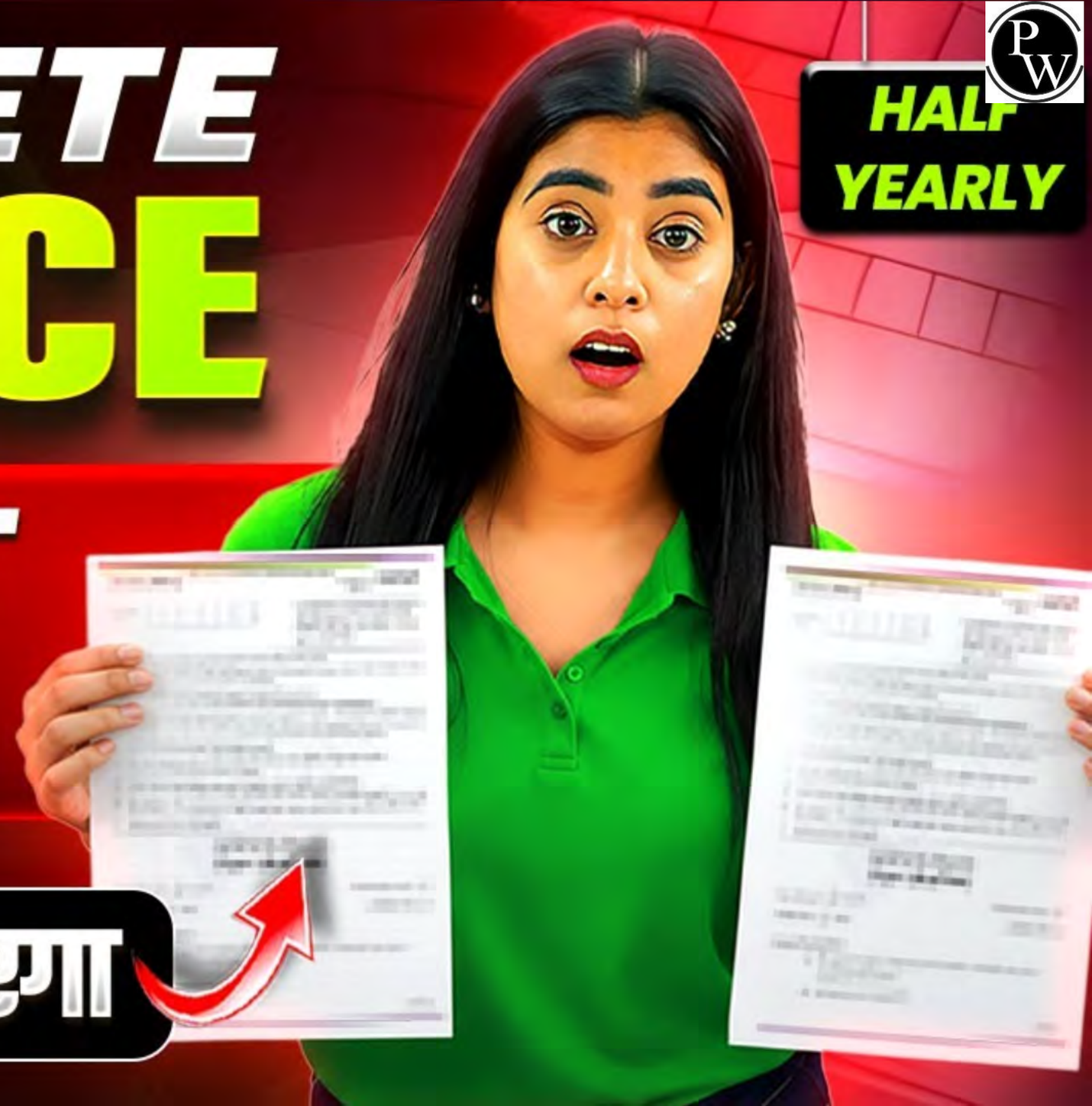
COMPLETE SCIENCE

ONE SHOT

CLASS 9TH

HALF YEARLY



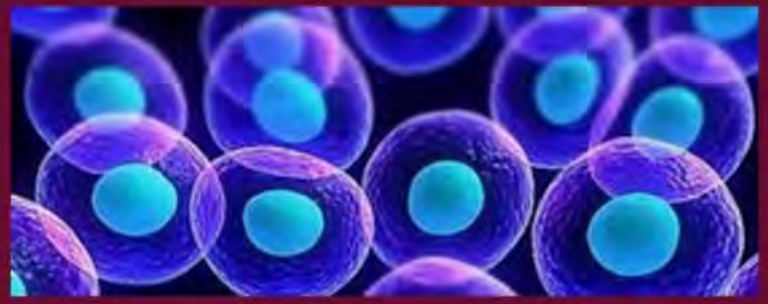
PAPER यहीं से आएगा


Most Important Topics
PCB
-By Samridhi Ma'am


Most Important Topics
The fundamental unit of life → Cell
BIOLOGY
-By Samridhi Ma'am

WHAT IS CELL ?

- The basic structural and functional unit of life
- All living organisms are made up of cell

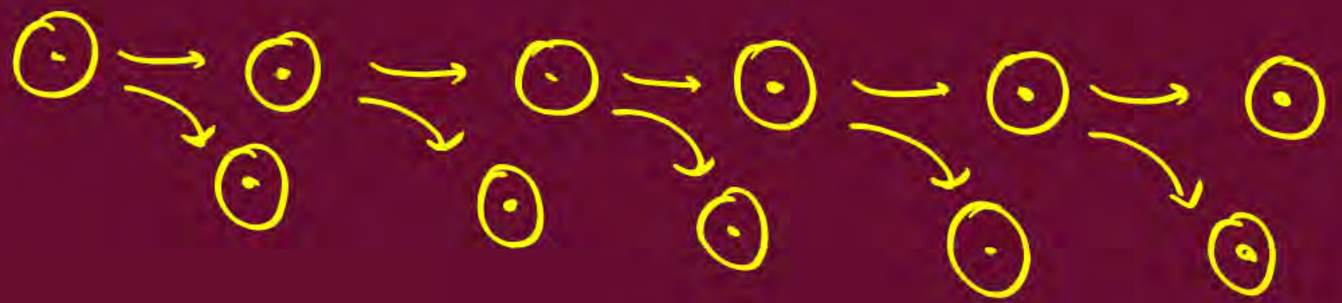


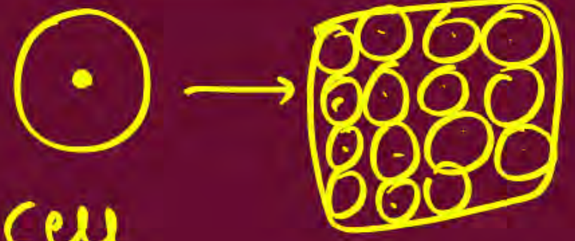
#Cytology

Cell theory

Robert Hooke	1665	Discovered and coined the term cell (dead cells → cork)
Antonie Van Leeuwenhoek	1674	Discovered first living cell
Robert Brown	1831	Discovered Nucleus
Purkinje	1839	Coined term 'protoplasm'
1) Mathias schleiden 2) Theodore Schwann 3) Rudolf Virchow	1838 1839 1855	•All plants are made up of cells •All animals are made up of cells •All cells came from pre existing cells

Omnis-Cellula-e-Cellula





Cell → Tissue → Organ → Organ System → Organism
↳ Human

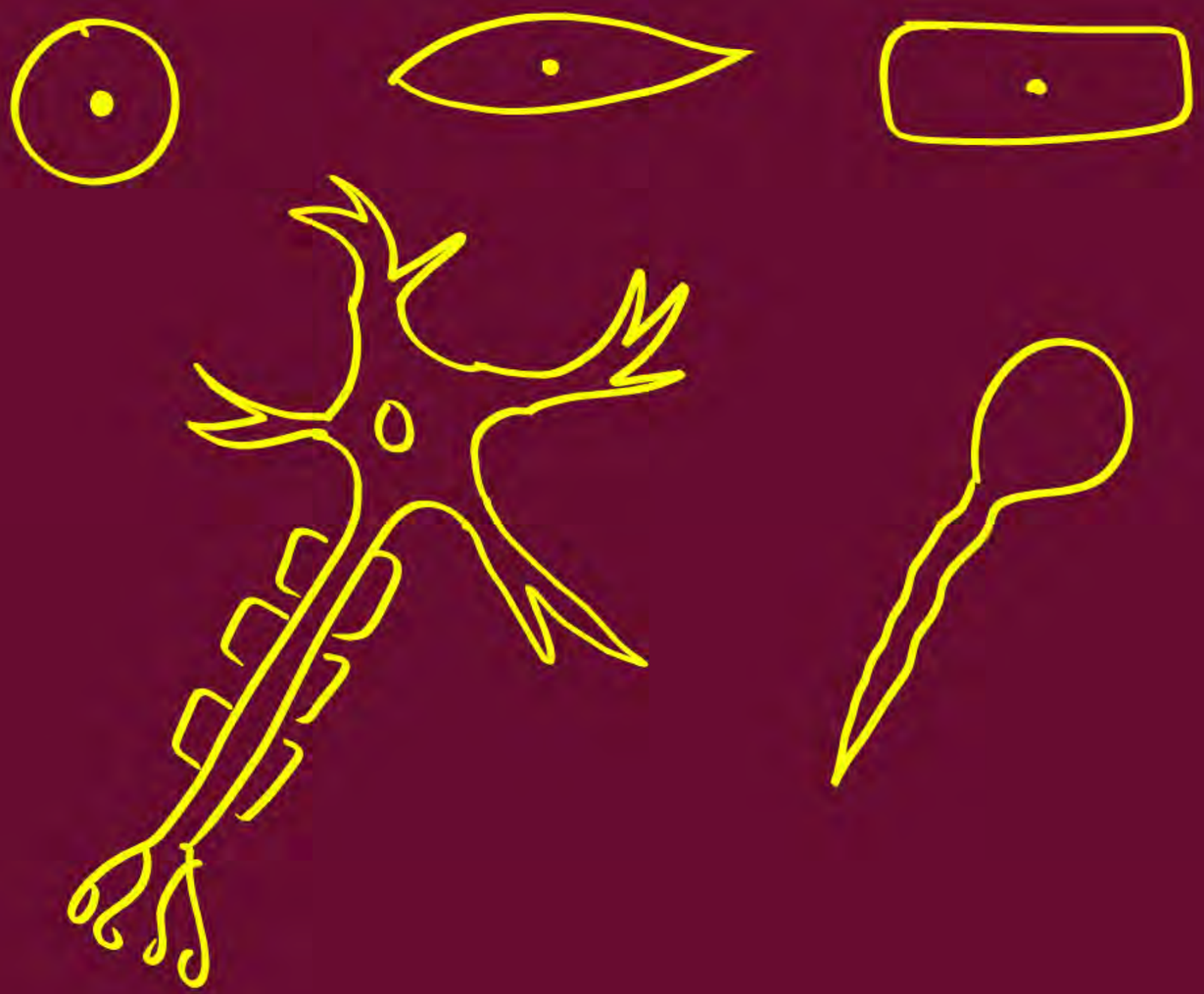
Cell
↓
Basic unit of life → Structure
→ Function

ORGANISMS SHOWS VARIETY IN CELL NUMBER,SHAPE AND SIZE

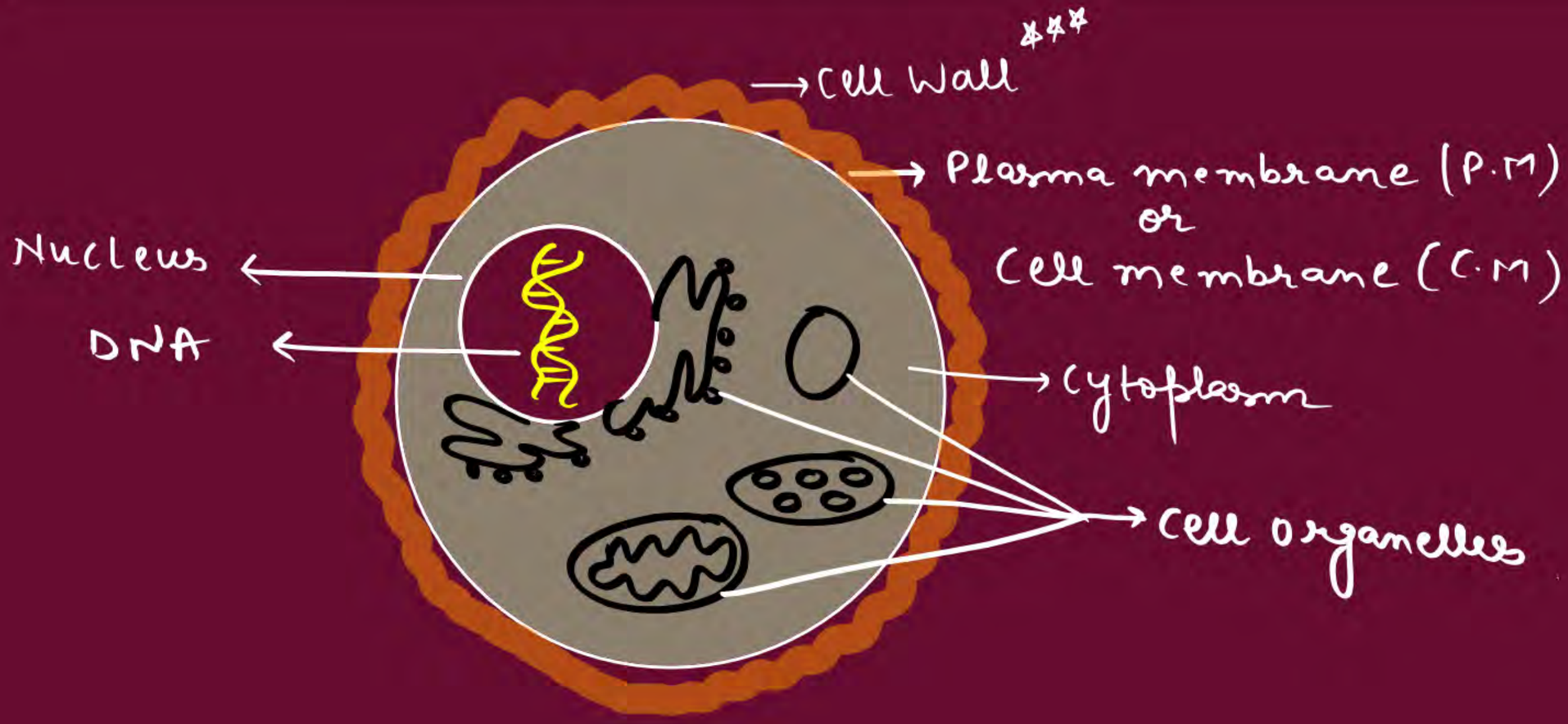
Classification of organism based on cell composition

- **Unicellular organism** → Organisms made up of only one cell, e.g; Chlamydomonas, Paramecium and bacteria (Yeast)
- **Multicellular organism** → Organisms made up of more than one cells; e.g; Plants and animals

- Ovum / Egg cell → Spherical ✓
- Smooth muscle cell - spindle shaped
- Erythrocyte (RBC) - round and biconcave
- Nerve cell - long and branched
- Largest living cell : Ostrich egg
- Smallest living cell : Mycoplasma (PPLO)



AN OVERVIEW OF CELL



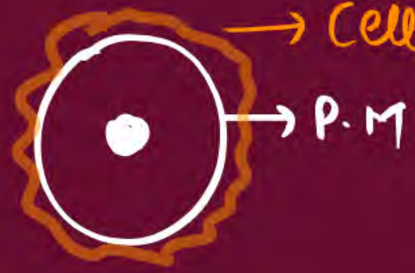
DNA = Deoxy ribo Nucleic Acid

MEMBRANES OF CELL ORGANELLES

Single membrane Bound	Double membrane Bound	Non- membrane bound
		↓ Membrane absent
Vacuole	Nucleus	Ribosome
Lysosome	Mitochondria	Centrosome(centriole)
Golgi apparatus	Plastids	
Endoplasmic reticulum		

CELL WALL AND ITS COMPOSITION

- Non living and rigid
- Forms outer covering of plasma membrane
- Provides shape to cell
- Provides structural support to cell



- plants → Cellulose
- bacteria → Peptidoglycan
- fungi → Chitin
- animals
- virus

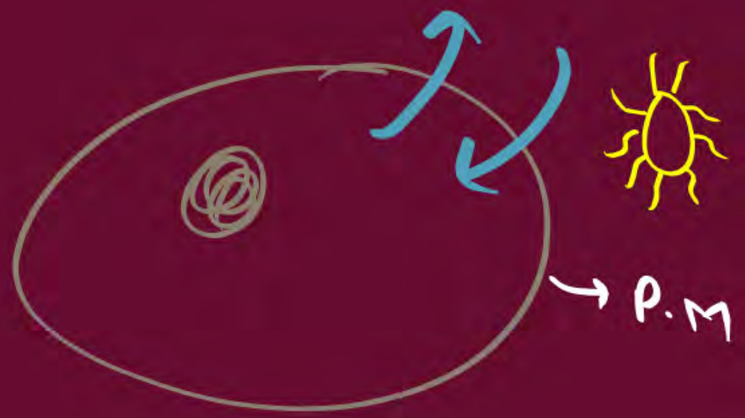
Cell Wall → present ?

(a) RBC
(b) Muscle Cell
(c) Leaf Cell
(d) WBC

PLASMA MEMBRANE / CELL MEMBRANE

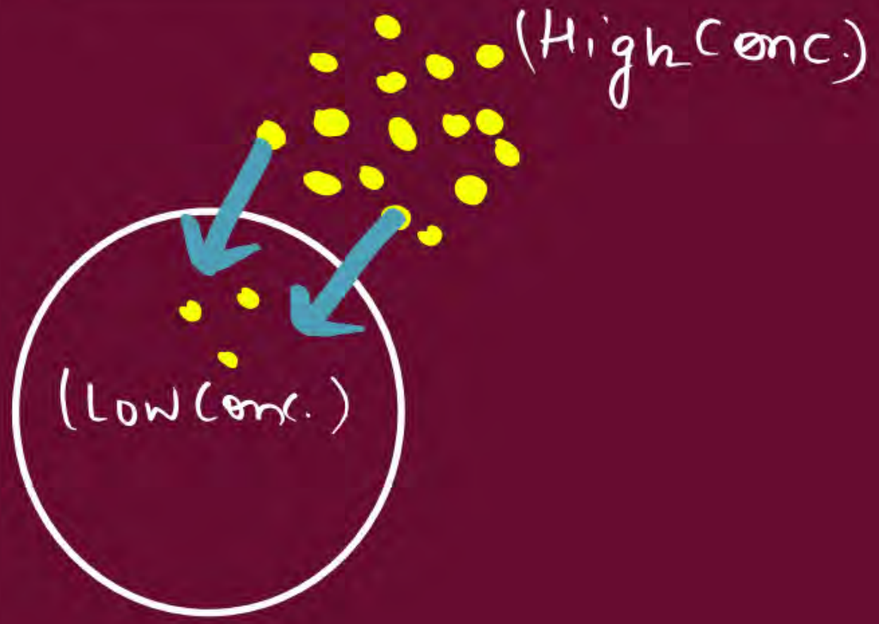
- Plasma membrane is mainly composed up of lipids and protein
- Some amount of carbohydrate also present
- Interacts with outside world
- Controls movement of substances in and out of the cell
- Semi- permeable and flexible

→ Phospholipid

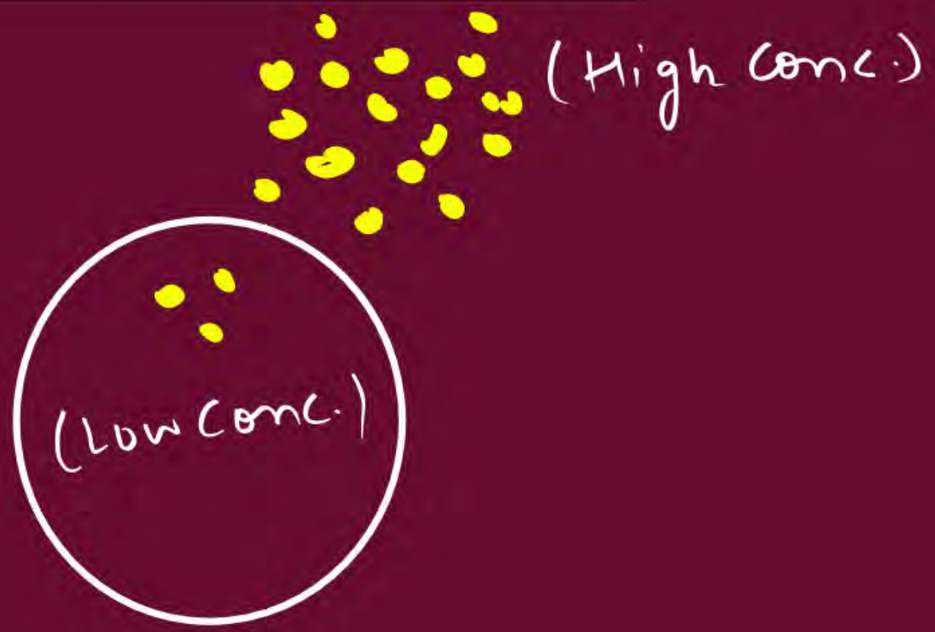


PASSIVE TRANSPORT VS ACTIVE TRANSPORT

#ch1



#Passive Transport (High → Lower)

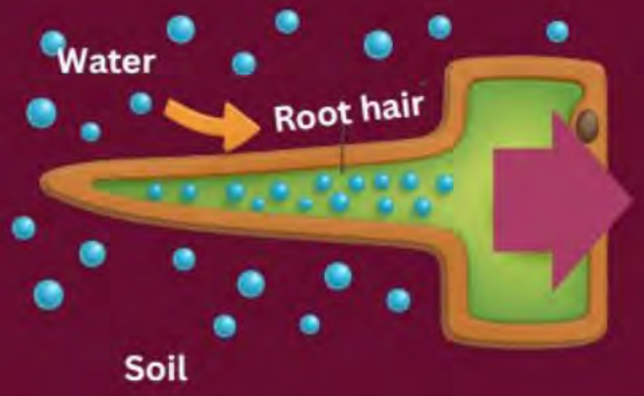
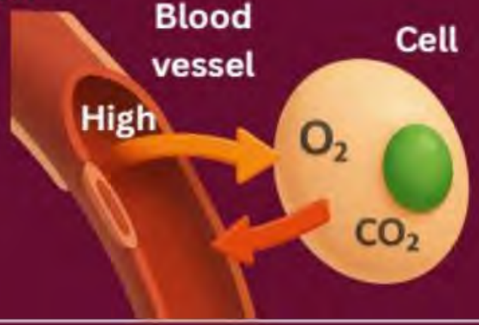


#Active Transport (Lower → High)

PASSIVE TRANSPORT VS ACTIVE TRANSPORT

Criteria	Passive Transport	Active Transport
Energy Requirement	No energy required	Requires energy (ATP)
Direction of Movement	Substances move from higher to lower concentration (high to low)	Substances move from lower to higher concentration (low to high)
Example Processes	Diffusion, osmosis	Endocytosis, exocytosis
Function	Facilitates the movement of molecules like oxygen or carbon dioxide	Moves substances like ions or larger molecules into/out of cells

OSMOSIS VS DIFFUSION

Aspect	Osmosis	Diffusion
Definition	Movement of water molecules through a selectively permeable membrane from low to high solute concentration	Movement of particles from an area of higher concentration to lower concentration
Type of Molecule	Usually involves water molecules	Involves gases like O_2 and CO_2 as well as other small molecules
Direction of Movement	From an area of higher water concentration to lower water concentration (toward higher solute concentration)	From higher concentration to lower concentration areas, regardless of solutes.
Example	Water Absorption by plant roots 	Exchange of gases in cells: • CO_2 diffuses out of the cell when its internal concentration increases. • O_2 diffuses inside when its concentration inside decreases. 

$(O_2 \rightarrow ?$

#Osmosis

- Passive Transport (H → L)
- Solvent/water molecules
- Cross P.M/semi-permeable.

(a) Inside

~~(b)~~ outside

(L) CO_2 → gases → diffusion (H → L)

H_2O = Osmosis

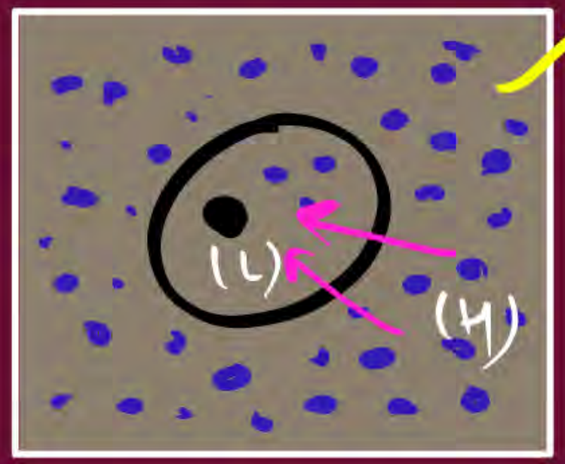
(H)

~~(a)~~ Outside → inside

(b) Inside → outside.

DIFFERENT SOLUTIONS AND THEIR EFFECT ON CELL

Aspect	Hypotonic Solution	Isotonic Solution	Hypertonic Solution
Solute Concentration	The solution has a lower concentration of solutes than the cell	The solution has an equal concentration of solutes as the cell	The solution has a higher concentration of solutes than the cell
Direction of Water Movement	Water moves into the cell from the surrounding solution	Water moves in and out of the cell at equal rates	Water moves out of the cell into the surrounding solution
Effect on Plant	The cell tends to swell	No change in the cell size	The cell will shrink
Cell	 Turgid cell	 Flaccid plant cell	 Plasmolysed plant cell



Osmosis

(H → L)

Hypotonic Soln

Solute ↓

Water ↑

Water moves inside the cell (Endosmosis)

↓

Cell will swell

Hypertonic Soln

Solute ↑
Water ↓

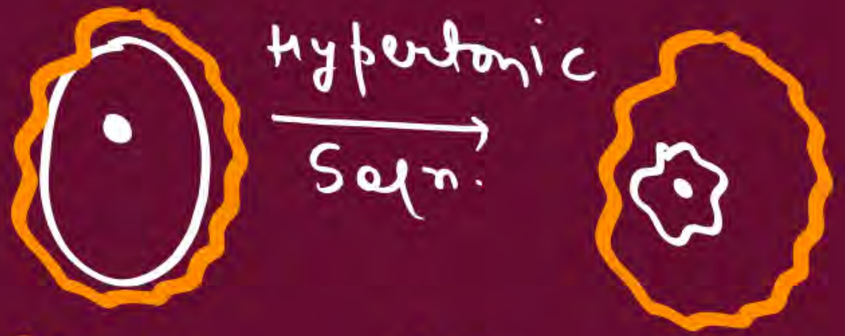
Water moves outside (EXOSMOSIS) ← exit

↓

Cell shrink

Osmosis

(H → L)



Plant cell # Plasmolysis

Hype 'R' tonic ⟶ Sh'R'ink

Hyp `O' tonic ⟶ Swell

↳ golu-molu.

NUCLEUS

Structure

Nuclear Membrane
- A double-layered structure surrounding the nucleus, regulating material exchange and protecting genetic material.

Nuclear Pore
- Openings in the nuclear membrane.
- Facilitate the transfer of materials between the nucleus and cytoplasm.

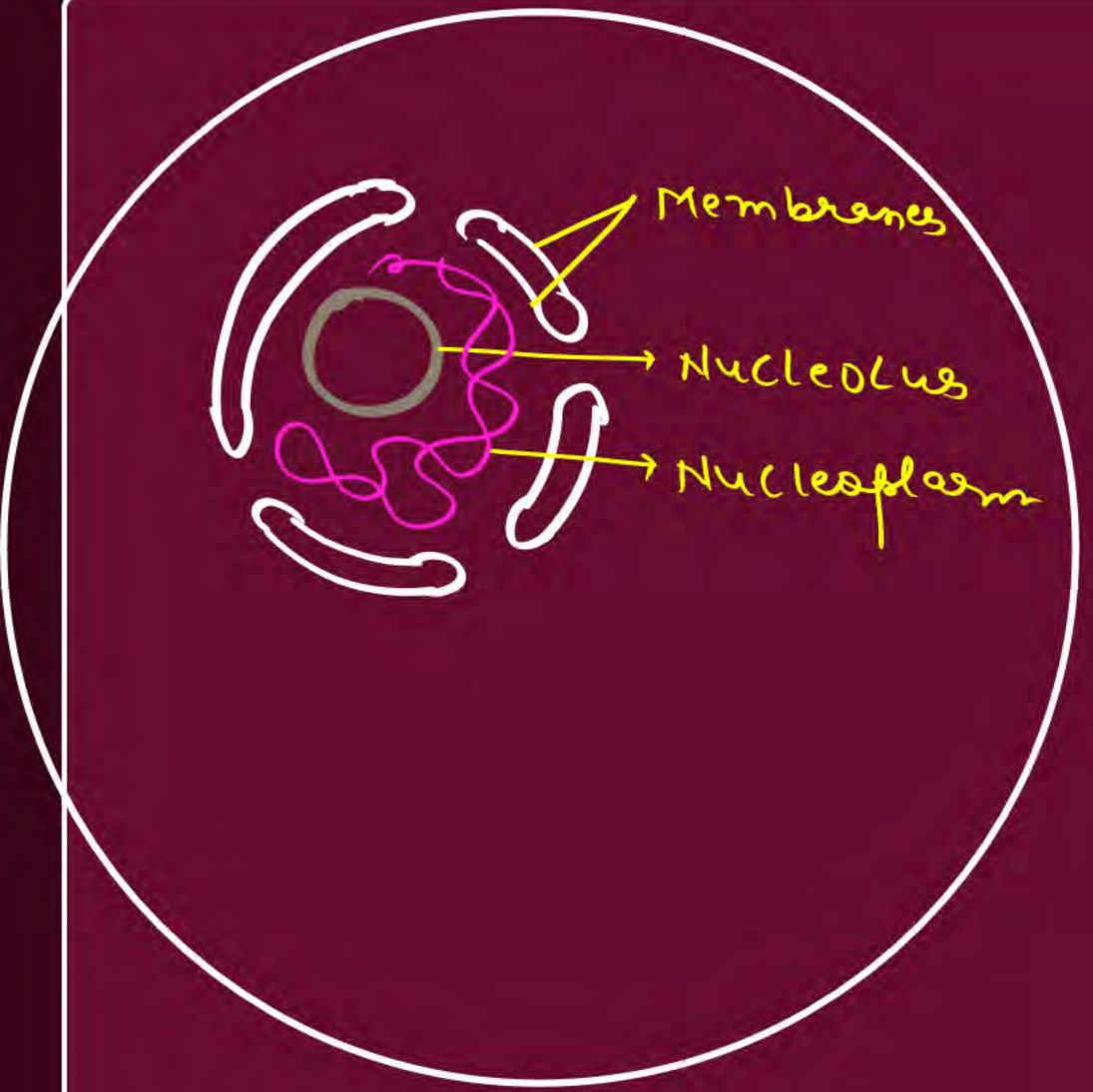
Contents of the Nucleus

Chromosomes
- Composed of DNA and proteins.
- Contain genetic information for inheritance.

genes

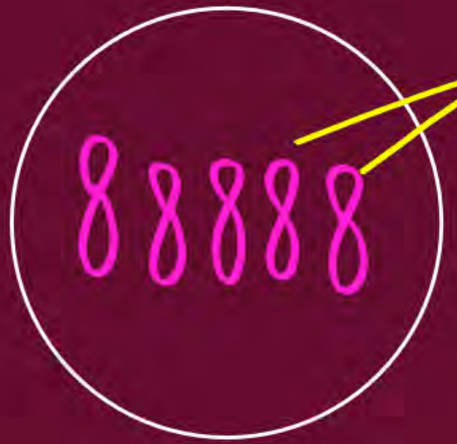
DNA (Deoxyribonucleic Acid)
- Molecule containing genetic instructions for the development, functioning, and reproduction of all living organisms.
- Functional segments of DNA are called genes.

Chromatin
- In a non-dividing cell, DNA exists as chromatin material.
- Appears as an entangled mass of thread-like structures.
- Condenses into chromosomes when the cell prepares to divide.



→ Chromatin
(Scattered DNA)

(Condensed DNA)



→ Chromosome

→ DNA

→ Protein

DNA

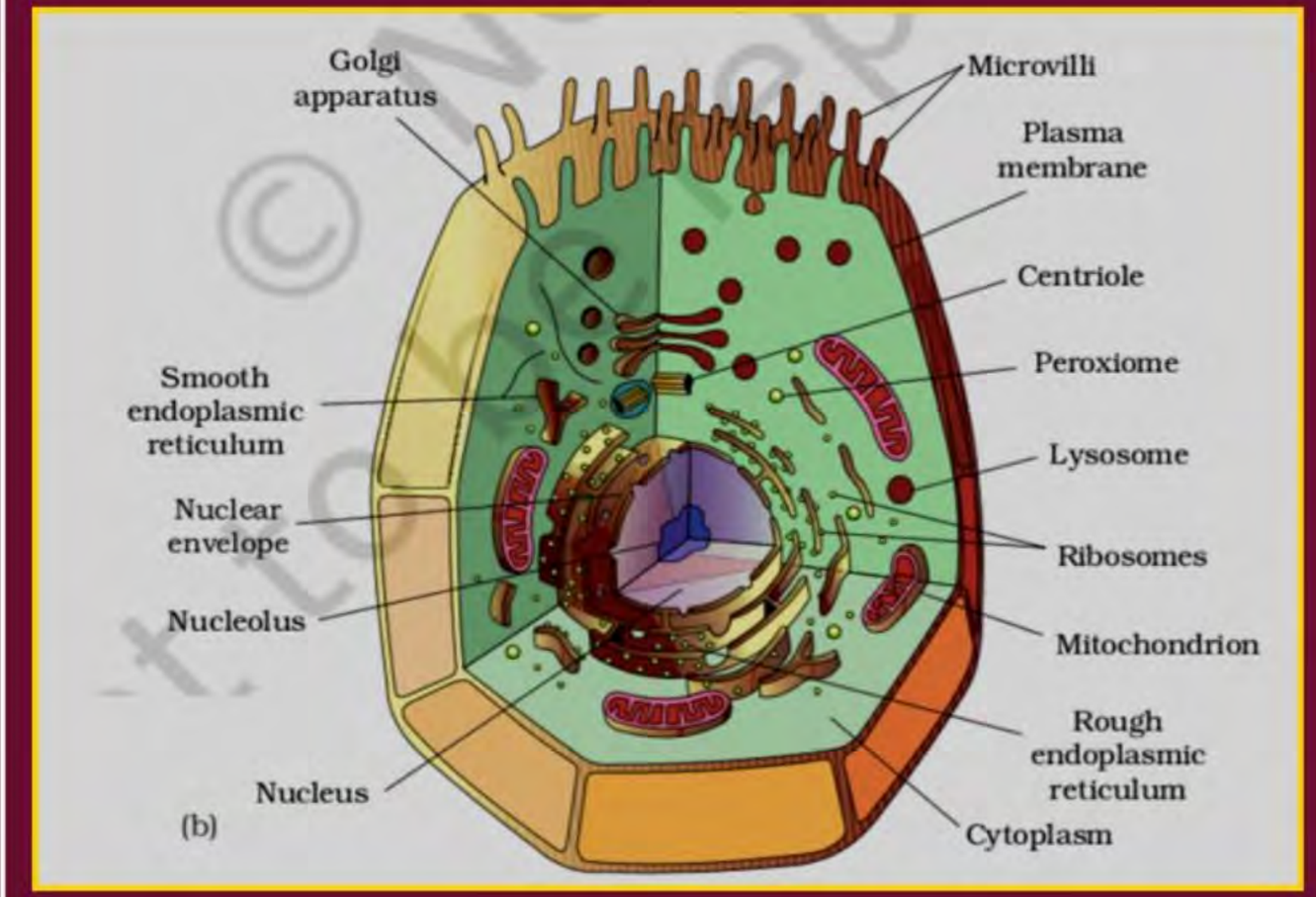
(i) coiling

(ii) Condensation

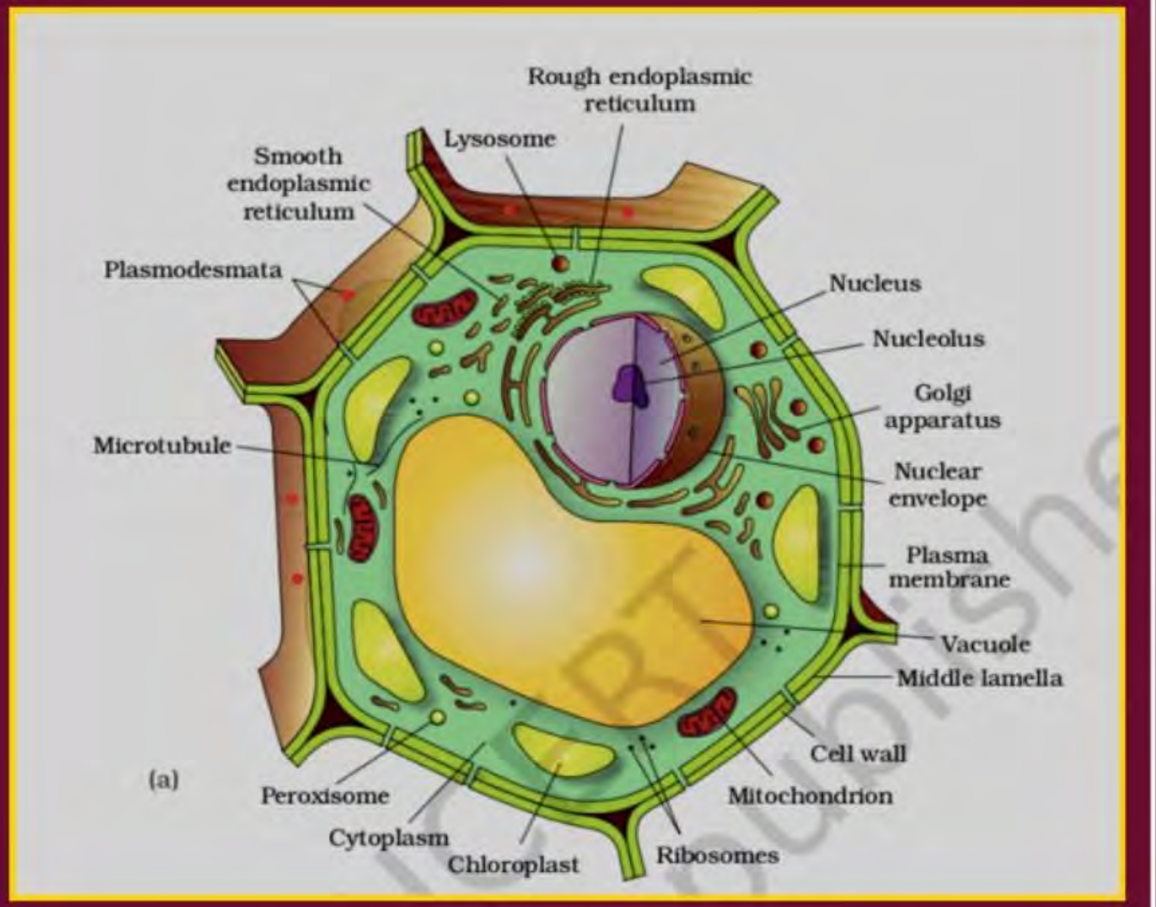
PROKARYOTIC CELLS VS EUKARYOTIC CELLS

Feature	Prokaryotic Cells	Eukaryotic Cells
Nucleus	Absent; genetic material located in a nucleoid region	Present; Well-defined membrane-bound nucleus containing DNA
Organelles	Lack membrane-bound organelles (Ribosome – ✓, Absent)	Contain membrane-bound organelles (e.g., mitochondria, chloroplasts)
Size	Generally smaller (1–10 µm)	Generally larger (5–100 µm)
Chromosome	Single	More than one
Examples of Organisms	Bacteria	Plants, animals, fungi, protists

PROKARYOTIC CELLS VS EUKARYOTIC CELLS



Animal Cell



Plant Cell

ENDOPLASMIC RETICULUM

(A large network of membrane-bound tubes and sheets in the cytoplasm)

Rough Endoplasmic Reticulum (RER)

Structure:
Appears rough due to the presence of ribosomes attached to its surface.

Function:
- Proteins are synthesised and transported to various parts of the cell using the RER.

Smooth Endoplasmic Reticulum (SER)

Structure:
Appears smooth due to the absence of ribosomes.

Function:
- Lipid Synthesis: Involved in the production of fats molecules or lipids.
- Detoxification: Detoxifies harmful substances, especially in liver cells of vertebrates.

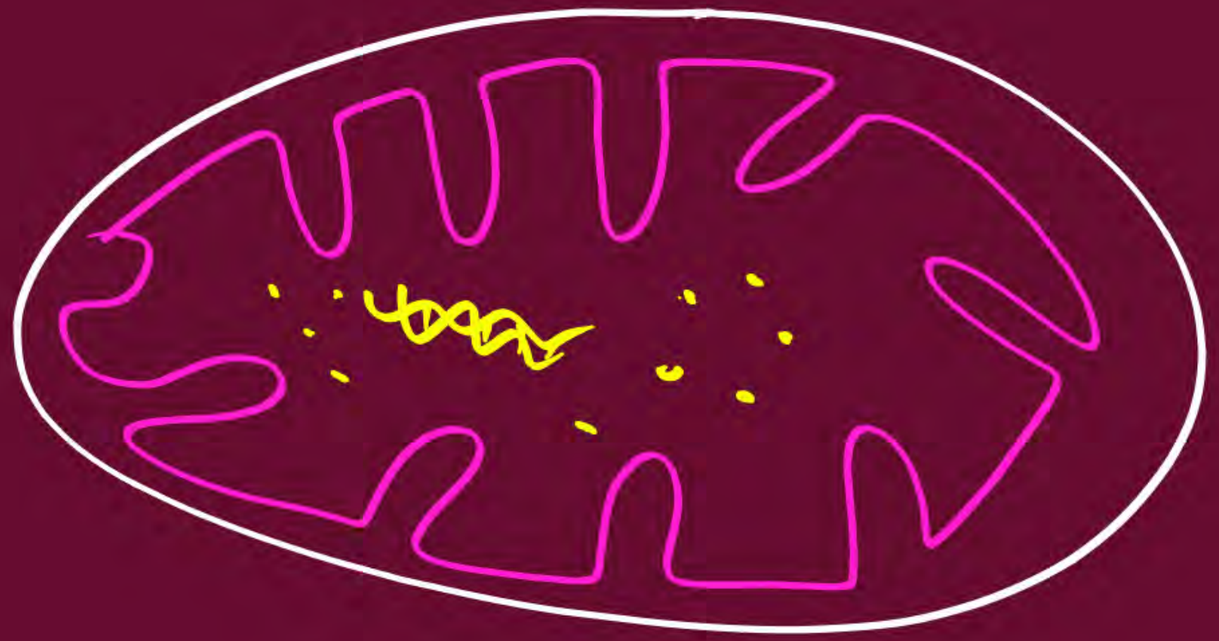

RER
SER

DIFFERENT CELL ORGANELLES: STRUCTURE AND FUNCTION

Organelle	Structure	Function
Golgi Apparatus	• Stacks of membrane-bound vesicles (cisternae) • Often have connections with the membranes of ER	• Packaging and Dispatch: Receives synthesized material from the ER and directs it to various targets inside or outside the cell. • Storage: Stores proteins and lipids synthesized by the cell. • Modification: Modifies proteins and lipids. • Lysosome Formation: Plays key role in the formation of lysosomes.
Lysosomes	• Membrane-bound sacs filled with digestive enzymes made by the RER.	• Digestion: Break down foreign materials (e.g., bacteria, food) and worn-out organelles. • Enzyme Action: Break complex substances into simpler ones. • Self-digestion: Lysosomes can digest their own cell if damaged ("suicide bags").
Vacuoles	• Membrane-bound sacs • large sized in in plant cells	• Turgidity and rigidity: Vacuoles provide structural support to plant cells. • Storage: Store amino acids, sugars, organic acids, and proteins. • Food vacuoles: In unicellular organisms like Amoeba, store ingested food. • Excess water and waste removal: Specialized vacuoles expel excess water and wastes in some unicellular organisms.

DIFFERENT CELL ORGANELLES: STRUCTURE AND FUNCTION

Organelle	Structure	Function
Mitochondria	• Double membrane: outer membrane is porous, inner membrane is folded (cristae). • Have their own DNA and ribosomes so it can produce their own protein.	• ATP production: Generate energy through cellular respiration, producing ATP Adenosine Triphosphate.
Ribosomes	• Small, spherical • Found free in the cytoplasm or attached to rough ER	• Sites of protein manufacture



PLASTID

(Double-membrane bound organelles found in the cells of plants)

Chromoplasts
(Colored plastid)

Function: Provide color to flowers, fruits, and some leaves.

Chloroplasts → food, → oxygen

- Contain the green pigment chlorophyll.
- Important for photosynthesis in plants.
- Besides chlorophyll, it also contains yellow and orange pigments.
- Consists of numerous membrane layers embedded in the stroma.
- Have their own DNA and ribosomes.

Leucoplast
(Colorless plastids)

Function: Primarily responsible for storage of substances.

Types of substances stored

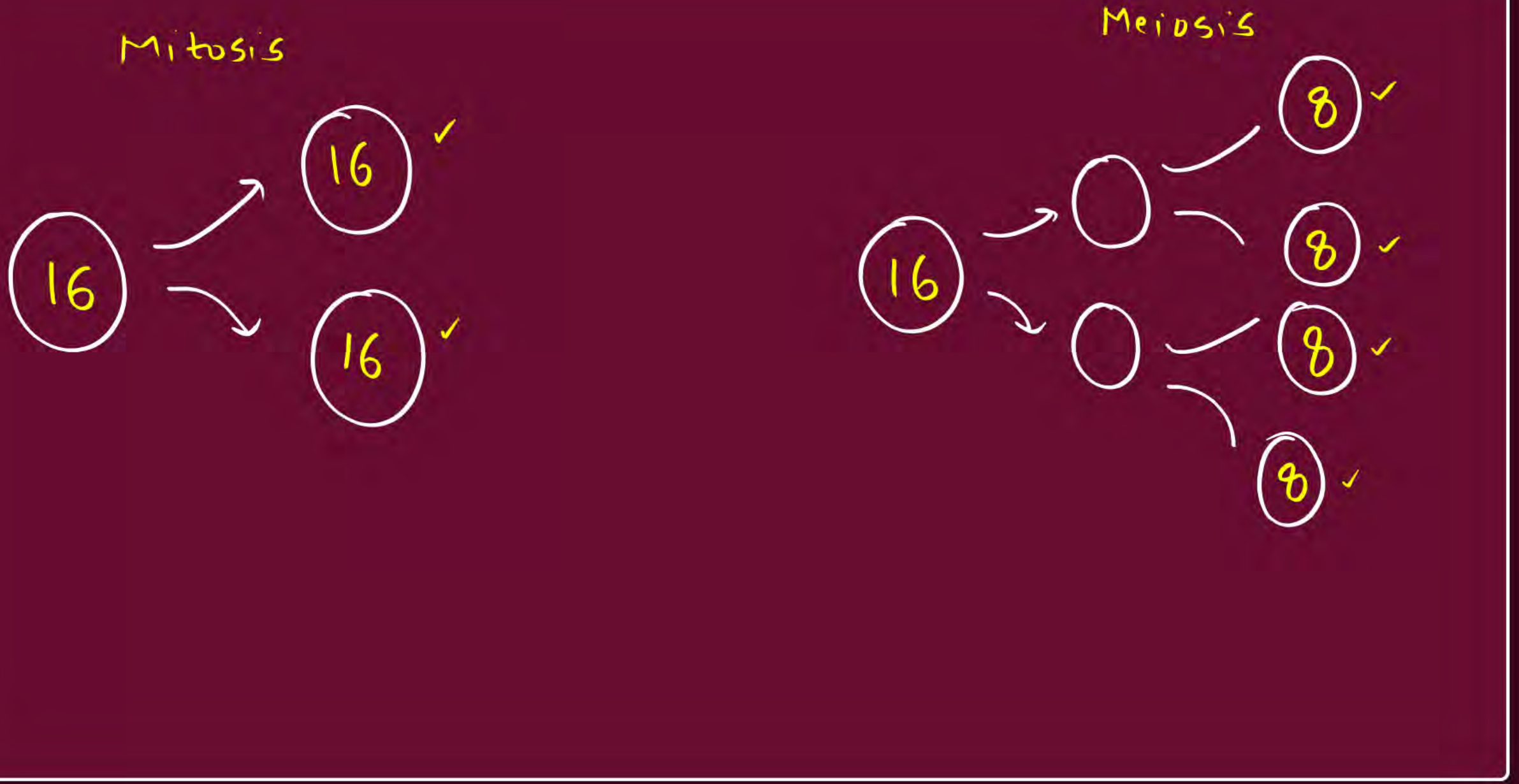
- Starch
- Oils
- Protein granules

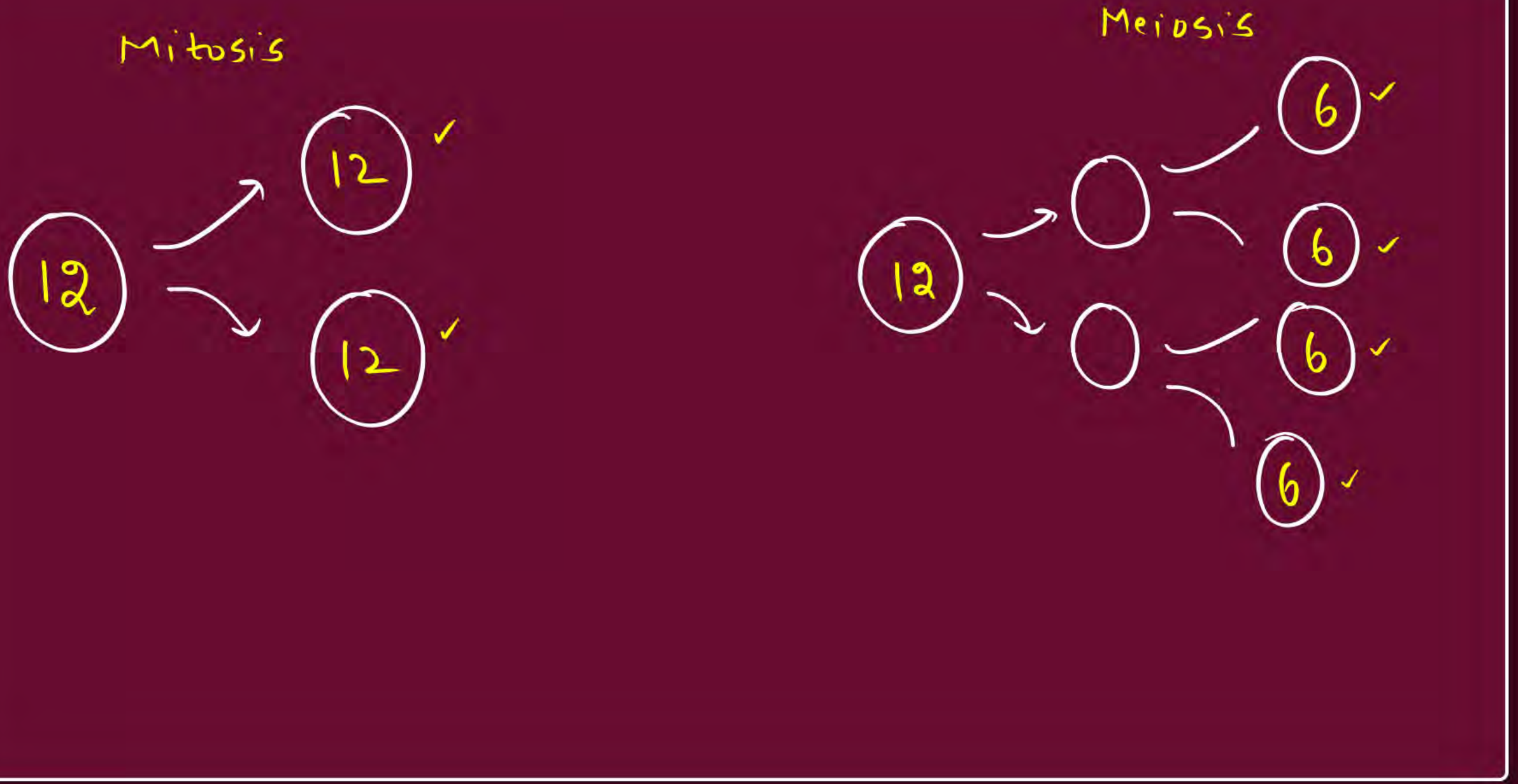
PLANTS CELLS VS ANIMAL CELLS

Feature	Plant Cells	Animal Cells
Cell Wall	Present; made of cellulose providing structural support	Absent
Chloroplasts	Present; contain chlorophyll for photosynthesis	Absent
Central Vacuole	Large and prominent, used for storage and maintaining turgor	Small or absent
Centrioles	Plants, animals, fungi, protists	Bacteria

MITOSIS VS MEIOSIS

Feature	Mitosis	Meiosis
Definition	The process of cell division that results in two identical daughter cells with the same chromosome number as the parent cell	The process of cell division that reduces the chromosome number by half, resulting in four daughter cells
Number of Division	One division	Two consecutive divisions (Meiosis I and II)
Genetic Variation	Daughter cells are genetically identical to the parent cell	Daughter cells are genetically different from each other and the parent cell
Occur in	Somatic (body) cells	Germ cells (reproductive cells)


Mitosis
16
16
16
Meiosis
16
8
8
8
8


Mitosis
12
12
12
Meiosis
12
6
6
6
6

Which cell organelle is known as the "powerhouse of the cell”?

#H.W

A Nucleus

B Golgi apparatus

C Mitochondria

D Ribosome

Which organelle is responsible for packaging and transporting materials within the cell?

A Endoplasmic reticulum

B Lysosome

C Golgi apparatus ✓

D Vacuole

What is the function of ribosomes?

A DNA replication

B Energy production

C Protein synthesis

D Lipid synthesis

Which of the following is present only in plant cells , not in animal cells?

A Nucleus

B Mitochondria

C Cell wall

D Ribosome

Which organelle helps in the synthesis of lipids and detoxification?

A Rough Endoplasmic Reticulum

B Smooth Endoplasmic Reticulum

C Golgi apparatus

D Ribosome

Which of the following is a single membrane-bound organelle?

A Nucleus (2)

B Mitochondria (2)

C Lysosome ✓ (1)

D Chloroplast (2)

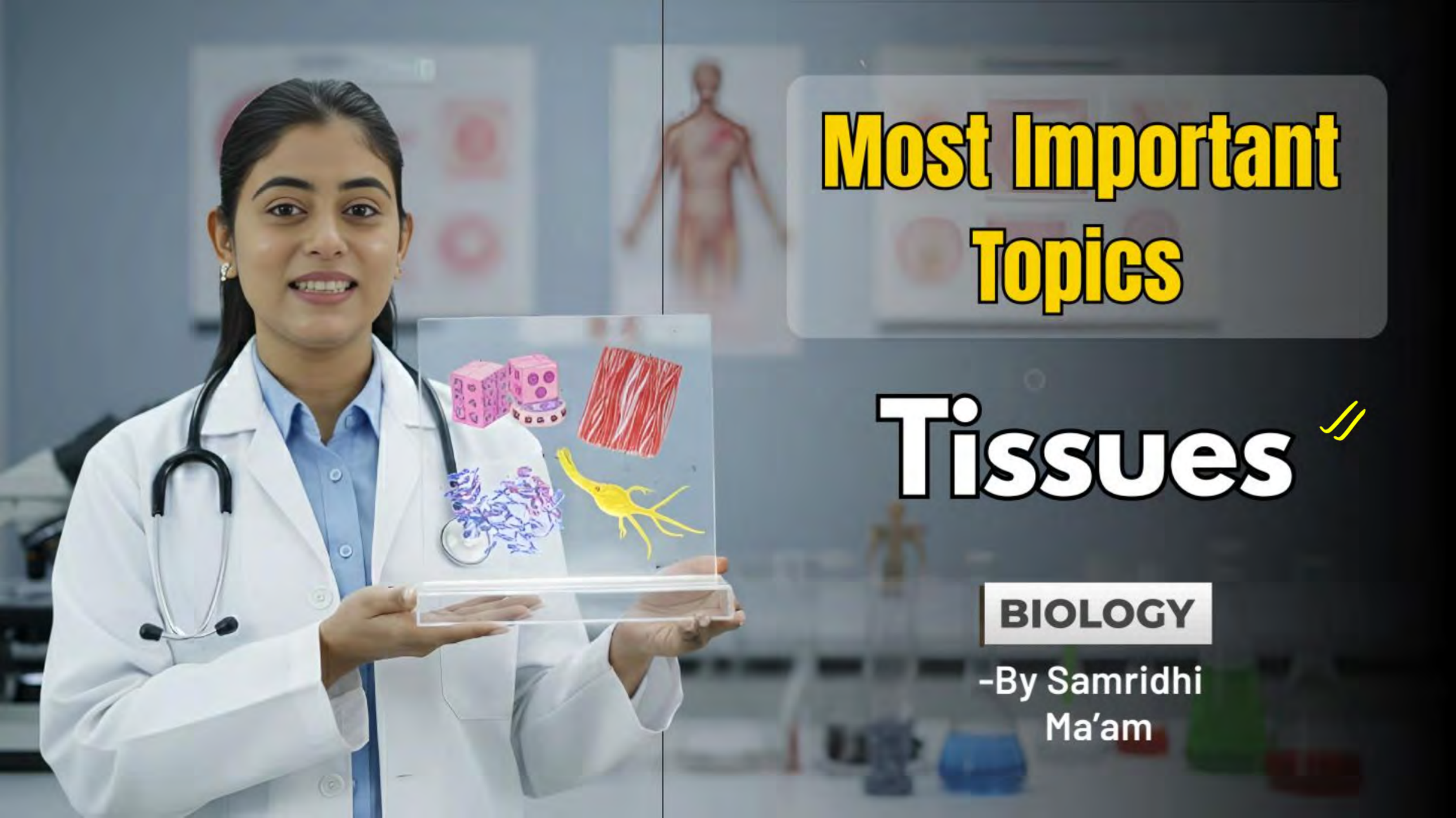
Which of these can be observed in both plant and animal cell?

A cell wall

B ribosomes

C nuclei

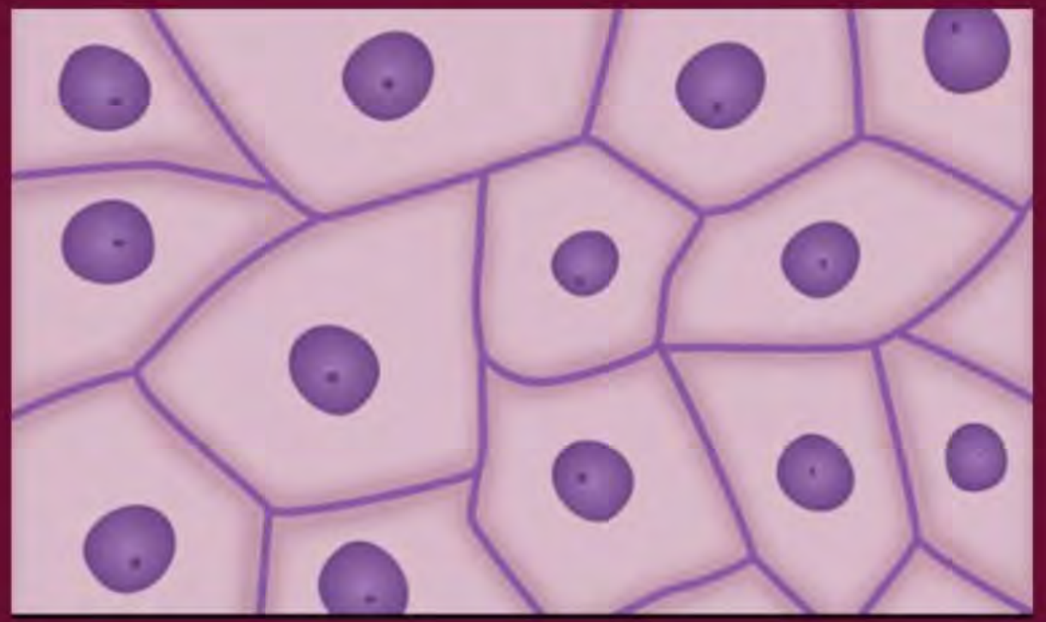
D both A and B


Most Important Topics
Tissues
BIOLOGY
-By Samridhi Ma'am

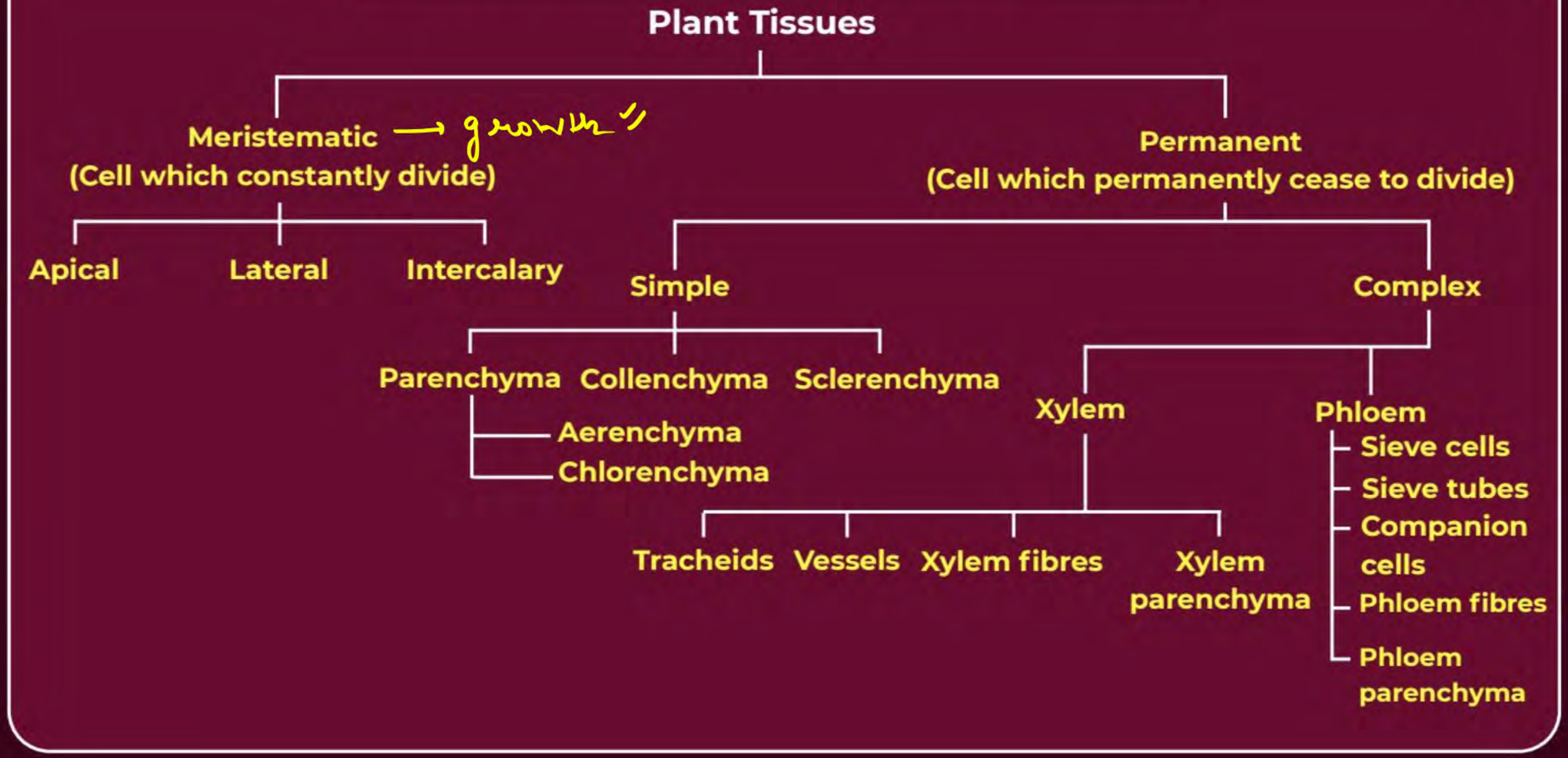
WHAT IS A TISSUE?

- Group of similar cells having common origin working together is known as tissue.
- Tissue ensures Division of labour

#Histology



PLANT TISSUES CLASSIFICATION

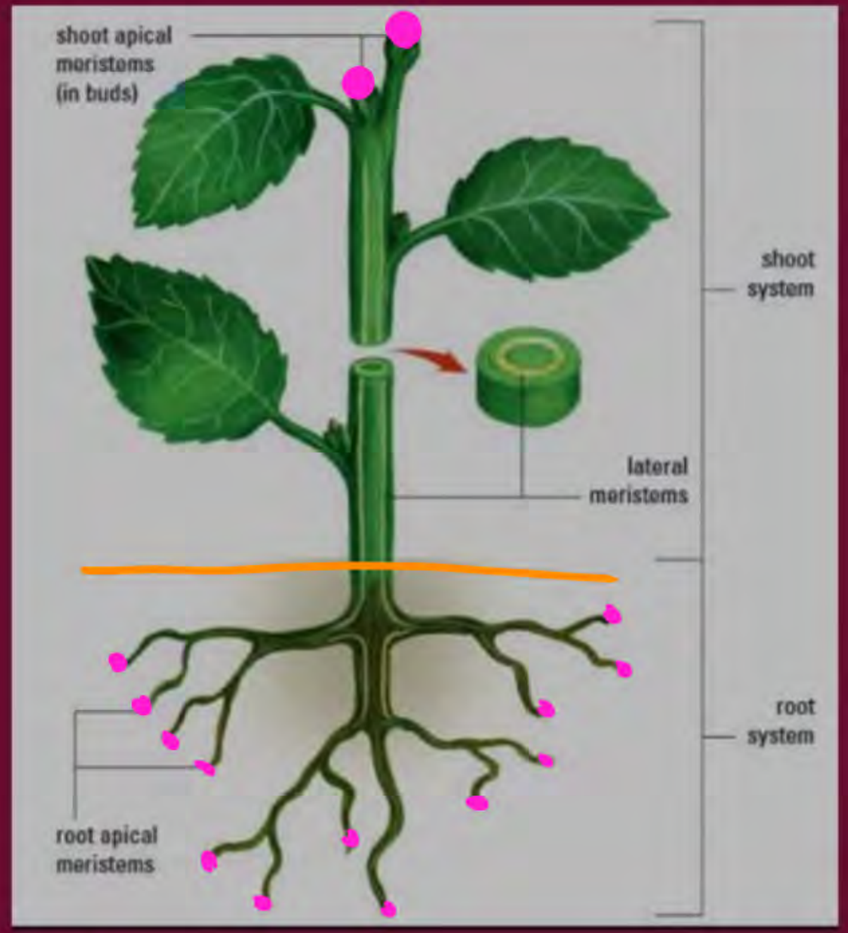


MERISTEMATIC VS PERMANENT TISSUES

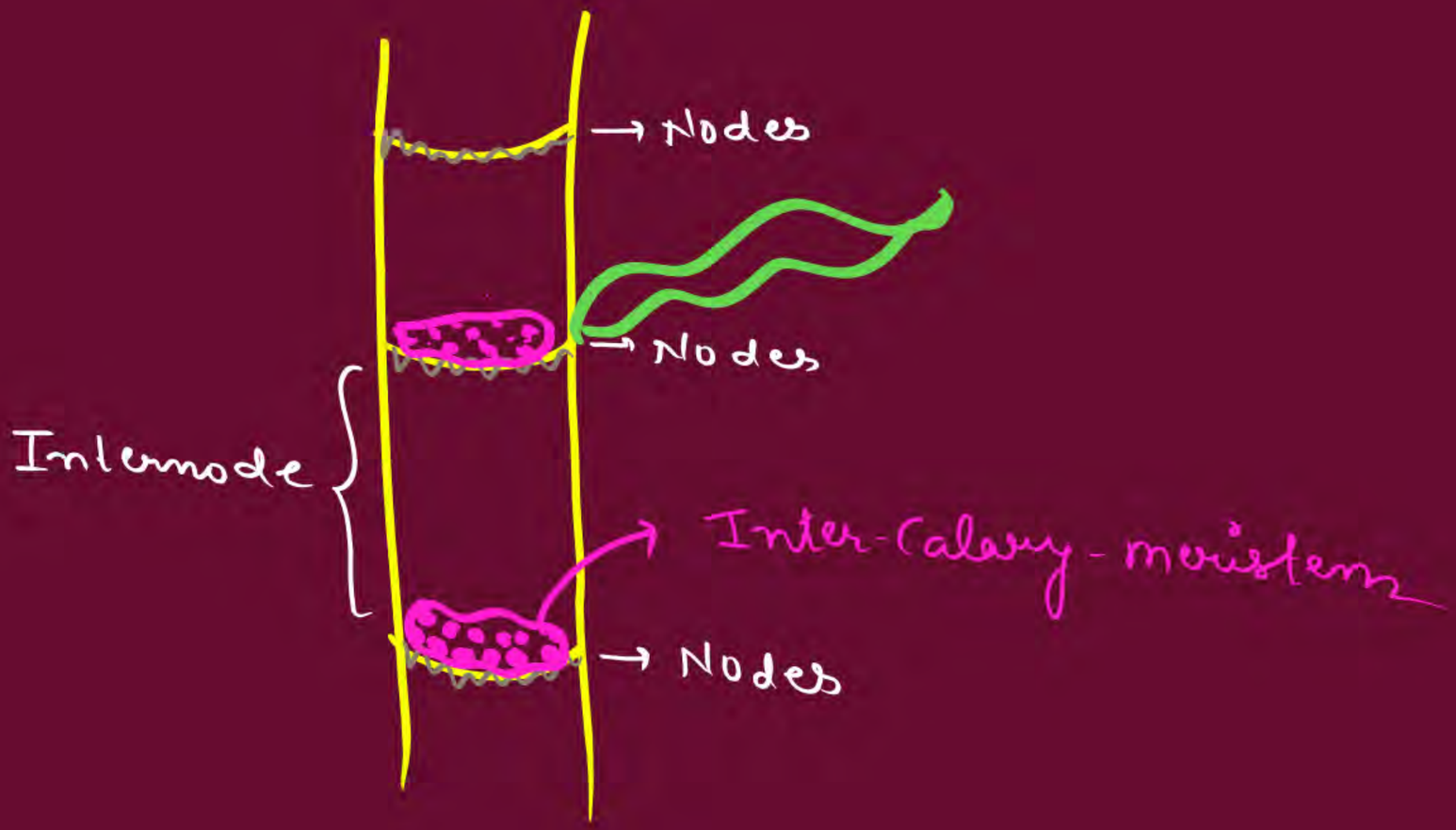
Aspect	Meristematic Tissue	Permanent Tissue
Cell Division	Actively dividing undifferentiated cells	Cells are fully differentiated and lose the ability to divide
Location	Apical (growing tip of stem, roots), lateral, intercalary (near node)	Various specific locations
Function	Growth and development	Specific roles (e.g., support, storage)
Cell Structure	Dense cytoplasm, thin cellulose walls, prominent nuclei	Cell wall may be thin or thick
Vacuoles	Lacks vacuoles	Present in various forms

APICAL MERISTEM VS INTERCALARY MERISTEM VS LATERAL MERISTEM

	Apical meristem	Intercalary meristem	Lateral meristem
Location	Tips of stem and roots	Near the node	Sides of roots and stems
Function	Increases the length of the stem and the root	Increase length between nodes	Increases the girth of the stem or root

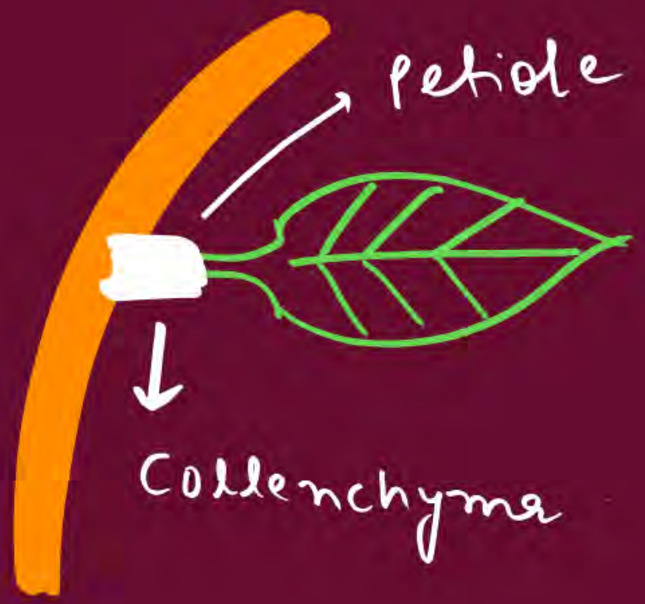


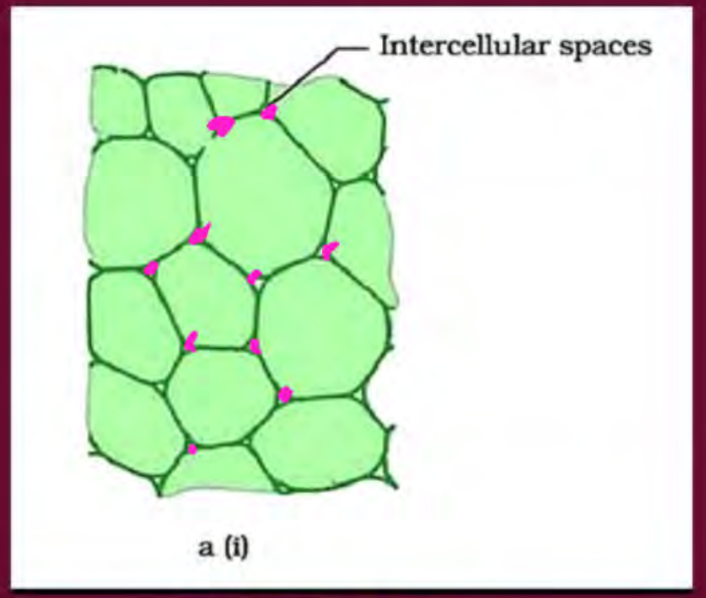
RAM


Nodes
Nodes
Internode
Inter-Calary-meristem
Nodes

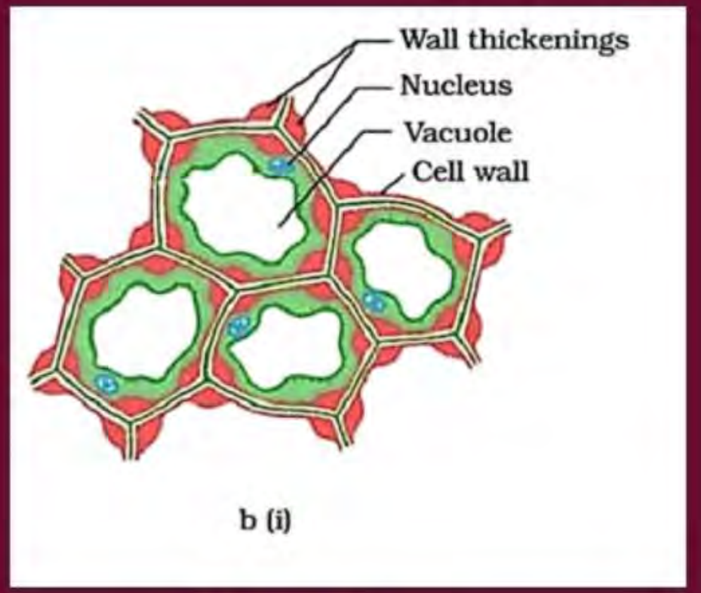
CLASSIFICATION OF SIMPLE PERMANENT TISSUES

Characteristic	Parenchyma (L)	Collenchyma (L)	Sclerenchyma (D)
Cell Type	It consists of unspecialised living cells	It consists of elongated living cells	It consists of long and narrow, dead cells
Cell Walls	Thin	Unevenly thickened at corners	Thickened with lignin
Intercellular Spaces	Large intercellular spaces	Very little intercellular space	Often no intercellular space
Functions	Storage of food, photosynthesis (chlorenchyma), flotation (aerenchyma)	Flexibility, mechanical support	Strength and rigidity, providing support
Location	All parts ~~Beneath epidermis, in various plant parts~~	Leaf stalks below epidermis, tendrils, stems of climbers	Stems, around vascular bundles of leaves, veins, hard seed and nut coverings

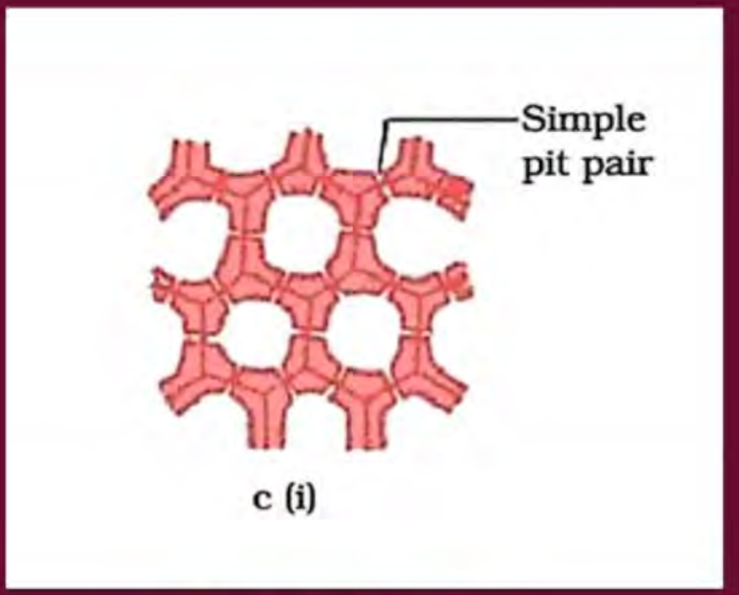

petiole
Collenchyma



Parenchyma



Collenchyma



Sclerenchyma

- Chlorenchyma : photosynthesis
- Aerenchyma : floating of plants

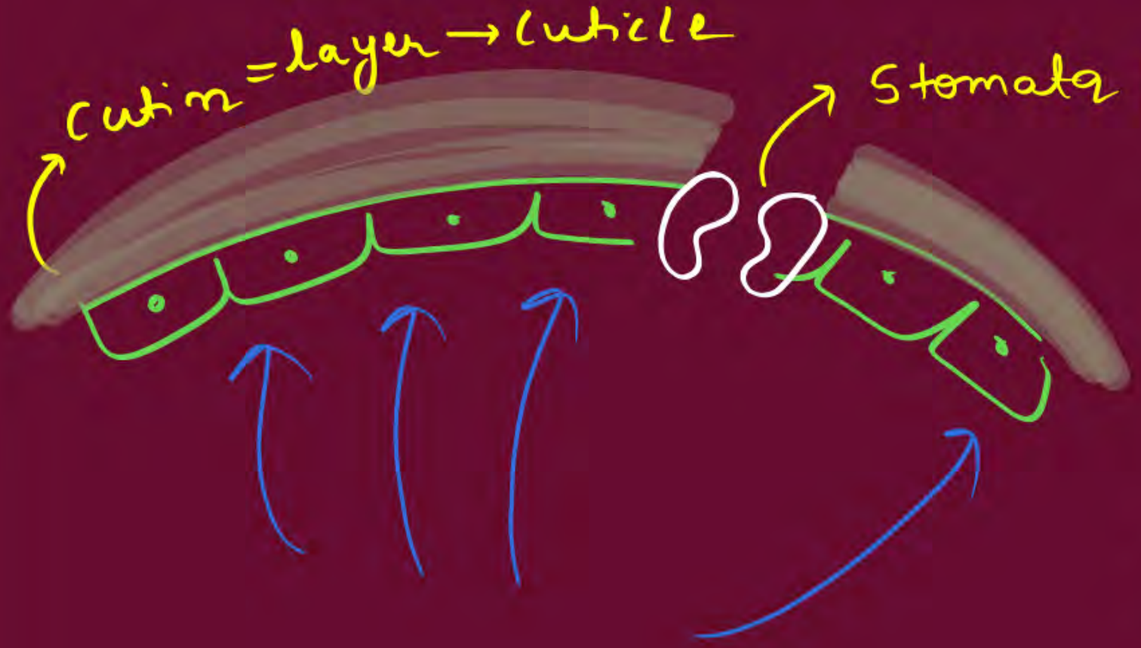
SIMPLE VS. COMPLEX PERMANENT TISSUES

Aspect	Simple Permanent Tissues	Complex Permanent Tissues
Cell Type	Made up of one type of cell	Made up of multiple types of cell
Examples	Parenchyma, Collenchyma, Sclerenchyma	Xylem, Phloem
Location	Present in all parts of plant	Limited to vascular regions of plant
Role in Plant	Food storage, support, flexibility	Conduction of water and nutrients throughout the plant body

XYLEM VS PHLOEM

Xylem	Phloem
Dead tissue	Living tissue
Dead: Tracheids, Vessels, Xylem fibres Living: Xylem parenchyma	Living: Sieve tubes, Companion cells, Phloem parenchyma Dead: Phloem fibres
Transports water and minerals (Ascent of sap)	Transports food material (Translocation)
Transport of water by xylem is unidirectional (upwards only)	Translocation is bidirectional (both upwards and downwards)

PROTECTIVE TISSUE : EPIDERMIS



Epidermis

- Epidermis provides protection to plants from injury, pathogen attack and water loss.
- Thick cuticle of epidermis lowers the rate of transpiration and prevents loss of water in xerophytes.
- Stomata in epidermis allows gaseous exchange to occur during respiration and photosynthesis.
- Epidermal cells of roots helps in better absorption by increasing surface area.

PROTECTIVE TISSUE : CORK

Bark
↓
Outer layer
↓
Cork
↓
dead

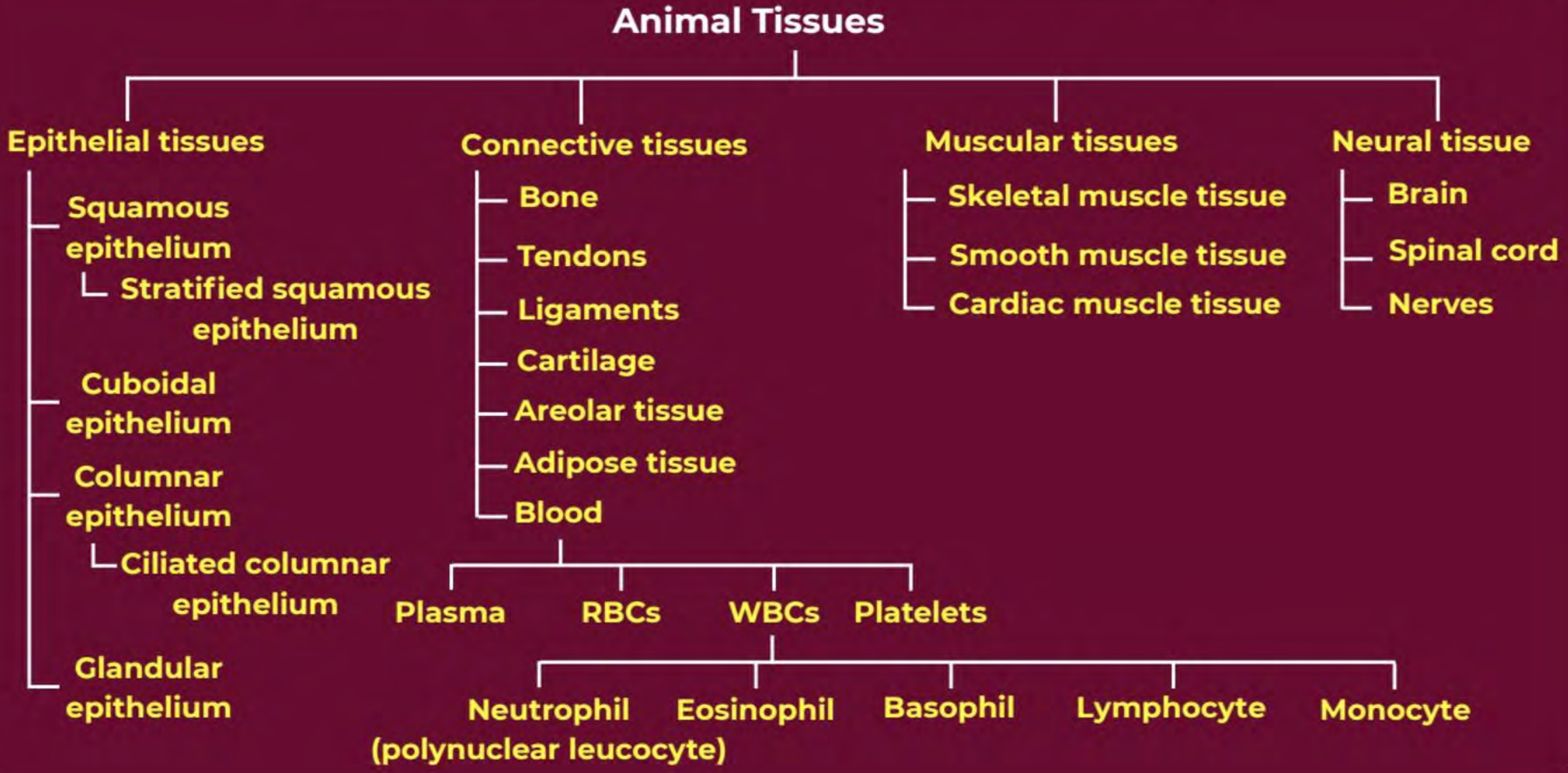
Cork
↓
Cell

Cell Wall
↓
Suberin

CORK

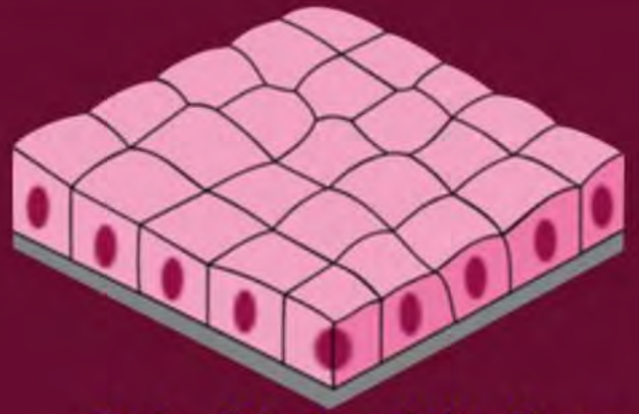
- Cells compactly arranged (intercellular space absent)
- Cell wall made up of : Suberin
- Impermeable /impervious to water and gases
- Cork prevents mechanical injury and loss of water.
- Cork is used in the making of many products such as bottle stoppers, shuttle cock, wooden paddles etc.

ANIMAL TISSUES CLASSIFICATION

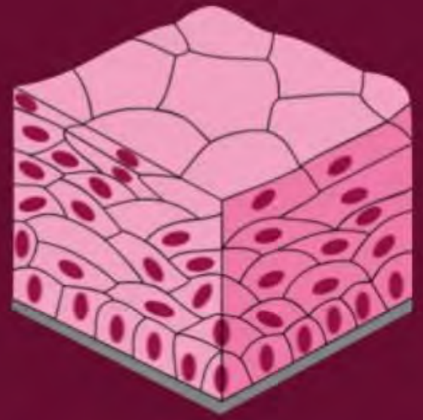


EPITHELIAL TISSUE

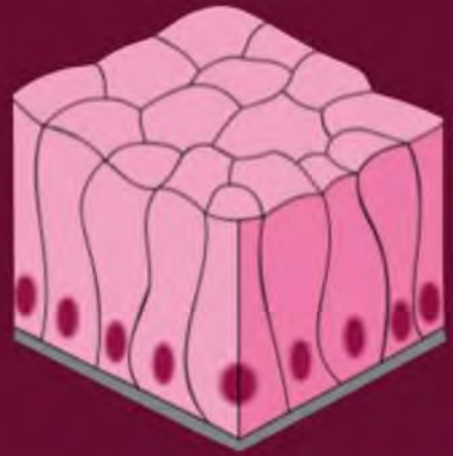
Squamous epithelium



Cuboidal epithelium



Stratified squamous epithelium

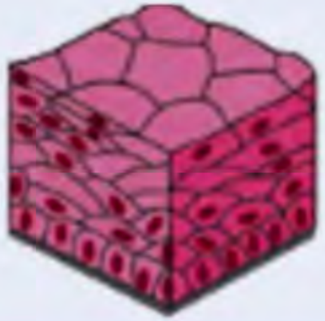


Columnar epithelium

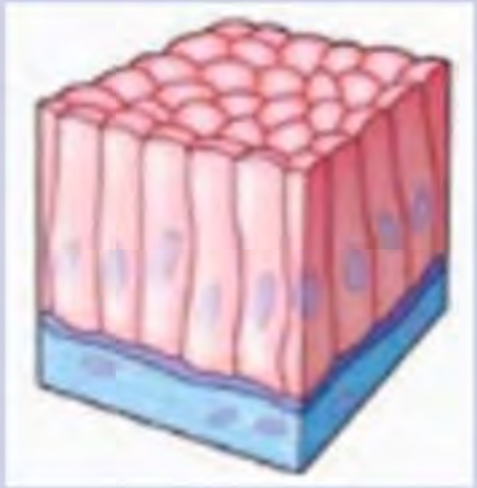
Simple

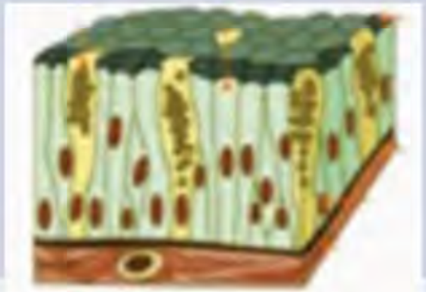
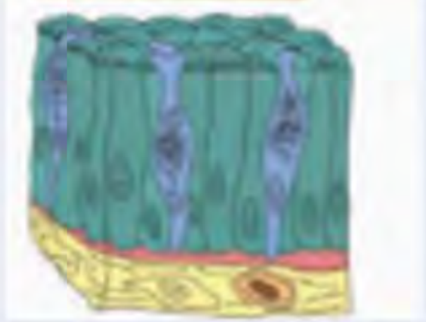
Stratified

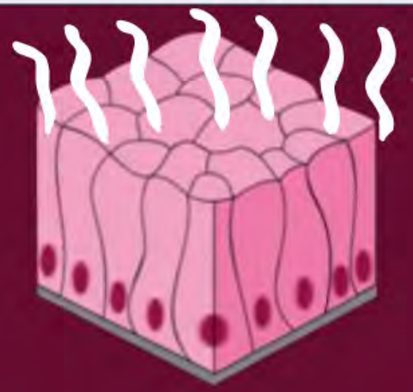
TYPES OF EPITHELIAL TISSUE

Name	Appearance (diagrammatic)	Location	Structure	Function
Squamous epithelium		Inner surface of mouth, oesophagus, blood-vessels, alveoli	Thin, small, flat cells form semipermeable membrane	Selective transport of substances
Stratified squamous epithelium		Skin	Many layers of cells	Preventing of wearing of organs, protection of organs

TYPES OF EPITHELIAL TISSUE

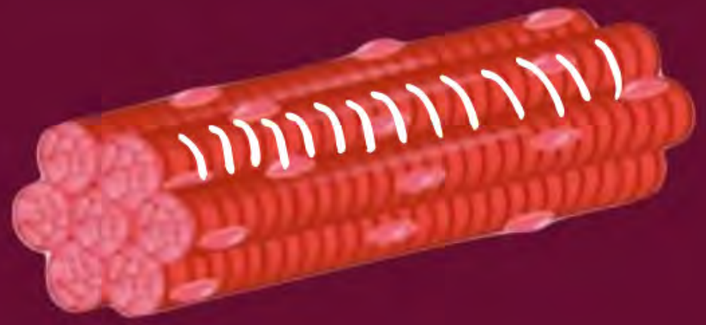
Name	Appearance (diagrammatic)	Location	Structure	Function
Columnar epithelium		Small Intestine, alimentary canal	Column-like tall cells	Secretion of digestive juice, absorption of nutrients
Cuboidal epithelium		Tubules of kidney (nephron), salivary gland	Cells are cuboidal	Reabsorption of useful materials from urine, secretion of saliva

Name	Appearance (diagrammatic)	Location	Structure	Function
Glandular epithelium		Inner layer of skin, etc.	Cells contain material which is secreted	Secretion of sweat, oil (sebum), mucus, etc.
Ciliated epithelium		Inner surface of respiratory tract	Upper free surface of cells bears minute hair-like processes	Push mucus and air forward to keep the air passage free

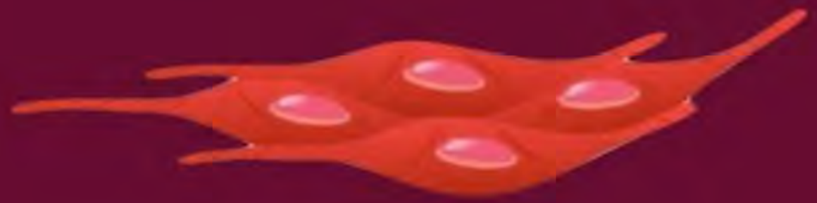


Ciliated Columnar epithelium

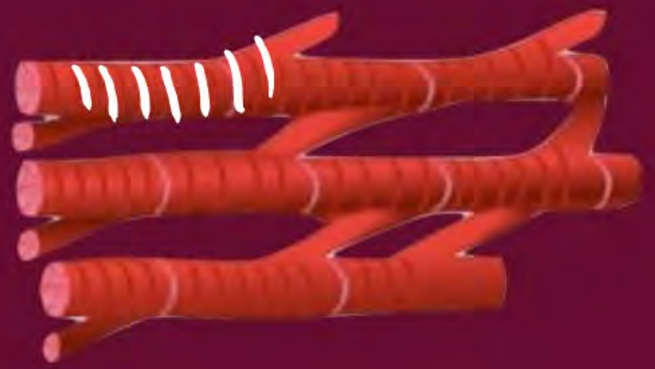
TYPES OF MUSCLE



Skeletal /Striated / voluntary muscles



Smooth /Non Striated / Involuntary muscles



Cardiac muscles (Involuntary muscles)

STRIATED MUSCLES VS. SMOOTH MUSCLES VS. CARDIAC MUSCLES

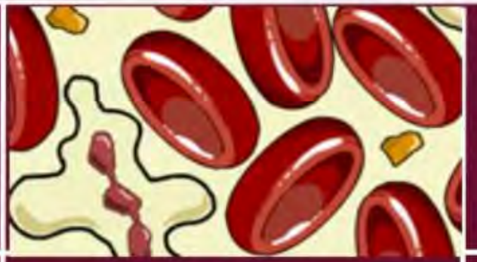
Feature	Striated Muscles	Smooth Muscles	Cardiac Muscles
Shape of cells	Long, cylindrical, unbranched	Spindle-shaped	Cylindrical and branched
Number of Nuclei	Multinucleate	Uninucleate	Uninucleate
Position of Nuclei	Peripherally located	Centrally located	Centrally located
Striations	dark and light bands (striations) present	absent	very light /faint dark and light bands (striations) present
Location	attached to bones; limbs neck face tongue	oesophagus trachea small intestine blood vessels iris of eye	heart

CONNECTIVE TISSUE

- Bind body parts together
- Serves as framework
- Fills space
- Store fats
- Protection against infections

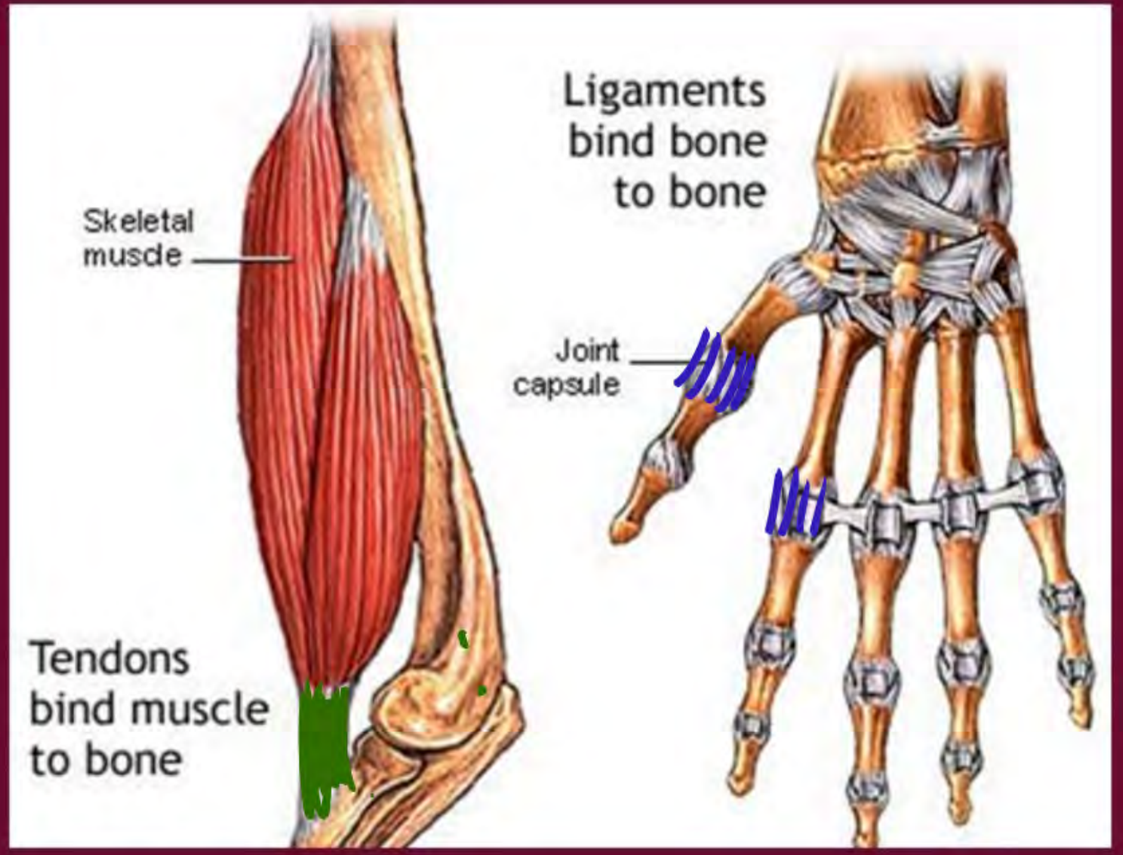
BLOOD

- Blood is fluid connective tissue
- Blood flows and transports gases, digested food, hormones and waste materials to different parts of the body.
- Blood provides protection

Plasma		Transportation of Digested food, CO_2 Waste, Hormones
Red blood cells		Hemoglobin in RBC helps in Oxygen transport
White blood cells		Produce antibody to kill pathogen
Platelets		Clotting of blood

LIGAMENTS VS TENDONS

Feature	Ligaments	Tendons
Connection	Connect bones to bones	Connect muscles to bones
Elasticity	Highly elastic	Limited flexibility
Strength	Considerable strength	Great strength
[illegible]	[illegible]	[illegible]

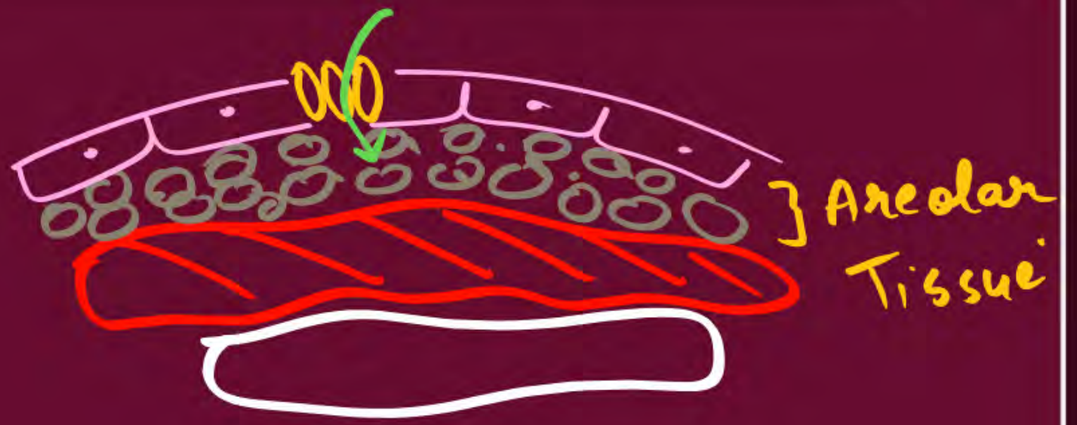


BONE VS CARTILAGE

Bone	Cartilage
Hard and non-flexible	Flexible not very hard
Porous	Non-porous
Blood vessels present	Blood vessels absent
Matrix made up of protein and mineral salts (Calcium & phosphorus)	Matrix made up of proteins
• It provides skeletal support to body • It provides shape to the body • It protects vital body organs such as brain, Lungs etc.,	• It provides support and flexibility to the body parts • It smoothens bone surfaces at joints

AREOLAR TISSUE

- Found between the skin and muscles, around blood vessels and nerves and in the bone marrow. It fills the spaces between different tissues and organs, hence called packing tissue.
- It helps in repair of tissues after an injury.
- It helps in fighting against foreign substances and toxins.

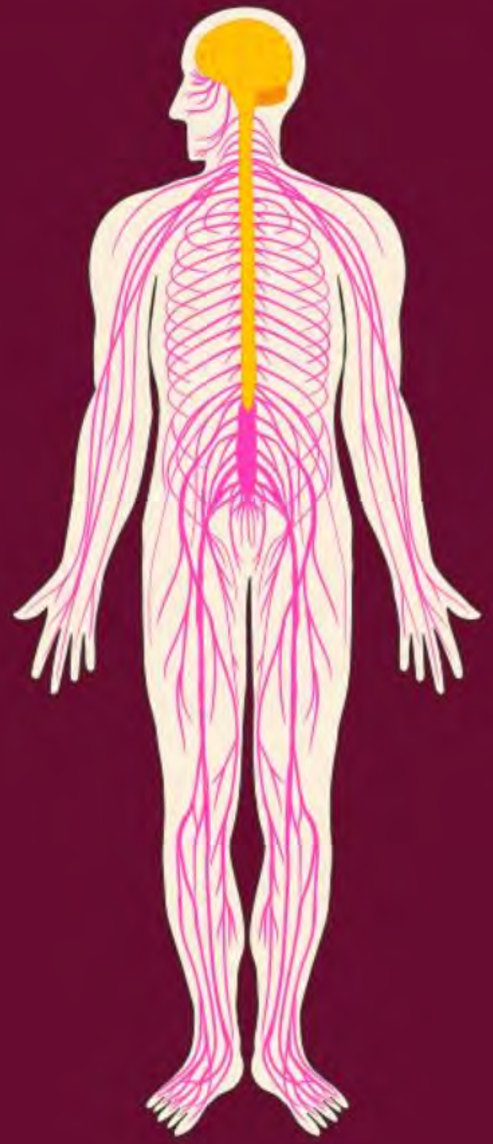


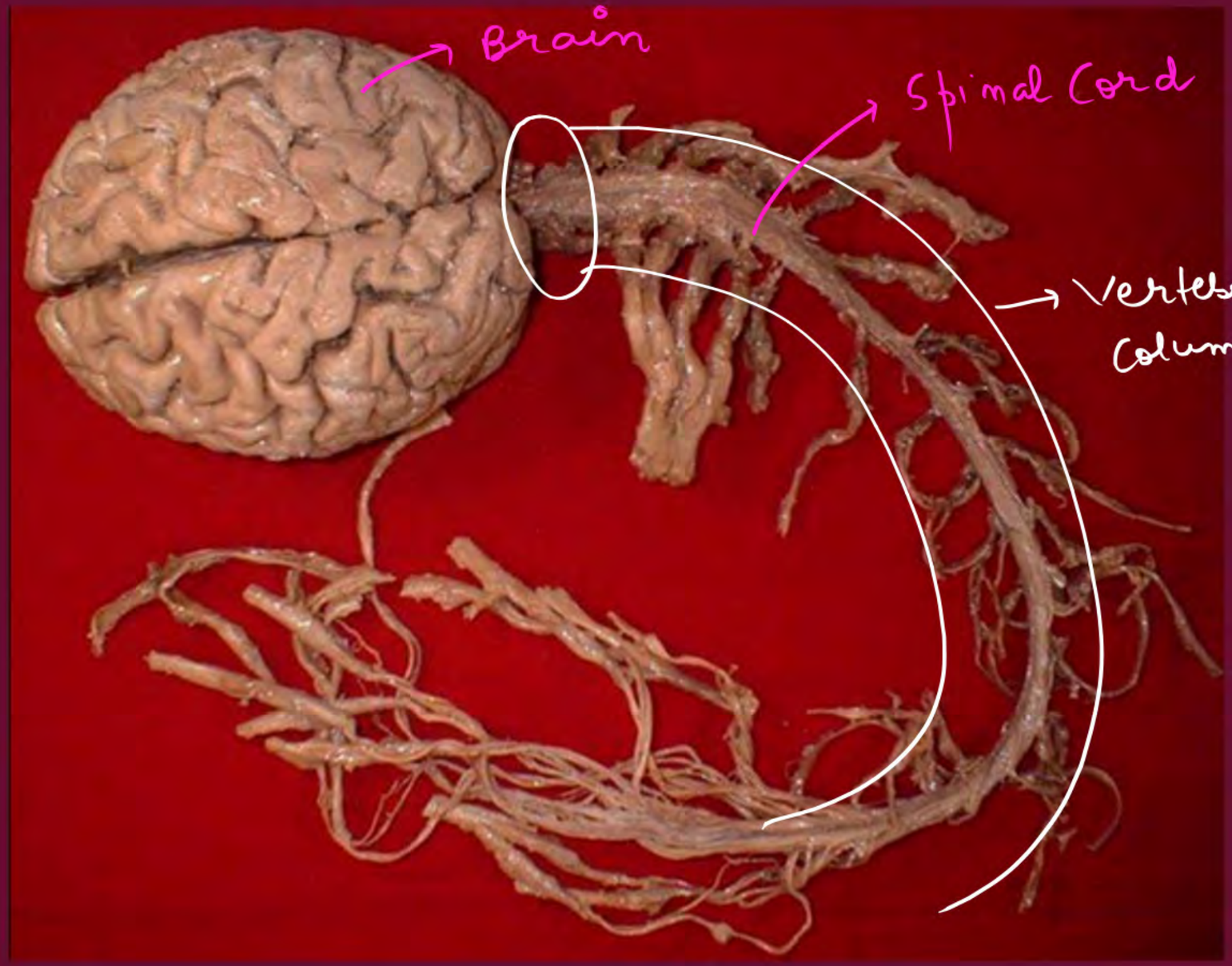
ADIPOSE TISSUE

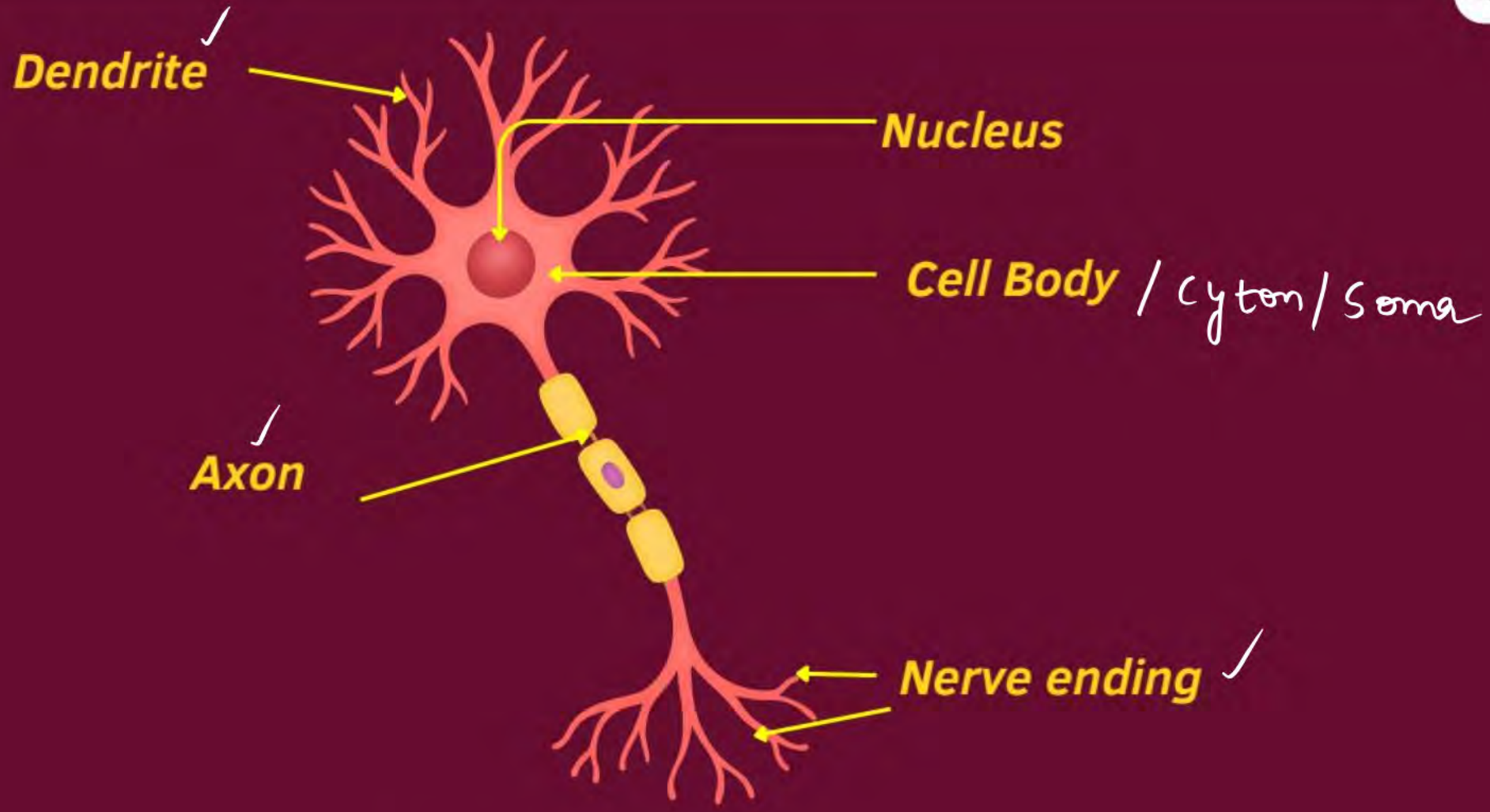
- It consists of a large number of oval and rounded adipose cells (adipocytes) filled with fat globules.
- Excess nutrients are converted into fats and stored in this tissue.
- The adipose tissue is abundant below the skin, between the internal organs (e.g., around the kidney).

NERVOUS TISSUE

- Neuron is a highly specialized cell.
- Responsible for the transmission of signals to and from the different parts of the body
- Structural and functional unit of nervous system
- Longest cell in human body.




Brain
Spinal Cord
Vertebral Column / Backbone



Structure of Neuron

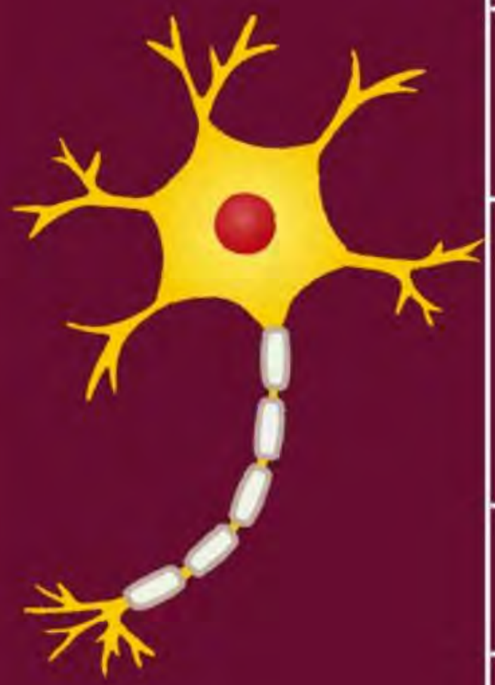
Dendrite → Cell Body → Axon → Nerve ending

Neuron
or
Nerve Cell

→ Nervous Tissue →

- Brain
- Spinal Cord

NEURON / NERVE CELL



Part	Details
Dendrites	Branched structure that collects information from previous neuron and passes on to the cell body.
Cell body	Broad, rounded part of the neuron that contains the nucleus, abundant cytoplasm (neuroplasm) and other organelles like mitochondria, endoplasmic reticulum, Golgi body etc.
Axon	Long tube-like structure that carries information from the cell body to the nerve endings .
Nerve ending	Terminal branched part of axon

Which of the following is not a simple permanent tissue?

A Parenchyma

B Collenchyma

C Sclerenchyma

D Xylem

Which plant tissue is responsible for transporting water?

A Phloem

B Xylem

C Parenchyma

D Collenchyma

Which of the following tissues in plants provides flexibility?

A Parenchyma

B Collenchyma

C Sclerenchyma

D Xylem

The phloem in plants is made up of:

A. Sieve tubes and xylem vessels

B. Sieve tubes, companion cells, phloem fibres, phloem parenchyma

C. Tracheids and vessels

D. Xylem parenchyma and fibres

Which connective tissue connects muscle to bone?

A Ligament

B Areolar

C Cartilage

D Tendon ✓

The function of cardiac muscle is:

A Movement of bones

B Movement of food in the intestine

C Pumping blood ✓

D Voluntary movement

Which of the following tissues is found in the skin of human beings?

A Muscular tissue

B Nervous tissue

C Epithelial tissue

D Cartilage

Which of the following is not a characteristic of skeletal muscles ?

A Striated appearance

B Multinucleated cells

C Voluntary control

D Found in internal organs

Which of the following tissues is non-living in plants?

A Parenchyma

B Collenchyma

C Sclerenchyma → dead

D Collenchyma


Most Important Topics
Matter in our Surroundings
Chemistry
-By Samridhi Ma'am

MATTER

What is Matter ?

Matter is anything that :

- Has Mass (weighs something
- Occupies space (takes up some volume)

	Matter
Chair & table	✓
Tree	✓
Water	✓
Air	✓
Love	✗
Almond	✓
Friendship	✗
Lemon water	✓
Hate	✗
Sand	✓
Thought/idea	✗
Smoke	✓

MATTER

Examples of Matter	Examples
Solids	 Stone  Books  Metals  Wood  Human body  Plant  Food
Liquids	 Water  milk  juice  oil  blood
Gases	 Air  oxygen  carbon dioxide  steam  smoke

CHARACTERISTICS OF PARTICLES OF MATTER

1 They have space between them.

- There is space between particles, which allows mixing or dissolving.
- Example : Salt or sugar dissolves in water.

2 They are very tiny.

- Particles are very tiny; millions can exist in a small crystal or drop.
- Examples : A few crystals of potassium permanganate can colour large amounts of water

3 They are always moving.

- Particles are always moving, and they move faster on heating. This causes diffusion.
- Example: Smell of perfume spreads in a room.

4 They attract each other.

- Particles attract each other. The force is string in solids, moderate in liquids, and weak in gases.

5 They can diffuse.

- Particles mix on their own (diffusion). It is fastest in gases, slower in liquids, and slowest in solids.
- Examples : Smell of food, tea or perfume spreading in air.

Which of the following have strongest force of attraction ?

(a)

Chalk

(b)

Ice cube

(c)

Iron nail ✓

TEMPERATURE & MOVEMENT OF PARTICLES

High Temperature

- Particles move (diffuse) at faster rate ; movement of particles increases

Low Temperature

- Particles move (diffuse) at slow rate ; movement of particles decreases

Kinetic Energy

- If a particle is moving at higher speed; it will posses more kinetic Energy

More temperature ; more movement of particles; particles have more kinetic energy

(a) Hot food = High temp → Move faster → reach us (smell)

(b) Cold pizza = Low temp → Move Slow

STATES OF MATTER

Solids

- Solids have a definite shape and volume.
- Particles are closely packed with strong forces of attraction.

Liquids

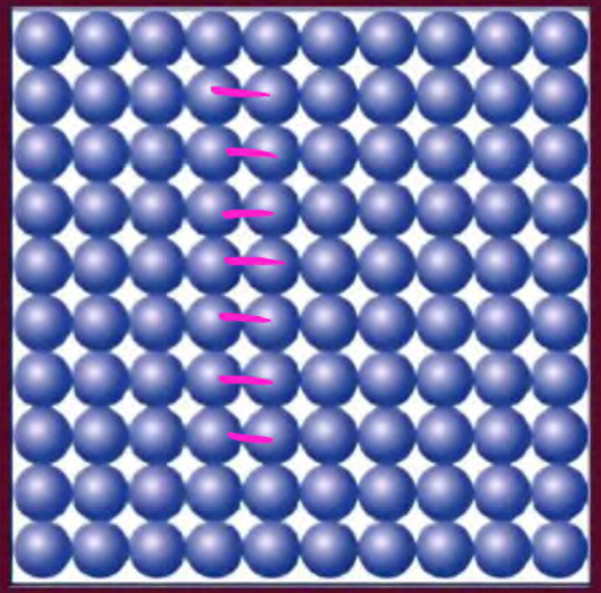
- Liquids have a definite volume but no fixed shape.
- They take the shape of the container.

Gas

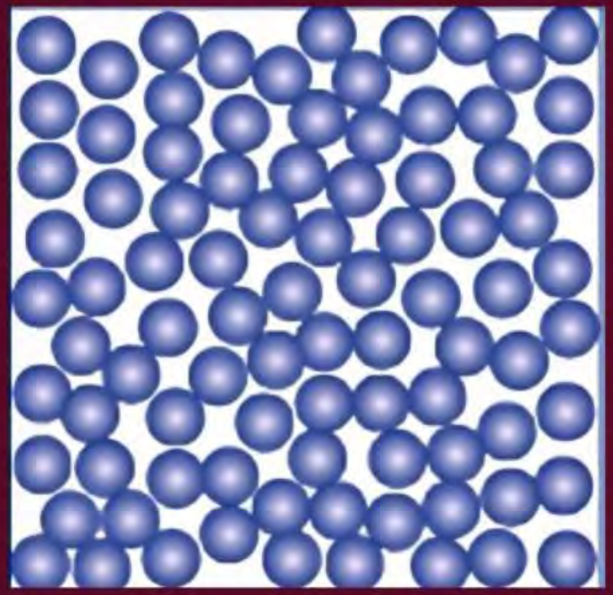
- Gases have no fixed shape and no fixed volume.
- They spread to fill the entire container.

STATES OF MATTER

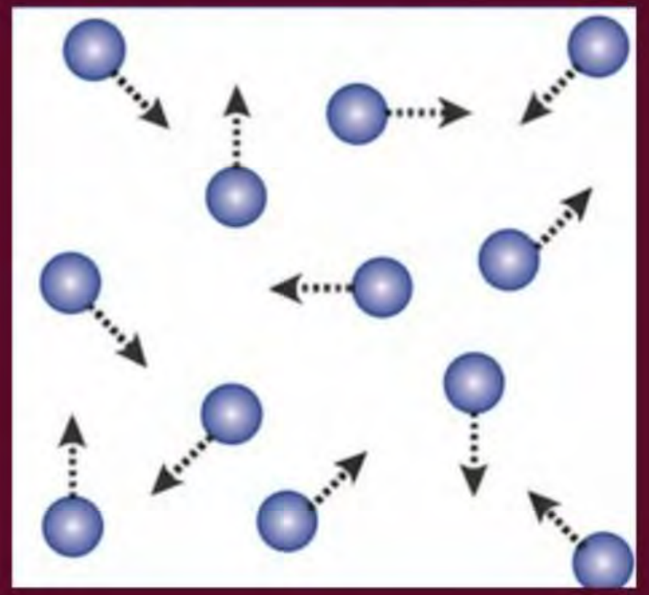
Solids



Liquids



Gas



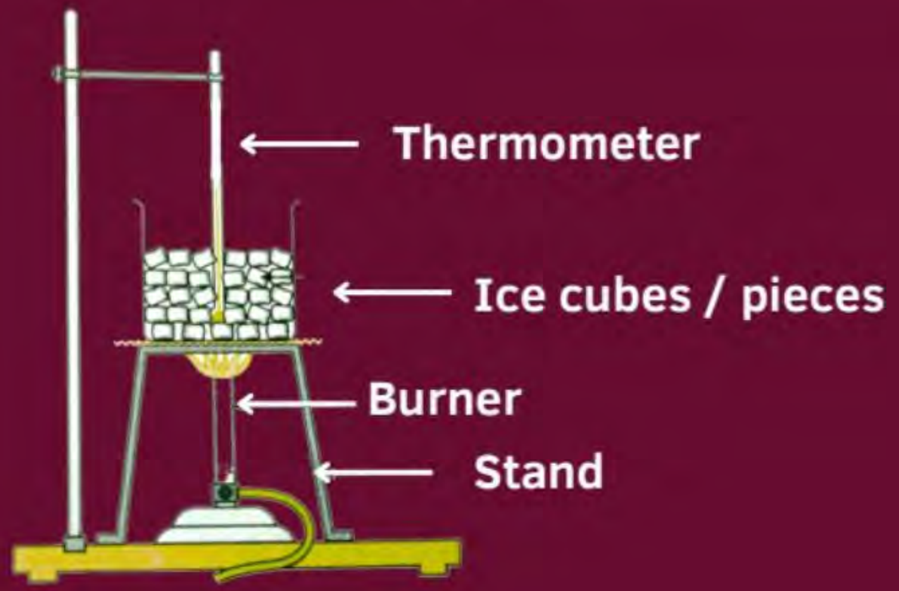
PROPERTIES OF STATES OF MATTER

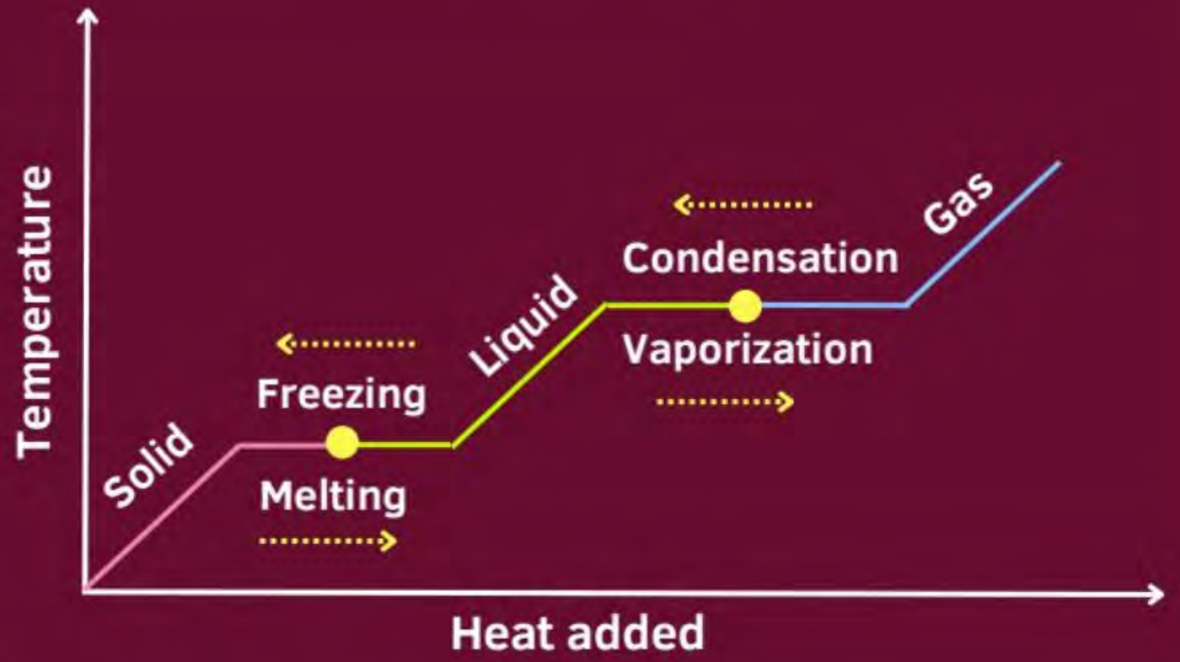
Property	Solids	Liquids	Gas
Shape	Fixed shape	No Fixed shape, take shape of container	No Fixed shape, fill entire container
Volume	Fixed volume	Fixed volume	No Fixed volume, spread to occupy full space
Compressibility	Incompressible	Slightly compressible	Highly compressible
Flow	Do not flow	Can flow	Flow very easily
Density	High density	Moderate density	Low density

PROPERTIES OF STATES OF MATTER

Property	Solids	Liquids	Gas
Particle Motion	Vibrate in fixed position	Slide over each other	No Fixed shape, fill entire container
Force of Attraction	Very Strong	Moderate	Very weak
Examples	Ice, iron, wood , brick	Water, milk, oil, juice	Air, oxygen, carbon dioxide

EFFECT OF TEMPERATURE





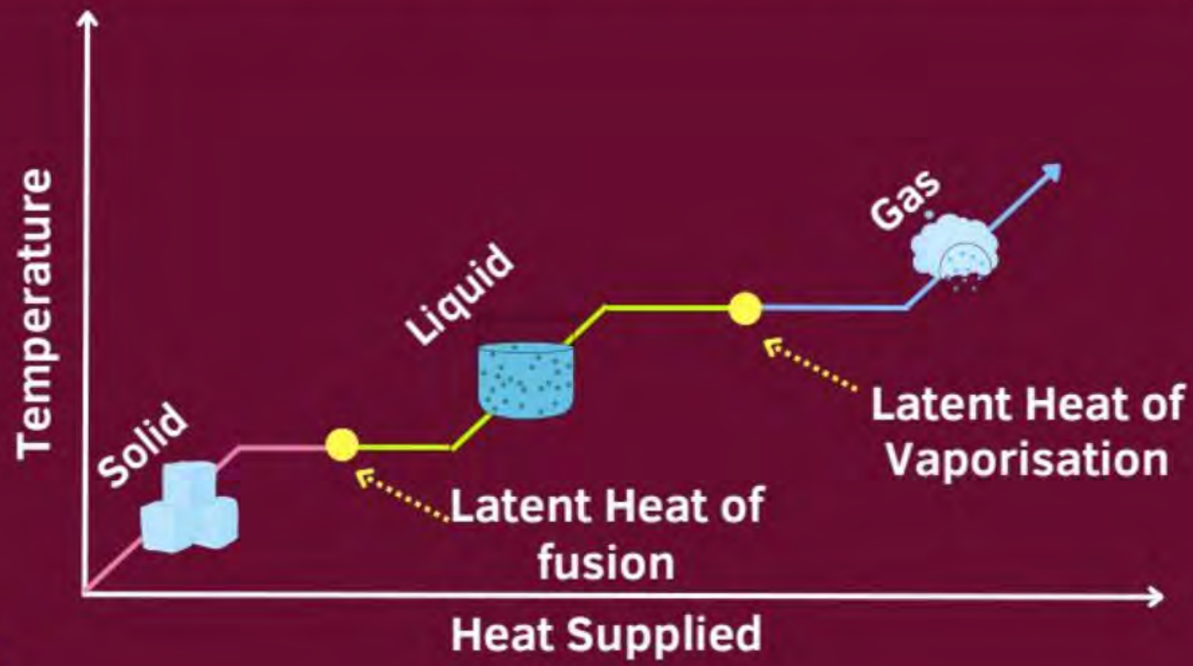
Melting Point :

- The melting point is the temperature at which a solid changes into a liquid.
- Example: Ice melts at 0°C or 273 K

Boiling Point : $l \rightarrow g$

- The boiling point is the temperature at which a liquid changes into a gas.
- Example: Water boils at 100°C or 373 K.

EFFECT OF TEMPERATURE



Latent Heat of Fusion :

The amount of heat required to change 1 kg of a solid into liquid at its melting point without temperature change.

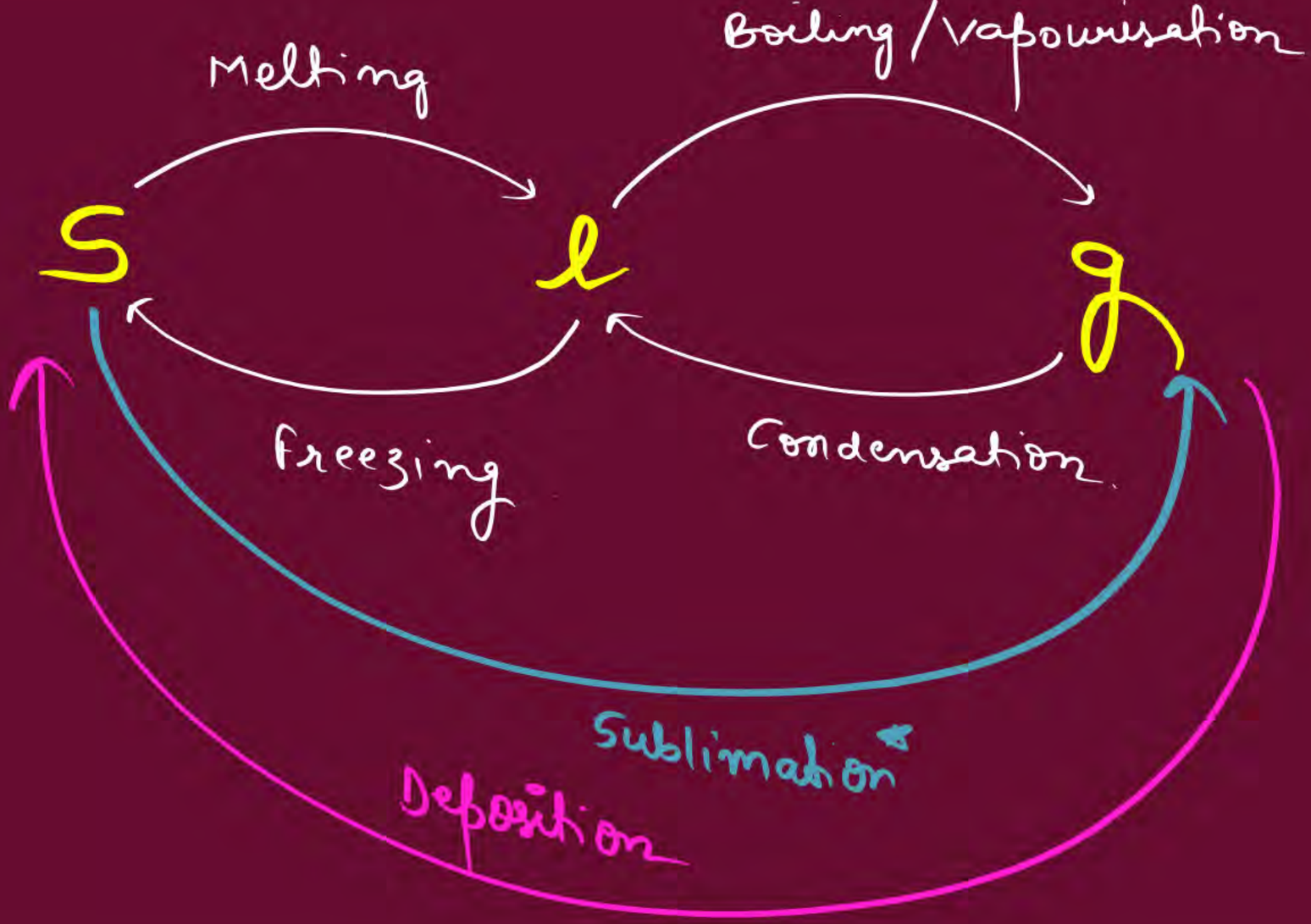
Latent Heat of Vaporization :

The amount of heat required to convert 1 kg of a liquid into gas at its boiling point without a rise in temperature.

1 Kg solid $\xrightarrow{\text{Latent heat of fusion}}$ liquid $\xrightarrow{\text{Latent heat of Vapourisation}}$ gas

SUMMARY

Process	Change of State
• Melting	Solid → Liquid
• Boiling / Vaporization	Liquid → Gas
• Condensation	Gas → Liquid
• Freezing	Liquid → Solid
• Sublimation	Solid → Gas
• Deposition	Gas → Solid


Melting
Boiling / Vapourisation
s
l
g
Freezing
Condensation
Sublimation
Deposition

EFFECT OF PRESSURE

- Pressure also effects the state of matter, especially gases.
- By increasing pressure and reducing temperature, gases can be converted into liquids.

· High pressure
· Low temp
} gas → liquid

Examples :

LPG (Liquefied Petroleum Gas)

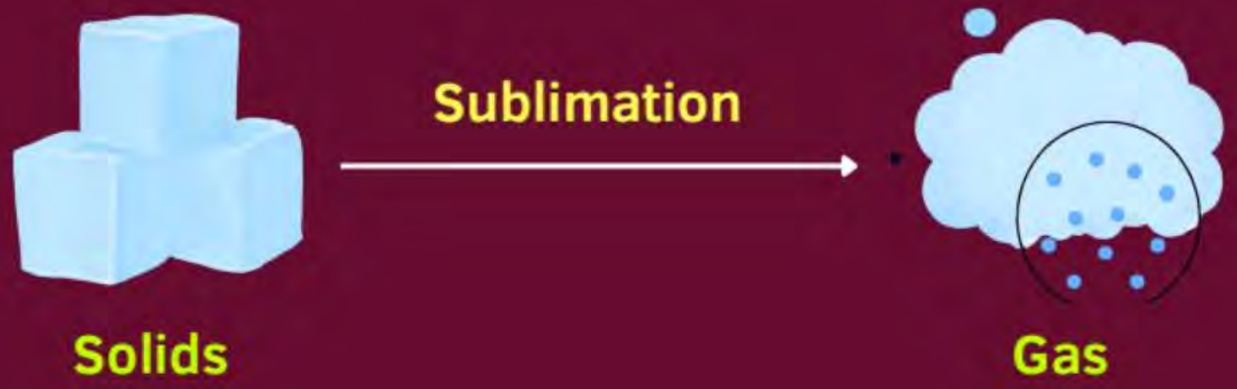
Stored in liquid form in gas cylinder under high pressure.

CNG (Compressed Natural Gas)

Methane gas stored under very high pressure for use as vehicle fuel.

Sublimation :

Sublimation is the change of state in which certain solids change directly into gases without first melting into liquids.



Deposition :

The reverse process is called deposition, where a gas changes directly into a solid.

EXAMPLES

Camphor

used in religious rituals, disappears on keeping in open air

Napthalene Balls

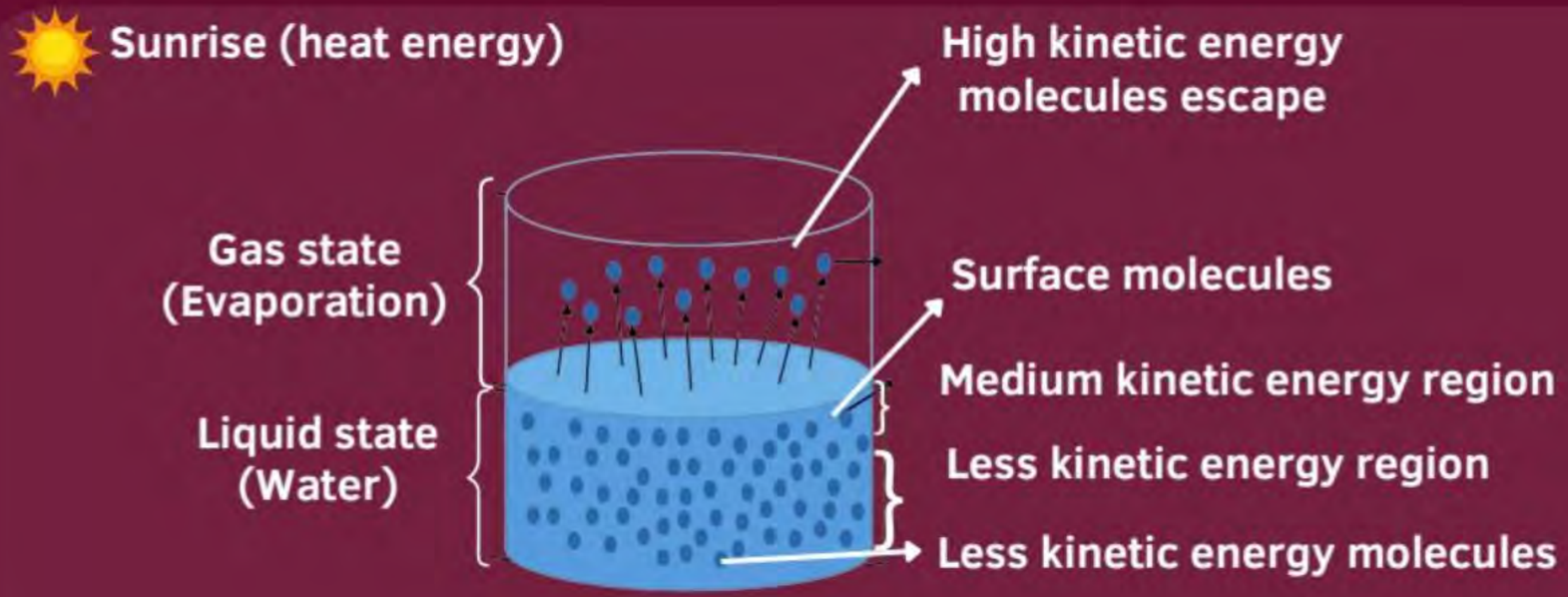
used to protect clothes from insects, slowly vanish

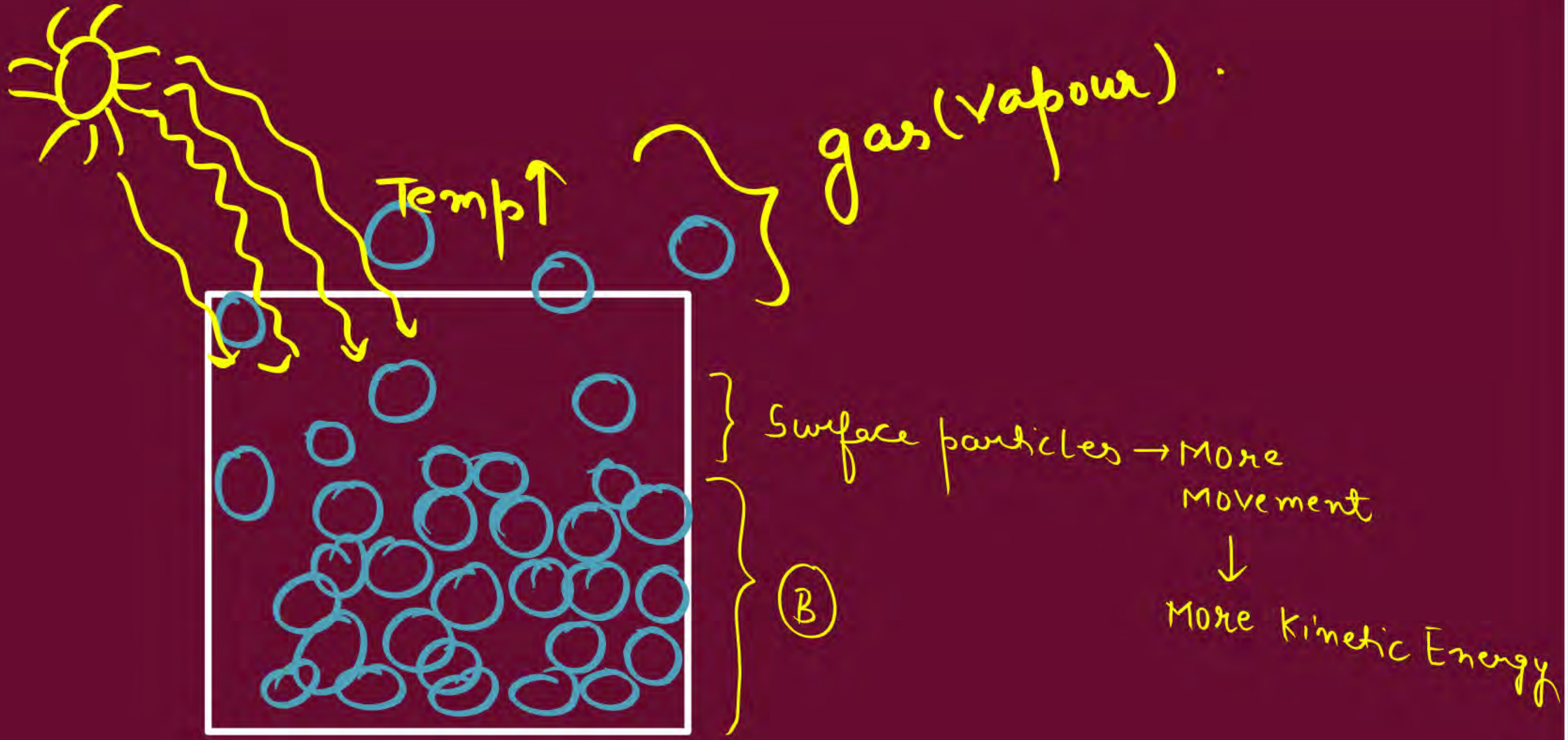
Dry ice (solid CO_2)

used for cooling, changes directly into CO_2 gas

EVAPORATION

- Process in which liquid particles at the surface escape into vapor.
- Happens only at the surface, unlike boiling.
- Can occur at any temperature below boiling point.
- It is a slow process.




Temp↑
gas (vapour)
Surface particles → More movement
↓
More Kinetic Energy
B

FACTORS AFFECTING EVAPORATION

Surface Area

- Larger the surface area, the faster the evaporation.
- Because more particles are exposed to air and can escape easily.
- Examples : Clothes dry faster when spread out than when folded.

Temperature

- Higher temperature increases the rate of evaporation.
- Because particles gain more kinetic energy and can leave the surface faster.
- Example : Clothes dry faster in the sun than in the shade.

Humidity

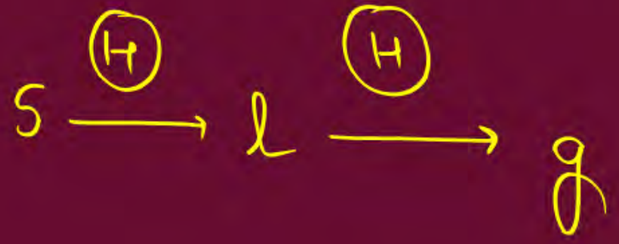
- Lower humidity = Faster evaporation
- If the air is dry, it can take in more vapour from the liquid.
- Example : Clothes dry slower on a humid (rainy) day than on a dry, sunny day.

Wind Speed

- Higher wind speed increases evaporation
- Wind carries away water vapour, allowing more evaporation.
- Example : Clothes dry faster on windy day.

EVAPORATION CAUSES COOLING

- Evaporation is not just a physical change — it also produces a cooling effect.
- When particles evaporate, they absorb heat from their surroundings to gain enough energy to escape as gas.
- As a result, the surrounding surface loses heat and becomes cooler.



EXAMPLES OF COOLING BY EVAPORATION

Sweating cools the Body

When sweat evaporates from the skin, it absorbs body heat, keeping us cool in hot weather.

Water cools Surfaces

People sprinkle water on floors and rooftops in summer to cool them. As water evaporates, it carries away heat.

Nail polish remover cold on skin

These liquids evaporates quickly, taking heat from the skin and creating a cool.

Which of the following phenomena increases with increase in temperature?

A Density

B Force of attraction between particles

C Kinetic energy of particles

D Number of particles

Temp ↑ K.E ↑

The best explanation for why " gases can be compressed easily " is:

A Gases have high kinetic energy

B Gases have large intermolecular forces

C Gases have large intermolecular spaces

D Gases do not have fixed mass

Which of the following substances shows “ sublimation ” ?

A Ice

B Water

C Camphor

D Milk

During evaporation, the particles of liquid:

A. Absorb energy from surroundings

Absorb Heat ⟶ Cooling.

B. Lose energy to surroundings

C. Become more closely packed ✗

D. Stop moving completely ✗

Which of the following " does NOT affect the rate of evaporation " ?

A Surface area ↑ E ↑

B Temperature ↑ E ↑

C Humidity ↓ E ↑

D Pressure of the liquid ✗

Which state of matter has " no fixed shape and no fixed volume " ?

A Solid

B Liquid → No fixed Shape, fixed Volume.

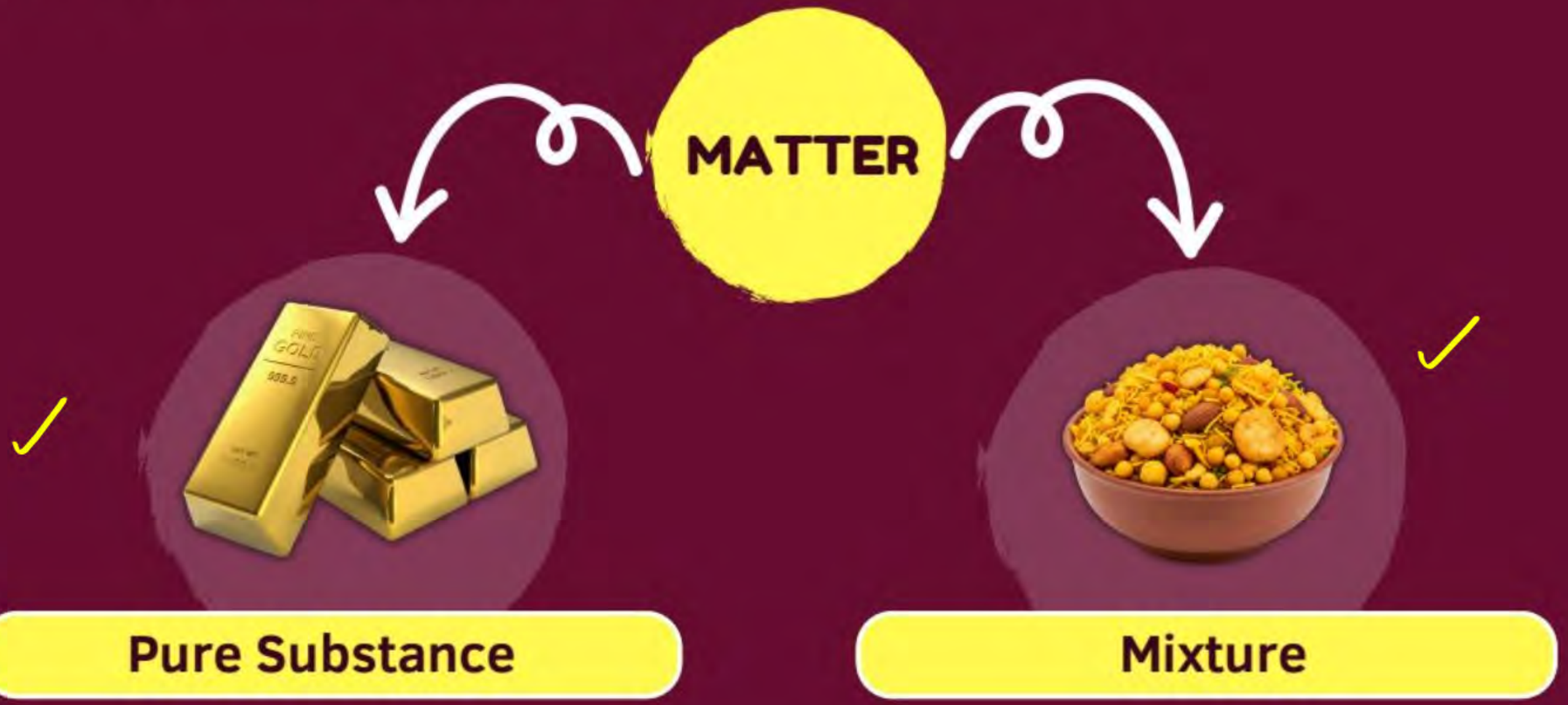
C Gas → No fixed shape; No fixed Volume.

D [redacted]


Most Important Topics
Is Matter Around Us Pure ?
Chemistry
-By Samridhi Ma'am

CHEMICAL CLASSIFICATION OF MATTER

This classification of matter is based on the chemical composition of different substances, which are as follows



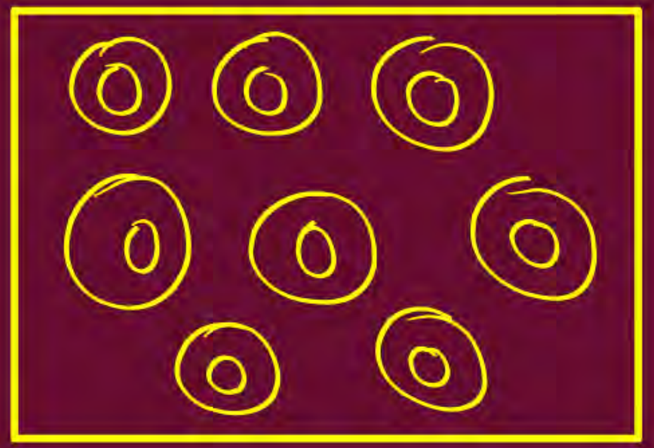
Pure Substance

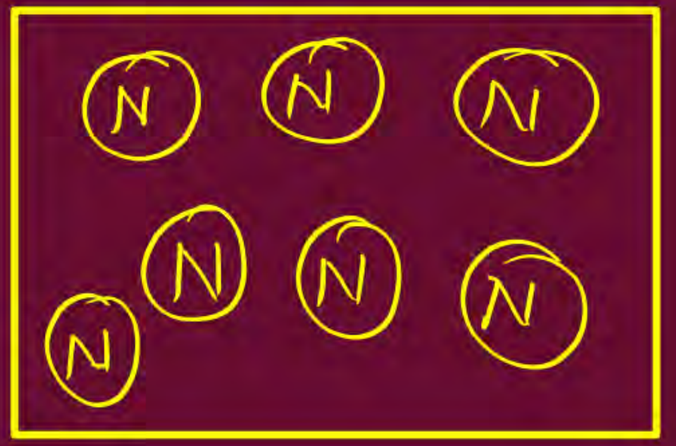
- A pure substance is a material that consists of only one type of particle.
- Pure substances have consistent properties and a fixed composition.
- Example: Gold, Water

Mixture

- A mixture is formed when two or more substances are combined, but each substance keeps its own properties.
- Mixtures can usually be separated by simple physical methods such as filtration or evaporation.

Salt Solution = Salt + Water — (a) pure
— (b) Mixture

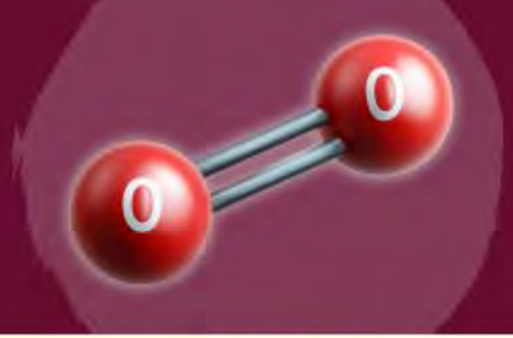




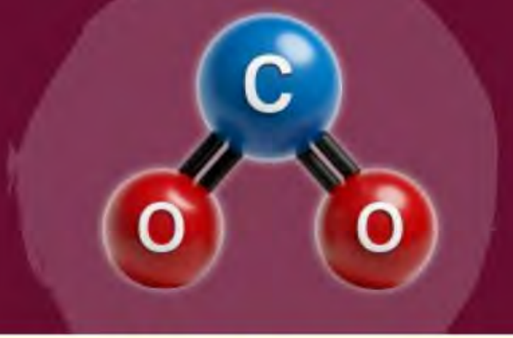
pure substances

CLASSIFICATION OF PURE SUBSTANCES

PURE SUBSTANCE

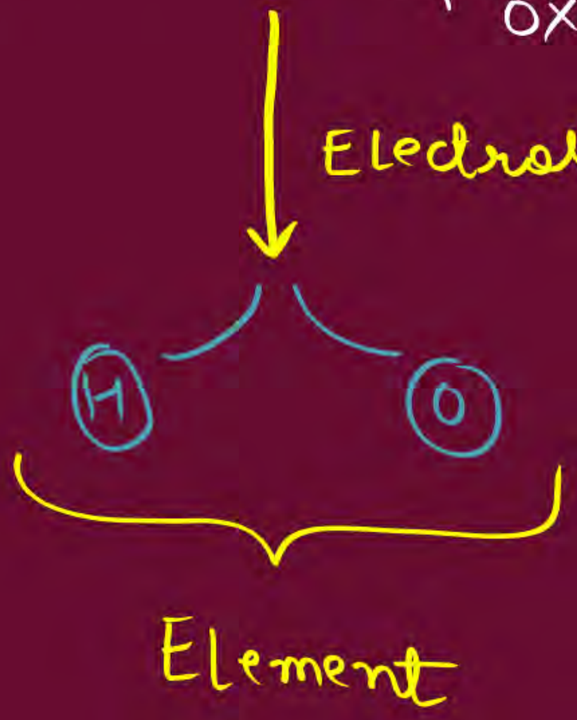


Element



Compound

Water = H_2O — Hydrogen (H), Oxygen (O)



Combination of element

⇒ Compound

H_2O

NaCl

Element

- An element is a pure substance that cannot be broken down into simpler substances by chemical reactions.
- It is made up of only one kind of [redacted] particle.

Compound

- Made of two or more elements chemically combined in a fixed ratio.
- Example: Water (H_2O) → Hydrogen + Oxygen (2:1).
- **Features:**
  - Properties differ from constituent elements.
  - Definite composition.
  - Separated only by chemical methods.

CLASSIFICATION OF ELEMENTS

Metals

- Gold
- Silver
- Copper
- Iron
- Sodium
- Magnesium
- Zinc
- Aluminium
- Sodium
- Mercury (Liquid at room temp.)

Non-metals

- Hydrogen
- Carbon
- Nitrogen
- Oxygen
- Phosphorus
- Sulfur
- Chlorine
- Bromine (Liq at room temp.)

Metalloids

- Silicon ✓
- Boron ✓
- Germanium ✓
- Arsenic ✓

- Elements with properties of both metals and non-metals.

CLASSIFICATION OF MIXTURES

MIXTURE

Homogeneous

Heterogeneous

Homogenous

- Uniform composition throughout.
- Example: Salt dissolved in water.

Heterogenous

- Non-uniform composition, and the different parts can be physically distinguished.
- Example: Sand mixed with water.

Feature	Homogeneous Mixture	Heterogeneous Mixture
Definition	A mixture with a uniform composition throughout.	A mixture where the composition is not uniform and different parts can be seen.
Appearance	Appears the same throughout.	Different parts or phases can be observed.
Example	Salt dissolved in water.	Sand mixed with water.
Seperation of Components	Components cannot be easily separated by physical means.	Components can often be separated by physical means.
Particle Size	Very small, not visible to the naked eye.	Larger particles, often visible to the naked eye.

SOLUTION

- A solution is a homogeneous mixture of two or more substances
- A solution generally has two components, which are as follows:

CHARACTERISTICS OF SOLUTIONS

$1nm = 10^{-9} m$

- **Particle Size:** Particles are very small, less than 1 nanometer (nm).
- **Appearance:** Clear and uniform; does not scatter light.
- **Stability:** Solute particles do not settle down and cannot be separated by filtration.

TYPES OF SOLUTIONS

Solution

Solid in Liquid
- Salt in water
- Salt = Solute
- Water = Solvent

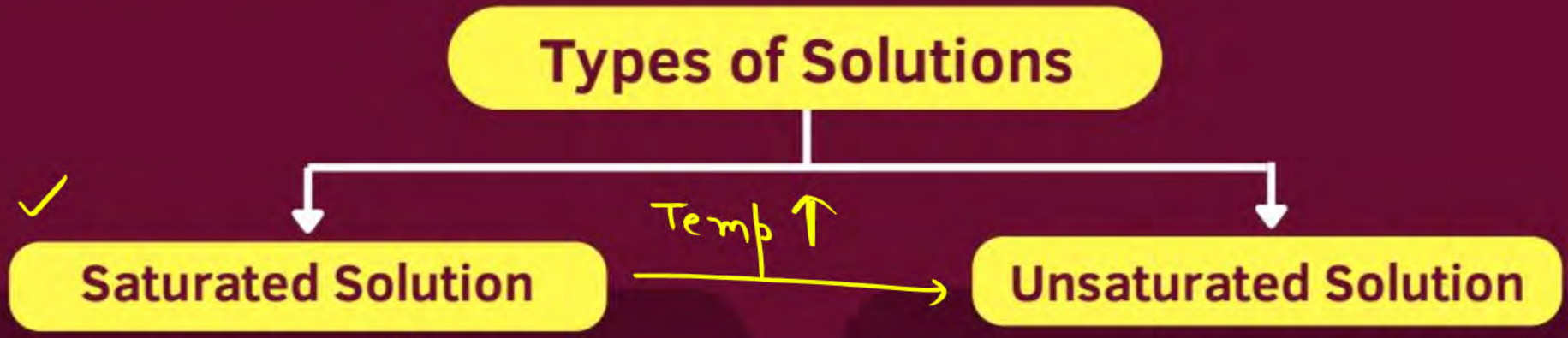
Gas in Liquid
- CO_2 in soda
- CO_2 = Solute
- Water = Solvent

Gas in Gas
- Air
- O_2 = Solute
- N_2 = Solvent

Liquid in Liquid
- Alcohol in water
- Alcohol = Solute
- Water = Solvent

TYPES OF SOLUTIONS

- A solution can be classified into two types depending on how much solute it can dissolve at a given temperature.



- Contains maximum solute at given temperature
- Extra solute remains undissolved
- **Example:** Sugar in water when no more can dissolve.

- Can dissolve more solute at given temperature.
- No undissolved solute present.
- **Example:** Sugar in water that can still dissolve more.

CONCENTRATION OF A SOLUTION

- The concentration refers to the amount of solute present in a given amount of solution. It can be expressed as:

1. Mass by Mass Percentage

$$\text{Concentration} = \frac{\text{Mass of Solute}}{\text{Mass of Solution}} \times 100$$

2. Mass by Volume Percentage

$$\text{Concentration} = \frac{\text{Mass of Solute}}{\text{Volume of Solution}} \times 100$$

3. Volume by Volume Percentage

$$\text{Concentration} = \frac{\text{Volume of Solute}}{\text{Volume of Solution}} \times 100$$

SUSPENSION

- A suspension is a heterogeneous mixture in which solid particles are spread throughout a liquid but do not dissolve. The particles are quite large, bigger than those in solutions or colloids.

- **Examples of Suspensions:**

Sand in water

The sand particles settle when left undisturbed.

Chalk powder in water

The sand particles settle when left undisturbed.

KEY FEATURES OF SUSPENSIONS

- **Particle Size:** Larger than 1000 nm (1 μm).
- **Appearance:** Cloudy or opaque; particles can be seen with the naked eye
- **Stability:** Particles settle on standing and can be separated by filtration.

COLLOIDAL SOLUTION

- A colloid is a mixture where particles of one substance are spread evenly throughout another.
- The particles are larger than those in a true solution but smaller than those in a suspension.
- Colloids look homogeneous to the naked eye, but they are actually heterogeneous in nature.
- **Examples of Colloids:**

Fog
A colloid of water droplets dispersed in air.

Milk
A colloid of fat particles dispersed in water

COLLOIDAL SOLUTION

- A colloidal solution generally has two components, which are as follows:

- Substance present in smaller quantity
- **Example:** Fat globules in milk.

- Substance in which dispersed phase spreads.
- **Example:** Water in milk

KEY FEATURES OF COLLOIDS

- **Particle Size:** Between 1 nm and 1000 nm.
- **Appearance:** Look homogeneous but show the Tyndall effect (scatter light).
- **Stability:** Particles do not settle on standing.

TYPES OF COLLOIDAL SOLUTIONS

Dispersed Phase	Dispersing Medium	Type of Colloid	Examples
Liquid	Gas	Aerosol	Fog, Mist
Solid	Gas	Solid Aerosol	Smoke, Dust in air
Gas	Liquid	Foam	Shaving Cream, Whipped Cream
Liquid	Liquid	Emulsion	Milk, Face cream
Solid	Liquid	Sol	Paints, Milk of magnesia
Gas	Solid	Solid Foam	Sponge, Foam rubber
Liquid	Solid	Gel	Jelly, Butter
Solid	Solid	Solid Sol	Coloured glass, Gemstones

DIFFERENCES BETWEEN SOLUTION, SUSPENSION AND COLLOIDS

Feature	Solution	Colloidal Solution	Suspension
Definition	Homogeneous mixture where solute completely dissolves in solvent.	Heterogeneous mixture with tiny particles dispersed throughout.	Heterogeneous mixture with large particles that do not dissolve.
Particle size	Less than 1 nm	1 nm – 1000 nm (1 μm)	Greater than 1000 nm (1 μm)
Appearance	Clear and uniform; does not scatter light.	Appears uniform but scatters light (Tyndall effect).	Cloudy or opaque; particles are visible.
Stability	Stable; particles do not settle.	Relatively stable; particles do not settle easily.	Unstable; particles settle on standing.
Seperation	Cannot be separated by filtration.	Cannot be separated by ordinary filtration.	Can be separated by filtration; centrifugation may also be used.
Examples	Saltwater, sugar in water.	Milk, fog, shaving cream.	Sand in water, chalk powder in water.

TYPES OF CHANGES

TYPES OF CHANGES

Physical Changes

Chemical Changes

PHYSICAL CHANGES

- A physical change is when a substance changes its form, shape, or state but its chemical composition remains the same.
- No new substance is formed during a physical change.
- These changes are usually reversible.
- **Examples:**

Melting of Ice

Breaking of Glass

Chopping of Wood

CHEMICAL CHANGES

- A chemical change occurs when a substance undergoes a reaction and forms a new substance with different properties.
- These changes are usually not easily reversible.
- **Examples:**

Burning of wood

Rusting

Cooking food

DIFFERENCES BETWEEN PHYSICAL AND CHEMICAL CHANGES

Feature	Physical Change	Chemical Change
Definition	Changes the form or appearance without changing the chemical nature.	Involves formation of a new substance with different chemical properties.
New Substance	No new substance is formed.	A new substance is formed.
Reversibility	Often reversible.	Usually irreversible.
Examples	Freezing of water, Melting of ice, Tearing paper.	Burning of wood, Rusting of iron, Cooking food.

Which of the following is a homogeneous mixture ?

A Sand and iron filings

B Oil and water

C Salt dissolved in water

D Smoke → Colloid

Which of the following is not a pure substance ?

A Oxygen gas

B Copper

C Milk

D Distilled water

The Tyndall effect is observed in:

A. Salt solution ✗

B. Air → Sol ✗

C. milk

D. True solutions ✗

A substance that can be broken down by chemical methods into simpler substances is:

A Element

B Mixture

C Compound

D Solvent

H_2O


Most Important
Topics
Motion
Physics
-By Samridhi
Ma'am

SCALAR VS VECTOR

Scalar

A scalar quantity has magnitude only.

Speed

Mass

Volume

Time

Vector

A vector has both magnitude and direction.

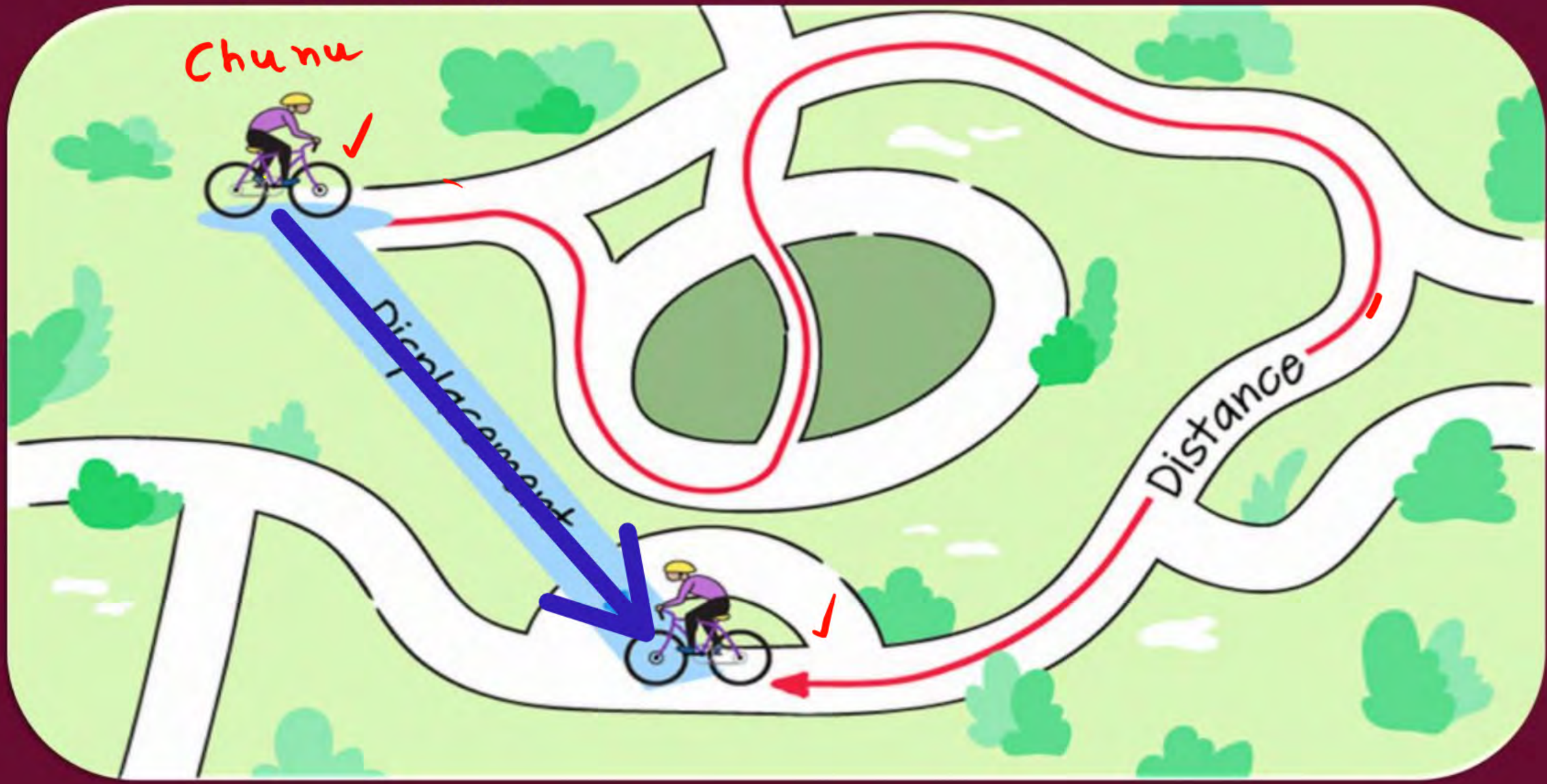
Velocity

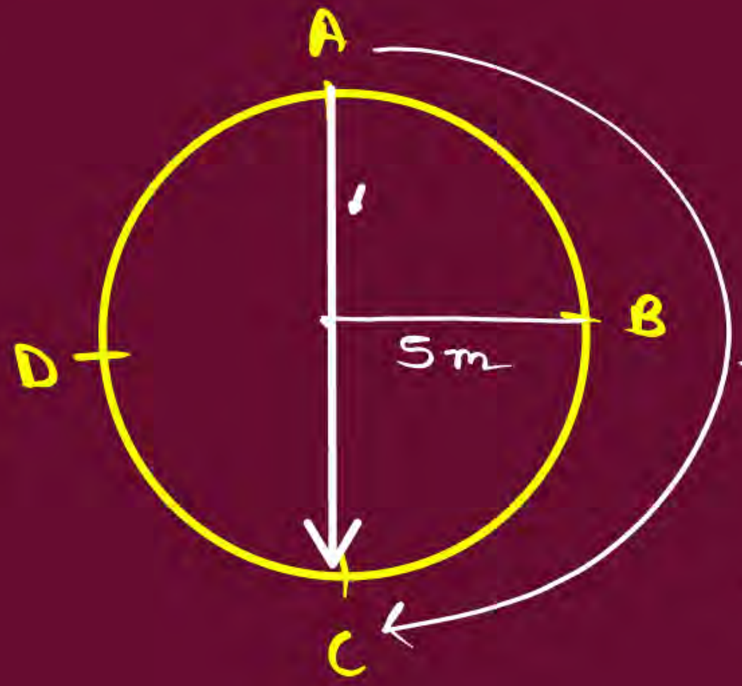
Weight

Force

Friction

Distance = 5km

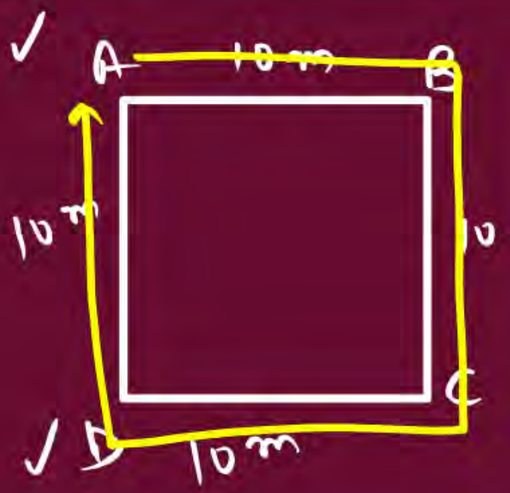




Distance = A → B → C

= 70 m

Displacement = 10m ✓



Displacement = 0

DISTANCE VS DISPLACEMENT

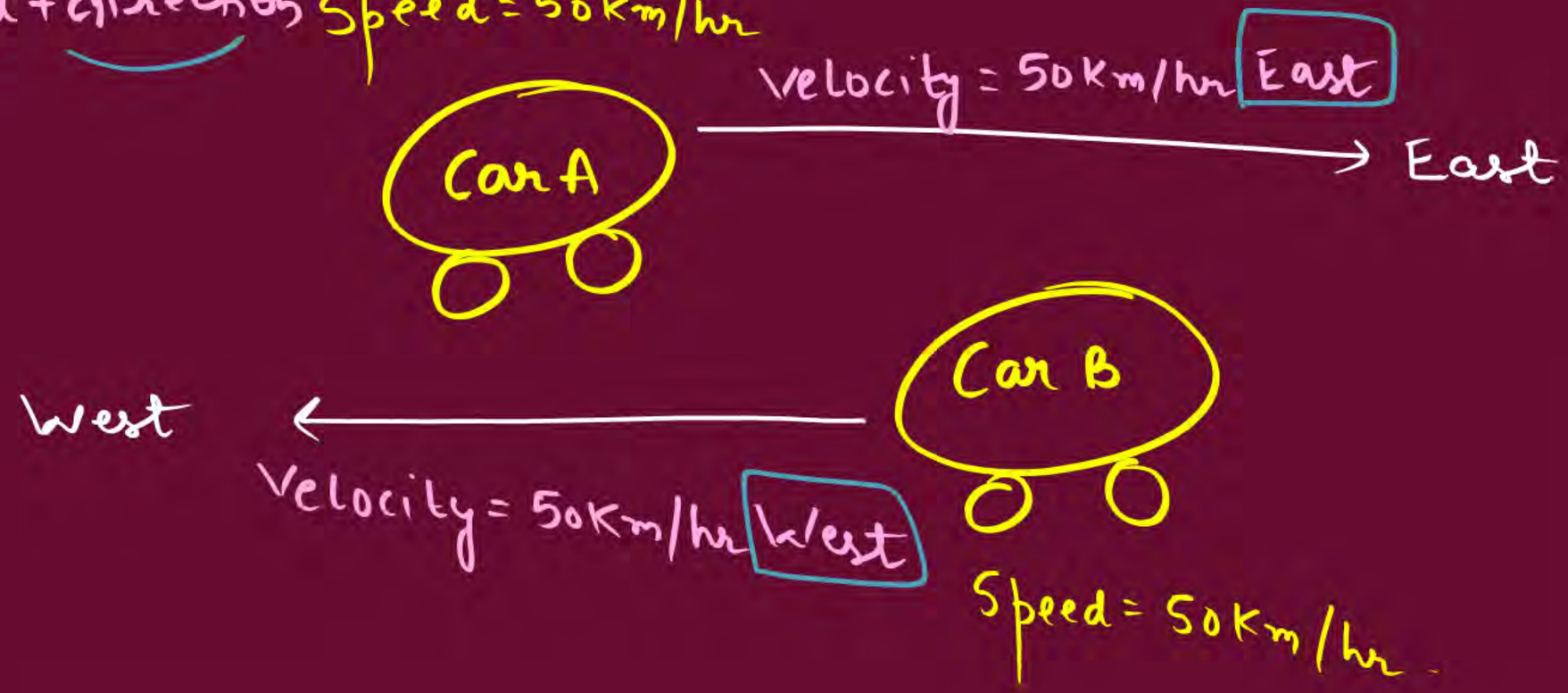
Aspect	Distance	Displacement
Definition	The total path length traveled by an object, regardless of direction.	The shortest distance between the initial and final positions, including direction.
Scalar / Vector	Scalar quantity (only magnitude).	Vector quantity (magnitude and direction).
Can be zero	Cannot be zero if the object has moved.	Can be zero if the object returns to the starting point.
Direction	Does not take direction into account.	Takes direction into account.
Example	A car traveling 5 km north and then 5 km south covers a distance of 10 km.	The displacement would be 0 km as the final position coincides with the starting point.

SPEED VS VELOCITY

Aspect	Speed	Velocity
Definition	The rate at which an object covers distance.	The rate at which an object changes its position in a specific direction.
Scalar / Vector	Scalar quantity (only magnitude).	Vector quantity (magnitude and direction).
Formula	Speed = Distance / Time	Velocity = Displacement / Time
SI unit	Meters per second (m/s).	Meters per second (m/s).
Example	A car moving at 60 km/h on a highway.	A car moving at 60 km/h towards the north

Velocity

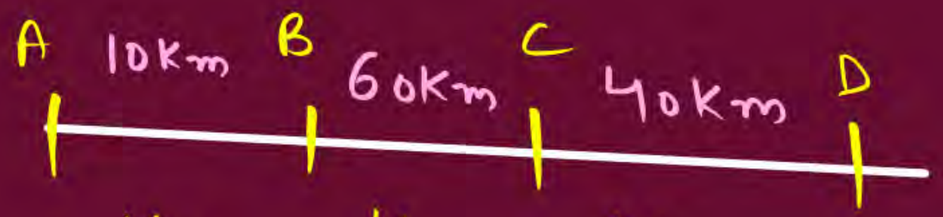
→ Speed + direction Speed = 50 km/hr



UNIFORM MOTION VS NON-UNIFORM MOTION

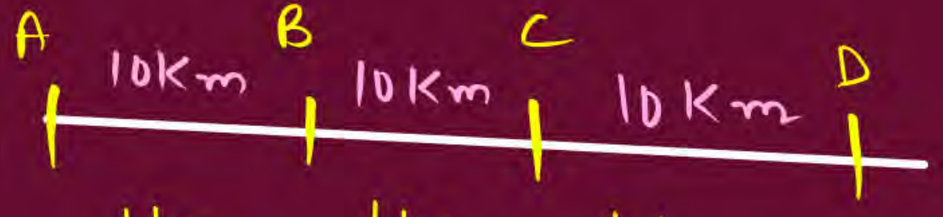
Aspect	Uniform Motion	Non-uniform Motion
Definition	Motion where an object covers equal distances in equal intervals of time.	Motion where an object covers unequal distances in equal intervals of time.
Speed	Constant speed	Variable speed.
Graphical Representation	Straight line on a distance-time graph.	Curved line on a distance-time graph.
Acceleration	No acceleration (zero acceleration).	Acceleration is present (positive or negative).
Example	A car moving at a constant speed of 50 km/h on a straight road.	A car accelerating or decelerating in traffic.

Non-uniform motion



10Km/hr 60Km/hr 40Km/hr

Uniform-motion



10Km/hr 10Km/hr 10Km/hr

Speed = Constant

ACCELERATION

Acceleration of a body is defined as the rate of change of velocity of the body with time. It is given by formula:

$$a = \frac{v - u}{t}$$

u = 80 m/s

v = 20 m/s

It is measured in m/s² or cm/s² or km/hr². Acceleration is a vector quantity.

If the velocity of the body increases with time, the acceleration is positive, and the kind of motion is called accelerated motion.

If the velocity of the body decreases with time, the acceleration is negative (retardation), and the motion is called decelerated motion.

ACCELERATION VS DECELERATION

Aspect	Acceleration	Deceleration
Definition	The rate of change of velocity of an object per unit time, increasing velocity	The rate of change of velocity of an object per unit time, decreasing velocity.
Effect on speed	Increases the speed of the object.	Decreases the speed of the object.
Graphical Representaion	Upward sloping line on a velocity-time graph.	Downward sloping line on a velocity-time graph.
Example	A car speeding up from 0 to 60 km/h.	A car slowing down from 60 km/h to a stop.

Rate of Change of Velocity = Acceleration

$$a = \frac{v - u}{t}$$

(A) $u = 10\ m/s$ ——— $v = 100\ m/s$ over $60\ s$

(B) $u = 10\ m/s$ ——— $v = 100\ m/s$ over $100\ s$

velocity { Speed, Direction } Change in velocity

$V = 60\ km/hr$ North

$V = 80\ km/hr$ South

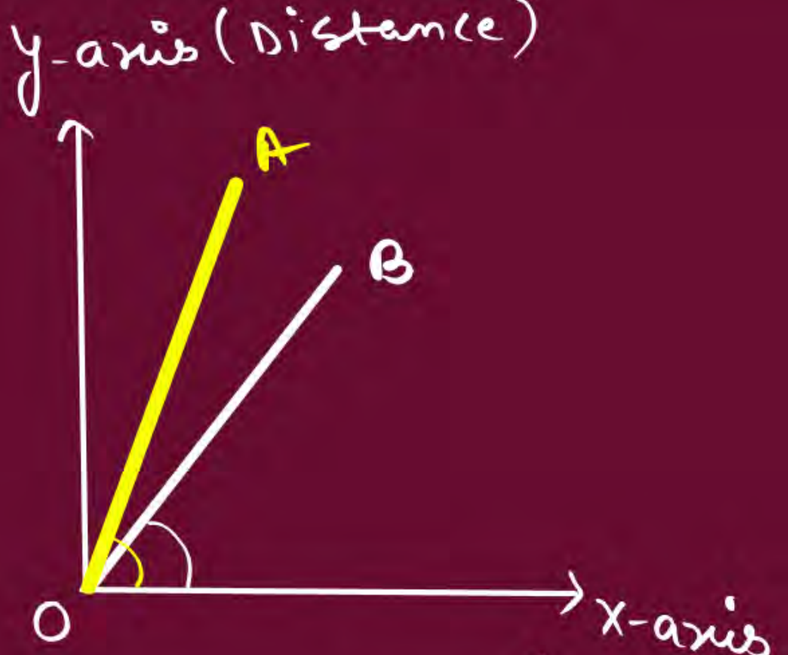
EQUATION OF MOTION

- $v = u + at$
- $s = ut + \frac{1}{2}at^2$
- $2as = v^2 - u^2$

where

u : Intial velocity
v : Final velocity
a : uniform acceleration
s : distance travelled / displacement
t : time taken

DISTANCE - TIME GRAPH



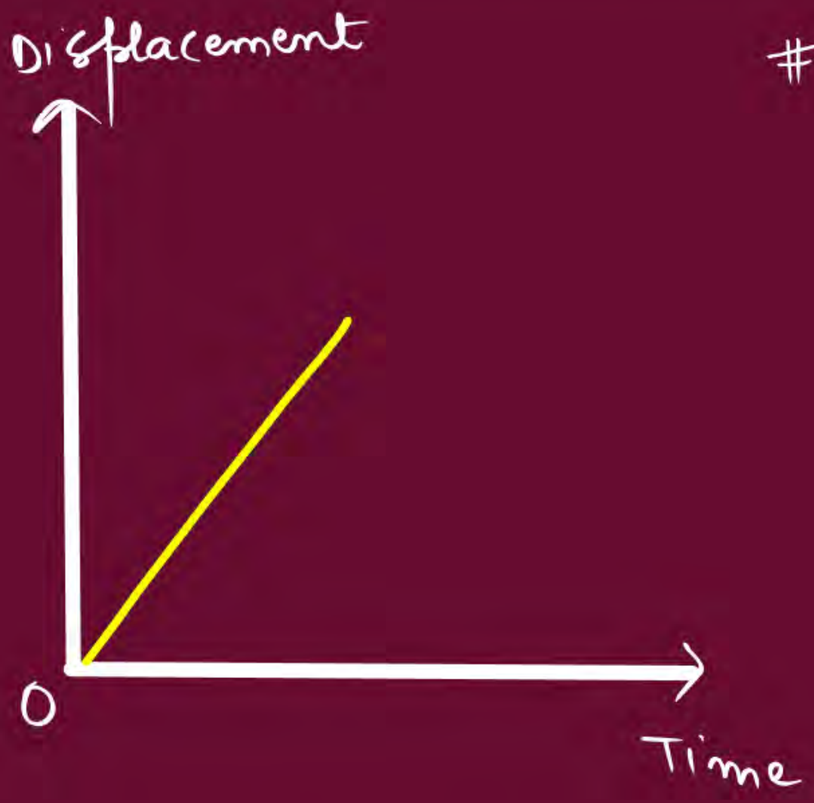
$$\#\ \text{Slope} = \frac{y}{x} = \frac{\text{distance}}{\text{Time}} = \text{Speed}$$

$$\theta_A > \theta_B$$

↓

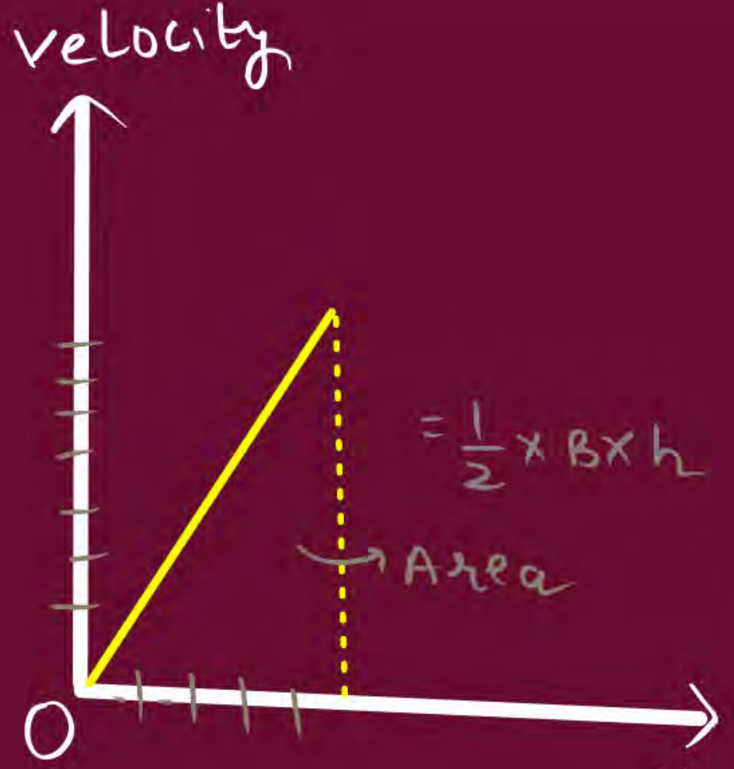
greater θ(angle) $\Rightarrow$ greater Speed.

DISPLACEMENT - TIME GRAPH



$$\#\text{Slope} = \frac{y}{x} = \frac{\text{Displacement}}{\text{time}} = \text{Velocity}$$

VELOCITY - TIME GRAPH



Slope $= \frac{y}{x} = \frac{\text{velocity}}{\text{time}} = \text{Acceleration}$

Area under the graph $= y \times x = \text{velocity} \times \text{time}$.

$= \text{Displacement}$.

$V = \frac{S}{t}$

$V \times t = S$

DISTANCE-TIME GRAPH VS VELOCITY-TIME GRAPH

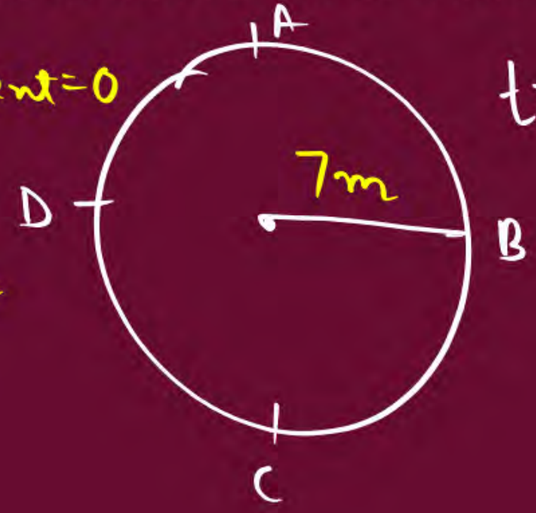
Aspect	Distance-Time Graph	Velocity-Time Graph
Axis Represeantation	Distance on the y-axis, time on the x-axis.	Velocity on the y-axis, time on the x-axis.
Slope Interpretation	Slope represents speed. ✓	Slope represents acceleration. ✓
Area Under the Graph	Not applicable for distance-time graph.	Represents the displacement. ✓
Graph Shape for Uniform Motion	Straight line with a constant slope for uniform speed.	Horizontal line parallel to the time axis for uniform velocity.
Graph Shape for Non-Uniform Motion	Curved line indicating variable speed.	A sloped line indicating acceleration or deceleration.
Example	The speed of a car at a specific moment captured by a speedometer.	The average speed of a car journeying from one city to another.

UNIFORM CIRCULAR MOTION

An athlete runs along the circumference of a circular path. This type of motion is known as circular motion. The movement of an object in a circular path is called circular motion.

When an object moves in a circular path with a constant velocity, its motion is called uniform circular motion.

In uniform circular motion, the magnitude of the velocity is constant at all points and the direction of the velocity changes continuously.



Displacement = 0

Distance = $2\pi r$

$t = 20s$

Distance = $2 \times \frac{22}{7} \times 7$

$= 44m$

$$v = \frac{2\pi r}{t}$$

$= v = \frac{44}{20}$

IMPORTANT FORMULA

1. Speed (v) $$v = \frac{s}{t}$$

where v : speed of the object
s : Distance travelled
t : Time taken

---

2. Velocity (v) $$v = \frac{displacement}{t}$$

where v : Velocity of the object
Displacement : The shortest distance between the initial & final positions.
t : Time taken

---

3. Acceleration (a) $$a = \frac{v - u}{t}$$

where a : Acceleration
v : Final velocity
u : Intial velocity
t : Time taken

IMPORTANT FORMULA

4. Average Speed (v_{av}) $v_{av} = \dfrac{\text{Total Distance}}{\text{Total Time}}$

where v_{av} : Average speed
Total Distance : Sum of all distances traveled
Total Time : Sum of all time intervals

---

5. Average Velocity (v_{av}) $v_{av} = \dfrac{u + v}{2}$

where v_{av} : Average velocity
u : Intial velocity
v : Final velocity

IMPORTANT FORMULA

1. Equation of Motion

First Equation of Motion : Velocity - Time Relation

$$v = u + at$$

where **v** : Final velocity (m/s)
u : Initial velocity (m/s)
a : Acceleration (m/s^2)
t : Time (s)

Second Equation of Motion : Position - Time Relation

$$s = ut + \frac{1}{2}at^2$$

where **s** : Displacement (m)
u : Initial velocity (m/s)
a : Acceleration (m/s^2)
t : Time (s)

IMPORTANT FORMULA

Third Equation of Motion : Position-Velocity Relation

$$v^2 = u^2 + 2as$$

where **v** : Final velocity (m/s)
u : Initial velocity (m/s)
a : Acceleration (m/s^2)
s : Displacement (m)

---

2. Uniform Circular Motion

Speed of an Object in Uniform Circular Motion

$$v = \frac{2\pi r}{T}$$

where **v** : Speed of the object (m/s)
r : Radius of the circular path (m)
T : Time period for one complete revolution (s)

An object is moving with uniform acceleration. Its velocity after 5 seconds is 20 m/s and initial velocity is 5 m/s. What is the acceleration?

A. $2\ m/s^2$

B. $3\ m/s^2$

C. $4\ m/s^2$

D. $5\ m/s^2$

$u = 5\ m/s$

$v = 20\ m/s$

$t = 5\ s$

$$a = \frac{v-u}{t} = \frac{20-5}{5} = \frac{15}{5} = 3\ m/s$$

The area under a **velocity-time graph** gives:

A. Acceleration

B. Displacement

C. Speed

D. Force

$= y \times x$

$= v \times t$

= Displacement.

Which of the following is a scalar quantity?

A Displacement

B Velocity

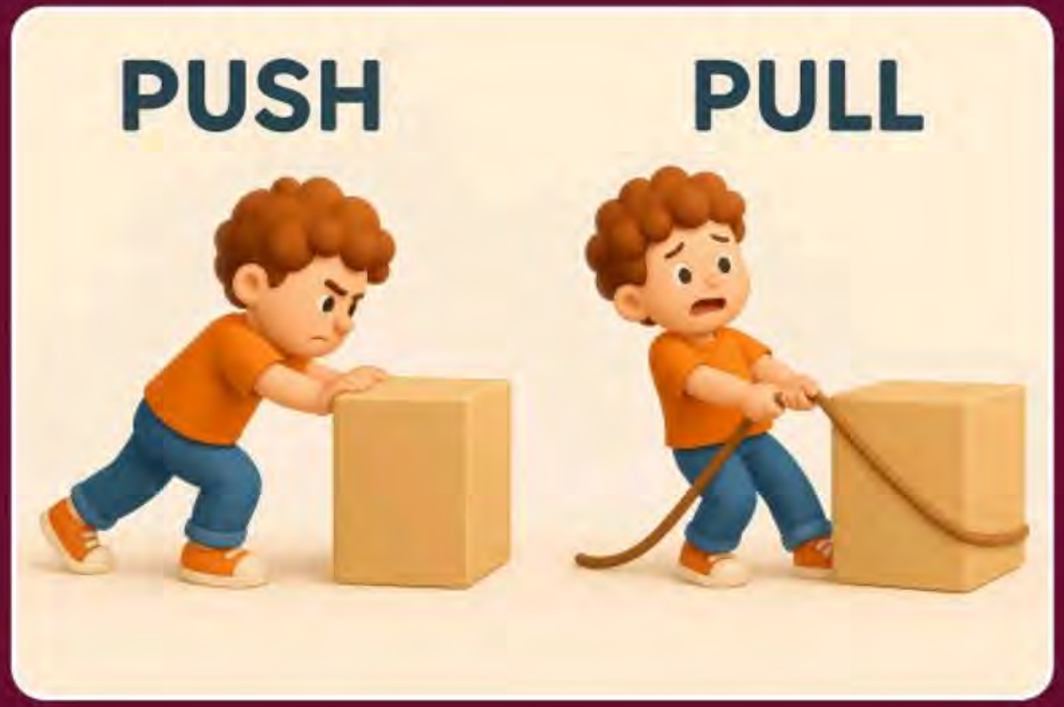
C Distance

D Acceleration


Most Important Topics
Force and Laws of Motion
Physics
-By Samridhi Ma'am

FORCE

- A force is a push or pull upon an object resulting from its interaction with another object.



- Effects of Force: → Causes Acceleration
  - Rest → Motion (0 m/s → 10 m/s)
  - Motion → Rest (20 m/s → 0 m/s)
  - Speed increase
  - Speed decrease
  - Direction change
  - Shape change

Change in velocity → Acceleration

FORCE

A force is anything that can cause a change to objects. Forces can:

- change the shape of an object
- move or stop an object
- hange the direction of a moving object.

TYPES OF FORCE

Friction Force

Gravity Force

Magnetic Force

Applied Force

Tension Force

Buoyant Force

Spring Force

EFFECT OF FORCE

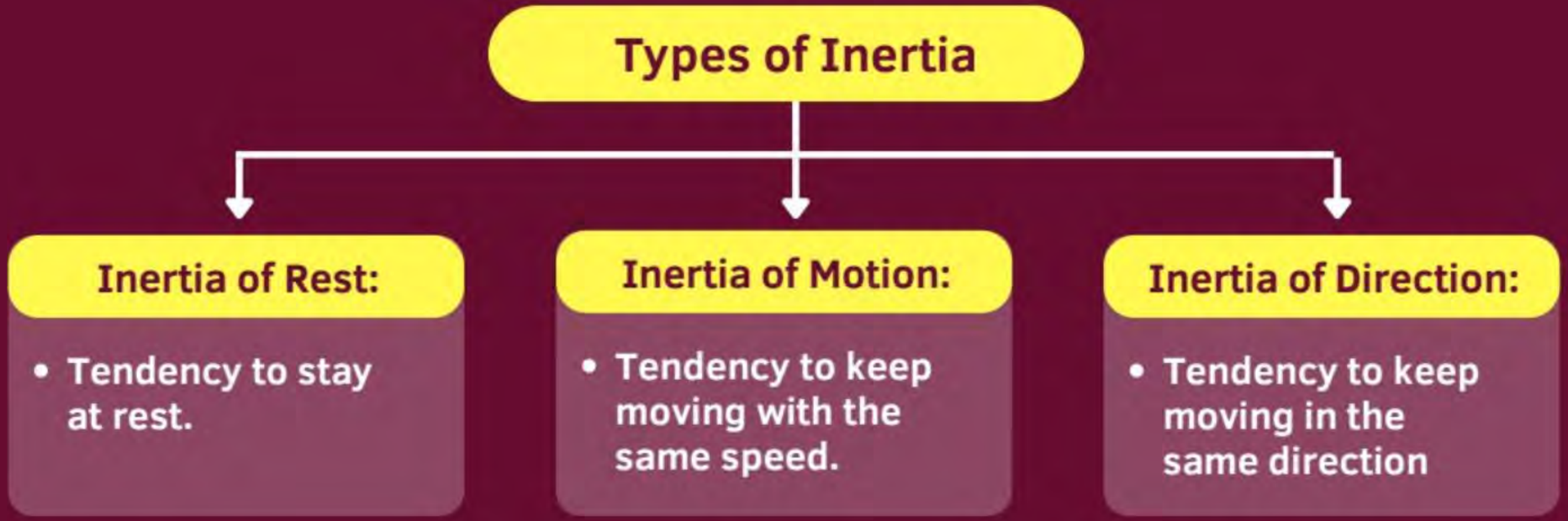
1. Force can **make a stationary body in motion**. For example a football can be set to move by kicking it, i.e. by applying a force.
2. Force can **stop a moving body** – For example by applying brakes, a running cycle or a running vehicle can be stopped.
3. Force can **change the direction of a moving object**. For example; By applying force, i.e. by moving handle the direction of a running bicycle can be changed. Similarly by moving steering the direction of a running vehicle is changed.
4. Force can **change the speed of a moving body** – By accelerating, the speed of a running vehicle can be increased or by applying brakes the speed of a running vehicle can be decreased.
5. Force can **change the shape and size of an object.** For example – By hammering, a block of metal can be turned into a thin sheet. By hammering a stone can be broken into pieces.

BALANCED FORCES VS UNBALANCED FORCES

Balanced forces	Unbalanced Forces
Forces that are equal in magnitude and opposite in direction.	Forces that are unequal in magnitude or not opposite in direction
Do not cause a change in the object's state of rest or uniform motion.	Cause a change in the object's state of motion, speed, or direction.
Net force acting on the object is zero.	Net force acting on the object is not zero.
Examples include a book lying on a table, where gravitational force and normal force are balanced.	Examples include pushing a car that starts to move
Results in no acceleration.	Results in acceleration or deceleration.

FIRST LAW OF MOTION (LAW OF INERTIA)

- An object continues in its state of rest or uniform motion unless acted upon by an unbalanced external force.
- **Inertia:** The tendency of an object to resist a change in its state of motion or rest.



TYPES OF INERTIA

Inertia of Rest

A book on a table won't move unless pushed.

Inertia of Motion

A ball rolling keeps rolling unless something slows it.

Inertia of Direction

A car turning quickly makes you lean sideways

FIRST LAW OF MOTION (LAW OF INERTIA)

Any object remains in the state of rest or in uniform motion along a straight line, until it is compelled to change the state by applying external force.

- **Explanation:** If any object is in the state of rest, then it will remain in rest until a external force is applied to change its state. Similarly an object will remain in motion until any external force is applied over it to change its state. This means all objects resist to in changing their state. The state of any object can be changed by applying external forces only.

INERTIA AND MASS

The property of an object because of which it resists to get disturbed its state is called Inertia. Inertia of an object is measured by its mass. Inertia is directly proportional to the mass. This means inertia increases with increase in mass and decreases with decrease in mass. A heavy object will have more inertia than lighter one.

In other words, the natural tendency of an object that resists the change in state of motion or rest of the object is called inertia.
Since a heavy object has more inertia, thus it is difficult to push or pull a heavy box over the ground than lighter one.

MOMENTUM (P)

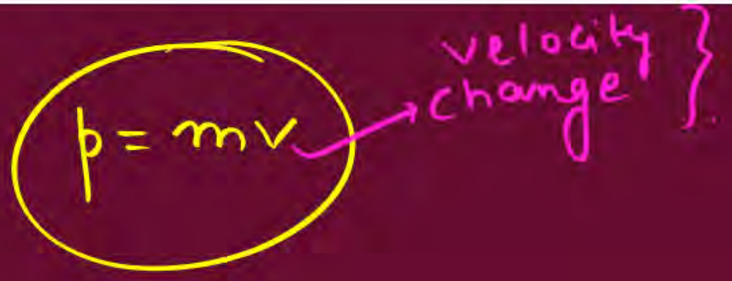
- The product of velocity and mass is called the momentum. Momentum is denoted by 'p'.

$$p = mv$$

Momentum = mass × velocity

Momentum of stationary object is 0 as a result of its velocity being 0.

Momentum ↑ as the mass ↑ or the velocity



Δp = change in momentum

SECOND LAW OF MOTION

- The rate of change of momentum of an object is directly proportional to the applied unbalanced force and takes place in the direction of the force.

$$\text{Force} = \text{mass} \times \text{acceleration} \quad (F = ma)$$

- **Momentum:** Momentum is the product of mass and velocity of an object.

$$p = mv$$

  - SI Unit: kg m/s
  - Nature: It is a vector quantity (has both magnitude and direction).

- **Relation between Force and Momentum:** Force is equal to the rate of change of momentum.

$$F = \frac{(mv - mu)}{t}$$

$$f \propto \frac{\Delta p}{t}$$

$$f = K \frac{\Delta p}{t} \quad (K = 1)$$

$$f = \frac{\Delta p}{t}$$

$$f = \frac{p_f - p_i}{\text{time}}$$

$$f = \frac{mv - mu}{\text{time}}$$

$$F = m\frac{(v-u)}{t} \quad = a$$

$$f = ma$$

Force = mass × Acceleration

Kg $\quad$ m/s^2

Force = Newton

= Kg m/s^2

SECOND LAW OF MOTION

- It states that the rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts.

MATHEMATICAL FORMULATION OF SECOND LAW OF MOTION

The rate of change in momentum = $\left(\frac{m \times v - u}{t}\right)$

According to Newton's second law of motion, we have

$$F \propto \frac{m\,(v-u)}{t}$$

$$F = km\left(\frac{m\,(v-u)}{t}\right)$$

$$F = kma$$

SECOND LAW OF MOTION

Here, $a = \left(\frac{v-u}{t}\right)$ = the rate of change of velocity.

= acceleration

k = a constant of proportionality

Putting m = 1 kg, a = 1 ms^{-2}

F becomes 1 N.

So, 1 N = k × 1 kg × 1 ms^{-2}

k = 1

From equation (1), we have

$$F = ma$$

This represents the second law of motion.

THIRD LAW OF MOTION

- Newton's Third Law of Motion states that there is always reaction for every action in opposite direction and of equal magnitude.
- Explanation: Whenever a force is applied over a body, that body also applies same force of equal magnitude and in opposite direction.

Example –

- (a) Walking of a person – A person is able to walk because of the Newton's Third Law of Motion. During walking, a person pushes the ground in backward direction and in the reaction the ground also pushes the person with equal magnitude of force but in opposite direction. This enables him to move in forward direction against the push.
- (b) Recoil of gun – When bullet is fired from a gun, the bullet also pushes the gun in opposite direction, with equal magnitude of force. This results in gunman feeling a backward push from the butt of gun.
- (c) Propulsion of a boat in forward direction – Sailor pushes water with oar in backward direction; resulting water pushing the oar in forward direction. Consequently, the boat is pushed in forward direction. Force applied by oar and water are of equal magnitude but in opposite directions.

THIRD LAW OF MOTION

- Newton's Third Law of Motion states that there is always reaction for every action in opposite direction and of equal magnitude.
- **Explanation:** Whenever a force is applied over a body, that body also applies same force of equal magnitude and in opposite direction.

Walking

recoil a gun

backward movement of a boat

When a force is applied on a body, it can change :

A Only the speed

B Only the direction

C Only the shape

D All of the above

Which law explains the motion of a rocket?

A. Newton's First Law

B. Newton's Second Law

C. Newton's Third Law

D. Law of Gravitation

Thank-you

love you

Most important Questions

= Physics → Chem → Biology