Unit–7

THE LIVING WORLD

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CONTENTS

Introduction

Living and nonliving things are two major components of our environment. We can recognize a living organism on the basis of certain characteristics which make them different from the nonliving things. Characteristics such as ability to move, breath, grow and reproduce are some we are all familiar with.

Despite the basic similarity between living things we see a vast variety of living things. Each type of living thing is different from the other and yet alike in their basic characteristics. This is what scientists call unity in diversity. To have better knowledge and understanding of the living world scientists have identified the characteristics of living things, named organisms and systematically classified them into groups. Classification of living things is based on their characteristics. In this unit, we shall study about the major characteristics of living things and their classification.

When one looks at the variety of living things and their characteristics one cannot help thinking about their structure because it is the way they are made which enables them to perform all the functions. To understand how living things function, it is essential to understand their basic structure. A major topic discussed in this unit is cell. Cell is the basic unit of structure function in living things. What is the structure of cell? How cells divide? What is the importance of cell division? You will find answers to these and other similar questions in the fifth section of the unit.

We observe that a gram seed always grow into a gram plant and animals always give birth to their own kind. We also observe that no two organisms are alike and that is why we see such a variety of organisms. What is the mechanism which ensures that parents' characteristics are transferred to the next generation? How children of the same parents are similar to their parents and siblings and yet they are different in many respects? We shall find answers to these questions in the seventh section.

It is hoped that you will find this unit interesting and informative.

Objectives

- After completing this unit, you will be able to:
- list and describe characteristics of living things
- classify plants and animals into kingdoms, classes, families and orders.
- explain the structure of cell.
- describe the process of simple cell division.
- explain the difference between mitosis and meiosis.
- define gene and their function
- explain the term biotechnology and its application.

7.1 Living and Non-Living Things

Living things and non – living things are two of the major components of the our environment. Living things include plants, animals and human beings. Non – living things include natural as well as man made things e.g. mountains, rocks, soil, rivers, manmade buildings and objects. Both the living and non – living things are essential components of the environment. Living things including man depend on their non – living environment for food, shelter and other basic needs of life. How we differentiate between a living and a non living organism? There are certain signs which tell us whether an object is a living organism or not. In the next section we shall read about characteristics of living things.

7.1.1 Characteristics of Living Things

The characteristics of living things include the following:

Characteristics of Living things
• Movement
• Nutrition
• Respiration
• Excretion
• Growth
• Sensitivity
• Reproduction
• Definite life cycle

Movement

Ability to move their parts or whole body is a characteristic of living things which we observe first. However, do not see plants moving the way animals move. In plants there is a partial movement of their parts. Have you ever thought how branches of plants move towards sun? You may have observed sunflowers and how they turn towards sun? Plant movements are partial and non reversible i.e. once their parts move they cannot go back to previous position.

Movements allow plants to reorient themselves in relation to changes in their surroundings. Plants need sunlight so their branches grow towards sun. Similarly vines need support to climb so when their branches come in touch with a solid object like a pole or trunk of another tree they wind around it. These are examples of partial movements in plants of which non – living things are not capable.

Nutrition

All living things require energy for the sustenance of life. Living things obtain this energy from food. Assimilation and uses of food for energy, growth, replacement and repair of

damaged parts is called nutrition. Food is the basic need of all living things. However animal obtain it by eating other animals and plants whereas plants prepare their own food from carbon dioxide and water using sun light as a source of energy to prepare food.

Respiration

Respiration is another characteristic feature of living things. All living things need oxygen to live which they get from their environment. The process of taking in oxygen and excreting carbon dioxide is termed as respiration. We can observe respiration in animals as they breathe. But we cannot directly observe this function in plants. Plants take in oxygen through the process of diffusion. To prepare their food they also absorb carbon dioxide through the process of diffusion. This process is called "photosynthesis" i.e. synthesis or preparation of food using light energy. The oxygen from the air spaces in the leaves and stems diffuses into the plants.

Excretion

In the body of living organisms a number of processes are going on as a result of which waste materials are produced. The body needs to get rid of waste products as they can poisonous for the body. Urea, carbon dioxide, solid waste and sweat are the waste materials produced in the body of the animals. The process through which a living organism removes the waste materials is called excretion. It is characteristic of both animals and plants. In plants carbon dioxide is produced as a result of respiration which is excreted through leaves. This process is most active at night that is the reason sitting under trees at night is dangerous.

Growth

An increase in the size of an organism which is irreversible is called growth. We sow seeds in few weeks time they grow into a plant, similarly a chick changes into a hen, and human child grows into an adult. These are all examples of growth in living organisms. You may argue that non-living object like a 'crystal' can also grow in size. However in a crystal the growth takes place due to the addition of more particles on the outer surface of the crystal. In contrast to this, growth in a living organism takes place as a result of many chemical and physical changes in the body of the organism. In this process new materials and parts are developed.

Sensitivity

Organisms as a whole or their parts respond stimuli. A change in the environment of the organisms to which they respond is called a stimulus (plural is stimuli). Sensitivity is the ability of living organisms to respond to stimuli.

Living organisms react or respond to the stimuli to seek safety from a danger, to fulfil a need. For example when a cat see a dog it runs away, or when it smells meat it tries to get it. Plants are also sensitive to various stimuli such as gravity, light, touch and change in temperature. Plant bends towards the source of light. Plants movement towards light is called phototropism. You may have seen a plant called touch me not. When we touch its leaves they fold up. You may have observed that in hot summers plant leave fold up. This

is their response to increase in temperature. In this way they control evaporation of water from leaf surface.

Non-living things are not sensitive to stimuli.

Reproduction

There is continuity to life. All living organisms reproduce young ones of their own kind. Different types of organisms have different mechanism of reproduction. Some give birth to young ones, others lay eggs. Plants reproduce in many ways. Some plants reproduce through seeds, in others a part of plant body like a shoot or bud can grow into a new plant.

Definite Life Cycle

Living organisms have a definite life-cycle. They are born; they grow, reproduce, become old and die.

Key Points

1. Living things have certain characteristic features which are not found in non – living things.
2. Nutrition, respiration, excretion, growth, reproduction, sensitivity and definite life cycle are characteristics of living things.

Self Assessment Exercise 01

Q.1 Select the correct answer:

i. Which of the following is not a characteristic feature of animals?
   a) Respiration
   b) Photosynthesis
   c) Reproduction
   d) Movement

ii. In which of the following the movement is partial?
   a) Fish
   b) Insects
   c) Green plants
   d) None of these

iii. Phototropism is plant's response to...
   a) Temperature
   b) Gravity
   c) Light
   d) Touch

iv. Non – living things like crystals or rocks grow in size as the living beings do but their growth is different because it...
   a) Does not involve addition of materials.
   b) Is not a continuous process
   c) Does not involve formation of new parts.
   d) Is limited to some parts of the object

Q.2 Write brief answers

   i. What is the difference in respiration and movement in plants and animals?
   ii. What are the indications of sensitivity in plants?
   iii. Compare the growth in non living objects with the living organisms.
   iv. Give examples of movements in plants.

7.2 Animals and Plants

A number and variety of living organisms is found on this planet earth. Studying the millions of animals and plants would be very difficult without sorting them into some sort of meaningful order i.e. classifying them. Just as making a good use of a library would be difficult without grouping the books in some systematic manner. Similarly studying the enormous number and vast variety of life without classifying living organisms will be difficult if not impossible.

Classification is grouping of living organisms according to similarities and differences of their characteristics. To identify animals and plants and to learn more about them, it helps to classify them. Biologists arrange organisms into groups on the basis of characteristics i.e. traits which are common. This systematic way of classifying organisms is the basis of the field of study called taxonomy.

Carolus Linnaeus (1758) a Swedish scientist, was the founder of modern taxonomy. At the time when Linnaeus wrote the taxonomy international language was Latin and still most of the scientific names are in Latin.

Figure 1: Carlolus

This system each type of animal and plant has one and only one scientific name which is not given to any other type of the organism. Then he presented a method for organizing all these named organisms into hierarchical groups, based on their similarities and differences. It is like a filing system, with the top levels including large number of different kinds of organisms and the lowest levels containing only a single type of plant or animal. In this hierarchical system of Linnaeus clearly defined shared characteristics are used to classify organisms into each group represented by these different levels.

Under this system organisms are first divided into very large groups. The biological term for these groups is “kingdom”. There are two major kingdoms: “animal kingdom” and “plant kingdom”. However there are many organisms which do not share characteristics with either animals or plants or which have some characteristics of a plant while others of an animal. Some biologists have put these in separate kingdoms. So besides animal and plant kingdom there are kingdom Monera, kingdom Protista, and Fungi. However it is not universally agreed upon classification there are other classifications systems also.

Kingdoms are again subdivided into groups containing fewer organisms than kingdom but having more features in common. These groups are called “phyla” (singular phylum).

Each phylum is then divided into smaller groups called “classes”. Classes are divided into orders, each order is divided into families and families into “genera” (singular genus) and genera are divided into species. All human beings are placed in genus “homo” and species “sapiens”. So the biological group of human beings is “Homo sapiens”! This is

the simplest classification there are other systems of classification which are more elaborate and have many more groups like sub orders and subfamilies.

Every species of organisms has been given a double name, one name for its genus the other for species. Genus name is always started with a capital letter and species name with small letter. Scientific name for domestic cat is "Felis catus", similarly scientific name for rose is Rosa berberifolia.

Species is the name given to the group of organisms so similar that they can mate together and produce young ones of their own kind.

Activity 1

Collect different types of leaves or items of stationary or cutlery and try to classify them into groups and subgroups. Use their common characteristic such as shape, colour, and texture of leaves. You must use one major characteristic to put them in one group. For example put all round leaves into one group and long leaves into the other. Then subdivide each group on the basis of texture e.g. soft, hard surface.

7.2.1 Kingdom Monera

Bacteria and a kind of water plants named blue green algae have been placed in this kingdom. Their body is formed of only one cell however their structure is different from other organisms made of one cell.

Viruses are also included in this group. These are smallest organisms which cannot be seen with a light microscope. Electron microscope is needed to observe virus since they are hundred times smaller than bacteria.

7.2.2 Kingdom Protista

All single celled organisms (called unicellular organisms) have been place into this kingdom. We need a microscope to see these organisms. Some of the members of this group have green colour substance called chloroplast and like all green plants they make their food through the process of photosynthesis. Chlamydomonas also belongs to this group.

There are other unicellular organisms in this group which are more like animals as they take in food and digest it; Amoeba, Paramecium, Stentor are examples of these organisms. These are also called Protozoa. Some biologists put them in a separate kingdom called Protozoa.

7.2.3 Kingdom Fungi

The mould that we see growing on stale bread, rotten fruit, or other foods and mushrooms which are often found sprouting here and there after rain belong to this kingdom. Fungi live and feed on dead organisms hence are called Saprophytes. These with the exception of yeast (Yeasts are unicellular organisms, consist of oval or round

cells, and reproduce chiefly by budding. We use yeast to ferment bread) are multicellular organisms. Their bodies are made of thin thread like structures called “hyphae”. In some these hyphae are spread like a network while in others they are bundled into a compact structure called “mycellium’. The stalk like structure we see in mushrooms is mycelium.

Figure 2: Fungai

7.2.4. Kingdom Algae

Algae are simple organisms. Like green plants they have chlorophyll and make their own food. They are largely aquatic organisms. They occur in a variety of other habitats: moist stones, soils and wood. Their unicellular variety has been placed in kingdom Protista. The algae reproduce by vegetative, asexual and sexual methods. Algae are of many different types, red, green, brown and golden algae are common Examples: Volvox, Ulothrix, Spirogyra and Chara are few of the examples of Algae.

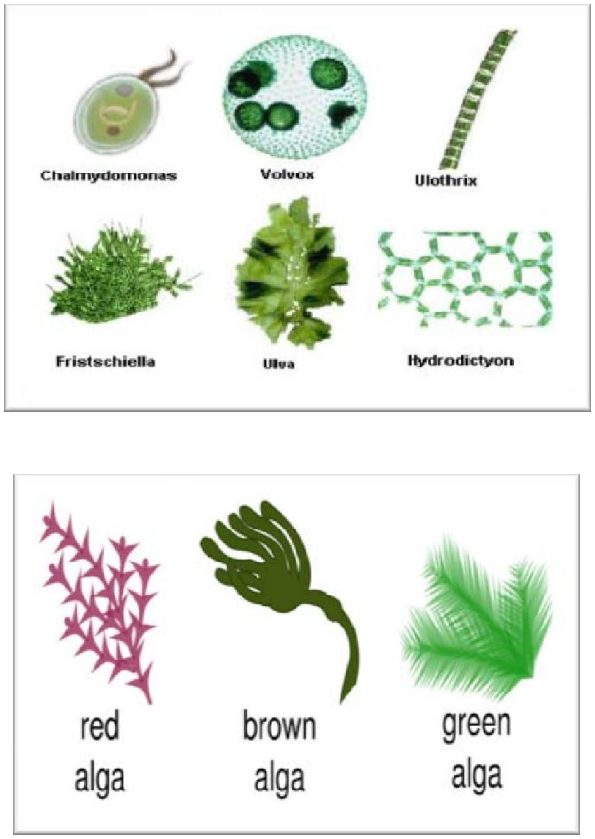


Figure 3: Different Types of Algae

Key Points

1. Classification is grouping of living organisms according to similarities and differences of their characteristics.
2. The term "kingdom" is used for the largest groups of organisms having common characteristics.
3. Kingdoms are again subdivided into groups containing fewer organisms than kingdom but having more features in common. These groups are called "phyla" (singular phylum).
4. Kingdoms are subdivided into groups having more features in common. These groups are called "phyla" (singular phylum). Each phylum is divided into smaller groups called "classes". Classes are divided into orders and orders into families, families to even smaller groups called genera and genera into species.
5. Kingdom Monera includes organisms formed of only one cell however their structure is different from other unicellular organisms. Bacteria and viruses fall in this group.
6. Kingdom Protista includes unicellular organisms. Their cell structure is different from organisms in kingdom Monera.
7. Kingdom Fungi includes moulds and mushrooms. They feed on dead organisms.
8. Kingdom Algae comprises of plants mostly living in water. These are multicellular and are autotrophs.

Self Assessment Exercise 02

Q.1 Choose the correct answer:

i. What is the biological term used for largest groups of organisms?
   a) Phylum
   b) Order
   c) Kingdom
   d) Family

ii. How is the kingdom Monera different from protista? Kingdom Monera ---
   a) Includes only unicellular plants
   b) Consists of multicellular organisms,
   c) Organisms which have different cell structure
   d) Includes primitive organisms.

iii. To which of the following kingdom mushrooms belong?
   a) Protista
   b) Monera
   c) Algae
   d) Fungi,

iv. Which of the following has chloroplast in their cell?
   a) Chlamydomonas & Volvox

b) Amoeba & Viruses
c) Moulds & Bacteria
d) Paramecium & Yeast

v. Saprophytes is an organism which...
a) Can prepare their food
b) Live on other organisms as parasites,
c) Are beneficial for their host
d) Use dead organisms as their food

Q.2 Answer the following questions:

i. Compare the characteristics of Algae and Fungi.
ii. Which type of organisms have been categorized under kingdom Monera?

7.3 Kingdom Plantae

This kingdom is divided into two major groups: non – flowering and flowering plants.

7.3.1 Non-flowering plants

As the name indicates Non-flowering plants do not have any flowers. They only have leaves and cannot have fruits. Non-flowering plants have following groups.

Bryophytes

Plants in this group have no flowers. These are commonly found in moist shaded areas in the hills. They have multi cellular body. Some Bryophytes have leaf like body called thallus while others have a stem with leaf like structures arranged on either side. They lack true roots, stem or leaves. However, they possess structures which resemble roots and stems in higher plants. Root like structure called Rhizoids serves the function of roots. They have chlorophyll and prepare their own food i.e. they are autotrophs.

Figure 4: Bryophytes

There are two divisions of Bryophyta:

1. Liverworts
2. Mosses.

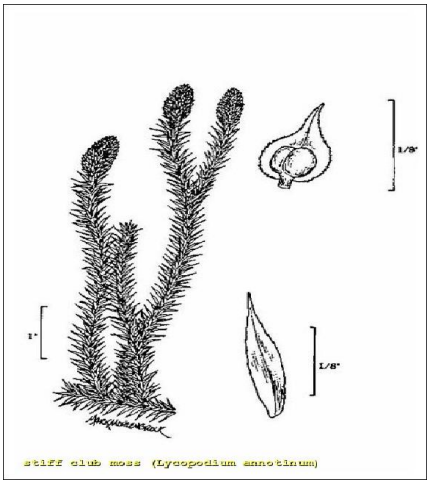
Common Examples include Funaria, Polytrichum and Sphagnum.

Pteridophytes

These are also non – flowering seed less plants. They produce spores which grow into new plant. These plants have chlorophyll and make their own food i.e. they are also autotrophs. The pteridophytes are vascular plants that they have a system of vessels for transport of food and water. The pteridophytes are found in cool, damp, shady places. Their body consists of true root, stem and leaves. Examples include horsetail, club mosses, psilotum, adiantum, pteris, and dryopteris.

Fern

Club Moss Lycopodium



Club Moss Lycopodium

Gymnosperms

These are non – flowering, vascular plants. They include pine trees you may have seen in Murree. The word "Gymnosperm" is a Greek word and it means "naked seed" (*gymno means* naked, *sperm* means seed). Unlike flowering plants which have their seeds enclosed in an ovary (i.e., fruit), seeds of Gymnosperms are exposed. Pine trees that you all are familiar with belong to this group. Other examples include; cycads, gnetum, ephedra, and welwitschia. All of them are woody trees, some shrubs, also adapted to desert life. It covers large area of earth.

Figure 5: Gymnosperms

7.3.2 Flowering Plants

Angiosperms

This group includes all the flowering plants which we see around us. They produce seeds. Unlike gymnosperms their seeds are enclosed in fruit (ovary).

They have a well developed vascular system. The angiosperms are a large group of plants occurring in wide range of habitats. They range in size from tiny, almost microscopic Wolfia to tall trees of Eucalyptus (over 100 metres). They provide us with food, fodder, fuel, medicines and several other commercially important products. On the basis of their seed structure Angiosperms are divided into two classes:

1. Dicotyledons
2. Monocotyledons

The dicotyledons are characterized by having two cotyledons in their seeds while the monocotyledons have only one. Gram seed, kidney beans, and coriander seed are a few examples of dicotyledonous seeds. The seeds can be divided into two parts or cotyledons whereas the seeds of wheat and corn cannot be divided into two parts. The former are dicotyledonous while the latter are called monocotyledons seeds.

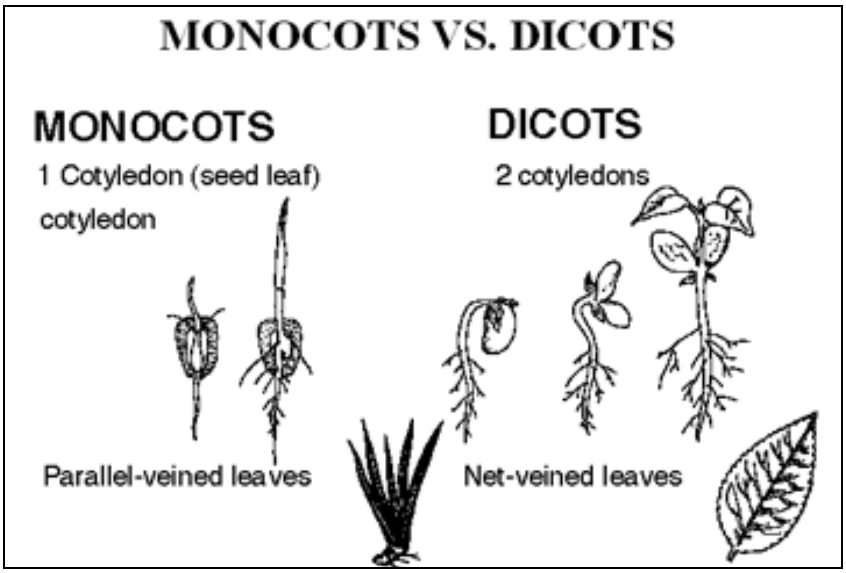


Figure 6: Monocots and Dicots

Key Points

1. The arrangement of organisms into groups and subgroups on the basis of similarities and differences is Classification.
2. The largest group of plants which consists of all plants is named as "kingdom Plantae".
3. The kingdom Plantae has been classified into flowering and non flowering plants.
4. Non flowering plants include algae, bryophytes, pteridophytes, and gymnosperms. They do not bear flowers and fruits.
5. Flowering plants or Angiosperms produce seeds, fruits, and flowers.
6. Angiosperms are divided into monocotyledons and dicotyledons, on the basis of number of cotyledons in seed.

Self Assessment Exercise 03

Q.1 Encircle the correct option.

i. Which of the following group of plants lacks true roots and stems?
   a) Angiosperm
   b) Gymnosperms
   c) Pteridiphyta
   d) Bryophyta

ii. Parallel-veined leaves are present in:
   a) Monocots
   b) Dicots
   c) Algae
   d) Ferns

iii. Mosses and liverworts are included in:
   a) Algae
   b) Bryophytes
   c) Fungi
   d) Pteridophyta

iv. Naked seeds are present in:
   a) Gymnosperms
   b) Angiosperms
   c) Ferns
   d) Algae

v. Which of the following group has well developed vascular system and has flowers?
   a) Algae
   b) Gymnosperm
   c) Pteridophyta
   d) Angiosperm

Q.2 Give short answers

i. What is the major difference between gymnosperms and angiosperms?
ii. How would you recognize monocot and dicot plants?
iii. Can you differentiate between bryophytes and pteridophytes?
iv. Write the names of groups of non-flowering plants.
v. Write a note on characteristics of flowering plants give some examples.

7.4 Classification of Animals

The animal kingdom has been divided into two large groups, Vertebrates and invertebrates. Vertebrates include the animals which have a back bone while invertebrates are animals without back bone. There are many phyla of invertebrate some of which are discussed below.

7.4.1 Invertebrates

As stated above the group invertebrates include animals without backbone.

Phylum-Protozoa

In this phylum single celled (unicellular) animals have been included. More than 50,000 living species of Protozoa have so for been described. These are very small, microscopic animals. They are found everywhere; in soil, in water and even inside the bodies of other animals including humans. Protozoa which live as paracite in human body cause diseases like malaria, dysentery, etc. Common examples: Amoeba, Parmecium, Plasmodium (malarial parasite). Some Protozoa's which live in the body of other organism benefit from the host body without causing harm to it; in some cases host benefit from the Protozoan. This type of relationship in which either of the two takes benefit is termed as "commensalism".

In Protozoa new individuals are produced by division of the organism into two, this is called binary fission (bi = two, fission = breaking), spore formation or by a process in which two organisms temporarily unite and exchange nuclear material and then each organism divide into two thus two new individuals are formed, this process is called "conjugation".

Activity 2

Carefully observe the diagram below and note down the shape of different Protozoa. See how they are different and how they are alike.

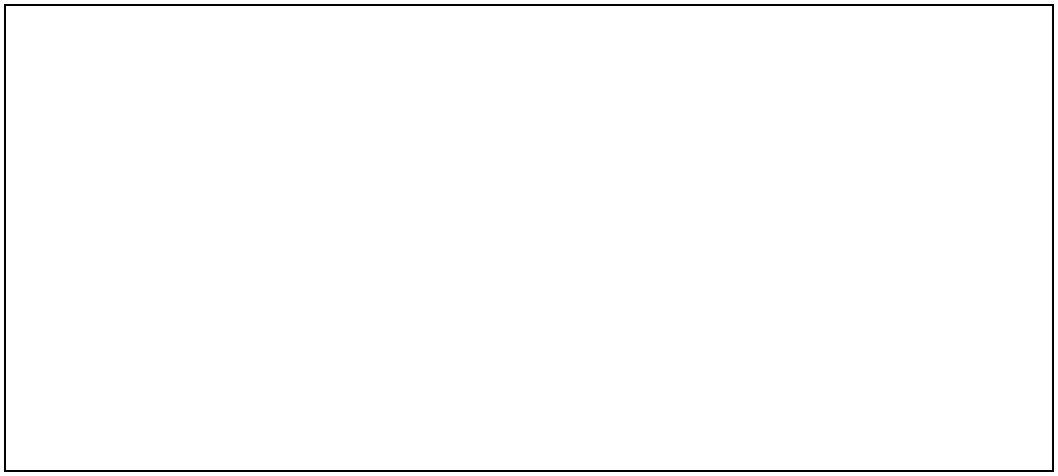


Figure 7: Invertebrates

Phylum – Porifera

Porifera are commonly known as sponges**.** The name "Porifera," means “having pores”. These are simplest form of multi-cellular animals which live permanently attached to a location in the water. There body does not have tissues, organs and systems. The body of a spore has numerous pores which let water flow through it continually. These pores open into internally into a system of canals. It has one or more larger holes which open outside. Water moves through these canals throughout the sponge's body. Special cells line these canals. The water while moving through the sponge brings oxygen and nutrients and takes away carbon dioxide and waste. Sponges reproduce by budding or by fragmentation. Sexual reproduction also takes place.

There are from 5,000 to 10,000 known species of sponges. Most sponges live in salt water **-** only about 150 species live in fresh water. These are primitive animals which evolved over 500 million years ago.

Sponges are found in variety of shapes, some are tube like, others have fan like body and there are some which resemble cup, cones, blobs, barrels, and crusts. Their size range in from a few millimeters to 2 meters tall.

Figure 8: Phylum – Porifera

Phylum – Coelenterata (Cnidaria)

The name “Coelentrate” means “hollow gut”. The name indicates that their body is like a gut. Hydra is one of the coelenterates. If you observe it under a microscope you will see that its body is like a hollow tube or stalk. It has a mouth opening at the top. Animals in this group live in water i.e. they are aquatic. Some are permanently attached to some support and are immovable, others are free-swimming. These are radially symmetrical animals.

Radial symmetry means that if the organism or part of it is vertically cut through the axis in any of two or more planes it will produce two halves that are mirror images of each other.

The size of coelenterate varies from 1mm (Hydra) wide to giant jelly fishes about meters in diameter. They have tentacles around their mouth. They use the tentacles for their

defence and capturing prey. Jelly fish, Sea anemone and Hydra are examples. There are about 10,000 species of Coelentrates.

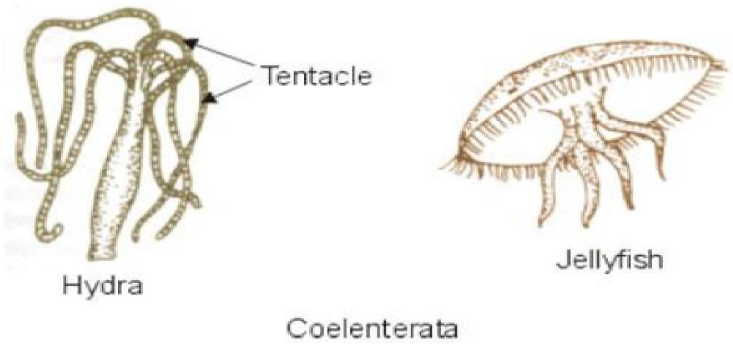


Figure 9: Phylum – Coelenterata (Cnidaria)

Phylum – Platyhelminthes

This phylum includes primitive type of animals. The upper and lower surface of these animals is flat in biological terms they have dorso-ventrally flattened body, hence are called flatworms. Flatworms are bilaterally symmetrical; that is, the left and right halves of the body are mirror images of one another. These are mostly found in the body of animals including human beings that is they are endoparasites. For example some live in the intestine of animals and human beings. Some of them absorb nutrients from the host directly through the surface of their body. Planaria, Taenia (Tapeworm), Fasciola (Liver fluke) are few examples of Platyhelminthese. About 7000 living species are described in this phylum.

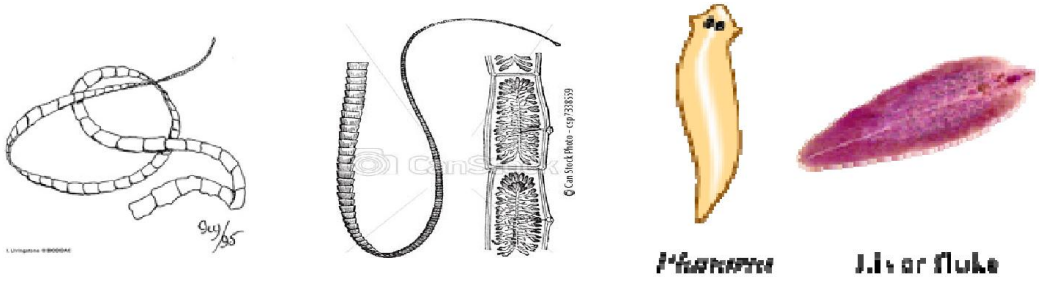


Figure 10: Phylum – Platyhelminthes

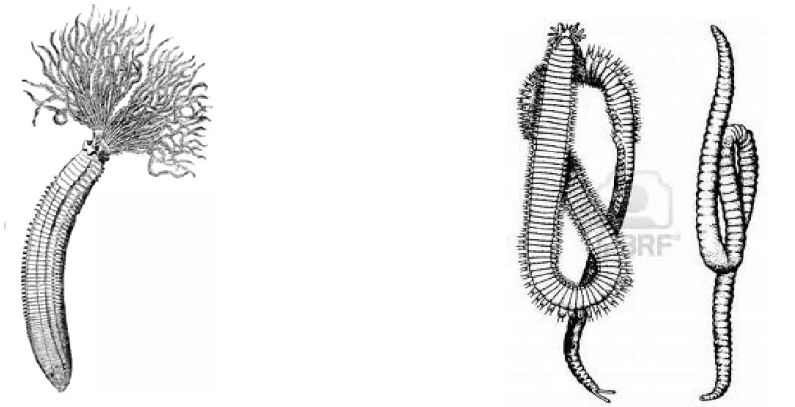
Phylum – Nematoda (Aschelminthes)

The body of the nematode is long and round, hence the name roundworms has been given to this group. They may be free living, aquatic and terrestrial or as parasites in plants and animals. Some of the examples include: Ascaris (Round Worm), Wuchereria (Filaria worm). About 500,000 living species have been described in this group.

Figure 11: Phylum – Nematoda (Aschelminthes)

Phylum – Annelida (Segmented worms)

They may be aquatic or terrestrial; free-living, and sometimes parasitic. About 1,000,000 species have been described. They have bodies consisting of many similar parts called segments. Each segment is marked off from the other by a ring. Common Earthworm is one example of this phylum you all have seen. Other examples include Nereis, Blood sucking leech. About 7000 species are described in this group.



Sea Anemone *Polychaete and Earth worm*

Figure 12: Phylum – Annelida (Segmented worms)

Phylum – Arthropoda

Arthropods are the most numerous animals on Earth. The Arthropods have segmented body with tough outer skin, the cuticle. Cuticle is a form of external skeleton or exoskeleton. Exoskeleton protects and supports the body. They have jointed legs.

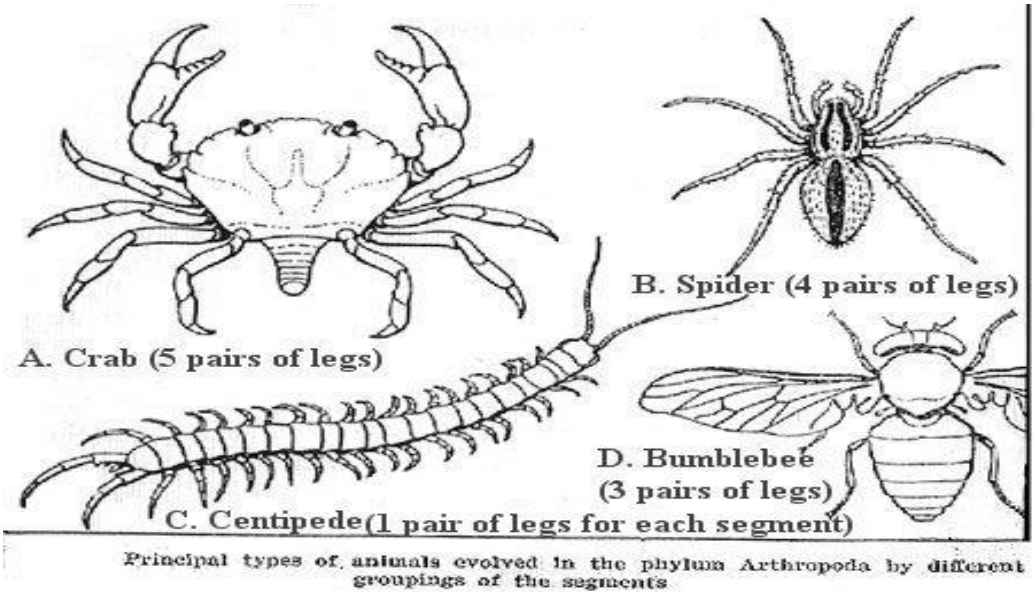
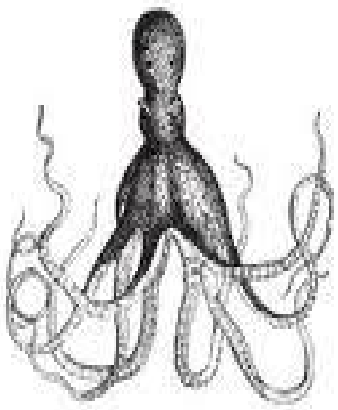


Figure 13: Some Arthropods

Phylum – Mollusca

This is the second largest animal phylum approximately 100,000 species are included in this group. Molluscs are terrestrial or aquatic. Their body is soft, covered with a shell. They have a muscular foot for locomotion. Examples: Apple snail, Pearl oyster, Sepia (Cuttlefish), Squid, Octopus.



Octopus

Figure 14: Some Molluscs

Phylum – Echinodermata

Exclusively marine in habitat. Approximately 6500 species are described. These animals have an endoskeleton of calcareous ossicles and, hence, the name Echinodermata (Spiny bodied).Examples include Star fish, Sea urchin, Sea lily, Sea cucumber and Brittle star.

Figure 15: Echinoderms

7.4.2 Vertebrates

These are animals with backbone in their body. This group has been divided into five classes.

Class Fishes

These are aquatic animals. They have a body shape which helps them to move in water as effectively and quickly as possible. Body shape which helps to move in liquid or gas effectively and quickly is called "streamlined body". Their body is divided into head, trunk and tail. They possess fins for swimming and gills for respiration. A cover called Operculum is present on gills. Their body surface has scales. They are cold blooded animals. They live in fresh water, rivers, sea, ponds, hill streams, lakes. There size ranges from one inch (gobies) to 40 feet long (e.g. shark). Over 30,000 species have been described. They are mostly oviparous i.e. lay eggs.

Examples include Flying fish, Hippocampus (Sea horse), Labeo (Rohu), Scolcodon (dog fish) shark, trout.

Figure 16: Class fishes

Class – Amphibia

The representatives of class Amphibia live both on land and in water that is why they have been given the name, "amphibia".

Amphibians are cold-blooded animals, meaning they do not have a constant body temperature but instead take on the temperature of their environment. They have moist, scale less skin that absorbs water and oxygen. Amphibians are most often found near areas where freshwater is available. Some amphibians become inactive when conditions are unfavourable for survival. This period of inactivity is called estivation when it occurs during hot, dry weather and hibernation when it occurs in response to cold temperatures. Activity resumes when favourable conditions return.

The thin skin of amphibians contains many glands. In some species poison glands are present in the skin to protect them against predators. For example in a type of frog the poison is particularly toxic. South American Indians use this poison to coat the tips of their arrows. Some amphibians protect themselves from enemies by changing colour to blend in with their surroundings. Sexes are separate. They are oviparous and lay eggs which have no shell. Eggs are usually laid in water or in a moist environment and fertilized externally. They change from an aquatic larval stage to a terrestrial form on reaching adulthood i.e. they go through metamorphosis. Respiration takes place either separately or in combination by lungs, skin, and gills. They have a three-chambered heart consisting of two atria and one ventricle.

Toad (Bufo), Frog (Rana), Tree frog (Hyla), and Salamander (Salamandra) are some of the examples.

Figure 17: Class – Amphibia

Class – Reptilia

Class reptilia includes animals which are cold blooded. The skin has dry scales which prevents water loss through the skin and protect the body. Most of the Reptiles are considered as tetra pods i.e. have two sets of paired limbs. Most of these animals have five clawed toes on each limb. All reptiles have spinal columns and a strong skeletal system with a rib cage. They have a well-developed brain and a central nervous system.

They have well-developed lungs. Most of them have two lungs, except some snakes. All Reptiles except crocodile have three-chambered heart. Crocodiles have four-chambered heart like mammals and birds.
Reptiles lay eggs which have protective shell. The offspring of reptiles resemble the adults at the time of birth itself. There is no metamorphosis, as in the case of amphibians.

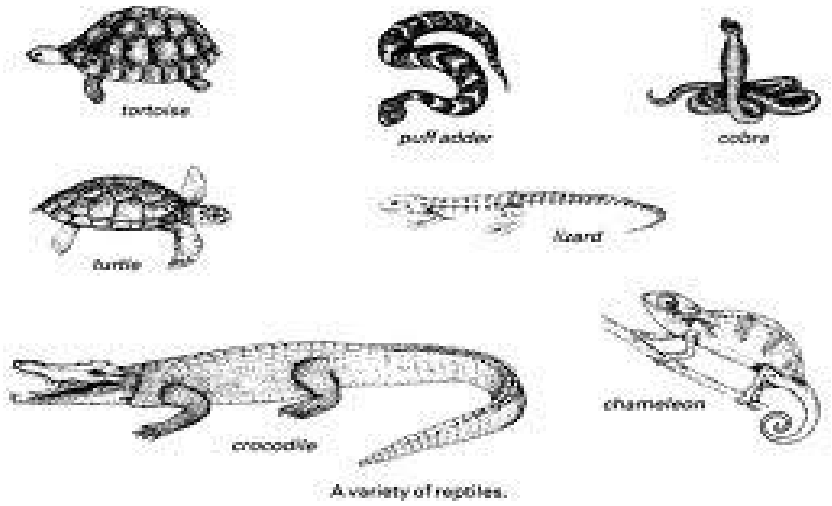


Fig 18: Class – Reptilia

Class – Aves

The characteristic features of Aves (birds) are the presence of feathers and most of them can fly except flightless birds (e.g., Ostrich). They possess beak. The forelimbs are modified into wings. The hind limbs generally have scales and are modified for walking, swimming or clasping the tree branches. Skin is dry without glands except the oil gland at the base of the tail. The digestive tract of birds has additional chambers, the crop and gizzard. They are adapted to various types of conditions e.g. they can fly in air, swim in water and walk on ground.

Heart is completely four chambered. They are warm-blooded animals. Respiration is by lungs. Sexes are separate. Fertilization is internal. They are oviparous and development is direct.

Examples: Crow, Pigeon, Parrot, Ostrich, Peacock, Penguin, Vulture.

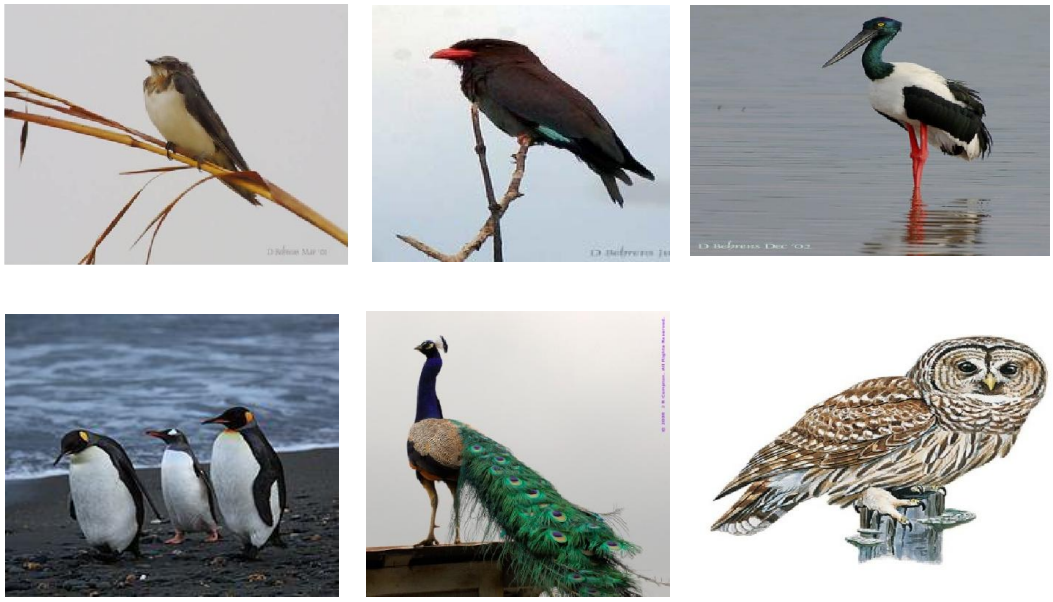


Figure 19: Birds

Class – Mammalia

Animals in this class has the most unique characteristic that is the presence of milk producing glands (mammary glands) hence the name "Mammalia" has been given to this class. The second distinguishing feature of Mammals is presence of hair on the skin. They have two pairs of limbs, adapted for walking, running, climbing, burrowing, swimming or flying. External ears or pinnae are present.

Mammals have a four-chambered heart. They are warm blooded (Endothermic) animals i.e. they can control their body temperature. They give birth to young ones. However there is an exception egg laying platypus is a mammal. Kangaroo, Flying fox, Camel, Monkey, Rat, Dog, Cat, Elephant, Horse, Blue whale, Tiger, Lion, dolphin, sealion are few examples.

Platypus

Koala Bear

Squirrel

Tiger

Key Points

1. The animal kingdom has been divided into two large groups, Vertebrates and invertebrates.
2. Phylum protozoa include single celled animals.
3. Phylum porifera includes multicellular organisms commonly known as sponges.
4. Phylum Coelentrata include multicellular water plants having a hollow body.
5. Phylum Platyhelminthes include flat worms some of which are parasites.
6. Phylum Nematoda includes round worms. Some of these are parasites others are free living animals.
7. Phylum Annelida consists of animals which have segmented body and live as parasites or as free living organisms.
8. The Arthropods have segmented body with tough outer skin, the cuticle.
9. Phylum Mollusca includes shelled animals.
10. Echinodermata have an exoskeleton of calcareous ossicles and, have radial symmetry.
11. Vertebrates are animals having vertebral column. They are further divided into five classes.
12. Fishes are cold blooded aquatic animals, having fins for swimming and gills for respiration.
13. Amphibians live both in water and on land. They are cold blooded animals with slimy and moist skin.
14. Reptiles are cold blooded animals which lay eggs and have dry scales on body.
15. Birds possess feathers and beak. Their forelimbs are modified into wings, and hind limbs are used in walking, running and swimming. They are warm blooded.
16. Mammals have mammary glands; female nourishes her young ones on her milk. They give birth to young ones. They have hair on their body.. They are warm blooded. All except one species are viviparous.

Self Assessment Exercise 04

Q.1 Encircle the correct option.

i. Which animal is oviparous?
   a) Kangaroo b) Rat
   c) Camel d) Platypus

ii. Earthworm belongs to phylum:
   a) Annelids b) Nematoda
   c) Platyhelminthes d) Coelentrata

iii. Starfish belongs to:
   a) Shelled animals b) Spiny animals
   c) Sponges d) Fishes

iv. Animals belonging to phylum Echinodermata possess _____ symmetry.
   a) No b) Radial
   c) Bilateral d) Trilateral

v. Hydra belongs to which group?
   a) Fishes b) Nematoda
   c) Mollusc d) Coelentrate

vi. Which class includes warm blooded animals?
   a) Fishes b) Amphibians
   c) Reptiles d) Birds

vii. Mammals have _____ chambered heart.
   a) 1 b) 2
   c) 3 d) 4

viii) Which of the following animal is a mammal but lay eggs?
   a) Whale b) Platypus
   c) Dolphin d) Sea lion

Q.2 Give short answers

i. How does classification help to learn about living things?
ii. What is the common characteristic of phylum protozoa and porofera?
iii. What does the term “cold blooded animal” mean? Name some cold blooded animals.
iv. Can you classify birds into further groups? Think of the characteristics you will use to further classify the group.
v. Compare the characteristics of Nematoda and platyhelminthes. Point out their similar features and features which are different.

7.5 Cells as Basic Unit of Life

The basic building block of all living organisms is cell. Robert Hooke discovered the cell in 1665. He observed the 'cells' in the thin sections of cork. However, Hook did not study the structure of the cell. What he saw under the microscope was like the walled compartments a monk would live in. That is why he gave the name "cell" was given. The word cell comes from the Latin word, ''cellula'', meaning "a small room".

As you have studied in previous unit, some living things are made of one cell while others are made of many cells.

Cell Theory

The cell theory was developed in 1839 by M. J. Schleiden and Theodor Schwann. According to this theory:

- All organisms are composed of one or more cells.
- All cells come from pre - existing cells i.e. cells divide to produce new cells.
- All functions of an organism occur within the cells,
- All cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

7.5.1 The Structure of Cell

The major material of all living cells is a jelly-like substance called protoplasm. In advanced organisms protoplasm contains many complicated structures; nucleus is the most prominent part. These parts are enclosed in membranes. Each structure performs some function in the cell. Cells having membrane bound structures are called "eukaryotic" cells. The cells of some organism such as bacteria or blue green algae, lack the nucleus and other membrane bound structures. These are called "prokaryotic" cells. Organisms in kingdom Monera have prokaryotic cells. Pro means before and karyotic means nucleus. Cells of all developed organisms including human beings are eukaryotic.

There is a variety of cells having different size, shape and functions (Figure **8.1**). The smallest cells are only 0.3 μm in length while the size of bacteria ranges from 3 to 5 μm. The egg of an ostrich is the largest isolated single cell. Human red blood cells are about 7.0 μm in diameter. Our nerve cells are some of the longest cells. Cells also vary greatly in their shape. They may be disc-like, polygonal, columnar, cuboid, thread like, or even irregular. The shape of the cell may vary with the function they perform.

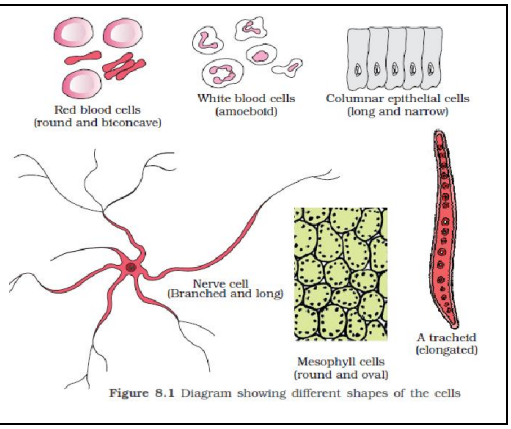


Figure 8.1 Diagram showing different shapes of the cells

Figure 21: Different Shapes of Cells

The cells of fungi, protozoa, other more developed plants and animals is divided into two basic parts, easily distinguishable under a light microscope. These parts are called “cell organelles”. These include: a nucleus and the cytoplasm that surrounds it.

Animal cells are enclosed in a membrane. Selected materials can pass through the cell membrane. For example oxygen can enter a cell through its membrane. Similarly carbon dioxide which is a waste material is excreted through the cell membrane. Water and other simple molecules can also pass through cell membrane. Plant cells have cell wall in addition to cell membrane. Cell wall gives shape to the cell and protects it from mechanical damage and infection. Simple molecules can pass across the cell wall. Cell membrane and wall protect the cells and also provide passage for selective substances.

Let us now discuss the structure of the cell in detail.

Cytoplasm

Cytoplasm is the fluid part of the cells. Ninety percent of the cytoplasm is water with molecules of salts and sugar dissolved in it. It also contains fats and proteins. If you observe the cell under the ordinary light microscope you can see it flowing about. It contains a number of particles. Some are food reserves like oil droplets or granules of starch others are cell organelles which perform specific functions in the cell. For examples mitochondria are energy house of the cell, ribosomes prepare cell proteins. These structures can be seen under electron microscope at much higher magnification.

The Nucleus

The nucleus (the plural nuclei) is an oval or spherical structure enclosed in a membrane.. In animal cells it is found near the center of the cell. In plant cells it is found at the side of the cell. The nucleus is the controlling agent in the cell. The nucleus regulates and directs all of the cell's activities—from nutrition to reproduction of the cell. When the cells are not dividing, the interior of the nucleus is filled with network of threadlike material called chromatin. It is made up of protein and a molecule called deoxyribonucleic acid (DNA). It is visible in a dividing cell. Nucleus also controls cell division.

Plant cell is different from animal cell. Plant cell has a cell wall outside the cell membrane. Animal cell has only one envelop i.e. cell membrane. Cells of plants which make their own food have another structure “chloroplast” which is lacking in animal cells. Animal cells have sometimes small fluid filled spaces called vacuoles these are not permanent whereas plant cell has a large vacuole which is permanent.

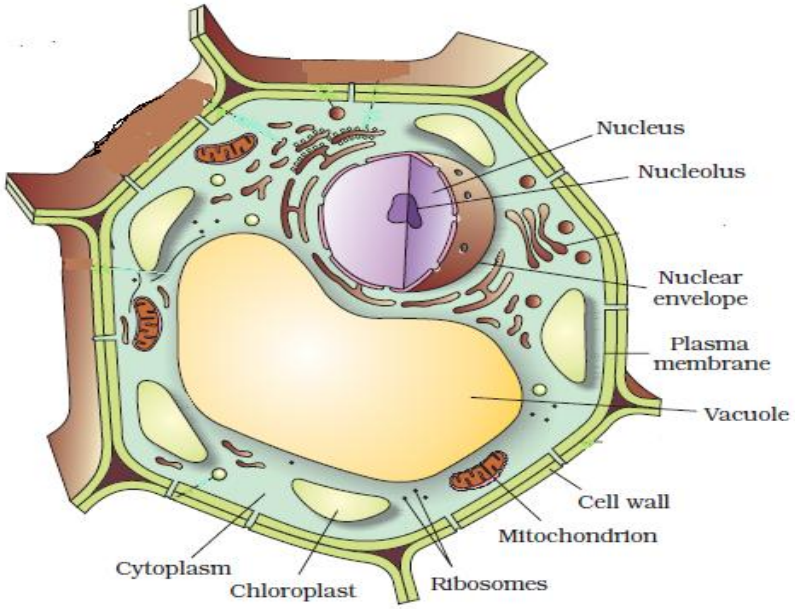


Figure 8.3 Diagram showing : (a) Plant cell

Figure 22: Plant Cell

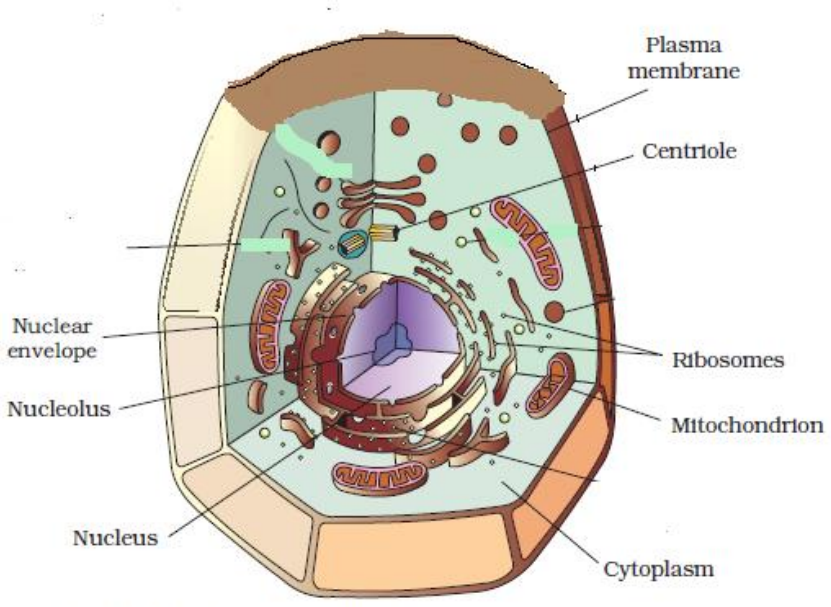


Figure 8.3 Diagram showing : (b) Animal cell

Figure 23: Animal Cell

Key Points

1. Bodies of all unicellular and multicellular organisms are formed of cells. All the body functions from feeding to reproduction are carried out at cellular level. Hence the cell is called the basic unit of structure and function in living organisms.
2. According to cell theory proposed by M. J. Schleiden and Theodor Schwann in183; all organisms are composed of one or more cells, all cells come from pre - existing cells, all functions of an organism occur at cellular level, cells contain the hereditary information which is transmitted to the next generation of cells.
3. There are two types of cells: eukaryotic and prokaryotic. Prokaryotic cells are usually independent, while eukaryotic cells are often found in multicellular organisms.
4. The prokaryote cell is simpler, lacking a nucleus and most of the other organelles of eukaryotes
5. Cells are formed of many important structures called cell organelles. Each cell organelles performs particular functions.
6. Cells are enclosed in a membrane called cell membrane. Plant cells have a cell wall along with a cell membrane.
7. Nucleus is the most important part of a cell. It controls all cell functions and contains hereditary material. It contains thread like material called chromatin material. It is visible in cell division.
8. Cells are filled with a fluid cytoplasm. Cytoplasm contains chemical substances as well as many cell organelles which are bounded in membranes. Mitochondria, ribosomes, are two of cell organelles. There are many others. Cell organelles are too small and visible only under high power electron microscope.

Self Assessment Exercise 05

Q.1 Select the best option

i. Which of the following is the control center of a cell?

a) Mitochondria b) Vacuole
c) Nucleus d) Ribosomes

ii. Where in a cell you will find the structure called chromosomes?

a) Cytoplasm b) Mitochondria
c) Vacuole d) Nucleus

iii. Which of the following is **NOT** a cell Organelles?

a) Vacuole b) Cell protein
c) Ribosomes d) Nucleus

iv. Which of the following becomes visible when a cell divides?

a) Nucleus b) Chromosomes
c) Mitochondria d) Ribosomes

v. Your teacher shows you a slide of an unknown cell under high power microscope. What would you look for to find out if it is plant or animal cell?

a) Nucleus b) Cell wall
c) Ribosomes d) Mitochondria

vi. Write brief answers.

a) What is the role of nucleus in cell?
b) What are the important points of cell theory?
c) Who proposed the cell theory? Also write the names of the scientists who proposed the theory.
d) What is the difference between a eukaryotic and prokaryotic cell? What types of cells are found in our body?

Q.2 Answer the following questions:

i. You are shown a eukaryotic and a prokaryotic cell. How can you tell which one is which?
ii. "A cell is a basic unit of structure and function", explain.
iii. Explain the structure of eukaryotic cell.

7.6 Cell Division

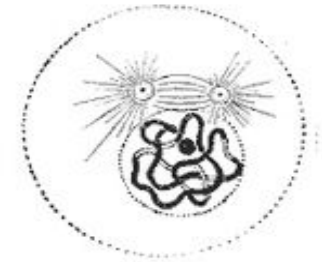
Do you know how many cells are present in our body? Well, if you stack as many sheets of paper as there are cells in our body it will make such a huge pile that you can go and come back from the moon twice! Yes, there are hundred trillion cells in our body (100, 000, 000, 000, 000,). Cells as you know are smallest living and functioning units in the body of all living organisms. It performs all the basic functions of life. It reproduces new cells by dividing. A mother cell divides into two daughter cells which are exactly like the mother cell. The daughter cells grow to a certain size and again divide in this way trillion cells of our body are produced. In all living organisms cells multiply in the same way i.e. by dividing. However cells do not just split into two cells. They go through a systematic process which involves many steps or phases. This type of cell division in eukaryotes is known as mitosis. Similar type of cell division in prokaryotes is known as binary fission.

You have studied that in sexually reproducing organisms two types of special cells one contributed by male (sperm) and the other by female (egg) unite together to form a daughter cell which through repeated divisions develops into a multicellular organism. Egg and sperm cells are formed by a special type of cell division called “meiosis”. Meiosis is different from mitosis. In mitosis the chromosomes of parent cell duplicate so that when the cell divides the daughter cells should have exactly the same number of chromosomes as of parent cell. In meiosis the each daughter cells receives only half number of chromosomes. Do you know? Eggs and sperms unite to form a single cell called “zygote” and the process of union of egg and sperm is called fertilization. You know that all organisms of a species have the same number of chromosomes in each generation. For example human beings have 46 chromosomes which exist as 23 pairs. Now if the eggs and sperm have the same number of chromosomes i.e. 46 then the zygote will get 92 chromosomes (46 = 46). It is therefore necessary that egg and sperms receive half number (haploid number) of chromosomes so that the zygote resulting from their union will have 46 chromosomes (in case of human beings). Meiosis also allows genetic variation through a process of DNA (Deoxyribonucleic Acid) shuffling while the cells are dividing.

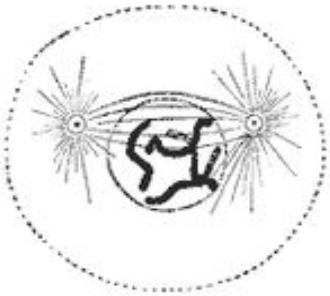
7.6.1 Mitosis

Mitosis is a fundamental process for life. New cells of any part of the body of plants and animals are formed through mitotic division of existing cells. Bone marrow produces new blood cells by mitosis. Similarly epidermal cells of our skin are replaced by mitotic division. In some parts of body, e.g. skin and digestive tract, cells are constantly sloughed off and replaced by new ones. New cells are formed by mitosis and so are exact copies of the cells being replaced. During mitosis, all contents of cell duplicate; including its chromosomes, and after that the cell splits to form two identical daughter cells. Duplication of chromosomes is important so that each one of the daughter cell have same number of chromosomes. The stages of mitosis are interphase, prophase, metaphase, anaphase and telophase.

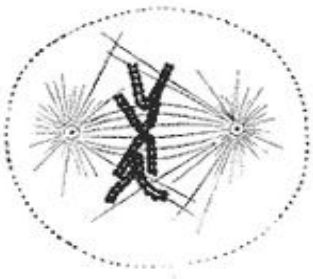
Interphase

Just before the cell starts to divide, number of long thread- like structures appear in the nucleus. These are called chromosomes. The chromosomes replicate themselves to form pairs of identical sister chromosomes, or chromatids. The centrosomes also duplicate.	

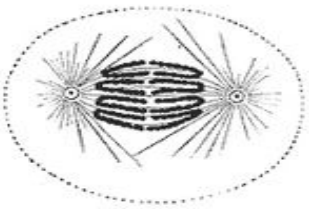
Prophase

As the prophase begins, chromosomes get thicker and shorter. Since the genetic material has already been duplicated earlier during interphase, the replicated chromosomes have two sister chromatids, bound together at the centromere. Some sets of fiber run from one centriole to the other; these are the spindle fibers. In plant cells the spindle forms without centrioles. The nuclear membrane disappears.	

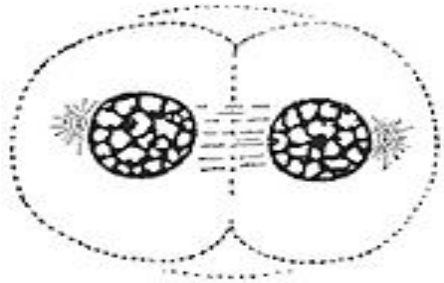
Metaphase

During metaphase the chromosomes arrange themselves at a plane midway between the two ends the spindle. This is called the equatorial plane. The cell divides at this point when nuclear division is completed. The chromatids are attached to the spindle fibers at the centromeres.	

Anaphase

During anaphase the two chromatids of each chromosome separate and become separate daughter chromosomes. Daughter chromosomes move to opposite poles, as if pulled along the spindle fibers.	

Telophase

A new nuclear envelope, forms around each set of separated sister chromosomes. Both sets of chromosomes, now surrounded by new nuclei, unfold back into chromatin. Mitosis is complete, but cell division is not yet complete.	

Cytokinesis

This is the stage at which cell divides into two daughter cells. In animal cells a dividing line called cleavage furrow is formed and finally divide the cytoplasm in half between the two daughter cells. In plants a cell plate is formed and cell is divided into two cell.

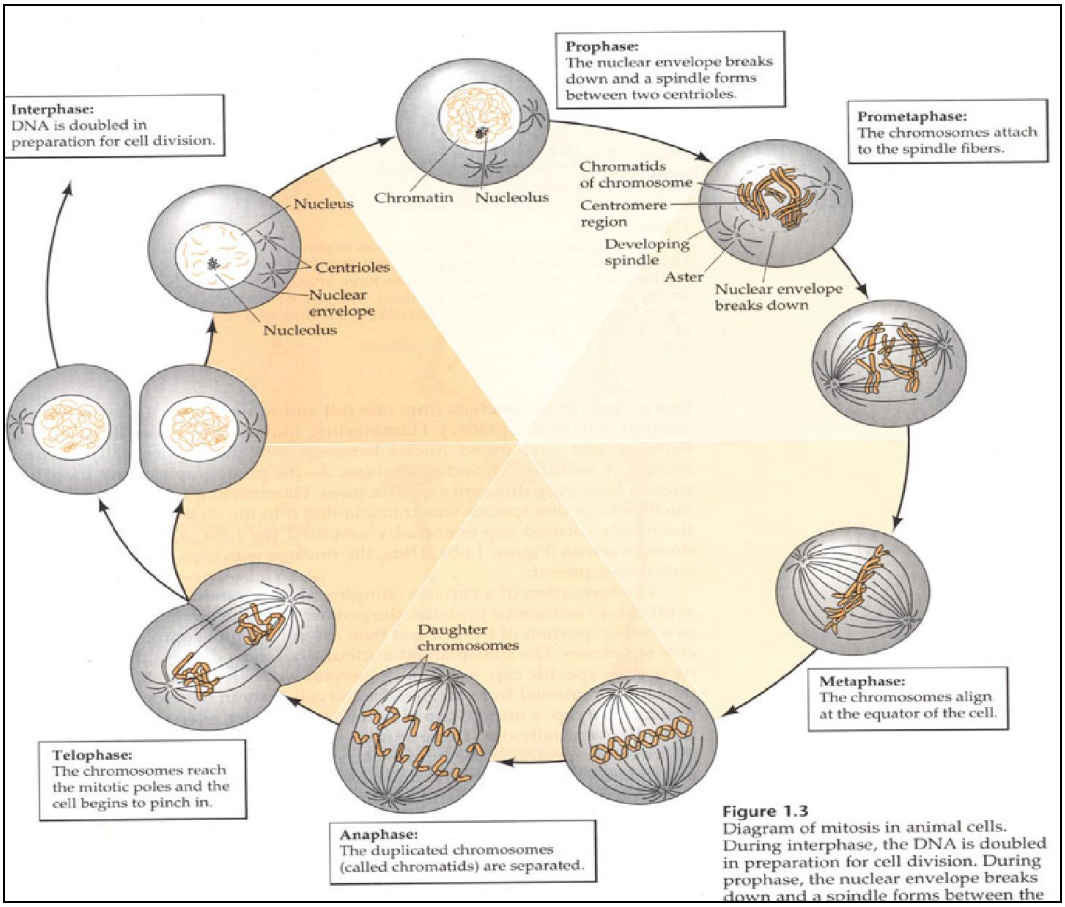


Figure 24: Cytokinesis

7.6.1.1 Significance of Mitosis

Mitosis is important for the maintenance of the chromosomal set; each cell formed receives chromosomes that are alike in composition and equal in number to the chromosomes of the parent cell.

Following are the occasions in the lives of organism where mitosis happens:

Development and growth

The number of cells within an organism increases by mitosis. This is the basis of the development of a multicellular body from a single cell i.e., zygote and also the basis of the growth of a multicellular body.

Cell replacement

In some parts of body, e.g. skin and digestive tract, cells are constantly sloughed off and replaced by new ones. New cells are formed by mitosis and so are exact copies of the cells being replaced. Similarly, RBCs have short life span and new RBCs are formed by mitosis.

Regeneration

Some organisms can regenerate their parts of bodies. The production of new cells is achieved by mitosis. For example; sea star regenerates its lost arm through mitosis.

Asexual reproduction

Some organisms produce genetically similar offspring through asexual reproduction. For example, the hydra reproduces asexually by budding. The cells at the surface of hydra undergo mitosis and form a mass called bud. Mitosis continues in the cells of bud and it grows into a new individual. The same division happens during asexual reproduction or vegetative propagation in plants.

7.6.2 Meiosis

Meiosis is a special type of cell division necessary for sexual reproduction. The cells produced by meiosis are gametes or spores. The animals' gametes are called sperm and egg cells.

In meiosis the chromosomes undergo a recombination producing a different genetic combination in each gamete. The outcome of meiosis is four (genetically unique) haploid cells.

Meiosis begins with one diploid cell containing two copies of each chromosome—one from the female organism and the other from male organism. Each of the resulting chromosomes in the gamete cells is a unique mixture of maternal and paternal DNA. This is how a variety of organisms are formed. Meiosis was discovered and described for the first time in sea urchin eggs in 1876 by the German biologist Oscar Hertwig.

Stages of Meiosis

Meiosis consists of two major phases of meiosis occur: meiosis I and meiosis II. During meiosis I, a single cell divides into two. During meiosis II, each of the two cells divide again.

Meiosis I

Let us take the example of meiosis in human beings. At the beginning of meiosis 1, a human cell contains 46 chromosomes, or 92 chromatids (the same number as during mitosis). Meiosis I has the following phases:

Interphase

As in mitosis the cell replicates its chromosomes. Each chromosome has two sister chromatids which are held together by a centromere.

Prophase I

Prophase I is also similar in some ways to prophase in mitosis. The daughter chromosomes i.e. chromatids shorten and thicken and become visible under a microscope. However, in meiosis two processes called "synapsis" and crossing over occur during prophase 1.

Synapsis is a process in which two homologous chromosomes come near each other. As you know each chromosome consists of two chromatids, the four chromatids aligned next to one another. The coming together of two chromatids is called synapsis and this combination of four chromatids is called a tetrad

After synapsis, segments of one chromatid in the tetrad pass to another chromatid in the tetrad. The exchange of chromosomal segments occurs in a complex and poorly understood manner. |This process is called Crossing over and it results in the formation of a new chromatid. After crossing the four chromatids of the tetrad are genetically different from the original four chromatids.

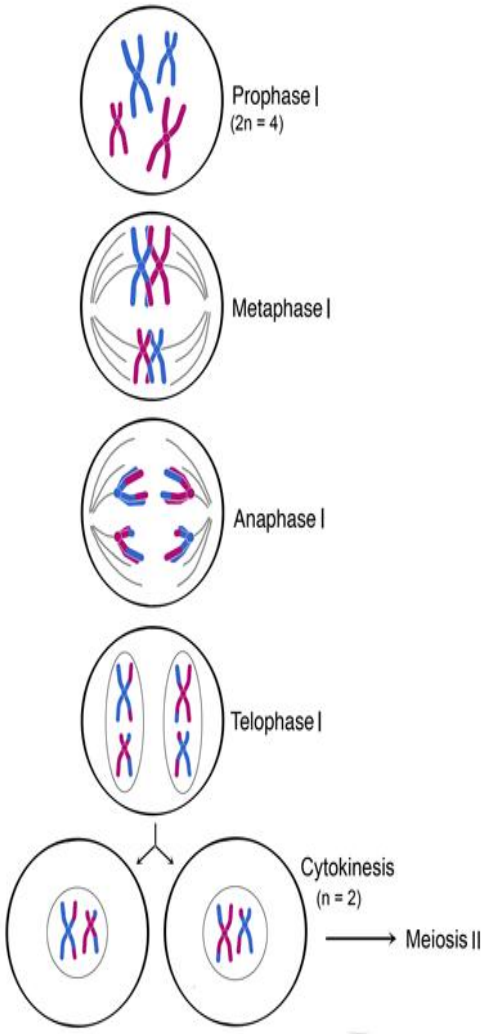


Figure 25: Meiosis

Metaphase I
At this stage the tetrads align on the equatorial plate (as in mitosis). The centromeres attach to spindle fibers, which extend from one poles of the cell to the other. One centromere attaches on one spindle fiber.

Anaphase I
At this stage of meiosis 1, the homologous chromosomes separate. One homologous chromosome (consisting of two chromatids) moves to one side of the cell, while the other homologous chromosome (consisting of two chromatids) moves to the other side of the cell. In this way one set of 23 chromosomes (each consisting of two chromatids) move to one pole, and the other set of 23 chromosomes (each consisting of two chromatids) move to the other pole of the cell. In this way the chromosome number of the resulting two cells is halved. For this reason the process is a reduction-division.

Telophase I
In telophase of meiosis I, the nucleus reorganizes, the chromosomes become chromatin, and a cytoplasmic division into two cells takes place. This process occurs differently in plant and animal cells, just as in mitosis. Each daughter cell (with 23 chromosomes each consisting of two chromatids) then enters interphase, during which there is no duplication of the DNA. The interphase period may be brief or very long, depending on the species of organism.

Meiosis II

Meiosis II is the second major stage of meiosis. It occurs in the same way as in mitosis. In meiosis II, a cell containing 46 chromatids undergoes division into two cells, each with 23 chromosomes. All the stages of this second phase of meiosis are exactly same as in mitosis.

During meiosis II, each cell containing 46 chromatids yields two cells, each with 23 chromosomes. Originally, there were two cells that underwent meiosis II; therefore, the result of meiosis II is four cells, each with 23 chromosomes. Each of the four cells is haploid; that is, each cell contains a single set of chromosomes.

The difference in the result of mitosis and meiosis is that 23 chromosomes in the four cells from meiosis are not identical because crossing over has taken place in prophase 1. The crossing over yields variation so that each of the four resulting cells from meiosis differs from the other three. Thus, meiosis provides a mechanism for producing variations in the chromosomes. Also, it accounts for the formation of four haploid cells from a single diploid cell.

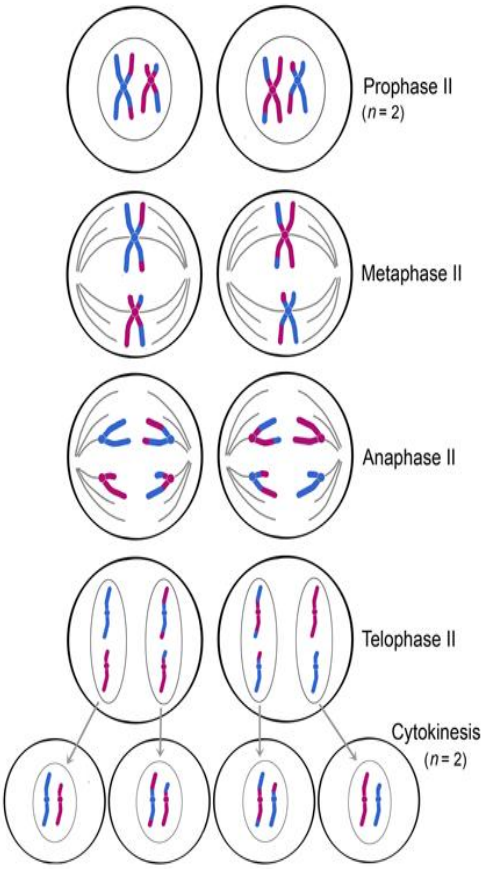


Figure 26: Meiosis

Key Points

1. Continuity of life is possible only through the process of reproduction. Every species can reproduce new individuals of its own kind.
2. Asexual reproduction requires only a single parental organism which gives rise to offspring by mitotic cell division. Offspring produced by mitosis are genetically similar to their parents.
3. Sexual reproduction usually involves two parents. A fertilized egg is produced through the union of two sex cells (sperms and egg) from each parent. The organisms produced by this process are genetically different from their parents.
4. Cell division is the process by which a parent cell divides into two or more daughter cells.
5. Mitosis is the process by which a eukaryotic cell separates the chromosomes in its cell nucleus into two identical sets, in two separate nuclei. Mitosis is important for the maintenance of the chromosomal set.
6. Meiosis is necessary for sexual reproduction. The cells produced by meiosis are gametes or spores.
7. The chromosomes in meiosis undergo a recombination producing a different genetic combination in each gamete.
8. Meiosis is divided into two stages, Meiosis I and Meiosis II.
9. Meiosis I separates homologous chromosomes, producing two haploid cells, so meiosis I is referred to as a reduction division.
10. Meiosis II is the second part of the meiotic process. The end result is production of four haploid cells from the two haploid cells produced in meiosis I.

Self Assessment Exercise 06

1. Choose the correct statement
   i. Which types of cells are produced through mitotic division?
      a) Skin cells b) Egg cells
      c) Sperm cells d) None of the above

   ii. Which of the following statement is true about mitotic division?
      a) It takes place when gametes are produced.
      b) It is completed in two phases
      c) Each daughter cell receives diploid number of chromosomes
      d) Each daughter cell receives haploid number of chromosomes

   iii. Meiosis is also called reduction division because Daughter cells …
      a) Have a smaller size than parent cell
      b) Lack some of the cell organelles
      c) Haploid number of chromosomes
      d) smaller nucleus than parent cell

iv. If the parent cell starts out with 24 chromosomes. If it divides by mitotic division what will be the number of chromosomes in daughter cells?

a) 48 b) 24
c) 12 d) 6

v. When synapse is formed during meiosis division? During …

a) Prophase 1 b) Metaphase 1
c) Anaphase 1 d) Telophase 1

vi. Synapse is formed between chromatids of …

a) All chromosomes
b) Any two chromosomes
c) Two similar chromosomes
d) Two dissimilar chromosomes

Q.2 Write down the answer of the following questions

i. Write names of different stages of mitosis in detail.
ii. What type of changes take place in a cell during interphase?
iii. What is a synapse?
iv. At which stage of meiosis chiasma forms?
v. What are homologous chromosomes?
vi. Explain different stages of Meiosis I.
v. What is difference between mitosis and meiosis? Explain briefly.

7.7 Cellular Organization

The body of multicellular organisms is not a haphazard collection of cells. The cells in a multicellular organism are specialized cells. It means that...

i. They do one particular job.
ii. Have a distinct shape according to their function.

There is a division of labour in the body of multicellular organisms, i.e. cells are specialized to perform specific functions. There are following levels of organization in the body of living organisms:

Cells ⟹ Tissues ⟹ Organs ⟹ Systems

Cell

As you have read in earlier sections cell is the basic unit of structure and function in the body of multicellular organisms.

Tissues

A collection of similar cells that group together to perform a specialized function is termed as tissue.

Organs

An organ is a structure that contains at least two different types of tissue which function together to perform a common function.

System

A system is a set of things working together as a part of as mechanism or an interconnecting network. In the body of multicellular organisms several organs work in conjunction as a system.

7.7.1 Cellular Organization in Human Body

There are four primary types of tissue in the human body: epithelial tissue, connective tissue, muscle tissue and nerve tissue.

1. Epithelial Tissue

In an epithelial tissue the cells are closely packed together to form continuous sheets just like the tiles in wall or floor. Epithelial surrounding different parts of the body to keep the body's organs separate, in place and protected. The outer layer of the skin, the inside of the mouth and stomach, and the tissue surrounding the body's organs are some examples of epithelial tissue are.

2. Connective Tissue

There are many types of connective tissue in the body. Connective tissue provides support and structure to the body. Most of the connective tissues contain fibrous strands

of the protein called collagen. Collagen adds strength to connective tissue. Some examples of connective tissue include the inner layers of skin, tendons, ligaments, cartilage, bone and fat tissue. Blood is also a form of connective tissue.

3. Muscle Tissue

All the muscles in the body are formed of muscle tissues. Muscle tissues can contract and expand back to their normal size. Muscles which are attached to the bones help in movement. You can see these muscles in your arms and legs. Bend your arm and watch the upper arm, it swells because the muscle in the upper arm has contracted that is how it has moved the bones of your fore arm. The muscles also form different organs like heart, stomach etc.

4. Nerve Tissue

Nerve tissues form brain and spinal Nerve tissue has the ability to generate and conduct electrical signals in the body. These electrical messages are managed by nerve tissue in the brain and transmitted down the spinal cord to the body.

ORGANS

There are many different organs in the body: the liver, kidneys, heart, eyes, ears, nose even your skin is an organ.

System

In human body and in most of the multicellular animals there are several systems e.g. Digestive system, respiratory system, excretory system, nervous system, skeletal system, muscular system and reproductive system. You will read about these systems in the next unit.

7.7.2 Plant Systems

Observe the flowering plants in your area. Do you notice what the two major parts of green plants are? As you can see there is stem growing above the ground bearing leaves and flowers and fruits. There is an underground part of these plants called root. Shoots and roots together make the two main “body systems:” in plants.

All of the functions necessary to keep the plant alive are performed in these two systems. These two body systems perform the following functions in plant:

- exchange of gases with its surroundings
- moving water and nutrients around internally
- reproducing

The root system generally grows underground. However there are certain plants which also have roots growing above the ground, Banyan tree, and money plant you can see roots hanging in the air. The root system performs the following major functions. It...

- Anchors the plant to the ground
- Absorbs water and minerals from the soil, and to store food.

There are two basic types of root system: primary root system and adventitious root system.

The primary root system consists of a main root and its branches. The primary root is the plant's first root which gives rise to lateral, or branch, roots. Adventitious roots are growing in an unusual position like on leaves or stems are called adventitious roots. Unusual places like leaves.

Figure 27: Adventitious roots of a banyan tree

The shoot system of flowering plants is composed of three parts namely: the leaf, the flower, and the stem.

The leaf is the food factory of green plants. Chloroplasts in a plant's leaves use carbon dioxide, water, and light energy to produce glucose and oxygen. This process of manufacturing glucose is called photosynthesis.

Flowers contain male or female reproductive structures. Male reproductive structures produce pollen grains. Female structures produce eggs. After eggs are fertilized by pollen, seeds are formed within a specialized structure called a fruit.

Stem supports the plant's leaves and flowers, and contains channels to transport the materials the plant needs.
The three major tissue systems of plants are:

- Dermal tissue
- Vascular tissue
- Ground tissue

The outmost layer of a plant is formed of dermal tissue system. The surface of the leaves, stem, and roots of a plant that we see consists of dermal tissue. The thin layer of cells that covers the surfaces of leaves, stems, and roots is epidermal tissue (epidermis).

In woody plants, the epidermal tissue is replaced by periderm tissue, which forms bark on stems and large roots.

Some cells of the dermal tissue system absorb water and minerals from the surrounding soil. Others produce a layer of wax to waterproof the surface of leaves. Still others contain chemical irritants for defence.

Plants have a network of tubes spread from the roots up the stalk to the leaves. It is called vascular tissue system. Water and nutrients absorbed by roots is transported by the vascular tissue system to the various parts of the plant, where they are needed for growth.

The vascular tissue which transports water and dissolved minerals from the roots to the rest of the plant is called Xylem. Water moves through the tubes in one direction.

Solutions of sugars produced during photosynthesis, as well as other dissolved nutrients and hormone are transported by Phloem**.** Phloem transports food materials both in downward as well as upward i.e. from photosynthesizing leaves to stem and upward from the root and stem to the leaves.

Third major tissue of plants is Ground tissue cells. They fill the spaces between the dermal and the vascular tissues. Depending upon their location in the plant they perform a number of functions. In the green parts of the plants ground tissues manufacture nutrients by photosynthesis.

In the stems, they provide storage and support and in the roots, they store carbohydrates.

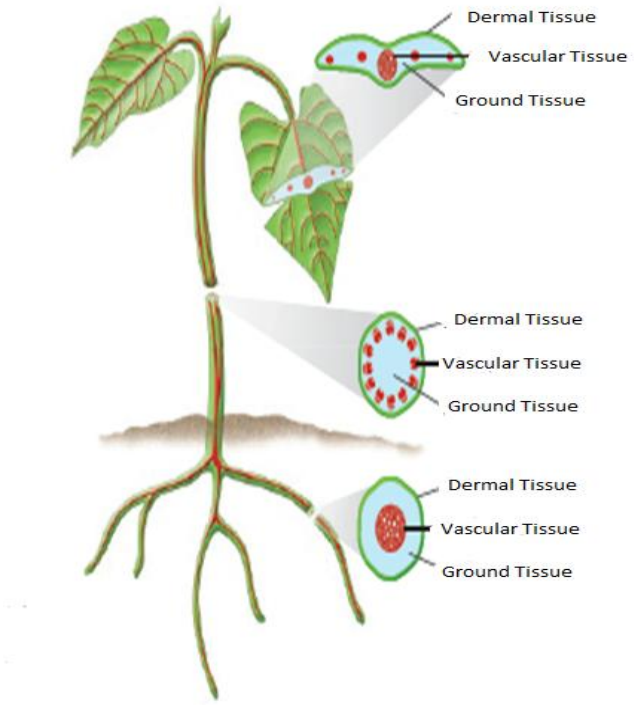


Figure 28: Position of Various Tissues in Green Plants

Key Points

1. The cells in the body of advanced multicellular organisms are organized in a systematic and hierarchical order into tissues, organs and systems.
2. There are four primary types of tissue in the human body: epithelial tissue, connective tissue, muscle tissue and nerve tissue.
3. Epithelial surrounding different parts of the body to keep the body's organs separate, in place and protected.
4. Connective tissue provides support and structure to the body.
5. Muscle tissues give shape to the body, form organs like heart and move the bones.
6. A system is a set of things working together as a part of as mechanism or an interconnecting network.
7. Human systems are composed of many organs each performing a specific function. There are nine major systems in the human body: skeletal, muscular, digestive, respiratory, excretory, circulatory, nervous, endocrine, and reproductive system.
8. There are two major systems in the body of green plants: shoot and root system.

Self Assessment Exercise 07

Q.1 Choose the correct statement.

i. The third level of cellular organization is tissue.
ii. Cells in a tissue perform different functions.
iii. Human body has three different types of tissues.
iv. Connective tissues connect the bones.
v. Inside of our stomach is lined by epithelial tissues.
vi. Our skin is a tissue.
vii. There are two types of plant tissue systems.
viii. Phloem tissues transport water from roots to the shoots and leaves.
ix. In xylem tissue materials are transported in only one direction.
x. Surface of green leaves is formed of ground tissues.
xi. Dermal tissues are absent in roots.
xii. Photosynthesis takes place in the cells of ground tissues.
xiii. In a plant nutrients are transported from leaves to roots and also from roots to leaves.
xiv. In plants water moves only from root to the stem and leaves and not in the opposite direction.
xv. In green plants food is stored in ground tissues.

Q.2 Answer the following questions:

i. Describe the functions of various tissues in plants.
ii. What are the different types of tissues in our body? Describe their functions.
iii. Explain the location of various tissues in green plants and describe their functions.
iv. What is the difference between primary and adventitious roots? Give examples of plants which have adventitious roots. Also explain the meanings of adventitious roots.

7.8 Genes at Work

Have you ever seriously considered how characteristics such as skin colour, height, hair colour etc are transferred from parents to offspring? Or how variations appear in the organisms of the same species and even children of the same parents? You know that all living organisms reproduce by cell division. You also know from your study of cell structure and division that each species has a specific number of chromosomes in their cells. Human beings have 46 chromosomes in their cells. In mitosis each chromosome divides into two chromatids so that the new cells inherit the same number of chromosomes. Chromosomes consist of a protein network and a long molecule of Deoxyribosenucleic acid (DNA) is coiled round the protein framework in a complicated way. It is the DNA part of chromosome which controls heredity characteristics. Heredity information is stored in DNA. The hereditary unit is called gene. A gene is a short length of DNA and so contains a section of genetic code. A gene consists of a unique sequence of DNA that provides the complete instruction to make a functional product called protein. Gene instructs each cell type such as , brain, liver to make specific sets of proteins and it is through this specificity that unique organism is developed.

Each cell in the human body contains about 25,000 to 35,000 genes, which carry information that determine their traits. Traits are characteristics you inherit from your parents. For example, if both the parents have green eyes, their children might inherit the trait of green eyes from them. The genes are not only present in humans — all animals and plants have genes, too.

Every cell of an organism contains a complete set of instruction for building the organism. This set of instruction is passed on to gamete (egg and sperm cells in animals and human beings) during meiosis. You know that during meiosis similar or homologous chromosomes pairs form synapse and exchange parts. In this exchange genes are also exchanged that is how variations occur.

7.8.1 Biotechnology

Biotechnology (sometimes shortened to "**biotech**") is the use of biological processes found in nature to make useful products, or "any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use". Biotechnology is a field of applied biology.

You know that yeast which is a unicellular organism. They reproduce by budding. It is used to raise dough to make bread. During their growth process, the yeast cells produce substances called enzymes. So when the yeast is added to cake or bread dough, one enzyme acts on the flour and changes the starch in it into sugar. Another enzyme then takes over and changes the sugar into alcohol and a gas called carbon dioxide. This gas spreads through the dough in the form of bubbles. That is how dough rises when we add yeast to it. This is one example of using a naturally occurring biological process to make a product.

Use of Biotechnology

Biotechnology is used in medical, crop production and agriculture, non food (industrial) uses of crops and other products, and for environmental uses.

Medicine

Biotechnology used in medicine in such areas as:

- Drug production
- Pharmacogenomics
- Gene therapy
- Genetic testing (or genetic screening

Pharmacogenomics uses information about a person's genetic makeup, or genome, to choose the drugs and drug doses that are likely to work best for that particular person. This new field combines the science of how drugs work, called pharmacology, with the science of the human genome, called genomics.

Genetic Testing

Genetic testing involves the direct examination of the DNA molecule itself. A scientist scans a patient's DNA sample for mutated sequences.
Genetic testing is now used for:
Carrier screening, determining sex, Identity testing, Newborn screening, etc.

Gene Therapy

Gene therapy may be used for treating, or even curing, genetic and acquired diseases like cancer and AIDS by using normal genes to supplement or replace defective genes. It can be used to target somatic cells (i.e., those of the body) or gametes (i.e., egg and sperm) cells.

Cloning

Cloning involves the removal of the nucleus from one cell and its placement in an unfertilized egg cell whose nucleus has either been deactivated or removed.
There are two types of cloning:

Reproductive cloning. After a few divisions, the egg cell is placed into a uterus where it is allowed to develop into a fetus that is genetically identical to the donor of the original nucleus.
Therapeutic cloning. The egg is placed into a Petri dish where it develops into embryonic stem cells, which have shown potentials for treating several ailments.

Tissue Culture

Tissue culture is the growth of a tissue in an artificial liquid culture medium. This technique is used in plants. New plants obtained from parent plants, by using this technique, are called clonal plants. They have same traits as of their parents.

Animal Biotechnology

In animals, biotechnology techniques are being used to improve genetics and for pharmaceutical or industrial applications. Molecular biology techniques can help drive breeding programs by directing selection of superior animals. Animal cloning, through somatic cell nuclear transfer (SCNT), allows for genetic replication of selected animals. Genetic engineering, using recombinant DNA, alters the genetic makeup of the animal for selected purposes, including producing therapeutic proteins in cows and goats.

Bioengineering

Biotechnological engineering or biological engineering is a branch of engineering that focuses on biotechnologies and biological science. It includes different disciplines such as biochemical engineering, biomedical engineering, bio-process engineering, biosystem engineering and so on. In general it is an integrated approach of fundamental biological sciences and traditional engineering principles.

Key Points

1. The chromosomes and genes are made of DNA, which is short for deoxyribonucleic acid.
2. Biotechnology is a field of applied biology that involves the use of living organisms and bioprocesses in engineering, technology, medicine and other fields requiring by-products.
3. Biotechnology has applications in four major industrial areas, including health care (medical), crop production and agriculture, non food (industrial) uses of crops and other products, and environmental uses.
4. Cloning involves the removal of the nucleus from one cell and its placement in an unfertilized egg cell whose nucleus has either been deactivated or removed.
5. Biotechnological engineering or biological engineering is a branch of engineering that focuses on biotechnologies and biological science.
6. Tissue culture is the growth of a tissue in an artificial liquid culture medium. This technique is used in plants. New plants obtained from parent plants, by using this technique, are called clonal plants. They have same traits as of their parents.

Self assessment exercise 08

Q.1 Anwer the following questions:

1. Define biotechnology. Explain its use in different fields.
2. What is difference between a gene and a chromosome?

Answers to Self Assessment Exercises

Self Assessment Exercise 01
Q.1 b, 2.c, 3. c, 4. c,
Q.2 For question 5 read the relevant sections of the unit.

Self Assessment Exercise 02
Q.1 a, 2. C, 3. D, 4.a, 5.d,
Q.2 6 – 7 Read the relevant sections of the unit.

Answers of Assessment Exercise 03
Q.1 I. d, II.a, III.b, IV. a, V.a,

Answers of Assessment Exercise 04
Q.1 I. d, II.a, III. b, IV. b, V. d, VI. d, VII. d, VIII. b

Answers of Assessment Exercise 05
Q.1 C, 2. D, 3. B, 4. B, 5. B, For questions 6 -9 Read the relevant sections of the unit.

Answers of Assessment Exercise 06
Q.1 I.a, II. C, III. C, IV. B, V. A, VI. C
Q.2 For question 2,i –iv read the relevant sections of the unit

Answers of Assessment Exercise 07
Q1. V, vii, ix, xii, xiii, xv are correct statements.
Q.2 For question 2 – 5 read the relevant sections of the unit

Answers of Assessment Exercise 08
Q1 & 2 Read the relevant sections of the unit

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