

PLEDGE

“India is my Country. All Indians are my Brothers and sisters.

I love my country, and I am Proud of its rich and varied heritage.

I shall always strive to be worthy of it.

I shall give my Parents, teachers and all elders respect,

and treat everyone with courtesy. I shall be Kind to animals

To my country and my people, I pledge my devotion

In their well-being and prosperity alone lies my happiness.”

Pydimarri Venkata Subba Rao

PREFACE

"Welcome to Biology: The Science of Life!"

Biology is the fascinating study of the living world around us. From the tiniest bacteria to the mightiest trees, biology explores the diversity, complexity, and beauty of life on Earth. This book is your introduction to the fundamental principles and concepts that govern the lives of all living things.

In these pages, we'll explore:

- The building blocks of life: cells, genes, and DNA
- The diversity of life: plants, animals, fungi, and microorganisms
- The processes of life: growth, reproduction, evolution, and ecology
- The human body and its systems

Our goal is to make biology accessible, engaging, and fun! We'll use clear explanations, stunning images, and interactive exercises to help you develop a deep understanding and appreciation for the natural world.

Join us on this journey of discovery!

Explore the wonders of biology and gain a new perspective on the incredible world of life that surrounds us."

NOTE: - The textbook is designed for AICU students to help them grasp the concepts covered in Biology in the Foundation and Bridge Course. This book is helpful for students who are away from modern education.

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1. FOOD COMPONENTS

Carbohydrates are nutrients that provide energy to the body. They include sugars, starches, and fibre.

Proteins are essential nutrients that are important for building and repairing tissues and for various metabolic functions in the body.

Fats are concentrated energy sources necessary for proper cell function and hormone production.

Vitamins are organic compounds essential for various metabolic processes in the body, such as growth, development, and immunity.

Minerals are inorganic nutrients important for various bodily functions, including bone health, muscle function, and nerve transmission.

Fibre is a type of carbohydrate that the body cannot digest but is important for digestive health and regulating bowel movements.

Water is vital for life; it is essential for various bodily functions, including hydration, temperature regulation, and nutrition.

Minerals inorganic nutrients are important for various bodily functions, including bone health, muscle function, and nerve transmission.

MALNUTRITIONAL DISEASES

Marasmus: - This is due to a deficiency of both proteins and carbohydrates. Lean and weak muscles, less developed muscles, dry skin, diarrhea, etc. are the symptoms of the disease.

Kwashiorkor: - This is due to a protein deficiency in the diet. Body parts become swollen.

Very poor muscle development, a fluffy face, a bulging abdomen, diarrhea, and dry skin are the symptoms of the disease.

Goitre: - Caused by prolonged iodine deficiency, which causes thyroid gland enlargement.

Taking iodized salt and seafood, which are good sources of iodine, can prevent goitre.

Vitamin Chart

Vitamins	Benefits	Defecency
Vitamin A	Helps to see better in the dark and moisturizes the skin	Night blindness Dry Skin
Vitamin B	Good for the heart and lungs	Loss of appetite heart disorder joint swelling
Vitamin C	Prevents cold, Keeps teeth and gums healthy	Causes Scurvey
Vitamin D	Helps in the growth of bones	Causes weak bones
Vitamin E	Helps to heal wounds	Poor muscle development

SUMMARY

- ✓ Food is the substance eaten by us to perform various activities of life and stay healthy.
- ✓ Food may be obtained from animals or plant sources. Plants are producers, and animals are heterotrophs.
- ✓ Human beings may be vegetarians or non-vegetarians.
- ✓ Carbohydrates, proteins, fats, vitamins, and minerals are the nutrients found in our food.
- ✓ Carbohydrates and fats are considered energy-providing foods.
- ✓ Proteins are body-building foods; vitamins and minerals are protective foods.
- ✓ Vitamins are of two types: fat-soluble and water-soluble.
- ✓ Fat-soluble vitamins A, D, E, and K and water-soluble vitamins B and C.

Answer the following questions

1. What are the sources of food?
2. What are the components of food?
3. Why do we need food?
4. What are the different edible parts of the plants?
5. Define food?
6. Why should we prefer cooked food?
7. What are herbivores, carnivores, and omnivores?
8. Draw the diagrams for any two fruits.

2. NUTRITION FOR ANIMALS

AUTO TROPHIC NUTRITION: Nutrition in animals involves the intake, digestion, absorption, and utilization of nutrients to sustain life, growth, and reproduction.

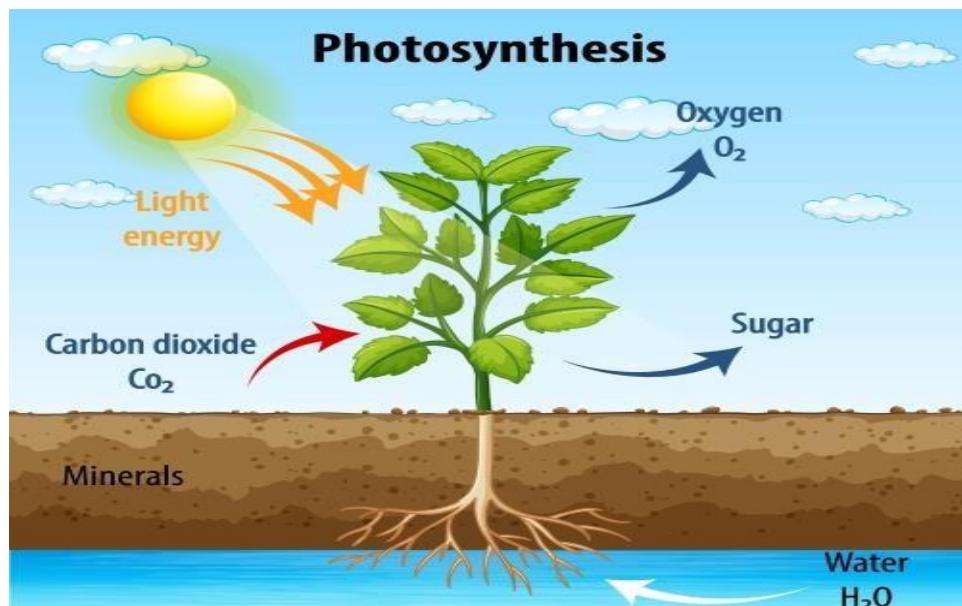
Intake: Animals consume food through various methods, depending on their species and environment. Some animals are herbivores, feeding primarily on plants, while others are carnivores, feeding on other animals. Omnivores consume both plant and animal matter. Filter feeders consume small particles suspended in water, while detritivores feed on decomposing organic matter.

Digestion: Food undergoes mechanical and chemical digestion to break down complex molecules into simpler forms that the body can absorb. Digestive enzymes break down carbohydrates, proteins, and fats into their component molecules (glucose, amino acids, and fatty acids, respectively). Digestion can occur in specialized organs such as the stomach, intestines, and oral cavity.

Absorption: once food molecules are broken down, they are absorbed across the lining of the digestive tract and into the bloodstream. Nutrients are transported to cells throughout the body for energy production, growth, and repair.

Utilization: Nutrients are used by cells for various metabolic processes, including energy production (through cellular respiration), the synthesis of new molecules, and the maintenance of cellular structures.

Excretion: Waste products from the digestion and metabolism of nutrients are excreted from the body. This process typically involves the elimination of undigested food (faeces) and metabolic waste products such as urea (in urine).



Introduction

“Photosynthesis is the process by which photoautotrophs convert light energy into chemical energy, which can later be used as fuel for the activities of organisms.”

The photosynthesis process requires three crucial elements to function: water, carbon dioxide, and light. If any of these elements are absent, then the process may be hindered.

Photosynthesis Process

The actual process occurs during the day, and two interrelated phases are involved in the process:

Light-dependent reaction

Light-independent reaction

Light-dependent reaction

This reaction requires sunlight to produce energy molecules (ATP and NADPH). Moreover, photosynthesis increases with more photons (light), and consequently, more energy molecules are produced.

Light independent reaction

Essentially, the light-independent reaction uses the energy molecules produced by the light-dependent reaction to produce even more energy molecules.

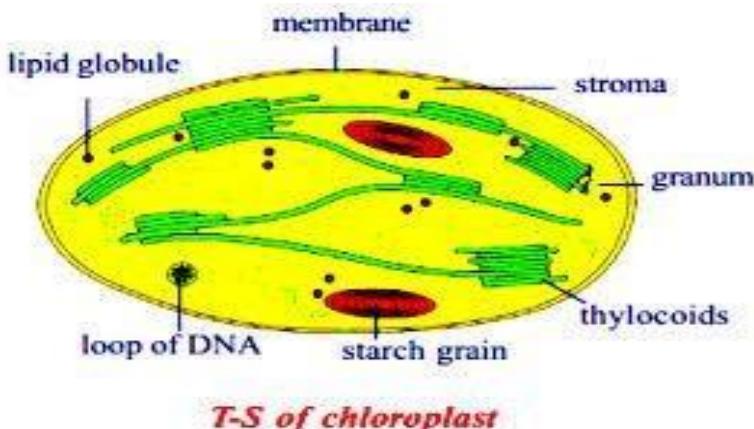
Process of Photosynthesis Step by Step

The sunlight is absorbed by the chlorophyll in the leaves of the plants. Carbon dioxide enters the plant through structures called the stomata, which are usually found on the underside of the leaves. Water is absorbed through the roots of the plant.

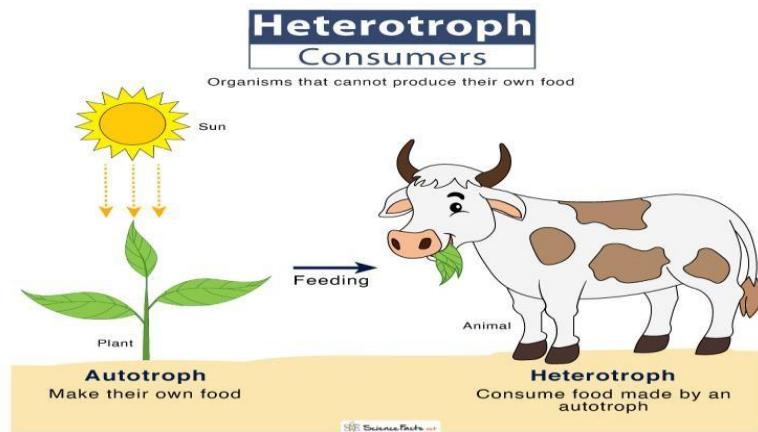
The light-dependent reaction occurs during the day. At this stage, water is split into its elements oxygen and hydrogen ions. Then, the ions go through a series of electron carriers, eventually leading to the accumulation of hydrogen ions. As electrons get transferred from one electron carrier to another, energy is released. In this case, ATP and NADPH are released.

The light-independent reaction uses the energy produced during light, depending on the reaction, to transform carbon dioxide into glucose. The transformation from carbon dioxide to glucose requires a few reactions. The same molecule produces glucose during this process.

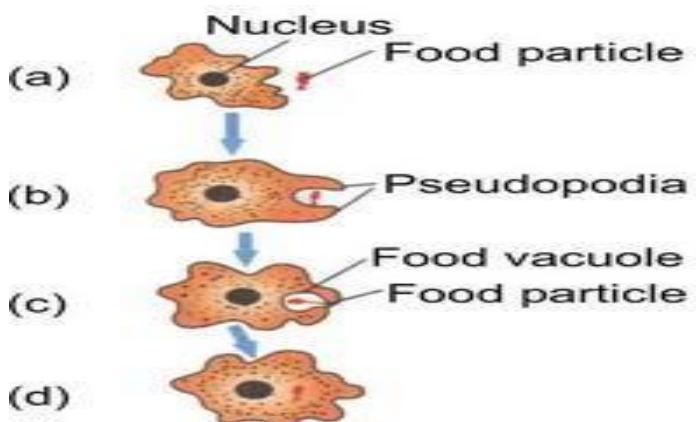
The lower parts of the leaves have rather “spaced out” cells. This structure permits carbon dioxide to permeate into other parts of the leaves, thereby facilitating the release of oxygen.



HETERO TROPHIC NUTRITION:



Amoeba



Types of Heterotrophic Nutrition



**Saprophytic
Nutrition**



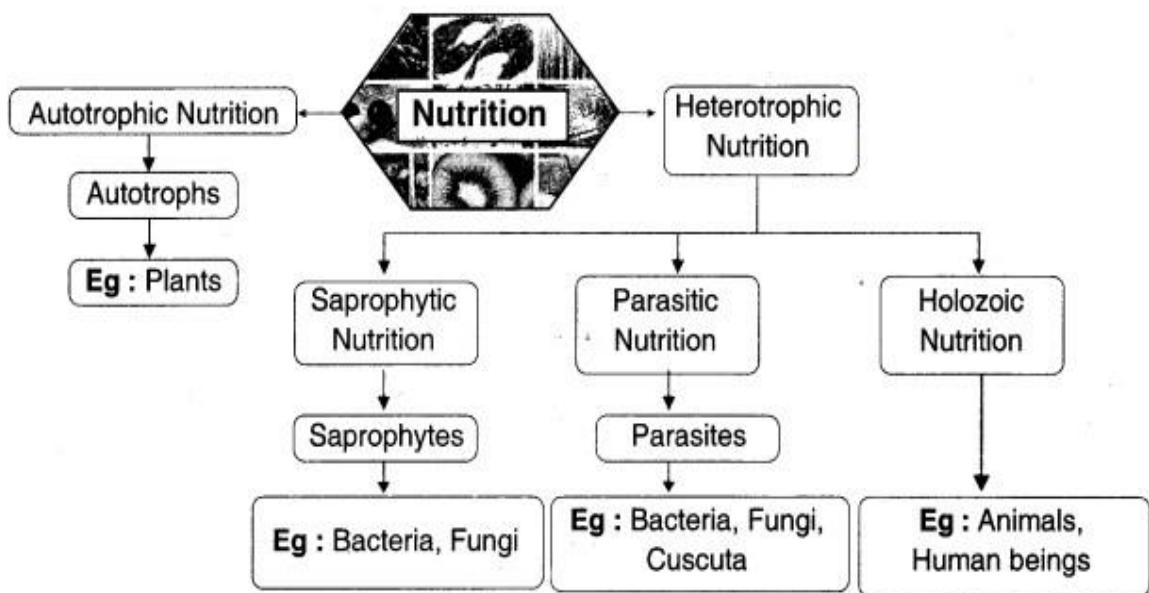
**Holozoic
Nutrition**



**Symbiotic
nutrition**



**Parasitic
Nutrition**



- a) Saprophytic Nutrition:** Some organisms break down the food materials outside their body and then absorb them. These are called saprophytes. Examples bread moulds, yeast, mushrooms, etc.
- b) Parasitic Nutrition:** Plants or animals that live in or on other plants or animals and get their food from them. E.g., Cucuta, leech, head louse, tapeworms, etc.
- c) Holozoic Nutrition:** Some organisms take in whole food material and break it down into simple substances inside their body. Examples: amoeba, dog, human, etc.

Name	Characteristic	Example
Parasitic plant	It feeds <i>on other plant</i> called the host and derives its nutrients.	Amarbel or Cuscuta
Saprophytic plant	It feeds on the dead <i>and decayed</i> matter for its nutrition.	Fungi
Insectivorous plant	It feeds on <i>small insects and animals</i> which sit on them and obtains its nutrition.	Pitcher plant.
Symbiotic plant	It provides shelter and in turn obtains food from the organism living in its shelter without harming it.	Lichens (Association of fungi and algae)

Nutrition in animals:

Here are some examples of nutrition in animals:

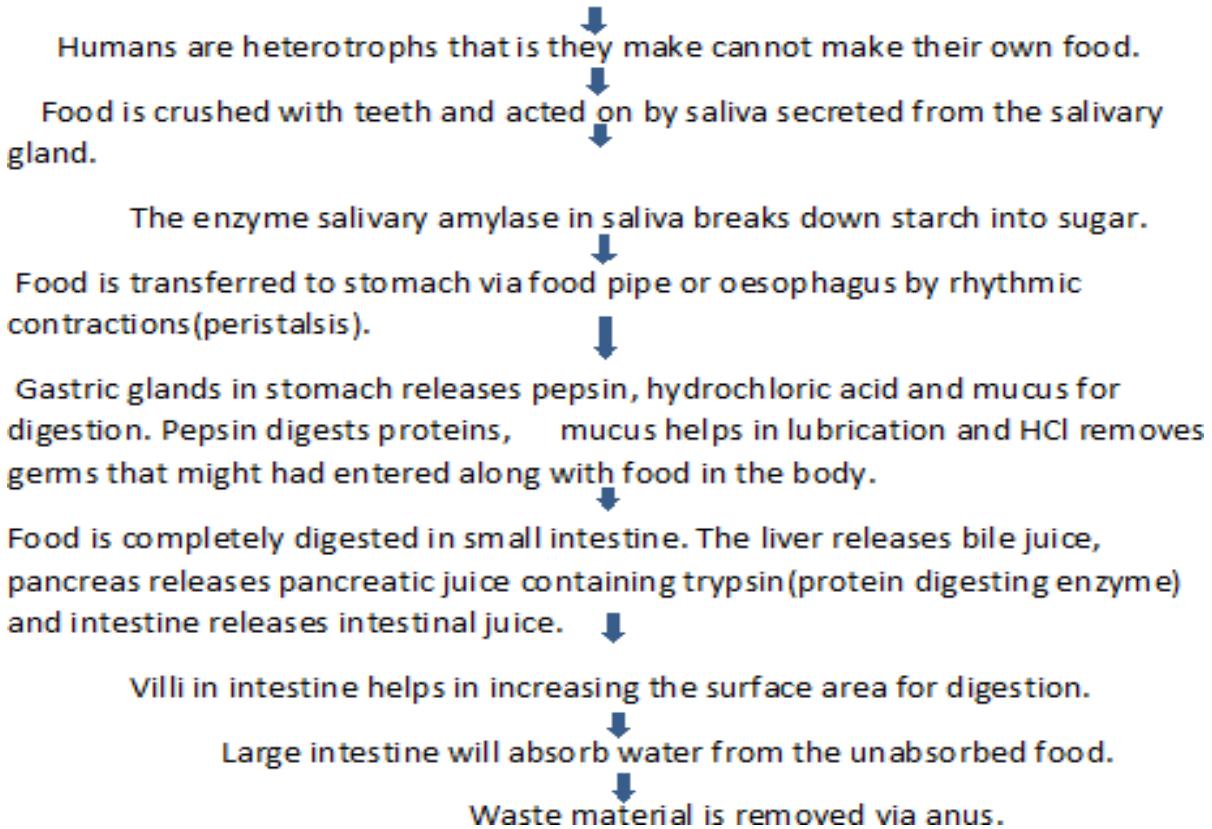
Carnivores: Lions, tigers, and wolves are examples of carnivores that primarily consume meat for their nutrition. Their diet consists mainly of other animals, which provide them with essential nutrients like protein and fats.

Herbivores: Cows, horses, and rabbits are examples of herbivores that primarily consume plant matter for their nutrition. They feed on grasses, leaves, and other plant materials, obtaining carbohydrates, proteins, vitamins, and minerals from their diet.

Omnivores: Humans, bears, and pigs are examples of omnivores that have a varied diet, consuming both plant and animal matter. They obtain nutrients from a wide range of foods, including fruits, vegetables, grains, meat, and fish.

Detritivores: Earthworms, dung beetles, and vultures are examples of detritivores that feed on decomposing organic matter. They break down dead plants and animals, obtaining nutrients like carbohydrates and proteins from the decaying material.

NUTRITION IN HUMANS



SUMMARY

- ✓ Different animals have different ways of acquiring food.
- ✓ Amoeba ingest their food with the help of their pseudopodia and digest it in the food vacuole.
- ✓ The human digestive system consists of the alimentary canal and digestive gland.
- ✓ The alimentary canal consists of buccal cavity, esophagus, stomach, small intestine, large intestine, and rectum anus.
- ✓ The salivary glands, liver, and pancreas are the digestive glands of the body that secrete various digestive juices.
- ✓ Photosynthesis is the process by which green plants containing chlorophyll produce glucose and oxygen in the presence of sunlight, carbon dioxide, and water.
- ✓ Chloroplasts are sites of photosynthesis.
- ✓ A diet containing all nutrients in sufficient proportions is called a balanced diet.
- ✓ Nutrition in animals involves the intake, digestion, absorption, and utilization of nutrients to sustain life, growth, and reproduction.

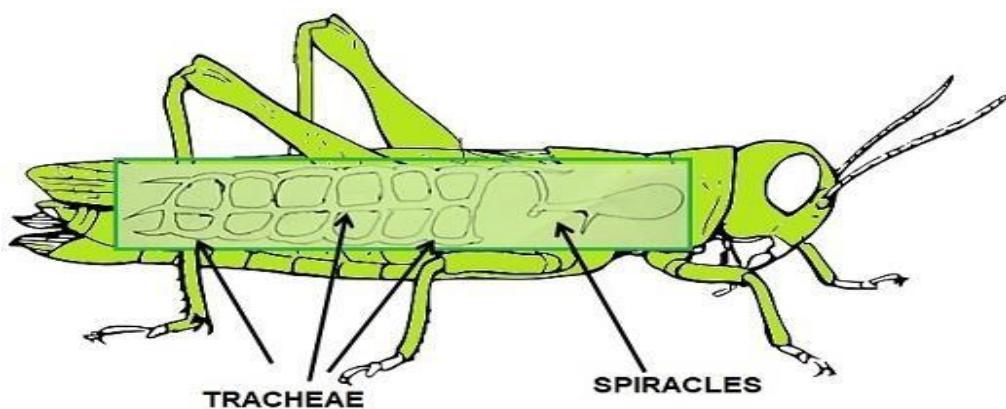
Answer the following questions:

1. What is the other name of the food pipe?
2. Which organ helps in getting the taste of the food that we eat?
3. What is meant by digestion? Name the various organs of the human digestive system.
4. What is saprophytic nutrition?
5. Draw the diagram of the chloroplast.
6. Explain the nutrition of human beings. Draw a diagram of the human digestive system.
7. What are herbivores, carnivores, and omnivores? Give examples.
8. Write the equation for photosynthesis

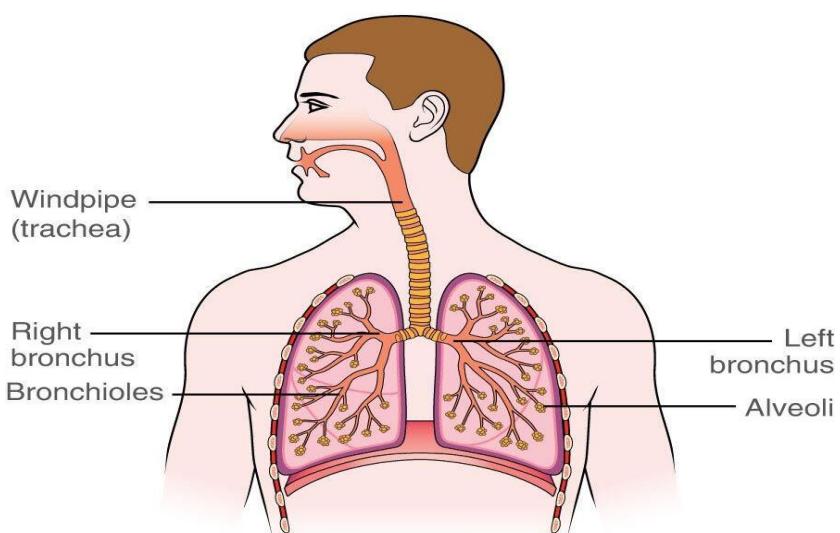
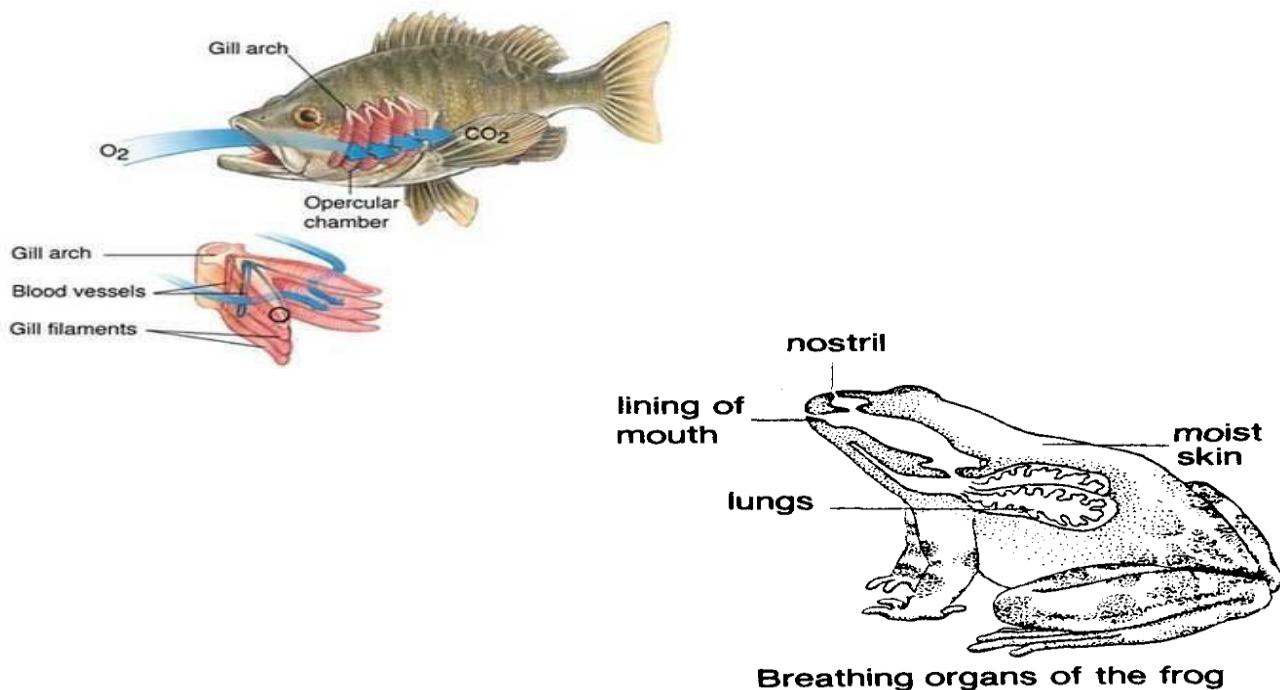
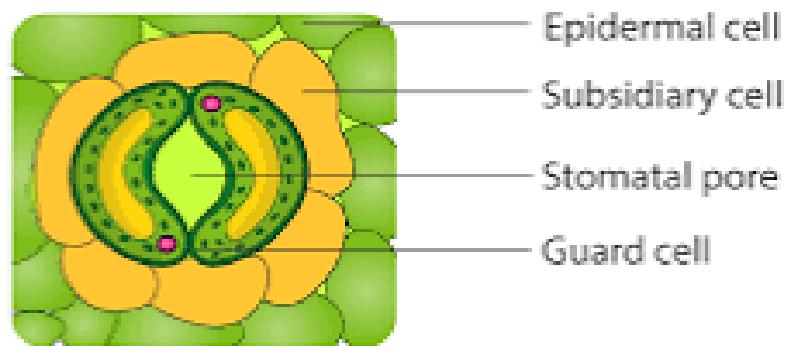
3. RESPIRATION

Respiration in plants -is a metabolic process where they break down glucose to release energy for cellular activities, just like in animals. It occurs in mitochondria, and it involves the intake of oxygen and the release of carbon dioxide. Unlike animals, plants also perform photosynthesis, which produces glucose and oxygen, creating a balance between respiration and photosynthesis for energy needs.

Respiration in animals- is the process by which oxygen is taken in and carbon dioxide is expelled. It occurs in specialized organs like the lungs in mammals, the gills in fish, and the tracheal systems in insects. The oxygen taken in during respiration is used in cellular respiration, where glucose is broken down to release energy for the organism's activities. Carbon dioxide, a by-product of cellular respiration, is then expelled from the body. This process is vital for the survival of animals, providing the energy needed for various physiological functions.



STRUCTURE OF STOMATA



SUMMARY

- ✓ Respiration is the process of taking oxygen into the cells, breaking down food for energy release, and eliminating waste products like carbon dioxide and water.
- ✓ Breathing is a part of the process of respiration, in which oxygen-rich air is taken in and carbon dioxide-rich air is taken out. It involves inhalation and exhalation.
- ✓ Based on the presence or absence of oxygen, respiration is of two types: aerobic respiration and anaerobic respiration.
- ✓ Stomata and lenticels help in the exchange of gases in plants. The roots take in the air present in the soil.
- ✓ Cockroaches, grasshoppers, and other insects respire through spiracles'; fish respire through gills; amoeba through the cell membrane; earthworms through their skin; and frogs through their skin while on land and through their gills while in water.
- ✓ The exchange of gases through gills is known as 'bronchial respiration' ' Insects such as cockroaches and grasshoppers do not have haemoglobin in their blood. So blood is colourless. They have a system tube called the 'Tracheal System' for the transport of gases.
- ✓ Other terrestrial organisms, such as reptiles, birds, and mammals, breathe through the lungs. Breathing in the lungs is called 'pulmonary respiration'.
- ✓ The human respiratory system comprises the nostrils, nasal cavity, pharynx, larynx, trachea, bronchus, bronchioles, alveoli, and lungs.
- ✓ 9."Alveoli" are called the 'structural and functional units of the lungs. Asthma, bronchitis, pneumonia, and emphysema are respiratory diseases

Answer the following questions:

1. Name two gases that are exchanged during respiration.
2. Name one animal that can breathe through its lungs as well as its skin.
3. What type of respiration occurs in insects?
4. What are inhalation and exhalation?
5. Name the breathing organ in insects.

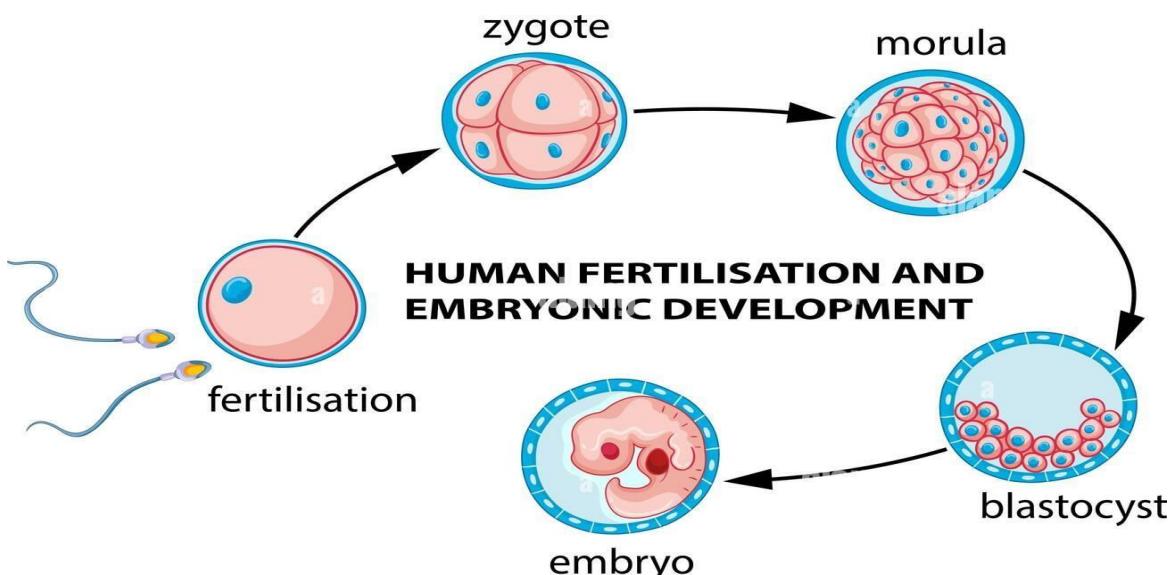
4. REPRODUCTION

Reproduction in animals can occur through sexual or asexual means. **Sexual reproduction** involves the fusion of gametes from two parents to form offspring with genetic variation. This process typically involves the following steps:

Gamete production: Specialized cells, called gametes (sperm in males and eggs in females), are produced through a process called gametogenesis.

Fertilization is the fusion of a sperm cell with an egg cell, usually occurring internally or externally, depending on the species.

Embryo development: The fertilized egg, or zygote, undergoes division and differentiation to form an embryo, which eventually develops into a new individual



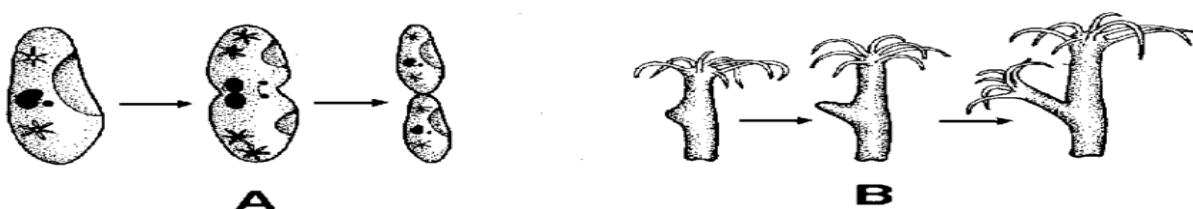
Asexual reproduction occurs without the involvement of gametes from two parents.

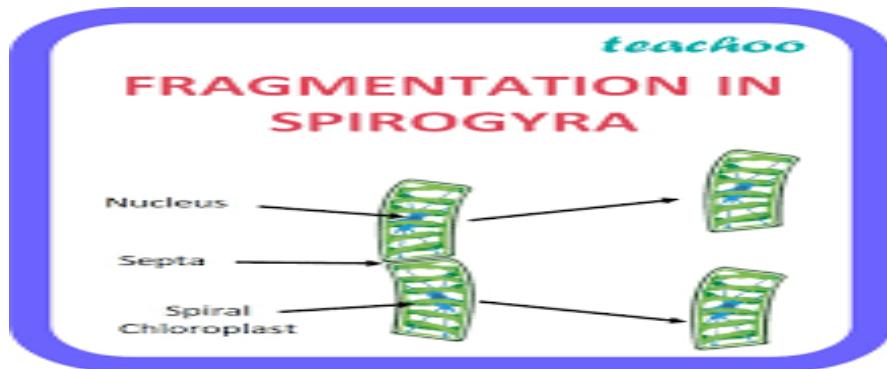
A. Fission: Single-celled organisms such as paramecium and bacteria reproduce by fission.

Paramecium divides into two; it is binary fission.

B. Budding: Where a new organism develops from an outgrowth or bud on the parent.

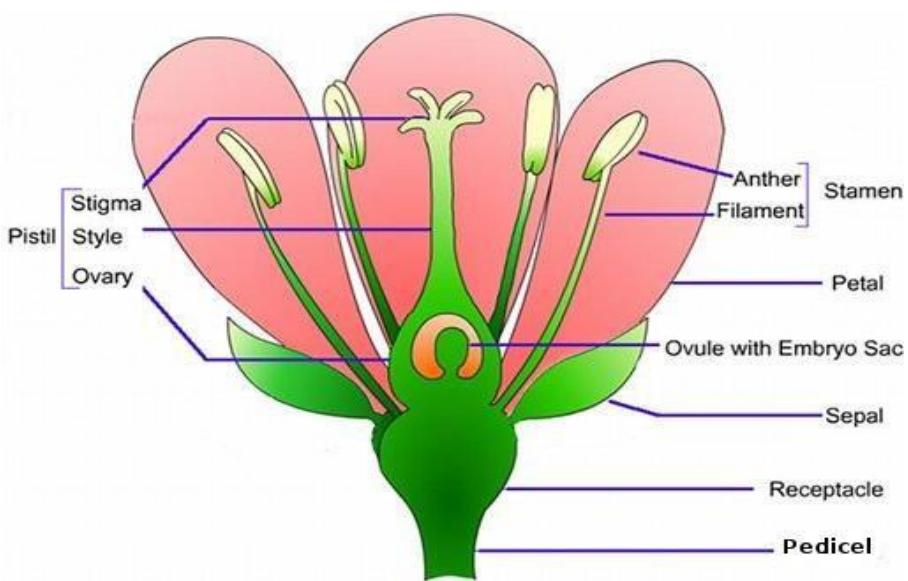
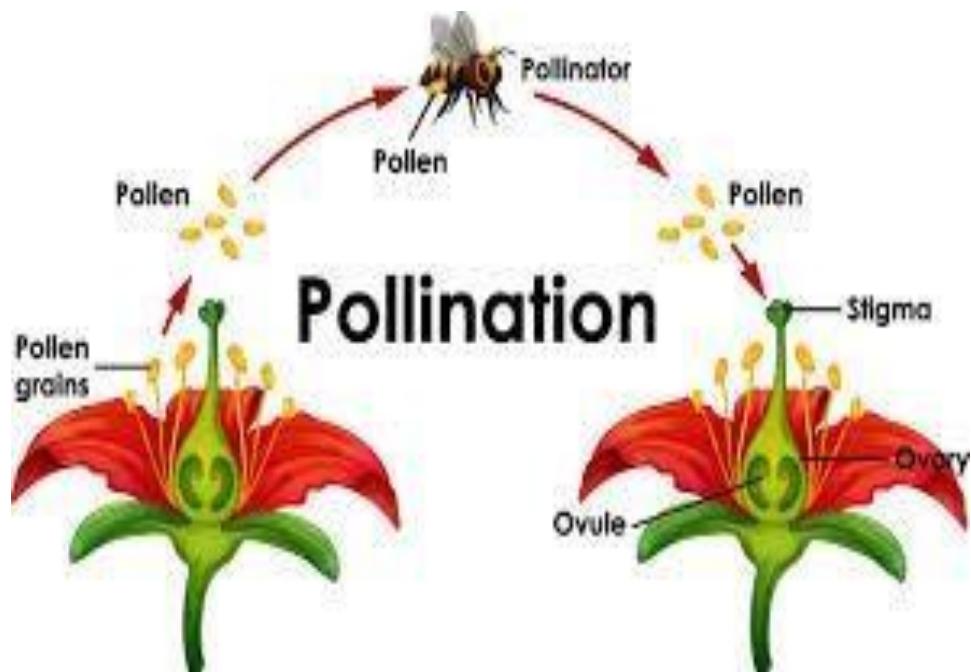
C. Fragmentation: where a parent organism breaks into fragments and each fragment develops into a new individual.





Sexual Reproduction:

Flowering Plants: Most flowering plants reproduce sexually through the production of flowers. Pollen grains produced by the male reproductive organs (anthers) are transferred to the female reproductive organs (stigma) either by wind, insects, birds, or other animals.



Unisexual flower: - A flower that has either stamens (Androecium) or pistils (Gynoecium).

It is called a unisexual flower. E.g., cucumber, bottle gourd, bitter gourd, etc.

Bisexual flower: - A flower that has both stamens and pistils (androecium and gynoecium).

E.g. natural, hibiscus, mango, etc.

Complete flower: A flower that has four or more whorls—at least one each of sepals, petals, stamens, and pistils—is called a complete flower. E.g., datura, hibiscus, mango, etc.

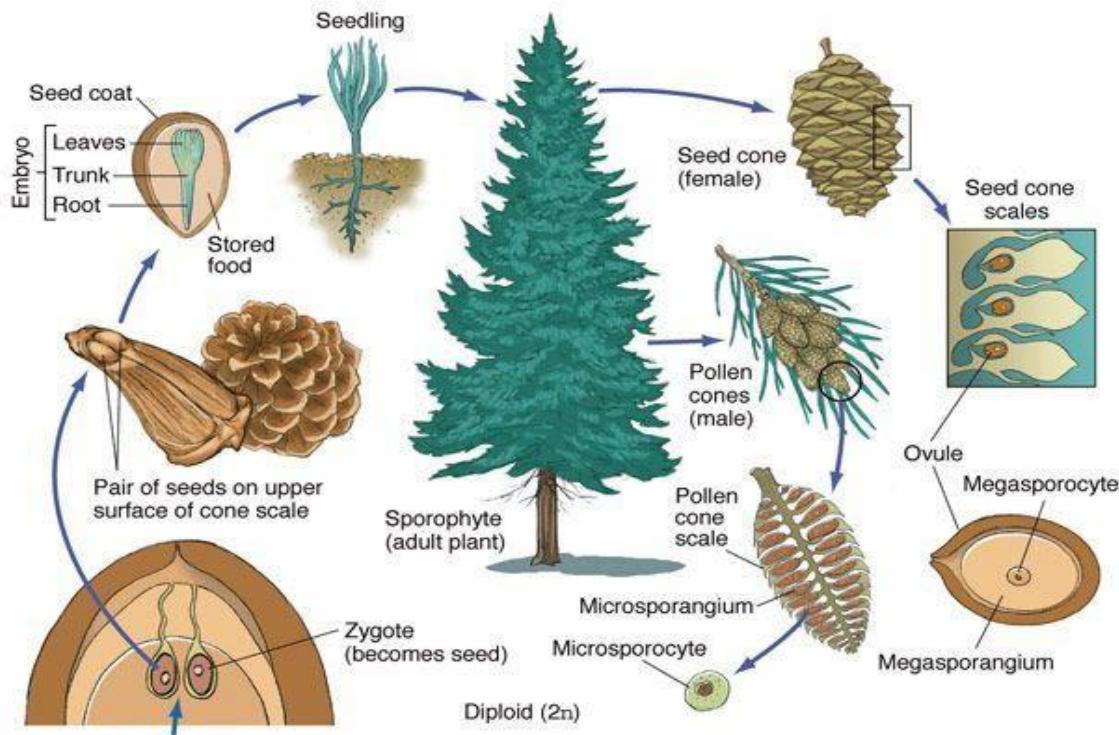
Incomplete flower: - A flower in which any of these four whorls is missing is an incomplete flower. E.g., cucumber, bottle gourd, papaya.

Self-pollination, or autogamy, is the process of transferring pollen from one flower to the stigma of another flower of the same plant.

Cross-pollination: The transfer of pollen grains from the anther of one flower to the stigma of another flower belonging to the same species is called cross-pollination, or allogamy.

Conifers: Conifers, such as pine trees, reproduce sexually through the production of cones.

Male cones produce pollen, which is carried by wind to female cones. Fertilization occurs within the female cones, leading to the formation of seeds.



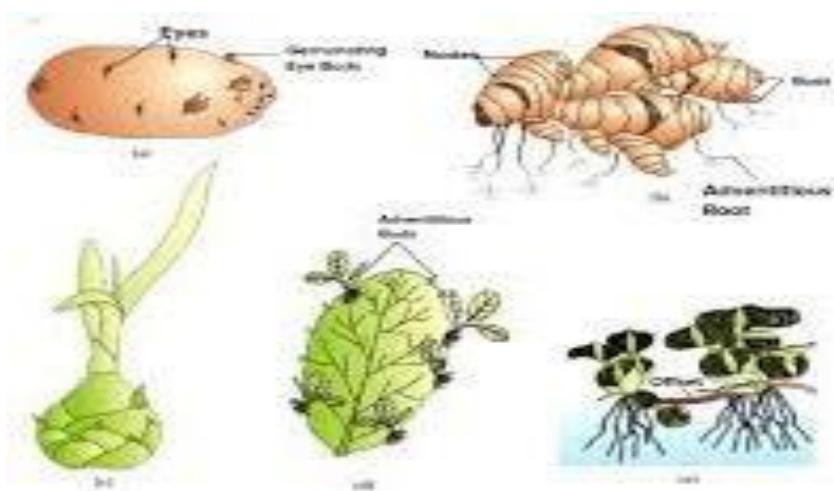
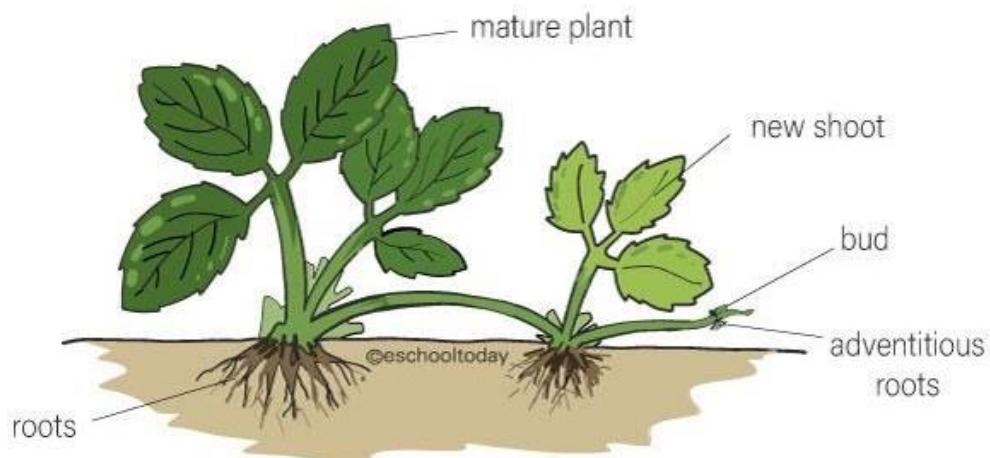
Asexual Reproduction

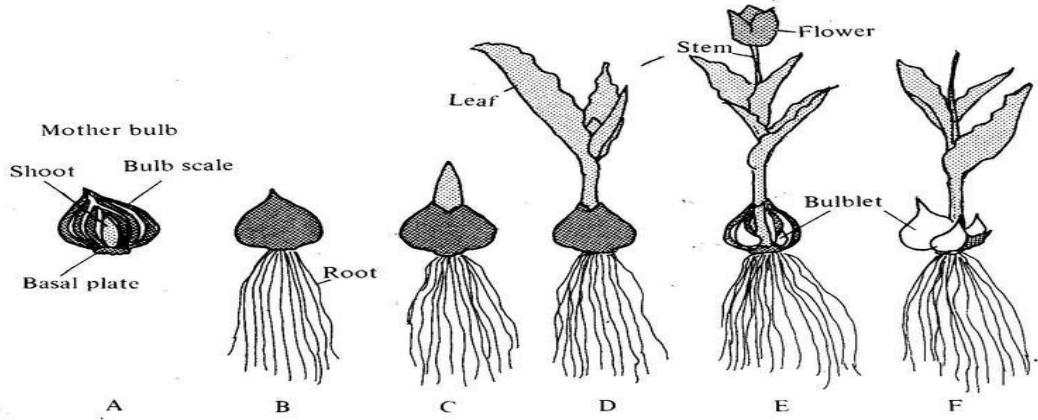
Runners: Some plants, like strawberries and spider plants, produce horizontal stems called runners that grow along the soil surface. These runners develop roots and new plantlets at their nodes, eventually forming new independent plants.

Bulbs: Bulb-forming plants, such as onions and tulips, reproduce asexually through the development of underground storage structures called bulbs. These bulbs produce new shoots and roots, leading to the formation of genetically identical offspring.

Rhizomes: Plants like ginger and bamboo reproduce asexually through underground stems called rhizomes. Rhizomes grow horizontally and produce new shoots and roots at various points, allowing the plant to spread and form colonies.

These examples showcase the diverse ways in which plants reproduce, utilizing both sexual and asexual strategies to ensure the survival and proliferation of species.

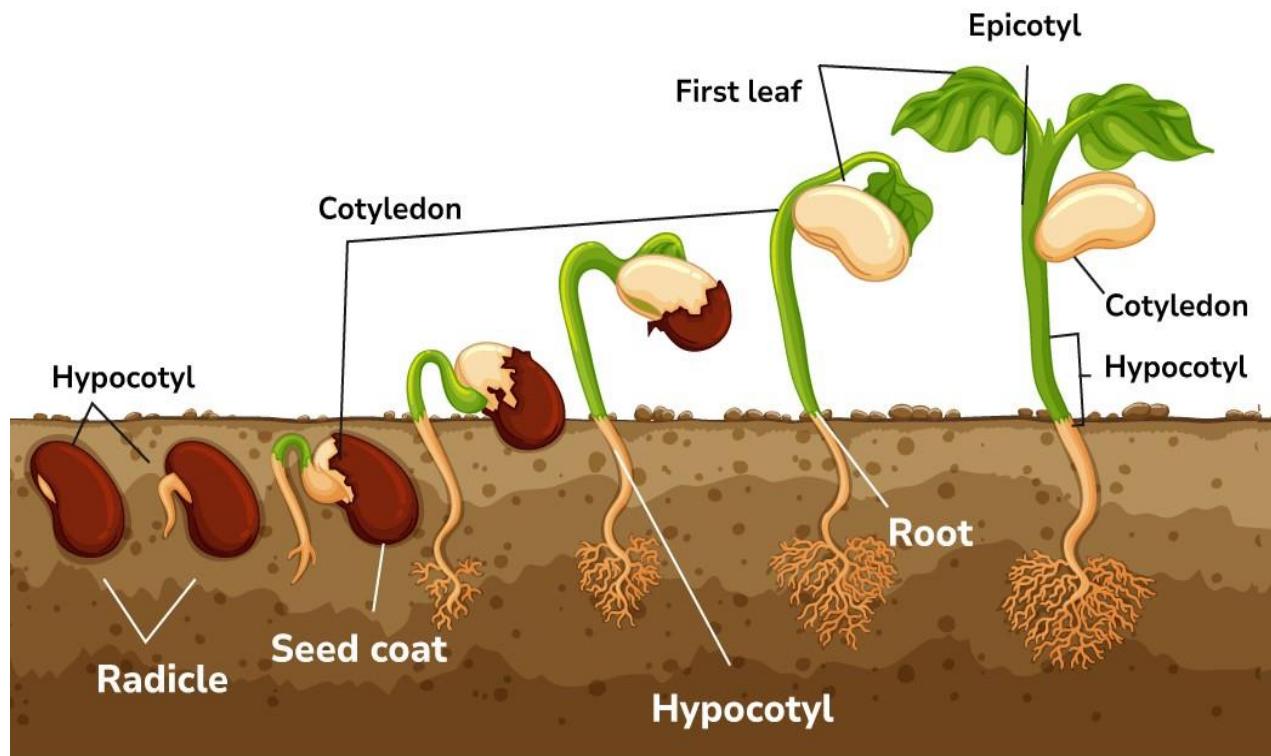




Germination:

When the seed is sown in moist soil, it begins to grow. The process by which a seed begins to grow is called **germination**. When a seed germinates, the seed coat splits tiny roots grow down, and a shoot grows upwards. This produces a seedling of the plant. The seedling grows further, and a new plant is formed. When the plant bears flowers, it again produces fruits and seeds. The seeds can germinate when sown in soil under suitable conditions to produce new plants.

Diagram of Seed Germination



SUMMARY:

- ✓ Reproduction is the process by which all living organisms produce organisms of their kind.
- ✓ Plants reproduce asexually and sexually.
- ✓ Fragmentation, budding, spore formation, and vegetative propagation are some of the asexual means of reproduction in plants.
- ✓ Natural vegetative propagation and artificial vegetative propagation are two types of vegetative propagation.
- ✓ Plants can be naturally propagated through leaves, stems, and roots.
- ✓ Artificial vegetative propagation includes cutting, grafting, and layering.
- ✓ A flower is the reproductive part of a plant. A bisexual flower has both the male and female reproductive parts, while a unisexual flower has either of the two reproductive parts.
- ✓ Pollination is the process of transferring pollen grains from the anther of one flower to the stigma of the same or another flower. There are also two types: self-pollination and cross-pollination.
- ✓ Wind, water, and insects are agents of pollination.
- ✓ The fusion of male and female gametes is known as fertilization. A fertilized egg is called a zygote, which further develops in the embryo.
- ✓ After fertilization, the ovary develops into fruit, and the ovules develop into seeds.
- ✓ The process by which a seed begins to grow and transforms into a seedling is called germination.

Answer the following questions:

1. Name one plant that can be reproduced through an underground stem.
2. What is pollination?
3. What are the 'stamen' and 'pistil' in a flower?
4. How does the bryophyllum plant reproduce?
5. What is meant by reproduction? Name any two types of methods of asexual reproduction in plants.
6. Explain the differences between self-pollination and cross-pollination.
7. What are the agents of pollination?
8. Draw the diagram of the flower and label the parts.

5. EXCRETION

Excretion is the process by which metabolic waste products and other harmful substances are removed from the body to maintain internal balance and prevent the build-up of toxins. In animals, excretion primarily involves the removal of waste products such as:

1. Nitrogenous Waste

Animals produce nitrogenous wastes, such as ammonia, urea, and uric acid, as by-products of protein metabolism. These wastes are toxic and must be removed from the body.

Different animals excrete nitrogenous wastes in various forms. For example, aquatic animals like fish excrete ammonia directly into the water, while mammals excrete urea in urine, and birds excrete uric acid as a semisolid paste.

2. Carbon Dioxide:

Carbon dioxide (CO_2) is produced as a by-product of cellular respiration, where glucose is broken down to release energy. Excess carbon dioxide must be removed from the body to maintain proper pH levels and prevent respiratory acidosis.

In animals, carbon dioxide is primarily eliminated through the respiratory system by exhaling it into the environment.

3. Other metabolic wastes:

Animals produce various other metabolic wastes, such as excess salts, water, and toxins that need to be eliminated to maintain homeostasis.

The urinary system, respiratory system, and integumentary system (skin) play essential roles in excreting these waste products from the body.

i) Urinary System: Many animals have a urinary system responsible for removing metabolic waste products, primarily nitrogenous wastes like urea and ammonia, from the body. In mammals, this system includes the kidneys, ureters, bladder, and urethra. The kidneys filter waste products from the bloodstream, producing urine, which is then excreted from the body.

ii) Respiratory System:- The respiratory system also plays a role in excretion by eliminating carbon dioxide, a waste product of cellular respiration, from the body through exhalation.

iii) Digestive System:- The digestive system removes undigested food and other waste products from the body through defecation.

These processes are vital for maintaining homeostasis and ensuring the proper functioning of the body's cells and systems.



Do plants also excrete like animals?

Do they also have excretory organs?

How do plants manage to get rid of waste products from their bodies?

Plants produce a variety of waste products during metabolism, but they do not have specific organs to excrete. Plants break down waste substances at a much slower rate than animals; therefore, the accumulation of waste is also much slower. They are also capable of managing and recycling waste.

Plants use completely different strategies for excretion than animals. Oxygen itself can be considered a waste product generated during photosynthesis in plants that exits through the stomata of leaves and lenticels of the stem.

Excretory products may be stored in leaves, bark, and fruits. When these dead leaves, bark, and ripe fruits fall off the tree, the waste products in them are disposed of. Waste may get stored in the fruits in the form of a solid body called 'Raphides'. Several toxic compounds are synthesized by the plants for protection against herbivores.

Most plant products that we think are waste may be beneficial to the plant in some way or another. Alkaloids, tannins, gums, etc. are products that are often protective for the plant's body.

Excretion:

Excretion is the removal of materials from a living being. Excretion is passive.

Humans excrete materials such as urine, carbon dioxide, sweat, and urea.

In plants, we find excretion through roots into their surroundings, including falling leaves, bark, and fruits.

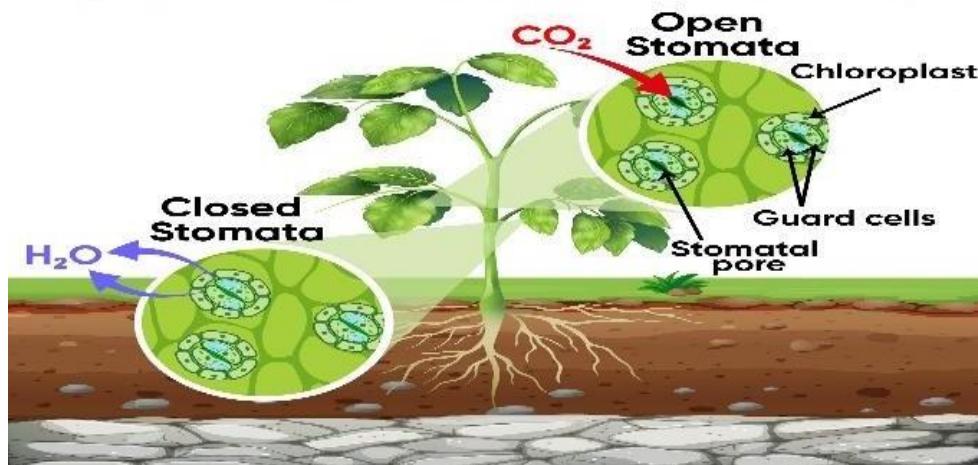
Secretion:

Secretion is the movement of material from one point to another point. It has an active nature.

Secretions include enzymes, hormones, and saliva.

Secretions occur in the plant body in the form of latex, resins, gums, etc.

OPEN AND CLOSED STOMATA



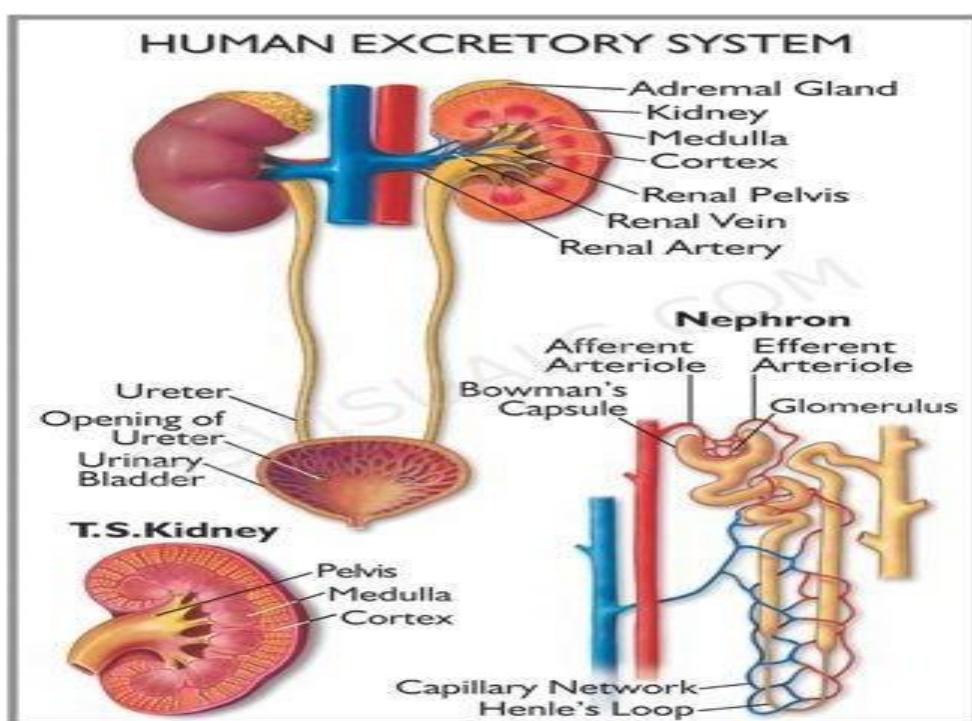
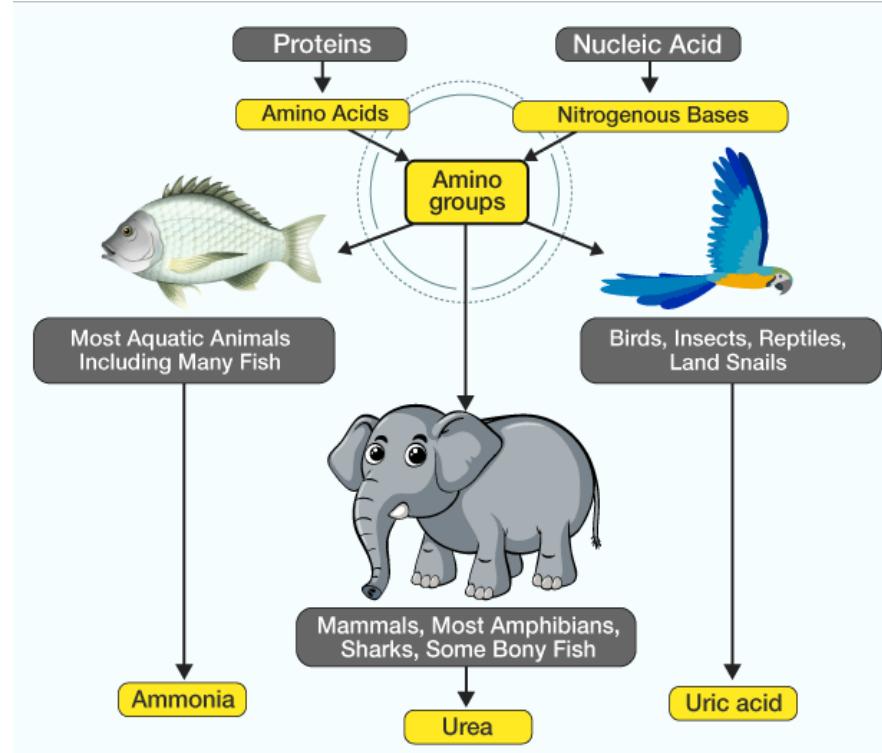
Tannins: These are organic compounds. These are stored in different parts of the plant and are dark brown. Tannins are used in leather, tanning and pharmaceuticals. E.g. Cassia, Acacia.

Resins: Resins mostly occur in gymnosperms in specialized passages called resin passages. Varnishes. E.g. Pinus

Gums: Plants like Neem, and Acacia ooze out a sticky substance called gum when branches are cut. The gums swell by absorbing water and help heal damaged parts of a plant. Gums are economically valuable and used as adhesives and binding agents in the preparation of medicines, food, etc.

Latex: Latex is a sticky, milky white substance secreted by plants. Latex is stored in latex cells or latex vessels. From the latex of Hevea brasiliensis (Rubber plant), rubber is prepared

Excretion in animals:



Excretion in humans

The excretory system is the system of an organism's body that performs the function of excretion, the bodily process of discharging waste.

Chemical waste like urea is excreted by the urinary system and skin. The excretory system in a human being consists of the following:

A pair of kidneys

A pair of ureters

The urinary bladder

Urethra

Kidneys: In human beings, there are a pair of bean-shaped, reddish-brown structures called kidneys.

They are present in the abdominal cavity attached to the dorsal body wall, one on either side of the spine. The position of the right kidney is lower than that of the left kidney. This is due to the presence of the liver above. The kidneys filter and clean the blood and form urine. Each kidney is convex on the outer side and concave on the inner side.

The inner side of each kidney has a raised structure called a fissure or hilus where the renal artery enters and a renal vein and ureter exit. The renal artery brings oxygenated blood filled with waste products (mainly urea) into the kidney. The renal vein carries blood with less waste and oxygenated blood out of the kidneys.

Ureters:

Each ureter arises from the hilus of the kidney. The ureters are muscular tubes. The movement of urine from the kidney to the urinary bladder is done in the ureters through peristalsis.

Urinary bladder:

It is a pear-shaped, distensible sac-like structure. It is situated in the pelvic region on the ventral side of the rectum in the abdomen. It stores urine brought by two ureters, and the capacity of the bladder is $300 = 800$ ml.

Urethra:

It is the tube that excretes urine from the bladder. The opening of the urinary bladder into the urethra is guarded by a ring of muscles helping in closing and opening it called a sphincter. It regulates the movement of urine. The urethra is 4 cm long in females and in males, it is about 20 cm long

Urine Composition

- Normal 95% water, 5% solutes
- Solute variations: diet, activity, metabolism, endocrine, body position
- Major organic solute is urea (protein, amino acid breakdown); makes up approximately one half of the dissolved solids
- Inorganic chloride, sodium, and potassium
- Urea and creatinine identify a fluid as urine
- May also contain cells, casts, crystals, mucus, and bacteria
 - Increases indicative of disease

SUMMARY

- ✓ During metabolism several harmful excretory products are formed and the
- ✓ The process of removing toxic waste from the body is called excretion.
- ✓ Plants do not have specific organs to excrete. Plants store waste products in their leaves, bark, roots, seeds, and fruits. When these ripen, they fall off the tree, and the waste products in them are removed.
- ✓ Plants produce two types of metabolites:
- ✓ Primary metabolites. Carbohydrates, proteins, and fats.
- ✓ Secondary metabolites. Alkaloids, tannins, resins, gums, and latex.
- ✓ The human excretory system comprises a pair of kidneys, a pair of ureters, a urinary bladder, and a urethra.
- ✓ Each kidney is composed of approximately one million nephrons, which are structural and functional units of the kidney.
- ✓ Kidneys remove nitrogenous waste from the body and maintain water balance, salt content, pH, and blood pressure in the human body.
- ✓ In addition to the kidneys, the lungs, skin, liver, and large intestine also remove waste from our body.
- ✓ During respiration, the lungs remove carbon dioxide and water.
- ✓ Skin consists of a large number of sweat glands richly supplied with blood capillaries from which they extract sweat and some metabolic waste.

1) Answer the following questions:

- 2) What is excretion?
- 3) What are the primary and secondary metabolites?
- 4) What secretion?
- 5) What is the composition of urine?
- 6) Draw a diagram of the human excretory system.
- 7) What are tannins?
- 8) Write the scientific name of the rubber plant.
- 9) Draw the diagram of the stomata.

6. CLASSIFICATION OF PLANTS ANIMALS

R.H. Whittaker gave the Five Kingdom classification for living organisms. He categorized living organisms based on multiple characteristics such as cellular structure, mode of nutrition, body organization, reproduction, phylogenetic relationship, etc. These five kingdoms were Monera, Protista, Fungi, Plantae, and Animalia.

Let's learn about the plant kingdom.

Plant Kingdom: Plantae

Kingdom Plantae includes all the plants. They are eukaryotic, multicellular, and autotrophic organisms. The plant cell contains a rigid cell wall. Plants have chloroplasts and chlorophyll pigment, which are required for photosynthesis.

Characteristics of Kingdom Plantae

The plant kingdom has the following characteristic features:

They are non-motile. They make their food and, hence, are called autotrophs. They reproduce asexually, either by vegetative propagation or sexually.

These are multicellular eukaryotes. The plant cell contains the outer cell wall and a large central vacuole.

Plants contain photosynthetic pigments called chlorophyll present in the plastids.

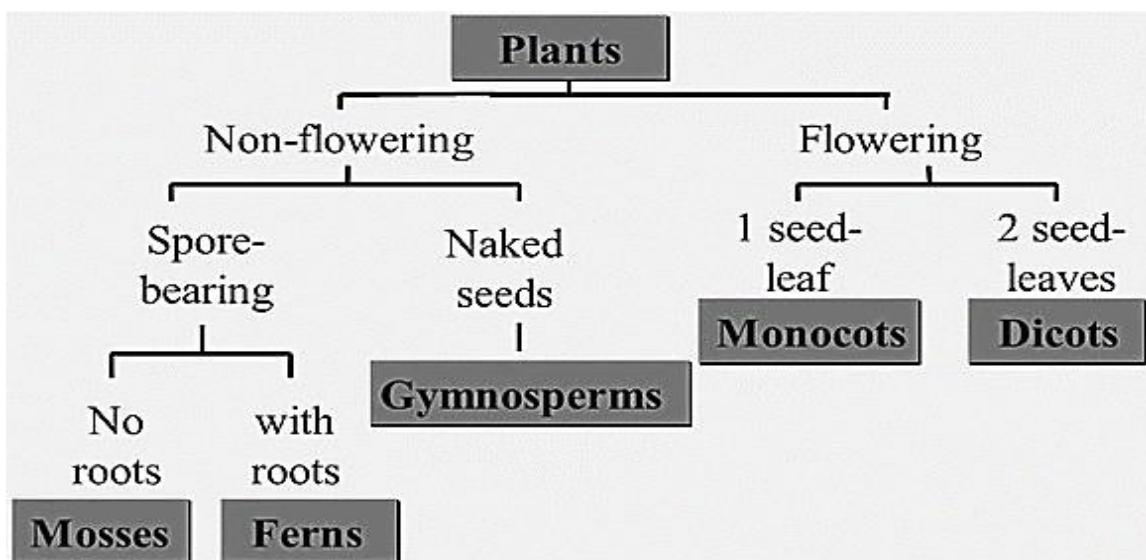
They have different organelles for anchorage, reproduction, support, and photosynthesis.

The plant kingdom is further classified into subgroups. Classification is based on the following Criteria.

Plant body: Presence or absence of a well-differentiated plant body. E.g., roots, stems, and leaves.

Vascular system: Presence or absence of a vascular system for the transportation of water and other substances. E.g., Phloem and Xylem.

Seed formation: The presence or absence of flowers and seeds, and whether the seeds are naked or enclosed in a fruit.



The plant kingdom has been classified into five subgroups according to the above-mentioned criteria:

1. Thallophyta
2. Bryophytes
3. Pteridophyta
4. Gymnosperms
5. Angiosperms

1. Thallophyta- A well-differentiated body structure, and the plant body is thallus-like. Includes plants with primitive and simple body structures. The plant body is the thallus; it may be filamentous, colonial, branched, or unbranched. Examples include green algae, red algae, and brown algae. Common examples are *Volvox*, *Fucus*, *Spirogyra*, *Chara*, *Polysiphonia*, *Ulothrix*, etc.

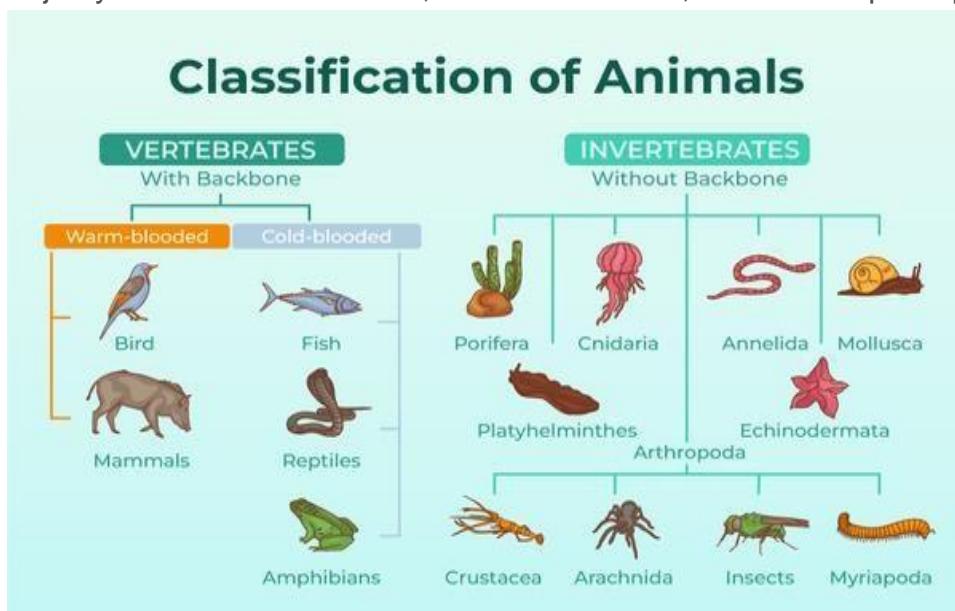
2. Bryophyta.

Bryophytes do not have vascular tissues. The plant body has root-like, stem-like, and leaf-like structures. Bryophytes are terrestrial plants but are known as “amphibians of the plant kingdom” as they require water for sexual reproduction. They are present in moist and shady places. Bryophytes include mosses, hornworts, and liverworts. Some of the common examples are *Marchantia*, *Funaria*, *Sphagnum*, *Antheoceros*, etc

3. Pteridophytes have a well-differentiated plant body into roots, stems, and leaves. They have a vascular system for the conduction of water and other substances. Some of the common examples are *Selaginella*, *Equisetum*, *Pteris*, etc.

4. Gymnosperms are cone-bearing plants that bear naked seeds. They fall under the kingdom Plantae and subkingdom Embryophyte. The gymnosperms category consists of both trees and shrubs. The largest group of gymnosperms is the conifers, which include cone-bearing trees such as pine, yew, cedars, redwood, and spruce.

5. Angiosperms Flowering plants are plants that bear flowers and fruits and form the clade Angiosperm, commonly called angiosperms. They include all forbs, grasses and grass-like plants, a vast majority of broad-leaved trees, shrubs and vines, and most aquatic plants



Animal Kingdom

Introduction

The organisms, which are eukaryotic, multicellular, and heterotrophic, are categorized as members of the members of the Animalia kingdom. The organisms of the Animalia kingdom have no cell wall.

Most of the animals in the Animalia kingdom are mobile. Classification of the Animalia Kingdom Based on the extent and type of body design differentiation, the Animalia kingdom is classified as:

1. Porifera
2. Coelenterata
3. Platyhelminthes
4. Nematoda
5. Annelida
6. Arthropoda
7. Mollusca
8. Echinodermata
9. Protochordate

Vertebrata- 1. Pisces 2. Amphibian 3. Reptilian 4. Aves 5. Mammalia

1. Porifera

The literal meaning of 'porifera' is the organism with holes.

The organisms of Porifera are non-motile and attached to some solid support.

Examples of this group are Sycon, Spongilla, Euplectelia, etc.

2. Coelenterata

Organisms of the Coelenterata group live in water.

The organisms in this group have cavities in their bodies.

Hydra and sea anemones are common examples of coelenterate.

3. Platyhelminthes

The organisms in this group do not have a true internal body cavity or coelom; therefore, they do not have well-developed organs. The bodies of organisms in this group are flattened from top to bottom; therefore, they are also known as flatworms. Planarian, liver fluke, tapeworm, etc. are typical examples of this group.

4. Nematoda

The organisms of the nematode have cylindrical bodies. The organisms have tissue but, such as no well-developed body (i.e., no real organ).

Filarial worms (causing elephantiasis disease), roundworms in the intestines, etc. are common examples of nematodes.

5. Annelida

The organisms of the Annelida group live almost everywhere, including in freshwater, marine water, and on land. Earthworms, nereis, and leeches are familiar examples of annelida.

6. Arthropoda

Probably, is the largest group of animals. In this group don't have well-defined blood vessels; rather, there is an open circulatory system. The literal meaning of arthropod is jointed legs; so, they have jointed legs. Prawns, butterflies, houseflies, spiders, scorpions, etc. are typical examples of arthropods.

7. Mollusca

The organisms of the Mollusca are invertebrates. Most of the organisms in the Mollusca group live in water. Snails and mussels are typical examples of Mollusca.

8. Echinodermata

The organisms of Echinodermata have spiny skins. Echinodermata are free-living marine organisms. Examples of Echinodermata are starfish, sea urchins, feather stars, etc.

9. Protochordate

The organisms in protochordata are normally marine. E.g., Balanoglossus, Herdmania, and Amphioxus. The organisms of protochordata show a typical feature of body design, called notochord; however, it is present there throughout life.

10. Vertebrata

The organisms of this kingdom have a true vertebral column and an internal skeleton structure. Vertebrates are further classified as

1. Amphibia
2. Reptilia
3. Aves
4. Mammalia

11. Pisces

The organisms in this group are typically different types of fish. Fish can live only in water. The skin of the fish is covered with scales or plates. Fish use oxygen dissolved in water by using gills. The tail of fish helps in their movements. Fish are cold-blooded organisms, and their hearts have only two chambers. Fish lay eggs.

12. Amphibia

The organisms of amphibians have mucus glands in the skin, and they have three-chambered hearts. Amphibians can live in water as well as on land. The organisms of amphibians respire through either gills or lungs. The organisms in amphibians lay eggs.

13. Reptilia

The organisms in this group are cold-blooded. The organisms of reptilian lay eggs with tough coverings.

14. Aves

The organisms of the Aves group are warm-blooded. The organisms in the Aves group lay eggs except for a few, such as bats. Most of the Aves have feathers.

15. Mammalia

The organisms in the Mammalia group are warm-blooded, and they have four-chambered hearts. Mammalia are typically characterized by their mammary glands. Mammary glands produce milk to nourish the young. Most mammals produce live babies; however, a few mammals, such as the platypus and the echidna, lay eggs. Mammals' skin has hairs along with sweat and oil glands.

SUMMARY

- ✓ Classification is the systematic study of organisms present in nature.
- ✓ In 1969, Whittaker classified all organisms into five kingdoms.
- ✓ They are 1. Monera 2. Protista 3. Fungi; 4. Plantae; 5. Animalia.
- ✓ The animals that are capable of interbreeding, perpetuating, or even individually reproducing come under the category of the category of species.
- ✓ Classification schemas keep changing as organisms keep evolving. It is tough to make one schema to fit all organisms as biodiversity diminishes or increases on Earth.
- ✓ Kingdom Plantae includes all the plants. They are eukaryotic, multicellular, and autotrophic organisms.
- ✓ The plant kingdom is also classified into two groups: Cryptogams are non-flowering and non-seed-bearing plants. E.g., Thallophyta, Bryophytes, and Pteridophyta Phanerogams are flowering and seed-bearing plants. E.g., gymnosperms, angiosperms
- ✓ Gymnosperms have a well-differentiated plant body and vascular tissues. They bear naked seeds, i.e., seeds are not enclosed within a fruit.
- ✓ Angiosperms are vascular plants that possess special characteristics such as flowers and fruits.
- ✓ Angiosperms are seed-bearing vascular plants with a well-differentiated plant body.

1. Answer the following questions:

2. What is the need for the classification of organisms?
3. Every organism in the world is important. Why?
4. How many types of animals are there in your surroundings?
5. How many types of plants are present in your surroundings?
6. What makes plants distinct from animals?
7. Who introduced 5 kingdoms at classification?
8. Write about the differences between cryptogams and phanerogams.

7. TRANSPORTATION

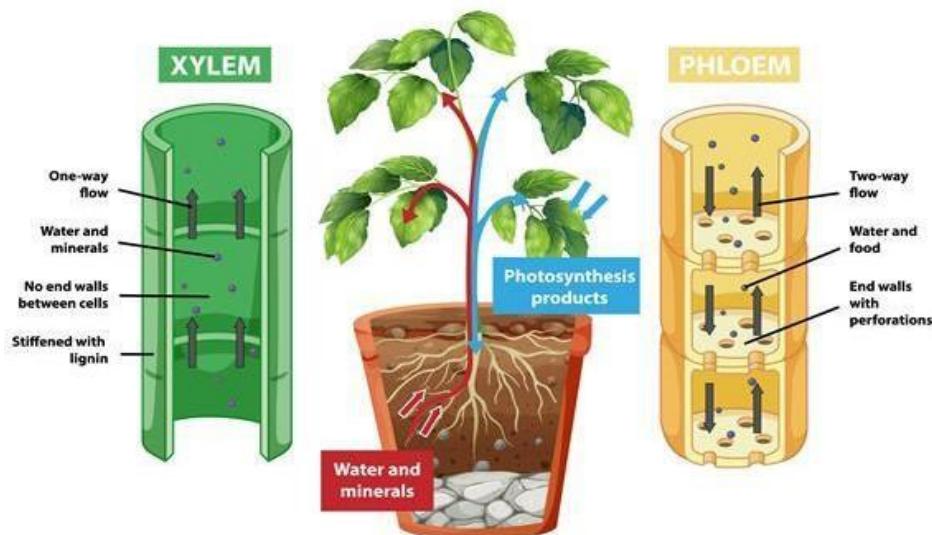
Transportation and excretion are essential processes in animals for maintaining internal balance, eliminating waste, and distributing essential nutrients and gases throughout the body.

Circulatory System: - Many animals have a circulatory system responsible for transporting nutrients, oxygen, hormones, and waste products throughout the body. In vertebrates, this system typically consists of a heart, blood vessels, and blood. The heart pumps blood, carrying oxygen and nutrients from the lungs and digestive system to cells while picking up carbon dioxide and waste products for excretion.

Respiratory System: Animals also have respiratory systems that facilitate the exchange of gases, primarily oxygen and carbon dioxide, between the body and the environment. In mammals, this often involves the lungs, where oxygen is absorbed into the bloodstream and carbon dioxide is released for exhalation.

Digestive System: The digestive system plays a role in transportation by absorbing nutrients from ingested food and transporting them to cells throughout the body. Nutrients are absorbed into the bloodstream through the walls of the intestines and transported to cells via the circulatory system.

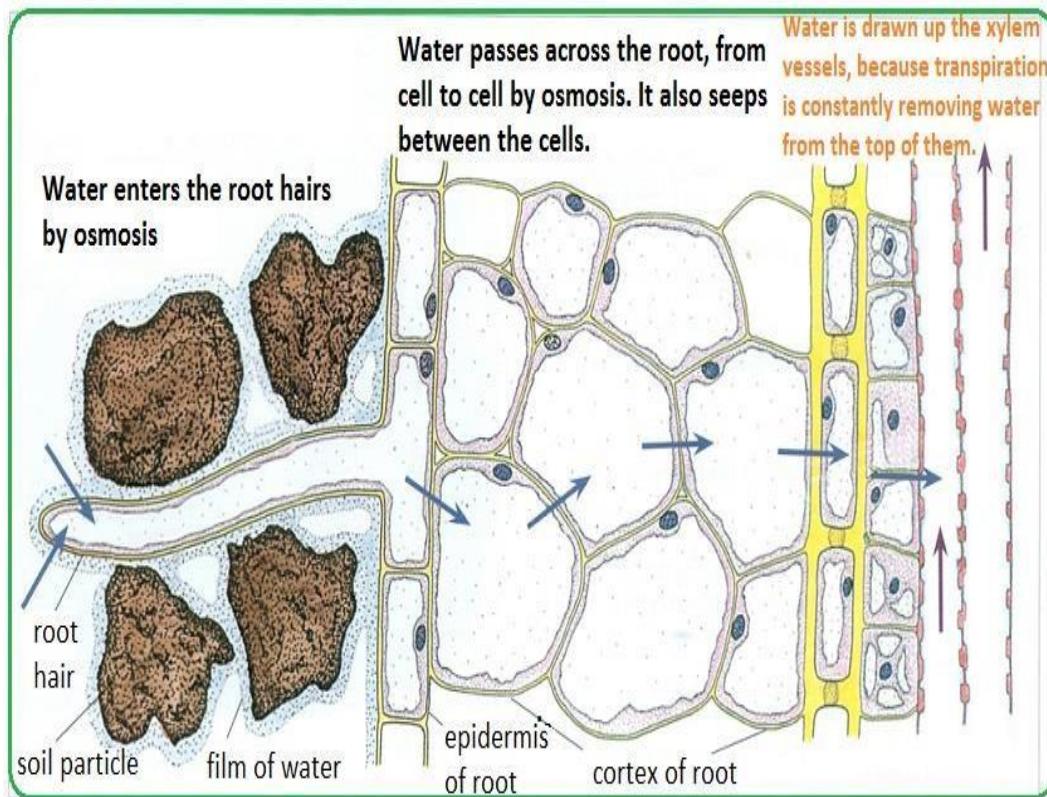
XYLEM AND PHLOEM



Differences between Xylem and Phloem

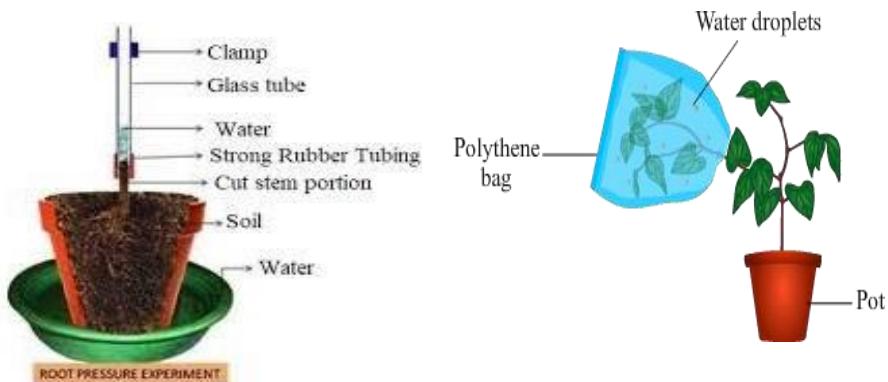
Xylem	Phloem
Consists of dead cells	Consists of living cells
-Transports water and mineral salts -Provide mechanical support to the plant	Transports sugar and amino acids
Transport is unidirectional	Transport – directional, upwards and downwards
Substances are transported by passive transport - osmosis, root pressure, capillary action, transpiration pull	Substances are transported by active transport, diffusion

Osmosis:



ROOT PRESSURE:

Root pressure can also be called osmotic pressure, which occurs within the cells of a root system. It causes the sap to rise through a plant stem to the leaves. It occurs in the xylem of some vascular plants.

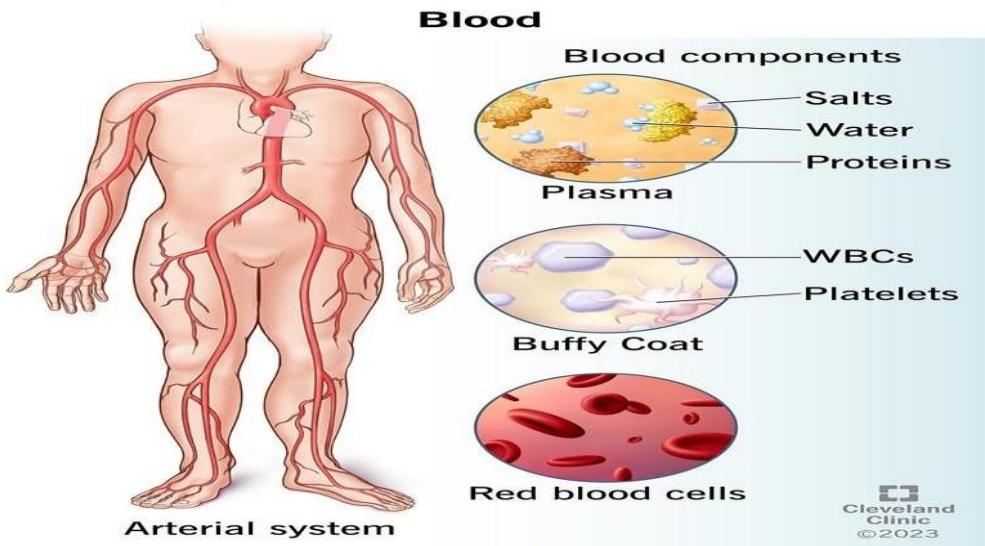


TRANSPERSION:

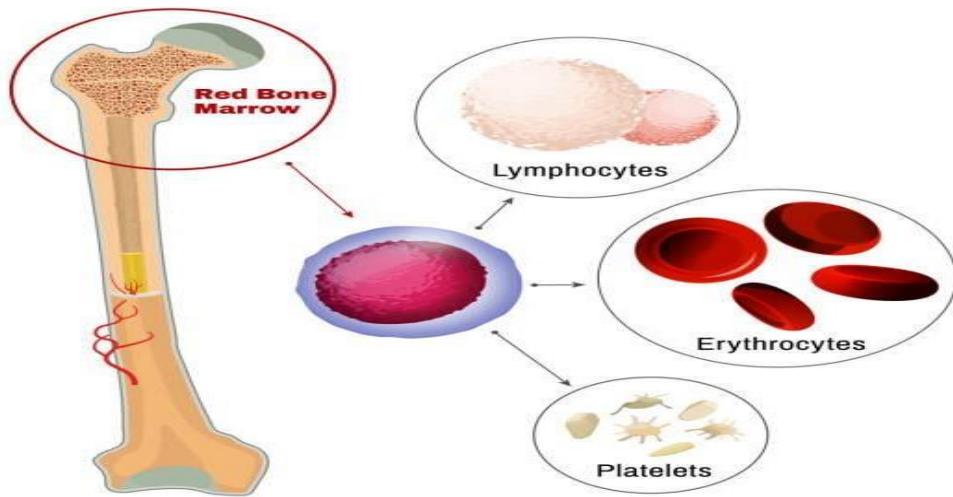
The evaporation of water through leaves is called transpiration. Water evaporates through the stomata of leaves and lenticels of Stem. The main driving force of water uptake and transportation in plants is the transpiration of water from leaves. The transpiration Creates negative water vapor pressure in the surrounding cells of the Leaf. Once this happens, water is pulled into the leaf from the vascular. The xylem is a continuous water column that extends from the leaf to the roots.

TRANSPORTATION IN ANIMALS:

BLOOD:



STEM CELLS HAEMATOPOIESIS



What happens when you get a cut on your body?

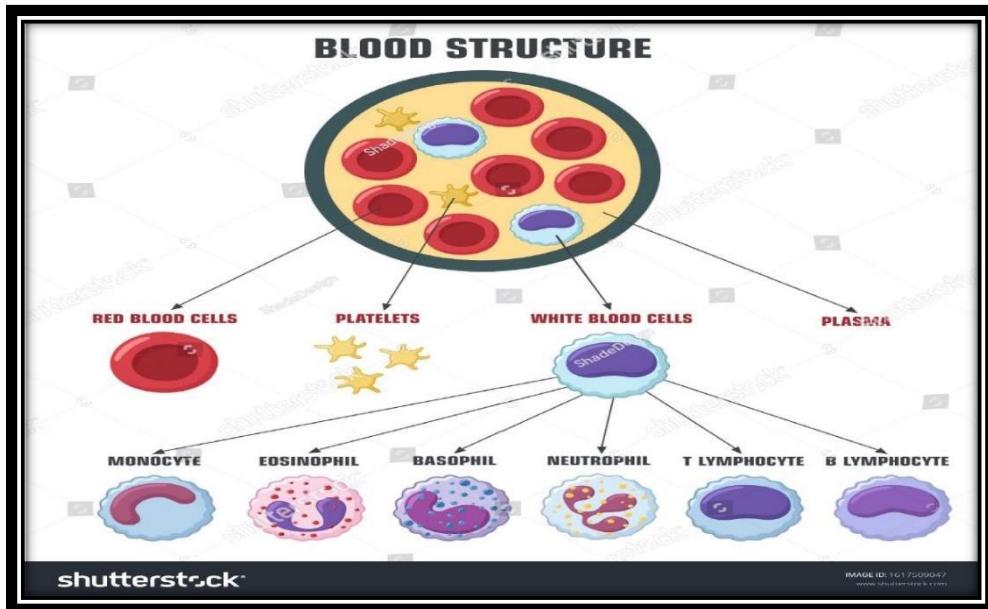
We see blood arising out of Blood is a liquid connective tissue. Normal adult human beings possess about 5 liters of blood in their bodies. Blood consists of two main components.

Liquid-state plasma:- 90 per cent of the plasma is water. Plasma contains 7 to 8 per cent proteins, 1 per cent salts, fats, glucose, vitamins, hormones, and many other substances.

Blood cells:- The blood cells that float in plasma are red blood cells, white blood cells, and platelets.

Why is blood red?

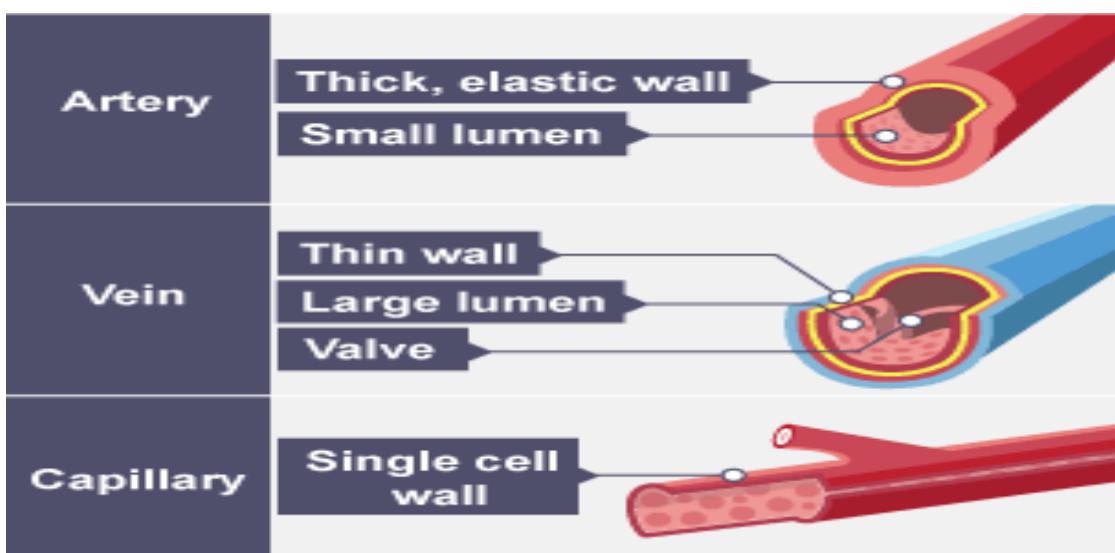
Red blood cells are biconcave and round, and the nucleus is absent. Due to the presence of hemoglobin, blood appears red. When oxygen binds to the iron molecule, hemoglobin is converted into ox hemoglobin and delivered to the cells of the body. Carbon dioxide in the cells enters the bloodstream. The average life span of red blood cells is 120 days.



White blood cells do not contain hemoglobin (pigment). Therefore, they are white.

They protect our bodies from many infections and diseases. We classify WBCs into 5 types.

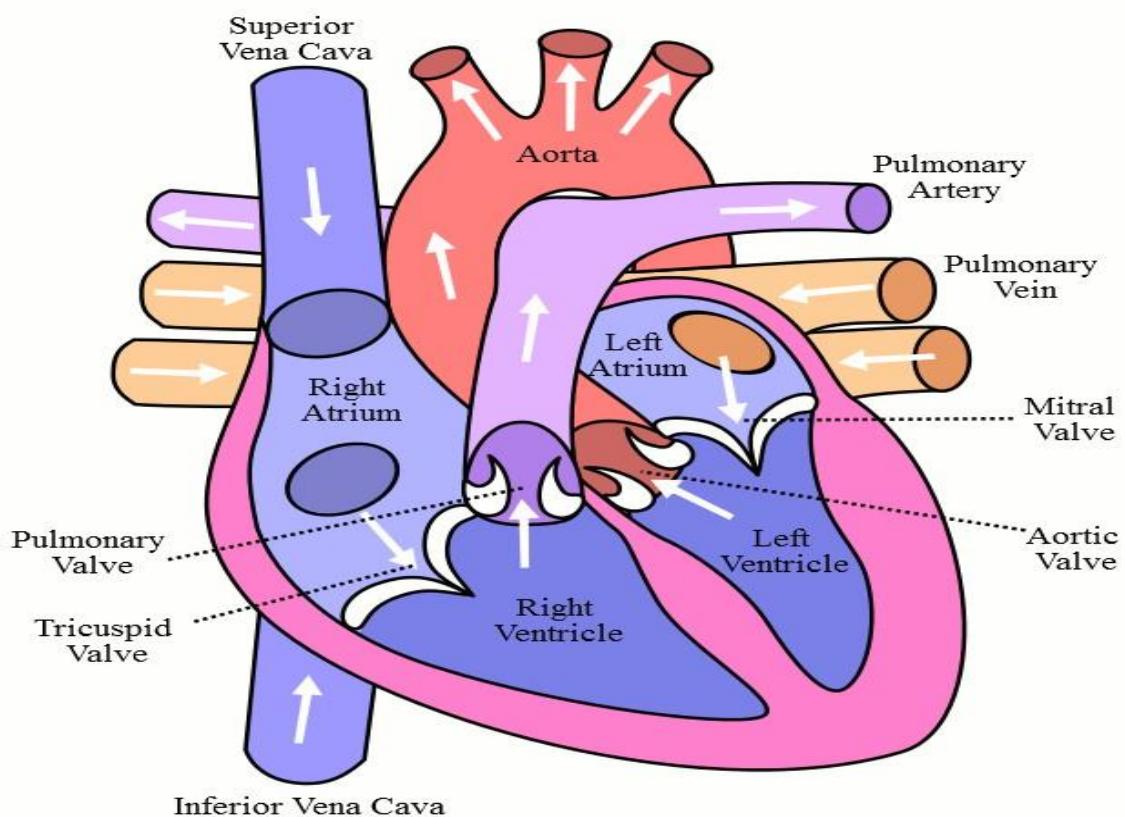
1. Eosinophil's
2. Basophils
3. Neutrophils
4. Lymphocytes
5. Monocytes.

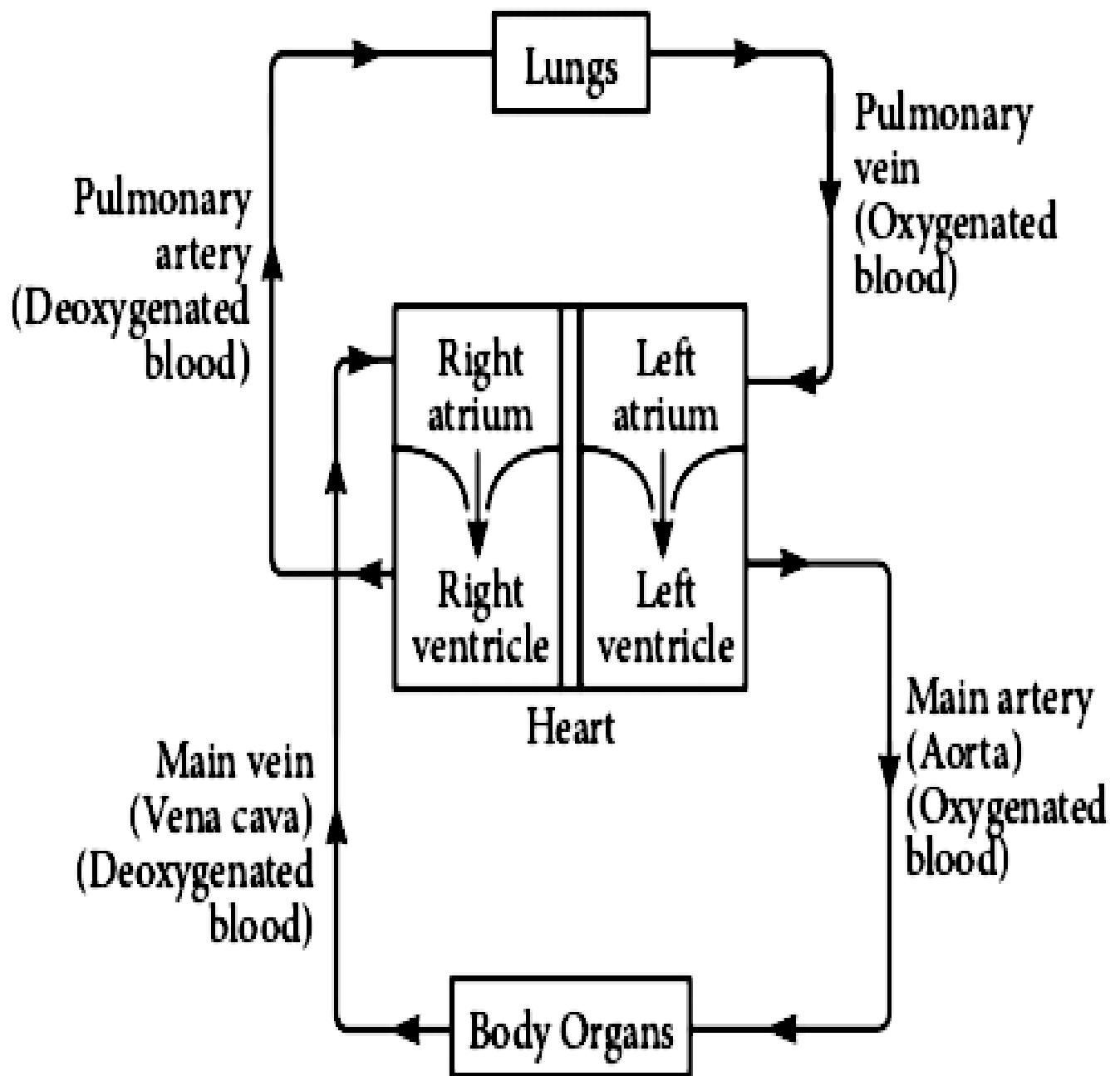


The blood transport system consists mainly of blood, blood vessels, and the heart. Blood vessels in our body were named and discovered nearly 400 years ago. A remarkable observation was made by a British physician named William Harvey. He observed that there were two major paths of blood flow.

1. Towards the heart
2. Away from the heart.

Structure of the heart and blood circulation:





Double circular blood transportation:

SUMMARY

- ✓ The human circulatory system comprises the heart, blood, and blood vessels.
- ✓ Blood flows through arteries and veins, and the heart acts as a pumping organ.
- ✓ Heart rate ranges between 70 and 80 times per minute in an adult human.
- ✓ Blood consists of RBC, WBC, platelets, and plasma. Blood appears red due to the presence of hemoglobin.
- ✓ Arteries carry blood from the heart to all parts of the body, and veins carry blood from all parts of the body back to the heart.
- ✓ The xylem and phloem are two types of vascular tissues found in plants.
- ✓ The roots absorb water, which moves up the stem through the xylem by the force developed in leaves by transpiration.
- ✓ The movement of sap (fluid containing water and dissolved nutrients) through the xylem is called the ascent of sap.
- ✓ Food is translocated from the leaves to other parts of the plant through phloem tissue.
- ✓ Osmosis, root pressure. Cohesion and adhesion forces and transpiration losses help the plants absorb water and minerals.
- ✓ The force of attraction between water molecules in xylem vessels is called the cohesive force.
- ✓ When water enters the xylem vessels, the attraction between the molecules in the xylem and the water holds the water and is called the cohesion force.
- ✓ Osmosis is the process of moving solvents through a semi-permeable membrane from a region of lower solute concentration to a region of a region of higher solute concentration.
- ✓ The active uptake of nutrient ions into the cell and xylem vessels of the plant will generate an osmotic flow of water in the plant.
- ✓ Root hair cells are adapted for taking up water and mineral ions by having a large surface area to increase the rate of absorption

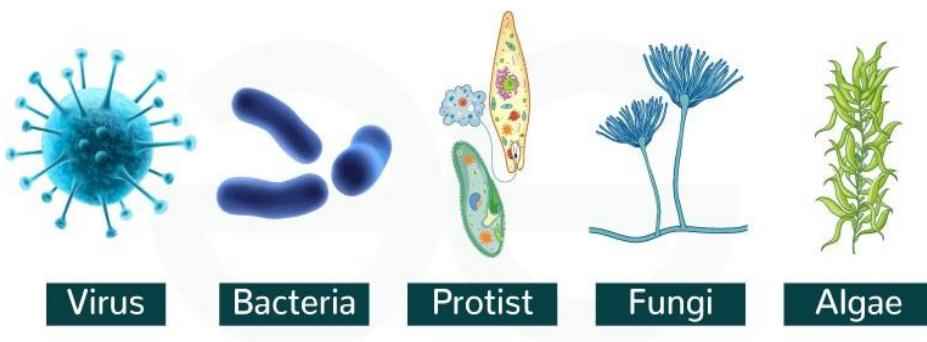
Answer the following questions:

1. Name the red pigment that carries oxygen in the blood.
2. Write the full form of RBC and WBC:
3. What is the function of stomata?
4. What is the function of blood in our body?
5. Define: a) Arteries; b) Veins; c) Capillaries
6. What are the components of blood?
7. Write down the differences between xylem and phloem.
8. What is root pressure?
9. Draw the diagram of the heart.
10. What is osmosis?

8. MICRO-ORGANISMS

If you observe a drop of water in a pond through a microscope, you will see a lot of tiny, rounded structures. These tiny creatures are known as microbes or microorganisms. They are all around us and are so small in size that they cannot be seen with bare human eyes. Microbes are classified into four groups.

1. Protozoa
2. Bacteria
3. Fungi
4. Algae



Microorganisms

Microorganisms are microscopic organisms that cannot be seen with the naked eye. These organisms are usually unicellular.

Bacteria

Bacteria are unicellular prokaryotic microorganisms. Some bacteria are useful for humans while some can be harmful. They are of four major types: Bacillus, Vibrio, Cocci and Spirilla.

Fungi

Fungi are saprophytic or parasitic organisms. They are mostly multicellular and not microscopic. However, yeast is a unicellular and microscopic organism.

Fermentation

Fermentation is a metabolic process that converts sugar to acids, gases or alcohol. Fermentation is used in the preparation of curd and alcohol.

Protozoa

Protozoa are single-celled microscopic animals which include flagellates, ciliates, protozoans and many other forms. A few examples of protozoa are amoeba, paramecium, euglena, plasmodium, etc.

Viruses

Viruses are organisms that possess nucleic acid but lack replicating machinery. Thus, a virus cannot survive without a living cell. Viruses are also considered to be on the borderline between living and non-living entities.

A few examples of viruses are influenza virus, HIV, rabies virus, poliovirus, tobacco mosaic virus, etc. Vaccines and antibiotics

Vaccines

A vaccine is a biological preparation that provides active, acquired immunity to a disease. Vaccines are usually made for viral diseases. A few examples of vaccines are the Salk vaccine for polio, the influenza vaccine, the rabies vaccine, etc.

Antibiotics

Antibiotics are inorganic or organic compounds that inhibit and kill microorganisms.

Antibiotics usually target bacteria. Thus, most bacterial diseases are treated with antibiotics.

Pathogens

A pathogen is any organism that causes disease. In this context, pathogens are Microorganisms. Bacteria, protozoa, and viruses can be pathogenic.

Carrier

A carrier is a person or organism infected with an infectious disease agent but who displays no symptoms of it. They can spread the infection since they already have the pathogen in their bodies.

Vector

A vector is an organism, which is a biting insect or tick that can transmit disease or parasite from one animal or plant to another. Common examples are mosquitoes. Aedes mosquitoes spread the dengue virus, and Anopheles mosquitoes spread the malarial parasite.

Airborne diseases

Certain diseases can spread by air. These diseases are called airborne diseases. Influenza is the best example of this type of disease.

Waterborne diseases

The diseases that spread through water are called waterborne diseases. Contaminated water is host to several pathogens. Typhoid is the best example of a waterborne disease.

Certain pathogens can cause diseases in plants. Just like humans, plants can be attacked by bacteria or viruses.

Several microorganisms cause diseases in plants like rice, potatoes, wheat, sugarcane, oranges, apples, and others



Food poisoning and preservation

1. Food poisoning

When food contaminated with pathogens or toxins is consumed, it causes food poisoning. The most common symptom is pain in the stomach. In severe cases, food poisoning can also cause death.

2. Food preservation

Food preservation is the most vital part of the food industry. Certain chemicals inhibit the growth of bacteria and increase the life of cooked food. Certain simple preservation methods can be carried out at home.

3. Chemical methods

Chemical preservatives are used in food preservation by major food industries because they are harmless to humans. Sodium meta-bisulphite and sodium benzoate are commonly used chemical preservatives. Uses of common salt: common salt, also known as sodium chloride, is used as a preservative at home. Vegetables are pickled with salt, as the salt removes water and kills bacteria and fungus cells.

4. Preservation by Sugar

Sugar is used for the preservation of jams, jellies, and squashes. The growth of microbes is restricted by the use of sugar, as it reduces the moisture content.

5. Preservation by oil and vinegar

Many food preparations, like pickles, are preserved by adding either oil or vinegar to them. Bacteria cannot grow in such a medium.

6. Pasteurization

Pasteurization is the process of superheating and cooling beverages to kill pathogenic microbes. Pasteurization ensures the taste of the beverage, such as milk, does not get destroyed.

SUMMARY

- ✓ Bacteria are single-celled living organisms with diverse shapes and structural features.
- ✓ They can live in almost every possible environment, including in or on the human body.
- ✓ Some of the bacterial diseases in humans include tuberculosis, gonorrhoea, cholera, tetanus, diphtheria, syphilis, and typhoid.
- ✓ One can kill harmful bacteria in food and water by properly cooking and boiling.
- ✓ Some of the bacterial diseases can be treated by taking antibiotics.
- ✓ As with bacteria, viruses are diverse and have a variety of shapes and features. These are much smaller than bacteria. Viruses replicate only when they have living resources in their vicinity.
- ✓ Some of the viral diseases in humans include dengue fever, chicken pox, measles, HIV/AIDS, and COVID-19 disease. Antibiotics do not work for viral infections.
- ✓ It is difficult to develop antiviral drugs because it is challenging to target the virus that is in the host cells without harming them.
- ✓ A non-infectious health condition that cannot be spread from one person to another is known as a non-communicable disease".
- ✓ The term "Vaccine" was coined by Louis Pasteur, a French scientist.
- ✓ Based on Jenner's experiment in 1881, Pasteur developed a vaccine for cattle and sheep against anthrax disease.

Answer the following questions:

1. What are the different types of microorganisms?
2. Which type of microorganisms are usually used in vaccines?
3. What are some of the main uses of microorganisms?
4. How do you identify plant diseases?
5. What are the causative organisms of plant diseases?
6. What are the signs and effects of plant diseases?
7. What are the other ways that you think disease may be prevented?
8. Name the disease that is spread through contaminated food and water.
9. Write the difference between communicable and non-communicable diseases, giving examples.

9. CELL, TISSUE-ORGANS

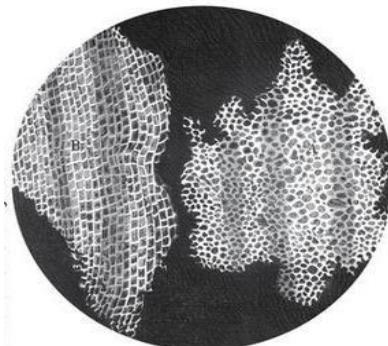


Cells, tissues, and organs are the hierarchical levels of organization in multicellular organisms, each playing distinct roles in maintaining the structure and function of the organisms. Cells are researched using a variety of methods, including cell culture, various types of microscopy, and cell fractionation. These have enabled, and are currently being utilized for, discoveries and studies into how cells work, ultimately leading to a better understanding of bigger creatures. Understanding the components of cells and how they function is crucial to all biological sciences

and is also required for biomedical research in sectors such as cancer and other disorders. Genetics, molecular genetics, biochemistry, molecular biology, medical microbiology, immunology, and cytochemistry are all linked to cell biology research. With the introduction of the compound microscope in the 17th century, cells were visible for the first time. After viewing a cell-like structure on a piece of cork in 1665, Robert Hooke used the term "cells" to describe the building blocks of all living organisms. However, the cells were dead and did not indicate the true overall components of a cell. Anton Van Leeuwenhoek was the first to examine live cells in his study of algae a few years later, in 1674. All of this came before the cell hypothesis, which argues that cells make up all living things and that cells are the functional and structural units of organisms.

In 1838, plant scientist Matthias Schneider and animal scientist Theodor Schwann observed live cells in plant and animal tissue, respectively, and came to this conclusion. Rudolf Virchow added to the cell hypothesis 19 years later, stating that all cells arise through the division of pre-existing cells. Despite its widespread acceptance, various investigations have cast doubt on the cell theory's veracity. Viruses, for example, lack membranes, cell organelles, and the ability to self-replicate, which are all common features of live cells. In 1665, Robert Hooke was the first to discover and name the cell. He noticed that it appeared oddly similar to cellula, or little apartments inhabited by monks, and so the name. However, what Hooke truly saw under the microscope were the dead cell walls of plant cells (cork). Micrographic published Hooke's description of these cells.

Drawing by Hooke



Cork tissue



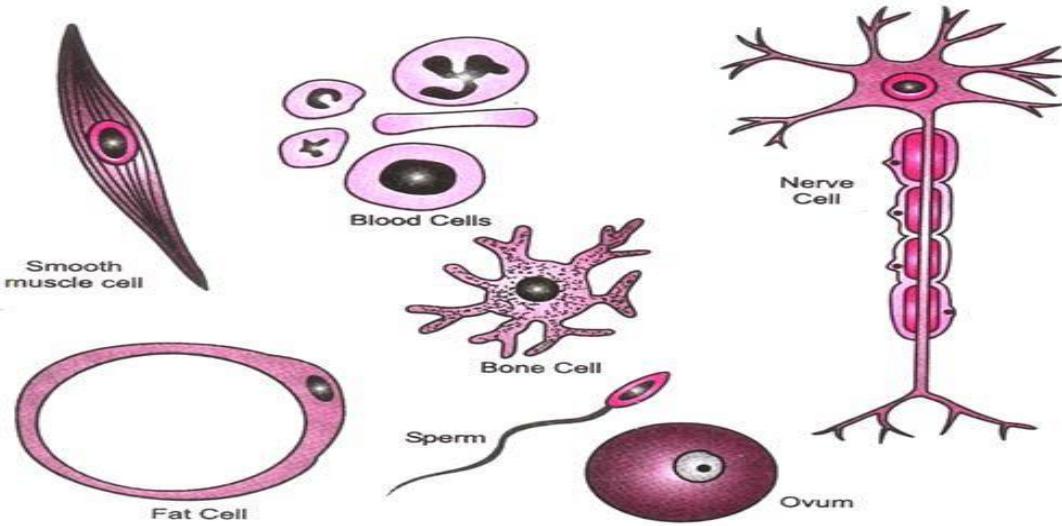


Figure : VARIOUS CELLS FROM THE HUMAN BODY

Cells:

Cells are the basic structural and functional units of life. They are the smallest independently functioning unit of an organism and perform various specialized functions. Cells can be grouped into different types based on their structure and function. Examples include muscle cells, nerve cells, epithelial cells, and blood cells. Cells contain organelles such as the nucleus, mitochondria, endoplasmic reticulum, and Golgi apparatus, which carry out specific functions within the cell.

Tissues:

Tissues are groups of similar cells that work together to perform a specific function. They are organized into various types based on their structure and function. There are four primary types of tissues in animals: epithelial tissue, connective tissue, muscle tissue, and nervous tissue. Epithelial tissue lines the surfaces of organs and forms protective barriers. Connective tissue provides support and structure for the body. Muscle tissue allows for movement and contraction. Nervous tissue transmits signals throughout the body.

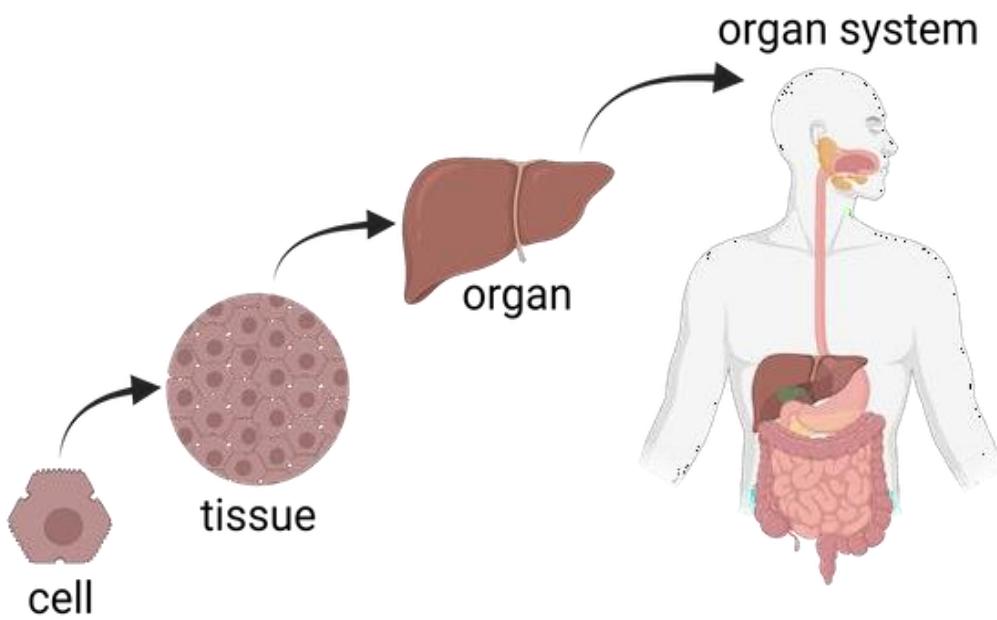
Organs:

Organs are structures composed of two or more types of tissues that work together to perform a specific function or set of functions.

Examples of organs in animals include the heart, lungs, liver, brain, and kidneys. Each organ has a specific role in maintaining homeostasis and carrying out essential physiological processes.

Organ system:

Organs are often organized into organ systems, which are groups of organs that work together to perform complex functions necessary for the survival of the organism. Examples include the respiratory system, digestive system, circulatory system, and nervous system. Together, cells, tissues, and organs form the hierarchical organization of multicellular organisms, with each level contributing to the overall structure, function, and survival of the organism.



Prokaryotic cell

Prokaryotes are organisms whose cells lack a nucleus and other organelles. Prokaryotes are divided into two distinct groups: the bacteria and the archaea, which scientists believe have unique evolutionary lineages.

Most prokaryotes are small, single-celled organisms that have a relatively simple structure. Prokaryotic cells are surrounded by a plasma membrane, but they have no internal membrane-bound organelles within their cytoplasm. The absence of a nucleus and other membrane-bound organelles differentiates prokaryotes from another class of organisms called eukaryotes. Most prokaryotes carry a small amount of genetic material in the form of a single molecule, or chromosome, of circular DNA. The DNA in prokaryotes is contained in a central area of the cell called the nucleoid, which is not surrounded by a nuclear membrane. Many prokaryotes also carry small, circular DNA molecules called plasmids, which are distinct from the chromosomal DNA and can provide genetic advantages in specific environments.

No Nucleus:

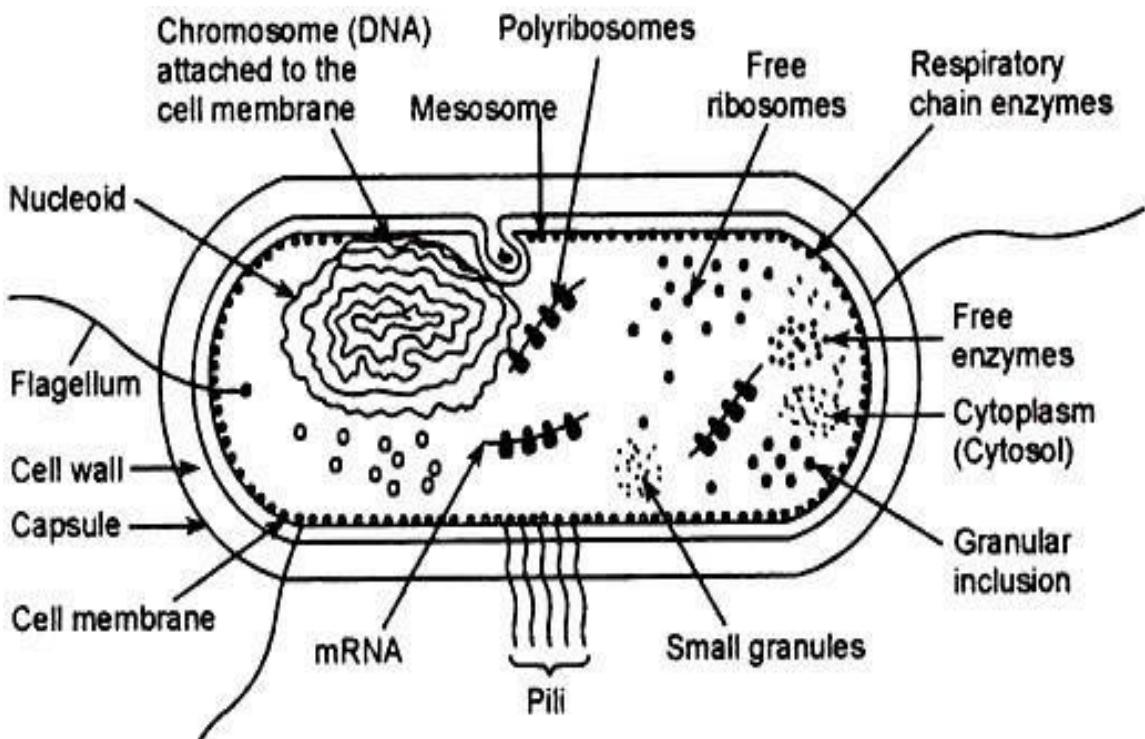
Prokaryotic cells lack a membrane-bound nucleus. Instead, their genetic material is typically found in a region of the cell called the nucleoid, which is not enclosed by a membrane.

Small Size:

Prokaryotic cells are generally smaller in size compared to eukaryotic cells. They typically range from 0.1 to 5.0 micrometres in diameter.

Simple Structure:

Prokaryotic cells have a simpler internal structure compared to eukaryotic cells.



Eukaryotic cell:

Eukaryotic cells are a type of cell that contain membrane-bound organelles, including a nucleus, where the genetic material is enclosed. These cells are found in organisms belonging to the domain Eukaryote, which includes protists, fungi, plants, and animals. Here are some key features of eukaryotic cells.

1. Nucleus

Eukaryotic cells have a well-defined nucleus that houses the cell's genetic material (DNA). The nucleus is surrounded by a double membrane called the nuclear envelope, which contains pores for the exchange of molecules between the nucleus and the cytoplasm.

2. Membrane-Bound Organelles:

Eukaryotic cells contain various membrane-bound organelles, each with specific functions. Examples include the endoplasmic reticulum, Golgi apparatus, mitochondria, chloroplasts (in plants), lysosomes, and peroxisomes.

3. Complex Structure: Eukaryotic cells are typically larger and more structurally complex than prokaryotic cells. They have internal compartments and structures that allow specialized functions and cellular processes.

4. Cytoskeleton: Eukaryotic cells have a network of protein filaments known as the cytoskeleton, which provides structural support, facilitates cell movement, and helps transport materials within the cell.

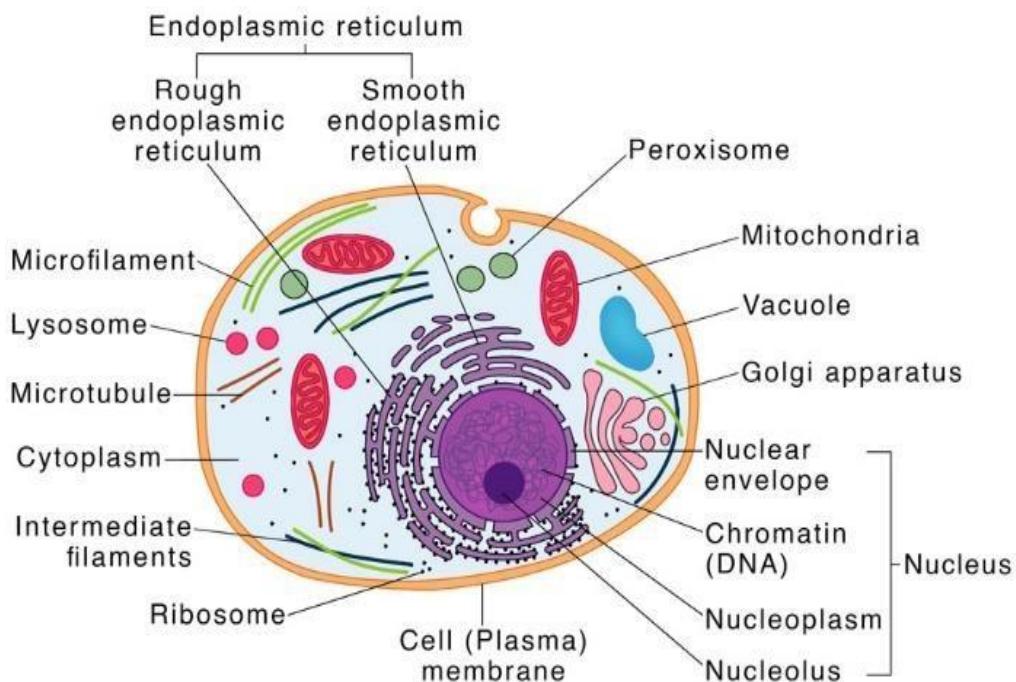
5. Mitochondria: Eukaryotic cells contain mitochondria, which are organelles responsible for energy production through cellular respiration. Mitochondria have their DNA and replicate independently of the cell.

6. Endosymbiotic Theory:

Mitochondria and chloroplasts are believed to have originated from prokaryotic cells through a process called endosymbiosis. According to this theory, these organelles were once free-living bacteria that were engulfed by ancestral eukaryotic cells and formed a symbiotic relationship.

Eukaryotic cells are incredibly diverse and have adapted to various environments and lifestyles. They are the building blocks of complex multicellular organisms and are essential for life as we know it.

Eukaryotic Cell



Plant cells and animal cells

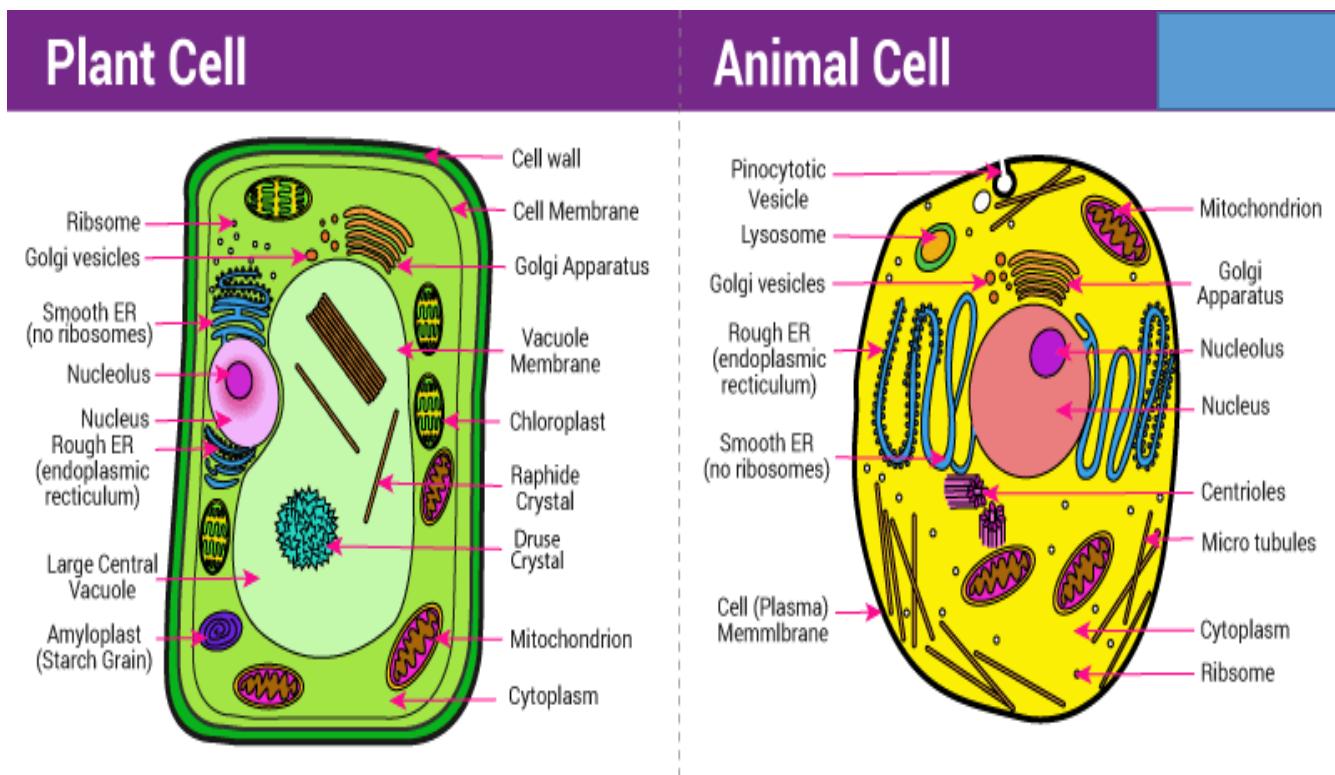
Plant cells and animal cells are both types of eukaryotic cells with many similarities, but they also have some distinct differences. Here's a comparison:

Plant Cell:

- 1. Cell Wall:** Plant cells have a rigid cell wall made of cellulose outside the cell membrane. This provides structural support and protection.
- 2. Chloroplasts:** Plant cells contain chloroplasts, organelles responsible for photosynthesis, which convert light energy into chemical energy (glucose).
- 3. Large Central Vacuole:** Plant cells typically have a large central vacuole that stores water, nutrients, and waste products. It helps maintain cell turgidity and regulates cell volume.
- 4. Plastids:** Besides chloroplasts, plant cells may contain other types of plastids, such as chloroplasts (for pigment storage) and amyloplasts (for starch storage).
- 5. No Centrioles:** Plant cells usually lack centrioles, which are involved in cell division in animal cells.

Animal Cell:

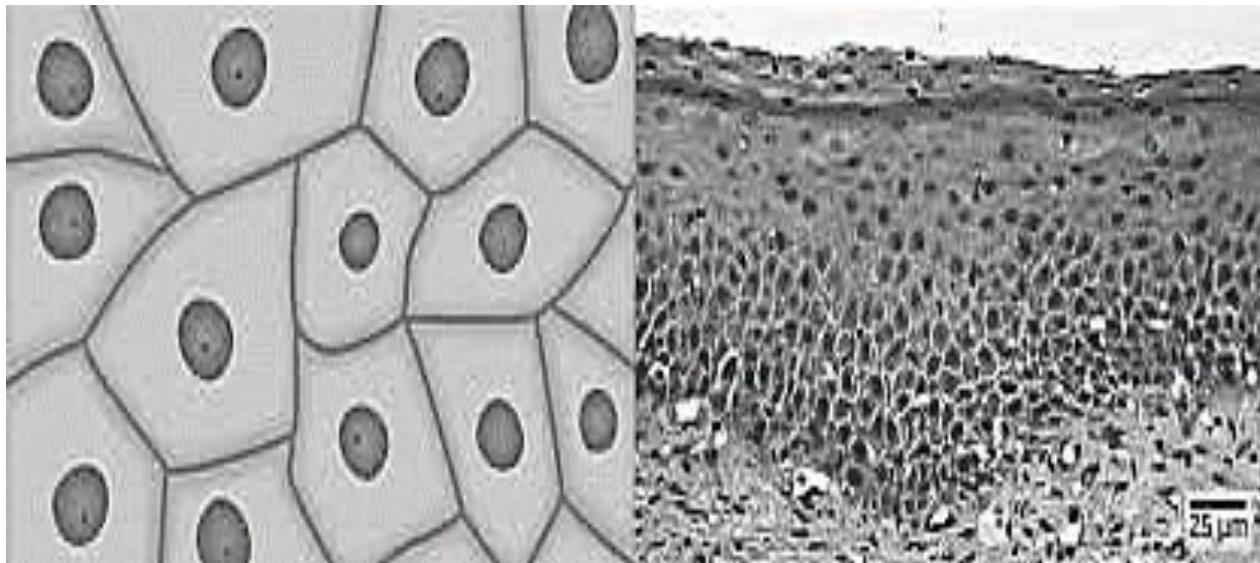
- 1. No Cell Wall:** Animal cells do not have a cell wall. Instead, they are surrounded by a flexible cell membrane.
- 2. No chloroplasts:** Animal cells do not contain chloroplasts or other organelles involved in photosynthesis.
- 3. Small Vacuoles:** Animal cells may have small vacuoles, but they are not as prominent as those in plant cells.
- 4. Centrioles:** Animal cells contain centrioles, which are involved in organizing microtubules during cell division (mitosis).
- 5. Lysosomes:** Animal cells typically contain lysosomes, organelles that contain digestive enzymes and break down waste materials and cellular debris.
- 6. Shape:** Animal cells often have a more varied shape, depending on their function and location in the body.



Cells are the basic structural and functional units of life, and they come in various types, each specialized for specific functions. Here are some of the different types of cells found in multicellular organisms

1. Epithelial Cells:

Epithelial cells form protective barriers on the surfaces of organs and tissues. They line the skin, respiratory tract, gastrointestinal tract, and blood vessels. Different types of epithelial cells include squamous (flat), cuboidal (cube-shaped), and columnar (elongated) epithelial cells, each adapted to their respective functions.

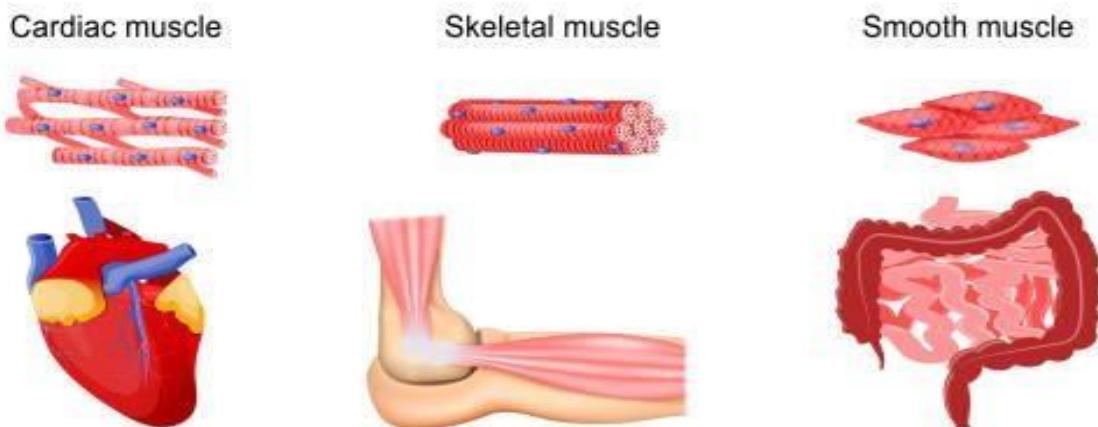


2. Muscle Cells:

Muscle cells, also known as myocytes, are specialized for contraction, and movement. There are three main types of muscle cells:

- A. **Skeletal muscle cells**: responsible for voluntary movements of the body.
- B. **Cardiac muscle cells** are found in the heart and are responsible for pumping blood.
- C. **Smooth muscle cells** are found in the walls of organs and blood vessels, controlling involuntary movements like peristalsis and vasoconstriction.

MUSCLE TISSUE



3. Nerve cells (neurons):

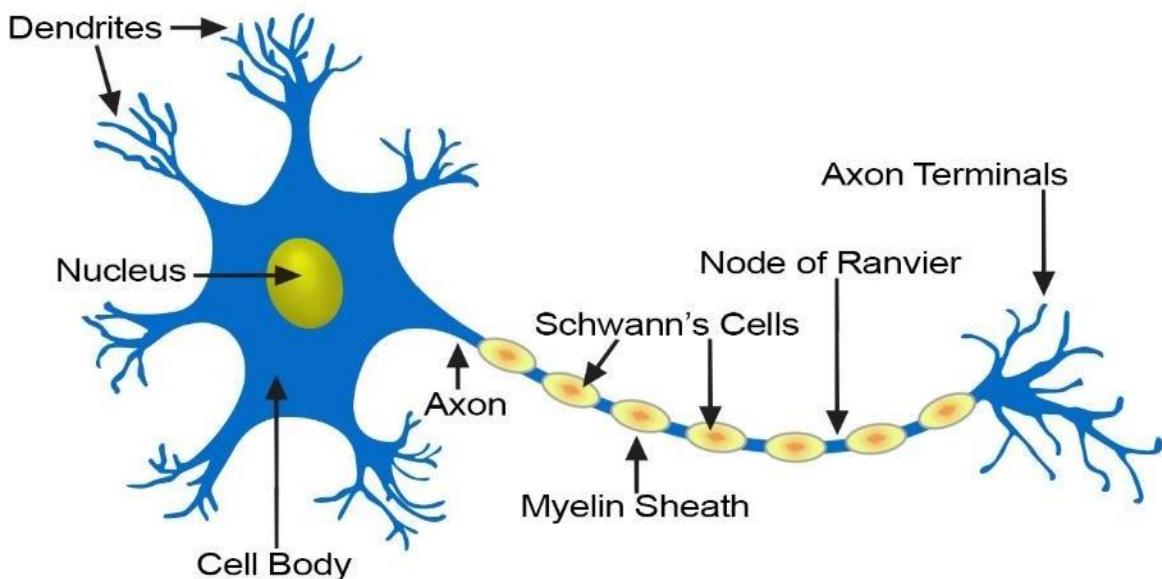
Neurons are specialized cells that transmit electrical impulses and carry information throughout the nervous system. They consist of three main parts:

A. Dendrites: Receive signals from other neurons or sensory receptors.

B. Cell body (soma): contains the nucleus and other organelles.

C. Axon: transmits signals away from the cell body to other neurons, muscles, or glands.

Structure of a Typical Neuron



Blood Cells:

Blood cells are responsible for transporting oxygen, nutrients, hormones, and waste products throughout the body. The main types of blood cells include:

Red blood cells (erythrocytes) carry oxygen from the lungs to tissues and remove carbon dioxide.

White blood cells (leukocytes): play a role in the immune response, defending the body against pathogens and foreign invaders.

Platelets (thrombocytes): assist in blood clotting and wound healing.

Adipocytes (fat cells):

Adipocytes store energy in the form of fat and regulate energy balance in the body. They also provide insulation and cushioning for the organs.

These are just a few examples of the many types of cells found in multicellular organisms, each with unique structures and functions essential for the organism's survival and proper functioning.

Different types of organ systems

There are several organ systems in the human body, each composed of multiple organs working together to perform specific functions necessary for the survival and well-being of the organism. Here are some of the main organ systems.

Nervous System:

Composed of the brain, spinal cord, and nerves. Responsible for transmitting signals and coordinating the body's responses to stimuli, including sensory perception, motor control, and cognition.

Digestive System:

Composed of the mouth, esophagus, stomach, intestines, liver, gallbladder, and pancreas.

Responsible for ingesting, breaking down, and absorbing nutrients from food, as well as eliminating waste.

Respiratory System:

Composed of the nose, trachea, bronchi, and lungs.

Circulatory System:

Composed of the heart, blood vessels (arteries, veins, and capillaries), and blood.

Responsible for circulating oxygen, nutrients, hormones, and waste products throughout the body and regulating body temperature.

Musculoskeletal System:

Composed of bones, muscles, ligaments, and tendons.

Responsible for providing structural support, facilitating movement, and protecting internal organs.

Urinary System:

Composed of the kidneys, ureters, bladder, and urethra.

Responsible for filtering waste products from the blood, regulating fluid balance, and maintaining electrolyte concentrations.

Reproductive System:

Composed of organs involved in reproduction, such as the ovaries, testes, uterus, and accessory glands.

Responsible for producing gametes (sperm and eggs), facilitating fertilization, and supporting the development and birth of offspring.

These organ systems work together to maintain homeostasis, support growth and development, and ensure the overall health and functioning of the human body.

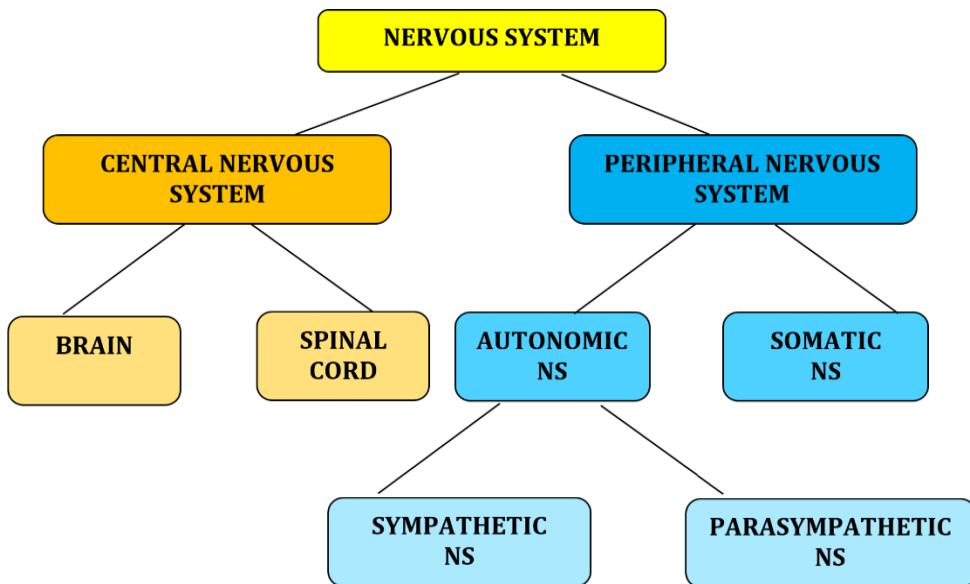
SUMMARY

- ✓ All living beings are made of cells. Cells are the structural and functional units of living beings.
- ✓ All cells share common components: the plasma membrane, cytoplasm, and genetic material.
- ✓ Basically, cells are divided into two types based on the membrane around the nucleus. Prokaryotic cells do not have a nuclear membrane around the nucleus. Eukaryotic cells have a prominent nucleus.
- ✓ Plant cells have plastids, a cell wall, and large vacuoles, whereas animal cells do not have them. Animal cells have centrioles and small-sized vacuoles; these are absent in plant cells.
- ✓ All organisms are made up of one or more cells; all the life functions of an organism occur within cells; all cells come from pre-existing cells. These are the main principles of cell theory.
- ✓ Plants have different kinds of tissues, i.e., meristematic, dermal, ground, and vascular tissues.

Answer the following questions

1. Write down the organelles present in a cell.
2. Write about the differences between prokaryotic and eukaryotic cells.
3. Why do cells show diversity?
4. Draw the diagrams of plant and animal cells and explain the differences between them.
5. Name the fluid connective tissue...
6. Organelles digest waste material present in cells.
7. Example of a prokaryotic living being.
8. What is a cell?
9. What is tissue?
10. Who discovered cells?

10. CONTROL AND COORDINATION



Nervous system:

Nervous system: the nervous system includes the brain, spinal cord, sense organs, and nerves. The sense organs receive the stimulus, and this stimulus, with the help of sensory nerves, reaches the brain and spinal cord. This information will be sent to different organs by motor nerves for action.

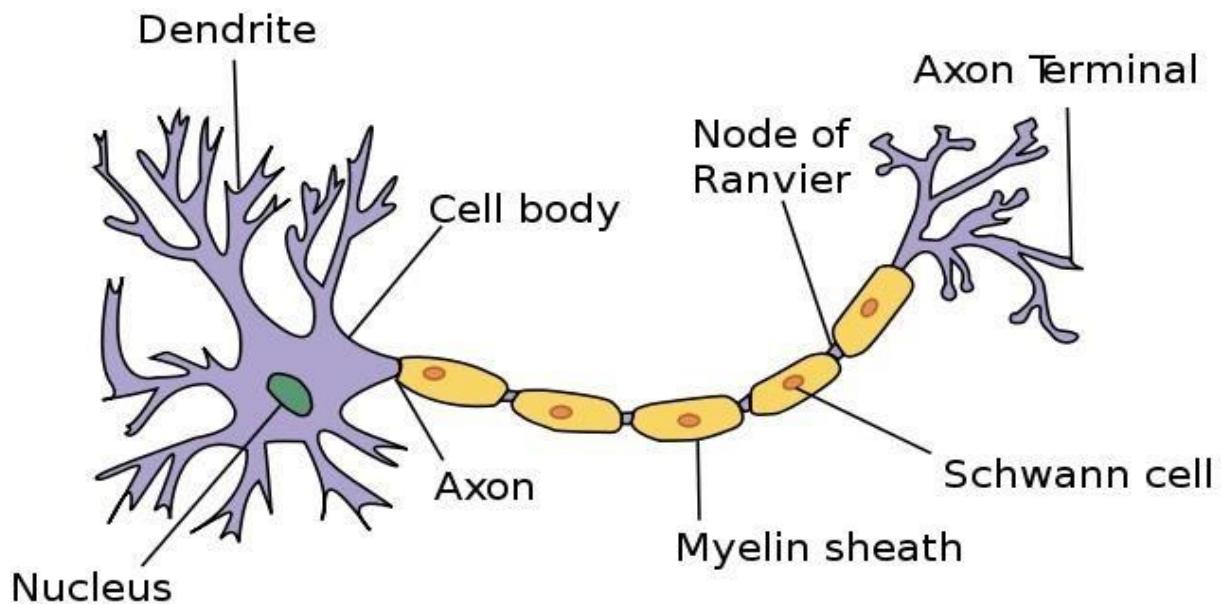
To know the function of nerve cells, let us observe the structure of nerve cells. Every nerve cell consists of 3 parts

1. Cyton
2. Dendrites
3. Axon (cell body).

The cell body contains a well-defined nucleus, surrounded by cytoplasm. It has cell organelles like any other cell. The cell body further transmits the impulse to the axon.

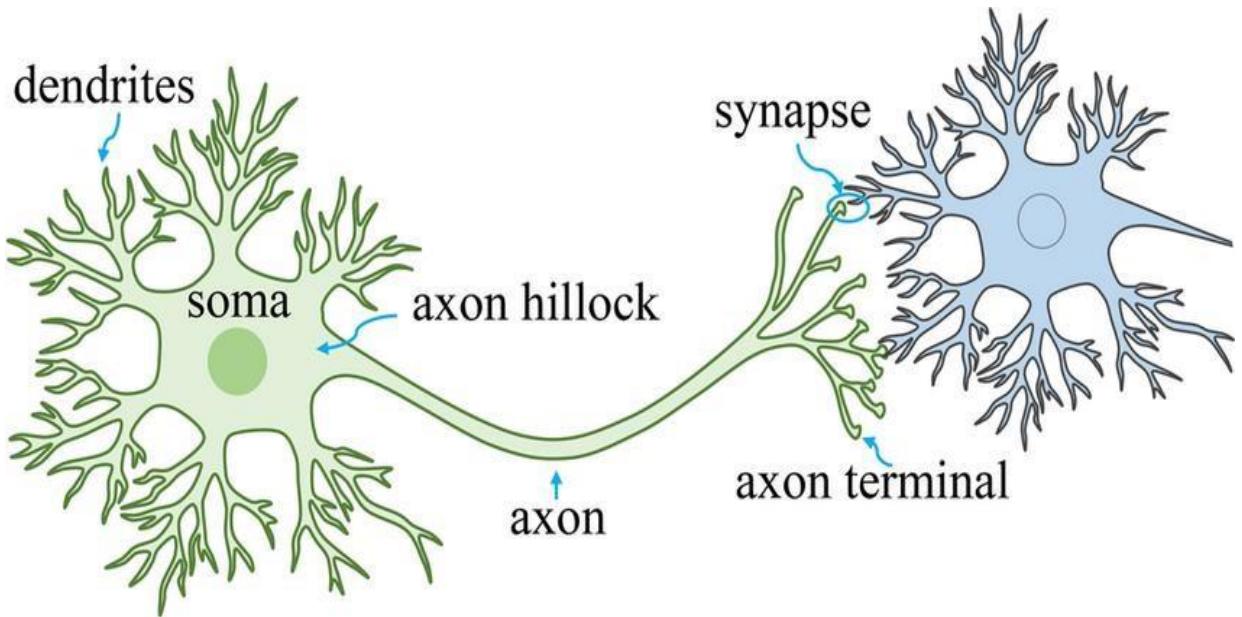
Dendrites: These are branched projections from the cell body. The dendric tip of the nerve cells receives impulses and sets off a chemical reaction that creates more electrical impulses, which are further transmitted to the cell body.

Axon: The longest branch arising out of the cell body is called the axon (or) nerve fibre. The axon is surrounded by a specialized fatty sheath called the myelin sheath. The nerve cell containing the myelin sheath is called the myelinated nerve cell. The myelin sheath is interrupted at regular intervals, called nodes of Ranvier. A nerve cell not having a myelin sheath is called a non-myelinated nerve cell. The myelin sheath separates the one axon from the adjacent axon. The information from one nerve cell to another will be passed through a synapse.



Synapse

Synapses are mainly found in the brain, spinal cord, and around the spinal cord. Beyond these areas, the axon carries the signals to the respective areas of our body. In this way, based on the ways of carrying messages, nerves are divided into three types.



Types of Nerves

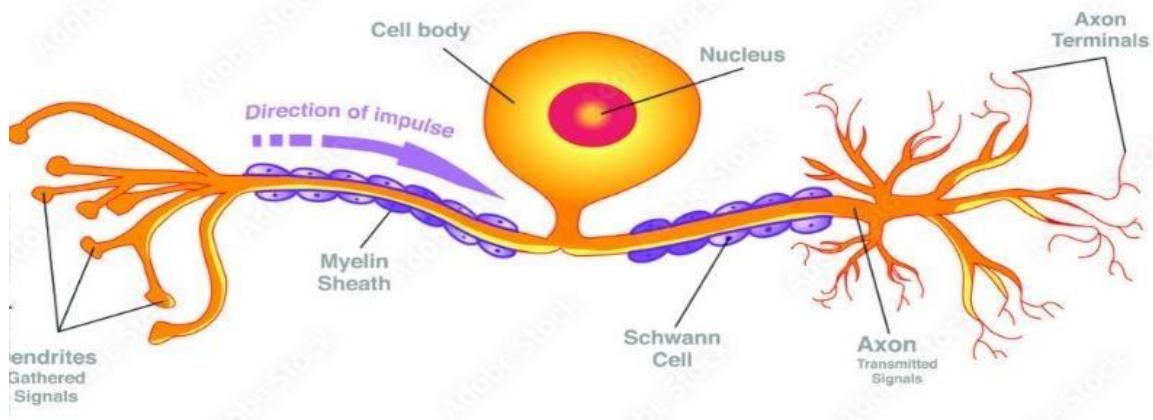
Based on their function, nerves are divided into three types.

- 1) Sensory nerves (afferent nerves)
- 2) Motor nerves (efferent nerves)
- 3) Mixed nerves

Sensory nerves:

Sensory nerves contain sensory fibres. Sensory nerves are also called afferent nerves. They carry the impulse from receptors (sense organs) to the central nervous system (brain and spinal cord).

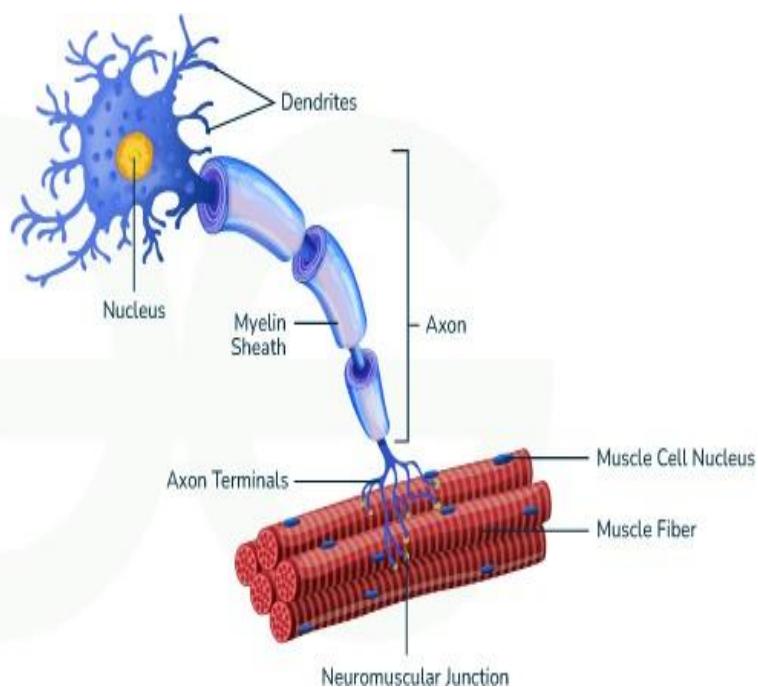
Sensory Neuron



Motor nerves:

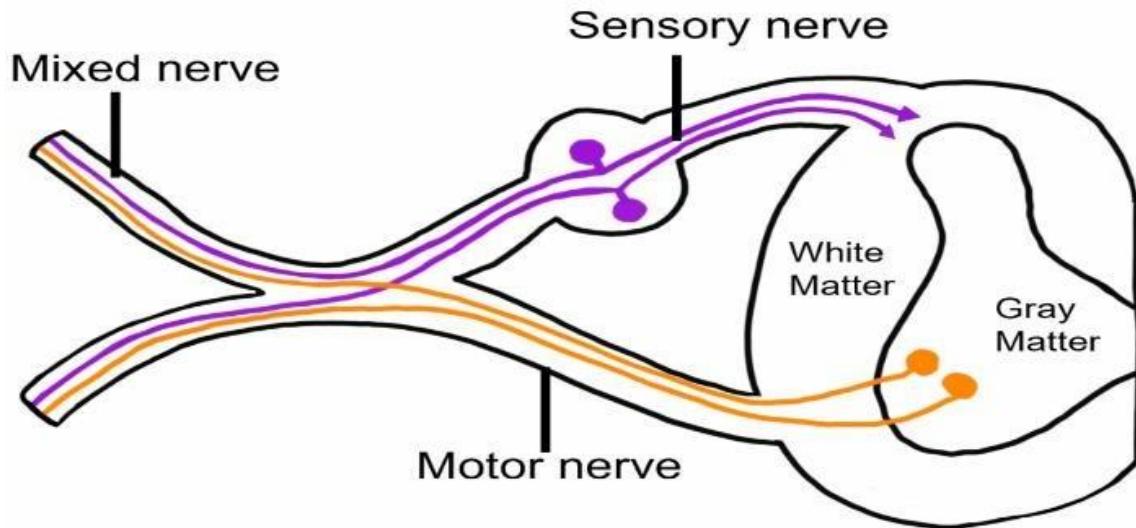
Motor nerves contain motor fibres. The motor nerve is also called the efferent nerve. They carry impulses from the central nervous system to different body parts.

Motor Neuron



Mixed nerves:

These nerves contain both sensory and motor fibres and perform the functions of both sensory and motor nerves.



Sense organs:

A receptor (or sense organ) is a group of highly specialized cells. Receptors help sensory nerves collect information from sensory organs. The sense organs that are present in our body—the eye, ear, nose, tongue, and skin—receive the stimulus. The stimulus then reaches the spinal cord and the brain through sensory nerves, where it is integrated. The message is then sent by motor nerves to the required organ (muscle or gland) for suitable action. In this way, a response is generated.

Human eye:

Acts as a photographic camera in which the conjunctiva, cornea, lenses, and humor refract the light rays to focus on the retina of the eye. Photoreceptors are stimulated, which change usual stimuli into nerve impulses, which are carried by the nerve fibres of the optic nerves to the visual area of the cerebrum, which interprets these impulses and initiates the proper response by which we can see.

Ear:

The receptors present in the ear detect sound stimuli. Nerve impulses from the ear are carried to auditors of the cerebrum by auditory nerves, thus we can hear.

Tongue:

Once the food enters the mouth, we grind and chew it. As a result, the chemicals released from the food stimulate the taste buds. Each taste bud is composed of a larger cluster of taste cells. Each taste cell is a chemoreceptor and detects the chemicals in food and initiates nerve impulses, which are carried by the nerves to the taste area of the brain to interpret the message. Thus, we can taste the food.

Nose:

The upper part of the nasal chamber has olfactory cells. These cells detect the chemical stimuli, convert them into nerve impulses, and send these impulses to an olfactory area of the brain through the olfactory nerve, thus knowing the smell.

Skin:

Skin is sensitive to touch, temperature, and pressure. The skin contains tactile receptors for touch. These receptors create a sense of touch. This message is passed on to the brain through sensory nerves. Due to this, we can feel a sense of touch, whether cold or hot.

Central Nervous System:

The Central Nervous System consists of the brain and spinal cord. Brain: Observe the figure of the human brain. The brain is a soft structure present inside the cranium of the skull. It is protected by three layers. The fluid present in between these layers is called cerebrospinal fluid. This fluid protects the brain from the shocks.

Peripheral nervous system:

As shown in the figure, the nerves attached to the spinal cord have two types of connections (or roots), one to the back or dorsal side and the other to the front or ventral side of the cord. The dorsal root carries messages of sensation inward, while the ventral pathway carries outward the instructions for muscular contraction. The peripheral nervous system is a vast system of the dorsal and ventral root spinal and cranial nerves that are linked to the brain and spinal cord on one end and muscles on the other. In our body, 12 pairs of cranial nerves arise from the brain, and 31 pairs of spinal nerves arise from the spinal cord.

Autonomous nervous system:

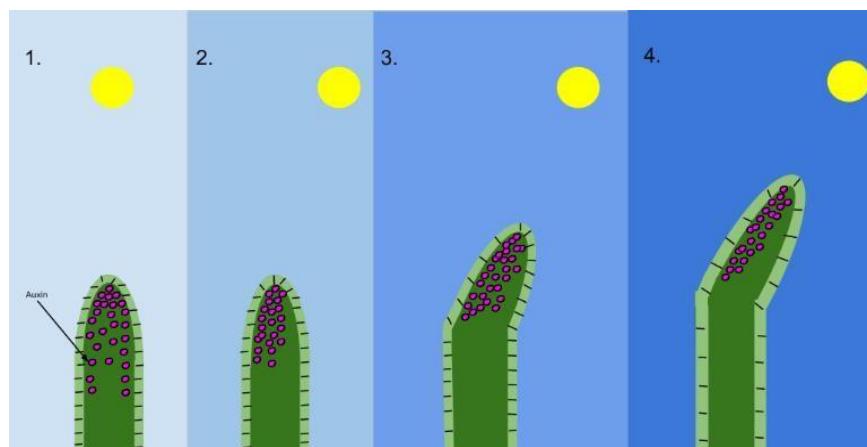
The peripheral nervous system involuntarily controls several functions of regions like our internal organs (for example, blood vessels), so it is called the autonomous nervous system. It has voluntary control of the muscles of some areas of the skin and the skeletal muscles.



Plant responses to hormones and their application in plant propagation

Auxins:

Auxins are a group of related molecules that are involved in almost every aspect of the plant's life cycle. Auxins stimulate growth through cell elongation, which is integral to the plant's responses to environmental changes. Auxins are responsible for two types of growth responses **Phototropism**, the bending or growth of a shoot toward light, and **Gravitropism**, a change in growth occurring after a change in gravitational force.



Cytokinins:

Like auxins, cytokinins are a group of related molecules that regulate growth and development. However, the plant's response to cytokinins is very different from its auxin response. Cytokinins come from the word cytokinesis, which means cell division. You will learn about cytokinesis, specifically mitosis. Cytokinins promote cell division, where one cell splits and two new daughter cells are formed. Cytokinins are important regulators of plant growth and development.

Gibberellins:

Gibberellins, or gibberellin acid (GA), are a group of over 100 molecules that are primary regulators of stem elongation and seed germination. They were discovered during research on the cause of the "foolish seedling" disease of rice. The disease, characterized by tall plants with little grain, is caused by an infection with *Gibberella fujikuroi*, a parasitic fungus that produces GA in the rice shoots, causing increased stem elongation.

Abscisic acid:

While GA facilitates seed germination, abscisic acid (ABA) inhibits it. Abscisic acid is a single molecule that regulates germination and the response of a plant to reduced water availability during drought stress. ABA levels increase as water becomes less available to the plant, evoking several responses, including the closing of stomata. Closing stomata slow transpiration (also called evapotranspiration), the movement of water in the plant from the root stem to the leaf and out through the stomata into the atmosphere.

Ethylene:

Ethylene is well known as the gaseous, ripening hormone. It also regulates seedling growth and the formation of root hairs and can lead to epinasty—the bending of branches downward. Many plants are sensitive to the effect ethylene has on fruit ripening. The iconic examples are tomatoes and bananas. These fruits are climacteric—they continue to ripen after harvest. The perception of ethylene by the cells that make up the fruit triggers the ripening process and the production of more ethylene.

Tropic and nastic movements in plants:

What happens if we touch the leaflets of the *Mimosa pudica* (touch me not) plant?

Why do the tendrils of plants move towards support?

In plants, there are two types of movements: tropic movement and nastic movement.

Plant parts show movement when they are subjected to external stimuli. In tropic movements, the direction of stimuli determines the direction of movement, whereas in nastic movements, the direction of movement may not be determined by the direction of stimuli.

When we touch the leaflets of the ‘touch me not’ plant, they shrink. This type of movement is called nastic movement. The response of plants to light and showing movement towards light is called ‘phototropism’.

Tendrils are thin thread-like growths; they grow towards the support and wind around them. This type of response to make contact (or touch) is called ‘thigmotropism’.

Roots always grow towards the earth, which is called ‘geotropism’.

The plants that grow near a rock or wall side grow towards regions containing water. Such a type of movement is called ‘hydrotropism’.

The chemical substance stimulates the pollen grain, which falls on the stigma. This type of response to chemicals is called ‘chemotropism’.

SUMMARY

- ✓ During metabolism, several harmful excretory products are formed, and the process of removing toxic waste from the body is called excretion.
- ✓ The human excretory system comprises a pair of kidneys, a pair of ureters, a urinary bladder, and a urethra.
- ✓ Each kidney is composed of approximately one million nephrons, which are structural and functional units of the kidney.
- ✓ Kidneys remove nitrogenous waste from the body and maintain water balance, salt content, pH, and blood pressure in the human body.
- ✓ A dialysis machine is an artificial kidney that filters the blood to remove metabolic wastes from the body.
- ✓ Plants do not have specific organs to excrete. Plants store waste products in their leaves, bark, roots, seeds, and fruits. When these ripen, they fall off the tree, and the waste products in them are removed.
- ✓ Plants produce two types of metabolites. i) Primary metabolites. Carbohydrates, proteins, and fats ii) Secondary metabolites. Examples: alkaloids, tannins, resins, gums, and latex
- ✓ Excretion means the removal of substances from the organism, and secretion is the movement of materials from one point to another.
- ✓ The nervous system and endocrine system work together in a coordinated manner and send information to various organs of the body.
- ✓ The human nervous system consists of a central nervous system and a peripheral nervous system.
- ✓ The central nervous system consists of the brain and spinal cord. The peripheral nervous system is formed by the cranial nerves and spinal nerves. The nerve cell is the structural and functional unit of the nervous system.
- ✓ There are three types of nerves. sensory nerves, motor nerves, and mixed nerves
- ✓ Eye, Ear, Nose, Tongue, and Skin—all five sense organs present in our bodywork by the effects of the nervous system.
- ✓ Endocrine glands are ductless glands that secrete hormones directly into the blood and play an important role in the coordination of different activities in the body.
- ✓ In plants, phytohormones regulate plant growth. Auxins, cytokinins, gibberellins, ethylene, and abscisic acids are the phytohormones present in plants.
- ✓ External stimuli make plants show different types of movements. There are tropic movements and nastic movements.

Answer the following questions:

1. What are the functions of the sensory nerve and the motor nerve?
2. Explain the structure of a nerve cell with the help of a diagram.
3. Mention the phytohormones present in plants and describe their uses.
4. Give examples of different types of topical movements in plants.
5. Which hormone helps to ripen the fruit?
6. Explain about the synapse.
7. What is the difference between primary metabolites and secondary metabolites?
8. Plants do not have excretory organs. How do they send out their waste products

11. ECOSYSTEM AROUND US

Introduction:

Environment refers to the environment in which an organism thrives. It constitutes both living and non-living things, i.e., physical, chemical, and biotic factors. In this chapter, we will learn about various components of the environment, their interactions, and how our activities affect the environment.

Ecosystem:

The ecosystem comprises all the biotic and abiotic factors interacting with one another in a given area. Biotic components include all living organisms such as plants, animals, microorganisms, humans, etc., and abiotic components include sunlight, temperature, air, wind, rainfall, soil, minerals, etc. E.g., pond ecosystem, grassland ecosystem, etc.

Saprophytes and decomposers:

Saprophytes feed on dead and decaying material, e.g., fungi and microorganisms. They absorb nutrients from dead and decaying plants and animal parts.

Decomposers break down the organic matter or waste material and release nutrients into the soil. For example, bacteria, worms, slugs, and snails. They are considered extremely important in soil biology. They break down the complex organic matter into simpler substances that are taken up by the plants for various metabolic activities.

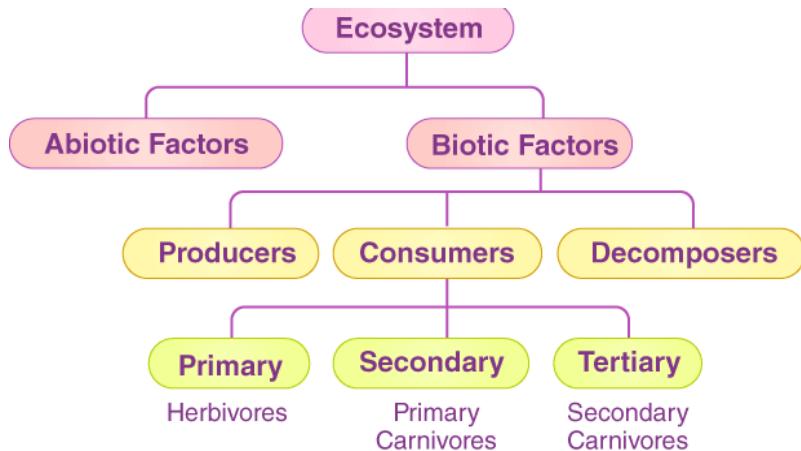
Abiotic components:

Non-living chemical and physical components of the environment, like the soil, air, water, temperature, etc.

Biotic components:

Living organisms of the environment, like plants, animals, microbes, and fungi.

Biotic and Abiotic Trophic Levels It refers to the various levels in a food web as per the flow of energy. The different trophic levels are:



What do you understand by trophic level?

The pyramid of trophic levels is a graphical representation.

It can be the pyramid of numbers, the pyramid of biomass, or the pyramid of energy.

All the pyramids start with producers.

a) Pyramid of numbers: gives the number of organisms present at each trophic level. It can be upright or inverted.

b) Pyramid of biomass: gives the biomass of each trophic level and could be upright or inverted.

c) The pyramid of energy is always upright, as it shows the flow of energy from one trophic level to the next trophic level.

The law of conservation of energy:

Energy can neither be created nor destroyed; rather, it transforms from one form to another.

In biological systems, it gets passed from one organism to another across trophic levels. To learn more about the law of conservation of energy, visit [here](#). Energy flow

Transfer of energy from one trophic level to another, depicting its direction and amount.

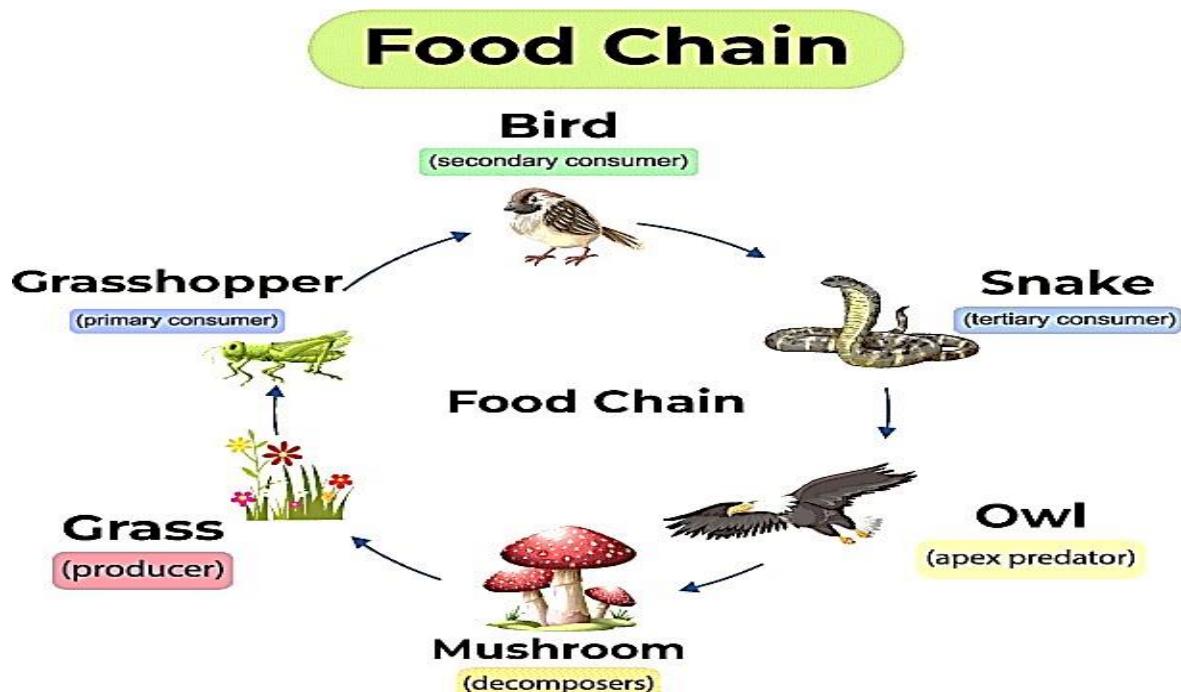
Can be represented by the pyramid of energy.

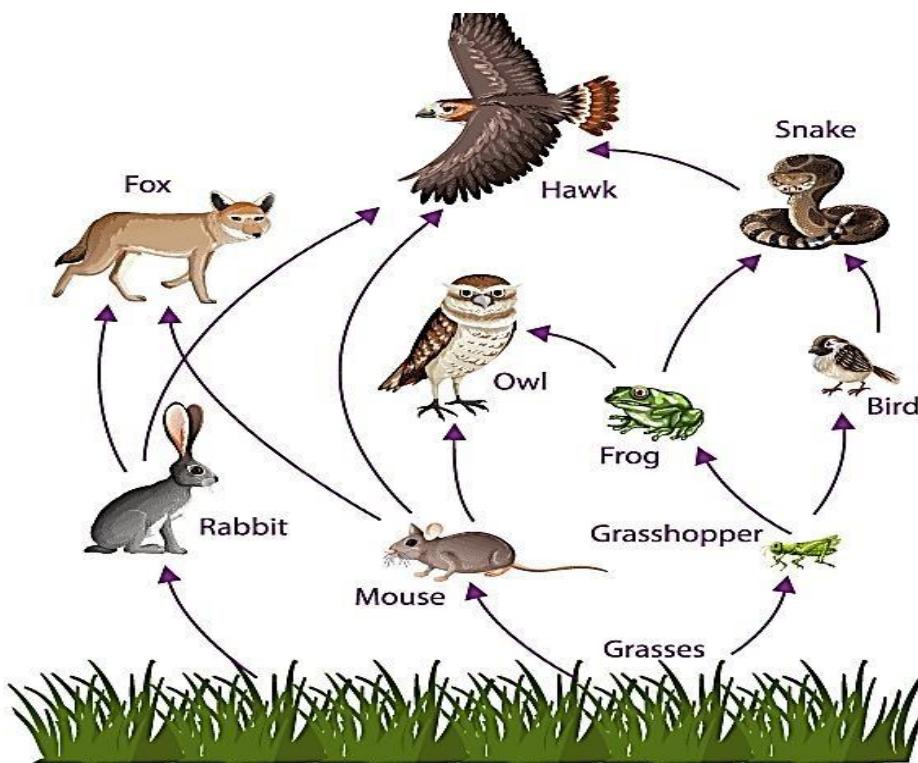
In any food chain, only 10% of the energy is transferred from one trophic level to another.

The food chain is a series of organisms, each dependent on the next as a source of food.

The food web is formed by the interconnections of different food chains.

Is a graphical representation of 'Who eats whom' in an ecosystem.





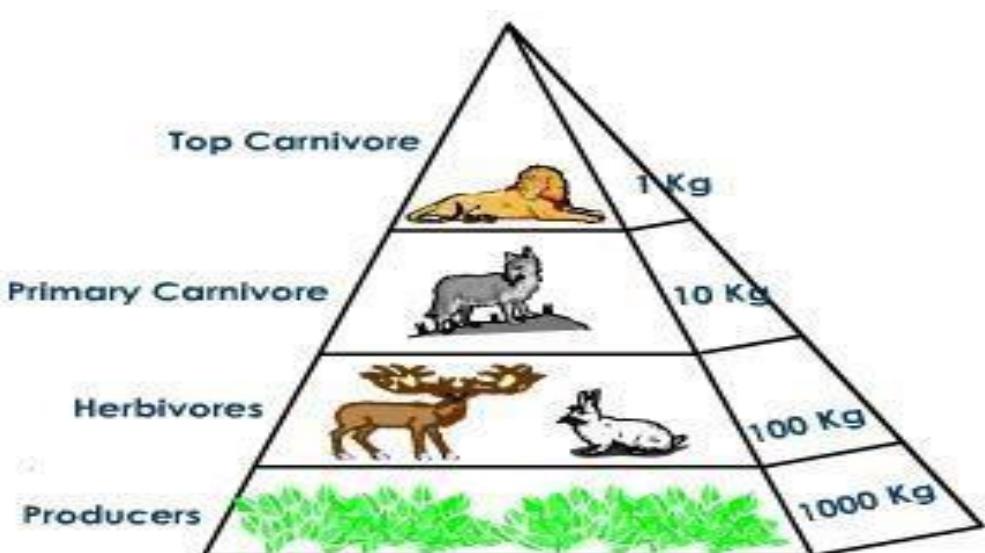
Characteristics of ecosystems

Includes a summary of trophic levels.

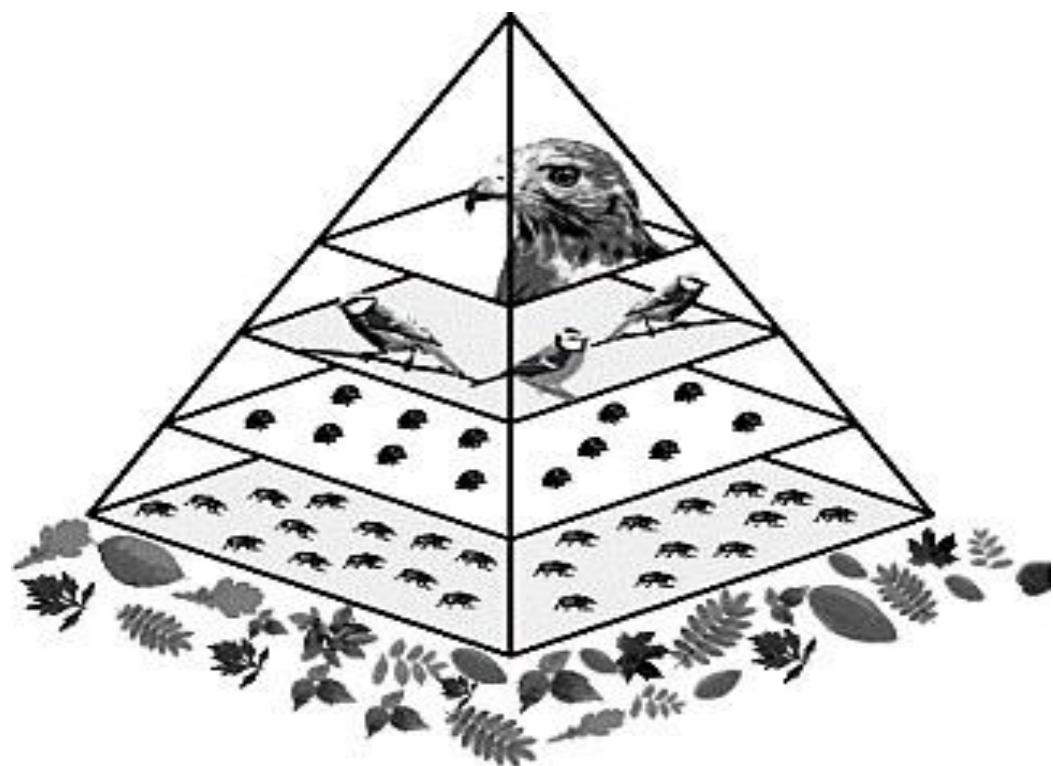
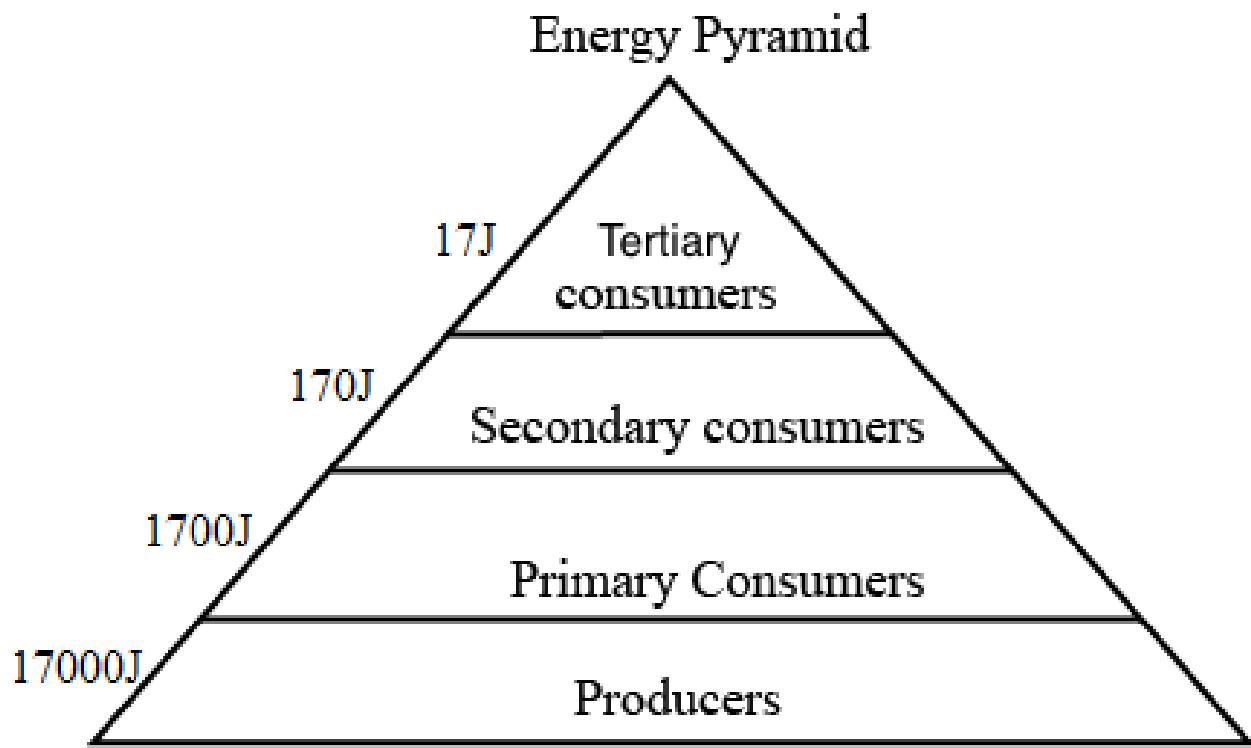
Their energy flow and pyramids. Environment

Includes all living and nonliving things.

Unlike ecosystems, there need not be any necessary interaction between them.



Upright Pyramid of biomass in a Terrestrial Ecosystem



Pyramid of numbers

SUMMARY

- ✓ An ecosystem is a Structural and functional unit of nature.
- ✓ The living organisms in a habitat are classified into Autotrophs, Heterotrophs,
- ✓ Parasites, Saprophytes and symbionts based on their nutrition.
- ✓ Food chains and food webs are diagrams that represent the feeding relationships of organisms 3. in an ecosystem.
- ✓ Food chains and webs model how energy and matter move through ecosystems.
- ✓ The ecosystem requires constant inputs of solar energy. Producers convert this solar energy into chemical energy. This energy is transmitted to the consumers through food. The energy flow in ecosystems is unidirectional. The amount of energy is decreased from one trophic level to another along the food chain.
- ✓ The graphical representation of the feeding level of an ecosystem is in the shape of a Pyramid called an Ecological pyramid. It shows the flow of energy from one organism to another.
- ✓ The cycles that involve the flow of nutrients on earth (elements essential for the living cell) from the environment to the organism and back through certain pathways are known as biogeochemical cycles.
- ✓ A Biome is a large community of plants and animals of all ecosystems of an area.
- ✓ Adaptations are special features that allow a plant or an animal to live in a particular habitat.

Answer the following questions:

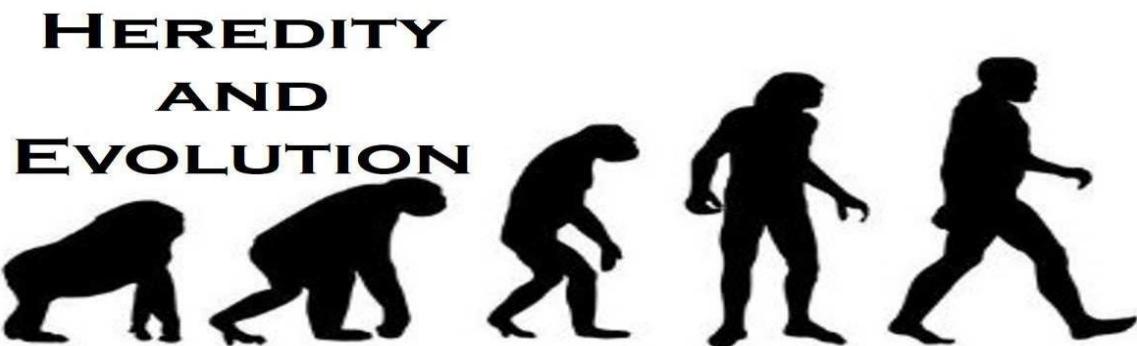
1. Draw the diagrams of the Number pyramid and Energy Pyramid.
2. Draw the diagram of any one food chain. Why do food chains form a food web?
3. Write 3 biotic and 3 abiotic factors
4. Explain with examples, a food chain and a food web.
5. What are ecological pyramids?
6. What are the components of a dynamic ecosystem?
7. What do we mean when we say habitat?
8. What do we call an ecosystem?

12. EVOLUTION AND HER PODIATRY

Introduction

Heredity refers to the passing of characteristics from one generation to the next. Evolution is defined as the gradual process by which a simple life form leads to the development of complex organisms over some time, spanning several generations.

Here in this chapter, we will learn about the mechanism by which variations are created, the rules of heredity determining their pattern of inheritance, and how the accumulation of these variations leads to evolution.



Heredity

The transfer of traits from one generation to the next is termed heredity. Genes are the functional units of heredity that transfer characteristics from parents to offspring. Genes are short stretches of DNA that code for a specific protein, or RNA.

Genetics is the branch of biology that deals with the study of genes, [heredity](#), and variations.

Sexual Reproduction

The mode of reproduction involves two individuals, one male and one female.

They produce sex cells, or gametes, which fuse to form a new organism.

Genes

The gene is the functional unit of heredity.

Every gene controls one or several particular characteristic features in living organs.

Heredity

The process by which the features of an organism are passed on from one generation to another is called heredity. The process is done by genes, which define the characters in the organism.

Mendel's Work

Gregor Johann Mendel, known as the 'Father of Genetics', was an Austrian monk who worked on pea plants to understand the concept of heredity. His work laid the foundation of modern genetics. He made three basic laws of inheritance: the Law of Dominance, the Law of Segregation, and the Law of Independent Assortment.

PEA PLANTS IN MENDEL EXPERIMENT

Seed shape	Seed colour	Pod shape	Pod colour	Flower colour	Flower location	Plant size
Round 	Yellow 	Inflated 	Green 	Purple 	Axial 	Tall 
Wrinkled 	Green 	Constricted 	Yellow 	White 	Terminal 	Dwarf 

Dominant Traits

The traits that express themselves in an organism in every possible combination and can be seen are called dominant traits.

In Mendel's experiment, we see that the tall trait in pea plants tends to express more than the short trait. Therefore, the tall trait of the plant is said to be dominant over the short trait.

Recessive Traits

A trait that is not expressed in the presence of a dominant allele is known as recessive. So, a recessive character or trait is present in an organism but cannot be seen if a dominant allele exists.

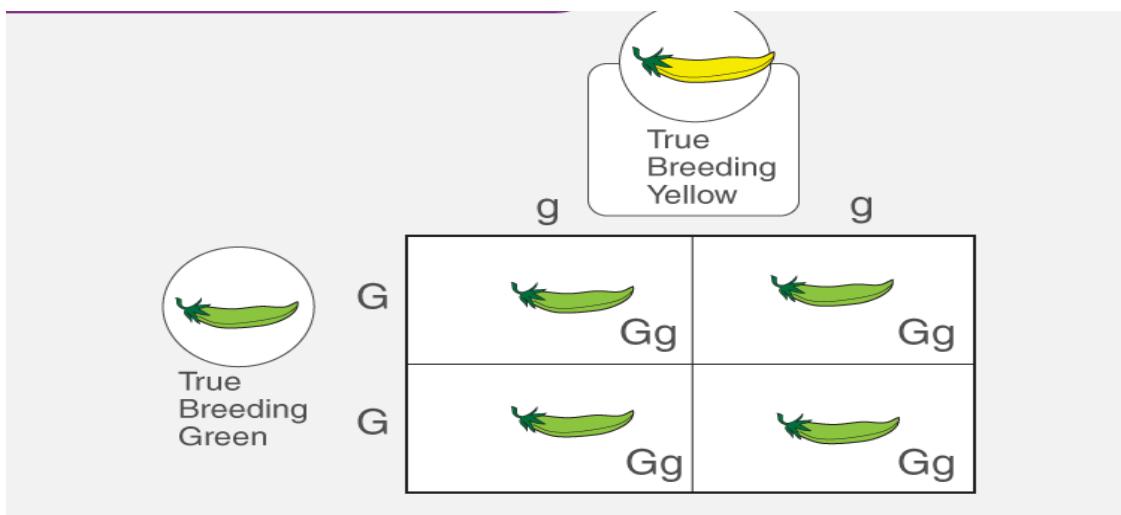
Monohybrid Cross

When only one character is considered while crossing two organisms, then such a cross is known as a monohybrid cross. The ratio of characters arising out of this cross at F₂ generation is called the monohybrid ratio.

E.g., If a tall plant (TT) is crossed with a dwarf plant (tt), we get 3 tall plants and 1 short plant at the end of the F₂ generation. So, 3:1 is a monohybrid ratio.

Here, the height of the plant is considered at a time.

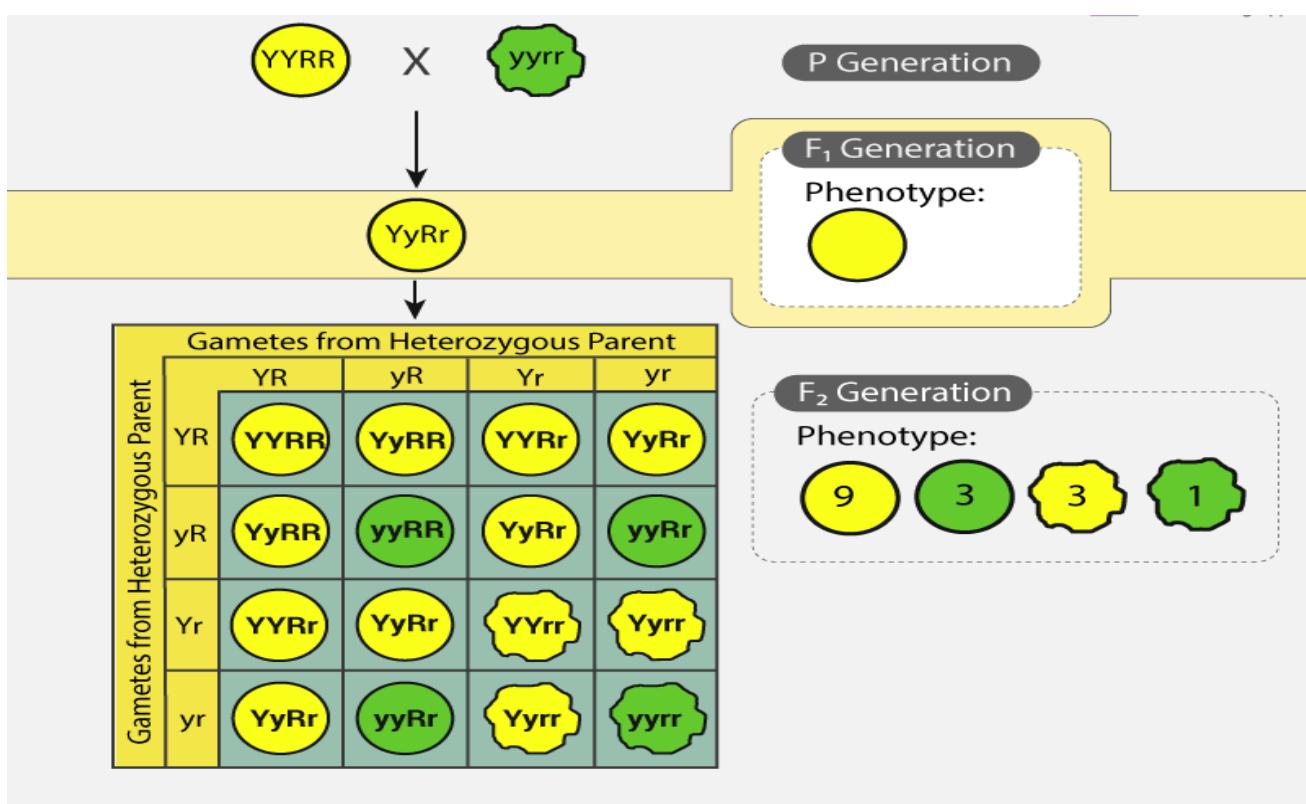
Below is an example of a monohybrid cross between a true-breeding pea plant with green pods (GG) and yellow pods (gg). Here, the green colour of the pod is the dominant trait. Hence, in the F₁ generation, all plants contain green pea pods.



Dihybrid cross

When two characters are considered while crossing two organisms, then such a cross is known as a dihybrid cross. The ratio of characters arising out of this cross at F₂ generation is called the dihybrid ratio. For, if a plant with round and green peas is crossed with a plant with wrinkled and yellow peas, The first-generation plants would all have round, green peas.

On crossing the same for an F₂ generation, we would observe four combinations of characters in the ratio of 9:3:3:1.



Inheritance

In biology, inheritance pertains to the transfer of traits from one generation to another.

The Laws of Mendel

The Law of Dominance says that a gene has two contrasting alleles, and one always expresses itself in the organism.

It is called the dominant gene, and it is expressed in any possible combination.

The Law of Segregation says that traits get segregated completely during the formation of gametes without any mixing of alleles.

The Law of Independent Assortment says that traits can segregate independently of different characters during gamete formation.

Charles Darwin

Charles Darwin, also called the "**Father of Evolution,**" was an English naturalist and biologist.

Five years of the expedition on a ship called HMS Beagle to Galapagos Island helped him write his theory of evolution.

In 1859, he published a book called Origin of Species, in which he put his theory of evolution in detail.

Natural Selection

It is the phenomenon by which a favourable trait in a population of a species is selected.

Changing natural conditions exert equal pressure on all the existing species.

Species or organisms that are better adapted to the changing conditions survive and reproduce, i.e., are selected by nature, and species or organisms that cannot adapt perish, i.e., are rejected by nature.

Evolution

Evolution is a tangible change in the heritable characteristics of a population over several generations. These changes can give rise to a new species, or they might change themselves to better adapt to the surrounding environment.

Origin of Species

After a successful expedition on HMS Beagle, Charles Darwin wrote a book on what he observed on the Galapagos Islands.

In the book The Origin of Species, he wrote a detailed theory of evolution that was mostly based on natural selection.

Evolutionary Evidence: Fossils

There are plenty of pieces of evidence to support the theory of evolution.

Fossils happen to be the biggest of them.

Fossils are the preserved remains of ancient animals or plants that died millions of years ago.

SUMMARY

- ✓ Evolution is a continuous process of developing more complex organizations from a simple level.
- ✓ Jean-Baptiste Lamarck was the first person to propose the theory of evolution. Lamarck explained the inheritance of acquired characters with examples.
- ✓ Charles Darwin proposed the natural selection theory. He observed a small group of related birds that are exhibiting diversity in the broken structure in the Galapagos Islands.
- ✓ Organs that are similar in structure but not similar in function are called homologous
- ✓ 4. Organs. The organs that are dissimilar in structure and similar in function are called analogous organs.
- ✓ The changes that occur among closely related groups of organisms are called variations.
- ✓ Mendel was considered the father of genetics. He did experiments on the pea plant based on the seven pairs of contrasting characters.
- ✓ An externally visible character is called a phenotype, and the genetic makeup of a character is called a genotype.
- ✓ Mendel proposed the Law of Dominance, the Law of Segregation, and the Law of Independent Assortment.
- ✓ Every cell of a human being contains 46 chromosomes. Out of 46 (23 pairs), 22 pairs are termed autosomes. The 23rd pair, X and Y chromosomes, are called sex chromosomes.

Answer the following questions:

1. What is evolution?
2. What does the Law of Segregation state?
3. What is meant by natural selection?
4. What is the evidence that proves Darwinism?
5. Mention the names of two theories that explain evolution.
6. Scientists who explained the inheritance of acquired characters.
7. The number of characters Mendel chose for his experiments on pea plants.
8. What is the number of autosomes and allosomes in human beings?
9. What are the evidences of evolution?
10. What are the salient features of Darwinism?

Famous inventions and Inventors of India	
Inventors Name	Inventions
Prafulla Chandra Ray	India's first pharmaceutical company.
Salim Ali	Naturalist who helped develop Ornithology
Srinivasa Ramanujan	mathematical analysis, number theory, infinite series, and continued fractions
C. V. Raman	He was a physicist who won the Nobel Prize in 1930 for his Raman Effect.
Homi Jehangir Bhabha	The chief architect of the Indian atomic energy program.
Jagadish Chandra Bose	Pioneered the investigation of radio and microwave optics.
Satyendra Nath Bose	Mathematician and physicist;
A.P.J. Abdul Kalam	Development of India's missile and nuclear weapons programs.
Har Gobind Khorana	A biochemist who won the Nobel Prize
Meghnad Saha	Astrophysicist

BIOLOGY- QUIZ

1. What is the natural compound present in green plants that gives them their colour?
2. Where would one find the smallest bone in the human body?
3. Which organ removes waste and extra fluid from your body?
4. What is the biggest animal on the planet?
5. What hormone regulates blood sugar levels by allowing cells to absorb and use glucose for energy?
6. What is the largest muscle in the human body?
7. A gamete is a reproductive cell. True or false?
8. What viscous substance produced by various glands and cells in the body is commonly found in the respiratory, digestive, and reproductive systems?
9. Where is the femur located?
10. What is the largest bone in the human skull?
11. In degrees Celsius, what is the average body temperature of a healthy human?

12. What animal is created when a male lion and a tigress breed?
13. What flexible, tube-like structure connects a developing foetus to the placenta in the womb?
14. What is the most common blood group in the UK?
15. What is the name of the male reproductive parts of a flower?
16. Which gas do plants release during photosynthesis?
17. What is the process called when a caterpillar develops into a butterfly?
18. Which part of the body makes platelets?
19. Which plant tissue is responsible for transporting water and nutrients from the roots to the rest of the plant?
20. Including wisdom teeth, how many permanent teeth does the average adult human have?
21. A Swiss cheese plant is technically known as what?
22. The movement of water molecules through a cell's partially permeable membrane is known as what?
23. The fat in a camel's hump is mainly for thermoregulation. True or false?
24. How many layers are there in a tree trunk?
25. The fly agaric belongs to what kingdom?
26. Jellyfish have hearts. True or false?
27. What is the scientific term for the study of mushrooms?
28. What fine powder containing male reproductive cells of plants is typically transported by insects, wind, or water for fertilization?
29. What are the four main chambers of the human heart?

CELL-ORGANELLES AND INVENTIONS:

1. Cell Membrane - Robert Hooke in 1665 first view the cells under the microscope and hence, he is credited with the discovery of cell membrane.
2. Centriole - Discovered by Edouard Van Beneden in 1883 and was described and coined by Theodor Boveri in 1888.
3. Centrosome - Discovered by Edouard Van Beneden in 1883 and was described and coined by Theodor Boveri in 1888.
4. Cytoskeleton - Nikolai K Koltsov in 1903 proposed that the shape of the cell is determined by the tubular network, the cytoskeleton. However, the word was introduced and coined by Paul Wintrebert in 1931 (in French, cytosquelette).
 - i. Microtubules - De Robertis and Franchi discovered microtubules in 1953 in nerve cell and later Sabatani, Bansch, Barnette in 1963 explained the structure of microtubule.
 - ii. Microfilament/Actin Filaments - Edward David Korn discovered microfilament in 1968 in Acanthamoeba castellanii.
 - iii. Intermediate Filaments - The group of Howard Holtzer in 1968 discovered intermediate filaments.
5. Cytosol - Discovered in 1835 and no single scientist can be accredited to its discovery.
6. Golgi Apparatus - Camillo Golgi identified it in 1897 and named after him in 1898.
7. Lysosomes - Discovered by Christian de Duve in 1949 (or 1950s).
8. Mitochondria - Albert von Kolliker studied mitochondria in muscle cell in 1857; Richard Altman first recognized them as cell organelle in 1894; Term "mitochondria" coined by Carl Benda in 1898.
9. Nucleus - Robert Brown discovered cell nucleus in 1833.
10. Ribosomes - Discovered by George Palade in 1955.
11. Endoplasmic Reticulum - Albert Claude in Belgium and Keith Porter at Rockefeller Institute in 1945.