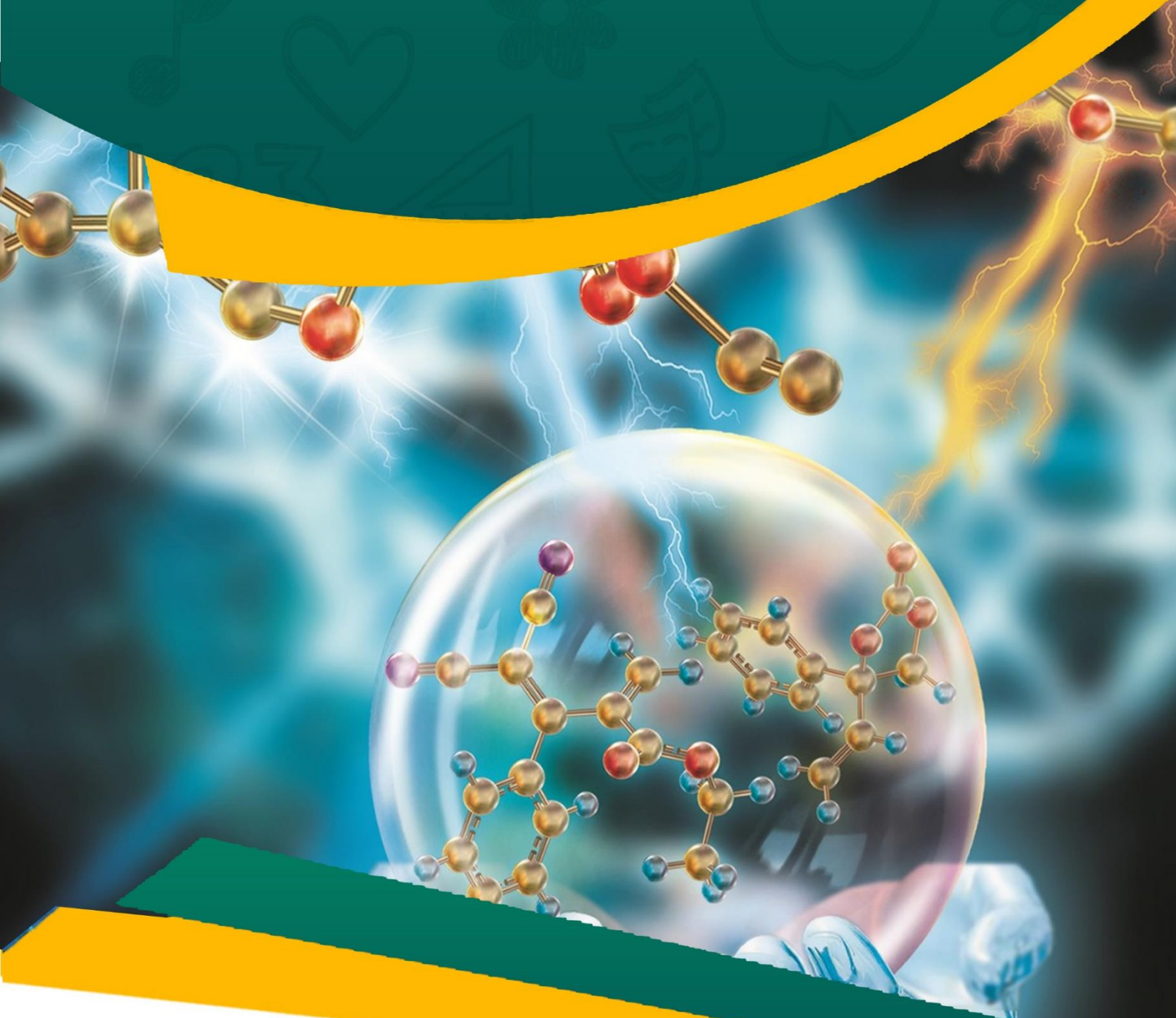


Science



Lesson - 2



Cell and Tissues	2
Tissues	7
Virus and Bacteria	10
Botany	11
Zoology.....	14
The Nervous System	17
Central Nervous System.....	18
Senses.....	21
Endocrine System.....	21
Transportation	22
Transportation in Plants.....	22
Transportation in Humans	23
Human skeleton and muscle system	26
Human Skeleton.....	26
Muscular system	27
Human Digestive System	28
Excretion System.....	29
Excretion in human beings.....	29
Excretion in Plants.....	30
Heredity and Evolution	30
Reproduction in Organisms	31

Living things are the organisms which possess life and have the ability to eat, grow, respire, reproduce, obtain and use energy for the metabolic process.

- There are certain characteristics by which living can be distinguished from non-living:
 - **Growth:** increase in the number of cell or mass.
 - **Reproduction:** living organism produce young ones of their same kind.
 - **Metabolism:** chemical reaction occurring inside a living cell.
 - **Response of stimuli:** living have the ability to sense the condition of their surroundings and respond to these stimuli.

CELL AND TISSUES

The cell is the **basic structural, functional, and biological unit** of all known organisms.

- It is the **smallest unit of life** and are often called the "**building blocks of life**". **Robert Hooke** discovered the cell in **1665**.
- **Anton Von Leeuwenhoek** first saw and described a live cell. **Robert Brown** later discovered the nucleus.
- A cell is called **fundamental unit of life** because it is **capable of existing on its own** and performing all the functions which are necessary for a living being.
- The study of cells is called **cell biology, cellular biology, or cytology**.
- All organisms are made up of cells. They may be made up of a:
 - a. Single cell (unicellular) like **Amoeba**, or
 - b. Many cells (multicellular).

TYPES OF CELLS

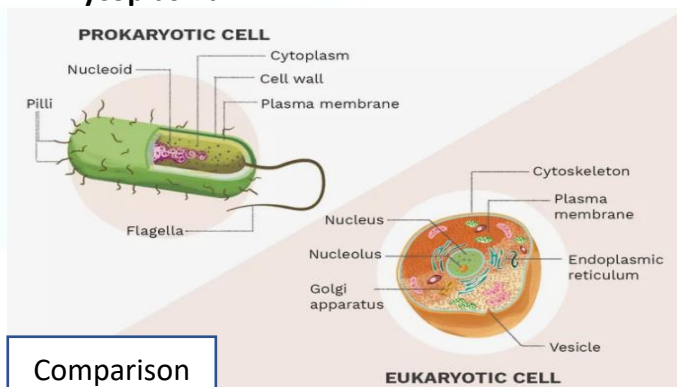
Based on **cellular structure**, Cells are of two types:

PROKARYOTIC CELLS

'Pro' refers to **primitive** or primary and 'Karyote' refers to **nucleus**.

- These are the **cells without nucleus**. As the membrane of the cell organelles are also absent, constituents of cell are not well defined.
- They are **single-celled microorganisms** and includes **archaea, bacteria (blue green algae), and cyanobacteria**.
- Number of mitochondria in bacterial cell is zero.

- The smallest known prokaryotic organism is **mycoplasma**.



- The cell size ranges from **0.1 to 0.5 μm in diameter**.
- These cells can perform **limited** functions.
- They **reproduce by binary fission** (asexual reproduction) and the hereditary material of these organisms can be **either DNA or RNA**.

EUKARYOTIC CELLS

Eukaryotes are organisms **whose cells have a nucleus**. They are advanced and complete cells.

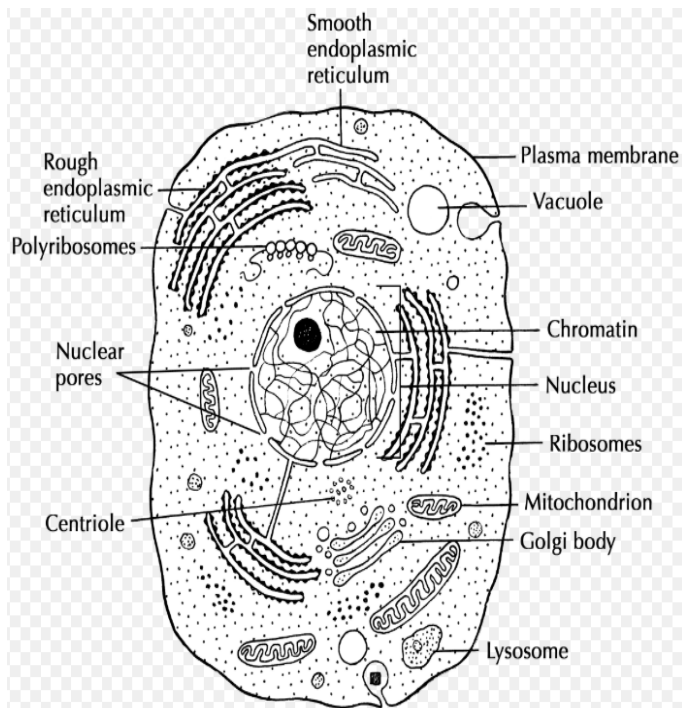
- They can be either Unicellular (single celled) or **multicellular** and involves **plants, fungi, protozoans, and animals**.
- Eukaryotes can reproduce both **asexually through mitosis** and **sexually through meiosis and gamete fusion**.
- Eukaryotic cells are **typically much larger** than those of prokaryotes.

IMPORTANT TERMS

1. **Mitosis:** In this **one cell divides** to produce two genetically identical cells.
2. **Meiosis:** In this DNA replication is followed by **two rounds of cell division** to produce four haploid (one set of chromosome) daughter cells.
 - These act as sex cells (gametes), each has a unique mix of the **corresponding pair of parental chromosomes** resulting from **genetic recombination** during meiosis.
3. The smallest cell is **Mycoplasma gallisepticum**.
4. The longest cell in human body is **Neuron**.
5. The biggest cell is **egg of ostrich**.
6. **Schilden and Schwan** established cell theory in the year 1838-39.

STRUCTURE OF CELL

The cell structure comprises **individual components with specific functions** essential to carry out life's processes.



These components include:

a. Cell membrane: It is also called **plasma membrane**, is a **biological membrane that surrounds the cytoplasm** of a cell.

- It is a **living part** of the cell and is **very thin & delicate**.
- It **supports and protects** the cell from external environment.
- It **controls the movement of substances** in and out of the cells.
- It is a **porous membrane** which **permit the movement of selective substances** in and out of the cell.
- Substances like CO₂ and O₂ can move across the cell membranes by a **process of diffusion**.
- It is made up of **phospholipid** molecules.

b. Cytoplasm: It is the **clear jelly like fluid that fills a cell**. It is thicker than water.

- It helps in keeping the cell's internal components in place.
- It acts as a store for vital chemicals such as amino acids, protein, sugar etc.
- Most of the chemical reactions of a cell takes place in the cytoplasm.

c. Cell Wall: It acts to **protect the cell chemically and mechanically** from its environment. It is an **additional layer of protection** to the cell membrane.

- The cell wall **lies outside** the plasma membrane. It is **non-living** part of the cell.

- It is **thick, freely permeable** and is made up of cellulose.
- It is present only in Plant cells and not in Animal cells.
- It also provide rigidity, shape and support to the cells.
- Different types of cell have cell walls **made up of different materials**.

d. Nucleus: It is known as the **genetic information centre of the cell**. It contains **cell's chromosomes** (hereditary material).

- It is **dark coloured, spherical or oval dot-like** structure present at the cell centre.
- It is the place **where almost all DNA replication and RNA synthesis** occur.
- It sends signals to the cells to **grow, mature, divide and die**.
- Nucleus has a fluid present in it, which is called **Nucleoplasm**.
- Chromatin is an **entangled mass of thread like structure** present within the nucleus, which leads to the formation of chromosomes.
- In case of prokaryotic cells, because of lack of clearly defined nucleus, nucleic acids are present and are known as **nucleoids**.

e. Nuclear Membrane: It **protects the nucleus** by forming a **boundary between the nucleus and other cell organelles**.

f. Protoplasm: The whole **fluid present inside plasma membranes** is protoplasm. It is made up of various chemical substances like water, ions, salt and organic molecule.

g. Mitochondria: It **generate energy** for the cell. They **by respiration produces ATP** (Adenosine triphosphate), the cell's energy unit.

- It is also called the **powerhouse of the cell**.
- They are small rod-shaped organelles and multiply by **binary fission**.

h. Ribosomes: They are the **protein synthesisers** of the cell.

- **Proteins** are needed for many cellular functions such as repairing damage or directing chemical processes.

- Ribosomes can be found floating within the **cytoplasm** or sometimes attached to the **endoplasmic reticulum**
- i. Chloroplast: are the **primary organelles for photosynthesis**.
 - It contains the **pigment chlorophyll**.
 - Chloroplast is bounded by two-unit membrane having **grana and stroma**.
 - Grana are membrane bounded **sac like structure** found in stacks containing chlorophyll molecule.
 - Stroma is the **matrix present inside the chloroplast** which contain photosynthetic enzymes and starch grain.
 - j. Lysosomes: They protect the cell by **engulfing the foreign bodies** entering the cell and **helps in cell renewal**.
 - These are **formed by Golgi bodies**. These are waste disposal systems of a cell.
 - It contains **several digestive enzymes** enclosed in a membrane. These enzymes can **break down** all organic material.
 - In case the cell gets damaged and lysosomes burst, the enzymes present in it digest the whole cell. Thus, these are also called **Suicidal bags of the cell**.
 - Thus, it keeps the cell clean and provides protection against virus and bacteria.
 - k. Endoplasmic reticulum (ER): It is involved in the **transportation of substances** throughout the cell.
 - It plays a primary role in the **metabolism of carbohydrates, synthesis of lipids, steroids, and proteins**.
 - The ER has two forms: the **rough ER**, which has **ribosomes on its surface** that secrete proteins into the ER, and the **smooth ER**, which lacks ribosomes.
 - l. Golgi apparatus: It consists of system of **membrane bound vesicles** (bags) arranged parallel to each other in stacks. These stacks are called **cisterns**.
 - Its primary function is to **process and package the macromolecules** such as proteins and lipids that are synthesized by the cell.
 - It helps in **storage, modification and packaging** of products in vesicles.
 - m. Vacuoles: These are **storage stacks for solid and liquid contents** filled in the membrane. These are small sized in animal cells and large sized in plant cells.
 - They **sequester waste products** and in **plant cells store water**. They are often described as **liquid filled space** and are surrounded by a membrane.
 - n. Centriole: They **aid in cell division by facilitating the separation of chromosomes**.
 - These spindle fibres act as **guides for the alignment of the chromosomes** when they separate during the process of cell division.
 - For this reason, they are located near the nucleus.
 - Though centrioles play a role in the reproduction within animal cells, plant cells are **able to reproduce without them**.
 - o. Nucleolus: It is the **site of ribosome synthesis**. Also, it is involved in **controlling cellular activities and cellular reproduction**.
 - p. Plastids: They are usually spherical in shape and are double membrane bound organelles. They are **responsible for manufacturing and storing of food**.
 - q. Centrosome: It is **only found in animal cell** taking part in cell division. It is not bounded by membrane consist of two centriole.
 - r. Chromoplast: It **provides various colours** to the plant like flower, fruit etc. Chromoplasts are of different kind:
 - Lycopene: In **tomato** it provides **red colour**.
 - Carotene: Provide **yellow or orange colour** in plant like **carrot**.
 - Betanin: found in **sugar beet**.
 - s. Cilia or flagella: They have the same internal structure. The **major differences is in their length**.
 - Cilia are short, and there are usually many cilia per cell.
 - On the other hand, flagella are longer, and there are fewer flagella per cell.
 - They facilitate **liquid movement** along the surface of the cell.

DIFFERENCE BETWEEN ANIMAL AND PLANT CELLS

Plant Cell	Animal Cell
It is usually larger in size.	It is comparatively smaller in size .
Cell wall is present.	Cell wall is absent.
It cannot change its shape	It can often change its shape.
Lysosomes are rare .	Lysosomes are always present.
A large vacuole is present in the centre.	Vacuoles are generally absent , if present, they are small
Cytoplasm is not so dense .	Cytoplasm is denser and more granular and almost fills the entire cell.
Golgi apparatus consists of simple smaller units.	Golgi apparatus is highly complex and prominent.
Mitochondria are fewer in number.	Mitochondria are numerous in number.
Nucleus lies on one side of the cell .	Nucleus lies in the centre of the cell .
Cell is square or rectangular in shape.	Cell is round or irregular in shape.

FUNCTIONS OF CELL

Important functions of cell are as follows:

1. They form the **structural basis** of all the organisms.
2. The **cells multiply and facilitate the growth in an organism**.
3. Various nutrients are **imported by the cells to carry out various chemical processes** going on inside the cells.
4. Cells require energy to carry out various chemical processes. This **energy is produced by the cells through a process called photosynthesis in plants and respiration in animals**.
5. A cell aids in reproduction through the processes called mitosis and meiosis.

CHROMOSOME

It is a thread like structure found in the nucleus. It becomes visible during cell division.

- Each chromosome is **made up of two chromatids** joined together at a point **centromere**.

- Bead like structure found on chromosome is called **gene**.
- Genes are made up of **DNA** (deoxyribo nucleic acid) which is the **carrier of genetic information** from generation to generation.
- In some viruses RNA is the genetic material called **retrovirus**. In prokaryotes there is **only one chromosome**.
- Chromosome was named by **Waldayer** in 1888 capable of self replication, which trasmit coded information from one generation to other.
- Eukaryotic cell posses many chromosome. A particular kind of species have **definite number of chromosome** in their cell, which are in pair known as **diploid**.
 - The set of unpaired chromosome is called **haploid**. Gametes have haploid set of chomosomes.
- Pegen – 40 pairs pf chromosomes
 - Chimpanzee – 24 pairs of chromosomes
 - Cat – 19 pairs
 - Dog – 39 Pairs
 - Human – 23 pairs
 - Horse – 32 pairs
 - Wheat – 21 pairs
 - Forg – 13 pairs

NUCLEIC ACID

It is complex organic compound found in cell. It contains special genetic instruction in coded form. Nucleic acid are of two kinds:

DEOXYRIBO NUCLEIC ACID (DNA)

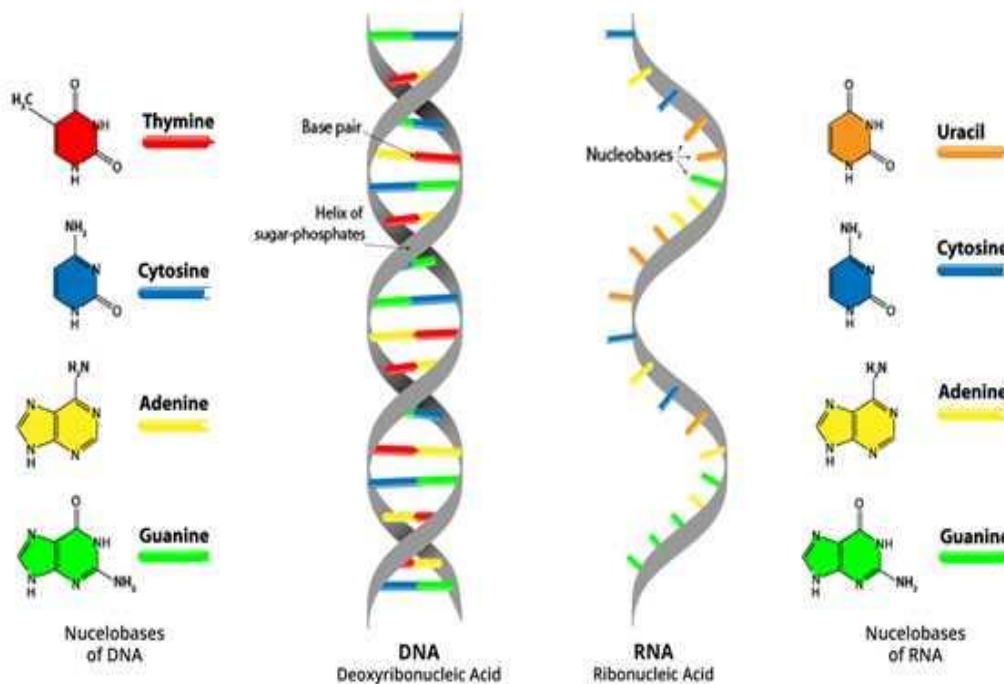
Frederic Miescher was the first who isolated DNA from the nucleus of pus cells.

- DNA is a macro molecule in which large number of nucleotides are present. Chemically a nucleotides has three components:
 - Nitrogen base
 - Sugar
 - Phosphate group
- Nitrogen base are of two types – **purines and pyrimidines**.
 - Purines contains two nitrogen base – **adenine and guanine**.
 - Pyrimidine nitrogen base are **thymine and cytosine**.

Thus there are four kinds of nucleotides present in DNA.

1. DNA molecule is consist of **two polynucleotide strand**, forming a **double helix**. Each strand has a backbone of **sugar and phosphate**.
 - Nitrogen base is attached to the sugar.
 - Sugar + Nitrogen base = Neucleoside
 - Sugar + Nitrogen base + phosphate = Nucleotide

- **Transfer RNA (tRNA)** is the carrier of amino acid and transfer it to the ribosome.



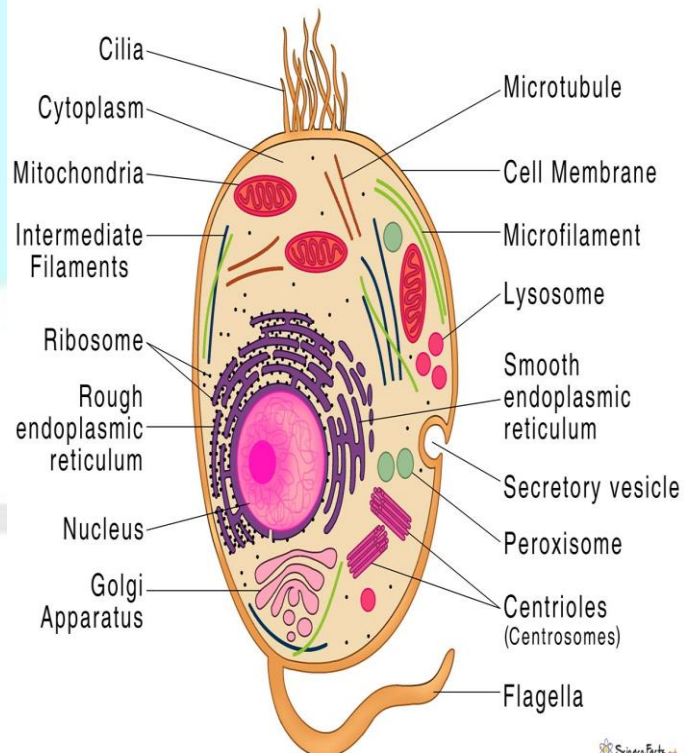
2. Nitrogenous base of the **two strands of a double helix** form a pair with the help of hydrogen bonds.
 - **Adenine pairs with thymine** whereas **guanine pairs with cytosine**.
 - Hydrogen bonding between nitrogenous base holds the two strands together.
 - This structure can be compared with the steps of **spiral staircase**.
- DNA is mainly found in **nucleus**. In small amount it is also found in **mitochondria and chloroplast**.
 - Gene: It is hereditary unit which is made by a segment of DNA found on the chromosome.

RIBONUCLEIC ACID (RNA)

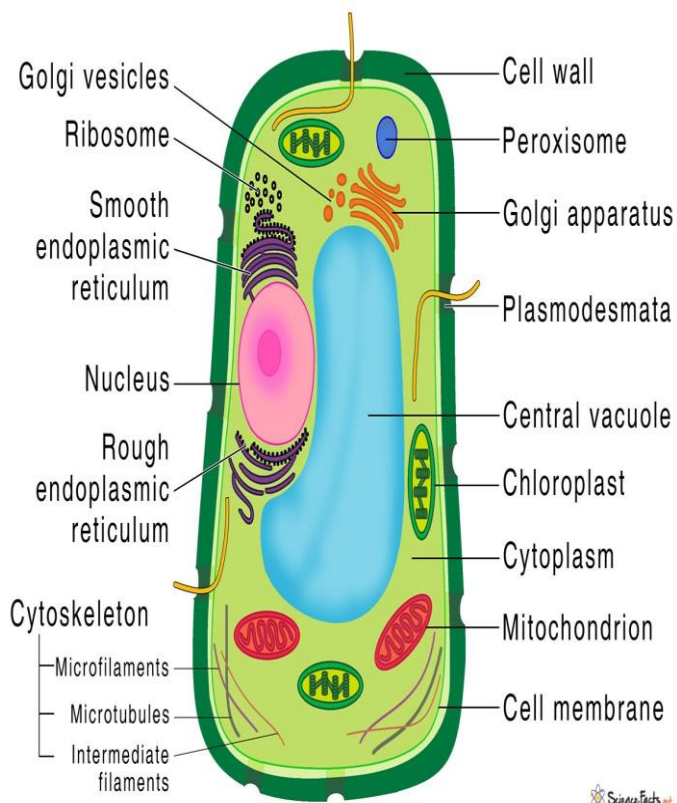
RNA is a **single stranded** nucleic acid made up of phosphate, ribose sugar and nitrogen base **uracil, adenine, guanine and cytosine**.

- It is found in nucleus as well as cytoplasm.
- RNA is of three kind:
 - **Messenger RNA (mRNA)** brings the message from DNA found in the nucleus to cytoplasm in the coded form.
 - **Ribosomal RNA (rRNA)** present in ribosome which is the site for protein synthesis.

Animal Cell



Plant Cell



STEM CELLS

Stem cells are a **class of undifferentiated cells that are able to differentiate into specialized cell types** and divide to produce more cells.

- Their significance lies in their **ability to differentiate (develop) into specialized mature cells** such as skin, bone, muscle cells etc.
- Two **main sources** of Stem cells are:
 - a. **Embryonic stem cells** that are derived from a **four- or five-day-old human embryo** that is in the blastocyst phase of development.
 - b. Adult tissue (adult stem cells) **exist throughout the body** and are **found in tissues such as brain, bone marrow, liver and blood**.
 - They remain in a **non-dividing state** for long until activated by disease or tissue injury.
 - **Placenta and umbilical cord** are also **rich sources of stem cells** and are collected after the birth of a baby. They are a type of non-embryonic stem cells.

IMPORTANT TERMS

1. Karyokinesis: **Division of nucleus** during cell division.
2. Haploid: Single set of chromosome in cell, found in gametes.
3. Diploid: **Two complete set** of chromosome, found in somatic cell.
4. Homologous chromosome: A pair of chromosome having **same size and shape** bearing corresponding gene.

5. Allele: **Alternative form** of characters governed by gene.
6. Phenotype: The **character of organism** which can be seen **directly**.
7. Genotype: **Genetic constitution** of organism.
8. Genome: All gene present in a haploid cell.
9. Cistron: **functional unit** of gene.
10. Muton: Unit of gene responsible for mutation
11. Recon: Unit of gene take part in recombination.

TISSUES

The term tissue **is used to describe a group of cells** found together in the body. The cells within a tissue share a **common embryonic origin**.

- Although there are many types of cells in the human body, they are **organized into four broad categories of tissues**.
- Each of the category is **characterized by specific functions** that contribute to the **overall health and maintenance** of the body.
- Plant are stationary and therefore, most of the tissues in them are **supportive and give structural strength**.
 - The tissues consist of dead cells, hence, need less maintenance.
- Animals are mobile. The tissues consist of living cells and hence need more maintenance and energy.

PLANT TISSUES

Some tissues in the plants keep on dividing throughout the year, whereas others do not divide at all.

- On the basis of their dividing capacity, plant tissues can be grouped into two types:

MERISTEMATIC OR GROWING TISSUES

Meristematic tissues in the plant, are located at specific regions. Therefore, the **growth of plants occurs only at these sites**.

- Depending on the region where these tissues are present, meristematic tissues can be of three types: **apical, lateral and intercalary**.
 - Apical meristematic tissue is present at the **growing tip of stems and roots**. It increases the length of stem and root.
 - Lateral meristematic tissue increases the girth of stem and root.

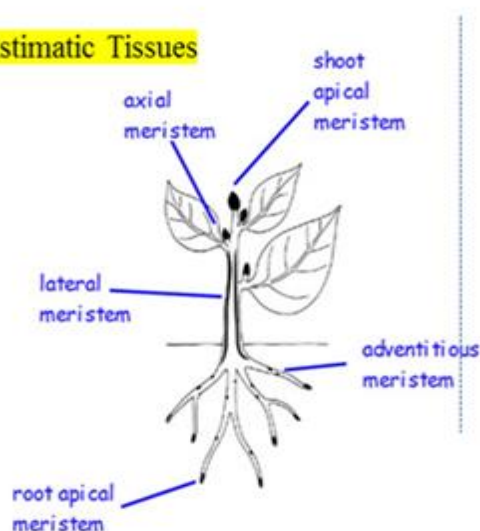
- Intercalary meristematic tissue is present at the base of the leaves or internodes on the twigs.
- The cells of the meristematic tissue are **very active**, have **dense cytoplasm**, thin cellulose walls and prominent nuclei.

PERMANENT TISSUE

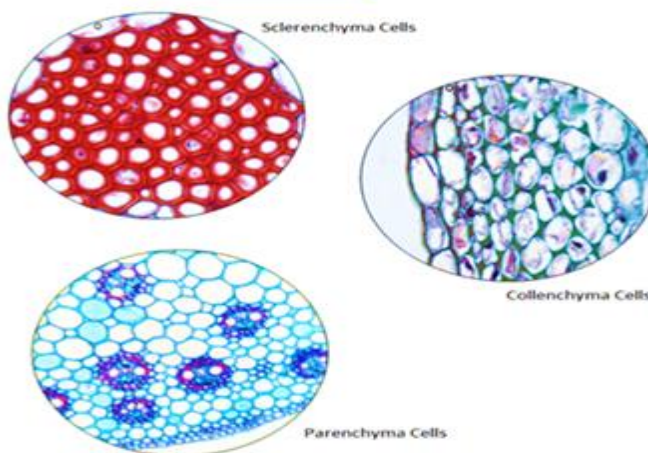
Some cells lose the ability to divide and form a permanent tissue. The process of taking up a permanent shape, size and function is called **differentiation**. They are of two types:

- Simple Permanent tissue consists of **unspecialised cells** with thin cell walls.
 - They are **live cells** and are loosely packed with large intercellular spaces.

Meristimatic Tissues



Permanent Tissues



- Sometimes this tissue **contain chlorophyll** and performs photosynthesis and is thus **chlorenchyma**.
- Sometimes, it has large air cavities which make parts of plant to float in air and is thus called **aerenchyma**.
- **Collenchyma** is another one which gives flexibility and mechanical support to the plants.
- The tissue which gives hardness and stiffness to the plant is called **Sclerenchyma**.
- Complex Permanent tissues are those which are made up of **more than one type of cells**.
 - These different types of cells coordinate to perform a common function, for example, xylem and phloem.

ANIMAL TISSUES

Different types of tissues are present in our body to perform specific functions.

- The four categories of **human tissues** are explained below:

EPITHELIAL TISSUE

The covering or protective tissues in the animal body are epithelial tissues.

- They refers to the tightly packed **sheets of cells that cover exterior surfaces of the body**, lines internal cavities and passageways, and forms certain glands.
- They perform functions like protection, secretion, absorption and excretion.
- These cells are **permeable** to some extent and, therefore, help in the exchange of materials between different parts of the body and the external environment.

CONNECTIVE TISSUE

The cells of connective tissue are **loosely spaced** and embedded in an intercellular matrix. The matrix may be **jelly like, fluid, dense or rigid**.

- They **binds the cells and organs of the body together** and functions in the protection, support, and integration of all parts of the body.
- Different types of connective tissue are as follows:
 - **Blood** is a type of connective tissue. It **transports** oxygen, nutrients, hormones and other compounds to various parts of the body.
 - **Bone** is also a type of connective tissue. Blood cells are embedded in a **hard matrix** which is composed of **calcium and phosphorous**.
 - **Ligament** is also a type of connective tissue. It connects the bones to each other. This

tissue is **highly elastic with considerable strength**.

- **Tendons** is a fibrous tissue with great strength and less flexibility. It connects muscles to bones.
- **Cartilage** is a **firm, flexible** connective tissue found in various forms in the larynx and respiratory tracts, in structure such as the external ear.
- **Adipose** tissue play a major role in **storing energy** in the form of fat.

MUSCLE TISSUE

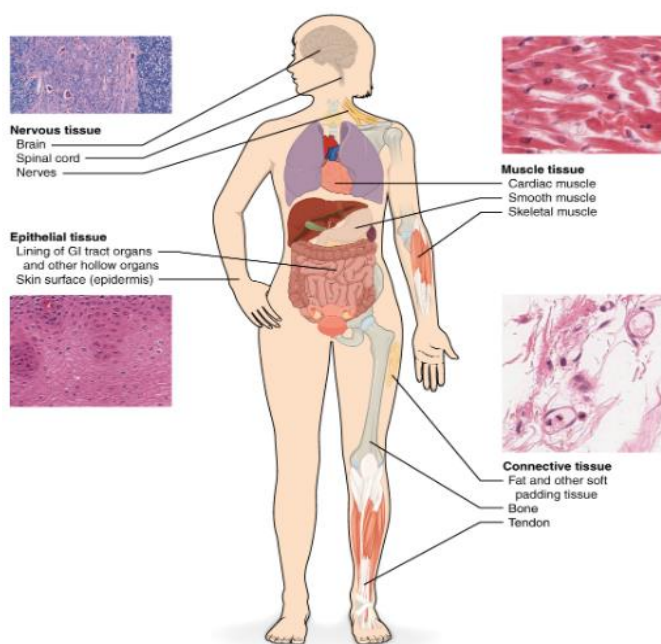
It is **excitable, responding to stimulation and contracting to provide movement**, and occurs as three major types:

- (a) Skeletal (voluntary/striated) muscle,
 - (b) Smooth muscle fibres (Unstriated) are long, with pointed ends and uninucleated.
 - (c) Cardiac muscle in the **heart**. These are involuntary muscles, which **shows rhythmic contraction and relaxation** throughout our life.
- Muscle fibres also contain **special proteins called contractile proteins** which contracts and relax to cause movements.

WHAT CAUSES FATIGUE IN OUR BODY?

Our muscle produces lactic acid during intense exercise. It is a by-product of metabolism in our body. It causes muscle fatigue.

- Lactic acid deposits can be reduced by stretching of muscles.



NERVOUS TISSUE

Nervous tissue is **also excitable**, allowing the **propagation of electrochemical signals** in the form of nerve impulses that communicate between different regions of the body.

EMBRYONIC ORIGIN OF TISSUES

- The **zygote, or fertilized egg**, is a single cell formed by the fusion of **an egg and sperm**.
- After **fertilization** the zygote **gives rise to rapid mitotic cycles**, generating many **cells to form the embryo**.
- The first embryonic cells generated have the **ability to differentiate into any type of cell** in the body.
- As cell proliferation progresses, **three major cell lineages** are established within the embryo.
- Each of these lineages of embryonic cells forms **the distinct germ layers**
 - a. Endoderm: Inner germ layer
 - b. Ectoderm: Outer germ layer
 - c. Mesoderm: Middle germ layer**From which all the tissues and organs of the human body eventually form.**
- Epithelial tissue originates in **all three layers**, whereas nervous tissue derives **primarily from the ectoderm** and muscle tissue from **mesoderm**.

TISSUE MEMBRANES

A tissue membrane is a thin layer or sheet of cells that covers the:

- a. **Outside** of the body (for example, skin)
 - b. Organs (for example, pericardium)
 - c. **Internal passageways** that lead to the exterior of the body (for example, abdominal mesenteries)
 - d. The **lining** of the moveable joint cavities.
- There are two basic types of tissue membranes: **connective tissue and epithelial membranes**.

Necrosis is a form of cell injury which **results in the premature death of cells in living tissue** by autolysis.

- Necrosis is **caused by factors external to the cell or tissue, such as infection, toxins, or trauma** which result in the unregulated digestion of cell components.

VIRUS AND BACTERIA

A **virus** is a sub microscopic **infectious agent** that replicates only inside the living cells of an organism.

- It has both the **characters of living and non-living**, so it is a connecting link between them.
- They became **active inside a living cells**. Nucleic acids replicate themselves and they reproduce rapidly.
- According to parasitic nature, virus is of three types:
 - Plant Virus: **RNA** is present as its nucleic acid.
 - Animal Virus: **DNA or sometimes RNA** is found in it.
 - Bacteriophage: They depend only on bacteria. They kill the bacteria. DNA is found in them.
- Those viruses in which RNA is found as genetic material are called Retrovirus.

Bacteria was discovered by **Antony Von Leeuwenhoek** of Holland in the year 1683. He is called as the **father of Bacteriology**.

- Bacteria are **microscopic, single-celled** organisms that thrive in diverse environments.
- Bacteria are classified as **prokaryotes**, which are single-celled organisms with a simple internal structure that **lacks a nucleus and contains DNA** that either floats freely in a twisted, thread-like mass called the **nucleoid**, or in separate, circular pieces called plasmids.
 - Ribosomes are the **spherical units in the bacterial cell** where proteins are assembled from individual amino acids using the information encoded in ribosomal RNA.
- On the basis of shape, bacteria is of different types:
 - Bacillus: This is rod like or cylindrical.
 - **Round** or coccus, they are **smallest** bacteria.
 - **Comma shaped** or Vibrio bacteria.
 - **Spirillum** or screw shaped.
- Humans' relationship with bacteria is **complex**. Sometimes bacteria lend us a helping hand, such as by curdling milk into yogurt or helping with our digestion. In other cases, bacteria are destructive, causing diseases like pneumonia.
- Some species of **Azotobacter, Azospirillum and clostridium bacteria** live freely in the soil and fix atmospheric nitrogen into the nitrogenous compound.

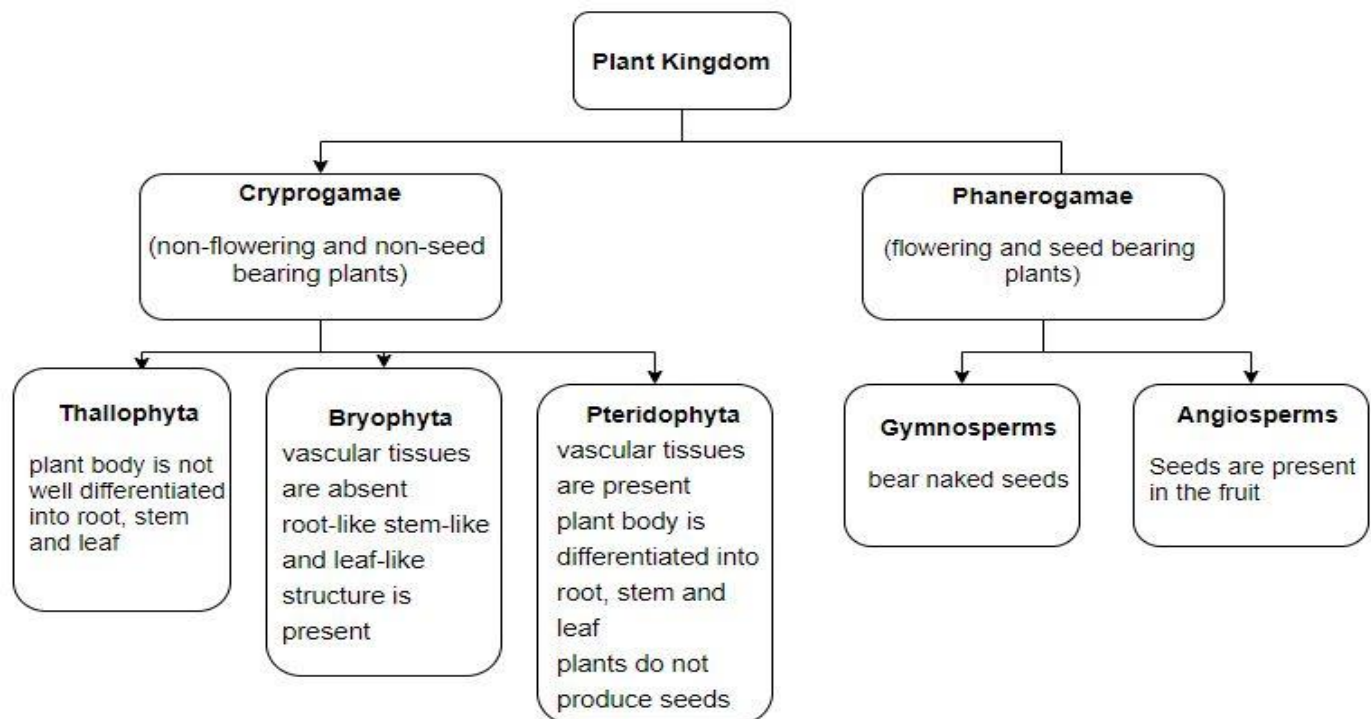
- The bacteria capable of **converting nitrite into nitrate** is **Nitrosomonas**.
- The species of **Rhizobium and Bradyrhizobium** etc. bacteria live in the roots of the leguminous plants capable of converting atmospheric nitrogen into its compound.
- Rhizobium is called **symbiotic** bacteria.
- In leather industry separation of hair and fat from leather is done by bacteria. This is called **tanning of leather**.
- Pickles, syrup is kept in salt or in dense liquid of sugar so that in case of bacterial attack bacteria are plasmolysed and destroyed.

BOTANY

Botany is the scientific study of plants. "Plants," including a wide range of living organisms from the smallest bacteria to the largest living things - the giant sequoia trees.

- By this definition plants include **algae, fungi, lichens, mosses, ferns, conifers** and **flowering plants**.
- **Theophrastus** is called the father of botany.

CLASSIFICATION OF PLANTS



1. **Cryptogams Plants:** There are **no flower and seed** in these types of plants. These are classified in the following groups:

THALOPHYTA

This is the **largest group** of the plant kingdom. The body of the plants in this group is **thalus** like i. e. plants are **not differentiated** into root, stem and leaves.

ALGAE

The green **non differentiated plants** (not differentiated into organs like root, stem and leaf) possessing chlorophyll are known as Algae.

- They usually **grow in water** or in **moist situations**.
- The fresh-water algae are **generally green or blue green in colour**, whereas the marine ones are red or brown.

- These are **autotrophic plants**, as they can manufacture their own food.
- The study of Algae is called **phycology**.
- **Agar - agar** is prepared from algae.

FUNGI

Non-green non differentiated plants characterised by **total absence of chlorophyll** are called Fungi.

- They grow either on dead, rotten organic matters as **saprophytes** or **live as parasites** on other living bodies, which are referred to as hosts.
- Accumulated food in fungi remains as **Glycogen**.

- Moulds and mushrooms are the familiar examples of saprophytic fungi.
- The study of fungi is called **mycology**.
- Fungi may create serious diseases in plants. Most damage is caused by rust and smut.

BRYOPHYTA

This is the **first group** of land plants.

- The plant body is **differentiated** into a small stem and simple leaves, but true roots are absent. There is **lack of xylem and phloem** tissue.
- They usually grow in **moist places**. E.g., Liverworts, **mosses**.
- The Sphagnum moss is used as fuel.

PTERIDOPHYTA

The plants of this group are mostly found in wet shady places, forests and mountains.

- The body of plants is **differentiated into root, stem and leaves**.

2. Phanerogams of floral plant: Plants of this group are well developed. All the plants in this groups bears flowers, fruits and seeds. Plants in this groups can be classified into two subgroups:

GYMNOSPERM

Gymnosperms (gymnos = naked, sperma = seed) are the **naked-seeded woody perennials**, either shrubs or trees.

- Ovules are present on the surface of the carpels and are **directly pollinated by the pollen grains**.
- There is nothing like ovary, style and stigma, and naturally there is no fruit. e.g. Cycas, Pinus, Gnetum.
- The longest plant of the plant kingdom, ***sequoia gignentia*** comes under it. This is also called **Red wood of California**.

ANGIOSPERM

Angiosperms (angion = a case) are the **closed-seeded plants**.

- These are the **most highly developed plants** which bear flowers having conspicuous accessory and essential whorls.
- Carpels have the ovary, style, and stigma.
- With the stimulus of fertilization, the ovary usually develops into the fruit and the ovules into seeds. Thus, the seeds remain within the fruits.

PLANT MORPHOLOGY

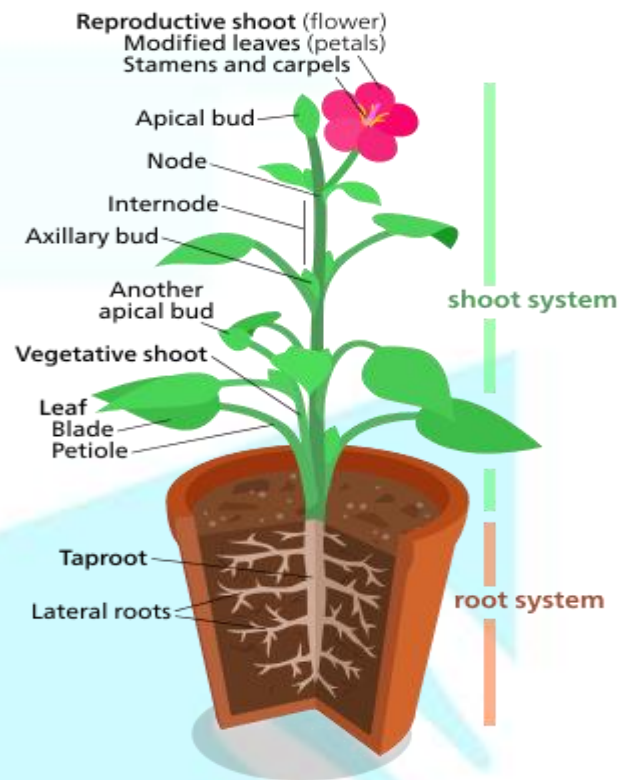
The **study of forms and features** of different parts of plants like roots, stems, leaves, flowers, fruits etc. is called Morphology.

ROOTS

Root is the **descending part** of the plant which develops from radicle. It generally grows in the soil **away from light**.

STEM

This is the part of a plant which **grows towards light**. So, they are usually **positively phototropic**. It develops from **plumule**.



LEAF

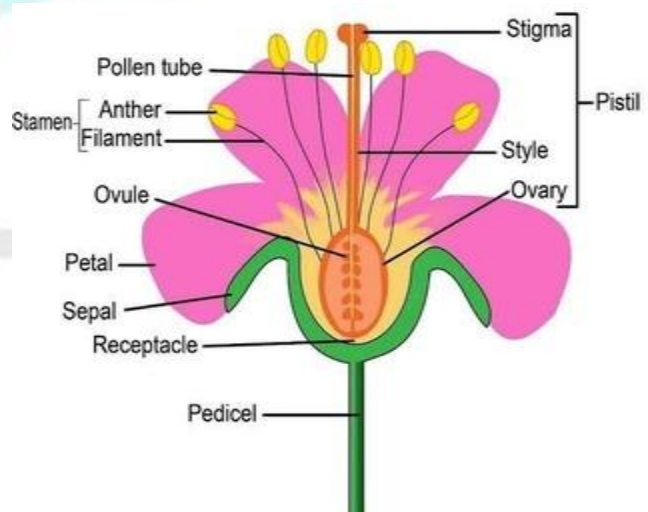
It is green in colour. Its main function is **synthesis of food through photosynthesis**.

- In cactus (xerophyte) leaves are modified into **spines**.

FLOWER

It is the reproductive part of the plant.

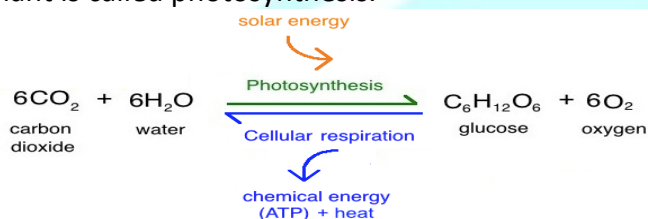
- In the flower **Calyx, Corolla, Androecium and Gynoecium** are found.
- Out of these **Androecium is male sex organ** and the **Gynoecium is female sex organ**.



- **Pollination:** After maturation of **anther**, the process of transfer of pollen grains to stigma is called pollination. It is of two types:
 - Self-pollination
 - Cross Pollination
- **Fertilisation:** Pollen tube reaches the egg cell after entering into the ovule through a pore called **micropyle**.
 - After that a male nucleus fuse with egg cell. This is called fertilization. Fertilized egg is called zygote.
- **Parthenocarpy:** In some plants fruits are developed from ovary without fertilization. This type of fruit is called **parthenocarpy**. Normally these types of fruits are **seedless**.
- Fruit is a matured or ripened ovary developed after fertilization. Formation of fruits takes place from ovary. Fruits are divided

PHOTOSYNTHESIS

In the presence of **water, light, chlorophyll and carbon dioxide**, the formation of carbohydrates in plant is called photosynthesis.



- Terrestrial Plants takes CO₂ from atmosphere whereas aquatic plants use carbon dioxide dissolve in water.
- Water enters into the cells of the leaves through **osmosis** and CO₂ through **diffusion** from atmosphere or release during respiration.
- Water necessary for photosynthesis is absorbed by the roots. Oxygen produced during photosynthesis is due to **photolysis of water**.
- The green colour of the plants is due to the presence of **chlorophyll**.
 - Chlorophyll are **photoreceptor molecule**, which trap the solar energy. There are different type of chlorophyll molecule.
 - There is an element of magnesium in the Centre of chlorophyll.
- Chlorophyll absorbs the **violet, blue and red** colours of light.
- The rate of photosynthesis is **maximum in red** light and is **minimum in violet light**.
- The process of photosynthesis is a **reaction of oxidation and reduction**. Oxidation of water

takes place forming oxygen and reduction of carbon dioxide takes place forming glucose.

- The stages of process of photosynthesis includes:
 1. **Photochemical** reaction: This reaction is completed in the **grana of the chlorophyll**. This is also called **Hill reaction**.
 - In the process breaking down of water takes place releasing hydrogen ion and electron.
 - For photolysis of water, energy is received from the light.
 - At the end of this process, ATP is formed from ADP & P.
 2. **Dark Chemical** reaction: This reaction takes place in the **stroma of chlorophyll**. In this reaction reduction of carbon dioxide takes place and **sugar or starch are formed**.
 - It is also known as **Calvin Benson cycle**.

ZOOLOGY

Scientific study of the structure, form and distribution of animals.

CLASSIFICATION OF ANIMAL KINGDOM

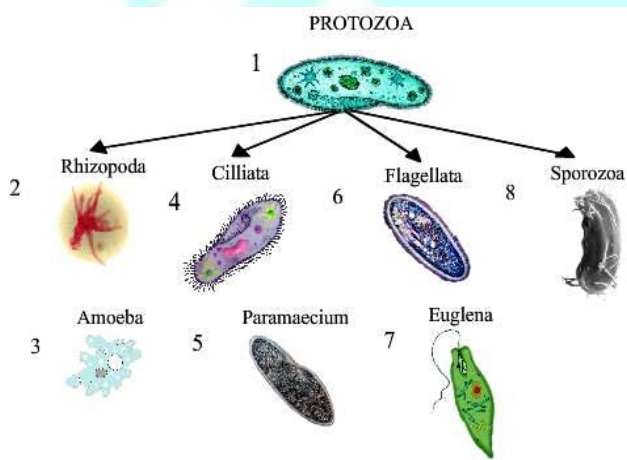
Animals kingdom of the world is divided into two sub kingdoms.

- Unicellular animals are kept in a **single phylum protozoa** whereas multicellular animals are divided into **9 phylums**.

1. **Phylum Protozoa:** It's body is made up of only one cell i.e. unicellular.

- There is one or more nuclei in its cytoplasm.
- It is **parasitic and free living**.

Example: *Amoeba*, *Euglena* and *Trypanosoma*.



2. **Phylum Porifera:** All animal of this group are found in marine water.

- These are **multicellular animals**, but cells do not make regular tissues.
- Skeleton is made up of minute calcareous or silicon spicules.

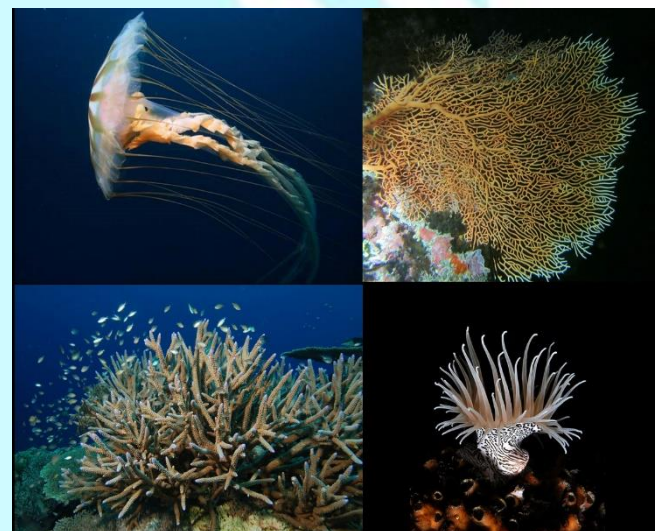
Example: *Sycon*, *sponge* etc.



3. **Phylum Coelenterate:** It is a group of **aquatic, or marine organisms**.

- They are usually found attached to the rocks at the bottom of the sea.
- These are the **multicellular and simplest group of invertebrate animals**, found in colonies or solitarily.
- These species exhibit a tissue-level organization. The mouth is enclosed by thin and short tentacles.
- They are **diploblastic animals**, in which, the body is made up of two layers of cells:
Ectoderm – One layer makes up the cells outside the body
Endoderm – the other forms the inner lining of the body.
- The body is radially symmetrical.

Example: *Hydra*, *Jelly fish*, *sea anemone* etc.



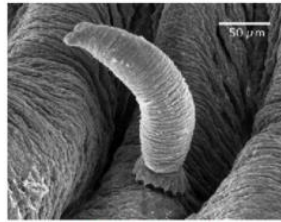
4. **Phylum Platyhelminthes:** These organisms are also known as **flatworms**. These are **acoelomates** and they include many free-living and parasitic life forms.

- Members of this phylum range in size from a single-celled organism to around 2-3 feet long.
- They are **triploblastic, acoelomate, and bilaterally symmetrical**.
- They may be **free-living or parasites**.
- The body has a soft covering with or without cilia.
- Excretion takes place by **flame cells**.

Example: *Planaria*, *liver fluke*, *tapeworm* etc.



Flatworms



Monogenian



Flukes



Tapeworms

5. **Phylum Aschelminths**: They are commonly known as **roundworms**.

- They are **bilaterally symmetrical and triploblastic**.
- In these animals, **alimentary canal is complete** in which mouth and anus both are present.
- There is no circulatory and respiratory systems, but nervous system is developed.
- They are **unisexual**.
- Most form are parasitic, but some are free living in soil and water.

Example: *Ascaris*, *thread worm*, *Wuchereria* etc.



Ascaris



Wuchereria

6. **Phylum Annelida**: The Annelids are found in aquatic as well as terrestrial environments.

- These are **bilaterally symmetrical** invertebrate organisms. Their **segmented body** distinguishes them from any other organism.
- Locomotion takes place through **setae** made up of **chitin**.

- Normally respiration takes place through skin, in some animals it takes place through **gills**.
 - Nervous system is normal, and blood is red.
 - They can be both unisexual and bisexual.
- Example: *Earthworm*, *Leech*, *Nereis* etc.



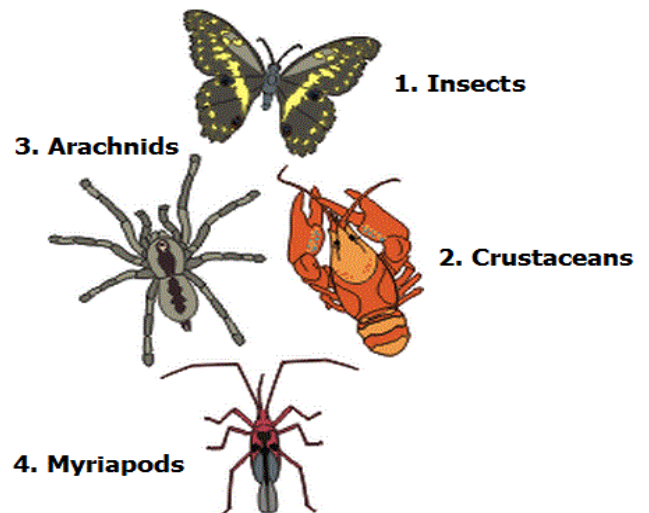
Phylum Annelida



7. **Phylum Arthropoda**: It is the **largest phylum** with about nine lakh species.

- They may be **aquatic, terrestrial or even parasitic**. They have jointed appendages and a **chitinous exoskeleton**.
- This phylum includes several large classes and contains the **class Insect** which itself represents a major portion of the animal species in the world. They possess the ability to survive in every habitat.

Phylum Arthropods



- Their body is divided into three parts: **head, thorax and abdomen**.
- They have an **open** circulatory system.
- The head bears a **pair of compound eyes**.
- The exoskeleton is made of **chitin**.
- They are unisexual and fertilization is either external or internal.

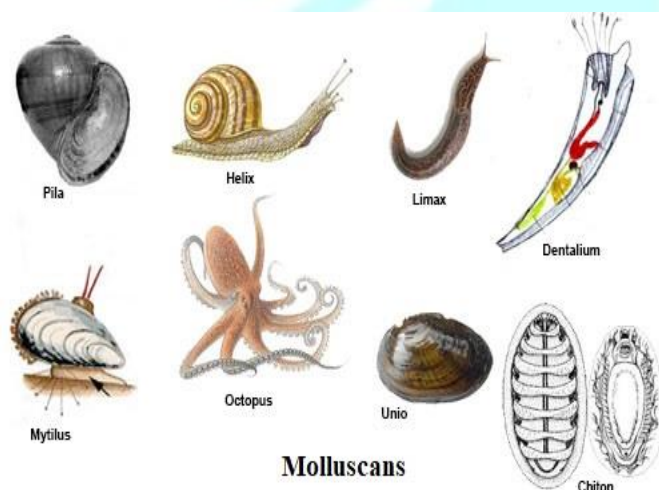
- They have a well-developed digestive system.
- The main excretory organ of insects are **Malpighian tubules**.

Examples: *Cockroach, prawn, crab, bug, fly etc.*

8. **Phylum Mollusca:** The term Mollusca was derived from the term given by Aristotle to cuttlefish. **Mollusc means soft.**

- These organisms are found in the **terrestrial as well as in deep seas**. Their size ranges from microscopic organisms to organisms 20 metres long.
- Their blood is colourless.
- Alimentary canal is well developed.
- Respiration takes place through **gills or ctenidia**.
- Excretion takes place through kidneys.
- The blood circulates through the open circulatory system.

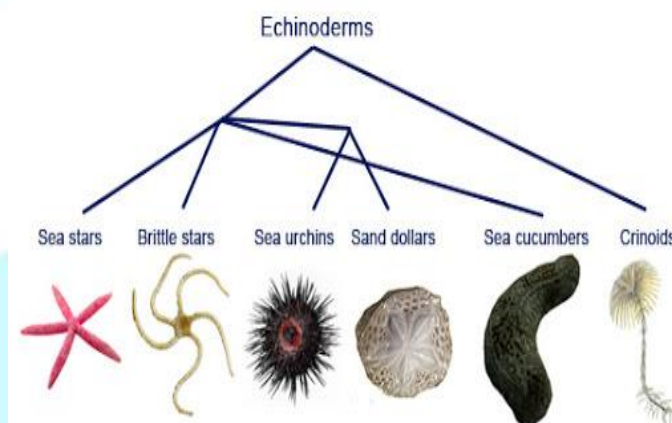
Example: *pila, octopus, squid etc.*



9. **Phylum Echinodermata:** All the animals in this group are **marine**.

- These are multicellular organisms with **well-developed organ systems**.
- All the animals belonging to this phylum share the same characteristics features. They are colourful organisms with unique shapes.
- They have a star-like appearance and are spherical or elongated.
- The skeleton is made up of calcium carbonate.
- They have an **open circulatory system**.
- They respire through gills or cloacal respiratory tree.

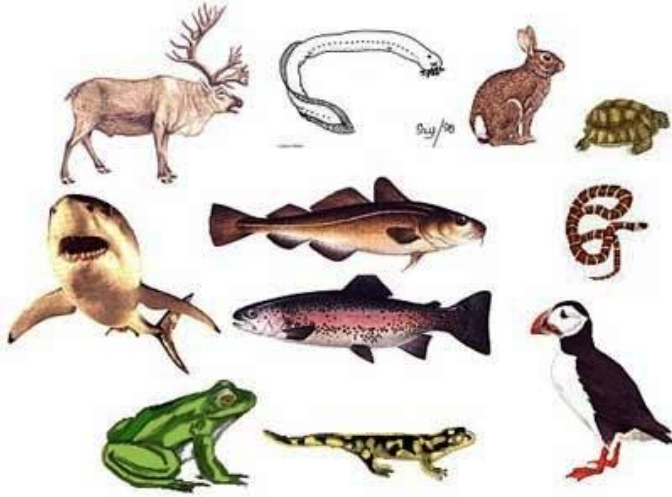
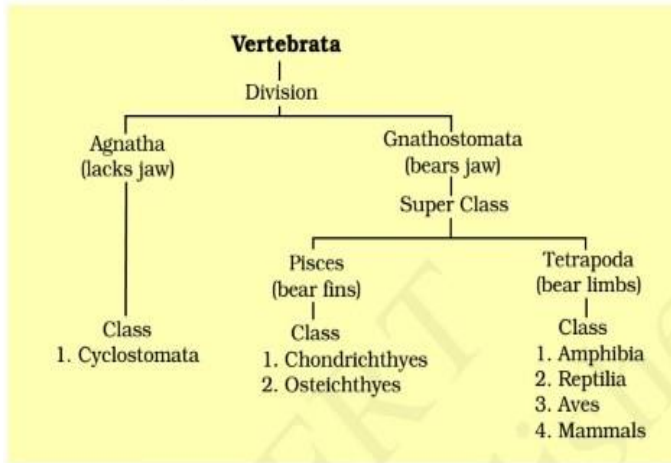
- They have a simple radial nervous system, and the excretory system are absent.
 - They reproduce sexually through gametic fusion and asexually through regeneration. Fertilization is external.
 - Brain is **not developed** in nervous system.
- Example: *Star fish, Sea urchin, Sea cucumber etc.*



10. **Phylum Chordata:** They includes all the vertebrates, i.e., animals with a backbone, and several invertebrates, i.e., organisms without a backbone.

- Animals belonging to phylum Chordata are fundamentally characterised by the **presence of a notochord, a dorsal hollow nerve cord and paired pharyngeal** [relating to the pharynx] gill slits.
- They are **bilaterally symmetrical, triploblastic, coelomate** with organ-system level of organisation.
- Phylum Chordata is divided into three subphyla: Urochordata or **Tunicata, Cephalochordata and Vertebrata**.
- Subphyla Urochordata and Cephalochordata are often referred to as **protochordates and are exclusively marine**.
- In Urochordata, notochord is present only in larval tail, while in Cephalochordata, it extends from head to tail region and is persistent throughout their life.

The subphylum Vertebrata is further divided as follows:



THE NERVOUS SYSTEM

Multicellular animals **must monitor and maintain a constant internal environment** as well as **monitor and respond to an external environment**.

- The organ system that **serves to coordinate and control the functioning of all other organ systems** in the body is known as **nervous system**.

IMPORTANT FACTS

In some animals, there is **also present a second control system** called the endocrine system.

- In these animals, **nervous system coordinates rapid responses to external stimuli**.
 - The **neural system provides an organized network of point-to-point connections** for a quick coordination.
- Whereas endocrine system **controls slower, longer lasting responses to internal stimuli**.
 - The endocrine system provides **chemical integration through hormones**.
- Basic functions of Nervous system are:
 - a. **Receive sensory input from internal and external environments**.
 - Receptors in nervous system **senses changes in the internal or external environments**.
 - Inputs can take many forms, including **pressure, taste, sound, light, blood pH, or hormone levels**, that are converted to a signal
 - b. **Integrate all the inputs**
 - Integration of Inputs takes place in the **brain or spinal cords**.
 - c. **Respond to the Stimuli**
 - The response is in the form of signals, **transmitted to organs than can convert the signal into some form of action**.

HUMAN NERVOUS SYSTEM

Nervous System is a complex network of nerve cells that carry message to and from the brain and spinal cord to various parts of the body.

In human, nervous system is divided into 2 parts:

- a. Central Nervous system (CNS): It consists of **Spinal cord and Brain**.
 - CNS is the **site of information processing and control**.
- b. Peripheral Nervous System (PNS): It contains **sensory and motor nerves and connects the**

brain and spinal cord (CNS) to the rest of the body.

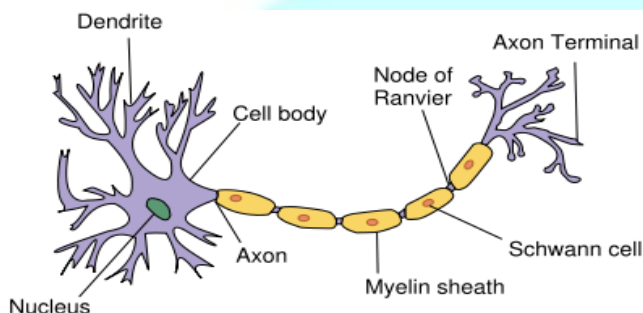
IMPORTANT FACTS

- Peripheral Nervous System consists of two components:
 - Sensory (afferent) pathways **that provide input from the body into the CNS.**
 - Motor (efferent) pathways that **carry signals to muscles and glands (effectors).**
- Peripheral Nervous System is of two types:
 - Somatic** Nervous System includes all nerves **controlling the muscular system and external sensory receptors.**
 - Autonomic** Nervous System, consists of motor neurons and **control internal organs.**

NEURON OR NERVE CELLS

A neuron (or neurone) is a nerve cell that **carries electrical impulses.** Neurons are the basic units of our nervous system.

- Our nervous system contains **about 10 billion nerve cells**, which **communicate with each other** in a specific manner.
- Neurons have a **cell body** (soma or cyton), dendrites and an axon.



STRUCTURE

- Neurons are connected to one another, but they **do not actually touch each other.** Instead they have tiny gaps called synapses.
- These gaps are **chemical synapses or electrical synapses** which pass the signal from one neuron to the next.
- It consists of a cell body that has a **large central nucleus and cytoplasm.**
- Several **short, thread like branches** called dendrites arise from the cell body.
- One branch arising out of the cell body is **very long in comparison to others.** This branch is called **axon.**

- Axon are generally covered by a **fatty sheath called myelin sheath.** Gaps on the sheath are known as **nodes of Ranvier.**
- Neurons communicate with each other using axons and dendrites. Neurons send signals to other neurons through the axons which release chemicals known as **neurotransmitters.**

TYPES OF NEURONS

- Based on **Connection**, there are three type of neurons:
 - Sensory neurons**, which carry information from tissues and organs into the central nervous system.
 - Motor neurons**, which transport signals from the central nervous system to the effector cells.
 - Interneurons **connect neurons** within the central nervous system.

CENTRAL NERVOUS SYSTEM

The Central Nervous System (CNS) is composed of the brain and spinal cord.

- The CNS is surrounded by **bone skull and vertebrae.**
- Fluid and tissue **also insulate** the brain and spinal cord.
- It receives the information from all parts of the body for processing and information.

SPINAL CORD

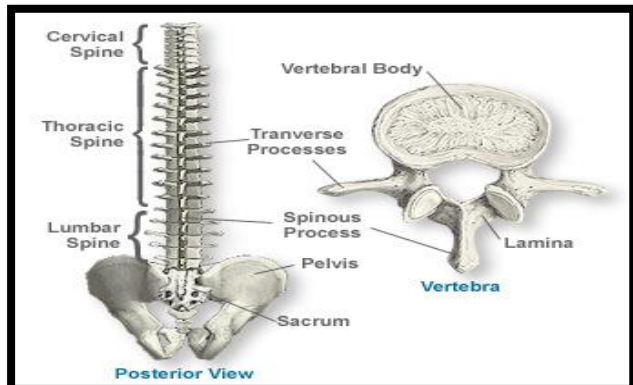
The spinal cord **runs along the dorsal side of the body and links the brain to the rest of the body.**

- Vertebrates have their spinal cords **encased in a series of (usually) bony vertebrae** that comprise the vertebral column.
- It controls the **reflexes below the neck region.**

IMPORTANT FACTS

Vertebrae are the **33 individual, interlocking bones** that form the spinal column.

- Each vertebra has three main functional components:
 - The **vertebral body** for load bearing
 - The **vertebral arch** to protect the spinal cord
 - Transverse processes** for ligament attachment.



HUMAN BRAIN

The human brain **controls nearly every aspect of the human body** ranging from physiological functions to cognitive abilities.

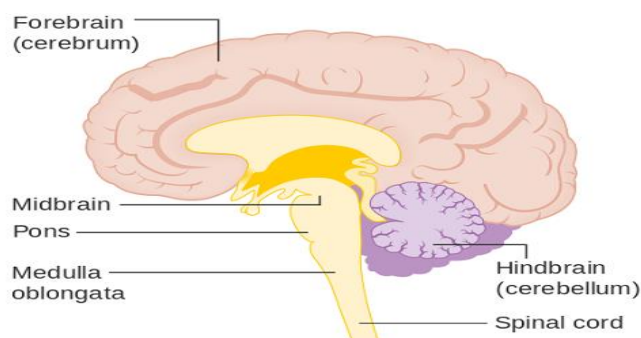
- It functions by **receiving and sending signals via neurons** to different parts of the body.
- On average, an adult brain weighs between **1.0 kg – 1.5 kg**.
- The brain is **enclosed within the skull**, which provides **frontal, lateral and dorsal** protection.
- Anatomically, the brain is contained **within the cranium** (skull) and is surrounded by the **cerebrospinal fluid**.

CEREBROSPINAL FLUID

It is a fluid that **circulates within the skull and spinal cord, filling up hollow spaces** on the surface of the brain.

- The primary function of the CSF is to **act as a buffer for the brain, cushioning mechanical shocks** and dampening minor jolts.
- It also provides **buoyancy and basic immunological protection** to the brain.

- Brain has **three main parts**:
 - a. Forebrain
 - b. Midbrain
 - c. Hindbrain



FOREBRAIN

The forebrain consists of **cerebrum, thalamus and hypothalamus**.

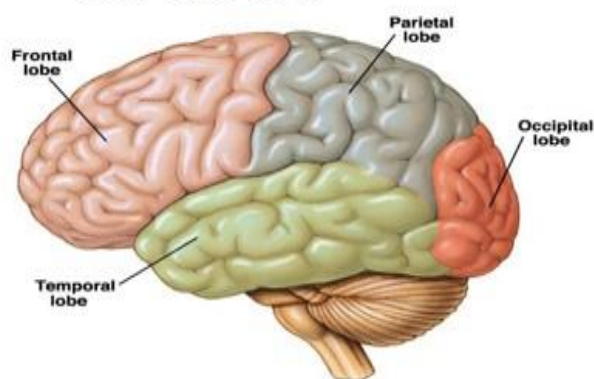
- It is the largest part of the brain and forms about **4/5 part of the brain**.

CEREBRUM

The cerebrum, the **largest part** of the human brain, is divided into **left and right cerebral hemispheres** connected to each other by the **corpus callosum**.

- The hemispheres are covered by a thin layer of **grey matter** known as the **cerebral cortex**.
- The cerebral cortex **contains motor areas, sensory areas and large regions** that are neither clearly sensory nor motor in function.
- Functions of Cerebrum:
 - a. It governs our **mental abilities** like thinking, reasoning, learning, memorizing and intelligence.
 - b. It controls **our will, emotions and speech**.
 - c. It controls **all involuntary functions**.

Cerebrum

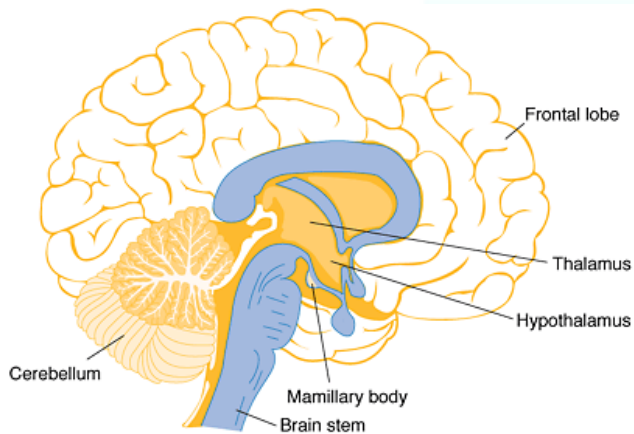


- Cerebrum consists of four parts:
 - a. The occipital lobe (back of the head) **receives and processes visual information**.
 - b. The temporal lobe **receives auditory signals, processing language** and the **meaning of words**.
 - c. The parietal lobe is **associated with the sensory cortex** and processes information about touch, taste, pressure, pain, heat and cold.
 - d. The frontal lobe **conducts motor activity and integration of muscle activity**.

THALAMUS

The thalamus is a **small structure within the brain located just above the brain stem** between the **cerebral cortex and the midbrain** and has extensive nerve connections to both.

- The main function of the thalamus is to **relay motor and sensory signals** to the cerebral cortex.
- It also **regulates sleep, alertness and wakefulness**.
- The thalamus derives its blood supply from a number of arteries.



HYPOTHALAMUS

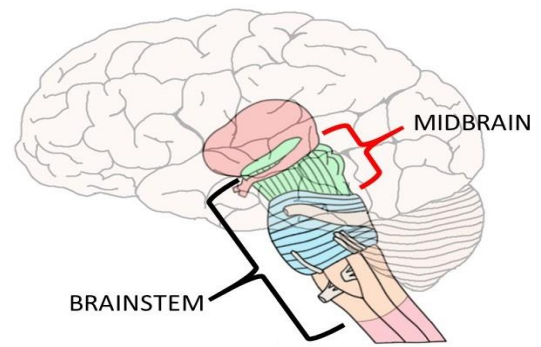
It is a small region below the thalamus.

- It **controls heartbeat, blood pressure, thirst and peristalsis**.
- It acts as a connecting link between the endocrine and nervous system.
- It synthesizes and **secretes certain neurohormones**, called releasing hormones or hypothalamic hormones.

MIDBRAIN

It is located between the **thalamus/hypothalamus of the forebrain** and **pons of the hindbrain**.

- It is composed of the **tectum and tegmentum**.
- Tectum serves as a **relay centre for the sensory information** from the ears to the cerebrum.
- Tegmentum forms the **platform for the midbrain** and **connects with the thalamus, cerebral cortex, and the spinal cord**.
- The midbrain serves important functions in **motor movement**, particularly movements of the **eye, and in auditory and visual processing**.
- The midbrain consists of **connections between the hindbrain and forebrain**.

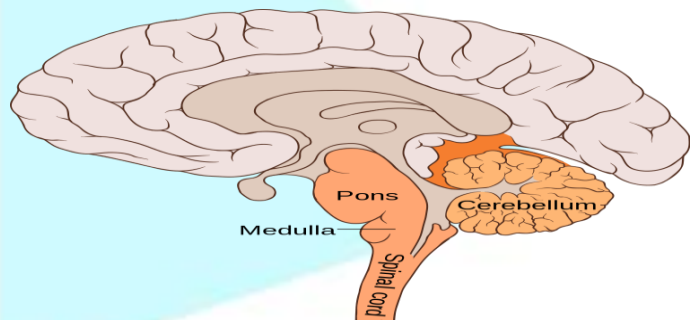


- **Midbrain and hindbrain** form the brain stem, which is **connected to the spinal cord**.

HINDBRAIN

The hindbrain comprises **pons, cerebellum and medulla** (also called the medulla oblongata).

- **Pons consists of fibre tracts** that **interconnect different regions** of the brain.
- Cerebellum has **very convoluted surface** in order to **provide the additional space** for many more neurons. The cerebellum is the **second largest part** of the brain.
- The cerebellum consists of **two hemispheres**, the **outer grey cortex** and the **inner white medulla**.



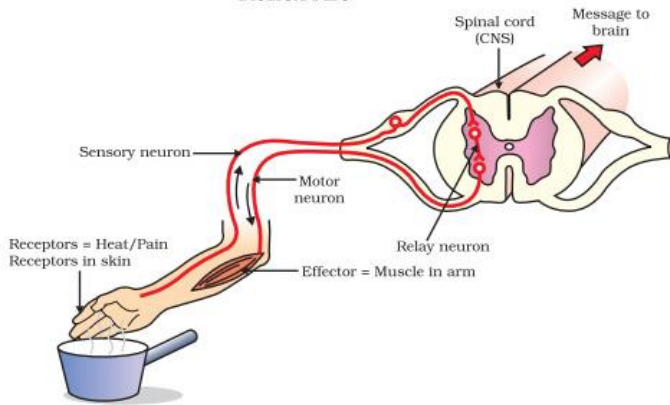
- The medulla of the brain is **connected to the spinal cord**.
- It helps us in **maintaining our posture and controlling our reflexes**.
- The medulla contains centres which control **respiration, cardiovascular reflexes and gastric secretions**.

REFLEX

A reflex, or reflex action, is an **involuntary and nearly instantaneous movement** in response to a stimulus.

- A reflex is **made possible by neural pathways called reflex arcs** which can act on an impulse **before that impulse reaches the brain**.
- The reflex is then an **automatic response to a stimulus** that does not receive or need conscious thought.

Reflex Arc



- Reflex actions are **controlled by spinal cord**.
- The reflex pathway comprises **at least one afferent neuron** (receptor) and **one efferent neuron** (effector or excitor) appropriately arranged in a series.
- The afferent neuron **receives signal from a sensory organ and transmits the impulse** via a dorsal nerve root into the CNS.
- The efferent neuron then **carries signals from CNS to the effector**. The stimulus and response thus forms a reflex arc.

SENSES

The physical process during which sensory systems **respond to stimuli and provide data for perception** is called sensation.

- Input to the nervous system is in the form of our five senses: **pain, vision, taste, smell, and hearing**.
- Sensory input **begins with sensors that react to stimuli in the form of energy** that is transmitted into an action potential and sent to the CNS.

SENSORY RECEPTORS

Sensory receptors are classified **according to the type of energy they can detect and respond to**:

1. Mechanoreceptors: **hearing** and balance, stretching.
2. Photoreceptors: light.
3. Chemoreceptors: smell and taste.
4. Thermoreceptors: changes in temperature.
5. Electoreceptors: **detect electrical currents** in the surrounding environment.

ENDOCRINE SYSTEM

The endocrine system is made up of glands that **produce and secrete hormones** and chemical substances which regulate the activity of cells or organs.

- These hormones regulate the **body's growth, metabolism, sexual development** and other functions.
- Hormones are **chemical messengers** which are produced by the body. They transfer information from one set of cells to another to **coordinate the functions** of different parts of the body.
- The major glands of the endocrine system are the **hypothalamus, pituitary, thyroid, parathyroid, adrenals, pineal** and the **reproductive organs**.
- The pancreas is also a part of this system. It has a role in hormone production as well as digestion.

WORKING

For the hormones that are regulated by the pituitary gland, a **signal is sent from the hypothalamus to the pituitary gland** in the form of a 'releasing hormone', which stimulates the pituitary to secrete a stimulating hormone' into the system.

- The stimulating hormone **then signals the target gland** to secrete its hormone.
- As the level of this hormone rises in the circulation, the **hypothalamus and pituitary gland shut down** the secretion of releasing hormone and stimulating hormone, which in turn slows the secretion by the target gland.

COORDINATION IN PLANTS

Plants use a **chemical system** instead of a nervous system to respond to external stimulus.

- They respond to stimuli such as light, gravity, touch and water.
- They coordinate their behaviour by **using their hormones and respond** to the environmental changes.
- Plant hormones are called **phytohormones**.
- Plant show two different types of movements:
 1. Growth dependent
 2. Growth independent
- Different hormones in plants are as follows;
 1. Auxin: Synthesised at the tip of the **stem** and help in **plant growth** by elongating the cell.

Its formation takes place in the **apical parts** of the plants.

2. Gibberellins: This is concerned with the **growth of the stem, seed germination and flowering**.
3. Cytokinin: It is present in the areas of cell division. It also helps in the opening of the stomata. It is helpful in **making RNA and protein**.
4. Abscissic acid: This acid **inhibits the growth of many parts** and is responsible for the closure of stomata.
5. Ethylene: This is the only **hormone** found in gaseous form. It helps in ripening the fruits. It increases the number of female flowers.
6. Florigens: It is **formed in leaves** but helps in blooming of the flowers.
7. Traumatins: This is a type of dicarboxylic acid. It is formed in injured cells by which the injury in plants is healed.

HORMONES IN HUMAN BEING

1. Adrenaline: This hormone is **secreted by adrenal glands**. It is **secreted directly** into blood and carried to other parts of the body.
 - It has a **specific action on heart** because of which the heart starts beating faster and the supply of oxygen to the muscles increases.
 - Adrenaline is an **emergency hormone**, that is, it is secreted by the body to cope with emergency situations.
2. Thyroxine: This is the main hormone **secreted into the bloodstream by the thyroid gland**.
 - Thyroxine regulates **carbohydrate, fat and protein** metabolism.
 - Iodine is necessary for the proper working of the thyroid gland. If iodine is deficient in our body, it may lead to a disease called **goitre**.
3. Growth Hormone (Somatotropin): It is secreted by the pituitary gland. It **regulates the growth and development** of our body.
 - This imbalance in hormone can lead to very short height (dwarfism) or extremely tall height.
4. Testosterone: It is secreted by anterior lobe of **pituitary gland**. It is responsible for the **pubertic changes** in males.
5. Oestrogen: This hormone is secreted by pituitary gland. It is **responsible for pubertic changes** in females.

6. Insulin: It is **secreted** by pancreas. It helps in regulating blood sugar level.

TRANSPORTATION

All organisms need **food, water and oxygen** for survival. They need to transport all these to various parts of their body.

- Animals **need to transport wastes** to parts from where they can be removed.

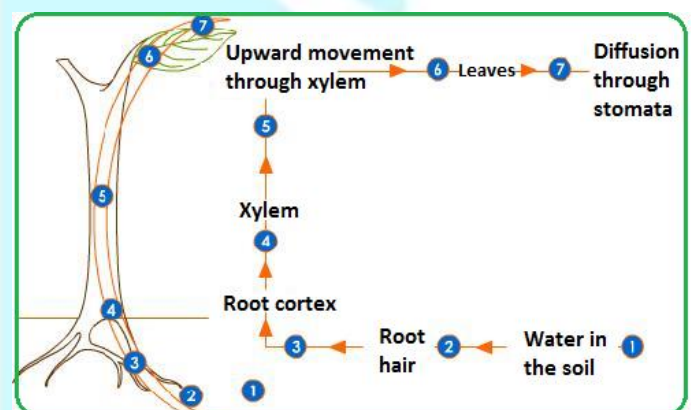
TRANSPORTATION IN PLANTS

In a flowering plant the substances that would need to be transported are water, mineral nutrients, organic nutrients and plant growth regulators.

TRANSPORT OF WATER AND MINERALS

Plants **absorb water** and minerals **by the roots**. The roots have **root hair**.

- The **root hair is in contact with the water** present between the soil particles.



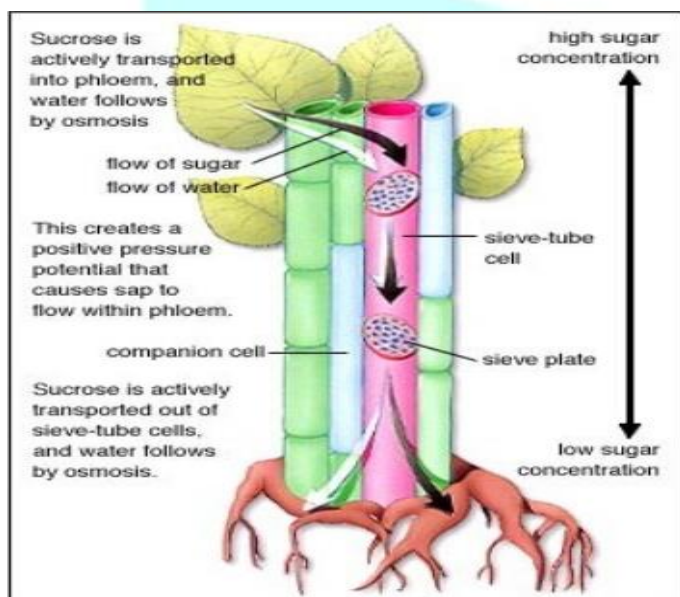
- The root hair **increase the surface area of the root for the absorption of water** and mineral nutrients dissolved in water.
- **Tracheids and vessels**, which are non-living cells of xylem, **transport water picked up by root hairs from soil to the leaves**.
- The **xylem forms a continuous network of channels** that connects roots to the leaves through the stem and branches and thus transports water to the entire plant.
- The upward movement of water and minerals termed '**ascent of sap**' is **against gravity** and is due to **transpiration pull**.
- Transpiration is the process in which **a lot of water evaporates from pores on the surface of**

leaf called **stomata**. This **evaporation** creates a **vacuum** and pulls up water through the **xylem**.

TRANSPORT OF FOOD MATERIAL

Sugars and other food molecules synthesized in the leaves are transported to other parts of the plant **through vascular tissues called phloem**.

- **Sieve tubes** are living cells of the phloem, which transport food
- Transport of food material from leaves to other parts of the plant is called **translocation**.
- This food may be **stored in fruits, stem or roots**.



IMPORTANT TERMS

1. **Osmosis**: It is a process by which molecules of a **solvent** tend to pass through a **semipermeable membrane** from a **less concentrated solution** into a **more concentrated** one.
 - The roots of the plant have a **higher solute concentration than the surrounding soil**, so water flows into the roots.
2. **Diffusion**: It is the movement of a substance from an **area of high concentration** to an **area of low concentration**.
 - Diffusion is the only means for gaseous movement in the plant body.
3. The **bulk movement of substances** through the conducting or vascular tissues of plants is called **Translocation**.

TRANSPORTATION IN HUMANS

CIRCULATORY SYSTEM

The circulatory system is an **organ system** that **permits blood to circulate and transport nutrients**,

oxygen, carbon dioxide, hormones, and blood cells to and from the cells in the body.

BLOOD

Blood is a **body fluid** that **delivers necessary substances such as nutrients and oxygen** to the cells and **transports metabolic waste products** away from those same cells.

- Blood is a **special connective tissue** consisting of a **fluid matrix, plasma, and formed elements**.
- The quantity of blood in the human's body is 7% of the total weight. So, there is an **average of 5-6 litres** of blood in human body. This is a dissolution of base whose **pH value is 7.4**.
- Female contains half litre of blood less in comparison to male.
- The **fluid part** of the blood is called **plasma**. About **55% of blood** is blood plasma.
- It is an **aqueous solution** containing **92% water, 8% blood plasma proteins**, and **trace amounts** of other materials like Na^+ , Ca^{++} , Mg^{++} , HCO_3^- , Cl^- , Glucose, amino acids, lipids, etc.'
- When **fibrinogen and protein** is extracted out of plasma, the remaining plasma is called serum.
- Blood has **cells of various kinds** suspended in it, like:
 - a. **Red blood cells (RBC)** which contain a red pigment called **haemoglobin** are most abundant.
 - Haemoglobin **binds with oxygen and transports it to all the parts of the body** and ultimately to all the cells.
 - RBCs are **circular** in shape. RBCs is formed in bone marrow and **get destroyed in liver and spleen** (graveyard of RBCs).
 - In Haemoglobin, **haeme** is iron containing compound called **haematin** and due to this the colour of blood is red. Globin is a **proteinous compound**. Anaemia disease is caused due to the deficiency of haemoglobin.
 - Number of RBC is measured by an instrument called **haemocytometer**.
 - b. **White blood cells (WBC)** are colourless and **fight against germs** that may enter our body.
 - Its formation takes place in Bone marrow, lymph node and sometimes in liver and spleen.
 - Its life span is from 2 to 4 days.
 - Its main function is to protect the body from the disease.
 - The ratio of RBC and WBC is 600:1.

RH FACTOR

Rh factor, also called **Rhesus factor**, is a **type of protein found** on the outside of red blood cells.

- The protein is **genetically inherited**.
- If you have the protein, you are **Rh-positive**. If you **did not inherit** the protein, you are **Rh-negative**.
- Rh group should also be **matched before transfusion and they should be similar**.

BLOOD TYPE

There are **four main blood groups** (types of blood) - A, B, AB and O.

- Each group can be either **Rh positive** or **Rh negative**, which means in total there are **eight main blood groups**.
- The main reason behind the difference in blood of human is the glycol protein which is found in Red Blood Corpuscles called **antigen**.
- Antigen are of two types – **Antigen A and Antigen B**. On the basis of **presence of Antigen or glycol protein**, there are **four types** of blood groups in Human.
- An opposite type of protein is found in blood plasma. This is called **antibody**. It is also of two types.

- c. **Platelets** (thrombocytes) can release a variety of substances most of which are involved in the **coagulation or clotting of blood**.
- It is found only in the blood of human and other mammals.
 - Its formation takes place in bone marrow and it dies in spleen.
 - In dengue fever number of platelets get reduced.

RELATIONSHIPS BETWEEN BLOOD TYPES AND ANTIBODIES

Blood Type	Antigens on Red Blood Cell	Can Donate Blood To	Antibodies in Cerum	Can Recieve Blood From
A	A	A, AB	Anti-B	A, O
B	B	B, AB	Anti-A	B, O
AB	A and B	AB	None	AB, O
O	None	A, B, AB, O	Anti-A and Anti-B	O

IMPORTANT POINTS

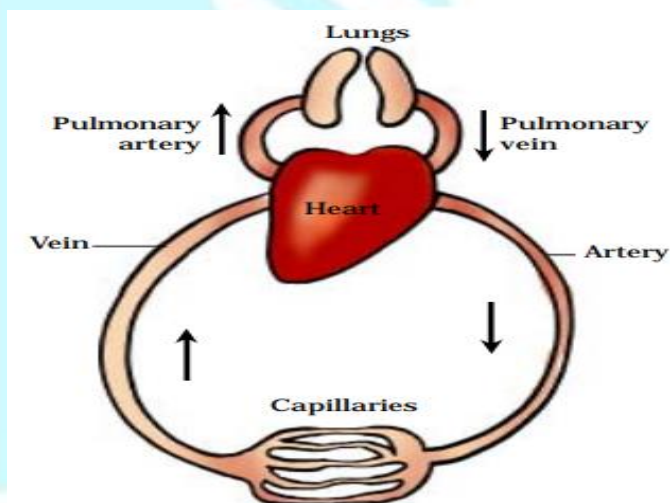
- **Antigen A and antibody a**, **Antigen B and antibody b cannot** live together.
- In case of so happened these get most sticky, which spoils the blood. This is called **agglutination of blood**.
- Thus, in blood transfusion adjustment of **Antigen and Antibody** should be done carefully.
- Blood group O is called **Universal donor** because it **does not contain any antigen**.

- Blood group AB is called **Universal receptor** because it **does not contain any antibody**.
- **Erythroblastosis Foetalis**: If the father's blood is Rh+ and the mother's blood is Rh-, then the child to be born dies at the pregnancy or short span of time after the birth.

BLOOD VESSELS

The blood vessels are the components of the circulatory system that **transport blood** throughout the human body.

- These vessels transport **blood cells, nutrients, and oxygen to the tissues** of the body.
- They also **take waste and carbon dioxide** away from the tissues.
- There are **different types of blood vessels** in the body:
- Arteries **carry oxygen-rich blood** from the heart to all parts of the body.
- Since the **blood flow is rapid and at a high pressure**, the arteries have **thick elastic walls**.



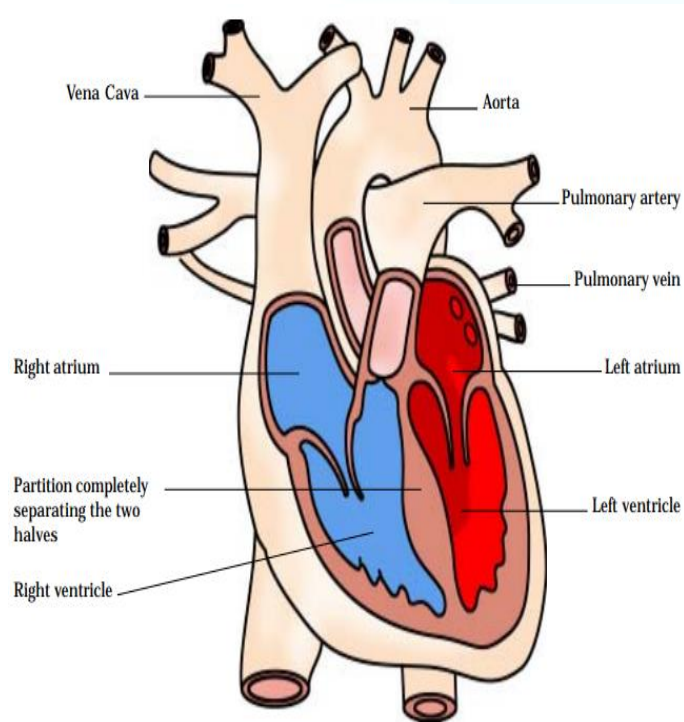
- Veins are the vessels which **carry carbon dioxide-rich blood** from all parts of the body back to the heart.
- The veins have **thin walls**.
- There are **valves present in veins** which allow blood to flow only towards the heart.
- Capillaries are **thin vessels** between the artery and the vein. The capillaries **allow the exchange of materials between blood and tissues**.

HEART

The heart pumps **oxygenated blood to the body** and **deoxygenated blood** to the lungs. It remain safe in the **pericardial membrane**.

STRUCTURE OF HEART

The heart is **located in the chest cavity** with its **lower tip slightly tilted towards the left**.

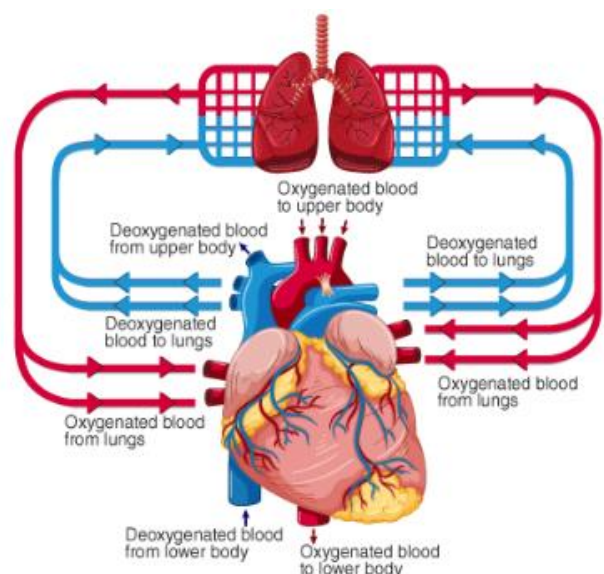


- It is **four-chambered**- two (right and left) atria (also called auricles), and two (right and left) ventricles.
- The **ventricles are the chambers that pump blood** and **atrium are the chambers that receive blood**.
- A muscular wall called **inter atrial septum** separates the right and the left atria, whereas **inter-ventricular septum** separates the left and the right ventricles.
- The partition between the chambers **helps to avoid mixing up of blood** rich in oxygen with the blood rich in carbon dioxide.
- Between the right auricle and the right ventricle there is a **tricuspid valve**.
- Between the left auricle and left ventricle there is a **bicuspid valve**.
- The heart is made of **specialized muscle cells** (cardiac muscle fibres), which **contract and relax**. The contraction and relaxation **follows a rhythm called heartbeat to pump blood** into the vessels.
- Abnormalities in heartbeat can be seen by taking **ECG or Electrocardiography**.
- Mammals have double circulation. It mean blood have to **cross two times from the heart** before circulating throughout the body.

- In the normal condition the heart of the human beats **72 times** and in a single beat it pumps approximately **70 ml of blood**.
- **Thyroxin and Adrenaline** are the hormones which **independently** controls the heartbeat.
- The blood pressure of a normal human is **120/80**. (Systolic – 120 and Diastolic – 80).

MECHANISM

- A large vein, the **vena cava collects impure or deoxygenated blood** (blood low in oxygen and high in carbon dioxide) through veins from all parts of the body and **empties into the right atrium**.
- At the same time **vein from the lungs brings oxygen-laden blood** to left atrium. At this time all the four chambers of the **heart are relaxed**.
- Then the **atria contract** and impure blood (blood full of carbon-dioxide) from **right atrium enters the right ventricle** and purified blood (blood full of oxygen) from left atrium enters the left ventricle.
- Valves **within the heart prevent blood from flowing back**. Next, the **ventricles contract while the atria relax**.
- Blood **to be purified is transported to the lungs** from right ventricle through two pulmonary arteries.
- The oxygen laden blood from the left ventricle gets pumped into a large artery called **aorta**. It **carries oxygenated blood** to all parts of the body.
- Veins bring **impure blood to the heart** and the **arteries take the pure blood away from the heart**.



TYPES OF CIRCULATION

PULMONARY CIRCULATION

It is a portion of circulation **responsible for carrying deoxygenated blood away from the heart** to the lungs and then brings oxygenated blood back to the heart.

SYSTEMIC CIRCULATION

It is another portion of circulation **where the oxygenated blood is pumped from the heart to every organ** and tissue in the body, and then back again to the heart.

CORONARY CIRCULATION

It is an essential portion of the circulation, where **oxygenated blood is supplied to the heart**.

HUMAN SKELETON AND MUSCLE SYSTEM

This section involves important points about human physiology ranging from human skeleton system to muscular system.

HUMAN SKELETON

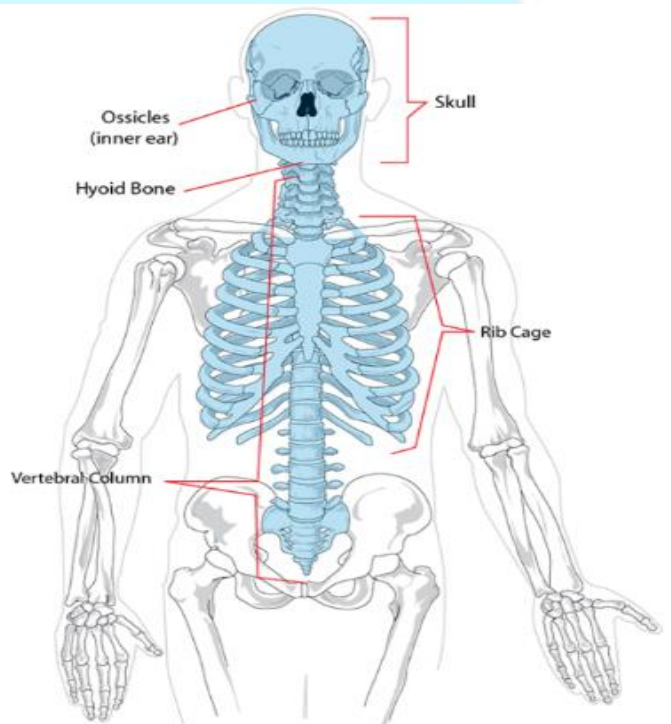
Skeletal system consists of a framework of bones and a few cartilages. This system has a significant role in movement shown by the body.

- In human beings, this system is made up of **206 bones and a few cartilages**. It is grouped into two principal divisions - the **axial and the appendicular skeleton**.

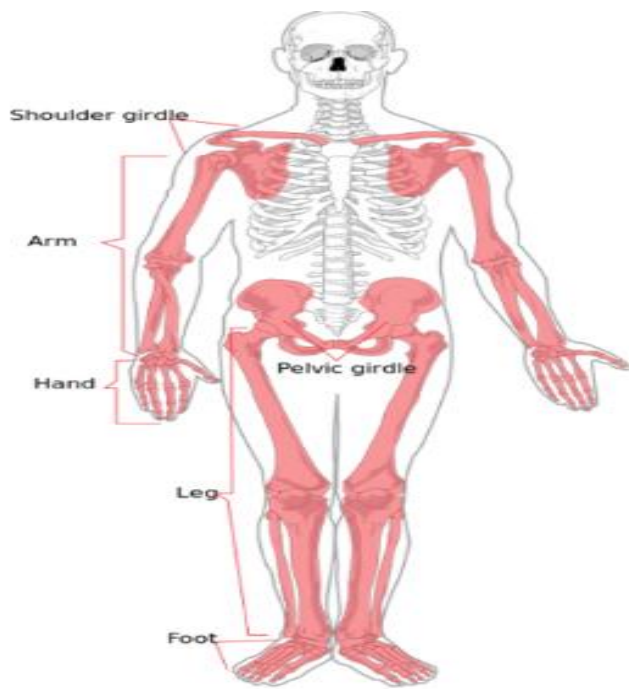
IMPORTANT FACTS

The human skeleton is **composed of around 305 bones at birth**. The number of bones in the skeleton changes with age. It **decreases to 206 bones by adulthood** after some bones have fused together.

- Axial skeleton comprises **80 bones distributed along the main axis** of the body. The **skull, vertebral column, sternum and ribs** constitute axial skeleton.



- The **bones of the limbs along with their girdles** constitute the appendicular skeleton.



IMPORTANT POINTS

- Number of bones in human face – 14
- Number of bones in human skull – 29
- Number of bones in ribcage – 24
- Longest bone – Femur
- It is almost **19.9 inches long** and is commonly known as the **thigh bone**.
- Smallest bone – Stapes
- It is the **third bone** in the middle ear.
- Only moveable bone in the skull - **mandible, or jawbone**
- There are **about 26 bones** in the human foot.
- The human hand, including the wrist, **contains 54 bones**.

MUSCULAR SYSTEM

The muscular system is an organ system consisting of **skeletal, smooth and cardiac muscles**.

- About **40-50 percent of the body weight** of a human adult is contributed by muscles.
- They have special properties like **excitability, contractility, extensibility and elasticity**.
- Muscles have been classified using different criteria, namely **location, appearance and nature of regulation** of their activities.
- Based on their location, three types of muscles are identified.

SKELETAL MUSCLES

They are **closely associated with the skeletal components** of the body.

- As their activities are under the **voluntary control of the nervous system**, they are known as voluntary muscles too.
- They are primarily **involved in locomotory actions and changes of body postures**.

VISCERAL MUSCLES

Visceral muscles are **located in the inner walls of hollow visceral organs of the body** like the alimentary canal, reproductive tract, etc.

- They are smooth in appearance.

CARDIAC MUSCLES

They are the muscles of the heart.

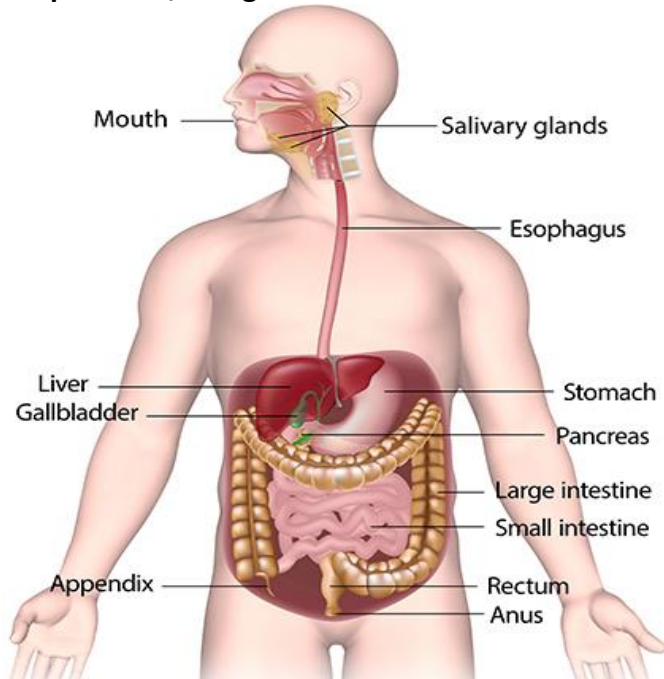
IMPORTANT POINTS

- Total number of muscles in human body - 639
- Longest Muscle - Sartorius muscle
- It is a **superficial muscle** that runs the **entire length of the thigh** and plays a role in **flexing the knee and hip**.
- Smallest Muscle – Stapedius muscle
- At just **over one millimetre in length**, its purpose is to **stabilize the smallest bone** in the body, the stapes.
- Largest Muscle - Gluteus maximus muscle
- It is responsible for **stabilizing the hip joint** and plays a **big role in our ability to move our thighs**.
- Strongest Muscle - Masseter Muscle
- This tiny but strong muscle **allows us to forcefully close our jaws**.

HUMAN DIGESTIVE SYSTEM

The digestive system of the human body comprises a **group of organs working together to convert food into energy** for the body.

- It is made up of the gastrointestinal tract, along with **accessory organs such as the liver, pancreas, and gallbladder.**



- The hollow organs that make up the **gastrointestinal tract** include the **mouth, stomach, esophagus, small intestine, and large intestine** that contains **rectum and anus.**

STOMACH

It serves as a **muscular bag which is situated towards the left side of the abdominal cavity.**

- This vital organ **acts as a storage for the food** and provides enough time to digest meals.
- The stomach also **produces digestive enzymes and hydrochloric acid** that maintains the process of digestion.

SMALL INTESTINE

The small intestine is a **thin, long tube of about 10 feet long** and is a part of the lower gastrointestinal tract.

LARGE INTESTINE

This is a **thick, long tube measuring around 5 feet** in length.

- It is present just beneath the stomach and **wraps over the superior and lateral edges of the small intestine.**

- It **absorbs water and consists of bacteria (symbiotic)** that support in the **breakdown of wastes to fetch small nutrients.**

RECTUM

Waste products are passed into the end of the large intestine called the rectum and eliminated out of the body as a solid matter called stool.

PANCREAS

It is the **second largest gland** present just behind the stomach.

- Pancreatic juice** secrets out of it in which 9.8% water and the remaining parts contain salt and enzymes.
- It is **alkaline liquid**; whose pH value is **7.5 – 8.3**. It contains the enzymes which can **digest all the three types of food materials** (carbohydrates, fat and protein); therefore it is called **complete digestive juice.**

LIVER

The liver is a **roughly triangular, reddish-brown accessory organ** of the digestive system located to the right of the stomach.

- It **produces bile, which helps in the digestion of fat** in the small intestine.
- It also **produces cholesterol** and special proteins to help carry fats through the body.
- Liver is the **largest gland** of the human body.
- Liver convert excess of amino acid into ammonia by **deamination**, which is further converted into urea and is thus released from the body.
- Liver also helps in the regulation of quantity of glucose in the blood.
- The liver **reserve some quantity of iron, copper and vitamin.**
- Liver is an **important clue in investigating a person's death** that has been due to poison on food.

GALLBLADDER

The bile is **stored and recycled** in the gallbladder. It is a **small, pear-shaped organ** which is located just next to the liver.

- It stored the bile coming out of liver.
- In case of obstruction in the bile duct, liver cells stop taking bilirubin from blood. As a result, bilirubin spreads throughout the body. This is called **Jaundice.**

DIGESTION PROCESS

The process of digestion begins from the mouth. Food particles gradually get digested as they travel through **various compartments of the gastrointestinal tract.**

- The digestion process takes place in the following steps:
 - a. **Ingestion:** It involves **mastication (chewing)**.
 - The **salivary glands, along with the tongue, helps to moisten and lubricate food**, before being pushed down into the food pipe.
 - Saliva is **secreted by salivary gland** in mouth in which **enzyme amylase** is present. They convert starch into simple sugar and **make it digestible**.
 - The nature of saliva is **acidic**.
 - No digestion takes place in the food pipe.
 - b. **Secretion:** The **stomach, small intestine, liver, and pancreas secrete enzymes** and acids to aid the process of digestion.
 - It functions by **breaking down food particles into simple components** and easily absorbable components.
 - c. **Digestion in stomach:** The process of converting **complex food particles into simpler substances** in the presence of enzymes and acids secreted by different digestive organs.
 - After reaching the food in stomach **gastric glands secrete the gastric juice**.
 - **Hydrochloric acid** secreted from the oxyntic cells of the stomach kills all the bacteria coming with the food and accelerates the reaction of enzymes. This acid makes the food acidic by which amylase reaction of the saliva end.
 - The enzymes in the gastric juice of the stomach are – **pepsin and renin**.
 - Pepsin breaks down the protein into peptones.
 - d. **Absorption:** This process begins in the small intestine where **most of the nutrients and minerals are absorbed**.
 - Digested food get mixed into blood during absorption.
 - The excess water in the indigestible matter is absorbed by the large intestines.
 - e. Use of absorbed food in the body is called **assimilation**.
 - f. **Excretion:** The process of **removing indigestible substances and waste by-products** from the body through the process of defecation.

EXCRETION SYSTEM

The biological process involved in the **removal of harmful metabolic wastes** from the body is called excretion.

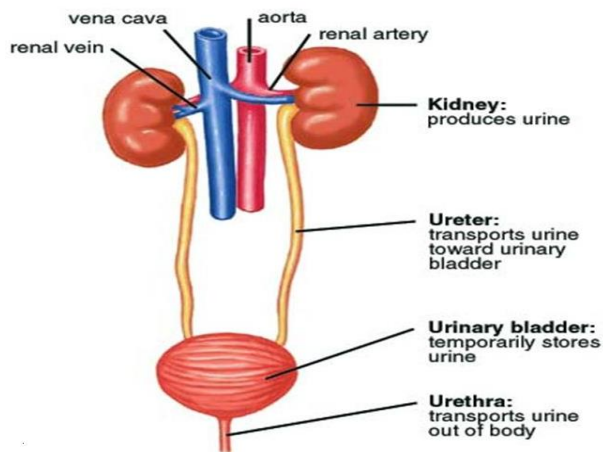
- Different organisms use **varied strategies** to do this.
- Many **unicellular organisms remove these wastes by simple diffusion** from the body surface into the surrounding water.
- Complex **multi-cellular organisms** (like humans) use **specialised organs** to perform the same function.

EXCRETION IN HUMAN BEINGS

Removal of nitrogenous substances (urea, ammonia, uric acid) formed during metabolism from the body of human is called Excretion.

The excretory system of human beings includes a **pair of kidneys, a pair of ureters, a urinary bladder** and a **urethra**.

- Kidneys are **located in the abdomen**, one on either side of the backbone.
- Kidney weighs 140 grams. There are two parts of it. Outer part is called **cortex** and the inner part is called **medulla**.
- Each kidney is made up of approximately 1,30,00,000 kidney ducts which are called **nephrons**. It is the structural and functional unit of Kidney.
- The main function of the kidneys is purification of blood plasma i.e. to excrete the unwanted nitrogenous waste substance through **urination**.
- In the kidneys
 - Urine produced in the kidneys **passes through the ureters into the urinary bladder** where it is stored until it is released through the urethra.
 - The purpose of making urine is to **filter out waste products from the blood**.
 - Nitrogenous waste such as **urea or uric acid** are removed from blood in the kidneys with the help of **cluster of very thin-walled blood capillaries**.
 - Each kidney has **large numbers of filtration units called nephrons** packed close together.
 - Some substances in the initial filtrate, such as **glucose, amino acids, salts and a major amount of water, are selectively re-absorbed** as the urine flows along the tube.



- The urine forming in each kidney eventually enters a long tube, the ureter, which connects the kidneys with the **urinary bladder**.
- Urine is **stored in the urinary bladder** until the pressure of the expanded bladder leads to the urge to pass it out through the urethra.

EXCRETION IN PLANTS

Plants use **completely different strategies for excretion** than those of animals.

- Oxygen itself can be thought of as a **waste product generated during photosynthesis**.
- They can **get rid of excess water by transpiration**.
- For other wastes, plants use the fact that **many of their tissues consist of dead cells**, and that they can even lose some parts such as leaves.
- Many plant waste products are **stored in cellular vacuoles**. Waste products may be **stored in leaves that fall off**.
- Other **waste products are stored as resins and gums**, especially in old xylem.
- Plants also excrete **some waste substances into the soil around them**.

HEREDITY AND EVOLUTION

New organisms are formed due to the process of reproduction. The reproduction process is of two types: **sexual and asexual**.

- Individuals belonging to the same species are distinct from each other on some level. The **differences that exist** between them are known as **variations**.
- Variations arise during reproduction.
- The organisms produced through sexual reproduction have more variations as compared to those produced through asexual reproduction.
- Existence of variation in organisms is considered to be **important for survival**.

HEREDITY

It is the phenomenon of **passing on or inheritance of traits/features** from parents to their offspring.

- Trait refers to the distinct **variations** in the characteristic of an organism.
- In the nucleus of each cell, the DNA molecules are packaged into **thread like structures** called chromosomes.
- There are **23 pair of chromosomes** out of which 22 are **autosomes** (non-sex determining) and 1 pair is **allosome/heterosomes** (sex determining).
- Each chromosome is made up of DNA. It is the chemical that makes up genes which are **responsible for the inheritance of characteristics**.
- For different traits there are different genes. However, a single gene can also be related to two traits.
- In human beings, there are around 20,000 genes.

INHERITANCE

The inheritance of characteristics depend on the **contribution from both parents**.

- Reproductive cells of parents (sperms and ovum) have 23 chromosomes each.
- Equal amount of genetic material is **contributed to child from both the parents**. Thus, for each trait there are two factors, one from each parent.
- Most genes have **two or more variations** that exist in pairs and are called **alleles**.
- They arise out of **mutation** (change in structure of gene) or genetic combination and are found at a **specific position on a specific chromosomes**.

DOMINANT TRAIT

The trait which **gets expressed over all other traits** is a dominant trait. It is denoted using a capital letter.

RECESSIVE TRAIT

The trait which is **not expressed over other traits** is a recessive trait. It is denoted by using a small letter.

GENOTYPE

It is the **complete genetic identity** of an organism that it inherits from its parents.

- A genotype of a particular organism includes genes that **determine both its physical and non-physical characters**.

PHENOTYPE

It is the **physical manifestation of the trait** carried by a particular gene.

SEX DETERMINATION

Different species use different strategies for the determination of sex of an individual.

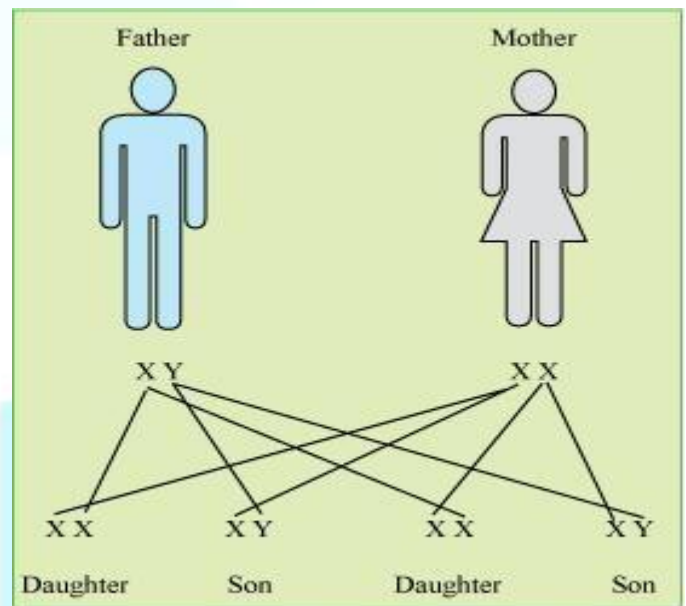
- For example, in snails, sex is not predetermined.

SEX DETERMINATION IN HUMAN BEING

In case of human beings, the sex of an individual is largely determined by his genes.

- The **inherited gene** decides whether the Individual would be a boy or a girl.
- All human cells contain 23 pairs of chromosomes. Most human chromosomes have a **maternal and a paternal copy**.
- There are 22 pairs of such chromosomes and are known as autosomes.
- The **23rd pair**, called the sex chromosomes, is **not a perfect pair**.
- Women (XX) have a **perfect pair** of sex chromosomes, both called X. But men (XY) have a mismatched pair in which one is a normal sized X, whereas the other is a **short one** called Y.
- In **females**, all the **egg cells have X chromosome** on them, whereas in **males**, **half of the sperms** have X chromosome and other half Y chromosome.
- During the fertilisation process, the egg cell may get fertilised with a **sperm containing X chromosome**.
- If this happens, then the **zygote produced would have two X chromosomes** which will produce a female child.
- Similarly, the egg cell **may get fertilised** with a sperm containing Y chromosome.

- In this case, the zygote produced will have one X and one Y chromosome which will result in a male child.



Sex determination in humans

X-LINKED RECESSIVE INHERITANCE

It is a condition in which mutation (alteration) in one gene on the X chromosome causes the medical condition in males but not in females.

- Females **rarely show signs of X-linked recessive conditions**, but they act as a carrier for the X-linked recessive condition.
- Medical conditions due to X-linked recessive conditions include:
 - **Colour blindness** is a very common in males.
 - **Haemophilia** is a blood clotting disorder. The excess loss of blood causes anaemia.
 - **Muscular dystrophy**, leading to loss of skeletal muscle control.

REPRODUCTION IN ORGANISMS

It is the process of producing young ones of the same kind either sexually or asexually.

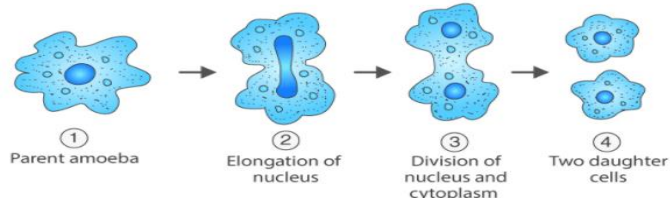
- The basic event in the reproduction is the creation of a **deoxyribonucleic acid copy**.
- The DNA in the cell nucleus is the source of genetic information.
- Chromosomes present in the DNA of the nucleus of a **cell contain information for the inheritance** of features from parents to the next generation.
- Reproduction can be of two types:

ASEXUAL REPRODUCTION

In the process of asexual reproduction, only one parent is involved. It can be further divided into more types:

FISSION

Fission is the method in which the **unicellular organism** divides into two equal parts and creates new individuals.



FRAGMENTATION

Some multicellular organisms such as spirogyra **simply break into simple pieces** or fragments, on maturation, which grow into new individuals.

REGENERATION

Some organisms have the ability to give rise to the new individuals from their body parts.

- If the organism is cut into many pieces, all the pieces grow into new individuals.

BUDDING

Some organisms develop an outgrowth, due to repeated cell division, at a specific site which looks like a bud.

- These buds develop into tiny individuals.
- On maturing, they detach themselves from the parent body and become new individuals.

VEGETATIVE PROPAGATION

It is the mode of reproduction seen in plants. In this method, the body parts such as the **root, stem or leaves** can develop into a new plant.

SPORE FORMATION

Spores are the **reproductive structure** of the 'lower plants', plants that **don't** flower.

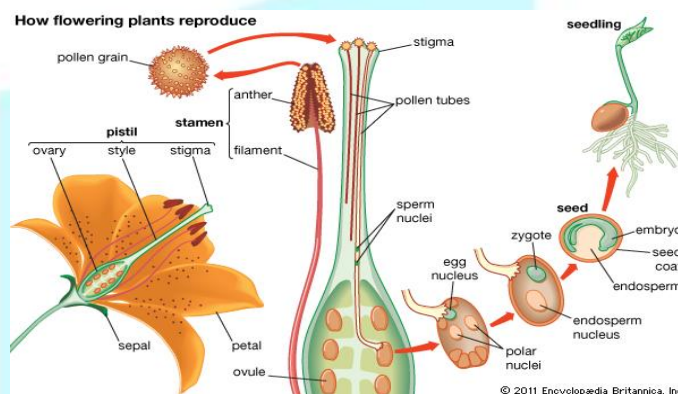
- Fungi, algae and even some bacteria have spores to pass their genes.

REPRODUCTION IN FLOWERING PLANTS

Inside the flowering plant, both male and female reproductive organ is present.

- Male reproductive organ is called **stamen** and female reproductive organ is **pistil** (or carpel).
- Stamen consists of anther which releases pollen. This pollen **gets transferred to pistil** either through the action of winds or through an insect or animal.

- This transfer of pollen from anther to pistil is known as **pollination**.
- Ovary is located at **bottom of pistil**. Apart from ovary, carpel also consists of **stigma and style**.
- Pollen from anther gets attached to stigma. Thereafter, it **ruptures** releasing the male sperm.
- This male sperm is **transferred to ovary** through style. Fertilisation takes place at ovary.
- Ovules mature at the same time ovary is maturing and turn into seeds while the ovary turns into a mature fruit.



REPRODUCTION IN HUMAN BEINGS

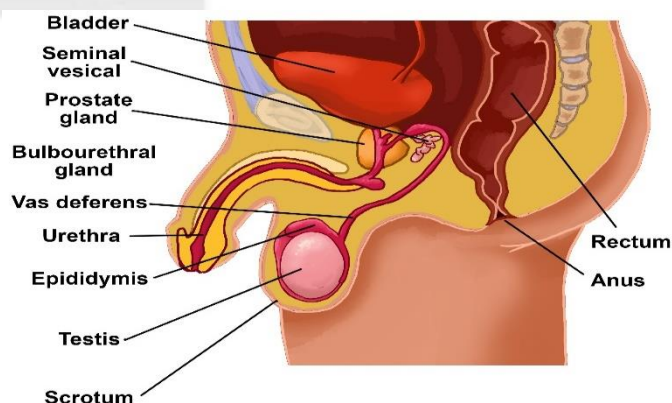
Human beings have specialised organs to carry out the **specialised functions** in the process of sexual reproduction.

- The age at which these organs begin to mature is called **puberty** and this period is called **adolescence**.

MALE REPRODUCTIVE SYSTEM

Sperms are the tiny bodies which consist of genetic material and a long tail that helps them to move.

- Sperms **fuse with the eggs** formed in the ovaries and fertilisation takes place.
- Formation of sperms takes place in the **testes**.
- Testes are located in **scrotum** which is outside the **abdominal cavity** as sperms are formed at a **lower temperature**.

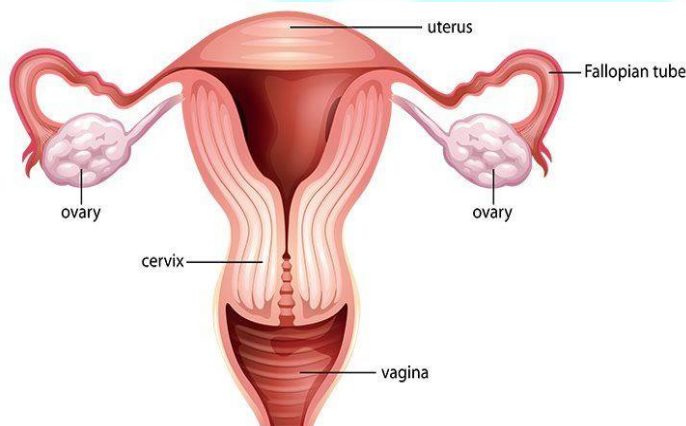


- Testes secrete a hormone called **testosterone** which brings pubertic changes in the boys.
- Sperms are delivered through **vas deferens** which is connected to urinary bladder, and therefore **urethra forms a common passage for both urine and sperms**.
- Gland such as prostate and seminal vesicles are also present on the passage of vas deferens.
- They **provide fluid medium** to the sperms for easy transport.

FEMALE REPRODUCTIVE SYSTEM

The eggs, which are **fertilised by the sperms**, are made in the ovaries. These ovaries **secrete some pubertic hormones**.

- One egg is produced ever month by either of the ovaries. The egg is carried to the womb (uterus) through fallopian tubes.
- The fallopian tubes are attached to an elastic bag like structure called **uterus**.
- Uterus opens into the vagina through the **cervix**.
- The sperms enter through the vaginal passage during **sexual intercourse**.



- They travel towards the egg in the tube. If the sperm is able to **fertilise the egg**, **zygote** is formed which gets implanted in the uterus.
- Placenta is a **flattened circular organ** in the uterus. It supplies nutrition to the embryo through umbilical cord.
- The **waste substances generated** in the embryo are transferred to the mother's blood through placenta.

DIFFERENCE BETWEEN EMBRYO AND ZYGOTE

Embryo comes from the Latin word '**embryon**' meaning 'organism which grows'. Zygote is the first stage in the developmental process in an organism.