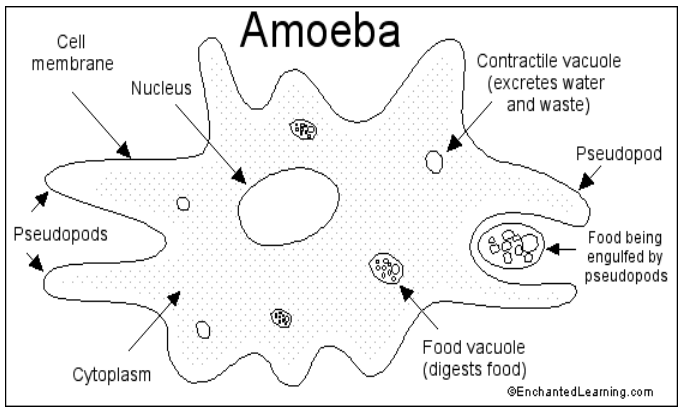
Biology - Structure and Functions

Introduction

- The basic structural unit of an organ is known as the cell.
- In 1665, Robert Hooke discovered the cell.
- A cell is a living organism.
- A human body has trillions of cells, which vary in shapes and sizes.
- The organism, which is made up of more than one cell, is known as multicellular organism.
- The single-celled organisms are known as unicellular organism. E.g. Amoeba.

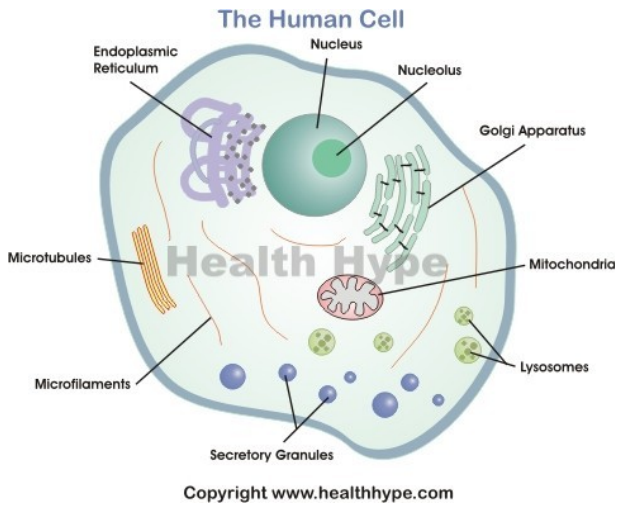


Amoeba

- A single-celled organism performs all the essential functions that a multicellular organism performs.
- Unlike other organisms, Amoeba has no definite shape; so, it keeps on changing its shape.
- Amoeba has pseudopodia, which means – pseudo means false and podia means feet.
- Amoeba is a full-fledged organism capable of independent existence.
- Shape of the cells are normally round, spherical, or elongated.
- Protoplasm is known as the living substance of the cell.
- The cells having nuclear substances without nuclear membrane are known as prokaryotic cells. E.g. bacteria and blue green algae.
- The cells having well organized nucleus with a nuclear membrane are designated as eukaryotic cells. All multicellular organisms are eukaryotic cells.

Cell Structure and Function

The basic parts of a cell are cell membrane, cytoplasm, and nucleus.



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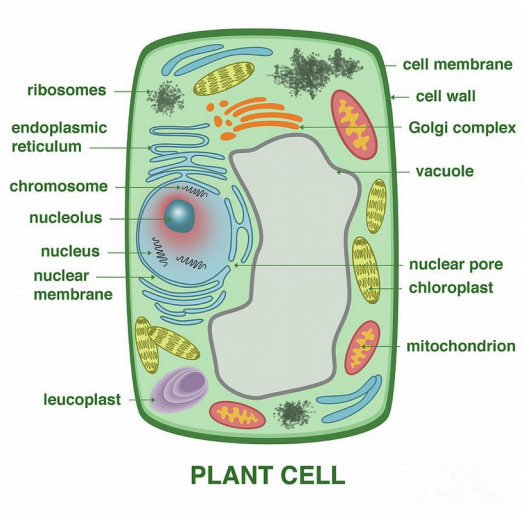
Cell membrane is also known as the **plasma membrane.**

- The plasma membrane is porous and allows certain substances or materials move both inward and outward.
- The central dense round structure in the center is known as **nucleus.**
- The jelly-like substance between the nucleus and the cell membrane (as shown

in the above image) is known as **cytoplasm.**

- Different organelles of cells are also present in the cytoplasm such as Mitochondria, Golgi bodies, Ribosomes, etc.
- Located in central part, nucleus is almost in spherical shape.
- Nucleus is separated from the cytoplasm by a porous membrane known as the **nuclear membrane**.
- The smaller and spherical structure, found inside the nucleus, is known as **nucleolus.**
- Nucleus contains thread-like structures known as c**hromosomes.**
- Chromosomes carry **genes** and help in inheriting the characteristics of the parents to the offspring.
- **Gene** is a fundamental unit of inheritance in living organisms.
- The entire constituents of a living cell are known as **protoplasm**, which include nucleus and cytoplasm.

Plant Cell



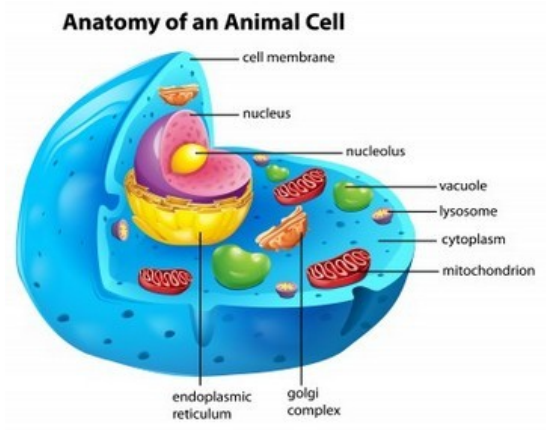
PLANT CELL

- Th

e cell membrane provides shape to the cells of plants and animals.

- In plant cell, cell wall is an additional covering over the cell membrane.
- An animal cell does not have cell wall.
- Cell wall gives shape and rigidity to plant cells.
- Cell wall gives protection, plant cells need protection against varying temperature, high wind speed, atmospheric moisture, etc.
- Bacterial cell also has a cell wall.
- Usually, most of the cells are microscopic in size and are not visible to the naked eye.
- The size of smallest cell is 0.1 to 0.5 micrometer found in bacteria.
- The size of largest cell is 170 mm × 130 mm, found in the egg of an ostrich.
- The size of the cells however has no relation with the size of the body of the animal or plant.
- Some small colored bodies in the cytoplasm of the cells of Tradescantia leaf are known as **plastids.**
- Plastids are found in different colors.
- Some plastids have green pigment and known as **chlorophyll.**
- Green colored plastids are known as **chloroplasts.**
- Chloroplasts give green color to the leaves.
- Chlorophyll is essential for the photosynthesis.

Introduction



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he fundamental unit of life is cell.

- Cell was first discovered by **Robert Hooke in 1665** in a simple microscope.
- In **1674, Antonie van Leeuwenhoek**, with the help of developed microscope, discovered the free living cells in pond water.
- In **1831, Robert Brown** had discovered the nucleus in the cell.
- In 1839, **Jan Evangelista Purkyně** used the term 'protoplasm' for the fluid substance found in the cell.
- The cell theory was proposed by **Matthias Jakob Schleiden (1838) and Theodor Schwann (1839).**
- According to the cell theory, all the plants and animals are composed of cells and that the cell is the basic unit of life.
- In 1855, **Rudolf Ludwig Carl Virchow** further expanded the cell theory and suggested that all cells arise from pre-existing cells.
- In 1940, the discovery of electron microscope made possible to observe and understand the complex structure of the cell.

Unicellular Organisms

- The single cellular organisms, such as Amoeba, Chlamydomonas, Paramoecium, and bacteria, are known as **unicellular organisms.**

Multicellular Organisms

- The organisms consisting of many cells are known as **multicellular organisms**. E.g. human being, animals, birds, etc.
- **Significant Characteristics of Cells**
- Each living cell has the aptitude to perform certain basic functions that are characteristic of all living forms.
- Each such cell has certain specific components within it known as cell organelles.
- Different types of cells have different function and each cell organelle performs a special function.
- These organelles collectively constitute the basic unit of life known as cell.
- All cells are found to have the same organelles, irrespective of their different functions and the organism they found in.

Structural Organization of Cell

- Following are the three basic features that every cell possesses –

◎ Plasma Membrane/Cell Membrane

◎Nucleus

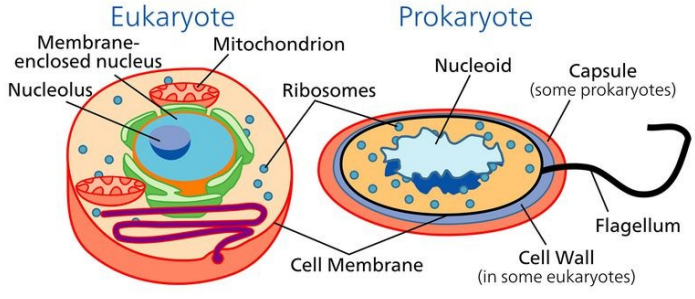
◎Cytoplasm

Plasma Membrane/Cell Membrane

- Plasma membrane is the outermost covering layer of the cell (as shown in the image given above).
- Plasma membrane allows certain materials to enter inside the cell and come out from the cell; therefore, it is known as **selectively permeable membrane.**
- The movement of water molecules through the selectively permeable membrane is known as **osmosis.**
- Cell Wall
- Plant cells have an addition protecting cover known as **cell wall** (absent in animal cell).
- The cell wall lies outside the plasma membrane; likewise, it also covers plasma membrane.
- The cell wall is essentially composed of cellulose.

Nucleus

- Nucleus or nuculeus is a Latin term and its meaning is kernel or seed.
- The nucleus has a double layered covering, which is known as nuclear membrane (see the image given above).
- The nuclear membrane has some pores, which allow certain materials come inside (in nucleus) and go outside (in the cytoplasm).
- The most significant feature of nucleus is – it contains **chromosomes.**
- Chromosomes are rod-shaped structures and it is visible only when the cell is about to divide.
- Chromosomes are composed of **DNA and protein.**
- **DNA (Deoxyribo Nucleic Acid**) molecules contain inheritance features from parents to next generation.
- DNA molecules also contain the information essential for constructing and organizing cells.
- Functional segments of DNA are known as **genes.**
- DNA is present as the part of chromatin material.
- Chromatin material is visible as entangled mass of thread like structures.
- Whenever the cell is about to divide, the chromatin material gets organized into chromosomes.
- The nucleus plays a central and significant role in cellular reproduction.
- The cell, which has no nuclear membrane, is known as **prokaryotes** (i.e. Pro = primitive or primary; karyote ≈ karyon = nucleus). See the image given below:
- The cell, which has a nuclear membrane, is known as **eukaryotes.**
- Prokaryotic cell does not have many other cytoplasmic organelles those are present in eukaryotic cells (see the image given above).



Cytoplasm

- Cells consist of cytoplasm inside the cell membrane, which contains many biomolecules including proteins and nucleic acids.
- There are many structures found in the cytoplasm known as cell organelles.

Cell Organelles

Following are the major cell organelles that play a major role in the functioning of cell –

◎Nucleus

◎Endoplasmic Reticulum

◎Ribosome ◎Golgi apparatus

◎Lysosomes ◎Mitochondria

◎Plastids ◎Vacuoles

Nucleus is discussed above.

Endoplasmic Reticulum

- The endoplasmic reticulum (or simply ER) is a large network of membrane-bound tubes and sheets.
- Based on visual structure, ER is categorized as rough endoplasmic reticulum (RER) and smooth endoplasmic reticulum (SER).
- When the ribosome attached on the surface of ER, it is known as **Rough Endoplasmic Reticulum** and without ribosome, it is known as **Smooth Endoplasmic Reticulum.**
- The SER helps in the manufacturing of fat molecules, or lipids, which is important for cell functioning.
- One of the significant functions of ER is to serve as channels for the transportation of materials (especially proteins) in various regions of the cytoplasm and also between the cytoplasm and the nucleus.

Ribosome

- The ribosomes, normally, present in all active cells.
- Ribosome are the sites of protein manufacturing.

Golgi Apparatus

- The Golgi Apparatus is named after the name of its discover **Camillo Golgi.**
- Golgi Apparatus consists of a system of membrane-bound vesicles arranged roughly parallel to each other in stacks known as **cisterns**
- The significant functions of Golgi Apparatus are the storage, modification, and packaging of products in vesicles.
- The Golgi apparatus also helps in the formation of lysosomes.

Lysosomes

- Lysosomes are a sort of waste disposal system of the cell.
- Lysosomes help in keeping the cell clean by digesting the foreign material as well as worn-out cell organelles.
- Lysosomes contain powerful digestive enzymes capable of breaking down all sorts of organic materials.
- Lysosome has a typical feature i.e. when the cell gets damaged lysosome most likely bursts and the released enzymes digest their own cell. Because of this reason,

lysosome is also known as the '**suicide bags'** of a cell.

Mitochondria

- Mitochondria, commonly, are known as the **powerhouses of the cell.**
- Mitochondria release the energy required for various chemical activities (essential for the life).
- Mitochondria release energy in the form of ATP **(Adenosine Triphopshate)** molecules.
- ATP is popular as the energy currency of the cell.
- Mitochondria have their own DNA and ribosomes; hence, they are capable to make some of their own proteins.

Plastids

- Plastids are present only in the plant cells
- Plastid is categorized as **– Chromoplasts** (it is colored plastids) and **Leucoplasts** (It is either white or colorless plastids).
- Plastids contain chlorophyll pigment, which are known as **Chloroplasts.**
- Chloroplasts play important role in the photosynthesis in plants.
- Chloroplasts also contain various types of yellow or orange pigments.
- Leucoplasts are the organelles in which some important materials such as starch, oils, and protein granules get stored.
- Plastids look like mitochondria (in terms of external structure).
- Like the mitochondria, plastids also possess their own DNA and ribosomes.

Vacuoles

- Vacuoles are commonly the storage sacs that contain solid or liquid materials.
- In animal cell, vacuoles are small; whereas in plant cell, vacuoles are of large size.
- Plant cells vacuoles are filled with cell sap and provide turgidity and rigidity to the cell.

Biology - Tissues

Introduction

- A group of cells that are similar in structure and work together to accomplish a particular function is known as **tissue.**
- Tissues are categorized as –
  - ◎ Plant Tissue & Animal Tissue

Plant Tissue

- Following are the major types of plant tissue –

◎Meristematic Tissues

◎Permanent Tissues

◎Simple Permanent Tissues

◎Parenchyma

◎Collenchyma

◎Sclerenchyma

◎Epidermis

- Complex Permanent Tissue

◎Xylem

◎Phloem

Meristematic Tissue

- Meristematic tissue mainly consists of actively dividing cells, and helps in increasing the length and thickening the stems of the plant.
- Meristematic tissue, commonly, present in the primary growth regions of a plant, for example, in the tips of stems or roots.
- Depending on the region (where the meristematic tissues are found); meristematic tissues are classified as **apical, lateral, and intercalary.**
- **Apical meristem** is present at the growing tips of stems and roots and helps in their growth.
- Lateral Meristem is found in stem or root region and helps in their growth.
- Intercalary meristem is found at the base of the leaves or internodes (on twigs) and helps in growth.

Permanent Tissue

- Cells of meristematic tissue later differentiate to form different types of permanent tissue.
- Permanent Tissue is further categorized as –

  ◎Simple Permanent Tissue and

  ◎Complex Permanent Tissue

Simple Permanent Tissue

- Simple Permanent Tissue further categorized as –

◎Parenchyma ◎Collenchyma

◎Sclerenchyma ◎Epidermis

- **Parenchyma tissue** provides support to plants and also stores food.
- Sometimes, parenchyma tissue contains chlorophyll and performs photosynthesis, in such a condition, it is known as **collenchyma.**
- The collenchyma tissue provides flexibility to plant and also provides mechanical support (to plant).
- The large air cavities, which are present in parenchyma of aquatic plants, give buoyancy to the plants and also help them float, are known as **aerenchyma.**
- The **Sclerenchyma** tissue makes the plant hard and stiff. For example, the husk of a coconut is made up of **sclerenchymatous tissue.**
- The cells of Sclerenchyma tissue normally are dead.
- The outermost layer of cells is known as **epidermis.**
- The epidermis is usually made up of a single layer of cells.
- The entire surface of a plant has the outer covering of epidermis, which protects all the parts of the plant.

Complex Permanent Tissue

- The complex tissue, normally, consists of more than one type of cells which work together as a unit.
- Complex tissues help in the transportation by carrying organic material, water, and minerals up and down in the plants.
- Complex Permanent Tissue is categorized as;

◎ Xylem and Phloem

- Xylem, normally, consists of tracheid, vessels, xylem parenchyma, and xylem fibers.
- Xylem is accountable for the conduction of water and mineral ions/salt.
- Phloem, normally, is made up of four types of elements namely −

◎ Sieve tubes ◎ Companion cells

◎ Phloem fibers and ◎ Phloem parenchyma

- Phloem tissue transports food from leaves to other parts of the plant.

Biology - Animal Tissue

Introduction

- The tissue found in animals have comparatively some different properties than the plant tissue.

Types of Animal Tissue

- Animal Tissues are divided as −

◎ Epithelial Tissue ◎ Connective Tissue

◎ Muscular Tissue ◎ Nervous Tissue

Epithelial Tissue

- Epithelial tissues are the covering and protective tissues in the animal body.
- Epithelial tissue covers almost all organs and cavities within the body.
- Epithelial tissue also forms a barrier to keep different body systems separate.
- Epithelial tissue cells are closely packed (as shown in the image given above) and form a continuous layer.

Connective Tissue

- Connective tissues are made up of the cells those are separated by non-living material, and known as an **extracellular matrix.**
- This matrix could be either liquid or rigid.
- Connective tissues are further divided as −

◎ Fibrous connective tissue

◎ Skeletal connective tissue and Fluid connective tissue

- Tendons are the example of fibrous connective tissue.
- Bone is an example of a skeletal connective tissue.
- Bone forms the framework and provide supports to the body.
- Blood is an example of fluid connective tissue.
- Blood has a fluid (liquid) matrix known as **plasma.**
- In plasma, the red blood cells (RBCs), the white blood cells (WBCs), and the platelets are remaining suspended.

Muscular Tissue

- Muscular tissue largely consists of elongated cells, and also known as muscle fibers.
- The muscular tissue is accountable for the movements in our body.
- The muscular tissue contains special proteins known as contractile proteins;

and this protein helps in contraction and relaxation and supports free movement.

Nervous Tissue

- The brain, spinal cord, and nerves all are composed of the nervous tissue.
- Cells of the nervous tissue are extremely particular and sensitive for being stimulated and then transmitting the stimulus swiftly from one place to another within the body.
- The cells of nervous tissue are known as nerve cells or neurons.
- Nerve impulses allow us to move our muscles whenever we want to do so.

Biology - Diversity in Living Organisms

Introduction

- Biodiversity term is used to define the diversity of life forms.
- Biodiversity is a word more often used to refer to the variety of life forms found in a particular geographic region.
- Diversity of life forms of a geographic region provides stability in the respective region.

Base of Classification

- Greek thinker **Aristotle** first classified animals based on their place of residence whether they lived on land, in water, or in the air.
- Later, all the living organisms are identified and categorized on the basis of their body design in form and function.
- The idea of evolution was first described by **Charles Darwin in 1859** in his book namely – **The Origin of Species.'**
- **Charles Darwin** first described this idea of evolution in 1859 in his book, 'The Origin of Species.'

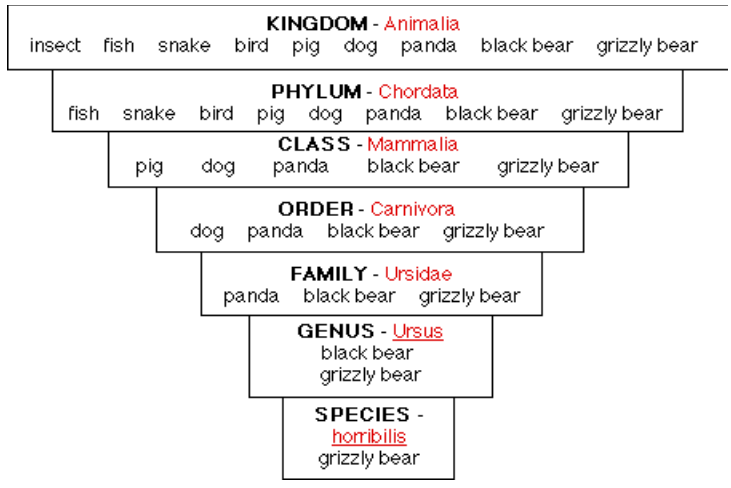
Hierarchy of Classification Groups

- Some biologists, namely **Ernst Haeckel (1894), Robert Whittaker (1959), and Carl Woese (1977)** have attempted to classify all living organisms into broad categories and named them 'Kingdoms.'
- Whittaker categorized into five kingdoms namely –

  1.Monera 2.Protista

  3.Fungi 4.Plantae
  5.Animalia

- Further, these kingdoms have been classification by naming the sub-groups at various levels as –



Monera

- The organisms of Monera kingdom do not have a defined nucleus or organelles, neither do any of them show multi-cellular body designs.

- The examples of this monera kingdom are bacteria, anabaena, blue-green algae or cyanobacteria, and mycoplasma.

Protista

- The organisms of Protista kingdom include many kinds of unicellular eukaryotic organisms.

Euglena

- The examples of Protista kingdom are algae, euglena, diatoms, and protozoans, etc.

Fungi

- The organisms of fungi kingdom are heterotrophic eukaryotic organisms.
- The organisms of this kingdom use decaying organic material as their food and therefore, they are also known as saprophytes.

Plantae

- The organisms of this kingdom are multicellular eukaryotes with cell walls.
- The organisms of plantae are autotrophs and they use chlorophyll for making their food (i.e. photosynthesis).
- All plants are examples of plantae kingdom.

Animalia

- The organisms of Animalia kingdom are all organisms which are multicellular eukaryotes without cell walls.
- Organisms of Animalia kingdom are heterotrophs.

Biology - Plantae Kingdom

Introduction

- Plantae kingdom includes all sorts of plants belonging to multicellular eukaryotes.
- These plants are autotrophs and they use chlorophyll for the photosynthesis.

Classification of Plantae Kingdom

- Based on distinct body structure, components, etc. plantae kingdom is further classified as −

1. Thallophyta 2. Bryophyta 3. Pteridophyta

4. Gymnosperms 5. Angiosperms

Thallophyta

- The plants of thallophyta do not have well-differentiated body design.
- The plants in thallophyta are known as algae and they are predominantly aquatic.
- Some of the significant examples of thallophyta are Spirogyra, Ulothrix, Cladophora, Chara, etc.

Bryophyta

- The plants of amphibian group are categorized as **bryophyta.**
- Though not distinctly developed, but the plant body can be differentiated to form stem and leaf-like structures.
- The examples of bryophyta are moss (Funaria) and Marchantia.

Pteridophyta

- Plants of pteridophyta have defined roots, stem, and leaves.

- Pteridophyta plants have specialized tissue that transports water and other materials from one part to another part of the plant.
- Examples of pteridophyta are Marsilea, ferns, and horse-tails.
- The commonality among the thallophytes, the bryophytes, and the pteridophytes are – all of them have naked embryos, which are known as spores.
- The reproductive organs of plants of these groups are known as **'cryptogamae,'** which means 'hidden reproductive organs'.

Gymnosperm

- The plants of gymnosperm bear naked seeds.
- These plants are normally perennial, evergreen, and woody.
- Examples of gymnosperm are pines (such as deodar, cycas, etc.

Angiosperms

- The plants of angiosperm bear covered seeds.
- Plants of angiosperm are also known as **flowing plants.**
- Plant embryos in seeds have a typical structures known as cotyledons, which is also called as **'seed leaves.'**

Biology - Animalia Kingdom

- The organisms, which are eukaryotic, multicellular, and heterotrophic, are categorized as **Animalia kingdom.**
- The organisms of Animalia kingdom have no cell-wall.
- Most of animals of Animalia kingdom are mobile.

Classification of Animalia Kingdom

Based on the extent and type of the body design differentiation, Animalia kingdom classified as −

1. Porifera 2. Coelenterata

3.Platyhelminthes 4.Nematoda

5.Annelida 6. Arthropoda 7.Mollusca

8. Echinodermata 9.Protochordata

10. Vertebrata

◎Pisces ◎Amphibia ◎Reptilia

◎Aves ◎Mammalia

Porifera

- The literal meaning of 'porifera' is the organisms with holes.
- The organisms of porifera are non-motile and attached to some solid support.
- The examples of this group are Sycon, Spongilla, Euplectelia, etc.

Coelenterata

- Organisms of coelenterata group live in water.
- The organisms of this group have cavity in their bodies.
- Hydra and sea anemone are the common example of coelenterate.

Platyhelminthes

- The organisms of this group do not have true internal body cavity or coelom; so, they neither have well-developed organs.

- The bodies of organisms of this group are flattened from top to bottom; therefore, they are also known as flatworms.
- Planareia, liverfluke, tape worm, etc., are the typical examples of this group.

Nematoda

- The organisms of nematode have cylindrical body.
- The organisms have tissue, but as such no well-developed body (i.e. no real organ).
- The filarial worms (causing elephantiasis disease), roundworm in the intestines, etc., are the common examples of nematodes.

Annelida

- The organisms of annelida group live almost everywhere including fresh water, marine water as well as on land.
- Earthworms, nereis, and leeches are the familiar examples of annelida.

Arthropoda

- Arthropoda, probably, is the largest group of animals. The animals of 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 the typical examples of arthropod.

Mollusca

- The organisms of mollusca are invertebrate.
- Most of the organisms of Mollusca group live in water.
- Snails and mussels are the typical example of Mollusca.

Echinodermata

- The organisms of Echinodermata have spiny skinned.
- Echinodermata are free-living marine organisms.
- The examples of echinodermata are starfish, sea urchins, feather star, etc.

Protochordata

- The organisms of protochordata are normally marine. E.g. Balanoglossus, Herdemania, and Amphioxus
- The organisms of protochordata show a typical feature of body design, called as notochord; however, it does present there throughout the life.

Vertebrata

- Vertebrata has been discussed in a separate chapter.

Biology - Vertebrata

Introduction

- The organisms of this kingdom have a true vertebral column and the internal skeleton structure.

Classification of Vertebrata

- Vertebrates are further classified as −

1.Pisces 2.Amphibia

3. Reptilia 4.Aves

5. Mammalia

Pisces

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

Amphibia

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

Reptilia

- The organisms of this group are cold bolded.
- The organisms of reptilia lay eggs with tough coverings.

Aves

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

Mammalia

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

Biology - Transportation in Humans

Introduction

- The blood is responsible to transport food, oxygen, and waste materials in human bodies.
- Blood usually consists of a fluid medium known as plasma where the cells remain suspended.
- Plasma is responsible to transport food, carbon dioxide, and nitrogenous wastes in dissolved form.
- However, oxygen is carried by the red blood cells.
- Many other substances such as salts, are also transported by the blood.

A Human Heart

- The heart is one of the most significant muscular organs of a human body.

- As both the oxygen and the carbon dioxide get transported by the blood; so, to avoid the oxygen-rich blood from mixing with the blood containing carbon dioxide, the heart has different chambers
- Oxygen-rich blood from the lungs comes to the thin-walled upper chamber of the heart on the left, i.e. the left atrium (see the image given above).
- When it is collecting the blood, the left atrium relaxes; however, while the next chamber, i.e. the left ventricle expands, then it (left atrium) contracts, so that the blood is transferred to it.
- Further, when the muscular left ventricle contracts (in its turn), the blood is pumped out to the body. Likewise, de-oxygenated blood comes from the body to the upper chamber on the right, the right atrium (as it expands).
- When the right atrium contracts, the corresponding lower chamber, the right ventricle, dilates and this act transfers blood to the right ventricle, which in turn pumps it to the lungs for oxygenation.
- The ventricles have thicker muscular walls (than the atria do), as ventricles have to pump blood into various organs.
- There are valves that ensure that the blood does not flow backwards when the atria or ventricles contract.
- The separation of the right side and the left side of the heart is beneficial, as it avoids oxygenated and deoxygenated blood from mixing.
- The animals, which do not use energy to maintain their body temperature, their body temperature depends on the temperature in the environment.
- Such animals (e.g. amphibians or many reptiles), have three-chambered hearts, and bear some mixing of the oxygenated and de-oxygenated blood streams.
- Fishes, on the other hand, have only two chambers to their hearts; however, the blood is pumped to the gills and get oxygenated there, and then passes directly to the rest of the body.

Blood Pressure

- The force that blood exerts against the wall of a vessel is known as blood pressure.
- The blood pressure is much greater in arteries than in veins.
- During the ventricular systole (i.e. contraction), the pressure of blood inside the artery, is known as systolic pressure.
- On the other hand, the pressure in artery during ventricular diastole (relaxation), is known as diastolic pressure.
- The normal measurement of systolic pressure is about 120 mm of Hg and diastolic pressure is 80 mm of Hg. Increase of this pressure is known as high blood pressure or hypertension.
- The instrument that measures the blood pressure is known as sphygmomanometer.

Lymph

- Some amount of plasma, proteins, and blood cells escape (through the pores present in the walls of capillaries), into intercellular spaces in the tissues and form the tissue fluid known as lymph.

- Though lymph is similar to the plasma of blood, but it is colorless and contains less protein.
- An important function of lymph is to carry digested and absorbed fat from intestine and drains excess fluid from extra cellular space back into the blood.

Biology - Transportation in Plants

Introduction

- The plants have low energy needs, as they use relatively slow transport systems.
- Plant transport systems move energy from leaves and raw materials from roots to all their parts.
- The xylem (tissue) moves water and minerals obtained from the soil to all other parts of the plants.
- The phloem (tissue) transports products of photosynthesis from the leaves (where they are synthesized) to other parts of the plant.
- Water moves into the root from the soil and then steady it moves into the root xylem, creating a column of water, which is progressively pushed upwards.
- Evaporation of water molecules from the cells of a leaf (see the image given above) creates a suction process, which pulls water from the xylem cells of roots; this process keeps going on.
- The loss of water in the form of vapor from the leaves (i.e. aerial parts) of the plant is known as transpiration.
- Transpiration, likewise, helps in the absorption and upward movement of water and minerals dissolved in it from roots to the leaves.
- Transpiration also helps in the temperature regulation (in plants).
- The transport of soluble products of photosynthesis is known as translocation, which occurs in the part of the vascular tissue known as phloem.
- Along with photosynthesis products, the phloem also transports amino acids and other substances, which are ultimately delivered to roots, fruits, seeds, and to growing organs.

Biology - Excretion

Introduction

- The biological process that involves in the removal of the harmful metabolic wastes from the human body is known as excretion.
- Different species (organisms) use different processes for the excretion. E.g. many unicellular organisms remove their wastes by simple diffusion process from the body surface into the surrounding water.

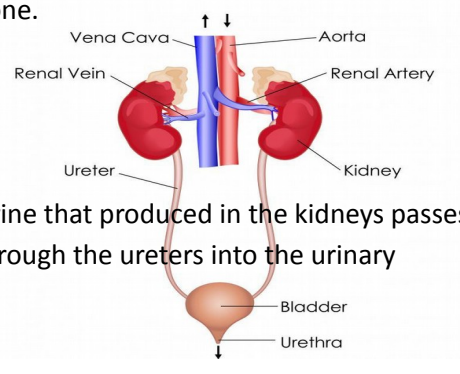
Excretion in Human Beings

The body parts that the excretory system (of human beings) includes are –

◎A pair of kidneys ◎A pair of ureters

◎A urinary bladder ◎A urethra

Kidneys are located in the abdomen (see the image given below), one on either side of the backbone.



- Urine that produced in the kidneys passes through the ureters into the urinary

bladder where it gets stored until released through the urethra.

- On the other hand, plants have completely different process for excretion than those of animals.
- Oxygen (released in the day-time) itself can be considered as a waste product generated during photosynthesis.
- Many plant waste products are stored in leaves that fall off.
- Some other waste products, in plants, are stored as resins and gums, especially in old xylem.

Biology - Control and Coordination

Introduction

In multicellular organisms, following the general principles of body organization, some specialized tissues are used to provide the control and coordination activities.

Nervous System

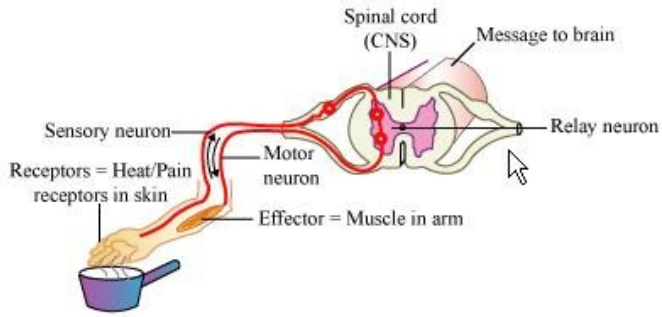
- Nervous system is specialized system that provide control and coordination in animals.
- All information, coming from our environment is detected by the specialized tips of some nerve cells, which are usually located in sense organs.
- The information, acquired at the end of the dendritic tip (shown in the image given below) of a nerve cell, sets off a chemical reaction that creates an electrical impulse.
- This (electrical) impulse, which travels from the dendrite tip to the cell body, and then along the axon to its end of the axon, sets off the release of some chemicals. These chemicals cross the gap, or synapse, and create a similar electrical impulse in a dendrite of the next neuron

Neuromuscular Junction

- Likewise, the nervous tissue is made up of an organized network of nerve cells or neurons, and is dedicated for carrying information via electrical impulses from one part of the body to another.

Reflex Actions

- If the nerves that detect heat, cold, or any such kind of more sensational element move muscles in a simpler way; so, the process of detecting the signal or the input and responding to it by an output action, is known as reflex action and such connection is known as a reflex arc (see the image given below).



Human Brain

- The communication between the central nervous system and the other parts of the body is established by the peripheral nervous system.
- Peripheral nervous system consists of cranial nerves, which arise from the brain and spinal nerves.
- The brain (shown in the image given below) facilitates us to recognize, think, and take actions accordingly.

The brain is categorized into three major parts or regions, namely the fore-brain, mid-brain, and hind-brain.

Among these three parts (of the brain), fore-brain is the main thinking part of the brain; further, fore-brain are specialized for hearing, smell, sight, etc.

When brain gives command, muscle moves – it happens because muscle cells have special proteins that change both their (muscle's) shape and arrangement in the cell in response to nervous electrical impulses.

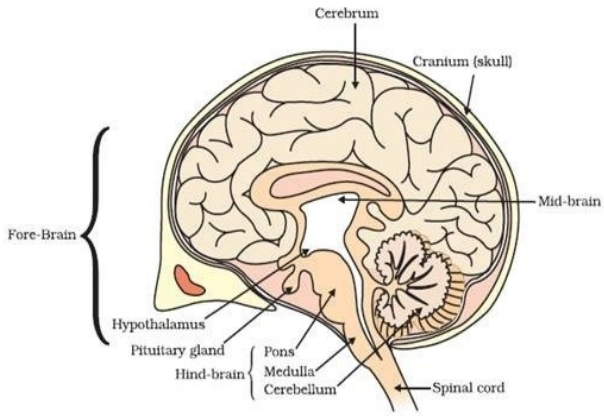


Figure 7.3 Human brain

Biology - Hormones in Animal

Introduction

- Human body has different glands (as shown in the image given below) that secret Hormones (liquid substance), which are essential for the different body functions.
- Adrenaline Hormone is secreted from the adrenal glands. It is secreted directly into the blood and then carried to different parts of the body.
- On the other hand, plants have hormones that control and regulate their directional growth.
- Iodine is essential for the thyroid gland that makes thyroxin hormone.
- Further, Iodine is an essential element for the synthesis of thyroxin.
- Deficiency of Iodine, that might cause goiter.
- The term "goiter" refers to the abnormal expansion of the thyroid gland (resulting into swollen neck).
- Thyroxin Hormone regulates carbohydrate, protein, and fat metabolism in the body and provide the best balance for body growth.
- Growth hormone, which is secreted by the pituitary gland, regulates growth and development of the body.
- The deficiency of growth hormone in childhood causes dwarfism short height.
- During the age of 10-12, there are certain physical change in the bodies of children, which is caused by the secretion of testosterone in boys and oestrogen in girls.
- As shown in the image given above, it is significant difference between male and female body i.e. males have testis (secretes Testosterone Hormone) and females have ovary (secretes Oestrogen Hormone).
- Insulin is a hormone, which is produced by the pancreas and helps in regulating the sugar levels of blood.
- If insulin is not secreted in proper amounts or on a proper time, the sugar level in the blood rises, which may cause different harmful effects in the body.

Biology - How do Organisms Reproduce?

Introduction

A basic occurrence in reproduction is the creation of a DNA copy; to produce copies of the DNA, cells use chemical reactions.

The DNA in the cell nucleus is actually the information source for creating proteins. Likewise, if the information is changed here, then different proteins will be created. And, these different proteins will eventually lead to altered the body designs.

DNA

DNA copies that generated would be similar, but may not be identical to the original. And, because of these variations, the new born cells are slightly different.

Further, the consistency of DNA copying during reproduction process is significant for the maintenance of body design and features.

Modes of Reproduction Used by Cell Organisms

The modes by which various Cell Organisms reproduce depend on their body designs. However, it is broadly categorized as −

Asexual Reproduction &

Sexual Reproduction

Let’s discuss each of them in Brief −

Asexual Reproduction

Asexual Reproduction can be studied through the following different sub-categories −

Fission

Fragmentation

Regeneration

Budding

Vegetative Propagation

Spore Formation

Let’s discuss each of them in brief −

Fission

In some unicellular organisms such as Amoeba, the cell split into two cells during the cell division and produce two new organisms (see the image given below).

It is also known as binary fission.

Amoeba Fission

Many bacteria and protozoa simply split into two equal halves during their cell division and produce two identical organisms.

Remember, some other single-celled organisms, such as Plasmodium (the malarial parasite), divide into many daughter cells simultaneously, known as multiple fission (see the image given below).

Plasmodium Multiple Fission

Fragmentation

After the maturity, some multicellular organisms, such as Spirogyra, simply breaks up into smaller pieces and these pieces or fragments grow into new individuals.

Regeneration

Some of the organisms, such as Planaria, if its body cut or broken up into many pieces, then many of these pieces grow into complete separate individuals; the whole process is known as regeneration.

Planaria

Budding

In some organisms, such as Hydra, because of the repeated cell division at one specific place, a bud develops, which later (once fully grown) gets detached from the parent body and becomes a new independent individual (see the image given below).

Hydra

Vegetative Propagation

Under a favorable condition, there are many plants, which parts like the root, stem, and leaves develop into new plants; such process is known as vegetative propagation (see the image given below).

Leaf of Bryophyllum Buds

Spore Formation

Some plants and many algae undergo sporic formation (through meiosis cell division) that leads to the formation of spores. Further, these spores grow into multicellular individuals.

Spore Formation

Biology - Sexual Reproduction

Introduction

The sexual mode of reproduction comprises the process of combining DNA from two different individuals.

There are two germ-cells (responsible for producing a new organism); one is large and contains the food-stores whereas the other one is smaller and likely to be motile.

The motile germ-cell, normally, is known as the ‘male gamete’ and the germ-cell containing the stored food is known as the ‘female gamete.’

Sexual Reproduction in Flowering Plants

As shown in the image given below, flowers have different parts, such as sepals, petals, stamens, and carpels. Among these, stamens and carpels are the reproductive parts and contain the germ-cells.

Flowers with Different Parts

Stamen is the male reproductive part, which produces pollen grains (yellowish substance).

Carpel, which is present in the center of a flower, is the female reproductive part.

Carpel is made of three parts.

The bottom part, which is swollen, is the ovary; the middle part, which is elongated, is known as the style; and the terminal part, which may be sticky, is known as the stigma.

Germination of Pollen Stigma

The ovary contains ovules and each ovule has an egg cell.

The male germ-cell that produced by the pollen grain fuses with the female gamete present in the ovule.

The fusion of the germ-cells or fertilization produces zygote, which is capable of growing into a new plant.

The flower, which contains either stamens or carpels, is known as unisexual, such as papaya, watermelon, etc.

The flower, which contains both stamens and carpels, is known as bisexual, such as Hibiscus, mustard, etc.

Reproduction in Human Beings

Human beings have typical sexual reproduction process where mature male and female mate to produce a new baby.

Male Reproductive System

The male reproductive system produces the germ-cells; further, other part of the reproductive system delivers the produced germ-cells to the site of fertilization.

The formation of sperms or germ-cells takes place in the testes.

The formation of sperm typically requires a lower temperature than the normal body temperature.

The testes secrete hormone, namely testosterone that brings changes in the appearance of boys at the time of their puberty.

The formed sperms are then delivered through the vas deferens, which unites with a tube coming from the urinary bladder.

The urethra, likewise, acts as a common passage for both the sperms and urine.

The sperms are fluids that consist of mainly genetic material; it has a long tail that helps to move towards the female germ-cell.

Female Reproductive System

The female germ-cells or eggs are produced in the ovaries.

The egg is transported from the ovary to the womb through a thin oviduct known as fallopian tube.

The two oviducts unite and form an elastic bag-like structure known as the uterus, which opens into the vagina through the cervix.

During the sexual intercourse, most likely, the egg and the sperm (zygote) get fertilized and implanted in the lining of the uterus.

The thickened lining (of the uterus) and richly supplied blood nourish the growing embryo (in the uterus).

The embryo receives nutrition from the mother's blood with the help of a special tissue known as placenta.

Likewise, the development of a child inside the mother's body, takes about nine months.

Biology - Reproduction in Animals

Introduction

Reproduction is the most essential for the continuation of a species.

Reproduction ensures the continuation of similar kinds of species, generation after generation.

Modes of Reproduction

Following are the two modes of reproduction −

Sexual reproduction

Asexual reproduction

Let us discuss each one separately −

Sexual Reproduction

In animals, males and females have different reproductive organs.

The reproductive parts in animals produce gametes that fuse and form a zygote.

The zygote develops into a new similar species.

The type of reproduction through the fusion of male and female gametes is known as sexual reproduction.

The male gametes, produced by testes, are known as sperms.

The female gametes, produced by ovary, are known as ova (or eggs).

In the process of reproduction, the first step is the fusion of a sperm and an ovum (egg).

Fertilization

Fusion of the egg and the sperm is known as fertilization (as shown in the above image).

During the fertilization, the nuclei of the sperm and the egg fuse together and form a single nucleus that result into the formation of a fertilized egg also known as zygote (shown in the image given below).

Zygote

The zygote further divides repeatedly to give rise to a ball of cells that begin to form groups. The groups develop into different tissues and organs constituting a full body. In the process, the developing structure is known as an embryo (shown in the image given below).

Embryo Development

The embryo continues to develop in the uterus and develops body parts such as head, face, ear, eyes, nose, hands, legs, toes, etc.

The stage of the embryo in which different parts of the body develop and can be identified is known as foetus (shown in the image given below).

Foetus in Uterus

In a defined period of time, when the development of the foetus is complete, the mother gives birth to the baby.

The animal which gives birth to young ones is known as viviparous animal. E.g. Human, cow, dogs, etc.

The organism that lays eggs is known as oviparous animal. E.g. all birds (except bats), lizard, etc.

Asexual Reproduction

The type of reproduction in which only a single parent, gets divided into two new offspring, is known as asexual reproduction. E.g. Hydra and Amoeba.

In hydra, the individuals develop from the buds; therefore, this type of asexual reproduction is known as budding (shown in the image given below).

Hydra

In amoeba, nucleus gets divided into two nuclei; therefore, such kind of asexual reproduction is known as binary fission.

Amoeba Fission

Cloning

Cloning is the modern science technique to produce an exact copy of a cell, any other living part, or a complete organism.

For the first time, cloning of an animal was successfully performed by Ian Wilmut and his colleagues at the Roslin Institute in Edinburgh, Scotland.

In 1996, they cloned successfully a sheep and named that Dolly.

Biology - Reaching the Age of Adolescence

Introduction

The phase of life, when the body undergoes radical changes, leading to reproductive maturity, is known as adolescence.

Adolescence normally begins around the age of 11 and lasts up to 18 or 19 years of the age. However, the phase of adolescence varies from person to person.

Starting from thirteen (13) to nineteen (19), 'teen' is suffix and common in every number; therefore, adolescents are also known as 'teenagers.'

In girls, adolescence phase may begin one year or two years earlier than the boys.

During the adolescence phase, the human body undergoes several changes, which are marked as the onset of puberty.

The most important change, which marks puberty, is that the boys and the girls become capable of reproduction.

Puberty, however, ends when an adolescent phase attains reproductive maturity.

Changes at Puberty

The most conspicuous change during the puberty is the swift increase in height.

In the beginning, girls grow faster than boys, but by reaching 18 years of the age, both attain their maximum height.

The rate of body growth (in terms of height) varies from person to person.

The changes occurring in adolescent boys and girls are also much different.

At puberty, especially the boys' voice boxes or the larynxes begin to grow and develop larger voice boxes.

The growing larynxes in boys can be seen as a protruding part of the throat; it is known as Adam's apple.

In girls, the larynx is small; hence, it is not visible from the outside.

Adolescence is also the phase of change in a person's way of thinking.

Hormones, which are the chemical substances, are responsible for the changes in adolescence.

The testes (in boys), at the onset of puberty, release testosterone hormone.

Once puberty is reached in girls, ovaries begin to produce the hormone namely estrogen; it is responsible to the breasts develop.

Endocrine glands release hormones directly into the bloodstream.

In the body, there are many endocrine glands or ductless glands.

The sex hormones are under the control of hormones released by the pituitary gland.

Reproductive Phase of Life in Humans

At puberty, the released egg (in women), and the thickened lining of the uterus along with its blood vessels get shed off in the form of bleeding known as menstruation.

The first menstrual flow begins at puberty and is known as menarche.

Menstruation occurs once in about 28 to 30 days.

By the age of 45 to 50 years, the menstrual cycle stops, which is known as menopause.

The thread-like structures in the fertilized egg are known as chromosomes.

All human beings have 23 pairs or 46 chromosomes in the nuclei of their cells.

In boys, out of 23 pairs of chromosomes, two chromosomes named X and Y are the sex chromosomes.

In girls, out of 23 pairs of chromosomes, two chromosomes named X and X are the sex chromosomes.

When a sperm carrying X chromosome fertilizes with the egg, the zygote would have two X chromosomes that develop into a female child (as shown in the image given below).

Sperm Eggs

When a sperm carrying Y chromosome fertilizes with the egg, the zygote would have two chromosomes i.e. X and Y and such zygote develops into a male child (as shown in the image given above).

Biology - Heredity and Evolution

Introduction

The principle of heredity determines the process by which traits and characteristics of an organism are reliably inherited.

There are some organisms (especially plants) in which there are very less variations and sometimes difficult to establish the differences, but in some other organisms (especially human beings), there are comparatively greater variations. This is the reason that offspring do not look similar.

Rules for the Inheritance of Traits – Mendel's Contributions

Johann Mendel is known as "father of modern genetics."

In human beings, the rules for inheritance of traits and characteristics are related to the fact that both the father and the mother equally contribute the genetic material to their child.

Further, each trait of an offspring is usually influenced by both paternal and maternal DNA.

Johann Mendel, who was an Austrian scientist, had experimented on peas and gave the "laws of inheritance."

Johann Mendel

Mendel used a various contrasting visible characters of garden peas – round/wrinkled seeds, tall/short plants, white/violet flowers and many more to prove his law of inheritance.

Mendel's law of inheritance became popular as "as the laws of Mendelian inheritance."

The frequency of an inherited trait changes one after another generation. This happens because of change in genes (as genes control traits).

Evolution – Charles Darwin

Charles Darwin was an English geologist, biologist, and naturalist; and, he is best known for his contributions to the science of evolution.

Charles Darwin

In 1859, Darwin published his book “On the Origin of Species” explaining the theory of evolution (by natural selection).

Darwin’s theory of evolution describes - how life evolved from a simple to more complex forms; whereas, Mendel’s experiments explains the mechanism for the inheritance of traits from one generation to the next.

Evolution is basically the generation of diversity and the shaping of the diversity by the means of environmental selection.

Over period of time, variations in the species may advise survival advantages or merely an example of the genetic drift.

Further, changes in the non-reproductive tissues, are largely because of environmental factors (not by inheritance).

Evolution of Human Beings

Study of the process of evolution of human beings specifies that most likely all human beings belong to a single species that evolved in Africa continent and over period of time spread across the world in phases.

The complex organs and other features most likely evolved and adapted to cope up with changing environment; the whole phenomenon is known as evolution. E. g., feathers (of birds) are believed to have been initially evolved for warmth, but later adapted for flight.

Biology - Life Processes

Introduction

The processes, which collectively perform the maintenance of our body system, are known as life processes.

The maintenance processes protect us from damage and break-down; however, to keep these maintenance processes working properly, we need to provide energy to them. Healthy food is the best source of such energy.

Nutrition

We need energy from outside in order to grow, develop, synthesize protein, and other substances.

The ultimate source of energy is varieties of healthy foods. These foods provide us nutrition essential for our survival.

Depending upon the sources, nutrition is categorized as Autotrophic Nutrition and Heterotrophic Nutrition.

Autotrophic Nutrition

The autotrophic nutrition is prepared through the process of photosynthesis.

Photosynthesis is a process by which autotrophic organisms (green plants) take in substances from the outside and then convert them into stored forms of energy.

During the process of photosynthesis, carbon dioxide and water, are converted into carbohydrates in the presence of sunlight and chlorophyll.

The final product carbohydrates provide energy to the plant.

Usually, green leaves are responsible for the photosynthesis process.

During the photosynthesis process, the chlorophylls present in the leaves, absorb the light energy and convert it (light energy) into chemical energy and split the water molecules into hydrogen and oxygen. And, finally carbon dioxide is reduced to hydrogen.

Crosssection of Leaf

A cross-section of a leaf is shown in the above image; in the above image, green dots are cell organelles, which are known as chloroplasts; the chloroplasts contain chlorophyll.

Heterotrophic Nutrition

There are different sources of heterotrophic nutrition; however, the nutrition, which is derived from the autotrophic organisms is known as heterotrophic nutrition.

For example, Amoeba (a unicellular organism) takes in food by using temporary finger-like extensions of the cell surface.

The finger-like extensions of the cell surface fuse over the food particle and form a food-vacuole (see the image given below).

Nutrition in Amoeba

Nutrition in Human Beings

The alimentary canal, starting from the mount to the anus, is fundamentally a long tube and accountable for the whole nutrition process.

As shown in the image below, the alimentary canal has different parts that play different functions.

When we eat any food stuff that we like, our mouth ‘waters,’ which is not only water, but also mixed with a fluid known as saliva.

Saliva is secreted by the salivary glands.

The saliva contains an enzyme known as salivary amylase; this salivary amylase breaks down the starch to give sugar. Starch is a complex molecule.

After the mouth, the food is taken to the stomach through the food-pipe known as oesophagus.

The muscular walls of the stomach support in mixing the food thoroughly in the presence of more digestive juices.

Further, the digestive functions are taken care by the gastric glands, which is present in the wall of the stomach.

The gastric glands release hydrochloric acid, a protein digesting enzyme known as pepsin, and mucus.

Human Alimentary Canal

The small intestine (shown in the image above) is the site of the complete digestion of carbohydrates, proteins, and fats.

The walls of the small intestine comprise glands, which secrete intestinal juice.

Further, the digested food is taken up by the walls of the intestine.

The inner lining of the small intestine has typical features i.e. numerous finger-like projections known as villi. Villi increase the surface area for absorption.

The villi are profusely supplied with the blood vessels; the villi take the absorbed food to each and every cell of the body, where it is utilized for obtaining energy, repairing of old tissues, and building up new tissues.

The unabsorbed food is sent into the large intestine where more villi absorb water from this unabsorbed food.

The rest of the waste material is removed from the body through the anus.

Biology - Respiration

Introduction

The food material, taken in during the process of nutrition, is used by cells and then they provide energy for various life processes.

Some organisms use oxygen to break-down glucose completely into carbon dioxide and water, such processes normally take place in cytoplasm.

The following diagram illustrates the whole process of break-down of glucose through various pathways −

Break-down of Glucose

During cellular respiration, the energy released, is immediately used to synthesize a molecule known as ATP.

ATP is further used to fuel all other activities in the cell. However, in these processes, ATP is broken down and give rise to a fixed amount of energy. This energy usually drives the endothermic reactions taking place in the cell.

Adenosine triphosphate or simply ATP is a small molecule used in cells as a coenzyme (see image given below).

More often, ATP is referred as the energy currency for most of the cellular processes (especially intracellular energy transfer).

ATP

Likewise, ATP transports chemical energy within cells for metabolism purpose.

In plants, at night, when the process of photosynthesis is not taking place, for such a period, CO_2 elimination is the major exchange activity.

On the other hand, during the day, the CO_2, which is getting generated during respiration, is used up for the photosynthesis process, hence there is no CO_2 release. But, at this time, oxygen release is the major event.

The terrestrial animals can breathe the oxygen free available in the atmosphere, but animals that live in water have to use the oxygen dissolved in water.

The rate of breathing in aquatic organisms is much faster than that of terrestrial organisms, because the amount of dissolved oxygen (in water) is fairly low in comparison to the amount of oxygen present in the air.

Respiration in Human

In human beings, air is inhale into the body through the nostrils.

Through the nostrils, the air passes through the throat and into the lungs.

Further, there are Rings of cartilage, present in the throat; these rings ensure that the air-passage does not collapse (see the image given below).

Human Respiratory System

Within the lungs, the passage gets divided into smaller and smaller tubes (see the image above), which finally terminate in balloon-like structures known as alveoli.

The alveoli provide a base or surface where the exchange of gases can take place.

The walls of the alveoli comprise an extensive network of blood-vessels. So, while breathing in, we lift our ribs and flatten our diaphragm; as result of this, the chest cavity becomes larger. During the process, air is sucked into the lungs and fills the expanded alveoli.

The blood, on the other hand, brings carbon dioxide from the rest of the body for release into the alveoli, and the oxygen in the alveolar air is taken up by blood in the alveolar blood vessels for further transportation to all the cells in the body.

Remember, during the breathing cycle, when we take air in and let it out, the lungs always store a residual volume of air so that there is sufficient time for the oxygen to be absorbed and for the carbon dioxide to be released.

In human bodies, the respiratory pigment is haemoglobin; and the haemoglobin has a high affinity for oxygen.

The haemoglobin is present in the red blood corpuscles.

In comparison to oxygen, carbon dioxide is more soluble in water and hence it is mostly transported in the dissolved form in blood.

Biology - Microorganisms: Friend and Foe

Introduction

The living organisms (available around us), which we cannot see with our naked eyes, are known as microorganisms or microbes.

Microorganisms are classified into the following four major groups −

Bacteria

Fungi

Protozoa

Algae

Viruses

Viruses are also microscopic microorganism.

Viruses get reproduced only inside the cells of the host organism, which may be a bacterium, plant, or animal.

The common ailments, such as cold, influenza (flu), and coughs are caused by viruses.

The serious diseases, such as polio and chicken pox are also caused by viruses.

The diseases like dysentery and malaria are caused by protozoans.

The diseases like typhoid and tuberculosis (TB) are caused by bacteria.

The single celled microorganisms are known as bacteria, algae, and protozoa.

The multicellular microorganisms are known as fungi and algae.

The microorganism can survive in any type of environment ranging from ice cold to hot desert.

Microorganisms are also found in the bodies of animals and human beings.

Microorganisms, such as amoeba, can live alone; whereas the fungi and bacteria live in colonies.

Some of the microorganisms are beneficial to us in many ways whereas some others are harmful and cause diseases to us.

Friendly Microorganisms

Microorganisms are used for various purposes, such as preparation of curd, bread, cake; production of alcohol; cleaning up of the environment; preparation of medicines; etc.

In agriculture, microorganisms are used to increase soil fertility by nitrogen fixation.

The bacterium lactobacillus helps in the formation of curd.

The microorganisms, yeast is used for the commercial production of alcohol and wine.

For the large scale use of yeast, it is grown on natural sugars present in grains like wheat, barley, rice, crushed fruit juices, etc.

The process of conversion of sugar into alcohol (by yeast) is known as fermentation.

Streptomycin, tetracycline, and erythromycin are some of the commonly used antibiotics; these are made from fungi and bacteria.

These days, antibiotics are mixed with the feed of livestock and poultry that check microbial infection in the animals.

Several diseases, such as cholera, tuberculosis, smallpox and hepatitis can be prevented by vaccination.

In 1798, Edward Jenner discovered the vaccine for smallpox.

Harmful Microorganisms

The microorganisms that cause diseases to human beings, animals, and plants, are known as pathogens.

Pathogens enter into humans' body through the air while breathing, the water while drinking, or the food while eating.

Some pathogens are transmitted by direct contact with an infected person or carried through an animal.

The microbial diseases that normally spread from an infected person to a healthy person through air, water, food or physical contact are known as communicable diseases. E.g. cholera, common cold, chicken pox, tuberculosis, etc.

Female Anopheles mosquito carries the parasite of malaria and known as carrier.

Female Aedes mosquito carries the parasite of dengue virus.

Human Diseases

The following table illustrates some Common Human Diseases caused by Microorganisms −

Human Disease	Causative Microorganism	Mode of Transmission
Tuberculosis	Bacteria	Air
Measles	Virus	Air
Chicken Pox	Virus	Air/Contact
Polio	Virus	Air/Water
Cholera	Bacteria	Water/Food
Typhoid	Bacteria	Water
Hepatitis B	Virus	Water
Malaria	Protozoa	Mosquito

Microorganisms causing Disease in Animals

In 1876, Robert Köch discovered the bacterium (Bacillus anthracis), which causes anthrax disease.

Anthrax, a dangerous disease caused by a bacterium, affects both human and cattle.

Foot and mouth disease of cattle is caused by a virus.

The following table illustrates some Common Plant Diseases caused by Microorganisms −

Plant Disease	Causative Microorganism	Mode of Transmission
Citrus canker	Bacteria	Air
Rust of wheat	Fungi	Air, seeds
Yellow vein mosaic of bhindi (Okra)	Virus	Insects

Food Preservation

Salts and edible oils are the common chemicals usually used to check the growth of microorganisms, they are known as preservatives.

Sodium benzoate and sodium metabisulphite are also used as common preservatives.

Common salt is usually used to preserve meat and fish for ages.

Sugar reduces the moisture content, which prevents the growth of bacteria; therefore, Jams, jellies, and squashes are preserved by sugar.

Use of oil and vinegar averts spoilage of pickles, as bacteria cannot live in such kind of environment.

When the milk is heated at about 700C for 15 to 30 seconds and then swiftly chilled and

stored; the process prevents the growth of microbes. This process was conceptualized by Louis Pasteur; therefore, it is known as pasteurization.

Nitrogen Cycle

Nitrogen Cycle

Biology - Why do We Fall Ill

Introduction

Health means a state of mental, physical, and social well-being.

The health of an organism largely depends on his/her surroundings or the environment.

Health

Major causes of poor health are - the garbage, which is thrown in an open area nearby residence or streets, or/and the open drain water lying stagnant around the residence area.

The public cleanliness is the key of good health.

Some diseases, last only for a short period of time, are known as acute diseases. E.g. cold, fever, etc.

The diseases that last for a long period of time, even as much as a lifetime, are known as chronic diseases. E.g. asthma, osteoporosis, etc.

Chronic diseases, normally, have very severe long-term effects on people's health as compared to the acute diseases.

Infectious Diseases

When microbes are the immediate causes of a disease, it is known as infectious diseases.

Some of the major agents of infectious diseases are viruses, bacteria, fungi, and some single-celled animals (protozoans).

Some diseases are caused by the multicellular organisms; such as worms.

Kala-azar or black fever is caused by a protozoan parasite of genus Leishmania (shown in the image given below).

Leishmania

Acne is caused by staphylococci bacteria (shown in the image given below).

Staphylococci

Sleeping sickness is caused by protozoan organism namely Trypanosoma (shown in the image given below).

Trypanosoma

Means of Spread

Most of the microbial agents can commonly move from an affected person to other in number of ways.

The microbial agents are 'communicated,' therefore, also known as communicable diseases.

Airborne Diseases

Some of the microbes can spread through the air; example of such airborne diseases are common cold, pneumonia, and tuberculosis.

AirTransmitted Diseases

Waterborne Diseases

Some diseases can also be spread through water, known as waterborne diseases. E.g. cholera etc.

Vector-borne Infections

Some diseases are transmitted by different animals including human beings; in fact, these animals carry the infecting agents. Therefore, such animals are intermediaries and known as 'vectors'.

Mosquitoes are the most common vectors.

Prevention

Infectious diseases can be prevented by means of public health hygiene measures.

Infectious diseases can be prevented through proper immunization (in advance).

Biology - Natural Resources

Introduction

The resources, available on the Earth and the energy being received from the Sun, are essential to meet the basic necessities of all life-forms on the Earth.

The biotic component incorporates all living of the biosphere.

Biotic Component

The abiotic component incorporates the air, the water, and the soil of the biosphere.

Biogeochemical Cycles

Biogeochemical cycles explain a constant interaction between the biotic and abiotic components of the biosphere.

Biogeochemical cycles are a dynamic phenomenon that helps to maintain the stability in the ecosystem.

The significant biogeochemical cycles are −

Water Cycle

Carbon Cycle

Nitrogen Cycle

Oxygen Cycle

Let’s discuss each of them in brief −

Water Cycle

The whole process, starting from the water evaporation, rainfall to flowing back into the sea via rivers, is known as the water-cycle.

Water Cycle

As shown in the image given above, water cycle is a complex phenomenon. During the process of water cycle, it helps ecosystem by maintaining its balance.

Water cycle helps in making new fertile soil, increasing the fertility of soil, providing nutrition to the biotic components in different ecological regions, etc.

Carbon Cycle

Carbon is found on the Earth in various forms, such as diamond and graphite (in solid form) and in combined state i.e. carbon and dioxide (as a gas).

Carbon is one of the essential elements for the photosynthesis.

Carbon Cycle

The process of photosynthesis converts carbon dioxide, which is present in the atmosphere or dissolved in water into glucose molecules.

The glucose provides energy to living things that involves the process of respiration.

In the process of respiration, oxygen may or may not be used to convert glucose back into carbon dioxide.

Lastly, the carbon dioxide goes back into the atmosphere.

Nitrogen Cycle

About 78 percent part of our atmosphere is shared by nitrogen alone.

Nitrogen is a part of many molecules, which are essential for the life.

There are a few varieties of bacteria that help in nitrogen-fixing.

These special bacteria convert the comparatively inert nitrogen molecules into

nitrates and nitrites essential for the life in direct or indirect way.

Nitrogencycle

The nitrogen-fixing bacteria are largely found in the roots of legumes.

Oxygen Cycle

In the total constituents of our atmosphere, about 21 percent is shared by oxygen.

Oxygen is also found in the Earth's crust.

Oxygen is an essential component of most of the biological molecules, including carbohydrates, nucleic acids, proteins, and fats (or lipids).

Oxygen, present in the atmosphere, is used especially up in the three following processes −

Combustion

Respiration

Formation of oxides of nitrogen

Oxygen Cycle

Oxygen is returned back to the atmosphere by the process of photosynthesis.

Oxygen is lifeline of most of the organisms found on the earth, but for some bacteria, it is poisonous.

Biology - Our Environment

Introduction

Environment is a natural world in which all living beings and non-living things exist.

The substances, which are broken down by the biological processes, are known as biodegradable.

The substances, which are NOT broken down by the biological processes, are known as non-biodegradable.

Environment

Ecosystem

An ecosystem comprises of biotic components (all living organisms) and abiotic components (all physical factors, such as temperature, rainfall, wind, soil and minerals) of a given area. E.g. Lake ecosystem, Forest ecosystem, Marine ecosystem, etc.

In a given geographic region, all the living organisms interact with each other and their growth, reproduction, and other activities are largely dependent on the abiotic components of the ecosystem.

In an ecosystem, all green plants and certain blue-green algae can produce their food (themselves) by the process of photosynthesis; hence, they are known as the producers.

The organisms, depending on the producers either directly or indirectly, can be termed as herbivores, carnivores, omnivores and parasites.

All those animals that eat plants are known as herbivores (also known as primary consumers). E.g. cow, goat, rabbit, deer, etc.

All those animals that eat other animals are known as carnivores (also known as secondary consumers) E.g. tiger, lion, snake, etc.

All those animals that eat both plants (and its products) and other animals are known as omnivores.

The larger size of carnivores and omnivores animals are known as tertiary consumers.

The microorganisms, such as bacteria and fungi, break-down the dead remains and waste products of organisms and hence they are known as decomposers.

Decomposers

The pyramid given above illustrates that the population of producers is maximum and as we go up, the population of subsequent consumers keeps decreasing.

Food Chain

A series of animals (of different biotic level) feeding one another forms a food chain.

Each level of the food chain forms a trophic level (see the image given below).

Food Chain

In the given image, (a) illustrates food chain in nature; (b) illustrates food chain in a grassland region; and (c) illustrates food chain of pond ecosystem.

The autotrophs (i.e. producers) exist at the first trophic level.

The herbivores (i.e. the primary consumers) come at the second trophic level.

The small carnivores (i.e. the secondary consumers) comes at the third trophic level and larger carnivores or the tertiary consumers comes at the fourth trophic level.

Transmission of Energy

While transmission of energy from one trophic level to second, large amount of energy gets lost, which cannot be used again.

The green plants (i.e. producers) in a terrestrial ecosystem capture about 1% of the energy of sunlight and convert it into food energy.

Secondly, when primary consumers eat green plants, about 10% of the food eaten is transmitted into its own body and made available for the next level of consumers.

Food Web

When the (food) relationship is shown in a series of branching lines instead of a straight line, it is known as a food web (see the image given below).

Food Web

Biology - Conservation of Plants and Animals

Introduction

The varieties of plants and animals that exists on earth, are essential for the wellbeing and survival of mankind.

Clearing of forests and using that land for other purposes is known as deforestation.

Some major consequences of deforestation are forest fires and frequent droughts.

Deforestation increases the temperature and pollution level on the earth.

Deforestation increases the level of carbon dioxide in the atmosphere.

Deforestation causes soil erosion; removal of the top layer of the soil exposes the lower, hard and rocky layers; likewise, the fertile land gets converted into deserts and known as desertification.

Deforestation also decreases the water holding capacity of the soil.

Biological diversity or biodiversity refers to the variety of organisms that exist on the earth, their interrelationships as well as their relationship with the environment.

Biosphere Reserves

To protect and conserve the biodiversity, the government set up rules, methods, and policies and created the protected areas such as wildlife sanctuaries, national parks, biosphere reserves, etc.

Plantation, cultivation, grazing, cutting trees, hunting, and poaching are strictly prohibited there.

The protected area where animals are protected from all sorts of human interference or disturbance (which can harm) to them and their habitat is known as Sanctuary.

The protected area reserved for wild life where they can freely live, use the habitats, and natural resources is known as National Park.

The large protected area for the conservation of wild-life, plant and animal resources, and traditional life of the tribals living in the area is known as Biosphere Reserve.

A biosphere reserve assists to maintain the biodiversity and culture of the respective region.

A biosphere reserve may also have some other protected areas within it. E.g. The Pachmarhi Biosphere Reserve has one national park namely Satpura and two wildlife sanctuaries namely Bori and Pachmarhi.

Endemic species are the species of plants and animals, which are found exclusively in a particular region.

Endemic species are not naturally found anywhere else other than the place where it is found. It means, a specific type of plant or animal may be endemic to a zone, a state or a country. E.g. Bison, Indian giant squirrel and Wild Mango are endemic fauna of Pachmarhi Biosphere Reserve (see the images given below0.

Giant Squirrel

The animals whose numbers are falling to a level that they might face extinction are categorized as the endangered animals.

Wild Mango

The book that keeps the record of all the endangered species is known as Red Data Book.

Biology - Classification of Organisms

Introduction

The technique of classifying organisms is known as Taxonomy.

Taxonomy is made up of two words i.e. ‘Taxis,’ which means ‘arrangement’ and ‘Nomos,’ which means ‘method.’

The Swedish botanist Carolus (Carl) Linneaeus has developed the modern taxonomic system.

Linneaeus has developed the following hierarchy of groups to explain the taxonomy −

Linneaeus

In this hierarchy, Domain is the highest order and the broadest category and Species is the lowest order category.

Further based on the difference between eukaryotes and prokaryotes (cells) ‘Domains’ classified into three broad categories namely −

Archea(Archeabacteria) − It comprises the bacteria that live in extreme environments.

Eubacteria − It comprises the bacteria that found in everyday life.

Eukaryote − It comprises almost all the world's visible living things.

The above given three domains are further categorized into Five following Kingdoms −

Kingdoms

Let’s discuss each kingdom in brief −

Monera − It comprises the unicellular organisms, e.g. bacteria.

Protista − Similar to monera (unicellular), but more developed and complex. It contains nucleus.

Plantae − All plants from smallest (such as algae) to the largest (such as Pine, Eucalyptus trees, etc.) are studied under this kingdom.

Fungi − It is a group of eukaryotic organisms that comprises microorganisms such as yeasts, molds, and mushrooms. The organisms of this kingdom do not make their food, they are basically parasites.

Animalia − It includes all the multicellular and eukaryotic organisms (of animal group). It is also known as Metazoa.

Binomial Nomenclature

The naming culture (of different organisms) practiced uniformly across the world is known as binomial nomenclature.

Binomial Nomenclature largely consists of two words – the first word beginning with a capital letter and known as genus (of the organism) and the second word begins with lower case letter and defines the species of the organism.

Binomial Nomenclature must be written in italic and also known as scientific name.

For example, the binomial nomenclature of human is - Homo sapiens; tiger - Panthera tigris, etc.

Eukaryotes and Prokaryotes

Cells are fundamentally categorized by prokaryotes and eukaryotes.

Prokaryotes

Prokaryotes are the smallest and simplest type of cells.

Prokaryotes have no true nucleus and no membrane-bound organelles. E.g. Bacteria.

Prokaryotes' Genome consists of single chromosome.

Reproduction is asexual; basically mitosis type.

Eukaryotes

Eukaryotes are complex in structure.

Eukaryotes have nuclei and membrane-bound organelles.

Eukaryotes' Genome consists of numerous chromosomes.

Reproduction is sexual; by mitosis and meiosis.

Biology - Cell Division

Introduction

The process of division of parent cell into two or more daughter cells is known as cell division.

In early 1880s, Flemming first observed the process of cell division.

Cell Division

Following are the three types of cell division −

Amitosis

Mitosis &

Meiosis

Let's discuss each of them in brief −

Amitosis

Parent cell gets divided into two parts, and each of them grows as a new complete organism.

Amitosis can be seen in less developed organisms. E.g. bacteria

Amitosis is also known as binary fission.

There is no stage of division, cell directly gets divided into two new organisms.

Mitosis

The process of division of parent cell into two new identical cells is known as mitosis.

In both the new cells, the number of chromosomes remain same.

Mitosis (cell division) occurs only in eukaryotic cells.

In mitosis, the division of the nucleus is preceded by the S stage (i.e. interphase - during this phase, the DNA is replicated).

After the interphase, the cytokinesis process begins, which divides the cytoplasm, cell organelles, and cell membrane into two new cells.

The process of mitosis is divided into the following stages −

Prophase

Prometaphase

Metaphase

Anaphase

Telophase

The stages of mitosis are described in the following image −

Mitosis

Let’s discuss each of them in brief −

Prophase

During the prophase, cell prepares to get divided.

The prophase process is also known as chromosome condensation, as chromatin fibers condense into discrete chromosomes.

Each chromosome has two chromatids and these two chromatids are joined at a place known as centromere.

Prometaphase

In this phase, the nuclear envelope gets disintegrated into small membrane vesicles.

Metaphase

In this phase, the two centrosomes start pulling the chromosomes towards opposite ends of the cell and ensure the equitable distribution of chromosomes.

Anaphase

In this phase two identical daughter chromosomes are formed.

Telophase

Telo is a Greek word meaning ‘end’.

In this phase, the nuclear envelop gets broken and a new nuclear envelop forms.

The new envelope gets formed around each set of separated daughter chromosomes; parallel, the nucleolus reappears.

Likewise, the mitosis is complete.

Cytokinesis

Cytokinesis, technically, is not a phase of mitosis, but rather a distinct process, essential for completing the cell division.

In this phase, cytoplasm begins to divide and completed with the development of two new identical cells.

Meiosis

Meiosis is a typical type of cell division in which the chromosome number gets reduced by half, creating four haploid cells. Each cell is genetically distinct from the parent cell.

Meiosis cell division process occurs in all sexually reproducing single-celled and multicellular eukaryotes, including plants, animals, and fungi.

Meiosis

Meiosis cell division is primarily categorized as Meiosis I and Meiosis II.

Biology - Virus

Introduction

A virus is a micro infectious agent, which is found as parasite in the living cells of other organisms.

Virus replicates swiftly inside the living cells of other organisms.

Virus is a Latin term meaning ‘poison’ and other ‘noxious’ liquids.

Viruses can infect any type of life forms, ranging from animals and plants to microorganisms, including bacteria and archaea.

Virus

The study of viruses is known as virology.

Virus is first discovered by Dmitri Ivanovsky in 1892.

Virus has the properties of living as well non-living.

One of the living properties is – virus has either DNA or RNA (never both).

One of the non-living properties is – virus has no protoplasm.

Types of Virus

Based on parasitic nature, virus is categorized as −

Animal Virus

Plant Virus

Bacterial Virus

Archaeal Virus

Viral Diseases in Human Being

Following are the list of diseases caused by virus in Human beings −

Chickenpox

Encephalitis

Influenza (or Flu)

Herpes (skin disease)

Human immunodeficiency virus (HIV/AIDS)

Human papillomavirus (HPV)

Infectious mononucleosis

Mumps (measles and rubella)

Shingles

Viral gastroenteritis (stomach flu)

Viral hepatitis

Viral meningitis

Viral pneumonia

Viral Diseases in Plants

Following are the list of diseases caused by virus in plants −

Peanut - Stunt Virus

Maize - Mosaic Virus

Lettuce - Mosaic Virus

Cauliflower - Mosaic Virus

Sugarcane - Mosaic Virus

Cucumber - Mosaic Virus

Tobacco - Mosaic Virus

Tomato - Twisted leaf disease

Lady finger - Yellow vein mosaic

Viral Diseases in Animals

Following are the list of diseases caused by virus in animals −

Cow – Herpes (Herpes virus)

Buffalo – Small pox (Poxverdi orthopox)

Dog – Rabies (Stereit virus)

Biology - Bacteria

Introduction

Bacteria normally comprises a large number of prokaryotic microorganisms.

Bacteria most probably were among the first life that formed to appear on the Earth.

Bacteria belong to Monera kingdom.

Bacteria

Bacteria usually inhabit in all range of environments, such as soil, water, acidic hot springs, radioactive waste, and the deep portions of Earth's crust.

The study of bacteria is known as bacteriology.

Bacteria play an important role in many stages of the nutrient cycle by recycling nutrients including the fixation of nitrogen from the atmosphere.

Bacteria grow to a fixed size and after maturity reproduce through asexual reproduction i.e. basically binary fission.

Under favorable conditions, bacteria can grow and divide very swiftly, and the bacterial populations can double merely in every 9.8 minutes.

When viruses that infect bacteria is known as Bacteriophages.

In order to modify themselves (to survive in the adverse environment), Bacteria frequently secrete chemicals into their environment.

Advantages of Bacteria

Bacteria are advantageous in many ways, such as −

Bacteria help in atmospheric nitrogen fixation.

Bacteria decompose dead plants and animals and clean the environment.

Bacteria are the major element that convert milk into curd and wine into vinegar.

Some specific types of bacteria are used in making proteins.

Some types of bacteria are also used as pesticides.

Disadvantages of Bacteria

Bacteria cause many diseases and infection to living organisms.

Bacterial Diseases

Bacteria cause many diseases, significant of them are –

Anthrax - caused by Bacillus anthracis

Brucellosis - caused by Brucella abortus

Botulism - caused by Clostridium botulinum

Coliform diseases - caused by Escherichia coli

Leprosy - caused by Mycobacterium leprae

Plague - caused by Yersinia pestis

Typhoid fever - caused by Salmonella typhi

Trachoma - caused by Chlamydia trachomatis

Diphtheria - caused by Corynebacterium diphtheria

Tetanus - caused by Clostridium tetani

Tuberculosis - caused by Mycobacterium bovis

Cholera - caused by Vibrio cholera

Syphilis - caused by Treponema pallidum

Whooping cough - caused by Bordetella pertussis

Gonrhoea - caused by Gonococcus

Potato wilt - caused by Pseudomonas solanacearum

Blight of rice - caused by Xanthomonas orzae

Fire blight of apple - caused by Invenia

Biology - Fungi

Introduction

Fungi are the members of eukaryotic organisms, which includes microorganisms such as molds, yeasts, and mushrooms.

Fungi do not photosynthesize rather they obtain their food by absorbing the dissolved molecules, usually by secreting digestive enzymes into their environment.

Fungus

Fungi are found in almost every part of the world, and they can grow in a wide range of habitats, ranging from extreme environments (such as deserts) to mild (such as temperate region).

Fungi are the primary decomposers in most of the ecological systems.

The study of fungi is known as mycology.

Fungi have membrane-bound cytoplasmic organelles, for example mitochondria, sterol-containing membranes, and ribosomes.

Fungi have also a cell wall and vacuoles (property of plants).

Fungi have no chloroplast and they are heterotrophic organisms (property of animals); likewise, fungi have both the properties of plants and animals.

Advantages of Fungi

Fungi have medicinal advantages, as they have been used for the manufacturing of antibiotics and various enzymes.

One of the most popular antibiotic drug penicillin is manufactured from the fungus Penicillium.

The ‘shiitake,’ one of the types of mushroom is a source of a clinical drug known as Lentinan.

Fungi are also used as the biological pesticides to control plant diseases, weeds, and insect pests.

In Japan, Lentinan is used to treat in cancer disease.

As they feed the dead organic matters, fungi recycle about 85 percent of the carbon from dead organic matter; likewise, fungi release the locked-up nutrients so that they can be used by other organisms.

Many varieties of fungi such as oyster mushrooms, straw mushrooms, shiitakes, milk mushrooms, truffles, and black trumpets are edible.

Mushroom

Portobello mushrooms and Button mushrooms are usually used in soups and salads.

Fungi are also used to produce industrial chemicals, including citric, malic and lactic acids.

Fungi are frequently used to produce industrial chemicals, such as citric, malic and lactic acids.

Disadvantages of Fungi

Some mushrooms, though they look like edible mushrooms, but they are poisonous that may cause even death to the person who ate.

Some Fungi can infiltrate the external layers of the human bodies and cause itching and rashes problems.

Certain fungi appear on food stuffs and destroy them shortly.

Fungi also cause various diseases to animals (including humans) as well as plants.

Fungal Diseases

Fungi cause many diseases, significant of them are −

Athlete's foot - Taenia pedis

Asthma - Aspergillus fumigatus

Ring work - Trichophyton

Meningitis - Cryptococcus neoformans

Baldness - Taenia captis

Dermatophilosis - Dermatophilus congolensis

Wart disease of potato - Synchytrium endobioticum

Rhinosporidiosis - Rhinosporidium seeberi

Rust of wheat - Puccinia graminis tritici

Red rot of sugarcane - Colletotrichurn falcatum

Biology - The Roots

Introduction

Root is the most essential part of a plant that grows down to the soil and water.

Root avoid the sunlight, as it grows down to soil and water, and absorbs mineral salt and water from the soil.

Roots

However, some typical roots are also aerial or aerating, that grow up above the ground or especially above the water.

Roots do not have leaves, buds, and nodes.

Functions of the Roots

The roots absorb mineral salts and water from the soil then supply them to other parts of the plants.

Roots provide foundation to plants and keep them static.

Some roots absorb foods for the contingency period; e.g. radish, carrot, etc.

Types of Roots

Primarily, roots are classified as −

Tap Root

Fibrous Root

Adventitious Root

Let’s discuss them in brief −

Tap Root

There is a main root (see the image given below) that grows faster and it has many branches. Usually, it occurs in dicotyledon plants.

Taproot

Fibrous Roots

There is as such no primary root rather there are numerous roots of similar shape, thickness, and size.

Fibrous Root

It is typical feature of monocots (plant).

Adventitious Root

A typical root that grows from any part of a plant except the primary root part.

Adventitious Root

Adventitious root may be underground or may aerial.

Modified Taproots

The following table illustrates some typical examples of modified taproots −

Taproots	Examples
Conical shape	Carrot
Napiform	Beet root
Fusiform	Radish
Pneumatophores	Sundari plants

Pneumatophores	Sundari plants

Modified Adventitious Roots

The following table illustrates some typical examples of modified adventitious roots −

Adventitious Roots	Examples
Aerial root	Orcede
Parasitic root	Kascutta
Moniliform root	Grapes
Prop root	Banyan tree
Stilt root	Sugarcane, maize, etc.

Note − Tuber is a stem that grow horizontally under the soil and develop roots on their lower surfaces. Major function of this swollen stem is to store food and nutrients. E.g. potato, onion, etc.

Biology - The Plant Stem

Introduction

A stem is one of the main structural axes of a vascular plant.

The stem, structurally, is categorized into nodes and internodes (see the image given below).

Stem

The other term used for the stem is shoot, but there is difference between stem and shoot, i.e. stem includes only stem part, whereas, shoot includes stem, leaf, flower, etc. (shoot term basically used for new plant growth).

Functions of Stem

Following are the significant functions of a stem −

Stems keep plant upright and support leaves, flowers, and fruits.

Stems comprise xylem and phloem (tissues) that transport fluids and nutrients between root and shoot.

Stems store nutrients and produce new cells and tissues.

Types of Stems

Stems are usually categorized as −

Underground Stem

The stem that grows inside the soil is known as underground stem. E.g. Potato.

Potato

Such type of stems store food for contingency period.

Subaerial Stem

The stem, which partial remains inside the soil and partial above (i.e. in the air), is known as subaerial stem. E.g. Cynodon

Cynodon

Aerial Stem

The stem, which entirely remains in the air (i.e. out-side of soil or water), is known as aerial stem. E.g. passiflora, grapes, etc.

Passiflora

Modification of Stems

Sometimes, stems perform some specific task (other than their regular task), for which they change their shapes and sizes.

The following table illustrates some of the examples that modified stems −

Location	Type	Example
Underground Modified Stem	Bulb	Garlic, Onion, etc.
	Corm	Saffron, Crocus, etc.
	Stem tuber	Potato
	Rhizome	Ginger
Subaerial Modified Stem	Stolon	Jasmin, Straberi, etc.
	Offset	Water plant, Pistia, etc.
	Sucker	Roses, Musa, etc.
	Runner	Mereilia, Cynodon, etc.
Aerial Modified Stem	Stem thorn	Lemon, Citrus
	Stem tendril	Grape
	Phylloclade	Cactus, Opuntia
	Bulbils	Ruscus, Agave
	Tendril	Passiflora

Biology - The Plant Leaf

Introduction

Leaves, usually, are thin and flattened organs, borne above ground.

There are varieties of leaves in terms of shapes, sizes, and textures. Likewise, different species of plants have different shapes, sizes, and textures of leaves.

Leaves

Some varieties of leaves are thick and juicy (especially of succulent plants).

Leaves are usually of green color because of the presence of chloroplast.

However, some show plants have colorful leaves (see image given below) −

Colorful Leaves

Succulent plants often have thick juicy leaves, but some leaves are without major photosynthetic function and may be dead at maturity, as in some cataphylls and spines (see image given below).

Thick Leaves

Functions of Leaves

Following are the major functions of leaves −

Leaves prepare food through photosynthesis.

Leaves are the most important parts through which plants respire.

Some leaves also store foods for the contingency period.

Leaves assist in reproduction and pollination.

Some leaves (especially of succulents plants – shown above), store chemical energy and water.

Modified Leaves

To survive in an adverse environment, some of the plant species (especially leaves) modified themselves. Following are the list of such leaves –

Spine leaves − Such leaves are look like spines, e.g. cactus plants (see image below).

Bract leaves − Also known as pseudanthia (or false flowers), they are colorful leaves (see image below).

Succulent leaves − These leaves store water and organic acids (see image below).

Tendril leaves − Such leaves take the form of tendril and support plant to climb, e.g. pea plants (see image below).

Scaly leaves − Some leaves modify themselves to protect buds known as scaly leaves, e.g. onion, garlic, etc. (see image below).

Hook leaves − Such leaves modified as nails known as hook leaves, e.g. Bignonia (see image below).

Modified Leaves

Pitcher leaves − Such leaves trap insects, e.g. pitcher plant. This is known as carnivorous plant (see image given below).

Pitcher Leaves

Biology - The Flowers

Introduction

Flowers, as all of us interpret, are the beautiful parts of the plants, which beautify the environment by their enthralling colors and decisive fragrance.

But flower is biologically the reproductive part of the plant.

Flowers

Functions of Flower

Following are the major functions of a flower −

The primary function of a flower is reproduction by the process of the union of sperm with eggs.

Depending upon the inherent property, flowers may facilitate selfing, which means fusion of sperm and egg from the same flower OR it may facilitate outcrossing, which means fusion of sperm and eggs from different individuals in the respective population.

The flowers produce diaspores (consisting of a seed or spore) without fertilization.

The flower is the site where gametophytes (is the sexual phase) develop.

Some of the flowers fascinate animals, birds, and other insects, so as to cause them to be vectors for the transfer of pollen.

After sometime of fertilization, the ovary of the flower develops into fruit that contains seeds.

Parts of Flower

Primarily, the parts of a flower are categorized as −

The Vegetative Part and

The Reproductive Part

Let’s discuss them in brief −

Vegetative Part

Calyx − Calyx is the outermost part that consists of some units known as sepals. It is typically of green color (see the image given below).

Corolla − Corolla is the second (next to calyx) coil towards the apex, composed of units known as petals. Petals are usually thin, soft, and colored. It attracts insets and birds that ultimately help in pollination.

Parts of Flower

Reproductive Part

Androecium − It consists stamens (the male sex organ). Every stamen has three parts namely Filament, Anther, and Connective.

Zoophilous By animals

Gynoecium − It is the inner most part of the flower and consists of carpels (female sex organ).

Carpels consist of ovary, style and stigma, collectively known as a pistil.

Reproductive Parts Flower

Pollination

Pollination is basically the process of movement of pollen from the anthers to the stigma.

When the pollens move to stigma of the same flower, it is known as self-pollination; on the other hand, if pollen move to stigma of other flower, it is known as cross-pollination.

Pollination Process

Pollination process occurs through different mediums (see the table) −

Process (Pollination)	Medium (Pollination)
Anemophilous	By air
Entomophilous	By insects
Hydrophilous	By water
Chiropteriphilous	By bats
Malacophilous	By shells
Ornithophilous	By birds

Biology - The Fruit

Introduction

For the common people, fruits are nutritious and delicious edible things, but for a botanist, fruits are the seed-bearing structure found in flowering plants.

During the ancient period or even today, many of the animals including human beings are dependent on fruits (for their survival).

Fruits

Likewise, fruit is usually fleshy seed-associated structures of a plant, which is edible in the raw state (not all types of fruits are edible, as some are poisonous) and tastes sweet or sour.

Structure of the Fruit

The layer, usually, surrounding the seeds, is known as ‘pericarp.’

Formed of ovary, pericarp is the edible part of fruit.

The pericarp further classified as epicarp, mesocarp, and endocarp.

Seedless Fruits

Some fruits are seedless (such as banana), which have pretty high commercial importance.

Further, some fruits are scientifically developed seedless such as pineapples, grapes, etc.

Types of Fruits

Based on the fertilization of the flowers, fruit is classified as −

True Fruits − When the fruit forms in the ovary (of the flower) through fertilization is known as true fruit. E.g. strawberry.

False Fruits − The fruits formed some other means (other than ovary), such as calyx, thalamus, corolla, etc. known as false fruits. E.g. pear, apple, etc.

Further, because of verities and diversities, fruits are classified as −

Simple fruit − It can be either dry fruit (such as coconut, walnut, etc.) or fleshy (such as gooseberry, tomato, etc.).

Aggregate fruit − It is formed from single flowers, which have multiple carpels. E.g. raspberry.

Multiple fruit − It is formed from a cluster of flowers, e.g. pineapple, mulberry, etc.

Fruits and their Edible Parts

Following table illustrates the name of fruits and their edible parts −

Fruits	Edible Parts
Apple	Thalamus
Banana	Mesocarp
Coconut	Endosperm
Coriander	Thalamus
Chinese date	Epicarp & Mesocarp
Custurd apple	Pericarp
Guava	Pericarp
Grape	Pericarp
Ground nut	Seed leaves
Jack fruit	Sepals
Lemon	Juicy pore
Litchi	Pulpy aerial
Mango	Mesocarp
Mulberry	Bract, sepals
Orange	Juicy hair
Pear	Thalamus
Papaya	Pericarp
Tomato	Pericarp
Wood apple	Mesocarp

Biology - Plant Diseases

Introduction

Like animals, plants also suffer from verities of diseases.

The biological agents that causing diseases to plants are known as pathogens.

Plant Disease

Some of the common plant pathogens are −

Viruses

Bacteria

Fungi

Nematodes

However, some non-pathogenic diseases (in plants) may also occur when the pH value, moisture, humidity, soil, etc. of soil change.

Viral Diseases in Plants

The following table illustrates the major plant diseases caused by virus −

Disease	Plants Affected
Bud Blight	Soy beans
Curly top	Beans, tomato, sugar beets, etc.
Mosaic leaf	Tomato, tobacco, corn, legume, potato, pea, sugar beet, cucumber, maize, cauliflower, sugarcane, bean, etc.
Yellowing of leaf	Barley, sugar beet, potato, etc.
Spotted Wilt Virus	Tomato, capsicum, etc.
Chlorosis Virus	Tomato, capsicum, etc.

Bacterial Diseases in Plants

The following table illustrates the major plant diseases caused by Bacteria −

Disease	Plants Affected
Blights	Vegetable crops, fruit trees, etc.
Bacterial wilts	Corn, tobacco, potatoes, alfalfa, tomatoes, etc.
Bacterial speck	Fruits and leaves of different plants
Cankers	Woody plants
Leaf spot	Cotton, beans, peas, etc.
Soft rots	Fleshy or succulent plant parts
Fire Bligh	Rosebushes, pome fruit trees, etc.

Fungal Diseases in Plants

The following table illustrates the major plant diseases caused by Fungi −

Disease	Plants Affected
Cankers	Largely woody plants
Downy mildew	Grains, onions, cucumbers, alfalfa, etc.
Ergot	Rye, barley, wheat and other grasses
Powdery mildew	Grains, legumes
Tuber diseases	Potato, sweet potato, etc.

Rusts	Wheat, barley, rye, oats, etc.
Root rots	All types of plants
Scab	Wheat, barley, rye, potato, etc.
Smuts	Oats, barley, corn, wheat, grasses, etc.
Wilts	Potatoes, alfalfa, etc.
Cavity spot	Carrot
Leaf blight	Carrot
Ring spot	Brassicas

Diseases by Nematodes in Plants

The following table illustrates the major plant diseases caused by Nematodes −

Disease	Plants Affected
Hairy root	Sugar beets, potatoes, soybeans, etc.
Root lesions	Different species of plants get affected
Root-knot	Tomatoes, peanuts, etc.

Biology - The Blood

Introduction

The body fluid, found in almost all multicellular fauna (animals, birds, reptiles, etc.), and responsible for transporting necessary substances such as oxygen and nutrients to different parts of the body, is known as blood.

Blood is basically connective tissue in the liquid form.

Blood

Blood is largely composed of blood cells and plasma.

Plasma constitutes about 55 percent of blood fluid.

The pH value of blood pH is ranging between 7.35 and 7.45, i.e. slightly basic.

Plasma is mostly water (i.e. 92% by volume) and contains dissipated proteins, glucose, hormones, mineral ions, and carbon dioxide.

The blood of vertebrate (animals) appears bright red when its hemoglobin is oxygenated; when it is deoxygenated, it (blood) appears dark red.

The blood accounts about 7 percent of the human body weight.

Functions of Blood

Following are the significant functions of blood in the body −

Transports oxygen to tissues and cells located in different parts of the body

Supplies nutrients (e.g. glucose, fatty acids, amino acids, etc.) to tissues and cells located in different parts of the body

Removes waste products (e.g. carbon dioxide, urea, etc.) and help to throw outside the body

Also strengthens the immune system of the body

Regulates the body temperature.

Blood Terminologies

Following are the significant terminologies that help to understand the blood −

Blood Cells − based on color and function blood cells are classified as Red Blood Cells (RBC) and White Blood Cells (WBC).

Red Blood Cells (see the image given below) consist of red pigments, known as haemoglobin, helps in oxygen transportation.

Haemoglobin

White Blood Cells − (WBC) increase the immune system of the body, as it fights with the harmful germs that enter in your body.

Platelets − Blood platelets have very important function i.e. it helps in blood clotting.

Lymph − Lymph is a colorless fluid, which contains specialized lymphocytes; lymphocytes are accountable for the immune responses of the body.

Blood Vessels

Following are the two major types of blood vessels −

Arteries and

Veins

Let’s discuss them in brief −

Arteries

The blood vessels that carry oxygen-rich blood (i.e. pure blood) from heart to all different parts of the body is known as arteries.

Arteries usually have thick (vessels) wall because of having high blood pressure.

All types of arteries transport oxygen rich blood from heart to different parts of the body except ‘Pulmonary Artery.’

Pulmonary Artery carries carbon dioxide rich blood from heart to the lung for the oxygenation purpose.

The tiny networks of blood vessels are known as capillaries. Capillaries are very thin structure.

Veins

The blood vessels that carry carbon dioxide rich blood (i.e. impure blood) from different parts of the body back to heart are known as veins.

Veins usually have comparatively thin (vessels) wall.

The pulmonary vein carries oxygen rich blood from lung to the heart.

Biology - Blood Group

Introduction

Based on the presence and absence of antibodies, the blood is classified into different groups.

Further, while classification, the presence and absence of the inherited antigenic substances also considered.

Blood Group

The types of blood groups are inherited and represent contributions from both the father and the mother.

ABO Blood Group System

In human blood, usually, there are two antigens and antibodies.

The two antigens are antigen A and antigen B.

The two antibodies are antibody A and antibody B.

The antigens are remaining in the red blood cells, whereas the antibodies are found in the serum.

Based on the antigen property, the blood group of all human beings can be classified as −

Blood Group A − antigen A and antibody B

Blood Group B − antigen B and antibody A

Blood Group AB − antigen A and antigen B and no antibody

Blood Group O − no antigen, but antigen A as well as antibody B

Consideration of the ABO system is the most imperative while transfusion of human blood.

The ABO blood group systems were first discovered by Karl Landsteiner in 1901.

Rh Blood Group System

The Rh system (the meaning of Rh is Rhesus) is another significant blood-group system. It is very important to match Rh system while blood transfusion.

Rh antigen first studied in Rhesus monkeys; therefore, its name is given Rh factor/system.

The person who does not have Rh antigen is known as Rh negative (Rh-ve) and the person who has the Rh antigen is known as Rh positive (Rh+ve).

Blood Transfusion

Based on the above discussed two blood grouping system (i.e. ABO and Rh), the following table illustrates the possibilities of blood transfusion among different blood groups –

Recipient	Donor				
O-	O+	A-	A+	B-	B+
	AB-	AB+			
O-	Yes	No	No	No	No
	No	No	No		
O+	Yes	Yes	No	No	No
	No	No	No		
A-	Yes	No	Yes	No	No
	No	No	No		
A+	Yes	Yes	Yes	Yes	No
	No	No	NO		
B-	Yes	No	No	No	Yes
	No	No	No		
B+	Yes	Yes	No	No	Yes
	Yes	No	No		
AB-	Yes	No	Yes	No	Yes
	No	Yes	No		
AB+	Yes	Yes	Yes	Yes	Yes
	Yes	Yes	Yes		

Conclusion

Based on the blood transfusion table given above the blood group O- is the universal donor, which can give blood to the person of any blood group.

Secondly, the blood group AB+ is the universal recipient, as it can accept blood from the person of any blood group.

Biology - Human Brain

Introduction

The brain of a human being is the central organ of the nervous system.

The human brain consists of three parts namely the cerebrum, the brainstem and the cerebellum.

Human Brain

The brain of a human being plays significant role, as it controls most of the activities of the human body.

The brain is located inside the head, and protected by the skull bones.

The brain consists of more than 86 billion neurons and almost equal number of other cells as well.

Brain activity is made possible because of the interconnections of all the neurons that are linked together.

The study of brain functions is known as neuroscience.

An adult human brain weighs about 1.2 to 1.4 kg (i.e. average weight); which is about 2% of the total body weight.

Parts of Human Brain

A human brain is primarily classified as the −

Forebrain

Midbrain

Hindbrain

Forebrain is largely made up of cerebrum, thalamus, hypothalamus and pineal gland.

Midbrain is largely made up of a portion of the brainstem.

Hindbrain largely made up of the remaining brainstem, cerebellum and pons.

Further, the (brain) hemisphere is conventionally classified into four lobes namely −

Frontal lobe

Parietal lobe

Temporal lobe

Occipital lobe

The naming is done according to the skull bones that overlie them.

Parts of Brain

Cerebrum

Divided into nearly symmetrical left and right hemispheres by a deep groove, the cerebrum is the largest part of the human brain.

Cerebrum normally controls higher brain functions including language, logic, reasoning, and creativity.

Functions of Human Brain

Major functions of human brain are −

Perceive or sense the signal coming from the (external) environment

Giving sense of feelings and emotion

Regulating and controlling the human behaviors

Regulating and controlling the physical action

Regulating the memory function

Process of thinking (and other cognitive process)

Biology - Skeleton System

Introduction

The human Skeleton system is an internal structure that provides support and strength to human body.

At the birth, there are about 300 bones, but over period time, specifically at maturity, the number of bones is 206.

Humans Skeleton

Classification of Bones

Human Skeleton system broadly classified into –

Axial skeleton and

Appendicular skeleton

Let’s discuss them in brief –

Axial Skeleton

With the total 80 bones, the axial skeleton consists of –

Vertebral column

Rib cage

Skull and other associated bones

Appendicular Skeleton

With total 126 bones, the appendicular skeleton consists of –

Pectoral girdles

Upper limbs

Pelvic girdle

Pelvis

Lower limbs

The image given below illustrates the names of the major bones of a human body.

Human Skeleton

Functions of Bones

Following are the major functions of skeleton system −

It provides support to the body

It protects many parts of the body, e.g. the skull protects brain; the vertebrae protect spinal cord; the rib cage protects lungs; the spine protects heart, and the sternum protects blood vessels

The skeleton system helps in movement

The skeleton system helps in the production of blood cells

The skeleton system stores minerals

The skeleton system helps in endocrine regulation

Biology - Endocrine System

Introduction

The endocrine system is study of the glands of an organism that secrete hormones directly into the circulatory system.

The organs through which the life running hormones are secreted are known as endocrine glands or simply ductless glands.

The hormone secreting glands are located in different parts of a human body (see the image given below).

Endocrine System

The scientific study of the endocrine system and its disorders is known as endocrinology.

Hormone

The hormone is a complex but very important chemical substance released by the different glands in the body.

The hormone is mainly made up of amino acid, catecholemines, and steroids.

It is the hormone which is responsible for the overall growth and development; safety and security; behavior, sexual characteristics, and reproductive activities of a human body.

Types of Endocrine System

Following are the major types of endocrine system −

Hypothalamus

Pineal Gland

Pituitary Gland

Thyroid Gland

Parathyroid Gland

Adrenal Gland

Pancreas Gland

Reproductive Gland (Ovaries & Testes Glands)

Let’s discuss these glands in brief −

Hypothalamus

It is located at the base of the brain.

It releases Growth hormone-releasing hormone, Somatostatin hormone, etc., important for the growth.

Pineal Gland

It is located at the base of the brain.

It releases melatonin hormone helpful in lowering the core body temperature.

Pituitary Gland

With the size of a pea, the pituitary gland is found at the base of the human brain.

The average weight of pituitary gland is about 0.5 grams.

It is also known as hypophysis.

Following are the hormones secreted by the pituitary gland −

Growth hormone (somatotropin) − It is abbreviated as GH and it stimulates growth and cell reproduction.

Thyroid-stimulating hormone (thyrotropin) − It is abbreviated as THS and it stimulates iodine absorption by thyroid gland.

Adrenocorticotropic hormone (corticotropin) − It is abbreviated as ACTH and it stimulates corticosteroid and androgen.

Beta-endorphin − it inhibits perception of pain.

Prolactin − it stimulates milk synthesis and release from mammary glands.

Thyroid Gland

Thyroid gland is located just below the larynx in the throat (pharynx).

The hormone secreted by the thyroid gland is known as thyroxine.

Following are the important hormones secreted by the thyroid gland −

Triiodothyronine(T3) − It stimulated body oxygen and energy consumption. It also promotes protein synthesis.

Thyroxine − It increases the basal metabolic rate.

Calcitonin − It stimulates osteoblasts and bone construction.

Parathyroid Gland

It is located in the neck of a human body.

It releases parathyroid hormone that helps in regulating the amount of calcium in the blood as well as within the bones.

Adrenal Gland

Adrenal gland is found above the kidneys.

It releases the following major hormones −

Glucocorticoids − It stimulates gluconeogenesis and fat-breakdown in adipose tissue.

Mineralocorticoids − It stimulates active sodium reabsorption in kidneys.

Adrenaline − It increases the supply of oxygen and glucose to the brain and muscles.

Dopamine − It increases heart rate and blood pressure.

Enkephalin − It regulates pain.

Pancreas Gland

Pancreas gland is located in the abdominal cavity (behind the stomach).

Pancreas is a mixocrine gland, as it releases both enzymes and hormones.

It releases the following major hormones −

Insulin − It regulates the metabolism of carbohydrates, proteins, and fats.

Glucagon − It raises the concentration of glucose in the bloodstream.

Somatostatin − It inhibits release of insulin and glucagon.

Reproductive Gland

The reproductive gland is classified as Testes in Male and Ovary in Female.

Testes releases androgens (hormone) that help in strengthening muscle, increasing bone density, maturation of sex organs.

Ovary releases progesterone hormone that helps during pregnancy period.

Biology - Endocrine Diseases

Introduction

The diseases caused by either the deficiency or excessive of hormones is known as endocrine diseases.

The branch of medicine that studies the endocrine disorders is known as endocrinology.

The List of Endocrine Diseases

The following table illustrates the endocrine diseases −

Glucose Homeostasis Disorders

Diseases Types Result

Diabetes Mellitus Type 1 Diabetes
Increases sugar levels

Type 2 Diabetes

Gestational Diabetes

Hypoglycemia Idiopathic hypoglycemia
Decreases sugar level (below normal)

Insulinoma

Glucagonoma Cause: Because of the overproduction of glucagon hormone tumor of the pancreas

Thyroid Disorders

Goiter Cause: deficiency of iodine
swelling of the neck or larynx

Hyperthyroidism (excessive production of thyroid hormone) Graves-Basedow disease Muscle weakness, sleeping problems, diarrhea, weight loss, etc.

Toxic multinodular goitre

Hypothyroidism

(low release of thyroid hormone)
Poor ability to tolerate cold, a feeling of tiredness, constipation, depression, and weight gain

Thyroiditis Hashimoto’s thyroiditis
Inflammation of the thyroid gland

Thyroid cancer Nodule in the thyroid region of the neck

Metabolic Bone Disease

Parathyroid gland disorders Primary hyperparathyroidism Alterations in the blood calcium levels and bone metabolism

Secondary hyperparathyroidism

Tertiary hyperparathyroidism

Hypoparathyroidism

Osteoporosis Bone weakness

Paget's disease of bone Weakening of bones

Rickets and Osteomalacia Child disease (because of vitamin D deficiency)

Pituitary Gland Disorders

Diabetes insipidus Excessive thirst and excretion of large amounts of severely dilute urine

Hypopituitarism

Pituitary tumors Pituitary adenomas

Prolactinoma

Acromegaly

Cushing's disease

Sex Hormone Disorders

Intersex disorders Hermaphroditism

Gonadal dysgenesis

Androgen insensitivity syndromes

Genetic and chromosomal disorders

Kallmann syndrome

Klinefelter syndrome

Turner syndrome

Acquired disorders Ovarian failure

Testicular failure

Disorders of Puberty Delayed puberty

Precocious puberty

Menstrual function or fertility disorders

Amenorrhea

Polycystic ovary syndrome

Biology - Carbohydrate

Introduction

Consisting of oxygen (O), carbon (C), and hydrogen (H), carbohydrate is a biological molecule.

Carbohydrate is one of the essential elements for the living organisms, as it plays various important roles.

Carbohydrate

Carbohydrate is the main source of energy, as about two-third energy requirement of living beings is fulfilled by it.

Glucose, sugar, and starch are the important examples of carbohydrate.

Source of Carbohydrate

Carbohydrates naturally are occurring in wide variety of foods, such as −

Wheat

Maize

Rice

Potatoes

Sugarcane

Fruits

Table sugar

Bread

Milk

Sugar that we eat in our everyday life is mainly sucrose (table sugar).

Sucrose is added in many food items while preparing, e.g. jam, biscuits, cakes, energy drinks, etc.

Further, many fruits naturally contain glucose and fructose.

Glycogen is another type of carbohydrate that found in the liver and muscle.

Cellulose found in the cell wall of plant cells is carbohydrate.

Types of Carbohydrate

The following table illustrates major categories and sub-categories of carbohydrate −

Class	Subgroup	Components
Sugar	Monosaccharides	Glucose, fructose, xylose, galactose
	Disaccharides	Sucrose, lactose, maltose, trehalose
	Polyols	Sorbitol, mannitol
	Oligosaccharides	Malto-oligosaccharides Maltodextrins
	Other oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides
Polysaccharides	Starch	Amylose, amylopectin, modified starches
	Non-starch polysaccharides	Cellulose, hemicellulose, pectins, hydrocolloids

Functions of Carbohydrate

Following are the major functions of carbohydrates −

Carbohydrates provide energy required for the proper function of the body.

Carbohydrates also store food in the body for the contingency period.

Carbohydrates form nucleic acids.

Carbohydrates also support skeleton system of animals.

Carbohydrates provide sweetness and flavor.

Carbohydrates break down the fatty acid.

Biology - Proteins

Introduction

Proteins, which are basically biomolecules, play wide range of functions in the body of a living organism.

Proteins are made up of tiny elements of different types of amino acids.

A sequence of amino acid residues in a protein is known particularly by the sequence of a gene; gene is encoded in the genetic code.

After formation, proteins exist for a fixed period of time and are then degraded and recycled.

The proteins get recycled by the cell's machinery by the process of protein turnover.

Most of the proteins contain linear polymers made up of series of up to 20 different L-α-amino acids.

The amino acids in a polypeptide chain are connected by peptide bonds (see the image given below).

Peptide Bond

The peptide bond, usually, has two resonance forms, which contribute some double-bond characters.

Protein Structure

Most of the proteins illustrate unique 3-dimensional structures (see image given below).

Protein Structure

However, proteins have not a rigid structure, but rather, proteins may vary between several related structures especially when they perform their functions.

Functions of Proteins

Following are the major functions of proteins −

In the cell, proteins are the chief actors that carry out the duties defined by the information encoded in genes.

Proteins are essential for the overall body growth.

Proteins play a role of bio-catalyst and biotic regulator.

Proteins provide instant energy especially during the emergency period.

Proteins help in catalyzing the metabolic reactions.

Proteins are the essential elements in DNA replication.

Proteins actively help in transporting molecules from one location to another in the body.

Types of Protein

Following are the major types of protein −

Enzymes − enzymes play important role especially during the breakdown of molecules. Enzymes are also required for the digestion and growth of the cell.

Structural Proteins − such type of proteins provide strength to cells, tissues, and organs.

Signaling Proteins − Such proteins facilitate cells to communicate with each other by providing signals.

Defensive Proteins − Such proteins help organisms to fight with infection and support damaged tissue in healing fast.

Hormone − Some hormones are proteins that help in metabolic activities.

Biology - Fats

Introduction

Fat is a significant foodstuff for many forms of life.

Fats serve structural as well as metabolic functions.

The fats are molecules made up of glycerol and fatty acid.

Fat is an organic compound of hydrogen, carbon, oxygen.

Based on the number and bonding of the carbon atoms, fats and oils, are categorized in the aliphatic chain.

Fat

Functions of Fats

Following are the major functions of Fats −

Fat is a vital dietary requirement.

The fat is usually the stored source of energy in the body that remained store beneath the skin.

Fat acts a protective layer especially in the human body and provide protection.

Some of the vitamins such as vitamin A, vitamin D, vitamin E, and vitamin K are fat-soluble,

which means they can only be absorbed, digested, and transported in conjunction with the fats.

Fats actively help in maintaining the healthy skin and hair.

Fats insulate body organs against external shock.

Fats also maintain body temperature.

Fats promote healthy cell function.

Types of Fats

Following are the major types of Fats −

Unsaturated Fats

The fats that remain in the liquid form at room temperature are known as unsaturated fats.

Unsaturated fats are beneficial for health, as it improves blood cholesterol levels, stabilize heart beats, etc.

Unsaturated fats are commonly found in vegetable oils, nuts, and many seeds.

Saturated Fats

Saturated fats have no double bonds between the carbons found in its chain.

Saturated fats can easily solidify and typically found in solid form at room temperature.

Saturated fats are found in animals' meat, cheese, ice cream, etc.

Biology - Vitamins

Introduction

Vitamin is one of the most essential organic compounds that organisms require for the growth and maintenance of the body.

Unlike other nutrients, vitamins are classified by their biological and chemical activity, instead of their structure.

Vitamins

The term vitamin was derived from a compound word namely "vitamin."

The Polish biochemist Kazimierz Funk, first used the compound word 'vitamin' in 1912.

Usually, vitamins are represented by the English capital letters, e.g. A, B, C, E, etc.

The body of a human being stores different vitamins widely; the vitamins A, D, and B12 are stored in substantial amounts, generally in the liver.

Deficiency of vitamins causes disease.

Based on solubility, vitamins are classified as water soluble vitamins and fat soluble vitamins.

Water-soluble vitamins can dissolve easily in water.

On the other hand, fat-soluble vitamins can be dissolved easily in fat.

Further, fat-soluble vitamins get absorbed easily through the intestinal tract.

List of Vitamins

By the time, thirteen vitamins are comprehensively recognized.

The following table illustrates the list of vitamins with their properties −

Vitamins	Chemical Name	Solubility	Deficiency disease
Vitamin A	Retinol	Fat	Night blindness, keratomalacia, etc.
Vitamin B1	Thiamine	Water	Beriberi
Vitamin B2	Riboflavin	Water	Ariboflavinosis, glossitis, etc.
Vitamin B3	Niacin	Water	Pellagra
Vitamin B5	Pantothenic acid	Water	Paresthesia
Vitamin B6	Pyridoxine	Water	Anemia
Vitamin B7	Biotin	Water	Dermatitis
Vitamin B9	Folic acid	Water	Megaloblastic anemia
Vitamin B12	Cyanocobalamin	Water	Pernicious anemia
Vitamin C	Ascorbic acid	Water	Scurvy
Vitamin D	Cholecalciferol	Fat	Rickets
Vitamin E	Tocopherols	Fat	Hemolytic anemia (in children)
Vitamin K	Phylloquinone	Fat	Bleeding diathesis

Functions of Vitamins

Vitamins have different biochemical functions, significant of them are −

Like hormone, vitamin D regulates and helps in mineral metabolism

Vitamin D also regulates and helps cells and tissue growth

Vitamin C and vitamin E act as antioxidants

Vitamin B complex acts as co-enzymes or the precursors of enzymes and helps them as catalysts in metabolic activities.

Biology - Minerals

Introduction

Mineral is a chemical element essentially required as nutrient for the proper functioning of the body and healthy life.

Minerals cannot be made by living organisms, rather it occurs in the Earth naturally.

Minerals

Most of the minerals that required for the proper function of a human life come from green plants, animals, and from drinking water.

Calcium, phosphorus, potassium, sodium, and magnesium are the five major minerals in the human body.

Minerals are present in the blood of a healthy human being at certain mass.

Major Minerals

The following table illustrates the list of major minerals along with their salient features −

Minerals Deficiency disease Sources

Potassium Hypokalemia Sweet potato, potato, tomato, lentils, banana, carrot, orange, etc.

Chlorine Hypochloremia Table salt

Sodium Hyponatremia Table salt, sea vegetable, milk, etc.

Calcium Hypocalcaemia Eggs, canned fish, dairy products, nuts, etc.

Phosphorus Hypophosphatemia Red meat, fish, bread, dairy products, rice, oats, etc.

Magnesium Hypomagnesemia Legumes, nuts, seeds, spinach, peanut butter, etc.

Iron Anaemia Meat, seafood, beans, nuts, etc.

Zinc Hair loss, diarrhea Red meat, nuts, dairy products, etc.

Manganese Osteoporosis Grains, nuts, leafy vegetables, legumes, seeds, tea, coffee

Copper Copper deficiency Seafood, oysters, nuts, seeds

Iodine Goitre Grains, eggs, iodized salt

Chromium Chromium deficiency Broccoli, grape juice, meat, etc.

Molybdenum Molybdenum deficiency Legumes, whole grains, nuts

Selenium Selenium deficiency Brazil nuts, meat, seafoods, grains, dairy products, etc.

Biology - Genetic Terminology

The following table illustrates the major Genetic Terminologies along with their brief explanations −

Sr.No. Terminology & Definition/Description

1

Allele

An alternative form of a gene

2

Amorph

A silent gene

3

Angelman syndrome

a rare genetically inherited form of mental retardation

4

Autosome

Synonymous with somatic chromosomes

5

Chimera

An exceptionally rare person composed of the cells derived from different zygotes

6

Chromosome

Rod-shaped or thread-like structures located within the cell nucleus that carry genes encoded by DNA

7

Cloned gene

A recombinant DNA molecule along with the gene of interest

8

Consanguinity

Having a common ancestor, i.e., blood relations

9

Crossing over

The exchange of genetic material between a pair of homologous chromosomes

10

Cross-pollination

Mating of two genetically different plants (but of the same species).

11

Dizygotic twins

Twins produced from two separate ova, which are separately fertilized

12

Deoxyribonucleic acid (DNA)

Composed of nucleic acids, DNA encodes the genes that facilitate genetic information to be passed to offspring.

13

Evolution

Genetic change in a population of organisms over period of time

14

Gamete

A reproductive sex cell (i.e. ovum or sperm)

15

Gene

Units of inheritance typically occurring at specific locations (a chromosome)

16

Gene Pool

All of the genes in all of the individuals in a breeding population

17

Gene Flow

The transference of genes from one population to another

18

Genetic Drift

Evolution, or change in gene pool frequencies, resulting from a random chance

19

Genetics

Study of gene structure, action, and the patterns of inheritance of traits from parent to offspring

20

Genome

The full genetic complement of a species

21

Genomic imprinting

Huntington's disease

The epigenetic phenomenon by which certain genes are expressed in a parent-of-origin-specific manner

An inherited disorder that results into death of brain cells

22

Genotype

27

Hybrid

Genetic constitution of a cell (of an individual organism)

Combining the qualities of two animals or plants of different breeds, varieties, species (also known as crossbreed)

23

Gout

28

Mutation

Genetically inherited metabolic disorder (or a type of arthritis)

Change that occurs in DNA sequence

24

Hemophilia

29

Genetic disorder (largely inherited), problem in blood clotting

Observable characteristics or traits of an individual resulting from the interaction between genotype and the environment

25

Heterozygous

30

Pleiotropy

A cell containing two different alleles of a gene

When one gene influences two or more apparently unrelated phenotypic traits

26

31

Psoriasis

An inherited disease categorized by recurring thick, reddish patches on skin

32

Syntenic

Genes occurring on the same chromosome

33

Zygote

The fertilized egg is known as zygote

Organisms & their Chromosome Counts

The following table illustrates the number of chromosomes present in respective organisms –

Organism	Scientific Name	No. of Chromosomes
Carp		104
Red viscacha rat	Tympanoctomys barrerae	102
Shrimp	Penaeus semisulcatus	86-92
Great white shark	Carcharodon carcharias	82
Pigeon	Columbidae	80
Turkey	Meleagris	80
African wild dog	Lycaon pictus	78
Chicken	Gallus gallus domesticus	78
Coyote	Canis latrans	78
Dhole	Cuon alpinus	78
Dingo	Canis lupus dingo	78
Dog	Canis lupus familiaris	78
Dove	Columbidae	78
Golden Jackal	Canis aureus	78
Gray wolf	Canis lupus	78
Maned wolf	Chrysocyon brachyurus	76
American black bear	Ursus americanus	74
Asiatic black bear	Ursus thibetanus	74
Brown bear	Ursus arctos	74
Polar bear	Ursus maritimus	74
Sloth bear	Melursus ursinus	74
Sun bear	Helarctos malayanus	74
Bat-eared fox	Otocyon megalotis	72
Black nightshade	Solanum nigrum	72
White-tailed deer	Odocoileus virginianus	70
Elk (Wapiti)	Cervus canadensis	68
Red deer	Cervus elaphus	68
Gray fox	Urocyon cinereoargenteus	66
Raccoon dog	Nyctereutes procyonoides	66

Chinchilla	Chinchilla lanigera	64
Echidna	63/64	
Fennec fox	Vulpes zerda	64
Horse	Equus ferus caballus	64
Spotted spunk	Spilogale x	64
Mule	63	
Donkey	Equus africanus asinus	62
Giraffe	Giraffa camelopardalis	62
Gypsy moth	Lymantria dispar dispar	62
Bengal fox	Vulpes bengalensis	62
American bison	Bison bison	60
Cow	Bos primigenius	60
Goat	Capra aegagrus hircus	60
Yak	Bos mutus	60
Elephant	Elephantidae	56
Gaur	Bos gaurus	56
Capuchin monkey	Cebus x	54
Sheep	Ovis orientalis aries	54
Water buffalo	Bubalus bubalis	50
Chimpanzee	Pan troglodytes	48
Gorilla	Gorilla	48
Orangutan	Pongo x	48
Human	Homo sapiens	46
Sable antelope	Hippotragus niger	46
Dolphin	Delphinidae Delphi	44
European rabbit	Oryctolagus cuniculus	44
Giant panda	Ailuropoda melanoleuca	42
Rat	Rattus norvegicus	42
Rhesus monkey	Macaca mulatta	42
Lion	Panthera leo	38
Pig	Sus	38
Tiger	Panthera tigris	38
Kangaroo	16	
Yellowfever mosquito	Aedes aegypti	6
Spider mite	4-14	
Jack jumper ant	Myrmecia pilosula	2
Honeybee	Apis mellifera	32

Biology - Viral Diseases

The following table illustrates the diseases caused by virus −

Disease Name	Organs Affected	Transmission
Influenza	Respiratory Tract	Droplets
Adenovirus Infections	Lungs, Eyes	Droplets, Contact Droplets
Respiratory Syncytial Disease	Respiratory Tract	Droplets
Rhinovirus Infections	Upper Respiratory Tract	Droplets, Contact
Herpes Simplex	Skin, Pharynx, Genital organs	Contact
Chicken pox (Varicella)	Skin, Nervous System	Droplets, Contact
Measles (Rubeola)	Respiratory Tract, Skin	Droplets, Contact

German Measles (Rubella) Skin Droplets, Contact

Mumps (Epidemic Parotitis) Salivary Glands, Blood Droplets

Viral meningitis Headache

Small Pox (Variola) Skin, Blood Contact, Droplets

Warts Kawasaki Disease Skin

Yellow Fever Liver, Blood Mosquito

Dengue Fever Blood, Muscles Mosquito

Hepatitis A Liver Food, Water, Contact

Hepatitis B Liver Contact with body Fluids

NANB Hepatitis Liver Contact with body Fluids

Viral Gastroenteritis Intestine Food, Water

Viral Fevers Blood Contact, arthropods

Cytomegalovirus Disease Blood, Lungs Contact, Congenital transfer

Shingles (varicella zoster virus) Skin

AIDS T-lymphocytes Contact with body Fluids

Rabies Brain, Spinal cord Contact with body Fluids

Polio Intestine, Brain, Spinal Cord Food, Water, Contact

Slow Virus Disease Brain

Viral pneumonia infection in lung

Arboviral Enephalitis Brain Arthropods

Ebola Whole body bodily fluids

Biology - Bacterial Diseases

The following table illustrates the diseases caused by bacteria −

Disease Name Bacteria Name Affected organs

Cholera Vibrio cholerae Small intestine

Anthrax Bacillus Anthrasis Skin, lung, and bowel disease

Diphtheria Corynebacterium diphtheriae Mucous membranes of your nose and throat

Leprosy Mycobacterium leprae Skin

Botulism Clostridium botulinum

Syphilis Treponema pallidum Genital part, lips, mouth, or anus

Tetanus Clostridium tetani Muscle (affected), nervous system

Trachoma Chlamydia trachomatis Eye

Tuberculosis Mycobacterium tuberculosis Lungs

Typhoid fever Salmonella typhi Almost of whole part of the body

Whooping cough Bordetella pertussis

Some Other Diseases

Disease Name Caused by Affected organs

Athlete’s foot Epidermophyton floccosum (fungi) Skin on the feet

Malaria Plasmodium vivax (Protozoa)

Amoebic dysentery Entamoeba histolytica Intestine

Filariasis Roundworms Lymph vessels

Hookworm disease Ancylostoma duodenale Intestine and lungs

Roundworm disease Ascaris lumbricoides Intestine

Blood fluke disease Schistossoma mansoni Skin, lymph, liver, and spleen

Biology - Branches of Biology

The following table illustrates the different branches of biology with their brief description –

Branch Studies

Anatomy Study of the internal structure of an organism

Aerobiology Study of airborne microorganisms

Agronomy Study of soil management and crop production

Agrostology Study of grasses

Araneology Study of spiders

Actinobiology Study of the effects of radiation upon living organisms

Angiology Study of the diseases of the circulatory system and of the lymphatic system

Bioinformatics of collecting and analyzing complex biological data including genetic codes through computer technology

Biotechnology Use of cellular and biomolecular processes to develop technologies and products, which ultimately help to improve human lives and the health of the planet.

Biochemistry Study of chemical and physio-chemical processes and substances, which occur within the living organisms.

Batrachology Study of amphibians including frogs and toads

Bioclimatology Study of the interactions between the biosphere and the Earth's atmosphere on time scales

Botany Study of plants

Bryology Study of mosses and liverworts

Cytology Study of the structure and function of plant and animal cells.

Cryobiology Study of biological material or systems at temperatures below normal

Chromatology Study of colors

Cetology Study of whales, dolphins, and porpoises

Chronobiology Study of periodic (cyclic) phenomena in living organisms

Conchology Study of mollusc shells

Chondrology Study of the cartilage

Craniology Study of the shape and size of the skulls of different human races

Cardiology Study of the diseases and abnormalities of the heart

Dendrology Study of trees

Dermatology Study of skin

Desmology Study of structures and anatomy of ligaments

Embryology Study of the prenatal development of gametes (sex cells),

fertilization, and development of embryos and fetuses.

Ecology Study of interactions among organisms and their environment

Ethology Study of animal behaviors

Entomology Study of insects

Etiologystudy of causation, or origination (largely of diseases)

Epigenetics Study of the changes in a chromosome that affect gene activity and expression (specifically phenotype change and NOT genotype changes)

Ethnobotany Study of a geographic region's plants and their possible uses through the traditional knowledge

Forestry Study creating, managing, using, conserving, and repairing forests

Gynaecology Study of medical practice that deals with the health of the female reproductive systems

Gerontology Study of the process of ageing and old age problems

Genetics Study of genes, genetic variation, and heredity

Genecology Study of genetic variation of species and communities in comparison to their population

Genetic engineering Study of developing technique of direct manipulation of an organism's genome by using biotechnology

Horticulture Study of practice of garden cultivation

Helminthology Study of parasitic worms

Herpetology Study of reptiles (including amphibians)

Hepatology Study of liver

Haematology Study of blood, its problems and treatments

Histology Study of tissue

Ichthyology Study of fishes

Ichnology Study of traces of organismal behavior

Kalology Study of beauty

Lepidopterology Study of moths and the butterflies

Limnology Study of inland waters (emphasizing of biological, physical, and chemical features)

Limnobiology Study of animals and plants of fresh water

Molecular biology Study of the structure and function of the macromolecules (such as proteins and nucleic acids)

Malacology Study of the Mollusca

Mycology Study of fungi

Nephrology Study of kidney

Neurology Study of nervous system

Ornithology Study of birds

Ophthalmology Study of eye

Osteology Study of skeleton system

Palaeozoology Study of animal fossils

Physiology Study of normal functioning of living organisms

Pathology Study of disease and a major field in modern medicine and diagnosis

Palaeobotany Study of plant fossils

Phycology Study of algae

Pomology Study of fruits

Phrenology Study of specific functions of brain

Sedimentology Study of sand, silt, clay, etc.

Serpentology Study of snakes

Saurology Study of lizards

SitologyStudy of food, diet, and nutrition

Spelaeology Study of caves

Taxonomy Study of nomenclature (classification) of animals

Trophology Study of nutrition (for healthy health)

Traumatology Study of wounds and injuries caused by accidents (or violence)

Zoogeography Study of distribution of animals

Zymology Study of the biochemical process of fermentation and its practical uses

Zootechny Study of domestication of animals (includes breeding, genetics, nutrition, and housing)

Zoonosology Study of animal diseases'

ZoologyStudy of animals

Biology - Inventions & Discoveries in Biology

The following table illustrates important inventions and discoveries in Biology −

Name of inventions/discoveries Discoverers & Inventors

Systemic circulation of blood William Harvey

Observation of microorganisms Antony van Leeuwenhoek

Sex hormones Eugen Stainak

Simple microscope Anton van Leeuwenhoek

Stethoscope René Laennec

First test tube baby Robert Edward and Patrick Steptoe

Vaccination Edward Jenner

Vitamin Casimir Funk

CT scan Godfrey Hounsfield & Allan Cormack

DNA Rosalind Franklin and Maurice Wilkins

DNA Structure James Watson and Francis Crick

DNA Fingerprinting Alec Jeffreys

Electrocardiogram (ECG) Willem Einthoven

5 kingdom classification R. H. Whittaker

Genetic code Marshall Nirenberg and Heinrich J. Matthaei

Genetic drift Sewall Wright

Father of heart transplantation Norman Shumway

Heart transplantation first performed Christiaan Barnard

Hormone William Bayliss

Insulin Frederick Banting and Charles H. Best

Malaria Parasite Charles Louis Alphonse Laveran

Magnetic Resonance Imaging (MRI) Damadian

Open heart surgery Dr. Daniel Hale Williams. And Dr. Daniel Williams

Penicillin Alexander Fleming

Polio vaccine Jonas Salk and a team

Rh factor in human blood Dr. Alexander S. Wiener and Karl Landsteiner

Cancer Hippocrates

Blood group (ABO group) Karl Landsteiner

Binomial nomenclature Carl Linnaeus

Bacteria (& protozoa) Van Leeuwenhoek

Aspirin Felix Hoffmann at Bayer in Germany

Jarvik-7 (first artificial heart) Willem Johan Kolff and Robert Jarvik

Anthrax vaccine Pasteur

Amoeba August Johann Rösel von Rosenhof

Oxygen in respiration and photosynthesis Joseph Priestley, Antoine Lavoisier and Jan Ingenhousz

Animal electricity Luigi Galvani

Cell Robert Hooke

Cell Theory Schleiden and Schwann

Chromosomes Hofmeister

Chioroplast Schimper

Mitochondria Kolliker

Nucleus Robert Brown

Nucleoplasm Strasburger

Enzyme Anselme Payen

Mitosis Walther Flemming

Meiosis Oscar Hertwig

Mutations Thomas Hunt Morgan and Lilian Vaughan Morgan

Virus Dmitri Ivanovsky & Martinus Beijerinck

Nobel Prize in Biology

Introduction

Gerty Cori

Cori, a Czech-American biochemist, was the first woman to be awarded the Prize in Physiology or Medicine.

She received the prize in 1947.

She was the third woman and first American woman who won a Nobel Prize in science.

Gerty Theresa Cori

She received the award for her work namely “the mechanism by which glycogen—a derivative of glucose—is broken down in muscle tissue into lactic acid and then resynthesized in the body and stored as a source of energy (known as the Cori cycle).”

The following table illustrates some of the eminent Nobel Prize winners −

Name Country/Year Work

Emil Adolf von Behring Germany (1901) Serum therapy

Sir Ronald Ross UK (1902) Worked on malaria

Ivan Petrovich Pavlov Russia (1904) Physiology of digestion

Albrecht Kossel Germany (1910) Cell Chemistry

Allvar Gullstrand Sweden (1911) Dioptrics of the eye

Alexis Carrel France (1912) Vascular suture and the transplantation of blood vessels and organs

Archibald Vivian Hill UK (1922) Production of heat in the muscle

Sir Frederick Grant Banting & John James Rickard Macleod Canada & UK (1923) Discovery of insulin

Karl LandsteinerAustria (1930) Discovery of human blood groups

Thomas Hunt Morgan US (1933) Role played by the chromosome in heredity

Carl Peter Henrik Dam Denmark (1943) Discovery of vitamin K

Sir Alexander Fleming UK (1945) Discovery of penicillin and its curative effect in various infectious diseases

Sir Ernst Boris Chain UK (1945)

Howard Walter Florey Austria (1945)

Carl Ferdinand Cori US (1947) Discovery of the course of the catalytic conversion of glycogen

Gerty Theresa Cori, née Radnitz

Max Theiler South Africa (1951) Yellow fever

Selman Abraham Waksman US (1952) Discovery of streptomycin, the first antibiotic effective against tuberculosis

Joshua Lederberg US (1958) Genetic recombination

Peyton Rous US (1966) Discovery of tumor-inducing viruses

Charles Brenton Huggins US (1966) Hormonal treatment of prostatic cancer

Har Gobind Khorana India & US (1968) Interpretation of the genetic code and its function in protein synthesis

Marshall W. Nirenberg US (1968)

Robert W. Holley US (1968)

Albert Claude Belgium (1974) Structural and functional organization of the cell

Christian de Duve

George E. Palade Romania (1974)

Baruch S. Blumberg US (1976) Origin and dissemination of infectious diseases

D. Carleton Gajdusek

Michael S. Brown US (1985) Regulation of cholesterol metabolism

Joseph L. Goldstein

Sir Richard J. Roberts UK (1993) Discovery of split genes

Phillip A. Sharp US (1993)

Paul Lauterbur US (2003) Magnetic resonance imaging

Sir Peter Mansfield UK (2003)

Andrew Z. Fire US (2006) Discovery of RNA interference

Craig C. Mello

Harald zur Hausen Germany (2008)
Human papilloma viruses causing cervical cancer

Françoise Barré-Sinoussi France (2008)
Discovery of human immunodeficiency virus

Luc Montagnier

Sir Robert G. Edwards UK (2010)
Development of in vitro fertilization

Tu Youyou China (2015) Discovery of a novel therapy against Malaria

Yoshinori Ohsumi Japan (2016)
Mechanisms for autophagy