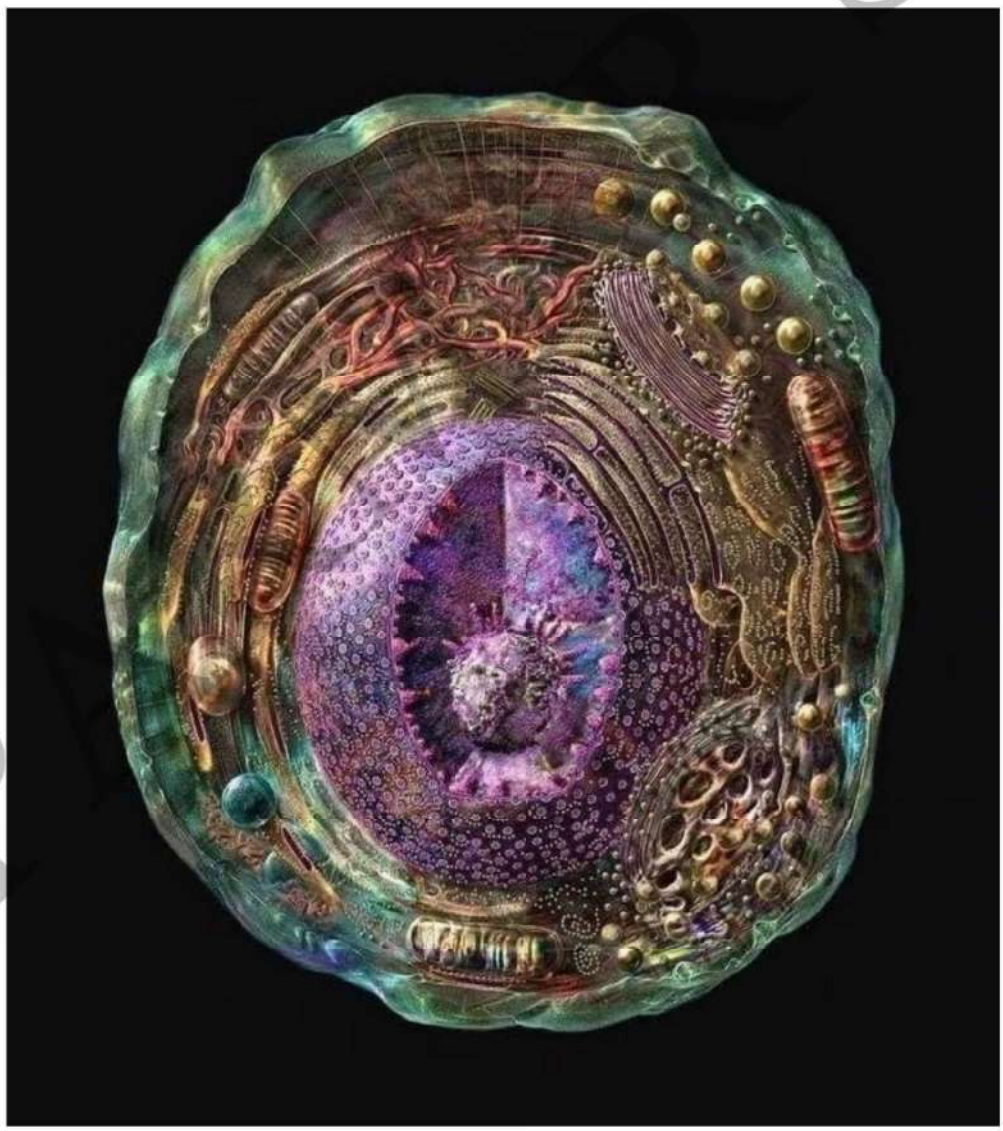
The Cell



Cell Defination

- building blocks of life
- fundamental unit of life
- structural or functional basis of life

Cell → Tissue → Organs → Organ system

Cell Study → is called cytology

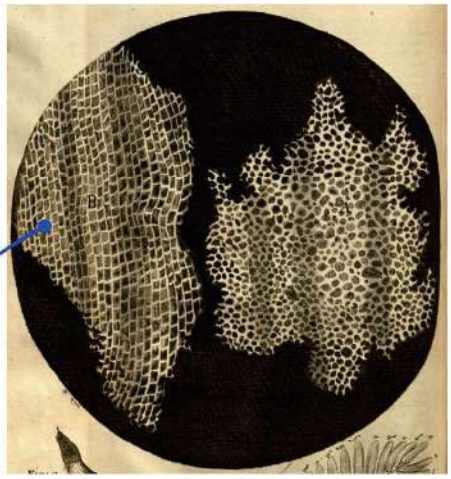
Cyto: Cell
Logy: Study

Cell Discovery

- First discovery by: Robert Hooke (1665)
- Observed in cork
- Cork is obtained from bark of tree → Dead cell

Father of cytology

Cork Cell



Honeycomb shape
(with compartments)

- The word "cell" comes from a Latin word "cellula", which means "small rooms"

Some other discoveries

- Antonie van Leeuwenhoek (1674) — Free living cells in water (Father of modern cytology)
  - in pond water
- Robert Brown (1831) — Nuclues
- Purkinje (1839) — named Protoplasm

Cell Theory

- "All the plants and animals are composed of cells"
- "Basic unit of life"

Given by: Schleiden and Schwan (1838)

Rudolf Virchow later published his famous Cell Theory "omnis cellula e cellula" in 1855

New cells are formed from the pre-existing cells

Also Longest cell

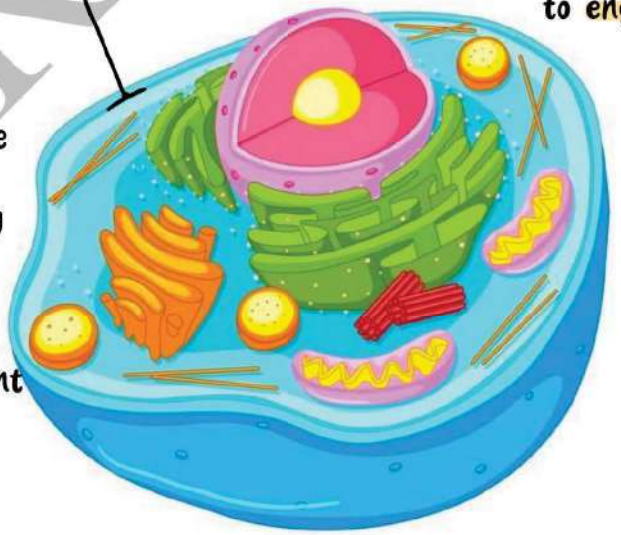
- Largest cell in male: Neuron
- Smallest cell in women: RBC

- Largest cell: Ostrich's egg
- Smallest cell: Mycoplasma (bacteria)
- Largest cell in human (female): Ovum
- Smallest cell in human (male): Sperm

Sex cells

Parts of Cell

- Cell membrane
  - Protects the cell: bodyguard
  - Thin, elastic, flexible
  - Living
  - Outer most covering
  - Provides definite shape and holds content of cell
  - Present in both plant and animal cell



Other characteristics:

- Selectively permeable (only allows some materials)
- Proteins+lipids (composition)
- Flexibility enables the cell to engulf food (Food and other materials from external environment)

Movements across Cell Nembrane

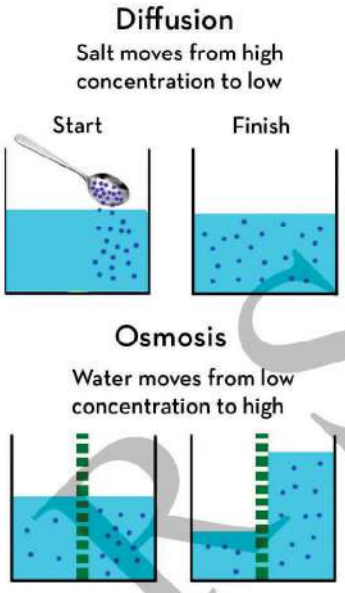
- **Diffusion**

- Spontaneous movement of molecules from high to lower concentration

Rate of Diffusion → mixing

Gases > liquids > solids

ex: Agarbatti smell diffusion, ions/molecules – CO_2 , O_2



- due to cellular activities, CO_2 production takes place

Conc. of CO_2 > Conc. of CO_2 inside cell → in external environment

CO_2 leaves cell through diffusion

The concentration of water is always a factor in Osmosis

Osmosis: Movement from high to low Concentration (of water) but through a semipermeable membrane

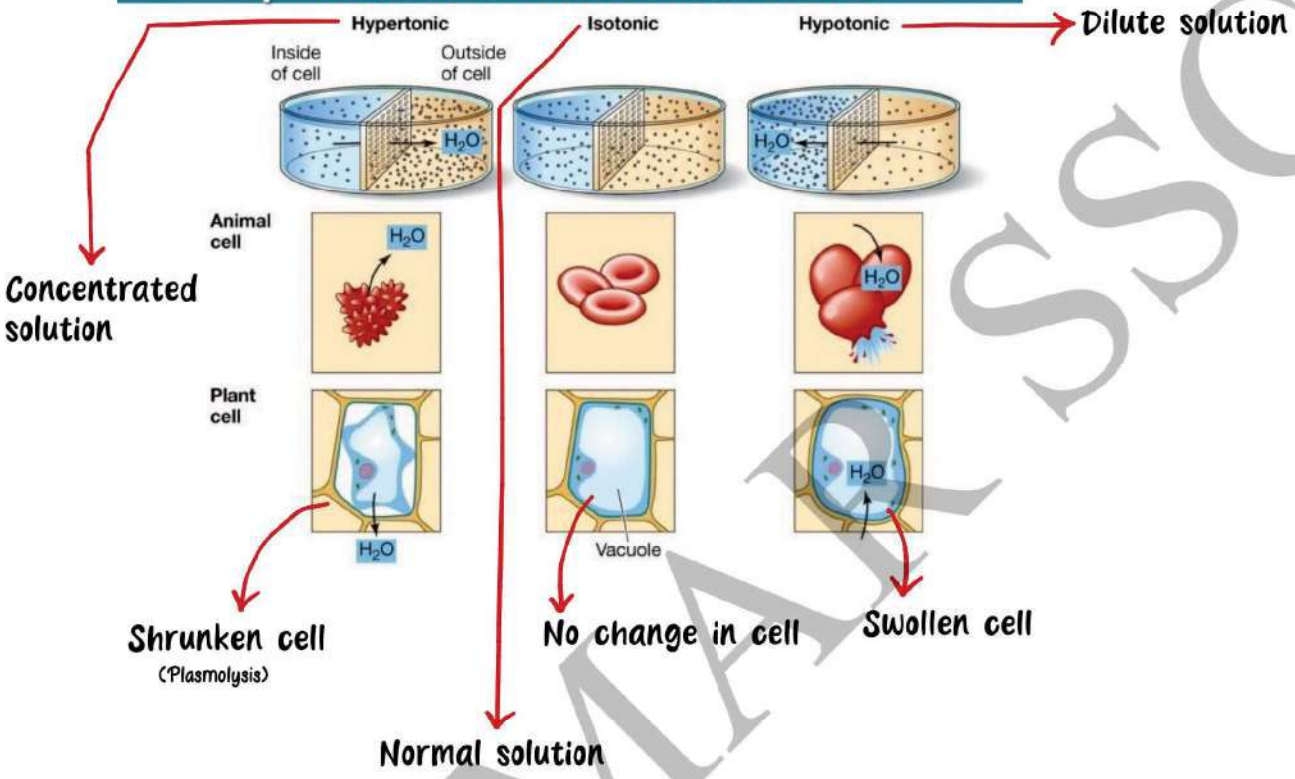
Solution = Solute + Solute

Hypertonic	Hypotonic	Isotonic
Solute > Solvent	Solute < Solvent	Solute = Solvent

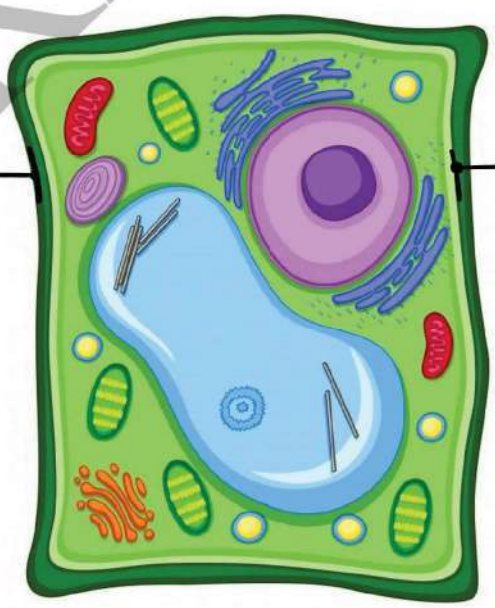
cell absorbs water through osmosis, no energy is required and lasts upto equilibrium state

→ Active Transport/Reverse Osmosis: Movement of molecules across a cell membrane from a region of low concentration to high concentration. It requires cellular energy

Summary: What happens to cells when placed in a solution which is :



* **Turgor pressure**: Causes enlargement and extension growth of cells



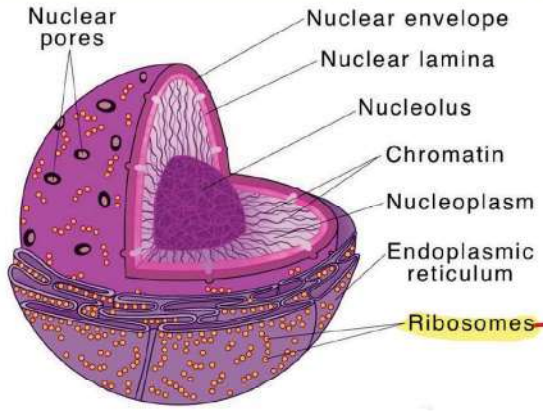
- **Cell wall**
  - Only present in plants /bacteria/fungus/algae
  - Non-living
  - Freely permeable
  - Determines shape
  - Made up of cellulose
  - Provides strength and turgidity to cells

- Cell membrane
  - bacteria cell wall made of: Peptin/peptidoglycan
  - Fungi: Chitin
  - Plant: Cellulose
  - Algae: Cellulose/pectin

- **Glycocalyx**
  A surface layer (slime layer) that covers the cel membrane in bacteria

Nucleus

- cellular component of cell
- Centrally located
- Large in size
- Largest cell structure



- involved in formation of proteins

- Nucleus is known as "Brain of the Cell", it controls the activities of different cell organelles
- Discovered by: Robert Brown

Components of Nucleus

Nuclear envelope

- Composed of membranes
- Covers Nucleus
- Separates nucleus from cytoplasm
- Permits materials between nucleoplasm and cytoplasm

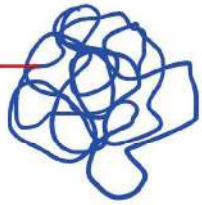
Nucleoplasm

- Liquid ground substance of nuclear envelope

Types:

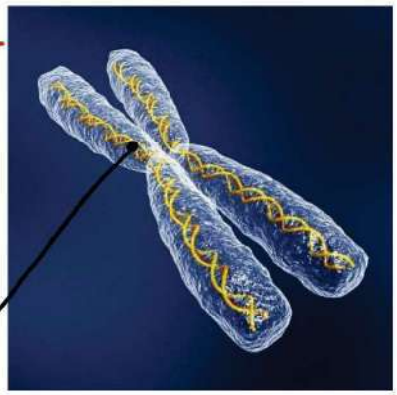
- Nucleolus
  - One/more in numbers
  - Form protein forming centers: Ribosomes
    - Do not have membranes
    - Discovered by: George E. Palade
- Chromatin material

Chromatin material



- Entangled mass of thread like structures
- During cell division they get organised in chromosome

Chromosomes



- Thread like structures
- Visible during cell division
- Components:
  - DNA
  - Proteins (Histone)

chromosomes: 23 pairs

- 22 pairs (autosomal)
- 1 pair (sex pair)
  - XY: Male
  - XX: Female

Total: 46 chromosomes

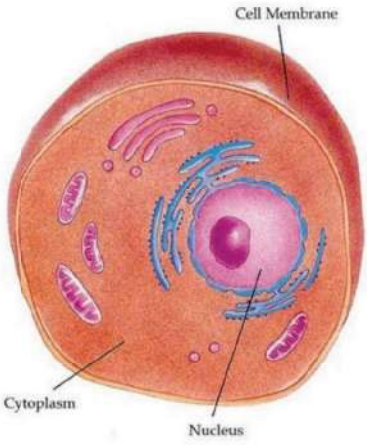
·Chromosome discovery: Walther Flemming

DNA

- Molecule discovery: Fredrick Mischer
- Double-helical structure: Watson and Crick (1953)

- Consists of genes
- Genetic information transferred from one generation to another

are functional segment of DNA



Cytoplasm

- Parts between plasma membrane and nuclear envelope
- Cell organelles present in cytoplasm
  - Cytosol: Aqueous ground substances of cytoplasm

Cytoplasm Inclusions

·Non-living components (pigments, nutrients, etc.) in cytoplasm

Cell organelles

- Membrane bound organelles
- Present to support complex activity of cell
- Different types

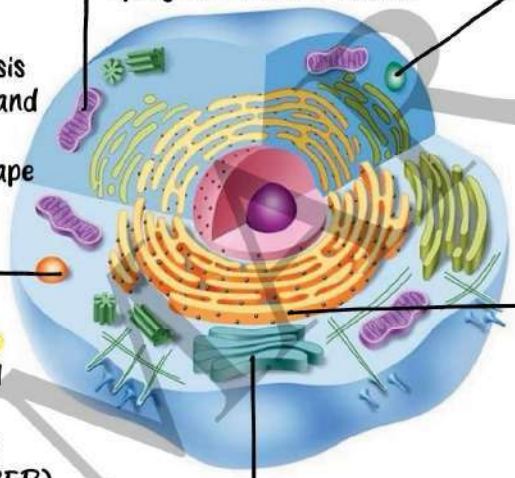
Mitochondria

- "powerhouse of the cell"- ATP (Adenosine Triphosphate), makes energy
- Two-membranes:
  - Outer: Porous
  - Inner: ATP synthesis
- Has its own DNA and ribosomes
- Shape: Sausage shape

Energy currency of the cell

1 μm: 10^{-6}m

- Length: 1–2 μm
- Diameter: 0.1–0.6 μm
- Involved in apoptosis (programmed cell death)



Vacuoles

in plants:
- Large, distinct
- Store cell sap
- Provide turgidity and rigidity
- 50–90% of volume
- Permanent

Cell sap consists of:
- Amino acids
- Sugars
- Organic acids

in animals: Small, temporary and stores glucose, glycogen, protein

- Membrane bound
- Solid or liquid filled
- Sac-like

Lysosomes

- "Suicidal bag of the cell"- waste disposal of cell
- Filled with digestive enzymes (Made of RER)
- Act as waste disposal system of cell
- When the cell gets damaged, lysosomes may burst and enzymes digest their own cell

Endoplasmic Reticulum

- Network of sac-like structures
- Rough ER: makes proteins, ribosomes present
- Smooth ER: synthesis of fats and lipids, ribosomes absent

Types:
- Long Tubules
- Vesicles
- Cisternae

- Attached to plasma membrane on one side and outer nuclear membrane on other

Peroxisome

- It breakdowns very long chain of fatty acids through beta oxidation
- Neutralises harmful toxins
- It has free radical scavengers (oxidative crystals)

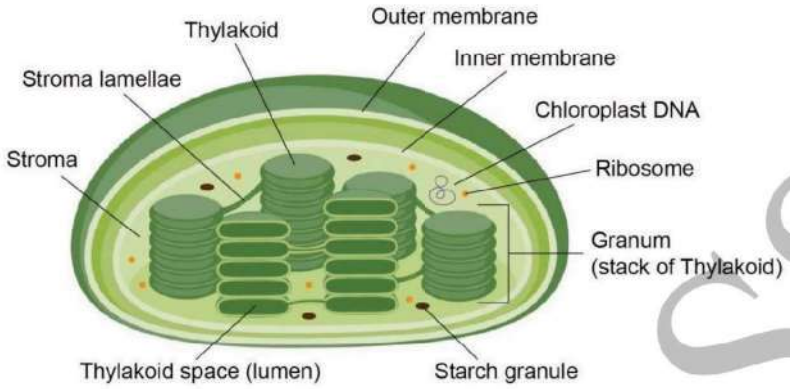
Golgi bodies

- Discovered by Camillo Golgi
- Consists of vesicles, cisternae, vacuoles
- Cis face: towards nucleus (Convex)
- Trans face: towards plasma membrane (Conclave and maturing)

Functions:
- Packaging and dispatching
- Stores, modification of package
- Simple sugars from complex sugars
- Forms lysosomes

Post office of cell

Functions:
- Proteins: RER
- Fats and lipids: SER
- Proteins and lipids act as hormones and enzymes (in RER)
- ER serves as transport betⁿ cytoplasm and nucleus
- Detoxify poisons and drugs (SER in Liver)



Plastids

- Only in plant cell, not in animal cell
- Has its own DNA and Ribosomes

Types:

Chloroplasts: contains chlorophyll pigment
Also contain yellow and orange pigments
Pigment: Green → contains Mg for food synthesis

Chromoplasts: contains different types of pigments which provides colour → imparts colour to flowers and fruits

Examples
- Red color in tomato: due to lycopene
- Green color in chilli: due to capsanthin

Leucoplasts: colourless or white in colour
Stores starch, oil and protein granules

3 types
- **Amyloplast:** storage of carbohydrates
- **Aleuroplast:** storage of proteins
- **Elaioplast:** storage of fats

Cell Division

Division of cells into new cells

Reason for division:
- growth of organism
- replace old, dead and injured cells
- for gamete formation (Meiosis)

Types:
- Mitosis
- Meiosis

Mitosis	Meiosis
It occurs in Somatic cells	It occurs in Germ cells
Nucleus divides only once	Nucleus divides twice
It is divided into prophase, metaphase, anaphase and telophase	Meiosis I and II divided into prophase I and II, metaphase I and II, anaphase I and II and telophase I and II
Daughter cells are diploid – 2	Daughter cells are haploid – 1
No crossing over takes place	Crossing over takes place
Increase number of normal cells	Produces egg and sperm cells
Involved in healing and growth	Involved in genetic variations
2 daughter cells are produced	4 daughter cells are produced
Malfunction results in cancer	Malfunction results in genetic disorder such as Down's syndrome, klinefelter's syndrome and Turner's syndrome.

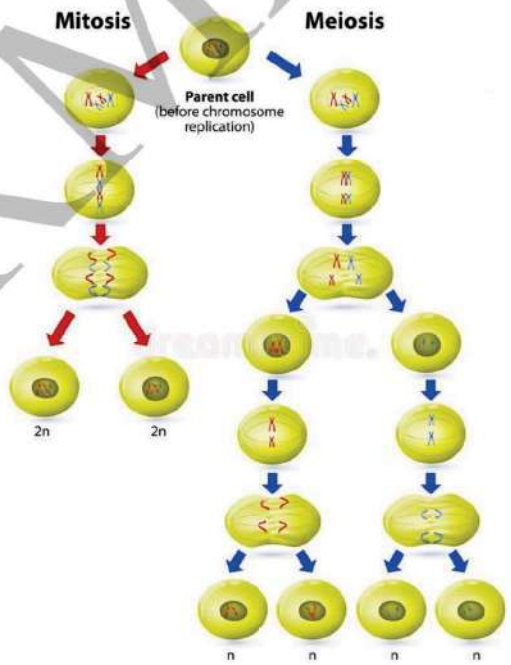
involved in reproduction

Largest cell in humans

Smallest cell in humans

*Learn only marked ones

Uncontrolled cell division



Types of cell

- Prokaryotic cell
- Eukaryotic cell

Prokaryotic Cell

- Size: 1–10 um
- Nucleus absent
- Nucleolus absent
- Cell organelles absent
- Chromosome: single

- Example: Bacteria, Cyanobacteria (Blue green algae), mycoplasma

Eukaryotic Cell

- Size: 5–10 um
- Nucleus present
- Nucleolus present
- Cell organelles present
- Chromosome: more than one

- Example: Plant and Animal cell

- Common in both: ribosomes

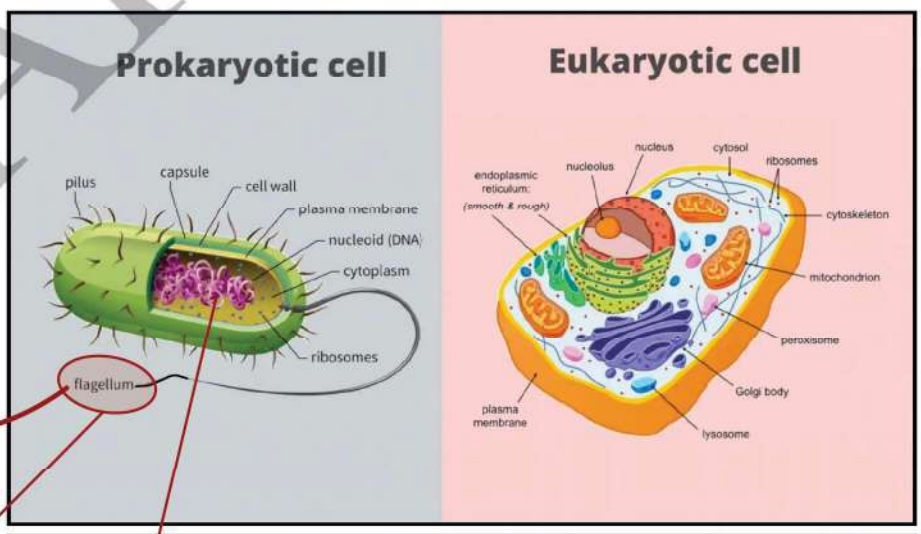


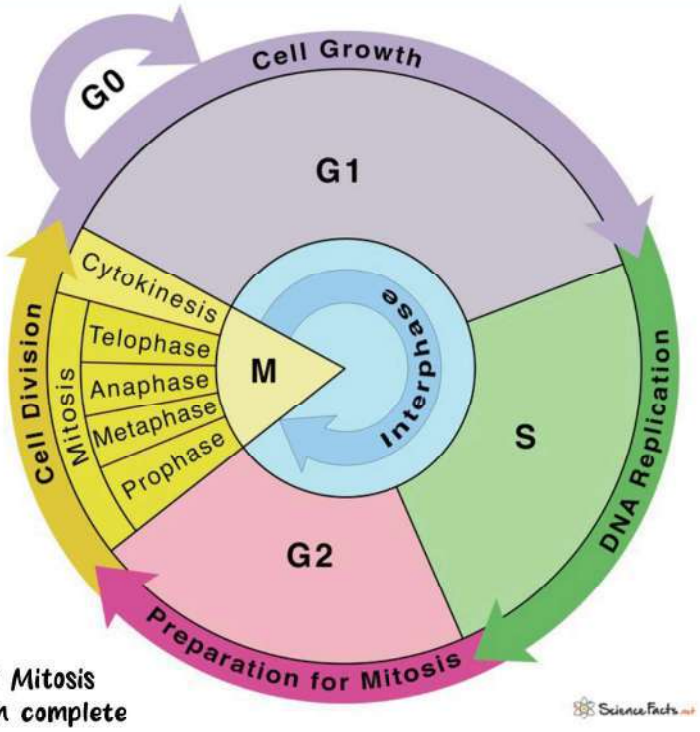
Figure: Prokaryotic Cell and Eukaryotic Cell

- Bacteria flagellum (helps in movement) 3 parts
- Basal body
- Hook
- Filament

These are appendages

Undefined nuclear region: Nucleoid

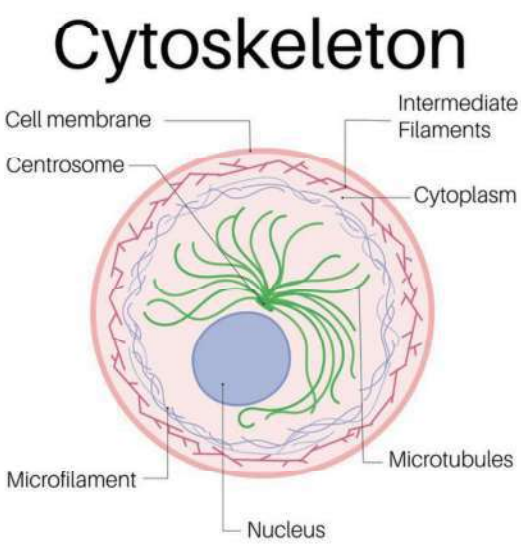
Cell Cycle



- G1: Cell growth
- S: Synthesis phase
- G2: Preparation of Mitosis
- Mitosis: Cell division complete

Cytoskeleton

- Helps in providing structural support to cell
- Helps in cell movements



Centrosome

- Made of two centrioles
  - In cylindrical form
  - In 9 + 0/ 9 + 2 form
- Microtubules organising centre

DNA Replication

- It is the process by which cell copies its DNA before dividing, ensuring each new cell has an identical copy of original DNA

4 base pairs (in DNA)		Base pairs (in RNA)	
Adenine	Thymine	Adenine	Uracil
Guanine	Cytosine	Guanine	Cytosine

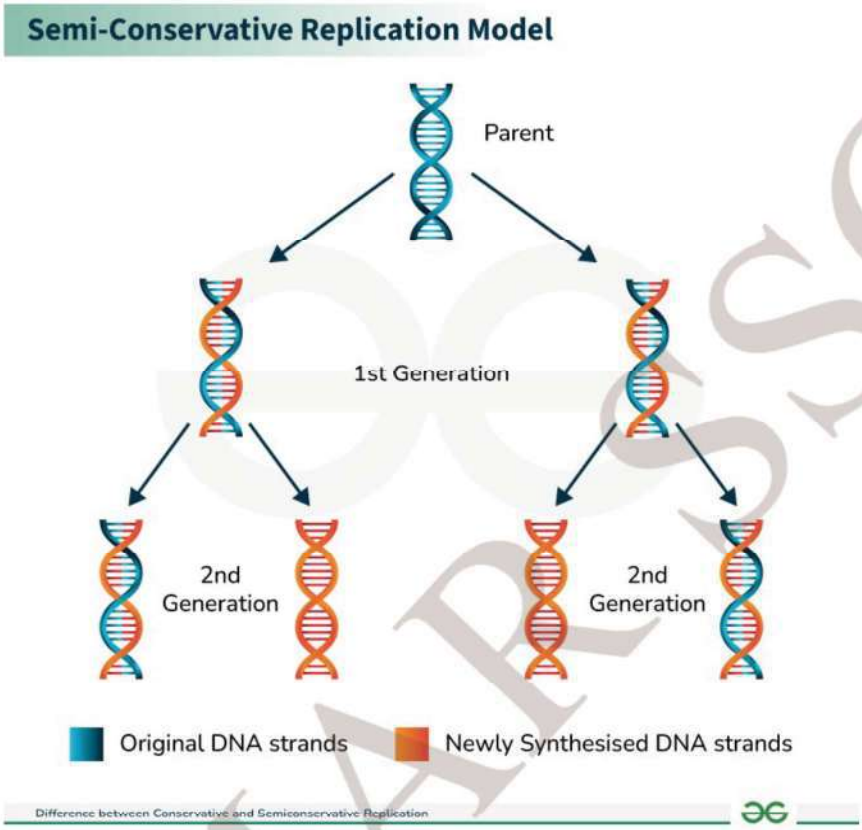
Enzymes essential for DNA replication in an animal cell

- Topoisomerase: Prevents DNA from getting tangled (avoids supercoiling)
- DNA Ligase: This enzyme facilitates the joining of DNA strands together (Gluer)
- DNA Polymerase: This enzyme doubles the amount of DNA in a cell during cell division (builder)
- DNA primase: It initiates DNA replication (new strands are produced)
- Helicase: Unwinding enzyme

** Reverse Transcriptase: The process of creating complimentary strands of DNA based on RNA

Semi Conservative DNA Replication

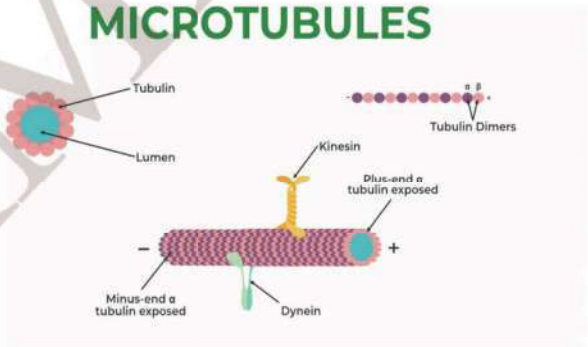
- It is the process of duplicating DNA to create two new double-stranded DNA molecules, each with one original strand and one new strand

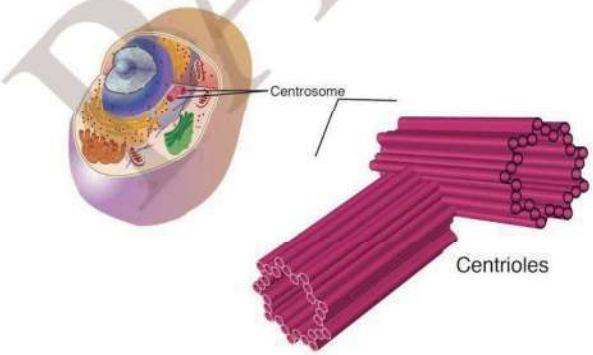


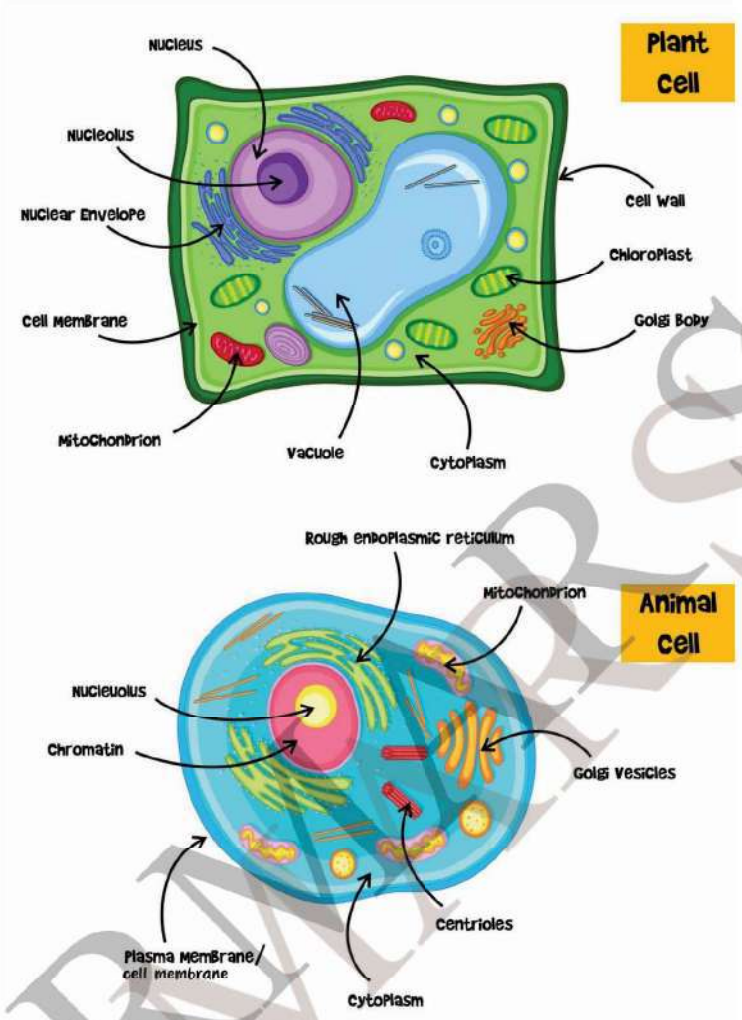
Microtubles

It helps in

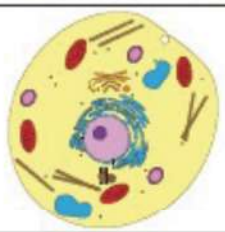
- Cell structure
- Cell division
- Intracellular transport







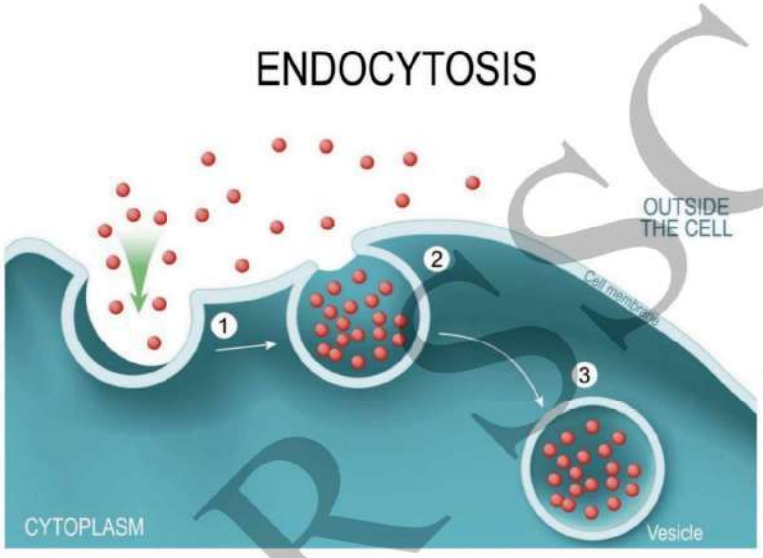
Animal Cell vs Plant Cell

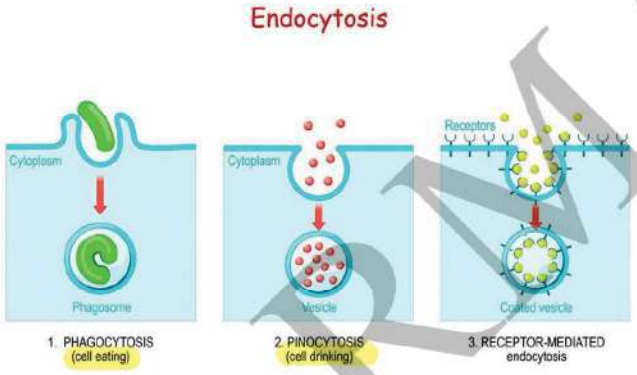
Plant Cell	Animal Cell
	
Plant cell is large and has a fixed rectangular shape.	Animal cell is small and irregular or round in shape.
Cell wall is present.	Cell wall is absent.
The nucleus lies on one side of the cell.	The nucleus lies in the center.
Mitochondria are present in fewer numbers.	Mitochondria are present in large numbers.
Plastids are present.	Plastids are absent.
Centrosomes are absent.	Centrosomes are present.
One large central vacuole is present.	Many small vacuoles are present.

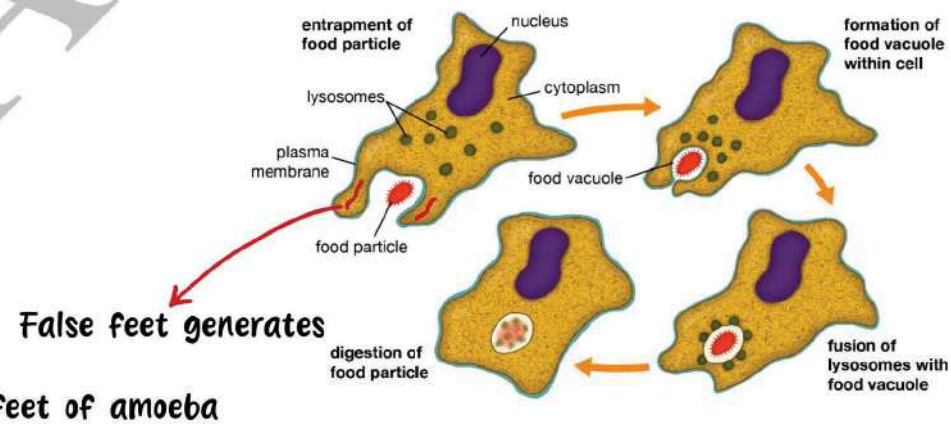
Endocytosis

- Type of active transport
- Movement of particle into the cell from external environment

Endo: andar
Exo: bahar







False feet generates

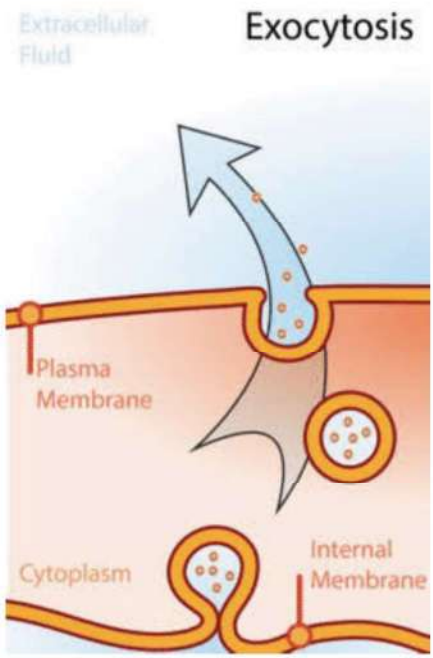
Pseudopodia: false feet of amoeba

Exocytosis

- Movement of particles from cell to the external environment
- It is also known as cell vomiting

Vomited particles are:

- Undigested residues from endocytosis
- Enzymes and hormones

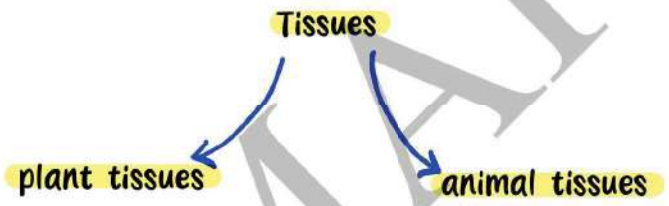


Study of tissues: Histology

S. No.	Plant Tissue	Animal Tissue
1.	Tissue organisation is targeted towards Stationery habit of plants.	Tissue organisation is targeted towards mobility of animals.
2.	Organisation is simple.	Organisation is complex.
3.	Many of the tissues are dead. For example, Cork	Most of the tissues are living.
4.	Growth is confined to certain areas.	Growth is not limited to areas
5.	less maintenance energy required	More maintenance energy required
6.	Plants grow continuously throughout life.	After reaching maturity stage animals do not show further growth.

Tissues

- group of cells that have similar structure combined together to perform a specific function forms a tissue



Importance

- Causes division of labour in multicellular organisms
- Decreases workload on individual cells
- Leads to organisation

Basic Unit of Life → Cell

Group of cells → Tissue

Group of tissues → Organs

Group of organs → Organ System

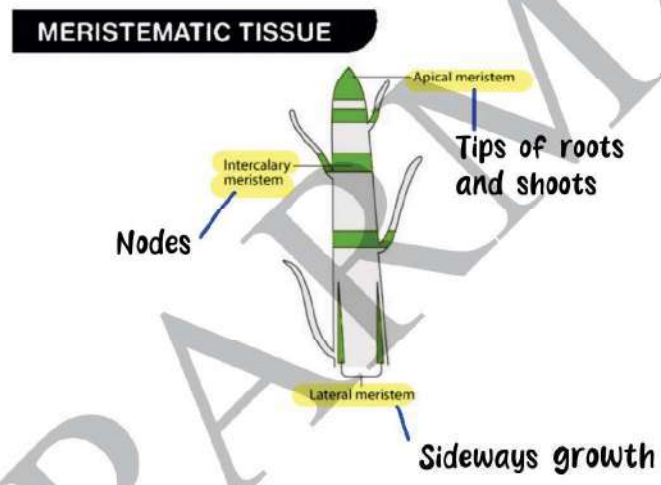
Group of Organs → Organism
System

Plant tissue

Meristematic tissue

Rapid cell division

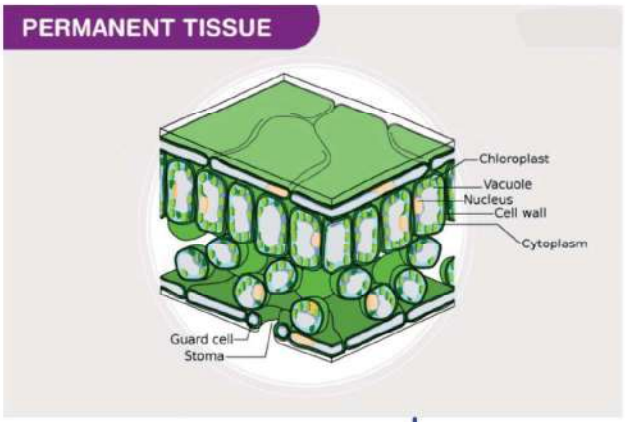
- occurrence: growing regions of plants (root, shoot, etc)
- shape: spherical, oval or rectangular
- Intercellular spaces: absent
- Vacuoles: absent
- Active cells
- Cytoplasm: dense
- Cell wall: cellulose
- Nuclei: prominent
- Cell division



- Height growth: Apical and intercalary
- Width growth: Lateral

Permanent tissue

- When cell lose the ability to divide, by the process of differentiation, theytake a permanent shape, size and function
- Structure: large central vacuoles Cell wall in thin/thick
- Function:
  - protection
  - Support
  - Storage
  - Photosynthesis



Types

- Simple
- Complex

Apical

- Present at shoot and root apex
- Increase in length of root and stem

Protoderm is present in root and shoot apical meristems

Intercalary

- Present at the base of leaves/internodes
- Increase length of leaves and internodes

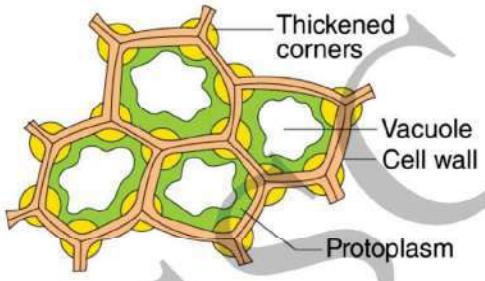
Lateral

- Present beneath the bark
- Increase girth of root or stem

Types of Simple Permanent Tissue

mechanical tissue

a) Collenchyma Tissue

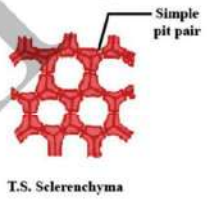


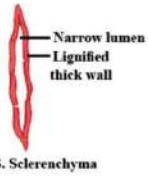
Occurrence: in leaf stalks and stem of dicots

Cell Structure
- Living
- Elongated
- Irregularly thickened at corners
- Very little intercellular space

Functions
- Provides mechanical strength and flexibility
- Allows bending of parts
  ex: tendrils and stems of climbers

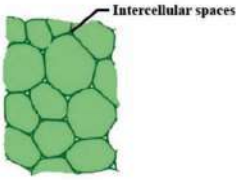
b) Parenchyma Tissue

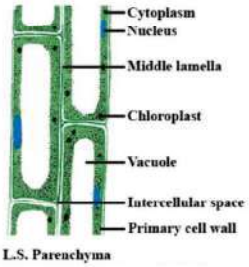




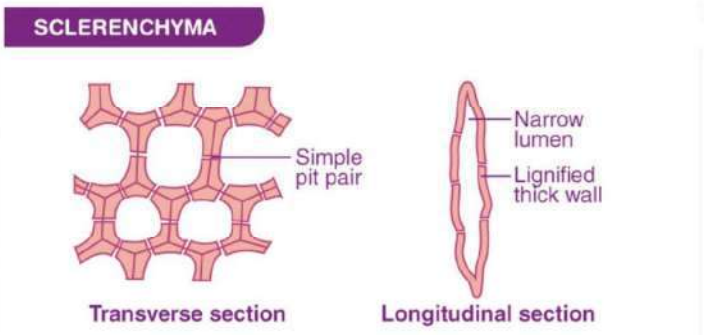
Functions
- Food storage tissue
- In some cases contains chlorophyll, called Chlorenchyma
- When loosely packed, intercellular airy spaces are present called Aerenchyma
  - Living cells

Provides buoyancy to parts, helps them float





c) Sclerenchyma Tissue

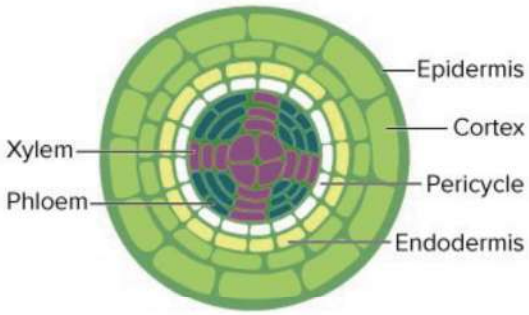


- Provides toughness to the tissue
- Occurrence: Outer parts
  eg: bark, husk of coconut, veins of leaves
- Mostly made up of dead cells
- Sclereids are responsible for hardness of seeds and the shell of walnut

Protective Tissue (part of simple tissues)

Types:
- Epidermis
- Cork

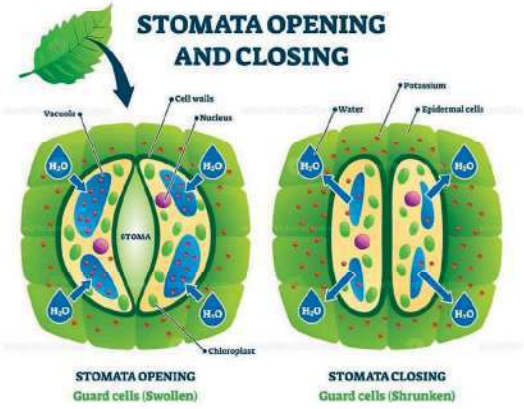
Dicot root



a) Epidermis

- Occurrence: Outermost layer of plant parts
  eg: leaves, flowers, stem and roots

Functions:
- Protects all parts of plants
- Prevents water loss
- Plants of dry habitats have thicker epidermis — cactus plant
- Epidermal cells on the aerial parts of plan secrete waxy secretions which prevents from:
  - Water loss
  - Injury
  - Fungi infection



Guard Cells

- Plants growing in desert have cuticle
- Layer of cutin is called cuticle
- Cutin is waxy materials and water resistant
- Cuticle aids in protection against water loss, injury and invasion of fungi
- Epidermal cells of the roots form hair like structures
- Long hair like parts increase absorption surface area of roots
- In leaves, epidermal cells form stomata
- Stomata are guarded by guard cells which are kidney shaped and regulate gaseous exchange

b) Cork

- Occurrence: in mature roots and shoots
- Dead
- Compactly arranged cells
- Walls have suberin which makes them impervious to gases

Transpiration	Guttation
Loss of water vapour	Loss of water droplets
Through stomata, cuticle and lenticels	Through hydathodes
Leads to loss of turgidity(wilting)	No effects on turgidity
Cools the plant body	No cooling of the plant body
• Happens at day time	• Happens at night time

Functions:

- Protection to mature roots and shoots

Complex Permanent Tissue

- Made up of more than one type of cells

Function

- Transport water, minerals and food materials

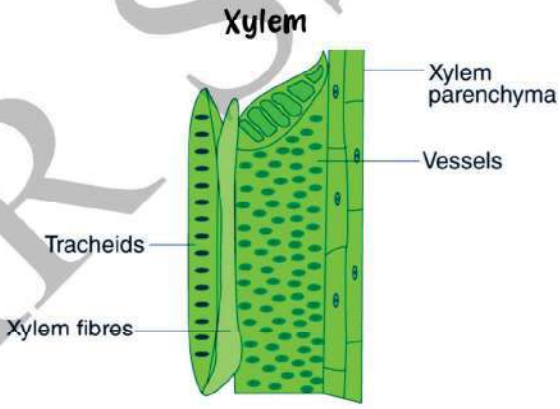
Types

- Xylem
- Phloem

} vascular tissues

Xylem

- Conducting tissue (one-way conduction) — Unidirectional
- Conducts water and minerals from roots to shoots



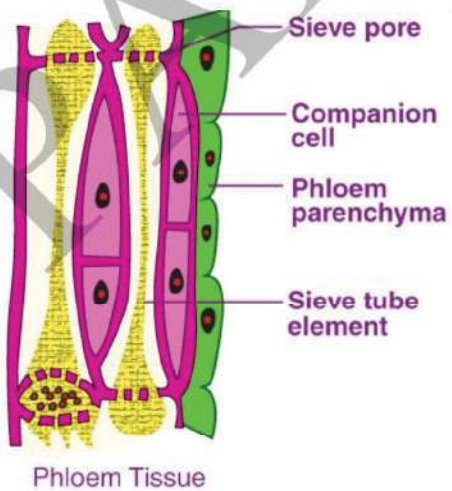
Xylem Types:

- Xylem parenchyma: food storage — Living
- Tracheids
- Vessels
- Xylem fibres

} Dead

Phloem

- Conducts food (two-way conduction) — Bidirectional



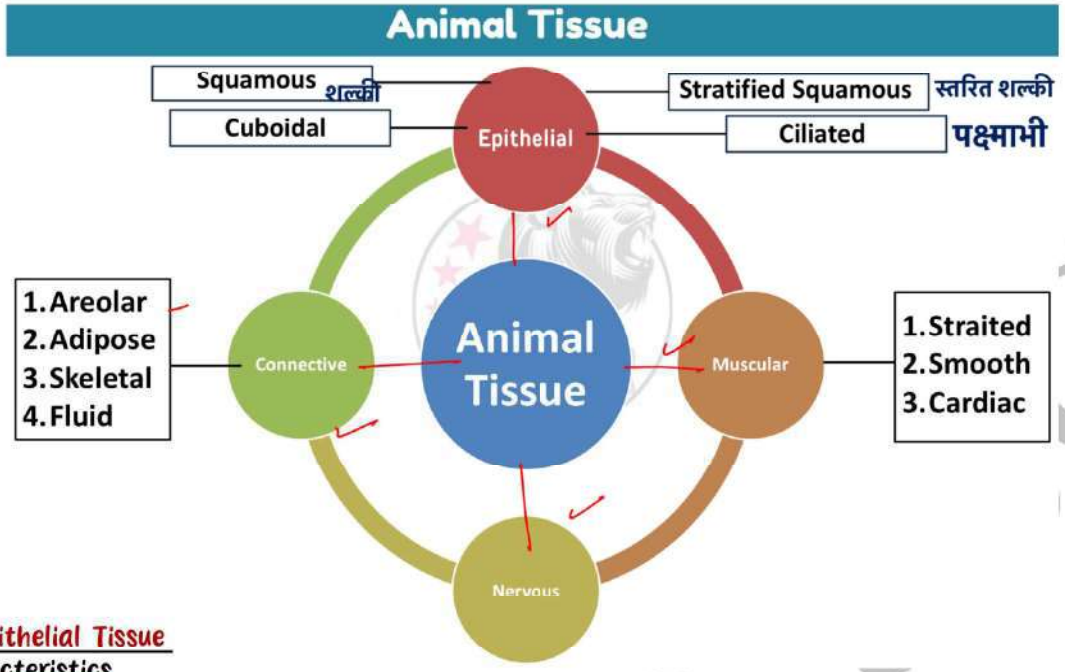
Phloem Tissue

Phloem Types:

- Sieve tubes
- Companion cells
- Phloem parenchyma: food storage

} Living

- Phloem fibers: rigidity and support — Dead



a) Epithelial Tissue

Characteristics

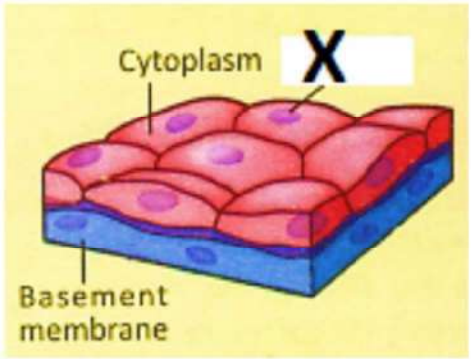
- Covering or protective tissue in animal body
- They are tightly packed with no intercellular spaces
- Cells form continuous sheet
- All epithelial tissues are separated by others through basement membrane

Function

- Protection to body from injury and damage

Types

i) Squamous Epithelial Tissue



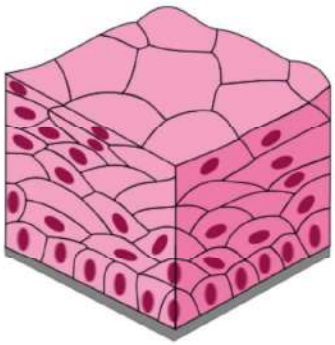
Structure

- Cells are extremely thin
- They are flat
- Irregular shaped

Types

- Simple Squamous Tissue
- Stratified Squamous Tissue

a) Simple Squamous Epithelial Tissue

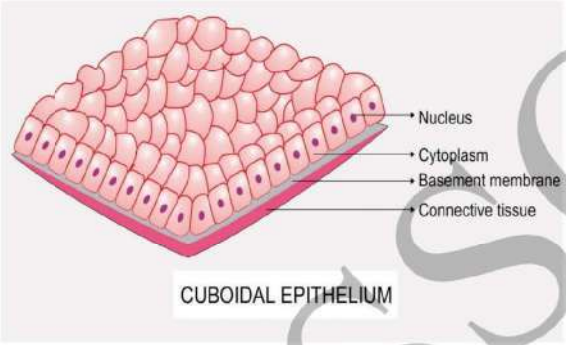


- Single layer of cells
- Forms delicate lining
- Eg., Mouth and oesophagus (food pipe)

b) Stratified Squamous Epithelial Tissues

- Cells are arranged in layers
- Prevent wear and tear
- Eg., Skin

ii) Cuboidal Epithelial Tissue



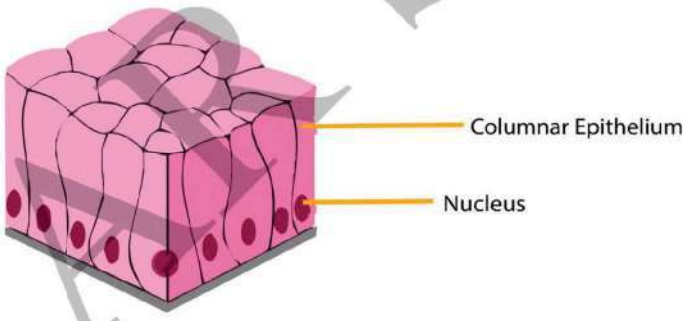
Structure

- Cube like : height and width of cells are equal

Occurrence

- Sweat glands
- Salivary glands
- Thyroid glands
- Lining of Kidney tubules

iii) Columnar Epithelial Tissue



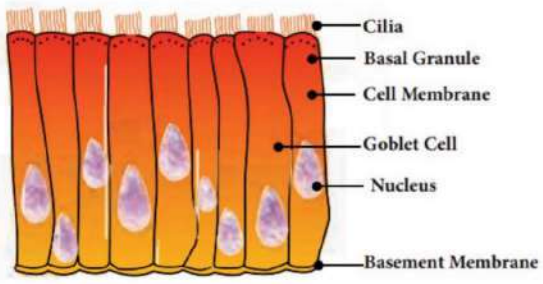
Structure

- Pillar like cells
- Tall > Wide

Occurrence

- Lining of intestine
- Lining of stomach, gallbladder

iii) Ciliated Epithelial Tissue



Structure

- Cuboidal/Columnar cells
- Cells have hair like projections on free surface called "cilia", which facilitates movement

Occurrence

- Respiratory tract
- Urinary tubules or kidney

Function

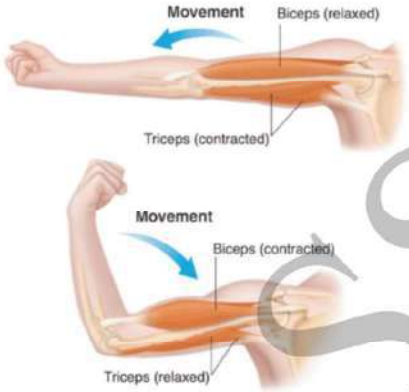
- Movement of mucus, urine, egg etc., through rhythmic beating of cilia

a) Muscular Tissue

- Composed of muscle cells or muscle fibres
- Muscle fibres: Elongated and large sized
- Contractile proteins are present in fibres

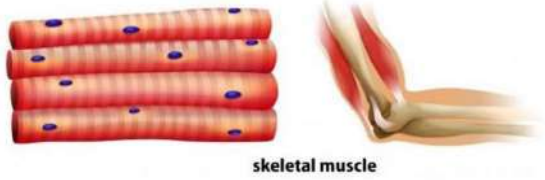
Functions

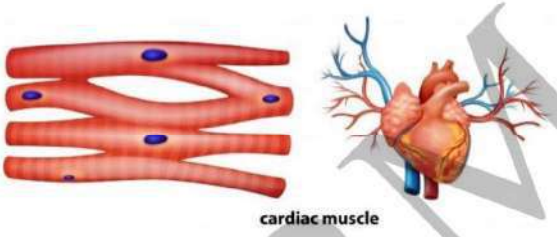
- Contraction and relaxation
- Contractile proteins: movement of body

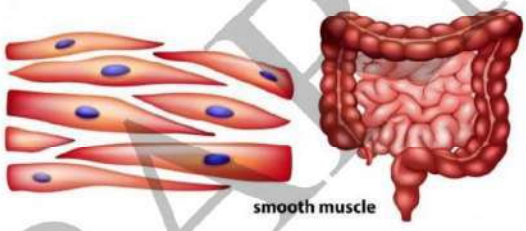


Types

- Cardiac muscle
- Skeletal muscle
- Smooth muscle







a) Skeletal Muscle

- Muscle fibres are elongated and cylindrical
- Fast in nature
  Unbranched
- Each cell is multinucleated (many nuclei)
- Striations are present (alternate dark and light bands
- Easily fatigue
- Helps in body movement
- Maintain posture

Other names

- Attached to skeletal: Skeleton Muscles
- Striations are present: Striated Muscles
- Are under our control: Voluntary muscles

Occurrence

- Biceps and Bone

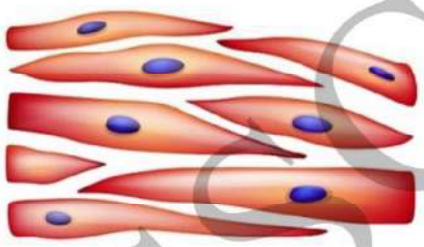
b) Smooth/Visceral Muscles

- Nucleus located at the centre of each cell
- Striations are absent
- Unbranched
- Slow
- Do not fatigue
- Spindle shaped/fusiform

soft interior organs: lung, liver, abdomen, intestines

Other names

- Found in visceral organs: Visceral Muscles
- Striations are absent: Unstriated muscles
- Not under our control: Involuntary Muscles



BlueRingMedia/Shutterstock.com

Functions of Smooth/Visceral muscles

- Peristalsis

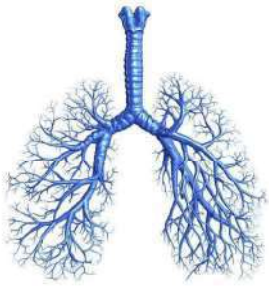
Organs that have visceral muscles

Intestine

Uterus

Blood vessels

Stomach

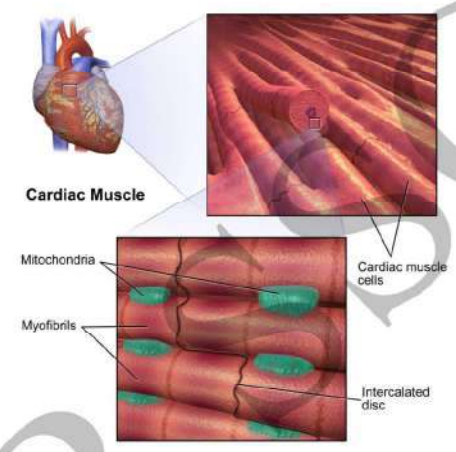


Bronchi

Iris

c) Cardiac Muscles

- Fibres are cylindrical in shape
- Each fibre is uninucleated
- Fibres are branched
- Striations are present
- Do not fatigue



Other names

- Cardiac muscle: only present in heart
- Striated: Striations are present
- Not under our control: Involuntary muscles

Function

- Perform contraction and relaxation in wall of heart
- Help to pump and distribute blood to body

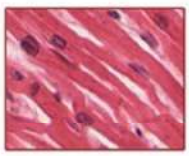
	Main features	Location	Type of cells	Histology
Skeletal muscle	- Fibers : striated, tubular and multi nucleated - Voluntary - Usually attached to skeleton			
Smooth muscle	- Fibers : non-striated, spindle-shaped, and uninucleated. - Involuntary - Usually covering wall of internal organs.			
Cardiac muscle	- Fibers : striated, branched and uninucleated. - Involuntary - Only covering walls of the heart.			

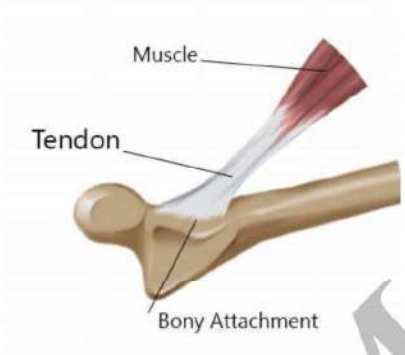
Figure 1. Key features of skeletal, smooth and cardiac muscle.

c) Connective Tissue

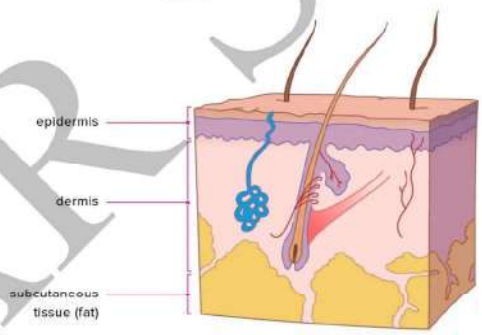
- Connects various body parts
- Cells are embedded in an intracellular matrix
- Matrix may be jelly, fluid, dense or rigid

Cartilage Blood Bone

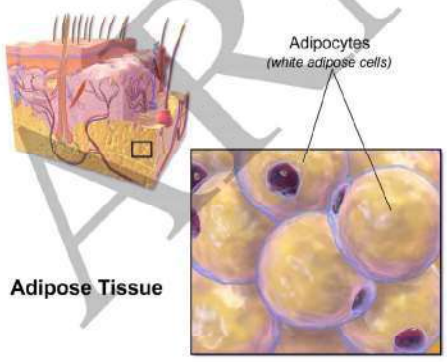
- Acts like binding, supporting and packing material
- Prevents organ from getting displaced by body movements



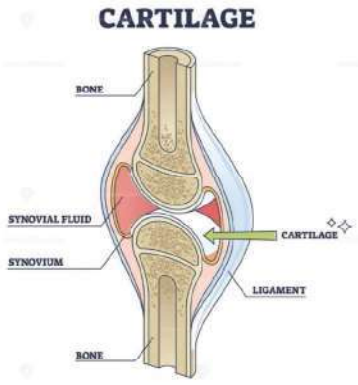
Tendons



Dermis



Adipose



Cartilage

Types of Connective tissue

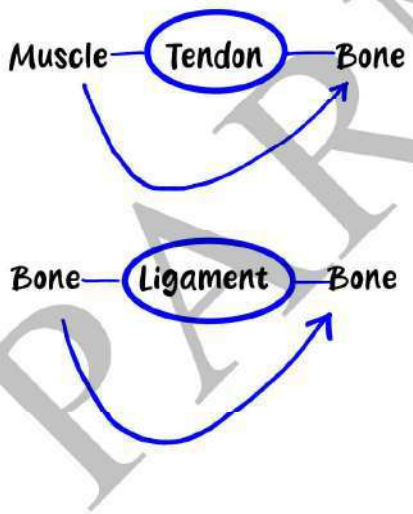
a) Areolar Connective Tissue

i) Loose Connective Tissue
ii) Dense Connective Tissue
- Ligaments
- Tendons

b) Adipose Connective Tissue

ii) Dense Connective Tissue

a) Tendons
- Fibrous tissue
- Great strength
- Limited flexibility
- Connects muscles to bones



b) Adipose Connective Tissue

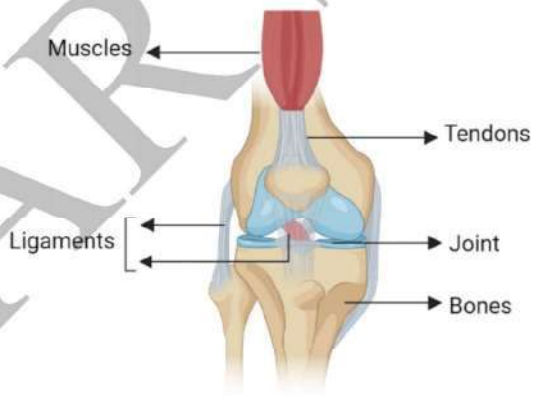
Structure
- Aggregation of fat cells
- Cells are round/oval — Adipocytes

Functions
- Prevents body from mechanical shock
- Acts as insulator

i) Loose Connective Tissue

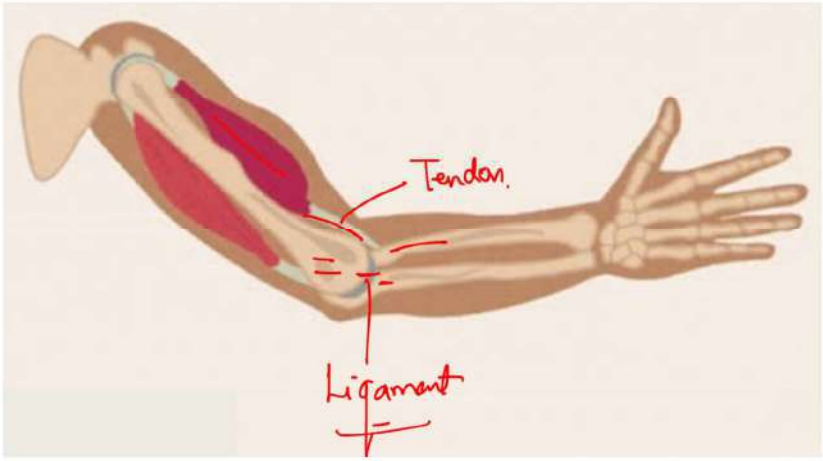
Structure
- Cells + loose gel like matrix

Occurrence
- Between skin and muscles
- In space inside organs
- In bone marrow



Tendons and Ligaments

b) Ligaments
- Considerable strength
- Little matrix is present
- Connects bones to bones



Occurrence
- Below the skin — fatty people have more adipose tissue
- Betⁿ internal organs

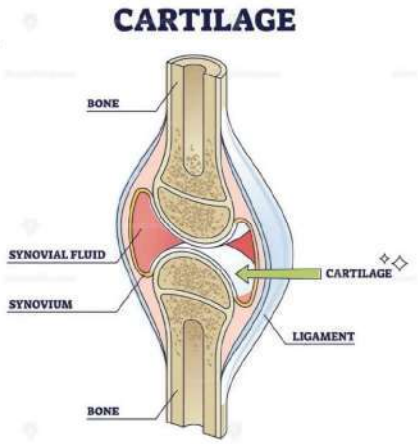
c) Skeletal Connective Tissue

Types

- Cartilage
- Bones
  - 300 bones: child
  - 206 bones: adult
  - Longest bone: Femur (In thigh)
  - Shortest bone: Stapes

i) Cartilage

- Widely spaced out cells
- Matrix is gel-like
- Matrix is slightly elastic
- Cartilage is flexible



Occurrence
- Ear pinna, nose tip, trachea, larynx
- Smoothens bone surfaces at joints

Function
- Support and flexibility to body parts

ii) Bones

- Very strong
- Non flexible
- Hard and rigid
- Matrix is hard and composed of calcium and phosphorous compounds

Functions

- Forms a framework
- Supports the body
- Provides shape to body
- Protects vital body organs like brain, lungs, etc.

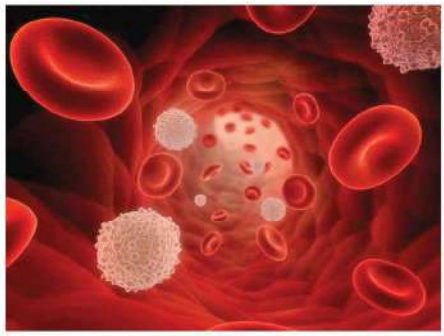
Layer: meningitis

22 bones in brain

- 8: cranial
- 14: facial

d) Fluid Connective Tissue

- Connects different part of the body
- Maintains a continuity



Types

- Blood
- Lymph

i) Blood

Function: transports gases, digested food, hormones, waste materials

Blood

- Liquid (55%)
  - Plasma (Yelkow in color)
    - 92%: water
    - 8%: protein, salt, hormones
      - Fibrinogen/Heparin: Anticoagulants
      - Globulin: Provides defence
      - Albumin: To maintain osmotic balance
  - When clotting proteins are removed from blood, the clear liquid that remains after is called serum
- Solid (45%)
  - RBC
  - WBC
  - Platelets

Solid

RBC (5 million/cubic m)

- red in colour due to presence of heme (Fe)
- Heme has high affinity towards oxygen
- Produced in bone marrow
- RBCs function: Transport O_2
- Graveyard of RBC: Spleen
- Shape: Biconcave; disc-shaped
- Also known as erythrocytes
- When mature, no nucleus
- Time period of RBC: 120 days
- End point: Spleen

WBC (10,000/cubic m)

- Also known as leukocytes
- Prevent from infection, provide our body a defence mechanism
- It is produced in bone marrow

Types

- Monocytes
- Lymphocytes
- Neutrophils
- Basophils
- Eosinophils

- Shape: round/irregular
- Life span: 12–20 days

Platelets (20,000/cubic m)

- Helps in blood clotting
- If suffering from dengue, it reduces
- Also known as thrombocytes
- Shape: Irregular
- Produced in bone marrow
- Life span: 7–10 days

Order in number:

RBC > Platelets > WBCs

- study of blood: hematology

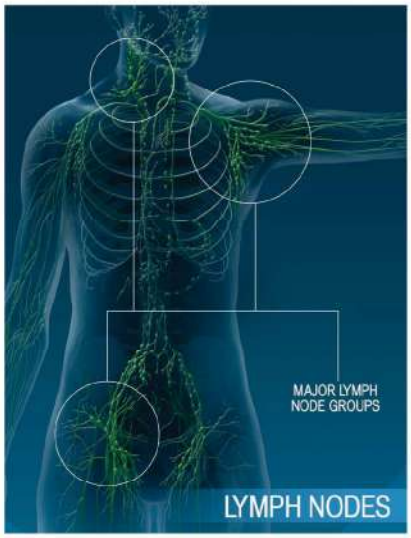
ii) Lymph

Structure

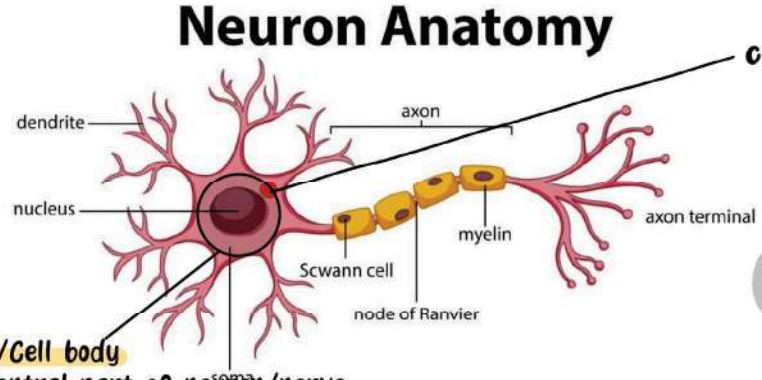
- Colourless fluid
- RBCs and Blood proteins are absent
- Similar to plasma
- Contains proteins, salt, glucose, water
- Slight yellow in colour

Function

- Provides defence



d) Nervous Tissue



Cyton/Cell body
- The central part of neuron/nerve
- It has Nissl bodies (protein synthesis)

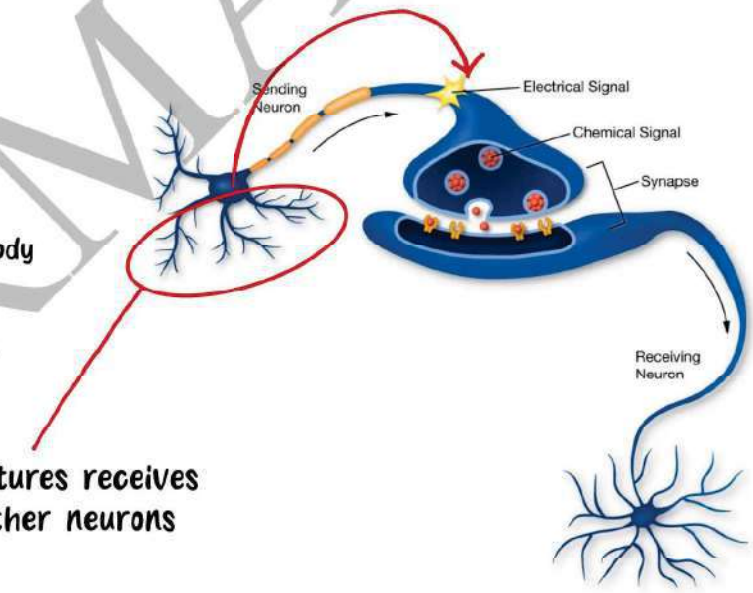
- Found in brain, spinal cord, nerves
- Fundamental unit of nervous system: Neuron

- Fundamental unit of kidney: Nephron
- Study of kidney: Nephrology

Function

Sense stimuli:
- Touch
- Smell
- Taste
- Hearing
- Sight

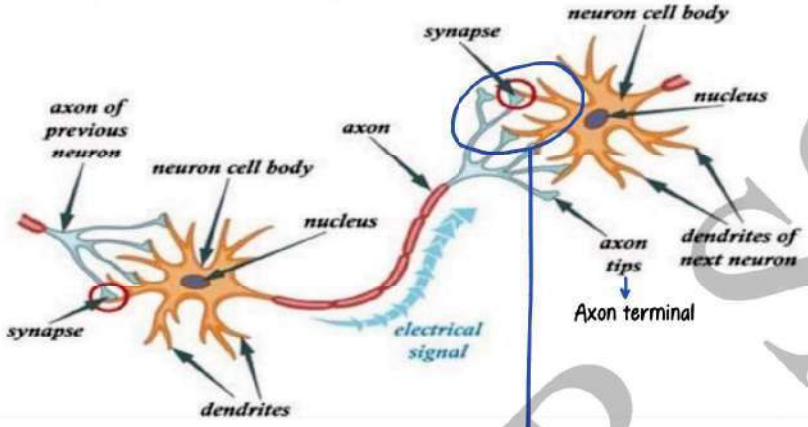
- Sending impulses across the body through electrical signals



Hair like structures receives signals from other neurons

- Longest cell
- Camillo Golgi: first created the illustration of neuron using his silver-staining technique (Black ink reaction)

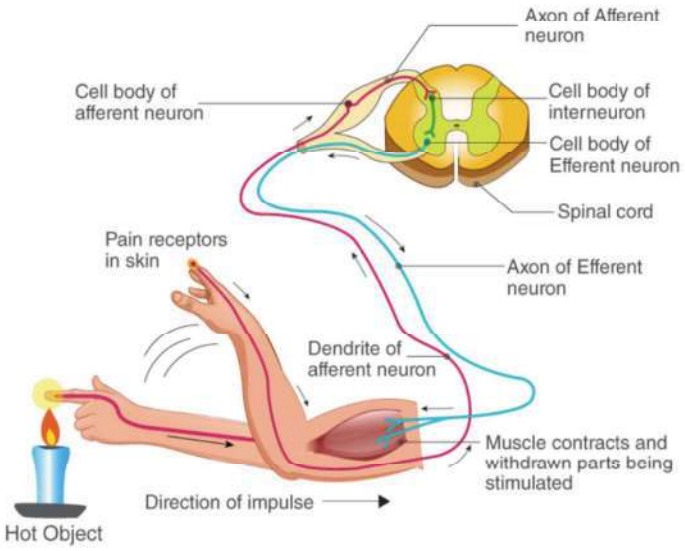
How do neurons transmit impulses (send message to other cells)?



one neuron's dendrite transmit information to other neuron's cell body

- The gap bet^{n} these two is called synapse

REFLEX ACTION



Plant Kingdom

The Hierarchy of Classification - Groups

Ernst Haeckel (1894) | Robert Whittaker (1969) | Carl Woese (1997)

Father of Taxonomy

- 1735: Carl Linnaeus
- Gave 2 Kingdom Classification
  - Animal
  - Plant

KINGDOM

1. Monera
2. Protista
3. Fungi
4. Plantae
5. Animalia

5 kingdoms

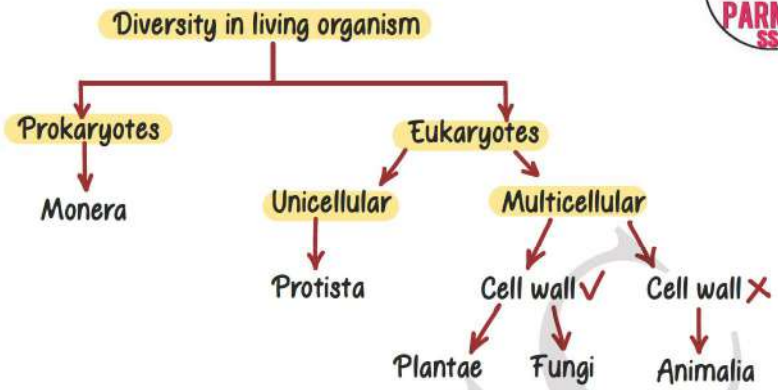
These two Kingdoms are very important

- 5 kingdoms classification by Robert Whittaker in 1969
- Ernst Haeckel in 1866 coined the term "Ecology"
  - 3 Kingdom Classification (1864)
- Father of Indian ecology: Ramdeo Mishra
- Carl Woese (1997): 3 domains

- Taxonomy: it is the science of describing, naming, and classifying organisms, including all plants, animals, and microorganisms

TRICK to learn the order

Kingdom	Kabaddi
Phylum (Animals)/ Division (Plants)	Play
Class	Class
Order	Our
Family	Of
Genus	Girls
Species	Some



Classification is based on following:

- Prokaryote v/s Eukaryote cell structure
- Unicellular/Multicellular organization
- Modes of nutrition
- Further classification is done into sub groups

KINGDOM MONERA

- Microscopic
- Prokaryotic

eg: Archaebacteria-Eubacteria, Cynobacteria (Blue-green algae)

- Can be autotrophic/heterotrophic
- Well defined nucleus and membrane bound organelles is absent
- Cell wall maybe present or absent

Kingdom Monera Classification

- Archaebacteria
  - Mostly autotrophs
  - Few are photosynthetic
- Eubacteria
  - Cell wall is present
  - Plasma membrane is present
  - Cytoplasm present
  - Ribosomes present

KINGDOM PROTISTA

Characteristics

- Unicellular eukaryotic organisms
- Locomotion through appendages
- Cell wall is absent (Eg: Euglena)

Mode of Nutrition

- Autotrophic/Heterotrophic

eg: Unicellular algae (diatoms) protozoa

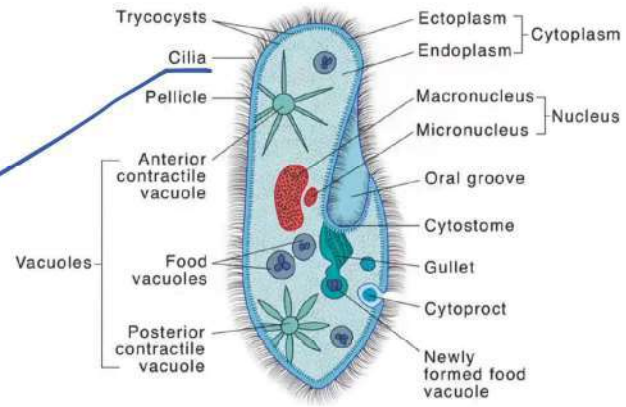
Classification of kingdom Protista

PHYLUM PROTOZOA

- Unicellular, mostly aquatic, solitary or colonial
- free living/parasitic/symbiotic

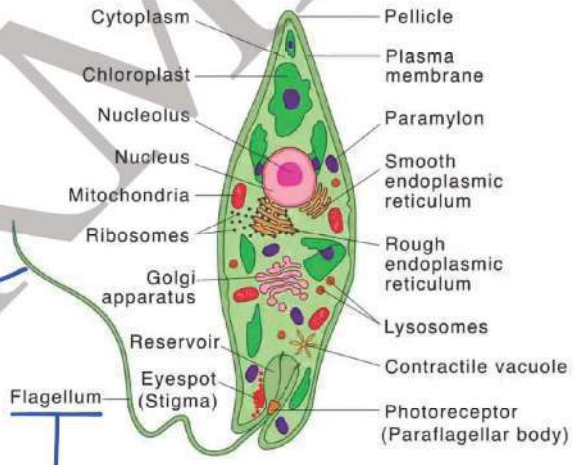
eg: Euglena, Amoeba, Paramecium, Plasmodium

Paramecium



- Helps in movement/locomotion
- Also, helps to move food to its oral cavity

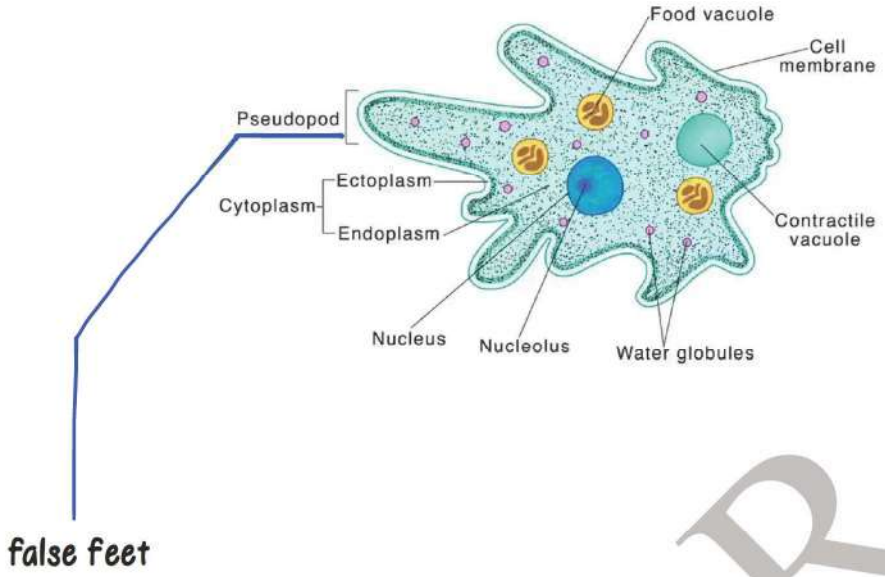
Euglena



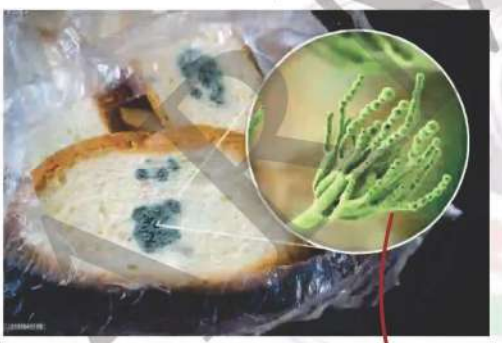
Euglena has a tail-like structure

Helps in cell movement

Amoeba



KINGDOM FUNGI



Fungus on Bread

Mushroom

Rhizopus/Bread mould

Characteristics

- Multicellular except yeast
- Cell wall is present and is made of complex sugar chitin

- Some are in symbiotic relationship — benefit from each other
  eg: Lichen – Blue green algae + fungi
  - changes colour due to global warming
  - gives food to fungus
  - gives water + shelter + minerals to algae
- India's first lichen park: Uttarakhand

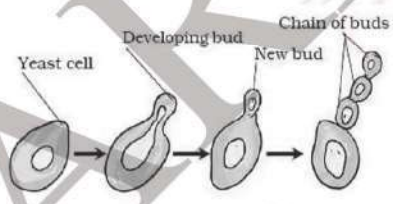
- Used in medicine: Penicillin
- Used in bakery: Yeast

Alexander Fleming discovered Penicillin (1st antibiotic)

Mode of nutrition

- Heterotrophic
- Saprophytic: Decaying organic material as food
- Parasitic: Dependent on protoplasm of a host organism for food

Types of fungi :-



Saccharomyces (Yeast)

Penicillium (Mold)

Agaricus (Mushroom)

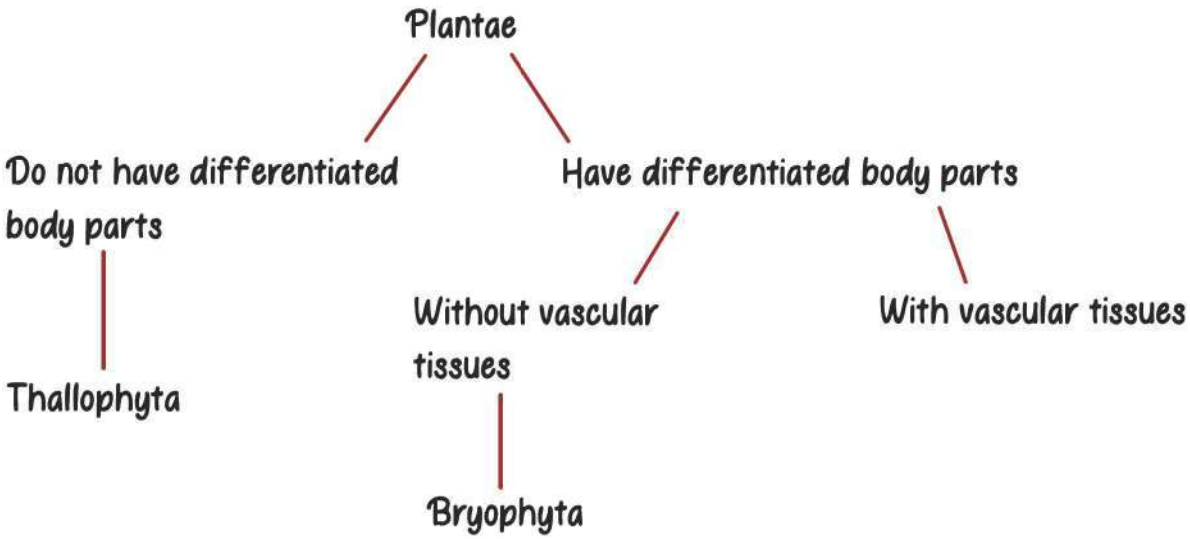
KINGDOM PLANTAE

- Multicellular
- Eukaryotes
- Cell Wall present — Made up of cellulose
- Autotrophic in nature
- Sedentary

Kingdom Plantae is classified based on:-

- Differentiation of plant body and distinct components
- Presence or absence of vascular tissues
- Ability to bear seeds
- Seeds are enclosed within fruits
- Ability to produce flowers

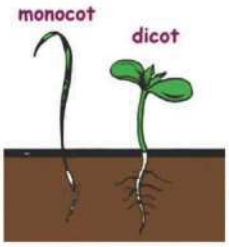
Classification of Plantae

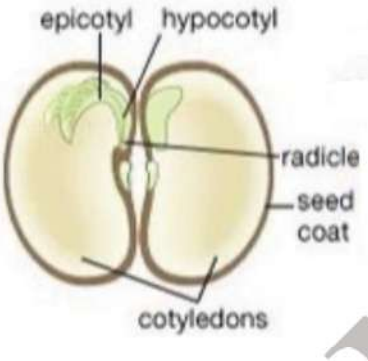


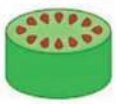
Classification of Plantae:-

Angiosperms

Monocots (One Cotyledon) | **Dicots (two Cotylodeons)**





	Seed	Root	Vascular	Leaf	Flower
Monocot					
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
Dicot					
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

single cotyledon

Two cotyledons

PHYLUMS OF KINGDOM PLANTAE

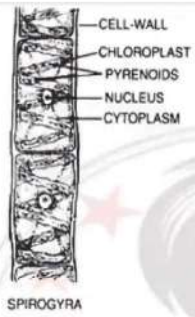
Characteristics of Thallophyta

- Plants do not have **well-differentiated body parts** — no distinguished root or stem or body
- Plants are called as algae
- Mostly aquatic
  eg: Spirogyra, Ulothrix, Ulva, and Chara
- Eukaryotic organisms
- Non-motile
- Autotrophic
- Different pigments are present edible and toxic

Chlorella (rich in proteins)

Thallophyta - Algae

- **Phycology**: Study of algae
- **Green algae**: Chlorophyceae
- **Red algae**: Rhodophyceae
- **Brown algae**: Phaeophyceae



SPIROGYRA


ULOTHRIX


CLADOPHORA

TRICK (Chlorophyceae)

- **S**: Spirogyra
- **U**: Ulothrix
- **V**: Volvox
- **C**: Chara
- **C**: Cladophora

TRICK (Phaeophyceae)

- **S**: Sargassum
- **E**: Ectocarpus
- **L**: Laminaria (also known as Kelp (mannitol is a sweet alchol made from kelp))
- **F**: Fucus


ULVA


CHARA


Sargassum

- **Antheridium**: the male sex organ of algae, Moses, ferns, fungi, and other non-flowering plants

Characteristics of Bryophyta

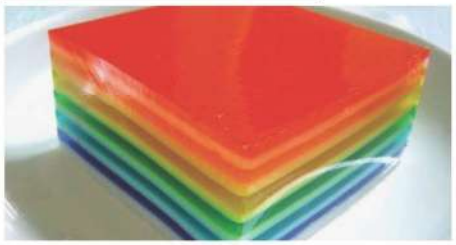
- They are known as "Amphibians of Plant Kingdom"
- Well differentiated body: Stem and leaves
- Root like structures present: Rhizoids
- Autotrophic, non-motile
- No specialised tissues for water and food conduction
- Found in damp and moist areas

  eg: Riccia, Moss (Funaria), Marchantia
- Reproduction is through water

Bryophyta:-

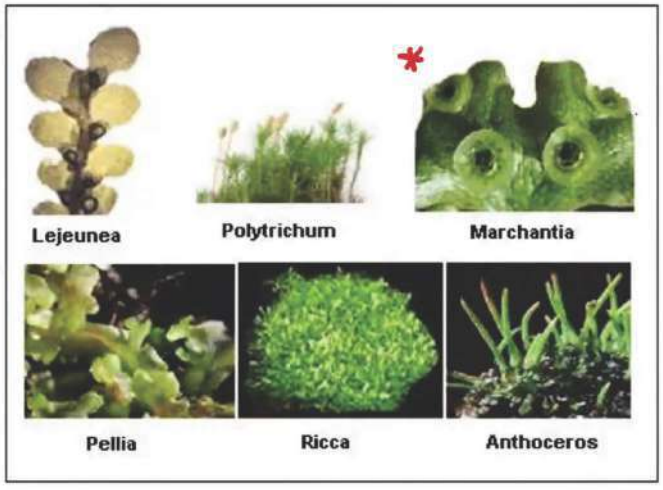
- **Male part**: Antheridium
- **Female part**: Archegonium

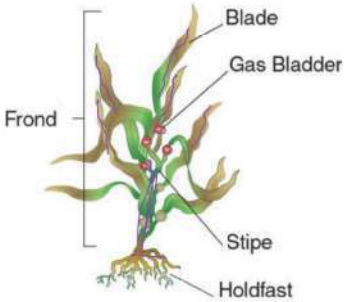
AGAR (Rhodophyceae)



Source

→ **P**: Porphyra, **G**: Gelidium, **P**: Polysiphonia, **G**: Gracilaria





Characteristics of Pteridophyta

Found in cracks of rocks, moist and shady places

zameen par

- First terrestrial plants
- Well-differentiated into roots, stem, and leaves
- Well-developed reproductive organs are hidden
- Specialised tissue for food and water conduction: Vascular tissues are present

  eg: Marsilea and fern, Horsetails

- Leaves are made of leaflets that bear spores called Sporophylls

Pteridophyta


Selaginella


Pteris


Pteris


Adiantum


Equisetum

With vascular tissues

- Do not produce seeds (Cryptogams) → Pteridophytes
- Produce seeds (Phanerogams)
  - Bear naked seeds → Gymnosperms
  - Bear covere seeds → Angiosperm

Difference Between Cryptogams and Phanerogams

Cryptogams	Phanerogams
→ Seeds, flowers, fruits are absent	→ Seeds, flowers, fruits are present.
→ Reproductive organs are hidden.	→ Reproductive organs are exposed.
→ Less evolved plants.	→ Highly evolved plants.
→ Mostly thallophytes, bryophytes and pteridophytes.	→ Gymnosperm and Angiosperm.

Characteristics of Gymnosperms

- Gymno: Without cover
- Sperma (Seeds without fruit) — Primitive and simple seeds
- Usually perennials, evergreen and mostly woody plants
- True roots, stem, and leaves are present
- Xylem vessel absent

eg: Pinnes and Deodar, Cycas

Pinus — coniferous forest: in temperate regions

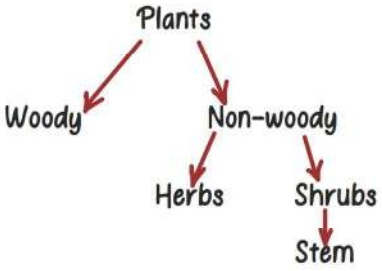
Pines

Deodar

- Phloem companion cells are absent

Characteristics of Angiosperms

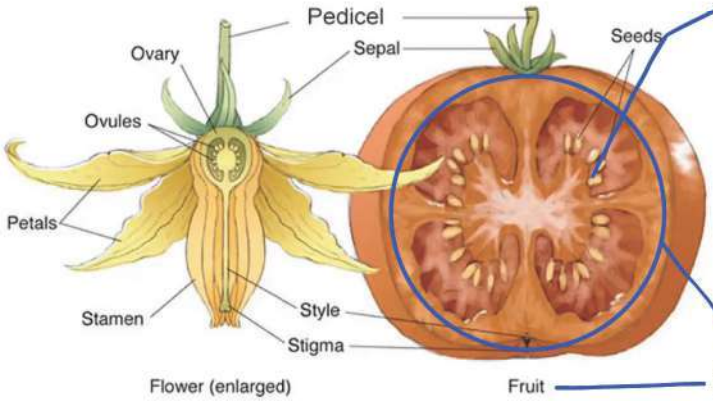
Types
- Monocots
- Dicots



- Angio: Covered
- Sperma: Seed
- They are flowering plants and produce seeds enclosed within fruit
- They are highly evolved
- Ovary gets modified into fruit
- Seeds have embryo inside it and these seeds develop inside ovary
- Embryos have structure called Cotyledons (seed leaves)

Flower to fruit:-

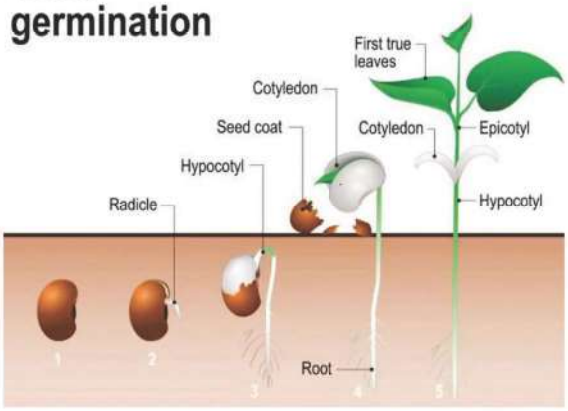
Cotyledons → Emerge → Green → During seed germination



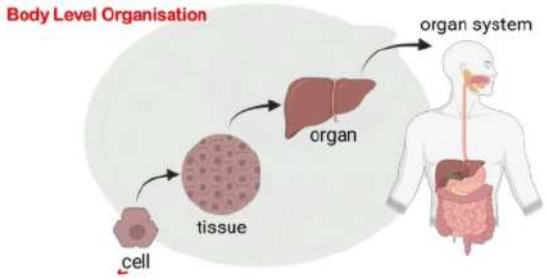
seeds that were earlier ovules

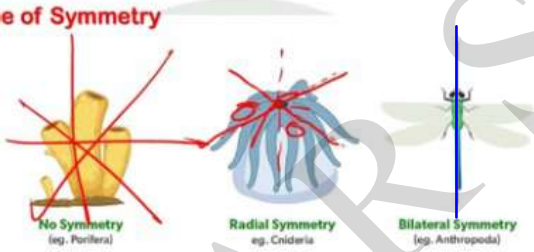
that was earlier ovary

Seed germination

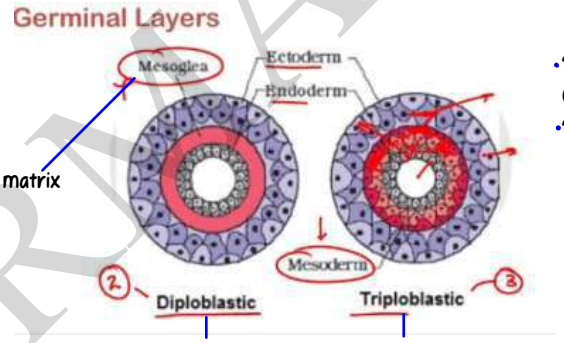


Animal Kingdom





- **No symmetry/Asymmetry:** Eg: Porifera
- **Radial Symmetry:** Symmetry along any plane passing through the centre. Eg: Coelentrata, Echinodermata, Ctenophora
- **Bilateral Symmetry:** Eg: Platyhelminthes or flatworms, Nematodes, Annelida, Arthropoda

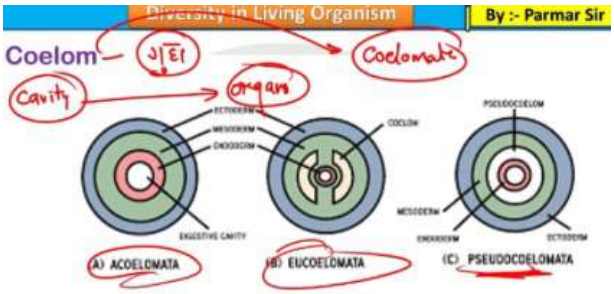


- Porifera, Coelenterata, Ctenophora: Diploblastic
- Rest all: Triploblastic

Mesoglea: jelly like matrix

- **Mesoderm:** Middle germ layer

2 germ layers — 3 germ layers



- **Coelom:** it is the body cavity present between the body wall, and the gut wall
- Coelom has a mesodermal lining

Porifera, Coelenterate, Ctenophora, Platyhelminthes	Acoelom
Nematoda/ Aschelminthes	Psuedocoelom
Annelida, Arthropoda, Mollusca, Echinodermata, Chordata	Eucoelom

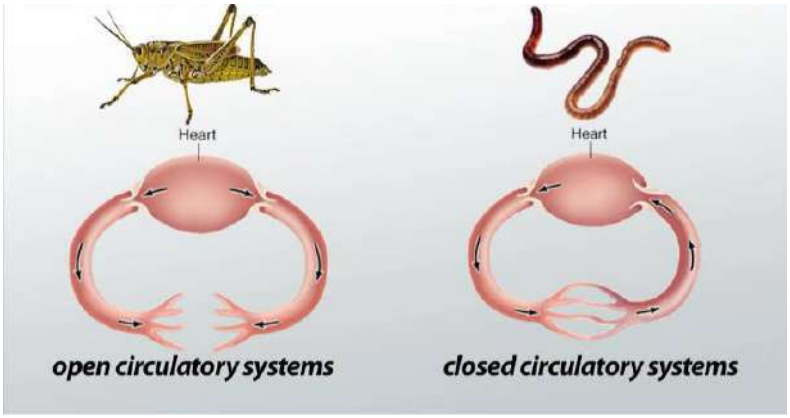
Eucoelomata: true ceolem

Psuedocoelomata: false coelom

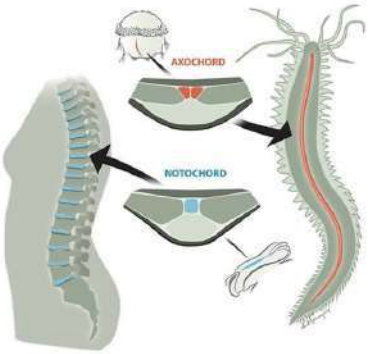
Segmentation seen in

- Annelida
- Arthropoda
- Chordata

Circulatory Systems



- Open Circulatory System: It is a system where there is no vessel to contain the blood and it flows freely through the cavities of the body
- Closed Circulatory System: The blood is enclosed in the vessels in the heart while circulating



Notochord

- Derived from mesoderm
- Rod like structure
- Present in dorsal side (upper side or back side of an animal)
- Eg: Chordata

KINGDOM ANIMALIA

- Eukaryotic
- Multicellular
- Heterotrophic
- Cell wall absent
- Most of them are mobile

- Classified into phylums on the basis of extent and type of body design differentiation found

All Phylums (in order)

	TRICK
•Porifera •Coelenterate •Ctenophora	PC[2]
•Platyhelminthes •Nematoda/Aschelminthes •Annelida •Arthropoda	PA[3]
•Mollusca •Echinodermata •Chordata	MEC

Characteristics of Porifera

- They have holes called pores i.e. body is perforated — Pores lead to large body cavity called Spongocoel
- Have water canal system (pores se paani)
- Asymmetrical body
- Cellular level organization
- Two layer germ layers: Diploblastic
- Exclusively aquatic

- Non-motile animals
- They are hermaphrodite (male + female)
- Mainly found in marine habitat
- Some are freshwater animals

Ostium: water canal system (spaces)

Spongocoel

Ectoderm: cells outside the body

Endoderm: cells inside the body

Endoskeleton is present

- Other examples: Euplectella, Spongilla(Freshwater sponge), Scyon, Euspongia (bathing sponge)
  - (Glass sponge)

Characteristics of Ctenophora

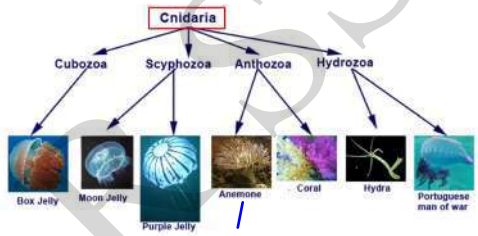
- Show bioluminescence
- Exclusively marine
- They are hermaphrodite
- They are also known as Sea Walnuts and Comb Jellies
- Radial symmetry
- Reproduction: Sexual reproduction
- Eg: Pleurobrachia and Ctenoplana

Characteristics of Coelenterata/Cnidaria

- Aquatic animals
- Body is soft
- Tissue level organisation
- Hard skeleton developed outside called Exoskeleton made of calcium carbonate
- Body made of two layers: Diploblastic
- Anus is absent
- Radial symmetry (divided in equal parts from anywhere)
- Central gastrovascular cavity is present

eg: Coral and hydra

- Mouth is present surrounded by tentacles
- Mostly marine some are freshwater animals (eg: Hydra)
- Stinging cells are present in Cnidoblast known as Nematocyst

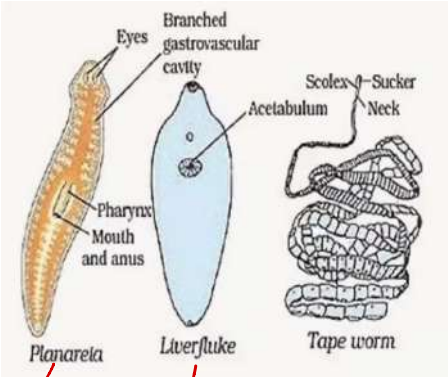


Sea anemone

Characteristics of Platyhelminthes

- They have dorsoventrally flattened body like a ribbon
- Bilateral symmetry
- Organ level organisation
- Triploblastic animals: three germ layers
- True internal cavity/coelom absent: Acoelomate

Body cavity



- They can be parasitic or free living

Free living Parasite

- Coelom have organs accommodated
- Either free, living or parasitic and terrestrial
- Suckers and hooks are usually present
- Hermaphrodite (Male+Female part present) animals
- Anus is absent
- They have FLAME CELLS for excretion and osmoregulation
- Incomplete digestive system (common opening for mouth and anus)

Characteristics of Nematodes/Aschelmithes

- Body is cylindrical
- Bilateral symmetry
- Triploblastic organisation
- Organ system organization
- No real organs present
- Pseudocoelom present — false cavity
- Alimentary is complete: mouth and anus (Different entry and exit point)
  eg: Elephantiasis (filarial worms)
  Worms in intestines (roundworms/pinworms)
- Sexes are separate
- Animals show sexual dimorphism
- Renette cells present
- Most forms are parasitic, but some are free living in soil/water
- Parasitic forms are pathogenic (causes disease)
- Eg: Ascaris, Wucheria, Ancyclostoma (hookworm)

Phylum Nematoda

Hermaphrodite: having both male and female part
Unisexual: either male or female part

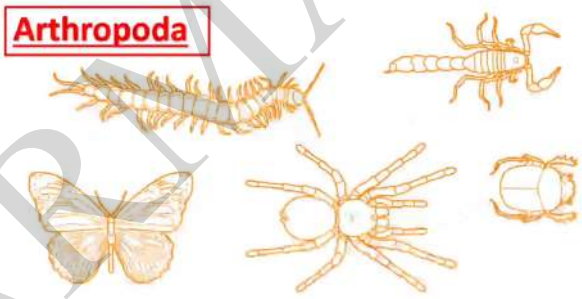
Characteristics of Annelida

- Bilaterally symmetrical
- Triploblastic
- Cylindrical/dorsoventrally flattened
- Brown colour skin is present
- True coelomate animal
- True organ packaged in coelom
- Organ system organization
- Body segmetation is present
- Reproduction: Sexually
- Locomotory organs paired, lateral appendages parapodia (Nereis)
- Alimentary canal is tube like extend from mouth to anus
- They are usually found in freshwater, marine water, land

- Nephridia: For osmoregulation and excretion

Characteristics of Arthropoda

- Largest phylum in animal kingdom ——— Insecta is the largest class
- They have jointed legs
- Bilateral symmetry
- Segmented body into head, thorax/cahals thorax, abdomen
- Open circulatory system (blood openly flows; not through a blood vessel)
- Coelom is present and is blood filled
- Triploblastic
- Respiration through gills, trachea
- Excreation through Malpighian Tubules
- Exoskeleton is made of chitin
- Unisexual
- Alimentary canal is complete
- Terrestrial/aquatic (fresh/marine animals)
- Sexes are separate

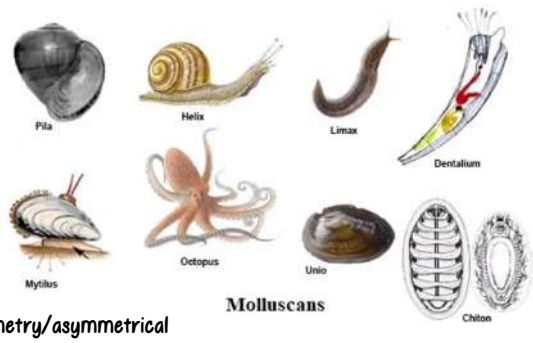


Devil fish: common name of octopus

Characteristics of Mollusca

↳ 2nd largest phylum

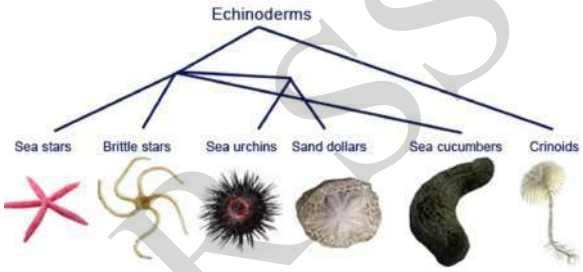
- Body is soft
- Exoskeleton is hard (snails)
- Little segmentation on body
- Open circulatory system
- Bilateral symmetry/asymmetrical



- Blue colour blood: Haemocyanin
- Alimentary canal is complete
- Kidney like organs for excretion is present
- Respiration through gills
- Unisexual
- Entire body covered in mantle (a fold of thin skin)
- Foot is for locomotion

- Cuttle fish belongs to phylum Mollusca

Characteristics of Echinodermata



- Spiny skinned organism
- Star shaped, spherical, elongated
- Radial symmetry
- Triploblastic
- Coelomic cavity is present
- No segmentation
- Organ system organization

Characteristics of Chordata

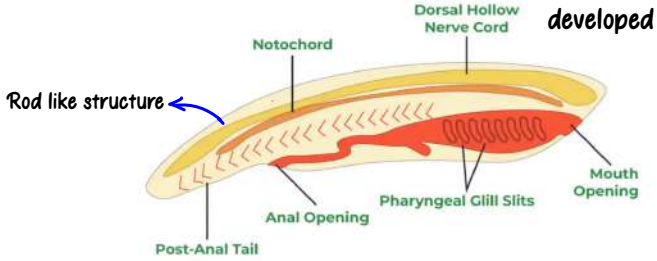
- They have notochord: rod like structure
- Paired gills slits in pharynx
- Bilateral
- Triploblastic
- Organ system level organisation
- Closed blood vascular system
- Heart is ventral
- Coelomate
  - Hemichordata → Invertebrates

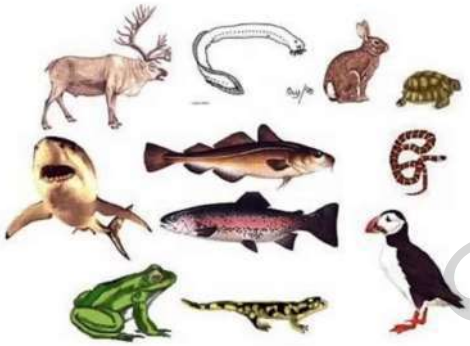
Types:

Notochord not developed properly — a) Protochordata

b) Vertebrata — Notochord properly developed

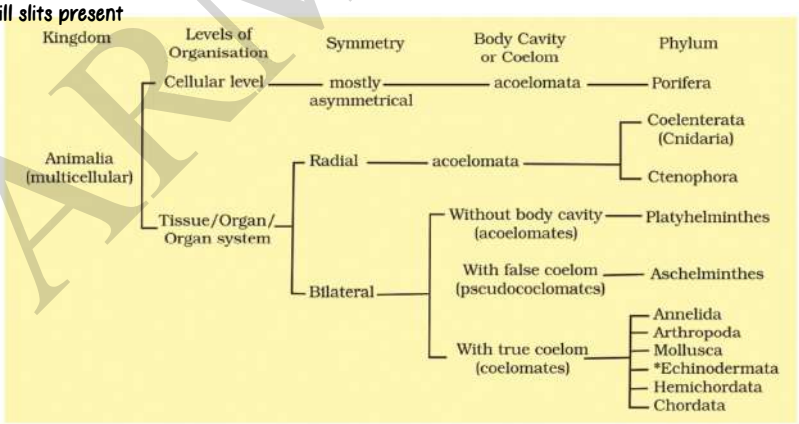
Basic structure of Chordates





Characteristics of Protochordata

- Do not have proper notochord present during all stages of life
- Bilaterally symmetrical
- Triploblastic
- Coelomate animals
- Nerve cord is present
- Pharyngeal gill slits present
- Post anal tail present



*Echinodermata exhibits radial or bilateral symmetry depending on the stage.

Figure 4.4 Broad classification of Kingdom Animalia based on common fundamental features

Phylum	Level of Organisation	Symmetry	Coelom	Segmentation	Digestive System	Circulatory System	Respiratory System	Distinctive Features
Porifera	Cellular	Various	Absent	Absent	Absent	Absent	Absent	Body with pores and canals in walls.
Coelenterata (Cnidaria)	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Cnidoblasts present.
Ctenophora	Tissue	Radial	Absent	Absent	Incomplete	Absent	Absent	Comb plates for locomotion.
Platyhelminthes	Organ & Organ-system	Bilateral	Absent	Absent	Incomplete	Absent	Absent	Flat body, suckers.
Aschelminthes	Organ-system	Bilateral	Pseudo coelomate	Absent	Complete	Absent	Absent	Often worm-shaped, elongated.
Annelida	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Absent	Body segmentation like rings.
Arthropoda	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Exoskeleton of cuticle, jointed appendages.
Mollusca	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	External skeleton of shell usually present.
Echinodermata	Organ-system	Radial	Coelomate	Absent	Complete	Present	Present	Water vascular system, radial symmetry.
Hemichordata	Organ-system	Bilateral	Coelomate	Absent	Complete	Present	Present	Worm-like with proboscis, collar and trunk.
Chordata	Organ-system	Bilateral	Coelomate	Present	Complete	Present	Present	Notochord, dorsal hollow nerve cord, gill slits with limbs or fins.

Characteristics of Vertebrates

Characteristics of Cyclostomata

- They are jawless vertebrates

eg: Petromyzon/Myxine, hog fishes, lamprey

Characteristics of Pieces

- They are fishes

eg: Dog fish, Shark, tuna

- Chambered heart: 2

Arthropoda

Crayfish

- Silverfish

Mammals

- Whale
- Dolphins

Characteristics of Amphibians

- They have mucous glands in skin for respiration
- They have 3 chambered heart → or through gills
  eg: Frogs, toads, salamander
- Cold blooded animals

Characteristics of Reptiles

- They have 3 chambered heart
- Exception: Crocodile 4 chambered heart
- Cold blooded animals
  eg: snake, turtle, lizard, crocodile

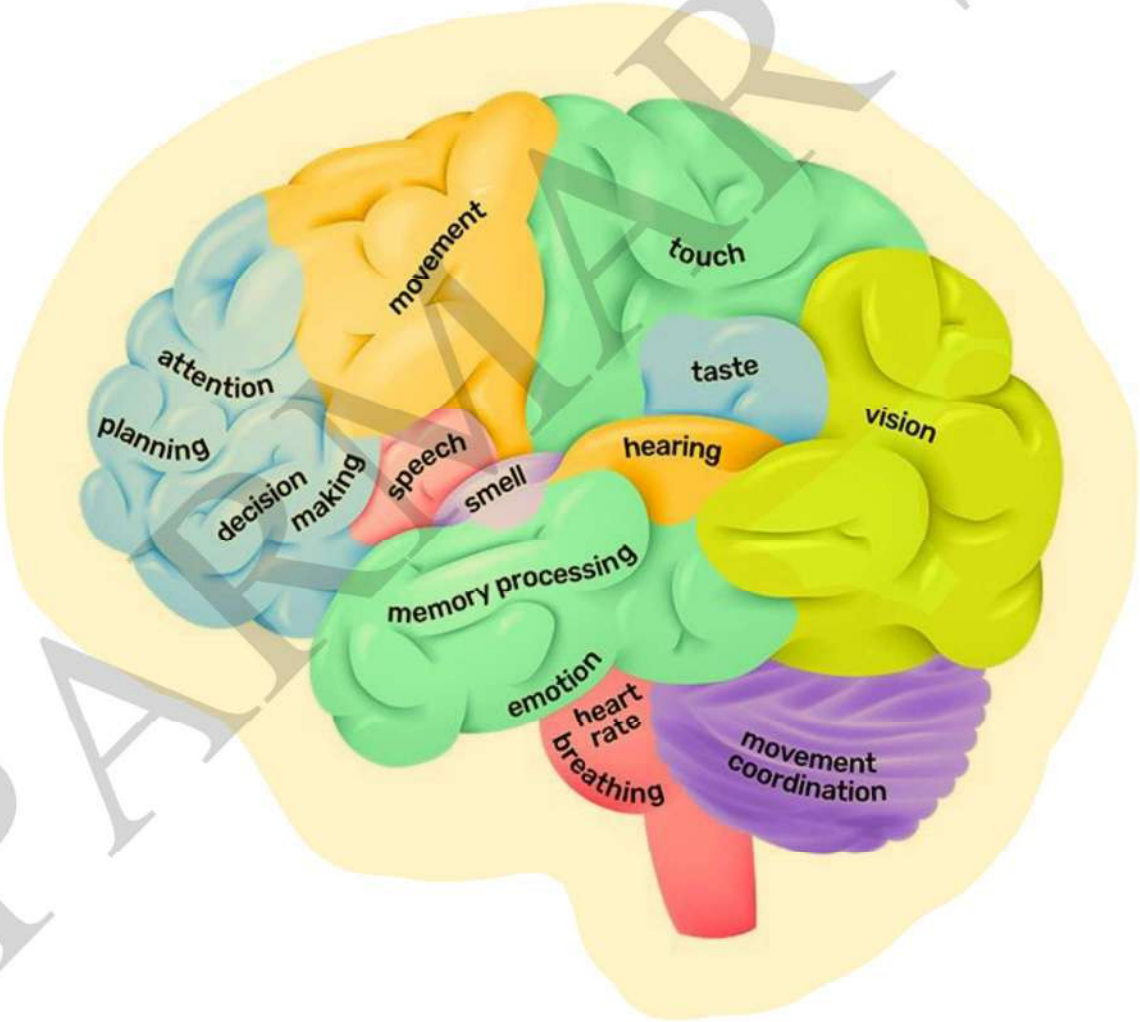
Characteristics of Aves

- They are warm blooded animals
- They have 4 chambered heart
- They lay eggs —— Oviparous

Characteristics of Mammalian

- They are warm blooded organism
- They have 4 chambered heart
- They have mammary glands ——— Viviparous
- Exception: Mammals but lay eggs eg: Platypus and echidnas

BRAIN



Nervous System

Central Nervous System

(1) Brain

(2) Spinal Cord

Peripheral Nervous System

(1) Nerves

Weight of brain

- Male: 1370 gm
- Female: 1300 gm

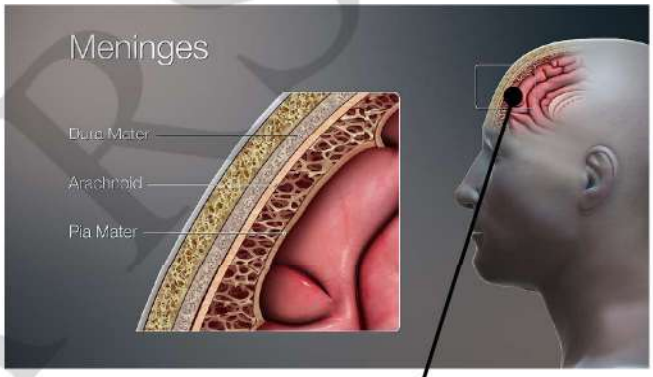
Central Nervous System (CNS)

- The brain is the central information, processing organ of our body, and acts as the "command and control system"

It controls:-

- Voluntary movements
- Balance of the body
- Functioning of vital involuntary organs (lungs, heart, kidneys, etc.)
- Thermoregulation
- Hunger and thirst
- Circadian rhythm etc.

- The human brain is well protected by skull



Meninges

- Pain receptors are present in meninges

Inside of the skull, brain is covered by: Cranial Meninges

Consists of:-

- **Dura Mater:** Outer layer
- **Arachnoid:** A very thin middle layer
- **Pia Mater:** Inner layer (which is in contact with the brain tissue)

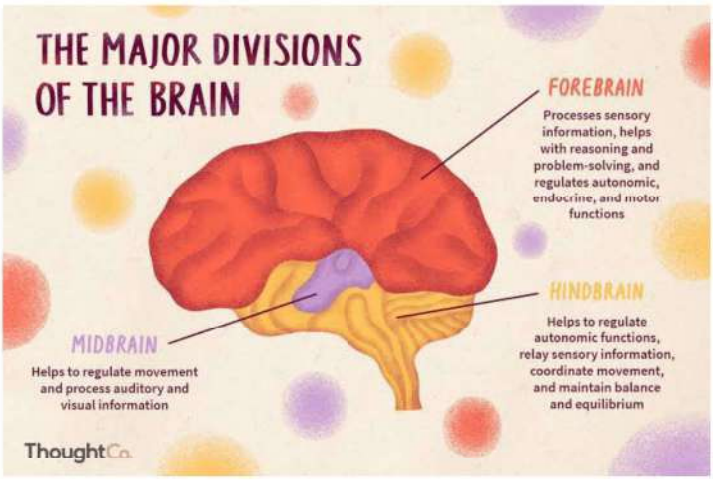
- Our brain demands half of sugar energy

- The adult brain accounts for mere of 2% of body weight but comsumes:-
  - 20%: O_2
  - 20-25%: Glucose

- Total no. of bones in skull: 22
  - 14: Facial bone
  - 8: Cranial bone

- **The Human brain can be divided into three major parts:-**

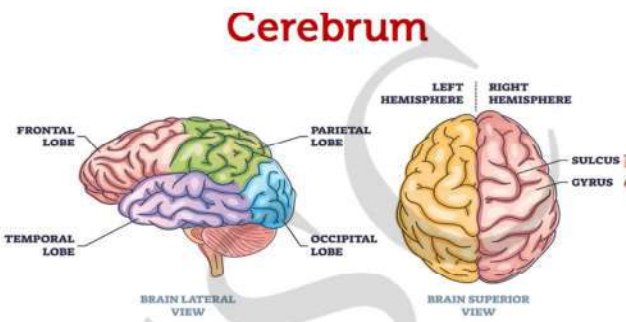
1. Fore Brain
2. Mid Brain
3. Hind Brain



→ Fore Brain

Functions:-

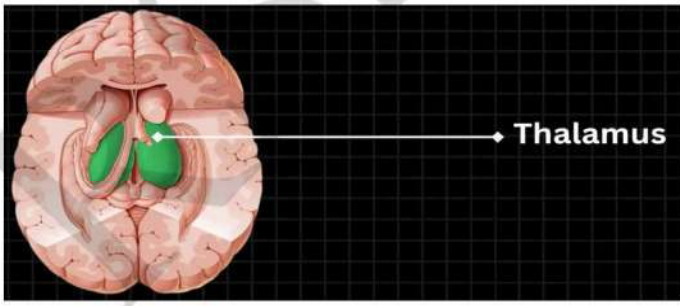
- Controls voluntary action
- Associated with hunger, memory, pain



Parts:-

(1) Cerebrum

- Largest part of brain
- The hemisphere of cerebrum are connected by tract of nerve fibres called as Corpus Callosum
- The layer of cell, which covers the cerebral hemisphere is called cerebral cortex (referred to as grey matter due to its greyish appearance)
- Cerebrum is responsible for memory, learning



(2) Thalamus (Pain and Sensation)

- Major coordinating centre for sensory and motor signalling
- Thalamus works as a "Relay Station" (takes information from body and sends it further to cerebral cortex)
  Body senses ⟶ Thalamus ⟶ Cerebral cortex
- Touch, taste, sound ⟶ these senses are processed by Thalamus to Cerebral Cortex

(3) Hypothalamus

- Lies at the base of thalamus
- Contains number of centres which control body temperature, urge for eating and drinking
- Contains several groups of neuro secretary cells, which secretes hormone called hypothalamic hormones

→ Mid Brain

- Located between Hypothalamus of forebrain and pons of hindbrain
- It is involved in several functions such as: motor control, particularly eye movements and processing of vision and hearing

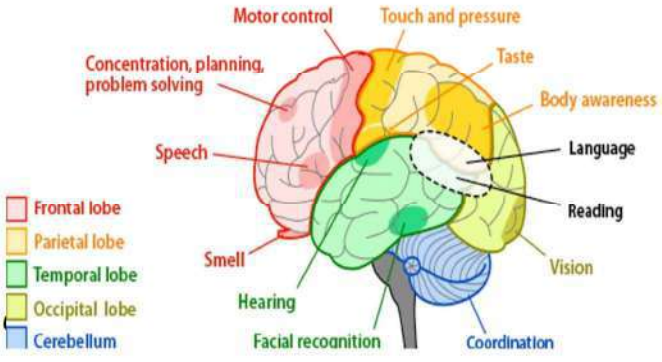
→ Hind Brain

Consists of:-

(1) Pons: Middle portion of the brain that coordinates face and eye movements, facial sensations, hearing and balance

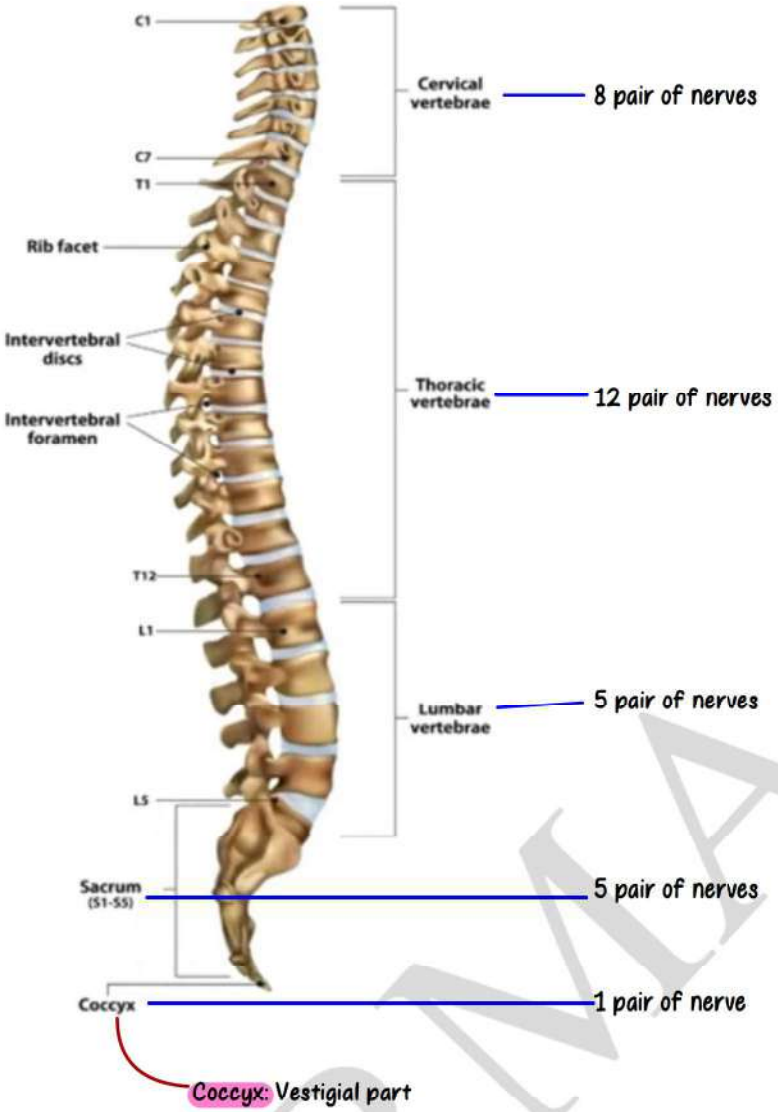
(2) Cerebellum: Maintains body posture and balance, also known as "little brain"

(3) Medulla Oblongata: It is connected to the spinal cord. The medulla c centres which control respiration, heartbeat, and gastric secretions



Spinal Cord

Total spinal nerves pairs: 31



Coccyx: Vestigial part

- It refers to the parts of nervous system outside the brain and spinal cord

Peripheral Nervous System

(1) Somatic Nervous System

- Voluntary

Types:-

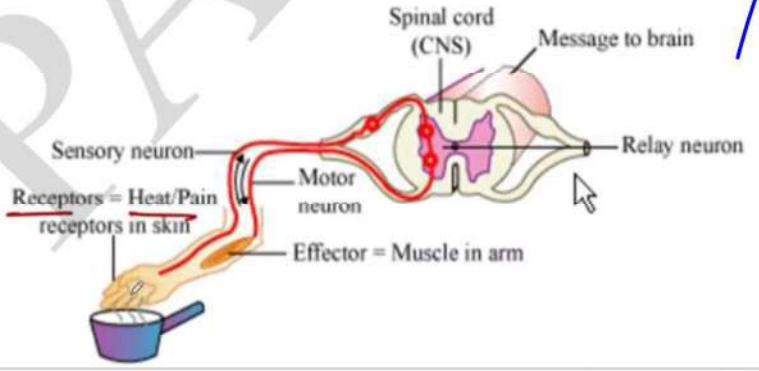
Sensory Nervous System: carry information from body organs to CNS

- Also known as Afferent nerves

Motor Nervous System: carry information from CNS to body organs

- Also known as Efferent nerves

- Pathway of PNS



Pathway transmits sensory information, such as pain, pressure, temperature, etc. through receptors (pain receptors, etc.)

↓

Travels through Sensory neurons

↓

Information carried to CNS → Brain

↓

Relay neurons

↓

Motor neurons

(2) Autonomic Nervous System

- Involuntary

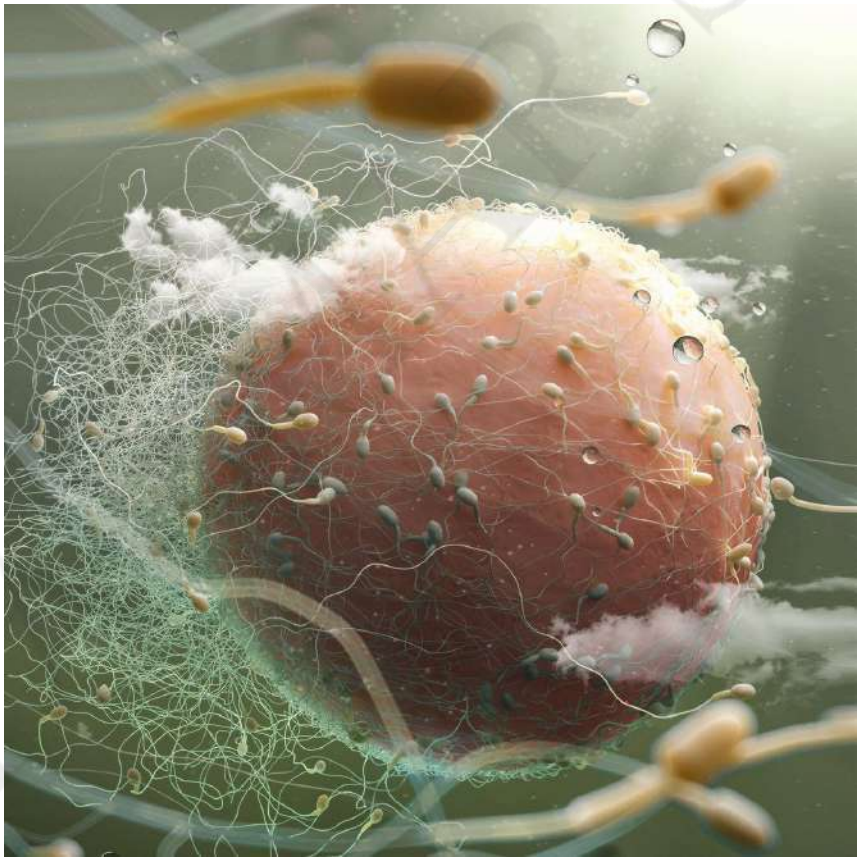
Types:-

- Sympathetic Nervous System: Controls body's "Flight-or-Fight" response — Help you in times of need, such as danger or stress
- Parasympathetic Nervous System: Controls body's "Rest and Digest" response — it relaxes the body's system and return them to normal

Diseases in Brain

- Meningitis
- Cerebrum ⟶ Alzheimer's: Degenerative brain disorder that leads to dementia (loss of memory)
    - Amnesia: Inability to remember events for a period of time, often due to brain injury or illness

REPRODUCTION



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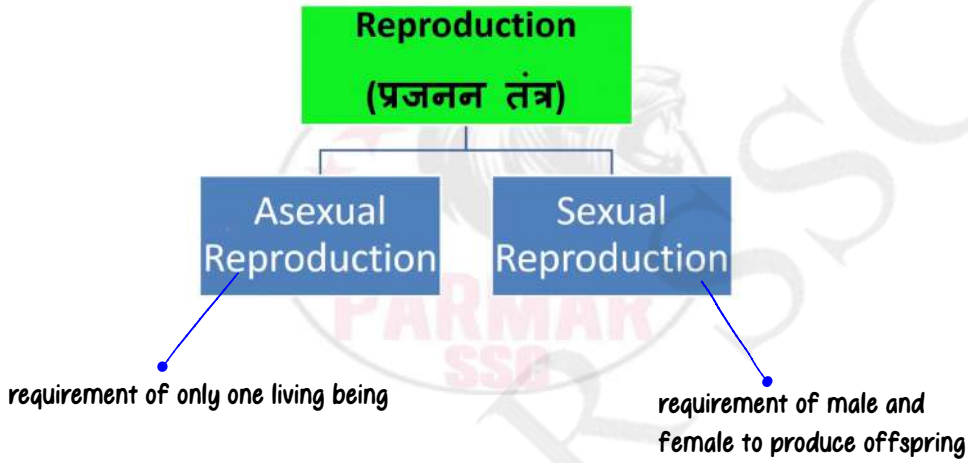


REPRODUCTION

- It is a method by which offsprings are produced by the living beings
- Reproduction is not a necessary instinct for survival of a living being

Asexual Reproduction	Sexual Reproduction
• Only one parent plant is involved • Occurs in unisexual plants • Occurs in lower plants • Genetic similarity is commonly seen here • Reproductive organs are not present	• Both male and female parents are involved • Occurs in bisexual plants • Occur in higher plants • Genetic diversity is commonly seen here • Fully developed reproductive parts are present

MODES OF ASEXUAL REPRODUCTION

(a) Binary Fission
(b) Multiple Fission
(c) Fragmentation
(d) Budding
(e) Spore Formation
(f) Regeneration
(g) Vegetative Propagation

ASEXUAL REPRODUCTION

TYPES OF ASEXUAL REPRODUCTION

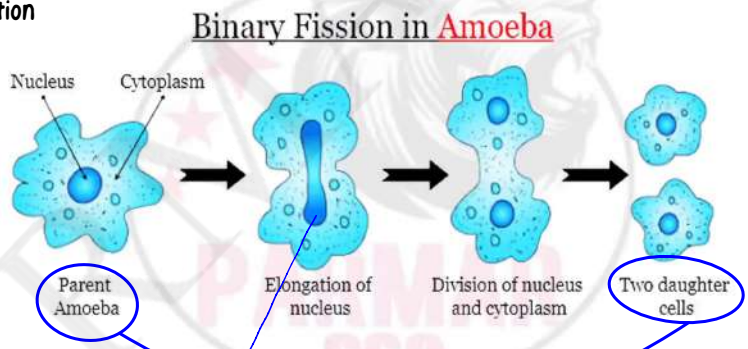
a) BINARY FISSION

- It is a process of reproduction in which a unicellular organism divides into two organisms
- Only for unicellular organisms

Protozoa that causes Kala Azar disease

reproduction on basis of particular orientation

any orientation



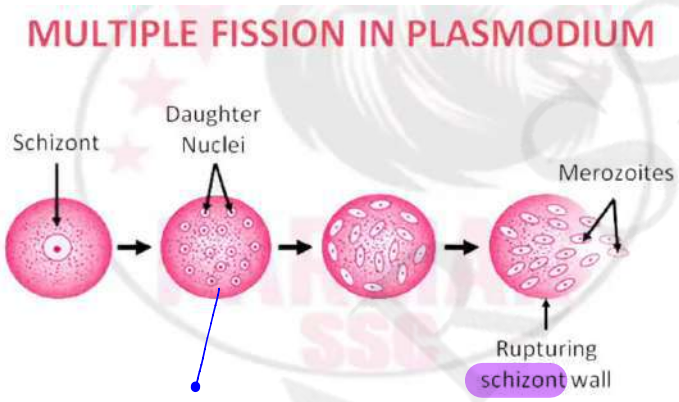
Bi: meaning two

Nucleus inside spreading to divide

Malaria causing protozoa

b) MULTIPLE FISSION

- It will develop many offsprings
- It happens in unicellular organisms: Malarial Parasite — Plasmodium

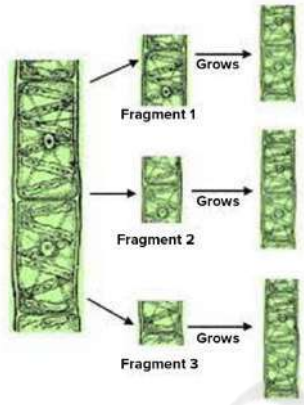


green algae

c) FRAGMENTATION

- it is used by simple multicellular organisms like spirogyra and sea anemone

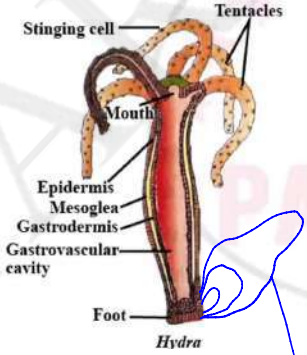
- Red algae mode of reproduction: Fragmentation



Breaks into half, which is not fully develop that later develops into complete spirogyra

d) BUDDING

- It is a process used by simple multicellular organisms like hydra and yeast



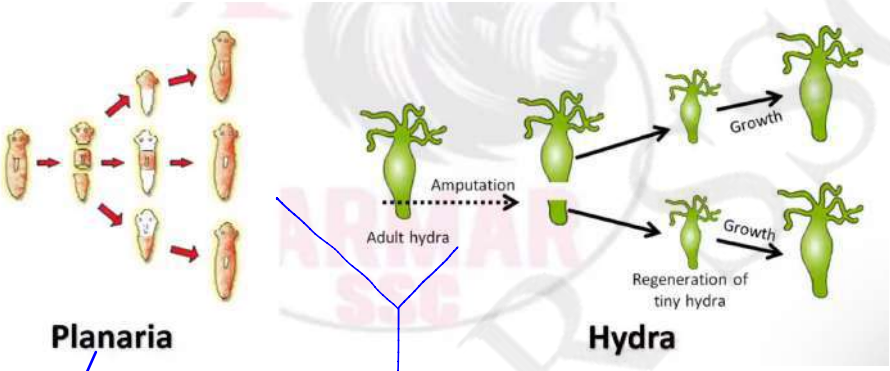
Develops buds to form complete hydra

e) REGENERATION

not exactly a method of reproduction

- It occurs in simple multicellular organisms like planaria and hydra, rhizopus

Bread mould



Phylum: Platyhelminthes
Eg: Tapeworms, flatworms

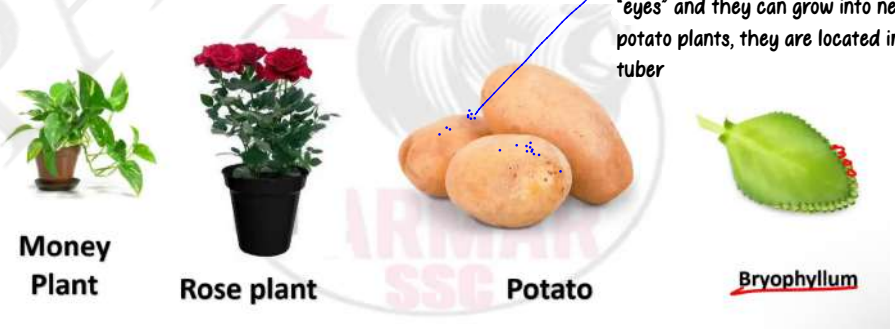
- They are free living

organisms repairs or regenerates the missing part of the body and form a complete organism again

f) VEGETATIVE PROPAGATION

- It is a type of reproduction where new plants grow from a fragment or cutting of parent plants

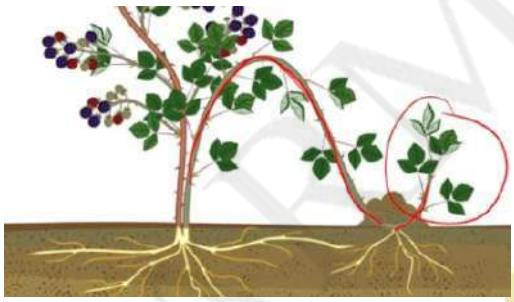
The buds on a potato are called "eyes" and they can grow into new potato plants, they are located in the tuber



VEGETATIVE PROPAGATION IN BRYOPHYLLUM

→Why is vegetative propagation done?

- To save time
- To get varieties of plants of same or different type



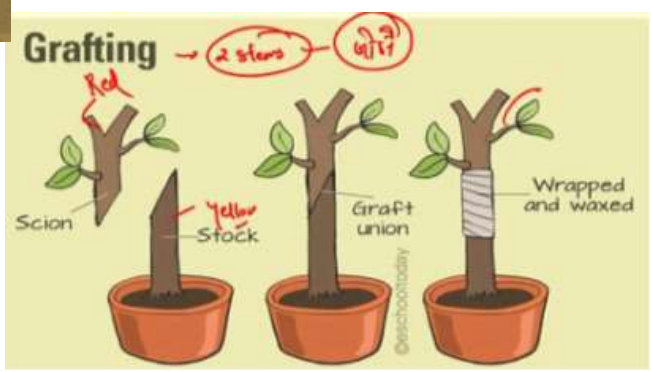
eg: in a barren land when it rains, grass grows as stems are present on the ground

TYPES

i) CUTTING: a part of plant (stem or leaf) is cut and planted into soil
eg: rose plant, money plant, sugarcane plant, banana plant

ii) LAYERING: the stem of the plant is bent to the ground and covered with soil
eg: Lemon, strawberry

iii) GRAFTING: cutting from some other plant attached to the stem of a plant and planted to soil
eg: Rose plant



g) TISSUE CULTURE

- Scientific artificial vegetative propagation is known as tissue culture
- Tissue from different parts of plant are cultured in chemicals in laboratory to develop into a new plant

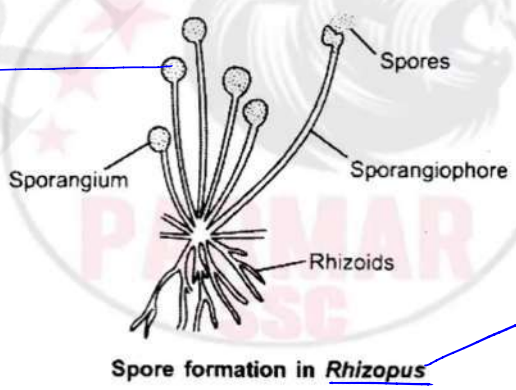
Ornamental Plants

- used in ornamental plants
  eg: Snake plant
- Cost of selling such plant is very high

h) SPORE FORMATION

- It occurs in simple multicellular organisms like rhizopus

Bob and stick like structures that releases spores and these spores further reproduces to rhizopus



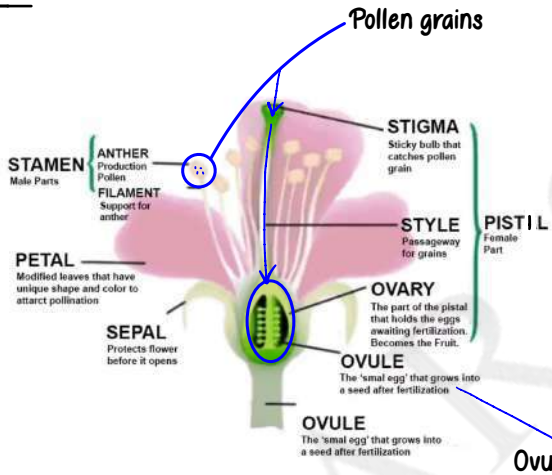
Spore formation in *Rhizopus*

- bread mould

- green colour fungus on bread: rhizopus

SEXUAL REPRODUCTION

PLANTS



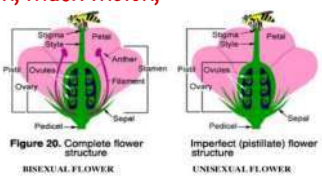
Pollen + Ovary → Zygote → Embryo → Seed

- **Reproductive organ in plants:** Flower

Two types of flower

- Male + Female part in same plant: Bisexual/Monoecious - eg: Hibiscus, sunflower, rose, lily, tulip, tomato, chilli, petunia
- Only Male or Female part: Unisexual — eg: Papaya, cucumber, watermelon, musk melon, bitter gourd

Both the male and the female unisexual flowers may be present in the same plant or in different plants



Male part has:

- **Filament:** supports anther
- **Anther:** produces pollen (Yellow colour)

collectively called STAMEN

collectively called PISTIL

Female part has:

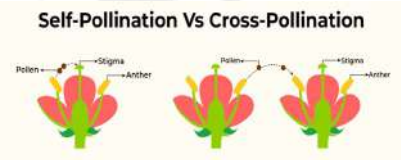
- **Stigma:** sticky bulb that catches pollen
- **Style:** passageway for pollen
- **Ovary:** the part of pistil that holds the eggs awaiting fertilisation. Becomes the fruit

The transfer of pollen from anther to stigma of a flower is called as pollination

Pollination: pollen grains reach stigma through

- Wind → Anemophily
  - Insects visit flowers and carry away pollen on their bodies
- Water → Hydrophily
- Insect → Entomophily

(a) **Self-pollination**: When the pollen lands on stigma of same flower
(b) **Cross-pollination**: When the pollen of a flower lands on stigma of another flower of same plant or that of a different plant of same kind



REPRODUCTION IN HUMANS

Male sex cells → Male gamete → Sperm

Female sex cells → Ovum

Sperm + Ovum → Zygote → Embryo → Child

FALSE FRUIT

- A fruit that develops from other parts of a flower, in addition to ovary, and does not require fertilisation
- Thallus is also involved
- Eg: Apple, cashew nut

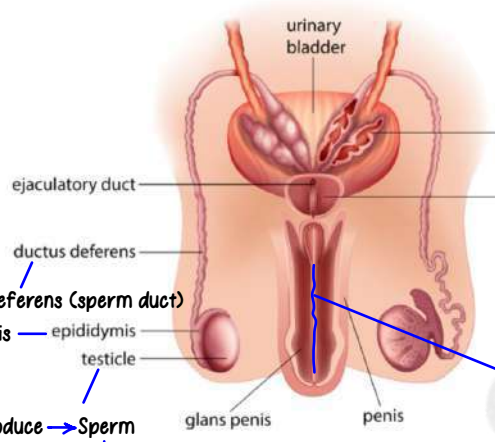
PARTHENOCARPIC FRUIT

- Seedless fruit, that develops without fertilisation of the ovule
- Eg: Banana, grape, cucumber

DRUPE FRUIT

It is a type of fruit with a hard shell that includes a seed and has

- an inner flesh
- Eg: Coconut



Seminal fluid (semen)

Vas deferens (sperm duct)

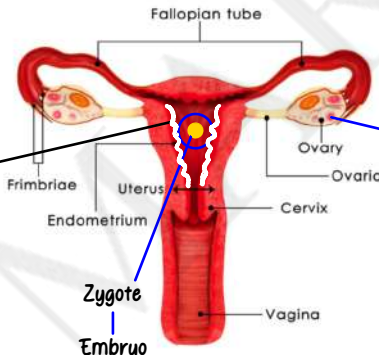
Layer of testis

Urethra

Produce → Sperm

Sperm production in males typically begins around the age of 10–12 years old

MALE REPRODUCTIVE ORGAN



Thickening of uterine wall for preparation for potential implantation of fertilised egg during pregnancy. When pregnancy does not occur after the uterine lining thickens, the lining is shed through mensuration

Ovules

A female is born with ovules (eggs) present in her ovaries, meaning they are present from birth

At the age of 12, the ovaries start to mature

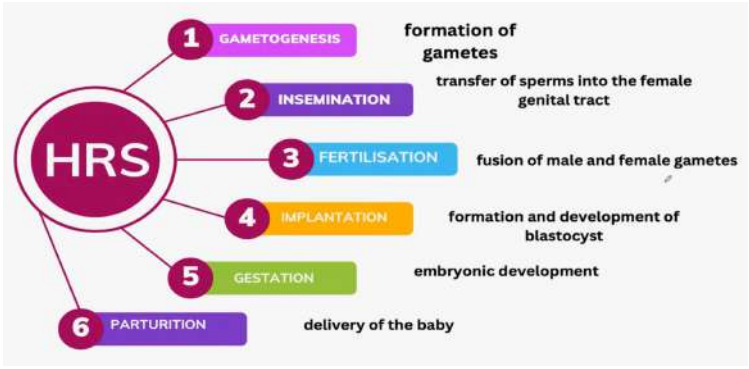
Zygote

Embryo

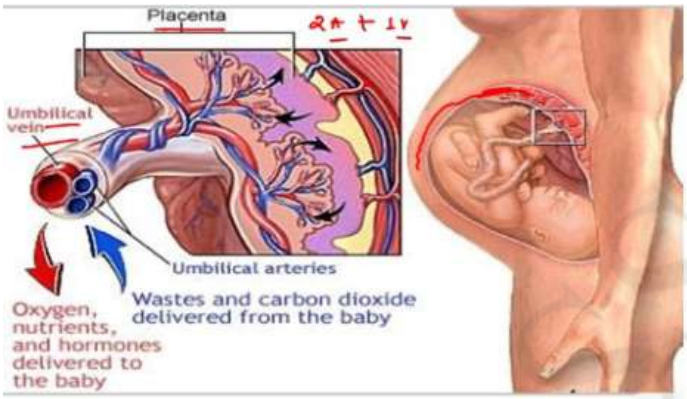
Fetus (Body parts visible)

FEMALE REPRODUCTIVE ORGAN

HUMAN REPRODUCTIVE SYSTEM



- Cervical cancer is caused by: HPV virus (Human Papilloma Virus)



ROLE OF ARTERY AND VEINS IN PREGNANCY

- **Artery:** Deoxygenated blood/waste
  - Fetus → Placenta
- **Veins:** Oxygenated blood/nutrition
  - Placenta → Fetus

- **IVF (In Vitro Fertilisation):** An egg is combined with a sperm in vitro (outside of mother's body in a lab) and later the embryo is transferred to the uterus of the mother

Types of Fertilisation

(a) **Internal Fertilisation:** The process of a sperm cell and an egg cell fusing inside the female body during reproduction
- **Eg:** In humans

(b) **External Fertilisation:** A reproductive process where a male sperm fertilises a female's egg outside of the female's body
- **Eg:** Frog, earthworms, crab

- **Parthenogenesis:** A type of asexual reproduction, where an organism develops from an unfertilised egg, without the need for sperm —— The unfertilised egg completely develops into a new organism
- **Eg:** Honey bees, Lizards

LIFE PROCESS

DIGESTION+RESPIRATION

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4 components of Life Process:

- Digestion
- Respiration
- Circulation
- Excretion

DIGESTIVE SYSTEM

Mouth (Buccal Cavity)

Releases Salivary Amylase (enzyme)

releases bile juice, it is stored in gall bladder

Food pipe (Length: 25 cm)

Food directly goes to stomach

in stomach HCL is released

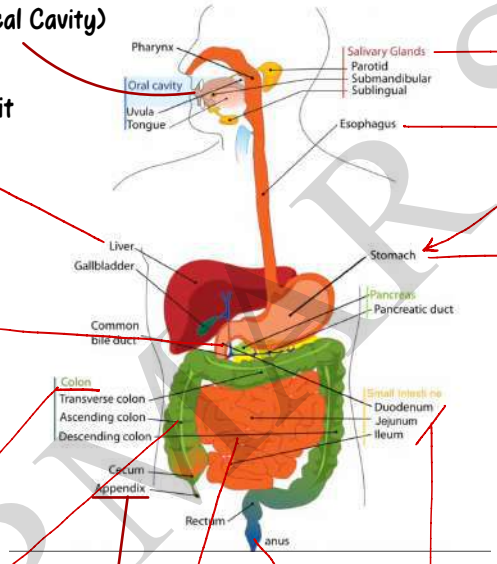
Gastric juice, medium is Acidic

pH value: 1.6

highly acidic

Sphincter muscles

Allows food to pass into small intestine



Vestigial

Food excretion

Large intestine

small intestine

jejunum and ileum is inside and duodenum is outside

Longest part of large intestine

Complete digestion

finger-like projections: Villi (provides surface area for food absorption) — Site for major digestion

→ Salivary Amylase: breaks complex carbohydrates to simple carbohydrates

Stomach —
1. HCl: kills harmful bacteria; medium — Acidic
2. Pepsin: breaks protein → Amino acids (20 Amino acids)

HCl is present in gastric juice → pH: 1.6

- Mucus membrane: protects inner delicate lining of stomach from gastric juice

- **Sphincter muscle**: it allows food to pass from stomach to small intestine

- **Small intestine**: 7–8 m length, longest part of alimentary canal
  - **3 parts**: Duodenum, Jejunum, Ileum
  - Major part of digestion occur here

- **Bile juice** functions
  - Stored in Gall Bladder
  - Secreted by liver
  - Small intestine: basic/alkanine
  - Fat globules (large) → Smaller fat globules

- **Pancreatic juice** (secreted by Pancreas)
  - Second largest gland
  - **amylase**: breaks carbs
  - **lipase**: fats → fatty acid
  - **trypsin**: proteins → amino acid
    - Works in basic medium provides by bile juice

- **Large Intestine**: 1.5 m length
  - **Cecum** is the first part of the large intestine, and it connects the small intestine to the colon
  - **Colon**: Responsible for absorbing water from indigestible food residues

- **Maltase**: in salivary gland and small intestine

$$\text{Maltose} \xrightarrow[\text{enzyme}]{\text{Maltase}} \text{Glucose}$$

- **Alimentary Canal:** the whole passage along which food passes through

Liver and pancreas are not its part

Mouth
↓
Oesophagus
↓
Stomach
↓
Small intestine
↓
Large intestine
↓
Rectum
↓
Anus

Roughage found in
- Fibre — Promotes peristalsis
- Green leafy vegetables: Fruits

Liver (Study of liver: Hepatology) — Cells stores: Glycogen

- Liver converts glucose into glycogen and amino acids into proteins
- It is of dark red brown colour
- **Position:** right of abdomen side
- **Kupffer cells:** star shaped phagocytic cells in the lining of liver sinusoids (They are involved in breakdown of RBCs) — Kupffer cells have ability to regenerate
- It is the largest gland
- **Hepatocytes:** They are the major parenchymal cells of the liver responsible for various cellular functions

Villi

- The finger-like projections in small intestine
- They help in increase of surface area for food absorption

Respiration

- It is a biochemical process of enzyme, including oxidative breakdown of organic compounds inside living cells, releasing energy in the form of ATP

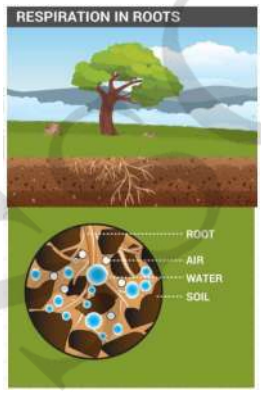
Breathing

- The process of taking O_2 and releasing of CO_2

Respiration in Plats

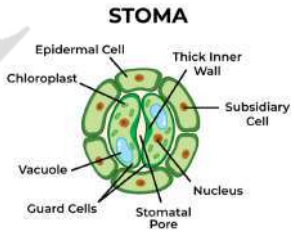
By Roots

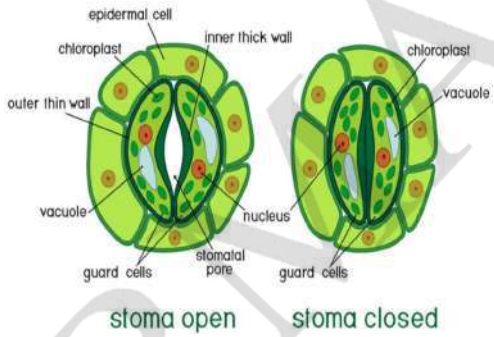
- Air occurs in soil interspaces
- Root hairs as well as Epiblema cells of the young roots are in contact with them
- Oxygen from the soil air diffuses through root



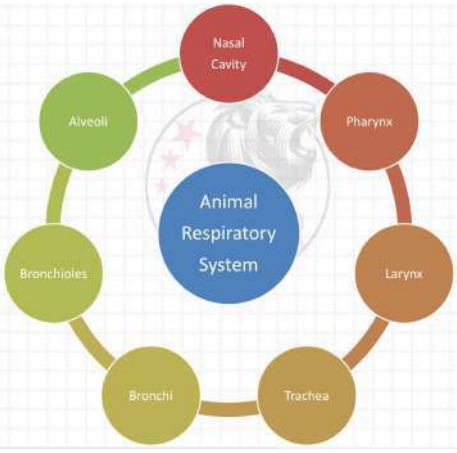
By Leaves

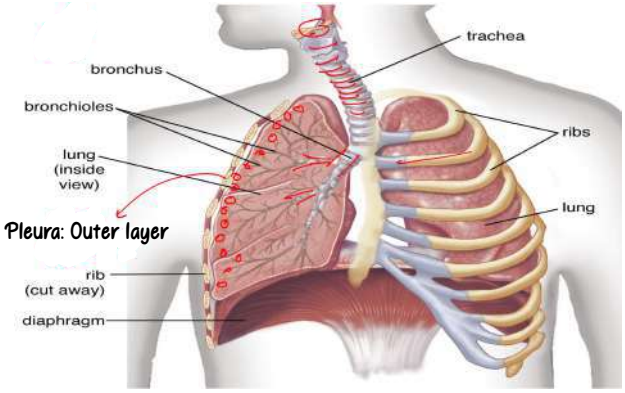
- Leaves and young stems are suited to quick exchange of gases
- Stems are covered by impermeable Epidermis to prevent loss of water
- Epidermis of leaves contain Pores called STOMATA, bordered by Guard Cells

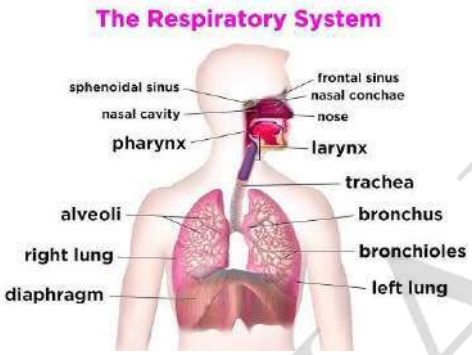


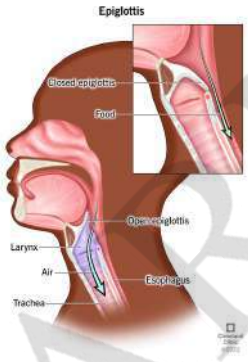


Respiration in Animals









- **Epiglottis:** It protects our airway and prevents food and liquid from entering our lungs while we swallow

Mechanism of Respiration

Inhalation

↓

Nose

Hair: Traps the dust particles present in the inhaled air by allowing only filtered air to enter the body

Mucus: Moistens the air and traps dust particles and kills the bacteria

↓

Pharynx

Common passage for food and air

↓

Larynx

It is also known as voice box (Adam's Apple)

↓

Trachea

It is surrounded by rings of cartilage so that the trachea does not collapse during inhalation

Inhale	Exhale
• During inhalation, lungs expand or inflate	• During exhalation, the lungs contract
• Rib cage → Up	• Rib cage → Down
• Diaphragm → Down	• Diaphragm → Up
• N_2: 78%	• N_2: 78%
• O_2: 21%	• O_2: 16%
• CO_2: 0.036%	• CO_2: 4.4%

Alveoli

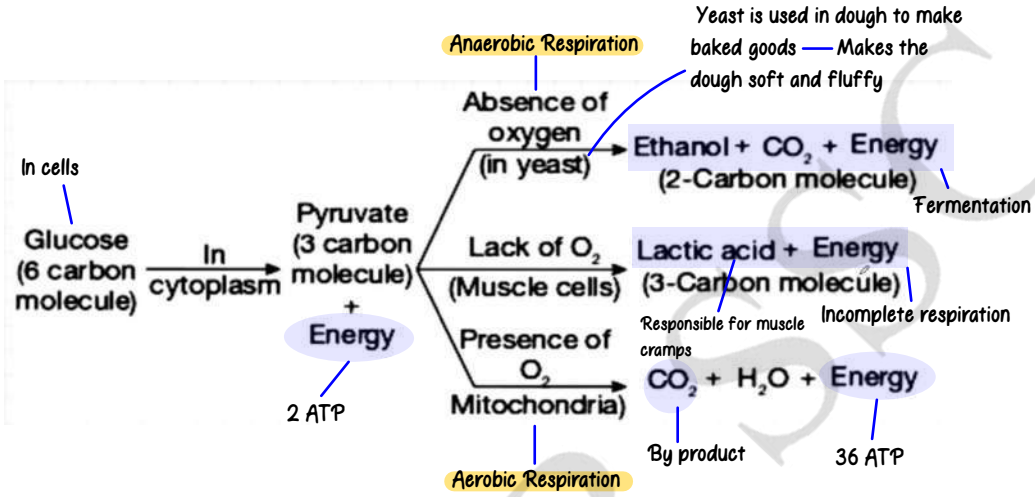
- They are tiny air sacs at the end of the bronchioles
- They allow for exchange of O_2 and CO_2 between the lungs and blood

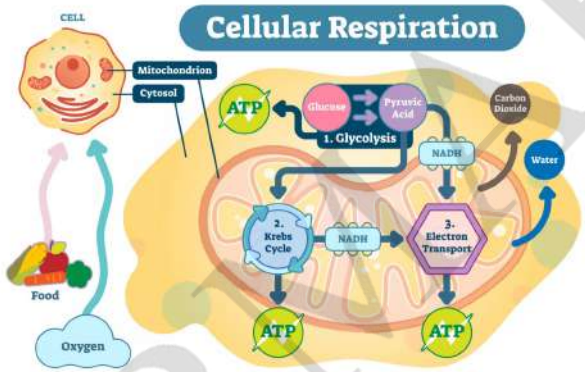
Causes diffusion

Alveoli → O_2 (High conc. → Low conc.) → Travels to → Blood → Cell → Energy → Organelles → Mitochondria

- Respiration centre is in Medulla Oblongata

Aerobic Respiration vs Anaerobic Respiration

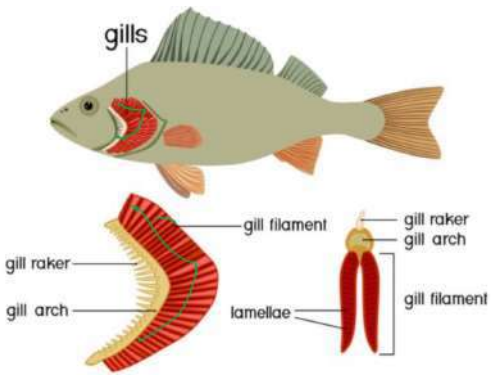




→ Nicotinamide adenine dinucleotide (NADH) is a coenzyme that plays a vital role in cellular respiration by transporting electrons to the Electron Transport Chain

Respiration in Various Organisms

→ Respiration in insects through: Trachea
→ Respiration in fish through: Gills
→ Respiration in amphibians
- Frogs
  - Land: Lungs
  - Water: Skin
- Toads respire through: Gills



CIRCULATION AND EXCRETION

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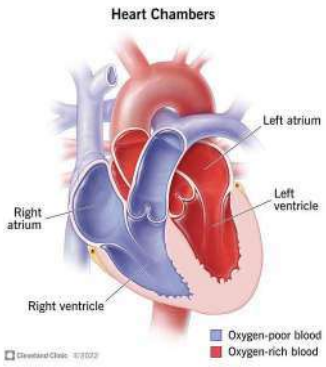
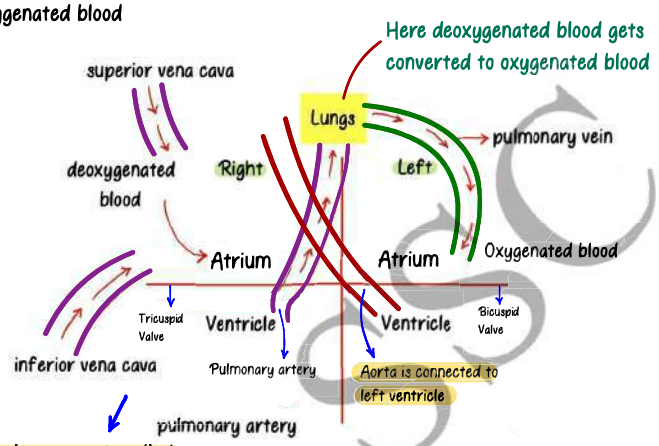
Human Heart

- Four chambers: Two (left and right) atria, and two ventricles (left and right)
- Human heart is a pumping organ —— Pumps oxygenated blood





This whole process is called double circulation

Very thick

- Artery: Carry blood from heart to different body parts
- Oxygenated blood carried by: Artery
- Deoxygenated blood carried by: Vein

Vena cava comprises of:-

- Superior vena cava
- Inferior vena cava

} Veins carry deoxygenated blood from different body parts to heart (right atrium)

- Aorta is the largest artery
- Vena cava (inferior vena cava) is the largest vein

Few Exceptions:-

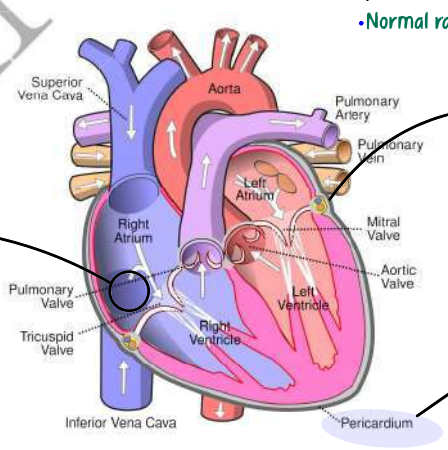
- Pulmonary Artery: Carries deoxygenated blood (right ventricle to lungs)
- Pulmonary vein: Carries oxygenated blood (lungs to left atrium)

- Systole: The heart contracts and pumps blood out of the body (120 mm of Hg)
- Diastole: The heart relaxes and fill with blood to prepare for the next beat (80 mm of Hg)

Pulse Rate

- The number of times, your heart beats per minute
- Normal range: 60–100 beats per minute

A pacemaker is a small, battery-powered device that prevents the heart from beating too slowly which is placed inside the heart through surgery



Coronary Artery
The main blood vessel that supply oxygen rich blood to heart muscles

Sinoatrial Node
Acts as heart's pace maker, generating electrical signals that causes heart's upper chamber to contract

Outer membrane of heart

Sphygmomanometer: It is used to measure blood pressure

Double Circulation

The passage of same blood twice through heart in order to complete one cycle

Example

(i) The blood pumped by the right ventricle (deoxygenated blood) is transported through pulmonary artery to lungs where CO_2 is exchanged with O_2 through diffusion and returns back to the heart through pulmonary vein

(ii) The oxygenated blood from left ventricle is transported through aorta to different body parts (cells and tissues) where O_2 is exchanged with CO_2 through diffusion and then returned back to the heart through vena-cava

Some Basic Pointers

Blood

- A special connective tissue consists of fluid matrix, plasma, and formed elements

Plasma

- The liquid part of blood or lymph, which is straw coloured, viscous fluid, and contains about 90-92% of water and 6-8% proteins

Lymph

- A clear yellowish, slightly alkaline, coagulable fluid, containing white blood cells in a liquid resembling blood plasma

Heart Beat

- The rhythmic contraction and relaxation of the heart, which includes one systole (contraction phase) and one diastole (relaxation phase) of the heart. Heartbeat count of healthy person is 72 times per minute

Sound of Heart

- Lub-Dub
- Lub: The sound of mitral and tricuspid valves closing
- Dub: The sound of aortic and pulmonary valves closing

Cardiac Output

- The amount of blood pumped by heart per minute is called cardiac or heart output. The value of cardiac output of a normal person is about 72 x 70 = 5,040 mL or about 5L/min

Electrocardiograph (ECG)

- ECG machine is used to record electrocardiogram

Erythrocytes or Red Blood Cells

Structure:-

- Red colour, circular, biconcave, denucleated, elastic, lack of cell organelles, like ER, ribosomes, mitochondria, etc.
- 4.5-5.5 m^{-3} of blood

Lifespan and Formation:-

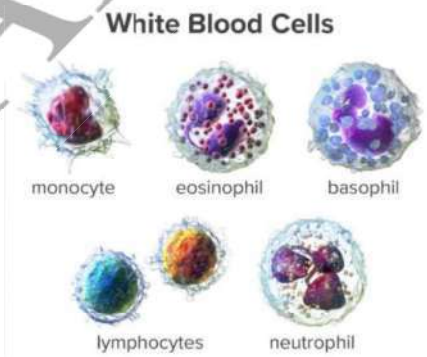
- Present from birth onwards by bone marrow
- Life: 120 days

Function:-

- Transport of O_2 and some amount of CO_2

Leukocytes or White Blood Cells

- 5000-10,000 m^{-3} of blood



(1) Monocytes

- 2-10%
- Largest of all bean shaped nucleus
- Formed in Bone Marrow having life span of 10-20 hours
- Function: Phagocytic, engulf germs

(2) Eosinophils

- 1-6%
- Bilobed nucleus, having granules in cytoplasm
- Found in the bone marrow having lifespan of 4-8 hours in blood
- Function: Immunity, non-phagocytic

(3) Basophils

- 0-1%
- Three lobed nucleus
- Found in the bone marrow having lifespan of 4-8 hours in blood
- Function: Release heparin and histamine

(4) Lymphocytes

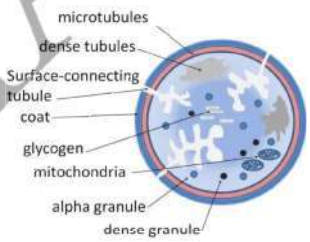
- 20-40%
- Large Rounded nucleus, having Lymph nodes, spleen thymus
- Found in Bone Marrow
- Life span: Few days to Months to year
- Function: Non-phagocytic
- Secrete: Antibodies

(5) Neutrophils

- 40-75%
- Many lobed Nucleus having fine granules
- Found in Bone Marrow
- life span: 4-8 hours
- Function: Phagocytic, engulf germs

Platelets or Thrombocytes

- 1,50,000-4,50,000 m^{-3} of blood
- Colourless, rounded or oval
- Non Nucleated fragments of cell
- Formed in Bone marrow having life span of a week
- Function: Helps in blood clotting

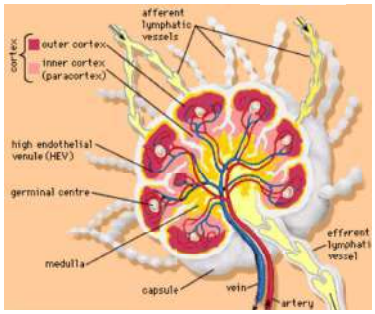


Lymph

- The colourless mobile fluid connective tissue drains into the lymphatic capillaries from the intercellular spaces
- Composition: It is composed of fluid matrix, plasma, white blood corpuscles or leukocytes

Functions:-

(i) It drains excess tissue fluid from extra celluar spaces back into the blood
(ii) It contain lymphocytes and antibodies
(iii) It transport digested fats



Blood Group

- **Discovery**: Karl Landsteiner
- **Universal donor**: O−
- **Universal acceptor**: AB+

- Bombay Blood Group: Discovered by Y. M. Bhende (1952)

Given B+ blood

A+ B+

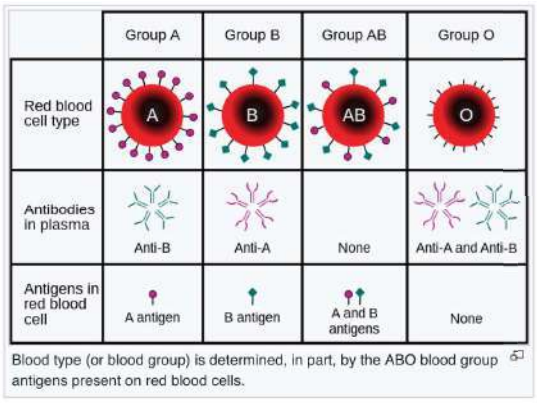
can die due to blood coagulation

Rh is derived from the use of blood of rhesus monkeys in the basic test for determining the presence of Rh antigen in human blood

- Rh factor is a protein on the surface of RBCs
- Rh+ – Protein present
- Rh− – Protein not present

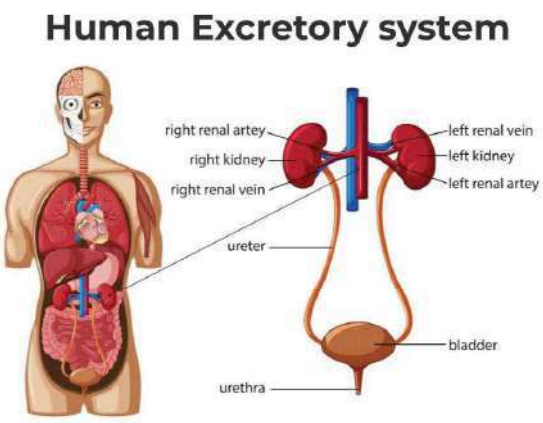
Blood Type Compatibility

Blood Type	Gives	Receives
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	Everyone
A-	A+, A-, AB+, AB-	A-, O-
O-	Everyone	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-



Blood type (or blood group) is determined, in part, by the ABO blood group antigens present on red blood cells.

Human Excretory System

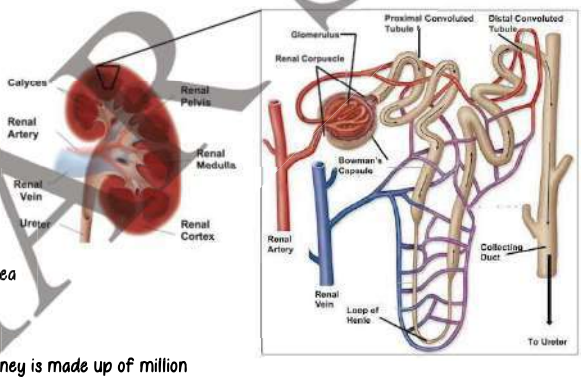


Structure of Kidney

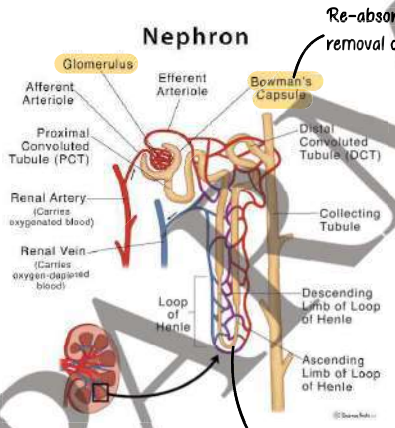
- Size: 10–12 cm in length
- Width: 5–7 cm in width
- Thickness: 2–3 cm thick
- Average weight of about: 120–170 g
- Bean shaped
- Right kidney is positioned slightly lower in comparison to left kidney (located on dorsal side)

Structure of Nephron

- A nephron consists of Glomerulus, Bowman's Capsule, PCT (Proximal convoluted tubule), JG A (Juxtaglomerular Apparatus) and collecting duct



- Nephron: Basic unit of Kidney
- Millions of nephron present in one kidney
- Nephrons remove waste material from blood
- Outer layer of kidney: Renal fascia, Cortex



Re-absorption and removal of nutrient/urea

- Each kidney is made up of million filtering units called nephron. Each nephron includes a filter called as glomerulus and a tubule. The nephron work through a two step process: The glomerulus filters the blood, and the tubule returns needed substances to blood and removes waste

Tube filled with: Glucose, Amino acids, water, salt, urea

Urine Components:-

- Water: 95%
- Urea: 2%
- pH: 4.5–5

- Waste Product: Ammonia
- Kidney converts ammonia to urea

Dialysis

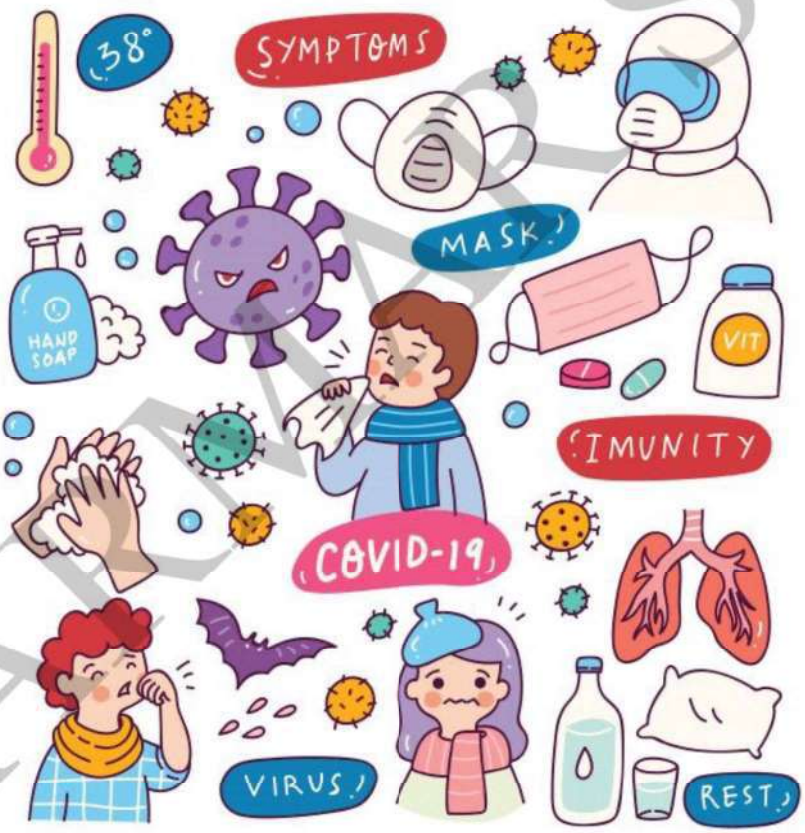
- Artificial kidney
- The procedure involves removal of waste in excess fluid from the blood, when the kidneys are no longer functioning properly, the machine removes blood from body filters it through a dialyzer and returns the clean blood to the body

- Urea: NH_2CONH_2 (Synthesised by Friedrich Wohler) from simple inorganic compound NH_4Cl and KCNO
  ↓
  Nitrogenous waste
- The colour of urine is yellow — This colour comes from urochrome/urobilin, a waste product that comes from breakdown of haemoglobin

- Kidney stone: Kidney, stones (made of Calcium Oxalate) are hard deposit of minerals and acid salts that stick together in concentrated urine
- Main causes: drinking less than two litres of water, obesity, eating food with too much salt and sugar

- Bilirubin: an orange-yellow pigment formed in the liver by breakdown of haemoglobin and excreted in bile
- The colour of solid waste from anus is yellow due to bilirubin

DISEASES



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Classification of Diseases on the Basis of Time

(1) Acute Disease

Diseases that last for short period of time

Eg: Fever, Cold, Cough

(2) Chronic Diseases

Disease that last for a long period of time

Eg: Diabetes, TB (tuberculosis), Elephantiasis

Communicable and Non-communicable Diseases

(1) Communicable Disease

These diseases spread from one person to another

Eg: AIDS, cold, chickenpox, COVID

(2) Non-communicable Disease

These diseases cannot spread from contact

Eg: Diabetes, arthritis, glaucoma, polio

Pathogens Responsible for Diseases

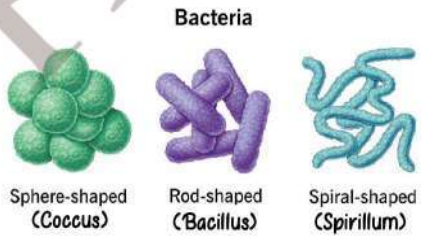
Pathogens: An organism that causes disease in a host

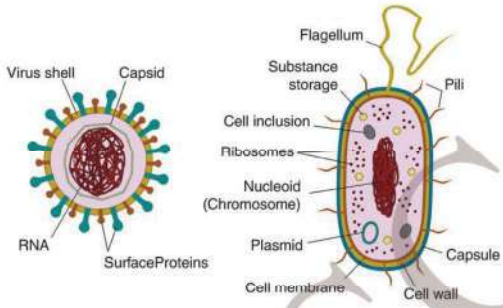
1) Virus
2) Bacteria
3) Protozoa
4) Fungus

- In virus, the genetic material is included in a protein envelope known as Capsid
- Genetic Material can be made of RNA (retrovirus with single stranded RNA) or DNA (with double stranded DNA)

Antibiotics work against the formation of cell wall. Viruses are surrounded by a protective protein coating; they don't have cell walls that can be attacked by antibiotics like bacteria does

Examples of Bacteria





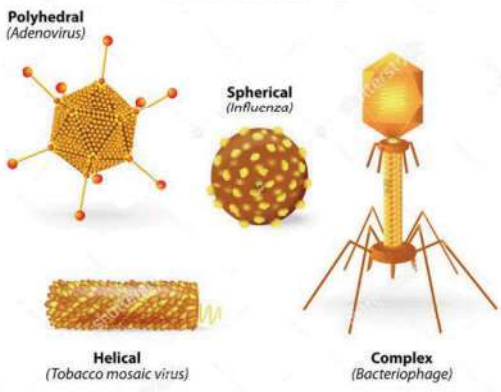
VIRUS

- Genetic material: DNA/RNA + Protein
- Non-living entity
- It needs a host cell
- Parasitic in nature
- It cannot be treated with antibiotic
- Smaller (20-400nm)

BACTERIA

- They are prokaryotes, they lack true nucleus and membrane bound organelles. Instead, they have nucleoid and their genetic material is called Genophore (bacterial DNA)
- Unicellular and living entity
- Divides on its own
- Parasitic/Saprophytic
- Antibiotics can be used to treat bacterial infections
- Larger (1000nm)

Different Viral Shapes

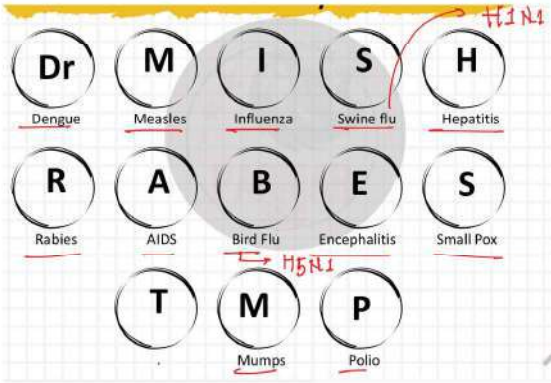


Diseases caused by Virus

- A virus requires a host (parasite) to replicate (becomes living entity later

TRICK

Swine flu
Caused by: H1N1 virus (in pigs)
Bird flu
Caused by: H5N1 (in birds)

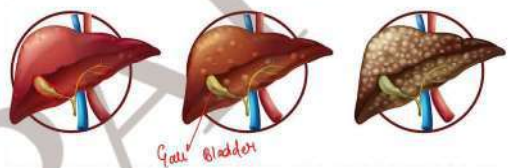


Hepatitis Types: A, B, C

- Affects: Liver
- Symptom: Jaundice (mainly affects liver)

- India's first indigenous Hepatitis-A vaccine: Havisure

- Hepatitis A: Transmission through food
- Hepatitis B: Sexually transmitted through bodily fluids
- Hepatitis C: Transmitted when in contact with infected blood



Mumps

- It a viral disease that affects the parotid salivary glands (cheek and jaw area)

Flu

- It is caused due to influenza
- Influenza also known as "evil influence of stars"

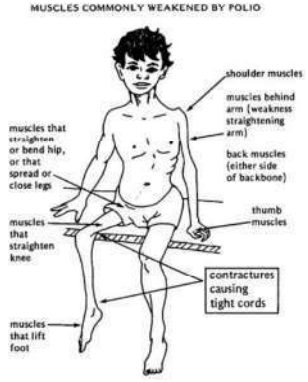
Common Cold

- It is caused by Rhinovirus

Polio

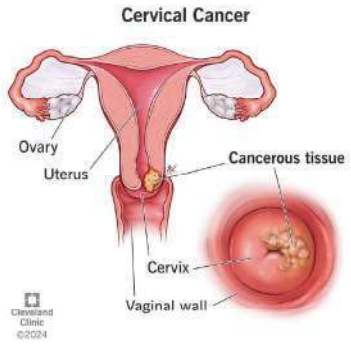
- Totally eradicated from India, as declared in 2014
- It affects the nervous system, the nerves in spinal cord or brain stem
- Virus: Poliomyelitis/Polio virus
- 1st polio vaccine was created by: Dr. Jonas Salk

- India launched the Pulse Polio Immunization Programme on October 2, 1995



Cervical Cancer

- It affects the cervix region in women
- Virus: Human Papillomavirus Causes(HPV) cancer in the cervix
- Detected through: Smear Test



Chicken Pox

- Caused by: Varicella Zoster Virus

Small Pox

- Caused by: Variola Virus
- Vaccine by: Edward Jenner (1796)
- Eradicated from India in: 1977

Dengue

- Caused by: Flavivirus virus (DENV1-4)
- Carrier of virus: Aedes Aegypti mosquito Calso responsible for Chikungunya)

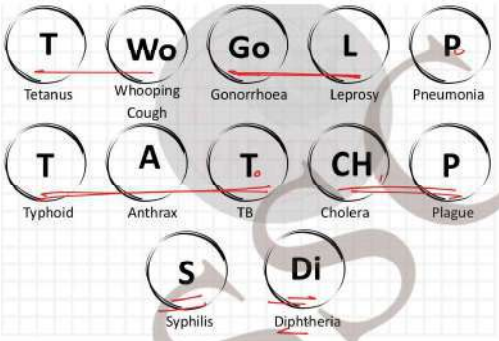
Rabies

- Caused by: Lyssavirus
- Nervous system is affected ——Leads to hydrophobia

AIDS

- Acquired Immunodeficiency Syndrome
- Sexually-transmitted diseases
- Virus: HIV Human Immunodeficiency Virus (retrovirus)
- Death: due to weak immune system
- Method of transmission: sexual contact, blood transfusions, from mother to baby
- Test: ELISA Test (Enzyme-linked Immunosorbent Assay)
- AIDS DAY: 1st Dec

Diseases caused by Bacteria

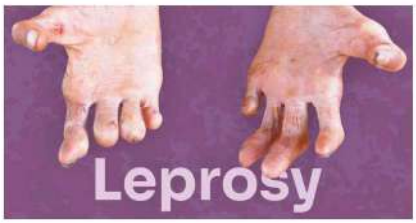


Plague

- Caused by: Yersinia pestis
- Death due to plague known as: Black Death
- 1897-1906: 12 Million death in India

Leprosy

- Caused by: Mycobacterium leprae
- Affects skin
- Also known as Hansen's Disease

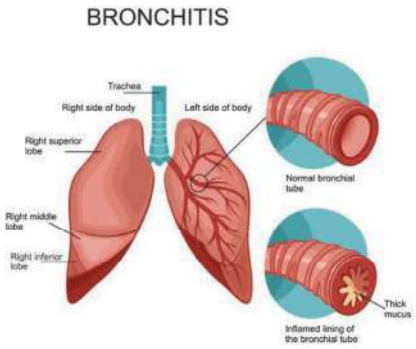


Cholera

- Caused by: Vibrio cholera
- It is a water borne disease
- Death due to cholera known as: Blue Death

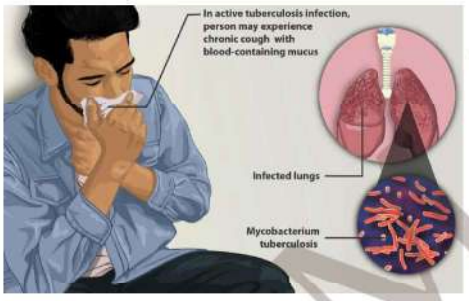
Bronchitis

- Caused by: Bordetella pertussis



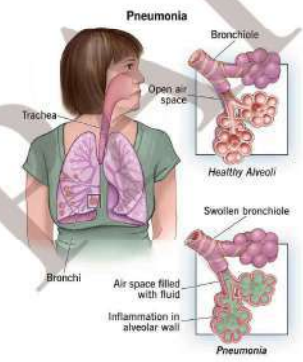
Tuberculosis

- Caused by: Mycobacterium tuberculosis
- Vaccine against it: BCG (Bacillus Calmette-Guerin)



Pneumonia

- Caused by: Streptococcus pneumoniae

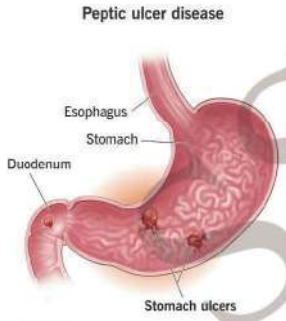


Diarrhoea

- Caused by: E. Coli (Escherichia coli)

Peptic Ulcers

- Caused by: Helicobacter pylori

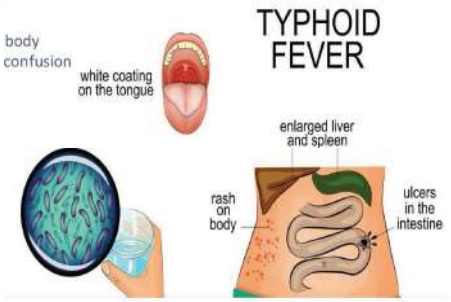


Diphtheria

- Caused by: Corynebacterium diphtheriae

Typhoid

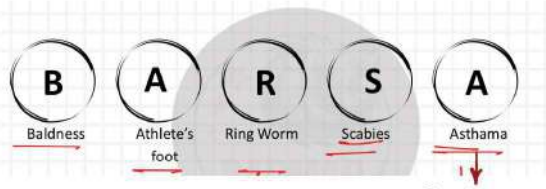
- Caused by: Salmonella typhi
- Symptoms: Fever, headache, body aches, tiredness, rash, delirium and mental confusion
- Test to detect: Widal Test



Acne

- Caused by: Staphylococcus bacteria

Diseases caused by Fungi



Respitory tract infection

Diseases caused by Protozoa

Malaria

- Malaria Day: 25th April
- Protozoa: Plasmodium
- Carrier: female Anopheles mosquito
- Treatment: Quinine (found in bark of cinchona tree)
  - Found in Evergreen forest

Sleeping Sickness

- Protozoa: Trypanosoma
- Carrier: Tse Tse fly

Kala Azar

- Protozoa: Leishmania
- Carrier: Sandfly

Enlarged spleen

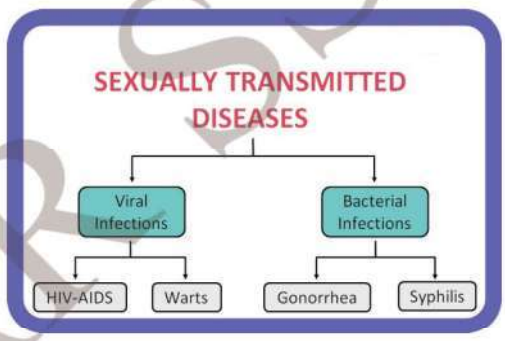
Water-borne Diseases

- Hepatitis A
- Diarrhoea
- Typhoid
- Cholera
- Giardiasis

Air-borne Diseases

- Influenza
- Tuberculosis
- Measles
- Pertussis
- Chickenpox
- Covid-19

Sexually Transmitted Diseases



Genetic Disorders

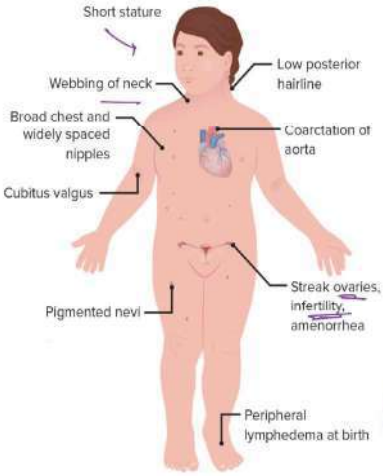
(1) Chromosomes: Disorders in chromosomes

(a) Autosomal Diseases: A genetic disorder that occurs when a gene on a non-sex chromosome is muted

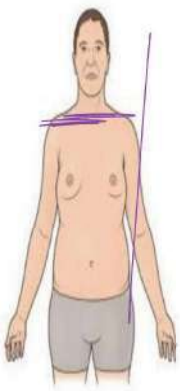
- Eg: Down's syndrome: The person has an extra copy of chromosome 21 for a total of 47 chromosomes (also known as Trisomy 21)
- Albinism: The body makes little or no melanine
- Haemophilia
  - Affects the recessive gene located on X chromosome
  - It is a rare disorder in which the blood does not clot

(b) Sex: Disorders that affect the sex chromosomes

- Eg: Turner's syndrome: One X chromosome is missing in females (XO)
- Klinefelter syndrome: One extra X chromosome is present in males (XXY)



Turner's Syndrome



The signs.

- A taller less muscular body than males there age.
- Broader hips and longer legs.
- Larger breast.
- Weaker bones.
- A lower energy level.
- Smaller penis and testicles
- Delay in puberty or go a parcel amount.
- Less facial, and body hair following puberty.

Klinefelter Syndrome

(2) Gene: Disorders in gene, it is also known as Mendelian Disorders

- Eg: Sickle cell anemia, Thalassemia, Colour blindness

→ Glaucoma: It is a disease that damages the eye's optic nerve leading to vision loss or blindness (usually a genetic disorder)

- There is an increase in eye fluid pressure

↓

Trachoma infection caused by bacteria can be one of the reasons for increase in eye fluid pressure

→ Pandemic: Sudden increase in cases across several countries, continents, or the world

→ Epidemic: Sudden increase in cases spreading through a large population

→ Endemic: The diseases that are constantly present in a population or region with relatively low spread

- Wilson disease: excessive amount of deposition of Cu
- Mad Hatter Disease: due to Mercury poisoning (also responsible for Minimata disease)

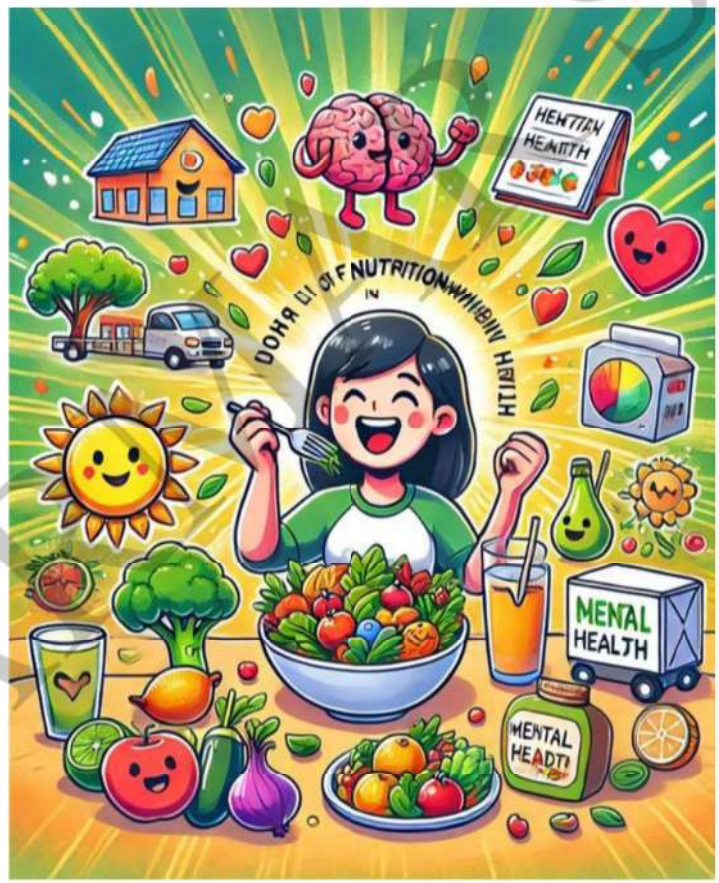
→ Inhaling iron dust causes Siderosis disease

- Itai Itai: caused due to Cadium deposition
- Blue baby syndrome: caused due to Nitrate deposition

Diseases in Plants

- Citrus canker: bacteria —— Citrus fruits
- Rust of wheat: fungus
- Yellow vein mosaic: virus —— affects Tobacco
- Aster Yellow: bacteria
- Crown Gall: bacteria
- Ergot: fungus —— Bajra
- Snow mold: fungus
- Black knot: fungus
- Blight: fungus/bacteria

NUTRITION IN ANIMALS AND PLANTS



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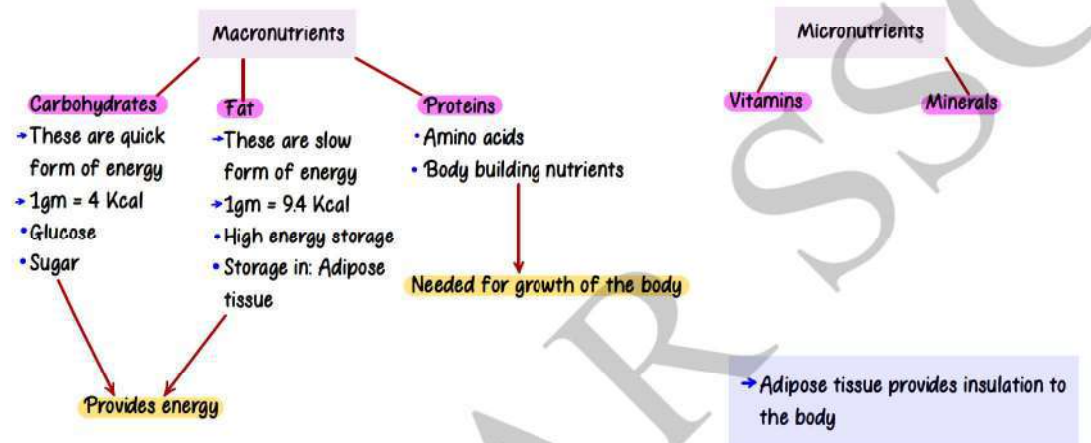
Nutrition in Animals

→1912: Casimir Funk, coined the term "Vitamin"

Nutrients divided into two categories:-
(1) Macronutrients: They are needed in large quantities
(2) Micronutrients: They are needed in small quantities



→Adipose tissue provides insulation to the body

Carbohydrates/Sugar

Types:-
(1) Monosaccharides: they are made of one molecule of sugar
- Glucose
- Fructose (present in fruits/honey)
- Galactose

(2) Complex Carbohydrates
(a) Disaccharides: they are made of two molecules of sugar
- Sucrose
- Maltose (it is grain sugar, found in grains)
- Lactose (it is milk sugar, found in milk)

(b) Polysaccharides: they are made of two or more molecules of sugar
- Glycogen
- Starch
- Cellulose

Fats

Types:-
(1) Saturated fats
- They are not easily digested as the molecules are tightly packed together
  Have higher melting point
- Found in red meat, pork

(2) Unsaturated fats
- There are easily digested
- Healthier
- Found in vegetable oil, nuts, and seeds

→Trans fat: it is a type of unsaturated fat that occurs naturally or artificially in food
- Cannot be easily digested
- Eg: Chips

Proteins

- Produced by the breakdown of amino acids (total: 20 amino acids)
- Requirement: 0.8 gm/kg of body weight per day

Present in: egg (albumin), yolk (fats, vitamins, cholesterol), soybeans, pulses, chicken, fish

The white part of an egg turns solid and white when cooked due to the process of protein denaturation

Protein in:-

- Milk: Casein
- Hair/Nail: Keratin
- Rice: Glutelin, Albumin
- Grains: Gluten

Amino Acids

Types:-

(1) Essential Amino Acids

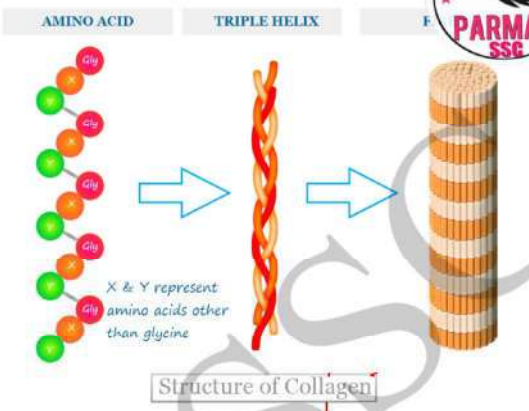
They are not synthesised by our body

- Histidine
- Isoleucine
- Leucine } Important for synthesis of collagen
- Lysine } Important for synthesis of collagen
- Methionine
- Phenylalanine
- Threonine
- Tryptophan
- Valine

(2) Non-Essential Amino Acids

They are synthesised by our body

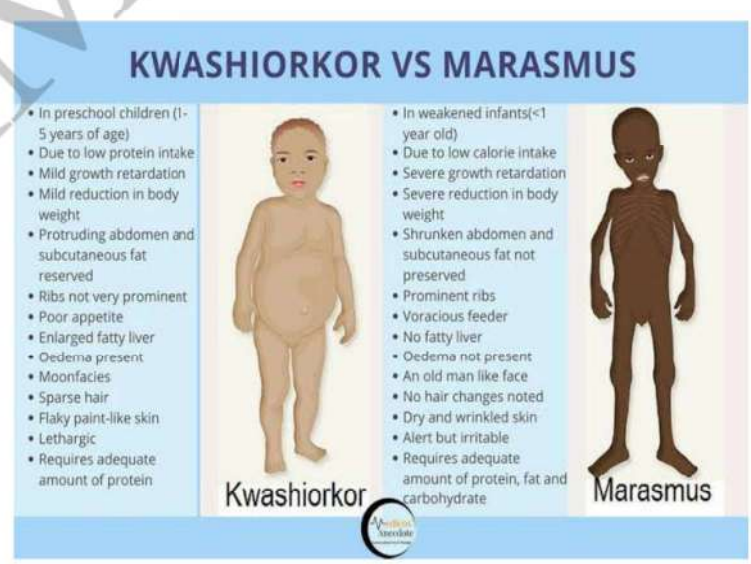
- Alanine
- Aspartic acid
- Asparagine
- Glutamic acid
- Serine



Structure of Collagen

- Collagen is most abundant protein of our body
- Found in extracellular spaces (skin, bone joints)
- Triple helical structure of collagen discovered by: G. N. Ramachandran
- Vitamin C is important synthesis of collagen

- Deficiency caused due to Proteins: Kwashiorkor
- Marasmus is a severe form of malnutrition that results from a deficiency in protein and other nutrients



Vitamins on basis of Solubility

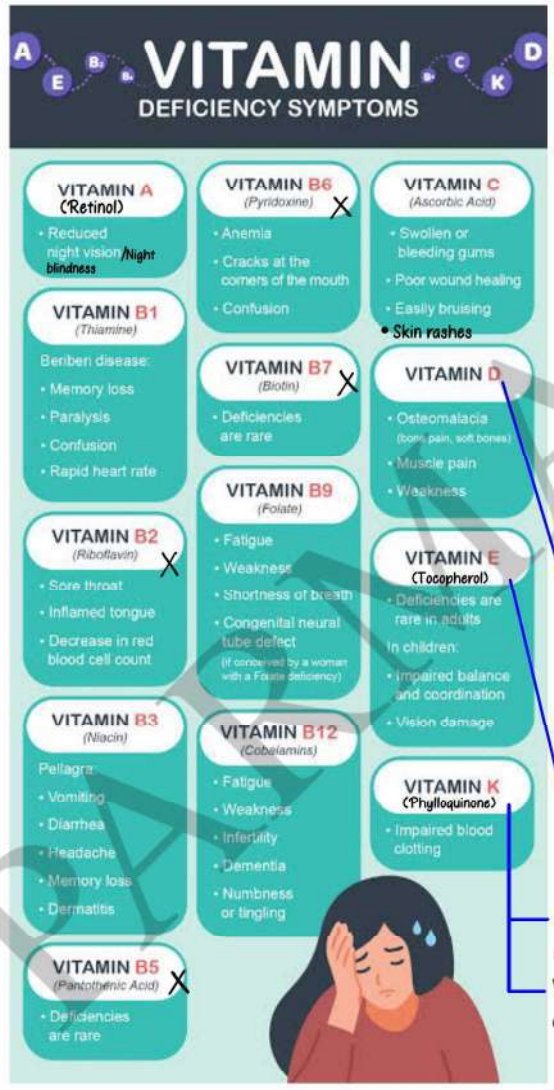
(1) Water Soluble Vitamins
- Vitamin B
- Vitamin C

(2) Fat Soluble Vitamins
- Vitamin A
- Vitamin D
- Vitamin K
- Vitamin E

Beauty Vitamin as it produces antioxidants

Vitamins	Chemical Name
Vitamin A	Retinol
Vitamin D	Calciferol
Vitamin E	Tocopherol
Vitamin K	Phylloquinone
Vitamin B1	Thiamine
Vitamin B2	Riboflavin
Vitamin B3	Niacin
Vitamin B5	Pantothenic acid
Vitamin B6	Pyridoxine
Vitamin B7	Biotin
Vitamin B9	Folic acid
Vitamin B12	Cyanocobalamin
Vitamin C	Ascorbic acid

Total: 8 (vitamin B)



Ergocalciferol: D_2
Cholecalciferol: D_3

Vitamin D is also known as "Sunshine Vitamin"

Deficiency causes:
→ Pernicious anaemia

Deficiency also causes anti-sterility

→ Pellagra is a 3D disease
- D: Diphtheria
- D: Dermatitis
- D: Diarrhoea

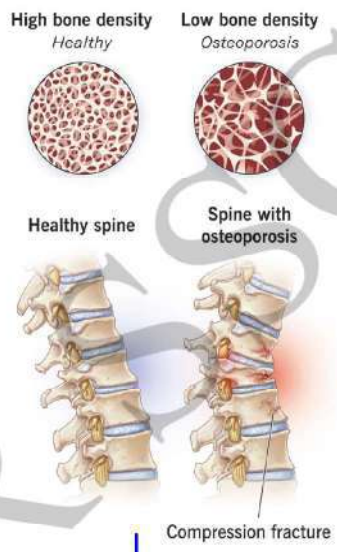
Hemorrhagic disease of newborn

Vitamin K facilitates blood clotting

Sources of Vitamins

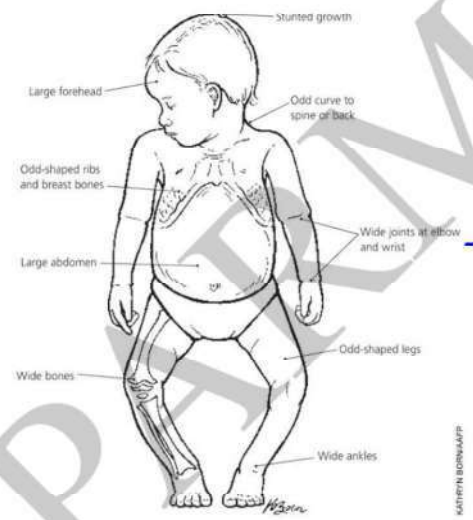
Vitamin Name	Solubility	Sources
Vitamin-A	Fat	Spinach, carrots, sweet potatoes and red peppers. Yellow fruits, such as mango, papaya and apricots.
Vitamin-B	Water	Meat (especially liver), seafood, poultry, eggs, dairy products, legumes, leafy greens, seeds and fortified foods, such as breakfast cereal and nutritional yeast.
Vitamin-C	Water	Potatoes, green pepper, spinach, lemons, broccoli, strawberries, peas, pears, lime and animal-based sources like pork, chicken, seafood.
Vitamin-D	Fat	Cord liver oil, Salmon, swordfish, Tuna fish, egg yolk, orange juice, and fortified cereals.
Vitamin-E	Fat	Green leafy vegetables, such as kale, spinach, turnip greens, collards, Swiss chard, mustard greens, parsley, romaine, and green leaf lettuce.
Vitamin-K	Fat	Soya bean, cucumbers, asparagus, Apium graveolens dulce, coriander, head lettuce, sauerkraut, kale, brussels sprouts, whole grain, peas.

Osteoporosis



→ Deficiency of Vitamin D in adults causes **Osteoporosis**

→ **Osteomalacia**: a condition that causes bones to soften, and is often caused by vitamin D deficiency



Deficiency of vitamin D in children causes Rickets

Minerals

→ Millets: Jawar, Bajra, Ragi

↓

Has abundant minerals like:

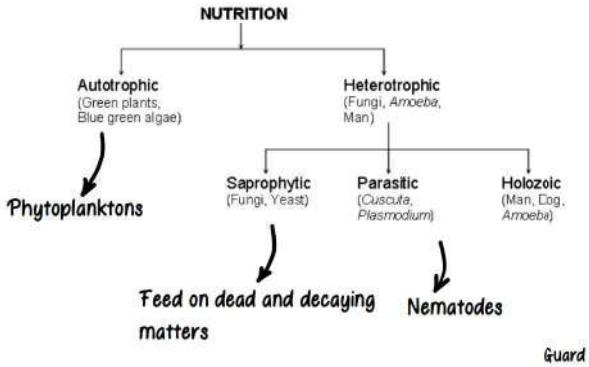
→ **Magnesium**: involved in metabolism, supports bone health

→ **Zinc**: important for wound healing, involved in protein synthesis and cell growth

→ **Iodine**: essential component of thyroid hormone which regulates metabolism, growth, and development, iodine also impacts brain function and cognitive development

Nutrition in Plants

Mode of Nutrition



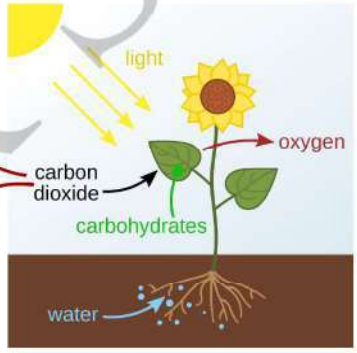
- Plants make food through photosynthesis
  - They require:-
    - CO_2
    - Water
    - Sunlight
  - Light energy is converted to Chemical energy

Chlorophyll → Chloroplast → Plastids → Cell of a plant

- **Autotrophic**: in this mode of nutrition an organism can produce its own food, using light, water, carbon dioxide, and other chemicals

- **Heterotrophic**: in this mode of nutrition an organism cannot produce its own food, however, takes nutrition from other sources of organic carbon, mainly plant or animal matter
  - (a) **Saprophytic**: in this, the organism, particularly fungi, obtain nutrients directly from dead organic matter or wastes
  - (b) **Parasitic**: these plants derive some or all of its nutrition requirements from another living plant (host)
  - (c) **Holozoic**: it is the type where the organism consume solid or liquid food and break it down internally

Guard cells regulate the opening and closing of stomatal pores and they respond to changes in CO_2 concentration in leaves

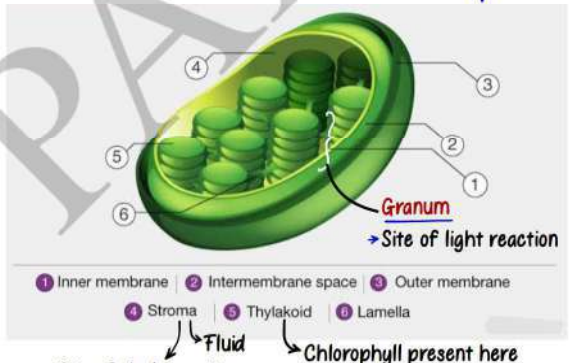


$$6CO_2 + 6H_2O \xrightarrow[\text{Sunlight}]{\text{Chlorophyll}} C_6H_{12}O_6 + 6O_2$$

Stored in the form of starch

Mesophyll cells are cells that are primary site of photosynthesis

Chloroplast



- Chlorophyll makes plant appear green because it absorbs red and blue light from sunlight while reflecting green light

Two types of Reactions in Chloroplast

Light Dependent Reaction

- Light splits water into Hydrogen and Oxygen
- Forms: ATP + NADPH

Light Independent Reaction (Calvin Cycle)

- CO_2 enters through stomata, which will be reduced to $C_6H_{12}O_6$

Reduced by: ATP + NADPH

Macronutrients and Micronutrients in Plants

Macro	Micro
N - Nitrogen	Fe- Iron
P- Phosphorus	Mn - Mangnanese
K - Potassium	Cu - Copper
S - Sulfur	Zn - Zinc
Ca - Calcium	B - Boron
Mg - Magnesium	Cl - Chloride
Carbon, Hydrogen, Oxygen	Mo - Molybdenum

NPK used in Urea

- 1828, Friedrich Wohler synthesised Urea
- Urea is nitrogen containing fertilizer

Urea: CH_4N_2O or NH_2CONH_2

- Legumes such as lentils do not require fertilisers as their roots have Nitrogen Fixing Bacteria — Rhizobium, Azobacter

Extras:-

- Chlorella (algae) is rich in protein and iron
- Spirulina is a Blue Green Algae
- Starches are made of long chain of glucose
- At least half of the carbon dioxide fixation on earth is carried out by algae through photosynthesis
- Only 1% sunlight is captured by terrestrial plant

HEREDITY AND EVOLUTION

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What is Heredity?

- The phenomenon of Inheritance from parents to offsprings

Variations

- Variation is differences in the characteristics or traits of individuals of some species

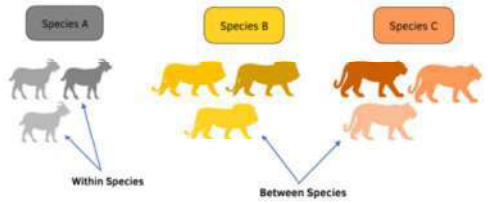


Fig 1. Types of Variation. Variation can occur both within and between species.

- Variation is necessary for survivability
- It is seen more in sexual organisms than asexual organisms (as only a single parent involved in asexual reproduction)

Types of Traits

(1) Acquired Traits: Characteristics that develop in an organism during its lifetime as a result of environmental influences rather than genetics

- Eg: Teaching, riding bike, etc.

(2) Inherited Traits: Characteristics or quality that is passed down from parents to their offsprings through DNA

- Eg: Eye colour, blood group, etc.

Inheritance of Traits

- It takes place through the transfer of Genetic material from parents to offsprings
- Unit of Heredity: Gene

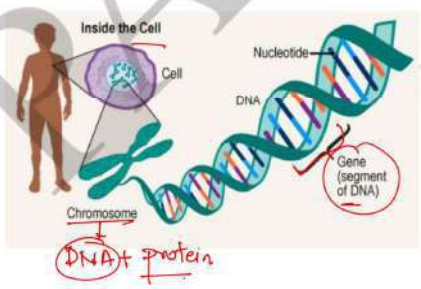
Alleles

- The kind of alternate forms of genes for a particular character are called as alleles

Types:-

(1) Dominant Traits: Trait that is expressed out when one or both alleles are dominant

(2) Recessive Traits: Trait that is expressed out when both the alleles are recessive



→ Father of Inheritance: Gregor Johann Mendel

→ Gregor Johann Mendel conducted experiments of Inheritance traits in Pea Plant (Pisum sativum)

Reasons to choose pea plant:-

- It is easier to grow
- It has short life cycle
- It can be self-pollinated or cross-pollinated by hand
- Different traits were easily observable
- Mang offsprings of pure pea plant can be easily obtained through self-pollination

Three Laws of Inheritance

→ 1st Law → Mendel's Law of Dominance: It stated that when parents with contrasting traits are crossed, only the dominant trade will appear in the offsprings

→ 2nd Law → Mendel's Law of Segregation: It stated that during the formation of gametes, the pairs of gene variants, or alleles are separated from each other

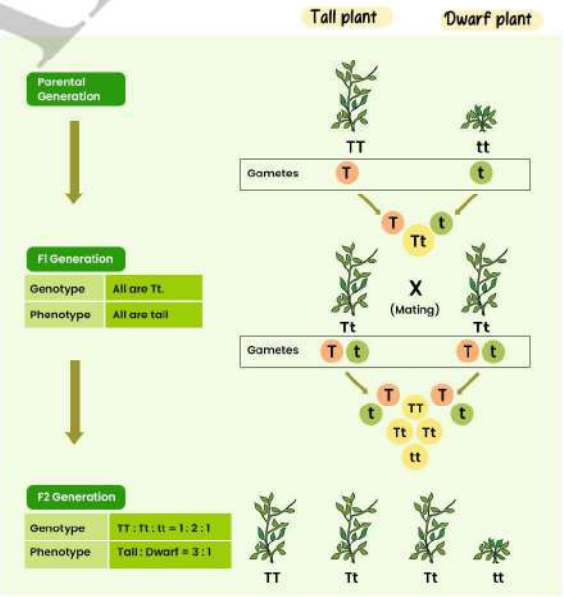
→ 3rd Law → Law of Independent Assortment: It stated that during gamete formation, alleles of two (or more) different genes get sorted into gametes independently of one another

Monohybrid Cross

- A genetic cross between two individuals that differ in a single trait
- Eg: A cross between a tall pea plant and a short (dwarf) pea plant

→ TT: Dominant trait

→ tt: Recessive trait



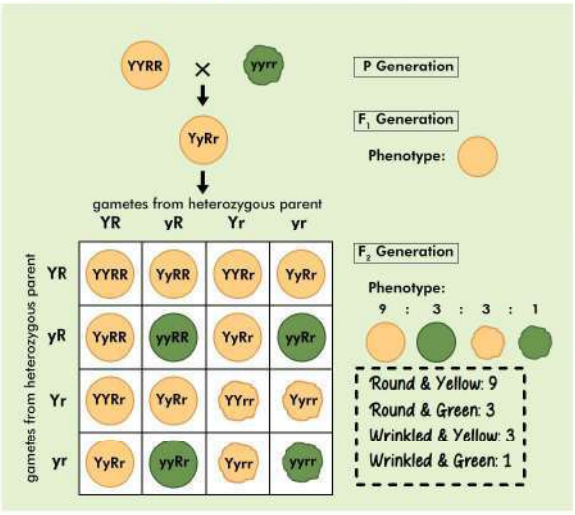
Dihybrid Cross

- A genetic cross between two heterozygous individuals with two observed traits that are controlled by two distinct genes
- Eg: A cross between round yellow pea plant and wrinkled green pea plant

→ YYRR: Dominant trait

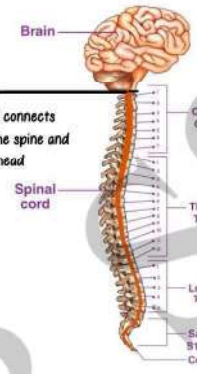
→ yyrr: Recessive trait

Round & Yellow shape Wrinkled & Green colour



- Bones in adult human beings: 206
- Bones in children: 300
- Total Axial bones: 80
- Total Appendicular bones: 126

AXIAL SKELETON



Bones in Spinal Cord

Adults only have 26 bones

- Cervical: 7 vertebrae
- Thoracic: 12 vertebrae
- Lumbar: 5 vertebrae
- Sacral: 5 vertebrae
- Coccygeal: 4 vertebrae

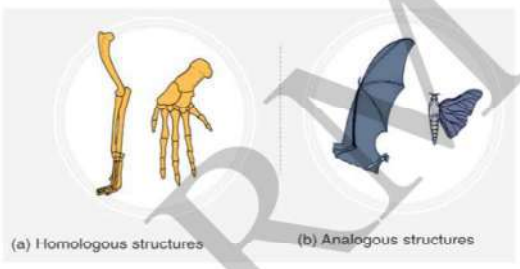
} Later fuses to form 1

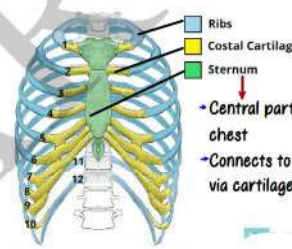
Homologous Organs

- They are organs that have the same structure but different function and are inherited from an common ancestor

Analogous Organs

- They are organs of different species that have different anatomical structure but perform similar functions



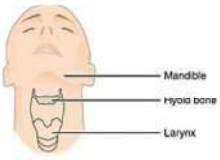


Bones in Rib Cage

- Total: 24 + 1 (sternum) = 25

→ Central part of chest

→ Connects to ribs via cartilage

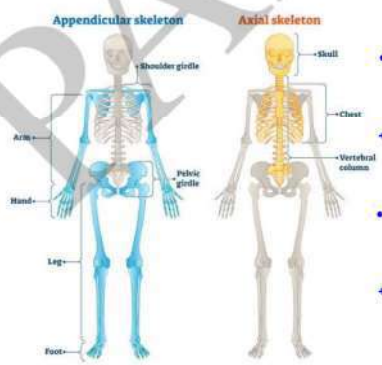


Hyoid bone

Bones in Skull

- Total: 22 bones
- Cranial: 8
- Facial: 14

Skeletal System



(1) Appendicular Skeleton

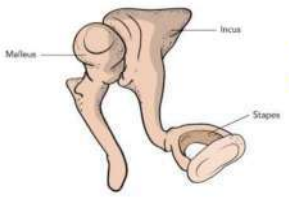
- It provides support and leverage for moving the limbs

→ Eg: bones in shoulder, pelvis, limbs, etc.

(2) Axial Skeleton

- It protects and supports the heart, lungs, brain, and spinal cord

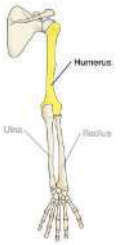
→ Eg: bones in head, neck, back including skeleton etc.



Bones in Ear

- Total: 3 x 2 =6
- Incus
- Malleus
- Stapes

APPENDICULAR SKELETON

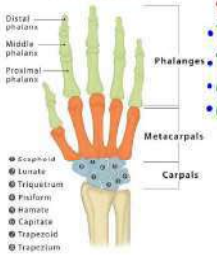


Bones in Arm

- Total: 3
- Radius
- Ulna
- Humerus

27 + 3 =30
30 x 2 (arms) = 60

Hand Bones



Bones in Hand

- Total: 27
- Phalanges: 14
- Metacarpals: 5
- Carpals: 8

Bones in Legs

- Total: 4
- Femur (thigh bone): 1
- Patella: 1
- Tibia: 1
- Fibula: 1

4 x 2 =8

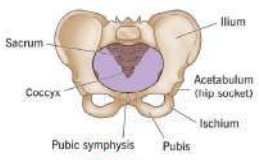
Bones in Foot

- Total: 26
- Tarsals: 7
- Metatarsal: 5
- Phalanges: 14

26 x 2 =52

Clavicle: 2
Scapula: 2

Bones in Pelvis



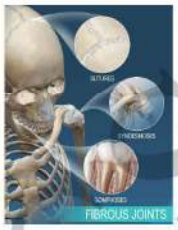
- Total: 2

Joints and it's Types

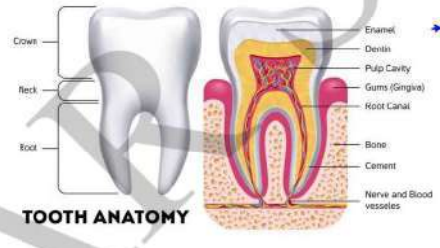
(1) Synovial Joint: It a freely movable joint in the body that allows for a wide range of motion

(2) Fibrous Joint: A fibrous joint is a fixed joint where bones are connected by collagenous fibrous connective tissue

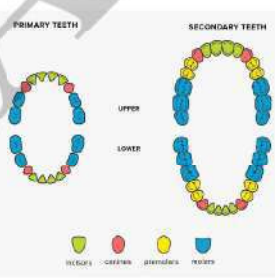
(3) Cartilaginous Joint: Cartilaginous joints allow for more movement than fibrous joints, but less movement than synovial joints



Teeth and it's Structure



Enamel: Hardest part of the body (made of Calcium phosphate)



Total: 32 (16 in upper jaw + 16 in lower jaw including wisdom teeth)

Incisors
- They are used for bitting and cutting of food
- Total: 4

Canine
- They are used for tearing of food
- Total: 2

Premolars
- Used in grinding of food
- Total: 4

Molars
- They are used for chewing and crushing of food
- Total: 6

Dental Formula

$\frac{2,1,2,3}{2,1,2,3} = \frac{I, C, P, M}{I, C, P, M}$ → (Adults)

In children there is no premolars

$\frac{2,1,0,2}{2,1,0,2} = \frac{I, C, P, M}{I, C, P, M}$ → Total = 20 (Milk teeth)