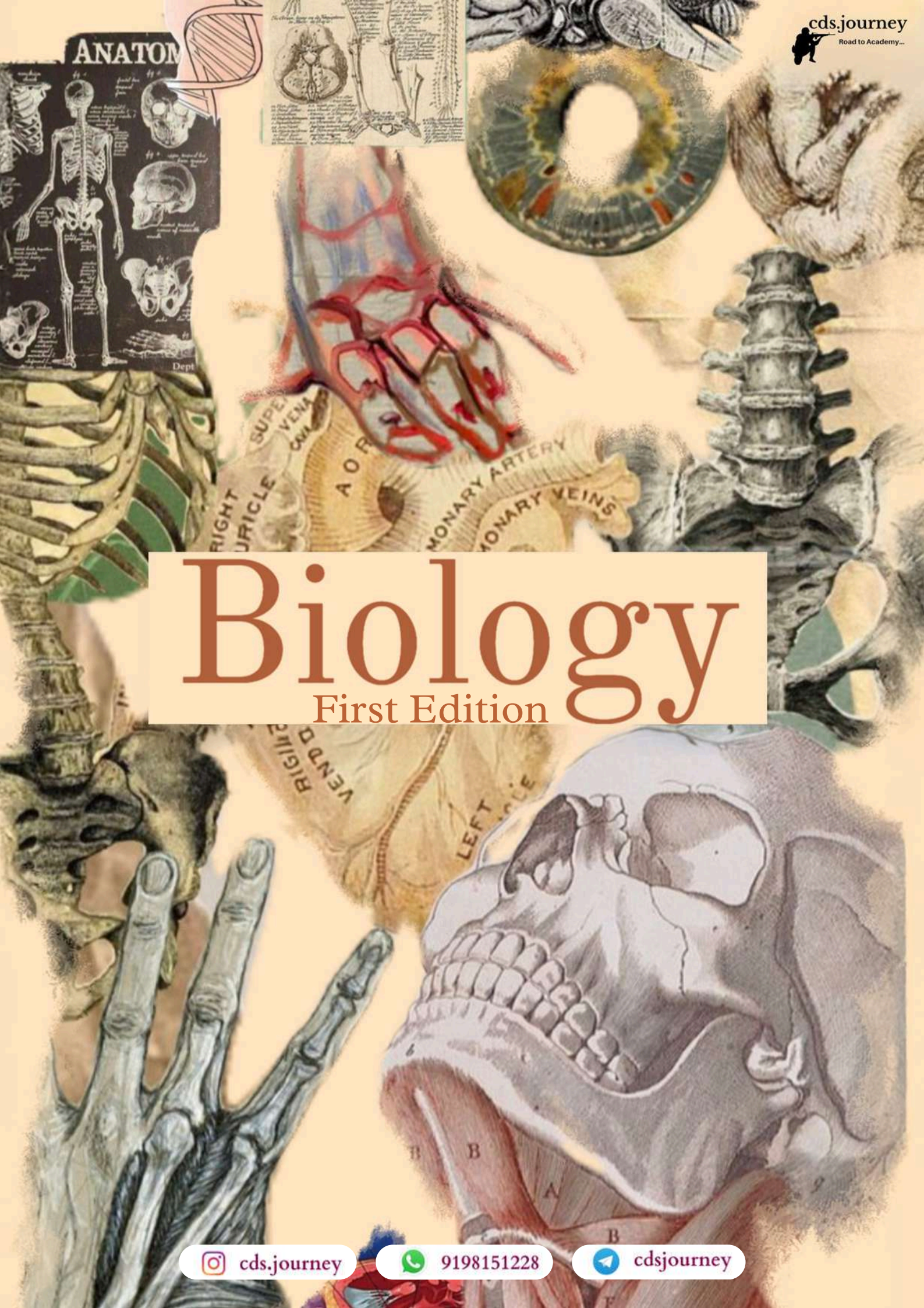
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और एक दिन अचानक किसी result की pdf में मुस्कुराता हुआ तुम्हारा roll number तुम्हारे सारे संघर्षों, सारी परेशानियों और प्रश्नों का जवाब देगा 🏅
तुम बस ख़ामोशी से लगे रहो, आएगा दिन ।

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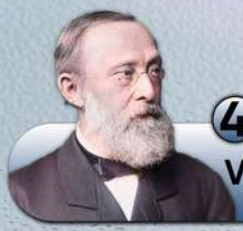
CELL

THE CELL IS THE BASIC STRUCTURAL AND FUNCTIONAL UNIT OF ALL FORMS OF LIFE.

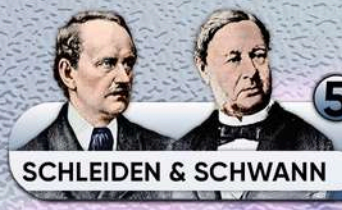
1. ROBERT HOOKE — DISCOVERY OF CELL

2. ANTON VON LEEUWENHOEK — DISCOVERY OF LIVING CELL

3. ROBERT BROWN — DISCOVERY OF NUCLEUS



4. VIRCHOW — ALL CELLS ARISE FROM PRE-EXISTING CELLS



5. SCHLEIDEN & SCHWANN — THE CELL THEORY

6. PURKINJE — TERM PROTOPLASM

UNICELLULAR ORGANISMS

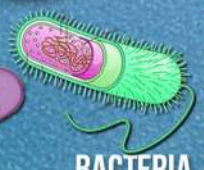
- MADE OF ONE CELL
- SINGLE CELL PERFORMS ALL LIFE FUNCTIONS

EX - AMOEBA, CHLAMYDOMONAS, PARAMECIUM, BACTERIA

AMOEBA

CHLAMYDOMONAS

PARAMECIUM



BACTERIA

MULTICELLULAR ORGANISMS

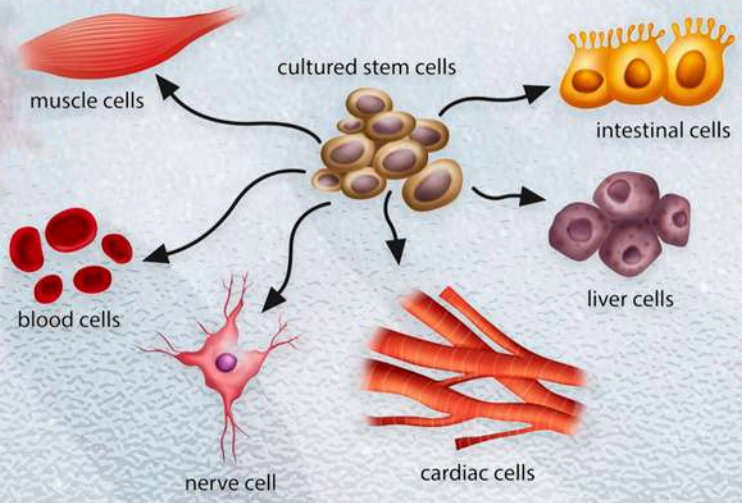
- MADE OF MORE THAN ONE CELL
- SPECIALIZED CELLS PERFORM DIFFERENT LIFE FUNCTIONS

EX - PLANTS, ANIMALS, FUNGI

OCTOPUS

PETROMYZON

Human Stem Cell Applications



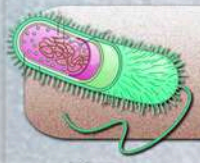
The **shape and size** of cells are related to the **specific function** they perform.

Division of labour is also seen within a cell.

Each such cell has got certain specific components within it, known as **CELL ORGANELLES.**

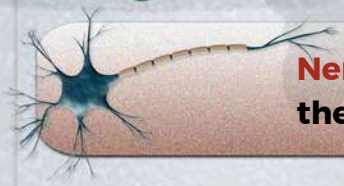
Generally, a cell has **plasma membrane, nucleus and cytoplasm.**

Cell differ greatly in size , shape and activities.



Bacteria could be 3 to 5 um in length. (um – micrometre)

Mycoplasma, smallest cells, are o.3um in length. **NO CELL WALL**



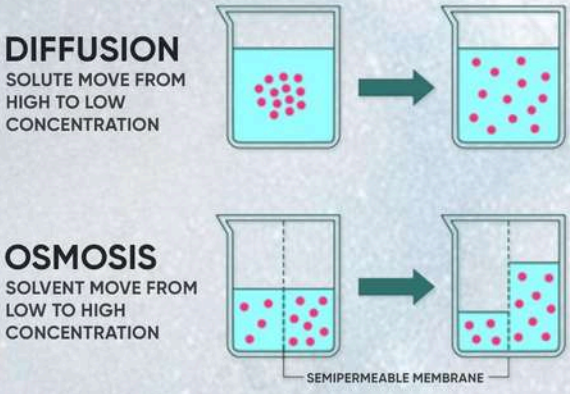
Nerve cells are some of the longest cells.

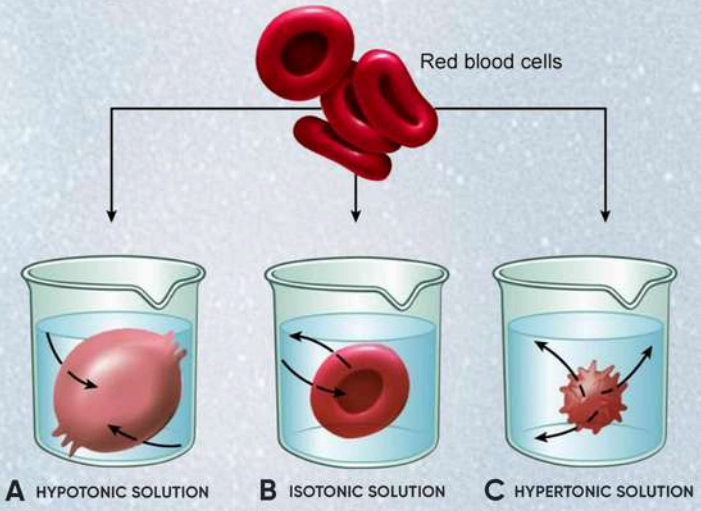
The largest isolated single cell is the egg of an **ostrich.**

Among multicellular organisms, human **red blood cells** are about 7.0um in diameter.

The smallest cell in the human body is the **sperm (male gamete).**

DIFFUSION vs OSMOSIS





DIFFUSION VS OSMOSIS

Diffusion is important for cells to obtain nutrition from its environment and exchange gases & water.

Three kind of medium :- Hypotonic, Hypertonic, Isotonic.

01 Cell intakes oxygen - cellular respiration. Cell excreted out carbon dioxide - cellular waste.

02 Unicellular freshwater organisms and most plant cells tend to gain water through osmosis.

03 The movement of substances from High Concentration to Low Concentration.

04 Solute move from High Concentration to Low Concentration.

01 Solvent move from Low Concentration to High Concentration.

02 The movement of water from High concentration to Low Concentration through a semipermeable membrane.

ACTIVE TRANSPORT

- Active transport is an energy dependent process, in which ATP is utilized.
- A few ions or molecules are transported across the membrane against their concentration gradient,
- From lower to the higher concentration.
- Reverse osmosis.
- e.g., Na+/K+ Pump.

PASSIVE TRANSPORT

- Many molecules are transported across the membrane along the concentration gradient,
- From higher to lower concentration.
- Diffusion and Osmosis.

OSMOSIS

HYPOTONIC

The medium surrounding the cell has a higher concentration of water than the cell.
Cell gains water by osmosis as outside solution is very dilute.

Cell swells up.

CYTOLYSIS

HYPERTONIC

When the medium has a lower concentration of water than the cell, meaning that it is a very concentrated solution, the cell will lose water by osmosis.

Cell shrinks.

PLASMOLYSIS

ISOTONIC

When the medium has exactly the same water concentration as the cell, there will be no net movement of water across the cell membrane.

Cell remains same.

AWESOME!

CELL

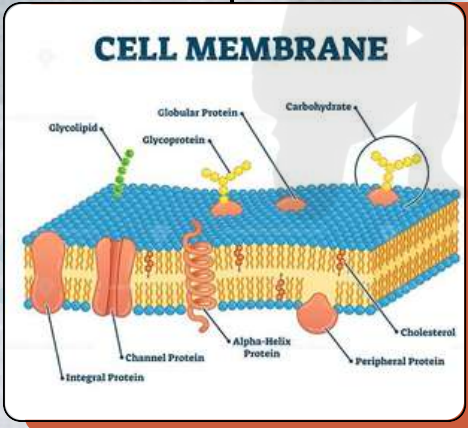
CELL OR PLASMA MEMBRANE

Outermost covering of the cell that **separates** the contents of the cell from its **external environment.**

Universal membrane **or Selectively permeable.**

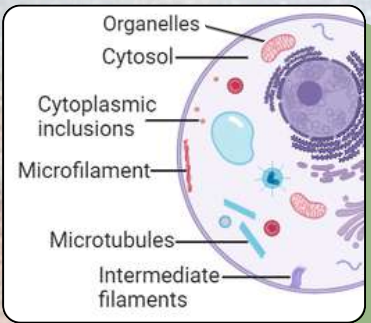
Cell membrane is mainly composed of **lipids and proteins (phospholipids)** bilayer also contains cholesterol, carbohydrates.

The **ratio** of protein & lipid varies considerably in **different cell types.**



Allows or permits the **entry and exit** of materials in and out of the cell.

Transfer of gases like **oxygen and carbon dioxide** through **Diffusion.**



CYTOPLASM

Cytoplasm is the **gel-like liquid** that fills the inside of a **plasma membrane.**

Protoplasm consists of **cytoplasm & nucleus,** it contains **various proteins,** other essential molecules.

It **consists of** the **cytosol, organelles, cytoskeleton & inclusion.**

Cytosol: Semi-fluid, jelly-like substance that makes up most of the cytoplasm & contains water, ions, proteins, lipids, & small molecules.

Organelles: Structures like Mitochondria, ER, Golgi apparatus, & Ribosomes are suspended in the cytoplasm.

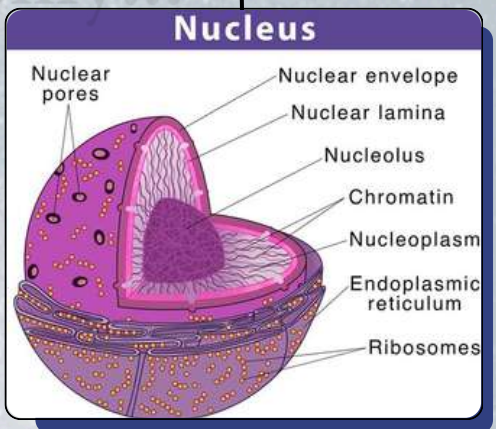
Cytoskeleton: A network of protein fibers (microfilaments, microtubules, and intermediate filaments) that provide structural support, motility and maintenance.

Inclusions: Temporary structures like stored nutrients (Phosphate granules, cyanophycean granules & glycogen granules), pigments, waste products.

NUCLEUS

Nucleus membrane has **pores** which **allow the transfer of material** from inside nucleus to outside cytoplasm.

- Nucleus has **double membrane.**
- Nucleus plays a **central role in cellular reproduction** the process by which a **single cell divides** and forms **two new cells.**
- Contains **chromosomes.**
- The nucleus is called as the **brain of the cell.**



- In some organisms like bacteria, the nuclear region of the cell poorly defined due to the **absence of a nuclear membrane.**

Such an undefined nuclear region containing only **nucleic acids** is called a **nucleoid.**

CELL RATIO: Water > Protein > Nucleic acid > Carbohydrates > Lipids > Ions.

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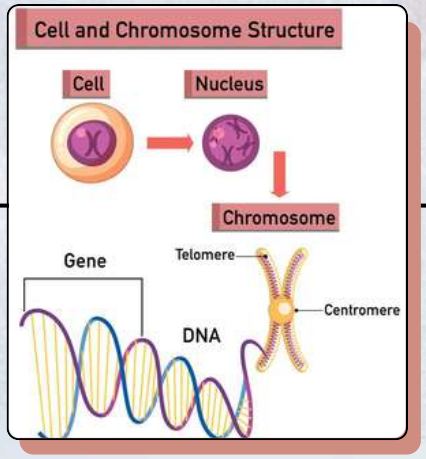


CHROMATIN MATERIAL

Present inside the nucleus.

Visible under microscope during cell division separated into daughter cells.

CHROMOSOMES

Rod shaped structure visible only when the cell is about to divide.

Chromosomes are composed of DNA and protein

CENTROSOME

- Centrosome is an organelle usually containing two cylindrical structures called centrioles.
- Present in animal cells.
- The centrioles form the basal body of cilia or flagella, and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

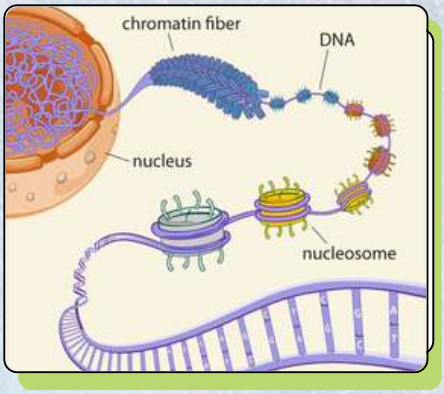
Made up of DNA and histone, proteins.

DNA wraps around histone proteins to form nucleosomes, which are the basic unit of chromatin.

Chromosomes contain information for inheritance of the features from parents to next generation in the form of DNA (Deoxyribose Nucleic Acid) molecules.

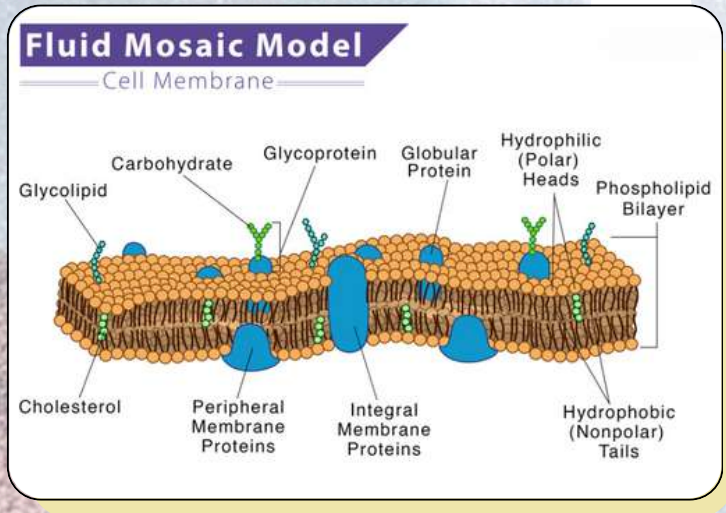
Chromatin's main function: package DNA into a more compact form to prevent tangling.

Chromatin fibers can unwind for DNA replication & transcription.



DNA molecules contain information necessary for constructing & organizing cells.

Functional segments of DNA are known as genes.



THE FLUID MOSAIC MODEL IS A BIOLOGICAL MODEL THAT EXPLAINS THE STRUCTURE AND FUNCTION OF THE CELL MEMBRANE

PROPOSED BY SINGER AND NICOLSON (1972) WIDELY ACCEPTED AS FLUID MOSAIC MODEL.

PROTEINS ARE EMBEDDED IN THE LIPID BILAYER IN A RANDOM DISTRIBUTION, FORMING A MOSAIC-LIKE STRUCTURE.

THE PHOSPHOLIPIDS HAVE HYDROPHILIC HEADS FACING OUTWARD AND HYDROPHOBIC TAILS FACING INWARD.

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CELL WALL

ALGAE

Cell wall , made of cellulose, Pectins/Galactans, hemicellulose , mannans , silica and minerals like calcium carbonate.

PLANTS

Cell wall , made of cellulose , hemicellulose , pectins , lignin and proteins.

- Cell wall is a external layer that gives shape, rigidity to the cell and protects the cell from mechanical damage and infection, and is mainly made of cellulose which is a complex substance and provides structural strength to the cell.
- Helps protect the cell in hypotonic external medium.
- Helps in cell-to-cell interaction and provides barrier to undesirable macromolecules.
  - **FUNGI :** Cell wall , made of chitin.

BACTERIA

Bacteria cell has 3 layer envelope.

Cell wall : peptidoglycan.

Glycocalyx → Cell wall → Cell membrane

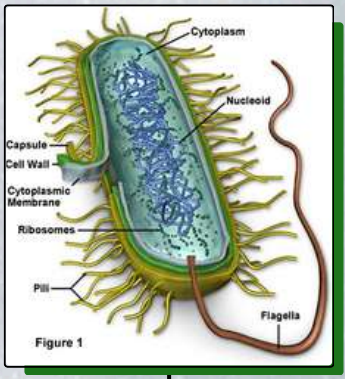


Figure 1

Glycocalyx: Outermost layer, made of polysaccharides, glycoproteins, & glycolipids.

Glycocalyx:

- Loose (Slime layer)
- Thick (Capsule) made of Polypeptides .

Bacteria cell has 2 types of Cell membrane:

- **MESOSOMES :** DNA replication, Cell membrane formation, Respiration, Secretion.

  Mesosomes are analogous to mitochondria.
- **FLAGELLUM :** Hair-like, motility organelle that helps bacteria move through liquids and perform other functions.

FLAGELLUM MADE OFTHREE SUBSTRUCTURES:

HOOK: A hook-shaped structure at the proximal end of the filament that enters the cell wall and attaches to the basal body.

BASAL BODY: Flagellum inside the cell wall, firmly bound into the cell envelope. It contains the rotary motor.

FILAMENT: A long, thin, structure made of the protein flagellin.

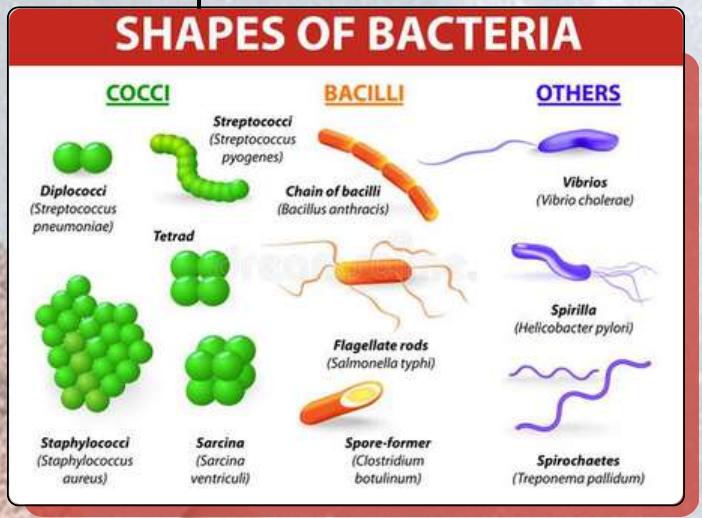
The four types of bacteria are based on their shape:

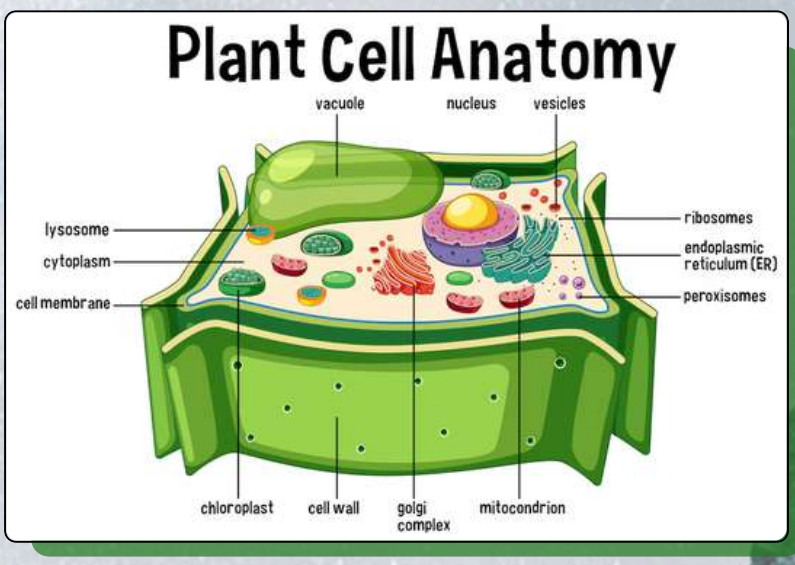
- **BACILLUS:** Rod-shaped bacteria.
- **COCCUS:** Spherical or oval-shaped bacteria.
- **SPIRILLUM:** Spiral-shaped bacteria.
- **VIBRIO:** Curved-shaped bacteria

GRAM STAINING PROCESS.

- Bacteria are stained with crystal violet dye.
- Iodine.
- Alcohol-wash.

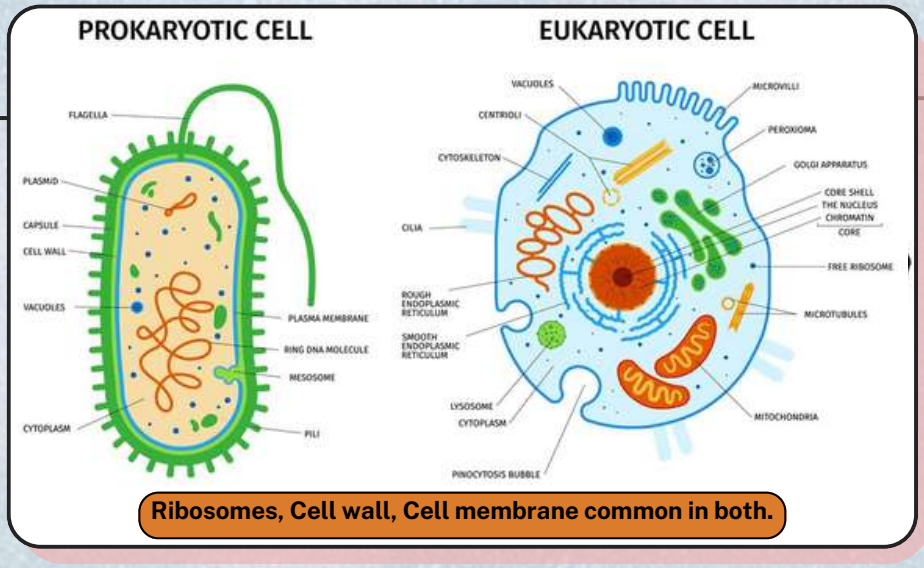
- **GRAM-POSITIVE BACTERIA:** Retain purple stain.
- **GRAM-NEGATIVE BACTERIA:** Do not retain purple stain.





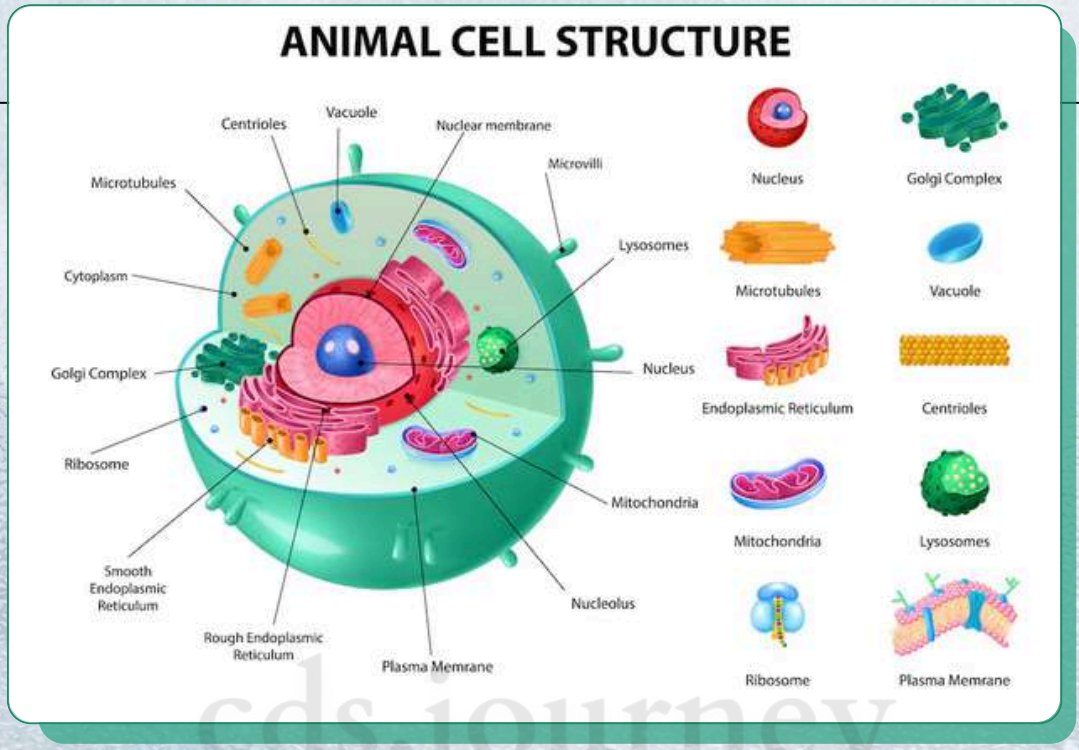
Prokaryotes VS Eukaryotes

Prokaryotes	Eukaryotes
Prokaryotes (Pro = primitive; karyote = nucleus)	Eukaryotes (Eu – True, karyotes – nucleus)
Undefined nucleus.(NUCLEOID) (unicellular)	Well defined nucleus (multicellular)
No membrane bound organelles.	Membrane bound organelles.
Prokaryotic cells may vary greatly in shape and size .	Plant and animal cells are different cell walls, plastids and large central vacuole.
Single circular chromosome and divide/ multiply rapidly.	More than one linear chromosomes and slower cell division.
Genetic material or DNA is naked.	Genetic material or DNA, is contained within the nucleus
Comparatively large size.	Smaller in size.
Ex: Bacteria, blue green algae, mycoplasma	Ex: Plants, Animals, Fungi , protists.

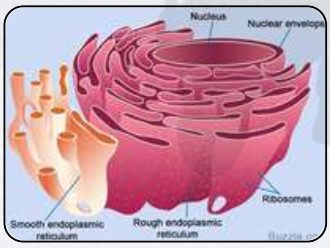


Ribosomes, Cell wall, Cell membrane common in both.

Note :- Viruses lack membranes and hence do not show characteristics of life until they enter a living body and use its cell machinery to multiply.



Cell Organelles



ENDOPLASMIC RETICULUM

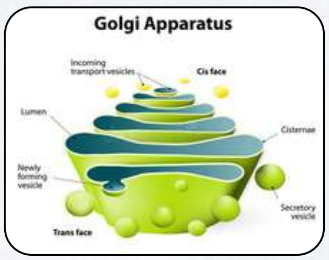
It is a large network of membrane-bound tubes and sheets.
It looks like long tubules or round or oblong bags (vesicles).
ER membrane is similar in structure to the plasma membrane.
Has two types :- SER & RER

ROUGH ENDOPLASMIC RETICULUM

- Rough surface due to presence of ribosomes on the surface.
- Ribosomes are site of protein. synthesis.
- Transport the material b/w cytoplasm and nucleus.
- Manufactured proteins packaged into vesicles and directed to different parts of the cell based on their function.

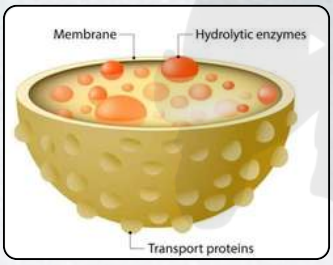
SMOOTH ENDOPLASMIC RETICULUM

- Smooth surface due to absence of ribosomes on the surface.
- Helps in lipid formation.
- SER plays a crucial role in detoxifying many poisons and drugs.
- In Animal cells lipids – like steroidal hormones are synthesized in SER.



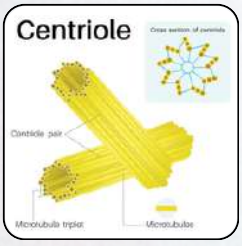
GOLGI APPARATUS

- It is a system of membrane-bound vesicles (flattened sacs) arranged approximately parallel to each other in stacks called cisterns.
- First described by Camillo Golgi.
- The material synthesized near the ER is packaged and dispatched to various targets inside and outside the cell through the Golgi apparatus
- Formation of Lysosomes.
- Storage, modification and packaging in vesicles.
- Converts simple sugars into complex sugars.
- Golgi bodies consist of many flat, disc – shaped sacs or cisternae of 0.5um to 1.0um diameter.
- Golgi apparatus is the important site of formation of glycoproteins and glycolipids.
- The Golgi cisternae are concentrically arranged near the nucleus with distinct convex cis or the forming face and concave trans or the maturing face.



LYSOSOMES

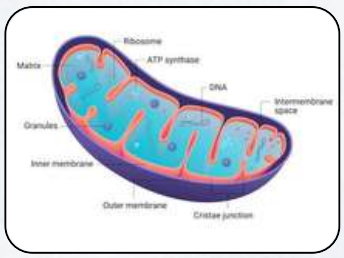
- Lysosomes help keep the cell clean by digesting any foreign material and worn-out cell organelles .
- Structurally lysosomes are Membrane bounce sacs filled with digestive enzymes.
- These enzymes are made by RER.
- Waste disposal system of the cell.
- 'Suicide Bags' of a cell.
- The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes optimally active at acidic PH.
- (Hydrolases – Esterases including lipases, phosphatases, glycosidases, peptidases, and nucleosidases.).
- These enzymes are capable of digesting carbohydrates , proteins , lipids and nucleic acids .



CENTRIOLES

- Centrioles are organelles found in most eukaryotic cells.
- Essential for a variety of cellular processes, including cell division, cell polarity, and intracellular traffic.
- Centrioles are not membrane-bound organelles.

MITOCHONDRIA

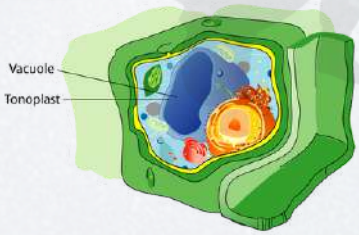


- Powerhouse of the cell.
- Double membrane.
- The outer membrane is porous while the inner membrane is deeply folded.
- Has its own DNA & Ribosomes.
- The mitochondria divide by fission.
- The energy is used to make new chemical compounds and carrying out mechanical activities of the cell.
- Help in generation of the energy currency of the cell ATP (Adenosine triphosphate).

MICROBODIES

- Microbodies, also known as cytostomes, are small organelles found in the cytoplasm of cells that contain enzymes involved in metabolic pathways of sugars, amino acids, and fats.
- Many membrane bound minute vesicles called microbodies.
- Contain various enzymes , are present in both plants and animal cells.
- 0.2 – 1.5 micrometers in diameter.
- Visible with an electron microscope.
- Do not contain separate DNA.
- Spherical or vesicular shapes.

VACUOLES



- Storage sacs for solid or liquid contents.
- Vacuoles are small-sized in animal cells while plant cells have very large vacuoles.
- The central vacuole of some plant cells may occupy 50-90% of the cell volume.
- Many substances of importance in the life of the plant cell are stored in vacuoles. (amino acids, sugars).
- The vacuole is bound by a single membrane called TONOPLAST.
- In plants, the tonoplast facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole .
- Their concentration is significantly higher in the vacuole than in the cytoplasm.
- In Amoeba the contractile vacuole is important for osmoregulation and excretion.
- Vacuoles are full of cell sap and provide turgidity and rigidity to the cell in plants .

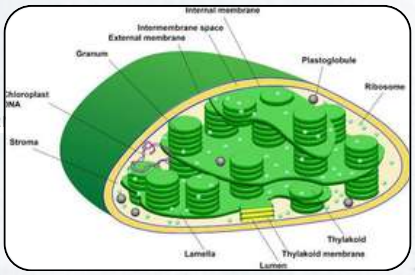
- Eukaryotic Ribosomes (80S).
- Subunit : 60S and 40S

- Mitochondria, Plastids(Chloroplast Ribosome) have 70S
- Cytoplasmic Ribosomes have 80S

- Prokaryotic Ribosomes (70S).
- Subunit : 50S and 30S

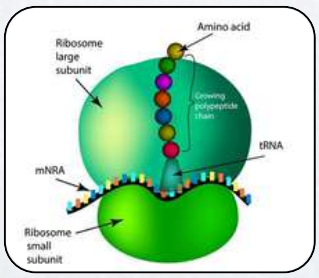
S : Svedberg unit stands for the sedimentation coefficient.

PLASTIDS

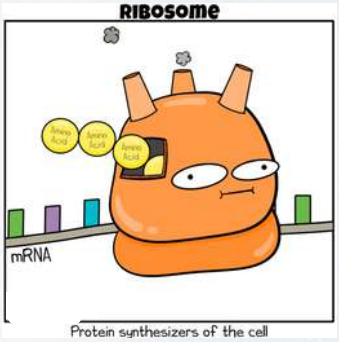


- Only found in plant cells.
- They also have their own DNA & RIBOSOMES.
- Are of two types :- Chromoplasts and Leucoplasts
- Chromoplasts with green pigment (chlorophyll) are known as chloroplast.
- These help the cell in photosynthesis.
- Plastids are similar to mitochondria in external structure.
- In the chromoplasts fat soluble carotenoid pigments like carotene , xanthophyll and others are present.
- This gives the part of the plant a yellow , orange or red color.
- The leucoplasts are the colorless plastids of varied shapes and sizes with stored nutrients:
  1. Amyloplasts store carbohydrates (starch), eg : potato
  2. Elaioplasts store oils and fats.
  3. Aleuroplasts store proteins.
- Majority of the chloroplasts of the green plants are found in the mesophyll cell of the leaves.
- The DNA present in chloroplast is circular , double stranded.

RIBOSOME



- A ribosome is an intercellular structure made of both RNA and protein.
- Site of protein synthesis in the cell.
- The ribosome reads the messenger RNA (mRNA) sequence.
- mRNA translates that genetic code into a specified string of amino acids.



- Amino acids grow into long chains that fold to form proteins.
- Transfer RNA (tRNA) acts as a bridge between messenger RNA (mRNA) and amino acids to help ribosomes synthesize proteins.
- A polyribosome, also known as a polysome, is a group of ribosomes that are bound to a messenger RNA (mRNA) molecule.
- Polyribosomes are found in both prokaryotic and eukaryotic cells.
- The ribosomes are attached to the mRNA in a similar way to beads on a thread.

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	PLANT CELL	ANIMAL CELL
CELL WALL	Present	Absent
CELL MEMBRANE	Present	Present
CELL SHAPE	Square or rectangular in shape	Irregular or round in shape
ENDOPLASMIC (ER)	Present	Present
NUCLEUS	Present and lies on one side of the cell	Present and lies in the centre of the cell
GOLGI APPARATUS	Present	Present
LYSOSOMES	Present but are very rare	Present
RIBOSOMES	Present	Present
PLASTIDS	Present	Absent
CYTOPLASM	Present	Present
CENTRIOLE	Absent in higher plants	Present
MITOCHONDRIA	Present	Present
VACUOLES	Large, centrally positioned vacuole	Usually small and numerous

 # ENDOMEMBRANE SYSTEM separates the cell into different compartments, or organelles, such as nucleus, endoplasmic reticulum (ER), Golgi apparatus, lysosomes.

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CELL DIVISION

CELL DIVISION IS THE PROCESS BY WHICH A CELL SPLITS INTO TWO DAUGHTER CELLS

MITOSIS

The process of cell division by which most of the cells divide for growth is called Mitosis.

In this, Mother cell divides to form two identical daughter cells.

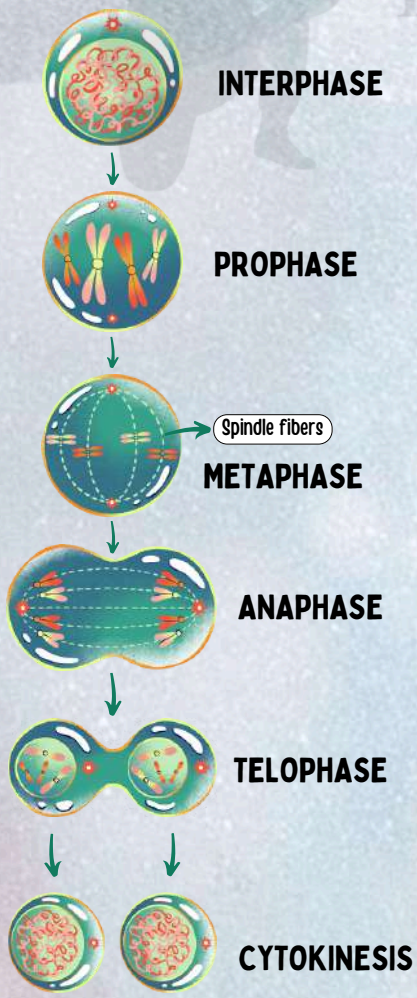
The daughter cells have the same number of chromosomes as mother cell.

MEIOSIS

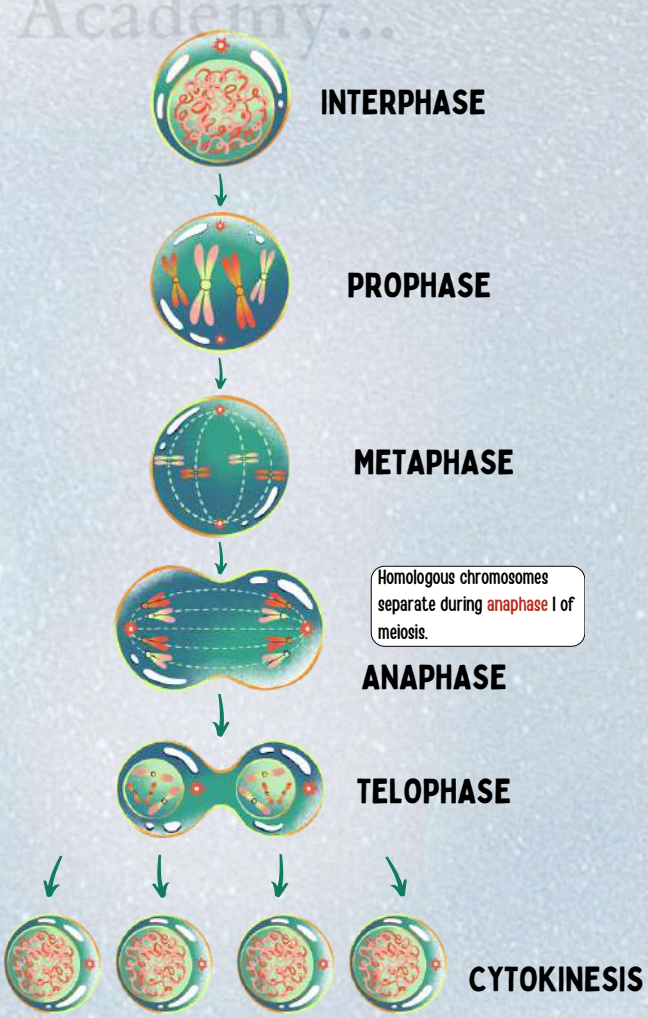
Meiosis involves two consecutive divisions.

When a cell divides by meiosis it produces four new cells instead of just two.

The new cells only have half the number of chromosomes than that of the mother cells

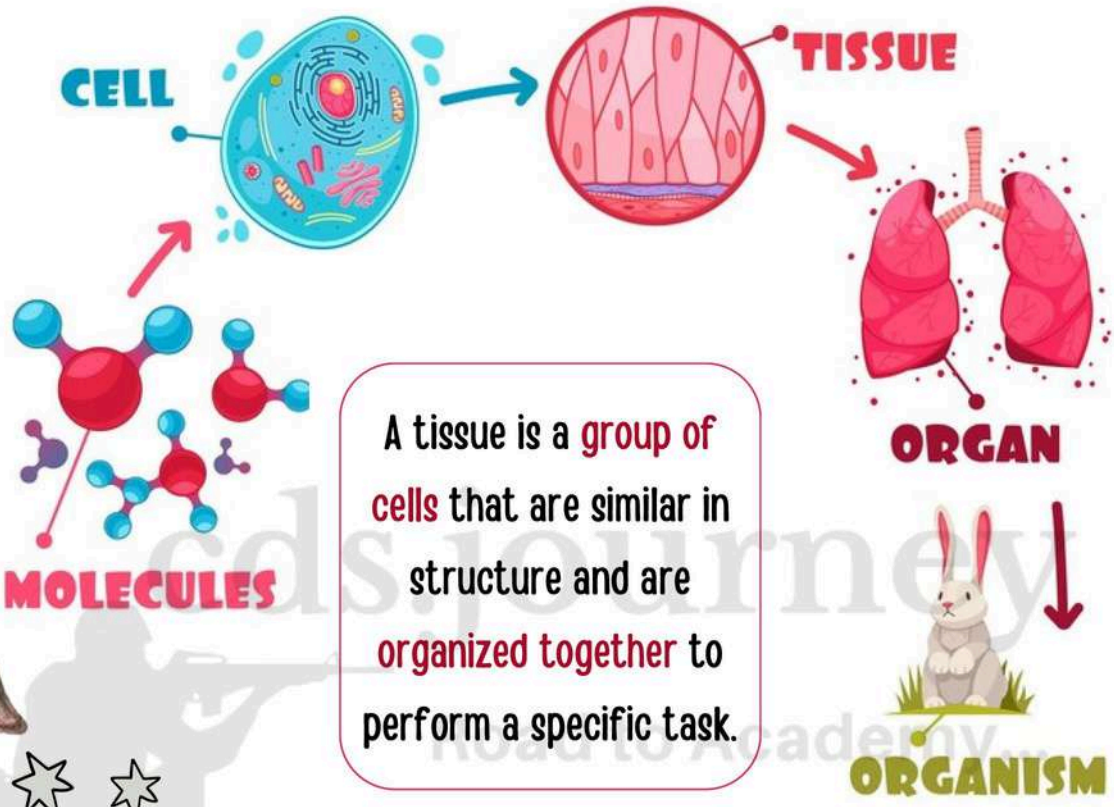


MITOSIS - TWO "DAUGHTER" CELLS



MEOSIS - FOUR "DAUGHTER" CELLS

Tissue



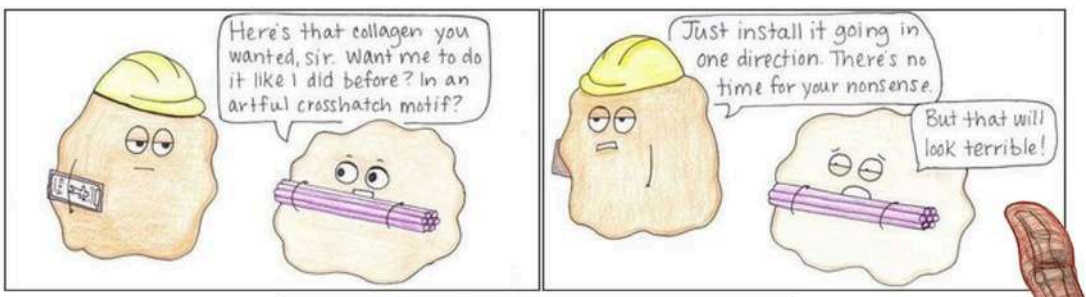
A tissue is a group of cells that are similar in structure and are organized together to perform a specific task.

PLANTS

- Plants are stationary or fixed.
- They have a large quantity of supportive tissue.
- Supportive tissue generally has dead cells.

ANIMALS

- Animals move around & consume more energy.
- Therefore, most of the tissues they contain are living.



How scar tissue is made.

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PLANT

MERISTEMATIC TISSUE

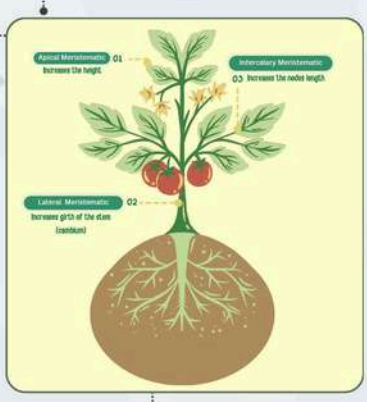
- Meristematic tissue are very actively divide.
- Contribute to the growth of the plant.
- Only simple tissue.
- No intercellular spaces.
- Cells are small and isodiametric.
- Presence of a prominent nucleus.
- Lack of vacuoles.
- Dense cytoplasm and thin cell walls.
- Single type of cells.
- Cells are undifferentiated.

PERMANENT TISSUE

- Do not show active division.
- Don't contribute to the growth of the plant.
- Complex as well as Simple tissue.
- Cells are loosely packed.
- Cells are variable in shape and size.
- Lack a prominent nucleus.
- Vacuoles are present.
- Thick cell walls.
- More than one type of cells.
- Cells are fully differentiated.

APICAL MERISTEMATIC

- Present at the growing tips of stems & roots.
- Increases the length of the stem and the root



LATERAL MERISTEMATIC

- The girth of the stem or root increases due to Lateral meristem (cambium).

INTERCALARY MERISTEMATIC

- Intercalary meristem seen in some plants is located near the nodes.

SIMPLE PERMANENT TISSUE

COMPLEX PERMANENT TISSUE

XYLEM

- Tracheids
- Vessels
- Xylem parenchyma
- Xylem fibres.

PHLOEM

- Sieve tubes
- Sieve cells
- Companion cells
- Phloem fibers
- Phloem parenchyma

PARENCHYMA

- AERENCHYMA
- CHLORENCHYMA

COLLENCHYMA

SCLERENCHYMA

SIMPLE PERMANENT TISSUE

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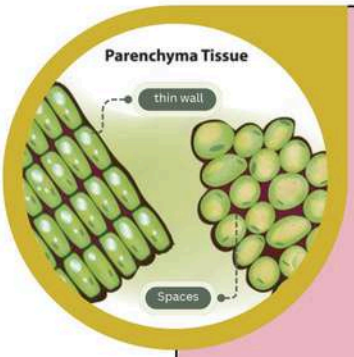
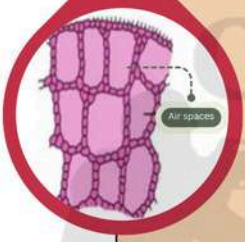
PARENCHYMA



- Mechanical support and food storage .
- Living cells.
- Loosely packed.
- Large intercellular spaces.
- There are two types of parenchyma:- (Aerenchyma & Chlorenchyma)

AERENCHYMA



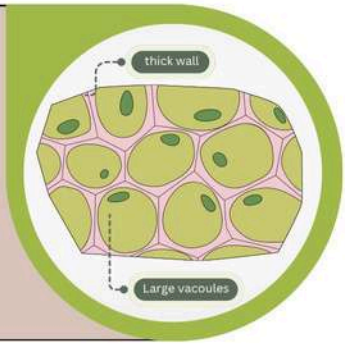
In aquatic plants, large air cavities are present in parenchyma to help them float.

CHLORENCHYMA

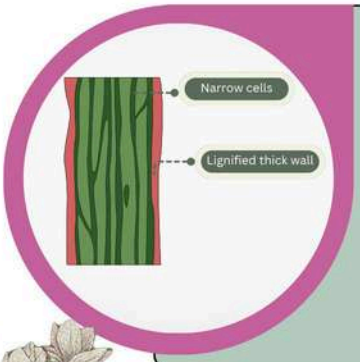
When it contains chlorophyll and performs photosynthesis, it is called Chlorenchyma

COLLENCHYMA

- Mechanical support and flexibility.
- Live cells.
- Cells thickened at the corners.
- Little intercellular space



SCLERENCHYMA



- Provides hardness.
- Dead cells.
- Long narrow cells.
- Walls thickened due to lignin.
- No intercellular space.

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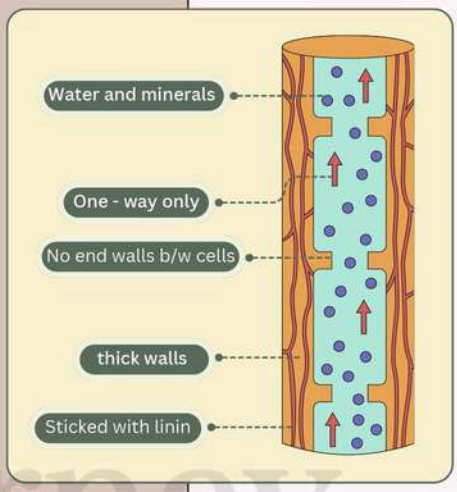
COMPLEX PERMANENT TISSUE

XYLEM

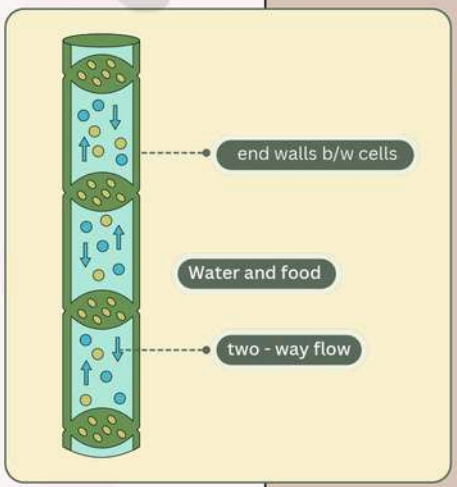
- Made of dead cells having thick cell lining.
- Tracheids and vessels :– they have broad tubular structure for transportation in plants vertically.
- Xylem parenchyma :– stores food and helps in transport of water in plants horizontally.
- Xylem fibres :– supportive in function.



- Tracheids and vessels - DEAD
- Xylem fibres - DEAD • Xylem parenchyma - LIVING

PHLOEM

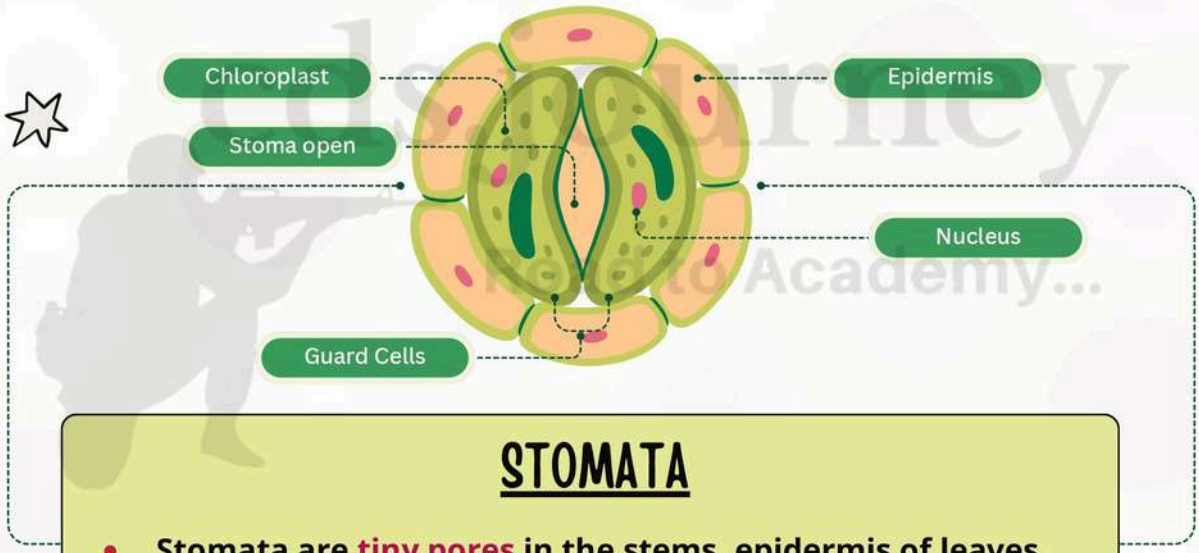
- Phloem is made up of living cells.
- Phloem transports food from leaves to other parts of the plant.
- For movement of food bidirectionally.
- Phloem is made up of five types of cells:-
  - Sieve cells :- elongated, tapering cells.
  - Sieve tubes :- Transport of food and nutrients.
  - Companion cells :- facilitate functions of sieve tubes
  - Phloem fibers :- provide flexibility to the phloem
  - Phloem parenchyma :- stores starch and proteins.



- Sieve cells & tubes - LIVING • Companion cells - LIVING
- Phloem parenchyma - LIVING • Phloem fibers - DEAD

EPIDERMAL TISSUE SYSTEM

- The epidermal tissue system forms the **outer-most covering** of the whole plant body.
- It is made up of **elongated , compactly arranged cell**, which form a **continuous layer.**
- **Protects cell** from environmental pathogens.
- **Lack** of intercellular space.
- The outside of the **epidermis** is often covered with a **waxy thick l**ayer called the **cuticle.**
- **Thickens** to protect the plant from **water loss** through **transpiration.**



STOMATA

- Stomata are **tiny pores** in the stems, epidermis of leaves.
- Stomata regulate the process of **transpiration and gaseous exchange.**
- Each stomata is composed of **two bean- shaped cells** known as **guard cells.**
- In **grasses** , the guard cells are **dumb-bell shaped.**
- The guard cells possess **chloroplasts** and regulate the **opening and closing** of **stomata.**
- The cells of **cork** are **dead** and compactly arranged **without intercellular spaces.**
- The walls of cork cells contain **suberin**, a **waxy substance** that makes them impervious to **gases and water.**
- SWELL - when H2O flow into them. SHRINK - when pores are closed.

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ANIMAL

EPITHELIAL TISSUE

- Simple Squamous Epithelium
- Squamous Epithelium
- Stratified Squamous Epithelium
- Tall Epithelial
- Cuboidal Epithelium
- Columnar Epithelial
- Glandular Epithelium

CONNECTIVE TISSUE

- Bones
- Blood
- Cartilage
- Dense connective tissue
  - Ligament
  - Tendons
- Loose connective tissue
  - Adipose tissue
  - Areolar tissue

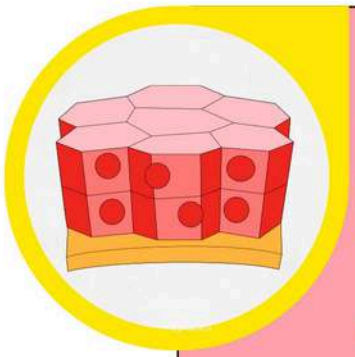
MUSCULAR TISSUE

- VOLUNTARY MUSCLES (Skeletal muscles)
- INVOLUNTARY MUSCLES (Smooth muscles)

NERVOUS TISSUE

- Brain
- Spinal cord
- Nerves

- Animal tissues are made up of animal cells that have been gathered together.
- The structure, function, and origin of these tissues are all different.



EPITHELIAL TISSUE

- Covering or protective tissues.
- Covers most organs and cavities
- It also forms a barrier to keep different body systems separate.
- Tightly packed and form a continuous sheet.
- They perform different functions including absorption, secretion, sensation, protection and secretion.

Skin, the lining of the mouth, the lining of blood vessels, lung alveoli and kidney tubules.

EPITHELIAL TISSUE

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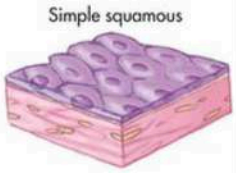
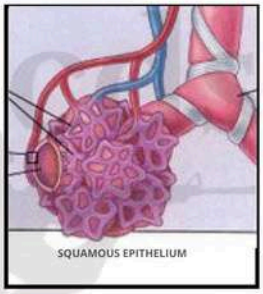
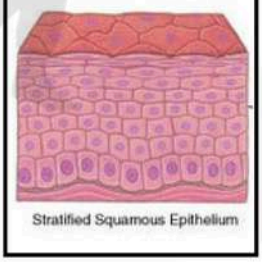
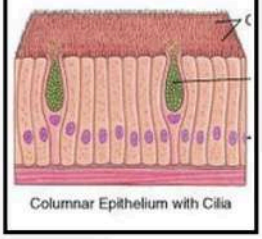
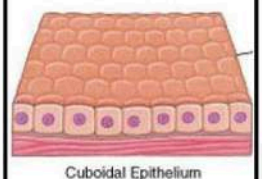
Type	Diagrammatic	Location	Structure	Function
SIMPLE SQUAMOUS EPITHELIUM		• Blood vessels • Body cavities • Alveoli of the lungs • Chambers of the heart	Single layer of flat, scale-like cells that lines body cavities.	Regulates the passage of substances into the underlying tissue
SQUAMOUS EPITHELIUM		• Esophagus • Lining of the mouth • Lining of blood vessels • Pharynx, Cervix	Large, polygonal cells with small, round nuclei.	Layers of cells that protect the body from external forces and water loss.
STRATIFIED SQUAMOUS EPITHELIUM		• Skin • Oral mucosa • Eye • Rectum • External female genitalia	• Top layer are flattened and squamous. • Deeper layers are cuboidal or columnar.	It's found in areas of the body that are subject to wear and tear.
COLUMNAR EPITHELIUM		• Respiratory tract • Fallopian tubes • Intestinal tract • Stomach, Uterus • Ducts of many glands	• Cells are elongated, column shaped. • Single layer	Columnar epithelium's functions include absorption and secretion.
CUBOIDAL EPITHELIUM		• Lining of kidney tubules • Ducts of salivary glands • Thyroid gland • Reproductive system	• Cube-shaped cells. • Tall and have large nuclei in the center of the cell.	Protection, Secretion, Absorption, and Excretion.

EPITHELIAL TISSUE

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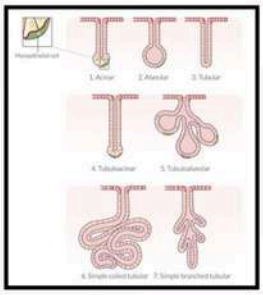
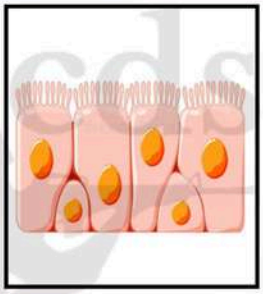
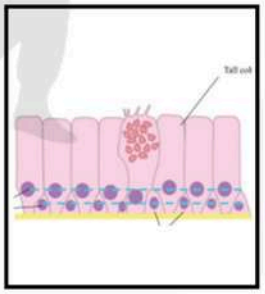
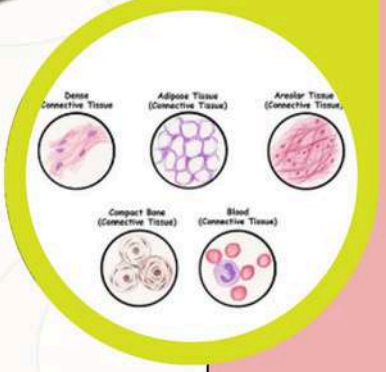
Type	Diagrammatic	Location	Structure	Function
GLANDULAR EPITHELIUM		Tissue folds inward, and forms a multicellular gland • Internal organs • Glandular organs • Skin	Either be a single cell or a group of cells specialized in producing specific substance.	Releases substances in the body, such as mucous, digestive juices, and other fluids.
CILIATED EPITHELIUM		• Trachea • Bronchial tubes • Bronchioles • Nasal cavities • Fallopian tubes	A thin tissue that contains hair-like structures	Cilia that move to move particles or fluid over the surface of the tissue
TALL EPITHELIAL		• Intestine • Stomach • Gall bladder Oviducts • Near the base of the cells	Made up of columnar epithelial cells, which are taller than they are wide	Protection, Secretion, Absorption, and Sensory Reception

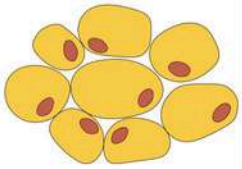


CONNECTIVE TISSUE

- The cells of connective tissue are loosely spaced & embedded in an intercellular matrix.
- The matrix may be jelly like, fluid, dense or rigid.
- Connective tissue is the most abundant and diverse type of animal tissue.

Specialized connective tissues include adipose, cartilage, bone, blood, and lymphatic tissues.

CONNECTIVE TISSUE

Type	Diagrammatic	Location	Structure	Function
ADIPOSE TISSUE		• Under the skin • B/w organs • Bone marrow • Breast tissue • Varies on the type of adipose.	• Made up of adipocytes. • Cells contain fats • Extracellular matrix contains white & yellow fibers.	• Stores fat for energy. • Act as an insulator • Cushions internal organs
AREOLAR TISSUE		Found between • Skin • Muscles • (bone narrow as well)	• Gel-like matrix of proteins, water, carbohydrates. • Network of fibers, includes collagen, elastin, and reticular fibers.	Provide supports to internal organs and helps in repair of tissues

CONNECTIVE TISSUE

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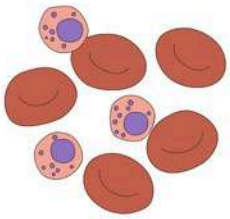
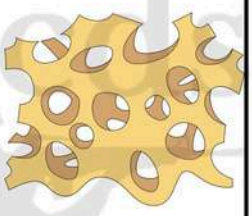
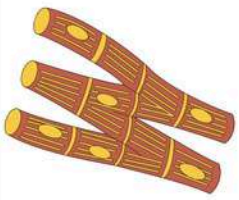
Type	Diagrammatic	Location	Structure	Function
BLOOD		• Red Blood Cells • White Blood Cells • Platelets.	Blood is made up of cells and cell fragments suspended in a liquid called plasma.	Blood flows and transports gases, digested food, hormones and waste materials
BONE		Bone is found in the upper extremity, where it provides a structural framework to function.	Composed of calcium and phosphorus fibers, and a mineralized ground substance.	Bone's main function is to provide mechanical support for the body.
LIGAMENT		• BONE + BONE • This tissue is very elastic & has considerable strength.	Ligaments are made of collagen molecules that are organized into parallel fibrils, and then into fibers.	Provides support to the organs and connects the bones together.
TENDONS		• MUSCLES + BONES • Great strength but limited flexibility	• Cells are elongated, column shaped. • Single layer	Tendons transfer force generated by muscles to bones, enabling movement around joints.
CARTILAGE		• Nose • Ear • Trachea • Larynx	• Widely spaced cells. • Matrix is composed of proteins and sugars.	It smoothens bone surfaces at joints.

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MUSCULAR TISSUE

- Muscular tissue consists of elongated cells, also called muscle fibers.
- This tissue is responsible for movement in our body.
- It contain special proteins called contractile proteins

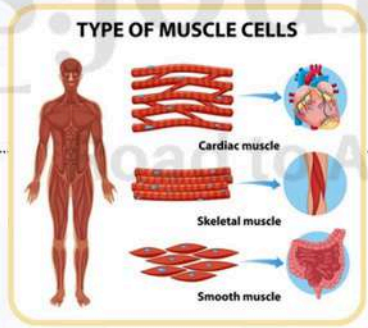
There are three types of muscle tissue:-

CARDIAC MUSCLES

- We cannot control them.
- Cylindrical
- Branched
- Uninucleate

SKELETAL MUSCLES

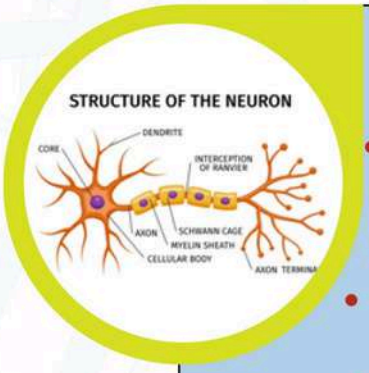
- Striated muscles.
- We can control them.
- Having many nuclei.
  - Long
  - Cylindrical
  - Unbranched
  - Multinucleate



SMOOTH MUSCLES

- Unstriated muscles.
- We cannot control them.
- Found in iris(eye), ureters, bronchi of the lungs
  - Long (pointed ends)
  - Uninucleate

NERVOUS TISSUE



- Nervous tissue is a soft tissue in the body that controls and coordinates many bodily functions.
- Transfer messages " kind of communication throughout the body.
  - Synapse (gap between two neuron)
  - Neuroglia make up more than one – half the volume of neural tissue in our body.

It's made up of neurons and glial cells, and is found in the brain, spinal cord, and nerves

REPRODUCTION

- **Reproduction means to reproduce. It is a biological process by which an organism reproduces an offspring who is biologically similar to the organism.**
- **Reproduction enables and ensures the continuity of species, generation after generation. It is the main feature of life on earth.**

ASEXUAL Reproduction

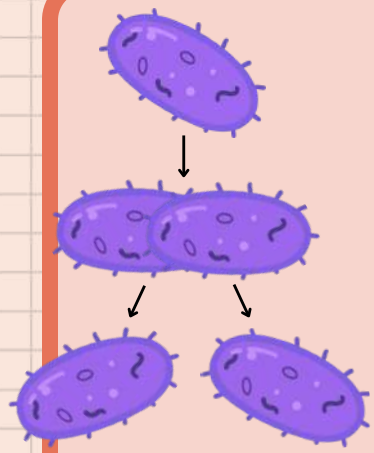
- **Single parent takes part.**
- **Offspring are genetically identical.**
- **No Fertilization.**
- **No Gametes.**
- **No Zygote.**
- **No mixing of hereditary material.**

SEXUAL Reproduction

- **Two parents take part.**
- **Variation occurs in offspring.**
- **Fertilization takes place.**
- **Gametes are involved.**
- **Zygote formation.**
- **Mixing of hereditary material.**

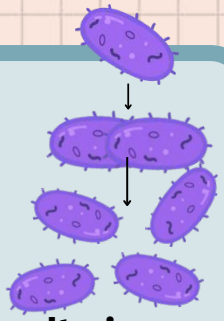
FISSION

BINARY FISSION



When the fission results in two daughter cells, it is binary fission (e.g. Paramecium , Amoeba, Leishmania)

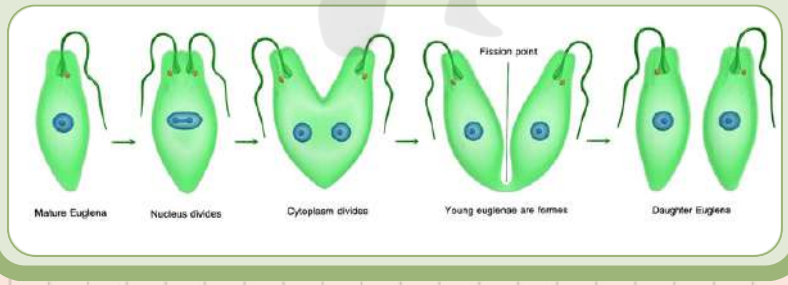
MULTIPLE FISSION



When fission results in many daughter cells, it is called multiple fission (e.g. Plasmodium, Sporozoans)

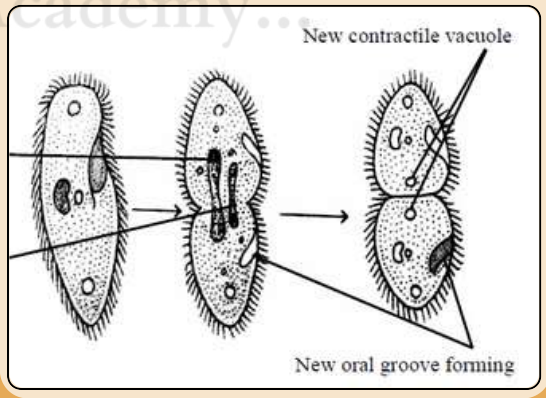
LONGITUDINAL BINARY FISSION

An organism splits into two equal halves along its length.
(e.g. Leishmania)



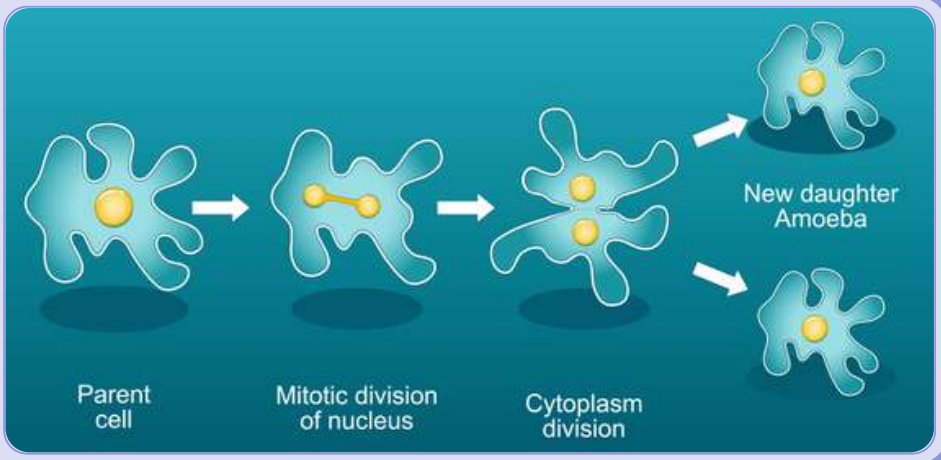
TRANSVERSE BINARY FISSION

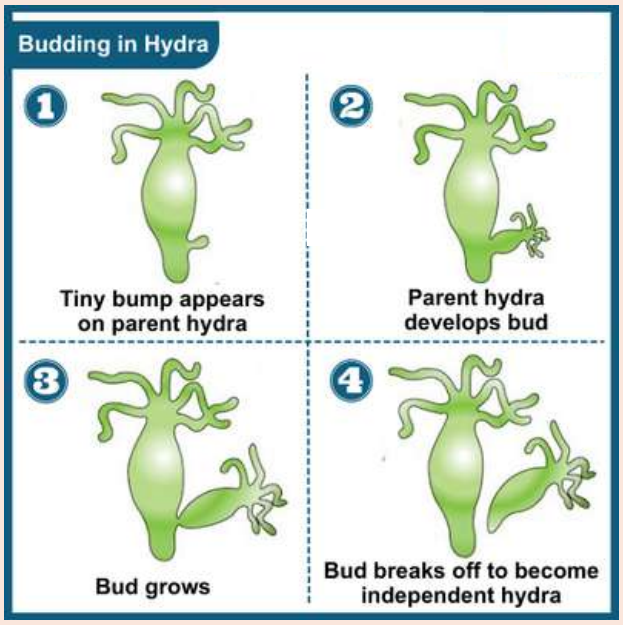
An organism divides into two equal halves along a transverse plane.
(e.g. Paramecium)



IRREGULAR BINARY FISSION

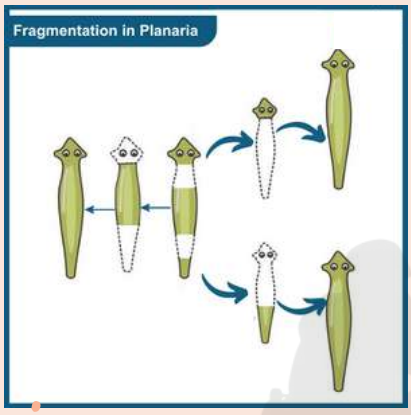
A type of asexual reproduction where a cell divides along any axis.
(e.g. Amoeba)





BUDDING

- A new organism develops from an outgrowth or bud due to cell division at one particular site.
- Bud may remain attached to the parent (yeast) or may separate and become a new individual (hydra).

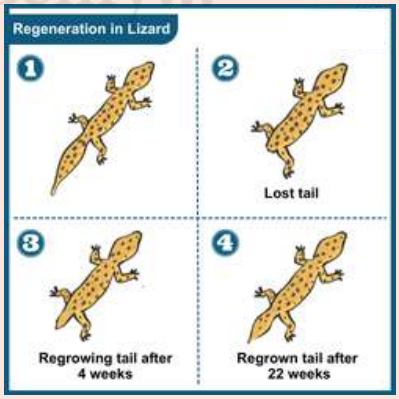


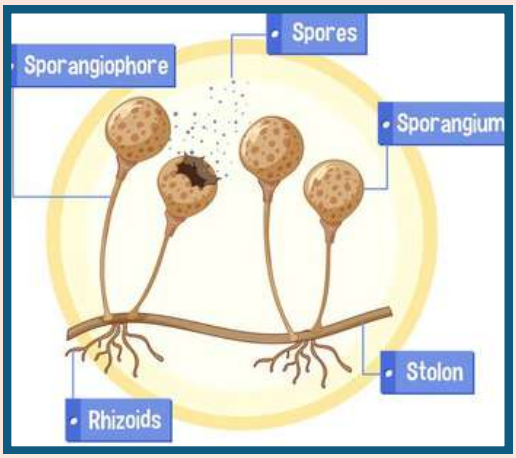
FRAGMENTATION

- An organism gets fragmented into smaller pieces and each piece grows into a whole new organism.
  - e.g. Planaria, hydra, spirogyra

REGENERATION

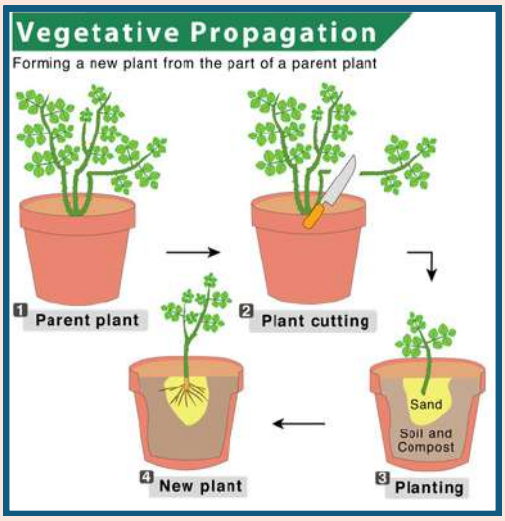
- Regeneration is the process of growing back the lost organ or body part by the organism (e.g lizard)





SPORE FORMATION

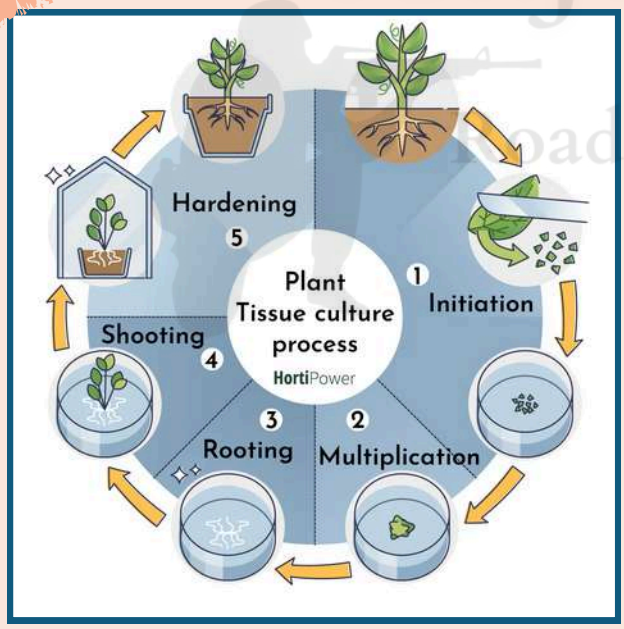
- Many Spores are stored in sacs called Sporangia.
- The bread mould or Rhizopus plant undergoes asexual reproduction using spores.
- They need moisture to grow. Hence, fungus is seen on the bread.



VEGETATIVE PROPAGATION

- The vegetative part of the plant, like leaves, stem, roots, gives rise to a new plant.
- Artificial or Natural.
- Artificial methods include cutting, grafting, layering and plant tissue culture

- Natural methods includes leaves (e.g. bryophyllum), stem (e.g. turmeric, ginger), runners/stolon (e.g. grass runners, strawberry), bulbs (e.g. onion, lily), etc



PLANT TISSUE CULTURE

- New plants are grown by removing tissue or separating cells from the growing tip of a plant.
- The cells are then placed in an artificial medium where they divide rapidly to form a small group of cells or callus.

- The callus is transferred to another medium containing hormones for growth and differentiation.
- The plantlets are then placed in the soil so that they can grow into mature plants.
- Using tissue culture, many plants can be grown from one parent in disease-free conditions. This technique is commonly used for ornamental plants.
- The callus is transferred to another medium containing hormones for growth and differentiation.

SEXUAL REPRODUCTION

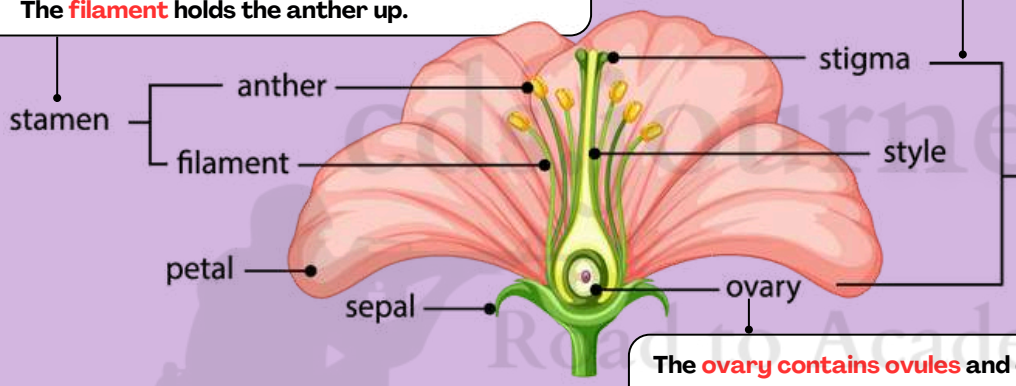
cds.journey
Road to Academy...

- The reproductive parts of angiosperms are located in the flower.
- The flower may be unisexual (papaya, watermelon) when it contains either stamens or carpels or bisexual (Hibiscus, mustard) when it contains both stamens and carpels.

- The stamen is made up of two parts: the anther and filament.
- The anther produces pollen (male reproductive cells).
- The filament holds the anther up.

- The swollen bottom part is the ovary.
- Middle elongated part is the style.
- The terminal part which may be sticky is the stigma.

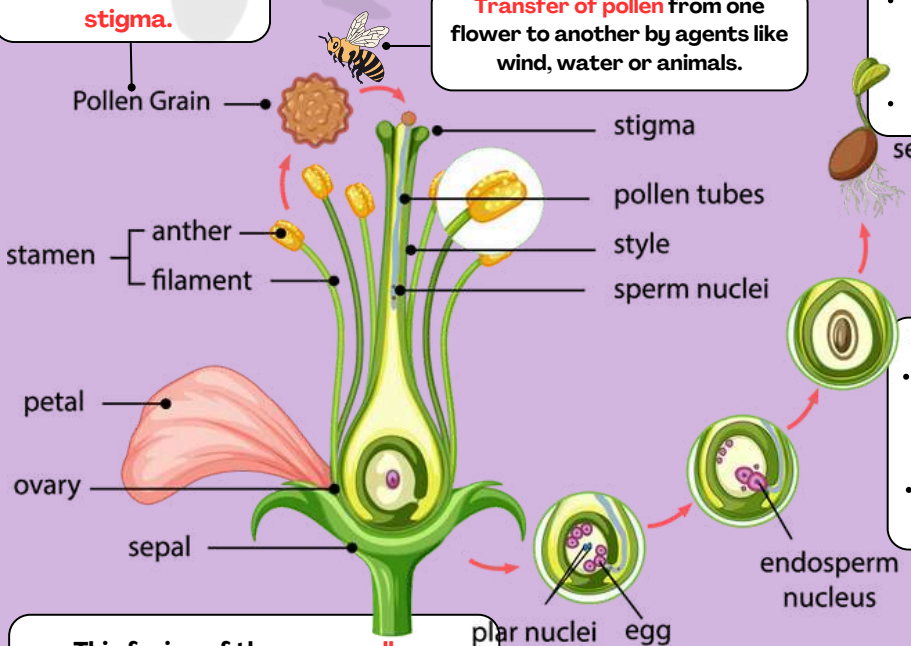
Carpel is present in the center of a flower and is the female reproductive part.



The ovary contains ovules and each ovule has an egg cell. The male germ-cell produced by pollen grain fuses with the female gamete present in the ovule.

The pollen needs to be transferred from the stamen to the stigma.

Transfer of pollen from one flower to another by agents like wind, water or animals.



This fusion of the germ-cells or fertilization gives us the zygote which is capable of growing into a new plant.

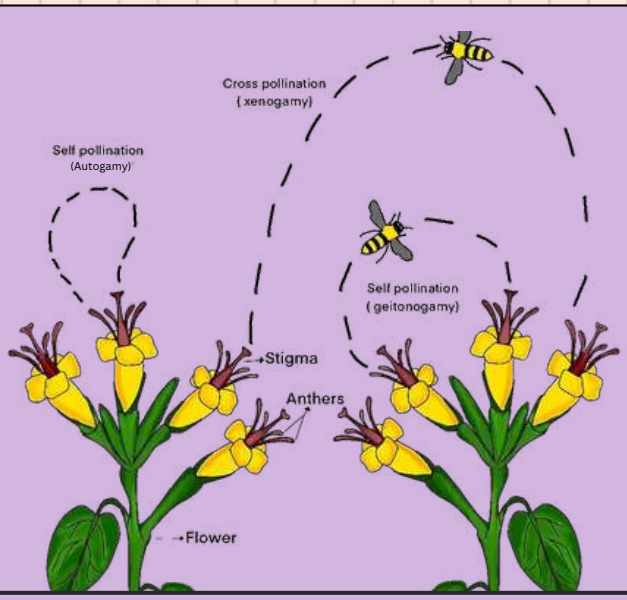
- The seed contains the future plant or embryo which develops into a seedling under appropriate conditions.
- This process is known as germination.

seed

- Ovule develops a tough coat and is gradually converted into a seed.
- Ovary grows rapidly and ripens to form a fruit.

SELF-POLLINATION

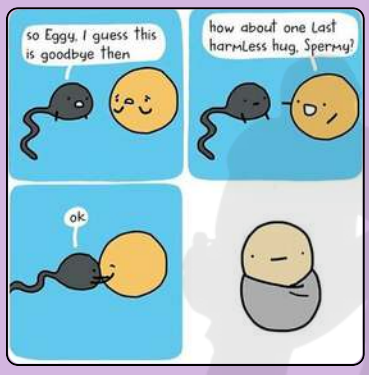
If this transfer of pollen occurs in the same flower, it is referred to as self-pollination



CROSS-POLLINATION

The pollen is transferred from one flower to another, it is known as cross-pollination

MALE REPRODUCTIVE SYSTEM



SEMINAL VESICLE

Produces seminal fluid that makes up majority of the semen.

VAS DEFERENS

A tube that transports mature sperm out of the testes

PROSTATE GLAND

Also produces fluid for transporting sperm and add nutrition

TESTIS

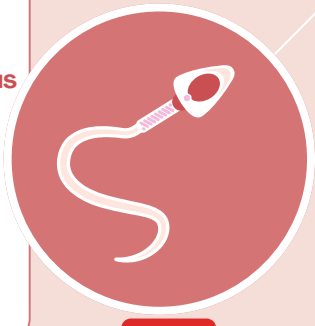
- A pair of testes.
- Present outside the body in a pouch called the scrotum.
- Sperm formation requires lower temperature.

PENIS

External male reproductive organ

SPERM

- Sperm production takes place inside the seminiferous tubules, and mature in the epididymis.
- Testosterone production occurs in cells surrounding the seminiferous tubules, called Leydig cells.



Sperm
male sex cell

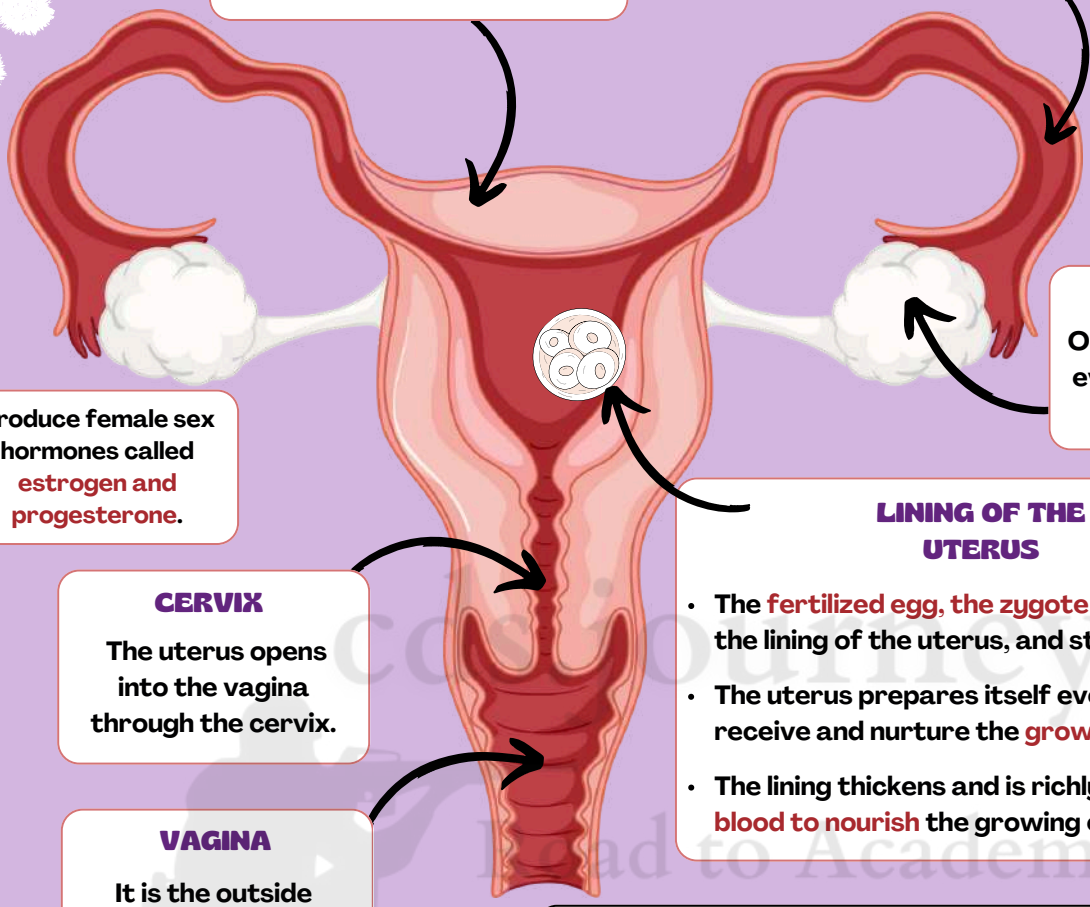
URETHRA

A tube from the bladder to the penis, where urine and sperm passes

FEMALE REPRODUCTIVE SYSTEM

UTERUS
The two oviducts unite into an elastic bag-like structure known as the uterus.

FALLOPIAN TUBES
The egg is carried from the ovary to the womb through a thin oviduct or fallopian tube.



OVARIES
One egg is produced every month by one of the ovaries.

Produce female sex hormones called estrogen and progesterone.

LINING OF THE UTERUS
- The fertilized egg, the zygote gets implanted in the lining of the uterus, and starts dividing.
- The uterus prepares itself every month to receive and nurture the growing embryo.
- The lining thickens and is richly supplied with blood to nourish the growing embryo.

CERVIX
The uterus opens into the vagina through the cervix.

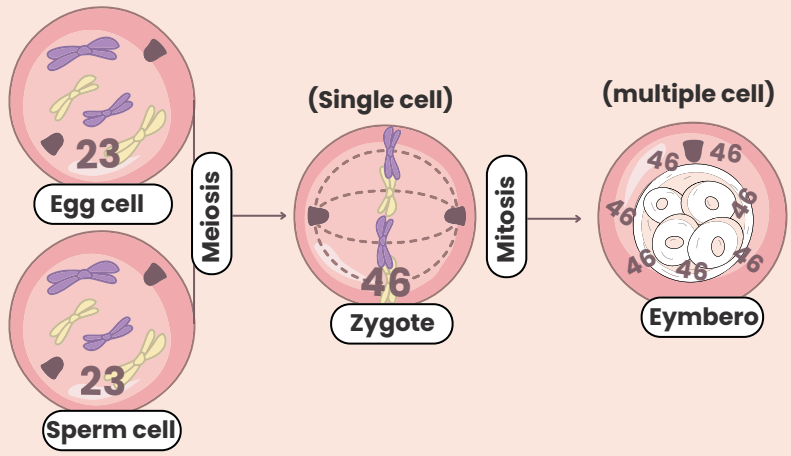
VAGINA
It is the outside passage way of the baby which is called as the "birth canal.'

Haploid
A cell or organism with one set of chromosomes.

In humans, gametes (sperm and egg cells) are haploid.

Diploid
A cell or organism with two sets of chromosomes.

In humans, most cells are diploid, including blood cells, skin cells, and muscle cells.



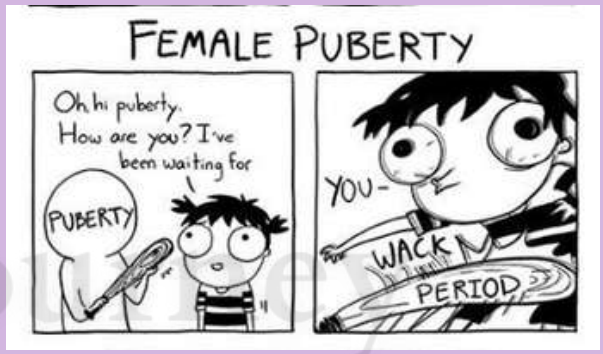
PUBERTY

Physical changes in boys

- Hair growth: armpits, chest & face.
- Thinner hairs in arms, legs.
- Oily skin.
- Genitals' growth.
- Voice Deeping.

Physical changes in girls

- Hair growth: armpits, public areas.
- Breast development.
- Darkening skin of nipples at tips of breast.
- Mensuration cycle.
- Voice Shrilled.

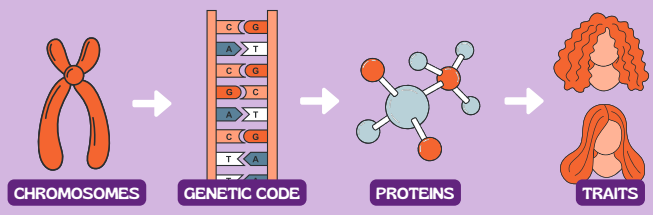


MENSTRUAL CYCLE

- If the egg is not fertilized, it lives for about one day.
- Since the ovary releases one egg every month, the uterus also prepares itself every month to receive a fertilized egg.
- Thus its lining becomes thick and spongy.
- As, this lining is not needed any longer.
- So, the lining slowly breaks and comes out through the vagina as blood and mucous.
- This cycle takes place roughly every month and is known as menstruation.
- It usually lasts for about two to eight days.

HEREDITY AND EVOLUTION

- **Genetics** is termed as the study to understand the functioning of **inheritance of traits from parents to offspring.**
- The **father of genetics** is Gregor Mendel. (worked on tea plant)
- The inbuilt tendency for variation during reproduction is the basis for **evolution.**
- A **gene** is the basic physical and functional unit of heredity.



- The **chromosomes** in the nucleus of a cell contain **information for inheritance** of features from **parents to next generation** in the form of **DNA (Deoxyribonucleic acid)** molecules.
- The **DNA** in the cell nucleus is the information source for making **Proteins .**
- A basic event in **reproduction** is the creation of a **DNA copy.**
- Cells use **chemical reactions** to build copies of their DNA.
- This creates **two copies of the DNA** in a reproducing cell, and they will need to be **separated from each other.**
- **DNA copying** is accompanied by the creation of an **additional cellular apparatus,** and then the **DNA copies separate**, each with its **own cellular apparatus.**
- As a result, the **DNA copies generated will be similar**, but **may not be identical to the original.**
- Therefore, the process of copying the DNA will have **some variations each time.**

Somatic Variation

- Acquired traits (after birth) not inherited from parents.
- Cannot passed on to the next generation.
- Reading books, developing skills etc.

Gametic variation

- Inherited traits by birth from parents.
- Passed on to the next generation.
- Skin color, eye color, Color blindness etc.

Gregor Mendel chose pea plants for his experiments on heredity because they were ideal for studying genetics :

- Pea plants grow quickly.
- The flowers of this plant are bisexual.
- They are self-pollinating, and thus, self and cross-pollination can easily be performed.
- The different physical characteristics were easy to recognize and study.

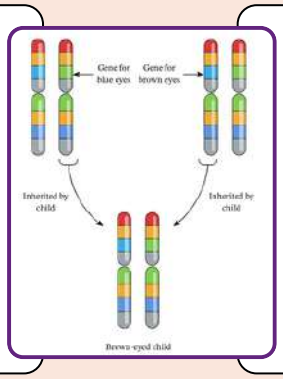
	Seed Color	Seed Shape	Pod Color	Pod Shape	Flower Color	Flower Position	Plant Height
Dominant Traits	Yellow	Round	Green	Inflated (Full)	Purple	Axial	Tall
Recessive Traits	Green	Wrinkled	Yellow	Constricted (Flat)	White	Terminal	Short

ALLELES

Different form of a given gene.

Maternal alleles

- Gene BROWN. (DOMINATE)
- Dominant allele denoted by capital letters. e.g. "T"



Paternal alleles

- Gene BLUE. (RECESSIVE)
- Recessive allele denoted by small letters. e.g. "t"

Genotype

Genotype is the genetic code responsible for phenotype, such as TT, tt, Tt.

Phenotype

Phenotype refers to an individual's observable traits, such as height, eye color and blood type.

F1 generation

Generation produced as result of cross fertilization.
Ex - crossing TT & tt produces Tt.

Homozygous

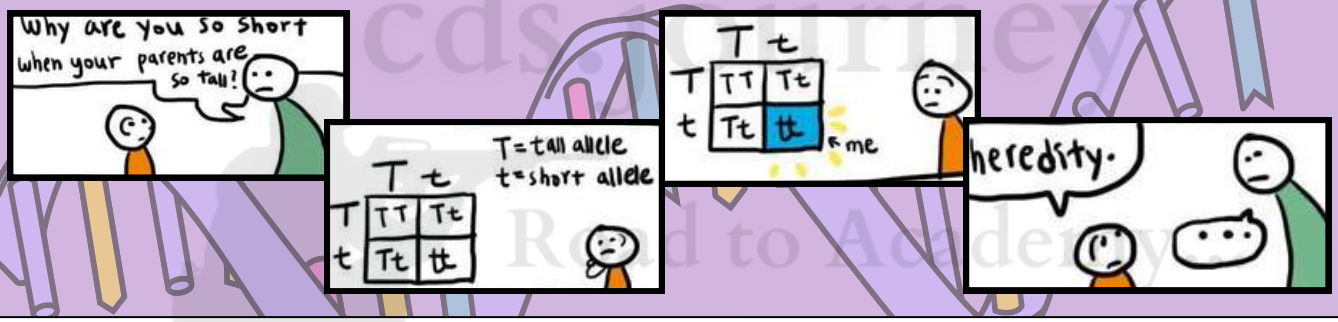
Homozygous means inherited the same alleles.
(Ex- TT)

Heterozygous

Heterozygous means inherited different alleles.
(Ex- Tt)

F2 generation

Generation produced as result of self fertilization of F1 generation.



Monohybrid cross

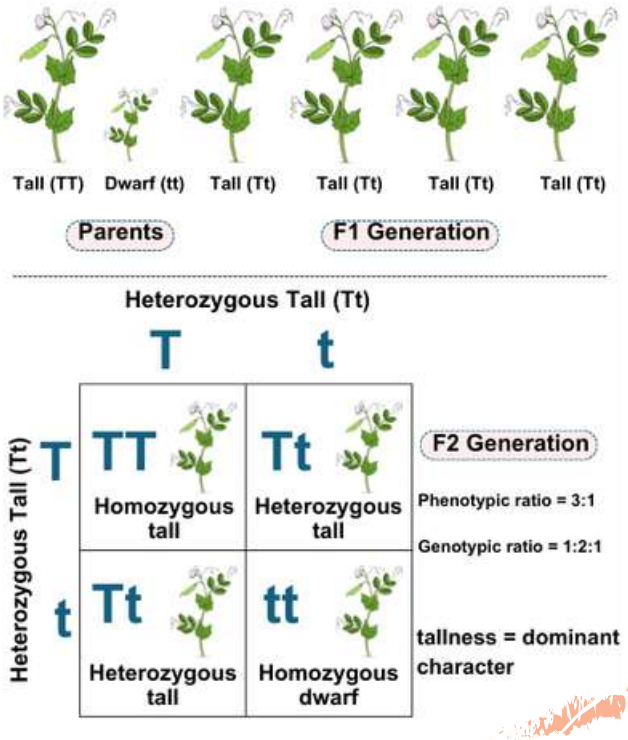
In F1 generation :

- Homozygous tall is crossed with homozygous dwarf.
- All the offsprings produced will be heterozygous tall.

In F2 generation :

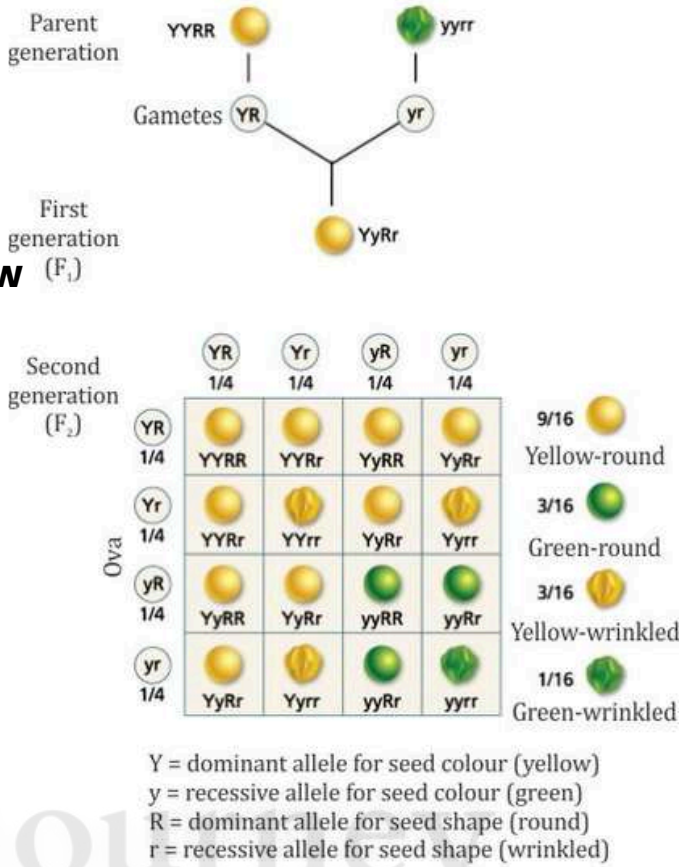
The offsprings of F1 is self crossed,

- Phenotypic ratio: 3:1
- Genotypic ratio: 1:2:1



DIHYBRID CROSS

- Two pairs of traits: seed shape (round or wrinkled) and seed color (yellow or green).
- Crossed pea plants with yellow & round seeds (YYRR) with green & wrinkled seeds (yyrr).
- F1 generation ratio – YyRr (Yellow & round seeds)
- Self crossed pea plants with Yellow & round seeds (YyRr) of F1 generation.
- F2 generation, observed a 9:3:3:1 phenotypic ratio.

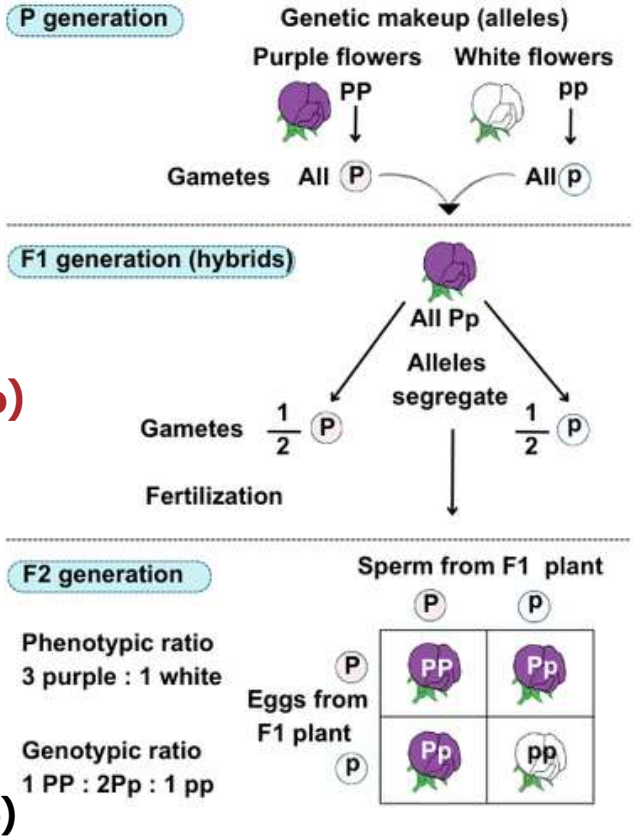


Y = dominant allele for seed colour (yellow)
y = recessive allele for seed colour (green)
R = dominant allele for seed shape (round)
r = recessive allele for seed shape (wrinkled)

- Genotypes: RRYY, RRYy, RrYY, RrYy, RRyy, Rryy, rrYY, rrYy, rryy
- Phenotypes: 9 round yellow seeds, 3 round green seeds, 3 wrinkled yellow seeds, 1 wrinkled green seed.

Purple and White flowers

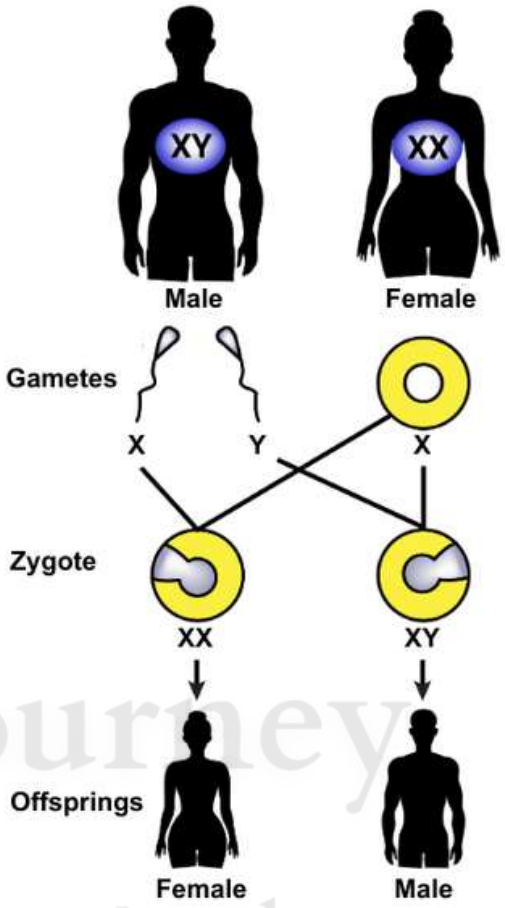
- Two alleles: purple flowers (P, dominant) & white flowers (p, recessive).
- Crossed purple-flowered (PP) with white-flowered (pp).
- F1 generation – Purple flowers (Pp)
- No white-flowered plants were observed.
- F1 generation (Pp) plants to self-pollinate.
- F2 generation – 3:1 ratio of purple to white flowers.



- Genotype: PP, Pp (purple), pp (white)
- Phenotype: 3 purple flowers (PP and Pp) to 1 white flower (pp)

SEX DETERMINATION

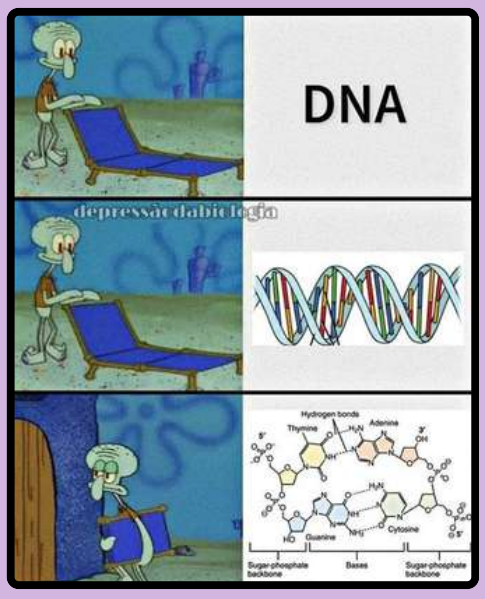
- Sex determination is primarily based on the presence of sex chromosomes.
- Humans have 23 pairs of chromosomes in each cell.
- Females have two X chromosomes (XX), one inherited from each parent.
- Males have one X chromosome & one Y chromosome (XY), X chromosome (mother) & Y chromosome (father).
- A child's sex is determined by the combination of sex chromosomes they inherit:



- If a child inherits an X chromosome from both parents (XX), they will develop into a female.
- If a child inherits an X chromosome from the mother and a Y chromosome from the father (XY), they will develop into a male.

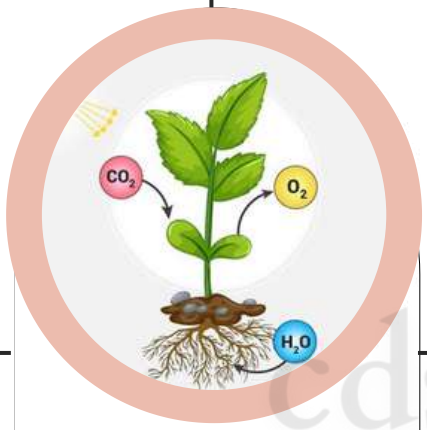
REMINDER

Tough Times Never Last, But Tough People Do!

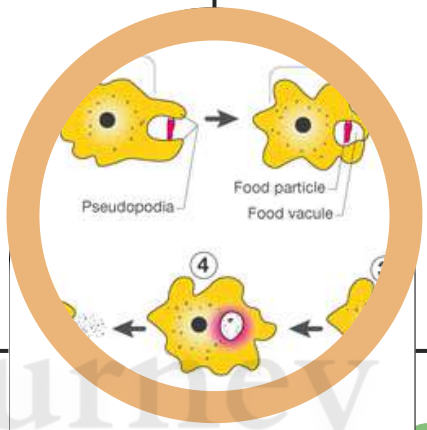


LIFE PROCESSES

NUTRITION



AUTOTROPHIC NUTRITION



HETEROTROPHIC NUTRITION

CHEMOAUTOTROPHIC NUTRITION

Chemical reactions to create their own food.

PHOTOAUTOTROPHIC NUTRITION

Uses sunlight to convert inorganic molecules into organic molecules.

HOLOZOIC NUTRITION

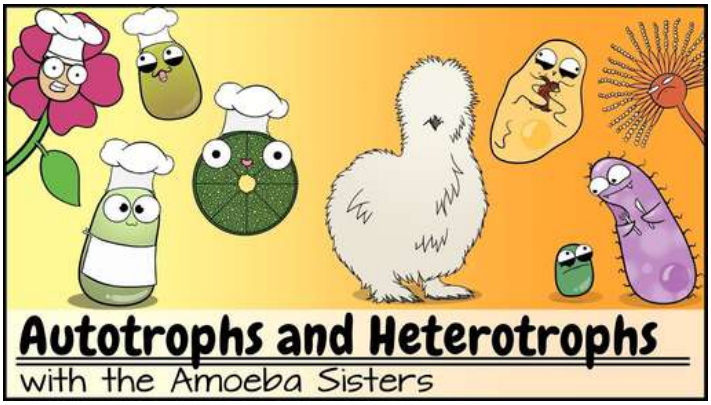
Engulfing food in solid or liquid form.

SAPROPHYTIC NUTRITION

Feed on dead and decaying organic matter.

PARASITIC NUTRITION

Organism lives in or on another organism.



Biofortification

Increases the nutritional value of food crops by improving their nutrient density.

DID YOU KNOW?

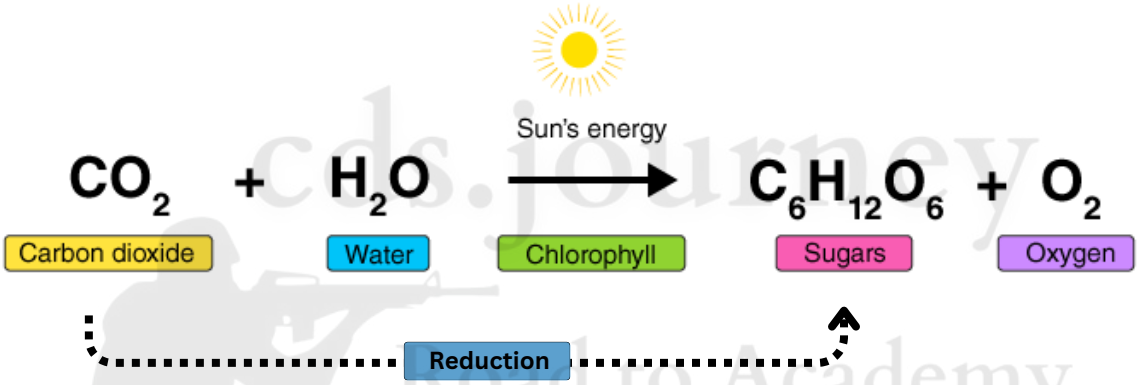
AUTOTROPHIC NUTRITION

The autotrophs, include green plants and some bacteria.

Make their own food using sunlight or chemicals.

Plants photosynthesize (use light energy) and are called photoautotrophs.

Few bacteria use chemicals to derive energy and are called chemoautotrophs.



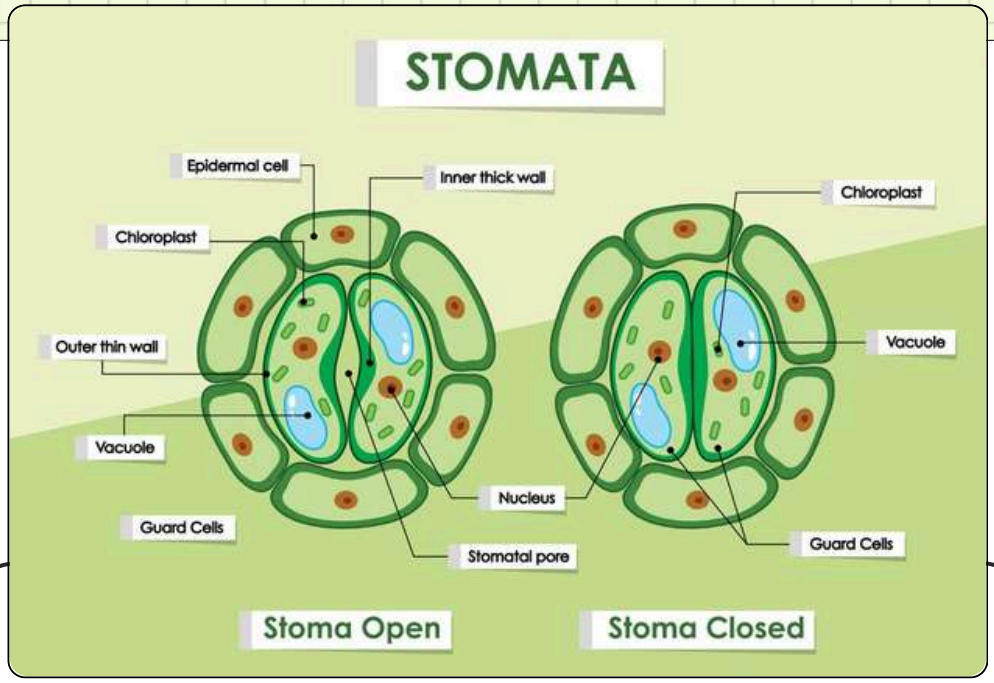
It's the process by which autotrophs take in substances from the outside and convert them into stored forms of energy.

Material is taken in the form of CO_2 & water which is converted into carbohydrates in the presence of sunlight and chlorophyll.

Light energy is absorbed by chlorophyll and converted into chemical energy.

Splitting of H_20 molecules into H and O_2, reduction of CO_2 to carbohydrates (glucose).

The carbohydrates which are not used immediately are stored in the form of starch.



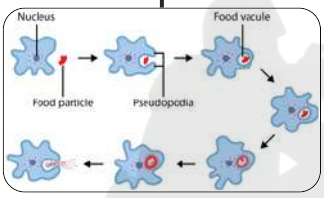
- Some cells contain **green dots.** These green dots are cell organelles called **chloroplasts** which contain **chlorophyll.**
- Massive amounts of **gaseous exchange** takes place in the leaves through **stomata** for the purpose of **photosynthesis.**
- During the **day**, plants take in **carbon dioxide** through open stomata and **release oxygen** into the environment. **(DIFFUSION)**
- At **night**, plants take in **oxygen** through closed stomata and **release carbon dioxide** into the environment.
- It is important to note that exchange of gases occurs across the surface of **stems, roots and leaves** as well.
- The plant **closes** these pores when it does not need carbon dioxide.
- The **opening and closing** of the pore is a function of the **guard cells.**
- Other materials like **nitrogen, phosphorus, iron** and **magnesium** are taken up from the soil by **autotrophs.**
- **Nitrogen** is an essential element used in the **synthesis of proteins** and other compounds.

Desert plants take up **carbon dioxide** at **night** and prepare an intermediate which is acted upon by the **energy absorbed** by the **chlorophyll** during the **day.**

HETEROTROPHIC NUTRITION

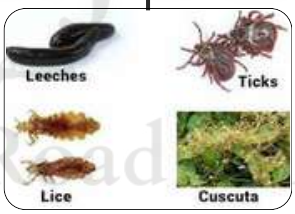
HOLOZOIC NUTRITION

- Organism takes the **complex organic** food materials into its body by the process of **ingestion.**
- Food break down **inside** the body.
- **Ex:** Humans, Amoeba, Animals like dogs, cats, frogs, etc.



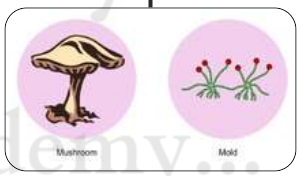
PARASITIC NUTRITION

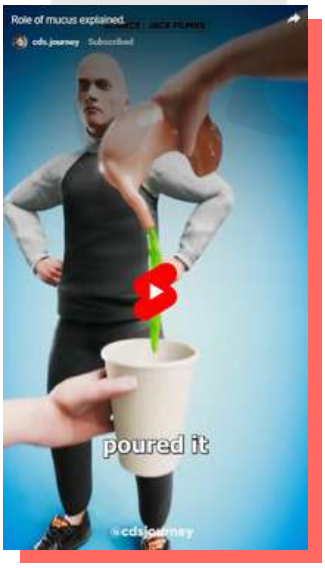
- Organism derives its food from the body of **another living organism** called its **host without killing** it.
- Food break down **inside** the body.
- **Ex:**Cuscuta, Leeches, Plasmodium, Lice, Tapeworms, Ticks.



SAPROPHYTIC NUTRITION

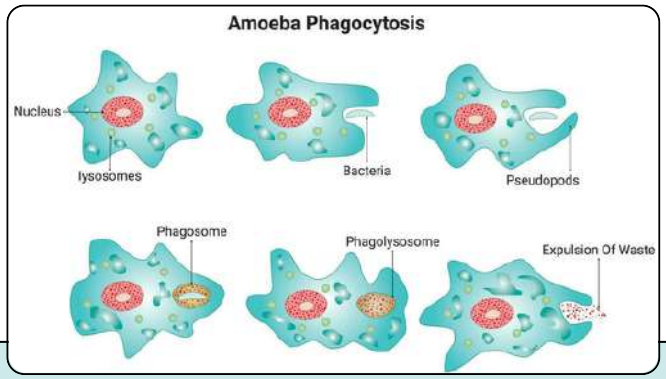
- Organism obtains its food from **dead organic matter** of dead plants dead animals and rotten bread.
- Food break down **outside** the body.
- **Ex:** Fungi, Bread mold, Rhizopus, Mushroom, Yeast.





DID YOU KNOW ?

Chlorophyll **absorbs red and blue light** for photosynthesis, while **reflecting green light,** making plants appear green.



- Amoeba obtains its food by the process of **phagocytosis.**
- It **engulfs** the food particle with the help of **pseudopodia.**

INGESTION → DIGESTION → ABSORPTION → ASSIMILATION → EGESTION

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NUTRITION IN HUMAN BEINGS

DID YOU KNOW?

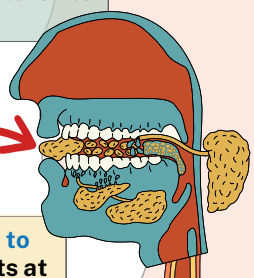
- **Small intestine** differs in various animals depending on the food they eat.
- **Herbivores** eating grass need a **longer small intestine** to allow the cellulose to be digested.
- **Meat** is easier to digest, carnivores like tigers have a **shorter small intestine.**

- Digestion start from **mouth.**
  - **Mechanical Digestion** – Breaking down of **food** into **smaller pieces.**
  - **Chemical Digestion** – Saliva has enzyme – **salivary Amylase** – breaks down **starch to glucose.**

AMYLASE is an enzyme that **breaks down** complex sugars, like **starches**, into simple sugars during digestion.

MOUTH

1



ESOPHAGUS transfers food from **mouth to stomach** by help of peristaltic movements at both ends **sphincters** are present.

ESOPHAGUS

2

STOMACH is the digestive system's most dilated portion.

- **Gastric juices** – Hydrochloric acid **(HCL)**
- **HCL** – **Kills harmful bacteria** and converts proenzyme pepsinogen to pepsin.
- **Pepsin** – breakdown of **proteins.**
- **Mucus** – Protects the stomach **lining from HCL.**
- Food is churned into a semi-solid mass in the stomach called **Chyme. (incomplete digestion)**

LIVER main job within the digestive system is to **absorb nutrients** from the **small intestine.**

BILE from the liver secreted into the small intestine also plays an important role in digesting **fat and vitamins.**

Bile salts break them down into smaller globules increasing the efficiency of enzyme action. **(Emulsification)**

LIVER

STOMACH

3

GALL BLADDER

Store and release bile, a digestive fluid that helps break down fats.

SMALL INTESTINE longest part of the alimentary canal, about 20 feet long in humans.

Small intestine is the site of the **complete digestion** of carbohydrates, proteins and fats

PANCREAS produces **alkaline pancreatic juice** to **neutralize** the acidic chyme from the stomach

Pancreas secretes **pancreatic juice** which contains enzymes like **trypsin and lipase.**

Trypsin for digesting **proteins** & **lipase** for breaking down emulsified **fats.**

PANCREAS

SMALL INTESTINES

4

A common pancreatic ducts from the pancreas and liver opens into the duodenum.

Duodenum is region which follows stomach.

Jejunum is the middle part

Ileum is the later region which continues further into the large intestine.

The **walls** of the small intestine contain glands which **secrete intestinal juice** (also called succus entericus)

- **Proteins** to **amino acids**
- **Complex carbohydrates** into **glucose**
- **Fats** into **fatty acids & glycerol**

Inner lining of the small intestine has numerous **finger -like projections** called **villi** which increase the surface area for absorption.

The **villi** are richly supplied with **blood vessels** which take the **absorbed food** to each and every cell of the body.

5

LARGE INTESTINES

The **unabsorbed food** is sent into the **LARGE INTESTINE** where its wall absorb more water from this material.

The rest of the material is **removed** from the body via the **anus.**

6

RECTUM

Acts as the stool's temporary storage

7

ANUS

Where stool exits the body

RESPIRATION

- Respiration broadly means the exchange of gases.
- Respiration is a metabolic process that occurs in all organisms.
- 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.

DID YOU KNOW?

- Aquatic organisms breathe faster than humans.
- Aerobic respiration releases up to 38 ATP molecules,19 times more energy than anaerobic respiration

BREATHING

- Physical act of inhaling and exhaling air through the lung.
- NO energy produced.

RESPIRATION

- Chemical process break down of glucose into energy.
- ATP produced.

INHALATION

- Ribs lift up and diaphragm flat.
- Volume of lungs increase.

EXHALATION

- Ribs downwards, diaphragm relaxes (dome-shaped)
- Volume of lungs decrease.

PROCESS OF RESPIRATION

- Break-down of glucose, a six-carbon molecule, into a three-carbon molecule called pyruvate
- This process takes place in the cytoplasm.
- Further, it may convert into ethanol and carbon dioxide. This process takes place in yeast during fermentation.

GLYCOLYSIS
(6 - CARBON)

CYTO | PLASM

PYRUVATE
(3 - CARBON)

ABSENCE OF OXYGEN
ANAEROBIC RESPIRATION
(IN YEAST)
→ **ETHANOL + CO_2 +ENERGY**
(2 - CARBON)

LACK OF OXYGEN
(IN MUSCLES)
→ **LACTIC ACID + CO_2**
(3 - CARBON)

PRESENCE OF OXYGEN
AEROBIC RESPIRATION
(MITOCHONDRIA)
→ **WATER + CO_2 +ENERGY**

Nostrils
↓
Nasal passage
↓
Nasal cavity
↓
Pharynx
↓
Larynx
↓
Trachea
↓
Bronchi
↓
Lungs
↓
Bronchioles
↓
Alveoli
↓
Blood capillaries

Aerobic Respiration

- Oxygen is present.
- Gases are exchanged.
- Found in the cytoplasm and the mitochondria.
- Glucose breaks down into carbon dioxide and water.
- Release of energy is greater than in the anaerobic process.
- All higher organisms such as mammals have this type of respiration.

Anaerobic Respiration

- Lack of oxygen.
- Gases are not exchanged.
- Found only in cytoplasm.
- Glucose breaks down into ethyl alcohol, carbon dioxide and energy.
- Build-up of lactic acid during sudden activity causes cramps.
- Lower organisms such as bacteria and yeast during fermentation.

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RESPIRATORY SYSTEM

01 - Nose and Nasal Cavity

The air passing through the nostrils is filtered by fine hairs that line the passage.

02 - Pharynx (Throat)

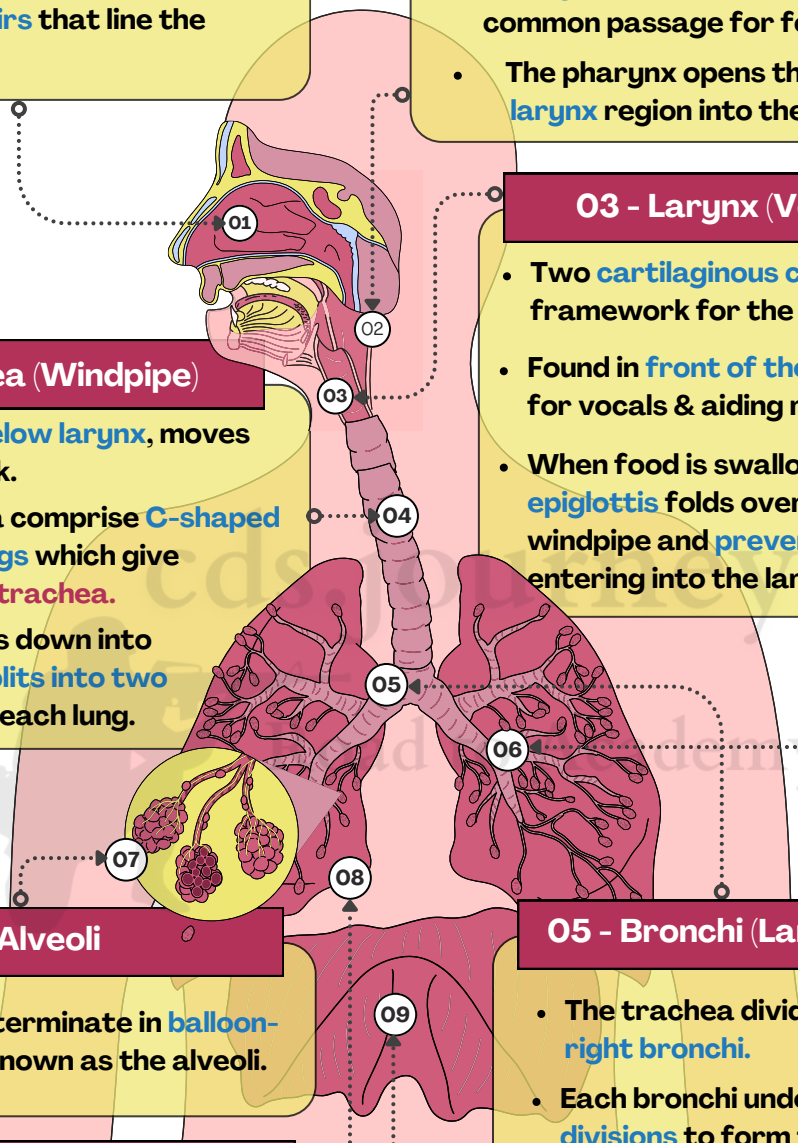
- The nasal chamber opens into the pharynx, a portion of which is the common passage for food and air.
- The pharynx opens through the larynx region into the trachea.

03 - Larynx (Voice Box)

- Two cartilaginous chords lay the framework for the larynx.
- Found in front of the neck, responsible for vocals & aiding respiration.
- When food is swallowed, a flap called epiglottis folds over the top of windpipe and prevents food from entering into the larynx.

04 - Trachea (Windpipe)

- Trachea rises below larynx, moves down to the neck.
- Walls of trachea comprise C-shaped cartilaginous rings which give hardness to the trachea.
- Trachea extends down into breastbone & splits into two bronchi, one for each lung.



05 - Bronchi (Large Airways)

- The trachea divides into left and right bronchi.
- Each bronchi undergoes repeated divisions to form the secondary and tertiary bronchi.
- Bronchioles ending up in very thin terminal bronchioles.

06 - Bronchioles

Bronchioles are small air passages and serve as conduits for air, connecting the larger bronchi to alveoli.

07 - Alveoli

The bronchioles terminate in balloon-like structures known as the alveoli.

08 - Lungs

- Primary organs of respiration in vertebrates.
- Located on either side of the heart.
- Spongy organs, estimates total surface area between 50 to 75 sq meters.
- Facilitate the exchange of gases between the blood and the air.
- Right lung is quite bigger and heavier than the left lung.

09 - Diaphragm

The diaphragm is a dome-shaped muscle that separates the chest cavity from abdominal cavity.

A

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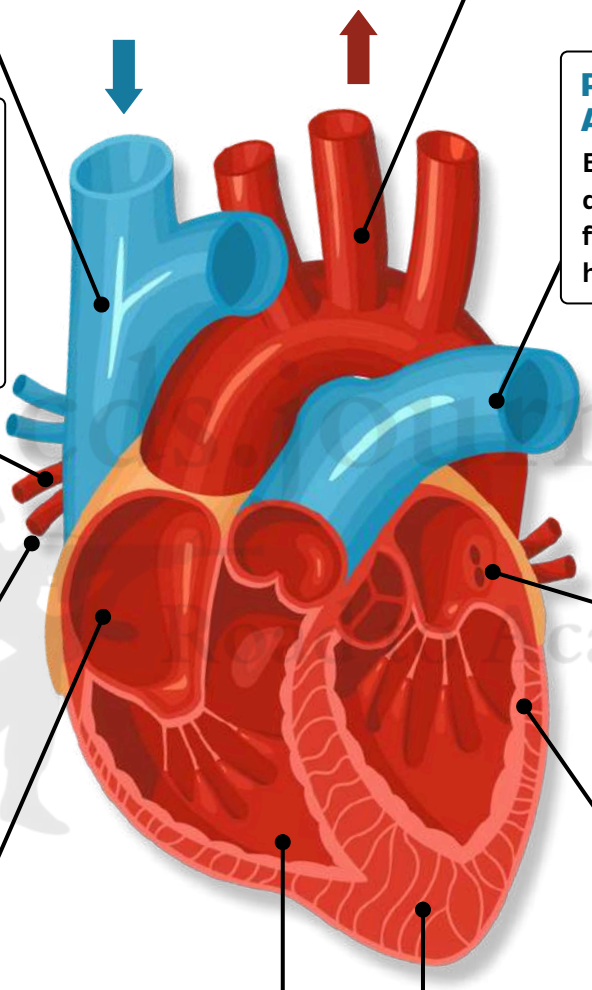
SUPERIOR VENA CAVA
A major vein that carries blood from the upper body (head, chest, and arms) to the heart.

AORTA
The main artery that carries blood away from the heart to the rest of the body.

INFERIOR VENA CAVA
Large vein that carries the deoxygenated blood from the lower and middle body into the right atrium of the heart.

PULMONARY ARTERIES
Blood vessels that carry deoxygenated blood from the right side of the heart to the lungs.



PULMONARY VEINS
Blood vessels that carry oxygenated blood from the lungs to the heart.

LEFT ATRIUM
The left atrium receives oxygenated blood from the lungs and pumps it into the left ventricle.

RIGHT ATRIUM
The right atrium receives deoxygenated blood from the body and pumps it into the right ventricle.

RIGHT VENTRICLE
The right ventricle pumps deoxygenated blood to the lungs.

SEPTUM
The septum is a wall of tissue separating the heart's right and left sides.

LEFT VENTRICLE
The left ventricle thick walls pumps oxygenated blood to the rest of the body via the aorta.

CAPILLARY
- Smallest blood vessels in the body.
- Exchange of material b/w the blood and surrounding cells.
- Connection b/w arteries and veins.

CORONARY ARTERIES
Carries blood to the heart muscle.

SUBCLAVIAN ARTERY
Supply oxygenated blood to head & neck.

CAROTID ARTERIES
Supply blood and oxygen to brain & eye.

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PULMONARY VEINS

- Carries **oxygenated** blood.
- It divides into **four veins.**
- **Thin-walled**, present on the surface of the body.
- Takes blood from the heart and **transports** it to the lungs.

PULMONARY ARTERIES

- Carries **deoxygenated** blood.
- It divides into **two arteries.**
- **Thick-walled**, Located deep in muscles.
- Takes blood from the lungs and **transports** it to the heart.

SYSTOLIC BLOOD PRESSURE

- The **pressure** in the arteries when the heart **contracts** (systole)
- Pressure is less than **120 mm Hg.**

BLOOD PRESSURE

Force that blood exerts against the walls of vessels.

B.P - ARTERIES > VEINS

DIASTOLIC BLOOD PRESSURE

- The **pressure** in the arteries when the heart is **relaxed** (diastole)
- Pressure is less than **80 mm Hg.**

UREOTELIC

- Organisms that excrete **urea** as waste.
- **Ex:** adult amphibians, cartilaginous fish, & mammals, including humans.

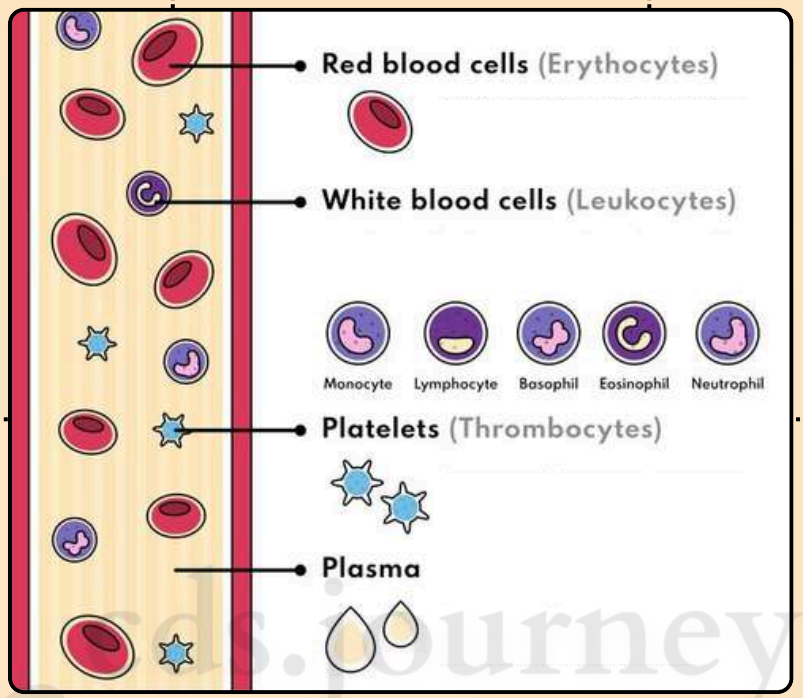
URICOTELIC

- Organisms that excrete **uric acid** as waste.
- **Ex:** birds, lizards, snakes, & terrestrial arthropods, such as insects.

AMMONOTELIC

- Organisms that excrete **ammonia** as waste.
- **Ex:** aquatic animals, fish, crustaceans, & echinoderms.

BLOOD



RED BLOOD CELLS (RBCS)

- Red blood cells (RBCs), also known as erythrocytes.
- The most common type of cell in the blood.
- RBCs contain hemoglobin, a protein that carries oxygen from the lungs to the body's tissues.
- Biconcave in shape.
- RBCs circulate for up to 120 days.
- The bone marrow produces 2–3 million RBCs every second.
- Removed by macrophages in the spleen and liver.
  "graveyard of red blood cells"
- The normal hemoglobin levels in the blood:
  - 12 to 16 grams per deciliter (g/dL) : females.
  - 13.5 to 17.5 g/dL : males.
  - 11 to 16 g/dL : children
- RBCs do not contain any cellular organelles like mitochondria, ribosomes, nucleus, Golgi apparatus, endoplasmic reticulum, etc.

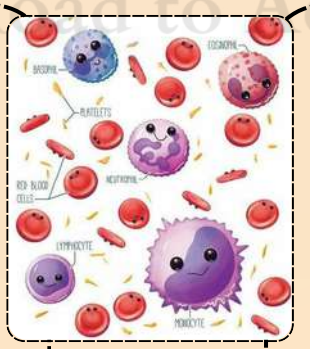
WHITE BLOOD CELLS (WBCS)

- White blood cells (WBCs), also known as leukocytes.
- WBCs help the body fight infection and other diseases.
- (WBCs) is usually less than the number of red blood cells (RBCs)
- A normal WBC count is between 4,000 and 10,000 per microliter.
- WBCs are colorless, lack of hemoglobin.
- The lifespan of a white blood cell (WBC) in humans is typically 13–20 days.
- They contain nucleus, Mitochondria, Golgi apparatus, Nucleolus, Endoplasmic reticulum, Centrioles, Lysosomes, and Peroxisomes.
- White blood cells (WBCs) are of two types granulocytes & agranulocytes :

GRANULOCYTES

- **Neutrophils**
  Most abundant
- **Eosinophils**
  Resist infections
- **Basophils**
  Least abundant

Heparin : Anticoagulant that prevents blood from clotting.



AGRANULOCYTES

- **Lymphocytes**
  - B lymphocytes
  - T lymphocytes

  Immune system response
- **Monocytes.**

NEUTROPHILS AND MONOCYTES ARE PHAGOCYTIC CELLS AND DESTROY INFECTIOUS AGENTS.

Colostrum is rich in IgA, an antibody that protects newborns by strengthening their mucosal immunity.

PLATELETS (THROMBOCYTES)

- Platelets, also known as thrombocytes.
- Small, colorless cell fragments in the blood.
- Help stop bleeding and form clots.
- Seal the blood vessels in a process called clotting (coagulation).
- They are made in the bone marrow.
- Normal range: 1.5 lakh to 3.5 lakh platelets per mcL.
- Platelets do not contain a nucleus, but they do contain other organelles.
- A single drop of blood contains tens of thousands of platelets.
- Low platelet count is called thrombocytopenia.

PLASMA

- Plasma is the liquid component of blood.
- Contributes to 55% of your blood's total volume.
- It's a light amber or straw-colored fluid that contains proteins, water, salts, sugars, fats, and other substances.
- Main function is to transport blood cells, hormones, nutrients, waste products, and other substances throughout the body
- Helps maintain blood pressure and volume.

LYMPH

- Lymph is a clear or white fluid that flows through the lymphatic system, which is part of the body's immune system.
- Lymph is also an important carrier for nutrients, hormones, etc.

BLOOD GROUP

ANTIGEN

- A substance that is capable of inducing immune response in the body by the production of antibodies.
- Rh–antigen are present on the surface of RBC.

ANTIBODY

- Antibody are proteins found in Plasma.
- Produced in response to antigen.
- Rh – antibodies are not present on red blood cells (RBCs).

ABO GROUPING

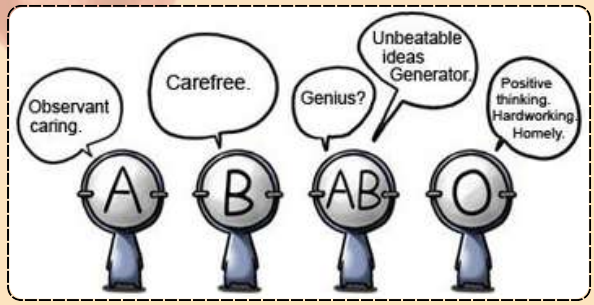
BLOOD GROUP	DONATE TO	RECIVE FROM	ANTIGEN & ANTIBOODY
A	A+ → A+ AB+ A- → A- AB-	A+ → A+ A- O+ O- A- → A- O-	ANTIGEN - A ANTIBODY - B
B	B+ → B+ AB+ B- → B- AB-	B+ → B+ B- O+ O- B- → B- O-	ANTIGEN - B ANTIBODY - A
AB	AB+ → AB+ AB- → AB-	AB+ → A+ A- B+ B- AB+ AB- O+ O- AB- → A- B- AB- O-	ANTIGEN - A & B ANTIBODY - ABSENT
O	O+ → UNIVERSAL DONOR O- →	O+ → O+ O- O- → O-	ANTIGEN - ABSENT ANTIBODY - A & B

ACTIVE IMMUNITY

- Acquired when the body produces its own antibodies (slow process) after exposure to an antigen.

PASSIVE IMMUNITY

- Provided by transferring antibodies from another source.



RH ANTIGEN

- Rh Antigen is similar to that of Rhesus monkey.
- Rh Antigen usually refers to Rh(D) antigen.
- We can be Rh +ve (if Rh antigen is presents) or Rh-ve (if Rh antigen is absent)

GOLDEN BLOOD GROUP

- One of the world's rare blood type.
- Rh-null (it has none of the Rh antigen).
- Less than 50 people in the world have this blood type.

BOMBAY BLOOD GROUP

- Doesn't have A, B & h antigen.
- Only have anti-h antibody.
- Also known as hh blood group.
- Discovered by Dr.YM Bhende, 1952 in Bombay

Reminder!

- Karl Landsteiner (1868–1943) discovered human blood groups.
- The opposite of an antigen is an antibody.
- O type is known as the "universal donor"
- AB+ type is known as the "universal recipient"

DID YOU KNOW?

Glycemic Index:

Carbohydrates :

Simple Carbohydrates:

- Monosaccharides: Single sugar - Glucose, Fructose, Galactose.
- Disaccharides: Double sugar
  Maltose (Glucose + Glucose)
  Sucrose (Glucose + Fructose)
  Lactose (Glucose + Galactose)

Complex Carbohydrates:

- Polysaccharides: Long chains of sugar molecules.
  - Starch
  - Glycogen
  - Cellulose
  - Fiber

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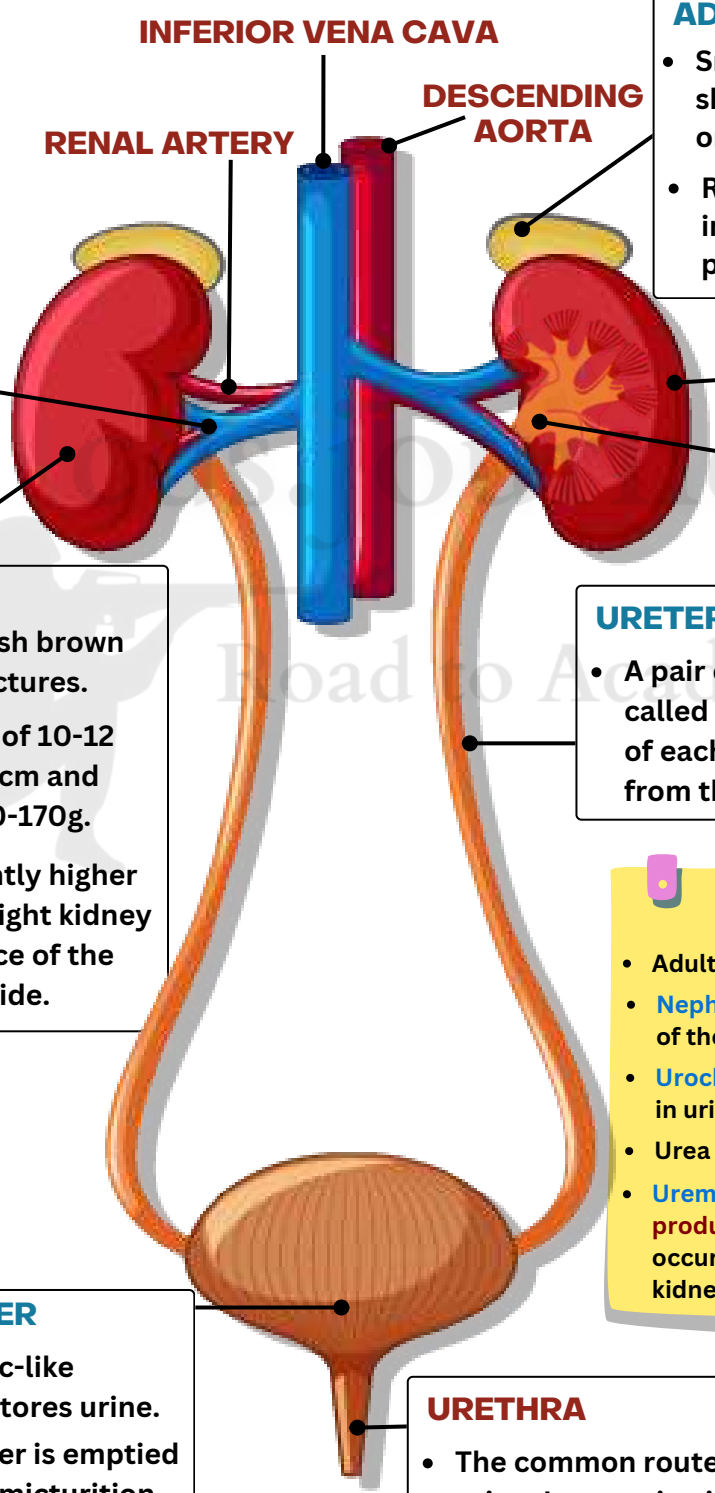
The accumulation of the toxins like excess water, salt, urea & the body removes all the metabolic wastes by the process called excretion.



ADRENAL GLANDS

- Small, triangular-shaped glands located on top of both kidneys.
- Regulate metabolism, immune system, blood pressure, stress.

KIDNEYS

- Kidneys are reddish brown bean-shaped structures.
- Kidney has length of 10-12 cm, a width of 5-7 cm and weighs around 120-170g.
- Left kidney is slightly higher & larger than the right kidney due to the presence of the liver on the right side.

URETER

- A pair of thin muscular tubes called the ureter comes out of each kidney extending from the renal pelvis.

#FUN FACTS

- Adult exert urine 1 - 1.5L per day.
- Nephrons are the functional units of the kidney.
- PH appx. 6
- Urochrome (Urobilin), a pigment in urine, causes its yellow color.
- Urea is formed in liver.
- Uremia is a buildup of waste products in your blood that occurs as a result of untreated kidney failure.

URINARY BLADDER

- It is a muscular sac-like structure, which stores urine.
- The urinary bladder is emptied by the process of micturition, i.e. the act of urination.

URETHRA

- The common route for sperms & urine. Its opening is guarded by sphincter muscles.

CONTROL AND 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 system.
- Hormones are chemical messengers, which assist the nervous system in carrying out various functions secreted by endocrine glands.

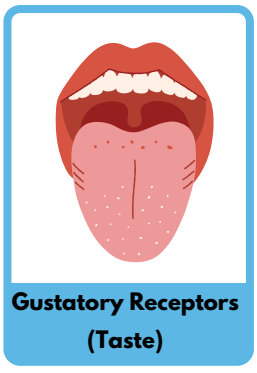
NERVOUS SYSTEM

CENTRAL NERVOUS SYSTEM (CNS)

- The brain and spinal cord make up the CNS.
- Brain : processing, memory, movement, and emotions.
- Spinal Cord : motor commands from the brain to the body and relays sensory information from the body to the brain.
- CNS is protected by the skull and vertebral column.

PERIPHERAL NERVOUS SYSTEM (PNS)

- The PNS is made up of all the nerves in the body.
- PNS relays information from the brain and spinal cord to the organs, arms, legs, fingers, and toes.
- PNS is made up of two main parts: the autonomic and somatic nervous systems.



Gustatory Receptors (Taste)

Phono Receptors (Hearing)

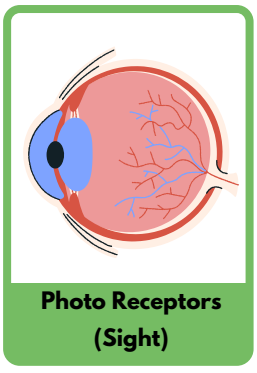
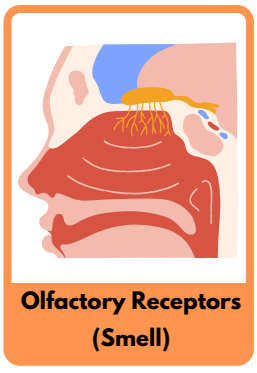
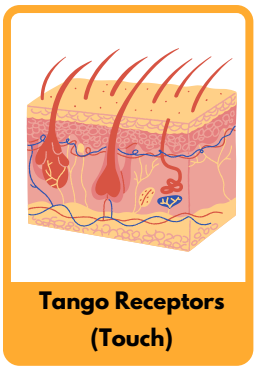


Photo Receptors (Sight)



Olfactory Receptors (Smell)



Tango Receptors (Touch)

SENSORY NEURONS

These neurons carry signals from the body's periphery to the central nervous system (Brain).

MOTOR NEURONS

These neurons carry signals from the CNS to the body's muscles, skin, and glands.

INTERNEURONS

These neurons connect various neurons (Brain & Spinal cord), acting as a "middle-man" between sensory and motor neurons.

REFLEX ACTION

① STIMULUS

The flame is stimuli within the environment.

② RECEPTOR

Sensory receptors on the hand will detect the heat from the flame.

③ SENSORY NEURON

A nerve that sends a message from a sensory receptor to the CNS (Central Nervous System).

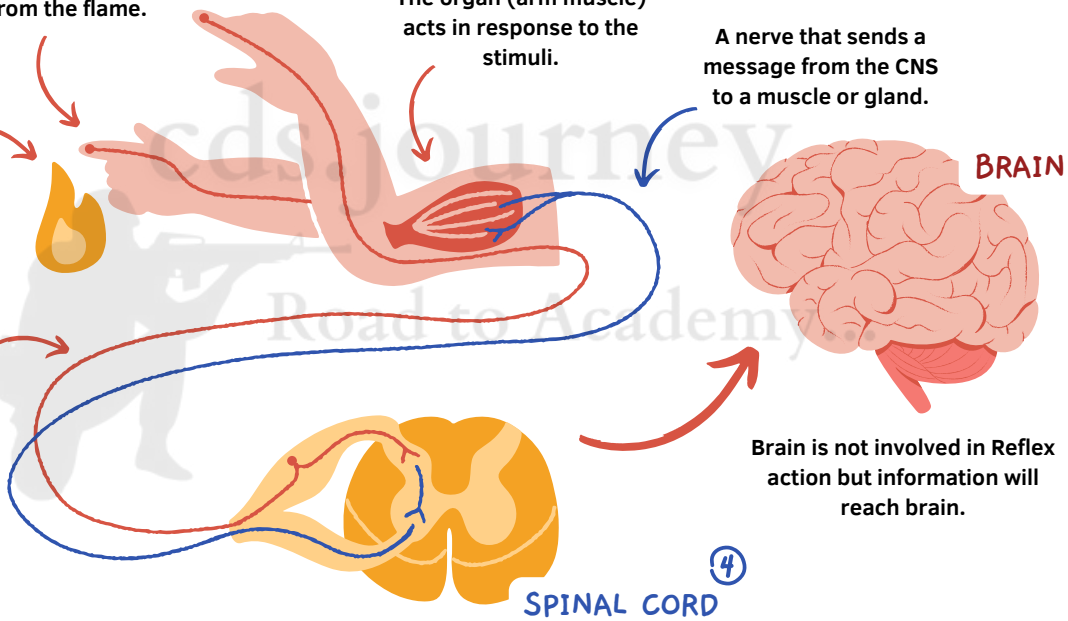
④ SPINAL CORD

⑤ MOTOR NEURON

A nerve that sends a message from the CNS to a muscle or gland.

⑥ EFFECTOR

The organ (arm muscle) acts in response to the stimuli.

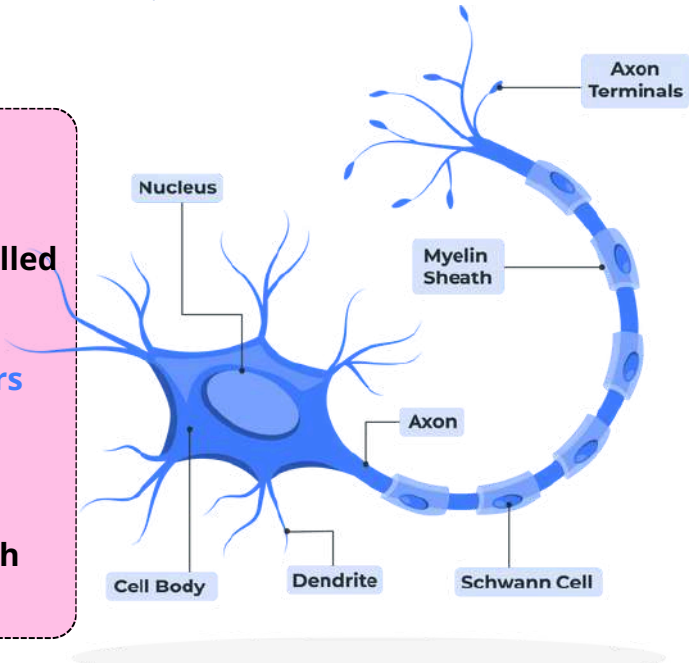


Brain is not involved in Reflex action but information will reach brain.

Stimulus
↓
Receptors
↓
Sensory Neuron
↓
Relay neuron
(Spinal Cord)
↓
Motor neuron
↓
Muscles
↓
Effector

NEURON

- The gap between two neurons is called a synapse.
- Neurotransmitters are chemical messengers that allow neurons to communicate with each other.



BRAIN

Cerebrum

- The largest part of the brain.
- It is divided into two hemispheres, or halves, called the cerebral hemispheres.
- Cerebrum control muscle functions and also control speech, thought, emotions, reading, writing, and learning.

Thalamus

A paired, egg-shaped structure in the center of the brain that acts as a relay station for sensory and motor information.

MID BRAIN

HIND BRAIN

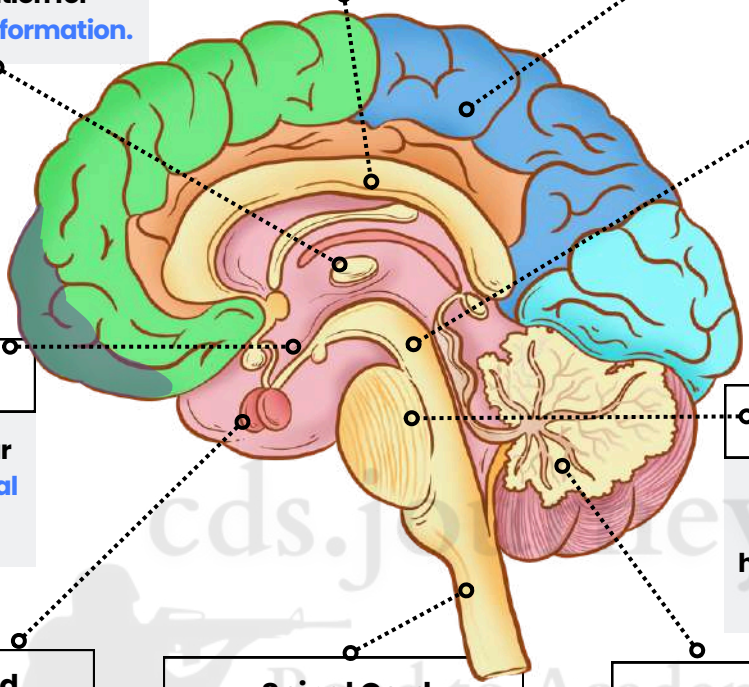
Pons

Pons coordinates eye and face movements, hearing, balance, sleep cycle and facial sensations.

FORE BRAIN

Hypothalamus

The key that turns our emotions into physical responses.



Medulla

Involuntary actions and maintaining breathing, heartbeat, blood pressure and vomiting.

Pituitary Gland

Control functions, including growth, fertility, and the involuntary nervous system

Spinal Cord

The spinal cord comprises nerves that supply information to think.

Cerebellum

Voluntary actions and maintaining body posture and balance.

FORE BRAIN

- Voluntary actions.
- Main thinking part of the brain.
- Receive sensory impulses from various receptors.
- Specialized for hearing, smell, sight, etc.

MID BRAIN

- Involuntary actions.
- Connects fore brain with mid brain.

HIND BRAIN

- Involuntary actions.
- PONS
- MEDULLA
- CEREBELLUM

- The brain is protected by 3 main layers :
  - The bony skull (cranium)
  - The cerebrospinal fluid.
  - The meninges (Dura mater, Arachnoid and Pia mater)

PLANT HORMONES

cds.journey
Road to Academy...

PLANT GROWTH PROMOTERS

- Promote cell division and enlargement, flowering, fruiting, and seed formation.
- Examples : auxins, gibberellins, ethylene, and cytokinins.

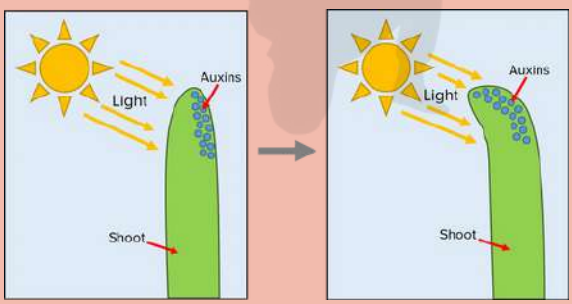
PLANT GROWTH INHIBITORS

- Inhibit growth and promote dormancy and abscission in plants.
- Examples : ethylene, abscisic acid.

PLANT GROWTH PROMOTERS

AUXIN

- When light is coming from one side of the plant, auxin diffuses towards the shady side of the shoot.



- Synthesized at the shoot tip, helps the cells to grow longer.
- Auxin promote flowering , e.g : in pineapples.
- Auxin also controls xylem differentiation and helps in cell division.
- Auxin also induce parthenocarpy (development of fruit without fertilization.) e.g : in tomatoes.

GIBBERELLIN

- Help : Growth of stem, Germination, Flowering.
- Cause : fruits like apple to elongate & improve its shape.

- Promotes : Bolting (internode elongation just prior to flowering) in beet, cabbages and many plants with rosette habit.

CYTOKININ

- Promote : cell division.
- Used to delay aging.
- Help overcome the apical dominance.
- Natural cytokinin's are synthesized in regions where rapid cell division occurs.
- Example : root ,apices , developing shoot buds young fruits etc.

PLANT GROWTH INHIBITORS

ABSCISIC ACID

- It acts as a general plant growth inhibitor and inhibitor of plant metabolism.
- It is also called stress hormones.
- Important role in seed development , maturation and dormancy.
- Its effects include wilting of leaves.
- Abscisic acid inhibits seed germination.

PLANT GROWTH INHIBITORS & PROMOTERS

ETHYLENE

- Ripening of fruits.
- Influences horizontal growth of seeds and seedlings.
- Formation of apical hook in dicot seedlings.
- Promotes senescence & is found in high concentration in ripened fruits.
- Promotes root growth & root hair formation, helping plants to increase their absorption surface.

Plant Hormones

Functions	Hormones				
	Auxin	Gibberelin	Cytokinin	Ethylene	Abscisic acid
Promotes cell elongation	✓	✓	✗	✗	✗
Helps in cell division & growth	✓	✓	✓	✗	✗
Promotes seed germination	✗	✓	✗	✗	✗
Aids in fruit ripening	✗	✗	✗	✓	✗
Maintains seed dormancy	✗	✗	✗	✗	✓
Promotes abscission	✗	✗	✗	✗	✓

HUMAN HORMONES

ENDOCRINE GLANDS

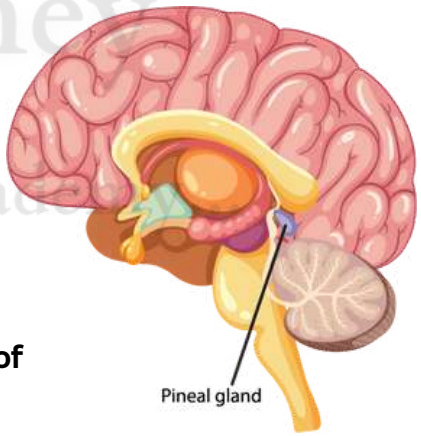
- Secrete hormones directly into the bloodstream.
  - Pancreas
  - Pituitary gland
  - Adrenal glands
  - Ovaries (women)
  - Testes (men)
  - Hypothalamus
  - Parathyroid glands
  - Thyroid gland
  - Pineal gland
  - Thymus

EXOCRINE GLANDS

- Secrete substances through ducts onto the body's surfaces.
  - Salivary glands
  - Lacrimal glands
  - Mammary glands
  - Brunner glands
  - Digestive glands
  - Pancreas
  - Sebum
  - Sweat

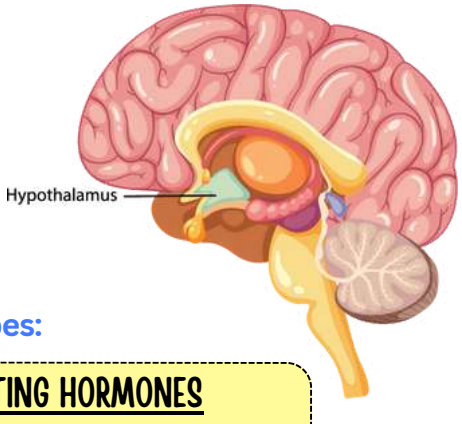
PINEAL GLAND

- Pineal gland is located on the dorsal side of forebrain .
- Pineal secretes a hormone called melatonin.
- Melatonin plays a very important role in the regulation of 24hr rhythm of our body.
- For example : it helps in maintaining the normal rhythms of temperature. sleep-wake cycle, body.



HYPOTHALAMUS

- It contains several groups of neurosecretory cells called nuclei which produce hormones.
- These hormones regulate the synthesis and secretion of pituitary hormones.
- The hormones produced by hypothalamus are of two types:



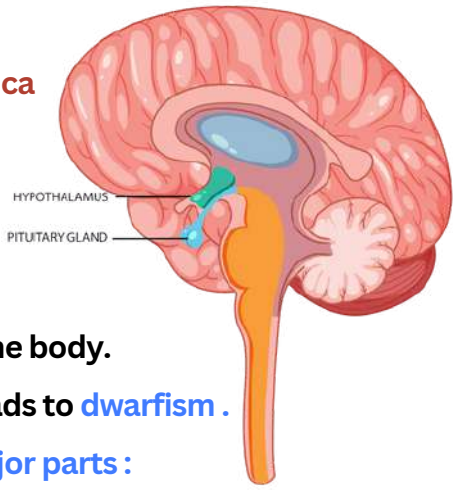
RELEASING HORMONES

(which stimulate secretion of pituitary hormones)

INHIBITING HORMONES

(which inhibit secretion of pituitary hormones)

PITUITARY GLAND



- Pituitary gland is located in a bony cavity called Sella turcica and is attached to hypothalamus by a stalk.
- Pituitary hormones regulate the growth and development of somatic tissues and activities of peripheral endocrine gland .
- Growth Hormone regulates growth and development of the body.
- If there is a deficiency of this hormone in childhood , it leads to dwarfism .
- The pituitary gland is divided into three major parts :

PARS DISTALIS

- The pars distalis region of pituitary, commonly called anterior pituitary.
- Pars distalis produces six trophic hormones .
- Growth hormone.
- Prolactin.
- Thyroid stimulating hormone.
- Adrenocorticotrophic hormone.
- Luteinizing hormone.
- Follicle stimulating hormones.

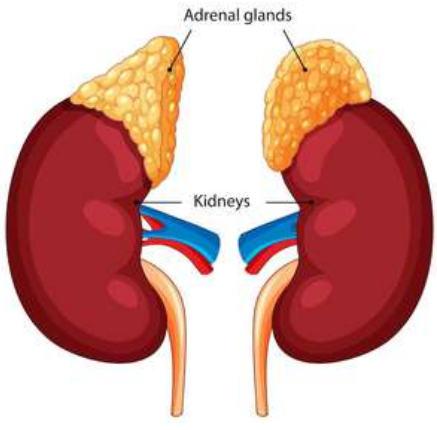
PARS INTERMEDIA

- Secretes only one hormone called melanocyte stimulating hormone .
- Melanin protects skin against UV rays.

PARS NERVOSA (NEUROHYPOPHYSIS)

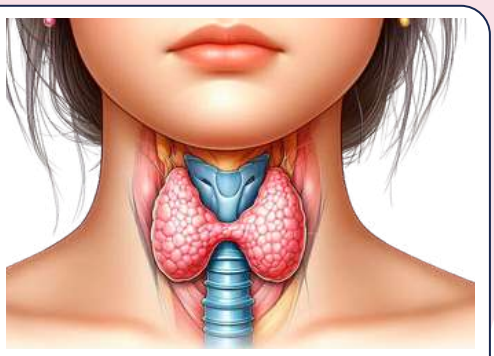
- Also known as posterior pituitary.
- Secretes two hormones:
- Oxytocin: Childbirth, Breastfeeding, Stress regulation (cortisol), intimacy.
- Vasopressin: Water balance, Blood pressure, Emotional & physical mobilization.

ADRENAL GLAND



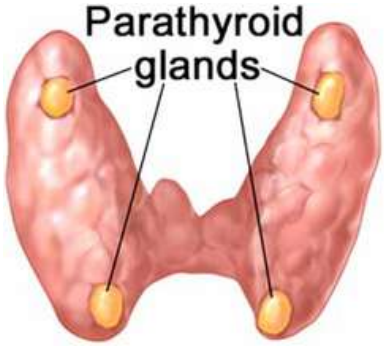
- Our body has one pair of adrenal glands , one at the anterior part of each kidney.
- Adrenaline is a hormone released from the adrenal gland.
- Adrenaline help to prepare for stressful or dangerous situations.
- Increase the heart beat , the strength of heart contraction and the rate of respiration.

THYROID GLAND



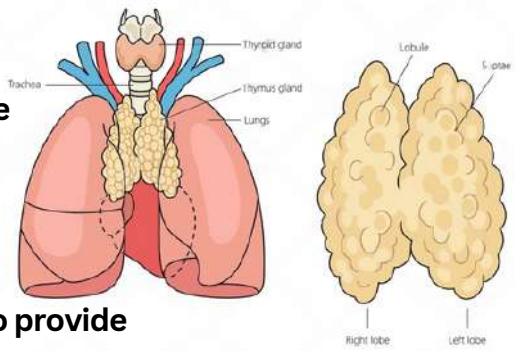
- The thyroid gland is composed of two lobes which are located on either side of the trachea.
- Both the lobes are interconnected with a thin flap of connective tissue called isthmus.
- The thyroid gland is composed of follicles and stromal tissues.
- Iodine is necessary for the thyroid gland to make thyroxin hormone.
- Thyroxine regulates carbohydrate, protein and fat metabolism in the body so as to provide the best balance for growth.
- Deficiency of iodine in our diet results in hypothyroidism and enlargement of the thyroid gland commonly called goiter.
- One of the symptoms in this disease is a swollen neck.
- In adult women , hypothyroidism may cause menstrual cycle to become irregular .
- Thyroid hormones play an important role in regulation of the basal metabolic rate.
- Thyroid gland also secretes a protein hormone called thyrocalcitonin (TCT) which regulates the blood calcium levels.

PARATHYROID GLANDS



- In human , four parathyroid glands are present on the back side of the thyroid gland.
- Parathyroid glands secrete a peptide hormone called parathyroid hormone (PTH) .
- The secretion of PTH is regulated by the circulating levels of calcium ions.
- Parathyroid hormone increases the Ca^2 levels in the blood.

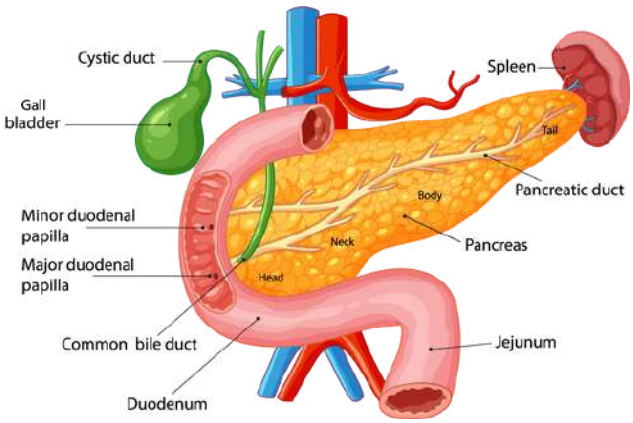
THYMUS



- Thymus plays a major role in the development of the immune system.
- This gland secretes the peptide hormones called thymosins.
- Thymosins also promote production of antibodies to provide humoral immunity .

PANCREAS

- Pancreas is a composite gland which acts as both exocrine and endocrine gland.
- The exocrine pancreas produces enzymes that help with digestion, including:
- Trypsin and chymotrypsin: Digest proteins
- Amylase: Digests carbohydrates
- Lipase: Breaks down fats
- The endocrine pancreas consists of 'islets' of Langerhans.



The three main types of Islets of Langerhans are called Delta cells, α– cells and β– cells .

DELTA CELLS

Regulates the function of alpha and beta cells through the secretion of somatostatin (SST).

α- CELLS

- Secrete glucagon.
- Glucagon increases blood sugar levels.
- Glucagon acts mainly on the liver cell (hepatocytes).

β- CELLS

- Secrete insulin.
- Insulin decreases blood sugar levels.
- Diabetic patients are successfully treated with insulin therapy.

- Insulin and glucagon are both hormone which produced by pancreas and helps in regulating blood glucose (sugar) levels.

PROTEIN/PEPTIDE/ POLYPEPTIDE

- Hypothalamus, pituitary, insulin, glucagon.

AMINO-ACID DERIVATIVES

- Epinephrine (adrenaline).

IODOTHYRONINES

- Thyroid hormone.

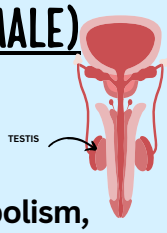
STEROIDAL HORMONES

- Cortisol, Aldosterone, Estradiol.

STEROID HORMONES (FEMALE)

- Estrogen (E)
- Progesterone (P)
- They are responsible for pregnancy, puberty, menstruation, menopause, sex drive, etc.

STEROID HORMONES (MALE)



- Testosterone
- They are responsible for sperm production, metabolism, inflammation, immune functions, sex drive, puberty, etc.

DIVERSITY

IN LIVING ORGANISMS

DO YOU KNOW...

Charles Darwin DIVERSITY IN LIVING ORGANISMS first to describe this idea of evolution in 1859 in his book "THE ORIGIN OF SPECIES"

Whittaker proposed has five kingdom on the basis of their cell structure.

Carl Linnaeus, is called the Father of Taxonomy. Taxonomy is the science of naming, describing and classifying organisms.

Later, Carl Woese introduced by dividing the Monera into two parts:

ARCHAEBACTERIA (ARCHAEA)

EUBACTERIA (BACTERIA)

HIERARCHY OF CLASSIFICATION

- KINGDOM
- PHYLUM / DIVISION
- CLASS
- ORDER
- FAMILY
- GENUS
- SPECIES

- ORGANISMS
  - PROKARYOTIC
    - UNICELLULAR
      - MONERA
  - EUKARYOTIC
    - UNICELLULAR
      - PROTISTA
    - MULTICELLULAR
      - WITH CELL WALL
        - NOT PERFORM PHOTOSYNTHESIS
          - FUNGI
        - PERFORM PHOTOSYNTHESIS
          - PLANTAE
      - WITHOUT CELL WALL
        - ANIMALIA

MONERA

- Unicellular Prokaryotes.
- They lack a true nucleus.
- They may or may not contain a cell wall.
- They may be heterotrophic or autotrophic mode of nutrition.

- Cyanobacteria
- Blue Green Algae

- Mycoplasm
- Bacteria

PROTISTA

- Unicellular, Eukaryotic.
- They exhibit an autotrophic or heterotrophic mode of nutrition.
- Possess pseudopodia, cilia, flagella for locomotion.

- Amoeba
- Paramaecium

- Diatoms
- Protozoans

FUNGI

- Multicellular, Eukaryotic.
- They exhibit a saprophytic mode of nutrition.
- Cell wall : chitin.
- Symbiotic relationship with blue-green algae.
- Not perform photosynthesis.

- Yeast
- Aspergillus

- Molds
- Mushroom

CRYPTOGAMS

- Non seed producing plant.

THALLOPHYTA

- Lack a well-differentiated body structure.
- Aquatic
- No vascular tissue.
- No seed / fruit / flower.

Spirogyra

Chara

Polysiphonia

Ulothrix

PLANTAE

- Multicellular, Eukaryotic.
- Cell wall : cellulose.
- Perform photosynthesis.
- Autotrophic nutrition.

PHANEROGAMS

- Seed producing plant.

BRYOPHYTA

- Well-differentiated body structure.
- Amphibians (water & terrestrial)
- No vascular tissue.
- No seed / fruit / flower.

Marchantia

Funaria

Mosses

Riccia

ANGIOSPERMS

- Well-differentiated body structure.
- Vascular tissue, produce fruit.
- Flowering plants.
- Seeds are enclosed within a fruit.

Mango

Tomato

Onion

Rose

PTERIDOPHYTA

- Well-differentiated body structure.
- Terrestrial (Earth)
- Vascular tissue.
- Fruit present.

Horsetails

Ferns

Marsilea

GYMNOSPERMS

- Well-differentiated body structure.
- Bear naked seeds
- Vascular tissue, not produce fruit.
- Seeds are not enclosed within a fruit.

Cycas

Pinus

Ephedra

Cedrus

ROOT SYSTEMS

FUNCTIONS

ANCHORING
Secure the plant to the soil.

ABSORPTION
Roots absorb water & nutrients from the soil using root hairs & thin-walled epidermal cells.

CONDUCTION
Transport water and nutrients from the soil to other parts of the plant.

STORAGE
Store nutrients and carbohydrates for times when the plant may not have access to them.

TYPES

TAP ROOT SYSTEM
- Taproot is the primary root system main root that grows vertically downwards, produces smaller lateral roots.
- Examples : Dandelions, Carrots, Oak, Parsnips, and Beets.

FIBROUS ROOT SYSTEM
- In a fibrous root system, the roots grow downwards into the soil, and also branch off sideways throughout the soil.
- When a plant is fully grown, the fibrous root system resembles a mat of roots.
- Examples : Rice, wheat, maize, corn, marigold, banana & all monocotyledons.

ADVENTITIOUS ROOT SYSTEM
- Roots arise from the part of the plants other than radicle.
- Examples : Screw pine, & Banyan, Mangroves.

MODIFICATIONS

FOOD STORAGE
- Storage of reserve food material.
- Examples : Radish (fusiform root), Carrot (conical root), Turnip (napiform root), Mirabilis (tuberous root)

CLIMBING
- Helps plants climb by attaching to a support.
- Examples : Betel, black pepper and money plant.

DEFENSE
- Stems modified into woody, straight & pointed thorns.
- Examples : Citrus, Bougainvillea.

PHOTOSYNTHETIC
- Roots develop chlorophyll when exposed to sun and can prepare food for plants.
- Examples : Taeniophyllum, Trapa and Tinospora.

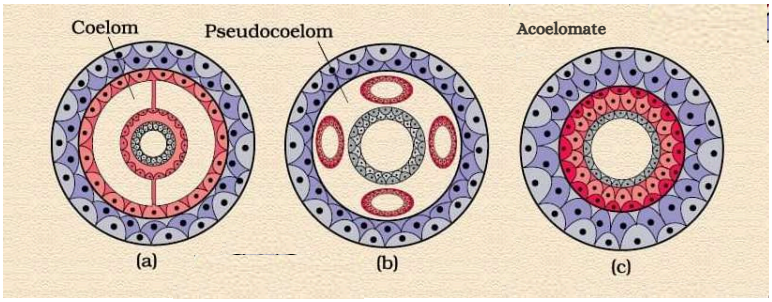
VEGETATIVE PROPAGATION
- When new plants grow from the roots of a parent plant called tubers.
- Examples : grafting, cutting, layering, tuber, bulb or stolon formation, suckering and tissue culture

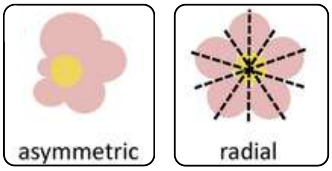
MONOCOTYLEDONS
- AKA monocots, these plants have one seed leaf.
- Examples : wheat, maize, ginger, onions, and garlic.

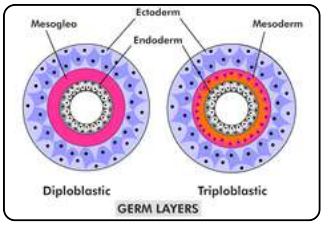
DICOTYLEDONS
- AKA dicots, these plants have two seed leaves.
- Examples : potatoes, tomatoes, peas, roses, groundnuts.

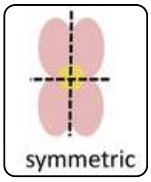
ANIMALIA

- Multicellular, eukaryotic organisms without a cell wall.
- Animalia can be simple or complex organisms.
- They exhibit an organ-system level of organization.
- They are genetically diverse.
- They are heterotrophs.









- Diploblastic: Animals with two germinal layers, the ectoderm and endoderm.
- Triploblastic: Animals with three germinal layers, the ectoderm, mesoderm, and endoderm.

- It is sub-divided into different phyla such as :

ANIMALIA	SYMMETRY	BODY CAVITY	LAYERS	EXAMPLE
PORIFERA	Asymmetry	Acoelomate	Diploblastic	e.g. Euplectella, Spongilla, Sycon.
COELENTERATA (CNIDARIA)	Radial symmetry	Acoelomate	Diploblastic	e.g. Hydra, Jellyfish, Anemones
ECHINODERMATA	Radial symmetry	Coelomate	Triploblastic	e.g. Sea Urchins, Starfish.
PLATYHELMINTHES	Bilateral symmetry	Acoelomate	Triploblastic	e.g. Tapeworm, Planaria, Liver fluke.
NEMATODA	Bilateral symmetry	Pseudocoelomate	Triploblastic	e.g. Ascaris, Wuchereria.
ANNELIDA	Bilateral symmetry	Coelomate	Triploblastic	e.g. Earthworms, Nereis, and Leeches.
ARTHROPODA	Bilateral symmetry	Coelomate	Triploblastic	e.g. Spiders, butterflies, mosquitoes.
MOLLUSCA	Bilateral symmetry	Coelomate	Triploblastic	e.g. Snails and octopus.
CHORDATA	Bilateral symmetry	Coelomate	Triploblastic	e.g. Marine animals

INVERTEBRATES

ANNELIDA

- Segmented cylindrical body or ringed worms.
- Body is differentiated into head & tail.
- Bilaterally symmetrical & triploblastic.
- Have a true body cavity.
- Habitat: marine, freshwater & land.

e.g. Earthworm, Leech.

ARTHROPODA

- Jointed appendages, exoskeleton & a segmented body.
- Largest phylum in the animal kingdom.
- Bilaterally symmetrical & triploblastic.
- Have well-differentiated organ system.
- Open circulatory system, Not differentiated blood vessels.

e.g. Spiders, mosquitoes, & butterflies.

CNIDARIA

- Have a hollow body cavity.
- Body is differentiated into two ends.
- Two layers of cells: inner and outer linings.
- Live in colonies (corals) as well as solitary (Sea anemone).
- Includes all aquatic animals.

e.g. Hydra, Jellyfish, Anemones

ECHINODERMATA

- Radial symmetry and triploblastic.
- Have true coelom cavity.
- Have hard calcium carbonate skeleton structure.
- Water vascular system : Allows echinoderms to move, breathe, and transport food & waste.
- Free-living marine animals.

e.g. Sea urchins, starfish

MOLLUSCA

- Less segmented body & Limbs are present.
- Foot that is used for moving around.
- Well-developed organ and organ system.
- Open circulatory system.
- Large group of animals.

e.g. Snails and octopus.

NEMATODA

- Nematodes have a cylindrical body.
- Fake body cavity.
- Bilaterally symmetrical and triploblastic.

e.g. Ascaris, Wuchereria.

PLATYHELMINTHES

- Commonly known as flatworms.
- Bilaterally symmetrical and triploblastic.
- No true internal body cavity or coelom.

e.g. Tapeworm, Planaria & Liver fluke.

PORIFERA

- Non-motile, multicellular organisms with a hard outer skeleton.
- Pores on the bodies create a water canal system, helps in the circulation of substances.
- Not well-developed organ or organ system. Include marine habitat.

e.g. Euplectella, Spongilla, Sycon.

VERTEBRATES

CYCLOSTOME

- Body is round and elongated like an eel.
- Skin is soft and smooth, devoid of any scales
- Two-chambered heart.
- Lateral line acts as a sense organ.

e.g. Petromyzon and Maxine.

AMPHIBIA

- These can live both on land & water.
- Three-chambered heart.
- Respiration : Lungs and Skin. Gills might be present externally in some adults.
- Skin is smooth & rough without any scales, but with glands that make it moist.

e.g. Frogs, Salamanders.

PISCES

- Found in fresh, marine, and brackish water.
- Body is usually streamlined.
- Spindle-shaped or elongated body as well.
- Respiration : Gills
- Cold-blooded organisms & Two-chambered heart.

e.g. fish, catfish, goldfish.

REPTILIA

- They are cold-blooded animals found in most of the warmer regions of the world.
- Skin is dry, and rough, without any glands.
- Respiration : Lungs.
- Three-chambered heart. However, crocodiles have a Four-chambered heart.

e.g. Snakes, Turtles, Lizards, Crocodiles.

AVES

- Warm blooded.
- Respiration : Lungs.
- Four-chambered heart.
- Lay eggs.

e.g. ostriches, eagles, and owls.

MAMMALIA

- Warm blooded.
- Have oil gland, hair.
- Respiration : Lungs.
- Four-chambered heart.

Platypus & echidna lay eggs.

Bat

Monkey

e.g. whales

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DISEASES

CONGENITAL DISEASE

- A medical condition that is present at birth and is inherited.
- Examples: Cystic fibrosis, Down syndrome, and Hemophilia.

ACQUIRED DISEASE

- A medical condition that develops after birth and is not inherited.
- Examples: Influenza, Malaria, Cancer, and Diabetes.

DISEASES CAUSED BY

VIRUSES

- COLD
- FLU
- SMALL POX
- CHICKEN POX
- MEASLES
- HEPATITIS
- MUMPS
- RABIES
- POLIO
- DENGUE
- HERPES
- EBOLI
- AIDS

BACTERIA

- PNEUMONIA
- CHOLERA
- DIPHTHERIA
- GONORRHEA
- PERTUSSIS
- TUBERCULOSIS
- SCARLET FEVER
- TETANUS
- PLAGUE
- LEPROSY

PROTOZOANS

- KALA-AZAR
- MALARIA
- AMOEBIC DYSENTRY
- SLEEPING SICKNESS

GENETIC-DISORDER

- SINGLE GENE INHERITANCE
- CHROMOSOMAL DISORDER
- MULTIFACTORIAL GENETIC INHERITANCE
- MITOCHONDRIAL INHERITANCE

DEFICIENCY

- ANEMIA - IRON
- GOITER - IODINE
- RICKETS - VITAMIN D
- KWASHIORKOR - PROTEIN
- SCURVY - VITAMIN C
- NEUROPATHY - VITAMIN B12
- OSTEOPENIA - CALCIUM
- MARASMUS - PROTEIN

EPIDEMIC

- CHOLERA
- MALARIA
- MEASLES
- DENGUE
- SMALLPOX
- YELLOW FEVER
- POLIO
- LYME
- HIV/AIDS

GENETIC-DISORDER

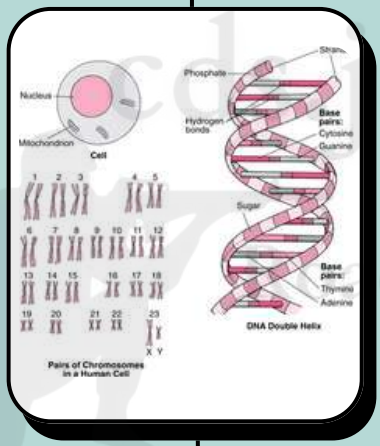
SINGLE GENE INHERITANCE

- **Cause:** mutation in single gene.
- AKA **Mendelian/ Monogenetic** inheritance.

- **e.g: Sickle cell anemia** (autosomal recessive).
- **Hemophilia** (sex-linked recessive)
- **Cystic fibrosis** (autosomal recessive)

CHROMOSOMAL DISORDER

- **Cause:** changes in the structure or number of chromosomes.
- Sometimes the whole **chromosome is gained or lost.**



- **e.g.**
- **Down's syndrome:** addition of a chromosome 21 (trisomy)
- **Turner's syndrome:** absence of an X chromosome(XO)
- **Kleinfelter's syndrome :** addition of an X chromosome (XXX)

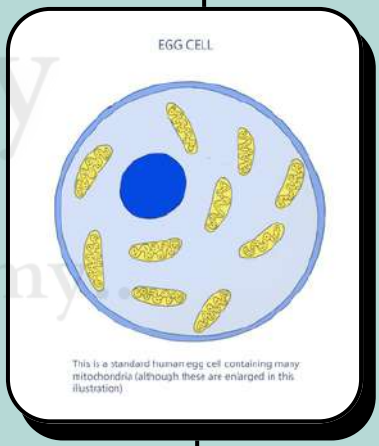
MULTIFACTORIAL GENETIC INHERITANCE

- **Cause:** combination of environmental factor and mutation in multiple genes.
- AKA **complex or polygenic** inheritance.

- **e.g.**
- Heart disease
- High blood Pressure
- Arthritis
- Alzheimer's disease
- Obesity
- Diabetes
- Cancer

MITOCHONDRIAL INHERITANCE

- **Cause:** mutation in the non-nuclear DNA of Mitochondria.
- Mitochondrial DNA is **inherited** from the **mother.**



- **e.g.**
- **Leber's Hereditary Optic Atrophy (LHON)**
- **Myoclonic epilepsy with ragged red fibers.**
- **Mitochondrial encephalopathy.**
- **Lactic acidosis.**

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PROTOZOANS

AMOEBOID PROTOZOANS

- Live in freshwater , marine , sea water or moist soil.
- Marine forms have silica shells on their surface.

SPOROZOANS

- Have an infectious spore-like stage in their life cycle
- E.g : Plasmodium which causes malaria.

CILIATED PROTOZOANS

- Thee are aquatic.
- Actively moving due to presence of thousand of cilia.
- E.g : Paramecium

FLAGELLATED PROTOZOANS

- Either free-living or parasitic.
- They have flagella .
- Parasitic forms cause diseases such as sleeping sickness.
- E.g : Trypanosoma

AMOEBIASIS (AMOEBIC DYSENTERY)

- Pathogen : entamoeba histolytica protozoa
- Infection : contaminated food and water.
- Affected organ : large intestine. house flies as mechanical carriers.

VIRUSES

- The viruses are non-cellular organisms:
  - Outside living cell : Inert crystalline structure
  - Inside living cell : take over the machinery of host cell to replicate themselves and killing the host
- Not "truly living" • Obligate parasites.
- In addition to protein , viruses also contain genetic material , that could be either RNA or DNA.
- No virus contains both RNA and DNA.
- Viruses that infect the bacteria are usually double stranded DNA viruses.
- Viruses that infect plants have single stranded RNA, infect animals have either single or double stranded RNA.
- In plants , the symptoms can be mosaic formation , leaf rolling and curling , yellowing and vein clearing, dwarfing and stunted growth .

COMMON COLD

- Pathogen : Rhino viruses.
- Infection : - droplets direct contact- transmitted through contaminated objects such as pens , books etc.
- Affected organ : nose and respiratory but not the lungs
- Symptoms : nasal congestion and discharge , sore throat , hoarseness , cough , headache , tiredness .

TYPHOID

- **Pathogen :** Salmonella typhi bacteria.
- **Mode of infection :** contaminated food and water
- **Affected organ :** small intestine.
- **Symptoms :** sustained high fever , weakness , stomach pain , constipation , headache and loss of appetite .

PNEUMONIA

- **Pathogen :** streptococcus pneumoniae and haemophiles influenzae bacteria.
- **Affected organ :** the alveoli (air filled sacs) of the lungs.
- **Symptoms :** fever , chills , cough and headache. lips and finger – nails turn gray to bluish in color.

MALARIA

- **Pathogen :** Plasmodium.
- **Affected organ :** Liver and RBCs.
- **Transmitting agent :** female Anopheles mosquito.
- **Plasmodium falciparum :** causes most fatal malaria (malignant malaria).
- **Plasmodium vivax :** most common.

VIROIDS

- **Infectious agent** that was smaller than viruses and caused **potato spindle tuber diseases.**
- Have **free RNA but lack of protein** coat that is found in viruses.
- The **RNA** of the viroid was of **low molecular weight.**
- **Discovered** by T.O Diener (1971).

BACTERIA

Disease :	Cause :
Cholera	Vibrio cholerae
Typhoid	Salmonella typhi
Tetanus	Clostridium tetani
Citrus canker	Xanthomonas citri

LICHENS

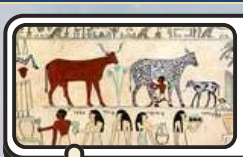
- Lichens are **symbiotic associations** i.e mutually useful associations, between algae and fungi.
- **Algae (photobiont) :** prepare food for fungi.
- **Fungi (mycobiont) :** provides shelter and absorbs mineral nutrients and water for algal partner.

BIOTECHNOLOGY

Biotechnology refers to the different technologies that make use of living cells and/ or biological molecules to generate useful products for the benefit of mankind.

Karl Ereky
(1878-1952)

The term **biotechnology** was coined by **Karl Ereky,** a Hungarian scientist,



Ancient Biotechnology

Early knowledge of food, shelter, domestication.

Classical Biotechnology

Fermentation based food production, and medicine.

Modern Biotechnology

Genetic engineering and molecular level manipulation.

Broad Domains of Application

- Agricultural Crop Improvement
- Food Innovations
- Diagnostics
- Energy & Environment Management
- Healthcare
- Animal Husbandry

COMMON NAMES OF BIOTECHNOLOGY

1 BLUE BIOTECHNOLOGY

Increasing seafood supply, reproduction of water-borne organisms, & **developing new drugs.**

2 RED BIOTECHNOLOGY

Manufacture **pharmaceutical products**: insulin, enzymes, antibiotics & vaccines.

3 GREEN BIOTECHNOLOGY

Plants to improve **nutritional quality,** quantity & production of eco-friendly products.

4 WHITE BIOTECHNOLOGY

Improve industrial processes in eco-friendly manner for the **production of valuable chemicals.**

5 BROWN BIO TECHNOLOGY

Treating arid and **desert soils.**

6 BLACK BIOTECHNOLOGY

Bioterrorism branch linked with **biological wars.**

7 YELLOW BIOTECHNOLOGY

Reducing saturated fats in cooking oils and modifying calorie intakes.

8 GREY BIOTECHNOLOGY

Environmental branch, restoring contaminated **natural ecosystems.**

9 GOLD BIOTECHNOLOGY

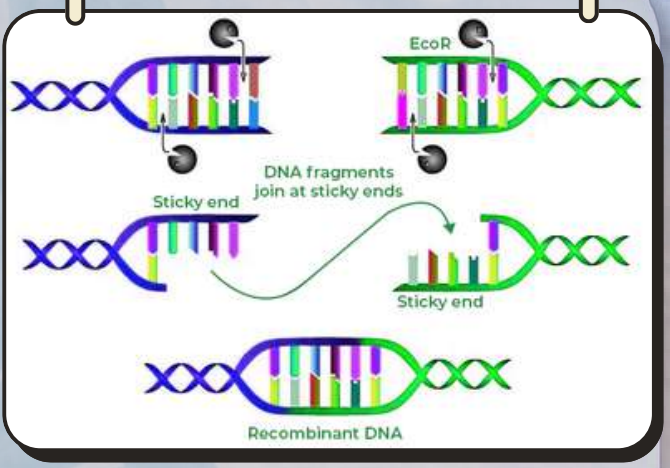
Bioinformatics analyzing data in **biological processes.**

BIOTECHNOLOGY MAINLY FOCUS ON:

1. Medicine and health care.
2. Crop production & agriculture.
3. Food processing.
4. Environmental protection.

rDNA TECHNOLOGY

- rDNA technology involves **combining DNA molecules** from different sources into one molecule to **create new genetic combinations.**
- **Common example :** **Human insulin treats diabetes** by regulating blood sugar levels, produced via rDNA technology in E. coli (heterologous system).
- **Another example :** Food and Drug Administration, USA (FDA) approved **production of blood anti-coagulant in milk of transgenic sheep and goat** for human use.



Gene therapy

- A **drug to treat disease**, so that it replaces the function of the defective gene.
- Treatment of diseases caused by gene defects such as **cystic fibrosis, thalassemia, Parkinson's disease.**

Gendicine

First commercial **gene therapy** product approved for **cancer treatment by China in 2003.**

COMMON TERMS OF rDNA TECHNOLOGY

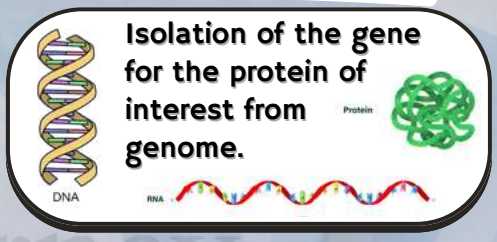
Genetic testing

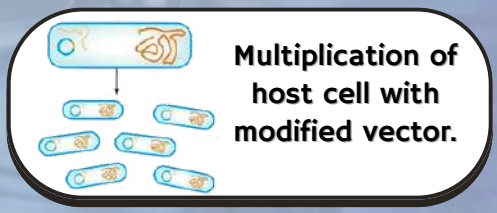
- Analyzing DNA to **detect genetic disorders** & defects, mutations, or variations in an individual's genetic composition **such as chromosomal defects in gene** & protein expression anomalies.

- **EXAMPLE:**

- **Phenylketonuria (PKU):** lack an enzyme needed to **break down phenylalanine,** which can affect growth.
- **Congenital hypothyroidism:** disrupt thyroid function, leading to **thyroid gland disorder.**

Steps in rDNA Technology :





Increase product of needed set protein.

PLANT TISSUE CULTURE

- Plant cells or tissues in **artificial medium supplemented with required nutrients,** has many applications in efficient clonal propagation.
- **Example:** cotyledons, hypocotyls, leaf, ovary, protoplast, petiole root, anthers, etc.

- **DIFFERENT SHAPES OF ROOTS :**
  - Spindle-shaped: Radish
  - Top-shaped: Turnip, Beet
  - Conical-shaped: Carrot
  - Indefinite-shaped: Sweet potato

Examples of successful applications of biotechnology

DOLLY SHEEP

- (5 Jul 1996-14 Feb 2003)
- First mammal cloned from adult somatic cell using nuclear transfer.
- Died due to progressive lung disease.

BT COTTON

- Genetically Modified Organism (GMO) with a foreign gene.
- From Bacillus thuringiensis (Bt) expressing protein conferring resistance to Bollworm

BT BRINJAL

- Lepidopteran resistant Bt Brinjal (Right)

HUMAN GROWTH HORMONE

- Human GH gene isolated from pituitary gland cell.
- Inserted in E. coil expressing recombinant Human GH, cultured in fermenters.

HUMULIN

- Human insulin gene isolated from pancreatic cells.
- Inserted into a bacterium expressing insulin cultured in large scale fermenters.

DNA

Double - stranded Deoxyribose.

- Proteins are surrounded by nuclear membrane.

NITROGEN BASES:

- Adenine (A).
- Cytosine (C).
- Guanine (G).
- Thymine (T).

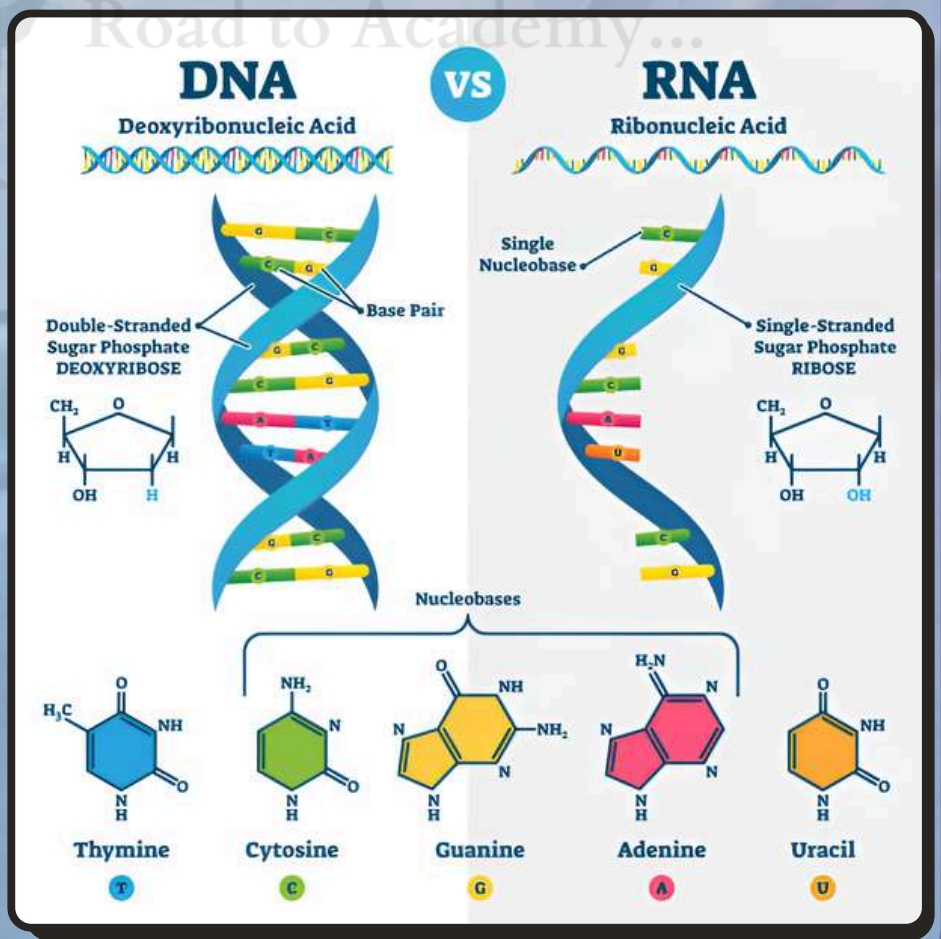
RNA

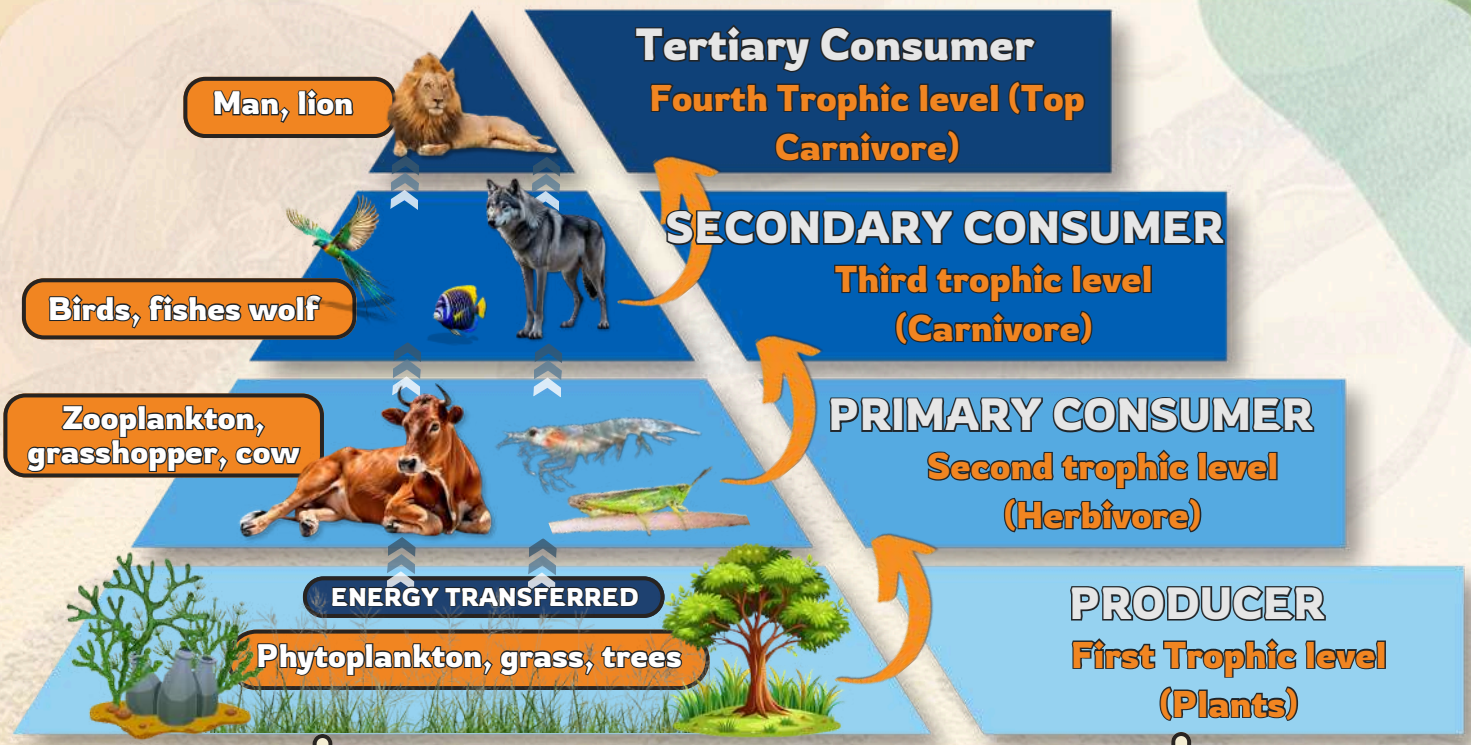
Single - stranded Ribose.

- Proteins are not surrounded by any membrane.

NITROGEN BASES:

- Adenine (A).
- Guanine (G).
- Cytosine (C).
- Uracil (U) (unique to RNA, replaces thymine).



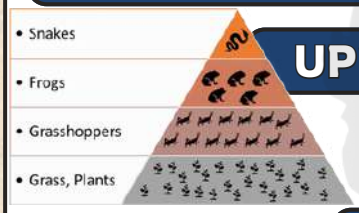


TROPHIC LEVELS IN ECOSYSTEM

- Organisms occupy a place in the natural surroundings or in a community according to their feeding relationship with other organisms.
- Based on the source of their nutrition or food, organisms occupy a specific place in the food chain.

ECOLOGICAL PYRAMIDS

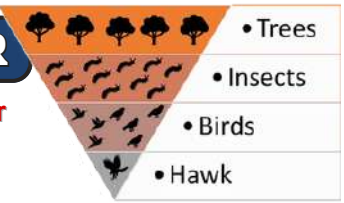
Represent trophic levels in terms of numbers, biomass, or energy.



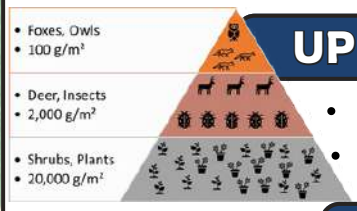
UPRIGHT PYRAMID OF NUMBERS

- The number of organisms decreases as we move up the trophic levels.
  - Starting with many producers and ending with few top predators.

INVERTED PYRAMID OF NUMBER



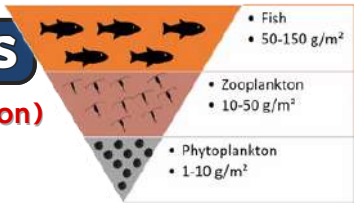
- When fewer large producers, like trees in a forest, support a larger number of herbivores.
  - Even more numerous smaller organisms at higher trophic levels.



UPRIGHT PYRAMID OF BIOMASS

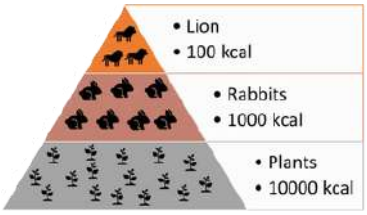
- The biomass decreases as we move up the trophic levels.
- The greatest biomass at the producer level & the least at the top predators.

INVERTED PYRAMID OF BIOMASS

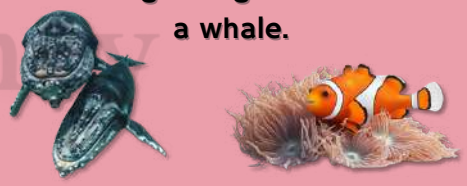


- In aquatic ecosystems, where the biomass of producers (like phytoplankton) is smaller than that of primary consumers (like zooplankton).

PYRAMID OF ENERGY



- Energy is transferred from one trophic level to the next, but only 10% of the energy is passed on to the next level (as per the 10% Law of energy transfer).
- Pyramids of energy are always upright, Energy at a lower trophic level is always than at a higher level.

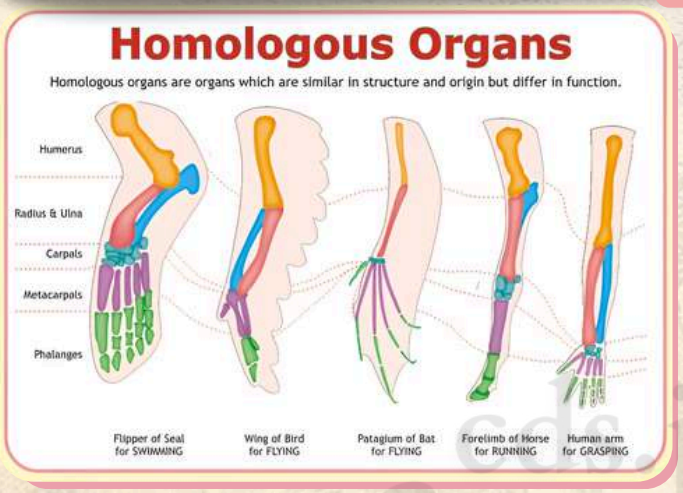
INTERACTION	TYPE OF SYMBIOSIS	EXAMPLE
Benefits / Benefits	**MUTUALISM** Mutualism results in positive effects for both species involved.	Lichens and zooxanthellae  Bees and Flowers
Negatively Affected / Negatively Affected	**COMPETITION** Organisms compete for limited resources.	• Trees in a forest • Lions on a pride • Fish in a pond • Cheetahs and Lions • Red and Grey Squirrels
Benefits / Unaffected	**COMMENSALISM** One organism benefits, and the other is neither helped nor harmed.	Barnacles growing on the back of a whale.  Sea anemone and clownfish
Negatively Affected / Unaffected	**AMENSALISM** One organism is negatively affected by the presence of another, but the second organism is unaffected.	Black walnut tree secretes chemicals that inhibit the growth of nearby plants, without benefiting itself directly. 
Benefits / Harmed	**PARASITISM** One organism benefits, and the other organism is harmed.	Lice and scabies Cowbirds and cuckoos  Dog and tick
Benefits / Harmed	**PREDATION** One organism benefits, and the other organism is harmed.	Tarantula and Grasshopper  Spider and Insect

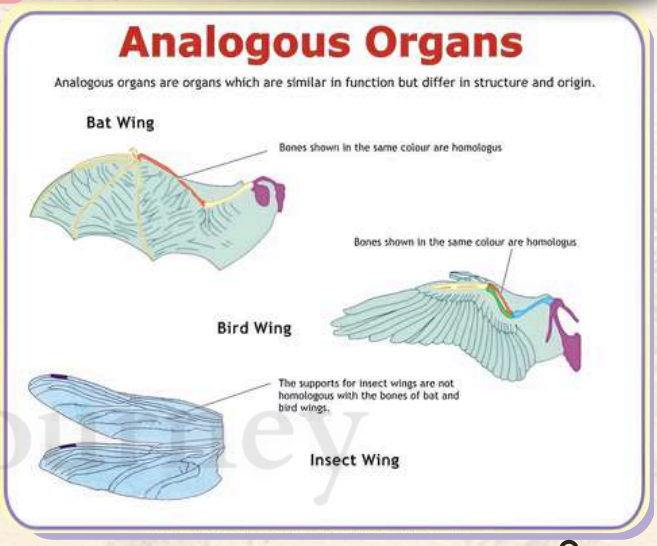
HOMOLOGOUS STRUCTURE

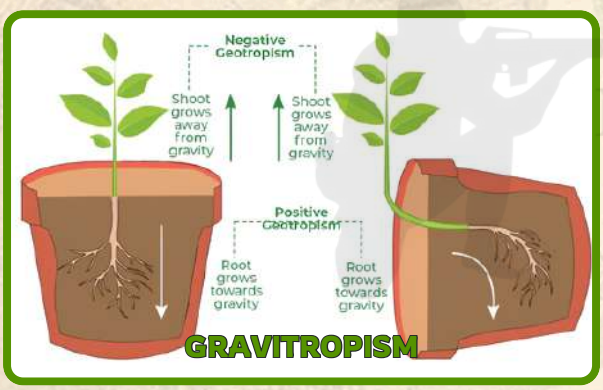
- Similar anatomy but Dissimilar functions.
- Inherited from a common ancestor.
- Ex : An arm of a human, the leg of a dog & a flipper of a whale are all homologous structures.

ANALOGOUS STRUCTURE

- Dissimilar anatomy but Similar Functions.
- Not inherited from ancestors.
- Ex : From wings in birds, bats and insects to fins in penguins and fishes are all analogous structures.





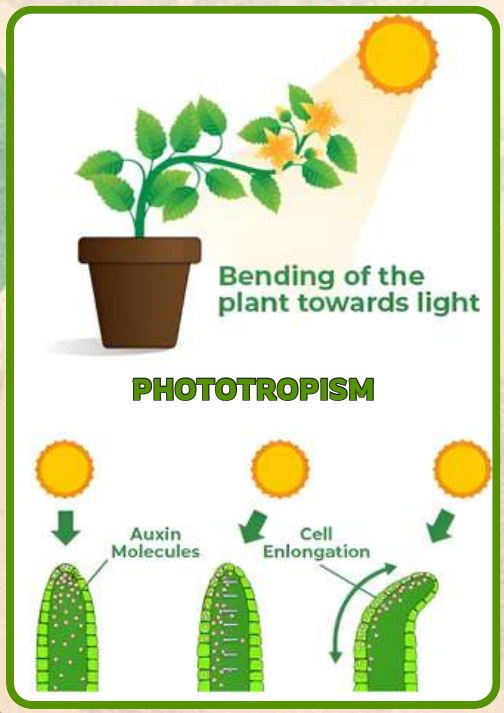


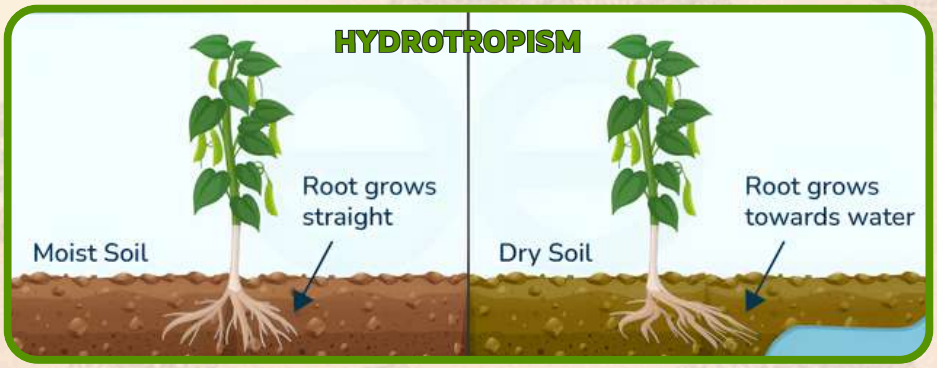
PLANT TROPISMS

- Plant Growth in Response to Directional Stimuli

EXAMPLES :

- Phototropism
- Gravitropism
- Thigmotropism
- Hydrotropism





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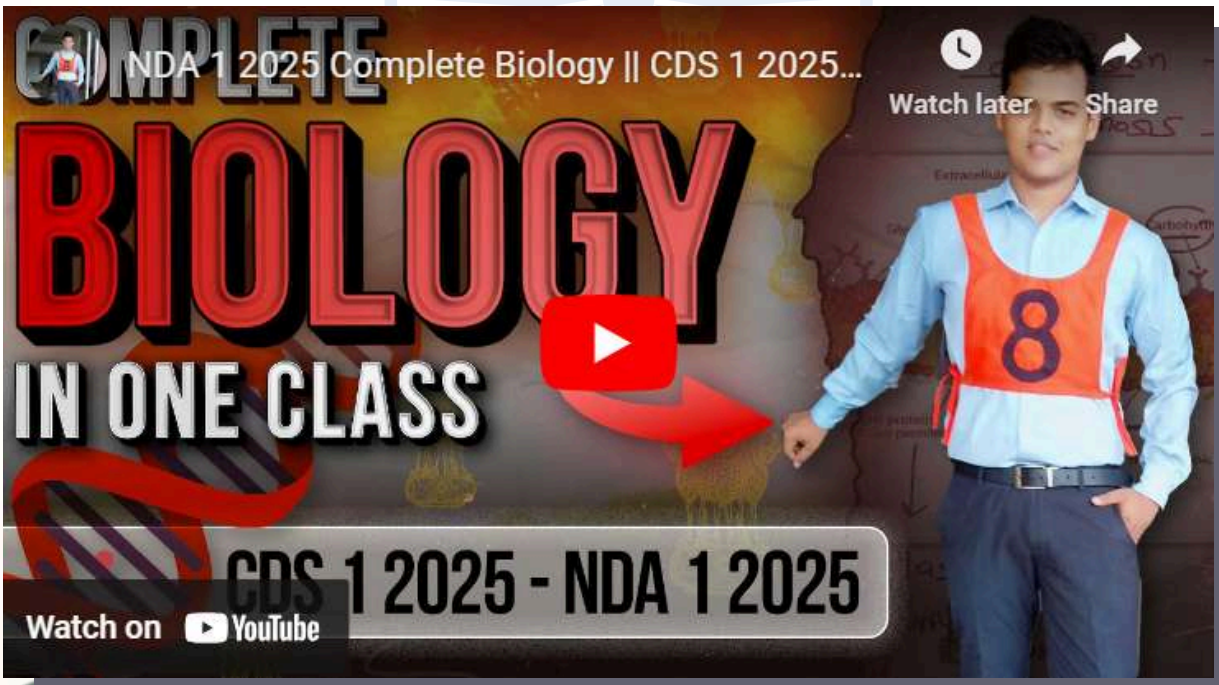

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