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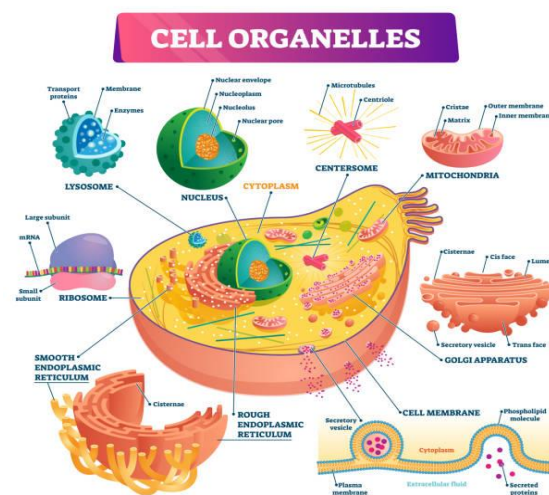
## Biology

Life, as we know it, took billions of years to evolve. From the very first precursor of life to the multitude of multicellular organisms that we see around us today, the most basic unit of all these is the cell.

### All About Cells

Cells are the basic structural and functional unit of life. The cell was discovered by **Robert Hooke**. A number of cells can work together to **form tissues and organs**.

- Note: The smallest cell is 0.1 to 0.5 micrometre in bacteria.
- The largest cell measuring 170 mm x 130 mm, is the egg of an **ostrich**.
- **Amoeba** acquires its food through **endocytosis**.



### Cellular Respiration

Cellular respiration is the process by which food releases energy in the mitochondria. Cells absorb glucose from food and burn it to produce energy.

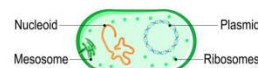
### Structural Organization of Cells

#### Prokaryotic & Eukaryotic Cells

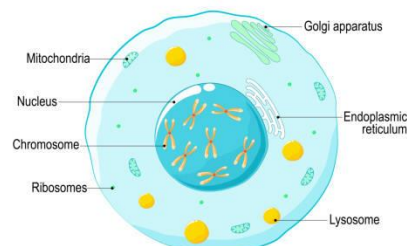
Two types of cells – **Prokaryotic** and **Eukaryotic** cells.

1. **Prokaryotes cells** - Prokaryotic cells are primitive and lack a well-defined nucleus. cells that have no defined nucleus. Eg: **Bacteria & Blue-green Algae**.
2. **Eukaryote cells** - Eukaryotic cells are more advanced and have a well-defined nucleus. cells which have definite nucleus. Eg: **Other than Bacteria & Blue-green Algae**.

#### Prokaryotic



#### Eukaryotic



## Cell Structure in Eukaryotic Cells

Eukaryotic cells have the most well-defined structure. These cells have cell membranes, membrane-bound cell organelles and a well-defined nucleus. The nucleus has its own membrane called the nuclear membrane.

### Cell Membrane

- The cell membrane is the **outer covering of a cell**.
- It is made up of a phospholipid bilayer membrane.
- It is **selectively permeable in nature**.
- The structure of a cell membrane is best described by the fluid mosaic model.

### Diffusion

The movement of molecules from a region of high concentration to a region of lower concentration is known as **diffusion**. E.g. carbon dioxide and oxygen move across the cell membrane by diffusion.

### Osmosis in Selectively Permeable Membrane

Osmosis is the movement of water across a semi-permeable membrane. Osmosis is a selective process since the membrane does not allow all molecules to pass through it. Water is usually the only free-flowing molecule across this membrane.

### Isotonic, Hypotonic, and Hypertonic Solutions

- **Isotonic solutions** are those which have the **same solute and pH concentration** as the surrounding body fluid or the cytoplasm.
- **Hypotonic solutions** contain a **lesser amount of solute concentration compared to the surrounding fluid** and can force the cell to rupture due to excess input of water into the cell.
- **Hypertonic solutions** contain a **higher concentration of solute compared to the surrounding fluid** and thus push water out of the cell, shrinking it.

## Parts of Cells

### ➤ Cell Walls in Plants

Plant cells are different from animal cells due to the presence of a cell wall. The cell wall is made of cellulose and gives a rigid structure to the plant cell. It provides structural support to plants. Due to cell walls, cells of plants, fungi and bacteria can withstand greater changes in surrounding conditions than animal cells. E.g. Cell wall enables the cells to withstand hypotonic solution without bursting.

### Cell Organelles

Eukaryotic cells contain various membrane-bound organelles that carry out various functions in the cell, **e.g. Nucleus, Endoplasmic reticulum, Golgi apparatus, Lysosomes, etc.**

### Endocytosis



Endocytosis is the invagination of the cell membrane, followed by pinching off, forming a membrane-bound vesicle. This is **commonly seen in Amoeba**.

## Nucleus in Cells

The **nucleus is the processing unit of the cell**. It is a double membrane-bound organelle which contains the genetic material for inheritance. The nuclear membrane contains pores that allow the transfer of materials from the nucleus to the cytoplasm. The **nucleus is the brain of the cell** as it controls various functions such as cell division, reproduction, inheritance, etc. The nucleus contains genetic material, i.e. **chromosomes that contain DNA**. **DNA carries information for inheritance from parents to offspring**. Prokaryotes lack a well-defined nucleus, and the genetic material is present in a region known as the nucleoid.

## Chromosomes

Chromosomes are the genetic material present in the nucleus. It contains DNA with associated proteins. They are present as threads **called chromatin**. During the growth phase of the cell, the chromatin condenses into a much thicker structure called a **chromosome**. Human cells contain **23 pairs of chromosomes (46)**.

- Chromosomes are made up of **DNA**.
- Segments of DNA in specific patterns are called **genes**.
- In prokaryotes, DNA floats in the cytoplasm in an area called the **nucleoid**.
- Chromosomes are not always visible. They usually sit around uncoiled and as loose shards called **chromation**.
- Chromosomes are usually found in pairs.
- Peas only have **12**, a dog has **78** chromosomes.
- The number of chromosomes is not related to the intelligence or complexity of the creature.

**Nucleolus:** It is a dense spherical granule contained within the nucleus. It stores proteins.

## Chromatin

Chromatin is a thread-like structure which serves as the genetic material present inside the nucleus of the cell. It is made up of **DNA and protein molecules**. DNA contains the hereditary information needed for the structure and function of the organism.

## Cytoplasm

The cytoplasm is the fluid found inside the cell. It gives the structure to the cell and houses different organelles of the cell. Scientists used to call the fluid protoplasm.

## Organelles

Organelles are structures present in the cytoplasm of the cell that helps in several functions of the cell.

## Endoplasmic Reticulum

The endoplasmic reticulum is a membrane-bound cell organelle that plays an integral role in the interpretation of the genetic information present in the nucleus.

## Rough ER

Rough ER is the one that has ribosomes on them. The ribosome is made up of nucleic acids and proteins. They are the site of protein synthesis. The Rough ER is also involved in the modification and folding of proteins.

## Smooth ER

Smooth ER does not have ribosomes and thus is not involved in protein synthesis. They are, however, involved in lipid metabolism and detoxifying of poisonous molecules.

**Ribosomes:** It synthesis protein, and Endoplasmic reticulum sent these protein in various part of the cell. Whereas Smooth Endoplasmic reticulum helps in the manufacture of fats. It a made up of ribonucleic acid.

### ➤ Functions of these proteins and fats:

- Protein and fat (lipid) help in building the cell membranes. This process is known as membranes biogenesis.
- Smooth Endoplasmic reticulum plays a crucial role in detoxifying many poisons and drugs.

## Golgi Apparatus

Golgi Apparatus is also called the **post office of the cell**. They package and transport the proteins across the cytoplasm. It is another packaging organelle like the endoplasmic reticulum.

### functions:

- It is the organelle that builds lysosomes (cells digestion machines).

## Lysosomes (suicidal bag):

They are referred to as suicide bags of the cell as they contain potent enzymes that can digest a cell. Lysosomes also help in defence by attacking a foreign object. It is a kind of waste disposal system of the cell.

## Mitochondria(power house):

Mitochondria are also called the powerhouse of a cell. They generate ATP(adenosine-tri-phosphate) via the electron transport chain. They also have a DNA **called mtDNA**, which makes them a semi-autonomous organelle. Mitochondria can make their own proteins.

- **ATP** is known as the **energy currency of the cell**.
- Mitochondria are strange organelles in the sense that they have their own DNA and ribosomes, therefore mitochondria are able to make their own protein.
- **Mitochondria** is absent in bacteria and the red blood cells of mammals and higher animals.

## Plastids

There are various types of plastids in different cells based on the pigment they contain. The chloroplast is the plastid where photosynthesis occurs, they contain **chlorophyll**. Plastids also contain their own DNA and ribosomes. These are present only in plant cells. **Plastids** are self-replicating. i.e. they have the power to divide, as they contain DNA, RNA and ribosomes.



**Types of plastids:** Some of the other plastids are **leucoplast and chromoplast**.

- **Leucoplasts** (white or colourless plastids) : Leucoplasts store starch, oil and protein granules. Chloroplasts contain membranes known as thylakoids embedded in the stroma.
- **Chromoplast** (colour plastids) impart colour flowers and fruits. present in which starch, oils and protein are stored.

**Centrioles:** centrioles are concerned with cell division. It initiates cell division.

## Vacuoles

Vacuoles are large vesicles that hold water or air in them and give structural rigidity to the cell. Vacuoles are common in plant cells. In animals, the vacuoles are either very small or absent.

## Cell Division

Organisms grow and reduce through **cell division**.

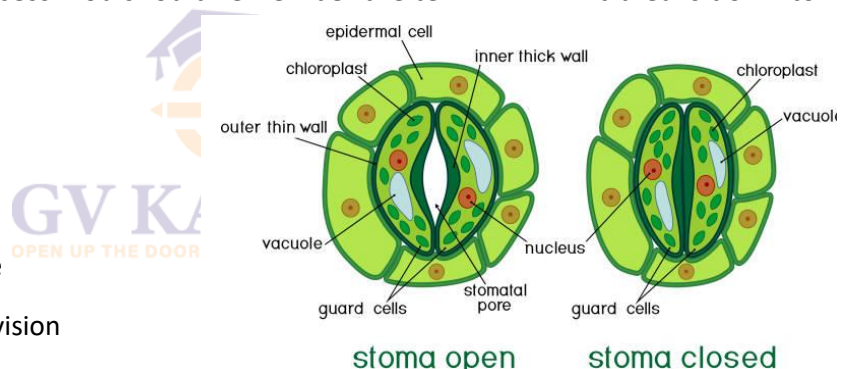
There is the methods of replication **mitosis and meiosis**.

**Mitosis:** It duplicates its DNA and the two new cells (daughter cells) have the same pieces and generic code. There are five steps in this process. You should remember the term **PMATI**. It breaks down to:

1. Prophase
2. Metaphase
3. Anaphase
4. Telophase
5. Interphase.

The main theme of **meiosis** is that there

are two cell division. Mitosis has one division

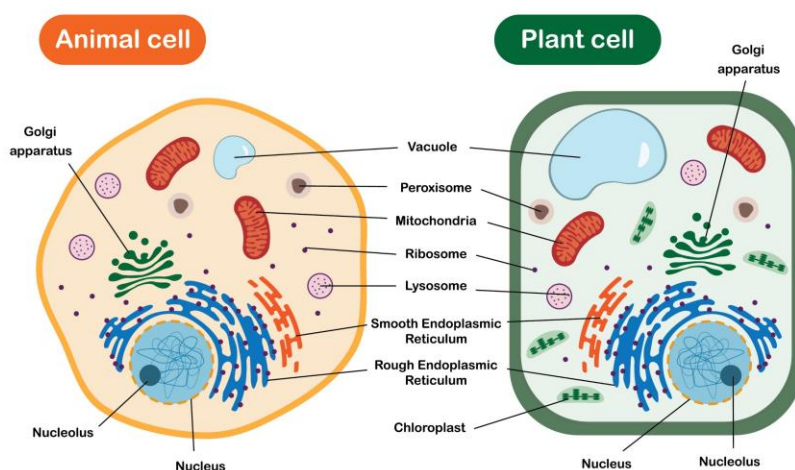


## Comparison between Plant and Animal Cells

Plants cells are different from animal cells structurally. Plant cells have cell walls and chloroplast which are missing in animal cells. Plants cells also have large vacuoles, which are either very small or missing in animal cells. The nucleus is present at the centre of the cell in animal cells and at the periphery in plant cells.

**Biology diagram** ●●●

## Structure of ANIMAL and PLANT CELL



### ➤ Some important facts regarding cells:

- **Nerve cells** in animals are the longest cells.
- Smallest human cell is **red blood cell**.
- Largest human cell is female **ovum**.
- The single largest cell in the world is of an **ostrich**.
- The smallest cells are those of the **mycoplasma**.
- Every minute about 3 million cells in our body die.
- **Sieve tube** in plants and the mature mammalian red blood cells do not have a nucleus.
- **The red blood cell** carries respiratory gases. Sieve cells in plants transport nutrients in plants.
- The **lysosomal enzymes** of the sperm cells digest the limiting membranes of the ovum (egg). Thus the sperm is able to enter the ovum.
- During the transformation of tadpole into frog. The embryonic tissues like gills and tail are digested by the **lysosome**.
- **Mitochondria** contain DNA, hence capable of replication. Matrix is a transparent, homogenous semi-fluid substance. In its active state. It remains saturated with water.

## Introduction to Tissues

**Tissues:** Tissues are a group of cells that combine together to perform a particular function.

### Plant Tissues

Plant tissues are of various types, and they are made up of similar types of cells. They are different from animal tissues since there are several differences between animal and plant cells. Meristematic tissues and permanent tissues are the two types of plant tissues.

### Animal Tissues

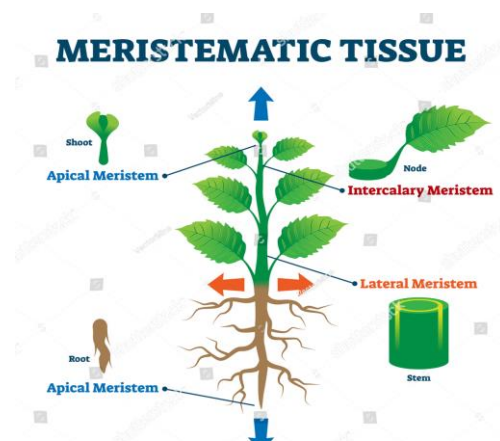
Animal tissues are made up of animal cells. These tissues are usually not rigid since the cells do not have cell walls.

### Plant Tissues

#### Meristematic tissues:

Meristematic tissues are seen in plants. They are primarily made up of rapidly dividing cells. They are the growing tissues of the plant. Meristematic tissues consist of a group of cells that have the ability to divide. These tissues are small, cuboidal, densely packed cells which keep dividing to form new cells. These tissues are capable of stretching, enlarging and differentiating into other types of tissues as they mature.

Meristematic tissues give rise to permanent tissues. Meristematic tissues can be of three types depending





on the region where they are present:

### a. Apical meristem

Apical meristem is present on the apex of the plant shoot and root. They are rapidly growing tissues and aid in increasing the height of the plant.

### b. Lateral meristem

Lateral meristem is present on the lateral walls of the stem. They help in the horizontal growth of the plant and increase the stem girth.

### c. Intercalary meristem

Intercalary meristem can be found between the nodes of the stem and the base of the leaf. They help in branching.

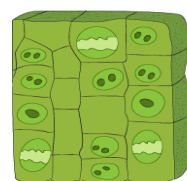
## Permanent tissues

Permanent tissues arise from the meristematic tissue and have structural and functional properties. Permanent tissue can be made up of either living or dead cells. They are specialised to perform a specific function, e.g. parenchyma, collenchyma, xylem, phloem, etc. Permanent tissues are of two types simple and complex permanent tissue. They have lost their ability to divide. They have attained their mature form. They are further classified into two types: **Simple and complex permanent tissues**.

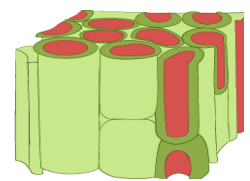
➤ **Simple permanent tissues:** These are tissues that are made up of only one type of cell. They usually have a structural role.

**1. Parenchyma-** Parenchyma tissues are made up of loosely packed cells with thin cell walls and large intercellular spaces. They are live cells and help in support and storage. Two types; Chlorenchyma and Aerenchyma.

These tissues are found in the soft parts of a plant such as the roots, stems, leaves, and flowers. The functions of parenchyma tissues are storage, photosynthesis, and to help the plant float on water.

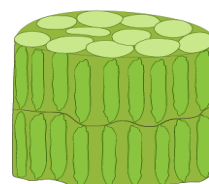


Meristematic

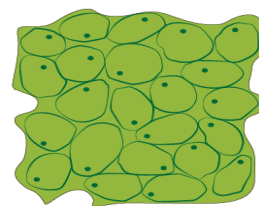


Sclerenchyma

**2. Collenchyma-** Collenchyma tissues are made up of live cells which have irregularly thickened corners and thus, have decreased intercellular spaces. They help in bending various parts of the plant without breaking. They are meant to provide mechanical support to the plant structure in parts such as petiole of the leaf.



Collenchyma



Parenchyma



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### 3. **Sclerenchyma**- Sclerenchyma tissues make up the hard and stiff parts of the plant.

They are made up of dead, long and narrow cells. They almost have no intercellular space as the walls are thickened due to the presence of lignin. Their main function is to provide strength and support to parts of the plant.

- **Complex permanent tissues:** Complex permanent tissues are made by the combination of different types of cells. These cells work together to perform a specific task. Unlike simple permanent cells which look the same and are made up of one type of cells, complex permanent tissues are made up of more than one type of cells. These different types of cells coordinate to perform a function. Xylem and Phloem are complex permanent tissues and are found in the vascular bundles in the plants.

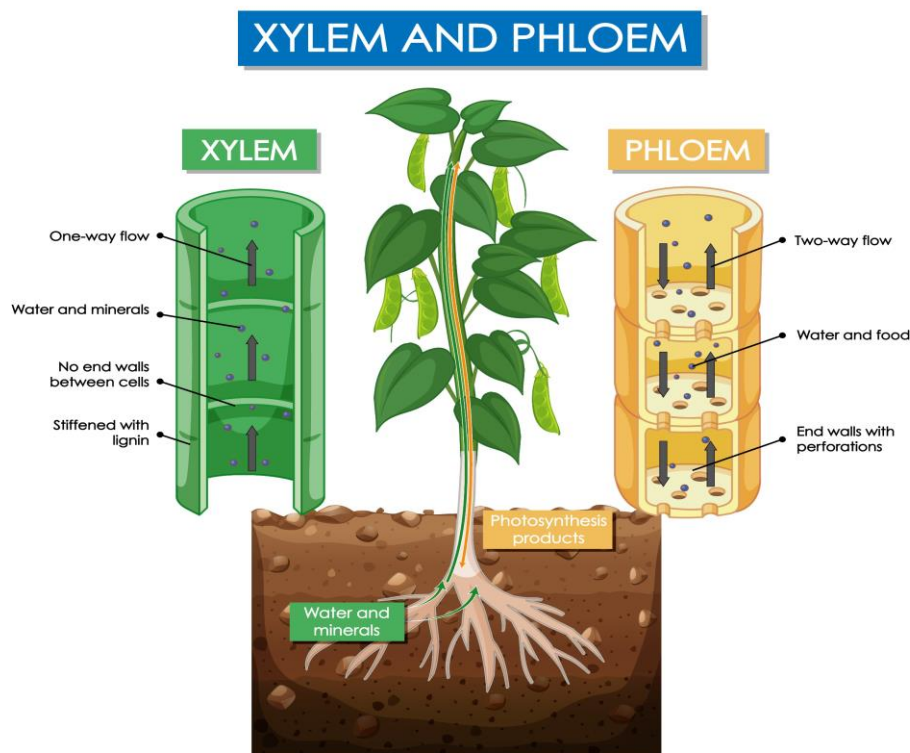
## Phloem

Phloem is made up of the following components – sieve tubes, companion cells, phloem parenchyma and phloem fibres. Phloem conducts food in both directions. Among all the components, phloem fibres are the only dead cells.

## Xylem

Xylem is made up of the following components. The vessels and tracheids – help in the conduction of water and minerals from the soil. Xylem parenchyma helps in food storage, and the xylem fibres provide mechanical support.

**Transportation in plants** - performed by two vascular tissues, xylem and phloem



**GS का रामबाण****GV KAKSHA****Latest TCS-Based GS/GK Smart pdf course****Gv witmover (SSC+RRB+State Exams)****xylem****Vascular Tissues****Phloem**

- Present in roots, stems and leaves
- Conducts water and minerals from roots to other plant parts
- Tracheids and vessels forms a continuous system of transportation.
- Cells in the roots absorb ions which helps in movement of water into the roots.

- Conducting tissue for nutrients from leaves to other parts of the plant.
- Consists of sieve tubes, companion cells, phloem fibres and phloem parenchyma.
- Translocation occurs in sieve tubes.

Xylem	Phloem
Cells are dead	Cells are alive
Carries water and minerals	Carries sugar and amino acids
Upward movement of	Flow is in all directions

Meristematic tissue	Permanent tissue
Cells divide repeatedly	Do not divide
Cells are undifferentiated	Cells are fully differentiated
Cells are small and isodiametric	Cells are variable in shape and size
Intercellular spaces are absent	Intercellular spaces are present
Vacuoles are absent	Vacuoles are present
Cell walls are thin	Cell walls may be thick or thin
Inorganic inclusions are absent	Inorganic inclusions are present



## Plant Structure & Functioning

Structure		Functions
Leaves	<ul style="list-style-type: none"> <li>Thin with a large surface area</li> </ul>	<ul style="list-style-type: none"> <li>Short distances for gases to diffuse Large area for absorption of light.</li> </ul>
	<ul style="list-style-type: none"> <li>Cells contain chlorophyll in chloroplasts.</li> </ul>	<ul style="list-style-type: none"> <li>Leaves are a plant's food factory. They are the main site of photosynthesis. where sugars are made from water and carbon dioxide, using sunlight energy that has been absorbed by chlorophyll.</li> </ul>
Stems	<ul style="list-style-type: none"> <li>Long and cylindrical. Woody tissues - xylem and fibres (sclerenchyma)- add strength.</li> </ul>	<ul style="list-style-type: none"> <li>Support the leaves, flowers and fruit. Can bend or resist the wind.</li> </ul>
	<ul style="list-style-type: none"> <li>Contain xylem and phloem (in veins).</li> </ul>	<ul style="list-style-type: none"> <li>Transport water, minerals to leaves and sugars to roots, flowers, fruit and roots.</li> </ul>
Roots	<ul style="list-style-type: none"> <li>Branch extensively through the soil.</li> </ul>	<ul style="list-style-type: none"> <li>Provide anchorage in the soil.</li> </ul>
	<ul style="list-style-type: none"> <li>Root hairs-provide huge surface area.</li> </ul>	<ul style="list-style-type: none"> <li>Enable absorption of water and nutrients.</li> </ul>
	<ul style="list-style-type: none"> <li>Contain xylem and phloem (in veins)</li> </ul>	<ul style="list-style-type: none"> <li>Enable transport of water and nutrients</li> </ul>
	<ul style="list-style-type: none"> <li>Root tip-area of cell division.</li> </ul>	<ul style="list-style-type: none"> <li>Grow into the soil.</li> </ul>
	<ul style="list-style-type: none"> <li>Root cap-covers the root tip.</li> </ul>	<ul style="list-style-type: none"> <li>Protects and lubricates the growing root.</li> </ul>

## Animal Tissues

### Epithelial Tissues

Epithelial tissues are seen on the outer layer of a body or organ surface. They form the outermost protective layer of most animals.

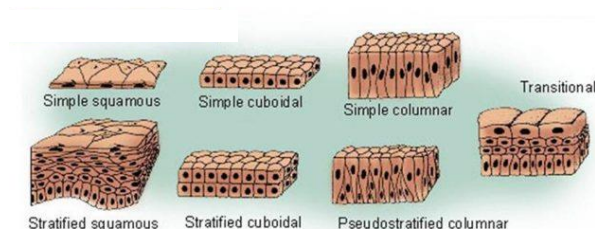
#### (i) On the basis of cell layers

- (a) When an epithelium has a single layer of cells it is called a simple epithelium.
- (b) Where as a multiple tier of cells are known as stratified epithelium.

#### (ii) On the basis of simple shape of cells:

- ✓ **Squamous Epithelium:** Squamous epithelium forms an extremely thin and flat layer of tissues. They are semi-permeable and, thus, perfect for gaseous exchange. They are present in the lining of the oesophagus and the mouth.
- ✓ **Cuboidal Epithelium:** As the name suggests, they are cuboidal in shape and form the lining of salivary glands and kidney tubules. They provide mechanical support. They also form glandular epithelium when they form glands.

### Epithelial Tissue



- ✓ **Columnar Epithelium:** These tissues line the organs which help in absorption and secretion, such as the lining of the intestines. They are made up of elongated cells. When cilia are present in these cells, they form ciliated columnar epithelium like those present in the respiratory tract.
- ✓ **Stratified Squamous Epithelium:** This kind of tissue is formed when multiple layers of squamous epithelium are arranged in a pattern. Our skin is made up of this kind of tissue.

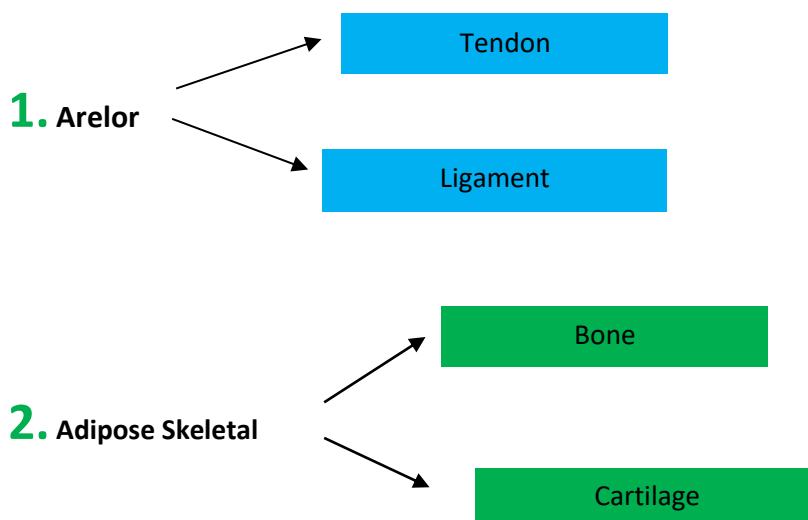
## Muscular Tissue

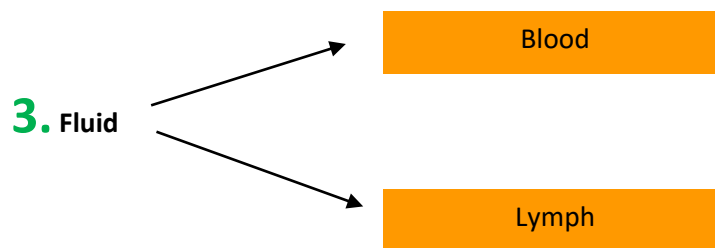
These tissues make up our muscles which are responsible for almost all the movements that take place in the body.

- **Striated/Skeletal Muscles:** All the voluntary movements in our body are carried out by the striated or skeletal muscles. They are called skeletal because these tissues are mostly attached to the bones. They are long, cylindrical, unbranched with striations and multinucleated. It attached primarily to bones. Its main function is to provide the force for locomotion and all other voluntary movements of the body.
- **Unstriated/Smooth Muscles:** Almost all involuntary movements in the body are carried out by the smooth or striated muscles. They are long, smooth, spindle-shaped and uninucleate. We can find them in places like the alimentary canal and blood vessels.
- **Cardiac Muscles:** Cardiac muscles make up our entire heart. These muscles are involuntary in nature and show rhythmic contractions and relaxations. The contraction and relaxation of the heart muscles help to pump the blood and distribute it to the various parts of the body. Structurally they may look quite similar to striated muscles, but they are branched, uninucleated and have intercalated discs.

## Connective Tissues

These tissues help in connecting different parts of the body. Examples include blood, bones, cartilages, tendons, ligaments, areolar tissues and adipose tissues.





1. **Areolar tissue:** It fills spaces inside organs found around muscles, blood vessels and nerves. Its main function is to joins skin to muscles, support internal organs, help in the repair of tissues. Whereas tendon's main function is to connect muscles to bones and ligament is connects bones to each other.
2. **Adipose tissue:** Its occurrence is below skin, between internal organs and in the yellow bone Marrow. Its main function is to storage of fat and to conserve heat.
3. **Skeletal tissue:** Bone & cartilage occurrences is in nose, epigotis and in intervertebral disc of mammals. Its main function is to provide support and flexibility to body part. Whereas bone protects internal delicate organs provides attachments for muscles, bone marrow makes blood cells.
4. **Fluid tissue:** Blood & Lymph blood transport 02 nutrients, hormones to tissues and organs. Whereas leucocytes fight diseases and platelets help in clotting of blood. Lymph transport nutrients into the heart and it also forms the defense system of the body.

## Diversity in Living Organisms

### Introduction to Taxonomy

#### Diversity

- Diversity is the presence of different organisms in the same ecosystem or geographical location.
- Diversity gives a chance for a more balanced ecosystem.

#### Evolution

- Evolution is the slow process by which organisms change according to their needs to survive the environment around them.
- Evolution leads to the formation of new organisms and more diversity in the ecosystem.

#### Charles Darwin

- Charles Darwin was an English biologist and a naturalist.
- He travelled on HMS Beagle to Galapagos Island in South America.
- Using his observation, he proposed the theory of evolution in his book **“On the Origin of Species” in 1859.**
- He explained that natural selection is the basic mechanism of evolution.
- His theory of natural selection became the basis for modern evolutionary studies.



# Taxonomy

## Taxonomical Hierarchy

Taxonomical hierarchy refers to the classification of living organisms into different groups or taxons. Kingdom is ranked at the highest level of the hierarchy and species is at the lowest rank, which is the basic unit of classification.

## Hierarchy of Classification

- Organisms are arranged into groups/levels according to their similarities.
- As we go up the hierarchy, the organisms have lesser similarities.

### Kingdom

- A kingdom is the highest level of classification which consists of a number of phyla or divisions (in case of plants) with similar characteristics.

#### ➤ Phylum/Division

- Phylum/Division is a level of classification which consists of a number of classes with similar characteristics.

#### ➤ Class

- A class is the level of classification which consists of a number of orders with similar characteristics.

#### ➤ Order

- An order is the level of classification which consists of a number of families with similar characteristics.

#### ➤ Family

- A family is the level of classification which consists of a number of Genus with similar characteristics.

#### ➤ Genus

- Genus is the level of classification which consists of a number of species with similar characteristics.

#### ➤ Species

- Species is the level of classification which consists of a number of organisms with similar characteristics and can interbreed to give rise to a fertile offspring.

## Nomenclature

### Carolus Linnaeus

- **Carolus Linnaeus** is a Swedish botanist and physician who is also called the '**Father of taxonomy**'.
- He introduced the Binomial nomenclature and laid the ground rules which paved way for modern taxonomy.

## Binomial Nomenclature

- Binomial Nomenclature was introduced by Linnaeus as a method of naming organisms in taxonomy.
- It consists of two parts.
- The first part is the Genus name which is written in capital.
- The second part is the species name, which is not capitalised.

## Five Kingdom Classification

### Classification of Kingdom

**Storer** and **Usinger** classified animals into following phylums

Character	Monera	Protista	Fungi	Plantae	Animalia
<b>Cell type</b>	Prokaryotic	Eukaryotic	Eukaryotic	Eukaryotic	Eukaryotic
<b>Cell wall</b>	Non-cellulosic	Present in some	Present	Present	Absent
<b>Nuclear membrane</b>	Absent	Present	Present	Present	Present
<b>Body organisation</b>	Cellular	Cellular	Multicellular/ loose tissue	Tissue/ organ	Tissue/ organ/organ system
<b>Mode of nutrition</b>	Autotrophic and heterotrophic	Autotrophic and heterotrophic	Heterotrophic	Autotrophic	Heterotrophic
<b>Examples</b>	Bacteria archaebacteria cyanobacteria and some primitive fungi	Amoeba Euglena Dinoflagellates	Acholrophyllus, heterotrophic fungi	Multicellular eukaryotic plants	Multicellular animals

## 5 Kingdom classification

- 5 Kingdom classification is the most accepted system of classification given by **R.H. Whittaker**.
- This classification solved most of the issues in taxonomy related to the placement of bacteria and fungi.
- The 5 kingdoms are **Monera, Protista, Fungi, Plantae and Animalia**.

### Kingdom Monera

## Monera

- All the prokaryotic organisms are placed in this Kingdom.
- Bacteria and their ancient cousin, archaeobacteria are the organisms that makeup Kingdom Monera.
- These are **prokaryotic, unicellular, autotrophic/heterotrophic organisms**.
- Bacteria have a cell wall made up of **polysaccharides**.

## Archaea

- The category in the kingdom Monera which consists of the organisms surviving in extremely hot conditions.
- They are considered to be the most ancient living organisms present on the planet.

## Eubacteria

- Eubacteria is phylum of Monera consists of all the bacteria that survive in a normal environment.
- All the major helpful and pathogenic bacteria we know today fall under this category.

## Gram +ve/-ve bacteria

- Some bacteria have a very thick cell wall which makes them take up Gram stain and appear violet.
- There are other bacteria which have a thin cell wall and on Gram staining appear pink.
- Usually, gram +ve bacteria are pathogenic in nature.

## Kingdom Protista

## Protista

- Kingdom Protista is made up of all the **eukaryotic unicellular organisms except yeast**.

## Protozoan

- Protozoans are the **unicellular eukaryotic organisms that come under the Kingdom Protista**.
- Examples include **paramecium, amoeba, Plasmodium, euglena, leishmania etc.**
- In these, all the metabolic activity like digestion, respiration, excretion and reproduction takes place in unicellular body.
- Respiration and excretion take place through diffusion.

## Fungi like Protists

- This kingdom includes unicellular fungi like yeast and moulds.

## Plant-like Protists

- Kingdom Protista includes some unicellular algae which are photosynthetic.





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# Kingdom Fungi

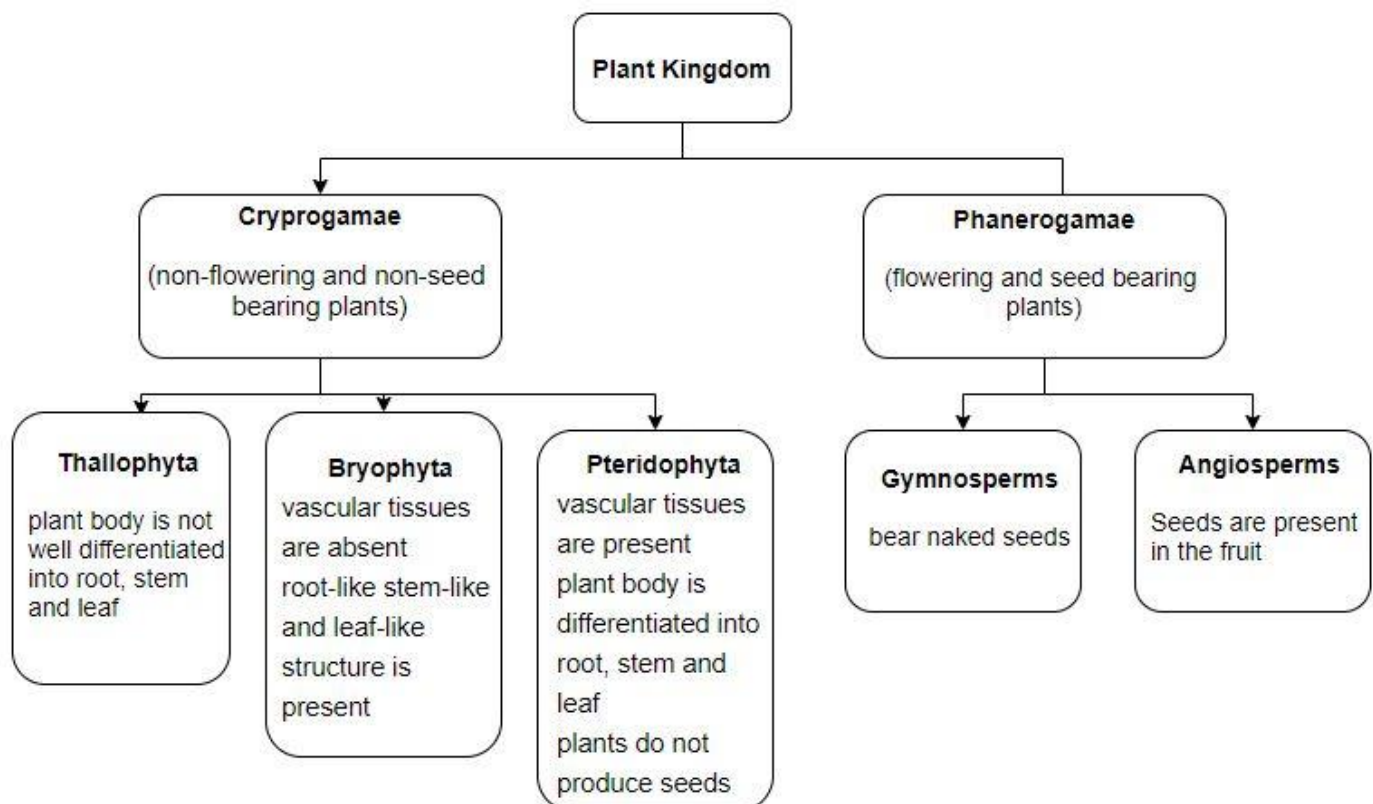
## Fungi

- The organisms of Kingdom Fungi are **mostly saprophytic**.
- It is the only Kingdom which has the **multicellular and unicellular organisms**.
- Majority of them have a cell wall **made up of chitin**.

# Kingdom Plantae

## Plantae

- All plants and trees we see around us come under this Kingdom.
- All of them are **autotrophic with chloroplast in their cell**.
- Their cell wall is made up of **cellulose**.
- The plant kingdom is classified into two major divisions as **Cryptogams and Phanerogams**.



## Cryptogamae

- Cryptogams literally mean '**plants with hidden reproductive parts**'
- Cryptogams are plants that produce spores to reproduce instead of seeds.
- So these plants do not have flowers or fruits.
- Cryptogams are further classified as **thallophytes, bryophytes and pteridophytes**.

## Phanerogamae

- Phanerogams are plants that **produce seeds for reproduction**.
- Some of them do not produce flowers, while the others produce flowers.
- Phanerogams are further classified as **gymnosperms and angiosperms**.

## Classification of Cryptogamae

### ➤ Thallophyta

- Thallophyta is the **first division of the plant kingdom**.
- It consists of **red, green and brown algae**.
- They don't have a lot of differentiated structure.
- Examples are *Spirogyra, Ulothrix, Cladophora, Ulva and Chara*.

### ➤ Bryophyta

- Bryophyta is the **2nd division of the plant kingdom**.
- These are the first plants to have differentiated roots and shoots.
- Examples are *Funaria and Marchantia*.

### ➤ Pteridophyta

- Pteridophyta is the **3rd division of the plant kingdom**.
- These plants have proper differentiation of roots, stems and leaves.
- Examples of pteridophytes are *Marsilea, ferns and horsetails*.

## Classification of Phanerogamae

### ➤ Gymnosperms

- Gymnosperm stands for **naked seed**.
- They are the first phanerogams since they produce seeds, which are not enclosed in a fruit.
- Examples are pines and *deodar, cycas, etc.*

### ➤ Angiosperms

- Angiosperm is the last division of the plant kingdom and has what scientist assume, is the most evolved organism on the planet.
- They bear **flowers and fruits, inside which the seeds are found**.



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## Cotyledons

- Cotyledons are structures present in seeds for nutrition during germination when leaves are not yet developed.
- Angiosperms either have two cotyledons making them dicots or only one, making them monocots.

## Dicots and Monocots

- Angiosperms, the highly evolved plants on the planet Earth, are further classified based on the number of cotyledons their seeds have.
- When seeds have two cotyledons, they are called dicots.
- Dicots have a tap root system and reticulate venation. Examples: Mango, Pea, Beans, etc.
- If seeds have only one cotyledon, they become monocots.
- Monocots show a fibrous root system and parallel venation.
- Examples: all grains like wheat, maize, rice etc.

# Kingdom Animalia

## Animalia

- Kingdom Animalia is made up of **eukaryotic, multicellular, heterotrophic organisms**.
- Mode of nutrition is holozoic and they are either **herbivores or carnivores**.
- Most animals are motile, they can move independently in search of food, shelter or mate.
- Animals are made up of many organ systems, that aids in performing specific functions that are necessary for the survival of the organism.
- Most of the animals are bilaterally symmetrical, while primitive animals are asymmetrical and cnidarians and echinoderms are radially symmetrical.

## Porifera

- This phylum consists of the **sponges**.
- They are mostly **marine, very few are freshwater**.
- All the animals are **sessile** (fixed in one place).
- Cells are loosely arranged (cellular grade of the organization).
- Animals are diploblastic with outer ectoderm and inner endoderm held with jelly-like mesoglea.
- Exoskeleton in the form of spicules made up of silica or calcium carbonate.
- Sponges have pores all over the body. Body pores are called Ostia.
- Water from outside enters the body through Ostia and leaves through one large opening called the osculum.
- These are **multicellular animals**.
- Their skeleton is made up of minute calcareous or siliceous spicules.
- e.g., **Sycon, Sponge etc.**





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## Coelenterata

- These animals are aquatic, mostly marine.
- They are solitary or colonial. Each individual is known as **zooid**.
- Animals are radially symmetrical.
- Sessile forms are called **Polyps** and free-living forms are called **Medusa**.
- Cells are organized into tissues (tissue grade of the organization).
- Animals are diploblastic, outer ectoderm and inner endoderm. Mesogloea separates these two layers.
- The body has a single opening called a hypostome surrounded by sensory tentacles.
- Body cavity (coelom) acts as gastrovascular cavity i.e. coelenteron.
- special types of cells called Nematocysts are present for capturing and paralyzing prey, present in tentacles.
- They have specialised cnidoblast cell to help in catching the food.
- Phenomenon of polymorphism (many forms) and metagenesis (alternation of generation) are associated with coelenterates.
- Examples: **Hydra, Jellyfish, Corals, Obelia, Sea-anemone**.
- Hydra has a tendency of regeneration of body organs.

## Platyhelminthes



- This phylum consists of the organisms that are bilaterally symmetrical, triploblastic and flattened.
- Organ- system grade of the organization is seen.
- Animals are triploblastic with outer ectoderm, middle mesoderm and inner endoderm.
- Acoelomate i.e No body cavity.
- The digestive system is incomplete or absent.
- Mostly parasites, a few are free living.
- Animals of this phylum have alimentary canal with single opening, anus is absent.
- Excretion takes place by flame cells.
- These are hermaphrodite animals (males are not separated from females).
- Examples: **Liver fluke, Tapeworm**.

## Nemotoda or Phylum-Aschelminthes

- These organisms have bilaterally symmetrical, triploblastic and cylindrical body.
- Organ system grade of the organization is seen.
- Pseudocoelom is present.
- Have a tubular digestive system with openings at both the ends.
- They are endoparasites.
- Mouth is provided with hooks and suckers.
- Their alimentary canal is complete in which mouth and anus both are present.



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- There is no circulatory and respiratory system but nervous system is developed. Excretion takes place through protonephridia.
- They are unisexual.
- Most forms are parasitic but some are free living in soil and water.
- Examples: **Ascaris, hookworm, filarial worm, Threadworm etc.**
- Threadworm is found mainly in the anus of child. Due to which children feel itching and often vomits. Some children urinate on the bed at night.

## Annelida

- These organisms have **bilateral symmetry and triploblastic**.
- They are mostly aquatic, few are terrestrial.
- These are the first organism to have a true coelom.
- Coelome is compartmentalized by intersegmental septa.
- Body long and metamerically segmented (segmentation from outside and inside of the body).
- Alimentary canal is well-developed.
- These are the first to have proper organ systems.
- Nervous system is normal and blood (called haemolymph) is red (iron rich haemoglobin).
- Their blood flows in closed vessels.
- Like in earthworm, there are five pairs of blood vessels called as heart.
- They respire through skin, in some animals respiration takes place through coelom.
- Excretion by nephridia.
- They move through setae **made up of chitin**.
- Examples: **leech, Nereis earthworm, etc.**

## Arthropoda

- This is the largest phylum with 80% of all known living animals.
- Animals with jointed appendages (in Greek Arthron: jointed, poda: legs).
- The body has three segments/regions as head, thorax and abdomen.
- Body is covered by an exoskeleton made of chitin.
- They are bilaterally symmetrical and have an open circulatory system.
- Compound eyes are present
- Circulatory system is open type. Cockroach's heart has 13 chambers.
- Trachea or book lungs, body surface are respiratory organs.
- Examples: **insects, scorpions, spiders, millipedes, centipedes, crabs, lobsters, Cockroach, Prawn, Bug, Fly, Mosquito, Bees, etc.**
- Insects generally have six feet and four wings.
- Ant is a social animal which reflects division of labour.
- Termite is also a social animal which lives in colony.



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## Mollusca

- They are bilaterally symmetrical, with a reduced coelomic cavity and little segmentation.
- They have an open circulatory system and kidney like organs for excretion.
- Body is soft and usually enclosed in a shell. The shell may be external or internal.
- They show the presence of Foot, Mantle and Mantle cavity.
- Their alimentary canal is well- developed.
- Respiration takes place through gills or ctenidia. Blood is colourless.
- Excretion takes place through kidneys.
- Examples: **pearl oysters, bivalves, sepia, octopus(Devil-fish),, snail, slug, Pila, Aplysia (Sea rabbit), Doris (Sea lemon), Sepia (Cuttle-fish).**
- Eyes of octopus are similar to chordate eyes.

## Echinodermata

- They are spiny-skinned and free-living, exclusively marine.
- The animals are usually pentamerous.
- They are triploblastic and have a coelomic cavity.
- They have a water-driven tube system for moving forward.
- All the animals in this group are marine. They have water vascular system. Brain is not developed in nervous system.
- They have a special capacity of regeneration.
- These are the only invertebrate animals which contain proper bone like structures (ossicles).
- Examples: **starfish, sea urchin, sea cucumber, sea lily, etc.**

## Hemichordates

- Hemichordata is bilaterally symmetrical and triploblastic.
- In addition to these, they have a notochord that runs along the back of the animal and separates the nervous tissue from the gut.
- They are marine animals and bridge non-chordates to chordates.
- Porifera to Echinodermata are non-chordates/invertebrates.
- Example: **Balanoglossus, also called acorn worm.**



## Chordata/Vertebrata

- Presence of dorsal, tubular, hollow nerve cord.
- Presence of notochord.
- Presence of pharyngeal gill slits.
- Presence of post-anal tail.
- Bilaterally symmetrical body.
- Presence of three germ layers.
- Organ-system level of organization.
- Presence of ventral heart and hepatic portal system.
- Presence of well-developed endocrine glands
- Except for a few primitive forms, the animals have a vertebral column instead of a notochord. These animals are called vertebrates.

## Pisces

- Class Pisces include all bony and cartilaginous fishes.
- They are exclusively aquatic.
- Body is streamlined with paired and unpaired fins.
- These are aquatic animals cold-blooded vertebrates.
- Heart is two-chambered.
- Lateral line system is well developed.
- Respiration takes place through gills.
- Examples: **Sharks, Rays, Rohu, Mrigal, Green carp, Trygon, Scoliodon, Torpedo, etc**

## Amphibia(First land vertebrates)

- Amphibians live both, on land and in water and lay their eggs in water.
- Respiration is through gills in the larval stage and through the lungs in adults.
- They are cold-blooded animals.
- They have a three-chambered heart.
- Respiration takes place through gills, skin and lungs.
- Examples: **frog, toads, salamander, Necturus, Ichthyophis ,etc**

## Reptilia(First true land vertebrates)

- These are the first completely land animals.
- These are crawling animals.
- The skeleton is completely flexible.
- Reptiles are cold-blooded and breathe through their lungs.



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- They have a three-chambered heart (except crocodile -- Four chambered) and lay eggs with tough coverings.
- Body is covered with scales, scutes or hard plates.
- Examples: **snakes, crocodiles, turtles, lizards, Tortoise, Sphegnodon etc.**
- Cobra is the only snake which makes nests.
- Heloderma is the only poisonous lizard.
- Sea snake is also called Hydrophis belcheri. It is the world's most poisonous snake.

## Aves (Aerial Vertebrates Birds)

- All birds belong to this class.
- They are warm-blooded, have a four-chambered heart and breathe through lungs.
- They have their forelimbs modified into wings which help in flight.
- Jaws are modified into beaks.
- Birds have no teeth, beak helps in feeding.
- Bones are hollow and most of them are fused to reduce body weight.
- An exoskeleton is in the form of feathers.
- They have a single ovary and pneumatic bones. e.g., **Crow, Peacock, Parrot etc.**
- **Flightless birds** are **Kiwi and Emu.**
- **Largest bird** is **Ostrich.**
- **Smallest bird** is **Humming bird.**
- **Largest zoo in India** is **Alipur (Kolkata)** and the largest zoo of the world is Cruiser National Park in South Africa.

## Mammalia

- They are warm-blooded, breath through their lungs and have a four-chambered heart.
- Presence of hair on their body, sweat and oil glands are exclusive characters of mammals.
- Presence of pinna i.e external ear is also seen only in mammals.
- They also have mammary glands to feed their young ones.
- They usually give birth to live young ones.
- Tooth comes twice in these animal (diphyodont).
- There is no nucleus in their red blood cells (except in camel and llama).
- External ear is present.
- Examples of mammals: **humans, cattle, whales, horses, bats, rats, etc**
- Mammalia is divided into three sub-classes
- **Prototheria** It lays eggs, e.g., Echidna.
- **Metatheria** It bears the immature child, e.g., Kangaroo.
- **Eutheria** It bears the well developed child, e.g., Humans.
- They give birth to young ones, but Echidna and Platypus are the egg laying mammals.

## Introduction

All living organisms have certain common characteristics such as breathing, growing, requiring nutrition, producing offspring, responding to stimuli, etc. that distinguish them from non-living things. There are certain vital processes that maintain homeostasis and proper functioning of the body, they are called life processes. These processes continue to occur even when we are sleeping or not performing any action. These processes are essential for all living organisms including plants and animals. These life processes are nutrition, photosynthesis, transportation, metabolism, respiration, reproduction and excretion.

In this chapter, we will learn about the details of these processes occurring in plants, animals and human beings in particular.

## Life

Earth happens to be the only known planet having a life. There are beings who live, die and become part of nature again. The living organism can be differentiated from the inanimate entities on various parameters of life processes.

## Life Process

- The maintenance of living organisms is essential even if they are moving, resting or even sleeping.
- The processes which together perform the function of maintenance of 'life' are called as life processes.
- Nutrition, respiration, circulation, and excretion are examples of essential life processes.
- In unicellular organisms, all these processes are carried out by a single cell.

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## Nutrition

The process of acquiring food that is needed for nourishment and sustenance of the organism is called nutrition.

- There are two main modes of nutrition, autotrophic and heterotrophic.
- Autotrophic nutrition is present in plants, algae and some bacteria. Organisms produce their own food using light energy or chemical energy by photosynthesis or chemosynthesis, respectively.
- Heterotrophic nutrition is present in bacteria, fungi and animals. They derive energy from organic compounds. Such as animals eating plants or other animals for food.
- Heterotrophic nutrition has subtypes such as holozoic, saprophytic and parasitic nutrition.

## Autotrophic Nutrition

If an organism can nourish itself by **making its own food** using sunlight or chemicals such mode of nutrition is called as autotrophic nutrition.

- Plants photosynthesize (use light energy) and are called photoautotrophs.
- Few bacteria use chemicals to derive energy and are called chemoautotrophs.



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## Photosynthesis

- Photosynthesis is an important process by which food is formed.
- The plants make food using sunlight and water, which provides nourishment to other organism and themselves.
- Chlorophyll present in the green parts absorbs light energy.
- This light energy is used to split water into hydrogen and oxygen.
- Hydrogen is then used to reduce carbon dioxide into carbohydrates, typically glucose.
- Chlorophyll is essential for photosynthesis and stomata to facilitate intake of carbon dioxide.

The overall reaction occurring in photosynthesis is as follows:



## Stomata

- Stomata are pores on the leaves that help in the exchange of gases.
- They are mostly found on the underside of the leaf.
- Each stoma is guarded by guard cells, which control the opening and closing of the pore.
- The water content of the guard cells is responsible for their function.

## Saprophytic Nutrition

Some organisms feed on **dead and decaying organic matter**. This mode of nutrition is called saprophytic nutrition.

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- The food is partially digested outside the body and then it is absorbed.
- E.g. **Fungi** are saprophytes.

## Parasitic Nutrition

Some organisms feed at the expense of another organism and in turn cause harm. This is called the parasitic mode of nutrition.

- These parasites live on the body or in the body of a host organism and derive the nutrients directly from the body of the host.
- E.g. **Leech** is an ectoparasite while Ascaris is an endoparasite. Cuscuta is a parasitic plant.

## Nutrition in Amoeba

- Amoeba feeds by holozoic mode of nutrition.
- It engulfs the food particle using pseudopodia, the process is called phagocytosis.
- The engulfed food gets enclosed in a food vacuole.
- As the food vacuole passes through the cytoplasm, digestion, absorption and assimilation take place.
- When the food vacuole opens to outside, the egestion of undigested food takes place.



## Nutrition in Paramoecium

- **Paramoecium** also exhibits holozoic nutrition.
- However, they have cilia that help them to engulf the food through the oral groove.
- A food vacuole is created enclosing the food.
- It moves through the cytoplasm, the process is called cyclosis.
- Food digested in the food vacuole is absorbed by the cytoplasm.
- Undigested food is given out to a tiny pore called anal pore or cytopyge.

## Nutrition in Humans

- Humans are omnivores, they can eat plant-based food as well as animal-based food.
- Being more complex, humans have a very complicated nutrition system.
- The digestive system has an alimentary canal and associated digestive glands, which together function to nourish the body.
- There are five stages in human nutrition; Ingestion, Digestion, Absorption, Assimilation and Egestion.
- Four stages i.e. **ingestion, digestion, absorption and egestion** take place in the alimentary canal while assimilation of food takes place in the whole body.

### Five stages of Food Process

- |                       |  |  |
|-----------------------|--|--|
| ➤ <b>Ingestion</b>    | <div style="display: flex; align-items: center; justify-content: center;"> <div style="flex-grow: 1; border-bottom: 1px solid black; margin: 0 10px;"></div> <div style="font-size: 2em;">➔</div> </div> | <b>to Intake Food</b>                            |
| ➤ <b>Digestion</b>    | <div style="display: flex; align-items: center; justify-content: center;"> <div style="flex-grow: 1; border-bottom: 1px solid black; margin: 0 10px;"></div> <div style="font-size: 2em;">➔</div> </div> | <b>Food Digest here</b>                          |
| ➤ <b>Absorption</b>   | <div style="display: flex; align-items: center; justify-content: center;"> <div style="flex-grow: 1; border-bottom: 1px solid black; margin: 0 10px;"></div> <div style="font-size: 2em;">➔</div> </div> | <b>Body absorbs Vitamins, Minerals from Food</b> |
| ➤ <b>Assimilation</b> | <div style="display: flex; align-items: center; justify-content: center;"> <div style="flex-grow: 1; border-bottom: 1px solid black; margin: 0 10px;"></div> <div style="font-size: 2em;">➔</div> </div> | <b>Converts Nutrition's into Energy</b>          |
| ➤ <b>Egestion</b>     | <div style="display: flex; align-items: center; justify-content: center;"> <div style="flex-grow: 1; border-bottom: 1px solid black; margin: 0 10px;"></div> <div style="font-size: 2em;">➔</div> </div> | <b>Waste Excrete</b>                             |

## Alimentary Canal

- The alimentary canal in **humans** is a long tube of varying diameter.
- It starts with the **mouth and ends with the anus.**
- **Oesophagus, stomach, small intestine and large intestine** are the parts of the alimentary canal.

## Mouth

- It is the opening of the alimentary canal and helps in the **ingestion of food**.
- The buccal cavity which is present behind the mouth is also commonly referred to as the mouth.
- The buccal cavity has teeth and a tongue.
- The set of teeth helps in the mastication of food.
- The tongue has taste buds on it and thus helps in tasting the food.
- The **salivary glands** open also in the buccal cavity and pour saliva which initiates the process of digestion.

## Teeth

- Teeth are the hard structures present in the **buccal cavity**.
- They help us to **cut, shear and masticate the food we eat**.
- The vertical section of a tooth shows four layers **enamel, dentine, cement and dental pulp**.
- **Enamel** is the outermost, shiny, highly mineralized and the hardest part of the human body.
- **Dentine** makes the bulk of the tooth and contains 70% inorganic salts.
- **Cement** is present at the lining of a tooth and bony socket.
- **The dental pulp** is the central soft part of a tooth and contains nerve endings, blood and lymph vessels along with connective tissue.
- There are four types of teeth in humans, **Incisors, canines, molars and premolars**, each with a specific function.
- Incisors cut the food, canines tear the food while molars and premolars crush it.
- The dental formula in adult humans is **2:1:2:3**.

## Oesophagus & Stomach

### Oesophagus

- The swallowed food passes into the oesophagus.
- It is a muscular tube, about **25 cm long, with a sphincter (valve/opening) at each end**.
- Its function is to transport food and fluid, after being swallowed, from the mouth to the stomach.
- Food is pushed down by peristaltic movements.

### Stomach

- The stomach is a thick-walled **bag-like structure**.
- It receives food from the oesophagus at one end and opens into the **small intestine at the other end**.
- The inner lining of the stomach secretes mucous, hydrochloric acid and digestive juices.
- Food is churned into a semi-solid mass in the stomach and is called chyme.
- Enzymes present in the gastric juice break down the food.
- **Hydrochloric acid** helps in the **partial digestion of proteins and also kills harmful bacteria**.
- The **mucus** secreted by the **wall of the stomach resists the action of HCl on itself**.



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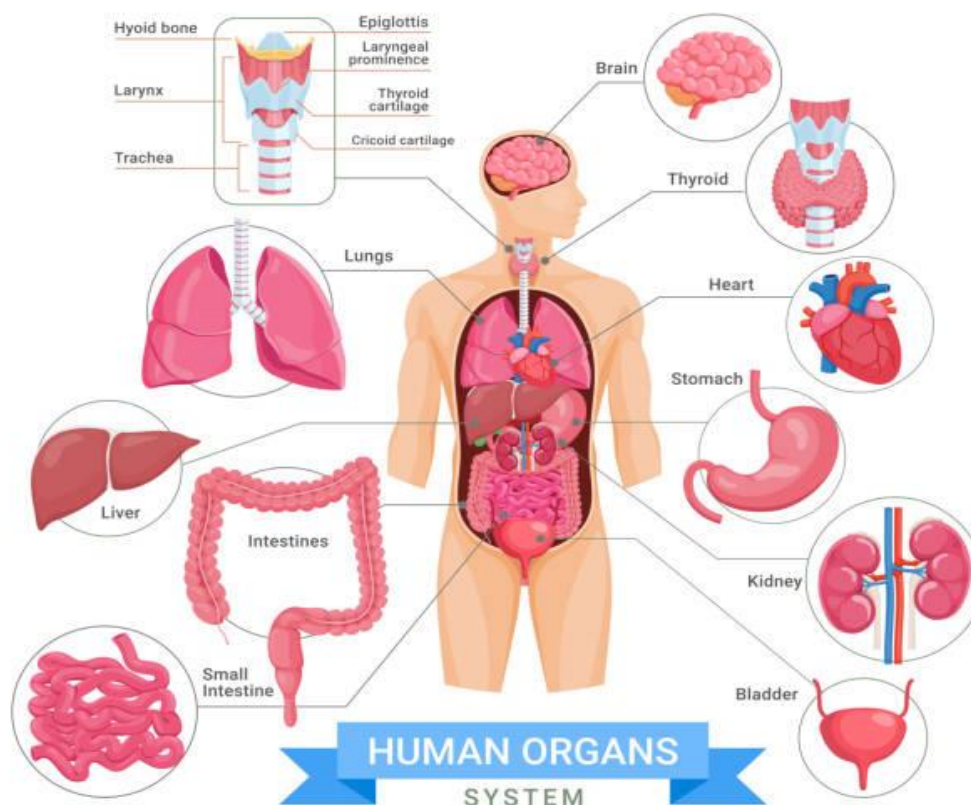


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## Small Intestine

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- The small intestine is the longest part of the alimentary canal, **about 20 feet long in humans**.
- It has regions, **duodenum**, the region which follows the stomach, **jejunum** is the middle part and the **ileum** is the later region which continues further into the large intestine.
- The internal surface of the small intestine is folded into finger-like **projections called villi**.
- A common pancreatic duct from the pancreas and liver opens **into the duodenum**.
- Most of the chemical **digestion and absorption take place in the small intestine**.

## Large Intestine

- The large intestine in humans is **about 5 feet long**.
- It has two regions, **colon ( about 1.5 m)** and **rectum (10 cm in length in the adult)**.
- The region of large intestine after ileum is called colon while the last part is called the **rectum**.
- **Colon** has three regions as, ascending colon, transverse colon and descending colon.
- At the base of the ascending colon, a small finger-like out-growth is seen and is called an **appendix**.
- It houses many useful bacteria required for digestion of food.
- Rectum opens to outside by **anus**.
- The anus has internal and external anal sphincters.

## Peristalsis

A constant wave-like movement of the alimentary canal right from the oesophagus to the small intestine is called as peristalsis.

- Muscles present in the wall of the alimentary canal are responsible for peristalsis.
- This movement helps to push the food through the alimentary canal.

## Digestive Glands

- Several glands produce digestive juices that help in digestion of the food.
- **Salivary glands, Gastric glands, Liver, Gallbladder, Pancreas** are few to name.
- **Salivary glands** secrete **saliva which initiates digestion in the mouth itself**.
- **Gastric glands** present in the **wall of the stomach secrete hydrochloric acid and enzyme pepsin**.
- **The liver secretes bile** which is stored in the gallbladder. **Bile helps in digestion of fats**.
- The pancreas secretes many digestive enzymes and its secretion is called **as pancreatic juice**.
- Enzymes like **trypsin, chymotrypsin, lipase, amylase** are present in the pancreatic juice.

## Pancreas



- The pancreas is a long, flat gland present behind **the stomach in humans**.
- It is one of the major digestive glands and is of mixed nature i.e. **endocrine as well as exocrine**.
- **As an endocrine organ**, it secretes two hormones called insulin and glucagon which maintain the blood sugar level.
- **As an exocrine gland**, it secretes pancreatic juice which is nothing but a mixture of many digestive enzymes.
- The digestive enzymes secreted by the pancreas include trypsin and chymotrypsin and proteases which digest proteins.
- It also includes amylase which digests the starch content of the food.
- **Pancreatic lipases** are the pancreatic enzymes that **help in digestion of fats**.

## Holozoic Nutrition

The mode of nutrition in which animals take their food as a whole is called as holozoic nutrition.

In holozoic nutrition, food passes through five steps as ingestion, digestion, absorption, assimilation and egestion.

## Physiology of Digestion

- Mechanical digestion of food takes place in the buccal cavity where teeth **masticate the food, saliva gets mixed and it turns into a bolus**.
- Digestion of starch starts in the buccal cavity itself, with the action of salivary amylase present in the saliva.



- Salivary amylase converts starch into **maltose**.
- In the stomach, the churning of food takes place due to the muscular contraction and relaxation of its wall. It breaks down the food into **simpler substances**.
- Digestion of proteins starts in the stomach with the action of **pepsin**. Proteins are broken down into **smaller fragments called peptide by the action of pepsin**.
- The bolus after mixing with gastric juice, turn into a fine soluble form known **as the chyme**.
- Chyme enters into the small intestine where complete digestion takes place due to the action of various enzymes present **in the pancreatic juice, bile and intestinal juice**.
- The digested food is completely absorbed by the **villi and microvilli of the small intestine**.
- Undigested food then enters into **the large intestine**.
- The colon is responsible for absorption of water and salts whereas rectum stores the undigested food temporarily before defaecation.

## Digestive System in Other Animals

- Digestive systems in different animals vary in structure and function.
- The structure of the digestive system depends on the food habits of the animal.
- **Alimentary canal** in herbivores is long as the cellulose content of their plant-based diet takes a long time to digest.
- On the other hand, the alimentary canal of carnivorous animals is comparatively shorter because meat gets digested faster.



## Anatomy of Digestive Tract



- The alimentary canal in humans is approximately **30 feet (9m) long**. It is also called the **gastrointestinal tract**.
- It starts with the mouth and ends in the anus.
- Between these two openings, the alimentary canal is a tube of varying diameter.
- **Oesophagus, stomach, small intestine** (divided into three regions duodenum, jejunum and ileum) and large intestine(having two regions colon and rectum) are the parts of the alimentary canal.
- **Salivary glands, pancreas and liver** act as major digestive glands.
- Glands present in the wall of the stomach and small intestine also contribute to the digestion of food.

## Role of HCl

- Hydrochloric acid in the stomach is secreted by the gastric glands present in its wall.
- the **pH of the gastric acid** is usually between **1.5 to 3.5**
- This acid serves the following functions:
  1. Converts inactive **pepsinogen and pro-rennin** into **active pepsin and rennin** respectively.
  2. Provides an **acidic medium for protein digestion**.
  3. **Kills bacteria entered** through food and prevents infection.
  4. Prevents **putrefaction of food in the stomach**.

- A thick layer of mucus secreted by the mucous glands of the stomach prevents itself from the action of gastric acid.
- Excess acid damages gastric mucosa and causes gastric and duodenal ulcers.

## Salivary Glands

- Salivary glands are the exocrine glands that secrete saliva and through a system of ducts, it is poured into the mouth.
- In humans, three major pairs of salivary glands are present, **parotid, submandibular and sublingual**.
- In healthy individuals between **0.5 to 1.5 litres** of saliva is produced per day.
- Saliva serves the following functions in the oral cavity:
  1. It lubricates and protects the soft and hard tissues of the oral cavity
  2. It also gives **protection from dental caries**
  3. Saliva prevents **microbial growth in the oral cavity**.
  4. Saliva can encourage soft tissue repair by decreasing clotting time and increasing wound contraction
  5. Saliva contains the **enzyme amylase** that **hydrolyses starch into maltose and dextrin**. Hence saliva allows digestion to occur before the food reaches the stomach
  6. **Saliva** acts as a solvent in which solid particles can dissolve in and enter the taste buds located on the tongue.



## Heterotrophic Nutrition

When an organism depends on others for food, such a mode of nutrition is called as a **heterotrophic mode of nutrition**.

- These organisms depend on autotrophs for their nutritional requirements.
- E.g. Animals which eat plants as their food are called herbivores.
- Animals which eat other animals as their food are called carnivores.
- **Holozoic, saprophytic and parasitic nutrition** are all types of heterotrophic nutrition.

## Glandular Epithelium

- Many small glands present in the inner layer of the stomach and intestine take part in the digestion of food.
- These glands are present in the epithelial lining of the **stomach and intestine**.
- The glands present in different regions of the stomach are **called gastric glands**.
- They are responsible for the secretion of mucus, hydrochloric acid and enzymes like pepsinogen.
- The glands present in the epithelial lining of the small intestine and large intestine are called intestinal glands.
- Glands of the small intestine are responsible for the secretion of intestinal juice also called succus entericus.
- Intestinal juice contains hormones, digestive enzymes, alkaline mucus, and substances to neutralize hydrochloric acid coming from the stomach.
- Intestinal juice completes the digestion started by the pancreatic juice.
- Glands of the large intestine are associated with the absorption of water and electrolytes.

## Villi and Micro Villi

- Complete **digestion and absorption of food take place in the small intestine.**
- Pancreatic juice coming from the pancreas, bile from the liver and intestinal juice secreted by the intestinal glands complete the digestion of food material.
- All the digested nutrients are absorbed by the long finger-like projections present in the ileum of the small intestine.
- These small finger-like projections of the inner wall of intestine are called as **villi (singular: villus).**
- Each villus has its cell membrane of the lumen side again folded into microscopic processes, called microvilli.
- Villi increase the internal surface area of the intestinal walls making available a greater surface area for absorption.
- Digested nutrients pass into the semipermeable villi through diffusion.
- Villi also help in chemical digestion of food by secreting digestive enzymes.

## Liver

- The liver is the **largest and major digestive gland of humans**
- Liver, in humans, is located in the upper right-hand portion of the abdomen.
- This **organ is dark reddish-brown** in colour due to an extensive blood supply.
- Some of the important functions of the liver are as follows:
  1. It secretes **bile that helps in digestion.**
  2. It filters the blood coming from the digestive tract before passing it to the rest of the body.
  3. It **detoxifies various metabolites and antidote.**
  4. The liver makes proteins important for **blood clotting and other functions.**
  5. It **stores and releases glucose as needed.**
  6. It processes **haemoglobin, from the dead and worn out RBCs, for the iron content (the liver stores iron).**
  7. Conversion of **harmful ammonia to urea takes place in the liver.**

## Digestive Juices

- **Pancreatic juice, bile and intestinal juice** (succus entericus) are collectively called **digestive juices.**
- A common duct from digestive glands pours the secretions into the **duodenum.**
- Chyme enters the small intestine where complete digestion takes place due to the action of various enzymes.
- In the duodenum, the acidity of chyme is turned to alkalinity by the action of bile coming from the liver. This is necessary for pancreatic enzyme action.
- **Bile** also emulsifies the fats into smaller globules.
- **Pancreatic and intestinal amylases** break down carbohydrates into glucose.
- **Trypsin and chymotrypsin** are the proteases responsible for the breakdown of proteins finally into amino acids.
- **Lipase** is the enzyme which acts on the emulsified fats and breaks them down into glycerol and fatty acids.



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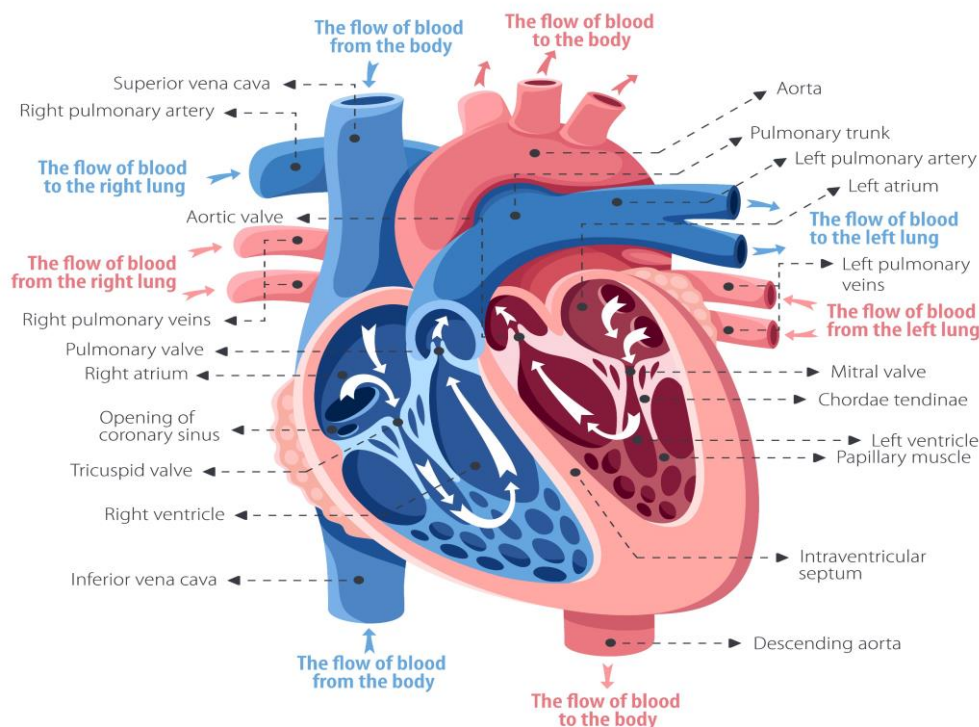
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## Water Absorption in Large Intestine

- The large intestine is not involved in the digestion of food or absorption of nutrients.
- The major function of the large intestine is to absorb water from the remaining indigestible food matter and make the stool solid.
- The large intestine also helps in the absorption of vitamins made by bacteria that normally live in the large intestine.
- The innermost layer of the large intestine also acts as a barrier and protects from microbial infections and invasions.
- Rectum stores the undigested food temporarily until defecation.

## Heart



- The heart is a muscular organ in most animals, which pumps blood through the **blood vessels** of the circulatory system. Blood provides the body with oxygen and nutrients, as well as assists in the removal of **metabolic wastes**. In humans, the heart is located between the lungs, in the middle compartment of the chest.
- In humans, other mammals, and birds, the heart is divided into four chambers
  - **Upper left**
  - **Right atria**
  - **Lower left**





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- **Right ventricles.**

Commonly the right atrium and ventricle are referred together as the right heart and their left counterparts as the left heart. Fish, in contrast, have two chambers, an atrium and a ventricle, while reptiles have three chambers. In a healthy heart blood flows one way through the heart due to heart valves, which prevent backflow. The heart is enclosed in a protective sac, the pericardium, which also contains a small amount of fluid. The wall of the heart is made up of three layers: epicardium, myocardium, and endocardium.

- The heart pumps blood with a rhythm determined by a group of pace making cells in the sinoatrial node. These generate a current that causes contraction of the heart, traveling through the atrioventricular node and along the conduction system of the heart. The heart receives blood low in oxygen from the systemic circulation, which enters the right atrium from the superior and inferior venae cava and passes to the right ventricle. From here it is pumped into the pulmonary circulation, through the lungs where it receives oxygen and gives off carbon dioxide. Oxygenated blood then returns to the left atrium, passes through the left ventricle and is pumped out through the aorta to the systemic circulation-where the oxygen is used and metabolized to carbon dioxide. The heart beats at a resting rate close to **72 beats per minute**. Exercise temporarily increases the rate, but lowers resting heart rate in the long term, and is good for heart health.

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- **Pericardium Shield:** protect **Heart** from **fraction of Surrounding Structure**.
- **Cardiac Septum:** divides **Heart into two Parts Left & Right**.
- **Pulmonary Artery:** remove **Deoxygenated Blood (Impure Blood)**  
**From Heart.**
- **Pulmonary Aorta:** remove **Oxygenated Blood (Pure Blood)**  
**From Heart.**
- **Oxygenated Blood:** having **High O<sub>2</sub> & Low CO<sub>2</sub>**.
- **Deoxygenated Blood:** having **High CO<sub>2</sub> & Low O<sub>2</sub>**.



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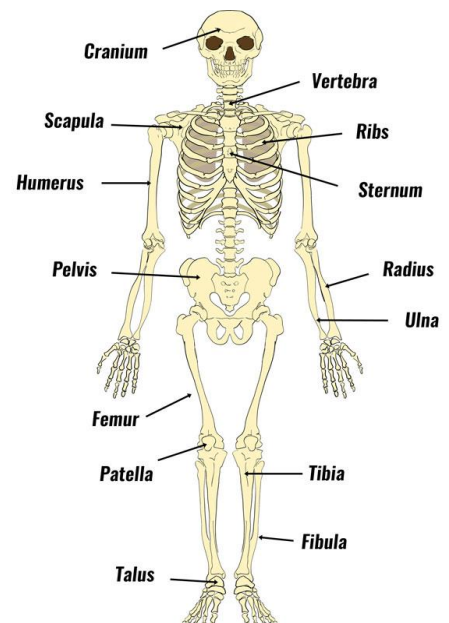


## Lymph

- **Lymph** is **yellow fluid** flows only in one direction from tissue towards heart.
- **Lymphocytes** present in lymph helps to prevent the body from diseases by killing harmful bacteria. It helps in **healing the wounds**.
- The **Pulmonary Artery** carries deoxygenated blood to the lungs.
- The veins have valves that prevent backflow of blood.

## Skeleton

- The human skeleton is made up of **206 bones**. At birth, new born has more than 300 bones.
- The human skeleton performs **six major functions Support, movement, protection, production of blood cells, storage of minerals and endocrine regulation**.
- The main bones of the human skeleton:
  - **The Skull:** Cranium, Mandible & Maxilla
  - **Shoulder girdle:** clavicle and Scapula
  - **Arm:** Humerus, Radius and Ulna
  - **Hand:** Carpals, Metacarpals and Phalanges
  - **Chest:** Sternum and Ribs
  - **Spine:** Cervical area (top 7 vertebrae)



- Thoracic (next 12), Lumbar (bottom 5 vertebrae), Sacrum (5 fused bones) and Coccyx (the tiny bit at the bottom of the spine).
- **Pelvic girdle:** Ilium, Pubis and Ischium
- **Leg:** Femur, Tibia and Fibula
- **Ankle:** Talus and Calcaneus
- **Foot:** Tarsals, Metatarsal: and Phalanges



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## BONES

- Bones are formed by the **ossification of Cartilage**. **Calcium** is needed for strong bone growth.
- A Joint is the point where two or more bones meet. There are three main types of joints as given below:
  - **Fibrous (immoveable)**
  - **Cartilaginous [partially moveable]**
  - **Synovial (freely moveable joint).**
- **Tendon** Joins the **muscles and bones**.
- **Ligament:** joins **bone to bone**. Ligaments are made up of **yellow fibres**.
- The skeletal system in adult body is made up of 206 bones.

### ❖ Structure of bones

- The skeleton makes up about **30-40% of an adults body mass**.
- The skeleton's mass is made up of non-living bone matrix and many tiny bone Cells.
- Roughly half of the bone matrix's mass is water, while the other half is collagen protein and solid crystals of calcium carbonate and Calcium phosphate.
- Living bone cells are found on the edges of bones and in small cavities inside of the bone matrix.
- The bone cell allow bones to:
  - (1) grow and develop
  - (2) Be repaired following an injury or daily wear
  - (3) Be broken down to release their stored minerals.
- **Long bones:** eg. **Femur, Tibia, Fibula, Metatarsals and Phalanges**
- **Short bones:** eg, **Carpal bones of wrist and Tarsal bones of foot.**
- **Flat bones:** eg. **Frontal, Parietal and Occipital bones of the Cranium.**
- **Irregular bones:** eg. **Vertebrae, Sacrum and Coccyx** of the spine as well as the sphenoid, ethmoid and zygomatic bones of the skull.
- **Sesamoid bones:** eg. **Patella and Pisiform bone of carpals.**
- **Red Bone Marrow** produces red & white blood cells in a process known as **haematopoiesis**.
- Red bone marrow is found in the hollow space inside of bones known the medullary cavity. The amount of red bone marrow drops off at the end of puberty, replaced by yellow bone marrow is used to store energy in the form lipids.
- Bone cells also release **Osteocalcin, a hormone** that helps regulate blood sugar and fat deposition.



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# Respiration

## Introduction to Respiration

- Respiration broadly means the **exchange of gases**.
- Animals and plants have different means of exchange of gases.
- At a cellular level, respiration means the burning of the food at the for generating the energy needed for other life processes.
- Cellular respiration may take place in the **presence or absence of oxygen**.

## Respiration in Humans

- The human respiratory system is **more complex and involves breathing, exchange of gases and cellular respiration**.
- A well defined respiratory system helps breathing and exchange of gases.
- Breathing involves the inhalation of oxygen and exhalation of carbon dioxide.
- The gaseous exchange takes place in the lungs and oxygen is supplied to all cells of the body.
- **Cellular respiration takes place in each and every cell.**



## Respiratory System

- The human respiratory system involves the **nose, nasal cavities, pharynx, larynx, trachea/windpipe, bronchi, bronchioles and alveoli**.
- **Bronchioles and alveoli** are enclosed in a pair of lungs.
- The rib cage, muscles associated with the rib cage and diaphragm, all help in inhalation and exhalation of gases.
- Exchange of gases takes place between an alveolar surface and surrounding blood vessels.
- Alveoli provide a large surface area for exchange of gases.

## Physiology of Respiration

- Breathing in humans is facilitated by the action of internal intercostal and external intercostal muscles attached to the ribs and the diaphragm.
- When the dome-shaped diaphragm contracts and becomes flattened and the rib cage is expanded due to the action of intercostal muscles, the volume of the lungs increases, pressure there drops down and the air from outside gushes in. This is inhalation.
- To exhale, the diaphragm relaxes, becomes dome-shaped again, chest cavity contracts due to the action of intercostal muscles, the volume inside the lungs decreases, pressure increases and the air is forced out of the lungs.
- Inhaled air increases the concentration of oxygen in the alveoli, so oxygen simply diffuses into the surrounding blood vessels.





- Blood coming from cells has more concentration of carbon dioxide than outside air and thus carbon dioxide simply diffuses out of the blood vessels into the alveoli.
- Thus, breathing takes place due to the combined action of intercostal muscles and diaphragm while the exchange of gases takes place due to simple diffusion.

## Inhalation and Exhalation

- The process of taking in air rich in oxygen is called **inhalation**.
- Similarly, the process of giving out air rich in carbon dioxide is called **exhalation**.
- One breath comprises one inhalation and one exhalation.
- A person breathes several times in a day.
- The number of times a person breathes in one minute is termed as his/her **breathing rate**.

## Diffusion

Diffusion is the movement of molecules from high concentration area to the low concentration area without spending any energy.

## Cellular Respiration

Cellular respiration is set of metabolic reactions occurring inside the cells to convert biochemical energy obtained from the food into a chemical compound called adenosine triphosphate (ATP).

- Metabolism refers to a set of chemical reactions carried out for maintaining the living state of the cells in an organism. These can be divided into two categories:
- **Catabolism** – the process of breaking molecules to obtain energy.
- **Anabolism** – the process of synthesizing all compounds required by the cells.
- Therefore, respiration is a catabolic process, which breaks large molecules into smaller ones, releasing energy to fuel cellular activities.
- Glycolysis, Krebs cycle and electron transport chain are the important processes of the cellular respiration.

## Aerobic Respiration

Aerobic respiration is a process in which the food i.e. glucose is converted into energy in the presence of oxygen.

- The general equation of aerobic respiration as a whole is as given below-



- This type of respiration takes place in animals, plants and other living organisms.

## Respiration in Lower Animals

- Lower animals lack a sophisticated respiratory system like **lungs, alveoli etc.**
- Respiration in them takes place by simple exchange mechanisms.
- Animals like **earthworms take in gases through their skin.**
- **Fishes have gills for gaseous exchange.**
- Insects have a tracheal system, which is a network of tubes, through which air circulates and gaseous exchange takes place.
- Frogs breathe through their skin when in water and through their lungs when on land.

## Respiration in Muscles

- Respiration in muscles can be anaerobic when there is not enough oxygen.
- Glucose gets broken down into carbon dioxide and lactic acid.
- This results in the accumulation of lactic acid that makes the muscles sore.
- This type of anaerobic respiration is also known as **lactic acid fermentation.**

## ATP



- It is the **energy currency of the cell.**
- ATP stands for **Adenosine Tri-Phosphate.**
- This molecule is created as a result reactions like **photosynthesis, respiration etc.**
- The three phosphate bonds present in the molecule are high-energy bonds and when they are broken, a large amount of energy is released.
- Such released energy is then used for other metabolic reactions.

## Respiration in Plants

- Unlike animals and humans, plants do not have any specialized structures for gaseous exchange
- They have stomata (present in leaves) and lenticels (present in stems) which are involved in the exchange of gases.
- Compared to animals, plant roots, stems, and leaves respire at a very lower rate.

## Transpiration

- Transpiration is a biological process in which water is lost in the form of water vapour from the aerial parts of the plants.
- This process occurs mainly through the **stomata where the exchange of gases (oxygen and carbon dioxide) occurs.**
- Transpiration helps in the transportation of water from roots to upper parts of plants and this is explained **by 'transpirational pull theory'.**
- Loss of water, especially from leaves, acts as a straw effect and pulls water upwards from roots.

- Transpiration also acts as an excretory mechanism in plants as it helps to get rid of excess water.

## Why Do We Need Lungs

- In unicellular organisms like an **amoeba** exchange of gases takes place through a general body surface by **osmosis**.
- In lower animals like an **earthworm**, the gaseous exchange takes place through their **moist skin**.
- The requirement for oxygen is sufficiently met in these ways.
- But as the animal starts becoming more and more complex, for example, humans, the requirement of oxygen cannot be met alone by diffusion.
- Moreover, diffusion will not be able to supply oxygen to the deep-seated cells.
- This difficulty has led to the evolution of a more complex mechanism of gaseous exchange and that is the development of lungs.
- The **alveoli** present in the lungs provide a **large surface area required for the necessary gas exchange**.

## Transportation in Human Beings

### Transportation



- All living organisms need a few necessary components like **air, water, and food for their survival**.
- On a regular basis, animals ensure these elements by **breathing, drinking and eating**.
- The required elements are transported to their body cells and tissues by a transportation system.
- In plants, the **vascular tissue** is responsible for transporting the substances.

### Transportation in Humans

- Transportation in humans is done by the **circulatory system**.
- The circulatory system in humans mainly consists of **blood, blood vessels and the heart**.
- It is responsible for the supply of oxygen, and nutrients, and the removal of carbon dioxide and other excretory products.
- It also helps to **fight infections**.

### Heart

- The muscular organ which is located near the chest slightly towards the left in the thoracic region.
- The heart is the main **pumping organ of the body**.
- The human heart is divided into four chambers which are involved in the transportation of **oxygenated and deoxygenated blood**.

- The upper two chambers are called **atria** whereas the lower two chambers are called as **ventricles**.
- The flow of blood through the heart is as follows:

## Blood Vessels

- Blood vessels carry blood throughout the body.
- There three types of blood vessels; **arteries, veins and blood capillaries**.
- Arteries carry oxygenated blood and veins carry deoxygenated blood.
- Gaseous exchange takes place between blood and cells at **capillaries**.

## Blood Pressure

The pressure exerted by the blood when it flows through the blood vessels is called blood pressure.

- There are two different variants of blood pressure; systolic and diastolic blood pressure.
- The pressure exerted on the walls of arteries when the **heart is filling** with blood is called **diastolic** pressure. It constitutes the **minimum** pressure on arteries.
- The normal range of diastolic blood pressure should be **60 – 80 mm Hg**.
- The pressure exerted on the walls of arteries when the **heart is pumping** the blood is called **systolic** pressure. It constitutes the **maximum** pressure applied to the arteries.
- The normal range of systolic blood pressure should be **90 – 120 mm Hg**.

## Bleeding

- Bleeding occurs when the blood vessels rupture.
- Bleeding is stopped by the platelets that help in the clotting of blood at the site of the injury.
- **Blood Clotting** is the process of forming a clot in order to prevent excess loss of blood from the body.
- It is a gel-like mass which is formed by the platelets and a fibre-like protein in the blood.

## Double Circulation

- In the human body, blood circulates through the heart twice.
- Once it goes through the heart during pulmonary circulation and second time during systemic circulation.
- Hence, circulation in human beings is called double circulation.





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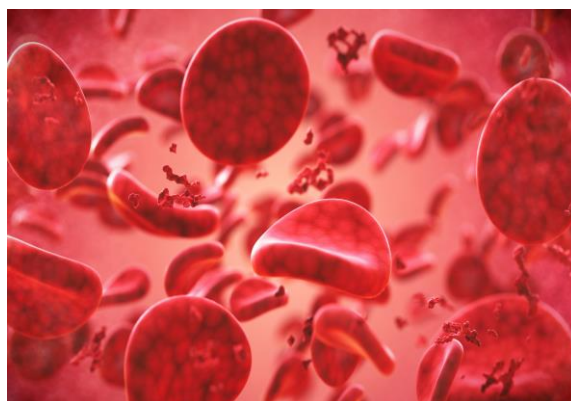


## Blood (Fluid Connective Tissue)

**Blood** is a body fluid in humans and other animals that delivers necessary substances such as nutrients and oxygen to the cells and transports metabolic waste products away from those same cells. In vertebrates, it is composed of blood cells suspended in blood plasma.

### ❖ Blood

- Blood in Body: **5-6 Litre (5040 ml.)**
- Blood Made in: Liver (Baby 2-3 years)  
Bone Marrow: **(Adult)**



➤ **Blood Cells + Plasma = Blood**

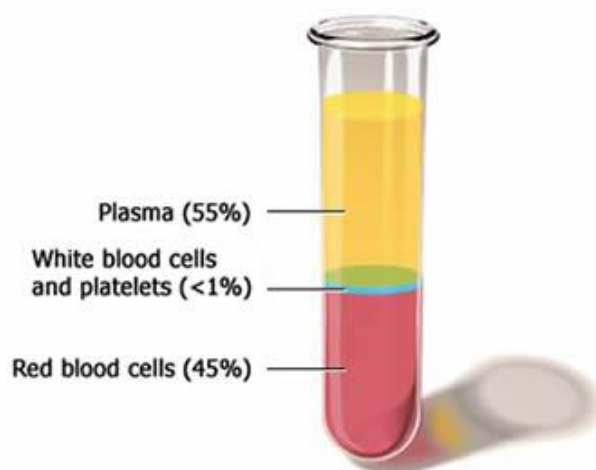
➤ **Blood - Fibrin = Serum**



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➤ **Blood** consists of

1. **Plasma (Liquid)**
2. **Corpuscles (Solid)**
  - a. **RBC (Erythrocyte)**
  - b. **WBC (Leukocyte)**
  - c. **Platelets (Thrombolytic)**





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## Plasma (Liquid)

### ➤ Blood plasma Consists of:

- Water 90%
- Plasma Proteins 6-8 %
- Electrolytes (Na & Cl) 1%

### ➤ Proteins in Plasma:

- **Fibrin & Thrombin:** To help in Blood Clotting.
- **Heparin:** To help in Anticlotting of Blood inside the body (for circulation of Blood)

### ➤ Other components:

- Nutrients (eg. Glucose and amino acids)
- Hormones (eg Cortisol, thyroxine)
- Wastes (e.g. Urea)
- Blood gases (e.g. CO<sub>2</sub>, O<sub>2</sub>)

## Corpuscles (Solid)

### • RBC (Erythrocyte-44%)

- Nucleolus Absent
- **Life: 120 Days**
- Haemoglobin in Bowl - 270 Million Haemoglobin
- **Red Colour- Fe (Iron)**
- **Example- Octopus (Haemocyanin contains Copper -Blue colour) & Cockroach- Absence of Haemoglobin results into White colour.**
- 4-5.5 million per mm cube
- **Haemoglobin: 12-16 gm Per 100ml.**
- **Camel & Llama** RBC has Nucleus.

### • WBC (Leukocyte-1%)

- **Life: 3-4 Days**
- WBCs work as **Antibody (Immunity Boost)**
- **Made in: Bone Marrow**
- It contains **Nucleolus**
- WBCs is made up of **5 types of cells** as given below:

### ➤ Disease Related to RBC & WBC

- **Anaemia:** Less RBC
- **Polycythemia:** High RBC
- **Leukopenia:** Less WBC
- **Leukaemia:** High WBC
- **Universal Donor Group: O<sup>-</sup>**
- **Universal Receiver Group: AB<sup>+</sup>**



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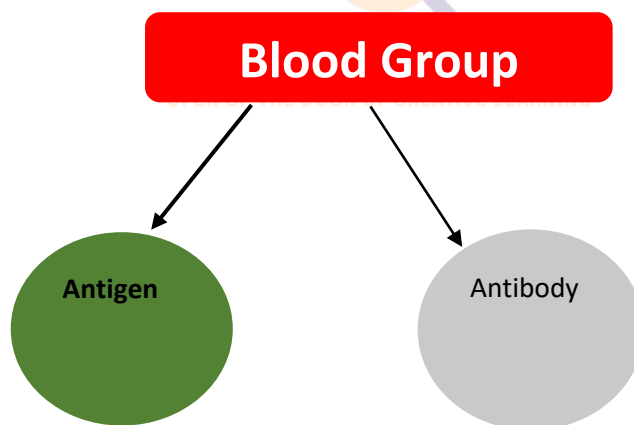
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Specific WBC	Function	Deferential%
Neutrophil	General phagocytosis: acute bacterial infections	54-62%
Eosinophil	Kills parasites, allergic condition	1-3%
Basophil	Release heparin and histamine	<1%
Monocyte	Phagocytosis of large particles in typhoid, malaria	3-9%
Lymphocyte	Produce antibody	25-33%

### • Platelets (1%)

- Platelets are tiny blood cells that help your body form clots to stop bleeding. If one of your blood vessels gets damaged, it sends out signals to the platelets. The platelets then rush to the site of damage. they form a plug (clot) to fix the damage.
- **Dengue:** because of low **Platelets**.



Blood Group	Antigen	Antibody	Receive	Donate
A	A	B	A, O	A, AB
B	B	A	B, O	B, AB
AB	AB	O	A, B, AB, O	AB
O	O	AB	O	A, B, AB, O

## Transportation in Plants

### Transportation in Plants

- Transportation is a vital process in plants.
- The process involves the transportation of water and necessary nutrients to all parts of the plant for its survival.
- Food and water transportation takes place separately in plants.
- **Xylem** transports water and **phloem** transports food.

### Phloem

- The phloem is responsible for translocation of nutrients and sugar like carbohydrates, produced by the leaves to areas of the plant that are metabolically active.
- Sieve tubes, companion cells, phloem fibres, and phloem parenchyma cells are the components of this tissue
- The flow of material through phloem is bidirectional.

### Translocation

- Transport of food in the plant through phloem via a process such as mass flow is called as **translocation**.
- Photosynthates i.e. sugars and organic molecules such as amino acids, organic acids, proteins and inorganic solutes like potassium, magnesium, nitrate, calcium, sulfur and iron from source tissues (mature leaves) to the sink cells (areas of growth and storage) are transported through the phloem.
- Material like sucrose is loaded from leaves to phloem using the energy of ATP.
- Such a transfer increases the osmotic pressure causing the movement of water from nearby cells into phloem tissue and the material gets transported through the phloem.
- The same pressure is also responsible for the transfer of substances from phloem to tissues where food is required.
- Thus the bulk flow of material through phloem takes place in response to an osmotically generated pressure difference.

### Xylem

- Xylem tissue transports water in plants from root to all other parts of the plant.
- Xylem tissue is made up **tracheids, vessels, xylem fibres and xylem parenchyma**.
- The flow of water and minerals through xylem is always unidirectional.



## Root Pressure

- Conduction of water through the xylem, from roots to upper parts of plants, is due to many forces acting together.
- One of the forces responsible for this is root pressure.
- Root pressure is osmotic pressure within the cells of a root system that causes sap to rise through a plant stem to the leaves.
- Root pressure helps in the initial transport of water up the roots.

## Transport of Water

- Water is absorbed by the roots and is transported by xylem to the upper parts of the plant.

Imbibition, osmosis, root pressure and transpiration are the forces that contribute towards the upward movement of water, even in the tallest plants.

- **Imbibition** is a process in which water is absorbed by the solids. E.g. seeds take up water when soaked.
- **Osmosis** is a process where water moves from the area of its lower concentration to the area of its higher concentration.
- At the roots, the cells take up ions by an active process and this results in the difference of concentration of these ions.
- It leads to movement of water, in the root cells, by osmosis.
- This creates a continuous column of water that gets pushed upwards. This is root pressure.
- Transpiration contributes to the upward movement of water by creating a stow effect.
- It pulls the water column upwards as there is a continuous loss of water from leaves.
- All these forces act together for water transport through the xylem

## Excretion in Humans

### Excretion

Excretion is the process of removal of metabolic waste material and other non-useful substances.

- Organisms like animals have an advanced and specialized system for excretion.
- But plants lack a well-developed excretory system like that in animals.
- They do not have special organs for excretion and thus excretion in plants is not so complex.

## Excretion in Unicellular Organisms

- In unicellular organisms such as amoeba and bacteria, the waste product is removed by simple diffusion through the general body surface.



- Unicellular organisms like the amoeba, and paramecium excrete excess through tiny organelles called contractile vacuoles.
- Undigested food in unicellular animals is excreted when the food vacuole merges with the general body surface and opens to the outside.

## Excretory System of Humans

- The excretory system in humans includes
  - a pair of kidneys,
  - a pair of ureters,
  - a urinary bladder and
  - urethra.
- It produces urine as a waste product.

## Kidneys

- Paired kidneys are the main excretory organs of the body.
- They are basically the filtration units of the human body.
- Each kidney is made up of many tiny filtration units called **nephrons**.
- Kidneys perform crucial functions like:
  1. Filtering waste materials, medications, and toxic substances from the blood.
  2. Regulation of osmolarity i.e. fluid balance of the body.
  3. Regulation of ion concentration in the body.
  4. Regulation of pH.
  5. Regulation of extracellular fluid volume.
  6. Secreting hormones that help produce red blood cells, promote bone health, and regulate blood pressure

## Nephron

**Nephrons are the structural and functional unit of kidney.**

- Each kidney has millions of nephrons and it forms the basic structural and functional unit of the kidney.
- Each nephron has two parts: Malpighian body and renal tubule.
- Malpighian body is made up of cup-like structure called Bowman's capsule which encloses a bunch of capillaries called glomerulus.
- They together filter waste materials along with many useful substances.
- Renal tubule has regions called proximal convoluted tubule, Loop of Henle and distal convoluted tubule.
- These regions absorb back useful substances into the blood and also filter remaining waste substances.
- The output from nephrons is called urine.

## Haemodialysis

- **When the kidneys fail**, it results in a lot of complications and to compensate this situation a technology called dialysis has been developed.
- It uses a machine filter **called a dialyzer or artificial kidney**.
- This is to remove excess water and salt, to balance other electrolytes in the body and remove waste products of metabolism.
- Blood from the body is removed and flowed through a series of tubes made up of a semipermeable membrane.
- A dialysate flows on the other side of the membrane, which draws impurities through the membrane.

## Excretion in Plants

- The **cellular respiration, photosynthesis, and other metabolic reactions** produce a lot of excretory products in plants.
- Carbon dioxide, excess water produced during respiration and nitrogenous compounds produced during protein metabolism are the major excretory products in plants.
- Plants produce two gaseous waste products i.e. oxygen during photosynthesis and carbon dioxide during respiration.
- Excretion of gaseous waste in plants takes place through stomatal pores on leaves.
- Oxygen released during photosynthesis is used for respiration while carbon dioxide released during respiration is used for photosynthesis.
- Excess water is excreted by transpiration.
- Organic by-products generated by the plant are stored in different forms in different parts.
- The gums, oils, latex, resins, etc. are some waste products stored in plant parts like barks, stems, leaves, etc.
- Eventually, plants shed off these parts.
- Few examples of the excretory products of plants are oil produced from orange, eucalyptus, jasmine, latex from the rubber tree, papaya tree, and gums from acacia.
- Sometimes plants even excrete into the soil

## Introduction

The human body is a complex machine performing tons of functions and processes to maintain and sustain life. Explore how the body controls its movements and coordinates its actions with other parts of the body and the environment by exploring notes for Class 10 Chapter 7 Control and Coordination.

## The Nervous System

### Movement in organisms

The ability of organisms to move certain body parts is **movement**.

When they move from one place to another, it is called **locomotion**.

Organisms show movements in response to stimuli.

### Introduction to control & coordination

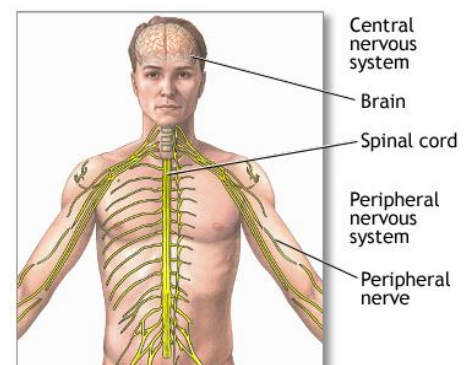
- Organisms move in response to various kinds of stimuli like light, heat, nutrients/food, etc.
- All the activities in animals are controlled and coordinated by the nervous and endocrine systems.
- Hormones are chemical messengers, which assist the nervous system in carrying out various functions. They are secreted by endocrine glands.
- Hormones in plants coordinate the movements.

## THE NERVOUS SYSTEM

### Neuron

Neuron is the structural and functional **unit of the nervous system**.

- Each neuron has three main parts: dendrites, cyton/soma/cell body and axon.
- Dendrites receive impulses from other neurons.
- **Cyton/soma** processes the impulse.
- Axon transmits the impulse, either to another neuron or to muscles/glands, etc.
- Axon may be myelinated or non-myelinated.
- The impulse transmission is faster in myelinated neurons.



## Central nervous system

The central nervous system (CNS) is made up of the brain and the spinal cord. Functions of different parts of the brain are:

- The **cerebrum** is responsible for **reasoning, logic, emotions, speech, memory, visual processing, recognition of auditory and taste stimuli**, etc.
- **Cerebellum** regulates and **coordinates body movements, posture and balance**.
- **Pons** relays signals from the **hindbrain to the forebrain**.
- **Medulla Oblongata** controls all involuntary movements like vomiting, sneezing, yawning, heartbeat, breathing, blood pressure, etc.
- Medulla oblongata continues as the spinal cord which runs through the vertebral column and it controls reflex actions.

### ❖ Drugs that act on Nervous System

- **Caffeine** inhibits the release of neurotransmitters by blocking the action of adenosine.
- **Nicotine in Tobacco** enhances the Acetylcholine and acts as a stimulant.
- **Thorazine drugs** affect cognitive or thinking processes.
- **Amphetamines** are similar to noradrenaline and stimulate the release of noradrenaline and dopamine in brain.
- **Cocaine** blocks the uptake of dopamine thus leads to hallucinations.
- **Methamphetamine** acts similarly as cocaine.
- **Marijuana (Cannabis sativa)** acts on neurotransmitter serotonin.
- **Depressant** effects are seen with tranquillizers like barbiturates and benzodiazepines. These act by action of the inhibitory transmitter GABA.

### ❖ Diseases of Nervous System

1. **Huntington's chorea**
2. **Dementia**
3. **Alzheimer disease (memory loss);**
4. **Parkinson's disease** (involves tremors of the limbs and difficulty in maintaining balance along with muscle rigidity due to lack of dopamine);
5. **Epilepsy**
6. **Cerebral palsy**
7. **Depression** (lack of serotonin/ nor epinephrine);
8. **Schizophrenia**
9. **Phobias**



## Peripheral nervous system

- The nerves coming out from the brain and the spinal cord constitute the peripheral nervous system (PNS).
- There are **12 cranial nerves and 31 spinal nerves in humans**.

## Somatic nervous system

- It forms a part of the PNS.
- The nerves of PNS that control the voluntary actions of the body form the somatic nervous system.

## Autonomic nervous system

- All the nerves of the PNS that control the involuntary actions in the body form the autonomic nervous system. E.g. respiration, heart rate, blood pressure, digestion, etc. are regulated by the autonomic nervous system.
- Two divisions of the autonomic nervous system are the sympathetic and parasympathetic nervous system.
- The sympathetic nervous system prepares the body for intense physical activity and is often referred to as the fight-or-flight response, while the parasympathetic nervous system has almost the exact opposite effect and relaxes the body and inhibits or slows many high-energy functions.



## Reflex action

Reflex action is a sudden, involuntary reaction of the body in response to stimuli.

## Reflex arc

- It is the path followed by an electrical impulse during a reflex action.
- The impulse travels from the receptor organ to the spinal cord/brain. It is processed there and the information is brought back to the concerned muscle to carry out the action.
- Thus, the receptor organ, sensory/afferent neuron, interneuron, motor/efferent neuron and effector organ are the components of a reflex arc.

## Protection of CNS

The brain is protected by 3 main layers –

- The bony skull (cranium)
- The cerebrospinal fluid
- The meninges (Dura mater, Arachnoid and Pia mater).



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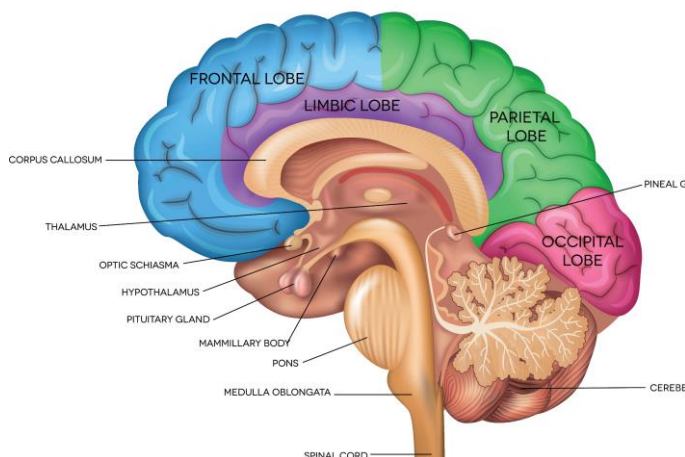
# BRAIN

**Human Brain:** The human brain is the central organ of the human nervous system, and with the spinal cord makes up the central nervous system. The brain consists of the cerebrum, the brainstem and the cerebellum.

## ANATOMY OF THE BRAIN

### TYPES OF BRAIN

1. Fore Brain
2. Mid Brain
3. Hind Brain



## FOREBRAIN

1. Cerebrum
2. Thalamus
3. Limbic System (Hypothalamus)



➤ **Cerebrum:** is the largest part of the brain and is composed of Ispothalamus right and left hemispheres. It performs higher functions:

- Interpreting touch
- Vision and hearing
- Speech
- Reasoning (Intelligence)
- Emotions Learning
- Control of movement

➤ **Thalamus Functions:** It carries **sensory information** to from the body to Cerebrum & Limbic System

➤ **Limbic System:** Between Cerebrum & Thalamus

- **Functioning:** Hunger
- Thirst
- Fear
- Anger
- Sexual Responses



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- **Hypothalamus:** The hypothalamus is a small region of the brain. It's located at the base of the brain, near the pituitary gland. While it's very small, the hypothalamus plays a crucial role in many important functions, including: releasing hormones, regulating body temperature.
  - Hormones connected to system is the part of same Nerve.

## Mid Brain

- **Position:** Between **Hindbrain & Forebrain**
- **Functioning:** 1. Controlling of **Reflex Moments**  
2. Controlling of **Hearing Reflexes**

## Hindbrain

- **Position:** Backside of Brain  
**Parts:** 1. Cerebellum  
2. Pons  
3. Medulla
- **Functioning:**
  1. **Cerebellum:** Balance of Body, Voluntary Moments
  2. **Pons:** Controls Sleep, Breathing Pattern
  3. **Medulla:** Its controls automatic action like Breathing, Blood Circulation, Heart Rate, Swallowing

## Facts about the human brain

- The human brain is the largest brain of all vertebrates relative to body size.
- It weighs about 3.3 lbs. (1.5 kilograms).
- The average male has a brain volume of 1,274 cubic centimetres. The average female brain has a volume of 1,131 cm<sup>3</sup>.
- The brain makes up about 2 percent of a human's body weight. The cerebrum makes up 85 percent of the brain's weight.
- It contains about 86 billion nerve cells (neurons) the "grey matter"
- It contains billions of nerve fibres (axons and dendrites) - the "white matter."
- These neurons are connected by trillions of connections, or synapses.
- Smallest part of Brain: Mid Brain
- **Hind Brain** responsible Blood Circulation of the Body.

## Plant Hormones and Movements

### Plant hormones

Control and coordination in plants are carried out by hormones.

Plant Hormone	Function
<b>Auxin</b>	Helps in Growth of Plant Tissue
<b>Cytokinin</b>	Promotes Cell division, delays ageing of cells
<b>Gibberellins</b>	Helps in the growth of stems, initiates seed germination, promotes flowering, cell division and seed growth after germination
<b>Absciscic acid</b>	Inhibits growth and causes wilting of leaves, promotes dormancy of buds and seeds
<b>Ethylene</b>	This is a gaseous hormone which causes the ripening of fruits

### Growth independent movements

The movements which are not growth related are called nastic movements. These movements occur in response to environmental stimuli but the direction of response is not dependent on the direction of the stimulus.

- The movement in the touch-me-not plant is thigmonastic movement (movement in response to touch).

### Growth-related movements in plants

The movements which are growth related are called tropic movements. These movements occur in response to environmental stimuli and the direction of the response is dependent on the direction of the stimulus.

Examples:

- **Phototropic movement** (light-dependent)
- **Geotropic movement** (gravity-dependent)
- **Chemotropic movement** (chemical-dependent)
- **Hydrotropic movement** (water-dependent)
- **Thigmotropic movement** (touch dependent)

## ➤ Geotropism

Movement of plant parts in response to earth's gravitational force is known as geotropism/gravitropism.

- **Towards gravity** – positive geotropism
- **Away from gravity** – negative geotropism
- The root grows towards gravity and shoot grows away from gravity

## ➤ Phototropism

Movement of plant parts in response to light is known as phototropism.

- **Towards light**- positive phototropism
- **Away from light** – negative phototropism
- Stems move towards light and roots move away from light

## ➤ Hydrotropism

Movement of plant parts in response to water or moisture.

- **Towards water**-- positive hydrotropism
- **Away from water** – negative hydrotropism
- Again, root movement in search of water is positive hydrotropism
- E.g. movement of roots towards high humidity level

## ➤ Chemotropism

Movement of plant parts in response to chemical stimuli is known as chemotropism.

- **Towards chemical** – positive chemotropism
- **Away from chemical** – negative chemotropism
- The growth of pollen tube towards the ovule is positive chemotropism

## ➤ Thigmotropism

Movement of plant parts in response to touch is called as thigmotropism.

- **Towards touch** – Positive thigmotropism
- **Away from touch** – negative thigmotropism
- Movement of tendrils around the support is positive thigmotropism



# The Endocrine System

## Exocrine glands

Exocrine glands are glands that discharge secretions by means of ducts, which open onto an epithelial surface.

## Endocrine glands

Endocrine glands are the ductless glands which secrete hormones into the bloodstream in humans. The endocrine glands present in the human body are the pituitary, thyroid, adrenal, pineal, pancreas, ovary (female), testis (male), etc. Let us now learn more about each of the glands below.

## Pituitary gland

- It is a pea-sized gland located at the base of the brain.
- It is the master gland as it controls the **secretions of all the other endocrine glands**.
- It also secretes **Growth Hormone (GH)**. Under-secretion of GH causes Dwarfism and over-secretion causes Gigantism in children and 'Acromegaly' in adults.

## Thyroid gland



- It is a butterfly-shaped gland located in the throat.
- It secretes the hormone '**Thyroxine**' which regulates the metabolism of the body.
- Iodine is required to synthesize thyroxine in the body.
- In the case of iodine deficiency, under-secretion of thyroxine leads to **goitre**.

## Pancreas

- It is a leaf-like gland present behind the stomach in the abdomen.
- It is an **endocrine as well an exocrine gland**.
- As an endocrine gland, it manufactures two hormones – **Insulin and glucagon**. Both these hormones act antagonistically and regulate the sugar level in the blood.
- As an exocrine gland, it secretes enzymes to break down the proteins, lipids, carbohydrates and nucleic acids in food.
- An insufficient amount of insulin from the pancreas leads to diabetes.

## Adrenal gland

- Occurs in pairs above each kidney.
- It decreases in size with age.
- Secretes the hormone adrenaline **which helps in flight and fight response**.
- Also secretes nor adrenaline

## Gonads

- Gonads are the gamete-producing organs – **testes in males and ovaries in females.**
- The testes produce the male hormone testosterone and the ovaries produce the female hormones oestrogen and progesterone.
- **Testosterone** and oestrogen help in producing gametes and are responsible for the sexual characteristics of males and females respectively.
- **Progesterone** is the pregnancy hormone.

## Other endocrine organs

- The other endocrine organs include the hypothalamus, parathyroid, pineal and thymus glands.

# Introduction

All living organisms multiply or reproduce and produce offspring of a similar kind. Reproduction is an essential process for the existence of a species and the continuation of life.

Here, in this chapter, we will learn about how different unicellular and multicellular organisms such as bacteria, algae, plants, animals and human beings reproduce. What are the different reproductive structures and modes of reproduction such as cell division, vegetative reproduction, asexual reproduction, and sexual reproduction.

## Reproduction

Reproduction is the process by which all organisms multiply in number and increase their population.

## Asexual reproduction

Asexual reproduction is a method of reproduction that involves only one organism. A single organism reproduces two or multiple organisms on its own. This is seen in all unicellular organisms, some multicellular organisms and a few plants.

## Sexual reproduction

The mode of reproduction that involves two individuals; one male and one female. They produce sex cells or gametes which fuse to form a new organism.

# Asexual Reproduction

## ➤ Fission

- Fission is an asexual reproduction that is common in most of the **unicellular organisms.**
- When the fission results in two daughter cells, **it is binary fission (e.g. paramecium).**
- When fission results in many daughter cells, **it is called multiple fission (e.g. Plasmodium).**
- Planes of fission may be different for different organisms.

## ➤ Budding

- Budding is a type of asexual reproduction in which a small cyst-like structure is formed on the parent's body, which gives rise to a new individual.
- Bud may remain attached to the parent (yeast) or may separate and become a new individual (hydra).

## ➤ Regeneration and fragmentation

- Regeneration is the process of growing back the lost organ or body part by the organism (e.g. lizard).
- Fragmentation is the process by which an organism gets fragmented into smaller pieces and each piece grows into a whole new organism.
- E.g. **Planaria, Hydra**
- Fragmentation and Regeneration in Hydra

## ➤ Spore formation

Organisms such as fungi make spores that can grow into complete new individuals when dispersed from their fruiting body. Spores are produced inside sporangia. They are covered by a thick outer layer that protects them in adverse conditions. When spores get suitable environmental conditions they germinate and begin to grow.



## ➤ Vegetative propagation

- This is a type of asexual reproduction seen in plants.
- The vegetative part of the plant, like leaves, stem, roots, gives rise to a new plant.
- Vegetative propagation can be artificial or natural.
- Natural vegetative propagation happens through leaves (e.g. bryophyllum), stem (e.g. turmeric, ginger), runners/stolon (e.g. grass runners, strawberry), bulbs (e.g. onion, lily), etc.
- Artificial methods include cutting, grafting, layering and plant tissue culture.

# Sexual Reproduction

## Types of Cell division

Two types of cell division are seen in eukaryotic organisms:

### Mitosis

- Takes place in somatic cells
- Maintains the chromosome number
- Produces two, diploid daughter cells
- Required for asexual reproduction, development and growth, cell replacement and regeneration

## Meiosis

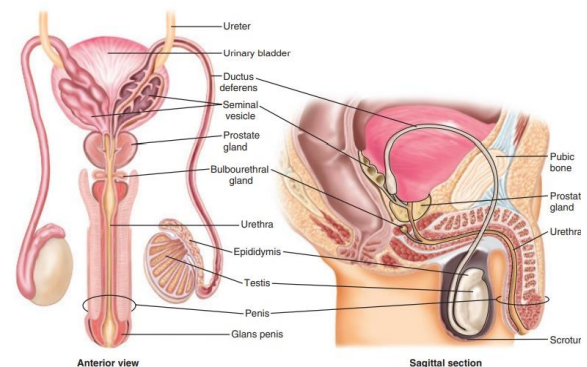
- Takes place in sex cells
- Reduces the number of chromosomes by half
- Produces four haploid daughter cells
- Required for sexual reproduction, i.e gamete formation

## The Reproductive System

In humans, there is a remarkable difference in the male and female reproductive systems. Testes are the main reproductive structure in males where sperms (male gametes) are produced and ovum (female gamete) is produced inside the ovary. Let us now learn in detail about male and female reproductive systems in humans.

### Male reproductive system

- The main reproductive organ in males is a pair of testes.
- They produce the male sex cells called sperms and also produce the male sex hormone **testosterone**.



### Male main reproductive organs

- The main reproductive organ in males is **a pair of testes**.
- They are present in scrotal sacs outside the body and contain seminiferous tubules as the structural and functional unit.
- Male sex cells, sperms, are produced by seminiferous tubules and mature in the epididymis.
- Leydig cells or interstitial cells present in between the seminiferous tubules secrete hormone testosterone.

### Male accessory reproductive organs

- Several accessory reproductive organs aid in the reproductive process.
- The prostate gland and the seminal vesicles are glands of the reproductive system which make semen and nourish the sperm.
- Penis, having urethra passing through it, is called **copulatory organ**.

### Male Ducts

- In males, the vas deferens and the **urethra are the main ducts**.
- A single vas deferens carries sperms from respective testis up to the urethra.
- The urethra acts as a common passage for **semen and urine**.



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Reproductive Organ	No	Function
Testes	2	Produce sperm and testosterone
Sperm duct	2	Conduct the sperm from the testes to urethra
Seminal vesicles	2	Secrete seminal plasma
Epididymis	2	Temporarily store sperm and provides mobility
Urethra	1	Conduct urine and sperms.
Prostate gland	2	Secrete an alkaline fluid to neutralise the acidity of urethra and make the sperm more active
Cowper's gland	2	Secrete an alkaline white lubricating fluid
Penis (have rich blood supply)	2	Pass urine and deposit sperm in female genital tract

## Female reproductive system

The human female reproductive system consists of a pair of ovaries, a pair of fallopian tubes/oviducts and the accessory organs such as the uterus and the vagina.

### Female main reproductive organ

- The main reproductive organ in a female is a **pair of ovaries**.
- They produce the female sex cells called eggs or ova and also produce female sex hormones called **estrogen and progesterone**.

### Female accessory reproductive organ

- **Uterus, oviducts, and vagina** are the accessory reproductive organs in human females.
- The uterus is the site of fetal development and the vagina receives sperm from the male.
- **Ovum** is carried from ovaries to the uterus through a pair of oviducts.





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# Menstrual Cycle

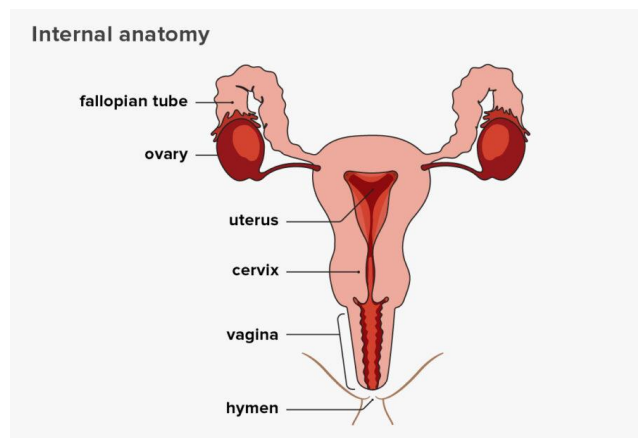
## Menstruation

- **Menstruation is the cyclic event of the release of the ovum from the ovary and its removal from the body when fertilization does not happen.**
- During menstruation, the blood-rich endometrium of the uterus also breaks down while the ovum is removed from the body.
- Two pituitary hormones, LH and FSH, and two ovarian hormones, estrogen and progesterone, all have their roles in menstruation.
- In humans, the cycle repeats every 28 days.

## Fertilization

### Human reproduction

Humans reproduce sexually. The male produces sperms and the female produces eggs. When the sperm fuses with the egg, it forms a zygote that gives rise to a new progeny.



Reproductive Organ	No	Function Performed
Ovaries	2	To produce ova and hormones.
Oviducts	2	To move the ovum towards uterus.
Uterus	1	To provide space for developing child
Vagina	1	To receive the sperms.

## Contraceptive Methods

### ➤ Reproductive health

Reproductive health deals with the prevention of STDs and unwanted pregnancy. Understanding the reproductive system is also a part of reproductive health awareness.

### ➤ Contraceptives

- Contraceptives are devices that prevent unwanted pregnancy and help avoid STDs.
- Contraceptives can be of various types such as mechanical barriers, hormonal/chemical methods, surgical methods, etc.



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## ➤ Coitus Interruptus

- It is a very unreliable contraceptive method where the coitus is stopped before the male ejaculates inside the female reproductive tracts.

## ➤ Rhythm Method

- Another unreliable method of contraception is where coitus is avoided when the female is fertile and the chances of fertilization are very high.

## ➤ Condoms

- One of the most effective methods of contraception.
- A mechanical barrier that stops the semen from entering the female tract preventing pregnancy.
- It also avoids the possibility of contracting STDs.

## ➤ Diaphragms

- Diaphragms are barriers that can be added inside the female reproductive tracts.
- They stop the entry of semen inside the female tract and thus prevent pregnancy.

## ➤ Contraceptive Pills

- Contraceptive pills are chemical methods of contraception.
- They change the level of hormones in the body that prevents the release of the ovum from the ovaries.

## ➤ Emergency Pill

- Emergency pills are those pills which can be taken after coitus to avoid pregnancy.
- They quickly change the level of hormones in the body and prevent a successful implantation even if the egg gets fertilized.

## ➤ IUD

- IUD stands for Intrauterine Device.
- They can be used for a couple of years.
- It is a device that is inserted into the uterus, changing its shape and preventing successful implantation of the zygote.

## ➤ Sterilization

- Sterilization is a surgical method of going permanently sterile.
- This can be done in both males and females.
- In males, it is called vasectomy and in females, it is called tubal ligation.

# Reproduction in Plants

Plants reproduce by both, asexual and sexual methods. Vegetative propagation is a type of asexual reproduction in plants. Let's learn now about sexual reproduction in plants.

## Sexual reproduction in flowering plants

- Sexual reproduction in plants happens through flowers.
- Essential whorls of the flowers such as androecium and gynoecium help in the sexual reproduction of plants.

## Non-essential parts of flowers

- The typical structure of flowers contains essential whorls and non-essential whorls.
- Sepals and Petals are called non-essential whorls as they do not directly take part in reproduction.
- Sepals protect the inner delicate whorl during bud condition and also perform photosynthesis if they are green in colour.
- Petals, when they are coloured, attract insects for **pollination**.

## Essential whorls of flowers



- Androecium and gynoecium are called as essential/reproductive whorls of a flower.
- Androecium produces pollen grains containing male gametes and gynoecium produces ovules which are female gametes.
- Bisexual flowers contain both the whorls while unisexual flowers contain either of them.
- Each individual member of androecium is called a **stamen** and consists of **anther and filament**.
- Anther produces haploid pollen grains.
- Each individual member of gynoecium is called **pistil** and consists of **stigma, style and ovary**.

## Pollination

The process of transfer of pollen grains from anthers to the stigma of a flower is known as pollination.

- It is required for fertilization.
- Pollination has two types, self-pollination (autogamy) and cross-pollination (allogamy).
- In self-pollination, the transfer of pollen grains takes place from anthers to the stigma of the same flower or another flower of the same plant.
- In cross-pollination, pollens are transferred from anthers to the stigma of another flower.
- Many pollinating agents play their roles in cross-pollination. Examples: water, wind, insects, birds, bats, etc.



## Fertilization

Fusion of male and female gametes is known as fertilization.

- In flowering plants after pollination, the pollens germinate on the stigma surface of pistil and generate two male nuclei.
- Ovule has egg cell and two polar nuclei.
- One male nucleus fuses with two polar nuclei and forms triploid endosperm.
- Another male nucleus fuses with the egg cell and forms the zygote that gives rise to the embryo and future plant.
- After fertilization, ovary becomes fruit and ovules turn into seeds. All other parts wither away.

## Introduction

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

## Ecosystem

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

### Mode of nutrition in animals and plants

Autotrophic and Heterotrophic are the two modes of nutrition in living organisms. Plants and some bacteria are autotrophic as they make their own food. Animals, fungi and some bacteria are heterotrophic as they derive their food from other organisms.

## Saprophytes and decomposers

Saprophytes feed on dead and decaying material, e.g. fungi and microorganisms. They absorb nutrients from dead and decaying plants and animal parts. Decomposers break down the organic matter or waste material and release nutrients into the soil. For example, bacteria, worms, slugs, and snails. They are considered extremely important in soil biology. They break down the complex organic matter into simpler substances that are taken up by the plants for various metabolic activities.

## Abiotic components

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

## Biotic components

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

## Trophic levels

It refers to the various levels in a food web as per the flow of energy. The different trophic levels are –

- Producers (T1)
- Primary consumers (herbivores-T2)
- Secondary consumers (primary carnivores -T2)
- Tertiary consumers (Sec carnivores -T3)
- Quaternary consumers (Ter. carnivores T4)
- Decomposers

## Pyramid of trophic levels

- Is a graphical representation.
- Can be the pyramid of numbers, the pyramid of biomass or the pyramid of energy.
- All the pyramids start with producers.

a) **Pyramid of numbers:** gives the number of organisms present at each trophic level.

It can be upright or inverted.

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

c) **Pyramid of energy:** is always upright as it shows the flow of energy from one trophic level to the next trophic level.

## Law of conservation of energy

- Energy can neither be **created** nor destroyed; rather, it transforms from one form to another.
- In biological systems, it gets passed from one organism to another across trophic levels.

## Energy flow

- Transfer of energy from one trophic level to another depicting its direction and amount.
- Can be represented by the pyramid of energy.
- In any food chain, only 10% of the energy is transferred from one trophic level to another.

## Food chain

A series of organisms each dependent on the next as a source of food.

## Food web

- Is formed by interconnections of different food chains.
- Is a graphical representation of 'Who eats Whom' in an ecosystem.



## Characteristics of ecosystem

- Includes the summary of trophic levels.
- Their energy flow and pyramids.

## Environment

- Includes all living and nonliving things.
- Unlike ecosystems, there need not be any necessary interaction between them.

## Pollution

Pollution is the introduction of harmful materials (pollutants) into the environment. Pollution can be due to natural causes such as volcanic eruptions, forest fires, etc. or due to human activities, such as carbon emission, industrial runoff, etc.

### ➤ Air pollution

Introduction of pollutants, organic molecules, or other hazardous substances into the earth's atmosphere.

Sources:

- Natural – forest fire, dust storms, and volcanic activity
- Man-made – power plants, homes, industries, oil refineries, and transportation

## Ozone layer depletion

The ozone layer protects the earth from the sun's ultraviolet (UV) radiation. CFCs released into the atmosphere react chemically with ozone molecules and are depleting the layer.

## Garbage management

- Involves all the activities and actions required to manage waste from its inception to its final disposal.
- Ensures environmental best practices are followed along with proper monitoring and regulation.

Steps involved:

1. Segregation of waste
2. Collection
3. Transport
4. Treatment
5. Processing & Recycling
6. Disposal

## Biodegradable waste

- Waste is derived from plants or animals.
- Decomposed into the soil by a natural agent such as weather, water, air, heat, micro-organisms, etc.

## Biodegradation

Decomposition of garbage or waste material by living organisms or biological processes.



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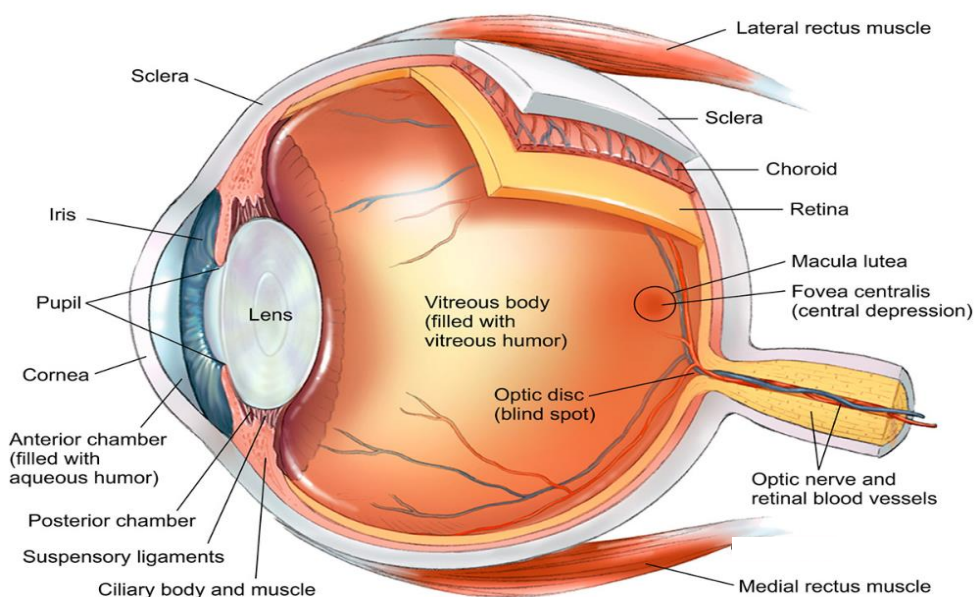


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## HUMAN EYE



Right Eye (viewed from above)

- The human eye is an organ which reacts to light and pressure and differentiates between about 10 million colours. The eye is composed of the anterior segment and posterior segment.
- The anterior segment is made up of the **Cornea, Iris and Lens.**
- The **cornea** is transparent and more curved, comprised of the vitreous, retina, choroid and the outer white shell called the sclera.
- The eye is made up of three layers or coats. The **outermost layer (fibrous tunic)** is composed of the **Cornea and Sclera.**
- The **middle layer (vascular tunic or uvea)** consists of the **Choroid, Ciliary Body, Pigmented Epithelium and Iris.**
- The **innermost layer** is the **Retina, which gets its oxygenation from the blood vessels of the choroid and retinal vessels.**
- **Sclera** is a tough and thick white sheath that protects the inner parts of the eye.
- **Conjunctiva** is a thin transparent membrane that is spread across the sclera. It keeps the eyes moist and clear by secreting small amount of mucus and tears.
- **Cornea** is the transparent layer of skin that is spread over the pupil and the iris. The function of the Cornea is to refract the light that enters the eyes.
- **Iris** is coloured, pigmented part of the eye. It controls **the amount of light that enters the eye by changing the size of the pupil.**



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- **Pupil** is small opening located at the middle of the Iris. It allows light to come in.
- **Lens:** Transparent structure inside the eye that focuses light rays onto the retina
- **Retina** is light sensitive tissue that lines the back of the eye, it contains millions of photo receptors (Rods and Cones) that detect dim and coloured lights and convert light rays into electrical impulses that are transmitted to the brain via Optic Nerve. The **image formed on the retina is real and inverted.**
- **Rods are highly sensitive to dim light**, e.g. Owl's eyes contains rods only, Cones are sensitive to bright light e.g., Human eyes contains cones only.
- **Aqueous humour** is a watery fluid that is present in the area between the lens and the cornea. It is **responsible for the nourishment of both the lens and the cornea.**
- **Vitreous humour is a transparent semi solid.** jelly like substances that fills the interior of the eyes. Its role is to maintain the shape of the eye and refraction of light before it reaches the retina.
- **Optic nerve** located at the end of the eyes behind the retina. The **Optic nerve** is responsible for **carrying all the nerve impulses from the photoreceptors to the brain, without which vision would not be possible.**
- **Macula:** Small central area in the retina that contains special light sensitive cells and allow us **to see fine details clearly.**

## ❖ Defects of the Eye

- **Myopia (near sightedness)** is a defect of vision in which far objects or distant objects appear blurred but near objects are seen clearly because image is focussed in front of the retina.
- **Myopia** can be corrected by **using concave lens that helps to focus the image on the retina.**
- **Hypertropia (farsightedness)** is a defect of vision in which there is **difficulty with near vision but far objects can be seen clearly because image is focussed behind the retina.**
- **Hypertropia** can be corrected by **using Convex lens.**
- **Astigmatism** is a defect of vision in which the lens, is warped, causing images not to focus properly on the retina. **Cylindrical glasses can correct this defect.**
- **Cataracts is clouding** of the lens, which prevents a clear, sharp image being produced clouding results in blurred vision.
- **Glaucoma** is a disease caused by **Increased Intraocular Pressure (IOP)** usually resulting from a malfunction to the eye's drainage system. (or can cause irreversible damage to the optic nerve and retinal fibres to permanent loss of vision).



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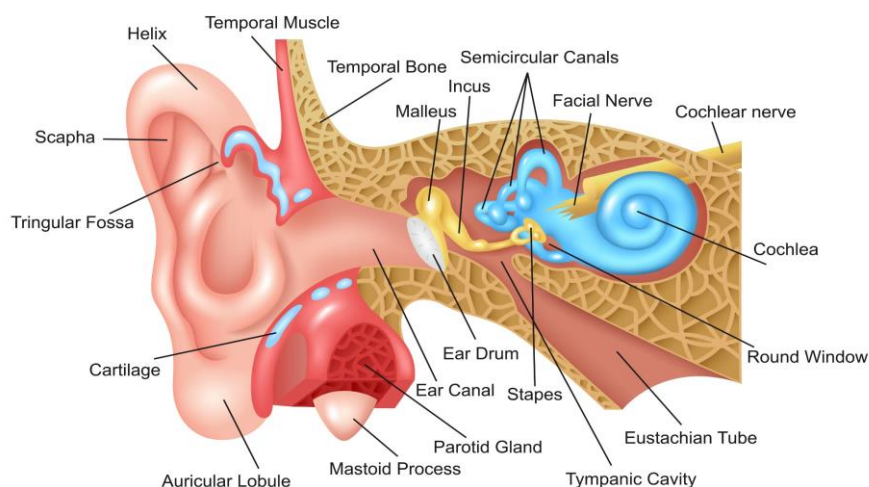
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## The Ear



## Human Ear Anatomy

- Ear are meant for both balancing and hearing is controlled by **auditory area of temporal lobe of cerebral cortex**.
- **Mammalian ear** is made up of three parts i.e, external, middle and inner ear.
- **External ear** includes a Pinna or Auricle (Cartilage covered by skin placed on opposite sides of the head), Auditory canal or ear canal, and Tympanic membrane ear drum).
- **The external ear** collects sounds. Sound travels through the Auditory canal, a short tube that ends at the Ear drum.
- **Middle ear includes** Ear drum, Tympanic cavity and Ear ossicles 3 tiny bones are Malleus (Hammer), Incus (Anvil) and Stapes (Stirrup).
- **Stapes** is the smallest bone in the body.
- The Cochlea is filled with fluid and contains the Organ of Corti (a structure that contains thousands of specialised sensory hair cells with projections called cilia). The vibrations transmitted from the middle ear cause tiny waves to form in the inner ear fluid, which make the cilia vibrate. The hair cells then convert these vibrations into nerve impulse or signals which are sent through the Auditory Nerve to the brain where they are interpreted as sound, The round window (fenestra cochlea) is a membrane that connects the cochlea to the middle ear, it helps dampen the vibrations in the cochlea.

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# BIOMOLECULES

## Vitamin Information

Vitamin	Vitamin Chemical Name	Year of Discovery	Food Source	Solubility	Deficient Disease	Overdose Disease
<b>Vitamin A</b>	Retinol, Retinal & Four Carotenoids including Beta Carotene.	1913	Cod Liver Oil	Fat	Night Blindness, Hyperkeratosis, keratomalacia	Hypervitami--nosis A
<b>Vitamin B1</b>	Thiamine	1910	Rice Bran	Water	Beriberi, Wernic-Kekorsakoff Syndrome	Drowsiness
<b>Vitamin B2</b>	Riboflavin	1920	Meat, Eggs	Water	Ariboflavinosis	
<b>Vitamin B3</b>	Niacin, Niacinamide	1936	Meat, Eggs & Grains	Water	Pellagra	Liver Damage
<b>Vitamin B5</b>	Pantothenic Acid	1931	Meat, Grains, In many foods	Water	Paraesthesia	Diarrhoea, Nausea & heartburn
<b>Vitamin B6</b>	Pyridoxine, Pyridoxamine, Pyridoxal	1934	Meat, Dairy products	Water	Anemia peripheral Neuropathy	Nerve damage
<b>Vitamin B7</b>	Biotin	1931	Meat, Eggs, Dairy products	Water	Dermatitis, Enteritis	
<b>Vitamin B9</b>	Folic Acid, Folinic Acid	1941	Leafy Green Vegetables	Water	Megaloblast & Deficiency during pregnancy	May mask Symptoms of <b>B12 Deficiency</b>
<b>Vitamin B12</b>	Cyanocobalamin& Methylcobalamin	1926	Eggs, Animal Products	Water	Megaloblastic anemia	Acme- like Rash
<b>Vitamin C</b>	Ascorbic Acid	1920	Citrus, Fresh Foods	Water	Scurvy	Vitamin C Megadosage
<b>Vitamin D</b>	Cholecalciferol	1920	Cod Liver oil	Fat	Rickets & Osteomalacia	Hyper-vitaminosis D
<b>Vitamin E</b>	Tocopherols, Tocotrienols	1922	Wheat Germ oil, Unrefined Vegetable oil	Fat	Mild Hemolytic Anemia in infants	Increased the chances of Heart Failure
<b>Vitamin K</b>	Phylloquinone, Manaquinones	1931	Leafy Green Vegetables	Fat	Bleeding diathesis	Increases coagulation in Patients



Bio molecules are the substances that are essential for a living being to perform the basic functions, e.g., carbohydrates, proteins, lipids (fats), nucleic acids and vitamins.

## Carbohydrate

- It was believed that these are the organic compounds which have carbon, hydrogen and oxygen in the ratio of **1 : 2 : 1** but starch and some others are exceptions. So this definition has been changed. According to modern definition, these are the Polyhydroxy, Aldehydes and Ketones or their derivatives.
- These are the source of energy and about 50-75% energy is obtained by the oxidation of carbohydrates.
- The main end product of carbohydrate digestion is glucose, which is called blood sugar. It oxidises to give energy along with CO<sub>2</sub> and H<sub>2</sub>O.
- 1 gm glucose provides about 17 kJ energy or 4.2 kcal energy.
- Carbohydrates are better fuel as compared to proteins and fats as they readily decompose to give energy.
- Main sources of carbohydrates are **wheat, maize, rice, potato etc.**

The carbohydrates are categorised into following **three types**:

### Monosaccharides

- These are simple sugars, which cannot be hydrolysed further, e.g., **ribose, glucose, fructose, galactose etc.**
- In human beings, blood glucose level is 100-120 mg/mL. Extra glucose, if any, is converted into glycogen in the liver by a process called glycogenesis.
- **D-fructose** is the sweetest of all sugars and is found in fruit juice, honey etc.

### Oligosaccharides

- They release 2-10 monosaccharides on hydrolysis, like **disaccharides, e.g. sucrose, lactose maltose etc and trisaccharides, like raffinose etc.**
- Sucrose is also called invert sugar. It gives glucose and fructose when subjected to hydrolysis.

### Polysaccharides

- They release more than ten monosaccharides on hydrolysis. These are non-sugars, i.e., do not have sweet taste, e.g., **cellulose, glycogen and starch.**
- Cellulose is found in plant cell wall and is digested by ruminants (like cow, goat, buffalo, etc), but not by carnivorous or omnivorous animals like human beings. Thus, it acts as roughage in case of human beings.

### Function of Carbohydrates

- Carbohydrates provide energy, that acts as reserve food, help in the synthesis of nucleic acid and form exoskeleton of animals. Excessive intake of carbohydrate results in digestive problems and obesity.

## Proteins

These are found in all living cells. These are the compounds of **carbon (C)**, **hydrogen (H)**, **oxygen (O)**, **nitrogen (N)** and **sulphur (S)**. These form 15% part of human body. Snake venom, ricin of castor and bacterial toxins are proteinaceous in nature. Main sources of protein are **groundnuts, soyabean, pulses, fish etc.**

## Function of Proteins

- These are important for the growth and repair of the body (75% of our body is protein only). However, in the deficiency of carbohydrates, these acts as the source of energy. Protein also control the development of genetic characters.
- Deficiency of protein causes Kwashiorkor** (a disease in which hands and legs of children get slimmed and the stomach comes out) and Marasmus (a disease in which muscles of children are loosened). **Kwashiorkor** occurs in children between 1 to 5 years of age and **marasmus** in children below 1 year.

## Lipids (Fats)

- These are also the compounds of carbon (C), hydrogen (H) and oxygen (O).
- Chemically, these are the ester of glycerol and fatty acids. These are present in cytoplasm, cell wall etc.
- The main source of fats are **ghee, butter, almond, cheese, egg yolk, meat, soyabean etc.**
- Fats are digested by enzymes called lipases in the small intestine. Generally, at 20°C, these are in solid state but if their state is liquid at this temperature, these are termed as oils.
- Fatty acids are of two types- Saturated and Unsaturated. Saturated fatty acids are found in coconut oil and palm oil, while unsaturated fatty acids are found in fish oil and vegetable oil.
- Excess of saturated fats raises the level of blood cholesterol and may cause arteriosclerosis. This may lead to heart attack.

## Function of Lipids

The main functions of lipids are

- These provide twice the energy than that from carbohydrates.
- These remain under the **skin and prevents the loss of heat from the body.**

## Malnutrition Effects

- Deficiency of fat results in **dry skin and weight loss.**
- If fat is in excess**, the body gets fatty and result in several **heart diseases and high blood pressure.**
- The skin fat, in case of whales and seals, forms a thick layer called the blubber. It acts as reserve food and also maintains the body temperature.



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## Vitamin

- It was first discovered by **FG Hopkin**. However, the term **vitamin** was coined by **C Funk**.
- Vitamin is an organic compound, which cannot be synthesised in sufficient quantities by an organism and must be obtained from the diet.
- They provide no calories, they only regulate chemical reactions occurring in the metabolism of the body.

These are divided into two groups

1. **Fat soluble vitamin**, viz. **vitamin- A, D, E and K**.
2. **Water soluble vitamin**, viz. **vitamin-B and C**.
  - **Vitamin-B12** contains cobalt. Vitamin-D is synthesised in our skin by the action of ultraviolet rays of the sunlight. Vitamin-K is synthesised in our colon by the bacteria.
  - Water soluble vitamins normally do not show hypervitaminosis (this disease occurs due to excess intake of vitamins) as excess of these vitamins is normally excreted through urine.
  - In balanced diet, all the important nutrients (like carbohydrate, protein, fats, vitamins etc.) are available in sufficient quantity.

## SYSTEMS OF HUMAN BODY

### Integumentary System

The human skin (integumentary) is composed of a minimum of three major layers of tissue, the epidermis, dermis and hypodermis.

### Epidermis

The top layer of skin is made up of epithelial cells and does not contain blood vessels.

### Dermis

- It gives elasticity to the integument, allowing stretching and conferring flexibility, while also resisting distortions, wrinkling and sagging.
- **Nails** grow 1 mm per week on an average.
- Protein, keratin stiffens epidermal tissue to form finger nails.

### Hypodermis

- It is made up of adipose tissue.

*It performs several important functions*

1. Protect against invasion by **infectious organisms**.
2. Protect the body from **dehydration**.
3. Maintain **homeostasis**.
4. Act as a receptor for **touch, pressure, pain, heat and cold**.
5. Protect the body against sunburns by secreting melanin.

6. Generate vitamin-D through exposure to ultraviolet light.
7. Store water, fat, glucose and vitamin-D.

## Animal Nutrition and Digestion

Animals are not able to synthesise their own food, therefore they obtain it from outside environment for their nutritional requirements.

## Mineral Nutrients

- These are metals, non-metals and their salts other than the four elements—carbon, hydrogen, nitrogen and oxygen and constitute about 4% of total body weight.
- **Milk, eggs, meat, fruit, food, vegetables** etc are the sources of minerals.

*Minerals are of two types*

**1. Macronutrients** These are required in large amount, e.g., **calcium (Ca)**, **phosphorus (P)**, **potassium (K)** etc.

**2. Micronutrients** These are required in very small amount (**less than 1 g**), e.g., **iodine (I)**, **iron (Fe)**, **zinc (Zn)** etc.

Mineral	Major Food Source	Uses	Deficiency Disease
<b>Macronutrients</b>			
<b>Calcium (Ca)</b>	Milk, cheese, bread and vegetables	Muscle contraction, nerve action, blood clotting and the formation of bone.	Tetany and rickets
<b>Phosphorus (P)</b>	Cheese, eggs, peanuts and most foods	Bone and tooth formation, energy transfer from foods, DNA, RNA and ATP formation.	Tetany and rickets
<b>Sulphur (S)</b>	Dairy products, meat, eggs and broccoli	Formation of thiamine, keratin and coenzymes	Disturbed protein metabolism
<b>Potassium (K)</b>	Potatoes, meat and chocolate.	Muscle contraction, nerve action, active transport	Nervous disorder, poor muscles leading to paralysis.
<b>Sodium (Na)</b>	Any salted food, meat, eggs and milk.	Muscle contraction, nerve action and active transport.	Nervous, depression, muscular cramps, pH disbalance
<b>Chlorine (Cl)</b>	Salted food and seafood.	Anion/cation balance and gastric acid formation	Loss of appetite muscle cramps.

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<b>Magnesium (Mg)</b>	Meat, chocolate and green vegetable	Formation of bone, formation of coenzymes in cell respiration.	Irregularity of metabolism.
<b>Micronutrients (Trace Elements)</b>			
<b>Iron (Fe)</b>	Liver, kidney, red meat, cocoa powder and water cress	Formation of haemoglobin myoglobin and cytochromes	Anaemia and low immunity
<b>Fluorine (F)</b>	Water supplies, tea, sea food, meat, liver and beans	Resistance to tooth decay	Weak teeth (if present in excess causes mottling of (teeth))
<b>Zinc (Zn)</b>	Meat, liver and beans	Enzyme activation and carbon dioxide transport	Anaemia, retarded growth, weak immunity and fertility
<b>Copper (Cu)</b>	Liver, meat and fish	Enzyme, melanin and haemoglobin formation	Anaemia, weak blood vessels and connective tissues.
<b>Iodine (I)</b>	Seafood, iodised salt and fish	Thyroxine production	Goitre
<b>Manganese (Mn)</b>	Tea, nuts, spices and cereals	Bone development and enzyme activation	Irregular growth of bones and connective tissues
<b>Chromium (Cr)</b>	Meat and cereals	Uptake of glucose	Irregular metabolism
<b>Cobalt (Co)</b>	Meat and yeast	Synthesis of vitamin-B12, formation of red blood cells	Anaemia

## Water

About **70% of the human body consists of water**. Two-third of water exists inside cells, the other one-third is outside the cells in tissue fluid and blood plasma. It is essential for digestion, transportation, excretion and to regulate body temperature.

Many factors affects the health of human body. One of them is adulteration.

## Food Adulteration

Addition of undesirable, cheap and harmful substances in the food is called food adulteration.

Indian Standards Institution (ISI) Mark and mark (Agricultural marketing) are given by the Bureau of Indian Standards after testing the purity and quality of material and food respectively.





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Food Item/Stuff	Adulterant
Milk, curd and cheese	Water and urea
Sweets	Saccharin, harmful colour
Ghee	Vanaspati and animal fats
Cereals	Stones, sand and grit
Dhania powder	Powdered horse dung
Haldi powder	Lead chromate
Pulses	Metanil yellow
Edible oils	Argemone oil
Black pepper	Papaya seed

## DISEASES

It is a condition of the body or its part in which functions are disturbed. The diseases may be broadly classified into two types, i.e., congenital and acquired.

### Congenital Diseases

These are anatomical or physiological abnormalities present from birth.

They may be caused by

- **A single gene mutation** (alkaptonuria, phenylketonuria, albinism, sickle-cell anaemia, haemophilia and colour blindness).
- **Chromosomal aberrations** (Down's syndrome, Klinefelter's syndrome and Turner's syndrome).
- **Environmental factors** (cleft palate and harelip). Unlike the gene and chromosome induced congenital defects, environmentally caused abnormalities are not transmitted to the children.

### Acquired Diseases

These diseases develop after birth. They are further of two types, i.e., communicable and non-communicable.

1. **Communicable** (infectious) diseases are caused by pathogenic micro-organisms, such as **bacteria, viruses, parasites or fungi**; the diseases can be spread, directly or indirectly, from one person to another. Infectious diseases, are also known as transmissible diseases.
2. **Non-communicable** (non- infectious) diseases are not passed by organisms among people, but come from genetic or lifestyle factors.

## COMMUNICABLE DISEASES

These are the diseases which may pass or carried from on human or animal to other. Communicable diseases are illness caused by germs such as bacteria, viruses and spread by an infected person, animals or object to other persons.

### Viral Diseases

Viruses are parasitic and causes a number of diseases.

### Bird Flu(H<sub>5</sub>N<sub>1</sub>)

Bird flu (Avian influenza) is a disease caused by an influenza virus-A, that primarily affect birds.

*The following persons may be on higher risk for developing the bird flu*

- Farmers and others, who work with poultry.
- Travellers, visiting affected countries.
- Those who have touched an infected bird.
- Those who eat raw or undercooked poultry meat, eggs from infected birds.

### Symptoms

**Fever, cough, sore throat, muscle aches and eye infection** (conjunctivitis).

### Treatment

Treatment with the antiviral medication oseltamivir (tamiflu) or zanamivir (relenza) may make the disease less severe. Oseltamivir may also be prescribed for persons, who live in the same house as those diagnosed with avian flu.

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### Severe Acute Respiratory Syndrome (SARS)

It is a serious form of pneumonia. It is caused by a virus that was first identified in 2003. Infection with the SARS virus causes acute respiratory distress (severe breathing difficulty) and sometimes death.

### Symptoms

**Cough usually starts 2-3 days** after other symptoms like **Fever, headache and muscle aches**.

### Treatment

Antibiotics to treat bacteria that cause pneumonia, Antiviral medications. High doses of steroids to reduce swelling in the lungs. Oxygen, breathing support (mechanical ventilation) or chest therapy.

### Hepatitis

Hepatitis is a swelling and inflammation of the liver. It is not a condition, but is often used to refer a viral infection of the liver.

Hepatitis can be caused by:



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- Immune cells in the body attacking the liver and causing autoimmune hepatitis. Infections from viruses (**such as hepatitis-A, B or C**), bacteria or parasites. Liver damage from alcohol, poisonous *mushrooms* or other poisons.
- **Medications**, such as an overdose of acetaminophen, can cause harm or death also.

## Symptoms

Abdominal pain or distention. Breasts development in males. Dark urine and pale or clay coloured stools. **Fatigue, general itching, fever, usually low-grade jaundice (yellowing of the skin or eyes) and loss of appetite, nausea, vomiting and weight loss.**

## AIDS

**Acquired Immuno Deficiency Syndrome (AIDS)** is a disease of the human immune system caused by the Human Immunodeficiency Virus (HIV). AIDS was first recognised by the Centres for Disease Control and Prevention (CDC) in **1981**.

## HIV Infection

AIDS is a condition caused by HIV infection. The condition gradually destroys the immune system, which makes it harder for the body to fight infections.

## Transmission

HIV can be spread by the following

- **Through sexual contact** i.e. oral, vaginal and anal sex.
- **Through blood transfusions, accidental needle sticks or needle sharing.**
- From mother to child: A pregnant woman can transmit virus to her foetus through their shared blood circulation or a nursing mother can pass it to her baby through breast's milk.

## Test for AIDS

- **Enzyme Linked Immunosorbent Assay/ Enzyme Immuno Assay (ELISA/EIA)**
- **Radio Immuno Precipitation Assay/ Indirect Fluorescent Antibody Assay (RIP/IFA)**
- **Polymerase Chain Reaction (PCR)**
- **Western Blot Confirmatory Test.**

## NON-COMMUNICABLE DISEASES

There are various kinds of non-communicable diseases, which affect the health of human beings. Some of the common non-communicable diseases are

### Diabetes

Diabetes is a long-term condition caused by too much glucose (sugar) in the blood. There are two main types of diabetes

#### Type 1

Diabetes occurs when the body doesn't produce enough insulin to function properly or the body's cells don't react to insulin. This is known as insulin resistance.

#### Type 2

Diabetes is far more common than type 1 diabetes, which occurs when the body doesn't produce any insulin at all.

### Symptoms

Symptoms common to both types of diabetes include

- I. **Feeling very thirsty.**
- II. **Urinating frequently, particularly at night.**
- III. **Feeling very tired.**
- IV. **Weight loss and loss of muscle bulk.**

### Cancer

It is uncontrolled growth of abnormal cells in the body. Some diseases cause emergence of tumours in body. These are called neoplastic diseases. This includes from a minor role to a lethal cancer.

### Causes of Cancer

- Cancer is induced by **physical, chemical and biological factors or agents**. These are called carcinogens or cancer causing agents. Ionising radiations such as X-rays, and non-ionising radiations such as ultraviolet (UV) damage the DNA leading to neoplastic transformation.
- **Tobacco** smoke contains chemical carcinogens that **causes lung cancer**. **Viruses** also cause cancer. These are called oncogenic viruses as they have genes called viral oncogenes.

### Cancer Detection and Diagnosis

**Leukaemia or blood cancer** can be detected based on **biopsy and histopathological** studies of the tissue and blood and bone marrow tests for increased cell counts. Cancers of internal organs are detected using techniques such as **Radiography Computed Tomography (RCT) and Magnetic Resonance Imaging (MRI)**.

## Cancer Therapy

- **Cryo Surgery** It is the technique of using extreme rapid cooling that freeze tissues, thereby destroy them. Rapid cooling to temperature below freezing point produces irreversible cell damage and cell death occurs at 20°C to 90°C.
- **Proton Therapy** It is a type of particle therapy, which uses a beam of protons to irradiate diseased tissue, most often in the treatment of cancer.
- **Radiation Therapy** Radiation therapy is a cancer treatment. Its goal is to kill cancer cells and shrink tumours.
- **Stem Cell Transplantation** Stem cell transplants can be an effective treatment for people with certain forms of cancer, such as leukaemia and lymphoma.
- **Peripheral Blood Stem Cell Transplantation (PBSCT)** It is also called peripheral stem cell support. This procedure restore stem cells that has been destroyed by high doses of chemotherapy.

## Heart Diseases

Some heart diseases are as follow

### Angina Pectoris

Human with angina, experience pain in the centre of the chest. The chest can feel constricted and tight, but the pain can also be oppressive, as if something is crushing your chest. Pain starts in the centre of the chest behind the breast bone (sternum) or on the left side of the front of the chest. It can spread out to other parts of your body like your arms and stomach.

### Myocardial Infarction

- It is commonly known as **heart attack**, results from the interruption of blood supply to a part of the heart, causing heart cells to die.
- This is most commonly due to occlusion (blockage) of a coronary artery following the rupture of a vulnerable atherosclerotic plaque, which is an unstable collection of lipids (cholesterol and fatty acids) and white blood cells (especially macrophages) in the wall of an artery.
- The result is ischemia (restriction in blood supply) and ensuing oxygen, if left untreated for a sufficient period of time, can cause damage or death (infarction) of heart muscle tissue (myocardium).

### Heart Arrest

- It occurs when the heart is unable to provide sufficient pump action to distribute blood flow to meet the needs of the body. Heart arrest can cause a number of symptoms including shortness of breath, leg swelling and exercise intolerance.
- The condition is diagnosed with echocardiography and blood tests. Treatment commonly consists of lifestyle measures such as smoking cessation, light



exercise including breathing protocols, decreased salt intake and other dietary changes and medications.

## Arthritis

- It affects the musculoskeletal system, specifically the joints. It is the main cause of disability among people over 55 years of age in industrialised countries.
- **Rheumatoid Arthritis (RA)** It is a long-term disease that leads to inflammation of the joints and surrounding tissues. It can also affect other organs.

## Osteoarthritis

It is a joint inflammation that results from cartilage degeneration. It can be caused by ageing, heredity and injury from trauma or disease. The most common symptom of osteoarthritis is pain in the affected joint(s) after repetitive use.

## Gout

Gout is a kind of arthritis. It can cause an attack of sudden burning pain, stiffness and swelling in a joint, usually a big toe. These attacks can happen over and over unless gout is treated. Overtime, they can harm your joints, tendons and other tissues. Gout is most common in men.

## Sexually Transmitted Diseases

- **Gonorrhoea** It is caused by bacteria *Neisseria gonorrhoeae*. Anyone who has any type of sexual contact can catch gonorrhoea. The infection can be spread by contact with the mouth, vagina, penis or anus.
- **Syphilis** It is a sexually transmitted infection caused by the spirochete bacterium *Treponema pallidum* sub-species *pallidum*. The primary route of transmission is through sexual contact; it may also be transmitted from mother to foetus during pregnancy or at birth, resulting in congenital syphilis.
- **Genital herpes** It is a Sexually Transmitted Infection (STI) caused by the Herpes Simplex Virus (HSV).
- **Trichomoniasis** It is a sexually transmitted infection caused by the parasite *Trichomonas vaginalis*.

## Mental Disorder

A mental disorder or mental illness is a psychological pattern or anomaly, potentially reflected in behaviour, that is generally associated with distress or disability and which is not considered part of normal development of a person's culture. This may be associated with particular regions or functions of the brain or rest of the nervous system, often in a social context.

## Alzheimer's Disease

It is a progressive mental deterioration that can occur in middle or old age, due to generalised degeneration of the brain. It is the commonest cause of premature senility.

## DRUGS

A drug is a substance, which when taken in, alters the body functions. Repeated use of drugs particularly for obtaining quick pleasure is called drug abuse.

## Some Simple Drugs

Below are the types of simple drugs.

### Analgesic (Pain Killers)

These drugs act in various ways on the peripheral and central nervous system; they include paracetamol (acetaminophen), the non-steroidal anti-inflammatory drugs (NSAIDs) such as the salicylates, narcotic drugs such as morphine, synthetic drugs with narcotic properties such as tramadol and various others.

### Anaesthetic

An anaesthetic is used to temporarily reduce or take away sensation, usually so that painful procedures or surgery can be performed.

There are two types of anaesthetics

- **General** which make the patient unconscious.
- **Local** which numb the part of the body that would otherwise feel pain.

### Antibiotics (Bactericidal)

These are powerful medicines that fight bacterial infections. When used properly, antibiotics can save lives. They either kill bacteria or stop them from reproducing.

### Antihistamines

These are medicines that can be used to relieve severe itching and help in breaking histamine cycle. It leads to thickening and weeping of the skin and generally makes the eczema worse and more likely to become infected because scratching breaks the skin.

### Tranquiliser

It is a drug that induces tranquility in an individual. The minor tranquilisers induce a feeling of calm and relaxation. Depending on the medication and dosage, this can range from feeling of mild euphoria to states of drowsiness, confusion and lightedness.

### Sedative

It is a substance that induces sedation by reducing irritability or excitement. At higher doses it may result in slurred speech, staggering gait, poor judgment and slow, uncertain reflexes.

Doses of sedatives such as benzodiazepines, when used as a hypnotic induce sleep, tend to be higher than amounts used to relieve anxiety, whereas only low doses are needed to provide a peaceful and calming sedative effect.

## Narcotic

It is originally referred medically to any psychoactive compound with any sleep-inducing properties.

## Antipyretics (Temperature Reduction)

These are drugs or herbs that reduce fever. Antipyretics cause the hypothalamus to over ride an interleukin-induced increase in temperature. The body then works to lower the temperature, resulting in a reduction of fever. Bacteria of cholera and TB was discovered by **Robert Koch**

Disorders	Hormone	Quantity	Gland
Dwarfism	GH	Deficiency	Pituitary
Gigantism	GH	Excess	Pituitary
Acromegaly	GH	Excess	Pituitary
Simmond's disease	GH	Deficiency	Pituitary
Diabetes insipidus	ADH	Deficiency	Pituitary
Cretinism	Thyroxine	Deficiency	Thyroid
Simple goitre	Thyroxine	Deficiency	Thyroid
Myxoedema	Thyroxine	Deficiency	Thyroid
Exophthalmic goitre	Thyroxine	Excess	Thyroid
Tetani	Parathyroid	Deficiency	Parathyroid
Plummer's disease	Thyroxine	Deficiency	
Addison's disease	Mineralocorticoids (aldosterone) and glucocorticoids (cortisol)	Deficiency	Adrenal cortex
Crohn's disease	Mineralocorticoids	Excess	Adrenal cortex
Cushing disease	Corticosteroid	Excess	Adrenal cortex

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Disease	Pathogen	Affected Organ	Symptom
<b>Tuberculosis</b>	<i>Mycobacterium tuberculosis</i>	Lungs	Repeated coughing, high fever.
<b>Diphtheria</b>	<i>Corynebacterium diphtheriae</i>	Respiratory tract	Difficulty in respiration (mainly in child of age 2-5 yrs).
<b>Whooping cough or pertussis</b>	<i>Bacillus pertussis</i>	Respiratory system	Continuous coughing.
<b>Cholera</b>	<i>Vibrio cholerae</i>	Intestine	Vomiting, acute diarrhoea, muscular cramps, dehydration etc.
<b>Leprosy or Hansen's disease</b>	<i>leprae Mycobacterium</i>	Chronic infection of skin and nerve	Ulcers, nodules, scaly scabs (the infected part of the body becomes senseless).
<b>Tetanus (lock jaw)</b>	<i>Clostridium tetani</i>	Central nervous system	Painful contraction of neck and jaw muscles followed by paralysis of thoracic muscles.
<b>Pneumonia</b>	<i>Diplococcus pneumoniae</i>	Lungs	Sudden chill, chest pain, cough, high and fever.
<b>Typhoid</b>	<i>Salmonella typhi</i>	Intestine	High fever, diarrhoea and headache
<b>Anthrax</b>	<i>Bacillus anthracis</i>	Skin and intestine	—
<b>Plague</b>	<i>Pasteurella,</i>	Blood disease	High fever, weakness and
<b>(i) Bubonic plague</b>	<i>Yersinia pestis</i>		haemorrhage which turn black.
<b>(ii) Pneumonic plague</b>	”	Lungs	Haemorrhage of bronchi, lungs.
<b>(iii) Septicemic plague</b>	,,		Anaemia, fever, chills leading to death with in two days.
<b>Gonorrhoea (sexual disease)</b>	<i>Neisseria gonorrhoea</i>	Urinary tract	Swelling in urinary tract

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Disease	Pathogen	Affected Part	Symptom
<b>Measles (<i>Rubella disease</i>)</b>	Rubella virus	Whole body	Loss of appetite, reddish eruption on the body.
<b>Chicken pox</b>	Varicella virus	Whole body	High fever, reddish eruption on body.
<b>Small pox</b>	Variola virus	Whole body	Light fever, eruption of blood on body
<b>Polio or poliomyelitis</b>	Polio virus	Throat, backbone and nerve	Fever, backbone and intestine wall cells are destroyed. It leads to paralysis.
<b>Influenza (flu)</b>	Influenza virus	Whole body	Inflammation of upper respiratory tract, nose throat and eyes.
<b>Rabies(<i>hydrophobia</i>)</b>	RNA virus called rabies virus	Nervous system	Encephalitis, fear of water, high fever, headache, spasm of throat and chest leading to death.
<b>Hepatitis (<i>Epidemic Jaundice</i>)</b> (i) Hepatitis-A (ii) Hepatitis-B	Hepatitis virus	Liver	Loss of appetite, nausea, whitish stool and jaundice.
	Hepatitis-A virus		Not fatal
	Hepatitis-B virus		Fatal
<b>Dengue fever</b>	RNA containing dengue virus	Whole body particularly, head, eyes and joints	High fever, backache, headache, retro-orbital pain behind the eye ball.
<b>AIDS (<i>Acquired Immuno Deficiency Syndrome</i>)</b>	HIV (Human Immuno Deficiency Virus)	White blood cells	Weak immune system.
<b>Herpes</b>	Herpes virus	Skin	Swelling of skin.
<b>Ebola virus disease</b>	Ebola Virus(filovirus)	Whole body	Fatal hemorrhagic fever, liver and kidney disfunction vomiting, headache.
<b>Swine influenza (flu)</b>	H <sub>1</sub> N <sub>1</sub> flu virus	Whole body	Headache, tiredness, sore throat, Vomiting, breathing problems.



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(muscles)

Disease	Pathogen (Causative agent)	Vector	Parts Affected and Symptoms
Pyorrhoea	<i>Entamoeba gingivalis</i>	None, infection by lip kissing.	Bleeding of gums.
African trypanosomiasis	<i>Trypanosoma gambiense</i>	Tse-tse fly( <i>Glossina palpalis</i> )	Blood and nervous tissue. Man feels sleepy, may cause death.
Amoebic dysentery( <i>Amoebiasis</i> )	<i>Entamoeba histolytica</i>	None, Infection by contamination.	Colon (intestine). Develop loose motion with blood, pain in abdomen
Diarrhoea	<i>Giardia</i>	None, infection by contamination	Digestive system causes loose motions, vomiting.
Kala azar or dum dum fever	<i>Leishmania donovani</i>	Sand flies( <i>Phlebotomus</i> )	Spleen and liver enlarge and high fever develops.
Filaria or elephantiasis	<i>Wuchereria bancrofti</i>	<i>Culex</i> mosquito	Swelling of legs, testes and other body parts.
Malaria	<i>Plasmodium</i> sp.	Female <i>Anopheles</i> mosquito	Periodical attacks of high fever, pain in joints accompanied by chill, heavy perspiration and fast pulse.

Disease	Pathogen (fungi)	Symptoms
Asthma or aspergillosis	<i>Aspergillus fumigatus</i>	Obstruction in the functioning of lungs.
Athlete's foot	<i>Tinea pedis</i>	Skin disease, cracking of feet.
Scabies	<i>Acarus scabiei</i>	Skin itching and white spot on the skin.
Ringworm	<i>Tricophyton Verrucosum</i>	Round red spot on skin.
Baldness	<i>Tinea capitis</i>	Hair fall.

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Test	Disease	Test	Disease
Ames test	Carcinogenecity	Widal test	Typhoid
Dick test	Scarlet fever	Wayson stain test	Plague
Montoux test	Tuberculosis	Tourniquet test	Dengue fever
Rose-Waaler test	Rheumatoid fever	ELISA test	AIDS
Wassermann test	Syphilis		

## Vaccination

- It is the process of artificial introduction of germs or the germ substance called **antigen** into the body for developing resistance to a particular disease. The material introduced into the body is called **vaccine**.
- A vaccine is a dead or weakened microbes. They are unable to produce disease as they are less in number but they stimulate the body to produce antibodies.
- World Health Organisation (WHO) in 1974 officially launched a global vaccination programme to protect children from six fatal diseases. Diphtheria, pertussis, tetanus, polio, **TB (Tuberculosis)** and **measles**. It was launched in India in 1985.
- BCG (Bacillus Calmette Guerin) vaccine** is given to protect against **TB (Tuberculosis)**.
- DPT (diphtheria, Pertussis and Tetanus) vaccine** is given to babies within **first 6 weeks** of their birth.

Age	Vaccination	Dose
8-24 months	▪ DPT	▪ Booster dose
	▪ Polio (oral)	▪ Booster dose
	▪ Cholera vaccine (can be repeated every year before summer)	▪ One
5-6 years	▪ DT (Bivalent vaccine against diphtheria and tetanus)	▪ Booster dose
	▪ TAB (vaccine against <i>Salmonella typhi</i> , <i>S. paratyphi A</i> and <i>S paratyphi B</i> ) or Typhoid Paratyphoid vaccine	▪ Two doses at intervals of 1-2 months
10 years	▪ Tetanus, TAB (typhoid)	▪ Booster dose
16 years	▪ Tetanus, TAB	▪ Booster dose



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## HUMAN GENETIC DISORDERS

The important human genetic disorders can be categorized as follows:

Disorder	Chromosome Complement	Effect
Down's syndrome	Trisomy 21 (extra chromosome number)	Short stature, epicanthus, small round head, protruding lower lip, flattened nasal bridge, mental retardation, short life, daffiness.
Edward's syndrome	Trisomy 18 (extra chromosome number)	Long but narrow skull, small face, short digits, webbed neck, corneal opacity, mental retardation.
Cri-du-chat syndrome	Deletion in short arm of chromosome 5	Microcephaly, increased distance between eyes, moon face, severe mental deficiency, cat like cry of neonate.
Patau's syndrome	Trisomy 13 (extra chromosome number)	Left palate and lip, polydactyl, mental retardation, anomalies in dermal pattern, heart viscera and genitalia.

## GENETICS

It is the study of heredity and variations. The term 'Genetics' was coined by W Bateson in 1905. **Gregor Johann Mendel** (commonly called **Father of Genetics**) proposed three laws

- Law of Dominance** It states that crossing of plant with red and white flower produced plants only with red flower i.e., dominant trait appear and recessive disappeared.
  - Law of Segregation** It states that allele of a gene separate during gamete formation. It is also called law of purity of genetics or law of splitting of hybrids. It gives 3 : 1 ratio in F<sub>2</sub> generation.
  - Law of Independent Assortment** It states that two or more genes assort independently during inheritance. It gives 9 : 3 : 3 : 1 ratio in F<sub>2</sub> generation. Linkage is an exception to this law.
- Test Cross** The cross between heterozygous F<sub>1</sub> and homozygous recessive is called test cross. In test cross, the monohybrid ratio is 1 : 1 and dihybrid ratio is 1:1:1:1.
  - Back Cross** The cross between heterozygous F<sub>1</sub> hybrid and homozygous dominant allele is called back cross.



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## Some Important Genetic Terms

- **Phenotype** It is the physical appearance of an individual.
- **Genotype** It is the entire genetic complement of an individual organism.
- **Alleles** The two individual genes in a particular gene pair that occupies same locus (position) on homologous pair of chromosome.
- **Dominant and Recessive Traits** (inherited character) The traits may be dominant or recessive depending upon the fact that on crossing the individuals (which are homozygous for a particular trait of same character the trait which appears in the F<sub>1</sub> generation is called dominant and the other one is recessive.
- **Hybrid** An offspring, which is obtained from a cross between two genetically different parents.
- **Linkage** The phenomenon of genic inheritance in which genes of a particular chromosome show their tendency to inherit together, i.e., tendency to retain their parental combination even in the offsprings is known as linkage.
- **Mutation** It is a sudden change of a gene (gene mutation) or chromosome (chromosomal mutation) from one form to another, which are passed to the daughter cells.
- **Heteroploidy** It is the variation in chromosome number.
- **Pleiotropy** It occurs when one gene influences multiple phenotypic traits.



Name	Chromosomes Complement	Effect
Turner's syndrome	44+XO (45)	Phenotypically female, sterile due to undifferentiated gonads, webbed neck, low posterior hair line increased carrying angle of elbow, short stature.
Noonan's syndrome	44+ YO (45)	Phenotypically male, short stature, webbed neck, drooping upper eyelid, little development of gonads.
Super males	44+XYY (45)	Male, tall, excess testosterone secretions, subnormal intelligence.
Super females	44+XXX(47) 44+XXXX(48)	Female, mental retardation, low fertility but genitalia normal.
Klinefelter's syndrome	44+XXY(47) 44+XXYY(48)	Male tall with long legs, some with gynecomastia, small testes, azospermia, infertile, increased excretion of gonadotropin.

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Disorder	Dominant/ recessive	Autosomal/ Sex-linked	Symptoms	Effect
<b>Phenylketonuria</b>	Recessive	Autosomal (chromosome 12)	Failure of brain to develop infancy mental retardation.	Defective form of enzyme phenyl alanine hydroxylase.
<b>Sickle-cell anaemia</b>	Recessive	Autosomal (chromosome 11)	Aggregation of erythrocytes, more rapid destruction of erythrocytes leading to anaemia.	Abnormal haemoglobin in RBCs
<b>Haemophilia A/B</b>	Recessive	Sex-linked (X-chromosome)	Failure of blood to clot.	Defective form of blood clotting factor VIII/IX.
<b>Colour blindness</b>	Recessive	Sex-linked (X-chromosome)	Failure to discriminate between red and green colour.	Defect in either red or/and green cones.
<b>Huntington's disease</b>	Dominant	Autosomal (chromosome 4)	Gradual degeneration of brain tissue in middle ages.	Production of an inhibitor of brain cell metabolism.
<b>Cystic fibrosis</b>	Recessive	Autosomal (chromosome 7)	Mucus clogging in lungs, liver and pancreas anomalies.	Failure of chloride ion transport mechanism.





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## Vitamins

- **Vitamin C** was the first vitamin to be produced by a fermentation process using Acetobacter, a wild bacterium.
- Bacteria used for industrial production of **vitamin-B12** are propionibacterium shermanii, P. freundenreichii and Pseudomonas denitrificans.
- **Vitamin-B2 (Riboflavin)** is synthesised by many micro-organisms including bacteria, yeasts and fungi. The fungus, Ashbya gossypii is **used for the microbial production of vitamin-B2**.

## Biotechnologies in Human Health

- **Monoclonal antibodies** are made outside the body by the hybrid cell cultures known as **hybridomas**.
- Monoclonal antibodies (mAb) are antibodies that are identical because they were produced by one type of immune cell and are all clones of a single parent cell.
- **A biochip** is a discrete collection of gene fragments on a stamp-sized chip that can be used to screen for the presence of particular gene variants.
- Biochips allow rapid screening of gene profiles, a tool that promises to have a revolutionary impact on medicine and society.
- Biochips can **help in identifying precise forms of cancer**.
- **Gene therapy** is the treatment of disease by replacing, altering or supplementing a gene whose absence or abnormality is responsible for the disease. Gene therapy is unique as it employs the genetic material, i.e. DNA, itself as the means of treatment.
- DNA finger printing is the technique, in which the banding pattern of DNA fragments is compared and can be used in many species, including human, to indicate relativity. (used for rape victim, paternity, other criminals).
- **Human insulin or humulin** is the first genetically engineered pharmaceutical product, developed by Eli Lilly and company in 1982.
- **Genentech**, a California-based company, have produced **human growth hormone** (hGH) from genetically engineered bacteria.
- **Somatostatin** is the first polypeptide, which was expressed in E coli as a part of the fusion peptide.
- **BST or Bovine Somatotropin** is produced in a large quantity from milk production in cows.
- In 1997, a transgenic cow '**Rosie**' produced human alpha-lactalbumin protein enriched milk (2.4 grams per litre).
- It is possible to cure **phenylketonuria** disease by using recombinant DNA techniques in early period of pregnancy.
- **Urokinase** is involved in dissolution of blood clots. It has been synthesised in huge quantity by using genetically engineered bacteria with urokinase genes.



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Antibiotics	Source	Action
<b>Penicillin</b>	Penicillium chrysogenum, P notatum + Phenyl Acetic Acid	<b>Tonsillitis, Sore Throat, Gonorrhea, Rheumatic Fever, some Pneumonia types</b>
<b>Griseofulvin</b>	Penicillium griseofulvum	<b>Antifungal, especially for Ringworm</b>
<b>Nystatin</b>	Streptomyces noursei	<b>Antifungal for Candidiasis and overgrowth of Intestinal Fungi during excessive antibiotic treatment.</b>
<b>Hamycin</b>	Streptomyces pimprina	<b>Antifungal Antibiotic</b>
<b>Fumagillin</b>	Aspergillus fumigatus	<b>Broad spectrum antibacterial especially against Salmonella and Shigella.</b>
<b>Bacitracin</b>	Bacillus licheniformis	<b>Syphilis, Lymphonema or Reticulosis.</b>
<b>Streptomycin</b>	Streptomyces griseus	<b>Meningitis, Pneumonia, Tuberculosis and Local Infection. Toxic in some, through eighth cranial nerve.</b>
<b>Chloramphenicol</b>	Streptomyces venezuelae,	<b>Typhoid, Typhus, Whooping cough,</b>
<b>Chloromycetin</b>	S. lavendulae	<b>Atypical Pneumonia, Bacterial Urinary Infections.</b>
<b>Tetracyclines/ Aureomycin</b>	Streptomyces aureofaciens	<b>Viral pneumonia, Osteomyelitis, Whooping Cough. Eye infections.</b>
<b>Oxytetracycline /</b>	Chlorotetracycline □	<b>Intestinal and Urinary Infections</b>
<b>Terramycin</b>	Hydrogenation Streptomyces rimosus	<b>(Spirochaetes, Rickettsia, Viruses)</b>
<b>Erythromycin</b>	Streptomyces erythreus (= S. erythraeus)	<b>Typhoid, Common Pneumonia, Diphtheria, Whooping Cough etc.</b>
<b>Gentamycin</b>	Micromonospora purpurea	<b>Effective against Gram (+) bacteria</b>
<b>Polymixin</b>	<b>Bacillus polymyxa</b>	<b>Antifungal</b>

## AGRICULTURE

Agriculture is derived from Latin words Ager and Cultura. Ager means land or field and Cultura means cultivation. Therefore, the term Agriculture means cultivation of land, i.e., the science and art of producing crops and livestock for economic purposes. It was the key development in the rise of sedentary human civilisation, whereby farming of domesticated species created food surpluses that nurtured the development of civilisation.

## AGRONOMY

The branch of agriculture that deals with field crop production and soil management. Agronomists generally work with crops that are grown on a large scale (e.g., small grains) and that require relatively little management. Agronomic experiments focus on a variety of factors relating to crop plants, including yield, diseases, cultivation and sensitivity to factors such as climate and soil.

## Cropping Pattern

### Crop Rotation

It is the practice of growing a series of dissimilar types of crops in the same area in sequential seasons. It confers various benefits to the soil. Crop rotation also mitigates the build-up of pathogens and pests that often occurs, when one species is continuously cropped and can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants.

### Intensive Cropping

It refers to efficient use of water, nutrients and tillage. The interdependence of and synergies among water, nutrients and energy in regard to increasing crop performance is generally preferred.

### Zero Tillage

It is a way of growing crops from year to year without disturbing the soil through tillage. No-till is an agricultural technique, which increases the amount of water and organic matter (nutrients) in the soil and decreases erosion. It increases the amount and variety of life in and on the soil.

It has two distinctive features

- **Sole Cropping** It is to cultivate a pure variety of crop.
- **Monoculture** Planting a sole crop in a field regularly but harvest it single in a year.

### Companion Planting/Cropping

It is the planting of different crops in proximity on the theory that they assist each other in nutrient uptake, pest control, pollination and other factors necessary in increasing crop productivity.

## Intercropping

It is the practice of **growing two or more crops in proximity**. It is particularly important not to have crops competing with each other for physical space, nutrients, water or sunlight.

The most common goal of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilised by a single crop.

## Multiple Cropping

It is the practice of growing two or more crops in the same space during a single growing season.

It can take the form of double-cropping, in which a second crop is planted after the first has been harvested or relay cropping, in which the second crop is started amidst the first crop before it has been harvested.

## Farming System

### Mixed Farming

It is one in which crop production is combined with the rearing of livestock. The livestock enterprises are complementary to crop production, so as to provide a balance and productive system of farming.

### Ranching

It is the practice of raising the grazing livestock such **as cattles, sheep or poultry**. The area is known as **ranch** and the practice is called ranching. The ranching and cowboy tradition originated in Spain. During the Reconquista in middle ages the Spanish nobles got huge lands on grants.

### Terrace Farming

It is a piece of sloped land, which has been landscaped in such a way that, the practice of farming can be easily carried out.

Generally, this type of farming is done in the mountain regions along the slope. The land is cutout along the slope and terraces are made. This system is more common in North-Eastern hilly tracts of India.

### Truck Farming

### (Marketing Gardening)

It is a horticultural practice of **growing fruits, vegetables, etc.**, on commercial basis, in trucks for direct delivery to big restaurants, hotels and motels. This technique was evolved by the english speaking farmers, who referred them as truck farms in 19th century.





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## Organic Farming

Organic agriculture means a process of developing a viable and sustainable agroecosystem. It is an **agricultural practice that relies on crop rotation, green manure, compost and biological pest control.**

Organic farming uses fertilisers and pesticides but strictly limits the use of synthetic fertilisers, pesticides, plant growth regulators such as hormones, livestock antibiotics, food additives and genetically modified organisms.

## Blanching

In it, the young shoots of a plant are covered to exclude light to prevent photosynthesis, which would produce chlorophyll and thus, remain pale in colour. Blanched vegetables have a more delicate flavour and texture than unblanched.

## SEED SCIENCE

- It is a basic and most important input of agriculture. A good quality seed is one, which is free from adulterants, diseased or insect-pest infestations, which hinder or reduce the quality of a seed.
- The era of hybridisation of seeds started after 1930. The hybrid seeds are the cross bred seeds, which are artificially developed so as to have the desirable characters. While developing a hybrid seed, it goes through the various developmental stages.

These are

- **Nuclear Seed** It is initial pure seed of an improved variety available with the breeder.
- **Breeder's Seed** It is the seed obtained from the progeny (generation) of nucleus seed.
- **Foundation Seed** The breeder seeds grown on State Government farms and agriculture universities under scientific observations and check.
- **Registered Seed** The seeds grown from nucleus, breeder's and foundation seeds.
- **Certified Seed** The seeds certified before release as a new variety having all the desirable characters.

## Synthetic and Composite Seed Varieties

- **Synthetic variety:** It is a variety developed by selecting a number of inbred lines with good General Combining Ability (GCA). Synthetic varieties can be developed by using clones or inbreds, e.g., ICMS 7703.
- **Composite variety:** It is a variety that is developed by mixing of seeds of various outstanding inbred lines, which have similar characteristics. So, the exact reconstitution of composite variety is not possible, e.g., Sona, Shakti, African tall etc.



## Hybrid Seed

- It is produced by cross-pollinated plants. In hybrid seed production, the crosses are specific and controlled. The advantage of growing hybrid seed compared to inbred lines comes from heterosis.
- To produce hybrid seed, elite inbred varieties are crossed with well-documented and consistent phenotypes (such as yield) and the resulting hybrid seed is collected.

## Artificial Seed

It is encapsulated plant propagule (somatic embryo/shoot bud) in a suitable matrix, containing substances like nutrients, growth regulators, herbicides, insecticides, fungicides and mycorrhizae, which will allow and help it to grow into a complete plantlet.

## Genetically Modified Seeds

It is that they have been altered or modified, through biotechnology to have their genetic structure changed. This is usually accomplished by either adding or taking away genes of the original.

## Terminator Seed

The term Terminator seeds as it applies to the area of agriculture can be defined as a descriptive term used by some for seeds that have been genetically engineered to produce a crop whose first generation produces sterile seeds, thus preventing a second generation from being grown from seeds saved from the first.

## Traitor Technology

In this technology, to make the induced gene active, certain chemicals are used. Many Multi National Corporations (MNCs) are trying to bring this in India and environmentalists are opposing it.

## Crop Diversification

It is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. **Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops.**

## AGROFORESTRY

It is an integrated approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock. It combines agricultural and forestry technologies to create more diverse, productive, profitable, healthy and sustainable land-use systems. A narrow definition of agroforestry is trees on farms.



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## Vermicomposting

It is a method of using worms to transform organic waste into a nutrient-rich fertiliser. It is a healthy and clean way to eliminate wastes going into our landfills, which improves the environment. Vermicomposting is inexpensive and only takes two to three months to produce results.

## Plant Preservation

Like other organisms plants can also be infected with the disease. All these disease causing agents are called **Pests**. Main causative agents are virus, bacteria and fungi. As for example, wheat is infected with rust and smut. In paddy, generally blast is found, which is spread by Gandhi bug. In cotton, bollworm causes disease. Keeping fruits and vegetables fresh for a longer period without hampering its physical and chemical properties, is called fruits and vegetables preservation. Essential Commodities Act, 1955 has Part-3 for its revelation.

## Methods of Preservation

Various methods of preservation are

### Low Temperature

Microbes become inactive at **low temperature**. We can keep them in freezer.

### Pasteurisation

It is a mild heating treatment at temperatures up to 100°C (which is the boiling point of water at elevations up to 300 metres above sea level). This method causes only a slight decrease in taste and nutritional value. Pasteurised products therefore spoil faster than sterilised products.

### Canning

There are two primary methods of canning A hot water bath and pressure canning which ever method you use, be sure to use jars with lids made specifically for that technique. Glass canning jars, which are reusable, come in various sizes (most are single pints or quarts), so choose one that best suits your canning needs.

## Integrated Pest Management (IPM)

It is an ecological approach to agricultural pest control that integrates pesticides/herbicides into a management system incorporating a range of practices for economic control of a pest. An IPM system is designed around six basic components

### Acceptable Pest Levels

- The emphasis is on control, not eradication. IPM programmes first work to establish acceptable pest levels, called action thresholds and apply controls if those thresholds are crossed. IPM holds that wiping out an entire pest population is often impossible and the attempt can be expensive and environmentally unsafe.

- These thresholds are pest and site specific, meaning that it may be acceptable at one site to have a weed such as white clover, but at another site it may not be acceptable.
- By allowing a pest population to survive at a reasonable threshold, selection pressure is reduced. This stops the pest gaining resistance to chemicals produced by the plant or applied to the crops. By not killing all the pests there are some un-resistant pests left that will dilute any resistant genes that appear.

## Preventive Cultural Practices

Selecting varieties best for local growing conditions and maintaining healthy crops is the first line of defence, together with plant quarantine and cultural techniques such as crop sanitation (e.g., removal of diseased plants to prevent spread of infection).

## Monitoring

Regular observation is the cornerstone of IPM. Observation is broken into two steps, first inspection and second, identification. Visual inspection, insect and spore traps and other measurement methods and monitoring tools are used to monitor pest levels. Since, insects are cold-blooded, their physical development is dependent on the temperature of their environment. Many insects have had their development cycles modelled in terms of degree days. Monitor the degree days of an environment to determine when is the optimal time for a specific insect's outbreak.

## Responsible Pesticide Use

Synthetic pesticides are generally used as required and often only at specific times in a pest life cycle.

## Locust Control and Research

On seeing the grave situation of locust attack, a warning centre as, locust warning organisation has been created, at Jodhpur. It has locust surveillance and monitoring through 5 circle offices and 23 outposts.

## Mechanical Controls

They include simple hand-picking, erecting insect barriers, using traps, vacuuming and tillage to disrupt breeding.

## Biological Controls

The main focus for biological control is on promoting beneficial insects that eat target pests. Biological insecticides, derived from naturally occurring [microorganisms \(e.g., Bt, entomopathogenic fungi and entomopathogenic nematodes\)](#).



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## Animal Husbandry

The rearing of animals for specific purposes is called domestication and such animals are called domestic animals. Domestication of animals started during the hunting and gathering phase of human civilisation.

## BUFFALOES

Bubalus bubalis is its scientific name. Generally, it is assumed that India is place of its origin. There are two types breeds of buffaloes

### Exotic or Marshy

These are generally found in **Myanmar, Philippines, Malaysia, Thailand, Singapore, Indonesia, China**. These are used for cart mainly. Its breeds are **Jerangi, Kuhzestani, Ongole, Sinhala, Manofi, Suinue and Walede**.

### Aquatic or Indian

These are heavy or light weighted and generally preferred to stay in water. It has low heat-tolerance capacity.

These are again categorised into two types

### Heavy Weight Buffaloes

It includes three breeds

- **Jaffrabadi** Its place of origin is supposed to be at Junagarh, Kutch and Jamnagar of Gujarat. It gives 15-18 L milk per day. Its milk contains 7-9% fat.
- **Murrah** It found generally in Punjab, Haryana, Delhi, Rajasthan, Uttar Pradesh etc. It generally gives about 25 L milk per day.
- **Nili Ravi** It is found mainly in Ferozpur of Punjab. Horns are small, white spots on mouth and head. Gives on an average 1500-1800 L milk per year.

### Light Weight Buffaloes

It includes following breeds

- **Bhadawari** It is generally found in Etawah, Agra, Gwalior and surrounding areas. It gives 4.5 L milk per day. 12-14% fat is found in its milk. Male buffaloes are used as load carrying cattle.
- **Mehsana** It is found in Mehsana, Sabar Kantha, Palanpur and Banaskatha. It gives 8-9 L milk per day. 8-13% fat is present in its milk. It is considered as a hybrid of Murrah and Surti breeds.
- **Surti** It found in Gujarat, South-West part, Anand, Nadiad and Vadodara. It gives on an average 1700 L milk per year. 8-12% fat is available in its milk.
- **Nagpuri or Ellichpuri** It found in Nagpur, Akola and Amrawati. It gives on an average 1000-1200 L milk per year. 7-8% fat is present in its milk.
- **Tarai** It found in Tarai belt of Ramnagar, Tanakpur. It gives about 900-1200 L milk in a year.
- **Manda** It found in the boundary of Mondosa and Parlakimedi mountain. Male is used for carrying heavy loads.



- **Toda** It found on the Nilgiri mountain in Tamil Nadu. It gives about 4-8 L milk per day.

## COWS

Scientific name of cow is *Bos indicus* and *Bos taurus*. In India, 30 varieties of cows are present. Rearing of cow and bull is preferred in India. 16% of the world cow and bull are present in India.

## Varieties of Cows

Some varieties of cows are as follows

## Humped Indian Breeds

These are high milk-yielding and their calves are not used for agricultural purposes.

Following are its important breeds

- **Sahiwal** Actually found in Mont- Gomari in Pakistan. In India, it is found in Punjab, Delhi, Uttar Pradesh, Madhya Pradesh and Bihar. It gives around 2150 L milk in a year. 4-6% is content of fat in its milk.
- **Red Sindhi** Found in Allahabad, Guwahati, Bengaluru. It gives around 5440 L milk in a year.
- **Gir** Generally found in Junagarh, Kathiawad, Mumbai, Pune, Ahmedabad, Hyderabad. Oxen are very strong. It gives 1746 L milk on an average. Fat content is 4-5% in its milk.
- **Deoni** Similar to Gir breed. It gives 1600-1650 L milk in a year. Fat content is 4-5% in its milk.

## Dual Purpose Breeds

These breeds give more milk along with its calf is very useful in ploughing. Following are its breeds

- **Haryana** It found in Rohtak, Haryana. It give 1000-1100 L milk in a year. Maximum milk yielding capacity is 3178 kg/yr Calf is best for ploughing activities.
- **Nimari** It mainly found in Khargaun. Oxen are very strong.
- **Tharparkar** It mainly found in Kutch, Marwar and in Northern Mumbai. It is also known as Thari. Its average milk yielding capacity is 1474 kg.

## Load Carrying Breeds

- **Nageri** Main place of origin is believed to be Rajasthan. Now maximum found in Haryana, Uttar Pradesh and Punjab. Famous for fast walk and heavy load.
- **Malvi** Main place of origin is Uttar Pradesh, now also found in Madhya Pradesh and in Rajasthan.
- **Amritmahal** It found in Mysore of Karnataka. These breeds are fast running and quick.
- **Gangatiri** Main place of origin is Uttar Pradesh. These are very useful for agricultural practices.



- **Siri** It basically a hilly breed. Found in Darjeeling and Sikkim. Used in carrying heavy loads.

## Without Humped Cows (Exotic Breeds)

### Milk Yielding Breeds

- **Jersey** Its colour is almond and body is, spotted, milk yielding capacity is 4500 L per year 5% fat content in its milk.
- **Brown Swiss** It mainly found in Switzerland. It gives 5200 L milk in a year. Fat content is 4%.

## SHEEP

There are many breeds of sheep (*Ovis aries*) in our country. Today sheeps are raised in all parts of the world. Sheep provides us with wool, skin and mutton. A sheep lives for about 13 years.

### Exotic Breeds of Sheep

- **Merino** This is the main representative of the Merino breed in Australia and is found in extremely high number throughout New South Wales, Queensland, Victoria and Western Australia.
- **South Devon** The South Devon is a longwool and meat breed which originated in South Devon and Cornwall in England. They are of the English Longwool type and are similar to Devon Longwoolled but are larger. Both sexes are polled and are naturally hornless.
- **Lincoln** It is found in England and it is useful for wool and meat.
- **Corriedale** It is mainly found in New Zealand and Australia. It is useful for wool and meat.
- **Romney Marshy** The Romney Marshy are found in England. Romney wool has the finest fibre diameter of all the longwool breeds. These are mainly used for wool production.

### Shearing of Wool

It is essential to promote the health of sheep. The removal of hairs (wool) from the recommended periods for shearing of wool are winter (February-March) and rainy (August- September) season when rich grazing ground is available.

The sheeps are washed properly before the removal of hairs. The manufacture of wool from sheep hairs is a complicated process consisting of cleaning, drying, bleaching, dyeing, spinning and twisting.

## GOAT

There are many breeds of goat (*Capra capra*) in our country. Goat provide us milk, meat, skin and hair. The fine soft wool called Pashmina is the underfur of Kashmir and Tibet goats.

## Noori

World's first Pashmina goat clone, produced in Kashmir has been named Noori and Arabic word referring to light. Funded by world bank, the clone project was a jointy worked on Skaust and Nari Karnal.

The clone has come as good news for fine fibre producing Pashmina goats, which are only spotted at an altitude of 14,000 feet in **Ladakh**.

## Asom Hilly Breeds

These are smaller dwarf breeds of goats found in the hilly tract of Asom and other Eastern states.

## PIGS

- It is also called hog or swine and is an omnivorous, non-ruminant, gregarious mammal of genus *Sus*.
- All breeds of pigs have descended from the European wild boar *Sus scrofa* or a crossbreed of this and the Asiatic species,
- *S. indicus*. The care and management of pigs is called piggery.
- Pigs are the most prolific breeders and quick growers among the domestic animals.
- A group of 10 sows (female hog) and one boar may produce over 160 piglets in a year.
- Pigs are most useful domestic animals, especially of lower classes of society. They are most economical source of meat and animal fat.

## GV KAKSHA OPEN UP YOUR LEARNING CAMELS

The camel is a large, horn less, ruminant mammal of genus *Camelus*. It is popularly called the **ship of the desert** because of its great travelling power in a desert.

It is a valuable beast carrying burden in hot desert and semi-desert regions as it can live on minimum food and water when travelling with load. There are two types of camels

1. **Arabian camels** (*Camelus dromedarius*) With a single hump, short hair and found in North Africa to India. It does not occur in wild form.
2. **Turkish or Bactrian camels** (*Camelus bactrianus*) With two humps, long hair and found in Gobi desert of Central Asia. It occurs in wild form also.



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## Scientific Names of Fruits

Fruit	Scientific Name
Mango	Mangifera India
Orange	Citrus aurantium
Apple	Pyrus Malus
Banana	Musa Paradisiaca
Guava	Psidium Guajava
Water Melon	Citrullus Lanatus
Sweet Potato	Ipomoea Batatas

## Scientific Names of Vegetables

Vegetables	Scientific Names
Potato	Solanum Tuberosum
Tomato	Lycopersicum Esculentum
Ginger	Zingiber Officinale
Onion	Allium Cepa
Turmeric	Curcuma Longa
Capsicum	Capsicum annum
Lemon	Citrus Limon
Black pepper	Piper Nigrum
Carrot	Daucus Carota
Coriander	Coriandrum Sativum



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## Scientific Names of Plants

Plants	Scientific Names
Tulsi	Ocimum Santurum
Neem	Azadirachta Indica
Rose	Rosa
Tea	Camellia Sinensis
Tobacco	Nicotiana Tabacum
Cotton	Gossypium
Peepal	Ficus Religiosa Linn
Bamboo	Bambusoideae
Saffron	Crocus sativus
Sugar Cane	Saccharum
Maize	Zea Mays



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## Scientific Names of Animals

Animal	Scientific Names
Frog	Anura / Rana Hexadactylus
Dog	Canis Familiaris
Cobra	Naja Naja
Cat	Felis catus
Camel	Camelus Dromedarius
Bird	Aves
Cockroach	Blattodea
King Cobra	Ophiophagus Hannah
Mosquito	Culicidae
Fox	Vulpes Vulpes
Python	Python Molurus
Cow	Bos Taurus
Nilgai	Boselaphus Tragocamelus
Lion	Panthera Leo
Pig	Sus
Sparrow	Passeridae
Honey Bee	Apis
Tiger	Panthera Tiger
Sheep	Ovis Aries
Peacock	Pavo Cristatus





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Animal	Scientific Names
House Fly	Musca Domestica
Zebra	Equus Quagga
Monkey	Cercopithecidae
Rat	Rattus Rattus
Lizard	Lacertilia
Butterfly	RhopaloCera
Horse	Equus Caballus
Cheetah	Acinonyx Jubatus
Sea Snake	Hydro Phiinae
Snake	Serpentes
Giraffe	Giraffa
Rabbit	Oryctolagus Cuniculus
Elephant	Elephantidie
Fish	Vertebrata
Eagle	Accipitridae



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## PH Value of Elements

Element	PH Value
Pure water	7
Vinegar	2.5-3.4
Wine	2.8-3.8
Milk	6.4-6.6
Ocean water	8.4
Saliva	6.5-7.5
Urine	4.8-8.4
Blood	7.4
Lemon juice	2.2-2.4

## Glasses & their Use

Glass	Usage
Flint Glass	Camera, Lens
Pyrex Glass	Testing labs, kitchen pots
Soda Glass	Tube light
Crown Glass	Electric Bulb
Crooks Glass	Spectacles
Potash Glass	Spectacles, Kitchen Pots
Mild Glass	Test Tube, Wine Glass

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## Scientific Studies of Different Fields

Field	Study
Study of coins	Numismatic
Study of Sound	Acoustics
Study of Insect moth	Entomology
Study of Birds	Ornithology
Study of Silk Insect	Sericulture
Study of Honey Bee	Apiculture
Study of Fruits Production	Horticulture
Study of Fisheries	Pisciculture
Study of Fungus	Mycology
Study of Algae(shaiwal)	Fycology
Study of Flowers	Anthology
Study of Fruits	Pomology
Study of Fishes	Ichthyology
Study of Snakes	OPhyology
Study of Trees	Dendrology
Study of Lizards	Sorology
Study of Serum	Serology

## Substance used for Glass Colour

Cuprous Oxide	Red
Cupric Oxide	Peacock Blue
Potassium Dichromate	Greenish Yellow
Ferrous Oxide	Green
Ferric Oxide	Brown
Manganese Oxide	Pink
Cobalt Oxide	Blue
Gold Chloride	Ruby
Cadmium	yellow

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## ➤ Diseases Caused by Virus

Disease	Virus Name	Spread by
Yellow Fever	Flavi Virus	By Mosquito bite- Aedesaegypti
HIV Aids	Human Immunodeficiency Virus	Sexual Contact ELISA Test
Nipah Virus	Nipah Virus	Exposure to Bat & Pig
Ebola	Ebola Virus	Infected by Animal Bite
Zika	Zika Virus	Aedes Mosquito
Japanese Encephalitis	Japanese Encephalitis Virus	By Mosquito Bites
Polio	Polio Virus	Contagious Viral Infection due to poor Sanitation
Covid-19	Corona Virus	By contact RTPCR Test

## ➤ Diseases Caused by Bacteria

Disease Name	Caused by	Spread by
Tuberculosis	Mycobacterium Tuberculosis	In Contact With Infected Person
Pneumonia	Streptococcus Pneumoniae	In Contact With Infected Person having Cough
Cholera	Vibrio Cholerae	Contaminated Water Poor sanitation
Typhoid	Salmonella Typhi	Contaminated Food & Water
Leprosy	Mycobacterium Laprae	In Contact With Infected Person

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## ➤ Diseases Caused by Fungi

Disease Name	Caused by	Spread by
Ring Worms	Skin Contact	Humans
Rust of wheat	Air/ Seeds	Wheat & other crops
Athletiz Foot	--	--
Maclura Foot	--	--

## ➤ Diseases Caused by Protozoa

Disease Name	Caused by	Spread by
Kala-Azar	SandFlies	Humans
Malaria	Female Anopheles Mosquito	Humans
Dysentery	--	--
Sleeping-Sickness	Tsetse Fly	Humans
Okra(Ladies Finger)	Insects	Okra Plant
Anthrax	Contact With infected Meat	Most Animals including Humans
Cholera	Water/Food	Humans
Citrus Canker	Air	Citrus Fruit Plants





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## Latest Previous Year Questions

### Graduation Level Questions- Phase 9

- The exaggerated response of the **immune system** to certain antigens present in the environment is called allergy.
- **Euglena** does NOT figure among the Five Kingdom Classification proposed by RH Whittaker (1969).
- **Malaria** is NOT a disease caused by bacteria.
- **Rotenone** is an example of a natural pesticide.
- **Amphibians' eyes are without eyelids** is NOT a characteristic of Amphibia class of animals.
- Ascariasis, a disease is caused due to **Common round worms** helminths is known to be pathogenic to man.
- Different species of Plasmodium (a tiny protozoan) are responsible for different types of malaria, of these, malignant malaria is the most serious is caused by **plasmodium falciparum**.
- **Abiotic factor** is the term used for a non-living part of an ecosystem that shapes its environment.

### Higher Secondary Level- Phase 9

- **Plasmodium** Parasites are responsible for Malaria in Humans.
- Plants & Animals communities living together in similar climatic conditions are called **Biome**.
- **Pedagogy** related to study Soils as a collection of natural bodies.
- **Vitamin D** made in the Kidneys
- **Herpetology** is the branch of Zoology that deals with the study of Amphibians & Reptiles.
- **Albumin** Proteins is found in Plasma.
- **Phylum Echinodermata** is group of animals are Marine & characterised by a spiny skin.
- Ozone depletion from the atmosphere becomes the reason for causing of **Skin Cancer**.
- The natural aging of a lake by nutrient enrichment of its water is called **Eutrophication**.
- Elephantiasis, also known as Lymphatic Filariasis, is caused by **Parasitic Worms**.
- **Allergy** also known as Hypersensitivity, is used to describe a condition in which the human body has an exaggerated response to a substance (e.g- Food & Drug)
- **Mental Barriers** is not a Barrier under innate immunity.
- **Monera & Bacteria** are included in kingdom.
- **Autotrophs or the Producers** is at the first trophic level of the food chain.
- The naked-seeded plants are called **Gymnosperms**.
- Malaria is caused by the **Plasmodium Protozoa**.

### Latest Matriculation Level Questions

- Respiratory failure is a condition in which your blood doesn't have enough **Oxygen** or has too much **Carbon dioxide**.
- Herpetologist Deepak Veerappan has a **Snake** named after him which is known as "Xylophis Deepaki"
- **Redworms** need moist Surroundings for their survival.
- Mosaic is a viral Disease that affects **Plants**.
- Human red Blood cells are formed mainly in the **Bone Marrow**.
- The **canopy Layer** is the Primary layer of the rainforest & forms a roof over the two remaining Layers.
- Honey is composed of water & two types of Sugars: **Fructose & Glucose**.
- The inability to utilise voluntary motor abilities effectively in all the aspects of life from play to structured skilled tasks is known as **Dyspraxia**.,
- **Vegetative, Sexual & Asexual** are three processes of reproduction in plants. **All of them** are adopted by algae.
- **Queen Honey Bee** is not a Hermaphrodite.
- **Vitamin K** dependent Carboxylase is found in the liver.
- **3 Hydrogen Atoms** are in a molecule of Phosphoric Acid.
- During the process of respiration in plants, **Oxygen** is not released as a product.
- Crayfish & Ticks are classified into **Crustacean & Arachnida**, respectively.
- Roots that grow out from the tree trunk & which helps to support the tree are called **Buttress Root**.
- Elephantiasis Disease in which there is chronic inflammation of the organs, is caused by **Wuchereria**.
- Ciliate, or ciliophoran are the member of **Protozoa**. CREATIVE LEARNING
- The most unique characteristic of animals of the Mammalia class is the presence of **Mammary glands**.
- Common cold is caused by the **Rhino Virus**.
- Typhoid Fever could be confirmed by **Widal Test**.
- **Octopus** is an example of the Phylum Mollusca.

## SSC CGL 2020 all Questions

- **Nephron** is the structural and functional unit of kidney.
- Carbon and energy requirements of an autotrophic organism are fulfilled by **Photosynthesis**.
- **Two** arteries are there in an umbilical cord.
- Lymph is a light clear fluid made up of white blood cells that attack harmful **bacteria** in the blood.
- Viscose fibre is obtained from **cellulose**.
- **Malaria** diseases is caused by a parasite.
- **Vitamin C** is a water-soluble vitamin.



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- **Bones** of the body is associated with the rickets disorder.
- **Arboriculture** is a practice of establishing and managing individual trees generally for amenity purposes.
- **Mycology** is a branch of biology that studies fungi.
- **Chlorophyceae** is also called "green algae".
- **Stomach** organs secretes hydrochloric acid that helps our body in killing pathogenic bacteria.
- **Termite** is another name for 'white ant'.
- **Totipotency** is the ability of a single cell to produce a fertile, adult individual.
- Melatonin encodes proteins in cells to prevent **virus** entry.
- **Yeast** ingredient is called the sugar eating fungus'.
- The vertebrae are a part of **Spinal cord** body systems in humans.
- **Mangifera indica** is the botanical name of mango.
- **Supply of food to plant parts** does NOT figure among the main functions of the root system of a plant.
- **Breathing root** is NOT a storage root.
- The colour of an emerald is generally **green**.
- **Sigmund Freud** is the founder of the field of psychoanalysis.
- **Diphtheria** diseases is caused by bacteria.
- **Venation** is the pattern of veins in the blade of a leaf.
- The scientific study of birds is called **ornithology**.
- **Wandering Albatross** is the largest sea bird with the longest wingspan.
- **Cytoplasm** includes glycogen, poly- $\beta$ -hydroxybutyrate granules, sulphur granules and gas vesicles.
- Collagen is a type of **protein**.
- Glucagon, a peptide hormone, is produced by the **pancreas**.
- Kala-azar disease is caused by **protozoa**.
- **Xylem** is the water transporting tissue in plants.
- Spider webs are made up of **Silk**, a natural fibre made up of protein.
- Homeostasis is the call the property of an organism of self-regulation and the tendency to maintain a steady state within an external environment which is liable to change.
- **Plague** is disease caused by a virus.
- **Eardrum** behaves like a stretched rubber sheet.
- The liver is affected and skin and eyes turn yellow due to the deposit of bile pigments. **Jaundice** is the digestive disorders is described here.
- **Kiwi** is a flightless bird.
- A **watershed** is a natural geo-hydrological unit of land, which collects water and drains it through a common point by a system of streams

- **Coral** is a sessile animal, that relies upon its relationship with plants like algae to build the largest structures of biological origin on earth.
- The scientific study of dreams is called **oneirology**.

### Latest NTPC Previous Year Questions of all Phases

- **Chicken Pox** is caused by a Virus.
- **Large intestine** is not a part of the circulatory System.
- **Carl Linnaeus** is the father of Taxonomy.
- **Photosphere** is the Glowing Surface of the sun.
- Lichen is an organism which monitors **Air Pollution**.
- **Fire Blight** disease related with Apple.
- Excessive Curvature of eye lens leads to **Myopia**.
- **Malawi** launched the first malaria Vaccine to immune children on the occasion of world malaria Day.
- **AB<sup>+</sup>** is considered as the Universal Recipient.
- Bile is secreted by the **Liver**.
- **Typhoid** is caused by the Bacteria.
- Beriberi is caused due to deficiency of vitamin **B1**.
- **Marchantia Plants** belongs to Bryophyta.
- **Spinal Cord** is composed of nerve fibres that transmit impulses to & from the brain.
- **Green plant** is not an abiotic component.
- **Metazoa** is classified under kingdom animalia.
- Botanical name of Banyan Tree is **Ficus Benghalensis**.
- **Robert Hooke** discovered Cell.
- The cause of Hepatitis A is a **Virus**.
- Taxol is extracted from **Yew Plant**.
- **Adipose Tissue** is the fat-storing Tissue in our body.
- **Mucus** protects the inner lining of the stomach from the action of acid, under normal conditions.
- **Autotrophs** use simple food material obtained from inorganic sources in the form of carbon dioxide & water.
- **Dendrite** part of a neuron is information required.
- Small bead-like structures inside the ovary of flowers is called **Ovules**.
- **Xylem** is the main tissue that transports water in a plant from its roots to its leaves.
- **Saliva** helps in food digestion.
- Zoological name of the Housefly is **Musca Domestica**.
- The smallest unit of the life capable of independent existence is **CELL**.



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- **High Blood Pressure** is an example of non-infectious disease.
- **Sarpagandha** medicinal plant can be used to Treat Blood Pressure.
- Litmus solution is derived from **lichen**.
- **Carbon dioxide** gas needed for photosynthesis .
- **Ribosomes** makes protein .
- **Ozone** protects the earth from ultra violet rays.
- female anopheles mosquitos a transmitter of **malaria**.
- **206** number of bones are present in human body.
- Scientific name of touch me not **mimosa pudica**
- When there is a lack of oxygen in our muscle cells 'the breakdown of pyruvate take place and it converted into **lactic acid & Energy**.
- Each kidney has a large no. of filtration units called **nephrons**.
- **Protochordata** is not a group of plants.
- **Eating food spoilt by microorganisms** is most likely to cause food poisoning.
- Blood is type of **Connective tissue**.
- Sugarcane plants are one of the most efficient convertors of **Sunlight** into chemical energy.
- **Vitamin K** activates proteins & calcium essential for Blood Clotting.
- **Redwood** is the tallest Tree in the world.
- **Ethology** describes the biological study of Animal Behaviour.
- **Marsilea Plants** has hidden reproductive organs.
- **Fermentation** is the process converting sugar into Alcohol.
- The inner lining of the small intestine has numerous finger like structures are called **Villi**.
- In human beings, **Haemoglobin** has a high affinity of Oxygen.
- **Crescograph** is an instrument used for measuring growth in plants.
- In a plant, the seed contains the embryo which develops into a seedling under appropriate conditions. This process is called **Germination**.
- **Theophrastus** is the father of Botany.
- **Gymnosperms** plant groups bear naked seeds.
- Iodine is essential for the synthesis of **Thyroxine**.
- **Lysosomes** are a kind of waste disposal system of the cell. They help to keep the cell clean by digesting any foreign materials as well as worn-out cell organelles.
- **Pituitary Gland**, which hangs by a thin stalk from the Hypothalamus, is called the master gland of the human body.
- **Haemoglobin** present in human blood that carries oxygen from our lungs to all parts of the body.





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- Kidney failure is treated periodically on a kidney machine. The process is called as **Haemodialysis**.
- **Nettle** is a plant which grows in the wild & has stinging hair on its leaves which cause painful stings when touched accidentally.
- **Fructose** is responsible for Sweetening in Fruits.
- **Lymph Fluid** carries absorbed fat from intestine & drains excess fluid from extra cellular space back into the blood.
- **Geomorphology** is the study of Landforms & their Evolution.
- **HCl** is produce from the human's Stomach.
- **Ingestion> Digestion> Absorption> Egestion** is the correct sequence of steps in digestive system.
- Near-Sightedness in Humans is called **Myopia**.
- **Ornithology** is the study of the Birds.
- Green plants & certain Bacteria manufacture their own food acc. To **Autotrophic Nutrition Process**.
- **Humming Bird** is that bird that can fly Backwards.
- The movement of a sunflower facing the sun is called **Phototropism**.
- **Pituitary Gland** is responsible for Dwarfism in Humans.
- **Leishmania** Unicellular Organism causes Kala-Azar.
- Human Growth Hormone is secreted by **Pituitary Gland**
- Andaman teal is an example of **Endemic Species**.
- **Epigraphy**- study of Inscriptions.
- **C. Linnaeus** gave the term 'Homo Sapiens'.
- **Triticum Aestivum** is the botanical name of Common Wheat.
- In human beings, Excretory products in the form of soluble nitrogen compounds are removed by the **Nephrons** in the kidneys.
- The book which keeps a record of all the endangered animals & plants is **Red Data Book**.
- **Liver** is the largest Gland of the body.
- **Cochlea** is not the part of the Eye.
- The Jelly like substance between the nucleus & cell membrane is called **Cytoplasm**.
- **Hyla** is also known as Tree Frog.
- **Auxin** is a Plant Hormone.
- **Hip Bone** is formed by the fusing of the illium, ischium & the Pubis.
- **Plastids** are only present in Plant cells.
- **Insulin** is an animal Hormone.
- **Protozoa** causes Kala-Azar.
- Parenchyma & Collenchyma are the types of **Simple Permanent Tissues**.



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- Trojan Horse is a form of **Virus Attack**.
- When respiration takes place even in absence of Oxygen, is called **Anaerobic Respiration**.
- Blood has a fluid matrix called **Plasma**, in which RBCs, WBCs & Platelets are suspended.
- **Tuberculosis** is not caused by a Virus.
- **Ligament** part of the Muscular System attaches Bone to Bone.
- **Estrogen** is a major Female Sex Hormone.
- **Edward Jenner** invented the Small pox vaccine.
- **Global Warming** can be attributed to 'Arctic Greening'.
- **Synovial Fluid** is the lubricating fluid found between the two bones at a moveable joint.
- Rods & cone cells are found in **Eyes**.
- **Rana Tigrina** is the Scientific name of Asian Frog.
- **Brassica Campestris** is the botanical name of Field Mustard.
- **Feline** is the generic name given to members of the Cat family.
- Non-Clotting of blood occurs because deficiency of **Vitamin K**.
- **AB<sup>+</sup>** is considered as universal Recipient.
- Humans cannot digest **Cellulose**.
- **Chlorofluorocarbons** responsible for the depletion of the Ozone Layer.
- **Respiratory System** is not found in Nematodes.
- Cytoplasm is a jelly like fluid is found between **Nucleus & Cell Membrane**.
- After Digestion Proteins are converted into **Amino Acids**.
- Pseudopodia are finger-like extensions on **Amoeba**.
- **Iron** is a micronutrient for crop Plants.
- The ultimate source of energy in plants is **Sunlight**.
- The release of **Adrenaline** Hormone causes simultaneous increase in heartbeat & breathing rate.
- **Heart & Brain** are the two main organs in the human body where the magnetic field produced is significant.
- **Carbohydrates** are stored in the form of starch which serves as an internal energy reserve to be used as & when required by the plant.
- **Penicillium** is a fungi.
- **HIV** leads to Aids.
- The ephedra plant is grouped under **Gymnosperm**.
- **Pollen** in polluted air causes Hay Fever.
- **Iodine** is essential for the synthesis of Thyroxine.
- Deficiency of **Vitamin A** causes the night Blindness.
- **Redwood** is the tallest tree Species in the world.



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- **Entomophily Pollination** occurs with the help of Insects.
- The energy Currency of the cell is called as **ATP**.
- **Plasma membrane** is the outermost covering of the cell that separates the contents of the cell from its external environment.
- Bamboo flowering causes **an increase in the population of rats**.
- **Funaria** is not a Thallophyte.
- **Spirogyra** is the plant body not differentiated into root, stem & leaves.
- **Cytology** is the study of Cell.
- **Goiter** is not an eye condition disease.
- **Carolus Linnaeus** is the father of binomial nomenclature of all species of living things.
- **Genus** level of classification of organisms comes between "Family & Species"
- **Cinchona** is the plant from the anti-malarial drug Quinine is extracted.
- **Xylem Tissue** part of a plant is responsible for transporting water from the roots of the plant to the rest of the plant.
- **Annelida** is not a vertebrate class.
- **Nomophobia** is fear of being out of cellular phone contact.
- **Stem** is the edible part of a potato plant.
- **Chlorophyll** is the pigment that gives plant their Green Colour.
- The fungus Puccinia graminis Causes **Black rust in wheat**.
- All the involuntary actions, including Blood Pressure, Salivation & Vomiting are controlled by the **Medulla**.
- In Human beings, the complete digestion of carbohydrates, proteins & fats take Place in **Small intestine**.
- Gastric glands produce the enzyme **Pepsin** during digestion, which digests proteins.
- Gustatory receptors are responsible for detecting **Taste**.
- **Petabyte** is the largest unit of memory.
- Plants having no vascular system known as **Bryophytes**.
- Synapse is the point at which a nervous impulse passes from **one neuron to another**.
- **Anthrax** is a disease caused by Bacteria.
- **Pepsin** used for the conversion of proteins into a peptide.
- Megaloblastic anaemia is caused by the deficiency of **Vitamin B9**.
- **Sunlight** natural resource is an inexhaustible Resource.
- **Green plants** is a biotic factor of an ecosystem.
- In human body, Salts are transported by **Plasma**.
- 'Touch me not' plant belongs to **Mimosaceae**.
- **Mangifera indica** is the scientific name of Mango.



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- **Eugenics** is the branch of science that aims at improving the genetic quality of human population.
- **Anxiety** is a tranquilizer normally administered.
- For treatment of **Heart disease** Arjuna Tree Primarily used.
- **Gibberella Fujikuroi** pathogen causes 'Bakane'(foolish seedling) disease in rice seedlings.
- The red panda eats **Bamboo leaves**.
- **Synovial Fluid** is found between the two bones at a moveable joint.
- **Vitamin A** has three active forms: Retinal, Retinol & retinoic Acid.
- **AIDS**- Acquired Immune Deficiency Syndrome.
- Function of Insulin in body- **It regulates how the body uses & stores Glucose & fat.**
- **Renal Artery** carries blood from the heart to the Kidneys.
- **Enzymes** is a Biological catalysts.
- **Trachea** is not a part of the alimentary canal of the human body.
- **Anthocyanins Pigments** are responsible to determine the colours of fruits & Vegetables.
- **Oxytocin** Hormones stimulates uterine contractions & dilation of the cervix.
- **Carbon dioxide, water & Sunlight** are required for Photosynthesis.
- **XX Chromosome** lead to the birth of a girl child.
- Common Name of E300- **Vitamin C.**
- **Arthropod Phyla** of animals have jointed legs.
- Corals are marine invertebrates with in the class Anthozoa of the Phylum **Cnidaria.**
- **Karl Landsteiner** discovered Blood Groups.
- A complete set of Nuclear DNA in an Organism is called **Genome.**
- **Oxygen** is not a green house gas.
- The petiole is a part of a **Tree.**
- **Sweet Revolution** related to production of Honey.
- **Deodar** Plants belong to Gymnosperms.
- **Diffusion** is a process by Oxygen can move across the plasma membrane.
- **Meristematic Tissue** is not an animal Tissue.
- The animals that can eat Plants & animals are called as **Omnivores.**
- **Carl Linnaeus** is the father of modern Botany.
- **Penicillium** is a Saprophytic Fungus.
- **Pisum Sativum** is the scientific name of Green Pea.
- **Saprophytic Nutrition** is in the organism takes in nutrients form from dead & Decaying Matters.
- **Rayon** is an example of manmade Fibre.
- The members of phylum **Echinodermata** are exclusively free-living marine animals.



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- The smallest Blood vessel is called **Capillary**.
- Light enters the eye through the **Cornea**.
- The branch-like structure of neurons is called **Dendrite**.
- The system of scientific naming organism was introduced by **Carolus Linnaeus**.
- **Glycogen** is the storage form of Carbohydrates in the body.
- **Knee joint** is the largest joint in the human body.
- **Vitamin K** activates proteins & calcium essential blood clotting.
- Leech belongs to the Phylum **Annelida**.
- Patients Suffering from **Diabetes** Disease can donate Eyes.
- **Vitamin B1**- is the water-soluble vitamin.
- **Chloroplasts** cell Organelle utilizes light energy during Photosynthesis.
- Sleeping Sickness is caused by **Tsetse Fly**.
- **Pavo cristatus** is the scientific name of Peacock.
- **Pepper** is not a good Preservative for pickles.
- Plant cell walls are composed of **Cellulose**.
- **Melanin Pigments** is mainly responsible for the colour of our hair, skin & Eyes.
- **Pituitary Gland** is an endocrine Gland in the Human Body.
- **Lysosome Organelles** helps to keep the clean by digesting any foreign material as well as worn out cell organelles.
- **Shearing** is the process of removing the fleece of the sheep along with a thin layer of skin.
- In Cockroaches, respiration occurs through the **Spiracles**.
- **Golgi Apparatus** is responsible for transporting, modifying & packaging proteins & lipids into Vesicles.
- **Asthma** is a disorder of the Respiratory System in the human body.
- **Plague** is not caused by Water Pollution.
- **Pancreas gland** produces the insulin Hormone.

## **CGL 2022 PYQ's**

- **Octopus** has more than one heart.
- **Possess only pitted thickenings** is a characteristic of fibres in relation to plant anatomy.
- **Acoustic** is called study of sound.
- **Entomology** is called study of insects.
- Organisms belonging to the phylum **Platyhelminthes** are also called Flatworms.





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- Ferrum is the latin name for **Iron**.
- **Man** belongs to the family of Hominidae.
- **Epilepsy** is a disorder resulting in abnormal electrical discharges from the brain cells causing seizures.
- **Pomology** is called the study of food.
- **Drosera** is a carnivorous plant.
- **Intercellular spaces are present** is a characteristic of permanent tissue.
- Camellia sinensis is a plant that produce **Tea**.
- Ozone is a molecule made up of **three** oxygen atoms.
- Hot water can be pollutant if it comes from **A power plant, An industry**.
- In the context of the spread of germs by faecal matter, **Fungi** is not figure in F-Diagram.
- **Five** eyes does Bee have.
- **Aerobic** refers to an environment in which oxygen is readily available.
- Capsaicinoids, carotenoids, phenolics and vitamins are dominant chemicals in **Chilli**.
- **Cholera** is caused by Drinking contaminated water.
- Colloidal System- such as gum, starch, proteins, cellulose, agar and gelatine- when placed in water, will absorb a large amount of water and swell up. These substances are called **Imbibants**.
- **Peribem** is the middle layer in the root apical meristem that gives rise to the cortex.
- **Limulus** is not a type of mosquito.
- Water Fluoridation is necessary **to prevent tooth decay** which is the controlled adjustment of fluoride to public water supply.
- **Fructose and glucose** are the examples of monosaccharides.
- According to WHO Hygiene refers to **Conditions** and practices that help to maintain **health** and **prevent** the spread of diseases.
- **Blight** is a type of plant disease.
- **Plant** is not abiotic.
- **Scorpion** is an example of Arthropod.
- The numerical taxonomy of plants is based on **all observable characteristics**.
- Pneumatophores are specialised **roots** in Hydrophytes.
- At least **a half** of carbon dioxide fixation on earth is carried out by algae through photosynthesis.
- **Petiole** is not a part of a flower.
- **Beri beri** cannot be prevented by Vaccination.
- **Acorn** is the nut of an oak Tree.
- **Notochord** is present in chordates.