PREFACE

The Grade 10 Biology Teacher's Guide is meant for teachers who want to deal effectively with their career dilemmas. It is also intended to help teachers to enhance their pedagogic effectiveness. It is intended to inspire teachers to exploit the latent talents in the teaching-learning process, which is definitely a worthy goal. It helps to explore some practical strategies that will help teachers to release the negative, stay positive, and enrich the teaching in the process.

This Teacher's Guide is aimed to achieve Students' Learning Outcomes through teaching materials and methodologies which suit 21st century teaching skills. It will help secondary school teachers to deliver and further plan their content lessons, seek basic information on given concepts and topics, and assess students' understanding of the taught concepts.

Each lesson in this book begins with objectives and ends with the keys for review questions from the Textbook. Every lesson consists of lesson objectives, preparation for lessons and **ITPR** method in which introduction (**I**), teaching (**T**), practice (**P**) and review (**R**).

Introduction - Check prior learning / get organized / warm up (Revision the previous lesson or giving the background of this lesson)

Teaching - This is mainly teacher-centred. Instructions/organization/explanation/ questioning (Explaining the concept of the lesson with examples, pictures and drawing diagrams given in Teacher's Guide)

Practice - This is mainly student-centred. Doing range of activities or exercises / working in groups / own (Doing the activities that given in Teacher's Guide)

Review - Lesson summary and review questions (Test the memory and knowledge of the finished lessons)

Besides, more information related with the lessons have been mentioned as the teaching aids. In teaching portion, photographs, illustrations and other examples are provided to support the teaching with annotations to elaborate the lesson. Review and assessments with the keys at the end of each lesson will definitely aid teachers to review and assess students' ability of attaining knowledge. Answers for review questions from Textbook and Summary are described at the end of each chapter to know the concept of each chapter. Answers for Practical Workbook are also given at the end of this book.

By reading this book thoroughly, it is hoped that teachers will be able to carry out successfully in 21st century teaching skills through the 5 C's: Collaboration, Communication, Critical thinking and problem solving, Creativity and innovation and Citizenship.

Yearly Lesson Plan for Chapter 1 to 5

Total Lesson hours : 135 hrs (180 periods)
Total Lesson periods : 180 periods - 25 periods (for holidays and other activities) = 155 periods - 20 practical periods = **135 Lesson periods**
One Lesson period : 45 minutes

Months	Chapter title	Chapter outline		Lesson period	Total period for each chapter
JUNE	CHAPTER 1 INTRODUCTION TO BIOLOGY	1.1	THE STUDY OF BIOLOGY	1	20
		1.1.1	The Importance of Biology in Everyday Life	1	
		1.1.2	The Different Fields of Study in Biology	1	
		1.1.3	Characteristics of Living Things	2	
		1.2	TAXONOMY	2	
		1.3	KINGDOM	2	
		1.3.1	Kingdoms of Living Things		
		1.3.2	Kingdom Protista	2	
		1.3.3	Kingdom Fungi	2	
		1.3.4	Kingdom Plantae	2	
JULY		1.3.5	Kingdom Animalia	4	
			Review questions	1	
			Concept map		
	CHAPTER 2 CELL STRUCTURE AND ORGANIZATION	2.1	CELLS AS THE BUILDING BLOCKS OF LIFE	1	20
		2.1.1	The Cell Theory	1	
		2.1.2	Prokaryotic and Eukaryotic Cells	3	
		2.2	EUKARYOTIC CELL STRUCTURE	6	
		2.2.1	Differences in Cell Structure		
		2.2.2	Cell Components (Table 2.2)		

Months	Chapter title	Chapter outline		Lesson period	Total period for each chapter
AUGUST	CHAPTER 2 CELL STRUCTURE AND ORGANIZATION	2.2.3	Cell Organization	4	
			(A) Plant Tissues Figure 2.4 Types of tissue system in plant		
			(B) Animal Tissues Figure 2.5 Types of tissue system in animal	4	
			Review questions	1	
			Concept map		
	CHAPTER 3 SUPPORT AND LOCOMOTION	3.1	SUPPORT SYSTEMS	1	25
		3.1.1	Support Systems in Aquatic Plants	2	
		3.1.2	Support Systems in Terrestrial Plants	3	
		3.1.3	Support Systems in Animals	3	
		3.1.4	Support System in Humans	6	
		3.2	MOVEMENT IN PLANTS	3	
		3.2.1	Tropic Movements		
		3.2.2	Nastic Movements		
		3.3	MOVEMENTS AND LOCOMOTION IN ANIMALS AND HUMANS	2	
		3.3.1	Movement and Locomotion in Various Simple Animals		
		3.3.2	Movement and Locomotion in Various Complex Animals and Humans	4	
			Review questions	1	
			Concept map		
	CHAPTER 4 A BODY SYSTEM TO SUSTAIN LIFE	4.1	NUTRITION	2	26
			(1) Autotrophic nutrition		
			(2) Heterotrophic nutrition		
		4.1.1	Plant Nutrition	5	
		4.1.2	Types of Nutrients	4	
		4.1.3	A Healthy Diet	1	
		4.2	DIGESTIVE SYSTEMS	2	
		4.2.1	Structure of the Human Digestive System	5	
		4.2.2	The Process of Digestion	4	

Months	Chapter title	Chapter outline		Lesson period	Total period for each chapter
DECEMBER	CHAPTER 4 A BODY SYSTEM TO SUSTAIN LIFE	4.3	A HEALTHY DIGESTIVE SYSTEM	2	
		4.3.1	Identifying a Healthy Digestive System		
		4.3.2	A Malfunctioning Digestive System		
			Review questions	1	
			Concept map		
JANUARY	CHAPTER 5 CONTINUATION OF LIFE	5.1	REPRODUCTION	11	36
		5.1.1	Reproduction in Fungi and Plants		
		5.1.2	Reproduction in Animals	9	
		5.2	INHERITANCE	4	
		5.2.1	Nature of Chromosomes, Genes and DNA		
FEBRUARY		5.2.2	Cellular Reproduction	4	
		5.2.3	The Role of Cellular Reproduction in Multicellular Organisms		
		5.2.4	The Role of Chromosomes and Genes in Inheritance	7	
			Review questions	1	
			Concept map		
			Lesson periods	127	
			Revision periods	8	
			Total	135	

WEEKLY PLAN

Chapter	Period (1)	Period (2)	Period (3)	Period (4)	Period (5)	Total periods	
1	1.1	1.1.1	1.1.2	1.1.3	1.1.3	5	20
1	1.2	1.2	1.3, 1.3.1	1.3, 1.3.1	1.3.2	5	
1	1.3.2	1.3.3	1.3.3	1.3.4	1.3.4	5	
1	1.3.5	1.3.5	1.3.5	1.3.5	Review questions (R.Q)/ Concept map (C.M)	5	
2	2.1	2.1.1	2.1.2	2.1.2	2.1.2	5	20
2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	2.2, 2.2.1, 2.2.2	5	
2	2.2, 2.2.1, 2.2.2	2.2.3 (A)	2.2.3 (A)	2.2.3 (A)	2.2.3 (A)	5	
2	2.2.3(B)	2.2.3 (B)	2.2.3 (B)	2.2.3 (B)	(R.Q)/(C.M)	5	
3	3.1	3.1.1	3.1.1	3.1.2	3.1.2	5	25
3	3.1.2	3.1.3	3.1.3	3.1.3	3.1.4	5	
3	3.1.4	3.1.4	3.1.4	3.1.4	3.1.4	5	
3	3.2, 3.2.1, 3.2.2	3.2, 3.2.1, 3.2.2	3.2, 3.2.1, 3.2.2	3.3, 3.3.1	3.3, 3.3.1	5	
3	3.3.2	3.3.2	3.3.2	3.3.2	(R.Q)/(C.M)	5	
4	4.1	4.1	4.1.1	4.1.1	4.1.1	5	26
4	4.1.1	4.1.1	4.1.2	4.1.2	4.1.2	5	
4	4.1.2	4.1.3	4.2	4.2	4.2.1	5	
4	4.2.1	4.2.1	4.2.1	4.2.1	4.2.2	5	
4	4.2.2	4.2.2	4.2.2	4.3, 4.3.1, 4.4.2	4.3, 4.3.1, 4.4.2	5	
4	(R.Q)/(C.M)					1	
5	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5	36
5	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5.1, 5.1.1	5	
5	5.1, 5.1.1	5.1.2	5.1.2	5.1.2	5.1.2	5	
5	5.1.2	5.1.2	5.1.2	5.1.2	5.1.2	5	
5	5.2, 5.2.1	5.2, 5.2.1	5.2, 5.2.1	5.2, 5.2.1	5.2.2, 5.2.3	5	
5	5.2.2, 5.2.3	5.2.2, 5.2.3	5.2.2, 5.2.3	5.2.4	5.2.4	5	
5	5.2.4	5.2.4	5.2.4	5.2.4	5.2.4	5	
5	(R.Q)/(C.M)					1	
					Lesson Periods	127	
					Revision periods	8	
					Totals	135	

1.1.1 The Importance of Biology in Everyday Life Period (2)

Lesson objectives

- To know how biology is important in daily life
- To understand the role of living organisms in food production and disease control

Preparation for lesson

Study the different types of food and ingredients of plant and animal products in our daily diet.

Introduction

Teacher should start the introduction with the following questions: What kind of food did you have for breakfast? What is your house built of? What do you use as cosmetics? Actually, our food, shelter, cosmetics, clothes, etc. are concerned with biology. Therefore, biology is very important in our everyday life.

Teaching

Teachers should explain **Biology** as follows: **Biology** as a science helps human **life** in many ways. It tells us about our body, helping us to develop cures and treatments for many diseases. It also tells us about the bodies of other animals and it can provide clinical treatment for farm animals and also for pets.

Human population is increasing day by day. As the results, farmers are growing high yield, disease resistant crop and advance method of animal husbandry. Tree woods are used for buildings and furniture. These are the examples of how biology is used in everyday life.

In the new field of biology, **bacteria**, the microorganisms are the first organisms to be genetically modified in the laboratory that could insert the desired characters into their gene to control pests and weeds that reduce yields.

Practice

First of all, when you enter the class room please make some questions to students as follows:

1. Why do you eat every day?
2. List the items that you usually eat for breakfast, lunch and dinner.
3. What contents are included in your daily food?
4. Which type of medicines do you usually use in your daily life?
5. What kind of cosmetics do you usually use in your daily life?
6. What kind of livelihood does your family depend on? (Different farming systems or others)
7. What kind of furniture and buildings are used in your home?
8. Teacher must gather all above informations and make the table as in the Textbook and fill up in the relevant column with the information obtained from the students.
10. What kinds of livestock are reared in your area?
11. Which crops are available in your place?
12. Do you occasionally use herbal medicine when you are sick?
13. How is your house built of?

14. Apart from the above items you can insert any other items useful to human and let them know the value of biology in daily life.

Activity - Let each student fill up the given table:

Student's name - .....

No.	Items	What I usually take/used/construct
1	morning breakfast	
2	lunch	
3	dinner	
4	cosmetics	
5	medicines	
6	my house	

Review and assessment

1. Who have modified organisms to yield greater amount of food and how do they improve food production in plants?

   Plant and animal breeders have modified organisms to yield greater amount of food and they improve food production in plants with better farming practices.

2. State about biological research in improved food production.

   Biological research has improved food production by developing controls for the diseased organisms, pests and weeds that reduce yields. Biologists must understand the nature of these harmful organisms to develop effective control methods.

3. What is veterinary?

   It is relating to the diseases, injuries and treatment of farm and domestic animals.

4. Why do we need to increase food production?

   We need to increase food production because the size of population is gradually increasing.

5. What do you think which kind of cosmetics is secured for your skin?

   Thanakhar

6. What do you usually use for washing your hair, traditional or chemical shampoo? What are they made up of?

   I usually use traditional shampoo for washing my hair. They are made up of Kim-mon-thee and Tayaw.

7. Match the following items:

i. Hut	a. are mostly seen along the road-side
ii. Thanakhar	b. is famous for rice and timber
iii. Mega 3	c. is made of bamboo
iv. Our country	d. is good for skin care
v. Paddy fields	e. is extracted from salmon oil

Answers: i. (c), ii. (d), iii. (e), iv. (b), v. (a)

1.1.2 The Different Fields of Study in Biology Period (3)

Lesson objective

- To study the different fields of Biology based on the nature and methods of studying of organisms

Preparation for lesson

Collect illustrations from the internet websites and from the Textbooks of the various Grade levels showing their different fields of study in biology before teaching this lesson.

Introduction

Students have learned some of the nature, structures and functions of plants and animals in previous Grades.

Teaching

Teacher should start the lesson by identifying and explaining the nature, structures and functions of plants and animals which they have learned previously.

Teacher should explain and analyze the different fields of study in biology with the help of collected illustrations and students' answers as correlated with this lesson.

Practice

Teacher should ask the following questions to students:

1. How many branches of biology are there? Mention as much as you can.
2. Define the term fossils.
3. What subject is bioinformatics?

Review and assessment

1. State the main branches of biology.

   The main branches of biology are:

   Botany : study of plants
   Zoology : study of animals
   Microbiology : study of microscopic organisms

2. Fill in the blanks with different fields of the study in biology.

i.		study of utilization of living organisms in industrial processes
ii.		study of fungi
iii.		study of varieties among living organisms
iv.		study of living processes
v.		study of cells
vi.		study of forms and structures of organisms

Answers: i. Biotechnology, ii. Mycology, iii. Biodiversity, iv. Physiology, v. Cytology, vi. Morphology

1.1.3 Characteristics of Living Things Periods (4, 5)

Lesson objective

- To know the main characteristics of living things

Preparation for lesson

Teacher should make charts with words and pictures showing the characteristics of living things.

Introduction

To start this lesson, teacher can ask questions to know if students understand "What are living things? And what are non-living things? What are the characters of living things?" Students can answer in many ways. Teacher should guide whether their answers are correct or not. Then teacher can continue to explain the main characteristics of living things as mentioned in the Textbook.

Teaching

Teachers should first go through explaining the seven important characteristics of living things. Make sure that the important points could be explained step by step.

The main characteristics of living things include their cellular structure, metabolism, growth, movement, irritability, reproduction and adaptability.

Practice

Teacher should construct questions and ask:

1. What are the characteristics of living things?
2. Do you know the terms respiration, excretion, etc.?
3. What are the differences between in the movement of animals and plants?
4. Can you explain the property of irritability in living things?
5. How do you understand the reproduction?
6. Can you explain the adaptability?

Review and assessment

1. What is stored in the nucleus?
   DNA (Deoxyribonucleic acid) is stored in the nucleus.
2. How can animals move?
   Animals can use different body parts to walk, jump, fly, hop, crawl or swim.
3. What do you mean by irritability? Give examples.
   Textbook Page 3, Irritability
4. Outline the different characters between asexual and sexual reproductions.
   Textbook Page 3, Reproduction [In asexual reproduction ..... new organisms.]
5. Why do some birds migrate from one continent to another continent?
   Some birds migrate from one continent to another continent because change of seasons or a shortage of food may cause certain birds to migrate to another place where the conditions are more favourable.

6. Decide which five of these characteristics are found in all living things.

movement	blood system	sight	growth	photosynthesis
nutrition	sensitivity	speech	excretion	

Answers: movement, growth, sensitivity, nutrition, excretion

1.2 TAXONOMY Period (6, 7)

Lesson objectives

- To know the classification of organisms
- To study the variety of organisms in the world
- To identify the plants and animals in nature
- To know how organisms are named scientifically for identification and how they are classified into related groups

Preparation for lesson

Teacher should prepare paper charts or vinyl sheets showing the classification of paddy and humans as examples. Teacher should also prepare to give other examples to get more familiar to plants and animals such as padauk and domestic cat in their surroundings.

Introduction

Teacher should introduce the hierarchic system of classification from the Textbook. The common names used by the people vary from culture to culture, for example, khwe in Myanmar, dog in English, chien in French, perro in Spanish, and cane in Italian. Often different names are used in different regions within a country to identify the same organism. Therefore, Taxonomy is the science of naming organisms and grouping them into logical categories.

Teaching

Teacher should know that the branch of biology that groups and names organisms based on their characteristics is called **taxonomy,** and that the **classification** and **nomenclature** are essential to biology. Moreover, teacher will continue to explain in detail the process of classification described in the Textbook. Scientists who study taxonomy are called taxonomists. They try to identify and classify organisms based on different characters. Taxonomists also consider the genetic make up of organisms to reveal their evolutionary relationships to other organisms.

Teacher should explain how the **taxonomic hierarchy** (classification) is made for *Oryza sativa* (paddy), *Pterocarpus macrocarpus* (padauk), *Homo sapiens* (human) and *Felis catus* (cat) as follows:

Example - Paddy	
Kingdom	: Plantae (Plants - Organisms able to make their own food)
Division	: Magnoliidae (Flowering plants that produce seeds enclosed in an ovary)
Class	: Monocots (Flowering plants with an embryo that bear a single cotyledon)
Order	: Poales (Monocot flowering plants which include the sedges and grasses)

6. Decide which five of these characteristics are found in all living things.

movement	blood system	sight	growth	photosynthesis
nutrition	sensitivity	speech	excretion	

Answers: movement, growth, sensitivity, nutrition, excretion

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Order	: Poales (Monocot flowering plants which include the sedges and grasses)

Family	: Poaceae (Grass family of monocotyledonous flowering plants)
Genus	: *Oryza* (thrive in hotter climates with longer daylight hours)
Species	: *Oryza sativa* L.

Example - Padauk	
Kingdom	: Plantae (Plants - Organisms able to make their own food)
Division	: Magnoliidae (Flowering plants that produce seeds enclosed in an ovary)
Class	: Eudicots (Flowering plants with an embryo that bear two cotyledons)
Order	: Fabales (The Fabales includes herbs, vines and trees with stipulate compound leaves.)
Family	: Fabaceae (Legume, pea, or bean family, physiological and economically important family because they possess root nodules that maintain the nitrogen balance in the soil, which is necessary for plant growth.)
Genus	: *Pterocarpus* (genus of tropical trees or climbers having usually broadly winged pods)
Species	: *Pterocarpus macrocarpus* Kurz

Example - Human	
Kingdom	: Animalia (Animals - Organisms able to move on their own)
Division	: Chordata (Chordates - Animals with a backbone)
Class	: Mammalia (Mammals - Chordates with fur or hair and milk glands)
Order	: Primates (Primates - Mammals with collar bones and grasping fingers)
Family	: Hominidae (Hominids - Primates without tail, with relatively flat faces and three-dimensional vision)
Genus	: *Homo* (Hominids with upright posture and large brains)
Species	: *Homo sapiens*

Example - Domestic cat	
Kingdom	: Animalia (Animals - Organisms able to move on their own)
Division	: Chordata (Chordates - Animals with a backbone)
Class	: Mammalia (Mammals - Chordates with fur or hair and milk glands)
Order	: Carnivora (Carnivore - eat meat)
Family	: Felidae (Cats)
Genus	: *Felis*
Species	: *Felis catus*

Practice

After teaching, teacher should ask and discuss the following questions:

1. Explain the term taxonomy.
2. Mention the taxonomic hierarchy.

3. State the aims of studying characteristics of organisms.
4. How many words should be used in scientifically naming of each plant and animal as stated in binominal system of nomenclature? Give examples.

Review and assessment

1. Define the terms:
   (a) Taxonomy
   Taxonomy is the branch of biology concerned with the grouping and naming of organism.
   (b) Classification
   Classification is essential to biology because there are too many different living things to sort out and compare unless they are organized into manageable categories.
   (c) Binomial nomenclature
   Textbook Page 4, No. 1.2.5. [**Linnaeus** ..... *Oryza sativa*.]
2. Select the genus name from the given scientific names:
   (a) *Rosa acicularis* (Answer: *Rosa*)
   (b) *Clarias gariepinus* (Answer: *Clarias*)
3. Choose the species name from the followings:
   (a) *Bacillus anthracis* (Answer: *anthracis*)
   (b) *Escherichia coli* (Answer: *coli*)

1.3 KINGDOMS Period (8)

1.3.1 Kingdoms of Living Things

Lesson objectives

- To know the classification system of living things
- To understand how and why organisms are placed in three domains and six kingdoms of systematic classification

Preparation for lesson

Study different forms of living things from the internet websites and also from the Textbooks of the previous Grades concerning with the microorganisms, unicellular and multicellular organisms, flowering and non-flowering plants, and invertebrates and vertebrates.

Introduction

Recall the forms and nature of plants and animals including microorganisms from the previous Grades. Then, introduce the meaning of classification, domains and kingdoms.

Teaching

Teacher and students interactively discuss the biology lessons which they have learned in the previous Grades.

Teacher must explain about the forms and nature of living things together with the classification system with the help of illustrations as related to this lesson.

3. State the aims of studying characteristics of organisms.
4. How many words should be used in scientifically naming of each plant and animal as stated in binominal system of nomenclature? Give examples.

Review and assessment

1. Define the terms:
   (a) Taxonomy
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3. Choose the species name from the followings:
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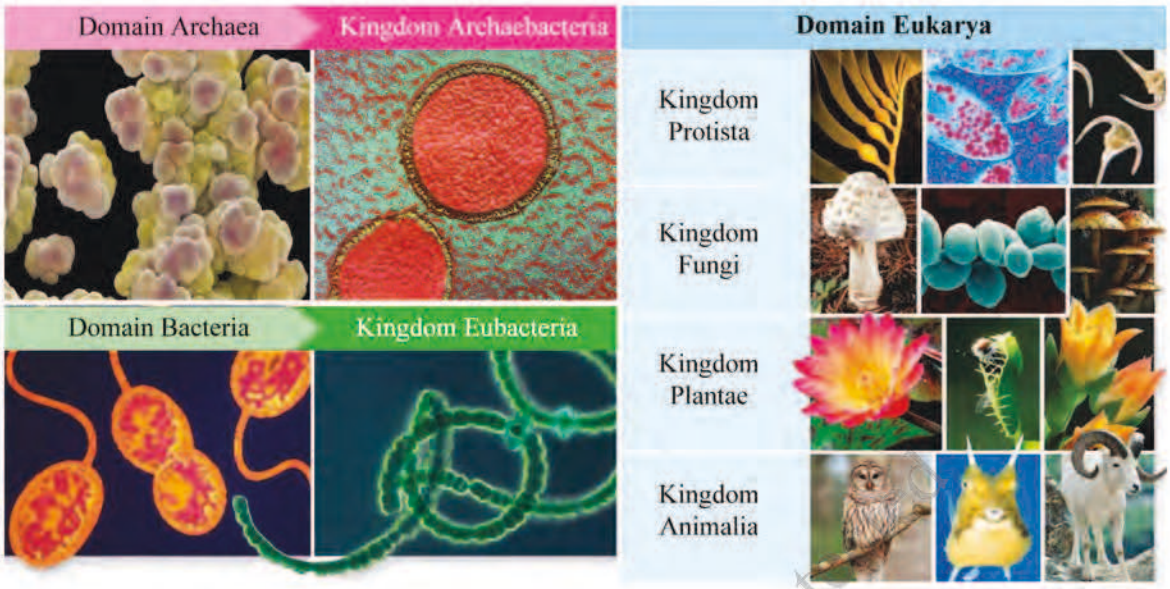


Practice

Teacher should ask the following questions to the students and discuss:

1. Which plants and animals do you know?
2. How are their structures organized?
3. Are they similar or different in structures?

Review and assessment

1. State the domains and kingdoms in living organisms.

   The three domains in living organisms are Archaea, Bacteria and Eukarya.The six kingdoms in living organisms are Archaebacteria, Eubacteria, Protista, Fungi, Plantae and Animalia.

2. Give a diagrammatic representation showing the relationship between the three domains and six kingdoms of living things.

   Textbook Page 5, Figure 1.1

3. Give the examples of the kingdom that includes those living in the extreme environments and their characteristics.

   Textbook Page 5, Table 1.1 Archaebacteria

4. Name the kingdoms with their respective examples.
   1. Archaebacteria (e.g., Thermophiles, Methanogens)
   2. Eubacteria (e.g., Bacteria, Cyanobacteria)
   3. Protista (e.g., *Amoeba*, *Euglena,* Slime mould, *Paramecium*)
   4. Fungi (e.g., Yeast, *Rhizopus,* Mushroom)
   5. Plantae (e.g., Algae, Liverworts, Mosses, Ferns, Conifers, Angiosperms)
   6. Animalia (e.g., Earthworms, Insects, Fish, Birds, Mammals)

Activity 1

Name the kingdoms of living things shown in the following illustrations:
(Note: teacher should ask the questions related to each illustration)

Activity 2

Prepare a few slides of microorganisms and let the students observe them under the microscope(s). Teacher can also prepare the vinyl or chart of microorganisms. Then, ask them the following question(s) to write down the answer(s) in their workbooks. Identify organisms which you have seen in your environment.

Viruses **Periods (9-11)**

Although viruses are not placed under any kingdom, they are studied as pathogens in microbiology.

Lesson objective

- To know the nature and characteristics of viruses

Introduction

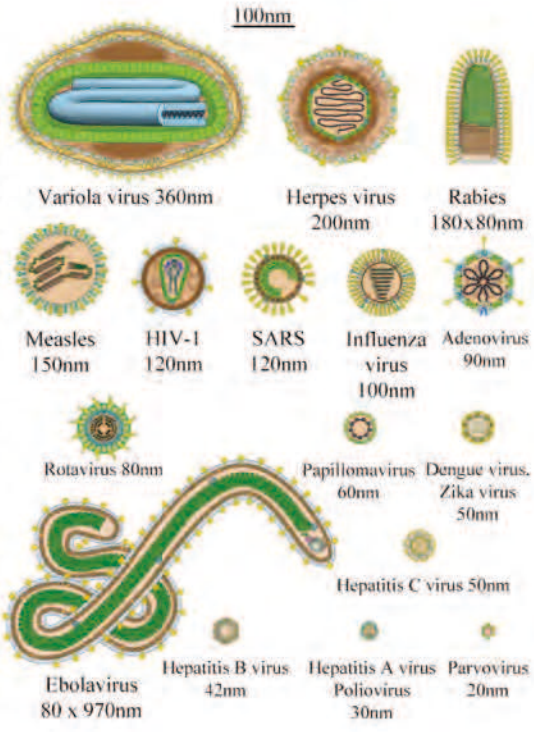
Viruses are not living organisms.

Teaching

Teachers should understand the seven characteristics of living things from the Textbook. To give more knowledge of viruses to the students, teacher should explain that viruses do not possess the seven characteristics of living things but a virus is a small infectious agent that replicates only inside the living cells of an organism. Viruses can infect all types of life forms, from animals and plants to microorganisms, including bacteria and archaea.

Prepare the following diagrams on a cardboard paper or on vinyl chart. Ask the students about the different types of viruses shown in the diagrams. Discuss the human diseases caused by respective viruses and the symptoms of each disease.

Human diseases caused by **viruses** include chickenpox, herpes, influenza, rabies, small pox, Acquired Immuno Deficiency Syndrome (AIDS) and Ebola virus disease (EVD).



Practice

Teacher should make the oral test to the students with the following questions:

1. Are the viruses living or non-living?
2. Can the viruses be harmful to plants and animals? Give examples of harmful viruses.
3. Name the human diseases which are caused by viruses.

Review and assessment

1. Why are not viruses regarded as living organisms?

   Viruses are not generally considered to be alive. They cannot move, feed, excrete, show sensitivity or grow and can reproduce only in the living host cells. Viruses cannot survive outside the host cells.

2. Mention the main particles that contain in the viruses?

   The main particles that contain in the viruses are DNA or RNA and a protein coat.

1.3.2 Kingdom Protista

Lesson objectives

- To know the nature of Kingdom Protista
- To understand characteristics of Protista
- To know how Protista can be grouped into Division/Phyla based on their characteristics
- To know how they can be grouped based on their mode of nutrition

Preparation for lesson

Study the different forms of living things from the Textbook of the previous Grades and other reading materials from the internet websites that concerned with microorganisms.

Introduction

Microorganisms are widespread in nature. Some are beneficial to life but some are harmful to livng organisms.

Teaching

Teacher should prepare the lesson from Table 1.2 in the Textbook with the following explanation.

More information for teacher

Chlorophyta is division of the kingdom Protista. They are largely aquatic or marine. They reproduce both sexually and asexually, but usually sexually.

Euglenophyta are sometimes regarded as algae, sometimes as protozoa. They possess a single flagellum. They are found in a wide range of aquatic habitats: ditches, ponds, puddles and rivers. Some species occur in brackish or marine waters.

Chrysophyta is a phylum of marine or freshwater protists. Members of this phylum include the diatoms, golden/golden-brown algae and yellow-green algae. Diatoms can reproduce sexually through cell division.

Rhizopoda is a phylum of the Protista. They are characterized by the possession of pseudopodia, which are used for locomotion and engulfing food particles. Rhizopods are found in the soil, freshwater and marine habitats.

Actinopoda, heterotrophic protists, are distinguished by their long slender, cytoplasmic projections. These fine projections are stiffened by a bundle of microtubules running down the axis of the structure called an axoneme.

Foraminifera are single-celled organisms. They can have one or many nuclei. Foraminifera also possess thread-like pseudopodia. A distinguishing structure in Foraminifera is the foramen, a hole that connects the wall (septa) between each chamber.

Practice

Teacher should ask the following questions to the students:

1. What types of microorganisms do you know?
2. How are the structures organized?
3. Are they similar or different in structures?
4. What are their modes of nutrition?
5. How do they reproduce?

Review and assessment

1. What is meant by protist?

   The term protist means "any eukaryotic organism that is not a plant, animal or fungus".

2. State the habitats of the protists.

   Protists live in water, but a few species live in moist area. Some can even live in the human intestine.

3. How can they reproduce new generation?

   They can reproduce asexually by fission, budding or fragmentation.

4. How many main groups of protists are divided based on their characteristics and explain about these groups?

   Textbook Page 7, 1.3.2 Characteristics of protista No. 6. a, b and c

5. Choose the plant-like protists from the following examples:


(a) *Amoeba*


(b) Diatoms


(c) *Euglena*


(d) *Paramecium*

Answers: (c) *Euglena*

6. Give two reasons, why some protists are known as plant-like protists.

   The two reasons are: (i) contain chlorophyll in chloroplasts
   (ii) make their own food (autotrophs)

7. Choose the correct words in the following statements.
   (a) The movement of *Amoeba* is by (flagella, cilia or pseudopodia).
   (b) The slime mould (make their own food, feed on dead organic matter).

   Answers: (a) pseudopodia (b) feed on dead organic matter

8. Explain the Phyla/ Divisions included in autotrophic protists.
   Textbook Page 7, Table 1. 2. AUTOTROPHIC PROTISTS
9. What are the major characteristics of heterotrophic protists?
   Textbook Page 8, Table 1. 2. HETEROTROPHIC PROTISTS
10. How many general groups of protists are divided based on their major characteristics and explain these groups?
    Textbook Page 7 - 8, Table 1. 2. Divisions/Phyla of protists
11. Give the examples of differences on locomotion or movements among the six groups of protists.

No.	Groups of protists	Examples	Differences
1	Chlorophyta	*Chlorella*	- without flagella
2	Euglenophyta	*Euglena*	- with flagella
3	Chrysophyta	*Diatom*	- have double shells of silica
4	Rhizopoda	*Amoeba*	- move by pseudopodia
5	Actinopoda	*Actinosphaerium*	- move by needle-like pseudopods
6	Foraminifera	*Podia*	- move by protoplasmic streaming

Activity 1

Name of Divisions/Phyla of the following photographs:

Activity 2

Prepare a few slides of protists and let the students observe under the microscope.

(1) Discuss the species that they observed.
(2) State the characteristics of the organism(s) which students have seen.

1.3.3 Kingdom Fungi — Periods (12, 13)

Lesson objectives

- To know the nature of Kingdom Fungi
- To know how they can be grouped based on their characteristics

Preparation for lesson

Teacher should prepare specimens and teaching aids (vinyl, chart and model) showing habit and diagram of yeast, mould and mushroom.

Introduction

A fungus is a eukaryotic organism. Yeasts, moulds and mushrooms are examples of fungi. The study of fungi is called mycology. All fungi are heterotrophs. Fungi reproduce by releasing spores into the air.

Teaching

Teacher starts the lesson with explanation of fungi. Ask the students to identify the forms and nature of fungi which they have learned.

Teacher has to be explained about the forms and nature of fungi accompanied with their classification system based on students' answers after reviewed the illustrations as related to this lesson.

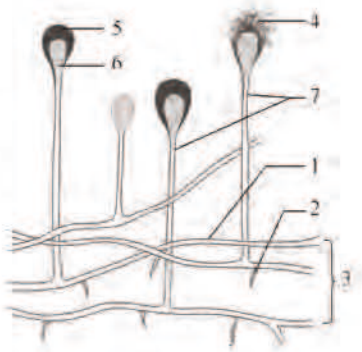
Practice

Teacher should ask the following questions to the student:

1. Which types of fungi do you know?
2. How are their structures organized?
3. Are they similar or different in structures?
4. What are their mode of nutrition?
5. How do they reproduce?

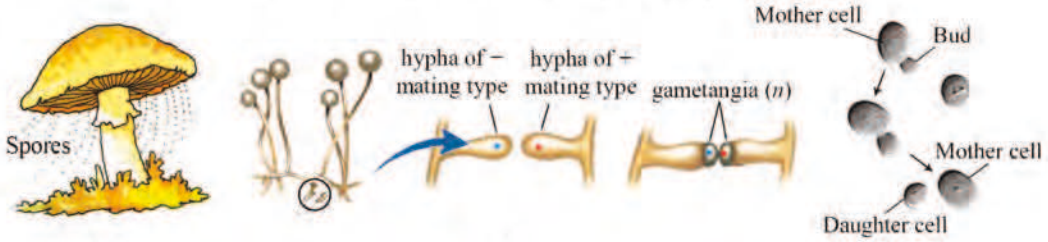
Review and assessment

1. What are the characteristics of the Kingdom Fungi?
   Textbook Page 8, No. 1.3.3. Characteristics of fungi
2. How many groups of fungi are subdivided based on their characteristics and name these groups?
   There are five groups based on their characteristics. They are Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota and Deuteromycota.
3. Explain the characteristics of each division of fungi. (Students' group work)
   Textbook Page 8 - 9, Table 1.3 Divisions of fungi
4. Label the diagram of *Mucor*:
   (a) Why are these fungi known as saprophytes?
   These fungi are known as saprophytes because they feed on decaying organic matter in the soil and water.
   (b) In which part of *Mucor* perform the saprophytic feeding?
   In *Mucor*, the hyphae of rhizoids perform the saprophytic feeding.



Answers:	1 = hypha, 2 = rhizoid, 3 = hyphae, 4 = spores, 5 = sporangium, 6 = columella, 7 = sporangiophores

5. Match the different types of reproduction given in the following figures.
(Sexual reproduction, Asexual reproduction, Vegetative propagation)



(A) (B) (C)

Answers:	(A) Asexual reproduction, (B) Sexual reproduction, (C) Vegetative propagation

Activity 1

Name the Divisions of fungi from the following illustrations:

(Teacher can carry out oral test)

Activity 2

Teachers have to prepare one or two or three of fungi concerning with this lesson by using microscope(s) and let the students observe. Then, ask them the following questions and write down the answers in their Workbooks.

1. Identify and classify the organisms which you have seen.
2. State the characteristics of the organisms which you have seen.

1.3.4 Kingdom Plantae — Periods (14, 15)

Lesson objectives

- To know about the nature of Kingdom Plantae
- To understand the characteristics of Plantae
- To know how they can be grouped based on their characteristics

Preparation for lesson

Study the different forms of flowering and non-flowering plants from the internet websites and from the Textbooks of the previous Grades concerning with the plants before teaching this lesson.

Introduction

The plant kingdom includes all the plants, trees, flowers and seeds which we can see around us. They are autotrophic eukaryotes which they can make their own food.

Teaching

Teacher should explain about plants with examples that found in school environs. Then, students are asked to identify the forms and nature of plants, which they have learned.

Teacher has to explain about the forms, nature and structures of plants with the help of illustrations based on students' answer as related to this lesson.

Practice

Then, teacher should ask the following questions to the students:

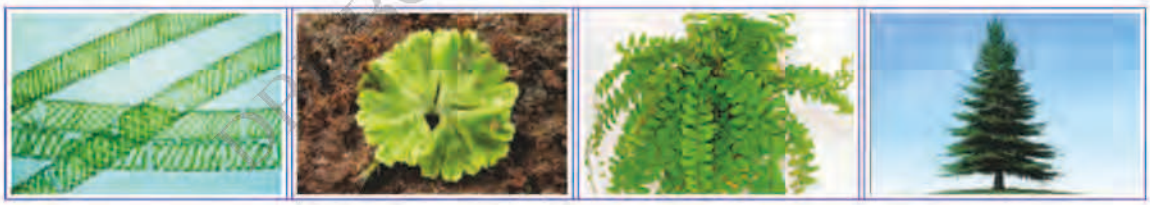
1. Which types of plants do you know among the kingdom Plantae?
2. How are the structures organized in Bryophyta?
3. What are the differences between mosses and ferns?
4. Name the most primitive land plant, its habitats and structure of its thallus.
5. Mention the different methods of reproduction found in plants.

Review and assessment

1. What are the characteristics of the Kingdom Plantae?
   Textbook Page 9, 1.3.4 Characteristics of Plantae
2. In Plantae, how many groups are subdivided based on their characteristics and name these groups?
   There are five groups based on their characteristics. They are Thallophyta, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae.
3. Discuss the characteristics on each division of plants. (Students' group work)
   Textbook Page 10 - 11, Table 1.4 Division of Plantae

Activity 1

Name the Divisions of plants from the following images:
(Teacher can carry out oral quiz)



Activity 2

Teachers have to prepare one or two or three of plants concerning with this lesson by using microscope(s) and let the students observe. Then, ask them the following questions and write down the answers in their Workbooks.

1. Identify and classify the organisms which you have seen.
2. State the characteristics of the organisms which you have seen.
3. Match the different groups of Plantae with the relevant characteristics.

A.	Thallophyta	(i)	Reproduction by spores
B.	Bryophyta	(ii)	Seed-bearing vascular plants
C.	Pteridophyta	(iii)	Flowering vascular plants`
D.	Gymnospermae	(iv)	Plant body is simple (thallus)
E.	Angiospermae	(v)	Gametophytic and sporophytic generations alternate with each other in a single life cycle.

Answers: A. (iv), B. (v), C. (i), D. (ii), E. (iii)

4. Mention the functions of two different organelles of a plant.
(a) Chlorophyll (b) Cell wall

Answers: (a) Photosynthesis, generate chemical energy as glucose molecules.
(b) Give the cell strength and structure and to filter molecules that pass in and out of the cell.

1.3.5 Kingdom Animalia — Periods (16, 17)

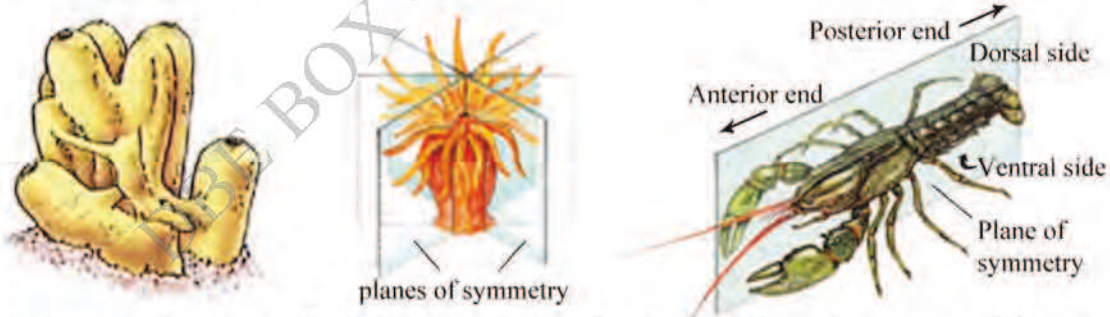
Invertebrate Phyla (Invertebrates)

Lesson objective

- To know the simple characteristics of some invertebrate animal groups or phyla

Preparation for lesson

Teacher should prepare the paper charts or vinyl sheets showing diagrams of invertebrate animals from Table 1.5 of the Textbook and also use the following diagrams to show the different body symmetries of invertebrate groups.



Asymmetry (sponge) Radial symmetry (coral polyp) Bilateral symmetry (lobster)

Introduction

Teacher should introduce the two major groups found under Kingdom Animalia in nature: namely **invertebrates** and **vertebrates**, giving examples found in the environs of the school.

Teaching

Teacher should explain in detail the characteristics of invertebrate phyla in Table 1.5 from the Textbook.

More information for teacher

Phylum Porifera
e.g., Sponges

Phylum Cnidaria
e.g., Sea anemone

Phylum Platyhelminthes
e.g., Turbellaria

Phylum Nematoda
e.g., Roundworm

Phylum Annelida
e.g., Sandworm

Phylum Mollusca
e.g., Nautilus

Phylum Arthropoda
e.g., Crab

Phylum Echinodermata
e.g., Brittle star

Practice

Teacher may ask the following questions:

1. How many major phyla of invertebrates do you know?
2. How many types of symmetry can you find in animal body plan?
3. What are invertebrates with a soft body?
4. Which animals have exoskeleton?
5. Name examples of invertebrates with bilateral symmetry.
6. Give examples of invertebrates which posses bilateral and radial symmetry.
7. What are the differences between roundworms and flatworms?

Review and assessment

1. Mention some invertebrates which you have learned.

   Invertebrates are sponges, jelly fish, earthworms, leeches, snails, insects and spiders.

2. Name some well known phyla of invertebrates with examples.
   Textbook Page 11 - 13, Table 1.5 Major phyla of invertebrates [Phyla with examples]

3. Complete the table below:

Invertebrate species	Type of body symmetry	Number of cell layers	Phylum
 Squid			
 Starfish			
 Leech			
 Sponge			
 Flatworm			
 Jellyfish			
 Roundworm			

Answers:

Invertebrate species	Type of body symmetry	Number of cell layers	Phylum
Squid	bilaterally	3	Mollusca
Starfish	bilaterally/radial symmetry	3	Echinodermata
Leech	bilaterally	3	Annelida
Sponge	asymmetry	2	Porifera
Flatworm	bilaterally	3	Platyhelminthes
Jellyfish	radial symmetry	2	Cnidaria
Roundworm	bilaterally	3	Nematoda

4. State True or False to the following statements.
   (a) Millipedes have two pairs of legs in each segment.
   (b) Sea urchin has a segmented body.
   (c) Earthworms can be divided into head, thorax and abdomen.
   (d) Corals have stinging cells.
   (e) Arthropoda is a large phylum consisting insects, crustaceans, centipedes, millipedes and scorpions.

Answers: (a) True (b) False (c) False (d) True (e) True

Phylum - Chordata (Vertebrata) **Periods (18, 19)**

Lesson objective

- To know the different characteristics of some vertebrates

Preparation for lesson

Teacher should prepare the charts, sheets or vinyl of diagrams from Table 1.6 of the Textbook showing different vertebrate groups under Phylum Chordata.

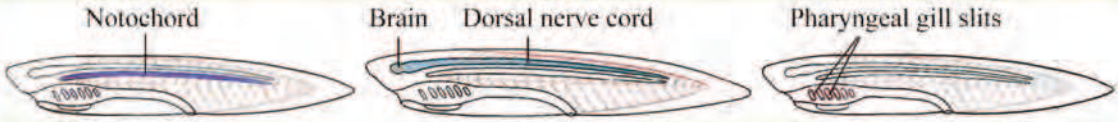
Introduction

Teacher should introduce the two major groups of animals: the **invertebrates** and the **vertebrates**. All the chordates are vertebrates with bilateral symmetry, three cell layers of ectoderm, endoderm and mesoderm, and hollow dorsal nerve cord. Distinct features of chordates are notochord, a dorsal nerve cord, pharyngeal gill slits and tail in embryo or in adults. All these features form in the early embryo of a chordate; they persist or are altered or may disappear in the adult.

Teaching

Teacher should explain in detail of fish, amphibians, reptiles, birds and mammals from Table 1.6 of the Textbook.

More information for teacher



Notochord Dorsal nerve cord Pharyngeal gill slits

The above characters can be seen in the adults of lower chordates but in the rest of the phylum these characters can be seen only in the embryological stages.

Practice

Teacher may ask the following questions:

1. How many major groups are there among the vertebrates? Name them giving examples for each group.
2. What are poikilothermic and homeothermic vertebrates?
3. Are invertebrates cold blooded or warm blooded?

Review and assessment

1. Describe the distinctive characters of chordates.
   Textbook Page 13, [All the chordates ..... trunk and tail.]
2. Name some vertebrates that are warm blooded.
   Birds and mammals
3. Are mammals living in water cold blooded?
   No. Mammals living in water are warm blooded animals.
4. How do different vertebrates obtain oxygen?
   Animals get oxygen in a number of ways. Aquatic animals, like fish, typically breathe through gills. Gills are flaps located on both sides of the fish or in its pharynx. As water flows into its gills, the blood vessels inside the gill arch, absorb oxygen through its red blood cells. Mammals breathe using lungs. Lungs are a pair of spongy, hollow organs on either side of the heart. The lungs have thousands of capillaries, on its air sac that help the gas exchange for oxygen. The muscle of the lung expands to let air in and contract to let air out.
5. Use the **key given to identify** each species in the illustrations below. Write the letter for each species (A to G) in the correct box beside the key. One has been done for you. Following figures show seven different species of amphibians to identify. Common names are given.

Rana temporaria (Grass frog)
A

Gymnopis multiplicata (Caecilian)
B

Triturus cristatus (Crested newt)
C

Necturus maculosus (Mudpuppy/Salamander)
D

Oreophrynella quelchii (Toad)
E

Polypedates leucomystax (Shrub frog)
F

Ambystoma tigrinum (Tiger salamander)
G

Key			
1(a)	long, narrow body, with or without legs	go to 2	
(b)	body not long and narrow, back legs are larger than the front legs	go to 5	
2(a)	body without legs	*Gymnopis multiplicata*	B
(b)	body with legs which are all of the same size	go to 3	
3(a)	Raised crest along the back of the body		
(b)	no crest along the back of the body	go to 4	
4(a)	gills present		
(b)	no gills present		
5(a)	skin is smooth	go to 6	
(b)	skin is not smooth		
6(a)	digits end in swellings		
(b)	digits do not end in round swellings		

Answers: 3 (a) = C, 4 (a) = D, 4 (b) = G, 5 (b) = E, 6 (a) = F, 6 (b) = A

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK
1. Page 1, No. 1.1.2 [The main branches of biology ..... microscopic organisms.]
2. Page 1-2, No. 1.1.2 [The different fields of biology ..... biology data.]
3. Page 3, No. 1.1.2 [Taxonomy is the study of classification of organisms.]
4. Page 3, No. 1.2.1 [The word ..... species.]
5. Page 4, No. 1.2.4 [Living organisms are grouped into domains, kingdoms and lower category hierarchies to make it easy for the biologists to classify the organisms.]
6. Page 4, No. 1.2.5 [Linnaeus introduced the Binomial ..... the organism.]
7. Page 5, No. 1.3.1 [The three domains are Archaea, Bacteria, and Eukarya. The six kingdoms are Eubacteria, Archaebacteria, Protista, Fungi, Plantae and Animalia.]
8. Page 5, Table.1.1 Archaebacteria and Eubacteria
9. Page 5, No. 1.3.1 [Organisms are divided ..... Plantae and Animalia.]
10. Page 7, No. 1.3.2 Animal-like Protists
11. Page 7, Table.1.2 The kingdom Protista contains unicellular, colonial and multicellular organisms whereas animals are only multicellular
12. Page 8, Table.1.2 Heterotrophic protists cannot be placed under a single phylum because they differ in major characteristics
13. Page 8, No. 1.3.3 The characteristics of Fungi
14. Page 10, Table.1.4 Bryophyta
15. Page 11, Table.1.4 Angiospermae
16. Page 12, Table.1.5 Platyhelminthes and Nematoda
17. Page 14, Table.1.6 Amphibians

SUMMARY

Biology is the study of living things which includes bacteria, protista, fungi, plants and animals. Out of many advances in biology, food production and disease control are improved by biological research. Main branches of biology are Botany (study of plants) and Zoology (study of animals and humans) and Microbiology (study of microscopic organisms). Some branches of biology, as mentioned in paragraph 1.1.2, are based on the method of studying organisms in different ways.

The main characteristics of living things are simplified under subheadings: cellular structure, metabolism, growth, movement, irritability, reproduction and adaptability are presented in this chapter. In addition, this chapter includes taxonomy, the study of classification of organisms, which is essential to biology as there are too many different living things to sort out, compared and organized into categories. In classification, similar organisms are grouped together into species, similar species into the same genus, then family, order, class, phylum and kingdom. Linnaeus introduced the Binomial System of Nomenclature in the year 1753, each plant and animal is given a two-word scientific name in Latinized Form. Scientific names become essential as a common factor for all scientists to understand the referred plant or animal.

Characteristics of viruses, although not considered as living organisms, are outlined. Organisms are divided into six kingdoms. Within the domains Archaea and Bacteria, kingdoms Archaebacteria and Eubacteria are placed, respectively. The remaining four kingdoms Protista, Fungi, Plantae and Animalia are placed within the domain Eukarya. Kingdom Protista includes strictly eukaryotic organisms. They are not plant, animal or fungus but can exist as plant-like protists, animal-like protists and fungus-like protists. Five general groups of protists are described in Table 1.2. The members of kingdom Fungi are parasites or saprophytes. The cell wall of hypha is chitinous. Five divisions of fungi are presented by the series of primitive to advanced. The plants belonging to the kingdom Plantae are eukaryotes. They contain chlorophyll and can make their own food by photosynthesis. Cellulose cell wall is present. The characteristics of five divisions of plantae are mentioned in Table 1.4. Kingdom Animalia is categorized into invertebrates (animals without a backbone) and vertebrates (animals with a backbone). Various groups of invertebrates and vertebrates are presented in Tables 1.5 and 1.6. This would serve as basic knowledge to comprehend the evolutionary and biodiversity trends of plants and animals.

CHAPTER 2
CELL STRUCTURE AND ORGANIZATION

Total Number of Lesson Periods : 20

2.1 CELLS AS THE BUILDING BLOCKS OF LIFE — Period (1)

Lesson objectives

- To know that all living organisms are composed of basic units called cells
- To understand differences between single cells which perform all functions of life and cells in multicellular organisms which are specialized to carry out additional particular functions in plants and animals

Preparation for lesson

Teacher needs to prepare teaching aids (vinyl, posters, sheets, charts, etc.) with figures or photos of single cell organisms (*Amoeba, Paramecium*, etc.) and multicellular organisms (humans, tigers, etc.).

Introduction

Teacher must introduce one-celled organisms and multicellular organisms from the previous Grades.

Teaching

Teacher should start with explanation on the structure and functions of a cell using a diagram showing some organelles as found in this cell. Then teacher differentiates the characters between the cells of unicellular organisms (bacteria) and multicellular organisms (plants, animals, humans) from the Textbook Pages 18, 19, Figures 2.1, 2.3.

Practice

Teacher then should ask the following question:

1. What is the basic unit of all living things and how are these units composed of?

Review and assessment

1. Differentiate the features of a single organism and a multicellular organism (for example, bacteria and cat).

   Textbook Pages 17, 18, Figure 2.1 [The simplest organisms ..... functions in plants or animals.]

2.1.1 The Cell Theory — Period (2)

Lesson objective

- To know and understand the cell theory

Preparation for lesson

Teacher should prepare teaching aids (vinyl, cards, charts with figures and labels, etc.) to explain the cell theory. The figures should include:

1. Diagrams of a cell and its components
2. Sperm and egg uniting to form a zygote
3. Chromosomes in mitotic cell division

Introduction

Teacher will introduce previous chapter (Textbook Chapter 1) which describes that organisms are either unicellular or multicellular and all cells arise from preexisting cells.

Teaching

Teacher should explain each point of the cell theory.

Practice

Teacher should ask the following questions:

1. What is the basic unit of organisms?
2. What information is carried in the cell?
3. Where do the chemical reactions occur in cells?

Review and assessment

1. What do you understand about the cell theory?
   Textbook Page 17, 2.1.1 The Cell Theory

2.1.2 Prokaryotic and Eukaryotic Cells — Periods (3-5)

Lesson objectives

- To know the nature of prokaryotic and eukaryotic cells
- To know the differences between prokaryotic and eukaryotic cells

Preparation for lesson

Teacher should prepare the teaching aids (charts with figures and diagrams, etc.) for the prokaryotic and eukaryotic cells described in the Textbook. Teacher should explain by using fully labelled figures in the large charts and compare the structure of prokaryotic and eukaryotic cells in detail.

Introduction

Teacher should point out the differences of prokaryotic cells and eukaryotic cells starting with prokaryote means a cell lacking a membrane-bounded nucleus and membrane-bounded organelles (e.g., a bacterium), eukaryote means a cell with most notably the membrane-bounded nucleus. The teacher will also point out that a eukaryote is an organism composed of such cell or cells with nucleus (e.g., plant cells and animal cells). Teacher also needs to tell that protists and fungi are also eukaryotes.

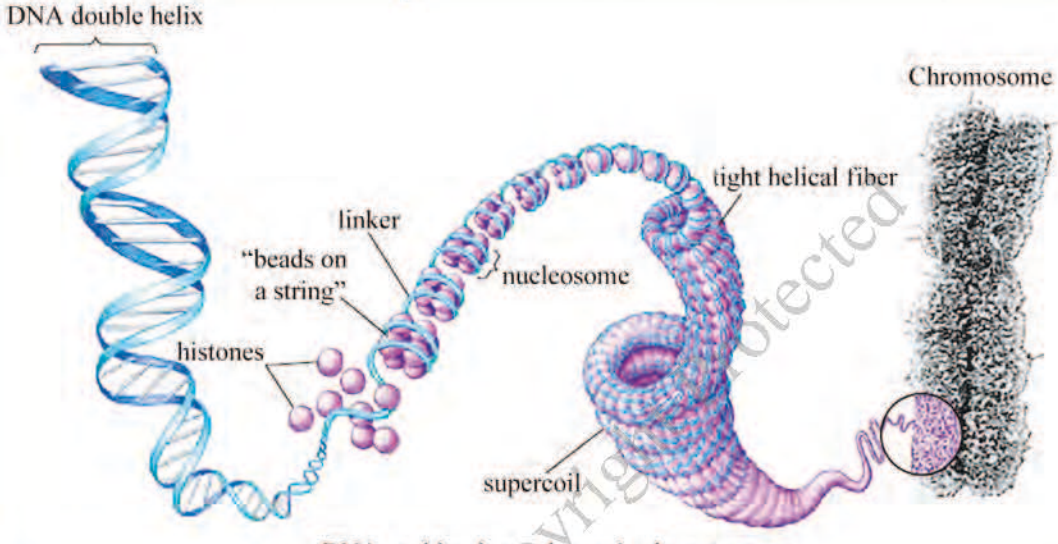
Teaching

Teacher should explain that the prokaryotic cells are mostly small and simple, for example, bacteria and also point out the eukaryotic cells are bigger and more complex, and multicellular organisms are made up of many eukaryotic cells.

Teacher should outline in detail on differences and similarities between prokaryotic and eukaryotic cells using Page 20, Table 2.1 of the Textbook.

More information for teacher

A crucial aspect of DNA packing is the association of the DNA with small proteins called **histones**. In fact, histone proteins account for about half the mass of eukaryotic chromosomes.



DNA packing in a eukaryotic chromosome

Practice

Teacher should ask the following questions:

1. How does the cell size differ in prokaryotic and eukaryotic cells?
2. Where are DNA located in the prokaryotic and eukaryotic cells?

Review and assessment

1. What is a eukaryote?

   A eukaryote is an organism consisting of a cell or cells in which the genetic material is DNA in the form of chromosomes contained within a distinct nucleus. Eukaryotes include all living organisms apart from the eubacteria and archaea.

2. What is a prokaryote?

   A prokaryote is a microscopic single-celled organism which has neither a distinct nucleus with a membrane nor other specialized organelles, including the bacteria and cyanobacteria.

3. Differentiate the prokaryotic and eukaryotic cells.

   Textbook Page 19, [The major difference between ..... cell walls are present.]

4. What are organelles and where can they be found?

   An organelle is a tiny cellular structure that performs specific functions within a cell. Organelles are embedded within the cytoplasm of eukaryotic and prokaryotic cells.

5. What is meant by chromosome, DNA and histone?

Chromosome is a threadlike structure of nucleic acids and proteins are found in the nucleus of most living cells, carrying genetic information in the form of genes. DNA: Deoxyribonucleic acids, a self-replicating material is present in nearly all living organisms as the main constituent of chromosome. It is the carrier of genetic information. Histone is any of a group of five small basic proteins found in chromatin.

2.2 EUKARYOTIC CELL STRUCTURE Periods (6-11)

2.2.1 Differences in Cell Structure

2.2.2 Cell Components

Lesson objectives

- To know the diversity in cell shape, size, internal organization and function in organisms
- To know about the organelles as found in plants and animals
- To identify the characteristics of organelles and their functions

Preparation for lesson

Teacher should prepare the teaching aids (vinyl, chart, etc.) with clearly labelled figures of cell wall, cell membrane, cytoplasm, nucleus, mitochondrion, endoplasmic reticulum, Golgi apparatus, lysosome, ribosome, chloroplast, vacuole, plasmodesma, centrosome and centrioles, and microvilli.

Introduction

Before teaching, teacher should explain about the nature of eukaryotic cells, containing various organelles as described in previous lesson of Chapter 1 of the Textbook. Teacher should explain the differences of plants and animals. Cell wall, chloroplast, and plasmodesmata are found in only plants cells, but vacuoles are found in both plant and animal cells. The vacuoles are much larger in plant cells than animals. Centrosome and centrioles, and microvilli are found only in animal cells. The remaining parts or components are found in both plants and animal cells.

Teaching

Teacher should begin the lesson by explaining that eukaryotic cells are found in the body of plants and animals. Teacher should explain about the cell wall, which can be found only in plant cells. The cell wall is the protective outer layer of a plant cell. It is made up of cellulose. The cell membrane or plasma membrane of a cell surrounds the cytoplasm. Its functions include to surround and protect the cell to act as a partially permeable membrane for transport of substances in or out of the cell.

The teacher should also point out that cytoplasm is found in both plants and animals and also known as cytosol. Nucleus is located inside the cytoplasm. Also tell that nucleus is a spherical or oval structure that controls the cell structure and activities. Mitochondria are known as 'the powerhouse of the cell'. It takes in nutrients from the cell, breaks it down, and turns it into energy (ATP). The energy is then in turn used by the cell to carry out various functions. Teacher should also explain structures and functions of each organelle.

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Practice

Teacher should ask the following questions:

1. Name some organelles of an animal cell.
2. List the three structures found only in plant cells.
3. What are the structure and functions of a nucleus found in a eukaryotic cell?
4. What are the locations and functions of lysosomes, Golgi apparatus and centrosome?
5. Why can chloroplast photosynthesize?
6. Why are microvilli present in some animal cells?

Activity

After asking the questions, teacher should organize 3 or 4 students as a small group to investigate and discuss the structure of a cell, and cellular organelles of plant and animal cells by using a microscope, cards or charts. Students should select any organelles from a given list and could match it with the respective functions.

Review and assessment

1. What is the role of the cell wall?

   The cell wall is the protective, semi-permeable outer layer of a plant cell. A major function of the cell wall is to give the cell strength and structure, and to filter molecules that pass in and out of the cell.

2. Explain the composition of the cell membrane.

   Phospholipids form the basic structure of a cell membrane, called the lipid bilayer. Scattered in the lipid bilayer are cholesterol molecules, which help to keep the membrane fluid consistent. Membrane proteins are important for transporting substances across the cell membrane.

3. What is cytoplasm?

   Cytoplasm is semifluid jelly-like structure which composes of fluid, water and material. It includes organelles.

4. Which organelles play a role in nuclear division of animal cells?

   Centrosomes play a role in nuclear division of animal cells.

5. What is the purpose of the mitochondria?

   Mitochondria are part of eukaryotic cells which perform cellular respiration. This means it takes in nutrients from the cell, breaks it down, and turns it into energy. They are known as the powerhouses of the cell.

6. What is the function of chloroplast?

   Chloroplasts are the food producers of the cell. These organelles are only found in plant cells and some protists such as algae. Animal cells do not have chloroplasts. Chloroplasts convert light energy of the sun into sugars that can be used by cells. The entire process is called photosynthesis. This process depends on the green chlorophyll molecules present in each chloroplast.

7. How does the structure of Smooth Endoplasmic Reticulum (SER) differ from the Rough Endoplasmic Reticulum (RER)?

   The main difference lies between the SER and RER is the presence of ribosomes, SER does not have ribosomes but RER has ribosomes. SER mainly produces and exports lipids and proteins and function for detoxification while RER produces and secretes proteins and few hormones.

8. What is the purpose of the Golgi apparatus?

   The purpose of the Golgi apparatus is to make lysosomes.

9. What is a lysosome?

   A lysosome is an organelle that contains digestive enzymes. It digests excess or worn out organelles and food particles.

2.2.3 Cell Organization

(A) Plant Tissues **Periods (12, 13)**

Lesson objectives

- To study the structures and functions of plants tissues
- To understand the forms and functions of various parts of plant

Preparation for Lesson

Teacher should prepare the different types of cells and tissues of plant with illustrations (vinyl, chart or model) from other Textbooks and the internet websites.

Introduction

Teacher should ask the question about the previous lessons. For example, What is a cell? What organelles are found only in plant cell?

Teaching

Teacher should explain that organisms are classified into two groups; unicellular and multicellular. In multicellular organisms, tissues which are found in plant are called plant tissues. Plant tissue is a collection of similar cells performing an organized function for the plant. And then teacher should continue to explain the plant tissues from the Textbook.

Teacher should prepare the following information before teaching the lesson. And then explain word diagram in Figure 2.4 from the Textbook.

Practice

After teaching, teacher should ask the following questions:

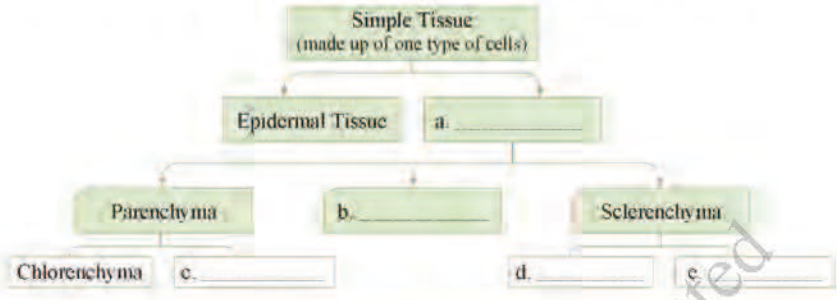
1. What is meristematic tissue?
2. What is permanent tissue?
3. Differentiate between simple tissue and complex tissue.

Review and assessment

1. Name the three basic types of permanent tissue found in the higher plant.

   Epidermal tissue, ground tissue and vascular tissue

2. Mention the two types of cells found in sclerenchyma tissues of plant.
   Fibre and sclereid cells
3. What are the components of xylem tissue?
   Vessel, tracheid, xylem parenchyma and xylem fibre
4. Fill in the boxes of the following chart with the correct words.



Answers: a. Ground tissue b. Collenchyma
c. Aerenchyma d. Fibre e. Sclereid

5. What are the components of ground tissue system of plant?
   Parenchyma, collenchyma and sclerenchyma
6. How many types of tissues are found in higher plant?
   Two types: meristematic tissues and permanent tissues

Level of Organization in Plants

Organ Systems **Periods (14, 15)**

Lesson objectives

- To study the organs and organ systems of plants
- To understand the structures and functions of organs and organ systems of plants

Preparation for lesson

Teacher should collect teaching aids and prepare the different types of cells and tissues, organs and organ systems of plants with illustrations (vinyl, chart or model) from the internet websites. All parts of plant should also be prepared from any available plants.

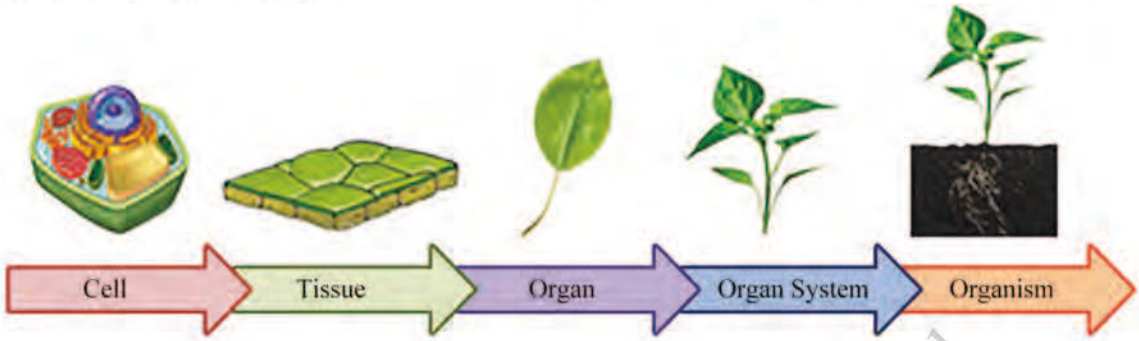
Introduction

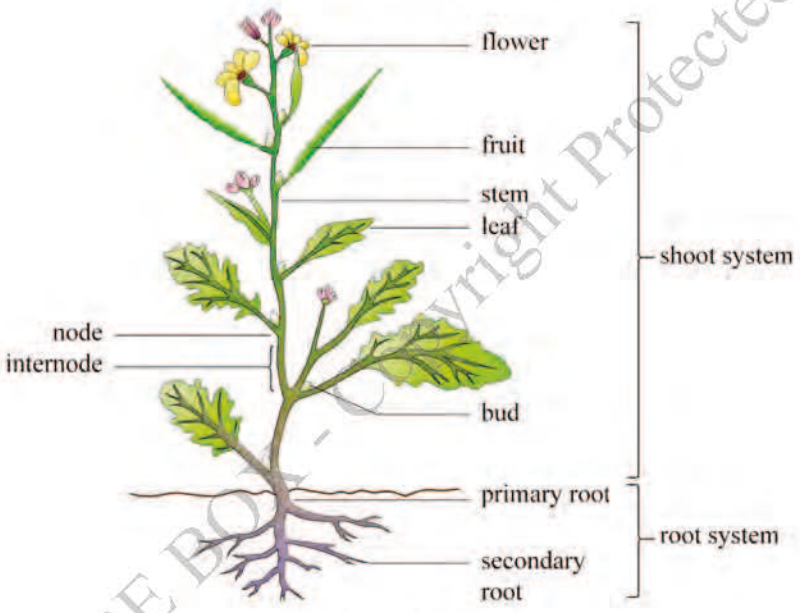
Teacher should ask the questions related to the previous lessons to the students. For example: Which type of tissues transport water and dissolved salt? What is phloem tissue? Where can xylem be found? Teacher should give guidance for the correct answers.

Teaching

Teacher should explain the level of organization in plant from the Textbook with available plant specimens. In the previous lessons, students have already learned about the cells and tissues. Therefore, teacher continues to explain that each plant tissue can be combined with other tissues to create organs such as leaves, flowers, stems and roots.

In addition, organs are further arranged or combined into organ systems that carry out life functions of the organism. During explanation, teacher should use the available teaching aids such as vinyl or chart.





A flowering plant

Practice

After teaching, teacher should ask the following questions:

1. Which one has less organs in plant and animal?
2. What are the functions of the stem?
3. Which part performs the reproductive system in plant?

Review and assessment

1. State how many systems are present in plant.

   The two systems are present in plant. They are the root system and the shoot system.

2. State the functions of the root system.

   Absorb water and mineral salts from the soil . Anchor the plant in the soil and give support to the plant.

3. What are the parts of the shoot system?
   The parts of the shoot system are stems, leaves, buds, flowers and fruits.

(B) Animal Tissues **Periods (16, 17)**

Lesson objective

- To gain knowledge about the animal tissues

Preparation for lesson

Teacher should prepare the teaching aids (vinyl, chart, etc.) showing animal tissues from the Textbook Figure 2.5.

Introduction

Teacher starts with explanation of tissue that is a cellular organizational level between cells and a complete organ. A tissue is an assemble of similar cells and their extracellular matrix from the same origin that together carry out a specific function. Organs are then formed together by the functional group of multiple tissues.

Teaching

Teacher should explain that the animal tissues consist of four basic groups; namely (1) epithelial or covering (2) connective or supporting (3) muscle or contractile and (4) nervous tissues. The epithelial tissues can be divided into two groups, simple and stratified. Connective tissues consist of loose connective, dense connective, cartilage, bone and blood tissues. The muscles are smooth muscles, skeletal muscles and cardiac muscles. Lastly the nervous tissue is made up of sensory, motor and relay neurons.

Practice

After teaching, teacher should ask the following questions:

1. What is tissue?
2. Name some types of tissues that you know.
3. Classify the basic groups of animal tissues.
4. Name the types of connective tissues.
5. List the types of muscle tissues.

Review and assessment

1. How are cells organized to form an organism?
   Similar cells are grouped into tissues, groups of tissues make up organs, and organs with a similar function are grouped into an organ system. Organ systems form an organism.
2. Identify the basic groups of tissue found in a higher animal.
   Animal tissues can be classified into four basic groups: (1) epithelial or covering (2) connective or supporting (3) muscle or contractile and (4) nervous tissues.

Organ systems **Periods (18, 19)**

Lesson objective

- To know and understand about the development of cell to organ systems

Preparation for lesson

Teacher needs to prepare charts as teaching aid showing the types of organ systems in the heading of organ systems from the Textbook.

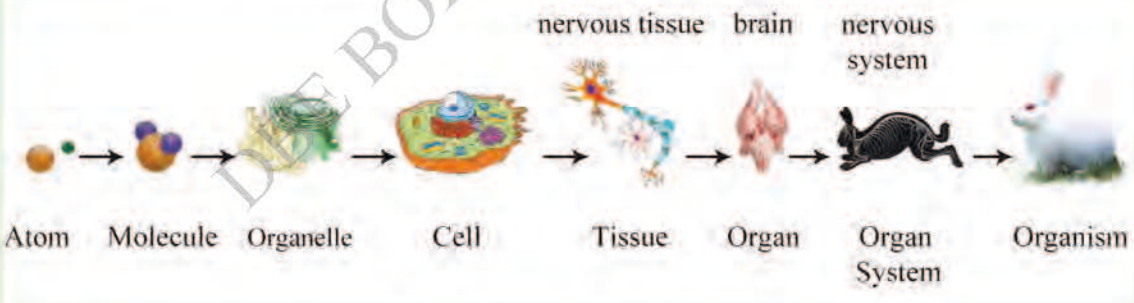
Introduction

Teacher begins by asking students whether they know that atoms are organized into molecules, molecules into organelles and organelles into cells, and that cells are the simplest level of organization in animals. Also explains that specialized cells show division of labour by being grouped into **tissues** and that the tissues may be further grouped into **organs** and the **organs** into **organ systems**.

Teaching

Teacher should explain that a living organism could be a unicellular or a multicellular organism and their living processes. In unicellular organisms, the single cell performs all the life functions, such as nutrition, respiration, excretion and reproduction. In multicellular organisms, different cells from various parts of the body perform different functions. More over, multicellular organisms have various levels of organization in their bodies. An organ system is a collection of two or more organs, which together perform some complex body functions. During explanation, teacher should use the available teaching aids such as vinyl or chart.

More information for teacher



Organization in living things

Practice

After explanation, teacher should ask the following questions:

1. List the levels of organization in the human body.
2. What is the digestive system?
3. What is the gas exchange system?
4. What is the reproductive system?
5. What is the circulatory system?

Review and assessment

1. Define the term organ and list the seven groups of organ systems.
   Textbook Page 29,30 [Organ are ..... functional unit.(1) Digestive system ..... (7) Reproductive system]
2. What do you understand the organ systems and explain any two of these systems?
   Textbook Page 30 [An organ system ..... of the body. Answer any two of the seven main systems in the human body.]
3. What are the different levels of organization?
   The levels, from smallest to largest, are: atom, molecule, cell, tissue, organ, organ system and organism.

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK
1. Page 17, [The basic principle No. 1 ..... 5]
2. Page 17, [All cells contain ..... genes.]
3. Page 19, [The major difference ..... called histone.]
4. Page 20, Table.2.1
5. Page 21, Table.2.2 Plant cell wall (Function)
6. Page 22, Table.2.2 (mitochondrion)
7. There are five levels of organization in multicellular organisms; cells, tissues, organs, organ systems and organisms.
8. Page 22, Table.2.2 Nucleus (Functions)
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10. Page 28, Figure.2.4
11. Page 29, [Animal tissues ..... cells together.]
12. Page 30, No.(2), (4) and (6)

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SUMMARY

Cells are the basic structure and functional unit of all living organisms. Cells are made of a number of different subunits called organelles which are microscopically small. Cells and organelles are observed by a microscope with a high magnification and resolution. The basic principles of the cell theory are also described in this chapter. Cells are of two types; prokaryotic and eukaryotic cells. In order to distinguish these two types of cells, explanation on their common characteristics and differences are provided with diagrams and tables. The components found in plant and animal cells are given in summarized form for easy understanding and learning. It explains how the cells are organized into tissues and organs. Simple explanations of plant and animal tissues supported by associate diagrams can easily be understood. Providing with examples, explanation on how tissues are organized into organs which in turn are organized into organ systems are also included in this chapter.

CHAPTER 3
SUPPORT AND LOCOMOTION

Total Number of Lesson Periods : 25

3.1 SUPPORT SYSTEM — Period (1)

Lesson objective

- To understand the support systems in plants and in animals including humans

Preparation for lesson

Prepare the teaching aids relating to the support systems in plants and in animals including humans.

Introduction

The support system such as cell, tissue, muscle and skeleton is very important to all living things for standing upright and movement. The organisms cannot stay without the support system.

Teaching

Teacher should explain the turgidity of the cell (cellulose cell wall) and conducting tissues (xylem conducts the water and phloem conducts the food) to support the plant. Teacher also explains the support in plants (cells and tissues), in vertebrates (the skeletal and the muscular systems), in insects and prawns (exoskeleton) and in other invertebrates (the muscular system).

Practice

After teaching the lesson, the teacher should ask the following questions:

1. How do you understand the support system?
2. What is the support system in plants?
3. What is the support system in animals?

Review and assessment

1. Compare the support systems in organisms.
   The support systems in plants are the turgidity of the cells and conducting tissues. The support systems in animals are the skeletal and the muscular systems.
2. What do the conducting tissues transport in plants?
   Xylem conducts the water and phloem conducts the food.

3.1.1 Support System in Aquatic Plants — Periods (2, 3)

Lesson objective

- To understand the various supports for the different types of aquatic plants

Preparation for lesson

The teacher needs to prepare the teaching aids such as vinyl, chart or video clips and facts relating to this lesson.

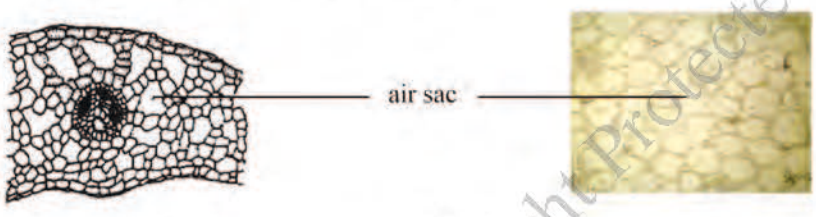
Introduction

There are the three types of aquatic plants: submerged plants, floating plants (free floating plants, submerged floating plants, trailing floating plants) and emergent plants. These types of plants have the different support systems.

Teaching

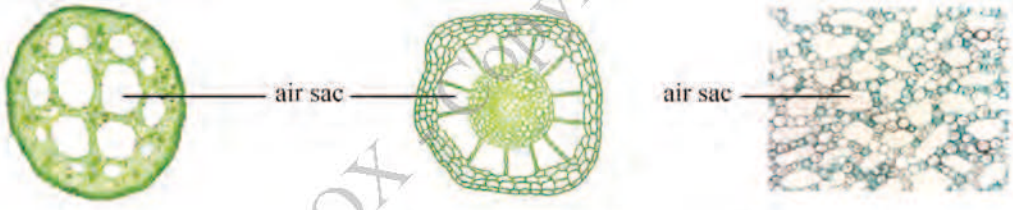
Teacher must explain that aquatic plants are hydrophytes which have adapted to live in aquatic environments. The most important feature of aquatic plants is the formation of aerenchyma – a parenchyma tissue with large intracellular air spaces that make them adapt to water. Then, explain the three types of aquatic plants.

To teach this lesson, teacher needs to prepare and collect the examples of submerged plants, floating plants (free floating plants, submerged floating plants and the trailing floating plants) and emergent plants as in the followings:



T.S of *Vallisneria* leaf with air sacs

T.S of water hyacinth petiole with air sacs



T.S of waterlily stem with air sacs

T.S of trailing floating stem with air sacs

T.S of sweet flag rhizome with air sacs

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Are the aquatic plants woody or non-woody?
2. Can the waterlily plant be adrift in the current? Explain it.
3. What feature helps water hyacinth to float on water?

Review and assessment

1. Why can the aquatic plants float on water?

   The aquatic plants can float on water because they have many air sacs in their leaves and stems.

2. What is the main support in aquatic plant?

   The main support in aquatic plant is the stems and leaves containing air sacs (aerenchyma tissue) which can have buoyancy and float in water.

Activity

Teacher must explain the nature of the following plants. The whole plant of submerged type immerses in the water. In free-floating type, the whole plant floats on the water surface and the roots hang down into the water. In submerged floating type, the roots anchor to the floor of the pond or lake and the leaves and flowers float on the water surface. There are floating horizontal stems in trailing floating type. In emergent type, the roots are at the bottom of the pond or the lake but their leaves and stems extend out of the water.

Practice

Display the prepared picture cards to the students and ask them to identify the name and type of aquatic plants as in the followings:

(a) Submerged plants

Elodea

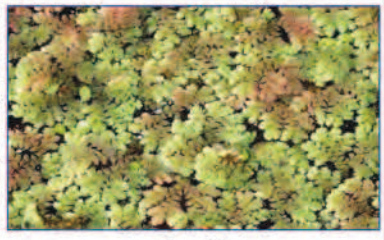
Red ludwigia

Sea grass

(b) Free floating plants

Water lettuce

Duck weed



Azolla

(c) Submerged floating plants

Floating heart plant

Water poppy

Asian marsh weed

(d) Trailing floating plants

Water primrose

Sessile joy weed

Rice paddy herb

(e) Emergent plants


Reed marsh


Horsetail


Sagittaria

Review and assessment

1. What is the nature of submerged plants?

   They are rooted in the bottom of a water course and the leaves remain submerged below the surface of the water.

2. How does free floating plant differ from submerged floating plant?

   In free floating plant, the plants float freely on the water surface. In submerged floating plant, the roots of the plants anchor to the bottom of the pond by roots but their leaves and flowers float on the water surface.

3.1.2 Support System in Terrestrial Plants — Periods (4-6)

(a) Physiological support

Lesson objectives

- To know the osmosis process in physiological support
- To understand the types of support in terrestrial plants

Preparation for lesson

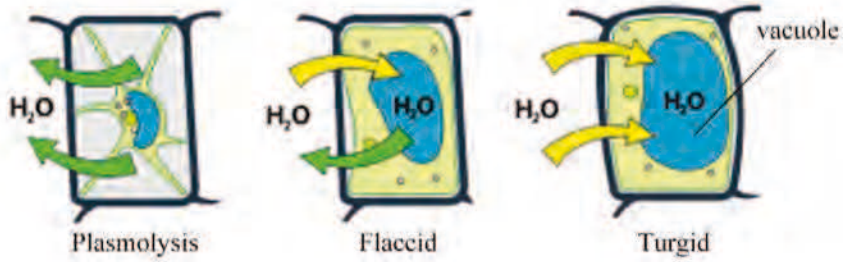
The teacher has to prepare the teaching aids such as vinyl, chart or video clips and facts relating to this lesson.

Introduction

Different plants have different means of obtaining support for their needs. In terrestrial plants, the support system differs from aquatic plants. There are two types of support in terrestrial plants: physiological and structural supports. The supports vary as the nature of plants.

Teaching

Teacher should start the lesson by showing fresh and wilted herbaceous plants. Teacher must explain that the water enters to the plant cells by the process of osmosis and also the stems, leaves and roots are the main supports while their cells are turgid. Then, explain the terms plasmolysis, flaccid and turgid.



Activity

Observe the physiological support in a herbaceous plant (Hin-nu-nwe) and teacher instructs to students as follows:

1. Take the two beakers, fill with water and place the two fresh Hin-nu-nwe plants A and B in each beaker.
2. The stem of each plant is pressed by using the thumb and forefinger to check the strength of stem.
3. The plant A is taken out from the beaker and left on the table where enough light is available while the plant B is still in the beaker containing water.
4. After a few hours, the two stems are compared by checking the strength of each stem. After doing this activity, the students need to be discussed the following facts.
   a. By naturally the stem of Hni-nu-nwe plants have thousands of cells. When the stems are fresh and have sufficient water, they are firm, strong and rigid. The rigid cells support the stem to fresh.
   b. When the stem A is taken out from the beaker and left on the table, the water dries out and the stem becomes weak, soft and flabby. This is due to loss of water and the cells become flaccid.
   c. But when the stem B left in the beaker it was found that the stem was still firm, strong and rigid due to turgidity of the cells.

Finally, the teacher should conclude the herbaceous plants are supported mainly by the turgid cells. Cells turgidity is supported by water.

Practice

After teaching, the teacher asks the following questions:

1. Do you know the herbaceous plants?
2. Why do the herbaceous plants stand upright?
3. What can happen when the plant does not receive water regularly?

(b) Structural support

Lesson objectives

- To understand the structural supports in plants
- To differentiate the woody and non-woody plants support
- To understand the woody plants that have specialized tissue for support

(e) Emergent plants


Reed marsh


Horsetail


Sagittaria

Review and assessment

1. What is the nature of submerged plants?

   They are rooted in the bottom of a water course and the leaves remain submerged below the surface of the water.

2. How does free floating plant differ from submerged floating plant?

   In free floating plant, the plants float freely on the water surface. In submerged floating plant, the roots of the plants anchor to the bottom of the pond by roots but their leaves and flowers float on the water surface.

3.1.2 Support System in Terrestrial Plants — Periods (4-6)

(a) Physiological support

Lesson objectives

- To know the osmosis process in physiological support
- To understand the types of support in terrestrial plants

Preparation for lesson

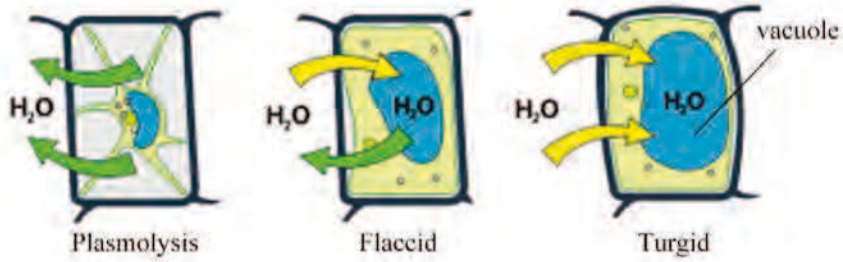
The teacher has to prepare the teaching aids such as vinyl, chart or video clips and facts relating to this lesson.

Introduction

Different plants have different means of obtaining support for their needs. In terrestrial plants, the support system differs from aquatic plants. There are two types of support in terrestrial plants: physiological and structural supports. The supports vary as the nature of plants.

Teaching

Teacher should start the lesson by showing fresh and wilted herbaceous plants. Teacher must explain that the water enters to the plant cells by the process of osmosis and also the stems, leaves and roots are the main supports while their cells are turgid. Then, explain the terms plasmolysis, flaccid and turgid.



Activity

Observe the physiological support in a herbaceous plant (Hin-nu-nwe) and teacher instructs to students as follows:

1. Take the two beakers, fill with water and place the two fresh Hin-nu-nwe plants A and B in each beaker.
2. The stem of each plant is pressed by using the thumb and forefinger to check the strength of stem.
3. The plant A is taken out from the beaker and left on the table where enough light is available while the plant B is still in the beaker containing water.
4. After a few hours, the two stems are compared by checking the strength of each stem. After doing this activity, the students need to be discussed the following facts.
   a. By naturally the stem of Hni-nu-nwe plants have thousands of cells. When the stems are fresh and have sufficient water, they are firm, strong and rigid. The rigid cells support the stem to fresh.
   b. When the stem A is taken out from the beaker and left on the table, the water dries out and the stem becomes weak, soft and flabby. This is due to loss of water and the cells become flaccid.
   c. But when the stem B left in the beaker it was found that the stem was still firm, strong and rigid due to turgidity of the cells.

Finally, the teacher should conclude the herbaceous plants are supported mainly by the turgid cells. Cells turgidity is supported by water.

Practice

After teaching, the teacher asks the following questions:

1. Do you know the herbaceous plants?
2. Why do the herbaceous plants stand upright?
3. What can happen when the plant does not receive water regularly?

(b) Structural support

Lesson objectives

- To understand the structural supports in plants
- To differentiate the woody and non-woody plants support
- To understand the woody plants that have specialized tissue for support

Preparation for lesson

The teacher needs to be thorough on the nature of cells and tissues of plants, trees, shrubs, herbs, climbers, creepers and various supports for the different types of terrestrial plants. For teaching aids, the cross sections of the woody plants from the Textbook or from the vinyl or chart or internet website, have to be prepared on vinyl or chart. The fresh specimens related to this lesson should also be prepared.

Introduction

The structural support is a permanent support. Various structural support systems are found in woody plants (trees and shrubs) and in non-woody plants (herbaceous plants and climbers).

Teaching

Teacher should start the lesson with revision on simple and complex tissues of plants in Chapter 2 and discuss the different types of plants such as woody trees, shrubs and herbs with weak stems.

Then, teacher must explain that the woody plants have modified tissue (sclerenchyma tissues, xylems, vessels and tracheids) and the cell wall for support. Sclerenchyma cells are dead cells having very thick walls and thus no water transport. Their main function is to provide support to the plant.

The cells of xylem vessels do not have cytoplasm. They have lignified thick walls due to the lignin deposited during the plant's secondary growth. The xylem vessels of the plant are long cylindrical structures placed end to end to conduct water from the roots to the leaves. Because of this, xylem vessels also play an important role in plant support. Non-woody plants are supported by the parenchyma and collenchyma tissues depending on the thicking of the cell wall.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Do you know the woody plants?
2. Are the herbaceous plants non-woody or not?
3. Why do the climbers have modification for growing upwards?

Review and assessment

1. How does the support system of woody plants differ from that of non-woody plants?

   The support system of woody plants is the lignified cell walls. The support system of non-woody plants is the turgidity of the cells.

2. Name the main tissues found in woody plants that involved in support to the plants.

   The main tissues found in woody plants are sclerenchyma tissues.

(c) Special support system

Lesson objectives

- To describe the special support system with modified structure
- To know the modified structure support to the plant for survival

Preparation for lesson

Teaching aids such as vinyl or charts or video clips related to the special structure of plants such as prop roots, tendrils, thorns, prickles, buttress roots, clasping roots, etc., must be prepared. The illustrations and the fresh specimens related to this lesson should also be prepared.

Introduction

Various plants have the special structural support systems to support the plants.

Teaching

Teacher must explain the different types of special structures with prepared teaching aids and fresh specimens for support the lesson.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Do you know modifications of support in plants?
2. What modifications do the climbers have for climbing up?

Review and assessment

1. What modifications are found in banyan tree for support?
   Prop roots are found in banyan tree for support.
2. Mention the modified roots that support the plants.
   The modified roots that support the plants are prop roots, buttress roots and clasping roots.

3.1.3 Support Systems in Animals — Periods (7-9)

Lesson objectives

- To distinguish the three types of skeletons providing support
- To know the parts and functions of the three types of skeletons

Preparation for lesson

Teacher will prepare teaching aids (vinyl, charts, etc.) for the diagrams and facts on the hydrostatic skeleton, exoskeleton and endoskeleton as shown in Page 36, Figure 3.15 from the Textbook.

Introduction

Teacher should introduce by recalling previous lessons and start with explanation on support systems of animals. There are the three types of skeletons among the animals. Then teacher explains the terminology of "hydrostatic" (hydro means water; static means stable), "exoskeleton" (exo means external) and "endoskeleton" (endo means within). The support system of invertebrates involves the use of body fluids and external skeletal system for their support which are also called **hydrostatic skeleton** and **exoskeleton** respectively. Exoskeleton is made of shell or very hard skin. **Endoskeleton** is a skeleton found within the interior of the body; it provides structural support and protection for the internal organs and tissues of an organism (e.g., vertebrates, sponge and echinoderms).

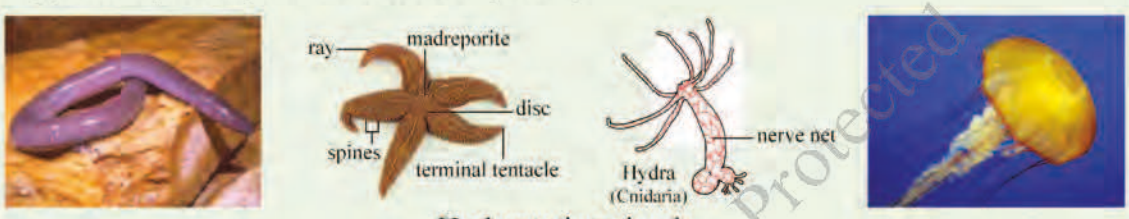
Teaching

Teacher should explain about the vertebrates (skeletal and muscular systems), insects and prawns (exoskeleton) and other invertebrates (hydrostatic skeletal system).

More information for teacher

Hydrostatic skeleton

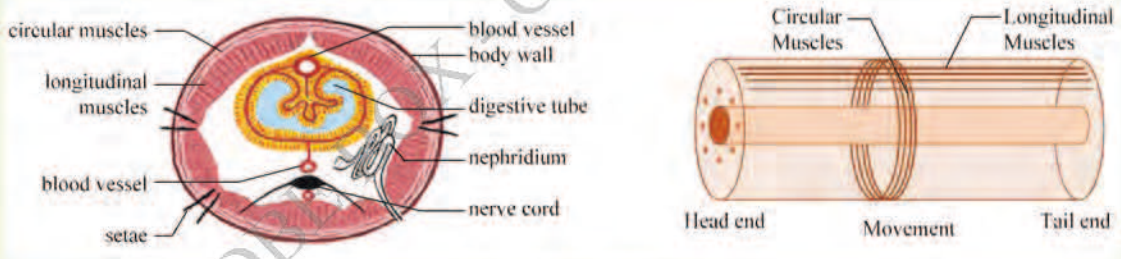
Hydrostatic skeletons have a role in the locomotion of annelids (earthworms), echinoderms (starfish and sea urchins), cnidarians (jellyfish), nematodes and other invertebrates. They have some similarities to muscular hydrostats. "A hydrostatic skeleton, or hydroskeleton includes circular and longitudinal muscles of the body wall supported by fluid pressure in the body cavity".



Hydrostatic animals

Functions of Hydrostatic Skeleton

Earthworms move by alternate contractions of circular and longitudinal muscles in the body wall. They possess fluid in body cavity that gives pressure to muscles in the body wall for locomotion.



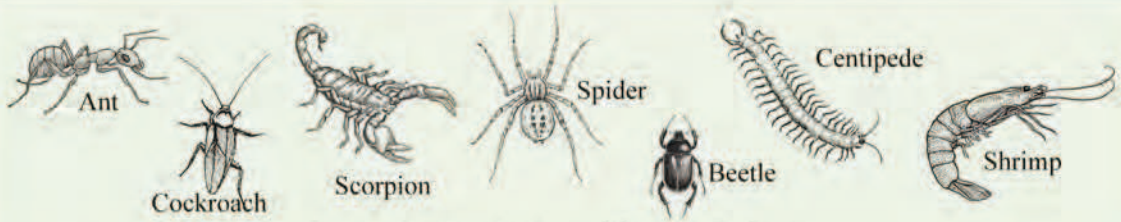
Hydrostatic animal

Exoskeleton

An exoskeleton is a hard, protective outer-body covering of an animal. Although exoskeletons provide support, they are not comprised of bones.

Functions of Exoskeleton

Exoskeletons contain rigid and resistant components that fulfill a set of functional **roles** including protection, excretion, sensing, supporting, feeding and acting as a barrier against desiccation in terrestrial organisms. Exoskeletons also have a **role** in providing an attachment framework for musculature. Exoskeletons contain **chitin**; the addition of **calcium carbonate** makes them harder and stronger.



Invertebrates supported by exoskeleton

Endoskeleton

An endoskeleton consists of a hard internal skeleton, buried in soft tissue. Invertebrate animals with an endoskeleton include all echinoderms, most sponges and molluscs that includes octopuses, squids and cuttlefish. Endoskeletons of echinoderm are calcareous and usually sit just beneath the skin. Endoskeleton of sponge consists of short, sharp rods called spicules. They are made of silica, calcium carbonate, or spongin, a tough protein. A mammalian skeleton has more than 200 bones. Some bones are fused; others are connected at joints by ligaments that allow freedom of movement.

Vertebrates supported by endoskeleton

Functions of mammalian endoskeletons

1. Provide a rigid framework that supports the body and protects the internal organs e.g., rib cage protects lungs and heart; skull protects brain.
2. Important for locomotion - although muscle contractions provide the power, skeletal structures actually bring about movement.

Rib cage

Skull

Locomotion

Endoskeleton of human

Practice

After teaching the lesson, the teacher should ask the following questions:

1. How do you understand the support system?
2. What is the support for animals?

Review and assessment

1. Name some terrestrial invertebrates that have exoskeletons.

   Some terrestrial invertebrates that have exoskeletons are grasshoppers, cockroaches and snails.
2. State the functions of exoskeleton among invertebrate.

   Exoskeletons contain rigid and resistant components that fulfill a set of functional roles in many animals including protection, excretion, sensing and supporting, feeding and acting as a barrier against desiccation in terrestrial organisms.
3. How do fluid pressures act like a skeleton in some invertebrate?

   The endoskeletons of echinoderms and some other soft-bodied invertebrates such as jellyfish and earthworms are also termed hydrostatic; a body cavity (the coelom) is filled with coelomic fluid and the pressure from this fluid acts together with the surrounding muscles to change the organism's shape and produce movement.
4. Name muscles that you can find in the cross section of an earthworm.

   Longitudinal muscles and circular muscles can be found in the cross section of an earthworm.
5. Describe the functions of mammalian endoskeleton.

   Textbook Page 37, No. 3.1.4. **Support System in Humans** [The human endoskeletal ..... pelvis and long bones.]

3.1.4 Support System in Humans — Periods (10-15)

Lesson objectives

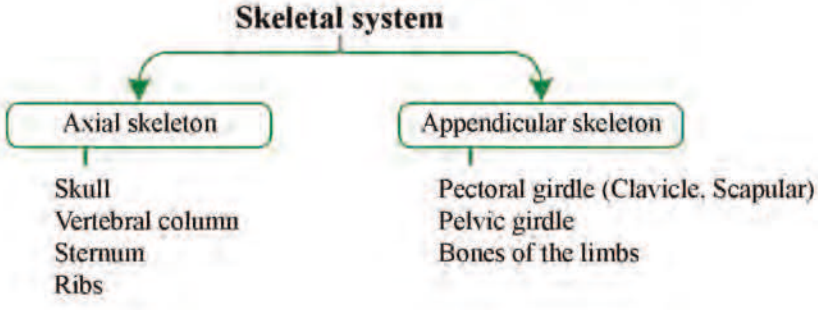
- To know parts of the skeleton in human and how they are arranged
- To distinguish the bones from the cartilage
- To know different joints and their role
- To know how to maintain a healthy musculoskeletal system

Preparation for lesson

Teachers should prepare diagrams of Page 38, Figure 3.16 and Page 39, Table 3.1 on card or vinyl from the Textbook.

Introduction

The skeletal system in an adult human body is made up of 206 individual bones. These bones are arranged into two major divisions: the axial skeleton and the appendicular skeleton.

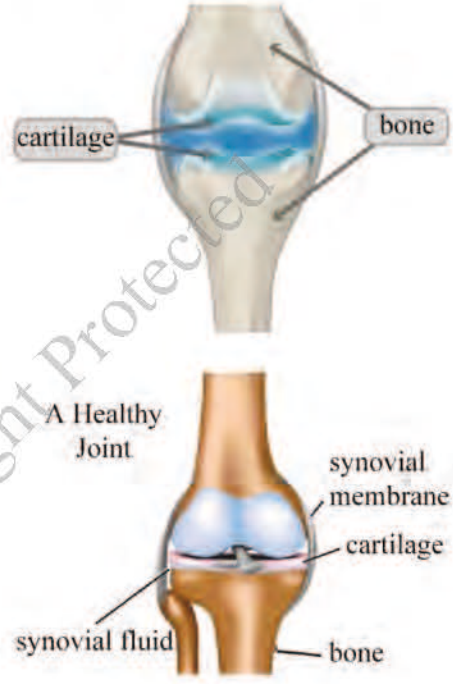


Teaching

Teachers should explain the human skeletal system from the Textbook.

The **axial skeleton** is the part of the **skeleton** that consists of the bones of the head and trunk of a vertebrate. In the human **skeleton**, it consists of 80 bones. The **appendicular skeleton** is the portion of the **skeleton** of vertebrates consisting of the **bones** that support the appendages, i.e. hands and legs are important for locomotion as well as supporting pectoral girdle and pelvic girdle.

Axial skeleton Appendicular skeleton



Differences between **bones** and **cartilages** must be explained. A bone is a hard connective tissue while cartilage is soft connective tissue. Bones form the skeletal structure of the whole body, whereas cartilage is present in flexible nose, ear, ribs, larynx and joints. Cartilages also act as a shock absorber in these joints.

Different synovial joints and their roles

Teacher should explain how bones are linked to each other by joints of many types: fibrous, cartilaginous and synovial. Five types of synovial joints and their functions could be explained by demonstrations on own's body (Refer to Textbook Table 3.1).

Practice

After teaching, teacher asks the following questions:

1. What are the two main divisions of the human skeleton?
2. Name the bones of the limbs in adult human skeleton.
3. What is the function of synovial fluid?

Activity

Teacher should show the diagram from Figure 3.16 on a chart without labels. Then ask the students to answer according to the teacher's questions. Use the card boards with labels if necessary:

1. Label the bones found in the legs.
2. Name the bones of the arm and hand.
3. Identify the cartilage and bone in the joints of human (use the above Figure 3.16).
4. List the types of synovial joints in human. Explain how they work.

Review and assessment

1. What are the two main divisions of the human skeletons?

   The two main divisions of the human skeletons are the axial skeleton and the appendicular skeleton.

2. Mention which bones are included under the axial skeleton.

   The bones that are included under the axial skeleton are skull, spine, ribs and breast-bone (sternum).

3. Name the bones of the limbs in adult human skeleton.

   The bones of the limbs in adult human skeleton are femur, patella, tibia, fibula, tarsus (ankle), metatarsus and phalanges.

4. How many bones are there in the adult human skeleton?

   There are about 206 bones in the adult human skeleton.

5. How do bones differ from cartilages?

   A **bone** is a hard connective tissue while **cartilage** is soft connective tissue. Bones form the skeletal structure of the body whereas cartilage is present in nose, ear, ribs, larynx and joints and also act as a shock absorber in these joints.

6. What are the functions of synovial fluid?

   Synovial fluid aids in the nutrition of articular cartilage by acting as a transport medium for nutritional substances, such as glucose, and provides lubrication of the articulating surfaces.

7. What do you understand by flexion and extension of limbs?

   Flexion refers to a movement that decreases the angle between two body parts. Flexion at the elbow is decreasing the angle between the ulna and the humerus. When the knee flexes, the ankle moves closer to the buttock, and the angle between the femur and tibia gets smaller.

   Extension refers to a movement that increases the angle between two body parts. Extension at the elbow is increasing the angle between the ulna and the humerus. Extension of the knee straightens the lower limb.

The Importance of Maintaining a Healthy Musculoskeletal System

Lesson objective

- To know how to maintain a healthy musculoskeletal system

Preparation for lesson

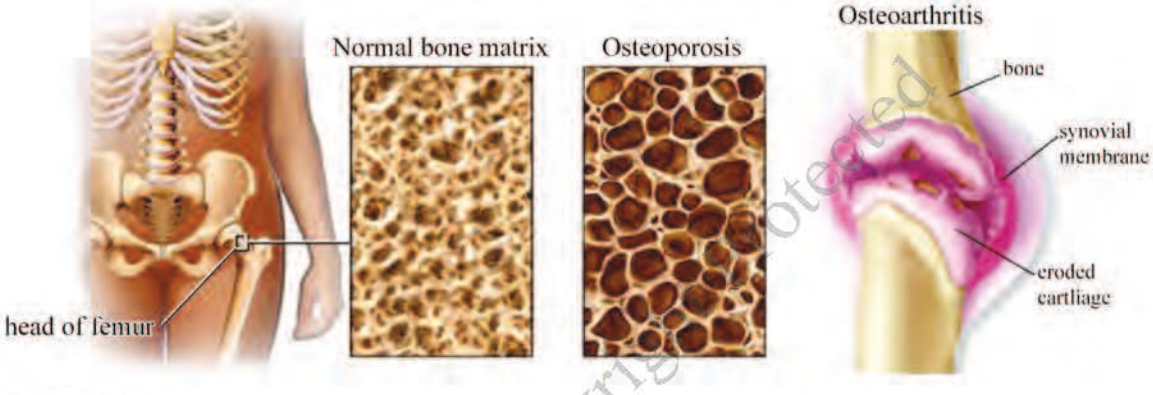
Teacher should prepare to make charts showing important points necessary to maintain healthy muscles and bones using on following figures and diagrams.

Joint Disease Types

Osteoarthritis (OA): The most common type, osteoarthritis is the "wear-and-tear" form that increases with age.

Rheumatoid arthritis (RA): Rheumatoid arthritis is an autoimmune condition affect the lining of the **joints**.

Osteoporosis: Bone density reduces with age and is easy to break.



Introduction

Teacher should start the previous lessons and explain the healthy musculoskeletal system that allows for normal physical activities such as walking, running, jumping and other activities.

Teaching

Teacher should start with the explanation of the importance of healthy musculo-skeletal system.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. How does osteoarthritis affect human?
2. Why is regular exercise important?
3. Which foods should be eaten to keep muscles and bones healthy?
4. Why do we need to lose weight?

Activity

Divide the students into two groups, Group 1 and Group 2. Focus on the following topic. Let Group 1 discuss about the disadvantages and Group 2 as advantages of the following topics from the Textbook Page 40 : (i) physical activity (running, walking) (ii) avoid sudden movements at joints (iii) eat balanced diet (iv) weight control (keep muscles, joints strong).

Write on the white board what Group 1 and 2 had discussed and teacher should give suggestions to their answers.

Review and assessment

1. Mention some dietary supplements for healthy joints.

   Folic acid, Vitamins C, B6, B12, E, D, Zinc, Calcium, Phosphorus, Iron, Minerals: Magnesium, etc.
2. Are too much vitamins good for your joints?

   Vitamins and **minerals** can be problematic in large doses. Too much iron can be toxic, causing symptoms like fatigue, **joint pain** and depression.
3. How does osteoarthritis affect human?

   Osteoarthritis is known to be a painful condition, but there are many other effects of this progressive disease. These include stiffness and difficulty moving, and loss of muscle tone, strength and stamina. Many people with OA also experience fatigue, poor sleep, anxiety, depression, social isolation, loss of work, financial difficulty and a general deterioration in quality of life.
4. Why is regular exercise important?

   Regular exercise is important because it is a crucial part of keeping your body healthy. Along with having a well balanced nutritional diet, exercise also decreases your risk for some of the most prevalent health issues. Those issues include diabetes, high blood pressure and cardiovascular disease.
5. Which foods should be eaten to keep muscles and bones healthy?

   Textbook Page 40, (c) Eat healthy food [Health of bones, ... cartilage repair.]
6. Why do we need to lose weight?

   We need to lose weight for reducing joint pain, improving joint health and keeping muscles strong.
7. When can the joints lead to injuries?

   Abnormal joints and muscles result in osteoarthritis in which damaged ends of bones rub against each other, causing joint pain and stiffness or the bones may become brittle and are more prone to fracture.

3.2 MOVEMENT IN PLANTS Periods (16-18)

Lesson objectives

- To know how the plants move
- To observe the types of movements in plants

Preparation for lesson

The teacher has to prepare the teaching aids such as vinyl, chart or video clips and facts relating to this lesson.

Introduction

The plants cannot move as an animal but they have the movement in different types: growth dependent movement (tropic movement) and non-growth dependent movement (nastic movement).

Teaching

Teacher must explain that the plants cannot move from one place to another but they have the movements of their parts when respond to the stimulus. Then, explain the types of movement in plants by interactive ways.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Can the plants move?
2. How do the plants move?
3. How many types of movements are found in plants?

Review and assessment

1. How do the plants move?

   The plants move with the movements of their parts when they respond to the stimulus.

2. How many types of movements in plants?

   Textbook Page 41, No. 3.2 Movements in Plants [Plants show two types ..... direction of stimulus.]

3.2.1 Tropic Movements

Lesson objective

- To understand what is the tropic movement in plants and the different types of tropic movements

Preparation for lesson

Before starting the lesson, collect the illustrations and more references related to the various types of movement in plants from any other book references or the internet websites and also from the Textbook.

Introduction

Movement of plants is not the same as in animals but they have the movement in different ways.

Teaching

Teacher should explain about the two types of movement in plants: the tropic movement and the nastic movement.

Teacher must explain about the various tropic movements in plants with the help of collected illustrations based on students' answers.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Have you seen the plants that are growing on veranda?
2. Which direction do they bend inside or outside of the house? Why do they bend?
3. Which parts of the cucurbit plants climb upon the shelf?
4. How do they climb to reach the shelf?

Review and assessment

1. State the differences between phototropism and geotropism.

   In phototropism, the shoot system of a plant bends towards the light whereas the root moves away from the light. In geotropism, the root bends towards the soil and the shoot moves away from the soil.

2. Enumerate the types of tropisms and give the responses of plants to each type.
The types of tropisms are:

(a) Phototropism (light)
(b) Geotropism (soil)
(c) Hydrotropism (water)
(d) Chemotropism (chemical)
(e) Thigmotropism (touch) and
(f) Thermotropism (temperature)

3.2.2 Nastic Movements

Lesson objective

- To understand what is nastic movement and how plants do the nastic movement

Preparation for lesson

Prepare the teaching aids relating to the nastic movement and collect the fresh specimens of *Mimosa* (Hti-ka-yone) and pitcher plants for teaching.

Introduction

Nastic movements in plants are not directional movements. They are not dependent on the direction of the stimulus. It is the movement of cells.

Teaching

Teacher has to start the lesson with the following questions to the students: Have you ever seen the Hti-ka-yone plants? What will happen when you touch these plants? Then explains about the nastic movement and demonstrates with collected plant specimens.

More information for teacher

The four types of nastic movements are:

(a) Seismonastic Movements

These movements are brought about by mechanical stimuli such as contact with a foreign body, fast wind and rain drops, etc. e.g., movements of leaflets in *Mimosa pudica* and *Neptunia oleracea*; insectivorous plants e.g., *Dionaea muscipula* and *Drosera rotundifolia* etc.

Mimosa pudica

Neptunia oleracea

Dionaea muscipula

Drosera rotundifolia

(b) Photonastic Movements

These movements are induced by fluctuations in the intensity of light. Such movements are exhibited by flowers of several plants. Many flowers open with the increasing illumination (light) of the day and close up with the decrease in light intensity e.g., *Passiflora edulis* (passion). Flowers of *Cestrum nocturnum* open at night, and close up with the dawn of the day.

Passiflora edulis

Cestrum nocturnum

(c) Thermonastic Movements

Such movements are brought about by changes in temperature. Many of the flower movements are thermonastic. Such flowers open with a rise and close with a drop in temperature (e.g., *Tulipa* sp.). Sometimes thermonastic movements are associated with photonastic movements.

Tulipa sp.

(d) Nyctinastic Movements

These movements are commonly called 'sleeping movements'. Some authors have classified such movements under the category of photonastic or thermonastic movements. These movements are induced by alternation of day and night. e.g., leaves of *Acacia concinna*, and flowers of *Nymphaea rubra*, etc.

Acacia concinna

Nymphaea rubra

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Do plants sleep at night?
2. Which plants sleep at night?
3. Why does Hti-ka-yone plant fold up when it gets touch?
4. How does Ye-ta-gaung plant respond to touch by the insect?

Review and assessment

1. What is nyctinastic movement?
   Nyctinastic movement is known as 'sleeping movement'.
2. Which plants close their leaves at night?
   Acacia concinna (Kinmun-gyin), *Arachis hypogaea* (Myae-pe), etc. close their leaves at night.

3.3 MOVEMENT AND LOCOMOTION IN ANIMALS AND HUMANS

3.3.1 Movement and Locomotion in Various Simple Animals Periods (19, 20)

Lesson objectives

- To know that movement in these animals is made possible by hydrostatic skeleton or a semi-rigid exoskeletal system and a muscular system working together
- To know movement and locomotion of simple animals such as earthworm and grasshopper (invertebrates)

Preparation for lesson

Teacher should prepare teaching aids (vinyl, charts, etc.) with diagrams which explain the roles of bones and muscles in movement and locomotion among invertebrates as shown in Figures 3.26 and 3.27 of the Textbook.

Introduction

Teacher should discuss and explain that movement and locomotion are important in animals for their survival. Teacher should also explain that the movements in animals vary according to their body structure and habit.

Acacia concinna

Nymphaea rubra

Practice

After teaching the lesson, the teacher should ask the following questions:

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Introduction

Teacher should discuss and explain that movement and locomotion are important in animals for their survival. Teacher should also explain that the movements in animals vary according to their body structure and habit.

Locomotion in earthworm

Teaching

Teacher should explain that skeletal and muscular systems work together to perform movement through support in animals. Make the students recall what they have learned above hydrostatic skeleton, exoskeleton and endoskeleton in the previous lessons.

Teacher must make the students understand about the roles of alternate contraction and relaxation of the circular and longitudinal muscles step by step in moving forwards.

Practice

After teaching, teacher asks the following questions:

1. How many layers of muscle are found in the body wall of the earthworm?
2. Name the outer layer of muscles that goes around the earthworm body.
3. Name the inner layer of muscles that goes along the full length of the earthworm body.
4. What happens when the circular muscles contract in earthworm?
5. What happens when the longitudinal muscles contract in earthworm?

Review and assessment

1. How many pairs of setae are present in each segment of the earthworm? State their functions.

   The earthworms have four pairs of setae in each of their segments except the first and last. While in locomotion, setae serve as anchors to help earthworms get a good grasp of the ground or their burrows' walls.
2. How does locomotion occur in an earthworm? Explain.

   Textbook Page 43, No. 3.3.1 [This locomotion process ..... backward of the front end.]

Locomotion in Grasshopper

Teaching

First, teacher should explain when a grasshopper walks on land, it uses three legs to support the body off the ground while the other three move together to make successive steps while walking forwards.

Then students should learn about the **antagonistic muscles** – flexor and extensor. After that teacher should explain the **jumping** of grasshopper.

In explaining the **flight** of grasshopper, teacher should emphasize on the alternate contractions of the antagonistic elevator and depressor muscles.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. How does a grasshopper jump?
2. How does a grasshopper fly?

Review and assessment

1. Explain how an insect is able to move from place to place.
   Textbook Page 44, **Locomotion in grasshopper** [**Jumping** and **Flight**]

3.3.2 Movement and Locomotion in Various Complex Animals and Humans

Periods (21-24)

Lesson objectives

- To know the antagonist and agonist skeletal muscle pairs involved in movement and locomotion of fish, frog, bird and humans (all vertebrates)
- To know that these muscles occur in pairs and are known as antagonistic pairs

Preparation for lesson

Teacher prepares the charts and vinyl of Figures 3.28, 3.29, 3.30 and 3.31 from the Textbook. Teacher may use similar figures available online such as actual photographs of movements.

Introduction

Teacher should recall and discuss the previous lessons on the locomotion of invertebrates such as earthworm and grasshopper.

Teaching

Firstly, teacher explains what is meant by the antagonist and agonist skeletal muscles and also how they work in pairs.

Teacher then explains that a streamlined body shape in **fish** reduces friction with water and moves forward by contracting and relaxing body muscles called **myotomes** on each side of body, alternately. The functions for steering and stability should also be explained.

Next teacher goes on to explain the **locomotion in frog** by telling the students that the frog's powerful legs are adapted for both **swimming** and **leaping.** Then continue to explain how the extensors and flexors muscles in the legs work together as pairs to perform those activities.

For the students to understand the **locomotion in birds**, the teacher must explain the movement of the wings. They must learn that weak upstroke and strong downstroke, as well as circular forward movement of wings lifted up the bird and thrust it forwards in air. Teacher should also point out that all these movements are carried out by antagonistic muscles pairs of pectorals and supracoracoideus on the breastbone, attached to humerus bone of wings.

Teacher should explain that antagonistic muscles pairs carried out **many types of movements in humans**. The names and functions of the agonist and antagonist muscle pairs of the upper arm and thigh which take part in the flexion and extension of the limbs should be explained.

Review and assessment

1. Explain how an insect is able to move from place to place.
   Textbook Page 44, **Locomotion in grasshopper** [**Jumping** and **Flight**]

3.3.2 Movement and Locomotion in Various Complex Animals and Humans

Periods (21-24)

Lesson objectives

- To know the antagonist and agonist skeletal muscle pairs involved in movement and locomotion of fish, frog, bird and humans (all vertebrates)
- To know that these muscles occur in pairs and are known as antagonistic pairs

Preparation for lesson

Teacher prepares the charts and vinyl of Figures 3.28, 3.29, 3.30 and 3.31 from the Textbook. Teacher may use similar figures available online such as actual photographs of movements.

Introduction

Teacher should recall and discuss the previous lessons on the locomotion of invertebrates such as earthworm and grasshopper.

Teaching

Firstly, teacher explains what is meant by the antagonist and agonist skeletal muscles and also how they work in pairs.

Teacher then explains that a streamlined body shape in **fish** reduces friction with water and moves forward by contracting and relaxing body muscles called **myotomes** on each side of body, alternately. The functions for steering and stability should also be explained.

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Teacher should explain that antagonistic muscles pairs carried out **many types of movements in humans**. The names and functions of the agonist and antagonist muscle pairs of the upper arm and thigh which take part in the flexion and extension of the limbs should be explained.

Practice

After teaching the lesson, the teacher should ask the following questions:

1. State the functions of pectoral and pelvic fins of fish.
2. Name the two muscles which control the flapping of wings in birds.
3. Name the two antagonistic muscles in the upper arms of human.
4. Name the two antagonistic muscles in the thighs of human legs.

Review and assessment

1. Describe swimming movements of the fish.
   Textbook Page 44, **Locomotion in fish** [Fish have ..... diving or rolling.]
2. Explain how birds achieve lift and thrust in flying.
   Textbook Page 45, **Locomotion in bird** [The antagonistic muscle ..... bird forward through the air.]
3. How do movement and locomotion occur in arms and legs of humans?
   Textbook Page 46 [Contraction of biceps ..... is termed extension.
   Contraction of the hamstring ..... the hamstring muscles.]
4. How does a frog perform swimming and leaping?
   Textbook Page 45, **Locomotion in frog** [The forg's ..... the next extension.]

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK

1. Page 32, [Aquatic plants may be distinguished into three groups: (1) submerged plants (2) floating plants and (3) emergent plants and they are rooted maximum sunlight.]
2. Floating plants can exist above the surface of the water because the leaves and stems of the floating plants have numerous air sacs.
3. Page 34, [The water ..... to get the support.]
4. Page 34, [The structural support ..... plants and climbers.]
5. Page 35, Special support structure, from Prop roots - Clasping roots
6. An exoskeleton is a rigid, but segmented flexible hard case that surrounds the body. A chitinous exoskeleton resists bending and acts as the skeletal framework of the body. Endoskeleton is a rigid but flexibly jointed internal bones that form the body's frame work and offer surfaces for muscle attachment for movement and locomotion.
7. There are three kinds of skeleton system: (1) hydrostatic skeleton found in many invertebrates, (ii) exoskeleton found in arthropods and (iii) endoskeleton found in vertebrates and sponges. So that "Skeleton systems can vary in different animals".
8. Bones in endoskeletons provide main support against gravity for animals including humans. The human skeleton has about 206 bones which provide sites for muscle attachment, making movement in flexibly jointed bones possible.
9. Page 39-40, Table 3.1
10. Page 39-40, Table 3.1
11. Page 41, 3.2.1 Tropic Movements [If the movement ..... as negative tropism.]
12. Page 41, [If the movement ..... as negative tropism and (a) - (f).]
13. Page 41, Phototropism is the movement of plants in response to light and geotropism is the movement of a plant part towards the soil in response to earth's gravity.
14. Page 42, [Nastic movements ..... immediately when touched.]
15. Page 41, [If the movement is ..... negative tropism and can answer the two types of tropic movements.]
16. Page 43, [Muscles act on the fluid ..... pass backward.]
17. Page 44, [The rear ..... forward and up.] [The movement ..... thorax.]
18. Page 44, [Fish have ..... diving or rolling.]
19. Page 45, [The strong ..... next extension.]
20. Page 45, [Most birds ..... through the air.]
21. Page 46, [There are about ..... antagonist.]

SUMMARY

Body support system in plants can be divided into aquatic plant and terrestrial plant. Specialized tissues serve as plant body support system. Support systems in submerged plants, floating plants (free floating, submerged floating, trailing floating) and emergent plants are included in aquatic plants. Aerenchyma cells with air cavities in leaves and stems mainly support the plant body in aquatic plants. In physiological support of terrestrial plants, the vacuoles of the cells are used by means of osmosis and in structural support, sclerenchyma, xylem, parenchyma and collenchyma tissues can serve as support system. In addition, special plant structures perform the support function.

Skeletons serve as bony support system and muscle attachment sites for animal locomotion. Plants cannot move from one place to another because they do not have any organs of locomotion. But movement in plants can be shown by their parts in the form of growth which is due to external stimuli. The trophic movement is caused by direction of stimulus and the nastic movement is by sensation of stimulus.

Hydrostatic skeletons support body through pressure of fluid in body cavity in soft- bodied invertebrates like earthworm. Longitudinal and circular muscles acting on the fluid enable the earthworm to go forwards. Exoskeletons, made of chitin, encased the internal organs of arthropods such as insects and prawns. Muscles inside the exoskeleton, enable the insects like grasshoppers to jump and fly by the flexor and extensor muscles in the hind legs, and by the elevator and depressor muscles of the wings located inside the body. In complex animals, antagonistic muscle pairs are used for locomotion supported by the endoskeletons composed of hard bones and cartilages. Fish swim in water by myotome muscles on either side of their bodies, propel themselves forwards by the tail fin, and steer and stabilize by other fins. Frogs jump and swim by the flexor and extensor muscles in the thighs of their legs. Birds fly by pectorals and supracoracoideus breast muscles flapping the wings. In humans, antagonist muscle pairs in the arms and legs flex and extend them in movement and locomotion supported by the axial and appendicular bones of their endoskeleton. The bones have hard dense matrix containing bone cells supplied by blood vessels and nerves by Haversian canal system. The cavities in long bones are filled with yellow or red marrow producing fat and blood cells respectively. Cartilages are connective tissues and flexible, protecting the ends of the bones, at joints, from wear and tear due to locomotion or movement. Bones are connected or joined by three types of joints, namely, fibrous, cartilaginous and synovial joints. The synovial joints are highly flexible and they consist of the gliding joint, pivot joint, ball and socket joint, saddle joint and hinge joints. These synovial joints enable movements in the shoulders, hips, arms, legs and feet during locomotion and other activities. It is important to maintain a healthy musculoskeletal system in humans; it should be free from joint and muscle pain and stiffness, and brittle bones which are easy to break. In addition to staying active, losing weight by regular exercise and eating healthy food for bones and muscles are also needed to maintain a healthy skeleton and musculature.

Practice

After teaching, teacher asks the following questions:

1. How many types of nutrition are there in organisms?
2. What is autotrophic nutrition?

Review and assessment

1. Name the modes of nutrition and define them.

   Textbook Page 49, No. 4.1 [There are two types of nutrition ..... nutritions.] Autotrophic nutrition, the organisms make or synthesize their own food.
2. Give the three main types of heterotrophic nutrition.

   Textbook Page 49, No. 4.1 [Three main types of heterotrophic nutrition ..... parasitic nutrition.]
3. Define holozoic nutrition.

   Textbook Page 49, No. 4.1 Holozoic nutrition [The organisms feed ..... their bodies.]
4. Give the examples of parasitic organisms.

   Textbook Page 50, No. 4.1 [The examples of parasitic organisms are dodder, fleas, lice and tapeworms.]

4.1.1 Plant Nutrition **Periods (3-7)**

Photosynthesis

Lesson objective

- To understand how plant synthesize food

Preparation for lesson

The teachers need to collect the teaching aids and facts relating to the lessons.

Introduction

Green plants synthesize their own food by the process of photosynthesis which is a metabolic reaction in which the light reaction is converted into glucose. When teaching, recall the previous lesson of plant nutrition and its types. Then, explain the autotrophic nutrition and how it is related to photosynthesis.

Teaching

After introducing the plant nutrition and photosynthesis, teacher should explain the following facts:

- process of photosynthesis
- equation representing for photosynthesis
- steps involved in photosynthesis

Practice

After teaching, teacher asks the following questions:

1. Which pigment of plant absorbs sunlight energy?
2. What are the raw materials of photosynthesis?

Review and assessment

1. Define photosynthesis.
   Textbook Page 50, No. 4.1.1 [Photosynthesis is a metabolic reaction ..... such as glucose.]
2. Where does the photosynthesis take place?
   Textbook Page 50, No. 4.1.1 [Photosynthesis occurs in the chloroplasts of plant cells.]
3. Write down the equation of photosynthesis.
   Textbook Page 50, Photosynthesis equation
4. Describe the steps in photosynthesis.
   Textbook Page 50, No. 4.1.1 [There are four steps in photosynthesis ..... chemical energy (sun light).]

Chlorophyll and Chloroplast

Lesson objective

- To know the chlorophyll and structure of chloroplast

Preparation for lesson

The teacher needs to study thoroughly about the chlorophyll and structure of chloroplast with the illustrations. Teaching aids are also needed to be prepared for teaching.

Introduction

Chlorophyll is a pigment that absorbs light of particular wavelengths (mainly blue and red). Chlorophyll in green plants spread on stacks of membrane in the chloroplast.

Teaching

Teacher can start the lesson with the following questions: What is photosynthesis? And then, teacher should explain about the chlorophyll and structure of chloroplast related to the students' answers. Then, continue to explain the following information about pigments and wavelength.

More information for teacher

Pigments and Wavelength

Plants have a unique property of capturing the light energy and convert it into glucose through the process called photosynthesis. The process starts with the absorption of light energy by some specialized organic molecules, called the chlorophyll pigments. The photosynthesis process using the green pigment called chlorophyll along with yellow and red pigments includes carotenoids, flavonoids, anthocyanin, etc. All these pigments stimulate the process of chemical reactions by reflecting the wavelengths of the light energy. The plant pigments are given below:

Chlorophyll

Chlorophyll is one of the main pigment in the green plants. The green colour of the leaves is due to the presence of pigment called chlorophyll. The various kinds of chlorophyll pigment are chlorophyll a, b, c, d, p. All of the green plants, cyanobacteria and algae have the pigment chlorophyll "a" (bluish green color) and "b" (olive green color).

Carotenoids

Carotenoids are the pigments of orange, red and yellow colours. These compounds are insoluble in water and are attached to the membranes of the cell bodies. These biomolecules are antioxidants which promote good eyesight in the humans.

Anthocyanins

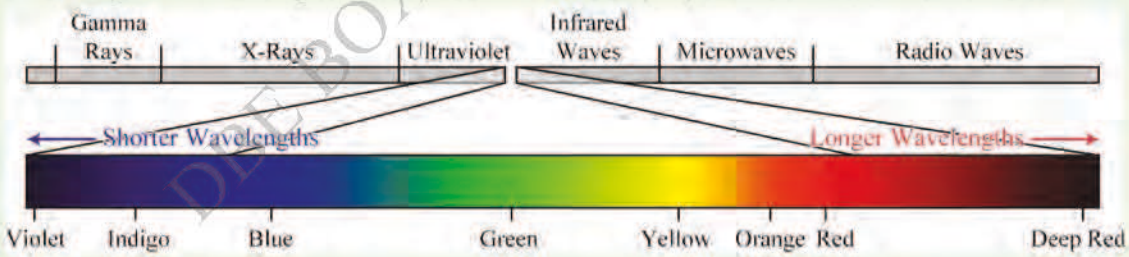
Anthocyanins are flavonoid pigments anthos meaning "flower" and cyanous (kyanous) meaning "dark blue". These pigments are present in all tissues of the plant groups providing red, purple, blue or black colour in stem, leaves, roots, fruits, and flowers depending on the plants.

Flavonoids

Flavonoids are yellow pigments that are seen in lemons and oranges. These are the chemicals that help to lower the cholesterol levels and have the antioxidant properties.

Wavelength

A wavelength is the distance between the two successive crests (peaks) of a wave. Light is measured by its wavelength (in nanometers). Visible light is usually having wavelengths in the range of 400-700 nanometers (nm) or one billionth of a meter.



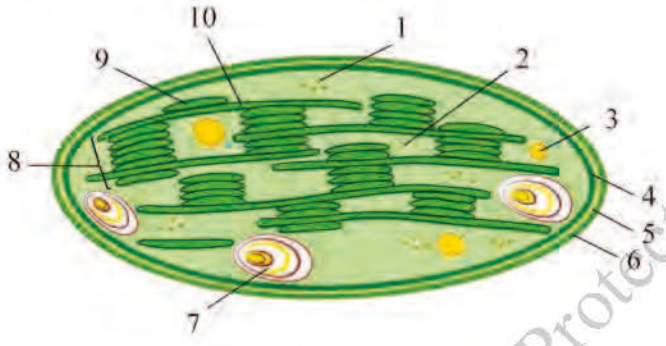
Practice

Match the following column A and B:

A	B
1. Green pigment	1. Olive green colour
2. Chlorophyll a	2. Carotenoids
3. Yellow pigment	3. Chlorophyll
4. Chlorophyll b	4. Bluish green colour

Review and assessment

1. What is chlorophyll?
   Textbook Page 50, No. 4.1.1 [Chlorophyll is a pigment ..... the chloroplast.]
2. Where can chloroplast be found?
   Textbook Page 50, No. 4.1.1 [Chloroplasts ..... plants.]
3. Label the structure of the given chloroplast.



(1) ribosome (2) stroma (3) drop of lipids (4) inner membrane (5) intermembrane space (6) outer membrane (7) starch granule (8) granum (9) thylakoid (10) lamella

Experiment which demonstrate that starch is formed during photosynthesis

Lesson objective

- To observe starch is present in the leaves

Preparation for lesson

Teacher should prepare the starch test. For demonstration of the starch test, iodine solution and cooked rice or raw potato are needed to prepare.

Introduction

The starch test is a simple experiment which determines the presence of starch in the leaf during photosynthesis. The iodine test is used for searching the presence of starch in the leaf.

Teaching

Teacher should explain how to test starch is present in the leaf during photosynthesis from the Textbook.

Practice

After teaching, teacher should ask the following questions:

1. What is the food prepared by green plants?
2. What is the storage form of glucose?
3. Where is starch temporarily stored?

Activity

After teaching, the teacher organizes small groups of students to observe and examine the colour changes from the cooked rice and raw potato after iodine test.

- put the cooked rice in the petridish
- peel off the raw potato and place in the another petridish
- drop the iodine solution into both petridishes
- examine the color changes from the cooked rice and raw potato

Review and assessment

1. What happen when iodine solution is dropped onto starch (cooked rice and potato)?

   The colour changes blue or blue black when iodine solution is dropped onto starch.

2. Variegated leaf has many colours, which portion of the variegated leaf can be photosynthesized?

   The green portion of the variegated leaf can be photosynthesized.

3. State how to observe the presence of starch in the leaves and potato.

   The presence of starch in leaves can be observed by iodine test. The chlorophyll from leaf was removed by boiling the leaf in alcohol and then put two drops of iodine solution. When the leaf colour changes to blue or blue black, it indicates the presence of starch. The presence of starch in potatoes can also be tested by iodine solution. The iodine is added to a peeled potato and then it will turn black.

Factors affecting photosynthesis and intake of substances required for photosynthesis

Lesson objectives

- To know the factors affecting photosynthesis
- To understand how to obtain required substances for photosynthesis

Preparation for lesson

The teacher needs to collect the facts about the external and internal factors influenced on photosynthesis and the method of intake of materials needed in photosynthesis from the Textbooks or websites. It is possible to prepare the teaching aids.

Introduction

Recall the requirements of photosynthesis from the previous lessons to the students and introduce the factors involved in photosynthesis.

Teaching

Teacher should explain the factors affecting photosynthesis and intake of substances required for photosynthesis.

Practice

After teaching, teacher should ask the following questions:

1. What are the requirements of photosynthesis?
2. What will happen if these requirements are insufficient?

Review and assessment

1. Which part of the plant absorbs light?
   Textbook Page 52, Table 4.1 [Light is ..... leaves.]
2. How does water enter to the leaves?
   Textbook Page 52, Table 4.1 [Water is absorbed ..... the leaves.]
3. Where does the carbon dioxide diffuse from?
   Textbook Page 52, Table 4.1 [Carbon dioxide ..... stomata.]
4. Explain the next stage after the carbon dioxide entering the leaves.
   Textbook Page 52, Table 4.1 [Carbon dioxide ..... in the leaf as starch.]

4.1.2 Types of Nutrients — Periods (8-11)

Types of nutrients in plants

Lesson objective

- To recognize the important role of nutrients in plants

Preparation for lesson

Prepare the types of nutrients - macronutrients, micronutrients and their names from the Textbooks or internet website.

Introduction

Plant requires a number of nutrients and these nutrients can be divided into macro and micronutrients.The required macronutrients for plants are carbon, hydrogen, oxygen, nitrogen, phosphorus, potassium, calcium, magnesium and sulfur. Important micronutrients include iron, chlorine, manganese, zinc, copper, molybdenum and nickel.

Teaching

Teacher starts the lesson by asking the following questions to the students: Which nutrients are needed for plants? Why are macronutrients needed for plants? Have you ever seen the leaves of plants turn yellow during their growing stage? Do you know why it is happened? Based on the students' answers, the teacher should explain the nutrients and their functions and nutrient deficiency symptoms in plants.

Practice

After teaching, teacher should ask the following questions:

1. What are the macronutrients for plants?
2. What are the differences between micronutrients and macronutrients?

Review and assessment

1. Where are essential elements and the other elements for the plants derived from?
   Textbook Page 52, No. 4.1.2 [Essential element ..... by fertilizer.]
2. Name the macronutrients for plants nutrition.
   Textbook Page 52, No. 4.1.2 [The macronutrients ..... sulphur (S).]

Macronutrients for plants

Lesson objective

- To know the functions and deficiency symptoms of macronutrients for plants

Preparation for lesson

Teachers should prepare the lessons of the functions and deficiency symptoms of macronutrients for plants using the teaching aids related to the Textbook, vinyl chart and internet websites. Then, teacher should prepare the more information of micronutrients for plants.

Introduction

Teacher should introduce the lesson from the Textbook by explaining the functions and deficiency symptoms of macronutrients for plants.

Teaching

Teacher starts the lesson by asking the following questions to the students: Have you ever seen the yellow leaves of plants during their growing stages? Why do the leaves become yellow? Based on students' answers, teacher must correct the answer and should explain the functions and deficiency symptoms of macronutrients for plants. And then, teacher continues to explain more information of micronutrients for plants.

More information for teacher

Micronutrients for plants

Micronutrients are essential elements even if required a trace amount for plants. It is also known as "secondary nutrients". They have the functions and deficiency symptoms.

Nutrients	Functions	Effects of deficiency
Iron (Fe)	- Important in chlorophyll synthesis, photosynthesis and nitrogen metabolism	- Chlorosis of younger leaves, on prolong deficiency veins also become chlorotic, stunted growth
Chlorine (Cl)	- Turgor regulation (stomatal regulation of water loss), ion balance, resisting diseases and photosynthesis reactions	- Bronze colour and wilting of leaves, stunted roots and club shaped tips and reduced fruiting
Manganese (Mn)	- Important in photosynthesis, nitrogen assimilation and aids in chlorophyll synthesis	- Chlorosis, grey spots on leaves
Zinc (Zn)	- Promotes growth hormones, starch formation, seed maturation and chlorophyll production	- Malformed leaves, chlorosis leaves and stunted growth

Nutrients	Functions	Effects of deficiency
Copper (Cu)	- Important in photosynthesis, protein and carbohydrate metabolism - Improves flavour of fruits and vegetables	- Necrosis of the tip of young leaves which wither and fall, bark becomes rough and splits, stunted growth
Molybdenum (Mo)	- Essential for nitrogen fixation and assimilation - Plays an important role in plant nodulation	- Slight retardation of growth, chlorosis, pale green leaves, reduced crop yield
Nickel (Ni)	- Benefitted the growth of nitrogen fixing species - Impart plant disease resistance	- Necrotic lesions in leaves

Practice

After teaching, teacher should ask the following questions:

1. What are the functions of nitrogen for plants?
2. What are the deficiency symptoms of calcium for plants?
3. What are the deficiency symptoms of iron for plants?
4. What are the functions of copper for plants?

Review and assessment

1. What are the functions of phosphorus in plants?
   Textbook Page 53, Table 4.2 [The functions of phosphorous for plants are: Components of nucleic acids ..... maturation and root growth.]
2. State the functions and deficiency symptoms of magnesium for plants.
   Textbook Page 53, Table 4.2 [Functions: Important ..... enzymes.] [Deficiency: Chlorosis in older leaves ..... leaf abscission.]

Types of Nutrients in Animals

Lesson objectives

- To learn the types of nutrients including macronutrients and micronutrients needed for humans
- To understand why they are important for health

Preparation for Lesson

Teacher makes charts showing names and photographs of two nutrient groups and their food sources.

Introduction

Before teaching this lesson, teacher begins with questions such as "Which nutrients are required to maintain your body?" "Why do you eat every day?" "Which substances are included in your daily food?" "How the food you eat is used for maintaining the body?" Tell the students that they can answer as many ways as they can think. Then, teacher guides to get right answer, pointing out "Which are correct for healthy life?"

Teaching

Teacher has to explain the types of nutrients included in macronutrients. Teacher should then explain the food sources, functions, effects of deficiency of each macronutrient.

Teacher can explain that vitamins and minerals are included in micronutrients which are needed in small quantities and they also play important roles in human health.

Practice

After teaching, teacher asks the following questions:

1. What are the most important macronutrients?
2. What are the benefits of macronutrients?
3. What are the three main micronutrients?

Activity 1

After teaching, the teacher organizes small groups of 4 or 5 students to discuss the types of nutrients in their daily diet. Point out why they are important for healthy life.

Activity 2

Teacher lets small groups of 4 or 5 students analyse their daily food and discuss which are essential for health and why they are needed.

Review and assessment

1. Describe the types and sources of macronutrients.

   Textbook Page 54, Table 4.3 (Types of nutrient and food sources)
2. What are the most important macronutrients and why are they important?

   The most important macronutrients are carbohydrates, proteins and fats. They are important because they provide the body with calories (energy) and the building blocks of cellular growth, immune function and overall repair.
3. What are micronutrients and why are they important?

   Micronutrients are one of the major groups of nutrients your body needs. They include vitamins and minerals. Vitamins are necessary for energy production, immune function, blood clotting and other functions. Meanwhile, minerals play an important role in growth, bone health, fluid balance and several other processes.
4. What is protein important for humans?

   Protein is an important component of every cell in the body. Your body uses protein to build and repair tissues. You also use protein to make enzymes, hormones, and other body chemicals. Protein is an important building block of bones, muscles, cartilage, skin and blood.

4.1.3 A Healthy Diet Period (12)

Lesson objective

- To be aware of the characteristics of a healthy diet to maintain health

Preparation for lesson

Teacher should make charts with words and pictures showing the meaning of characteristics of a healthy diet (i.e., balanced diet, calories, weight control, sodium control, proportionality of food groups, essential nutrients, portion size and water).

Introduction

Teacher starts lesson by telling students the benefits of a healthy diet, explaining the characteristic needed to make a healthy diet.

Teaching

Teacher should teach by emphasizing the importance of taking healthy diet to maintain the health of every person. Using the chart, the main characteristics of healthy diet, i.e., a balanced diet, weight control by eating less fats and sodium, amount (proportion) of each food type in a meal, essential food groups (carbohydrates, proteins, fats), the total food amount that should be eaten and importance of water should be explained in detail.

Practice

After teaching, teacher asks "What is a diet?" "Which groups of food do we usually eat?" "Is your daily diet balanced?" "Why is the total amount of food per meal important?" And lets the students discuss among themselves.

Activity

After teaching, the teacher organizes small groups of 4 or 5 students to discuss the types of nutrients in daily diet. Point out why they are important for healthy life.

Review and assessment

1. What is the balanced diet?

   Diet is the sum of food consumed by a person or other organism. A balanced diet is important because organs and tissues need proper nutrition to work effectively. Without good nutrition, the body is more prone to get disease, infection, fatigue and poor performance. Children with a poor diet run the risk of growth and developmental problems and poor academic performance. Bad eating habits can persist for the rest of their lives. Parents should learn more about healthy meal plans for kids.

2. Why are calories important in food per meal?

   Calories are important in food per meal because the human body needs calories to survive. Without energy, the cells in the body would die, the heart and lungs would stop and the organs would not be able to carry out the basic processes needed for living.

3. How can you reduce weight?

To manage weight, consume more fruits, vegetables, whole grains, fat-free or lowfat dairy products, seafood which can reduce risks of constipation and heart disease.

4. What is proportionality in each meal?

Portion size is a **recommended serving size** which is the amount of each food that a person should eat during a meal or snack.

5. Why is portion size important in a meal?

Portion size is important in a meal because it is the best way to maintain a healthy weight through life. Large portions make you eat more. Large portions have more calories. Larger portions encourage people to eat more and underestimate how much they are eating. Large portions will increase overeating which contributes to high obesity rates.

6. Discuss importance of water in a diet.

Drinking enough **water** is important for health. Water is important for food digestion, waste elimination, all other body functions and metabolic activities.

4.2 DIGESTIVE SYSTEM Periods (13, 14)

Lesson objectives

- To get knowledge of what are intracellular and extracellular digestions
- To understand the structures and functions of digestive systems in invertebrates and vertebrates including humans

Preparation for lesson

Prepare the diagrams of Figures 4.3 and 4.4 from the Textbook on a card board paper or on a vinyl chart.

Introduction

Before teaching, teacher can start with questions e.g., "Do you know where the alimentary canal starts and ends in a human's body?" "How many organs are included in the digestive tract?" Students can answer freely as they understand.

Teaching

Teachers should review the methods of digestion from the previous Grades. Teachers should understand the differences between intracellular and extracellular digestion by giving some examples.

Make questions as follows:

1. What is digestion?

Digestion is the process of breaking down food into nutrients.

4.2.1 Structure of the Human Digestive System Periods (15-19)

Lesson objective

- To make students familiar with the parts of the alimentary canal and their functions in humans

Preparation for lesson

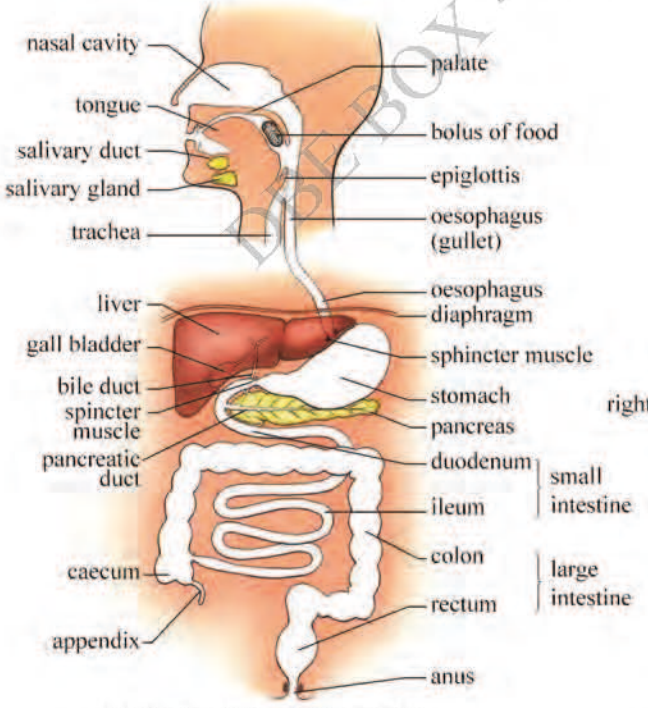
Draw the generalized diagrams of the human alimentary canal and associated glands in Figure 4.5 and the general structure of the alimentary canal in Figure 4.6 from the Textbook on the blackboard or show the chart with the diagrams you have prepared. Then explain in detail about functions of main parts of the human digestive system from Table 4.4 in Textbook.

Introduction

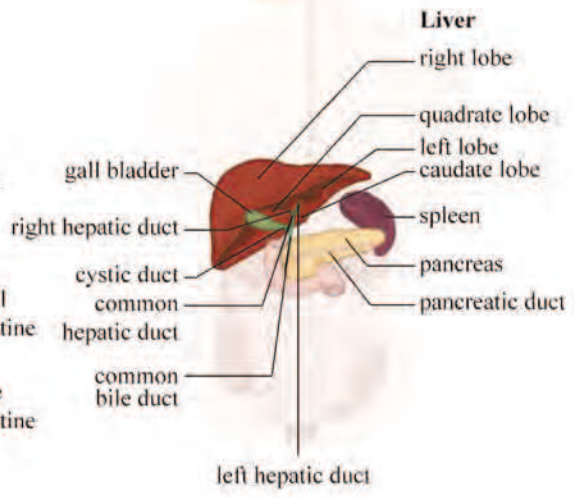
Teacher starts with an explanation of the human digestive system consisting of the gastrointestinal tract and the accessory organs (teeth, salivary glands, pancreas, liver and gall bladder). Digestion involves the breakdown of food into smaller and smaller components until they can be absorbed and assimilated into the body.

Teaching

Teacher can ask questions, for example, "How many cell layers are found in the wall of the alimentary canal?" "What are the accessory organs of the digestive system?" "What are the main regions of the alimentary canal?" Teacher also points out that **accessory digestive organs** (teeth, tongue, salivary glands, pancreas, liver and gall bladder) are not included in the digestive tract but they help in digestion.



Human alimentary canal



Human accessory digestive organs

Practice

After teaching the lesson, the teacher should ask the following questions:

1. Name the parts of the human alimentary canal and its associated organs.
2. State the function of villi in the ileum.
3. Draw an illustration of the human digestive system and label the parts and organs associated with it.

Review and assessment

1. Name the parts of the alimentary canal and its associated organs.
   The parts of the alimentary canal are mouth, oesophagus, stomach, duodenum, ileum, colon, rectum and anus. Its associated organs are salivary glands, liver, gall bladder and pancreas.
2. Explain how digestion takes place in stomach and duodenum.
   Textbook Page 58, Table 4.4 [stomach and duodenum]
3. State the function of villi in the ileum.
   The function of villi in the ileum is to increase surface area for absorption of digested food molecules.
4. Explain the functions of liver and pancreas.
   Textbook Pages 58, 59, Table 4.4 [liver and pancreas]
5. Draw the illustration of the human digestive system and label the parts and organs associated with it.
   Textbook Page 57, Figure 4.5
6. How does bile flow from gall bladder to duodenum?
   Bile flows from gall bladder to duodenum via bile duct.
7. How many parts can the small intestine be divided?
   The small intestine can be divided into two parts as duodenum and ileum.

4.2.2 The Process of Digestion — Periods (20-23)

Lesson objectives

- To understand the mechanical digestion of food
- To know the structure and dental formula of human teeth and the role of teeth in mechanical digestion
- To understand chemical digestion of food for absorption and assimilation

Preparation for lesson

Teacher has to provide diagrams showing human jaws and types of teeth on vinyl or charts or teacher should instruct the students how to draw the diagrams by themselves. Table 4.5 and Figure 4.7 from the Textbook.

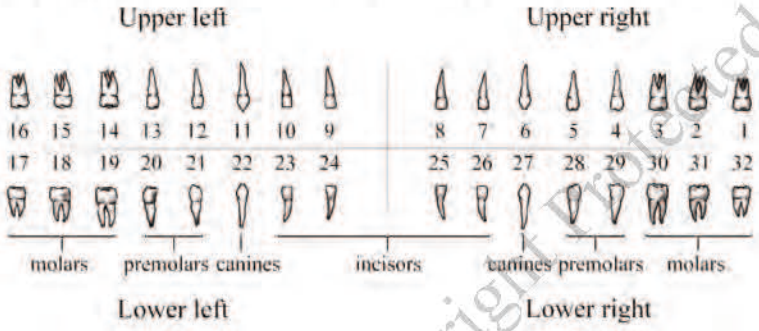
Teacher also prepares chart showing diagrams of chemical digestion on protein, carbohydrate and fats from Table 4.4 of the Textbook. Table 4.6 from the Textbook to explain differences of dental formula in human and animals with different diets.

Introduction

Teacher makes the students aware of the different types of teeth in humans, pointing out the teeth in the students' mouth and then explains their functions in mechanical digestion. Teacher starts by explaining, food has to be broken down and made soluble for absorption by small intestine.

Teaching

Teacher should explain the different types of teeth and functions as described in the Textbook. The teacher continues to explain the dental formula and instruct the students on how to write the dental formula. Teacher should continue to point out the differences of dental formulae in humans and animals with different diets.



Types, names and numbers in human teeth

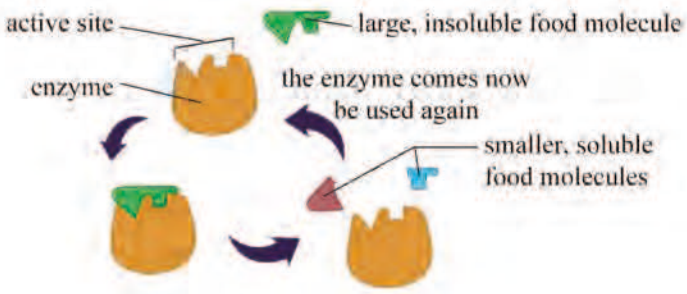
Teacher points out how main parts of the human digestive system function by **mechanical** and **chemical digestions**. Then explain how different food types; are digested and absorbed and how faeces are formed. Teacher should also emphasize the role of **enzymes** in chemical digestion.

Mechanical digestion

Mechanical digestion includes: chewing in the mouth and churning in the stomach.

Chemical digestion

During the chemical digestion of food, enzymes break down large food molecules by process of hydrolysis. Hydrolysis - a water molecule is added at the site where a bond is broken.



Practice

Teacher asks the questions e.g., "List the types of human teeth and write short notes on their functions" "Draw and label the diagram showing human jaws and teeth" "Tabulate and compare the different dental formulae in mammals based on different diets". Also ask to students where and how different food types such as carbohydrates, proteins and fats are digested and absorbed.

Review and assessment

1. Explain mechanical digestion and chemical digestion.
   Textbook Page 59, No. 4.2.2 [Mechanical digestion ..... biological catalysts.]
2. Summarize the types of human teeth and their functions.
   Textbook Page 59, Table 4.5 Summary of types of human teeth and their functions
3. Discuss how and where chemically digested food is absorbed in the gut.
   Textbook Page 58, Table 4.4 [Duodenum, Ileum and Colon]
4. Where can you find peristalsis?
   Peristalsis can be found in the oesophagus and intestine.
5. How many parts can the small intestine be divided?
   The small intestine can be divided into two parts: duodenum and ileum.
6. Which type of teeth is developed in carnivores?
   Canine is developed in carnivores.
7. Which teeth have more than one root?
   Premolars and molars have more than one root.
8. What are functions of different types of teeth?
   Textbook Page 59, Table 4.5 [functions]

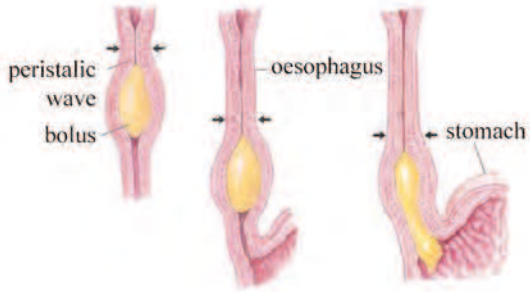
4.3 A HEALTHY DIGESTIVE SYSTEM — Periods (24, 25)

Lesson objectives

- To know what is meant by a healthy digestive system in human
- To know what can happen if a digestive system malfunctions

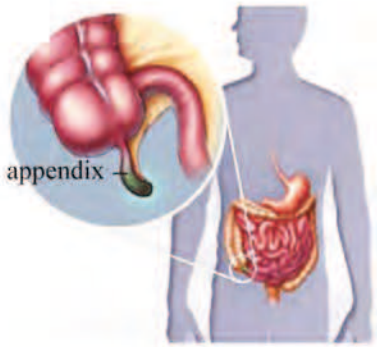
Preparation for lesson

Teacher should prepare charts, diagrams showing some common diseases of the digestive tract. Teacher also explains the term **peristalsis** with the help of diagrams or charts as below.

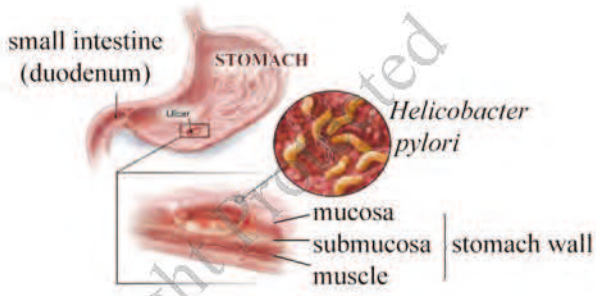


(a) Peristalsis in intestine

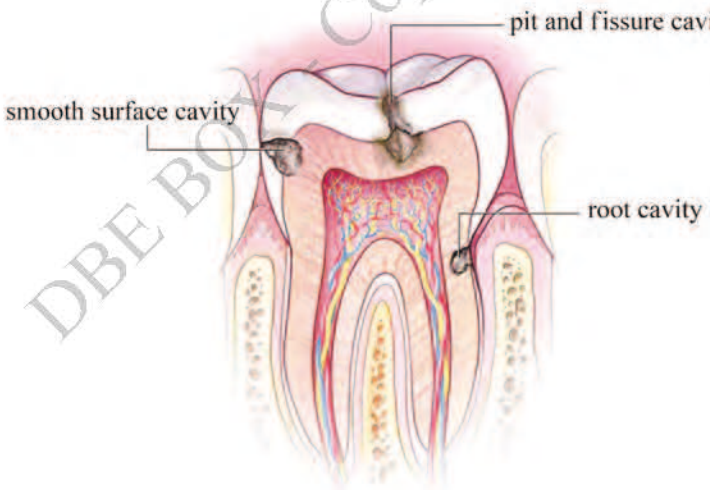
(b) Gall stones from gall bladder



(c) Appendicitis of man



(d) *Helicobacter pylori,* the bacterium causing stomach ulcer



(e) Tooth decay and cavities

Introduction

The teacher explains the characteristics of a healthy digestive system and what might be done to keep the digestive system healthy. Teacher also discusses the diseases and symptoms of a malfunctioning digestive system.

Teaching

The teacher explains that the coordinated contractions of the circular and longitudinal muscle layers of the digestive tract push food and fluids along the gut, in a process called **peristalsis** (see Figure) and that digestive **enzymes** and bile from accessory **glands** (salivary, liver, gall bladder, pancreas, etc.) and other digestive glands in the mucosa or lining of the mouth, stomach and small intestine, help in the chemical digestion of food. Teacher explains about digestive juices containing enzymes, secreted by the salivary glands, liver and pancreas which help to dissolve food so that soluble nutrients can be passed easily into the blood stream of gut wall. Teacher can also tell that the teeth should be healthy to cut and grind solid food into digestible smaller pieces which are easier to swallow.

Next, teacher tells the students about the importance of a cartilage flap called **epiglottis** which prevents the swallowed food from passing into the windpipe accidentally. Teacher should explain that in healthy person, the last part of intestine called the colon must move normally to expel the **faeces** (egestion) easily and regularly. Teacher also points out that the **pH** of the gastric juice should be acidic in the stomach but should be alkaline in the small intestine to be healthy.

Then teacher goes on to explain that parts of the digestive tracts and accessory organs should be free of infections, ulcer and cancer or growth and give some examples of **common diseases** in human gut and teeth.

Practice

Teacher asks the following questions to test if students understand their lesson:

1. What should be the features of a healthy digestive system in human?
2. Enumerate some common diseases of a malfunctioning digestive tract.

Review and assessment

1. What is the process of peristalsis?

   Textbook Page 61, No. 4.3.1 [(1) The organs of the gut ..... called peristalsis.]

2. Name the common diseases in human gut and teeth.

   Textbook Page 61, No. 4.3.2 [(1) constipation ..... tooth decay (dental caries).]

Practice

Teacher asks the questions e.g., "List the types of human teeth and write short notes on their functions" "Draw and label the diagram showing human jaws and teeth" "Tabulate and compare the different dental formulae in mammals based on different diets". Also ask to students where and how different food types such as carbohydrates, proteins and fats are digested and absorbed.

Review and assessment

1. Explain mechanical digestion and chemical digestion.
   Textbook Page 59, No. 4.2.2 [Mechanical digestion ..... biological catalysts.]
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   Textbook Page 59, Table 4.5 Summary of types of human teeth and their functions
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7. Which teeth have more than one root?
   Premolars and molars have more than one root.
8. What are functions of different types of teeth?
   Textbook Page 59, Table 4.5 [functions]

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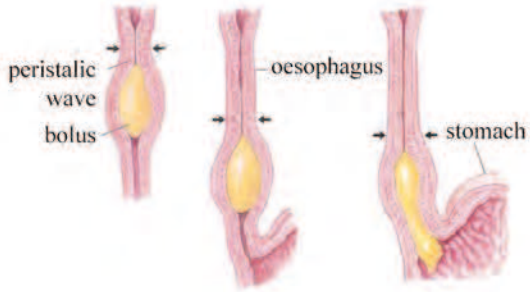
Lesson objectives

- To know what is meant by a healthy digestive system in human
- To know what can happen if a digestive system malfunctions

Preparation for lesson

Teacher should prepare charts, diagrams showing some common diseases of the digestive tract. Teacher also explains the term **peristalsis** with the help of diagrams or charts as below.



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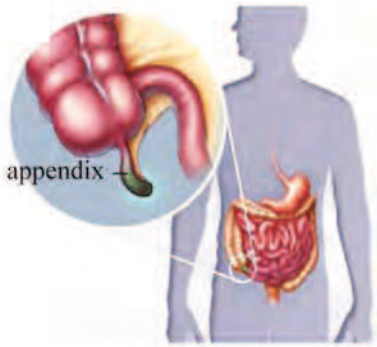

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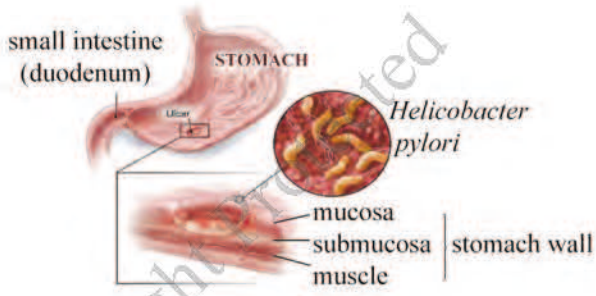

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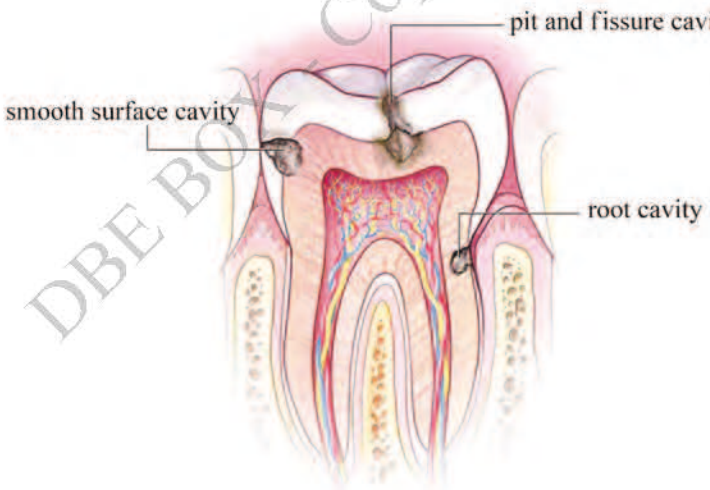

(e) Tooth decay and cavities

Introduction

The teacher explains the characteristics of a healthy digestive system and what might be done to keep the digestive system healthy. Teacher also discusses the diseases and symptoms of a malfunctioning digestive system.

Teaching

The teacher explains that the coordinated contractions of the circular and longitudinal muscle layers of the digestive tract push food and fluids along the gut, in a process called **peristalsis** (see Figure) and that digestive **enzymes** and bile from accessory **glands** (salivary, liver, gall bladder, pancreas, etc.) and other digestive glands in the mucosa or lining of the mouth, stomach and small intestine, help in the chemical digestion of food. Teacher explains about digestive juices containing enzymes, secreted by the salivary glands, liver and pancreas which help to dissolve food so that soluble nutrients can be passed easily into the blood stream of gut wall. Teacher can also tell that the teeth should be healthy to cut and grind solid food into digestible smaller pieces which are easier to swallow.

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Then teacher goes on to explain that parts of the digestive tracts and accessory organs should be free of infections, ulcer and cancer or growth and give some examples of **common diseases** in human gut and teeth.

Practice

Teacher asks the following questions to test if students understand their lesson:

1. What should be the features of a healthy digestive system in human?
2. Enumerate some common diseases of a malfunctioning digestive tract.

Review and assessment

1. What is the process of peristalsis?

   Textbook Page 61, No. 4.3.1 [(1) The organs of the gut ..... called peristalsis.]

2. Name the common diseases in human gut and teeth.

   Textbook Page 61, No. 4.3.2 [(1) constipation ..... tooth decay (dental caries).]

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK
1. Page 50 [The raw materials used during photosynthesis are carbon dioxide and water.] with photosynthesis equation
2. Page 51, Experiment to demonstrate that starch is formed during photosynthesis
3. Page 52, Table 4.1 Intake of substances required for photosynthesis
4. Page 52, Table 4.2 Macronutrients for plants (Functions)
5. Page 54, Table 4.3 Carbohydrates and proteins and effects of their deficiency
6. Pages 54, 55, Table 4.3 Carbohydrates, Fibres and Water (Function & Source Effects of deficiency)
7. Page 54, Table 4.3 (Macronutrients for humans)
8. Page 53, Micronutrients [Micronutrients ..... magnesium and postssium.]
9. Page 53, Macronutrients [Macronutrients ..... for metabolism.]
10. Pages 54, 55, Table 4.3 Macronutrients for humans (Effects of deficiency)
11. Page 59, Table 4.5 Summary of types of human teeth and their functions
12. Food are needed to be digested because degestion is important for breaking down food into nutrients, which the body uses for energy, growth and cell repair.
13. Food is chemical digestion and absorption in the mouth, stomach and duodenum in human digestive tract.
14. Page 55, No. 4.1.3 Characteristics of a healthy diet
15. Page 61, No. 4.3.2 [The digestive tract ..... tooth decay (dental caries).]

SUMMARY

Nutrition is a basic prerequisite to sustain life. There are two types of nutrition: autotrophic and heterotrophic nutrition. Organisms that make their own food are called autotrophs. Autotrophs can make their food by photosynthesis or chemosynthesis. Heterotrophs are those organisms which cannot make their own food. Holozoic, saprophytic and parasitic nutrition are the heterotrophic nutrition. In plant nutrition (photosynthesis), they make food in the presence of sunlight. Carbon dioxide and water are raw materials. Chloroplast is the site where food is made. Plants get the materials required for photosynthesis from their environment. The photosynthetic product, glucose is stored temporarily as starch in the leaf. Test for starch can be done with iodine solution. Nutrients are thus needed to sustain life and activity. Nitrogen, phosphorus, potassium, calcium, sulphur, magnesium, carbon, oxygen and hydrogen are macronutrients. Among them, carbon, oxygen and hydrogen are nonmineral essential elements and building blocks of macromolecules. The micronutrients are iron, boron, chlorine, manganese, zinc, copper, molybdenum and nickel. Types of nutrients, functions and deficiency symptoms are given in Tables.

Animals including humans require carbohydrates, fats, proteins, fibres and water in large amounts as macronutrients and vitamins and minerals in small amounts as micronutrients. Most energy is provided by carbohydrates but less by fats and proteins. Vitamins are essential for metabolic reactions and minerals are required for growth of bones, teeth and muscles. Types, food sources, functions and effects of some important nutrients are given in Tables 4.3. Balanced calories, less sugars and fats, right proportions of nutrients and amount of each meal, drinking enough water are properties of a healthy diet. Digestion occurs intracellularly in single-celled organisms and in a gastrovascular cavity of coelenterates, or extra cellularly in a digestive tract with mouth and anus mostly in invertebrates and vertebrates including humans. Human gut has specialized regions with different functions but the entire digestive tract has a wall with two muscle layers and internal lining of epithelium cells. Glands in mouth, stomach, small intestine and pancreas produce gastric juice with digestive enzymes. Mechanical digestion of food occurs in mouth by chewing using teeth. The food then passes through oesophagus to stomach. Chemical digestion of food starts in mouth and continues in the stomach and small intestine by digestive enzymes. The digested food in duodenum or first part of the small intestine produces glucose, amino acids, fatty acids and glycerol which are absorbed into blood vessels and lacteals in the epithelium lining of the ileum or second part of small intestine. Undigested food is passed outside as faeces through colon, rectum and anus. A healthy human digestive system should have movements, normal enzymes, proper food swallowing, regular defecation, free from diseases and friendly gut bacteria. Some common diseases that can cause malfunctioning of the human digestive tract are listed and explained briefly.

CHAPTER 5
CONTINUATION OF LIFE

Total Number of Lesson Periods : 36

5.1 REPRODUCTION

5.1.1 Reproduction in Fungi and Plants

Asexual reproduction **Periods (1, 2)**

Lesson objectives

- To study what is reproduction in fungi and plants
- To understand the types of reproduction in plants

Preparation for lesson

The teacher has to prepare the different types of reproduction found in plants with their illustrations citing from the reference books or internet websites and from the Textbook.

Introduction

Reproduction is the production of new offspring by asexually or sexually. Asexual reproduction may occur through fission, budding, fragmentation, spore formation and vegetative propagation. Then, recall reproduction in plants that was learned by students in the previous Grades.

Teaching

Teacher recalls reproduction in plants that was learned by students in the previous Grades. Teacher points out the different types of asexual reproduction found in fungi, algae and plants then explains their differences with illustrations from the Textbook or other available sources.

Practice

The teacher asks the following questions to the students: What is meant by plant reproduction? Name the types of reproduction in fungi and plants. When can you find the fungi in bread? What is meant by spore? Explain what you know about reproduction in algae.

Based on students' answers and teacher should explain the different types of asexual reproduction found in plants related to this lesson.

Review and assessment

1. What do you understand about reproduction as found in organisms and why is it important?

   Textbook Page 64, No. 5.1 [The production of new organisms ..... life on earth.]

2. What do you understand about asexual reproduction found in organisms?

   Textbook Page 64, No. 5.1.1 [A new individual ..... vegetative propagation.]

3. How many types of reproduction are there in fungi and plants?

   There are two types of reproduction found in fungi and plants. They are sexual and asexual reproductions.

4. Describe the types of asexual reproduction found in fungi and plants.

   (1) fission (2) budding (3) fragmentation (4) spore formation and (5) vegetative propagation.

5. Mention the reproduction found in *Spirogyra.*

   Textbook Page 65, Fragmentation [The breaking up ..... filamentous alga.]

Activity

Teacher divides the students into groups. Then, teacher asks to discuss following questions. "Give a diagrammatic representation of asexual reproduction in yeast. Discuss the fragmentation process of reproduction found in *Spirogyra* with the help of a diagram. With the help of diagram, explain the binary fission found in cyanobacteria."

Vegetative Propagation **Periods (3, 4)**

Lesson objectives

- To explain, "What is vegetative propagation?"
- To describe the types of vegetative propagation in plants

Preparation for lesson

Prepare the vinyl or chart of the different types of vegetative propagation found in plants including their economic uses referring to the Textbook.

Introduction

Vegetative propagation refers to a type of plant reproduction. It is considered as an asexual method of plant propagation.

Teaching

Recall the knowledge of the students on the reproduction in plants from the previous Grades. After recalling, teacher explains the different types of vegetative propagation found in plants.

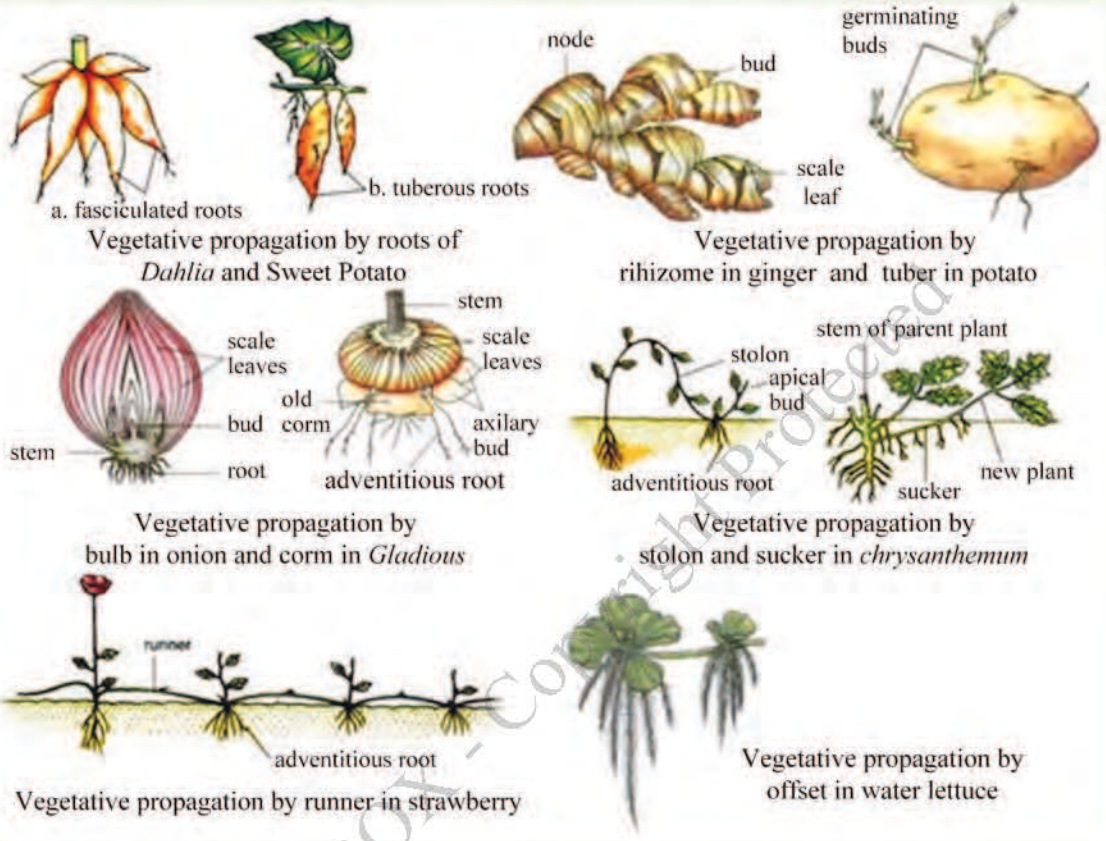
More information for teacher

Advantages of natural vegetative propagation

New plants contain the genetic material of only one parent, so they are essentially clones of the parent plant. (A plant with desirable traits, it can reproduce the same traits indefinitely). This can help to maintain consistent quality and taste in products made from plants or crops. Plants bypass the immature seedling phase and therefore reach the mature phase sooner. This can save a lot of time and money for commercial plant production. Growing from seed would take even longer.

Disadvantages of natural vegetative propagation

The potential of vegetative propagation impacts on diversity of a species. If a particular plant clone is susceptible to certain diseases, there is potential to loose entire crops.



Practice

Teacher asks the following questions to the students: "Have you ever seen *Bryophyllum* plants? Do you know how new plantlets are found in *Bryophyllum*? Do you know the reproduction of ginger and potato? Which type of reproduction is used in cultivation?"

Review and assessment

1. Define vegetative propagation in plants.
   Textbook Page 65, Vegetative propagation
2. Describe the vegetative propagation in *Bryophyllum.*
   Bryophyllum can be reproduced by vegetative propagation by its leaves.

Activity

Before starting this lesson that is three to four days ahead, take the specimens such as a leaf of *Bryophyllum,* pieces of ginger and potato grow them on wet soil. When the shoots appear from the specimens, let the students observe them. Then, ask them the following questions and the answers have to write down in their workbooks. "State the vegetative propagation of the given specimens which you have seen".

Artificial Methods of Vegetative Propagation **Periods (5, 6)**

Micropropagation (Tissue culture)

Lesson objective

- To know what is the artificial methods of vegetative propagation

Preparation for lesson

Collects the facts for the artificial methods of vegetative propagation found in plants including their economic uses referring to the Textbook of the previous Grades or other books or internet website.

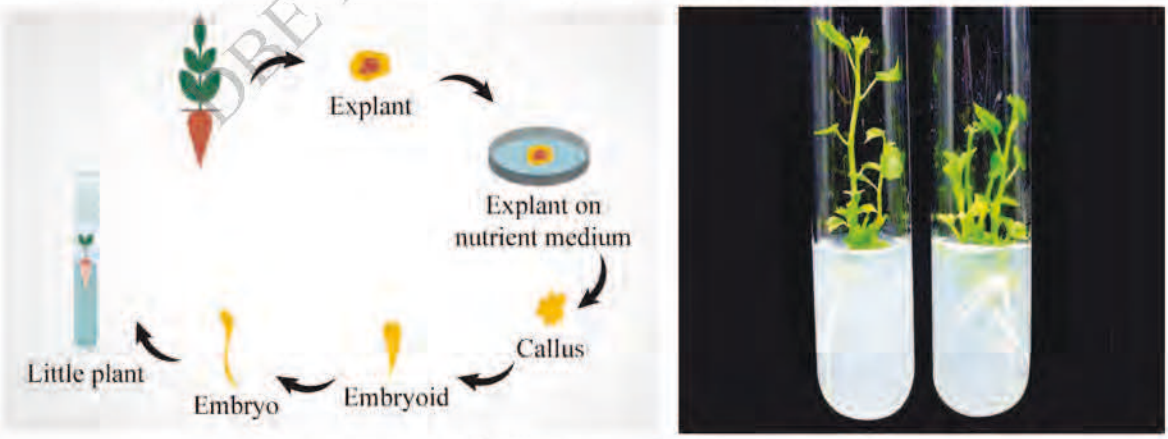
Introduction

The process of growing many plants from one plant by man-made method is called artificial method of vegetative propagation.

The new plants are produced from a small piece of the plant tissue in growing agar medium, are called micropropagation (tissue culture) as shown in figures.

Teaching

Teacher starts the lesson by recalling to the previous lessons. Recall the knowledge of the students on the reproduction in plants from previous Grades. After recalling, teacher explains the different artificial methods of vegetative propagation found in plants.



Micropropagation

More information for teacher

Advantages of artificial vegetative propagation

The new plants produced by artificial vegetative propagation will be exactly like the parent plants. The fruit trees grown from seeds may take many years before they start to bear fruit. But the fruit trees grown from cuttings or by grafting start to bear fruits much earlier (only after a few growing seasons). The plants grown by vegetative propagation usually need less attention in their early years than the plants grown from seeds. Many plants can be grown from just one parent plant by artificial propagation. Artificial propagation can produce seedless plants.

Disadvantages of artificial vegetative propagation

The plants do not have genetic variation and loose their vigor gradually. As there is no genetic variation, the offspring are less adaptable to the environment. If the parent has a disease, all the offspring inherit the disease. Plants that are air layered and cut plants generally do not have a strong root system. These plants may collapse in certain age.

Practice

Teacher asks the following questions to the students: "Have you ever seen rose, sugarcane, cactus, strawberry, grass, apple, avocado, plum, citrus plants? Do you know about the reproduction of these plants?" Based on students' answers, teacher has to explain the different types of artificial vegetative propagation found in plants.

Review and assessment

1. Enumerate the types of artificial vegetative propagation found in plants.
   The types of artificial vegetative propagation found in plants are (1) cutting (2) layering (3) grafting and (4) budding.
2. Describe the artificial vegetative propagation found in rose.
   Textbook Page 66, Cutting
3. What type of artificial vegetative propagation found in avocado plants?
   Grafting is the artificial vegetative propagation found in avocado plants.
4. Define Micropropagation in plants.
   Textbook Page 67, Tissue culture

Activity

Teacher needs to collect the branches or parts of rose or avocado or plum or croton (Ywet-hla) and citrus to demonstrate the artificial plant propagation such as cutting, grafting, etc.,. Teacher divides the students into groups. Then, asks the students to point out the four types of artificial vegetative propagation and match the plants with examples. Then, asks again to discuss the types of artificial vegetative propagation and their commercial values.

Sexual Reproduction in Plants **Periods (7, 8)**

Female gamete

Lesson objectives

- To describe the sexual reproduction in plants
- To explain the structure and functions of female gamete in plants

Preparation for lesson

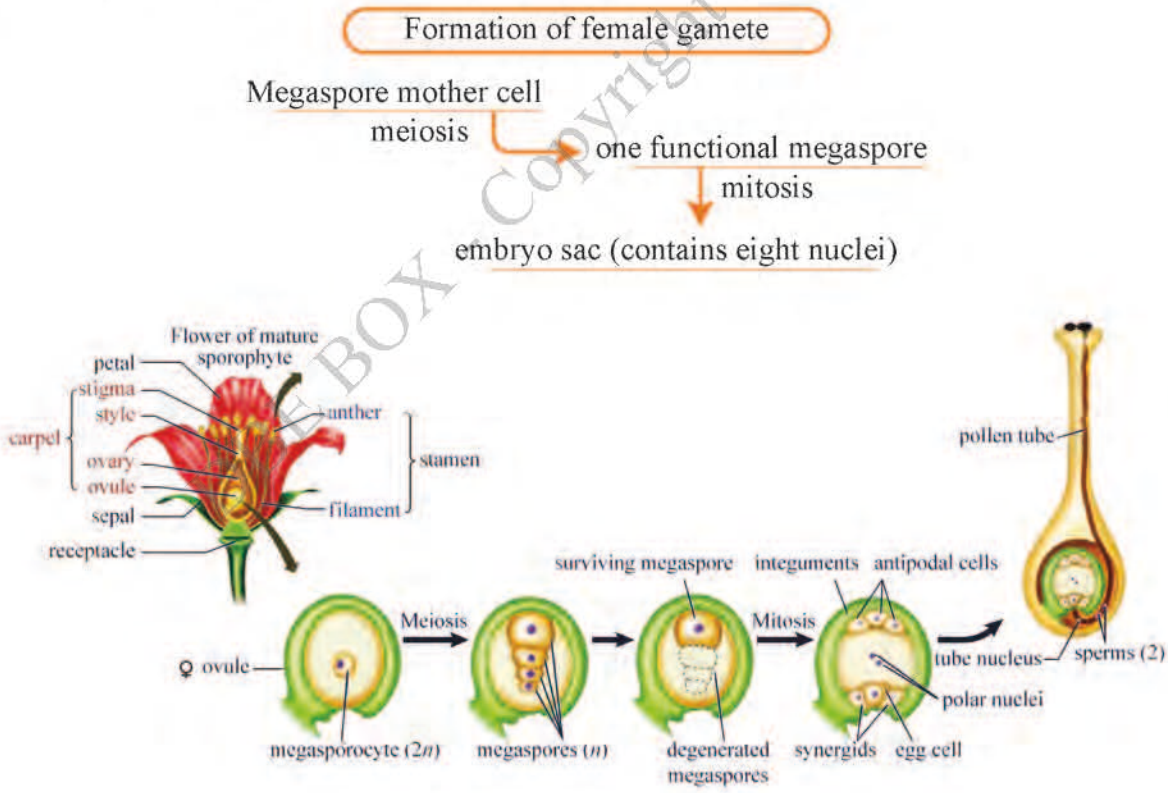
Prepare the teaching aids such as vinyl, charts or facts relating to this lesson.

Introduction

Production of new plant from parents' plants by the fusion of the sex cells or the gametes is called sexual reproduction. The two types of gametes are the male and female gametes.

Teaching

Review the sexual reproduction that they have learned from the previous Grades. Then teacher explains the formation of female gamete.



Formation of female gamete

Practice

Then, teacher asks a few questions: "What is meant by sexual reproduction in plants? What are the female reproductive organs of the plants? Do you know where the female gametes are located?" Teacher has to correct the students' answers and then explains on the sexual reproduction in plants together with the structure of a female gamete.

Review and assessment

1. What is the micropyle in the ovule?
   A pore at the tip of the ovule is the micropyle.
2. Define the term nucellus.
   The central and main part of an ovule that encloses the female gametophyte (embryo sac) is termed as the nucellus.

Activity

Draw and label the diagram of female gamete. Then, ask them the following question and tell them to write down the answer. "Identify the parts of female gamete which you have seen in the diagram" (Figure 5.12).

Male gamete **Period (9)**

Lesson objectives

- To study the structure and functions of male gamete in plants
- To learn the germination of the pollen grain

Preparation for lesson

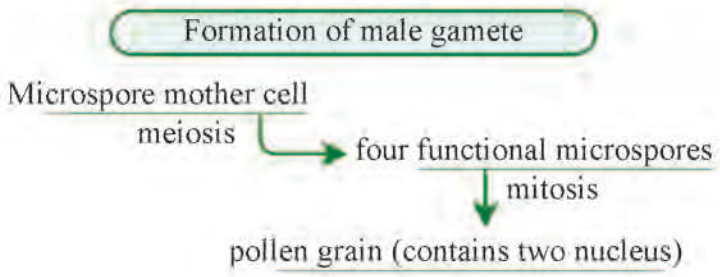
Collect the facts related to the male gametes of plant from the Textbook or from any other sources.

Introduction

Teacher should introduce what is male gamete, the formation of male gametes and where it can be found in plants.

Teaching

Review the sexual reproduction in flowers of plants from their knowledge. Teacher starts the lesson with sexual reproduction in flowers of angiosperms from the previous Grades. Then teacher explains the formation of male gamete.



Formation of male gametes

Practice

Then, teacher asks the following questions to the students: "What is the male reproductive organ in plants? Do you know the location of male gametes? What are pollen and pollen tube?" Teacher must guide the students' answers and discuss the sexual reproduction in plants.

Review and assessment

1. Describe the structure of male gamete found in plants.
   Textbook Page 68, Male gamete [The formation of male gamete ..... spinous outgrowth.]
2. Explain the formation of pollen tube.
   Textbook Page 68, Male gamete [Some weak spots ..... into two male gametes.]

Activity

Draw and label the diagram of germination of the pollen grain from the Textbook. Then, ask them the following question and instructs the students to write the answer in their workbooks. "Explain the germination of pollen grain".

Fertilization and Changes after fertilization **Periods (10, 11)**

Lesson objectives

- To study the process of fertilization found in plants
- To describe how double fertilization occurs in ovule of a flower
- To understand the changes after fertilization

Preparation for lesson

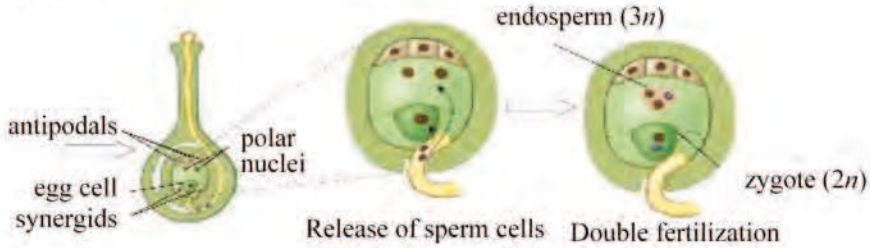
Vinyl, chart or video clips from internet relating to the fertilization need to prepare for this lesson.

Introduction

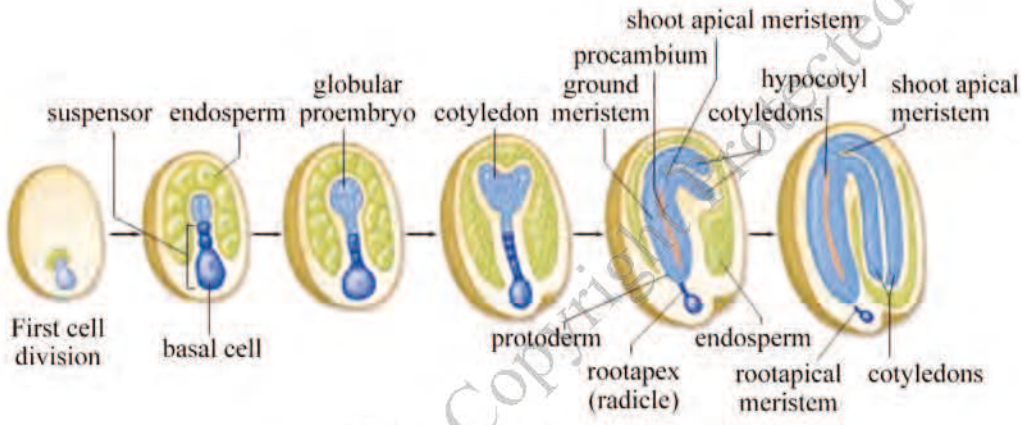
The fusion of male and female gametes is termed as **fertilization**. The fusion of three nuclei: two polar nuclei and a male gamete is called **triple fusion**. The process of fertilization and triple fusion is known as **double fertilization**.

Teaching

Teacher recalls their knowledge of sexual reproduction in flowers of the angiosperms from the previous Grades that they have learnt. Then, teacher explains fertilization and changes after fertilization.



Double fertilization



Changes after fertilization

Practice

Then, teacher asks the following questions to the students: "Where is the site of fertilization in flowers? Do you know the formation of fruit and how the fruit is developed?" Teacher must correct the students' answers and discuss the fertilization together with changes after fertilization.

Review and assessment

1. State the double fertilization found in plants.

   Textbook Page 69, Fertilization [The two polar nuclei ..... "double fertilization".]

2. Define the term fertilization.

   One of the two male gametes fuses with the female gamete or egg cell, resulting in the fertilized egg or oospore. This process is termed as "fertilization".

3. What is triple fusion?

   The fusion of three nuclei, i.e., the two polar nuclei and the male gamete is therefore termed as "triple fusion".

Activity

Draw a labelled diagram of L.S of ovule showing the process of fertilization. Ask the students to explain the fertilization found in plants.

5.1.2 Reproduction in Animals — Periods (12, 13)

Asexual Reproduction in Animals

Lesson objective

- To obtain the knowledge of asexual reproduction in lower animals

Preparation for lesson

Teacher produces Figures 5.15 from the Textbook on vinyl or charts, or draws them on the whiteboard. The charts should be of two types: with labels and without labels.

Introduction

Teacher starts by saying there are many types of reproduction i.e., asexual and sexual among animals.

Teaching

Teacher shows the picture of asexual reproduction in *Hydra* and explains the budding process. Point out that the bud forms a new offspring that drops off the parent. But also tell students that *Hydra* also has sexual reproduction.

Practice

Teacher should ask the students to draw and label the diagrams of asexual reproduction by budding in *Hydra*. Teacher starts by asking the students "Do you know asexual reproduction? Can you give examples of asexual reproduction? What are the differences between asexual and sexual reproductions?"

Review and assessment

1. Which types of reproduction are found in *Hydra?*
   Hydra has an asexual method of reproduction called **budding**. However, *Hydra* can also reproduce sexually by gametes.
2. Give another examples of asexual reproduction among animals.
   Planarians, sponges, tunicates and some cnidarians can reproduce asexually.

Sexual Reproduction in Animals — **Periods (14, 15)**

Lesson objective

- To learn about sexual reproduction in animals

Preparation for lesson

Teacher makes large posters or charts showing diagrams of steps in sexual reproduction (Figure 5.16) from the Textbook.

Activity

Draw a labelled diagram of L.S of ovule showing the process of fertilization. Ask the students to explain the fertilization found in plants.

5.1.2 Reproduction in Animals — Periods (12, 13)

Asexual Reproduction in Animals

Lesson objective

- To obtain the knowledge of asexual reproduction in lower animals

Preparation for lesson

Teacher produces Figures 5.15 from the Textbook on vinyl or charts, or draws them on the whiteboard. The charts should be of two types: with labels and without labels.

Introduction

Teacher starts by saying there are many types of reproduction i.e., asexual and sexual among animals.

Teaching

Teacher shows the picture of asexual reproduction in *Hydra* and explains the budding process. Point out that the bud forms a new offspring that drops off the parent. But also tell students that *Hydra* also has sexual reproduction.

Practice

Teacher should ask the students to draw and label the diagrams of asexual reproduction by budding in *Hydra*. Teacher starts by asking the students "Do you know asexual reproduction? Can you give examples of asexual reproduction? What are the differences between asexual and sexual reproductions?"

Review and assessment

1. Which types of reproduction are found in *Hydra?*
   Hydra has an asexual method of reproduction called **budding**. However, *Hydra* can also reproduce sexually by gametes.
2. Give another examples of asexual reproduction among animals.
   Planarians, sponges, tunicates and some cnidarians can reproduce asexually.

Sexual Reproduction in Animals — **Periods (14, 15)**

Lesson objective

- To learn about sexual reproduction in animals

Preparation for lesson

Teacher makes large posters or charts showing diagrams of steps in sexual reproduction (Figure 5.16) from the Textbook.

Introduction

Teacher should introduce that the reproductive parts in animals, produce gametes which fuse to form a zygote. The zygote develops into a new similar species. The type of reproduction through the fusion of male and female gametes is known as sexual reproduction. The female gametes produced by ovary are known as ova (or eggs). The male gametes produced by testis, are known as sperm.

Teaching

Teacher should explain (with the help of chart or vinyl or drawing on the blackboard) sexual reproduction pointing out that egg and sperm from female and male unites inside the body of female to form zygote which develops by stages into an embryo born as offspring.

Practice

After teaching, teacher asks the following questions:

1. What is the male gamete?
2. What is the female gamete?
3. What is the zygote?

Activity

Teacher asks the students to draw and label the process of development of embryo and young in sexual reproduction of animals.

Review and Assessment

1. Which type of cell division occurs in sexual reproduction?
   Meiosis cell division occurs in sexual reproduction.
2. What is the name of a single cell formed after fertilization in animals?
   The name of a single cell formed after fertilization in animals is zygote.
3. What is cleavage in fertilized egg?
   Cleavage is a continuous cell division of a zygote (a fertilized egg) into a ball of cells called embryo.

Sexual Reproduction in Humans **Periods (16-20)**

Lesson objectives

- To gain knowledge on sexual reproduction in humans
- To know the processes and developments during pregnancy and after birth in humans

Preparation for lesson

Teacher should make vinyl or charts of Figures 5.17, 5.18 and 5.19 from the Textbook or draw them on the blackboard or whiteboard. Prepare charts in sets with or without labels.

Introduction

Teacher should introduce anatomical terms or names of the parts of the reproductive organs of human male and female. In addition, teacher tells students about the terms that are used to describe the developing foetus in uterus.

Teaching

Teacher should explain the parts of reproductive organs and their functions with the help of vinyl or charts or drawings on the blackboard of Tables 5.1 and 5.2 from the Textbook.

Teacher should prepare the diagrams without labels of male and female reproductive organs and ask the students to label them.

Teacher should also explain the meaning or definition of fertilization, implantation, gestation, placenta, umbilical cord, amnion and amniotic fluid. Then continue to explain the process of development of embryo up to the birth of offspring or baby. Lactation and menstrual cycle are also explained clearly in the Textbook.

Practice

After teaching, teacher asks the following questions:

1. What is the function of ovary?
2. What is the function of testis?
3. What is the fertilization?
4. What is the embryo?
5. What is the duration of pregnancy?

Activity

Students are asked to draw a diagram of the developing foetus in human uterus with labels. Teacher can ask the meaning of each word related to sexual reproduction, such as "What is fertilization? Can you explain the process of implantation?"

Review and assessment

1. Tabulate the parts of female reproductive system and their functions.
   Textbook Page 71, Table 5.1
2. Draw the labeled diagram of male reproductive system.
   Textbook Page 72, Figure 5.18
3. Explain the development of embryo during the gestation period.
   Textbook Page 73, Gestation period
4. What is an umbilical cord?
   Textbook Page 73, Umbilical cord
5. Describe the process of birth.
   Textbook Page 73, Birth
6. Explain the process involving ovulation found in woman of reproductive age.
   Textbook Page 74, Menstrual cycle

5.2 INHERITANCE

5.2.1 Nature of Chromosomes, Genes and DNA Periods (21, 22)

Lesson objectives

- To explain what inheritance is
- To describe the structure and number of chromosomes found in organisms

Preparation for lesson

Teacher should prepare the vinyl or chart of Figures 5.20 and 5.21 concerned with this lesson from the Textbook. Teacher also must prepare to understand this lesson from available references such as internet website and other useful Textbooks.

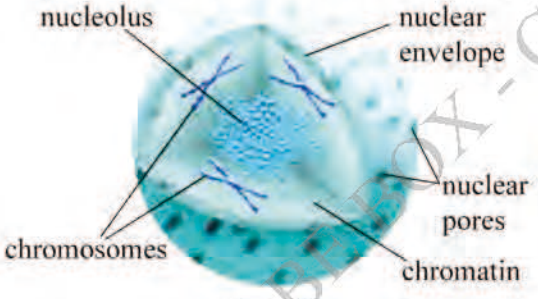
Introduction

Teacher should introduce the terms heredity and genetics concerned with this lesson. Then teacher also tells the structure and the number of chromosomes in plants and animals.

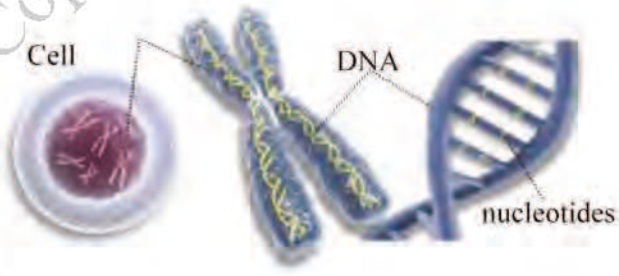
Teaching

Teacher starts the lesson with discussion on nucleus, genes, chromosomes, number of chromosome of living organisms from the Textbook. Then teacher must thoroughly explain on the terms inheritance, DNA, genes, chromosomes and karyotype that described from the Textbook.

Then, the teacher should explain the structure and number of chromosomes with the help of vinyl or illustrations from the figures of the Textbook.



Nucleus



Name of chromosomes, genes and DNA

Practice

Teacher should ask the following questions to the students: "Where is the location of chromosomes in the cell? Where is the site of the centromere in the chromosome? Do you know what is a gene?" Then, teacher must explain the term gene locus and allele concerned with this lesson.

Teacher needs to advise to the students' answers and explains about the structure of chromosomes together with number of chromosomes in living organisms.

Review and assessment

1. Describe the structure of chromosome.
   Textbook Page 74, [Each chromosome ..... segments of DNA.]
2. Define terms gene locus and allele.
   Textbook Page 75, Gene locus and Allele

Activity

- Teacher divides the students into groups.
- Draw a label diagram of Human karyotype.
- Then, ask the students following question and ask them to answers in their Workbooks. Explain the number of chromosome found in living organisms.
- Then, ask the students to discuss and compare the chromosome number of plants and animals.

Deoxyribonucleic Acid (DNA) **Periods (23, 24)**

Structure of DNA

Lesson objectives

- To explain what DNA is
- To describe the structure of DNA

Preparation for lesson

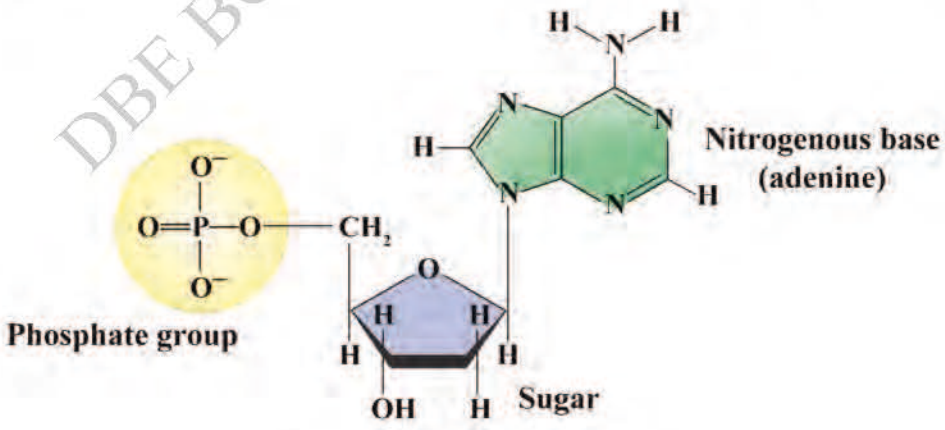
Prepare the illustrations or model of the structure of DNA found in chromosome in the nucleus of a cell from the Textbook, the other references and from internet.

Introduction

Teacher introduces that the DNA is chemical substance and it is basis of inheritance in all organisms. Teacher tells to students, DNA found in chromosome in the nucleus of a cell.

Teaching

Teacher should explain the structure of DNA and nucleotides with the help of illustrations.



Three parts of a nucleotide

Practice

Teacher asks the following questions to the students: "Explain what nucleotide is. Give the names of nitrogenous bases."

Review and assessment

1. What is DNA?
   Textbook Page 75, Deoxyribonucleic Acid (DNA)
2. What are complementary bases? OR Describe the base-pairing rule.
   Adenine and thymine are complementary bases, as are also cytosine and guanine. Complementary bases always bind with each other. They are always fixed pair. This is known as base-pairing rule.

Activity

Divide the students into groups. Ask each group to learn the structure of DNA in living organism with fully labelled diagram from the Textbook or from the vinyl chart or from the model. Then ask each group to explain, how to construct the structure of DNA found in living organisms?

5.2.2 Cellular Reproduction

5.2.3 The Role of Cellular Reproduction in Multicellular Organisms Periods (25-28)

Lesson objectives

- To study about cell division in living cell
- To describe what mitotic and meiotic cell divisions
- To explain about the role of cellular reproduction in multicellular organisms

Preparation for lesson

Prepare the illustrations from the Textbook Figures 5.24, 5.25 and from vinyl, chart or model for this lesson.

Introduction

Teacher should introduce the lesson from the Textbook by explaining about cell division.

Teaching

Teacher should explain mitotic and meiotic cell divisions with the use of vinyl or model. Teacher also explains the importance and the purposes of cell division.

Differences between mitosis and meiosis

Mitosis	Meiosis
Chromosome number stays the same	Chromosome number is halved
One division occurs to make two cells. Four stages of this division.	Two divisions occur to make four cells. Eight stages in these divisions.
Similar or homologous chromosomes do not pair.	Homologous chromosomes pair during prophase I. Pairing is called synapsis.
Two cells made are genetically identical.	Four cells made are genetically different.

Practice

Then, teacher asks the students that the number and size of chromosome changes in the cell division, "What are the result of mitotic and meiotic cell divisions?" "What are the differences between mitosis and meiosis?"

Review and assessment

1. Name the types of cell division.
   The types of cell division are mitosis and meiosis.
2. List the stages of cell division.
   The stages of cell division are prophase, metaphase, anaphase and telophase.
3. Mention the purposes of cell division.
   The purposes of cell division are growth, healing of wounds, reproduction and stem cell.

Activity

Teacher divides the students into groups. Draw the labelled diagrams of mitosis and meiosis. Then, each group of students should discuss and answer the following questions.

1. Explain the mitotic and meiotic cell divisions found in living organisms.
2. State the importance of mitosis and meiosis.
3. Give a tabulated account on mitosis versus meiosis
4. Explain the purposes of cell division.

5.2.4 The Role of Chromosomes and Genes in Inheritance Periods (29, 30)

Lesson objectives

- To describe the role of chromosomes and genes in inheritance
- To explain the terminologies in inheritance

Preparation for lesson

Study the illustrations and notes from the internet websites and from the Textbook.

Introduction

Genes are the units of heredity and responsible for inheritance. Genes contain information for the characteristics that passing genetically from the parents to the offspring.

Teaching

Teacher should explain the role of chromosomes, genes and other terminologies concerned with inheritance.

Practice

Then asks the following questions to the students: "Explain what heredity is. Describe the terms genotype and phenotype. Discuss dominant and recessive alleles".

Teacher must correct the students' answers and clear up the points that they do not understand.

Review and assessment

1. What is variation?
   Textbook Page 79, Variation
2. Define the terms homozygote and heterozygote.
   Textbook Page 80, Homozygote and Heterozygote

Activity

Ask the students the following questions and tell them to write down the answers in their Workbooks.

1. Describe the role of chromosomes and genes in inheritance.
2. Distinguish between the character and the trait.

Pattern of Inheritance **Periods (31-35)**

Lesson objective

- To predict and calculate the genotypes and phenotypes of offspring

Preparation for lesson

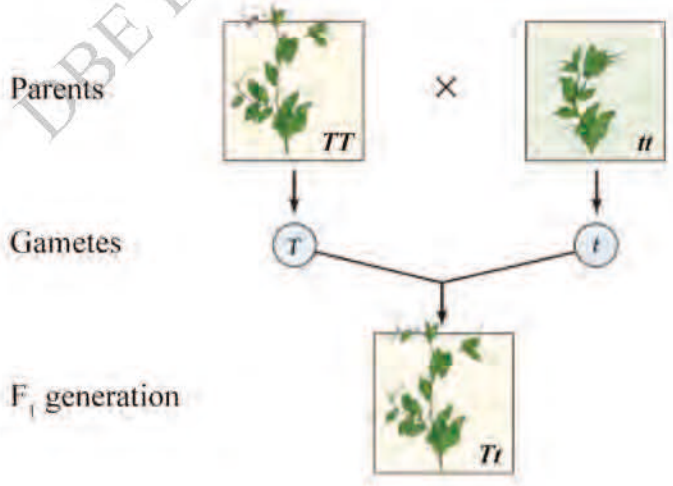
Prepare the pattern of inheritance from the Textbook.

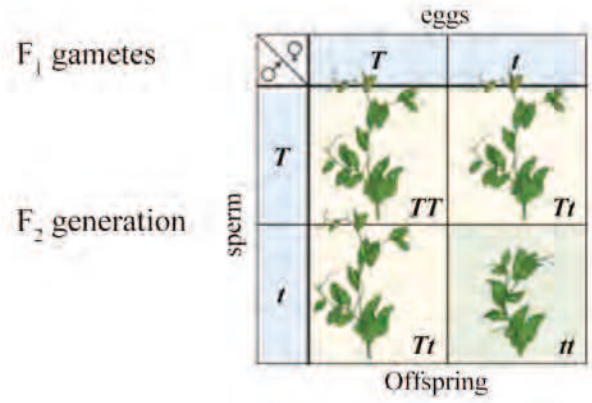
Introduction

Teacher should introduce the terms, breeding, trait, characters, etc., use in genetic problems to the students. Then, introduce the breeding experiments that are carried out to study the inheritance of characteristics in sexually reproducing plants and animals. At fertilization, male gamete fuses with female gamete to produce offspring or progeny.

Teaching

Teacher starts the lesson with explanation on terminologies. Next, teacher should explain the pattern of inheritance.





Practice

Teacher asks the following questions to the students: "How many types of gametes are obtained from heterozygous genotype and homozygous genotype? Are the results of genotypic and phenotypic ratio the same?"

Teacher must explain based on students' answers and explain on the pattern of inheritance in living organisms which is included in this lesson.

Review and assessment

1. Define the dominant and recessive traits.

   Textbook Page 79, **Dominant trait** and **Recessive trait**

Activity

Teacher divides the students into groups and asks to discuss the pattern of inheritance, then solve the following problems:

1. Determine the genotypes and phenotypes of offspring from the following matings in the guinea pig (dominant allele B produces black hair and its recessive allele b produces white hair.)
   (i) BB x BB
   (ii) BB x Bb
   (iii) BB x bb
   (iv) Bb x Bb
   (v) Bb x bb
   (vi) bb x bb

ANSWERS FOR REVIEW QUESTIONS FROM TEXTBOOK

1. Page 64, [Two main type ..... sexual reproduction.]
   Page 64-65, [Any two of Fragmentation, Fission and Spore formation]
2. Page 65, [In vegetative propagation ..... the method of vegetative propagation.]
3. Page 66, [Budding is a form ..... citrus.]
   Page 67, Figure 5.11
4. Page 68, [Just before pollination ..... two male gametes.]
5. Page 69, [The pollen tube ..... before fertilization.]
6. Page 70, [Sexual ..... a new individual.]
7. Page 71, Table 5.1
8. Page 72, Table 5.2
9. a human muscle cell (46), a mouse kidney cell (40), human skin cell (46), human sperm cell (23)
10. a mouse sperm cell (20), a mouse ovum (20)
11. Page 75, Genes
12. Page 75-76, DNA is composed of nucleotides. First paragraph of Structure of DNA and Figure 5.22
13. Page 75, Adenine (A), Thymine (T), Cytosine (C), Guanine (G)
14. Page 76, [In the two stands of DNA, ... cytosine and guanine.]
15. prophase, metaphase, anaphase and telophase
16. Page 77, Figures 5.24, 5.25
17. Page 78, Table 5.3
18. Page 79, Recessive trait, Dominant allele, Recessive allele, Genotype, Phenotype

SUMMARY

Asexual reproduction (gametes not required) and sexual reproduction (gametes required) occur in both plants and animals. Asexual reproduction takes place in yeast, *Spirogyra*, cyanobacteria and fern. Asexual reproduction in plants is commonly termed as vegetative propagation that takes place in *Bryophyllum,* rhizomes and tubers. Asexual reproduction in plants is of commercial value since the process of grafting can develop a plant variety of desired characteristics. Budding is a form of grafting most often used commercially. The axillary buds are grafted onto the stem of another plant in the procedure of budding. Sexual reproduction in plants is performed by the microspore mother cells in the anther (male) and megaspore mother cell in the ovule of the ovary (female) by undergoing meiosis and mitosis. The microspore mother cells produce four functional microspores after meiosis. The produced functional microspore undergoes mitosis to form a pollen grain with two cells. One of the cells divides to give two sperms at the time of pollination. One functional megaspore formed in the ovule undergoes mitosis to produce an egg cell. Sexual reproduction takes place by the fusion of the sperm and the egg cell in the ovule.

Asexual reproduction in animals takes place by fission, budding and fragmentation. This type of reproduction usually takes place in invertebrates. Sexual reproduction occurs in vertebrates and some invertebrates. The important structures and functions of male and female reproductive systems are given in simplified form for easy learning. The production of sperms and eggs, and process of fertilization up to birth are given.

The nucleus is a large centrally located organelle of primary importance since it controls the rest of the cell. Chromatin material lies within the nucleus. Chromatins condense to become chromosomes during cell division. Chromosomes contain DNA and genes. The life cycle of organisms requires two types of cell divisions: mitosis and meiosis. Mitosis is responsible for growth and repair while meiosis is required for gamete production. Cell division includes four stages: prophase, metaphase, anaphase and telophase. The cell cycle includes an additional stage termed interphase.

Mitosis will assure that each body cell (somatic cell) will have full diploid (2n), number of chromosomes and will be genetically identical to the mother cell. Meiosis produces four daughter cells, each with the haploid (n) number of chromosomes.

Gene inheritance involves a study of how individual genes are inherited. The same alphabetic letter is used for both dominant and recessive allele: a capital letter indicates the dominant allele and the small letter indicates the recessive allele. A homozygous dominant individual is indicated by two capital letters, and two small letters indicate a homozygous recessive individual. A capital and a small letter indicate a heterozygous individual. A heterozygous genotype produces two kinds of gametes while homozygous genotype produces only one type of gamete. The genotype of the offspring is formed by the combination of the gametes.

KEYS FOR PRACTICAL WORKBOOK

PRACTICAL 1 - OBSERVING ORGANISMS BY USING MICROSCOPE

Activity (1)

Caption: Compound light microscope

1. eyepiece
2. revolving nosepiece
3. objective
4. stage
5. diaphragm
6. power
7. lamp
8. arm
9. coarse adjustment
10. fine adjustment
11. stage control
12. base

Activity (1)

Eye piece	Objective	Magnification
10X	4X	40X
10X	10X	100X
10X	40X	400X
10X	100X	1000X

Exercises

1. (5 times)
2. (7 times)
3. (Asymmetry: C, D) (Radial symmetry: B, F, H, I) (Bilateral symmetry: A, E, G)

PRACTICAL 2 - STRUCTURE OF FUNGI AND PLANTAE

Activity (1)

Observations: The plant body of *Rhizopus* is differentiated into three types of hyphae; stolon, rhizoid and sporangiophore. The plant body of Mushroom consists of three parts; pileus, stipe and rhizoid.

Conclusion: Both *Rhizopus* and Mushroom reproduce by spores.

Activity (2)

1. Kingdom : Plantae
2. Division : Magnoliophyta
3. Class : Dicotyledons
4. Order : Sapindales
5. Family : Anacardiaceae
6. Genus : *Mangifera*
7. Species : *Mangifera indica*

Activity (3)

Observations:

Division – Bryophyta	Division – Angiospermae	Division – Thallophyta
Name – *Riccia*	Name – Roselle	Name – *Spirogyra*
Division – Pteridophyta	Division – Bryophyta	Division – Gymnospermae
Name – *Adiantum*	Name – *Funaria*	Name – Pine

Flowering Plants: Roselle

Non-flowering Plants: *Riccia, Spirogyra, Adiantum, Funaria* and Pine

PRACTICAL 3 - GROUPING AND CLASSIFICATION OF ANIMALS

Activity (3)

Vertebrates	A	D	F	G	I
Invertebrates	B	C	E	H	J

Activity (4)

A. Phylum - Chordata
B. Phylum - Cnidaria
C. Phylum - Mollusca
D. Phylum - Chordata
E. Phylum - Annelida
F. Phylum - Chordata
G. Phylum - Chordata
H. Phylum - Arthropoda
I. Phylum - Chordata
J. Phylum - Arthropoda

Activity (5)

1. Kingdom : Animalia
2. Division : Chordata
3. Class : Mammalia
4. Order : Primates
5. Family : Hominidae
6. Genus : *Homo*
7. Species : *H. sapiens*

Exercises

1.

Column A	1	2	3	4	5	6	7	8	9	10	11	12
Column B	e	h	f	a	k	b	c	g	j	l	d	i

2. A. Archaea B. Bacteria C. Eukarya D. Archaebacteria
E. Eubacteria F. Protista G. Fungi H. Plantae
I. Animalia

3.

Warm blood animals	Cold blood animals	Unicellular organisms	Multicellular organisms
1. B	1. A	1. C	1. F
2. E	2. D	2. J	2. I
3. G	3. H		
	4. K		

4.

1	2	3	4	5
A, C, D, F, G	A, G	F	D	E
B, E	C, D, F	G	C	B

PRACTICAL 4 - OBSERVING PLANT CELLS

Observations: Plant cells have cell wall, vacuole, cytoplasm, nucleus and plasma membrane. Plant cells have fixed shape. Onion cells do not have chloroplast but leaf cells of *Hydrilla* sp. have chloroplasts which contain starch.

Conclusion: A plant cell has a vacuole, nucleus, cell wall, plasma membrane and cytoplasm. A cell of a green plant has chloroplasts.

Exercises

1. membrane
2. vacuole
3. mitochondrion
4. chloroplast
5. cell wall
6. Golgi body
7. ribosome
8. rough endoplasmic reticulum
9. nucleus
10. nucleolus
11. smooth endoplasmic reticulum
12. cytoplasm

PRACTICAL 5 - OBSERVING THE COMPONENTS IN ANIMAL CELL

Activity (1)

No.	Names of components	Locations	Functions
1.	Cytoplasm	Outside of the nucleus and within the cell membrane	- Act as a site for chemical reactions to take place - Hold the organelles
2.	Nucleus	Inside the cytoplasm	- Control the cell's activities
3.	Mitochondrion	Inside the cytoplasm	- Aerobic respiration - Acts as a site for synthesis of lipids - Generate ATP as energy molecules

No.	Names of components	Locations	Functions
4.	Golgi apparatus	Located very near the rough endoplasmic reticulum and hence near the nucleus	- Collect, process and sorts molecules - Convert sugars into cell wall components - Make lysosomes
5.	Centrosome and centrioles	Near the nucleus	- Grow spindle microtubules for nuclear division

Activity (2)

smooth ER	rough ER	nucleus	centriole
lysosome	vacuole	mitochondrion	Golgi bodies

Exercises

1. a. excretory b. respiratory c. chemical d. pancreas e. circulatory
2. prokaryotic cell
3. A. endoplasmic reticulum B. mitochondrion C. nucleus D. ribosome E. centrioles

PRACTICAL 6 - OSMOSIS AND TURGOR PRESSURE

Observations: Slide 1- The cells of the onion scale gradually become turgid.
Slide 2- The cells of the onion scale gradually shrink.

Conclusions: Slide 1- The cell of the onion cell is turgid because the water outside the cell has higher water potential (low solute concentration) than in the cell. So move the water molecule across membrane into the cell.
Slide 2- The cells of the onion cell shrink because the salt solution has low water potential (high solute concentration) than the cell. So move the water molecule from the cell to salt solution.

Exercises

1. (c) rigidity and structure
2. (b) cell wall
3. (a) osmosis
4. (c) turgor
5. (a) flaccid

PRACTICAL 7 - OBSERVATION AND IDENTIFICATION OF SKELETON IN ANIMALS

Activity (2)

Exoskeleton	Endoskeleton
1. A	1. B
2. E	2. C
3. F	3. D
4. G	4. H

Exercises

1.

A. Axial skeleton	B. Appendicular skeleton
1. skull	1. girdles
2. vertebral column	2. bones of the limbs
3. sternum	
4. ribs	

2.

Exoskeleton	Endoskeleton
1. A	1. B
2. D	2. C
3. F	3. E
4. I	4. G
5. K	5. H
6. L	6. J

3. 1. pivot joint
   2. gliding joint
   3. hinge joint
   4. saddle joint
   5. ball and socket joint

PRACTICAL 8 - STARCH TEST

Observations: The green part of the leaf turns blue-black.
The inner part of the leaf is pink color turn into brown color.

Conclusion: If the starch is present, the leaf turns blue-black. If there is no starch, the leaf turns brown.

Exercises

1. (b) plants
2. (c) photosynthesis has taken place
3. (b) Iodine test
4. (a) glucose
5. (c) remove chlorophyll

PRACTICAL 9 – STUDY OF DIGESTIVE SYSTEM AND TYPES OF TEETH IN VERTEBRATES

Exercises

1. A. Macronutrients B. Micronutrients

2.

A. Macronutrients	B. Micronutrients
1. carbohydrate	1. vitamins
2. proteins	2. minerals
3. fats	
4. water	
5. fibres	

3. Caption: Digestive system in human

Labels :

1. salivary glands	4. pancreas	7. rectum	10. gall bladder
2. oesophagus	5. colon	8. appendix	11. liver
3. stomach	6. anus	9. small intestine	12. mouth

4.

1. mouth	4. stomach	7. colon
2. pharynx	5. duodenum	8. rectum
3. oesophagus	6. ileum	9. anus

5. (A) Caption: Human jaws and teeth (left side view)

1. lower jaw	3. premolars (2)	5. incisors (2)	7. root
2. molars (3)	4. canine (1)	6. crown	8. upper jaw

(B) 1. canine 2. molar 3. premolar 4. incisor

6. (a) 16 (b) 0 (c) 12 (d) 6 (e) 4 (f) 12 (g) 10

7. A. Mitosis B. Meiosis

8. A. Asexual (eg. *Hydra*) B. Sexual (man)

9. Caption. The female reproductive system in human (side view)

1. oviduct	4. cervix	7. urethra
2. funnel of oviduct	5. vagina	8. bladder
3. ovary	6. opening of vestibule	9. womb (uterus)

10. Caption. The male reproductive system in human (side view)

1. bladder	4. scrotum	7. urethra
2. seminal vesicle	5. testis	8. prostate gland
3. epididymis	6. penis	9. sperm duct

11. Functions of parts of the female reproductive system in humans
    From Textbook Page 71, Table 5.1

12. Functions of parts of the male reproductive system in humans
    From Textbook Page 72, Table 5.2

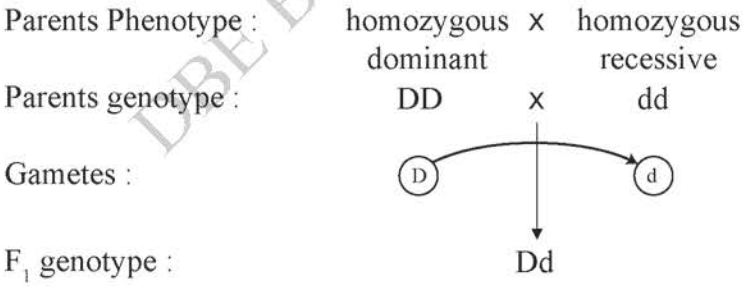
13. Caption. Developing foetus in human uterus
    1. placenta
    2. umbilical cord
    3. foetus
    4. uterine wall
    5. amniotic fluid
    6. amnion
    7. cervix

PRACTICAL 10 - EXERCISES OF MONOHYBRID CROSSES

1. - The gamete of genotype AA is Ⓐ because a homozygote produces only one kind of gamete.
   - The gamete of genotype Aa is Ⓐ and ⓐ because a heteozygote produces only two kinds of gamete.
   - The gamete of genotype aa is ⓐ because a homozygote produces only one kind of gamete.

2. (a) RR (c) Yy (e) ww (f) rr (g) TT and (h) Tt represent genotypes.
   (b) r and (d) w represent gametes.

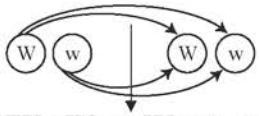
3. (a) DD (b) Dd and (e) dd represent genotypes.
   (c) D and (d) d represent gametes.
   In given: homozygous dominant is DD.
   homozygous recessive is dd.
   Cross between homozygous dominant DD and homozygous recessive dd.



4. (a) WW
   Gamete of WW is Ⓦ
   (b) Ww
   Gametes of Ww are Ⓦ and ⓦ
   (c) ww
   Gamete of ww is ⓦ

4. The genotype that consists of more than one gamete is (b) Ww.
So, crosses between Ww and Ww

Parents : Ww x Ww

Gametes : 

F_1 genotype : WW : Ww : Ww : ww

F_1 genotypic ratio : 1WW : 2Ww:1ww

5. In peas,
Given: tall plant dominant over dwarf
tall > dwarf
If homozygous tall cross with homozygous dwarf
(a) F_1: phenotype?
(b) F_2: phenotype?
(c) F_1 x tall ?
(d) F_1 x dwarf ?

(a) Cross between homozygous tall and homozygous dwarf

Parents phenotype : homozygous tall x homozygous dwarf

Parents genotype : TT tt

Gametes : 

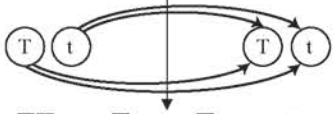
F_1 genotype : Tt

F_1 phenotype : Tall

(b) Cross between F_1 heterozygous tall and F_1 heterozygous tall

Parents phenotype : F_1 heterozygous tall x F_1 heterozygous tall

Parents genotype : Tt Tt

Gametes : 

F_2 genotype : TT : Tt : Tt : tt

F_2 phenotype : 3 tall : 1 dwarf

5. (c) Cross between F_1 heterozygous tall and homozygous tall

Parents phenotype : F_1 heterozygous tall x tall parent

Parents genotype : Tt TT

Gametes : T t T

Offspring genotype : TT : Tt

Offspring phenotype : All tall

(d) Cross between F_1 heterozygous tall and homozygous dwarf

Parents phenotype : F_1 heterozygous tall x dwarf

Parents genotype : Tt tt

Gametes : T t t

Offspring genotype : Tt : tt

Offspring phenotype : 1 tall : 1 dwarf

Answers: (a) The phenotype of the F_1 is all heterozygous tall.
(b) The phenotypes of the F_2 are 3 tall : 1 dwarf
(c) The phenotypes of the offspring are all tall.
(d) The phenotypes of the offspring are 1 tall : 1 dwarf

6. Given: brown eye B > blue eye b
Genotype of brown eye are BB, Bb
Genotype of blue eye is bb

(i) BB x Bb

Parents phenotype : brown eye x brown eye

Parents genotype : BB Bb

Gametes : B B b

Offspring genotype : BB : Bb

Offspring phenotype : All brown

6. (ii) Bb x bb

Parents phenotype :	brown eye	x	blue eye
Parents genotype :	Bb		bb
Gametes :	B b		b
Offspring genotype :	Bb	:	bb
Offspring phenotype :	1brown	:	1blue

Answer: (i) The genotypes of offspring are BB and Bb.
The phenotypes of offspring are all brown because brown > blue.

(ii) The genotypes of offspring are Bb and bb.
The phenotypes of offspring are 1 brown and 1 blue.

7. Determine the genotypes produced from the crosses of (a) RR x RR, (b) RR x Rr, (c) Rr x Rr and (d) Rr x rr (you need to show the manner of crossing).

Answer

(a) RR x RR

Parents :	RR	x	RR
Gametes :	R		R
Offspring genotype :		RR	

(b) RR x Rr

Parents :	RR	x	Rr
Gametes :	R		R r
Offspring genotype :	RR	:	Rr

(c) Rr x Rr

Parents : Rr x Rr

Gametes :

Offspring genotype : RR : Rr : Rr : rr

1RR : 2Rr : 1rr

(d) Rr x rr

Parents : Rr x rr

Gametes : R r r

Offspring genotype : Rr : rr

Answers: The genotype produced from cross (a) is RR.
The genotypes produced from cross (b) are RR:Rr
The genotypes produced from cross (c) are 1RR:2Rr:1rr.
The genotypes produced from cross (d) are Rr:rr.

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