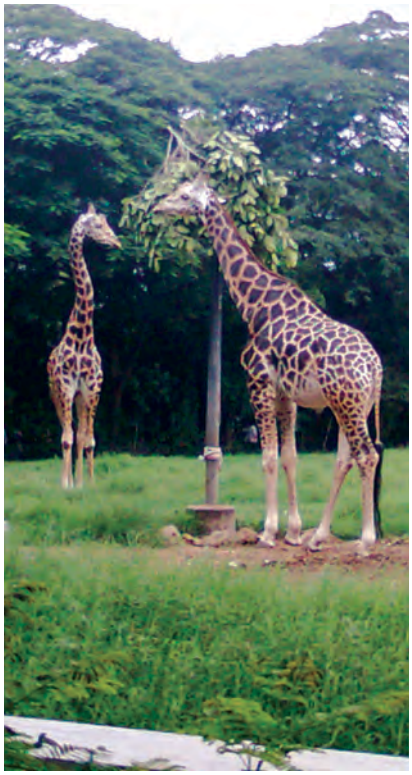
Chapter 5

ANIMAL KINGDOM





Introduction

Animals originated approximately 600 million year ago. More than 2 million existing varieties of animals have been identified. Of these more than 12,72,000 are invertebrates and fewer than 62,000 species are vertebrates.

TAXONOMY

The branch of biology dealing with identification, description, nomenclature and classification is called taxonomy. Biological classification helps us to identify organisms and later recognize those already classified.

MORE TO KNOW

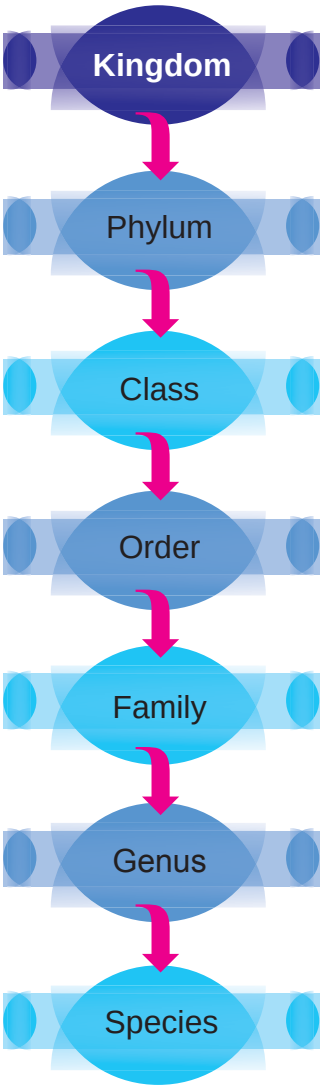
Aristotle, the father of Zoology was the first to classify animals based on their similarities and differences.

MORE TO KNOW

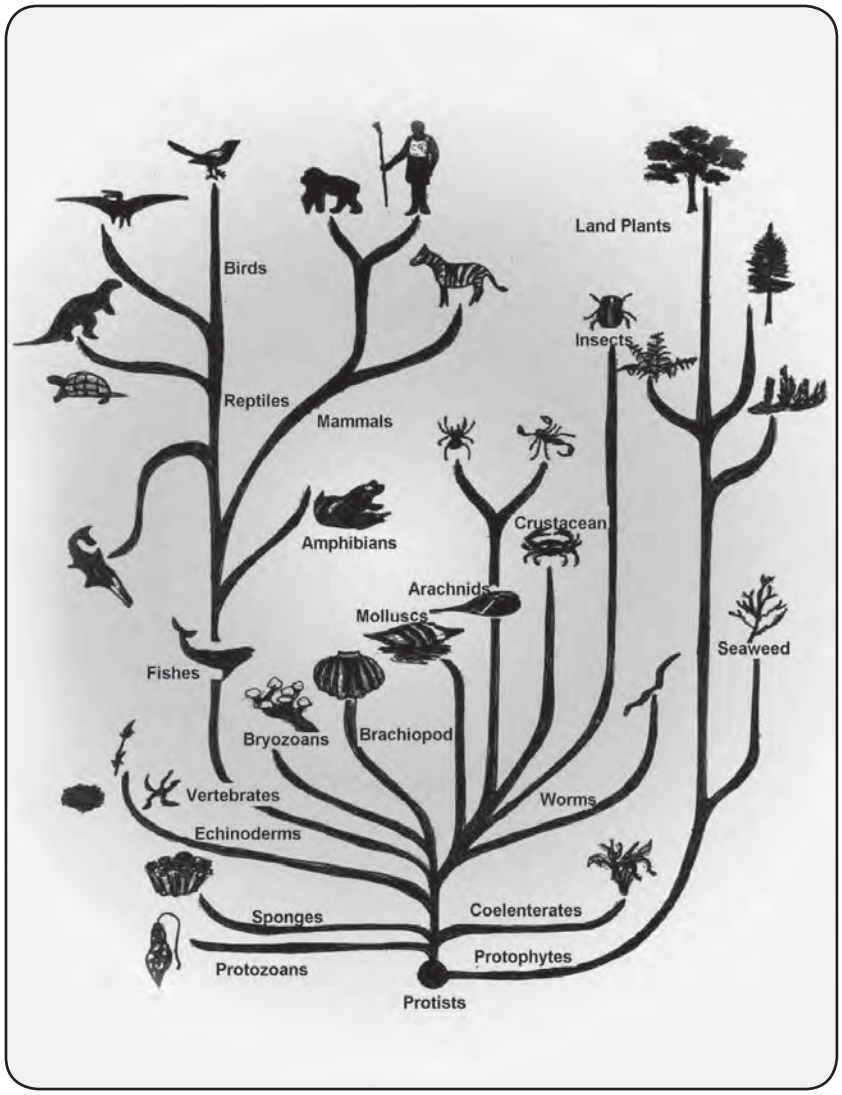
Carl Linnaeus, the Swedish Botanist is regarded as the father of modern taxonomy.

Levels of classification

Based on similarities and differences in the structure, animals are divided into small groups called taxons. Linnaeus classified organisms into kingdom, phylum, class, order, family, genus and species.



Units of Taxonomy



Evolutionary Tree

Criteria for classification

1. Grade of organisation – animals are grouped into unicellular and multicellular based on the number of cells.
2. Germ layers – the multicellular animals are classified into diploblastic (two germ layers) and triploblastic (three germ layers) animals.
3. Symmetry – it refers to the arrangement of body parts. Based on symmetry, animals are classified into

a. Assymetrical (eg. Amoeba)

b. Radially symmetrical (eg. Hydra)

c. Bilaterally symmetrical (eg. Earth worm)

4. Coelom – the space between the body wall and digestive tract is called coelom. Based on the nature of coelom, animals are divided into

a. Acoelomate – Animals without a coelom (eg. Tape worm)

b. Pseudocoelomate – Animals with a false coelom (eg. Round worm)

c. Eucoelomate – Animals with a true coelom (eg. Earth worm)

Toad

5. Body temperature – animals are classified into two groups on the basis of their ability to regulate body temperature into

a. Poikilothermic animals – whose body temperature varies with that of environment. (eg. Fish, frog)

b. Homeothermic animals – whose body temperature always remains constant irrespective of changes in the surrounding. (eg. Birds, man)

Animals are classified into two major groups, namely invertebrates and vertebrates based on the absence or presence of back bone (Vertebral column)

5.1. INVERTEBRATES

Invertebrates are classified into nine phyla namely

1. Phylum Protozoa (eg. Amoeba)
2. Phylum Porifera (eg. Sponges)
3. Phylum Coelenterata (eg. Hydra)
4. Phylum Platyhelminthes (eg. Tape worm)
5. Phylum Aschelminthes (eg. Ascaris)
6. Phylum Annelida (eg. Earth worm)
7. Phylum Arthropoda (eg. Cockroach)
8. Phylum Mollusca (eg. Snail) and
9. Phylum Echinodermata (eg. Star fish)

Phylum Protozoa

Paramoecium

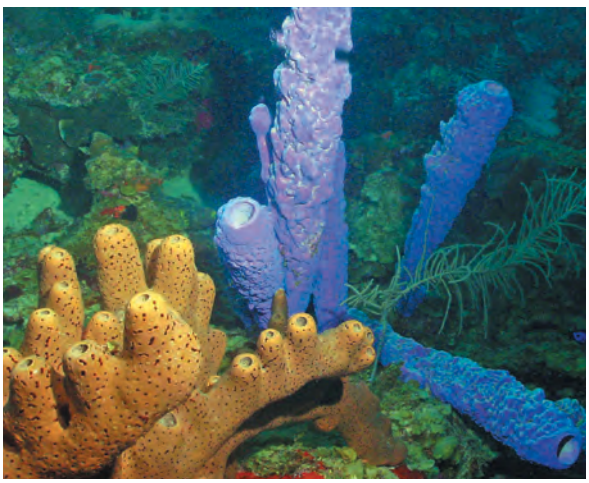
These are generally unicellular microscopic animals. Locomotion takes place by cilia, flagella or pseudopodia. Mode of nutrition may be holozoic, saprozoic or parasitic. They reproduce asexually through binary or multiple fission and sexually by conjugation.

ACTIVITY –5.1

- Collect a sample of water from a fresh water pond. Prepare a micro slide after adding a drop of methylene blue stain to the water. View the slide under a microscope. Try to find an amoeba.

Phylum Porifera

These are non-motile marine animals attached to some solid support such as rocks or shells. These are multicellular animals with perforated bodies. The cells are loosely arranged without the formation of tissues.The pores lead to a canal system which helps in circulating water throughout the body to bring in food and oxygen. They possess an internal skeleton made up of calcareous or silicious spicules. Reproduction is both by asexual (budding or gemmule formation) or sexual method (fusion of male and female gametes)



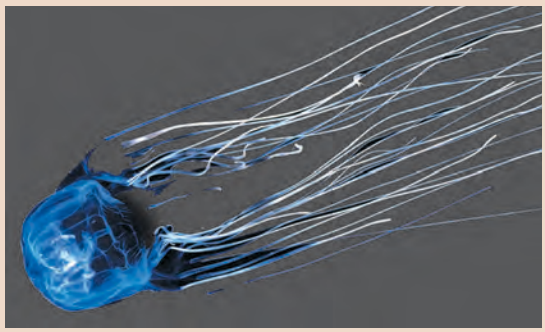
Sponges

Phylum Coelenterata

Sea anemone

These animals are aquatic with radial symmetry. There is a distinct body cavity called coelenteron or gastro vascular cavity. The body bears slender, flexible tentacles around the mouth. The tentacles at their tip bears stinging cells called cnidoblasts for offence and defence. Reproduction takes place either by asexual (budding or fission) or by sexual method (by gametes).

MORE TO KNOW



The Australian sea wasp or box jelly fish **(Chironex fleckeri)** is the most venomous coelenterate in the world. It has enough poison to kill about sixty people.

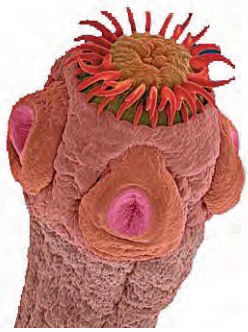
ACTIVITY –5.2

Observe a permanent slide of hydra under a dissection microscope. Observe the mouth, tentacles and basal disc of hydra and draw a neat labelled diagram.

Phylum Platyhelminthes (flat worms)

These are triploblastic, bilaterally symmetrical and acoelomate animals. These are either free living (eg. Planaria) or parasitic (eg. Tape worm). Parasites have organs of attachment such as hooks and suckers. They are mostly hermaphrodites (i.e. male and female sex organs are present in the same individual).

Planaria



Tape worm

Phylum Aschelminthes (round or thread worms)

The body is cylindrical, unsegmented and covered by a resistant cuticle. The animals are bilaterally symmetrical, triploblastic and pseudocoelomate. Circulatory and respiratory systems are absent. Sexes are separate and fertilization is internal. These are familiar as parasitic worms causing elephantiasis (filarial worm) and ascariasis (ascaris).

Ascaris

MORE TO KNOW

Earthworms are referred to as "Farmer's Friend"? Why?

Earthworm plays a vital role in improving the fertility of the soil. It ploughs the land and assists in the recycling of organic matter for the efficient growth of the plants. The soil system is loosened, stirred up and aerated by the vertical migration of earthworms.

Phylum Annelida

Do you know about vermicompost?

Which animal plays a vital role in vermicomposting?

Earthworm

Earthworms and leeches are familiar examples of annelids. The body is long, cylindrical and segmented (i.e. the body is divided into compartments called segments). They move with the help of setae and parapodia. They exhibit cephalisation (formation of a distinct head) and metamerism (segmental repetition of identical organs).

MORE TO KNOW

HIRUDIN - is a naturally occurring protein in the salivary glands of Leeches that has a blood anticoagulant property. Hence blood fails to clot ensuring continuous flow of blood when the leech sucks the blood. This property is widely used in the field of medicine and used in the treatment of blood clotting disorders and in the development of anticoagulant pharmaceuticals .

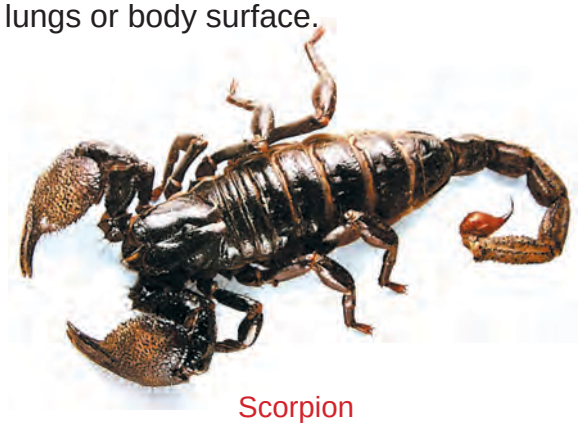
Phylum Arthropoda

Butterfly

Do you know which is the largest phylum?

Do you know which is the most successful group of animals on earth?

Arthropods are the largest group of organisms and insects are the most successful group of animals. These forms have jointed legs with a chitinous exoskeleton. They show open type of circulation and possess compound eyes. They respire by gills, tracheae, book lungs or body surface.



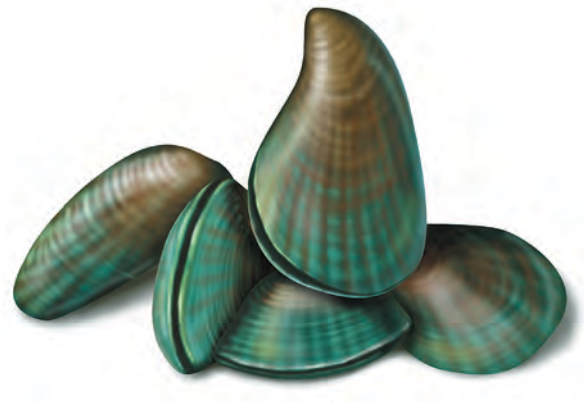
Scorpion

MORE TO KNOW

Insects form one of the most successful groups of animals. More than a million species of insects are known today.

Phylum Mollusca

Body is soft, unsegmented and without appendages. It is surrounded by a thin, fleshy structure called mantle which secretes a hard calcareous shell. They move around with the help of a muscular foot. Respiration is usually by gills called ctenidia.



Mussels

Phylum Echinodermata

These are spiny skinned organisms. Body is covered by calcareous spines. water vascular system is a characteristic feature of this group. These animals move with the help of tube feet and show great power of regeneration.

Starfish

ACTIVITY –5.3

Observe the preserved specimens of invertebrates. Draw neat diagrams.

List out the different poisonous invertebrates.

Biodiversity of India

India is endowed with an immense variety of plants and animals. It is a home to 2000 species of fishes, 182 species of amphibians, 453 species of reptiles, 1200 species of birds and 350 species of mammals. India ranks within the top 10 countries in the world in the biodiversity of vertebrates.

5.2. VERTEBRATES

Vertebrates are groups of animals which have a true vertebral column and internal skeleton. These are coelomate, triploblastic animals with a notochord and nerve chord.

How do vertebrates differ from invertebrates?

S.No.	Invetebrates	Vertebrates
01.	They do not have a back bone.	They have a distinct back bone.
02.	They include both unicellular and multi cellular organisms.	They include only multi cellular organisms.
03.	They have diversified locomotory organs such as pseudopodia, flagella, cilia, etc.,	They have two pairs of limbs for locomotion.
04	Organisms may be free living or parasitic.	All organisms are free living.
05.	Systems are simple in organisation.	Systems are complex and highly organised.
06.	Reproduction is by asexual or sexual methods.	Reproduction is only by sexual method.

Vertebrates are classified into five classes as follows.

1. Class Pisces.
2. Class Amphibia
3. Class Reptilia
4. Class Aves and
5. Class Mammalia

Class Pisces

These are aquatic animals and their skin is covered with scales which form the exoskeleton. The Endoskeleton is made up of either cartilage (eg. sharks) or bone (eg. catla). The body is streamlined. Respiration is by gills which are covered by an operculum on either side. Heart is two chambered (one Auricle and One Ventricle). Air bladder is present above the alimentary canal which regulates buoyancy. These are cold blooded animals. They are either oviparous or viviparous.

Lion fish

MIGRATION IN FISHES

Fishes can migrate vertically up and down the water column or horizontally across ocean or along rivers many Marine fishes make daily vertical migrations.

Types of Horizontal Migration are

1. **Anadromous Migration** – Fishes live in the ocean mostly and breed in fresh water.
2. **Catadromous Migration** – Fishes live in fresh water and breed in the ocean.
3. **Amphidromous Migration** – Fishes move between fresh and salt water during their life cycle but not for breeding.

Class Amphibia

Salamander

Amphibians are cold blooded vertebrates which can live on land as well as in water (dual life). Body is divisible into head and trunk. Skin is moist and slimy. The heart is three chambered (Two Auricles and one Ventricle). Respiration is by gills (tadpole), skin and lungs (adult). Fertilisation is external. They are oviparous (egg laying) showing complete metamorphosis.

MORE TO KNOW

Amphibians are good **indicators** of **environmental changes.** They breathe partially through their skin which makes them sensitive to radiation, pollution and habitat destruction. Scientists believe amphibians can show the first signs of environmental emergencies. In the last 20 years, the number of amphibian species have declined with some species becoming extinct due to acid rain, ozone depletion and chemical pollution.

MORE TO KNOW

Unforgiving fish?

The stone fish may be the highly **poisonous fish** in the world. The poison is carried in its skin and in sacs attached to razor sharp spines along its back. When attacked or even accidentally stepped on, the stone fish pushes its spines into the predator and releases the poison into the wounds which usually results in paralysis or death.

MORE TO KNOW

The drug derived from the extract of **Poison arrow frog** (Epipedobates tricolor) works as a powerful **painkiller**. It has the same benefits of morphine but without any side effects.

How to distinguish frogs from toads?

TOAD	FROG
Short hind legs.	Long hind legs.
Rough, warty skin.	Moist, smooth skin.
Spends little time in water.	Spends More time in water.
Walks and makes short hops.	Jumps.
Toothless.	Teeth in upper jaw.
Webless hind feet.	Webbed hind feet.

Indian Cobra

Class Reptilia

These are creeping or crawling terrestrial animals and their body is covered with dryskin or epidermal scales. Tympanum represents the ear. Heart is three chambered. Snakes and lizards shed their scales as skin cast. They are oviparous and development is direct.

Superlatives

The slowest reptile	-	Giant tortoises of Galapagos islands.
The fastest reptile	-	Spiny tailed Iguana of Costa Rica.
World's fastest snake	-	The black mamba of Africa
The world's longest snake	-	A reticulated python
Largest poisonous snake	-	King Cobra.
Smallest reptile	-	Gecko
Largest reptile	-	Komodo dragon.

Class Aves

Peacock

Birds are characterized by the presence of feathers, modified forelimbs (wings), beak and air filled bones (pneumatic bones). These are warm blooded and oviparous which lay cledoic eggs (with shell) with large amount of yolk (reserve food). The hind limbs are modified for walking, swimming or clasping.

Owl

MORE TO KNOW

Birds like **crows** and **ravens** have a large brain with large number of brain cells.

Birds like parrots just imitate the sounds of human.

MORE TO KNOW

- Woodpeckers not only peck the wood for insects but can also hear the sound of insects crawling inside the wood.
- Penguins can survive freezing cold temperatures because of a thick layer of the fat below their skin which act as heat insulator.
- Owls can easily hunt in darkness, since their eye balls are elastic and can be focused instantly at any distance. They can widely open their pupil to allow more light to enter.

Vedanthangal Birds Sanctuary

It is one of the spectacular breeding grounds in India. It is located in Kancheepuram District of Tamilnadu (about 75 km from Chennai). The bird life (Resident and Visitors) include Cormarants, Darters, Herons, Egrets, Open billed stork, Spoon bills, white ibis, Little grebe, Blackwinged suits, Grey pelican etc.

November to February is the ideal season to visit the sanctuary.

Vedanthangal birds sanctuary

Class Mammalia

Mammals are higher chordates characterised by a presence of milk

Dolphins

producing glands (mammary glands). Their skin has hairs as well as sweat and oil glands. Heterodont dentition (different types of teeth), external ears or pinnae, diaphragm (muscle which separate thorax and abdomen), pulmonary respiration (lungs), internal fertilization and viviparity are other salient features.

Echolocation in Bats

Bat

Echolocation is also called bio sonar which is used by several animals like bats. These animals emit ultrasound waves and listen to the echoes of those calls that return from various object in the surroundings. They use these echoes to locate, range and identify the objects. It is used for navigation and for hunting in total darkness.

MORE TO KNOW

- Mammals like Echidna and Platypus are egg laying.
- Whales and dolphins are mammals.
- African elephant is the biggest land mammal and blue whale is the biggest aquatic mammal.
- Kangaroos can leap up to 30 feet in one bounce.
- Pygmy shrew is the slowest mammal.
- Bats are the only mammals which can fly.

ACTIVITY –5.4

- Make a visit to the zoo and note down the different animals and their feeding habits.

5.3. VARIOUS MODES OF REPRODUCTION IN ANIMALS

Hippopotamus with young one

Lion with cub

Reproduction is the capacity of an organism to produce young ones of their own kind. Reproduction in an inherent capacity of organisms to ensure the sustenance of their species.

Major types of reproduction

All animals from protozoans to mammals have the ability to reproduce. Reproduction is basically of two types namely Asexual and sexual reproduction.

S.No.	Asexual Reproduction	Sexual Reproduction
01.	It involves a single parent.	It involves two parents (male and female) each capable of producing gametes.
02.	It doesnot involve the fusion of gametes.	It involves the fusion of male and female gametes [(i.e.) Sperm and ovum] resulting in the formation of zygote.

Asexual Reproduction

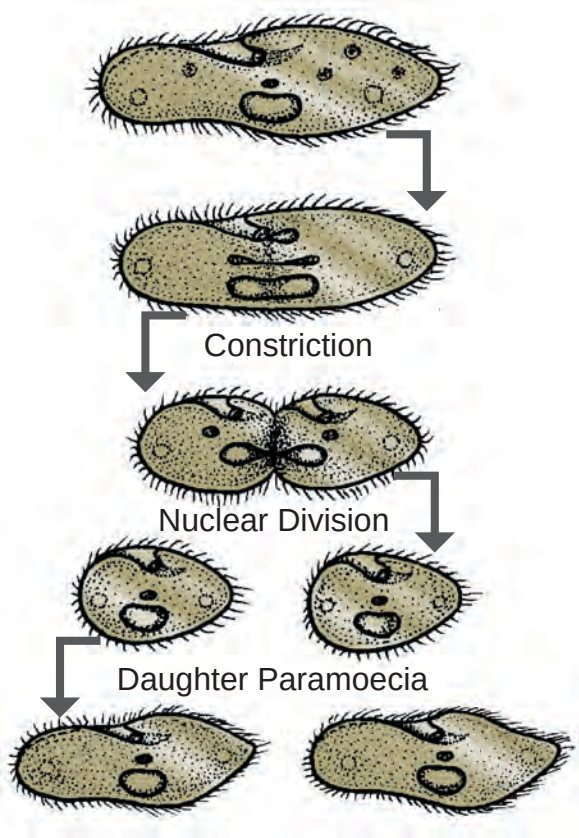
In asexual reproduction, new individuals are formed from a single parent. It may involve the whole body of an organism or body cells. These include multiple fission, binary fission, budding, regeneration gemmule and spore formation, etc.,

Binary fission : eg. Paramoecium

Paramoecium is an unicellular organism which reproduces by binary fission. In this process a constriction appears at the centre which divides the nucleus and cytoplasm into two parts. Thus a single paramoecium is divided into two.

Multiple Fission

Many protozoans reproduce by multiple fission under unfavorable condition. In this process, the nucleus of the parent cell divides repeatedly to form a number of daughter nuclei. Each daughter nucleus is surrounded by cytoplasm and plasma membrane and thus a number of daughter cells are formed. Each cell separates and leads an independent life.



Binary fission in paramaceium

ACTIVITY –5.5

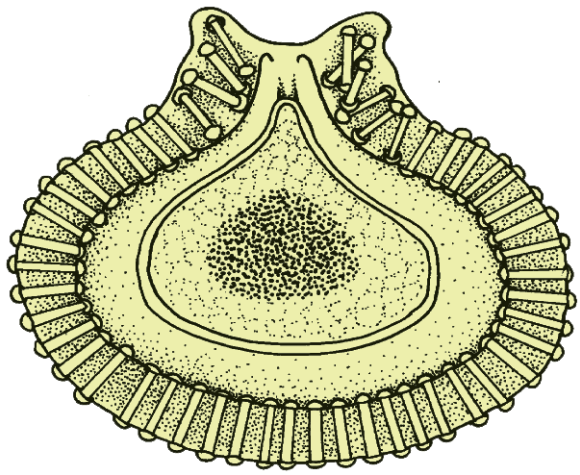
Observe a microslide of binary fission in amoeba.

Budding

Hydra reproduces asexually by budding. During budding the body wall of hydra produces an outgrowth (bud) due to repeated cell division at one specific site. This bud gradually grows in size and develops a mouth and tentacles at the free end. Soon a constriction appears at the point of contact and the daughter hydra gets separated from the mother and lead an independent life.

Budding

Gemmules



Gemmule

Gemmules are internal buds found in sponges and are resistant to unfavourable condition.

These buds have an outer thick layer with numerous air spaces and two inner chitinous layers. During favourable conditions, the cell mass comes out of the gemmule through an opening called the micropyle. Later the cell mass develops into a young sponge.

Spore and cyst formation

This type of reproduction is common among protozoan parasites such as plasmodium (malarial parasite). This method is also called sporulation. During unfavourable conditions, the protoplasm is condensed and covered by a thick, protective covering called the cyst. When conditions are favourable, the cyst gets dissolved. The protoplasm regains its original nature and the organism undergoes fission.

Regeneration

Animals like sponges, Hydra, Planaria and star fish exhibit regeneration. It is a complex process which involves the repair of damaged cells or tissues or redevelopment of severed part or formation of whole body from a small fragment.

Autotomy

It refers to the power of self cutting of body parts for defence. Examples – Regeneration of arms in star fish, regeneration of tail in house lizard.

Regeneration in man

Regeneration is highly limited in higher animals due to more specialization and complex organisation.

Examples of regeneration in man

1. Healing of wounds.
2. Replacement of dead or worn out blood cells.
3. Replacement of the horny layer of the skin.

Advantages of Asexual reproduction

1. It requires only one parent.
2. It does not involve gametes and fertilization.
3. The young ones have identical characteristics of their parents.

Disadvantages of Asexual reproduction

1. It does not result in large variations and hence donot lead to speciation and evolution.
2. Transmission of undersiable characters from parent to offspring without any change.

Sexual reproduction

All higher animals and a few lower organisms can reproduce sexually.

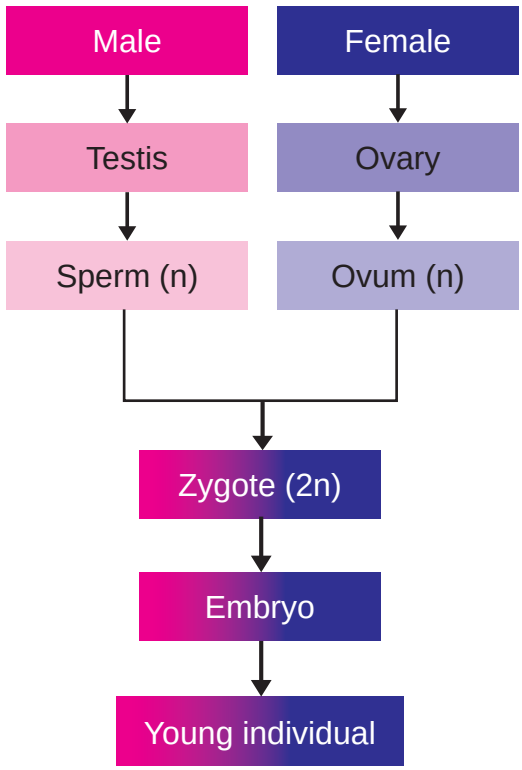
On the basis of the presence of gonads, organisms are classified into two types.

1. **Unisexual organisms** – with only one type of gonad (i.e. either testis or ovary) eg. - Human beings.
2. **Bisexual organisms** or Hermophrodites – Organism with both testis and ovary) eg - Tapeworm, Hydra.

Conjugation in paramecium

Lower organisms like paramecium reproduce sexually by conjugation. It involves the transfer of nuclear materials.

Schematic representation of sexual reproduction

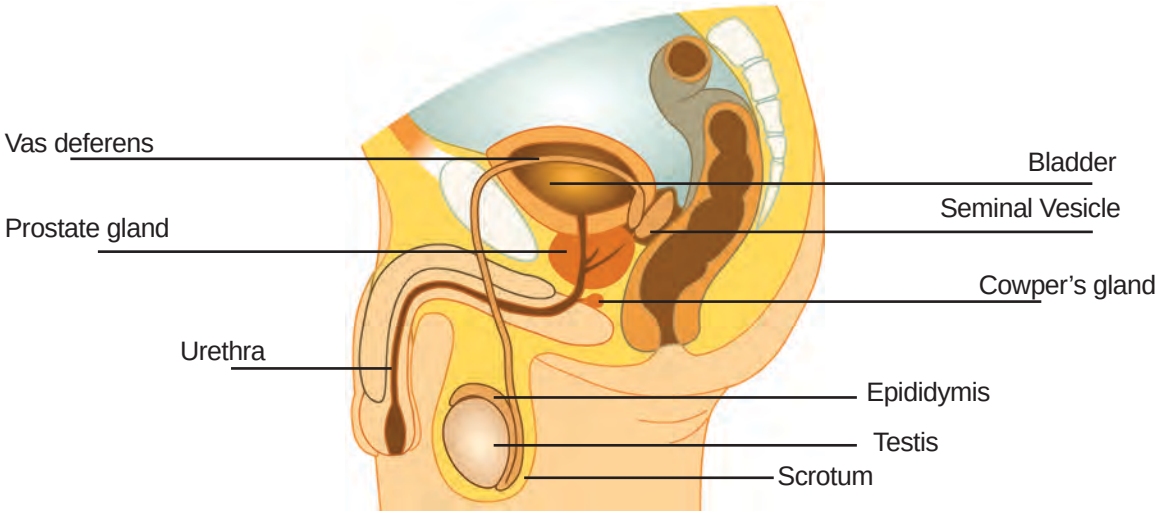


In higher organisms, two individuals of a species (male and female) are involved in sexual reproduction. The male reproductive organ is the testis which

produce the sperms. The female reproductive organ is the ovary which produce the ova or eggs. A sperm and an egg fuse to form a zygote. The fusion of sperm and ovum is called fertilization. The zygote further develops into an embryo and later becomes an adult.

5.4. REPRODUCTION IN HUMAN

Male reproductive system



Human male reproductive system

The male reproductive system includes the primary sex organs and accessory organs. The primary sex organs are the testis and the accessory organs are seminal vesicles, prostrate glands, urethra and penis.

A pair of testis are located in the scrotum outside the abdominal cavity because sperm formation requires a lower temperature than the normal body temperature. Each testis contains a coiled mass of tubules known as seminiferous tubules which produce sperms. The process of formation of sperms is known as spermatogenesis. The interstitial cells of the testis also secrete the male sex hormones (androgens) which control spermatogenesis and the appearance of male sexual characters such as growth of beard, moustache, body hair, hoarse voice, etc.,

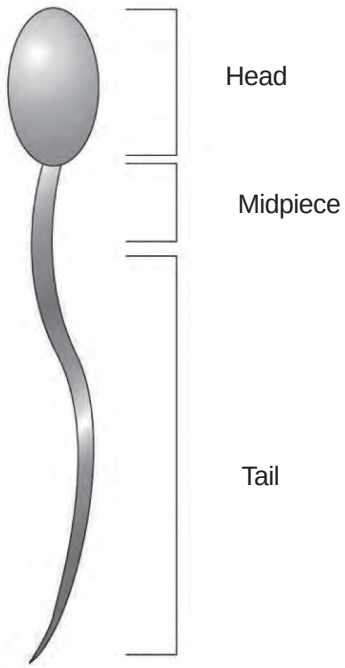
The sertoli cells of the testis provide nourishment to the developing sperms.

The sperms are delivered through the vas deferens which unites with the urethra which form a common passage for both sperms and urine. Along the path of vas deferens lies seminal vesicles and prostrate glands which add their secretions so that sperms are released in a fluid called semen. This fluid provides nutrition and helps in the transport of sperms.

Structure of a mature sperm

The sperm consists of four parts namely head, neck, midpiece and tail. The head contains a condensed nucleus containing haploid set (n) of chromosomes and a terminal acrosome (Golgi apparatus) containing hyaluronidase and proteolytic enzymes. The neck contains a proximal and a distal centriole. The distal centriole is continuous with axial filament. The

midpiece contains the spirally coiled mitochondria. The tail represents the remnants of cytoplasm and propels the sperm in the liquid medium.

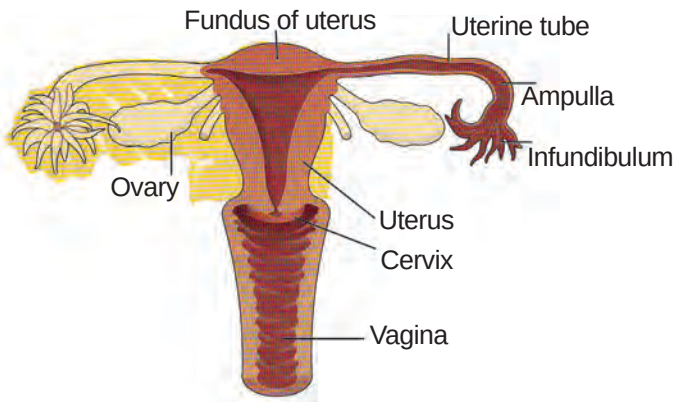


Sperm

MORE TO KNOW

Anton van Leeuwenhock (1632 - 1723) was the first to observe and draw sperm cells.

Female reproductive system



Human female reproductive system

The female reproductive system consists of ovaries and accessory organs such as fallopian tubes, uterus, cervix and vagina. The ovary produces an egg for every 28 days (menstrual cycle) as well as female sex hormones oestrogen and progesterone.

MORE TO KNOW

Sperm Bank

Sperms are collected in the form of semen and can be stored in sperm bank viable for several years in frozen state in liquid nitrogen at a very low temperature. These sperms are useful in invitro fertilization and artificial insemination techniques.

Each ovary consists of follicle cells which produce the ovum by a process known as oogenesis. The uterus is a hollow, thick walled muscular organ formed of three layers and the fertilized ovum is embedded and nourished in the uterus. Vagina is a muscular tube which connects the cervix and the external genitalia. It serves to receive sperms and as a birth canal. The oestrogen is responsible for oogenesis and for the appearance of female secondary sexual characters such as development of breasts, growth of hair, feminine voice, etc.,

Structure of egg of human ovum

The egg of human is alecithal (without yolk) and contain cortical granules and yolk platelets. The egg is surrounded by a number of egg membranes.

1. **Vitelline membrane** – The ovum is surrounded immediately by a thin transparent membrane.

2. **Zona pellucida** – It is a thick transparent membrane above the vitelline membrane.

3. **Corona radiata** – The outermost thick membrane formed by the follicle cells.

Menstrual cycle

The rhythmic series of changes in the female sex organs that occur for about 28 days throughout the reproductive life of women from puberty to menopause (except during pregnancy) is known as menstrual cycle. After ovulation, the mature ovum is brought to the fallopian tube and may get fertilized. When the ovum is not fertilized, the ovum along with the uterine wall is ruptured and discharged with blood and uterine tissue by a process called menstruation.

It involves three phases namely

1. The follicular phase (5th day – 14th day)
2. The luteal phase or Premenstrual phase (15th day – 28th day)
3. The menstrual phase (1st day – 5th day)

Menstrual cycle

1. Follicular phase: This phase is initiated by the secretion of Follicle Stimulating Hormone (FSH) of pituitary. During this phase primary ovarian follicles begin to grow and the mature graffian follicles burst and release the ovum into the fallopian tube (ovulation).

2. Luteal phase: This stage is influenced by Lutenising Hormone (LH) of pituitary gland.

After the release of the ovum, the ruptured part of graffian follicle is transformed into a transitory endocrine gland called corpus luteum. It secretes the pregnancy hormone called progesterone. This hormone causes the thickness of endometrium and prepares the uterus to receive the fertilized ovum. If the ovum is not fertilized, the ovum and uterine wall gets ruptured and discharged during menstrual phase.

3. Menstrual phase: The decline in progesterone and oestrogen initiates the shedding of unfertilized egg and endometrium with severe bleeding in a process called mensus or menstruation. At the termination of menstruation, the corpus luteum is converted into a scar tissue called corpus albicans.

5.5. FERTILIZATION

Fertilization is a process of fusion of male and female gamete to form a diploid zygote.

Types of fertilization

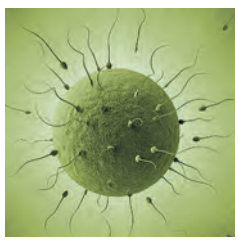
The two types of fertilization are

(a) **External fertilization** – The fusion of the gametes occurs outside the body of the animal. (eg. Frogs, Echinoderms).

(b) **Internal fertilization** – The fusion of the gametes occur within the body of the female. (eg. Reptiles, Birds and Mammals).

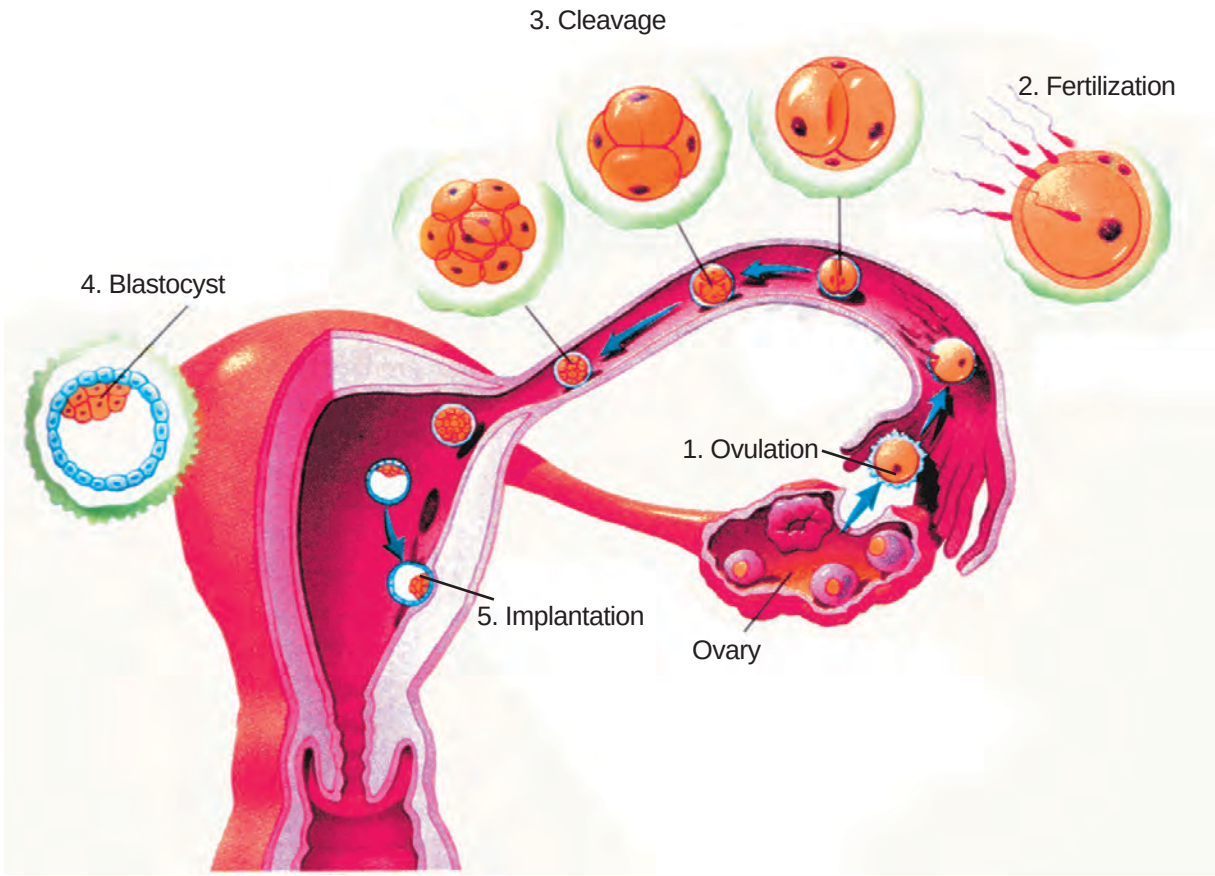
Mechanism of fertilization

At the time of ovulation, the ovum is fully matured and it enters the infundibulum of the uterine tube and passes into the ampulla. Fertilization of the ovum occurs in the ampulla of the uterine tube. Only one spermatozoan pierces the egg membrane Zona pellucida and enters the ovum. Polygamy (entry of more sperms) is prevented by the fertilization membrane around the ovum.



Fertilization

5.6. DEVELOPMENT OF EMBRYO



Blastulation to implantation

The fertilized ovum is called the zygote. As soon as it is formed, it becomes activated and mitotic divisions sets in. This is the first phase of embryo's development called the cleavage. As a result a ball of cells called the blastula is formed. The outer surface forms the trophoblast and the embryo gets attached to the wall of the uterus. This process is known as implantation. The implanted embryo develops the extra embryonic membranes such as amnion, allantois, chorion and yolk sac. Amnion provides a fluid medium to the developing embryo. It prevents dessication of the embryo and function as a shock absorber. The chorion and allantois fuse to form the placenta. It helps in the exchange of gases between the mother and the foetus and also the elimination of nitrogenous wastes from the foetus. The embryo and the placenta are connected by the umbilical cord which is derived from the allantois.

Stages in the development of the human foetus.

Gestation period : From the fertilization of the ovum to the birth of the baby it takes about nine months. The period during which the foetus remains inside the uterus is called the gestation period.

The development of foetus can be studied as phases of three month period – the first, second and third trimesters.

First trimester

During this period, the proliferation of cells takes place and gradually a single cell is transformed into a foetus. Organogenesis takes place resulting in the formation of organs.

Development of Human embryo

Second trimester

The foetus grows rapidly. The respiratory and circulatory systems become well developed and functional. The bones and muscles are well formed.

Third trimester

The length and weight of the foetus increases very rapidly and the development is completed.

Child birth

A few days before birth, the foetus turns head downwards in the uterus just above the cervix.

At the onset of childbirth, the uterus begins to contract rhythmically under the influence of oxytocin hormone. These contractions become stronger and more frequent. This marks the onset of labour pain. With continued powerful contractions, the amnion ruptures and the amniotic fluid flows out through the vagina.

Finally, the muscular contractions of the uterus and the abodmen expel the child through the dilated cervix and vagina. The umbilical cord that still connects the child to the placenta is tied and cut. A few minutes later, the placenta breaks away from the uterus and is expelled as 'after birth'.

Lactation

The first milk which comes out from the mother's mammary gland just after childbirth is known as colostrum. It is rich in proteins and nutrients. It also contains antibodies that provide immunity for the newborn infant. The secretion of milk is stimulated by the pituitary hormone prolactin.

Advantages of mother's milk

- It is easily available, clean, uncontaminated and sterile.
- It is available at a correct temperature for the baby's needs.
- It contains antibodies which shield the baby from external viral and bacterial infections.
- In rural areas breast milk is used as eye drops for viral conjunctivitis and minor eye infections as a first aid.
- The calorific value of breast milk is 70 per 100 ml of milk and this fully meet the requirements of the infant.
- Lactoferin a protein in breast milk, provides considerable protection against intestinal and respiratory infections.

MORE TO KNOW

The test tube babies are formed by the technique of invitro fertilization in which fertilization and early development takes place in an artificial medium outside. Steptoe and Edwards of UK were successful in producing the first test tube baby.

5.7. VIVIPAROUS ANIMALS

Vivipary means directly giving birth to young ones (e.g placental mammals). The young ones directly receives food and oxygen from the mother through the placenta and also excretes the wastes through it.

5.8. OVIPAROUS

Cledoic eggs

Non cledoic eggs

Oviparous animals lay eggs laden with yolk. The embryonic development takes place outside the body of the mother. Land dwelling animals lay eggs with shell (cledoic eggs). The shell gives protection and prevents dessication. These eggs are laid outside after the process of internal fertilization (e.g. Reptiles and insects).

MORE TO KNOW

Ovoviviparous animals

In these animals the embryos develop inside the eggs that are retained within the mother's body until they are ready to hatch. the young ones are nourished by the egg yolk and there is no placental connection. eg. Vipers

5.9. YOUNG ONES TO ADULT

The young ones which emerge from the egg either has resemblance or no resemblance with the adult. The young one has to pass through morphological, anatomical and physiological changes and get transformed into an adult. These changes which transform the young ones into adults are known as metamorphosis.

Metamorphosis in insects

In insects, the outer skin is cast off periodically and this process is known as moulting or ecdysis. The larval stages between two successive moultings are called stadia (singular - stadium). Thus the insect grows by a series of changes and these growing stages are called instars.

MORE TO KNOW

Moulting hormone

Moulting hormone or ecdysone or juvenile hormones are secreted by the neuro secretory cells of the brain and controls moulting in insects.

Types of metamorphosis

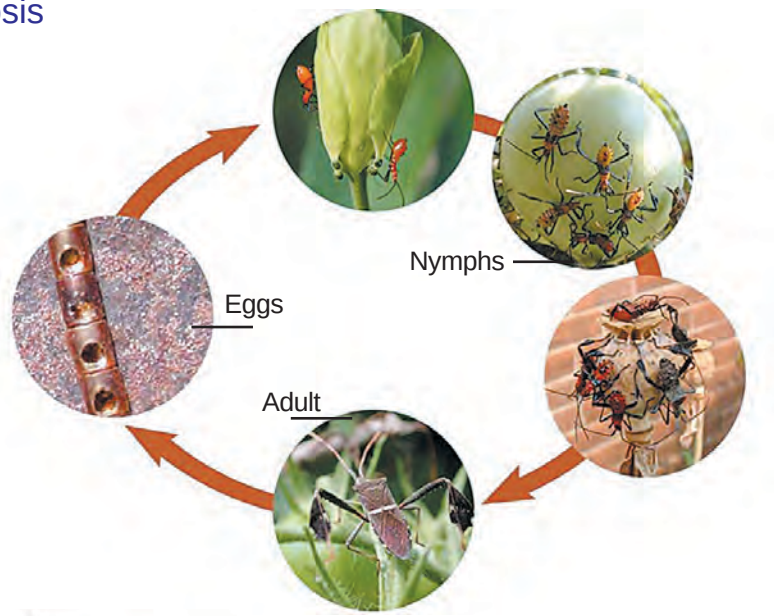
Incomplete metamorphosis

Lifecycle of Grasshopper:

The newly hatched young ones resembles the adult except in size, lack of wings and reproductive organs. the young ones (nymphs) undergo several intermediary stages through successive moultings to become an adult.

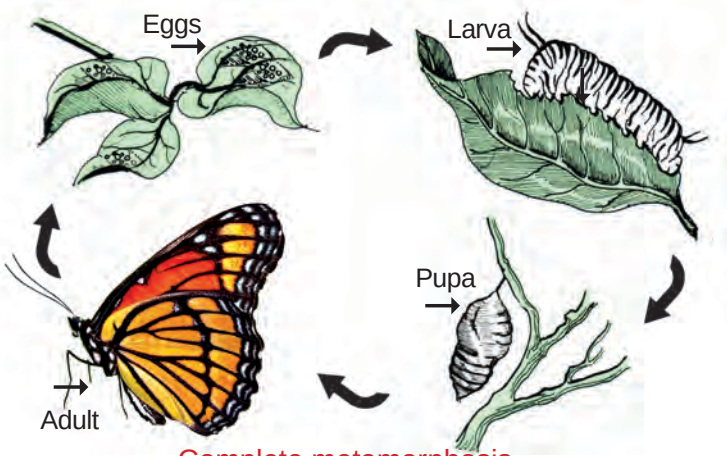
Egg ⟶ Nymph ⟶ Adult

e.g Grasshopper, Mayfly



Incomplete metamorphosis

Complete metamorphosis



Complete metamorphosis

Lifecycle of Butterfly

The young ones are strikingly different from the adults and the process of development starts with larva which hatch out of the egg. It is worm like and termed as caterpillar. The larva feeds voraciously on leaves and increase in size. Then the larva enters a resting stage the pupa and develops a pupal case (cocoon) around it. After a period of time, the adult or imago emerges out of the cocoon.

Egg ⟶ Larva ⟶ Pupa ⟶ Adult

e.g. Butterfly, silk moth.

EVALUATION

Section – A

1. The arrangement of body parts in an organism is known as symmetry. Classify organisms based on symmetry.

2. Reptilia → Pisces → Aves → Mammalia → Amphibia
   Arrange in correct sequence according to the evolutionary trend.

3. The eggs of mammals are alecithal (Without yolk). How do the mother feeds the young ones?

4. In some organisms both the male and female sex organs are present in a single individual. Name such organisms. Give an example.

5. The process of menstrual cycle stops during pregnancy and resumes after child birth. Name the hormone involved and mention its function.

6. During the time of delivery, the mother experiences severe labour pain. Name the hormone responsible for it and mention its significance.

Section – B

7. Millions of organisms inhabit the earth. They are classified and placed under different groups. Mention the need for classification.

Organisms	Locomotory organs
Paramoecium	Limbs
Fishes	Webbed feet
Frogs	Wings
Aves	Fins
Mammals	Cilia

8. a) Match the organisms with their locomotory organs.
   b) Correlate the locomotory organs with their mode of existence.

9. Bats are nocturnal animals. But, they could navigate in total darkness. Explain.

10. The eggs of birds are Cledoic (shell) and contains yolk.
    Mention the role of the shell and yolk in birds.

11. Most of the birds can fly. List out the structural adaptations which enable them to fly.

12. Earthworms can increase soil fertility. Justify.

13. The testis are located in the scrotum outside the abdominal cavity. Give reason.

14. In higher organisms the male and female can be distinguished by certain external features called secondary sexual characters. List out some male and female characters in human.

15. Both the Sperm and Ovum contains haploid set (n) of chromosomes. Give reason.

16. The developing foetus can communicate with the mother through the placenta. Mention the role of placenta.

17. The gestation period in human is about nine months which is divided into three divisions called trimesters. List out the changes which occur during the first trimester.

18. Mother's milk is the wholesome food for the child. Justify your answer.

19. In insects during metamorphosis, the outer skin is cast off periodically. Name the process and mention its significance.

Section – C

20. Match the following columns A, B and C to make meaningful sequences.

Column A	Column B	Column C
Tapeworm	Vermi compost	Calcareous spines
Earthworm	Spiny Skin	Parasite
Starfish	Locomotion	Soft body
Paramoecium	Shell	Organic farming
Mussels	Hooks and suckers	Flagella

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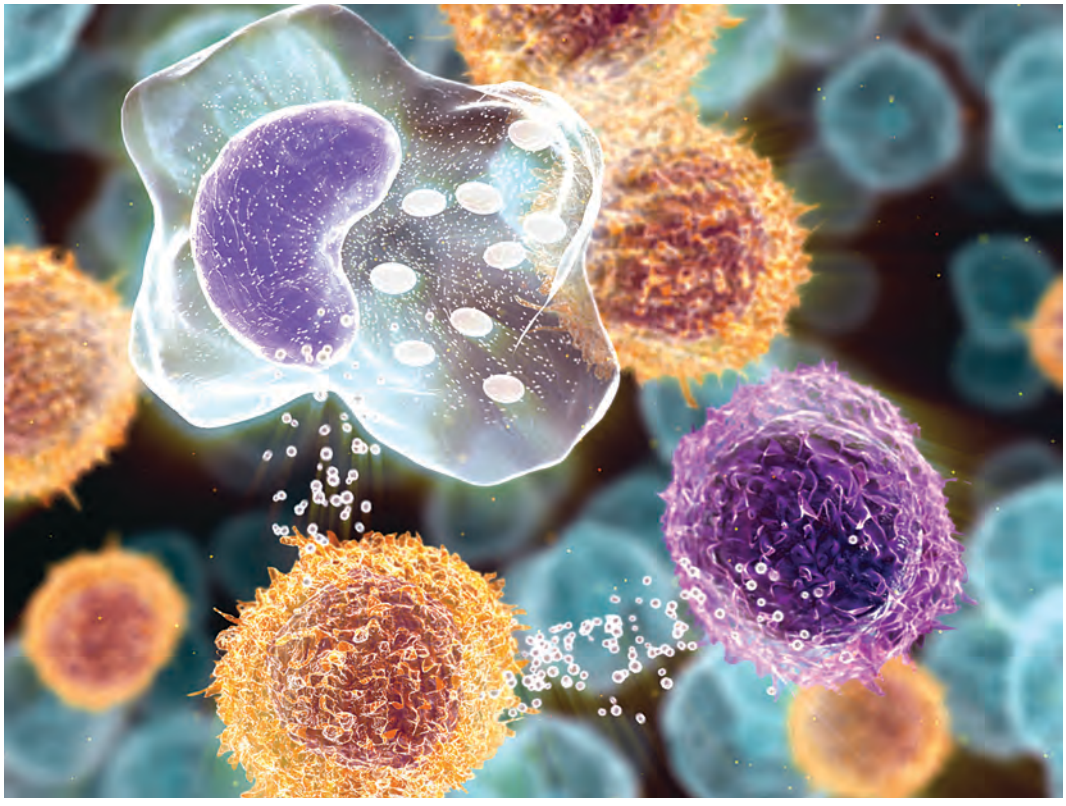
Chapter 6



CELLS AND TISSUES

6.1. PROKARYOTIC AND EUKARYOTIC CELLS

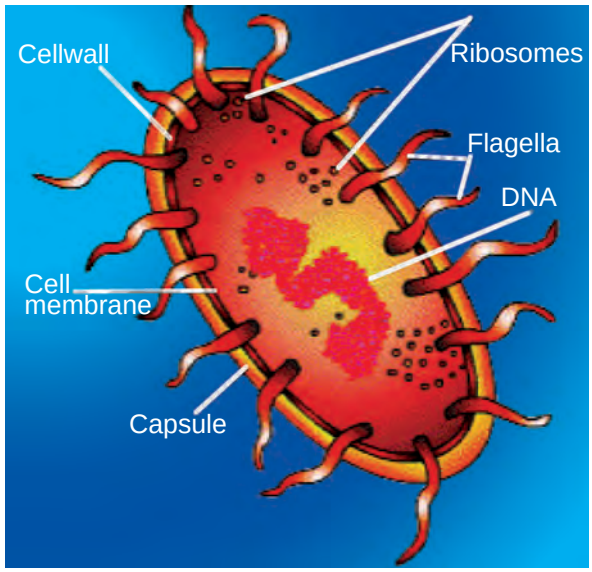
Based on the complexity of organization, especially nuclear organization, the cells are classified into two types.

i) Prokaryotic cells.

ii) Eukaryotic cells.

Prokaryotic cells

The cells of Bacteria and Cyano Bacteria (blue green algae) lack a well organised nucleus and are called prokaryotic cells. Their DNA (Deoxyribo Nucleic Acid) is not enclosed by a nuclear membrane. They also lack membrane bound organelles. The organisms which possess prokaryotic cells are called prokaryotic organisms or prokaryotes. They are considered to be primitive organisms.



A Prokaryotic cell (Bacteria)

Eukaryotic Cells

The cells of all plants (except bacteria and cyano bacteria) and animals possess a well organised nucleus and are called Eukaryotic cells. Their genetic material is enclosed by a nuclear membrane. They possess membrane bound organelles like Endoplasmic reticulum, golgi body, mitochondria, plastids and vacuoles. The organisms which possess eukaryotic cells are called Eukaryotic organisms or eukaryotes.

Differences between Prokaryotic cell and Eukaryotic cell

Prokaryotic Cell		Eukaryotic Cell	
1.	It is generally smaller (1-10 micro metre) in size	1.	It is comparatively larger (5-100 micro metre) in size.
2.	It lacks a well organised nucleus as its nuclear material is not surrounded by a nuclear membrane.	2.	It contains a well organized nucleus as its nuclear material is surrounded by a nuclear membrane.
3.	It has a single chromosome	3.	It has more than one chromosome.
4.	Nucleolus is absent	4	Nucleolus is present
5.	It lacks membrane bound cell organelles.	5.	It possess membrane bound cell organelles.
6.	Cell division occurs by fission or budding. Mitotic and meiotic divisions are absent	6.	Cell division takes place by mitosis and meiosis.
7.	Ribosomes are smaller	7.	Ribosomes are larger

6.2. MULTICELLULAR ORGANISMS

Do you know?

1. What is meant by unicellular organism?
2. Give one example for unicellular organism.
3. What are multicellular organisms?

The organisms having many cells in their body are called multicellular organisms. e.g. Most plants and animals. Multicellular level of organization represent an advanced state among living organisms. Multicellular organisms have different kinds of cells to perform different functions.

6.3 CELL AS A BASIC UNIT OF LIFE

Higher organisms contain organs; organs are composed of tissues; tissues are made up of cells and cells are formed from molecules. However, in all living organisms the cell is the functional unit. All biological activities revolve around the activity of the cell. Cell is defined as a unit of an organism delimited by a plasma membrane in animal cells, and cell wall and plasma membrane in plant cells. Thus, cell forms the basic unit of life.

MORE TO KNOW

- The study of cell is not possible without a microscope, Robert Hooke in 1665 coined the term cell.
- Anton van Leeuwenhoek (1674), studied the structure of bacteria, protozoa, etc. under the simple microscope which he himself designed.
- Robert Brown discovered that all cells contain nucleus.
- Purkinje coined the term, 'protoplasm' for the living substance present inside the cell.

Leeuwenhoek Microscope

Compound Microscope

CELL SIZE, SHAPE AND NUMBER

There is much variation in size, shape and number of cells in different organisms, and also in various parts of the body. Most of the cells are only a few micrometres in diameter and are visible only with the help of a microscope.

Cells may be spherical, spindle shaped, elongated, polyhedral or irregular in shape. The shape of the cells is determined by the specific function they perform.

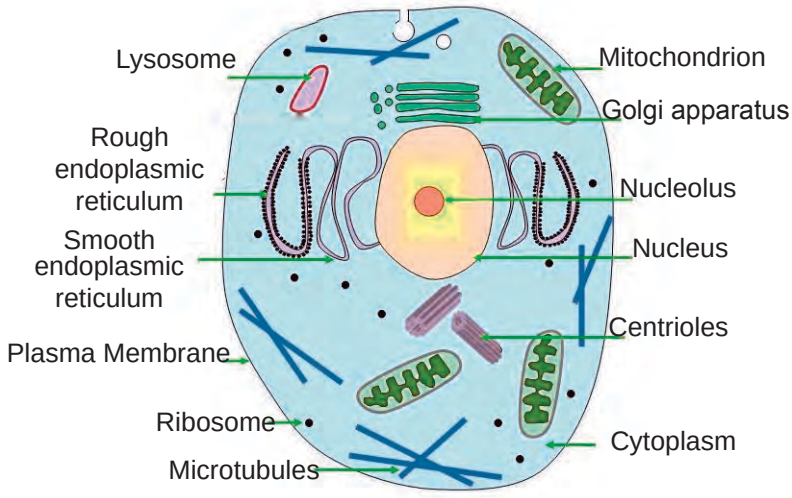
The number of cells is related to the size of the organ or body. Thus, small organisms have limited number of cells, while the larger ones such as elephant, whale or banyan tree have a countless number of cells.

STRUCTURAL ORGANIZATION OF A CELL

A cell is made of life giving substance called protoplasm. The protoplasm is a highly organised jelly like, viscous, semifluid, composed of molecules of various chemicals. Most of these are

organic molecules such as proteins, carbohydrates, fats, nucleic acid etc. Protoplasm is commonly called the 'physical basis of life'.

A plant cell consists of a cell wall and protoplast. Cell wall is absent in animal cells. Protoplast denotes the whole of protoplasm present in a cell. It is differentiated into plasma membrane, nucleus and cytoplasm.



Ultra structure of an Animal cell

Various cell organelles are suspended in the cytoplasm. Plant cells differ from animal cells in many ways.

Differences between Plant cell and Animal cell

S.No.	Plant cell	Animal cell
1.	Plant cell has an outer rigid cell wall which is made up of cellulose.	Animal cell lacks a cell wall.
2.	Plant cell is larger than animal cell.	Animal cell is comparatively smaller in size.
3.	Plant cell has large vacuoles which occupy more space in the cell.	Animal cell usually lacks vacuoles. Even if they are present, they occur in minute sizes.
4.	Centrosome is present only in the cells of some lower plants.	All the animal cells have centrosomes.
5.	Lysosomes are found only in the eukaryotic plant cells.	Lysosomes are found in all animal cells.
6.	Plant cell contains plastids.	Plastids are absent
7.	Mostly, starch is the storage material.	Glycogen is the storage material.

6.3.1. CELL MEMBRANE AND CELL WALL

Cell Membrane (Plasma membrane or Plasmalemma)

The contents of the cell are enclosed by a thin, delicate living membrane called cell membrane. It is the outer boundary of the cell. Cell membrane is flexible and is made up of a continuous bilayer of lipid molecules and protein molecules on both of its surfaces and also embedded in it.

Functions

- Plasma membrane selectively regulates the entry and exit of the substances into and out of the cell. Therefore, it is called a selectively

permeable membrane or semi-permeable membrane.

- It provides an outer boundary to the cell and protects the cell from injury.
- It allows the flow of materials and information between different organelles of the same cell, as well as between the adjacent cells.
- It provides some organic connections between the adjacent cells.

CELL WALL

Cell wall is present only in plant cells. It is a rigid protective covering outside the plasma membrane. Presence of cell wall in plant cells distinguishes them from animal cells. Most of the plant cell walls are made of cellulose.

The cell wall consists of three layers namely, middle lamella, primary wall and secondary wall. The middle lamella is a thin amorphous cement like layer between two adjacent cells. Primary wall is the first formed wall of the cell and is produced inner to the middle lamella. The secondary wall is a thick layer found inner to the primary wall.

Functions of cell wall

1. Cell wall gives a definite shape to the plant cells.
2. It provides mechanical strength to the cell.
3. It protects the protoplasm against injury.
4. It gives rigidity to the cell.

6.3.2. CYTOPLASM

Cytoplasm is a viscous, translucent, homogeneous and semifluid mass of protoplasm excluding the nucleus. The portion of cytoplasm immediately below the cell membrane is gel like and is called ectoplasm. The cytoplasm between the ectoplasm and nuclear membrane is liquefied and is called endoplasm.

Cytoplasm consists of vital molecules such as carbohydrates, lipids, proteins, amino acids, minerals and water. It is the seat of cellular metabolism. Different types of cell organelles are embedded within the cytoplasm. Each type of organelle performs specific functions in the cell.

Functions of Cytoplasm

- Cytoplasm helps in intracellular distribution of enzymes, nutrients and other biomolecules within the cell.
- Synthesis of different types of biomolecules such as proteins, nucleotides, fatty acids etc., takes place in the cytoplasm.

6.3.3. CELL ORGANELLES

A cell performs a variety of functions such as i) Synthesis of complex molecules and their breakdown, ii) Production of energy, iii) Secretion of certain substances, etc.. These activities of the cell are performed by different cell organelles. These organelles are enclosed by membranes. To understand the functioning of the cell, it is necessary to know briefly about the structure of cell organelles.

Endoplasmic Reticulum

Endoplasmic reticulum is a complicated and interconnected system of membrane bound channels and tubules. It is spread throughout the cytoplasm and

is continuous with the plasma membrane and nuclear membrane.

There are two types of Endoplasmic Reticulum.

a. Rough Endoplasmic Reticulum. (RER)

b. Smooth Endoplasmic Reticulum. (SER)

Rough endoplasmic reticulum

(Granular endoplasmic reticulum)

They are found in cells which synthesize proteins. This type of endoplasmic reticulum possesses rough walls because the ribosomes remain attached with membrane of endoplasmic reticulum.

Smooth endoplasmic reticulum

(Agranular endoplasmic reticulum)

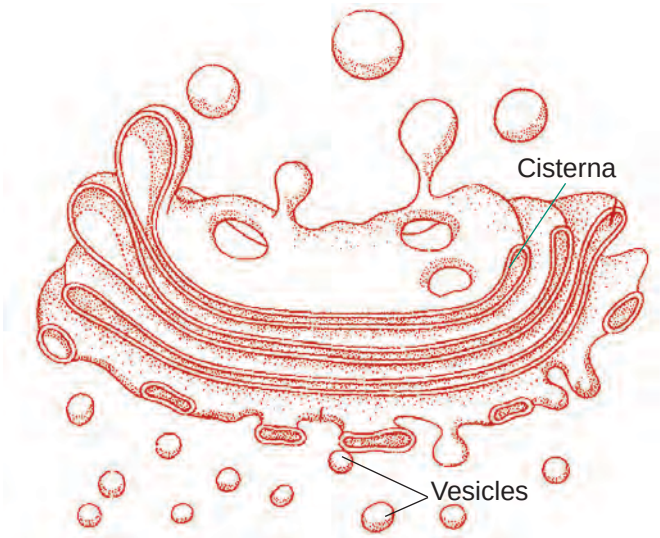
They are found in cells which synthesize lipid. The walls are smooth and ribosomes are not attached to its membrane.

Functions

1. Endoplasmic Reticulum (E.R) provides large surface area for the metabolic activities of the cell.
2. Rough endoplasmic reticulum plays an important role in protein synthesis.
3. Smooth endoplasmic reticulum is involved in the synthesis of steroid, hormones and lipids.

Golgi Complex or Golgi apparatus

The Golgi apparatus was first described by Camillo Golgi. Golgi complex consist of saucer-like compartments called cisternae, network of interconnecting tubules, vesicles and vacuoles at the peripheral regions. In plant cells, Golgi apparatus is referred to as dictyosomes.



Golgi complex

Functions

1. Golgi apparatus is involved in the formation of lysosomes.
2. It is also responsible for the synthesis of cell wall and cell membrane.

Lysosomes

Lysosomes are small membrane bound vesicles which contain various types of digestive enzymes. These serve as intracellular digestive system, hence they are called digestive bags. They are produced by the joint activity of Endoplasmic reticulum and Golgi apparatus. If the membrane of Lysosome happens to get ruptured, the enzymes of Lysosome would digest the entire cellular structure causing death of the cell. So Lysosomes are called 'suicide bags'.

MORE TO KNOW

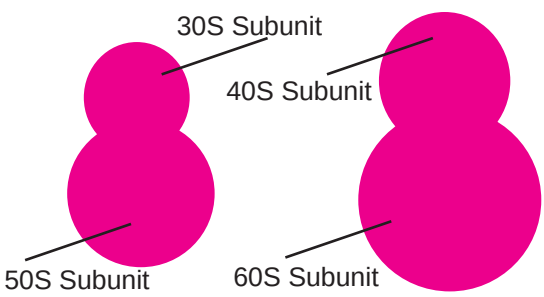
Lysosomes are involved in the destruction of aged and wornout cellular organelles. They are therefore also called demolition squads or scavangers or cellular housekeepers.

Functions

1. Lysosomes are involved in the intracellular digestion of food particles ingested by the cell through endocytosis.
2. The lysosomes of WBCs (White blood cells) destroy pathogens and other foreign particles and thus take part in natural defence of the body.

Ribosomes

Ribosomes are small granular structures made up of ribo nucleic acids (RNA) and proteins. They occur free in the cytoplasm as well as attached to the outer surface of the rough endoplasmic reticulum. Each ribosome consists of two subunits – a small subunit and a large subunit. At the time of protein synthesis many ribosomes get attached to messenger RNA and form a structure called polyribosome or polysome.



70S Ribosome 80S Ribosome

There are two types of ribosomes

a. 70S – Ribosome. It is small and consists of 30S and 50S subunits. It is seen in prokaryotic cells.

b. 80S – Ribosome. It is made up of 40S and 60S subunits. It is seen in eukaryotic cells.

Functions

Ribosomes play an important role in protein synthesis. So they are called, 'protein factories' of the cell.

Vacuoles

Vacuoles are fluid– filled sacs bound by a single membrane and are present in plant cells as well as in certain protozoans as food vacuoles and contractile vacuoles. In plant cells, major portion of the cell is occupied by vacuoles and are bound by the definite membrane called tonoplast. Vacuoles of plants are filled with cell sap containing minerals, sugars, amino acids and dissolved waste products.

Functions

i) Vacuoles store and concentrate mineral salts as well as nutrients.

ii) They maintain proper osmotic pressure in the cell for its turgidity and absorption of water.

Mitochondria

Mitochondria are globular or cylindrical organelles. Each mitochondrion is bound by two membranes – an outer continuous membrane and an inner membrane thrown into folds called cristae. These cristae divide the inner chamber incompletely. The inner chamber is filled with homogenous dense material called the matrix. The cristae have pin headed bodies called F_1 particles or Oxysomes which play an important role in respiration.

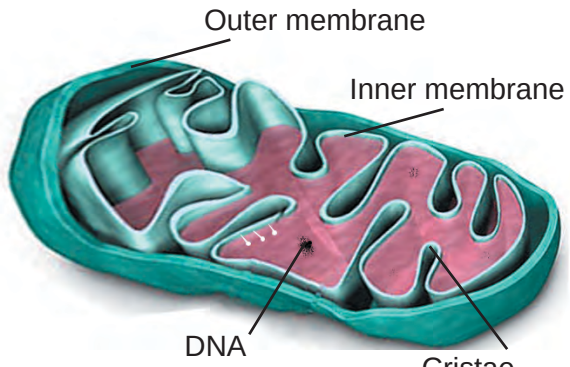
The matrix of mitochondria contains enzymes necessary for the oxidation of food during respiration and release of energy in the form of ATP molecules. Therefore mitochondria are called power houses of the cell. The mitochondria contain proteins, lipids and a small amount of DNA.

Functions

i) Mitochondria synthesize energy rich compounds such as ATP.

ii) Mitochondria provide important intermediates for the synthesis of several biochemicals like

chlorophyll, cytochromes, steroids, aminoacids etc.



Mitochondrion

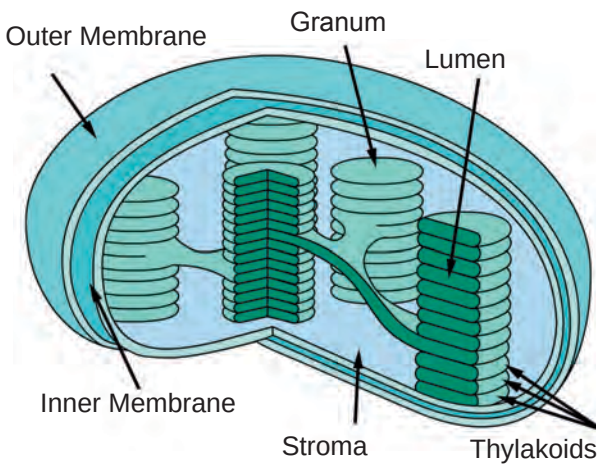
Plastids

Plastids are disc or oval shaped organelles which occur in plant cells only. Plastids are of three types. They are Leucoplasts, Chromoplasts and Chloroplasts.

i) **Leucoplasts:** These are colourless plastids which store food in the form of starch, lipids and proteins

ii) **Chromoplasts:** These are yellow or reddish in colour due to the presence of pigments other than chlorophyll. Chromoplasts provide colour to many flowers and fruits.

iii) **Chloroplasts:** These are green coloured plastids which possess the photosynthetic pigment chlorophyll.



Chloroplast

Each chloroplast consists of a double membraned envelope and a matrix. The inner membrane is arranged along the length of the plastids as lamellae. At certain regions, the lamellae are thickened and appear like pile of coins. These are called the grana. Each granum consists of disc shaped membranous sacs called thylakoids. Inside these grana, the chlorophyll is located. The non-thylakoid portion of the matrix is called stroma. It contains a number of enzymes involved in photosynthesis.

Centrosome

Centrosome is present in animal cells and in certain lower plants. It is absent in prokaryotic cells and in higher plant cells. It is located near one pole of the nucleus. It contains a pair of small, hollow granules called centrioles.

Functions

Centrioles play an important role in the formation of spindle fibres during cell division.

6.4. NUCLEUS

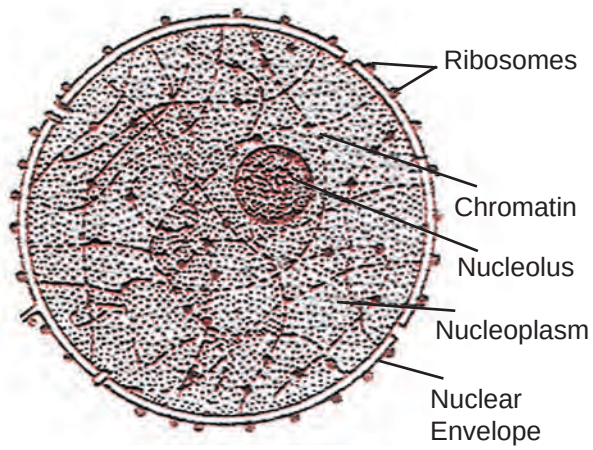
Nucleus is the major central structure in the cell. It is a dense spherical structure embedded in the cytoplasm. Nucleus has a double membraned envelope called nuclear envelope. Nuclear envelope encloses a ground substance called nucleoplasm or karyolymph. The nuclear envelope possesses many pores called nuclear pores.

The nucleoplasm has two types of nuclear structures i) the nucleolus and, ii) chromatin.

The nucleolus is a spherical body rich in protein and RNA. It is the site of ribosome formation. There may be one or more nucleoli in the nucleoplasm.

The chromatin is a network of fine threads composed of genetic material DNA (Deoxyribo nucleic acid) and

proteins. During cell division chromatin is condensed into thick cord like structures called Chromosomes. The chromosomes contain genes and each gene is responsible for one hereditary character of the organism. Genes contain information for inheritance of features from parents to next generation in the form of DNA molecule.



Nucleus

Functions:

i) Nucleus controls all the metabolic activities of the cell.

ii) It controls the inheritance of characters from parents to off-springs.

iii) It controls cell division.

6.4.1. CHROMOSOMES

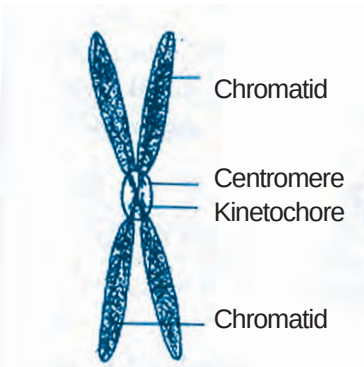
Chromosomes are thread-like condensed chromatin fibres which contain hereditary information and are visible only during cell division.

Each chromosome consists of two similar structures called chromatids. Both the chromatids are joined at a particular point called centromere. The primary constriction is the region of chromosome occupied by the centromere. The terminal part of chromosome is telomere.

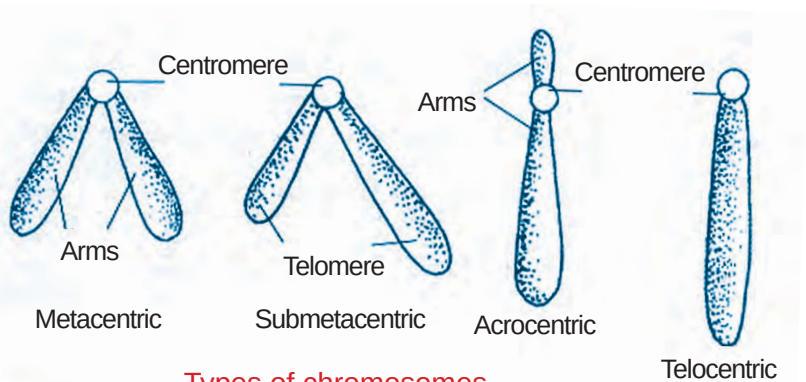
Types of chromosomes

Depending upon the position of the centromere, the chromosomes are of four types.

1. **Metacentric Chromosome :** The centromere lies in the middle of the chromosome and the two arms are almost equal in length. It is a V-shaped chromosome.
2. **Submetacentric Chromosome :** The centromere lies slightly away from the middle of the chromosome and hence, its one arm is slightly shorter than the other. It is a 'J' shaped chromosome.
3. **Acrocentric chromosome :** The centromere lies near the end and hence, one arm is very short and the other arm is very long. It is a rod-shaped chromosome.
4. **Telocentric Chromosome :** The centromere lies at one end of the chromosome, and hence, there is only one arm on one side. It is also a rod-shaped chromosome.



Structure of chromosome

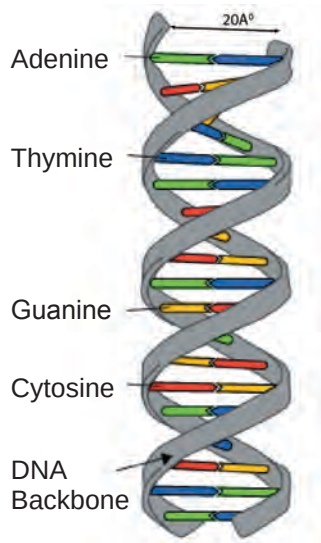


Types of chromosomes

DNA Structure

DNA (Deoxy ribonucleic acid) is the genetic material in most of the organisms and higher organisms. DNA is made up of millions of nucleotides. Each nucleotide is made up of a pentose sugar, a phosphate group and a nitrogenous base. The nitrogenous bases are of two kinds- Purines and Pyrimidines. Adenine and Guanine are the purines and Thymine and Cytosine are the pyrimidines.

The structure of DNA was proposed by Watson and Crick. DNA is a double stranded structure in which the two strands are coiled around each other forming a double helix. The backbone of the helix is formed of sugar and phosphate molecules. The nitrogenous bases are attached to sugar molecules. The two poly-nucleotide strands are held together by hydrogen bonds between specific pairs of purines and pyrimidines.



DNA structure

The two strands run in antiparallel and opposite directions. (i.e. they run in opposite direction 5' to 3' and 3' to 5' end). The two strands are intertwined in clockwise direction. The diameter of DNA molecule is $20A^0$ (Armstrong units).

6.5. CELL DIVISION AND TYPES

Let us take a seed and break it open. There is no plant inside the seed. Similarly if we break open an egg, there is no chick inside. But the seed, when sown in soil and watered, gives a plant which may grow into a tree. Similarly, the egg, when incubated, gives a chick. Have we ever thought how this is possible?.

Plants or animals make their beginning from a single celled zygote. This zygote divides several times to produce a plant or an animal. This process is called development and it occurs by cell division.

One of the most important characteristics of a living being is its ability to reproduce. The process of reproduction involves an increase in the number of cells by cell division. New cells can arise from pre-existing cells only through the process of cell division. Cell multiplication is needed for growth, development and repair of the body.

Cells divide by three different methods. They are Amitosis, Mitosis and Meiosis. In each case, division of nucleus occurs before the division of cytoplasm.

Amitosis (Direct division)

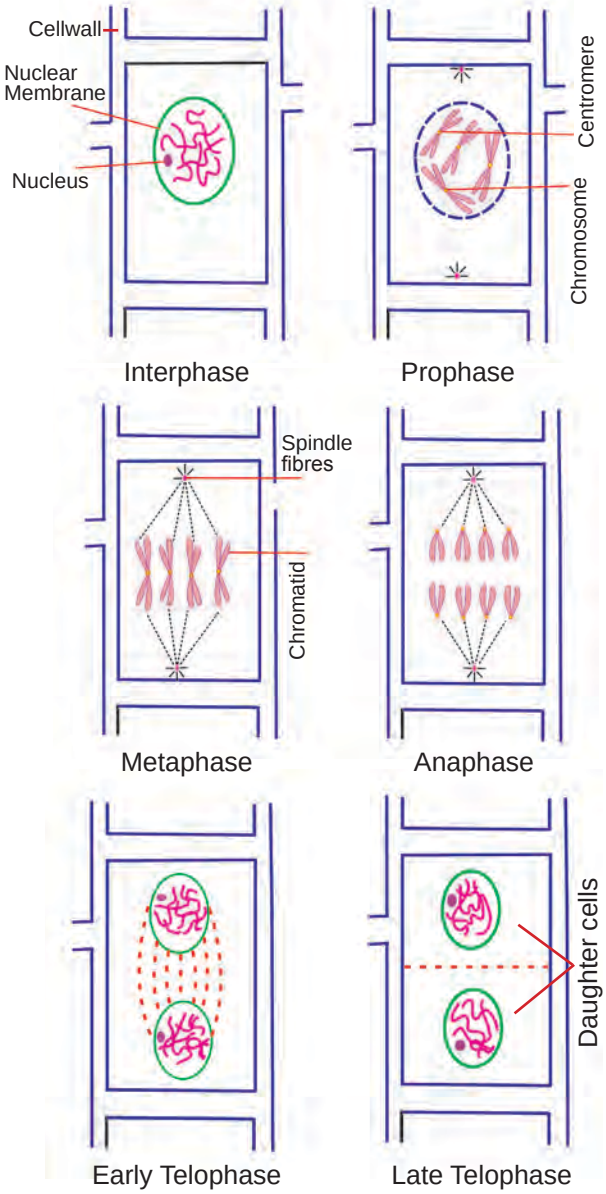
Amitosis is a simple method of cell division. It is also called direct cell division. The nucleus elongates and develops a constriction around its middle. The constriction gradually deepens and finally divides the nucleus into two daughter nucleus. This is followed by the constriction of the cytoplasm to form two daughter cells. This type of cell division is common in prokaryotes. (e.g. Bacteria, Amoeba)

Mitosis (or) Indirect cell division:

Mitosis takes place in somatic cells (body cells). It is a continuous process and takes place in four phases. These are Prophase, Metaphase, Anaphase and Telophase.

Interphase

Before a cell undergoes mitotic



Mitosis

division, it prepares itself for the division. This phase is called interphase. The chromatin material duplicates due to duplication of nucleic acids.

Prophase

- Chromatin network begins to coil and appears as long thread-like structures called chromosomes.
- Each chromosome consists of two chromatids that lie side by side and are joined along a point called centromere.
- Spindle fibres are developed from the poles towards the centre.

Nuclear membrane and nucleolus start disappearing.

Metaphase

- The nuclear membrane totally disappears.
- Chromosomes become shorter and thicker.
- The chromatids move to the centre of the cell with their centromeres.
- Centromeres are attached to the spindle fibres.

Anaphase

- The centromere of each chromosome divides into two.
- When each chromatid gets a centromere, it becomes a chromosome.
- One of these chromosomes moves to one pole and the other towards the opposite pole by the contraction of spindle fibres.

Telophase

- The daughter chromosomes reach the poles.
- The nucleolus and nuclear membrane reappear and thus two daughter nuclei are formed at the two poles of the cell.
- The spindle fibres disappear.
- This division of nucleus is called Karyokinesis.

Cytokinesis

The division of cytoplasm is called cytokinesis.

In plant cells, the cytoplasmic division occurs by the formation of a cell plate at the centre of the cell between the two daughter nuclei. Thus at the end of mitosis, two identical daughter cells are formed.

Meiosis

Meiosis is a type of cell division which takes place in the reproductive cells of organisms. This process can be observed in the formation of gametes.

6.6. DIFFUSION OR EXCHANGE OF SUBSTANCES BETWEEN CELLS AND THEIR ENVIRONMENT.

Materials are exchanged between the cytoplasm and external environment across the plasma membrane by different processes. Transport across the membrane may be passive or active.

Passive Transport

It is a type of diffusion in which an ion or molecule crossing a membrane moves its electrochemical or concentration gradient. No metabolic energy is consumed in passive transport.

Passive transport occurs by three processes namely (i) Osmosis (ii) Simple diffusion (iii) Facilitated diffusion

i) **Osmosis:** The to and fro movement of water molecules through the plasma membrane occurs due to differences in the concentration of the solutes on either side. The process by which the water molecules pass through a membrane from a region of higher water concentration to the region of lower water concentration is known as Osmosis.

The process in which the water molecules enter into the cell is known as endosmosis. The process in which the water molecules move out of the cell is known as exosmosis. In plant cells due to excessive exosmosis, the cytoplasm along with the plasma membrane shrinks away from the cell wall. This process is known as plasmolysis.

ii) **Simple diffusion:** In simple diffusion, molecules of gases such as oxygen and carbon dioxide enter the cell through the plasma membrane without the help of any permease (transport proteins).

iii) **Facilitated diffusion:** This is a special type of passive transport. Ions or molecules cross the membrane rapidly. Specific permeases in the membrane facilitates their crossing. Like simple diffusion, it also does not require any metabolic energy. It occurs only in the direction of a concentration gradient.

Active transport

Active transport is the movement of any substance through the cell membrane that requires energy. It is always against the concentration gradient. (i.e. from lower concentration to higher concentration). In this process the solute particles move against their chemical concentration or electrochemical gradient. Energy is required for this process. Some membrane proteins act as carrier molecules and transport the solute to the other side of the membrane.

Bulk transport

Cells continuously import or export large molecules across the plasma membrane. Macromolecules are secreted out from the cell by exocytosis and are injested into the cell from outside by endocytosis.

Exocytosis:

The outward transport of substances by means of carrier molecules is known as exocytosis. It is quite common in secretory or excretory cells.

Endocytosis

Endocytosis occurs by infolding or extension of the plasma membrane to form a vesicle or vacuole. It is of two types :

1) Phagocytosis
2) Pinocytosis

Phagocytosis (cell eating)

Substances are taken up in solid form. Cells which involve in this process are called phagocytes and said to be phagocytic. (e.g. white blood cells).

Pinocytosis (Cell drinking)

Substances are taken up in fluid form. (e.g. Amoeboid protozoans and certain kidney cells). Pinocytosis occurs in plants also.

6.7. TISSUES

TYPES, STRUCTURE AND FUNCTION OF PLANT TISSUES

The progressive evolution in plants has resulted in increasing complexity of structures. In higher plants, roots, stem, leaves and flowers carry out different functions. Due to this division of labour, the cells of the plants are differentiated to form different tissues. (See the flow chart in 4.2)

Meristematic tissues

ACTIVITY –6.1

Observe the growth of a small plant. It grows straight. Now cut the tip of the shoot apex and observe its growth.

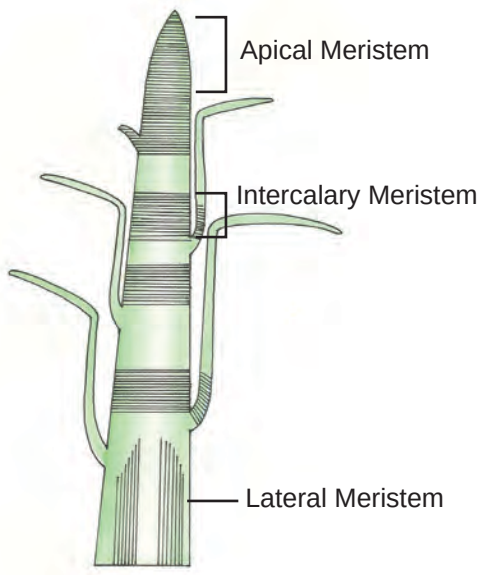
Does the plant continue to grow even after removing the shoot tip?

The growth of plants occurs only in certain specific regions. This is because the dividing tissue also known as meristematic tissue (Meristos – divisible) is located only at these points.

The meristematic tissues are made up of group of similar and immature cells, which can divide and form new cells. Meristematic cells divide continuously and thus help in increasing the length and thickness of the plant. Depending upon the position, meristematic tissues are of three types. They are as follows:

i) **Apical meristems:** Apical meristem is present at the growing tips of stems and roots and increases the length of the plant body.

Meristematic Tissue



Longitudinal section of a shoot showing position of meristems

ii) **Intercalary meristems:** These meristems occupy base of the leaves and the base of the internodal regions in plants such as grasses (mostly in monocotyledonous plants). These help in elongation of the internodes.

iii) **Lateral meristems:** This includes the meristematic tissues occupying the lateral regions of the stems and roots which bring about increase in the width of the plant body. (e.g. Cork cambium and Vascular cambium).

Characteristic features of meristematic tissues

- The meristematic cells may be round, oval, polygonal or rectangular in shape.
- Their cell walls are thin, elastic and made up of cellulose.
- They are closely arranged without intercellular spaces.
- They have dense cytoplasm with large nucleus.

Permanent Tissues

ACTIVITY –6.2

- Take a plant stem and cut it into very thin slices or sections.
- Now, stain the slices with saffranin. Place one neatly cut section on a slide and put a drop of glycerine.
- Cover with a cover-slip and observe under a microscope. Observe the various types of cells and their arrangement.
  a. Are all cells similar in structure?
  b. How many types of cells can be seen?

What happens to the cells formed by meristematic tissues?

Some cells produced by meristematic tissues stop dividing and form a permanent tissue.

They have definite structure and function. They are differentiated into various types to perform different functions.

The permanent tissues are classified as

i) Simple tissues and

ii) Complex tissues

Transverse section of a sunflower stem

Simple tissues

A tissue with the cells of similar structure (one type of cells) and function is called simple tissue. It is of three types.

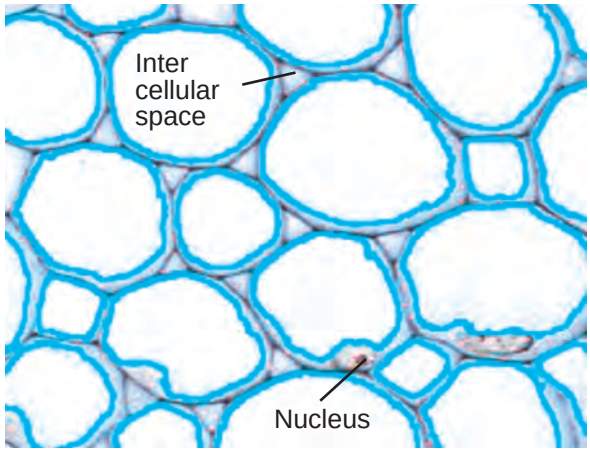
a. Parenchyma

b. Collenchyma

c. Sclerenchyma

Parenchyma

The cells of the parenchyma are generally thin walled with intercellular

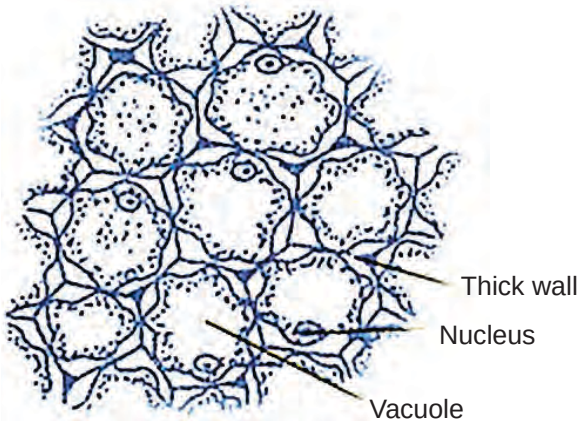


Parenchyma

spaces. They are living cells. They are generally present in all organs of a plant. They are oval or spherical or rectangular or cylindrical in shape. The cell wall is made of cellulose and pectic materials.

In general, the parenchyma cells serve to store and conduct food materials, water and minerals.

Collenchyma



Collenchyma

The cells of collenchyma are polygonal in cross section and have unevenly thickened walls. These thickenings are due to the deposition of more cellulose, hemi-cellulose and pectin.

The thickening is confined to the corners of the cells. They generally occur in the dicot stem in two or more layers below the epidermis. It is absent in the roots. It also occurs in petiole and pedicel. Like Parenchyma, Collenchyma is also a living tissue. The main function of Collenchyma is to provide strength and flexibility to the growing organs like young stem.

Sclerenchyma

It is a dead tissue. The cells are thick with lignified walls. They give mechanical support to the organs. This has two types of cells – Sclereids and Fibres.

Sclereids

Sclereids are stone cells which are commonly found in shells of the nut, pulp of certain fruits such as Pear and Sapota.

Fibres

The fibres are elongated strands with simple pits throughout its length.

Complex permanent tissues :

Xylem

Xylem is mainly concerned with the transport of nutrients, water and minerals upwards in the plant body. It forms a continuous tube through the roots, stems, leaves, flowers and fruits by the fusion of elongated cells.

It is composed of different kinds of cells namely,

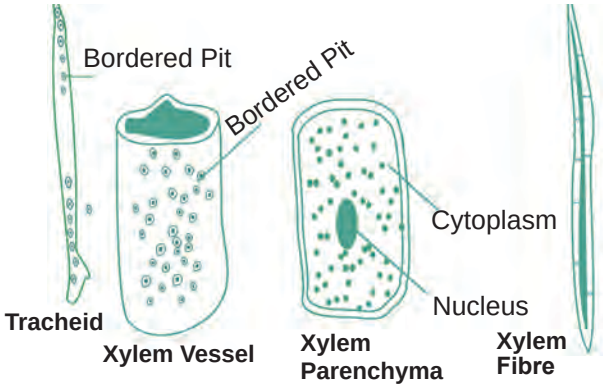
a. Tracheids
b. Xylem vessels.
c. Xylem fibres
d. Xylem parenchyma.

a. Tracheids

Tracheids are elongated, tapering cells with blunt ends. They have lignified secondary wall. They are the chief water conducting elements in Pteridophytes and Gymnosperms.

b. Xylem vessels

Xylem vessels have perforations at the end and are placed one above the other



Kinds of Xylem cells

like a long pipe line. They are seen in the xylem of angiosperms. They conduct water, mineral nutrients and also provide mechanical strength to the plant body.

c. Xylem Fibres

The fibres of Sclerenchyma associated with the xylem are known as xylem fibres. They give additional mechanical strength to the plant. They are also called wood fibres.

d. Xylem Parenchyma

The parenchyma cells associated with xylem are known as xylem parenchyma. It is the only living tissue amongst xylem cells. They store food reserves in the form of starch and fat. They also help in conduction of water.

Phloem

Phloem conducts food materials from leaves to the other parts of the plant. It is made up of four types of cells.

a) Sieve elements
b) Companion cells
c) Phloem fibres
d) Phloem parenchyma

Sieve elements

Sieve elements are the conducting elements of the phloem. Sieve elements are of two types – sieve cells and sieve tubes.

Sieve cells are present in Pteridophytes and Gymnosperms where as sieve tubes are present in Angiosperms.

Companion cells

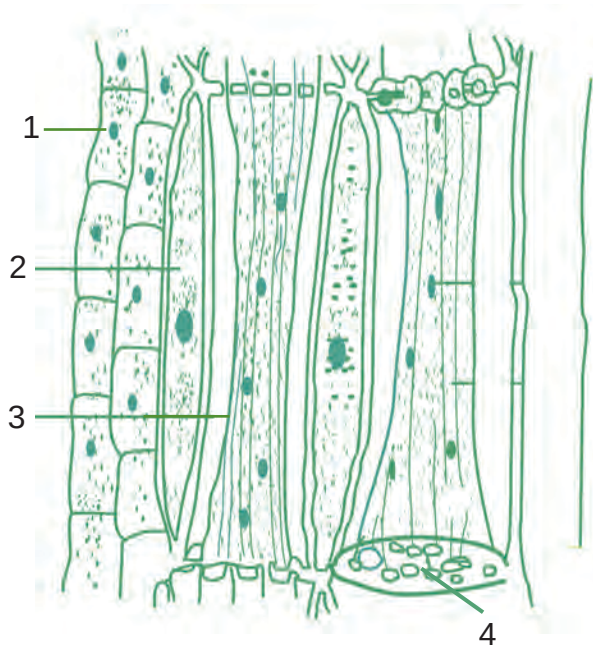
Companion cells are thin walled elongated specialized Parenchyma cells. They are associated with sieve elements. They have a prominent nucleus and cytoplasm. They help the sieve tube in conduction of food materials in angiosperms.

Phloem fibres

The fibres of sclerenchyma associated with phloem are called phloem fibres. They are also called bast-fibres. They give mechanical support to the plant. Among the four types of phloem cells, phloem fibres are the only dead tissues.

Phloem parenchyma

The parenchyma cells associated with phloem are called phloem parenchyma. They store starch and fats.



Phloem Tissue

1. Phloem Parenchyma
2. Companion Cell
3. Sieve tube
4. Sieve plate

EVALUATION

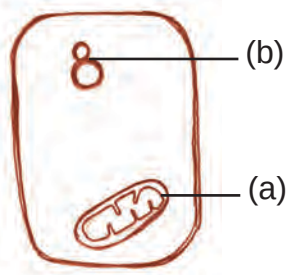
Section A

Choose the correct answer

1. Power house of the cell (chloroplast, nucleus, mitochondrion, lysosome).
2. The membrane of vacuole
   (cell membrane, nuclear membrane, plasma lemma, tonoplast).
3. The cell division common in prokaryotes
   (mitosis, amitosis, meiosis, both mitosis and meiosis).
4. Substances taken up in fluid form
   (phagocytosis, exocytosis, receptor-mediated endocytosis, pinocytosis).
5. The only living tissue amongst xylem cells
   (vessels, tracheids, xylem parenchyma, xylem fibres).

Section B

6. Observe the given figure of a cell and answer the following questions.



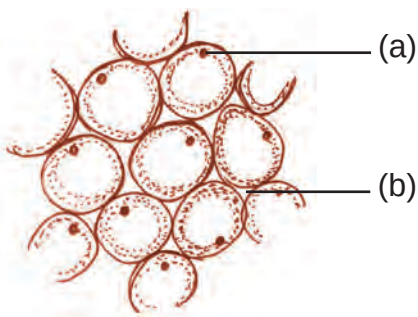
   i) Name the parts of the figure marked (a) and (b)

   ii) Give one function of each of the parts.

7. Phloem is a food conducting tissue it is made up of following four types of cells. Two cells are missing. Complete the missing cells.

   i) sieve elements ii) _____ iii) phloem fibres iv) _____

8. Observe the figure.



   i. Identify the tissue depicted in figure.

   ii. Copy the diagram and label the parts (a) and (b)

9. Complete the table

Name of the chromosome	Shape of the chromosome
1. Metacentric	1.
2.	2. 'J' shaped chromosome
3. Acrocentric	3.
4. Telocentric	4.

10. Read the following statements and correct them.

i) Golgi apparatus was first described by Watson and Crick.

ii) Cell wall is present in animal cells.

Section C

11. A) Write the technical terms of the following.

i) An organism whose body is made up of many cells.

ii) An organism which is made up of only one cell.

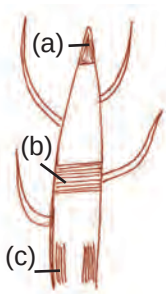
iii) An organism whose cells have well organized nucleus.

B) Fill in the blanks.

i) Division of cytoplasm is known as _____.

ii) Prokaryotic cells do not have well organized _____.

12. Answer the questions related to figure.



i) Copy the diagram and name the parts of the diagram marked a to c.

ii) Which part of the figure is responsible for elongation of stem?

iii) Which part of the figure is responsible for secondary growth?

iv) Name the part which is responsible for elongation of internodes.

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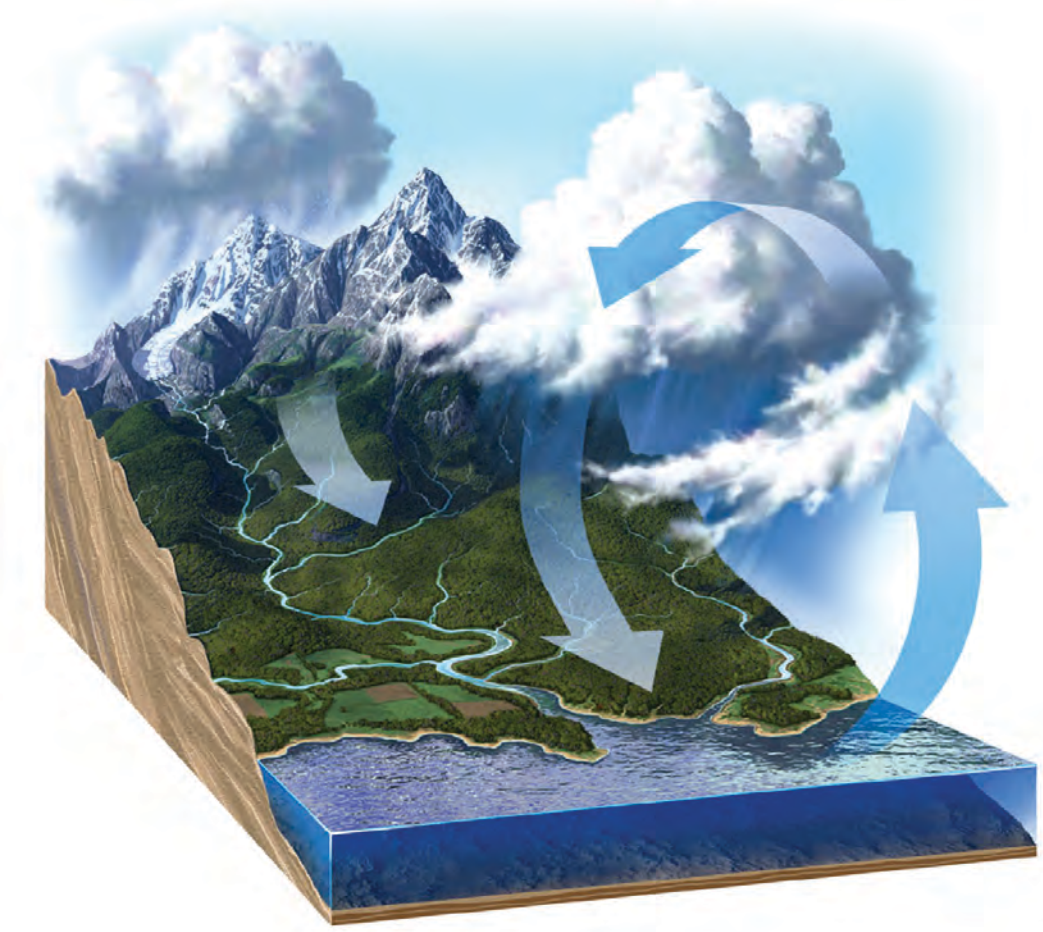
Chapter 7



BIO-GEO CHEMICAL CYCLE

7. BIO-GEO CHEMICAL CYCLE

Both abiotic (non-living) and biotic (living) components of the biosphere constantly interact with each other to form a dynamic, but stable system. Such interaction includes transfer of matter and energy between the different components of the biosphere.

All living organisms require Carbon, Hydrogen, Oxygen, Nitrogen, Sulphur, Phosphorous, Potassium and Calcium in large amounts. They get the nutrients from air (Atmosphere) water (Hydrosphere) and soil (Lithosphere).

The nutrient elements derived from the earth by the living organisms for use in their growth and development are called bio-geo chemicals. These bio-geo chemicals are used by the living organisms and are released to the environment, when the dead bodies of the organisms and their excreta are decomposed. These chemicals become available again for reuse and recycling.

The cyclic flow of elements or compounds between non-living environment (soil, rock, air, water) and living organisms is known as bio-geo chemical cycle.

7.1. LIFE AND NON-LIFE INTERACTIONS (BIOTIC & ABIOTIC FACTORS)

Environment means the surroundings in which animals and plants live including both the physical factors and other organisms. Thus, each and everything which surrounds and affects the living organisms constitute its environment.

The branch of biology which deals with the inter-relationships of organisms and their environment is called Ecology.

The organisms and the physical environment of the habitat form an ecological complex termed ecosystem.

Ecosystem (Environmental system) includes two essential components.

i) Abiotic components (Physical or non-living)

ii) Biotic components (living)

ABIOTIC COMPONENTS

The abiotic components of the environment are air, water, soil, light and temperature. Thus, abiotic components of our environment tend to affect us and all the living organisms variously. They play a vital role in their growth, development and survival. Green plants need light, water and carbon dioxide for photosynthesis. Animals need food, water and oxygen for their survival.

BIOTIC COMPONENTS

The biotic components of environment include all living organisms including human beings. Plants and animals are interdependent.

'Interdependence' – means the way in which the living organisms depend on each other in order to remain alive,

Interaction between insects and plants

grow and reproduce. For example bees depend for their food on pollen and nectar from flowers. Flowers depend on bees for pollination.

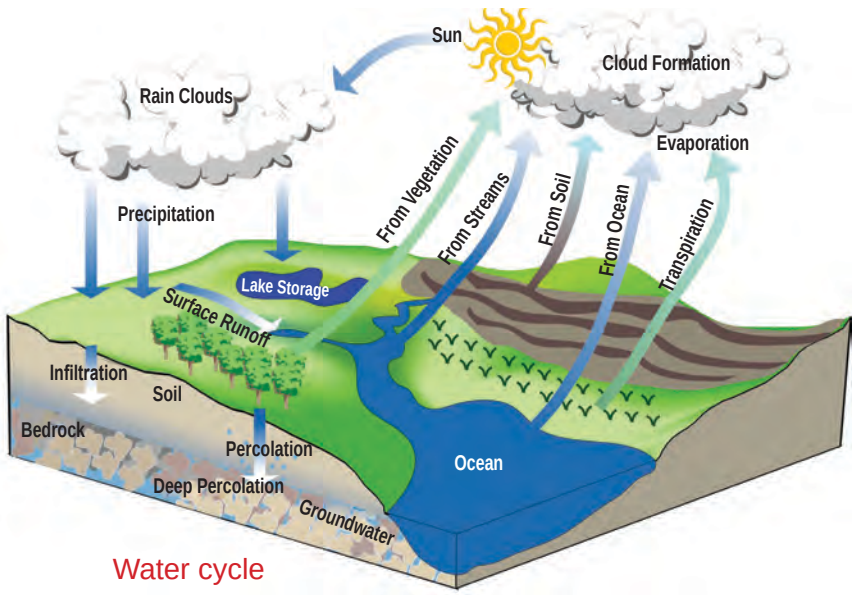
The green plants (autotrophs) are the producers of food for all living organisms. Solar energy is captured by autotrophs to synthesize food materials. The energy is transferred to herbivores when they consume plants. When carnivores feed on herbivores, the energy is transferred to carnivores. The final breakdown of organic wastes and dead materials are carried out by decomposers to return the energy to the environment. Thus the energy trapped by green plants is relayed through a series of heterotrophic organisms. This forms the food chain.

Grass - Rabbit - Fox -Tiger

Man and animals take in oxygen during respiration and give out carbon dioxide. The plants absorb this CO_2 during photosynthesis and liberate oxygen in to the atmosphere. Thus plants and animals are interdependent.

7.2. WATER CYCLE

Water is an important component of the environment and is essential for living beings. Oceans are the biggest store houses of water from which water evaporates to form clouds. Water also evaporates from other water bodies like rivers, lakes, ponds etc, to form clouds. On Condensation, water vapour in the clouds comes down as rain. The rainwater passes through rivers and eventually reaches the oceans.



Water cycle

The circulation of water also occurs through plants and animals. Plants absorb water from the soil or water reservoir and add it to the air (atmosphere) as vapour by transpiration. Water transpired by trees cools the surrounding air and plays a role in determining the micro climate around them. Animals take water from the water reservoir or from food. They return it to the air as vapours by respiration or to the soil as fluid by excretion. Mammals excrete water as sweat which evaporates from their bodies.

Water is also added to the environment by death and decay of organisms. Water vapour formed by transpiration and respiration form clouds. Rain adds water to soil for reuse by plants and animals.

MORE TO KNOW

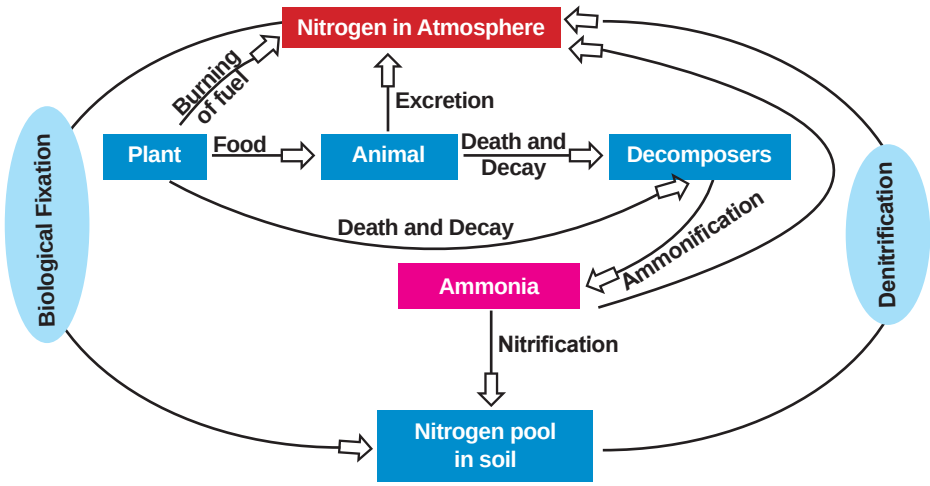
About two-thirds of our body is made up of water.

The Earth's water supply is made up of 97% oceans, 2% ice caps, 1% fresh ground water.

In 20 minutes, one thunderstorm can send down over 125,000,000 gallons of water. (One gallon is equivalent to 4.5 litres)

7.3. NITROGEN CYCLE

Nitrogen is an essential element required by organisms to synthesize proteins and nucleic acids. Though atmosphere contains about 78% of Nitrogen, it cannot be utilised by living organism unless it is converted into ammonia, amino acids or nitrates. These compounds which are available in the soil are cycled and recycled through the ecosystem.



Nitrogen Cycle in Nature

The process by which these forms get interconverted to maintain a constant amount of nitrogen in atmosphere, by physical and biological processes is called Nitrogen Cycle. The Nitrogen Cycle involves

i) **Nitrogen fixation**

ii) **Nitrogen assimilation**

iii) **Ammonification**

iv) **Nitrification** and v) **Denitrification**

Nitrogen fixation

During nitrogen fixation, nitrogen is oxidized to oxides by lightning and these oxides get dissolved in rain water and get precipitated. During biological nitrogen fixation, the nitrogen fixing bacteria such as Azotobacter, Rhizobium and blue green algae like Nostoc convert gaseous nitrogen to ammonia and nitrates.

Nitrogen assimilation

The nitrates absorbed by plants is utilized for making organic matter such as proteins, nucleic acids etc. Plant proteins and other nitrogenous compounds consumed by animals are converted into animal proteins.

Ammonification

Animal proteins are excreted out in the form of urea, uric acid or ammonia. When the plants and animals die, their proteins

are broken down to release ammonia by the action of bacteria and fungi. This process of ammonia formation is called ammonification.

Nitrification

During this process, the ammonia is converted into nitrites and nitrates by soil bacteria such as Nitrobacter and Nitrosomonas which are then absorbed by plants through their roots.

Denitrification

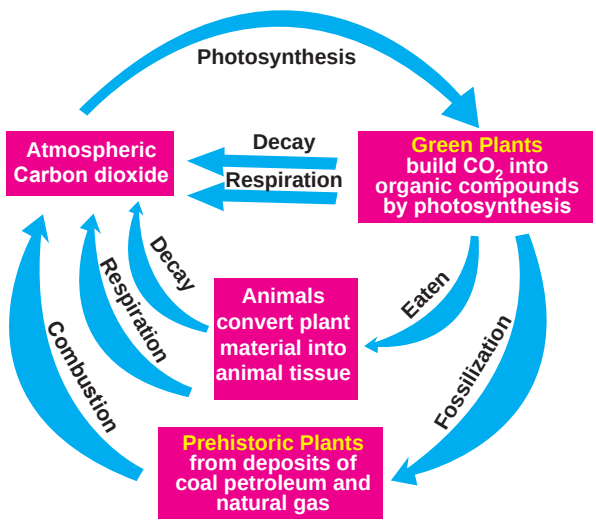
Free living soil bacteria such as Pseudomonas reduce nitrate ions of soil into gaseous nitrogen which returns to the atmosphere.

Organisms involved in Nitrogen cycle

Activity	Name of organism
Nitrogen Fixation	Rhizobium, Azotobacter and Nostoc.
Ammonification	Ammonifying bacteria and fungi.
Nitrification	Nitrosomonas and Nitrobacter.
Denitrification	Pseudomonas.

7.4. CARBON CYCLE

Carbon is the most significant element in the environment. All organic compounds contain carbon. The three main sources of carbon are i) CO_2 of the air and CO_2 dissolved in oceans, ii) Carbonate rock in the earth's crust and,



Carbon Cycle

iii) Fossil fuels like coal and petroleum. Being a main element involved in the fixation of energy by photosynthesis, it is closely linked to energy flow. The basic movement of carbon is from atmospheric reservoir to producers, to consumers and then to decomposers.

The atmospheric carbon dioxide enters into the living world, i.e. green plants, through the process of photosynthesis to form carbohydrates (food). The plant food is taken by herbivores and then passes through small and large carnivores.

The respiratory activities at each trophic level return carbon dioxide quickly to the atmosphere. Carbon dioxide is also returned to the atmosphere through decomposition of dead organic materials, burning of fossil fuels and volcanic activities.

MORE TO KNOW

Without the carbon cycle, carbon would not recycled, resulting in the inability for living things to survive.

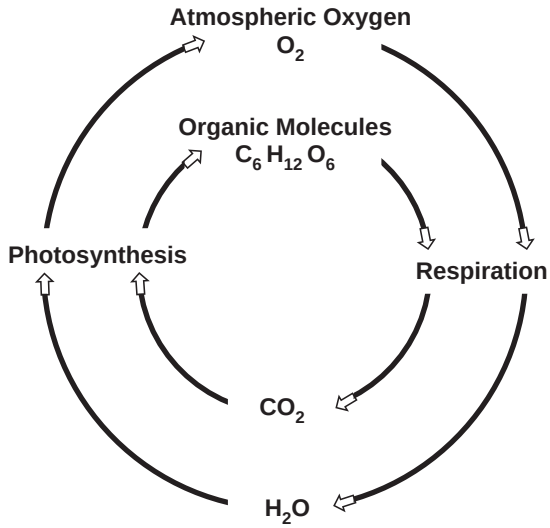
7.5. OXYGEN CYCLE

All living organisms require oxygen for respiration. Oxygen is one of the

constituents of water and forms about 20% of the air in the atmosphere.

Oxygen enters the living world through respiration. It oxidizes the food materials and produces energy and carbon dioxide. Oxygen is also used up in the burning of the materials and carbon dioxide is produced.

The carbon dioxide is utilized by the plants to produce food materials during the process of photosynthesis and oxygen is released. Oxygen combines with nitrogen to produce oxides of nitrogen, which are taken up by the plants to produce amino acids and proteins. These compounds, after breaking down, release oxygen in the atmosphere and maintain balance in the environment.



Oxygen Cycle

EVALUATION

Section A

Choose the correct answer

1. The life sustaining zone of the earth, where lithosphere, hydrosphere and atmosphere interact is called (ozonosphere, stratosphere, biosphere, none of these).
2. Biggest storehouses of water (river, lake, pond, ocean).

Section B

3. Construct atleast two food chains with the help of the organisms given

   (Lion, Tiger, Grass, Deer, Fox, Rabbit).
4. Study the relationship between the words in the first pair and then fill the missing word in the following pair.

   i) Denitrifying bacteria : Pseudomonas, ii) Nitrifying bacteria : ……..
   iii) Nitrogen fixing bacteria : …….

Section C

5. A) Plants and animals are inter-dependant.

   i) Do you agree with this statement? ii) Comment.

   B) List out biotic and abiotic components

   Air, Deer, Water, Dog, Man, Soil, Light, Plant.

FURTHER REFERENCE

Book

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Chapter 8

POLLUTION AND OZONE DEPLETION

8. POLLUTION AND OZONE DEPLETION

Can you say that the air we breathe in is pure or the water we use is clean? Is the heat during the summer months unbearable? What are the reasons for these changes?

The reason is pollution

What is pollution? Is it natural or man-made? What are its causes and effects? Let us try to find out the answers.

Definition

Pollution is an undesirable change in physical, chemical and biological characteristics of our land, air or water caused by excessive accumulation of pollutants (i.e. Substances which cause pollution).

8.1. KINDS OF POLLUTION

The pollution is of four major types namely air pollution, water pollution, land pollution and noise pollution. In terms of origin it may be natural or anthropogenic (man-made).

8.1.1. AIR POLLUTION

Degradation of air quality and natural atmospheric condition constitute air pollution. The air pollutant may be a gas or particulate matter.

MORE TO KNOW

Black Lung disease

It is common among coal miners due to the inhalation of carbon particulates which lead to Lung Cancer.

Air pollutants and their effects

1. **Particulate matter** – it comprises of small suspended particles such as soot, dust, pesticides, etc., and biological agents such as spores, pollen and dust mites. It causes respiratory ailments such as asthma, chronic bronchitis, etc.,

2. **Carbon monoxide** – is a product of incomplete combustion of fossil fuels in automobiles. It is highly poisonous to most animals. When inhaled, carbon monoxide reduces the oxygen carrying capacity of blood.

3. **Hydrocarbons** – hydrocarbons such as methane, are evolved from soil microbes (methanogens) in flooded rice fields and swamps. They are also generated during the burning of coal and petroleum products.

Brown air

4. **Sulphur dioxide** – is released from oil refineries and ore smelters which use the sulphur containing fuels. It causes harmful effects on plants and animals. It causes chlorosis (loss of chlorophyll) and necrosis (localised death of tissues). In human, it causes health problems such as asthma, bronchitis and emphysema.

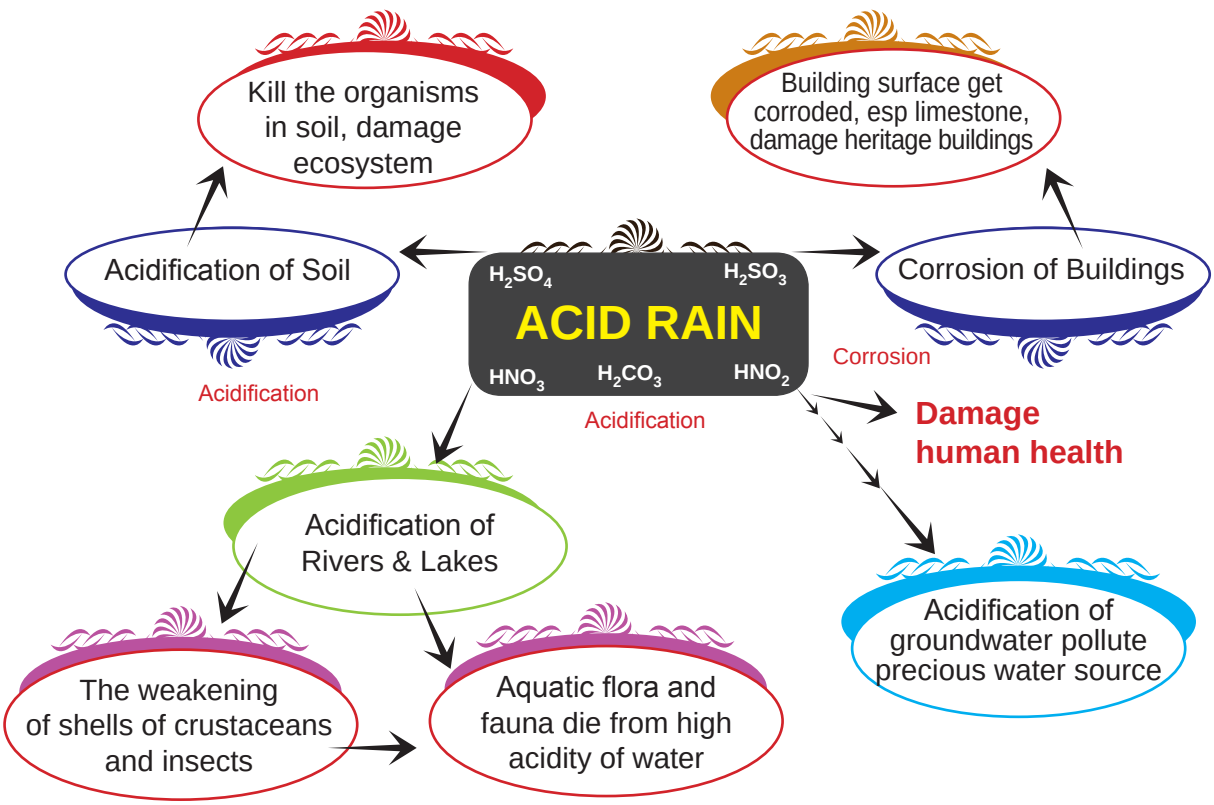
5. **Nitrogen oxides** – It causes reddish brown haze (brown air) in traffic congested city air which contributes to heart and lung problems.

Secondary effects of air pollution

Photochemical smog – Smog is a mixture of smoke and fog. It is formed in the atmosphere under the influence of sunlight by the photochemical reactions of hydrocarbons, oxides of nitrogen and oxygen, resulting in the formation of PAN (peroxy acetyl nitrate). PAN damages the chlorophyll and thus reduces photosynthesis and growth. It also causes acute irritation of eyes and throat. Visibility of the surrounding is reduced due to smog.

Acid rain – gases such as Sulphur di oxide and Nitrogen oxides are oxidized to form sulphuric and nitric acids along with water, and precipitate as acid rain. It damages building materials, plants and animals. It also makes the soil acidic.

Sculpture affected by acid rain



MORE TO KNOW

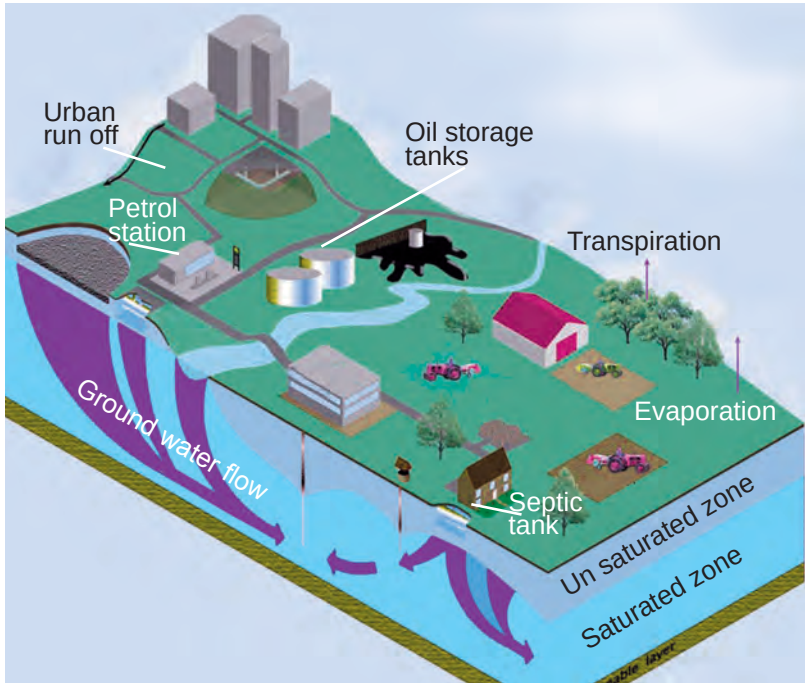
BHOPAL GAS TRAGEDY (2nd & 3rd Dec' 1984) refers to the industrial disaster which killed thousands of people and animals due to the inhaling of **methyl iso cyanate** (MIC) gas which leaked out from a fertilizer factory owned by Union Carbide Company. Many people who inhaled the gas, still suffer from respiratory, immunological and neurological disorders, cardiac failure, birth defects, etc,.

Control of air pollution

1. The particulates emitted by industries should be controlled by devices such as scrubbers, precipitators and filters.
2. Use of unleaded or low sulphur fuel is to be encouraged.
3. Shifting to non-conventional sources of energy (e.g solar energy, hydel energy, tidal energy, etc.,) in order to reduce the dependance of conventional sources.
4. Smoking in public places should be prohibited, because the cigarette smoke contains carcinogens such as benzopyrene. An average smoker runs the risk of developing heart and lung diseases.
5. Planting of trees along the road sides and around industrial areas.

8.1.2. WATER POLLUTION

Water pollution is defined as the adding of unwanted substances or the change of physical and chemical characteristics of water in any way which makes it unfit for human consumption. It is caused by waste products of industries (effluents), domestic sewage, oil spillage, agricultural and industrial run off etc.,



Sources and effects of water pollution

1. **Industrial wastes** –The industrial effluents containing heavy metals and chemicals such as arsenic, cadmium, copper, chromium, mercury, zinc, nickel, etc,. are directly released into the water bodies such as lakes, ponds and rivers without proper treatment. These wastes contaminate the water bodies and make them unsuitable for human consumption. Hot water is another noted pollutant from industries. Many

industries use water as a coolant for the machinery and release of hot waste water into the water bodies causing thermal pollution which affect both the plant and animal life.

2. **The surface run off** - the surface run off from agricultural land is contaminated with pesticides and residues of inorganic fertilizers. The run off from urban and industrial are rich in organic and inorganic compounds. These pollutants contaminate both surface and ground water resources.

3. **Oil spills** – An oil spill is an accidental discharge of petroleum products in oceans and estuaries from capsized oil tankers, offshore drilling and exploration operations. It can cause drastic damage to the marine and coastal bio diversity.

4. **Domestic Sewage** – It is rich in organic matter and detergents. Decomposition of organic matter increases the nutrient content of the water bodies. Availability of excess nutrients results in algal bloom on the surface of water resulting in the deficiency of oxygen content(BOD – Biological Oxygen Demand). This in turn leads to the death of aquatic organisms. This process is known as Eutrophication.

MORE TO KNOW

Biological magnification of **DDT** (Dichloro diphenyl trichloroethane) is seen in aquatic food chain. The concentration of DDT gradually increases at each trophic level. DDT inhibits calcium carbonate deposition in the oviducts of certain birds which result in the laying of thin shelled eggs. These eggs can easily break during incubation and the developing embryos are destroyed.

MORE TO KNOW

MINAMATA DISEASE

Mercury poisoning due to the consumption of fish captured from mercury contaminated **Minamata Bay** in **Japan** was detected in **1952**. Mercury compound in waste water are converted by bacterial action into extremely toxic **methyl mercury** which can cause numbness of limbs, lips and tongue. It can also cause deafness, blurring of vision and mental derangement.

Control of water pollution

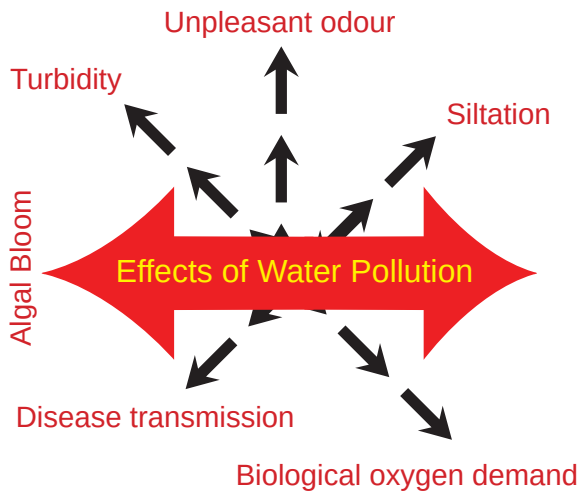
1. Sewage treatment plants should be installed to treat sewage before releasing into water bodies.

2. Excessive use of pesticides, herbicides and fertilizers should be avoided.

3. Biological control of insect pests and organic farming is to be followed in order to reduce the dependence on pesticides and inorganic fertilizers.

4. By legislation and strict enforcement.

5. By creating social awareness among people about the water pollution and the need for pure water.



MORE TO KNOW

REVERSE OSMOSIS (RO)

It is the most efficient way of obtaining purified drinking water. During this process, pressure is applied on the solution which has more concentration. This reverses the natural direction of water flow and osmosis from high gradient to low gradient. This process involves energy expenditure. The membranes used for RO process have a dense barrier layer which allow only the water to pass through and prevents the passage of solutes. Hence, it is best suited for **desalination** of sea water (removal of salt).

8.1.3. SOIL POLLUTION

Soil pollution is the unfavourable alteration of soil by the addition or removal of substances which decrease soil productivity and ground water quality. It usually results from different human activities like dumping of waste, use of agro chemicals, mining operations and urbanization.

Causes and effects

The industrial solid waste and sludge contain toxic organic and inorganic compounds as well as heavy metals. The radio active waste from nuclear power plants and nuclear explosions also contaminate the soil. Fly ash contains fine particulates which are released from thermal power plants. It settle on the ground and cause pollution.

The domestic waste is rich in organic matter and undergo decomposition. The hospital waste contains a variety of pathogens that can seriously affect human health.

Agricultural chemicals such as pesticides, insecticides and inorganic fertilizers may pollute drinking water and can change the chemical properties of the soil adversely affecting the soil organisms.

Control of soil pollution

Management of soil wastes include collection and categorization of wastes. Recovery of resources like scrap metals, plastics, etc., for recycling and reuse and safe disposal with a minimum environmental hazards is to be followed. Other notable methods of waste disposal include incineration (burning in the presence of oxygen) and pyrolysis (burning in the absence of oxygen). Afforestation and reforestation should be undertaken on a large scale to prevent soil erosion and loss of soil nutrients.

8.1.4. RADIOACTIVE POLLUTION

Nuclear power plant

The emission of protons, electrons and electromagnetic radiations released by the disintegration of radioactive substances such as radium, thorium, uranium, etc,. cause air, water and land pollution.

Effects :-

- The ionising radiations can cause mutations.

Nuclear explosion

- Strontium-90 accumulates in bones causing bone cancer.
- Iodine-131 can damage bone marrow, spleen, lymph nodes and can cause leukemia (blood cancer).

MORE TO KNOW

Chernobyl disaster (Ukraine)

The explosion at the Chernobyl nuclear power station was undoubtedly the world's worst nuclear disaster. The deadly radioactive material was released into the atmosphere. The inhabitants of Chernobyl were exposed to radioactivity which was hundred times greater than Hiroshima bomb. Babies were born with infirmities and people suffered from serious diseases like thyroid cancer.

Preventive measures

- Care should be taken to prevent the leakage of radioactive substances from nuclear reactors.
- Radioactive wastes should be disposed off safely.
- Strict measures should be followed in the construction and maintenance of nuclear power plants to prevent nuclear accidents.
- Control or prevention of nuclear tests.

8.1.5. NOISE POLLUTION

Noise may be defined as an unwanted and unpleasant sound that may have adverse effects on animals and humans. The unit of sound level is decibels (db). Noise level above 120 db is considered harmful to human beings.

MORE TO KNOW

Jet Aircraft (take off)	145 db
Heavy city traffic	90 db
Vaccum cleaner	85 db
Window Air conditioner	60 db
Normal speech	60 db

Sources

The different sources associated with noise pollution are industrial machinery, road, rail and air transport, loudspeakers, construction equipments, household appliances, crackers, etc,.

Effects

Noise seriously affects heartbeat, breathing, and can cause constriction of blood vessels. It can cause headache, sleeplessness, irritability and may seriously affect the productive performance of human. Loud noises (above 130 db) can cause damage to the ear drum, hair cells of cochlea (organ of hearing) and thereby

resulting in temperory or permanent loss of hearing. It can also seriously affect the concentration of students while learning.

Control measures

The industries should be established away from residential areas. Trees should be planted along roadside or highways to reduce noise levels. The industrial machinery and motor vehicles should be properly maintained in order to minimize the noise. The use of loudspeakers and bursting of crackers should be restricted. Effort must be made to create awareness among people about the harmful effects of noise and the need to control it.

MORE TO KNOW

Various laws and rules have been promulgated by the government of India from time to time to control pollution. Some of them are 1974 - Water (prevention, control of pollution) Act.

1980 - Forest Act.

1981 - Air (prevention, control of pollution) Act.

1986 - Environmental pollution Act.

1988 - Motor vehicles Act

8.2. GLOBAL WARMING

- July 1998 was the hottest month world over.
- In 1998 India had the hottest period in 50 years.
- Since 1988 nine of the hottest years in more than a century have been recorded.
- There is a rapid melting of snow and subsequent rise in sea level.

What could be the reason for these alarming changes in the climate and environment?

The answer is global warming which refers to an average increase in the temperature of the atmosphere or simply it is the warming of the earth.

Melting of glaciers

The root cause of this adverse climatic change is the greenhouse effect caused by greenhouse gases.

8.2.1. GREEN HOUSE EFFECT

The trapping of energy from the sun by green house gases in the atmosphere leading to rise in earth's temperature is known as the green house effect. The green house gases such as carbondioxide, methane, nitrous oxide, chloro fluro carbons, etc,. absorb and reflect infra red waves radiated by the earth causing increase in temperature as in a green house.

GREEN HOUSE

A green house

A green house is a structure primarly of glass or plastic in which temperature

and humidity can be controlled for the cultivation or production of plants.

Green house gases

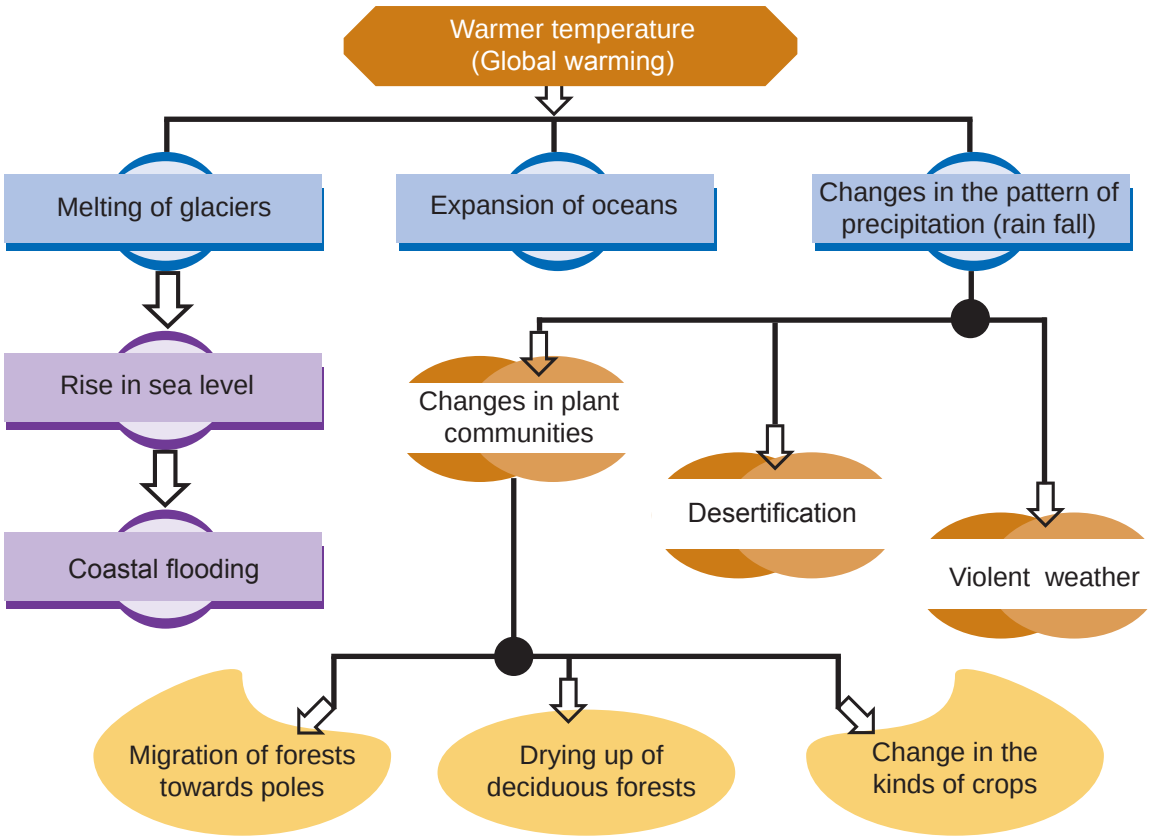
- **Carbondioxide** – most abundant greenhouse gas released by burning of fossil fuels, deforestation, respiration of animals, decaying of organic matter, etc,. At present there is an increase of 31% of carbondioxide.
- **Methane** – it is produced by the incomplete decomposition of organic compounds by methanogenic bacteria under anaerobic condition. It is also produced by the enteric fermentation in the cow and from the flooded rice fields.
- **Nitrous oxide** – is released by burning of fossil fuels, industrial processes, agricultural practices like ploughing etc,.
- **Chloro fluro carbons** – are coolant gases used in refrigerators, aerosols, solvents, etc,.

Effects of global warming

- The level of the sea rises due to the melting of glaciers and thermal expansion of water which will submerge many parts of countries.

Arctic Bear in melting snow

- Due to global warming the rise in temperature could create unexpected changes in weather conditions – making some regions hotter and others colder.



- The rainfall pattern could also change causing drought in some areas and flooding in others.
- Crops and forests may be affected by insect pests and plant diseases resulting in severe damage.
- Water borne and insect borne diseases such as malaria and dengue could spread to temperate countries.
- It can also result in the loss of bio diversity due to the extinction of coral reefs and other key species.

Control measures

Global warming can be controlled by reducing the use of fossil fuels, reforestation, carbon sequestration (trapping Co_2), shifting to renewable sources of energy such as solar power, wind power, hydel power, etc,.

Ten things you can do to reduce Global warming

1. Use less heat and air-conditioning.
2. Drive less (automobiles) and drive smart (bicyles).
3. Buy energy efficient products (★rated).
4. Use CFL (Compact Fluorescent Light) bulbs.
5. Reduce, reuse and recycle resources.
6. Use less hot water.
7. Use the “off” switch when needed.
8. Plant a tree.
9. Encourage others to conserve energy.
10. Do the energy auditing of household appliances.

MORE TO KNOW

EL NINO EFFECT

It causes erratic weather patterns which occur due to the interaction of unusually warm or cold sea surface temperatures in the eastern and central pacific oceans. It was once a rare cyclical weather condition which has become more frequent, persistent and intense.

Compact fluorescent light

CFLs are a great way to save energy eventhough they cost a little more and are slower to brighten up than an ordinary bulb. They produce less amount of heat.

8.3. OZONE DEPLETION

The ozone layer in the stratosphere is protective in function as it filters the harmful ultraviolet rays of the sun. This ozone is continously broken down and reformed; these two processes perfectly balance each other. But due to human activity, this balance is upset leading to the thinning of ozone layer (ozone holes). The decrease in the amount of ozone in the stratosphere is called ozone depletion.

Ozone depletion

Reasons

The ozone hole is due to chlorine and bromine formed in the atmosphere. The common ones are chloroflurocarbons, methyl bromide, nitrogen oxides, etc,. which are released from freezers, air conditioners, aerosol products, industrial solvents, etc,.

Effects

- In humans, it can cause the incidence of skin cancer, cataracts and poor immune response.
- In plants, it can affect crop yield and productivity.
- The UV radiation can also cause the death of phytoplanktons (producers), young fishes and larval forms.

Control measures

Controlling the production, use and emission of ozone depleting substances, recycling of chemicals and adoption of protection measures from sun's radiation are some of the measures to control ozone depletion.

8.4. SCIENCE TODAY – OIL SPILL

Do you know about the recent environmental problem in the Gulf of Mexico and USA?

What is an oil spill and what are its environmental implications?

An oil spill is a release of liquid petroleum hydrocarbons into the environment, mainly due to human activities. It includes the release of crude oil from tankers, offshore platforms, drilling rigs and wells.

Environmental impacts

Oil spill affects the physical, chemical and biological characteristics of water and land. It forms a thick black layer above the sea water and considerably increase its viscosity which interfere with the locomotion of organisms.

The oil floating on top of the water reduces the penetration of sunlight, limiting photosynthesis by marine plants and phytoplanktons (producers). It will, in turn, affect the other members of the marine food chain. The oil also drenches the plumage of birds and impairs their ability to fly and escape from predators. Birds may ingest the oil while preening their feathers resulting in kidney damage, altered liver function and metabolic imbalances.

The oil which covers the coats of aquatic mammals such as seals can reduce their heat insulation capacity, resulting in hypothermia (decrease in body temperature).

Crude oil contains a mixture of volatile hydrocarbons like benzene, toluene, xylene, etc,. which are carcinogenic in nature (cancer causing). Symptoms of exposure include dizziness, headaches, nausea, rapid heart beat and dehydration.

Control and preventive measures

- The oil spills can be controlled by preventing the release of oil or hydrocarbons during transit, exploration or accidents.
- The sea food should be thoroughly tested for contaminants before consumption.
- The oil spills may be cleared by using certain micro organisms such as bacteria. This process of clearing the oil spills by using bacteria is known as bio remediation.

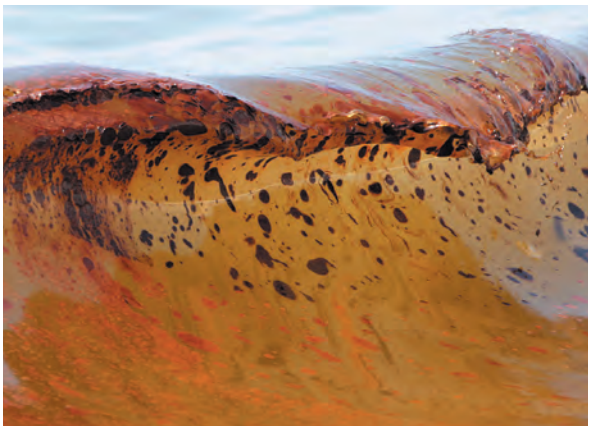
PSEUDOMONAS BACTERIA

Dr.Ananda Mohan Chakraborty

One of the notable achievements in bio remediation is the invention of Pseudomonas putida, a genetically engineered bacterium by an Indian American scientist Dr.Ananda Mohan Chakraborty. It is a rod shaped saprophytic soil bacteria with a diverse metabolism to degrade hydrocarbons and organic solvents like octane and toluene.

Recent episodes of Oil spills

Deep water horizon oil spill



Oil spill in gulf of mexico

It is a massive oil spill in the Gulf of Mexico and is the largest offshore spill in US history. It stemmed from a sea floor oil gusher that resulted from the April 2010 deep water horizon drilling rig explosion. The resulting oil slick covers atleast 2500 sq. miles fluctuating from day to day depending on weather conditions.

The spill continues to cause extensive damage to marine and wildlife habitat as well as fishing and tourism industries. The spill threatens an environmental disaster due to factors such as petroleum toxicity and oxygen depletion. More than 400 species which live in the Gulf of Mexico are at risk.

Mumbai oil spill (August 2010)

The spill occurred due to the collision of two oil tankers MSC Chitra and MV Khalijia off the coast of Mumbai. An estimated 400 tonnes of oil was spilled into the Arabian sea. The oil spill is proved to cause extensive damage to the marine eco-system, as well as the sensitive mangrove plants.

Agencies of Environmental Management

C.P.R – Environmental Education Centre, Chennai:

This centre promotes environmental awareness among the public. It gives guidance for environmental laws, environmental impacts and environmental management studies. It promotes the use of renewable sources of energy.

Madras Naturalists Society:

It creates environmental consciousness through seminars, camps, video shows and visits to wild life sanctuaries and national parks. It conducts surveys regarding pollution and deforestation.

MSSRF (M.S.Swaminathan Research Foundation):

It is a non-profit research organisation and was established in 1998. It carries out research and development in six major areas such as Bio-diversity, Bio-technology, Food scarcity, Coastal system research, Information and Education and Communication.

EVALUATION

Section – A

1. Bursting of crackers and use of loud speakers are restricted at night time due to noise pollution. Mention any two harmful effects of noise.

2. On 10/10/10 at 10 p.m. lights were put off all over the world for an hour marking the 'earth hour'. Mention its significance.

Section – B

A	B	C
Fossil fuels, Carbon Mon-oxide, Blood	Sulphur tri oxide, Acid rain, Damage monuments	PAN, Photochemical smog, Visibility

3. a) What is common in the above mentioned boxes A, B and C.
   b) PAN – PHOTOCHEMICAL SMOG.Construct two more pairs
   c) Relate the data in box A and B and prepare notes.

4. Water pollution due to domestic sewage leads to algal bloom and eutrophication. How can it damage the aquatic ecosystems.

5. Prepare two posters containing slogans to create awareness about harmful effects of noise.

6. We can realize the changes in the climate and seasons due to global warming. Mention any two changes.

7. Planting of green trees is encouraged. At the same time felling of trees also occur at an alarming phase. How can your strike a balance?

Section – C

8. The non conventional sources of energy are Solar Energy, Hydel Energy, Tidal energy etc., Write a note regarding their role in reducing pollution.

9. Oil spills in seas and oceans are of frequent occurrence due to oil explorations, tanker accidents etc., write a note on the influence of oil spills on marine life.

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1. Elements of Ecology - Clarke G.L., John wiley & sons, Newyork.
2. Fundamentals of Ecology - Odum E.P., W.B.Saunders Company, Philadelphia.

Websites

http://www.ecology.com
http://www.nationalgeographic.com

Scientific names, Common names and Tamil names of some plants and animals

S.No.	**Scientific Name**	Common Name	Tamil Name	How is it called locally?
1.	Brassica oleracea	Cabbage	முட்டைக்கோசு	
2.	Cyamopsis tetragonoloba	Cluster bean	கொத்தவரை	
3.	Arachis hypogea	Ground nut	நிலக்கடலை	
4.	Oryza sativa	Rice(Paddy)	நெல்	
5.	Vasella rubra	Spinach	பசலைக்கீரை	
6.	Crotalaria juncea	Sunn-hemp	சணப்பை	
7.	Eichhornia crassipes	Water hyacinth	ஆகாயத்தாமரை	
8.	Triticum vulgare	Wheat	கோதுமை	
9.	Impatiens balsamina	Balsam	காசித்தும்பை	
10.	Utricularia polyvaloides	Bladderwort	யுட்ரிகுலேரியா	
11.	Coriandrum sativum	Coriander	கொத்துமல்லி	
12.	Taraxacum officinale	Dandelion	டேண்டலியான்	
13.	Cuscutta reflexa	Dodder plant	அம்மையார் கூந்தல் (அல்லது)சடதாரி	
14.	Monotropa uniflora	Indian pipe	புகையிலைக் காளான்	
15.	Agaricus campestris	Mushroom	நாய்க்குடை	
16.	Allium cepa	Onion	வெங்காயம்	
17.	Nepenthes khasiana	Pitcher plant	குடுவைத்தாவரம்	
18.	Solanum tuberosum	Potato	உருளைக்கிழங்கு	
19.	Crocus sativus	Saffron	குங்குமப்பூ	
20.	Drosera burmannii	Sundew plant	எறும்புத்திண்ணி (சூரியப்பனித்துளித் தாவரம்)	
21.	Mimosa pudica	Touch-me-not plant (Sensitive plant)	தொட்டாற்சுருங்கி (தொட்டாற்சிணுங்கி)	
22.	Amoeba proteus	Amoeba	அமீபா	
23.	Paramoecium caudatum	Paramoecium	பாரமீசியம்	
24.	Hydra vulgaris	Hydra	ஹைடிரா	
25.	Obelia geniculata	Jelly fish	நொங்குமீன்	
26.	Periplaneta americana	Cockroach	கரப்பான்பூச்சி	
27.	Pila globosa	snail	நன்னீர் நத்தை	
28.	Lamellidans lamellidans	Freshwater mussel	நன்னீர் மட்டி	
29.	Asterias rubens	Star fish	நட்சத்திர மீன்	
30.	Naja naja	Cobra	நல்ல பாம்பு	
31.	Pavo cristatus	Peacock	மயில்	
32.	Tyto alba	Owl	ஆந்தை	

Chapter 9

IS MATTER AROUND US PURE?

Consider a balloon filled with air. Its mass is higher than an empty balloon. Increase in mass is due to the air filled. It shows that air has a certain mass. Similarly fine sand, rice, stone etc., have definite masses. Thus any substance that occupies a volume with characteristic mass can be called as matter.

All matters in the universe exist in three states. There are two ways of classification of matter.

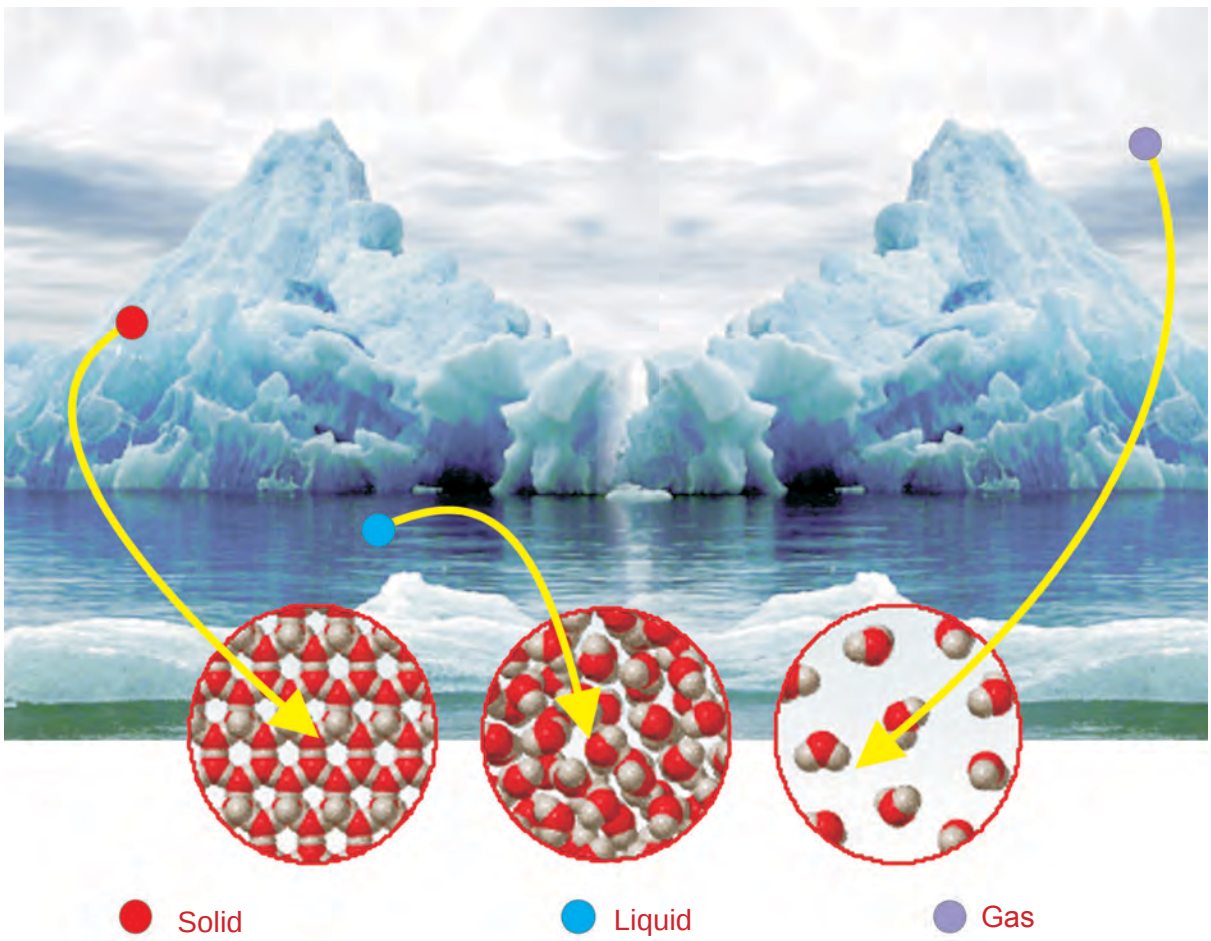
1. According to physical state as solid, liquid or gas.
2. According to its composition as element, compound or mixture.

PHYSICAL STATES OF MATTER

Solid: Solids have a definite shape and a definite volume. The shape of a solid does not change much with temperature. It is rigid and not compressed appreciably even at high pressures. They usually have high densities and expand only very slightly when heated. In a solid, the molecules are held tightly together in definite arrangements.

Liquid: Liquids have no definite shape and they take the shape of their container. They have a definite volume. They are not appreciably compressed by moderate pressures. They expand more than solids on heating and changes into the gaseous state. They have lower densities than solids.

Gas: Gases have no definite shape and volume and take the shape of the container and fill the entire container. They are easily compressed by even small pressures and also expand more than liquids on heating. They have low densities.



Is matter around us pure?

Matter may be classified as a pure substance or a mixture of two or more pure substances.The nature of matter can be determined by studying its properties and its composition.

Colour, odour, density, melting point and boiling point are often treated as physical properties of matter. The physical properties of a substance can be observed or measured without changing its composition.

During a chemical reaction, the compositions of substances are changed. For example, when the gaseous hydrogen element combines with oxygen, the compound, water is formed.

Hydrogen + oxygen ⟶ water

Water contains hydrogen and oxygen but the properties of water are different from those of hydrogen and oxygen. Most forms of matter that we encounter, for example the air we breathe, the gasoline for cars are not chemically pure.

The term “impure” is different from adulteration. According to scientists, the term “pure” means single form of matter.

A pure substance is a distinct type of matter. A substance has the same properties throughout the whole sample.

9.1. MIXTURES

Pure water is a familiar example of a substance. All samples of pure water have the same boiling point, whereas, seawater is not a pure substance. It contains both salt and water along with other dissolved substances.

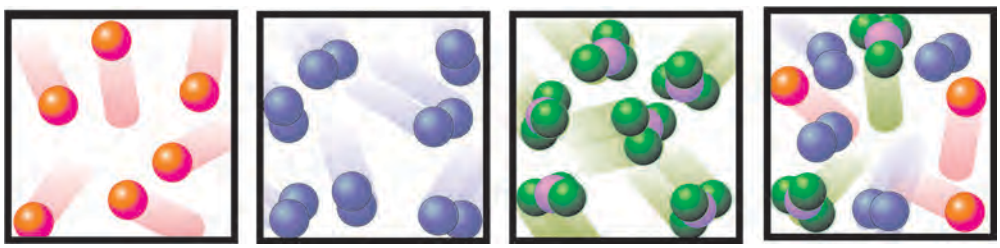
Thus a pure substance should consist of a single type of particle or matter whereas, substances like seawater, minerals, soil etc are examples of mixtures.

In mixtures, elements are physically mixed in any ratio and no new compound is formed.

MORE TO KNOW

The purity of a substance is often determined by measuring its physical properties. For example, a colourless, odourless, tasteless liquid which at atmospheric pressure, boils at 100° C, freezes at 0° C and has a density of 1.0 g cm^{-3} is water.

A pure substance is either an element or a compound.



a b c d

a) Atoms of an Element b) Molecules of an Element c) Molecules of a compound
d) Mixture of atom, element and a compound

ACTIVITY –9.1

Classify the following substances as element, mixture and compound.

(i) Ink (ii) Paint (iii) Oxygen (iv) Air (v) Water

9.2. CHARACTERISTICS OF MIXTURES

To understand the differences between mixtures and compounds, let us consider a mixture of iron and sulphur as an example of a mixture. Here iron and sulphur make a mixture.

Mixture has the properties of individual components. For example, mixture of iron and sulphur has their own properties. When touched with magnet, iron is attracted by the magnet. On the other hand, when burnt, sulphur escapes in the form of sulphur dioxide gas. Consider the chemical reaction between iron and sulphur.

Iron+Sulphur ⟶ Ferrous sulphide

Here, ferrous sulphide is a compound and not a mixture. The compound, ferrous sulphide does not have the properties of individual components, iron and sulphur.

Left - Sulphur and Iron
Right - Ferrous sulphide

ACTIVITY –9.2

The figure shows copper sulphate in one dish and copper sulphate with sodium chloride in another dish. Identify pure substance and mixture.

Examples of mixtures

Mixtures made up of two components are called binary mixtures and those containing three components are called ternary mixtures. Air and sea water are neither elements nor compounds but mixtures. Pure substances have fixed compositions. Composition of a mixture can vary. A cup of sweetened coffee, for example can contain either a little sugar or a lot. Similarly air may contain 0 to 5% by weight of water vapour.Sea water may contain 3.5 to 30% salt. Thus a mixture contains more than one kind of pure constituents or components.

The substances making up a mixture are called constituents or components.

ACTIVITY –9.3

Is air around us pure? Write reasons.

MORE TO KNOW

The lead in your pencil is actually a form of carbon called graphite mixed with clay.

What is a Compound?

Compounds are substances composed of two or more elements combined in fixed ratio by weight. The compound always has the same physical and chemical properties. A compound always contains the same percentage (by weight) of each element. For example, all samples of pure water are 11.19% (by weight) hydrogen and 88.81% (by weight) oxygen. This summary of many observations is called the law of constant composition.

Law of constant composition

A pure compound always contains the same elements combined together in the same definite proportions by weight irrespective of its method of preparation.

Types of mixtures	Examples
Solid in solid	Coins, alloys
Solid in liquid	Sea water
Solid in gas	Smoke(carbon particles in air)
Liquid in solid	Amalgam
Liquid in liquid	Alcohol and water
Gas in solid	Gas adsorbed by charcoal
Gas in liquid	Soda drinks
Gas in gas	Air

ACTIVITY – 9.4

Can you identify the different states or phases present in a glass of fruit juice with ice-cubes in it.

Is water a mixture or a compound?

Water is a compound because of the following reasons.

- It is homogeneous.
- It has definite physical constants such as boiling point, freezing point, density, etc.
- The properties of water are entirely different from those of its constituents, i.e, hydrogen and oxygen.
- Water has a definite composition by mass. The ratio of H:O by mass is 1:8.

Is air a mixture or a compound?

Air is a mixture because of the following reasons.

- Air does not have a fixed composition. The composition of air varies from place to place.
- Artificial air can be made by mixing the various components of air in the same proportions in which they occur at a place, and when this is done, no energy changes are noticed.
- The components of air can be separated by a physical method such as fractional distillation of liquid air.
- Liquid air does not have a definite boiling point. It boils over a range of temperature between -196^{O}C and -183^{O}C.
- If air were a compound, the composition of air expelled from water should not be different from the composition of air around us. But it is known that during respiration, exhaled air is lower in oxygen than ordinary air.

ACTIVITY – 9.5

Classify the following into mixture or compound.

(i) Alloys (ii) Smoke (iii) Juice (iv) Milk (v) Common salt (vi) Coffee (vii) Carbon di oxide (viii) Ice cream.

Composition of inhaled air and exhaled air during respiration.

Inhaled Air	Exhaled Air
Contains 78% nitrogen.	Contains 78% nitrogen.
Contains 20% oxygen.	Contains 16% oxygen.
Contains 0.03% Carbon dioxide.	Contains 4% Carbon dioxide.
Contains very little moisture.	Contains appreciable amount of moisture.

Composition of air

Gas	in mass %
Nitrogen	75.50%
Oxygen	23.20%
Argon	1.0%
Carbon dioxide	0.046%
Neon	Negligible
Helium	Negligible

ACTIVITY –9.6

Aspirin is a medicine for headache. It is composed of 60% carbon, 4.5% hydrogen and 35.5% oxygen by mass, regardless of its source. Is aspirin a mixture or a compound?

9.2.1. DIFFERENCES BETWEEN MIXTURE AND COMPOUND

Mixture	Compound
Elements are physically mixed in any ratio and no new compound is formed.	Elements are chemically combined in a fixed ratio to form a new compound.
They have no sharp or definite melting point, boiling point, density etc.	They have definite melting point, boiling point, density etc.
A mixture exhibits the properties of its constituent or component elements.	Property of a compound is different from its constituent or component elements.
They are either homogeneous or heterogeneous in nature.	They are always homogeneous in nature.
Constituents of a mixture can be separated by physical methods like filtration, magnetic separation etc.	Constituents of a compound cannot be separated by physical methods.

9.3. TYPES OF MIXTURES

There are two types of mixtures. They are,

i. Homogeneous mixture

ii. Heterogeneous mixture

9.3.1. HOMOGENEOUS MIXTURES AND THEIR TYPES

Homogeneous mixtures have only one phase. They have the same properties throughout a sample although the properties of different samples may be different. Homogeneous mixtures are called solutions.

There are three types of homogeneous mixtures.

Solid homogeneous mixture - Alloys

Liquid homogeneous mixture - Alcohol in water

Gaseous homogeneous mixture - Air

ACTIVITY –9.7

Which of the following are physical changes and which are chemical changes?

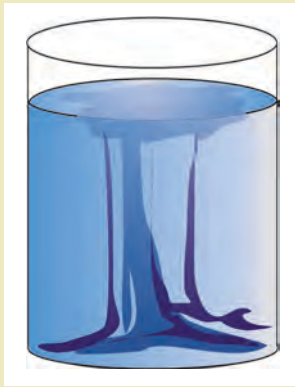
(1) Rusting of iron. (2) Melting of ice. (3) A seed grows into a plant. (4) Aluminium metal is rolled into a foil. (5) Candle burns.

Homogeneous Mixtures

Salt in water Strong tea Weak tea

ACTIVITY –9.8

A drop of ink mixes with water. Is it a homogeneous mixture or a heterogeneous mixture?



9.3.2. HETEROGENEOUS MIXTURES AND THEIR TYPES

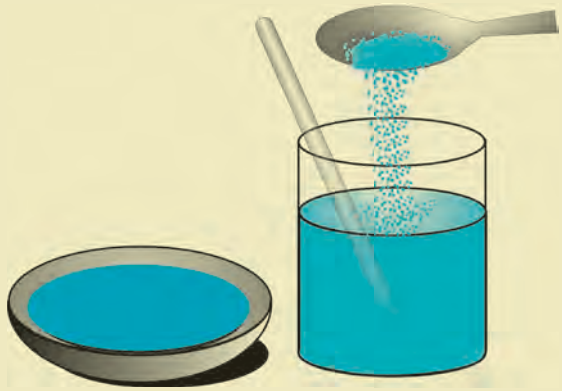
Heterogeneous mixtures have more than one phase. They do not have the same properties throughout a sample. Bits of the phases can be seen either with the eye or with a microscope. The phases can be in the same or different physical states.

Solid - solid heterogeneous mixture - mixture of sugar and salt

Solid - liquid heterogeneous mixture - ice cubes in water

Gaseous heterogeneous mixtures - smoke in air.

ACTIVITY –9.9



This beaker contains a solution of copper sulphate salt dissolved in water. Is it a homogeneous mixture or a heterogeneous mixture? Support your conclusion.

ACTIVITY –9.10

Classify each of the following as homogeneous or heterogeneous

(i) Tea (ii) Ink (iii) Fruit salad (iv) Sugar solution

Classification of matter

Matter

Mixtures

- Variable composition.
- Easily separated by physical methods.
- No physical constants.

Pure Substances

- Constant composition.
- Not easily separated by physical methods.
- Have definite physical constants.

Homogeneous Mixtures

- Have the same composition throughout.
- Components are indistinguishable.

Heterogeneous Mixtures

- Do not have the same composition throughout.
- Components are distinguishable.

Elements

- Contain atoms of the same kind.

Compounds

- Contain two or more elements in a definite ratio by mass.

9.4. SEPARATION OF DIFFERENT COMPONENTS OF A MIXTURE

People have used methods of separating and purifying materials since ancient times.

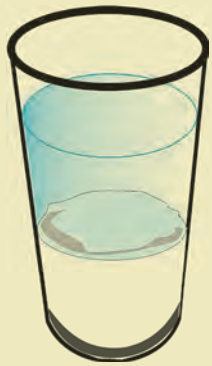
Today,

- The oil industry refines crude oil and separates it into fuels, lubricants and raw materials for chemical industry.
- The mining industry is based on the separation of metals and some non-metals from their ores.
- Pharmaceutical companies separate and purify natural and synthetic drugs etc.

In the laboratory, different methods of separation are used to get the individual component from a mixture. Some of the physical methods are,

1. Decantation: Used to separate a liquid from a solid (present as large particles) that does not dissolve in it.
2. Filtration: Used to separate a liquid from a solid (present as very small particles) which does not dissolve in the liquid.
3. Distillation: Used to separate a non-volatile solid and a volatile liquid present together as a solution.
4. Fractional distillation: Used for separating a mixture containing two or more liquids with an appreciable difference in their boiling points.
5. Separating funnel: To separate two completely immiscible liquids.
6. Sublimation: Used for separating a mixture of two solids, one of which sublimes.
7. Chromatography: Used to separate two substances based on the difference in the force of attraction between the substances and a solid (adsorption).

ACTIVITY –9.11



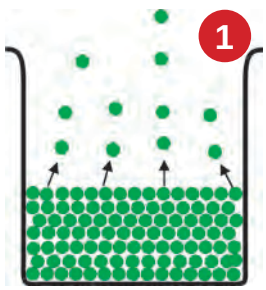
In a beaker, mix together an equal quantity of fine salt and white flour. Pour water into the beaker and stir well. Observe the solubility of flour and salt in water. Flour settles on the bottom of the beaker. Mention a suitable method of separation of flour from salt.

9.4.1. SEPARATION OF MIXTURES BY SUBLIMATION

By sublimation, a volatile solid substance is separated from a mixture containing a non-volatile solid substance.

Sublimation is defined as a process, in which a substance in solid state is directly converted into vapour state.

At high temperature, the molecules of volatile solid move far away from each other making the solid substance into vapour.

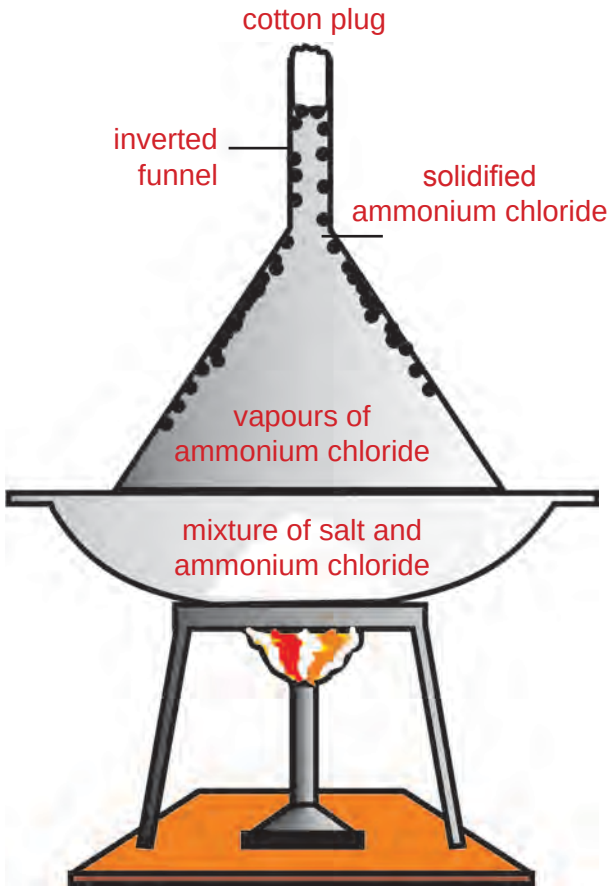


1. Solid molecules evaporate

2. Iodine crystal vapourises

3. Sublimation of dry ice (carbon dioxide in ice form)

Consider a mixture containing common salt and ammonium chloride. Both common salt and ammonium chloride are solid substances. Common salt is a non-volatile substance. It does not undergo sublimation. Ammonium chloride undergoes sublimation. Hence Ammonium chloride can be separated from common salt by sublimation.



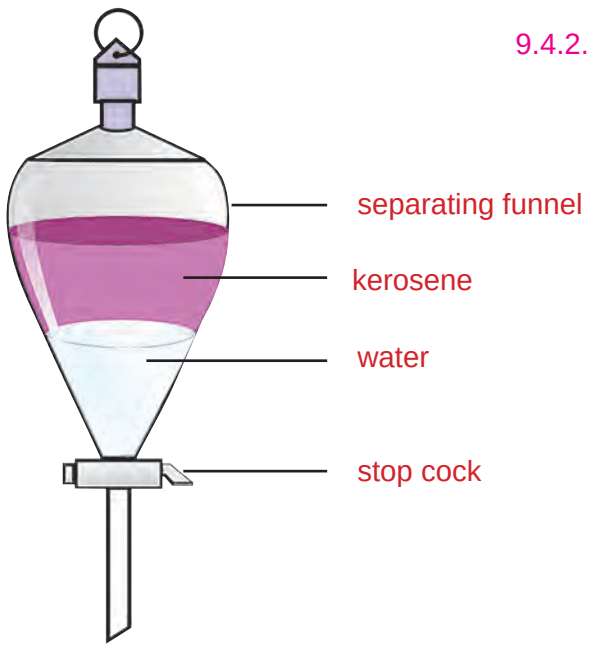
ACTIVITY –9.12

Take a mixture containing common salt and camphor in a china dish

- Keep it on a stand.
- Invert a funnel over the dish.
- Close the funnel stem by means of cotton.
- Heat the china dish.
- Observe the physical change.

MORE TO KNOW

Solids that undergo sublimation are camphor, naphthalene, benzoic acid, iodine and ammonium chloride.



9.4.2. SEPARATION OF A MIXTURE CONTAINING IMMISCIBLE LIQUIDS

Immiscible liquids are usually separated by using a device named "separating funnel".

Consider a mixture containing kerosene and water. Both the liquids are immiscible with each other. By using a separating funnel, one liquid can be separated from the other. Less denser liquid remains in the upper layer while high denser liquid remains in the lower layer.

ACTIVITY –9.13

- Take a mixture containing kerosene and water.
- Pour the mixture into a separating funnel.
- Close the mouth of the separating funnel.
- Shake it for 10 minutes.
- Hold the funnel in a stand for 15 minutes.
- Observe the changes.
- Note the lower and upper layers.
- What is the principle behind it?

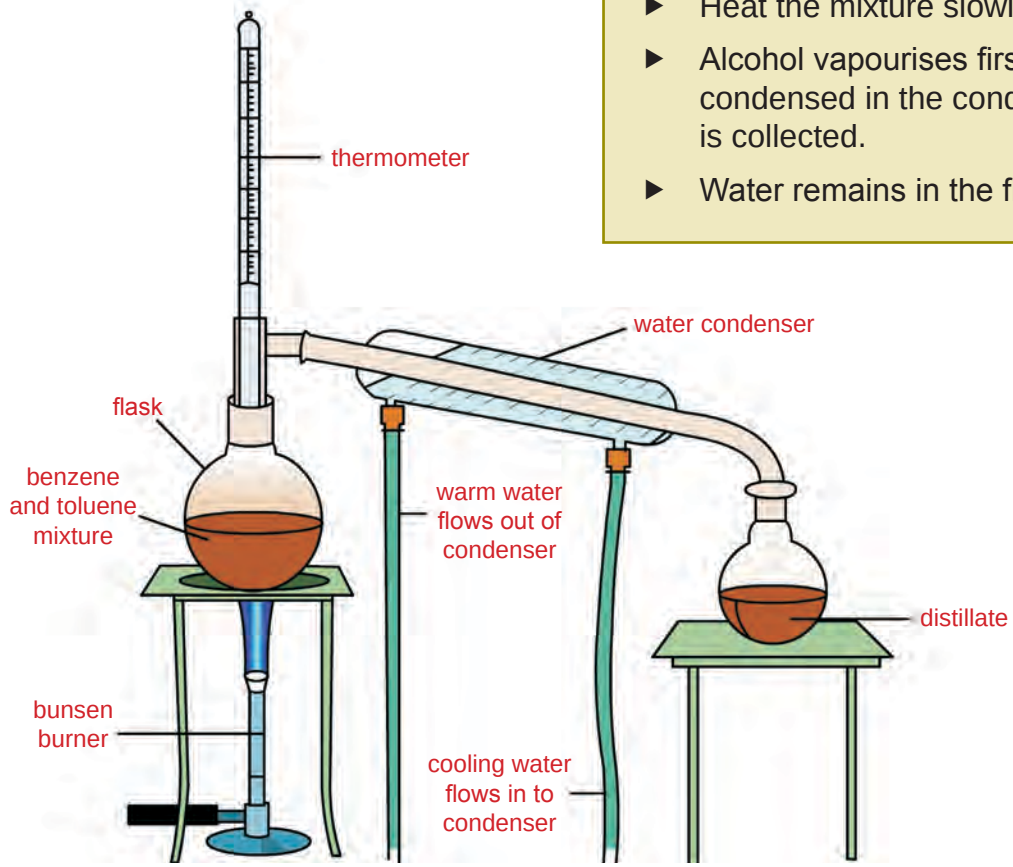
9.4.3. SEPARATION OF A MIXTURE CONTAINING MISCIBLE LIQUIDS

Fractional distillation is a suitable method for separation of a mixture containing miscible liquids. It works on the principle that the two liquids should vary in their boiling points by 298 K.

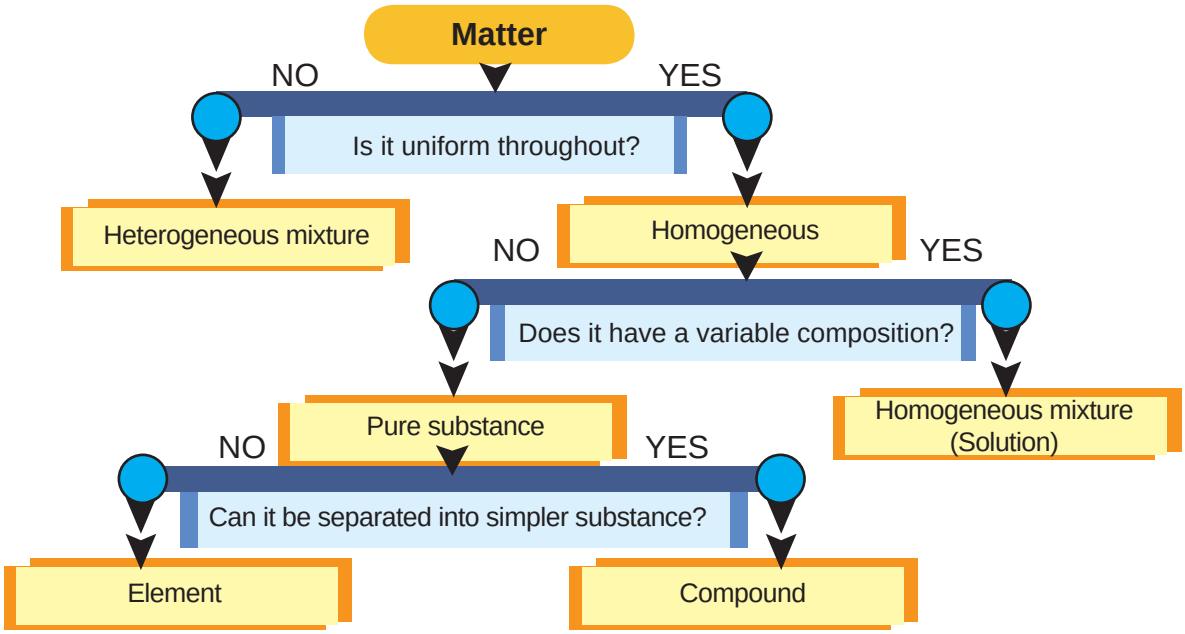
- Consider a mixture containing two liquids namely benzene and toluene.
- Both the liquids are miscible with one another.
- They can be separated by fractional distillation.
- Boiling point of benzene is 353 K.
- Boiling point of toluene is 384 K.
- The difference in their boiling points is 31 K.

ACTIVITY–9.14

- Take a mixture of alcohol and water in a distillation flask.
- Fit a thermometer.
- Fit a condenser.
- Heat the mixture slowly.
- Alcohol vapourises first and gets condensed in the condenser and is collected.
- Water remains in the flask.



Identification of element, compound and mixture.



EVALUATION

SECTION – A

Choose the correct answer.

1. The lead in the pencil we use is made of a material called graphite. Graphite is a mixture of _____ (carbon and clay, clay and nitrogen)
2. Pure water is a compound. It contains 11.19% by mass of hydrogen and oxygen _____ by mass. (88.81% , 31.81%)
3. Coins are mixtures of solid in solid. Smoke is a mixture of _____ (solid in gas, gas in solid)
4. Some pair of items are given below. Could you identify the incorrect pair?
   a) Air - gas in gas
   b) Seawater - solid in liquid
   c) Soft drinks - gas in liquid.
   d) Amalgam - liquid in liquid
5. Components of a given matter can be separated by various purifying techniques. Components of liquid air can be separated by adopting _____ physical method. (fractional distillation , distillation , sublimation)
6. Rusting of iron is a chemical change. The melting of ice is _____ (physical change , chemical change).

SECTION – B

7. Pure substance contains a single type of particles. Is sea water pure or not? justify.

8. In a compound two or more elements are combined in a fixed ratio by mass. Mention any two properties of a compound?

9. Homogeneous mixture contains a single type of phase. Heterogeneous mixture contains different types of phases. Quote one example for each type.

10. When a solid camphor is exposed to air, it changes into gaseous state. It is a physical change. Name the change that takes place? Could you give another example for such a change.

11. (a) Separation of a mixture containing water and kerosene can be done by use of _____ (distillation , separating funnel)

    (b) _____ (sublimation, chromatography) process is used to separate common salt and ammonium chloride.

12. A liquid 'A' has a boiling point of 353 K and another liquid 'B' has a boiling point of 384K. Both are miscible with each other. They are separated by "fractional distillation". Justify the reason for using fractional distillation method.

SECTION – C

13. In mixtures, components are combined in any ratio.

    (a) How does a mixture differ from a compound?

    (b) What are the types of mixtures?

    (c) Write one example each for either type?

14. All matters in the universe exist in three states namely solid, liquid and gas.

    (a) Why do solid substances have definite shape?

    (b) Write any two properties of a solid substance?

    (c) Will the solid substance expand on heating? Why?

FURTHER REFERENCE

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Websites

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