese are at high risk to have health problems such as, heart disease, high blood pressure, diabetes and arthritis (worn joints).

Dear learner! Be aware obesity can be controlled by:

- Eating less high energy foods(lower energy intake)
- Taking more exercise (increase energy output).
- Eating a balanced diet with a lower intake of energy

Dear learner! Be aware that in order to prevent malnutrition, it is better to:_

- Consume diverse and nutrient dense food,
- avoid junk foods and sugary foods, do regular physical exercise, etc.

Key words

Malnutrition: the insufficient, excessive or imbalanced consumption of nutrients, which leads to health problems.

Wasting :low weight for height

Stunting; low height for age

Underweight: low weight for age

Obesity: can be caused by a high intake of fatty foods, foods containing a lot of added sugar plus the effects of too little exercise.

Activity 2.11

List some the human activities which may cause obesity.

Attention

There are two ways in which people can identify being obese:

- Being 20% above the recommended weight for his or her height
- having a body mass index(BMI) greater than 30.

$$\text{Body mass index} = \frac{\text{Body mass (Kg)}}{\text{Height}^2 (\text{meters}^2)}$$

A person with a BMI Status below 18.5 is underweight,18.5–24.9 normal weight,25.0–29.9 overweight, 30.0 and above obese.

Adolphe Quetelet, a Belgian statistician and scientist, developed BMI in the 19th century. He based the formula on measurements of thousands of soldiers. It provided a useful guide to check on a healthy body mass, but it may not tell the whole story. Fitness training builds up larger muscles, which weigh more than fat and can make the BMI of a very high therefore, athlete with a large frame appear in the 'overweight' category.

Activity 2.12. Assignment

Calculate the BMI of a person who has a body mass of 60 kg and he is 1.6 m tall. Is he/she likely to be obese? If yes why?

Go to nearby health facility, measure your weight and height, calculate your body mass index and compare it with your age

Self-test exercise

Match Column A with column B

A	B
1. Low weight for height	A. Wasting
2. Low weight for age	B. Obesity
3. Low height for age	C. Underweight
4. High intake of fatty foods	D. Stunting
	E. Scurvy
	F. Rickets

☑ Checklist

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again. I can:

- Explain the meaning of malnutrition……..☐
- Differentiate problems relating to malnutrition……...☐
- Discuss how stunting, wasting, underweight and micronutrient deficiency……..……☐
- explain what cause obesity……....☐
- explain about body mass index(BMI)……..……☐

SECTION 2.7. SUBSTANCE ABUSE

Overview

Dear Learner, you will learn about different drugs which taken in to the body.

A drug is any substance taken into the body that change and affects chemical reactions in the body. Drug can be taken legally to reduce a symptom such as a headache or to treat a different types of infection, this is called medicinal drugs.

There are also other drugs which could also be one taken illegally in order to provide stimulation or induce sleep or create hallucinations (recreational drugs).

Learning competences

By the end of this section the students will be able to:

- describe the effects of tar and carcinogens in tobacco smoke on the gas exchange system
- describe the short-term effects of nicotine and carbon-monoxide on the cardio vascular system
- explain the social and psychological effect of drinking alcohol and chewing Khat
- discuss about consequences of doping.

Drugs

Activity 2.13

List some examples of drugs :-

1. which have medicinal value
2. Found in our foods that we eat

Can drugs be found in our food?

Dear learner! Be aware that some drugs are present in many food products such as: tea, coffee, energy drinks and alcoholic drinks. Though they have many useful medicinal properties their stimulant properties can produce caffeinism, a nasty condition that can readily addict.

 What is substance abuse?

Dear learner! Have you heard about substance abuse? It is using legal or illegal drugs (substances) in the wrong way or in the excess amount. Some of the drugs are medical drugs taken legally to reduce a symptom and pain of diseases. These drugs designed to suppress pain, treat, and cure diseases.

In addition to medical substances, other legal substances are present in many products such as:

- tea, coffee and 'energy drinks' (caffeine)

- tobacco(nicotine)
- alcoholic drinks(alcohol)

Dear learner! Be aware that although these substances are legal, they can cause serious effects when taken excessively or over long periods of time. Peoples are using drugs illegally to provide stimulation, induce sleep, or create hallucinations (recreational drugs) example of such drugs are: alcohol, tobacco, Khat, heroin etc. People are also using alcohol, nicotine and caffeine for their pleasurable effects, to help them relax or concentrate.

Dear learner! We hope you did well in different types of drugs? If you did, then you should go on to some of the commonly practiced drugs in our country which include:

Cigarettes smoking

Dear learner! Have you heard about cigarette? We hope you did. Cigarette is made up of a plant called tobacco (*Nicotianatobacum*) which originally cultivated and used in Central America. People use cigarette in order to stimulate their body or because they are addicted to it.

The chemical composition of cigarette leads to addiction and problem in human health. The main components of cigarette or tobacco are tar, carbon-monoxide and Nicotine.

Dear learner! We hope you enjoyed reading about tobacco, next you are going to learn about its component.

Tar

Tar is the black sticky substance found in cigarette that collects in the lungs when the smoke cools. The health effect of tar can be chronic bronchitis, lung cancer etc.

Attention

Currently, the smoking of a flavored tobacco called shisha has become fashionable among young people. However, the social, economic and psychological effect of shisha is similar to that of ordinary cigarette.

Activity 2.14

Describe some of the common smokers' reaction or their habits during smoking.

Dear learner! Be aware that one of the chemical component of Cigarette called tar has the following health effect:

Chronic bronchitis

When people smoke cigarette, the chemical substance called tar accumulates in the bronchioles. Tar irritates the lining of the bronchioles and stimulates the production of excess mucus.

The function of cilia in our lung is to remove dust, dirty and excess mucus from the lining of lungs. However, when cilia damaged by smoking, it will be difficult for cilia to remove the excess mucus and dirt. This leads to the collection of dirt, bacteria and viruses that block the bronchioles. This stimulates smoker's to cough which is an effort to move the mucus, the bronchioles and bronchi becomes thicker. This thickening of the bronchioles causes them to narrow and makes it difficult to breathe, this leads to infections such as pneumonia. This damage and obstruction of the airways is chronic bronchitis.

Dear learner! Be aware that in addition to above health effect tar contains different types of chemical compounds such as carcinogen (produce cancer) compounds.

Cancer starts because of the changes in the epithelial cells of the lungs that lead to the development of a mass of cells, known as a tumor. It is this tumor which results in cancer.

Emphysema

Dear learner! Have you heard about alveoli? It is a sac like structure found in the lung and used for exchanging of oxygen and carbon dioxide between our body cell and the surrounding environment.

Dear learner! Be aware that smokers usually have weakened alveoli wall

because of the above action of tar that result in coughing.

During coughing, some of the weakened alveoli burst. Then the amount of alveoli decrease as well as absorbing surface of the lungs is greatly reduced. Then the smoker cannot oxygenate his or her blood properly and the least exertion makes the person breathless and exhausted. Bronchioles collapse during expiration, trapping air in the alveoli, which often burst. This condition is called emphysema.

Carbon monoxide

Dear learner! Be aware that another chemical component of cigarette is carbon monoxide. Carbon monoxide is a poisonous gas found in cigarette. During cigarette smoking, the carbon monoxide enters to lung. This carbon monoxide diffuses across the walls of the alveoli and diffuses into red blood cells where it combines with hemoglobin to form the compound carboxy-hemoglobin.

The carbon monoxide combines permanently with hemoglobin. Then no more oxygen is carried by hemoglobin that results in the reduction of the volume of oxygen in blood. Therefore, less oxygen is supplied to the heart.

In this case, the heart beat increases to get more oxygen. Carbon monoxide may also damage the lining of the blood vessels. In this case, smokers put the health of their cardiovascular system at risk. The damaging of the walls of arteries may lead to the build-up of fatty tissue and the reduction of blood flow. This may result coronary heart disease (CHD) and stroke. These diseases are a major cause of death and disability in the world.

Activity 2.15

. 1. Explain about the important function of haemoglobin
2. what is the poisonous gas found in cigarette? Explain how this gas affect our lung?

Nicotine

Dear learner! Be aware that the third chemical component of cigarette is nicotine. Nicotine is a compound found in cigarette. It is a stimulating and

relaxing compound which has a molecular structure that allows it to interact with our nervous system. In addition to its stimulating effect, nicotine is a compound which produce addiction.

When people smoke cigarettes, nicotine from cigarette is absorbed through the alveoli to enter the Blood stream. Then it is able to go to the brain through blood circulation. In the brain, nicotine activates the release of dopamine, the natural neurotransmitter substance associated with our experience of pleasure.

Long-term exposure to nicotine eventually comes to have the reverse effect, actually depressing the ability to experience pleasure. So more nicotine is needed to 'satisfy', and cigarettes become addictive. Smokers find it increasingly hard to quit the habit.

Nicotine also increases the heart rate and blood pressure. It narrows the arterioles, which increases blood pressure. It decreases the blood flow, particularly in the hands and feet, and it makes blood clotting more likely. It also increases the stickiness of blood platelets that promote blood clotting.

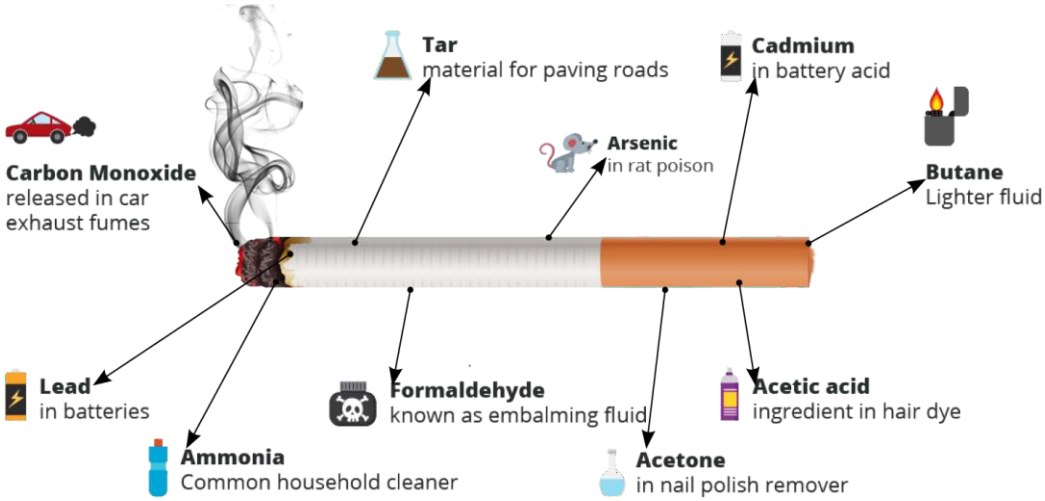


Figure 2.8 Substances in tobacco smoke

Drinking Alcohol

Dear learner! We hope you enjoyed reading about cigarette and next you will learn about alcohol.

Alcohol is a socially acceptable drug in many countries including Ethiopia. In Ethiopia, there are different types of alcohol drinks such as Tella, Arekie (Katicala), Beer, Wine. When human body consumes alcohol, it is absorbed through the wall of the stomach and small intestine and it is absorbed into the blood.

Alcohol is distributed throughout the body by the help of blood circulation. It is absorbed by liver cells and broken down by liver enzymes, Therefore its concentration in the blood decreases gradually.

Dear learner! Be aware that, to decreases the risk of alcohol-related harms, the World health organization identifies a standard drink as having 10 grams of pure ethanol. It recommended no more than two drinks per day on average for both men and women.

Attention

The breaking down of alcohol by liver enzyme happens more quickly in men than in women because men have more of these enzymes and their enzymes tend to be more active. They also have more water and less fat in their bodies than women do, which tends to cause the concentration of alcohol in the blood to decrease more quickly.

Activity 2.16

Why drinking alcohol is prohibited when someone is driving a car?

Dear learner! Be aware that alcohol is a depressant. It affects the brain by slowing down the transmission of nerve impulses. Consuming larger quantities of alcohol leads to:

- Loss of coordination,
- Loss of self-control.
- Loss of judgment and control of movements
- Slower reaction times(the interval between receiving a stimulus and making a response)loss of judgment and slower reaction times.

Dear learner! Have you heard about addiction? Addiction is the condition that people become dependent upon any kind drug. Next you will learn about alcohol addiction.

Alcohol drink and addiction

Some people become dependent upon alcohol and they are referred to as alcoholics. They feel tense and irritable. It is hard to cope with everyday problems without drinking they develop a tolerance as more enzymes that metabolize alcohol are made in the liver.

They, therefore, need to take greater quantities of alcohol to get the same effect. Alcoholics can cause their families pain and unhappiness.

Dear learner! Be aware that alcohol addicted people can become aggressive after drinking and spend a lot of money on drink. There are also other social problems such as crime, family disputes, marital break down, child neglect and abuse, absenteeism from work, vandalism, assault and violent crime including murder.

Long-term effects of alcohol

Dear learner! We hope you enjoyed reading about alcohol addiction. Next you will learn about the long-term effects of alcohol. Drinking large quantities of alcohol over a number of years can lead to stomach ulcers, heart disease, and brain damage. In addition, large amount of alcohol damage the liver tissue and replaced by scar tissue known as cirrhosis. This condition may leads to death unless the person stops drinking.

Attention

The liver is the site of the breakdown of alcohol and other toxins. Drugs are broken down in the body by enzymes and the products are excreted.

The breakdown products can be detected in the urine, and this is why urine tests are carried out to see if people have been taking drugs. Athletes taking part in competitions and car drivers who have been in accidents are routinely tested for drugs.

Heroin

Dear learner! Be aware that, Heroin is a powerful depressant that slows down the nervous system. It has a chemical structure that is similar to endorphins, a group of chemicals that are found in the brain.

Endorphins are made naturally in the brain and provide relief when the body experiences pain or stress. Endorphins work on the synapses in the brain and preventing neurons from transmitting impulses from pain receptors, so they producing pain relief.

When a person takes heroin, the heroin molecules bind to the endorphin receptor sites, blocking nerve transmission. This mimics the function of natural endorphins. Therefore, by using heroin, the feeling of pain disappears and addiction produced.

People practice to take heroin to reduce the pain. This is how the body develops a tolerance to the drug, and it has to be taken in ever-greater quantities in order to feel euphoria or just to reduce the pain.

Cannabis

Cannabis is the most commonly used illegal drug in the world. It is drug from Cannabis plant. Mostly it is the flower of cannabis plant, harvested, dried, and used as drug. Some people named this drug as weed, some call it pot, and others call it marijuana.

This cannabis plant has been used as a drug for both recreational and traditional medicines for a long period. This drug contains a stimulant or psychoactive component called Tetrahydrocannabinol (THC). Peoples used this cannabis by smoking, vaporizing, together to food and as extract.

Cannabis causes enjoyment, different states of mind and sense of time, difficulty concentrating, reduced short-term memory and body action relaxation and it results in an increase in appetite. The effect of cannabis in human body last for two to six hours, based on the quantity of the drug used. When cannabis is taken at high amount, it causes mental effects like: nervousness, panic, false beliefs, hallucinations, suspicion, and psychosis.

Figure 2.9 Cannabis

Chewing khat

Dear learner! We hope you did well in the previous lesson. If you did, then you should go to chewing khat. Good Luck!

Figure 2.10. Khat

Khat (*Catha edulis*) is bushy plant whose leaves are chewed for its stimulant effect. This plant is grown in southern Arabia and Eastern Africa including Ethiopia, Somalia, and Kenya. Khat is usually supplied as a bundle of leaves and fresh shoots wrapped in false banana leaves.

Activity 2.17

1. Describe how chewing chat affect our health

Dear learner! Be aware that Khat contains a chemical compound known as cathinone, which affects central nervous system (CNS). This cathinone can be found only in fresh Khat leaves. Chewing khat releases Cathinone into the saliva that can be absorbed to the body easily. Only fresh leaves are chewed, because cathinone soon degrades into old in dry plant material.

Although khat can be ingested as an infusion or smoked, the most common route of administration is to chew the fresh plant. The juice of the masticated material is swallowed, while the residues are spat out. In some places, teas

from dried leaves are also consumed.

Dear learner! Be aware that Ethiopia is one of the country where large number of people with the habit of chewing chat. In the previous years, it was mainly cultivated in eastern part of the country. However, currently, it is grown and consumed in all parts of the country. This current increment in khat consumption brings socio-economic, psychological, and physical health consequence on the individuals involved.

Chewing khat induce a state of joy and feelings of increased alertness and stimulation. At the end its consequence results in a depressed mood, irritability, loss of appetite, gastritis and peptic ulcer, disease and difficulty sleeping. In addition, the habit of chewing khat leads to some social problems like family fragment, multiple sexual practices and the spread of sexually transmitted infections (STIs) due to unprotected sex. Early initiation of sexual activity was also reported among Khat chewers.

Keywords

Drugs: refers to any substance taken into the body that modifies or affects chemical reactions in the body.

Heroin is a powerful depressant affecting the nervous system. It is taken into the body in the form of injection. People of ten share needles for injection. Sharing needles can result in infections such as HIV/AIDS

Nicotine: it is also a stimulant, it increases pulse rate and narrows blood vessels which can cause damage

Emphysema: walls between alveoli break making large sacs, reducing surface area massively and making difficult to breathe.

Carbonmonoxide:irreversiblybondswithhemoglobinwhichcanleadtooxygen starvation

Cannabis: stimulant or psychoactive component called Tetrahydrocannabinol (THC) Chewing khat contain a chemical compound known as cathinone it's consequence results a depressed mood, irritability, loss of appetite, gastritis and peptic ulcer disease and difficulty sleeping

Cathinone ; a chemical compound found in Khat which affects central nervous system (CNS).

Doping is the use of prohibited medications, drugs, or treatments in competitive sports.

Activity 5.18

1. Do you think that, doping affects athletics competion? If your answer is yes Why?

Doping

Dear learner! We hope you enjoyed reading about Khat and next you will learn about doping.

The term "doping" refers to the use of prohibited medications, drugs, or treatments in competitive sports. It is practiced in athletes with the intention of improving athletic performance. Performance enhancing drugs (PEDs) is another term used to for drugs used by athletes to improve their athletic performance. The practice of doping by athletes dates back centuries.

The World Anti-Doping Agency (WADA) uses a battery of blood and urine tests to determine if athletes are cheating. A key tool is the biological passport program, which tests all athletes for doping and performance-enhancing drugs.

Attention

The word doping is probably derived from the Dutch word dop, the name of an alcoholic beverage made of grape skins used by Zulu warriors in order to enhance their prowess in battle.

Why is doping such a big deal?

The most important reason doping is a big deal is the fact that many of these substances can have harmful and long-lasting side effects which may include:

Cardiovascular: irregular heart rhythm, elevated blood pressure, heart attack, sudden death.

Central Nervous System: insomnia, anxiousness, depression, aggressive behavior, suicide, headache, addiction with withdrawal, psychosis, tremor, dizziness, stroke

Respiratory: nose bleeds, sinusitis

Hormonal: infertility, gynecomastia (enlarged breasts), decreased testicular size, low sex drive, acromegaly (coarse bones in face, hands, and feet), cancer

The second issue is more of a moral dilemma. These banned substances are used to gain an unfair advantage which significantly devalues the spirit of competition.

As stated by the World Anti-Doping Agency (WADA), the purpose of an anti-doping program is "to protect the athletes' fundamental right to participate in doping-free sport and thus promote health, fairness and equality for athletes worldwide…"

 What substances are banned from use?

Dear learner! Be aware that some drugs are banned both in and out of competition due to their performance enhancing properties, while others are only banned during competition. Another reason for banning a drug is due to their ability to mask the presence of a different banned drug during testing.

In general, the following classes of drugs are banned: Street drugs, stimulants, anabolic steroids, peptide hormones (i.e. human growth hormone [hGH]), alcohol and beta blockers (for archery and rifle shooting only), diuretics, beta-2 agonists, anti-estrogens, blood doping, and gene manipulation.

Prohibited list: is the document identifying the substances and methods that are prohibited in competition, out of competition, and in particular sports. What are the criteria for adding a substance to the List? Must meet any 2 of the following 3 criteria:

- It has the potential to enhance or enhances sport performance;
- It represents an actual or potential health risk to the athlete;
- It violates the Spirit of Sport.

Who determines whether a doping violation has occurred?

The organizations that monitor for doping violations vary between sports. The largest anti-doping organization is WADA.

WADA has developed a coordinated, worldwide anti-doping program that applies to sports that have signed a pledge to uphold the WADA Code.

The WADA Code outlines their "anti-doping policies, rules, and regulations with sport organizations and among public authorities around the world".

More than 660 sports organizations have signed the WADA Code including the International olympic and Paralympic committees, all olympic sport international Federations, and National Olympic and Paralympic Committees. The practical application of the WADA regulations is performed by national anti-doping agencies.

Dear learner! We hope you enjoyed reading about doping and next you we learn about consequences of doping.

Doping Consequences

Physical and Mental Health: Physical health: depending on the substance, the dosage, and the consumption frequency, doping products may have particularly negative side effects on health. Some damages to the body are irreversible and may lead the athlete's life to be in great danger. The following section will outline the possible health consequences and sports benefits to using certain groups of doping substances.

Steroids: General side effects:

- Increased risk of liver disease
- Increased risk of cardiovascular disease
- High blood pressure
- Acne
- Baldness

In Males

Shrinking testicles, sexual side effects (reduced sperm production, impotence, libido disorders) Breast growth.

In Females

Deepening of voice Excessive hair growth on face & body abnormal menstrual cycles.

Erythropoietin (EPO)

- Increased blood viscosity (thickness/stickiness)
- Pulmonary embolism
- Increased risk of heart attack and stroke
- General weakness
- High blood pressure

Human Growth Hormone

- Severe headaches
- Loss of vision
- High blood pressure and heart failure
- Diabetes and tumors
- Crippling arthritis
- Irreversible acromegaly
- Enlargement of the hands & feet
- Protruding forehead, brow, skull & jaw
- Heart enlargement
- Water retention
- Liver and thyroid damage

Psychological health

Some doping substances may not be detrimental to the body but exercise an impact on mental health. It has been scientifically evidenced that anxiety, obsessive disorders, or psychosis are direct consequences of doping.

- Psychological dependence
- Increased aggression
- Mood swings

Social consequences: the existence of an athlete who was held guilty of doping may be completely disrupted. Indeed, doping may represent a danger to health, but it may also be prejudicial to fame, respect, and creditworthiness. Even in the future negative findings are regularly questioned by the media and the entourage. The poor image will remain in the collective unconscious and the athlete could remain isolated.

Financial consequences: as regards high-performance sports, an infringement of anti-doping rules often leads to a loss of income, the reimbursement of prize money, and of sponsorship money. An athlete suspended for several years, or even life-banned, cannot earn his/her living as usual and can be forced countries loss foreign treasures from athletes even banned countries from any sport competition in the world.

Sporting consequences: A doping violation may mean loss of results, rankings, medals, and qualification places at events. It could also have an impact on members of a team causing medals to be lost a day-to-day basis.

Legal consequences: Doping may have major legal consequences. A doped athlete may be suspended, i.e., he/she may not take part in a sports competition on or in organized training sessions.

Problems of using drugs

Dear learner! We hope you enjoyed reading about the important drug called doping and next you will learn about the problem of using drugs.

Peoples start using substances because of different reasons. Some people taking substances for stimulation, some for recreational value, and others use it because of the pressure from other people.

Whatever the reason, the effect is almost similar among all the users. When substance users first start taking a substance, users may think they can control how much they use. However, when time passes, they may want more of the drug to get the same feeling or effect. Over time some people can reaches beyond abuse to addiction.

Addiction can produce health, social, economic and cultural problems. Some

of the problems that drug users faced are:

» Eat more or less than normal
» Change their friends a lot
» Stop taking care of themselves
» Sleep at unusual hours
» Lack concern in things they used to love
» Have problems at work or with family
» Spend more time alone than they used to
» Switch quickly from feeling good to bad
» Financial problems–stealing, loss of job
» Strong desire to use the substance
» difficulty to keep a job,
» family break down and homelessness, tendency to avoid friends and families,
» Preferring the company of other addicts, and so they become isolated from the society

How people recover from drug addiction?

Dear learner! Be aware that addictions are treatable. With the right plan and resources, recovery is possible. The following are important steps in recovering.

Anyone who is addicted for any drug should admit to his friends, and to himself, that he has a problem.

- Find support from others.
- Rewrite daily routine.
- Enjoy the small successes.
- Recognize and avoid relapse.
- Reach freedom, and stay there

Self-test exercise

I. Match column A with column B.

A	B
1. A drug which attacks the liver tissue and produce cirrhosis.	A. Alcohol
2. A drug which has a chemical structure that is similar to endorphins, a group of chemicals that are found in the brain	B. Khat
3. A drug contains a stimulant or psychoactive component called Tetrahydro cannabinol (THC).	C. Doping
4. A drug contains chemical compound known as cathinone	D. Heroin
5. Use of prohibited medications, drugs, or treatments in competitive sports.	E. Cannabis
	F. Tar

II. Choose the correct answer and only write the letter in the space provided

1. What is the poisonous gas found in cigarette?
   a. Carbon monoxide b. carbon dioxide c. oxygen d. Tar
2. Which of the following is the components of cigarette or tobacco?
   a. Tar b. carbon-monoxide c. Nicotine. d. all
3. Which of the following is the health effect of tar?
   a. Chronic bronchitis b. lung cancer c. Emphysema d. all
4. Which of the following organ of the body is used to broken alcohol?
   a. Lung b. liver c. brain d. stomach

☑ **Checklist**

Direction: Put a tick (√) against each of the following tasks you can perform. If you are not able to perform any of these tasks, you need to read once again.

I can:

- Describe the effects of tar and carcinogens in tobacco smoke on the gas exchange system……..□
- Describe the short-term effects of nicotine and carbon-monoxide on the cardio vascular system……□
- Explain the social and psychological effect of drugs ……..□
- discuss about consequences of doping. ……..□

SECTION 2.8. INFECTIOUS AND NON-INFECTIOUS DISEASES

Overview

Dear learner! In this section, you will study about infectious and non-infectious diseases. Infectious diseases are diseases that are caused by disease causing organisms. Non-infectious diseases are diseases that caused by malnutrition, chemical effect, inherited or genetic factor etc.

In this section, particularly, you will study about the common infectious diseases known as HIV-AIDS. Malaria, Tuberclosis and COVID-19. In addition, you will study modes of transmission, control and preventative methods.

Learning competences

By the end of this section the students will be able to:

- Identify infectious and non-infectious diseases
- List the major infectious diseases
- explain about modes of transmission and prevention of infectious diseases
- explain about COVID-19
- Describe the cause of non-infectious diseases
- Explain about the cause of non-infectious diseases

Activity 2.19

List some diseases that occur in your surrounding and arrange them in the following table.

When you do this activity first list the name of familiar diseases around your surroundings, then write if it is infectious or non-infectious. Lastly you should write the cause such as virus, bacteria, parasitic worm, fungi, protozoa etc.

Name of the disease	Infectious	Non infectious	causes
1. 2. 3.			

Dear learner! We hope you did well in the previous section. If you did, then you should go on to the next section.

 What is disease?

Dear learner! Disease is a condition in which the body does not function normally, and which produces symptoms such as: headache, increased body temperature, pain, distress or feeling weak.

1. Infectious diseases are diseases that are caused by disease causing organisms. These types of diseases can be transmitted from person to person such as HIV-AIDS, tuberculosis, malaria etc.

 What are disease causing organisms?

Disease causing organisms are organisms, which cause diseases. Examples of disease causing organisms are bacteria, virus, protozoa, and fungi.

Attention

Endemic: This disease is occurring when disease-causing agent exists permanently in specific place or population, For example malaria is endemic in Afar region.

Epidemics are diseases that occur suddenly and then spread in a specific area or within a specific population group, For example, in 2015 Ebola was epidemic in west Africa.

Pandemic is an epidemic that spreads far more widely throughout the whole world. It affects a huge number of people. Example COVID-19

Section 2.7.1. Infectious Diseases

Dear learner! Be aware that there are different types of infectious diseases that caused by different disease causing organisms. Their difference is based on:

- the type of host that they infect, some infect human, some infect only plant etc.

- their mode of transmission, some are transmit by insects, some by contaminated water/food etc.
- type of disease causing organisms, some are caused by viruses, some by bacteria etc.
- the severity of the disease, such as the common cold, measles and influenza, only affect us for as short period of time. Others, such as tuberculosis (TB), human immune deficiency virus (HIV) infection may last a much longer time.

Transmission of infectious diseases

Dear learner! We hope you did well in the infectious diseases. If you did, then you should go on to the transmission of infectious diseases. Good Luck!

An understanding of the biology of the pathogen and its mode of transmission is essential to control and prevent the disease.

Different infectious diseases have different mode of transmission.

- Some infectious diseases are transmitted from one per-son to another by direct contact with a patient.
- Other infectious diseases are transmit by drinking contaminated water or by eating contaminated food, (food or water contains disease-causing organisms like bacteria and virus). Cholera, Ameba etc. This is because the infectious organisms can survive in water, human food, feces etc.
- Some infectious diseases are transmitted by insect bite. Such as malaria
- Some infectious diseases are transmitted by sexual inter-course Such as HIV-AIDS

Attention

The way in which a pathogen passes from one host to another is called the transmission cycle

Preventing infections and control methods of infectious diseases

Control is an attempt to break transmission cycles by removing the conditions that favor the spread of the disease causing organisms.

Vaccination: is a major control measure for many infectious diseases; it works by making the body to defend against disease causing organisms.

Personal hygiene; people of all ages should wash their hands after using the toilet and before handling or eating food; this protects the entrance of disease causing organisms into our body.

Hygienic food preparation: food should be covered to keep flies away, kitchen surfaces should be cleaned to kill bacteria, and food should be cooked exhaustively to make sure any bacteria are killed.

Boiling cooking and/or drinking water to kill the pathogens

Proper waste disposal: Household waste should be put into covered bins and collected at regular intervals.

Sewage treatment: toilet waste is a serious health threat if it is not disposed properly. Water pipe should be arranged far from toilet drainage.

Dear learner! Be aware that for example, the disease causing organism that cause giardia and cholera are transmitted through contamination of drinking water by feces and sewage.

Human immune deficiency virus infection/ acquired immune deficiency syndrome (HIV/AIDS)

Activity 2.20

Explain about HIV- AIDS

Dear learner! We hope you enjoyed reading this passage. Studying about the common infectious diseases is very interesting and important for the students. What do you think?

Acquired immunodeficiency syndrome is caused by the human immunodeficiency virus (HIV). HIV infection rates are especially high sub-Saharan Africa including Ethiopia.

Dear learner! Be aware that peoples who have HIV in their body are called HIV-positive or HIV carriers. Usually, these HIV positive people do not show any symptom of the disease for several years after infection.

Dear learner! Infection of HIV starts when the virus infects and enters to T-lymphocytes. These are cells that defend our body from diseases.

HIV replicates and survives in human T-lymphocyte cells. During its replication HIV, destroys these T-lymphocytes cells. As a result the number of T-lymphocytes gradually decrease which leads to declining of disease resistant mechanism of the body.

When the body reduced its disease resistant mechanism, it causes acquired immunodeficiency syndrome (AIDS). AIDS is the result of opportunistic diseases like pneumonia, TB, cancers; weight loss, diarrhea etc.

Dear learner! Be aware that HIV-AIDs can be transmitted by different methods. Next you will learn about these methods.

Transmission of HIV-AIDS

HIV can be passed from one person to another by direct exchange of body fluids such as:

- Fluid transfer from one person to another during sexual intercourse
- Blood transfusion from one person to another, during blood donation
- Sharing needles in intravenous drug users
- Mother to fetus across placenta, more often, through the mixing of blood during birth
- Mother to infant in breast milk

Attention

T_Lymphocyte cells (Immune cells) have another name called T-helper cells that defend our body from infection.

Opportunistic diseases: disease caused by different disease causing organisms that occurs when the body diseases resistance mechanism.

Retroviral drugs are drugs that are used to stop or reduce viral replication in human, but they do not kill the virus.

Prevention and control of HIV-AIDS

Dear learner! Be aware that there are no cure drug for HIV-AIDS and no vaccine for HIV, therefore it is very important to prevent this disease by the following methods.

- All blood should be tested before transfusions in activity of blood donation
- Needles used by intravenous should be sterile and used only once.
- People should avoid multiple sexual activity

Using condoms, if condom is properly used, it can prevent the virus transmission from carrier to healthy person

HIV-positive mother should be treated with appropriate retroviral drugs. These retroviraldrugscanalsosignificantlyincreasethelengthoftimebetweena person becoming infected with HIV and developing symptoms of AIDS and can significantly prolong life.

Tuberculosis (TB)

Dear learner! We hope you did well in the HIV. If you did, then you should go on to the next infectious disease called tuberculosis. Good Luck!

Tuberculosis is another example of infectious disease caused by the bacterium called *Mycobacterium tuberculosis* and rarely by *Mycobacterium bovis*. These bacteria live inside human cells, mainly in the lungs. TB has many symptoms like cough, chest pain, shortness of breath, fever, sweating, weight loss etc.

Dear learner! Be aware that after infection, some people develop TB quite quickly, while in others the bacteria remain inactive for many years. This difference is because of the difference in disease resistance ability between peoples.

TB transmission

Dear learner! We hope you enjoyed reading about tuberculosis and next, you will learn about transmission of tuberculosis.

TB bacteria can enter the lungs in airborne droplets. It spread when infected people with the active form of the illness cough or sneeze.

The bacteria are carried in the air in tiny droplets of liquid. Transmission occurs when people who are uninfected inhale (breath in) the droplets. These happen rapidly in places where many people are living in crowded conditions such as very crowded public transportation.

The other transmission way is by consuming undercooked meat and unpasteurized milk. This type of transmission mainly occurs for the TB transmits from infected animals.

Dear learner! We hope you did well about tuberculosis. If you did, then you should go on to the prevention and control of tuberculosis.

Prevention and control of TB

There are drugs and vaccines that are important to treat and prevent this disease.

1. Treatment of TB: A person, who shows symptoms relating to TB, should his/her sputum sample tested for the presence of TB bacteria. If a person is positive for TB, then patients should be isolated while they are in the most infectious stage (which is at two to four weeks). The treatment involves using several drugs to ensure that all the bacteria are killed. The treatment also need about six to nine months. If the bacteria not killed by treatment, it maybe because of drug resistance TB.

2. Vaccine: The only vaccine available for TB is the BCG vaccine, which is

derived from animal TB bacteria and protects up to 70–80% of people who receive it. This vaccine is given during early child or infant stage. The effectiveness of the vaccine decreases with in old age.

3. TB is relating to reduced immunity of the body, increasing standards of people who are living with HIV and treating HIV infected people help to reduce the incidence of TB.

4. Avoid overcrowding; TB is a disease transmitted by inhales the bacteria when infected person cough and sneeze therefore, covering the mouth and nose when coughing or sneezing and good ventilation reduces the spread of TB bacteria and.

5. Avoid eating undercooked meat and avoid drinking unpasteurized or not boiled milk. This is important to prevent TB transmission from animal to human.

Key terms

Drug resistance bacteria: are bacteria that do not killed by commonly used drugs. More powerful called second line drugs are important to kill these resistant bacteria.

Vector: is an organism that carries a disease-causing organism and transmit from one person to another or from an animal to a human. For example Anopheles mosquito.

Malaria

Activity 2.21

Refer to books or search for internet and write a short note for the following questions.

1. discuss how malaria is transmitted from patient to healthy person
2. List at least two ways that are used to prevent malaria?

Dear learner! We hope you enjoyed reading about tuberculosis and its transmission. Next you will learn about Malaria.

Malaria is caused by protozoa known as plasmodium Protozoa. Malaria is found in many parts of the world where *Anopheles* mosquito species that can act as vectors are found. It is very common in tropical and subtropical regions where humidity is high, a comfortable environment for mosquito breeding.

Dear learner! Be aware that female Anopheles mosquitoes feed on human blood to obtain the protein they need to develop their eggs. If the person they bite is infected with Plasmodium, they will take up some of the plasmodium together the blood meal.

When the mosquito feeds again another healthy person, she injects the plasmodium with her saliva. Then the parasites enter the red blood cells, where they multiply.

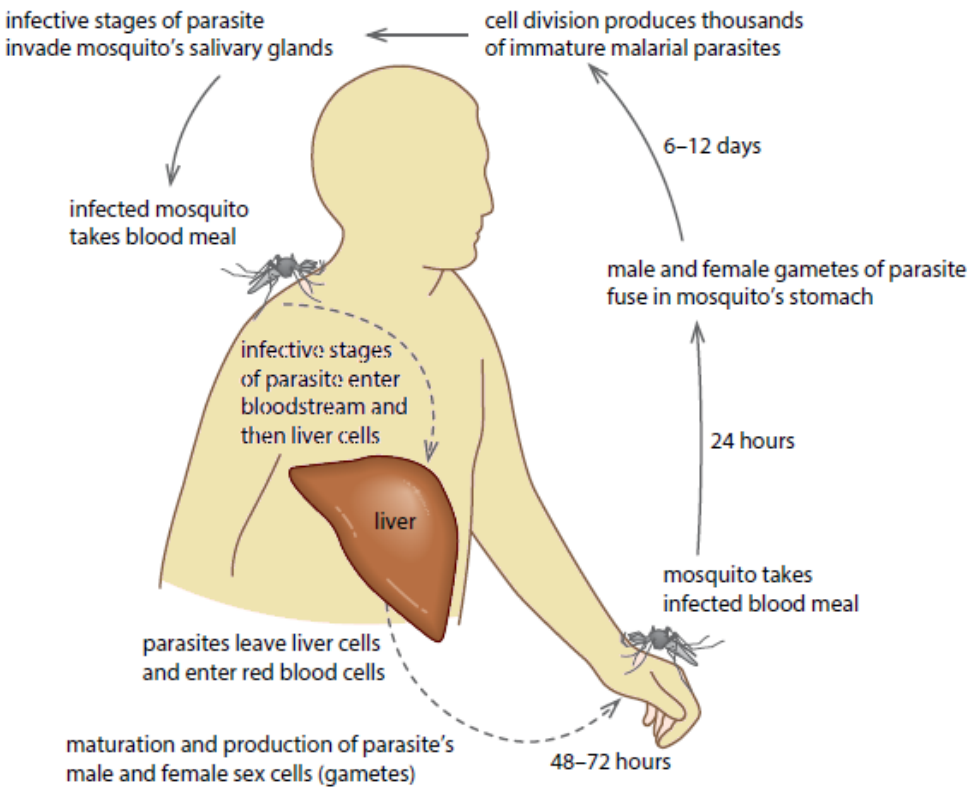


Figure 2.11. Life cycle of malaria

The life cycle of Plasmodium. Plasmodium has two hosts which are human and mosquito. The reproduction of plasmodium taken place in both hosts, sexual reproduction in mosquito and asexual preproduction in human.

Prevention and control of malaria

Dear learner! We hope you enjoyed reading about malaria and its transmission Next you will learn about prevent and control of malaria.

There are three main ways to control malaria:

1. Reducing the population of mosquitoes. This can be done by removing sources of water in which they can breed. Sometimes, it is possible to use Biological controls like fish which feeds on the larva of the mosquito. In addition using insecticide to kill mosquito is another way to reduce the number of mosquito.
2. Avoiding mosquitoes bite: This can be done by sleeping under a mosquito net, or using insect repellant.
3. Using anti-malarial drugs such as Artemisinin combination therapy (ACT) or Quartem and chloroquine to treat infected people. However, in many parts of the world *Plasmodium* has evolved resistance to some of these drugs.
4. Chloroquine resistance is widespread in parts of South America, Africa; newer drugs such as mefloquine are used in these areas.

Corona virus disease 2019 (COVID-19)

Key-Words

"**corona virus":** is derived from Latin corona, meaning "crown" or "wreath", itself a borrowing from Greek.

Incubation period: is a period from the time of exposure or entrance of infectious agent up to the time of the appearance of signs or symptoms of the disease.

Dear learner! We hope you know well about COVID-19. If you did, then you should go on to the detailed lesson about it. Good Luck!

Corona virus large family of viruses belongs to family coronoviridae which causes diseases in mammals and birds. This virus has extracellular covering structure called lipid envelop. The virus also has club shaped spikes proteins on

the outer surface of the virus.

Dear learner! Be aware that the viral envelope is made up of a lipid bilayer membrane (M),envelope(E)and spike proteins(S).The E and M protein are the structural proteins that combined with the lipid bilayer to shape the viral envelope and maintain its size. S proteins are needed for interaction with the host cells.

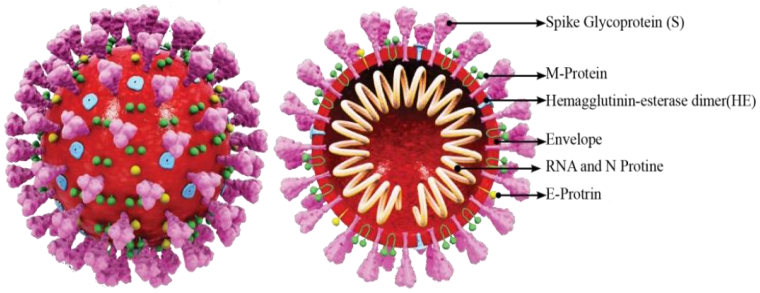


Figure 2.12 Structure of COVID-19

While SARS had occurred in 2003 in China, MERS occurred in Middle East countries in 2012. COVID-19 virus (previously called novel coronavirus) is a new strain of a coronavirus that first emerged in China in December1,2019.

Dear learner! Have you heard that the first case of pneumonia outbreak was reported in Wuhan, China? On 31 December 2019, the outbreak was traced to a novel strain of coronavirus that was given the name SARS-COV-2 by the international committee on Taxonomy of Viruses.SARS-CoV-2 may have originated in an animal and changed (mutated) so it could cause illness in humans.

In March 2020, the World Health Organization (WHO) declared COVID-19 as a pandemic. The disease caused by SARS-COV-2 known as coronavirus disease 2019 (COVID-19).

Dear learner! Be aware that most people infected with the COVID-19 experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.

Fig. 2.13 Pandemic of COVID-19

Activity 22: Think-pair-share

Describe the difference between epidemic and pandemic?

Dear learner! We hope you enjoyed reading about Corona virus; then you should go on to the next lesson about **the spread of corona virus.**

How does the corona virus spread?

The COVID-19 virus spreads primarily through the droplets and virus particles released into the air when an infected person breathes, talks, laughs, sings coughs or sneezes.

When many people are gathered and if there is poor ventilation, these droplets can be inhaled or land in the mouth, nose or eyes of a person close. It can also spread, if a person touches a surface with the virus on it and then touches his or her mouth, nose or eyes.

What are the symptoms of COVID-19?

COVID-19 symptoms can be very mild to severe. Even some people have no symptoms. The most common symptoms are fever, cough, and tiredness,

shortness of breath, muscle aches, chills, sore throat, headache, chest pain, and loss of taste or smell. This list is not all inclusive. These symptoms may appear two to fourteen days after exposure.

How is COVID-19 diagnosed?

COVID-19 is diagnosed or tested by taking fluid sample from nose or mouth and testing it through a laboratory test. Laboratory testing is important because some people with the coronavirus do not have symptoms at all.

Prevention and control of COVID-19

Dear learner! Be aware that there are many steps you can take to prevent yourselves from getting the COVID-19 virus and spreading it to others.

Follow important precautions or instructions:

1. Keep at least 6feet (2 meters) of distance between yourself and people outside your household.
2. Avoid crowds and indoor places that have poor ventilation.
3. Wash your hands often with soap and water for at least 20 seconds, or use an alcohol based hand sanitizer that contains at least 60% alcohol.
4. Wear a mask in public places, especially when social distancing is difficult.
5. Cover your mouth and nose with your elbow or a tissue when you cough or sneeze.
6. Throw away the used tissue. Wash your hands right away.
7. Avoid touching your eyes, nose and mouth
8. Clean and disinfect surfaces you often touch on a daily basis.

Vaccine: currently there are different type's vaccines produced by different countries. Examples of these vaccines are AstraZeneca's AZD1222 BioNTech'sBNT162 etc.

Currently, large number of people in different country including Ethiopia receives these vaccines.

Figure 2.15. Vaccine for corona

If you are suspect COVID-19 or if you are ill withCOVID-19 take the following precautions to avoid spreading the COVID-19 virus:

1. Stay home from school and public areas, except to get medical care.
2. Avoid public transportation, taxis and ride-sharing if possible.
3. Wear a face mask around other people.
4. Isolate yourself as much as possible from others in your home.
5. Use a separate bed room and bath room if possible.
6. Avoid sharing dishes, glasses, bedding and other household items.

Section 2.7.2. Non-infectious diseases

These are disease caused by malnutrition, chemical effect, inherited or genetic factor etc. These diseases are not caused by disease causing organisms. Some of the non-infectious diseases that you have learnt previously in this chapter are:

1. diseases caused by malnutrition like Kwashiorkor, Scurvy, night blindness marasmus etc.,
2. disease caused by cigarette smoke like lung cancer, Chronic bronchitis etc.
3. In addition there are other examples of sickle cell anemia, cancer, allergies, diabetes, podoconiosis, etc.
4. Tobacco use, physical inactivity, the harmful use of alcohol and unhealthy diets are all increase the risk of dying from non-infectious diseases.
5. Unhealthy diets and a lack of physical activity may show up in people as raised blood pressure, increased blood glucose, elevated blood lipids and

obesity. These can lead to cardiovascular disease, the leading non-infectious disease in terms of premature deaths.

SECTION 2.9 RENOWNED NUTRITIONISTS IN ETHIOPIA

Nutritionists are researchers or scientists who study nutrition.

Activity 23: Individual assignment

Using internet and books as a source of information write a paragraph on known nutritionists In Ethiopia.

Self-test exercise

Match column A with Column B.

A	B
1. Diseases that are caused by disease causing organisms.	A. Epidemics
2. Diseases that caused by malnutrition, chemical effect, inherited or genetic factor etc.	B. Endemic
3. Diseases which spreads far more widely throughout the whole world.	C. Infectious diseases
4. Diseases which exists permanently in specific place or population,	D. Non-infectious diseases
5. Diseases that occur suddenly and then spread in a specific area or within a specific population group.	E. Pandemic

II Choose the correct answer and write only the letter in the space provided.

1. Which of the following is the disease causing organisms?

   a. Bacteria b. virus c. protozoa d. all

2. Which of the following is the way for the transmission of HIV-AIDS?

   A. Fluid transfer from one person to another during sexual intercourse
   B. Blood transfusion from one person to another, during blood donation
   C. Sharing needles in intravenous drug users
   D. all

3. Corona virus disease 2019(COVID-19) is caused by:

A. bacteria B. protozoa C. virus D. fungi

4. Which of the following infectious disease transmit by insect bite?

A. Cholera B. HIV-AIDS C. Malaria D. All

5. Tuberculosis is example of infectious disease caused by:

A. Bacteria B. HIV C. Protozoa D. Virus

III. Say true or false

1. Infection of HIV starts when the virus infects and enters to T-lymphocytes.
2. The HIV retroviral drugs are used to cure HIV-AIDS
3. COVID-19 is a pandemic disease.

Iv. Give short answer for the following questions in the space provided.

1. List the mode of transmission of infectious diseases.
2. Mention some of the disease preventing and control methods of infectious diseases.

☑ **Checklist**

Direction: Put a tick (√) against each of the following tasks you can perform.

If you are not able to perform any of these tasks, you need to read once again.

I can:

- Identify infectious and non-infectious diseases……..……..…..…..□
- List the major infectious diseases ……..……..□
- Explain about modes of transmission and prevention of infectious diseases……..……..□
- explain about COVID-19……..□
- Describe the cause of non-infectious diseases……..…..□

Unit Summary

Nutrition is the process of taking in food and converting into energy and other vital nutrients required for life.

The important function of food in living things: Growth, repair, energy, Replacement of damaged tissues, Protect from diseases.

Nutrients are important chemical substances in food. These important nutrients are:
Carbohydrates: are one type of nutrients which provide energy for the human body. One gram of protein can provide 16 kJ of energy

Protein: Proteins are nutrients used for growth of the body and build a new cell when it is damaged. It is made up of amino acid composed of carbon, hydrogen, oxygen and nitrogen. One gram of protein can provide 17 kJ of energy

Lipids (Fats and oil) another nutrient which provide energy, composed of carbon, hydrogen oxygen. One gram of protein can provide 37 kJ of energy

Vitamins: are nutrients organic substances which are essential in small quantities for human body.

Minerals: Minerals are inorganic substances which are essential in small quantities

Water: Major composition of body fluid

Fiber: help to prevent constipation and keep the colon healthy.
The diet which contains all of the nutrients in the correct amount and proportion is called a **balanced diet.**

A **deficiency disease** occurs when a person does not have enough amount of one particular nutrient and suffers health problems as a result. Examples of deficiency diseases are kwashiorkor, marasmus, anemia, rickets and scurvy etc.

Malnutrition is caused by under nutrition.

Obesity is overweight which is caused as a result of an imbalance between the energy in human body and the energy he or she released.

Substance abuse is using of legal or illegal drugs/substances in the wrong way or in the excess amount.

The three important substances found in cigarette are: tar, carbon monoxide and nicotine.

Tar is a black sticky substance found in cigarette produce chronic bronchitis and lung cancer Carbon monoxide is a poisonous gas found in cigarette which can produce heart disease and stroke.

Alcohol gets distributed throughout the body by the help of blood circulation. It is absorbed by liver cells and broken down by liver enzymes, Therefore its concentration in the blood decreases gradually.

Khat is bushy plant whose leaves are chewed for its stimulant effect. The scientific name of this plant is known as *Cathaedulis* plant which is grown in southern Arabia and Eastern Africa, including Ethiopia, Somalia, and Kenya.

A disease is an illness or disorder of the body or mind that leads to poor health; each disease is associated with a set of signs and symptoms.

Infectious diseases are diseases that are caused by causative agent organism.

Non-infectious diseases are not caused by pathogens. They are inherited or genetic diseases and others are deficiency diseases.
Example of infectious diseases and their causative agents are summarized in

	Disease	**Causative agent (pathogen)**	**Type of organism**
1	Malaria	four species of Plasmodium	Protozoa
2	human immunodeficiency virus (HIV)	HIV/AIDS	virus
3	Tuberculosis (TB)	Mycobacterium tuberculosis and M. bovis	bacterium
4	COVID-19	SARS-COV-2	Virus

Unit review question

Choose the correct answer for the following questions.

1. Which of the following nutrient is a micronutrient?
   a. Protein b. Carbohydrate c. Vitamins d. Lipids
2. Which of the following is belong to deficiency diseases?
   a. Marasmus b. Diabetes c. Scurvy d. A and C
3. Which of the following diet is composed of carbon, hydrogen, oxygen?
   a. Carbohydrate b. Lipids c. Protein d. a and b
4. Which of the following mineral is used to build teeth and bones, it make muscles to contract and help for the transmission of nerve impulses?
   a. Iodine b. Calcium c. Iron d. Phosphorus
5. Which of the following is not true about obesity?
   a. It causes Heart disease b. your body stores the extra food as fat
   c. It caused by taking more exercise d. It is an increase in consumption of high-energy foods
6. Substance abuse is ……
   a. using legal drugs in the wrong way b. using illegal drugs/in the wrong way
   c. using legal or illegal drugs for medical purpose d. a and b
7. What *the health effect caused by tobacco tar*
   a. Chronic bronchitis b. Emphysema c. cathinone d. a and b
8. What type of drug is alcohol?
   a. Depressant b. Stimulant c. Activator d. all
9. Which of the following recover from drug addiction
   a. Admitting for the problem b. Enjoy the small successes.
   c. Recognize and avoid relapse d. all
10. What is the stimulant or psychoactive component found in cannabis
    a. Tetrahydrocannabinol b. Cathinone c. Nicotein d. Tar
11. Tuberculosis is another example of infectious disease caused by
    a. bacterium b. virus c. protozoa d. common cold

Answers for the self-tests

Section 1

1. Food is any beneficial substance that is eaten, drunk, or otherwise taken into the body to sustain life, provide energy, promote growth
2. For growth, to give energy, for replacement of damaged tissue, for protecting from diseases

Section 2

1. Nutrition is the process of taking in food and converting it into energy and other vital nutrients required for life

Section 3

Match column A with column B

1. B 2. A 3. C 4. E 5. D

II. Choose the correct answer for the following questions

1. D 2. D

Section 4

1. Balanced diet is the diet that contains all of the nutrients in the correct amount and proportion.
2. Lunch: Bread , Egg , Green paper , Orange and water

Section 5

1. Shortage of protein-Kwashiorkor
   Shortage of Carbohydrate –Marasmus
2. Shortage of Iron causes anemia.

Section 6

1. A 2. C 3. D 4. B

Section 7

Matching

1. A 2. D 3. E 4. B 5. C

Choose the correct answer

1. A 2. D 3. D 4. B

Section 8

Matching

1. C 2. D 3. E 4. B 5. A

Choose

1. D 2. D 3. C 4. C 5. A

Say true or false

1. True 2. False 3. True

Short answer questions

Some infectious diseases are transmitted from one per-son to another by

1. direct contact with a patient.
2. drinking contaminated water
3. eating contaminated food
4. Insect bite.
5. Sexual-inter-course

Preventing and control methods of infectious diseases are:-

1. Vaccination
2. Personal hygiene
3. Hygienic food preparation
4. Boiling
5. Proper waste disposal
6. Sewage treatment

Feedback to Activities

Feedback to Activity 2.1

1. Food is important for living things like us because is beneficial substance taken into the body to sustain life, provide energy, promote growth, etc3. By eating rice our body gets carbohydrates which is the major sources of energy in our diet.

Feedback to Activity 2.2

Nutrients are chemical substances found in food and are used by the human body for growth or to provide energy. These are protein, carbohydrate, lipids minerals and vitamins.

Feedback to Activity 2.3

Food belonging to fructose, sucrose, starch etc.

Fructose is Sometimes called "fruit sugar," fructose is a naturally occurring sugar found primarily in fruits;

Sucrose or table sugar is found naturally in sugar cane and sugar beet

Starch is found in ay foods like Potato, bread, Cereal foods, pasta, rice etc.

Feedback to Activity 2.4

Answer: One gram of carbohydrate can provide, on average, 16 kilojoules (kJ) of energy

Feedback to Activity 2.5

Answer:

Think about the types of food you ate in the past 24 hours, and construct a table similar to that of table 5.1. Explain whether the food is a balanced diet or not. If not, add some food staffs in order to make it a balanced diet.

Feed back to Activity 2.6:

Nutrient	Sources	Use in the body	Deficiency disease
Vitamin C	Orange and lemon	build teeth and bones	Scurvy
Vitamin D	milk, butter, fish and made by skin in the presence of Sun	strengthens bones and teeth	Rickets
Vitamin A	Carrot	To make pigment of the eye, help to see at night.	Night blindness
Iron	Red meat, liver, kidney, eggs, groundnuts, Tikur teff	synthesize the hemoglobin of red blood cells	Anemia
Iodine	Iodized salt, fish food	make thyroid gland to work properly	Goiter
Calcium	milk, cheese	Build teeth and bones	Soft bone

Feedback to Activity 2.7

Our body needs energy not only when we are doing some activities but also it needs energy when we are resting, such as lying in our bed

This is because even though, we are resting on bed, our body requires energy from food for different physiological activities and biological metabolism. E. g protein production in the cell, digestion, circulation etc.

Feedback to Activity 2.8

The male adult manual worker in the picture requires more energy because he is involving in some work which needs physical activity.

Feedback to Activity 2. 9

Answer: Vitamin D is important in strengthen bone and teeth. the main source of vitamin D is sunlight. Vitamin D is the only vitamin that the human body can make upon exposure of the skin to sun light.

Feedback to Activity 2.10

Answer: Yes it causes malnutrition because of excessive feeding. This leads to obesity. Obesity is also one example of malnutrition.

Feedback to Activity 2.11 Obesity

Obesity is formed which is the imbalance between the energy stored and released by the body. An increase in consumption of high-energy foods without an equal increase in physical activity leads to an unhealthy increase in weight. In other way, decreased levels of physical activity can also result in an energy imbalance and leads to weight gain.

Some the human activities which may cause obesity?

i. Sitting and watch TV: This may leads to obesity because there is a formation of stored energy because energy is saved as a result of sitting to watch TV.
II. Playing computer games: This may leads to obesity because energy is reserved as a result of less activity; therefore energy is stored and leads to obesity.
III. Going to school by taxi: this may lead to obesity because energy preserved because of going to school by taxi

IV. Eating breakfast with high fats and sugars contents: this may leads to obesity because of eating foods with high fats and sugars.

Feedback to Activity 2.12

I This activity is important to develop your skill to calculate BMI. A body mass of 60 kg and is 1.60 m tall. Is he likely to be obese?

Answer: 1. The BMI of the person is 23.4. The person is not obese because BMI between 18.5–24.9 is a normal weight.

2. You should go to nearby health facility to measure their weight and height, ask them to calculate your body mass index and compare it with your age.

Feed back to Activity 2.13

1.Some of the drugs are medical drugs taken legally to reduce a symptom and pain of diseases , example aspirin.

2. In addition some drugs can be found from food like tea, coffee, tella, katicala etc.

Feedback to Activity 2. 14

Answer: the common smokers reaction or their habits during smoking is coughing

Feedback to Activity 2.15

1. Answer: the function of hemoglobin in red blood cell is to carry oxygen.

2. The poisonous gas found in cigarette is carbon monoxide. This carbon monoxide from the cigarette reacts to hemoglobin. If car bon-monoxide reacts to hemoglobin; it results in no more oxygen is carried by hemoglobin.

Feedback to Activity 2.16

Drinking alcohol is prohibited when someone is driving. This is because when a person takes larger quantity of alcohol, he/she may lose the ability to concentrate, make good judgments and quickly react to situations.

Feedback to Activity 2.17

Chewing chat results in a depressed mood, irritability, loss of appetite, gastritis and peptic ulcer, disease and difficulty sleeping.

Feedback to Activity 2.18

Doping affects athletics competition because it is one of the performance enhancing drugs used by athletes to improve their athletic performance. Therefore it is prohibited drugs, in competitive sports.

Feed back to Activity 2.19

Infectious diseases like cholera, Pneumonia etc. Non-infectious diseases like chronic bronchitis, diabetics etc.

Feedback to Activity 2.20

HIV-AIDs is a disease caused by HIV. If someone is HIV positive, his body carries the virus but there is no symptom of disease because the T-lymphocytes are not reduced in their amount.

When the body of human starts to produce symptom when it carries HIV and reduced in its disease resistant mechanism, we call it AIDS. This is because of reduced in the amount of T-cells. It causes acquired immunodeficiency syndrome (AIDS). AIDS is the result of opportunistic diseases like pneumonia.

Feedback to Activity 2.21

1. Transmission of malaria occur by vector called female anopheles mosquito.
2. The malaria control mechanism specifically the vector control mechanism like reducing the population of mosquitoes, avoiding mosquito's bite should be mentioned in the discussion.

Feedback to Activity 2.22

Epidemic is the spreading of disease in specific place and Pandemic is an epidemic that spreads far more widely throughout the whole world. It affects a huge number of people. Example, COVID-19.

Feedback to Activity 2.23

Individual assignment

Refer to a book and write a paragraph on known nutritionists in Ethiopia.

The key to the answers for unit review questions

Choose the correct answer for the following questions.

1. C 2. D 3.D 4.B 5. C 6.c 7. D 8.A 9.D 10.A 11.A

References

Jane , B. et al (2016). Campbell Biology. 11th Ed. Pearson higher education Ltd.

Mackean, D. G., & Hayward, D. (2014). Cambridge IGCSE Biology. 3rd Ed. Hodder Education.

Starr, C., Taggart, R., Evers, C., & Starr, L. (2015). Biology: The unity and diversity of life. Cengage Learning.

UNIT THREE: ECOLOGY

INTRODUCTION

 Dear Lerner, this chapter will re-introduce you to the field of ecology and to several key concepts that you may have covered in primary school science education. We will start this chapter with definition of basic ecological terms, brief description of ecological levels, and survey of major global terrestrial and aquatic biomes, processes of ecological succession and wind it up with survey of various ecological interactions.

LEARNING OUTCOMES

Upon successful completion of this unit, you will be able to:

- Explain ecological terms
- Differentiate between the biotic and abiotic components of an ecosystem
- Discuss the ecological levels
- Describe the major terrestrial and aquatic ecosystems and the fauna and flora of each biome
- Differentiate between terrestrial and aquatic ecosystems
- Describe what is ecological succession
- Tell ecological relationships in ecosystems

UNIT CONTENTS

This unit includes the following two major contents organized in sections.

REQUIRED LEARNING TIME

You are expected to spend 15 learning hours of the semester to learn this unit. You should use the allocated study time properly and efficiently to cover the lessons included in this unit.

LEARNING STRATEGIES

For your successful distance learning process, you can use the following learning strategies wherever they are appropriate to the topics/subtopics of the lesson: mind mapping, mentally rehearsing, short visits/onsite observation, comparing and contrasting, drawing and taking pictures, creating analogies, paraphrasing, summarizing (outlining and preparing flow chart summaries), taking short notes, underlining or highlighting key points.

SECTION 3.1. ECOLOGY

Section 3.1.1. Common Ecological Terms

Dear learner! This first lesson will re-introduce you to the field of ecology and to the common ecological terms that you may have covered in primary school science education.

COMPETENCIES

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

- Define ecological terms (ecology, biotic, abiotic, habitat, niche)

Activity 1

Dear learner, when you hear the word ecology, what do you think of? Make a list of some of the topics you think you will learn about as you study about ecology. Write short report about the topics you think and submit it at a tutorial center.

What is Ecology?

Dear learner, every day, you share your environment with many organisms. These can be as small as houseflies or mosquitoes. They can be dust mites that you cannot even see. Larger animals include dogs, cows, and hyenas. You

need to know about your environment. The reason is simple: your environment affects you and every other organism in it.

Dear learner, the branch of biology that deals with the study of the interactions among organisms and with their environment is known as **ecology**. Scientists who study ecology are called **ecologists**. Because our planet has many diverse plants, animals, and environments, ecologists tend to study smaller areas called **ecosystems**. An ecosystem consists of the physical environment (**abiotic factors**) and all the living things (**biotic factors**) within it. Animals are **consumers** since they cannot make their own food and must obtain their food from producers or other consumers. Bacteria and fungi are **decomposers**. They eat dead plants and animal remains and convert them into substances that can be reused.

Each type of living thing in an ecosystem has a place in which it lives. This is known as its **habitat**. The combination of the job an organism does and the place in which it lives is called its **niche**. What are some jobs that organisms do? Plants and algae trap the energy in sunlight and produce their own food. Because of this, they are known as **producers**. Animals are **consumers; bacteria** and fungi are **decomposers**.

Exercise 3.1: Self-assessment questions

Part One: Match items under column A with the appropriate item under column B.

A	B
1. Scientists who study ecology	A. Producers
2. A place in which organisms live	B. Decomposer
3. Physical environment	C. Ecology
4. Feed on other living organisms	D. Abiotic factor
5. Physical environment and all the living things	E. Niche
6. The living component	F. Ecosystems
7. Jobs an organism does and the place in which it lives	G. Ecologist
8. Make their food using light energy	H. Biotic factor
9. Feed on the dead body of organisms	I. Habitat
10. Study of the interactions among organisms and with their environment	J. Consumers

Part Two: Critical thinking question

1. Why do we need to study about our environment?
2. Describe what animals share with your surrounding?
3. Briefly state What ecologists study.

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task. I can:

- define the common ecological terms _____ ☐

Section 3.1.2. Biotic and Abiotic Components

Dear learner! In the previous lesson, you learned some of the basic terminology used in the study of ecology. You are now ready to look at biotic and abiotic components of the ecosystems and their influences on the distribution of organisms.

COMPETENCIES

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

- Explain the biotic and abiotic components of an ecosystem
- Discuss the effects of biotic and abiotic factors on the distributions of species

Activity 2

Dear learner, abiotic and biotic factors influence the distribution of organisms in their environment. Enumerate at list five abiotic and biotic factors you knew and present your report to a tutorial center.

What are abiotic factors?

Dear learner, an ecosystem consists of the physical environment (**abiotic factors**) and all the living things (**biotic factors**) within it. The abiotic factors

include water, sunlight, oxygen, soil, nutrients, and temperature. The biotic factors in an ecosystem include the plants, animals, fungi, and bacteria that live within it.

Energy: All organisms require a usable source of energy to live. **Solar energy** from sunlight, captured by chlorophyll during the process of **photosynthesis**, powers most ecosystems. Lack of sunlight is rarely the most important factor limiting plant growth for terrestrial ecosystems, although shading by trees does create intense competition for light among plants growing on forest floors. In many aquatic environments, however, light cannot penetrate beyond certain depths. As a result, most photosynthesis in a body of water occurs near the surface. Surprisingly, life also thrives in environments that are completely dark. These ecosystems are powered by bacteria that derive energy from the oxidation of inorganic chemicals such as hydrogen sulfide. Bacteria with similar metabolic talents support communities of caved dwelling organisms.

Temperature is an important abiotic factor because of its effect on metabolism. Few organisms can maintain a sufficiently active metabolism at temperatures close to 0°C (32°F), and temperatures above 45°C (113°F) destroy the enzymes of most organisms (Fig.3.1). Most organisms function best within a specific range of environmental temperatures.

Water is essential to all life. Aquatic organisms are surrounded by water, but they face problems of water balance if their own solute concentration does not match that of their surroundings. For terrestrial organisms, the primary threat is drying out in the air. Many land animals have watertight coverings that reduce water loss, such as reptilian scales. Most plants have waxy coatings on their leaves and other aerial parts.

The distribution and abundance of photosynthetic organisms, including plants, algae, and photosynthetic bacteria, depend on the availability of **inorganic nutrients** such as compounds of nitrogen and phosphorus. Plants obtain these nutrients from the soil. **Soil structure**, **pH**, and **nutrient content** often play major roles in determining the distribution of plants. In many aquatic ecosystems, low levels of nitrogen and phosphorus limit the growth of algae and photosynthetic bacteria.

Several abiotic factors are important in aquatic, but not terrestrial, ecosystems. While terrestrial organisms have a plentiful supply of oxygen from the air, aquatic organisms must depend on **oxygen dissolved** in water. This is a critical factor for many species of fish. Cold, fast-moving water has higher oxygen content than warm or stagnant water. **Salinity (saltiness),** currents, and tides also play a role in many aquatic ecosystems.

Some abiotic factors affect terrestrial, but not aquatic, ecosystems. For example, **wind** is often an important factor on land. Wind increases an organism's rate of water loss by evaporation. The resulting increase in evaporative cooling can be advantageous on a hot summer day, but it can cause dangerous wind chill in the winter. In some ecosystems, frequent occurrences of natural disturbances such as storms or fire play a role in the distribution of organisms.

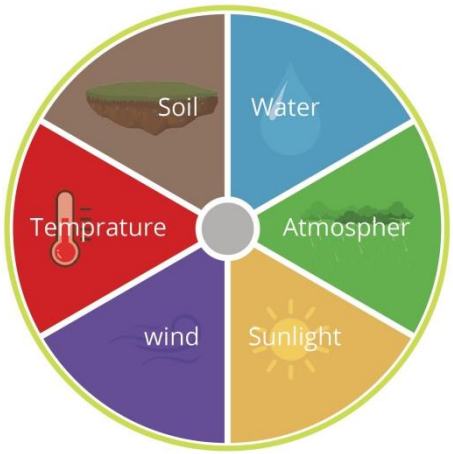


Figure 3.1. Common abiotic factors of terrestrial and aquatic biome

Activity 3

Dear leaner! Make a field visit in your locality and take note on the various abiotic factors (e.g., temperature, water, pH, salinity, etc.). Materials required include notebook, pencil, plastic bags, pH meter, thermometer, pot, and hygrometer. Prepare short note about the abiotic factor that affect the distribution of organisms and present your observation at a tutorial center.

What are biotic factors?

Dear learner, biotic factors are the **living components** of the ecosystem that influence the distributions of organisms in their environment. Often, the ability of a species to survive and reproduce is reduced by its interactions with other species, such as **predators** (organisms that kill their prey) or **herbivores** (organisms that eat plants or algae). Herbivores could affect the distribution of a food species. In addition to predation and herbivory, the presence or absence of **pollinators**, **food resources**, **parasites**, **pathogens**, and **competing organisms** can act as a biotic limitation on species distribution. Such biotic limitations are common in nature (Fig. 3.2).

Activity 4

Dear learner! Make a field visit in your locality and take note on the effects various biotic factors that affect the distribution of organisms (e.g., predators, herbivores, parasite, decomposers, competing organisms, etc.). Write short note about the biotic factor that influences the distribution of organisms and submit your results at a tutorial center.

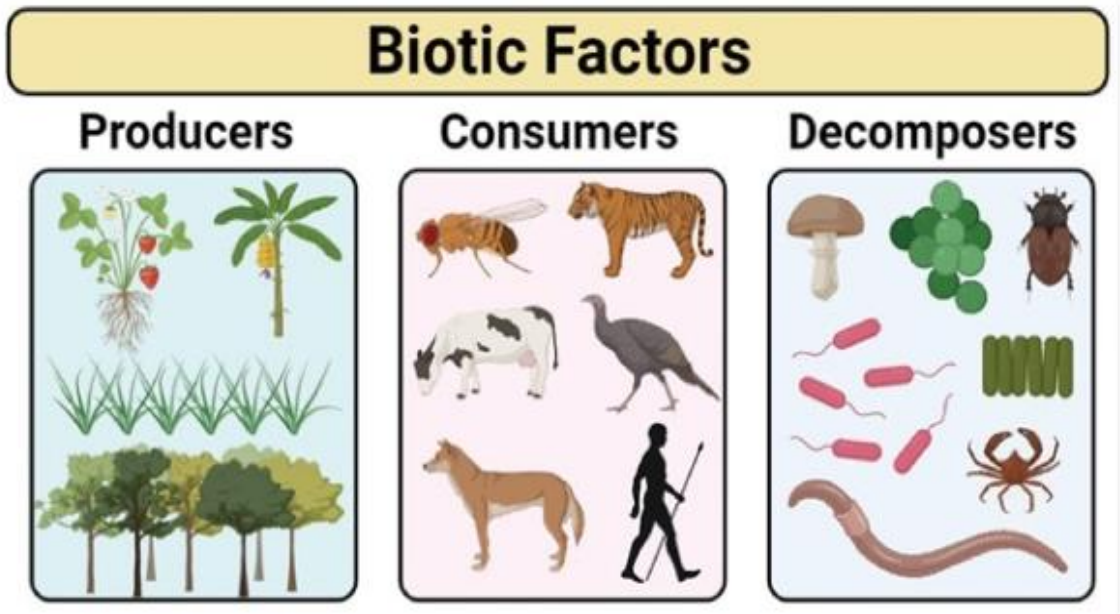


Figure 3.2 Common biotic factors of terrestrial and aquatic biomes

Exercise 3.2: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. Temperature is an important abiotic factor because of its effect on metabolism.
2. Soil structure, pH, and nutrient content often play major roles in determining the distribution of plants.
3. In many aquatic environments light can penetrate to the entire depth of the water body.
4. The presence or absence of pollinators, parasites, pathogens, and competing organisms can affect distribution of species.
5. Many land animals have watertight coverings that reduce water loss, such as reptilian scales.

Part Two: Critical thinking questions

1. Enumerate five biotic factors that affect the distribution of organisms.
2. Wind is often an important factor on land. Explain.
3. State three abiotic factors that affect the distribution of organism in aquatic ecosystems.
4. Solar energy is an important factor for most ecosystems. Explain.
5. Which abiotic factor is more important for aquatic organisms compared to terrestrial ones?

☑ Self-evaluation checklist

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Explain the biotic and abiotic components of an ecosystem ___ ☐
- Discuss the effects of biotic and abiotic factors on the distributions of species _____ ☐

Section 3.1.3. Ecological Levels

Dear learner! Now, you are familiar with biotic and abiotic components of the ecosystems and their effect on the distribution of organisms. Next, you will study about the various ecological levels and the relationships that exist in all ecosystems.

COMPETENCIES

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

- Describe the ecological levels

Activity 5

Dear learner, what do you think when you hear the phrase ecological levels? Summarize the properties of the different ecological levels and prepare a short report and present you finding at a tutorial center.

Dear learner, ecologists study individual organisms. They study relationships among organisms of the same species and connections among organisms of different species. They also study the effects of abiotic factors on species that live together. To make it easier to examine all of these biotic and abiotic interactions, ecologists have organized the living world into levels. The levels are the **organism** by itself, **populations**, **communities**, **ecosystems** and **biosphere** (Fig. 3.3). The traditional ecological investigation usually starts at the level of the individual.

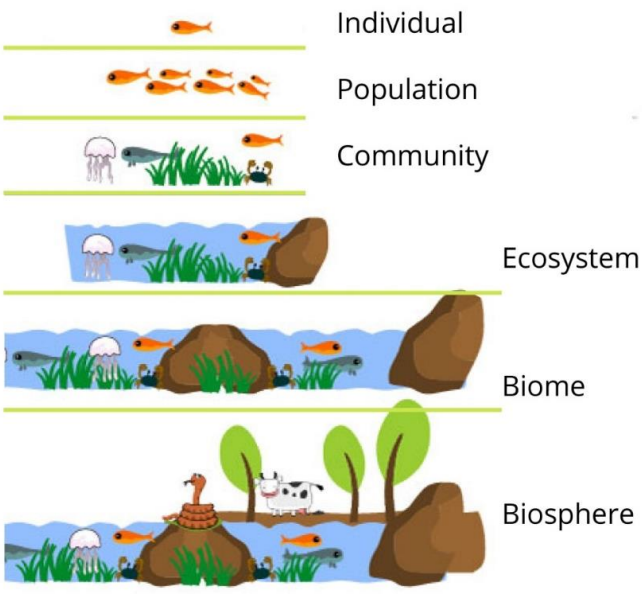


Figure 3.3 Ecological Levels

What is a population?

Dear learner, a **population** is a group of interbreeding organisms that are members of the same species living in the same area at the same time. Members of the same population may compete with each other for food, water, mates, or other resources. Some species have adaptations that reduce competition within a population. For instance, frogs have a life cycle in which the young tadpoles and adult frogs look very different and have different diets. Tadpoles eat algae and adult frogs eat insects; therefore, they are not competing with each other for food.

Activity 6

Dear learner! Ask a biologist about properties of population of plants and animals. Materials required include notebook, pencil, binocular, and meter. Write a brief note about your discussion with the biologist and submit at the tutorial center.

Activity 7

Dear learner! Make a field excursion to a nearest national park or sanctuary and study the properties of biological community. Materials required includes notebook, pencil, binocular, meter. Prepare a brief note about your field experience and present at a tutorial center.

What is a biological community?

A **biological community** consists of the different species within an area, typically a three-dimensional space, and the interactions within and among these species. Examples of interactions include **predation, parasitism, herbivory, competition,** and **pollination**. In a biological community, changes in one population may cause changes in other populations. For instance, if the number of mouse-eating birds (e.g., hawks) in a community increases slightly, the number of mice in that community will decrease slightly. In a healthy forest community, there are many populations that depend on each other. These

might include birds eating insects, mushrooms growing from decaying leaves or bark. While these populations are connected to each other, they are all affected by abiotic factors. These relationships between different populations and their surroundings create an **ecosystem**.

ATTENTION: SAMPLING

A variety of methods can be used to sample populations to determine their size and density. For immobile organisms such as plants, or for very small and slow-moving organisms, a **quadrat** may be used. A quadrat is a way of marking off square areas within a habitat, either by staking out an area with sticks and string, or by the use of a wood, plastic, or metal square placed on the ground. After setting the quadrats, ecologists then count the number of individuals that lie within their boundaries. The number and size of quadrat samples depends on the type of organisms under study and other factors, including the density of the organism. This ensures that enough individuals of the species are counted to get an accurate sample that correlates with the habitat, including areas not sampled.

Exercise 3.3: Self-assessment questions

Part One: Match items under column A with the appropriate item under column B.

A	B
1. The different species within an area	A. Population
2. Populations and their surroundings	B. Biome
3. A biogeographic region with a typical; vegetation	C. Ecosystem
4. Interbreeding organisms that are members of the same species	D. Community
5. A member of a population	E. Individual

Part Two: Critical thinking questions

1. State briefly the concept of a quadrat.
2. Changes in one population may cause changes in other populations. Explain.

3. The size and the number of quadrats you use in your field survey is different. Explain.
4. How do the young tadpoles and adult frogs reduce competition for food?
5. Write the characteristic features of a biological community.

☑ **Self-evaluation check list**

Put a tick☑against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task. I can:

- describe the ecological levels _____ ☐

Section 3.1.4. Ecosystems

 Dear learner! Previously, you learned about the various ecological levels and the relationships that exist in almost all ecosystems. You have also defined ecological levels_ population, community, and ecosystem. You have also discussed the properties the respective ecological levels by giving example. Next, you will learn in depth about ecosystems and their components. For example, you could ask question like how big or small a typical ecosystem?

COMPETENCIES

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

- explain the terrestrial and aquatic ecosystems

ACTIVITY 8

Dear learner! What are ecosystems? Explain the concept of ecosystem and write the properties of an ecosystem and present it at your tutorial center.

 What are ecosystems?

Dear learner, the community of organisms in a habitat, plus the non-living part of the environment (e.g., air, water, soil, light, etc.) makes up an **ecosystem**. A lake is an ecosystem, which consists of the plant and animal communities

mentioned above, and the water, minerals, dissolved oxygen, soil and sunlight on which they depend. An ecosystem is self-supporting. In a woodland ecosystem, the plants absorb light and rainwater for photosynthesis; the animals feed on the plants and on each other. The dead remains of animals and plants, acted upon by fungi and bacteria, return nutrients to the soil.

Dear learner, lakes and ponds are clear examples of ecosystems. Sunlight, water and minerals allow the plants to grow and support animal life. The recycling of materials from the dead organisms maintains the supply of nutrients. So, a population of carp forms part of the animal community living in a **habitat** called a lake. The communities in this habitat, together with their watery environment, make up a self-supporting ecosystem. A carp is a secondary consumer at the top of a food chain, where it is in competition with other species of fish for food and with other carp for food and mates. The whole of that part of the Earth's surface which contains living organisms (called the **biosphere**) may be regarded as one vast **ecosystem**. No new material (in significant amounts) enters the Earth's ecosystem from space and there is no significant loss of materials. The whole system depends on a constant input of energy from the Sun and recycling of the chemical elements.

Types of ecosystems

Dear learner, an **ecosystem** is made of all of the different populations in a biological community and the community's abiotic factors. There are two major kinds of ecosystems—**terrestrial and aquatic**. Terrestrial ecosystems are those located on land. Examples include forests, fields, and a rotting log. Aquatic ecosystems are found in both freshwater and salt water. **Freshwater ecosystems** include ponds, lakes, and streams. Oceans are a type of saltwater, or marine, ecosystem.

Activity 9

Dear learner! Ask a biologist about components of an ecosystem. Materials required includes notebook, pencil, etc. Write a brief note about your discussion with the biologist and submit it at a tutorial center.

Exercise 3.4: Self-assessment questions

Part One: Say true if the statement is correct or false if the statement is wrong.

1. Marine ecosystem includes ponds, lakes, and streams.
2. New material enters and leaves the Earth's ecosystem from space.
3. Terrestrial ecosystems are those located on land.
4. The community of organisms in a habitat, plus the non-living part of the environment makes up an ecosystem.
5. A population of carp could forms part of the animal community living a lake.

Part Two: Critical thinking question

1. The biosphere is an ecosystem. Explain.
2. What are the two major types of ecosystems?
3. A lake is an ecosystem. Explain.
4. State components of an ecosystem.
5. An ecosystem is self-supporting. Explain.

☑ Self-evaluation check list

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Explain the terrestrial and aquatic ecosystem _____ ☐

Section 3.1.5. Biomes

Dear learner! Now, you are familiar with ecosystems and the components of ecosystems. Next, you will learn about the distribution and the characteristic features of the different terrestrial and aquatic biomes. While reading features of the respective biome make sure you focus on the various abiotic factors (e.g., temperature, rainfall, soil, latitude, altitude, nutrients, oxygen, etc.) and biotic factors (e.g., flora & fauna). Your study of this section starts with brief

description of the characteristic features the common terrestrial and followed by with that of aquatic biomes.

Key terms

Fauna: animal species found in a particular area.

Flora: plant species found in a particular area.

COMPETENCE

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

- define biome
- describe the major terrestrial and aquatic biomes
- mention the fauna and flora of each biome
- express love and respect to fauna and flora and their biomes

Activity 10

Dear learner! What do you think when you hear the word are biome? State the characteristic features of the typical terrestrial or aquatic biomes in your locality and present it at a tutorial center.

 What are biomes?

Dear learner, a **biome** is a major terrestrial or aquatic life zone characterized by **vegetation type** in terrestrial biomes and the **physical environment** in aquatic biomes. In this section, we will briefly survey the terrestrial biomes, followed by the aquatic biomes.

SECTION 3.1.5.1. TERRESTRIAL BIOMES

 Dear learner, terrestrial biomes vary greatly. For example, at the North Pole, the weather is very cold and there are no plants. As you move south, the weather gets warmer and there is a change in the size, number, and kinds of

plants that cover the ground. As you continue south, the temperatures rise and you encounter forests. Still farther south are grasslands and deserts, with high summer temperatures and little rainfall. Near the equator, you find abundant growth and much rainfall.

Tropical rain forests

What are the tropical rain forests?

- Located between latitudes 10° north and south in equatorial Africa, the East Indies, Southeast Asia, South America, and Central America.
- Rain that falls throughout (annual total of 130 to 200 centimetres).
- Average temperature of 25°C (77°F) and little variation in day length, allow photosynthesis to continue year-round.
- Broadleaf evergreen trees are dominant in tropical rain forests (Fig.3.4).
- Tropical forests are home to millions of animal species.
- The animal species includes amphibians, birds and reptiles, mammals and arthropods.
- Deforestation is an ongoing threat to tropical rain forests.
- Located in developing countries with fast-growing human populations who look to the forest as a source of lumber, fuel, and potential agricultural land.

Figure 3.4 Tropical forest biome

Desert

What is a desert?

- Receive an average of less than 10 centimetres of rain per year.
- Temperature in **hot deserts** may exceed 50°C while in **cold deserts** air temperature may fall below –30°C.
- Examples of desert biome include **Chile's Atacama Desert** and **China's Gobi** desert.
- Plants are succulents such as cacti or euphorbs, deeply rooted shrubs, and herbs (Fig.3.5).
- Plant adaptations include tolerance of heat and desiccation, water storage, and reduced leaf surface area.
- Fauna include snakes and lizards, scorpions, ants, beetles, migratory and resident birds, and seed-eating rodents. Many species are **nocturnal**.
- Some species surviving solely on water obtained from breaking down carbohydrates in seeds.
- Urbanization and conversion to irrigated agriculture has reduced the natural biodiversity of some deserts.

Figure 3.5 Desert biome

What are Savannas?

- Located in equatorial and sub-equatorial regions (e.g., Africa, India, and Australia).
- Africa's savannas are famous for their abundant wildlife.
- Averages rain fall 30–50 cm per year.
- Temperature is warm year-round, averaging 24–29°C.
- Characterized by scattered trees found at different densities.
- Grasses and small non-woody plants make are common (Fig.3.6).
- Herbivores include giraffes, zebras, elephants, a variety of antelopes, and immense herds of wildebeests.
- Lions and hyenas are carnivores that eat the grazers.
- Cattle ranching and overhunting have led to declines in large-mammal populations.

Figure 3.6. Savanna biome

Activity 11

Dear learner! Ask a biologist about the plants and animal species in savanna biome. Materials required include notebook, pencil, plastic bags, pH meter, and thermometer. Write a brief note about your discussion with the biologist and present it at a tutorial center.

What are temperate grasslands?

- Temperate grasslands are warm in summer, but cold in winter.
- Annual rainfall is 25 to100 centimetres, with rains throughout the year.
- North America's grasslands are shortgrass and tallgrass prairies.
- During the 1930s, much of the shortgrass prairie of the American Great Plains was plowed to grow wheat.
- The Tallgrass Prairie National Preserve was created in 1996 to protect the little that remains.
- North America's prairies once supported enormous herds of elk, pronghorn antelope, and bison that were prey to wolves (Fig.3.7).

Figure 3.7. Grassland biome

What are Boreal Forests?

- The **boreal forest**, also known as **taiga** or coniferous forest
- Found south of the Arctic Circle and across most of Canada, Alaska, Russia, and northern Europe.
- Has cold, dry winters and short, cool, wet summers.
- Annual rainfall is from 40 cm to 100 cm.
- Little evaporation occurs because of the cold temperatures.

- Cold-tolerant cone-bearing (coniferous) plants are predominant
- Evergreen coniferous trees like pines and spruce with needle-shaped leaves are common (Figure 3.8).
- Plant species diversity is less than that seen in temperate forests and tropical wet forests.

Figure 3.8. Northern Coniferous Forest biome

What is the temperate broadleaf forest?

- Found mainly at mid-latitudes in the Northern Hemisphere, with smaller areas in Chile, South Africa, Australia, and New Zealand.
- Rainfall can average from about 70 to over 200 cm annually.
- Average temperature is 0°C in winter while in summers (up to 35°C).
- The dominant plants are deciduous trees, which drop their leaves before winter, when low temperatures would reduce photosynthesis and make water uptake from frozen soil difficult (Fig. 3.9).
- Many mammals hibernate in winter, while many bird species migrate to warmer climates.

- Temperate broadleaf forest has been heavily settled on all continents.
- Logging and land clearing for agriculture and urban development cleared virtually all the original deciduous forests in North America.

Figure 3. 9 Temperate Broadleaf Forest biome

What is the tundra?

- **C**overs up to 20% of Earth's land surface.
- Rainfall averages from 20 to 60 cm annually in arctic tundra but may exceed 100 cm in alpine tundra.
- Averages winters temperature could be below –30°C while summer temperatures generally average less than 10°C.
- Plant communities are called *alpine tundra*, on very high mountaintops at all latitudes, including the tropics.
- The vegetation is mostly herbaceous, consisting of a mixture of mosses, grasses, and forbs.
- A permanently frozen layer of soil called permafrost restricts the growth of

plant roots (Figure 3.10).

- Fauna includes musk oxen, caribou and reindeer are migratory. Predators include bears, wolves, and foxes.
- The major human impacts are mineral and oil extraction.

Figure 3.10 Tundra biome

Exercise 3.5: Self-assessment questions

Part One: Match items under column A with the appropriate item under column B.

A	B
1. Dry shrub land	A. Savanna
2. At latitudes 30° north and south	B. Temperate broad leaf Forest
3. Broadleaf forest near equator	C. Boreal Forest
4. Conifers dominate	D. Desert
5. African grassland with trees	E. Tundra
6. North American grassland	F. Tropical rain forest
7. Low-growing plants at high latitudes or elevations	G. Prairie

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task

I can

- define biome _____ ☐
- describe the major terrestrial biomes _____ ☐
- mention the fauna and flora of each biome _____ ☐
- express love and respect to fauna and flora and their biomes____ ☐

SECTION 3.1.5.2. AQUATIC BIOMES

Previously, you have learned about terrestrial biomes and the flora and fauna. Next, you will discuss about the distribution and the characteristic features of the different aquatic biomes. While reading features the respective biome make sure you focus on the various abiotic physical factors and biotic factors (e.g., flora & fauna).

Aquatic biomes, which occupy roughly 75% of Earth's surface, are determined by their salinity and other physical factors. Freshwater biomes (lakes, streams and rivers, and wetlands) typically have salt concentrations of less than 1%. The salt concentrations of marine biomes (oceans, intertidal zones, and coral reefs) are generally around 3% (Fig. 3.11). Aquatic biomes are classified into freshwater and marine.

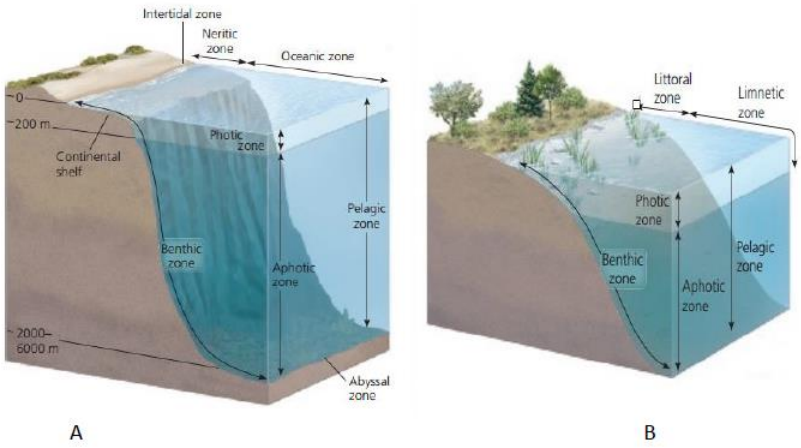


Figure. 3.11 Zonation of marine (A) and freshwater (B) biomes

Key terms

Aphotic zone: There is little light penetration

Photic zone: zone of sufficient light for photosynthesis

Pelagic zone: The photic and aphotic zones together

Abyssal zone: the part of the ocean 2000–6000 m below the surface

What are the lakes?

- Could be as small as ponds to lakes covering thousands of square kilometers.
- The salinity, oxygen concentration, and nutrient content differ among lakes (Fig. 3.12).
- Rooted and floating aquatic plants in lakes live close to shore.
- Phytoplankton and zooplankton live in the open water zone of a lake.
- Fishes live in all zones with sufficient oxygen.
- Runoff from fertilized land and dumping of wastes lead to nutrient enrichment, which can produce large numbers of algae (an algal "bloom") oxygen depletion, and fish kills.

Figure 3.12. Lakes biome

Activity 12

Dear learner! Ask a biologist about the plants and animal species and the major human impacts in a lake biome. Materials required include notebook, pencil, plastic bags, pH meter, and thermometer. Write a brief note about your discussion with the biologist and present it at a tutorial center.

What are the wetlands?

- Are environments in which the soil is either permanently or periodically saturated with water.
- Are shallow bodies of water_ marshes, swamps, bogs, mudflats, and salt marshes.
- Both the water and the soils are periodic low in dissolved oxygen.
- Have a high capacity to filter dissolved nutrients and chemical pollutants (Fig.3.13).
- Are among the most productive biomes on Earth.
- Woody plants dominate the vegetation of swamps, while bogs are dominated by sphagnum mosses.
- Are home to a diverse community of invertebrates, birds, and many other organisms.
- Help purify water and reduce peak flooding. Draining and filling have destroyed up to 90% of wetlands in Europe.

Figure 3.13 Wetlands biome

What are streams and rivers?

- The most prominent physical characteristic of streams and rivers is the speed and volume of their flow.
- Headwater streams are generally cold, clear, swift, and turbulent (Fig.3.14).
- The salt and nutrient content of streams and rivers increases from the headwaters to the mouth. Headwaters are generally rich in oxygen.
- A great diversity of fishes and invertebrates inhabit unpolluted rivers and streams.
- Municipal, agricultural, and industrial pollution degrade water quality and kill aquatic organisms.
- Damming and flood control impair the natural functioning of stream and river ecosystems and threaten migratory species such as salmon.

Figure 3.14 Streams and Rivers biome

What are estuaries?

- An **estuary** is a transition area between river and sea.
- Seawater flows up the estuary channel during a rising tide and flows back down during the falling tide (Fig.3.15).
- Nutrients from the river make estuaries, like wetlands, among the most productive biomes.
- Saltmarsh grasses and algae, including phytoplankton, are the major producers in estuaries.
- Estuaries support an abundance of worms, oysters, crabs, birds, mammals, and many fish species that humans consume.
- Filling, dredging, and pollution from upstream have disrupted estuaries worldwide.

Figure 3.15. Estuaries biome

Exercise 3.6: Self-assessment questions

Part one: Critical thinking questions

1. Discuss some of the limiting factors for organisms in lakes.
2. Write the major physical and chemical factors that affect the distributions of plants estuaries ecosystem?
3. State the major human impacts in the estuaries and the solutions.
4. Planktons are important in aquatic ecosystems. Explain.
5. State the major human impacts in streams and rivers.

Self-evaluation check list

Put a tick☑against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task

I can

- Tell the features of aquatic biomes _____ ☐

Section 3.1.6. Ecological Succession

Dear learner! Now, you are familiar with terrestrial and aquatic biomes features. You have learned about types of the characteristics of the various terrestrial biomes such as rainfall, temperatures, plant and animal species, major threat to the respective biome. Similarly, you have seen the features of the various aquatic biomes. Next, you will discuss about ecological succession – primary and secondary succession.

COMPETENCE

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

- Describe ecological succession

Activity 13

Dear learner! What do you think when you hear the phrase ecological succession? Could tell the difference between primary and secondary successions? How might the early species facilitate the arrival of other species? Write a brief note on ecological succession and present it a tutorial center.

What is ecological succession?

Dear learner, changes in the composition of terrestrial communities are most apparent after a severe disturbance, such as a volcanic eruption or a glacier, strips away all the existing vegetation. The disturbed area may be colonized by a variety of species, which are gradually replaced by other species, which are in turn replaced by still other species—a process called **ecological succession**. When this process begins in a virtually lifeless area, such as on a new volcanic island or on the rubble (moraine) left by a retreating glacier, it is called **primary succession** (Fig. 3.16).

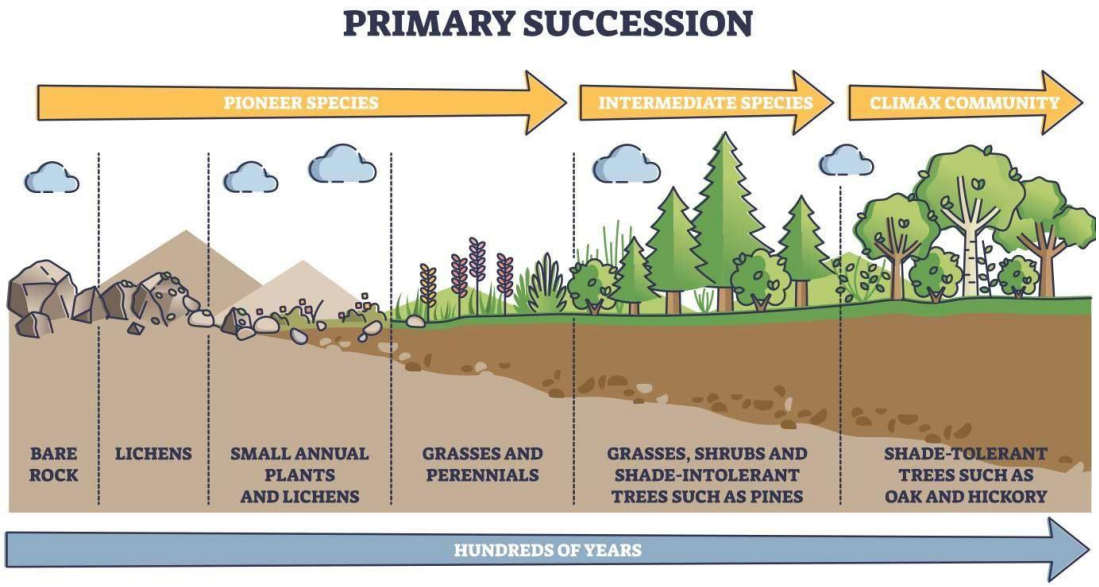


Figure 3.16 Primary successions

During primary succession, the only life-forms initially present are often **prokaryotes and protists** (pioneering species). Lichens and mosses, which grow from windblown spores, are commonly the first macroscopic photo synthesizers to colonize such areas. Soil develops gradually as rocks weather and organic matter accumulates from the decomposed remains of the early colonizers. Once soil is present, the lichens and mosses are usually overgrown by grasses, shrubs, and trees that sprout from seeds blown in from nearby areas or carried in by animals. Eventually, an area is colonized by plants that become the community's dominant form of vegetation (**climax community**). Producing such a community through primary succession may take hundreds or thousands of years. Early-arriving species and later-arriving ones may be linked by one of three key processes facilitating inhibiting and tolerating.

In contrast to primary succession, **secondary succession** involves the re-colonization of an area after a major disturbance has removed most but not all of the organisms in a community (Fig. 3. 17). Following the disturbance, the area may return to something like its original state. For instance, in a forested area that has been cleared for farming and later abandoned, the earliest plants to recolonize are often herbaceous species that grow from windblown or animal-borne seeds. If the area has not been burned or heavily grazed,

woody shrubs may in time replace most of the herbaceous species, and forest trees may eventually replace most of the shrubs.

Keywords
Climax community: a stable community that undergoes little or no change **Limiting factor:** any biotic or abiotic factor that restricts the existence, numbers, reproduction, or distribution of organisms **Primary succession:** colonization of barren land by pioneer organisms **Secondary succession:** sequence of changes that take place after a community is disrupted by natural disasters or human actions **Succession:** the orderly, natural changes that take place in the communities of an ecosystem **Tolerance:** the ability of an organism to withstand changes in biotic and abiotic environmental factors

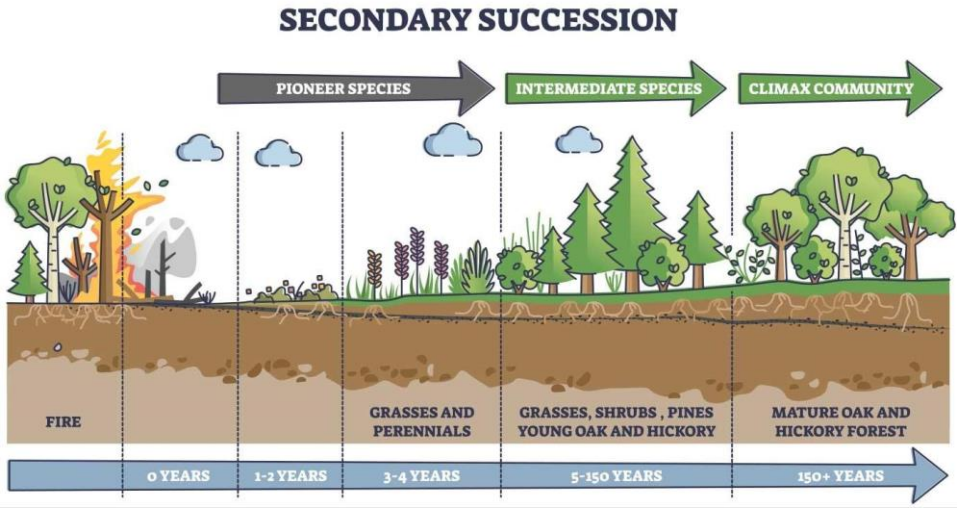


Figure 3.17. Secondary succession

Exercise 3.7: Self-assessment questions

Part one: Critical thinking questions

1. What is a climax community?
2. After a flood destroys everything growing on the land, which type of succession is most likely?
3. What is succession?

☑ **Self-evaluation checklist**

Put a tick ☑ against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- describe ecological succession _____ ☐

SECTION 3.2. ECOLOGICAL RELATIONSHIPS

Dear learner! In the previous sections, you have learned about ecological succession. You have discussed about types of ecological succession–primary and secondary succession. Next, you will learn about key ecological relationships. These **interspecific interactions** include **competition, predation, herbivory, parasitism, mutualism,** and **commensalism**.

COMPETENCE

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

- discuss ecological relationships in ecosystems

Activity 14

Dear learner, interactions between species can help, harm, or have no effect on the individuals involved. Explain how competition, predation, and mutualism differ in their effects on members of two interacting species and present your answer at a tutorial center.

- **Competition(-/-)**

What is a competition?

Competition is interaction that occurs when individuals of different/same species each use a resource that limits the survival and reproduction of both individuals (Fig. 3.18). Weeds growing in a garden compete with garden plants for soil nutrients and water. Predators compete for prey such as hares. In

contrast, some resources, such as oxygen, are rarely in short supply on land; most terrestrial species use this resource but do not usually compete for it.

Figure 3.18 Intraspecific competitions between two lions

- **Predation (+/-)**

What is predation?

Predation is interaction in which an individual of one species, the predator, kills and eats an individual of the other species, the prey (Fig.3.19). For example, a rotifer (a tiny aquatic animal that is smaller than many unicellular protista) that kills a protista by eating it can also be considered a predator. Because eating and avoiding being eaten are prerequisites to reproductive success, the adaptations of both predators and prey tend to be refined through natural selection.

Figure 3.19. **Predation**

- **Herbivory** (+/-)

What is herbivory?

Herbivory is an exploitative interaction in which an organism—an herbivore—eats parts of a plant or alga, thereby harming it but usually not killing it. Examples of herbivores include cattle, sheep, giraffe and goat. However, most herbivores are invertebrates, such as grasshoppers, caterpillars, and beetles (Fig. 3.20). Herbivores have many specialized adaptations. Many herbivorous insects have sensors on their feet that enable them to distinguish between plants based on their toxicity or nutritional value. Goats also use their sense of smell to examine plants, rejecting some and eating others. Other herbivores also have specialized teeth or digestive systems adapted for processing vegetation.

Figure 3.20. Herbivory

- **Parasitism (+/-)**

What is parasitism?

Parasitism is exploitative interaction in which one organism, the **parasite**, derives its nourishment from another organism, its **host**, which is harmed in the process (Fig.3.21). Endoparasites such as parasitic roundworms live and feed inside their host. An ectoparasite such as a tick feeds while attached to a host's external surface. Many parasites have complex life cycles involving multiple hosts. The blood fluke, which currently infects approximately 200 million people

around the world, requires two hosts at different times in its development: humans and freshwater snails.

Figure 3.21. *Parasitism*

- **Mutualism (+/+)**

What are the effects of participating in a mutualism?

Mutualism is interaction that benefits individuals of both of the interacting species. Mutualisms are common in nature, including cellulose digestion by microorganisms in the digestive systems of termites and ruminant mammals, animals that pollinate flowers or disperse seeds, nutrient exchange between fungi and plant roots in mycorrhizae, and photosynthesis by unicellular algae in corals (Fig.3.22). In some mutualisms, such as the acacia-ant, each of the interacting individuals depends on the other for their survival and reproduction. Both partners in a mutualism incur costs as well as benefits. In mycorrhizae, for example, the plant often transfers carbohydrates to the fungus, while the fungus transfers limiting nutrients, such as phosphorus, to the plant.

Figure 3.22. Mutualism

- **Commensalism**(+/0).

What is a commensalism?

Commensalism is interaction that neither benefits the individuals of one of the interacting species but neither harms nor helps the individuals of the other species. For instance, cattle egrets feed on insects flushed out of the grass by grazing bison, cattle, horses, and other herbivores (Fig. 3.23). Because the birds increase their feeding rates when following the herbivores, they clearly benefit from the association. Much of the time, the herbivores are not affected by the birds. At times, however, the herbivores too may derive some benefit; for example, the birds may remove and eat ticks and other ectoparasites from the herbivores' skin, or they may warn the herbivores of a predator's approach.

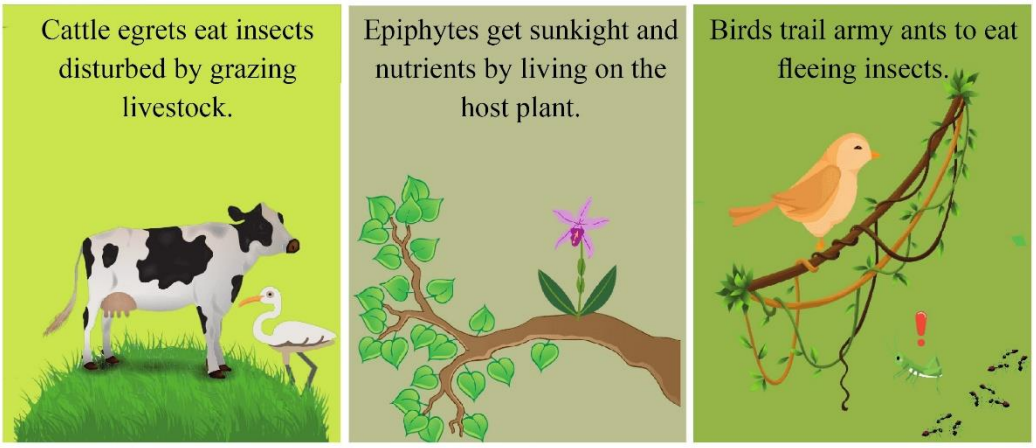


Figure 3.23. Commensalism

Activity 15

Dear learner! Ask a biologist about two ecological interactions you have studied in this section (e.g., **competition, predation, herbivory, parasitism, mutualism, commensalism** etc.). Materials required includes notebook, pencil. Write a brief note about your discussion with the biologist and present it at a tutorial center.

Exercise 3. 8: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

A		B
1.	One free-living species feeds on another and usually kills it	A. Mutualism
2.	Two species access a resource	B. Predation
3.	One species feeds on another that it lives on or in	C. Parasitism
4.	Two species interact and one benefits while the other is neither helped nor harmed	D. Interspecific competition
5.	Two species interact and both benefit by the interaction	E. Commensalism

☑ **Self-evaluation check list**

Put a tick☑against each of the following task(s) which you can perform. If you cannot perform any of these tasks, go back and read the lesson for that particular task.

I can:

- Discuss ecological relationship in ecosystems _____ ☐

UNIT REVIEW

- **Ecology** is the study of relationships organisms to one another and to their surrounding environment.
- Abiotic factors are the non-living components of the ecosystem that influence the distributions of organisms in their environment. Examples of abiotic factors includes: energy, light, temperature, water, nutrients, salinity, etc.
- Most organisms are adapted to live within a relatively narrow range of temperatures and will not thrive if temperatures are colder or warmer. The growing season of plants, for example, is importantly influenced by temperature.
- All organisms require water. On land, water is often scarce, so patterns of rainfall have a major influence on life.
- Almost all ecosystems rely on energy captured by photosynthesis; the availability of sunlight influences the amount of life an ecosystem can support, particularly below the surface in marine communities.
- The physical consistency, pH, and mineral composition of the soil often severely limit terrestrial plant growth, particularly the availability of nitrogen and phosphorus.
- Biotic factors are the living components (e.g., predators, herbivores, parasite, decomposers, competing organisms etc.)of the ecosystem that influence the distributions of organisms in their environment.
- A population is a group of organisms that belongs to the same species.
- A community is all of the populations of different species in an ecosystem.
- An ecosystem is a unit containing the community of organisms and their environment, interacting together.
- The Earth has terrestrial biomes and aquatic biomes.

- Biomes located on land are called terrestrial biomes. Biomes located in bodies of water are known as aquatic biomes.
- Major terrestrial biomes are tropical forests, savannas, deserts, temperate grasslands, temperate forests, boreal forests, and tundra. The same biome can occur in different geographic locations with similar climates.
- Temperature and precipitation, and variations in both, are key abiotic factors that shape the composition of animal and plant communities in terrestrial biomes.
- A biome is a large group of ecosystems that shares the same type of climax community. All the ecosystems within the biome have similar climates and organisms.
- Aquatic biomes, which occupy roughly 75% of Earth's surface, are determined by their salinity and other physical factors. Freshwater biomes (lakes, streams and rivers, and wetlands) typically have salt concentrations of less than 1%. The salt concentrations of marine biomes (oceans, intertidal zones, and coral reefs) are generally around 3%.
- **succession:** the orderly, natural changes that take place in the communities
- When this process begins in a virtually lifeless area, such as on a new volcanic island or on the rubble (moraine) left by a retreating glacier, it is called **primary succession.**
- In contrast to primary succession, **secondary succession** involves the re-colonization of an area after a major disturbance has removed most but not all of the organisms in a community.
- Some key relationships in the life of an organism are its interactions with individuals of other species in the community. These **interspecific interactions** include **competition, predation, herbivory, parasitism, mutualism,** and **commensalism**.

REVIEW QUESTIONS

Part One: Match items under column A with the appropriate item under **column** B.

	Column A		**Column** B
1.	Cold temperatures and high winds that prevent tree growth in mountain areas	A.	Predator-prey relationship
2.	The first organisms to grow on a new patch of cooled, hardened lava	B.	Limiting factors
3.	Ability of mosquitoes to survive in very different conditions all over the world	C.	Secondary succession
4.	An old forest that has not had any fire damage in over 200 years	D.	Tolerance
5.	Weeds and wildflowers beginning to grow in a field after a corn crop is harvested	E.	Pioneer species
6.	Millipedes, centipedes, insects, slugs, and earthworms under a log	F.	Climax community
7.	A tick on a cat	G.	Abiotic factor
8.	An owl eating a mouse	H.	Parasitism
9.	Rain	I.	Biological community
10.	A rain forest	J.	Habitat

Part Two. Fill in the blanks below with the following words to make correct statements about the material you read in this section: **desert, tundra, plankton, photic zone, rain forest.**

1. The driest biome is _____the biome.
2. The part of the marine biome that is shallow enough for sunlight to penetrate is called the _____
3. The base of the entire marine biome food chain is formed by _____.

4. The_____ biome is a home to more types of life than any other biome.
5. The _____ is so cold that very little life exists there.

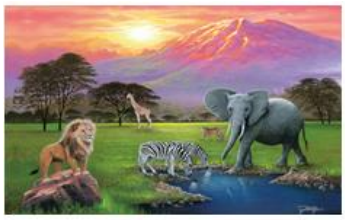
Part Three. Critical thinking questions

1. State the major threat to tropical rainforest.
2. What are common animal species in savanna biome?
3. Discuss the major human impact to the savanna biome and the solutions
4. Desert animals have various adaptive mechanisms to cope up with adverse ecological conditions. Describe some of the adaptive mechanisms.
5. Explain the difference between intraspecific competition and inter specific competition.
6. Carefully look at the diagrams given below and answer the questions that follow

I. Which diagram stands for biotic factors of an ecosystem?

II. Which diagram stands for abiotic factors of an ecosystem?

III. Which diagram represents: an ecosystem, community, individual, and population levels of ecology.



A

B

C

D

E

F

7.Carefully look at the diagram given below and identify the various ecological levels (individual, population, community, ecosystem and biosphere levels)

FEEDBACK TO THE ACTIVITIES, UNIT REVIEW QUESTIONS & SELF-ASSESSMENTS

🗝Exercise 3.1: Self-assessment questions

Part One: Match items under column A with the appropriate item under column B.

1. G	2. I	3. D	4. J	5. F
6. H	7.E	8. A	9. B	10. E

Part Two: Critical thinking question

1. **Answer:** Our environment affects us and every other organism in it.
2. **Answer:** Birds, fish, amphibians, reptiles, mammals, insects, etc.
3. **Answer:** Ecologists study individual organism, population, biological community, ecosystems, study the interaction between organism and with their environment, etc. They could study at the field as well as in the laboratory.

🗝Feedback to Activity 2

Abiotic: solar energy, temperature, water, inorganic nutrients, pH, oxygen dissolved, etc.

Biotic: predators, herbivores, parasite, decomposers, competing organisms

🗝 Feedback to Activity 3

- Task 1: arrange the necessary material for the field visit
- Task 2: go to the field in your village or school compound study the various abiotic factors (e.g., temperature, water, pH, salinity, etc.)
- Task 3: For example, measure the temperature of a soil, pH, and salinity
- Task 4: take a note of the parameters
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor

🗝 Feedback to Activity 4

- Task 1: arrange the necessary material/tools for the field visit
- Task 2: go to the field in your village or school compound study various biotic factors that affect the distribution of organisms (e.g., predators, herbivores, parasite, decomposers, competing organisms etc.)
- Task 3: make observation the various types of biotic factors
- Task 4: take a note the relationships between organism (e.g., grass & cattle, insects & birds etc.).
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor

🗝 Feedback to Exercise 3.2: Self-assessment questions

Part one: say true if the statement is correct false if the statement is wrong.

1. True	2. True	3. False	4. True	5. True

Part 2: Critical thinking question

1. **Answer**: water, soil, oxygen, salt, & temperature
2. **Answer**: Wind increases an organism's rate of water loss by evaporation.
3. **Answer**: oxygen, saltiness, currents, and tides.
4. **Answer:** It is a limiting factor for photosynthesis
5. **Answer:** Water

🗝 Feedback to Activity 5

- To make it easier to examine the biotic and abiotic interactions, ecologists have organized the living world into levels. The levels are the organism itself, populations, communities, and ecosystems.
- **Organism**: the individual plant or animal
- **Population:** group of organisms that belongs to the same species
- **Community:** different populations in a certain area at a certain time
- **Ecosystem:** community plus the abiotic component

🗝 Feedback to Activity 6

- Task 1: arrange the necessary material/tools for the field visit
- Task 2: go to the field nearest national park or sanctuary
- Task 3: make observation and ask ecologist about **population**
- Task 4: take a note about the properties a plant/animal **population**
- Task 5: prepare a field report the properties
- Task 6: make a presentation to your study partner/tutor

🗝 Feedback to Activity 7

- Task 1: arrange the necessary material/tools for the field visit
- Task 2: go to the field nearest national park or sanctuary
- Task 3: make observation and ask an ecologist about the properties of biological community
- Task 4: take a note about the properties of biological community
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor

🗝 Feedback to Exercise 3.3: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B

1. D	**2. C**	**3.** B	**4. A**	**5. E**

Part Two: Critical thinking question

1. **Answer:** A quadrat is a way of marking off square areas within a habitat, either by staking out an area with sticks and string, or by the use of a wood, plastic, or metal square placed on the ground.

2. **Answer:** Yes, if the number of mouse-eating birds in a community increases, the number of mice in that community will decrease.

3. **Answer**: It depends on the type organism and density.

4. **Answer**: They feed different food sources.

5. **Answer:** Composed of the living components of the ecosystems

🗝 Feedback to Activity 8

- **Ecosystem:** Is community of organisms in a habitat, plus the non-living part of the environment (e.g., air, water, soil, light, etc.)**.** Each ecosystem has its characteristic flora (plant life) and fauna (animal life) plus climatic feature.

🗝 Feedback to Activity 9

- Task 1: arrange the necessary material/tools for the field visit
- Task 2: go to the field nearest national park or sanctuary or lake, or forest, etc.
- Task 3: make observation and ask ecologist how the different components of ecosystem interact

- Task 4: take a note on how the different components of ecosystem interact.
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor

🗝Feedback to Exercise 3.4: Self-assessment questions

Part One: Say true if the statement is correct false if the statement is wrong.

1. False	2. False	3. True	4. True	5. True

Part Two: Critical thinking question

1. **Answer: Biosphere** is the part of the Earth's surface which contains living organisms. Therefore, could taken as an ecosystem.
2. **Answer:** Terrestrial and aquatic ecosystems.
3. **Answer:** Because a lake has both living and non-Living components.
4. **Answer:** Living (community of organisms) and non-Living (e.g., air, water, soil, light, etc.**)**
5. **Answer:** It has the necessary components to sustain itself_ the biotic and abiotic components

🗝Feedback to Activity 10

- A **biome** is a major terrestrial or aquatic life zone, characterized by **vegetation type** in terrestrial biomes and the **physical environment** in aquatic biomes.
- The major terrestrial and aquatic biomes:

1. tropical forest
2. Desert biome
3. Savanna biome
4. Freshwater
5. Marine

🗝 Feedback to Exercise 3.5: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1. D	2. B	3. F	4. C
5. A	6. G	7. E	

🗝 Feedback to Activity 12

- Task 1: arrange the necessary material for the field visit
- Task 2: go to the field nearest lakes biome
- Task 3: make observation and ask ecologist about the physical and chemical features; plants and animals; and human impacts
- Task 4: take a note about the physical, chemical features; plants and animals, and human impacts
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor.

🗝 Feedback to Exercise 3.6: Self-assessment questions

Part one: Critical thinking question

1. **Answer:** Tide, salinity, nutrients, etc.
2. **Answer:** Salinity, oxygen concentration, and nutrient content differ greatly among lakes and can vary with season.
3. **Answer:** Runoff from fertilized land and dumping of wastes lead to nutrient enrichment, which can produce large numbers of algae & oxygen depletion, and fish kills.
4. **Answer:** Because Planktons are the major producers in estuaries.

5. **Answer:** Runoff from fertilized land and dumping of wastes lead to nutrient enrichment, which can produce large numbers of algae & oxygen depletion, and fish kills.

🗝Feedback to Activity 13:

- Disturbed area may be colonized by a variety of species, which are gradually replaced by other species, which are in turn replaced by still other species—a process called **ecological succession**. When this process begins in a virtually lifeless area, such as on a new volcanic island or on the rubble (moraine) left by a retreating glacier, it is called **primary succession.** In contrast to primary succession, **secondary succession** involves the recolonization of an area after a major disturbance has removed most but not all of the organisms in a community.

🗝Feedback to Exercise 3.7: Self-assessment questions

Part one: Critical thinking question

1. **Answer: Climax community:** a stable community that undergoes little or no change.
2. **Answer:** Secondary succession
3. **Answer: succession:** the orderly, natural changes that take place in the communities of an ecosystem

🗝Feedback to Activity 14:

- I**nterspecific interactions** include competition, predation, herbivory, parasitism, mutualism, and commensalism. Interactions could have positive (+) or negative (-) effects on the survival and reproduction of individuals engaged in the interaction. For example, **predation** is a +/_interaction, with a positive effect on the survival and reproduction of members of the predator population and a negative effect on members of the prey population. **Mutualism** is a +/+ interaction in which the survival and reproduction of individuals of each species is increased in the presence of the other.

🗝 Feedback to Activity 15

- Task 1: arrange the necessary material for the field visit
- Task 2: go to the field nearest national park, forest
- Task 3: make observation & ask ecologist about how the various ecological interactions influence the distribution organisms
- Task 4: take a note about the competition, predation, herbivory, parasitism, mutualism, commensalism etc. Make observation for example on grass vs. cattle, insects vs. birds; plants vs. insects; gazelle vs. lion
- Task 5: prepare a field report
- Task 6: make a presentation to your study partner/tutor

🗝 Feedback to Exercise 3.8: Self-assessment questions

Part One: Match items under column A with the appropriate item under **column** B.

1. B	2. D	3. C	4. E	5. A

Feedback to the unit review questions

Part I: Match items under column A with the appropriate item under **column** B.

1. B	2. E	3. D	4. F	5. C
6. I	7. H	8. A	9. G	10. J

Part II: Fill in the blanks

Desert	Photic zone	Plankton	Rainforest	Tundra

IV. Critical thinking questions

1. **Answer**: The major threat to the rainforest is deforestation.
2. **Answer:** Wildebeests and zebras, and predators, including lions and hyenas, are common inhabitants.

3. **Answer:** Many species are nocturnal. Water conservation is a common adaptation, with some species surviving solely on water obtained from breaking down carbohydrates in seeds.

4. **Answer:** Interspecific interactions is interaction between members of different species. Intraspecific interaction is interaction between members of the same species.

5. **Answer:** Cattle ranching and overhunting. Conservation education about sustainable use of natural resources.

6. **Answer:**

   A. Biotic component of the ecosystem is picture D

   B. Abiotic component of the ecosystem is picture B

   C. Picture F is individual, picture C is population, picture A is community, and picture E is ecosystem.

7. **Answer:** individual(A) → population(B)→ community(C) → ecosystem(D) → biosphere (E)

References

Jane, B. et al (2016). Campbell Biology. 11th Ed. Pearson higher education Ltd.

Mackean, D. G., & Hayward, D. (2014). Cambridge IGCSE Biology. 3rd Ed. Hodder Education.

Starr, C., Taggart, R., Evers, C., & Starr, L. (2015). Biology: The unity and diversity of life. Cengage Learning.