

TOPICS

Discovery, Cell theory

Basic details of cell, cell membrane

cell wall, Endomembrane System

ER

Golgi bodies

Lysosome

vacuole

Mitochondria

Plastids

ribosome

cytoskeletal Elements

Nucleus

Chromosome

Microbodies

What is cell ?



chamber / compartment

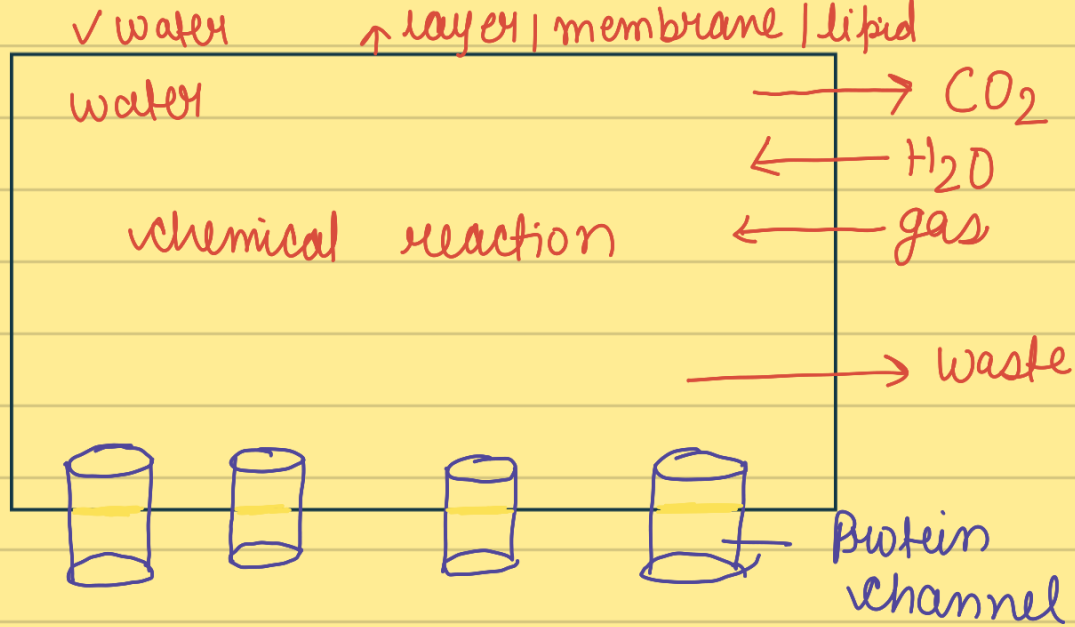
Liquid $\rightarrow$ H_2O
chemical reaction
compartment
inner environment

cell is a compartment which separate inner environment (chemical reaction) with outer environment (water)

what is required to make cell

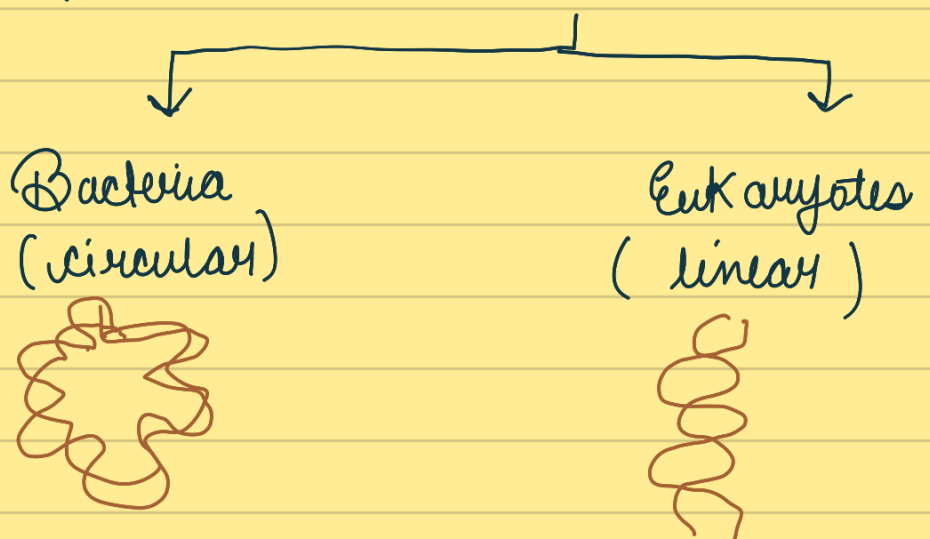


1. Separation from outer environment (with the help of lipid layer)
2. Exchange from outer environment (- Exchange directly
(H_2O , gas) $\hookrightarrow$ water soluble move by channel)
3. Genetic material - DNA Double stranded require Information store
for all reaction inside cell



so in all cells basic requirement is

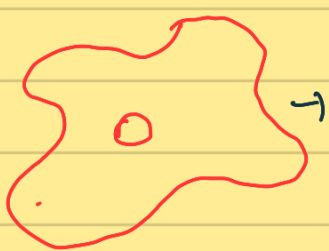
- ① Membrane
- ② Transport protein on - Exchange membrane
- ③ Genetic material - In all cells dsDNA



Definition of cell

Fundamental structural and functional unit of living organisms.

why cell is smallest unit of life → because presence of unicellular organism.



→ Amoeba (Eukaryotes)



→ Bacteria

① unicellular organism independent existence

② single cell can perform all function

Mitochondria - not have independent existence so that's why it is sub cell.

unicellular organisms are capable of

1. Independent Existence
2. Performing the essential functions of life

Note: - anything less than a complete structure of a cell does not ensure independent living

Discovery of cell

Robert Hooke - dead cells → 1st cell observe by Robert Hooke → Bark of stem → cork cells (dead)

Anton von Leeuwenhoek first saw and described a live cell - (protozoa, Bacteria, spermatozoa, RBC)

↳ with the help of microscope.

Robert Brown → nucleus

Note:- 1950s → Electron microscope available than detail structure of organelle and cell observe

cell theory

Matthias Schleiden (German Botany) → observe many plants → all plants are made up of plant cells which form tissue..

Schwann (1839) British zoologist

- (a) Animal cell observe → Presence of plasma membrane
- (b) Observe many plant cell → cell wall present
- (c) proposed → all living organism is made up of cell and its product

Schleiden and Schwann formulated cell theory.

Scheiden and Schwann — drawback
(not able to tell, how new cells arise)

Rudolf Virchow → 1855 → cells divided and new cells are formed from pre-existing cells

(Omnis cellula - e- cellula)

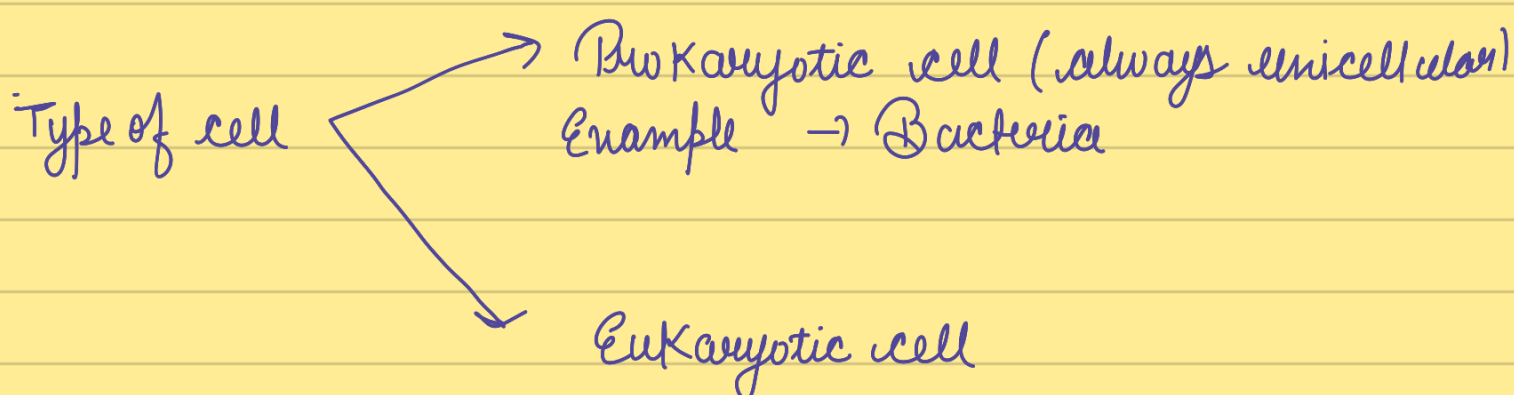
Modify cell theory

① all organism is made up of cells & its products.

② all cells arise from pre-existing cell

Exception of cell theory → Virus

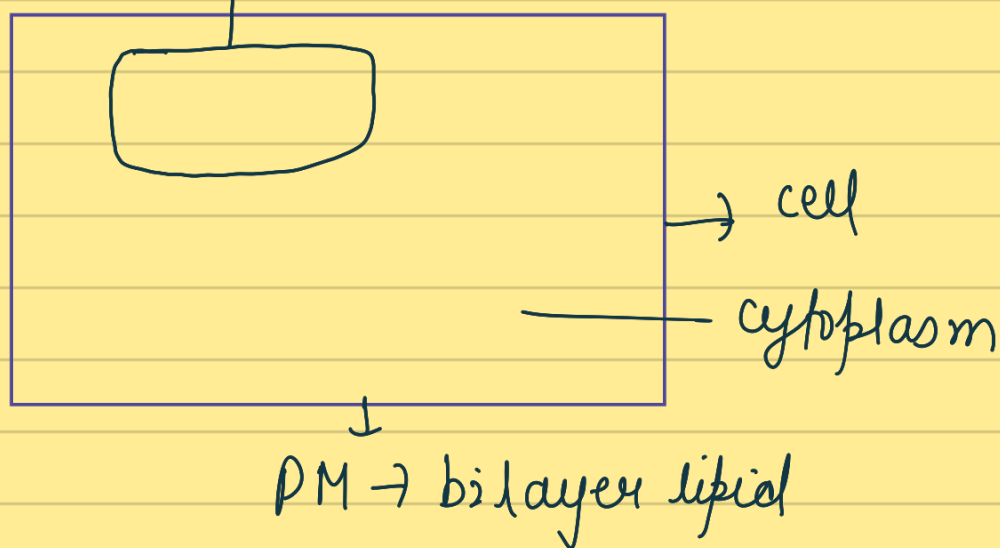
some detail about cell



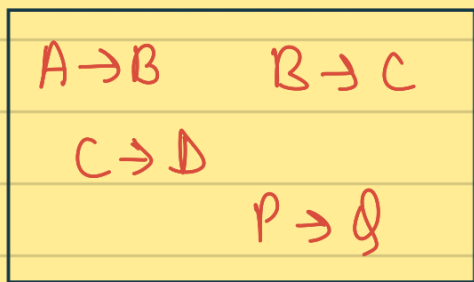
Feature of all Eukaryotic cell

① Membrane bound organelle → ER, Golgi bodies, mitochondria, vacuole (membrane - lipid)

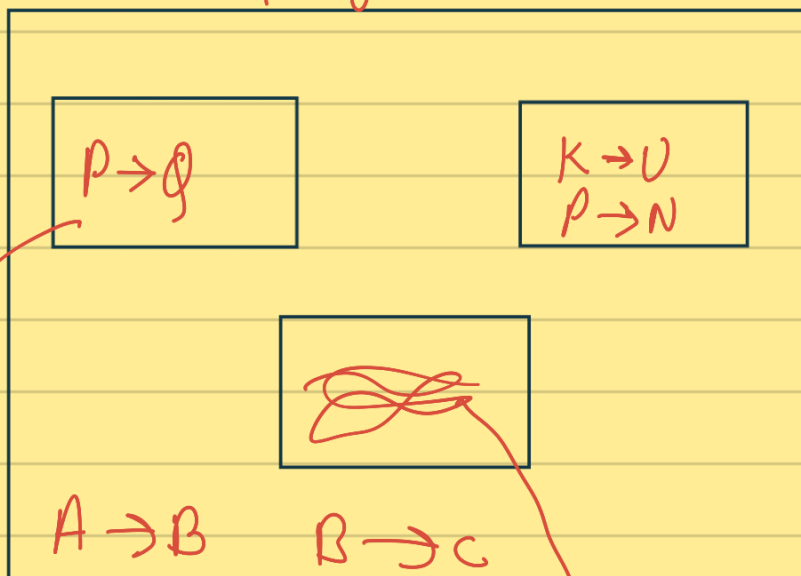
② compartmentalization →
↳ chamber organelle



Prokaryotic cell



Eukaryotic cell



Organelle / compartmentalization

Nucleus (DNA)

Eukaryotic cell

unicellular organism

Multicellular

Example → Protista

Plant cell

Animal cell

↳ Plastids present

↳ Plastids absent

↳ Sap vacuole present

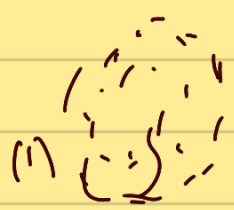
↳ Sap vacuole present

↳ Centriole absent

↳ Centriole present

↳ Cell wall present

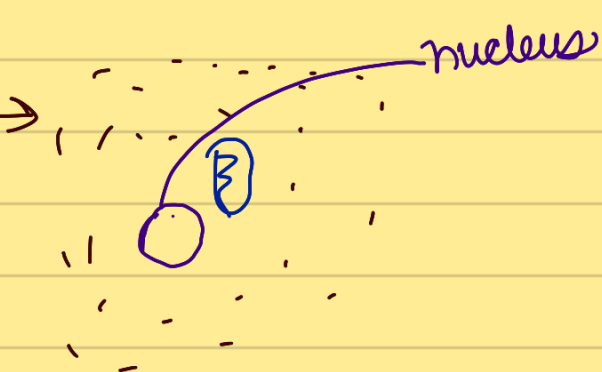
↳ Cell wall absent



cytosol (liquid)

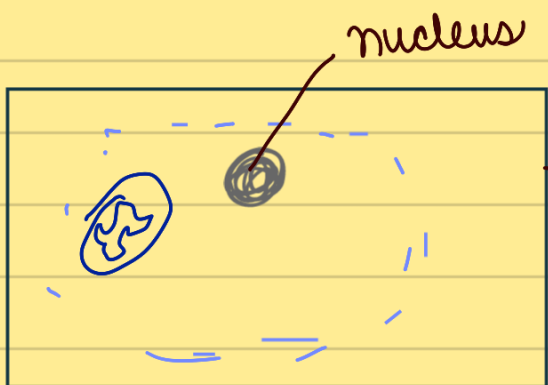


(2) cytosol + organelle = cytoplasm



(3) cytosol + organelle + nucleus = protoplasm

4)



nucleus

membrane

organelle + cytosol + nucleus + membrane

→ Protoplast + cell wall → Plant cell

Protoplast = Protoplasm + membrane

Protoplasm = nucleus + cytoplasm

cytoplasm = organelle + cytosol

cytosol = liquid - (chemical reaction)
occur

Q - Glycolysis occur in

- ✓ a) cytosol (b) organelle (c) protoplasm
(d) cytoplasm

Q Krebs cycle occur in

- (a) cytosol (b) cytoplasm (c) Nucleus (d) cell wall

membrane presence or absence in Eukaryotes

without membrane

- 1) Ribosome (plant cell, Animal cell, Bacteria cell)
- 2) Centriole (animal)
- 3) Nucleolus (plant & animal cell)

Single membrane

- ↳ Vacuole / lysosome
- ↳ Peroxisome
- ↳ ER
- ↳ Golgi body
- ↳ Eukaryotic flagella & cilia

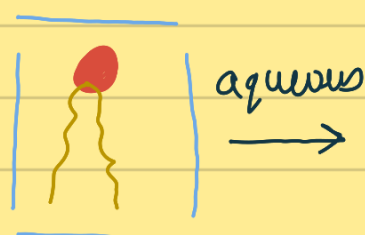
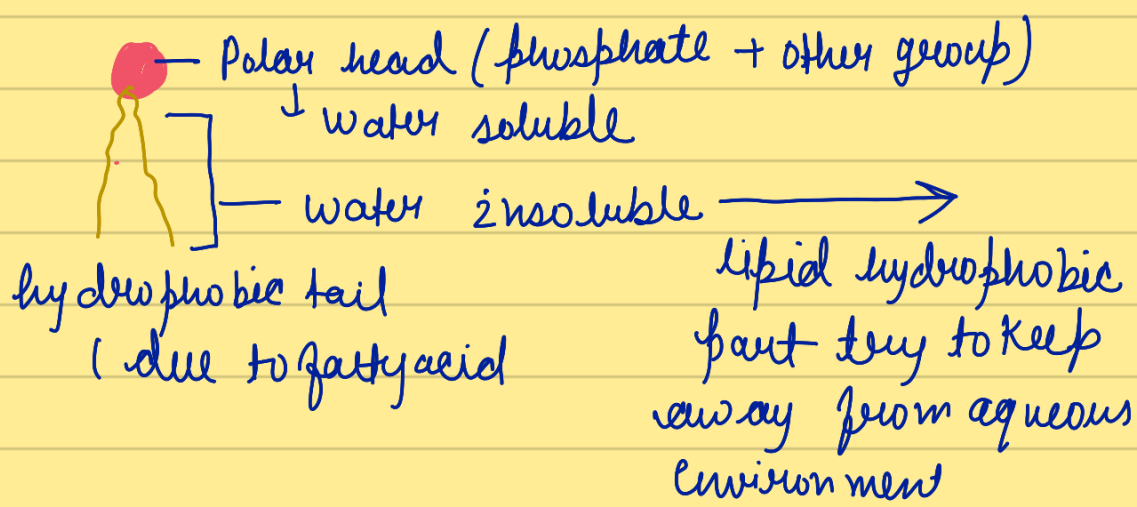
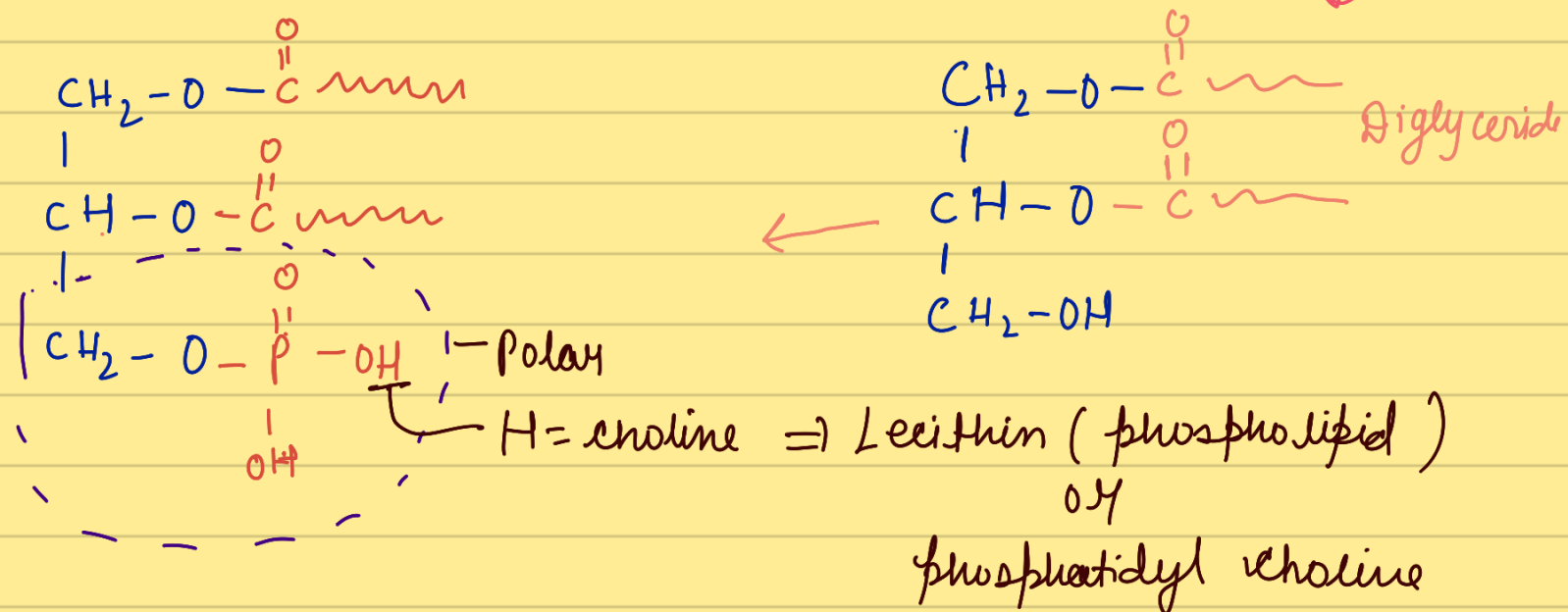
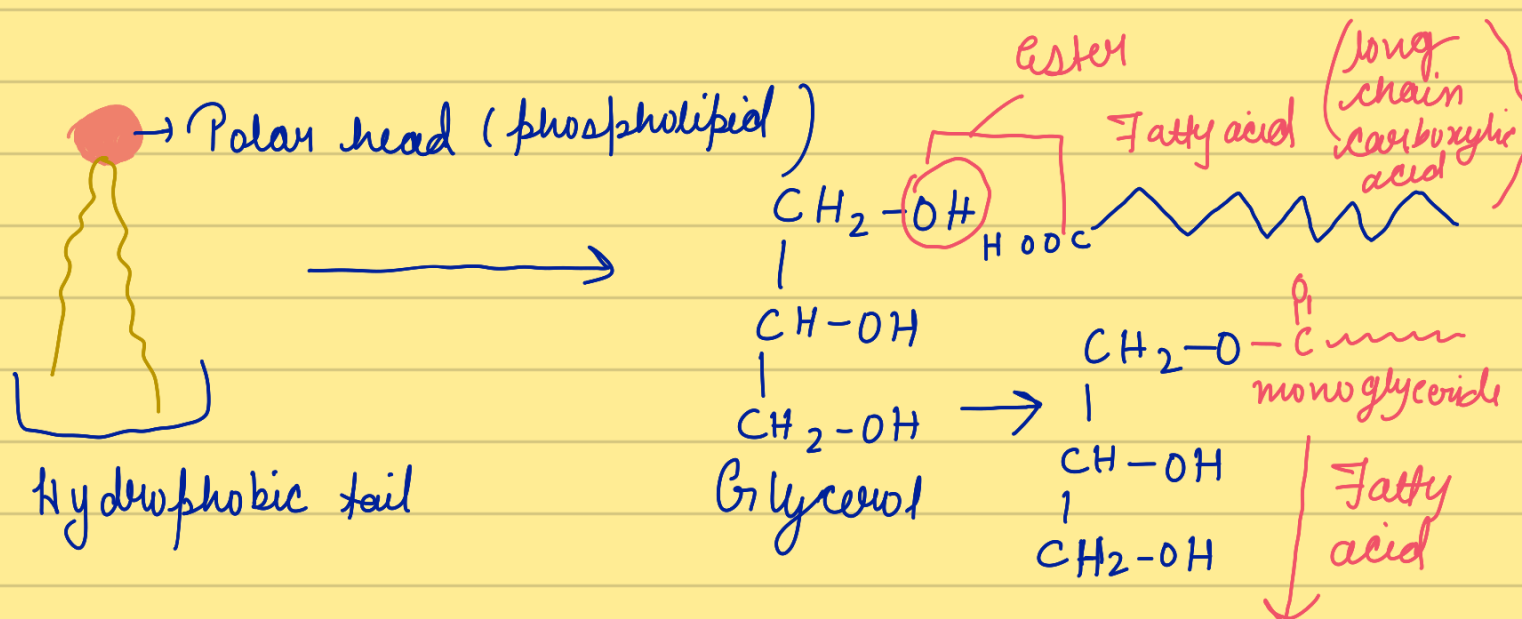
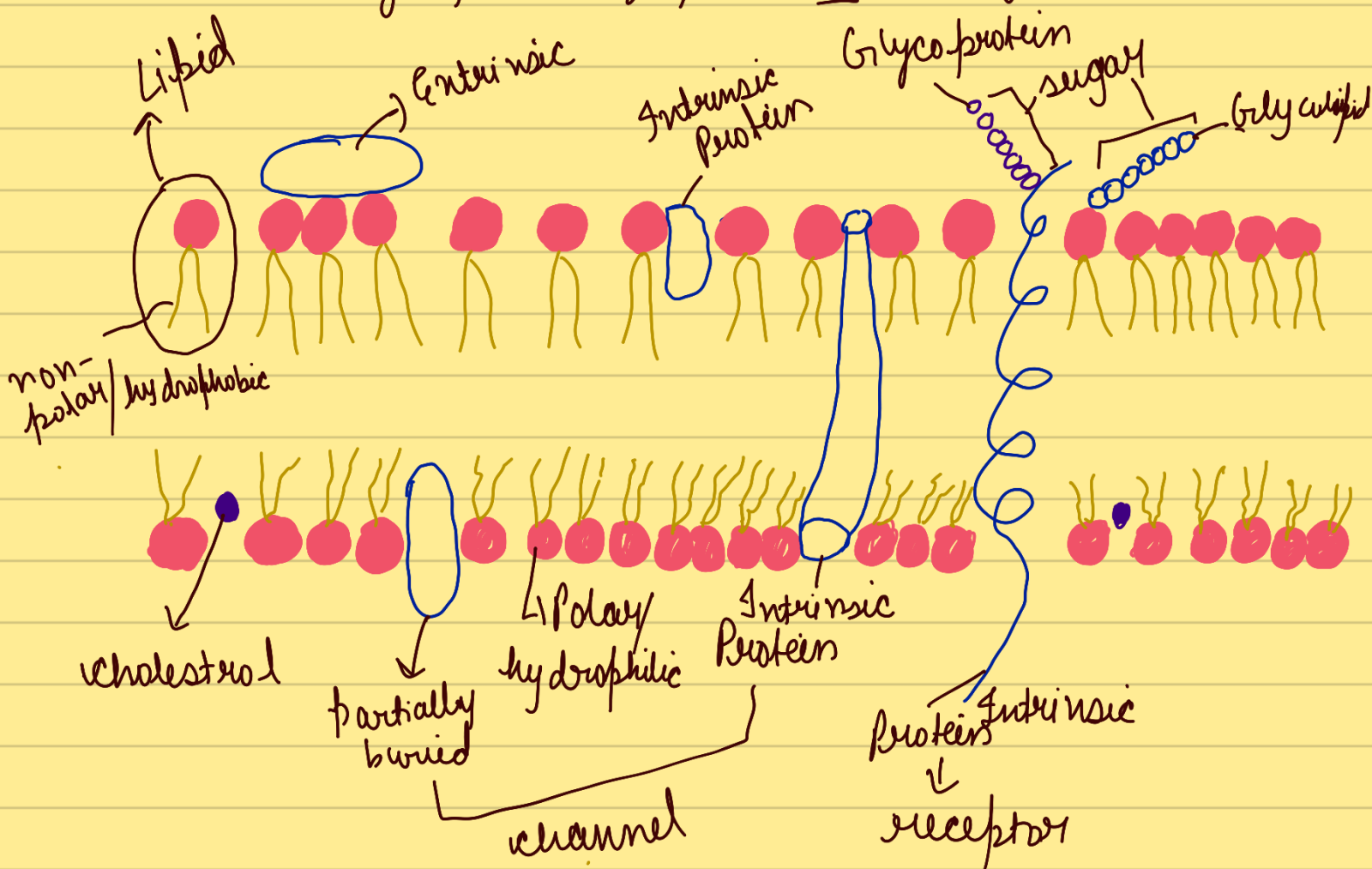
Double membrane

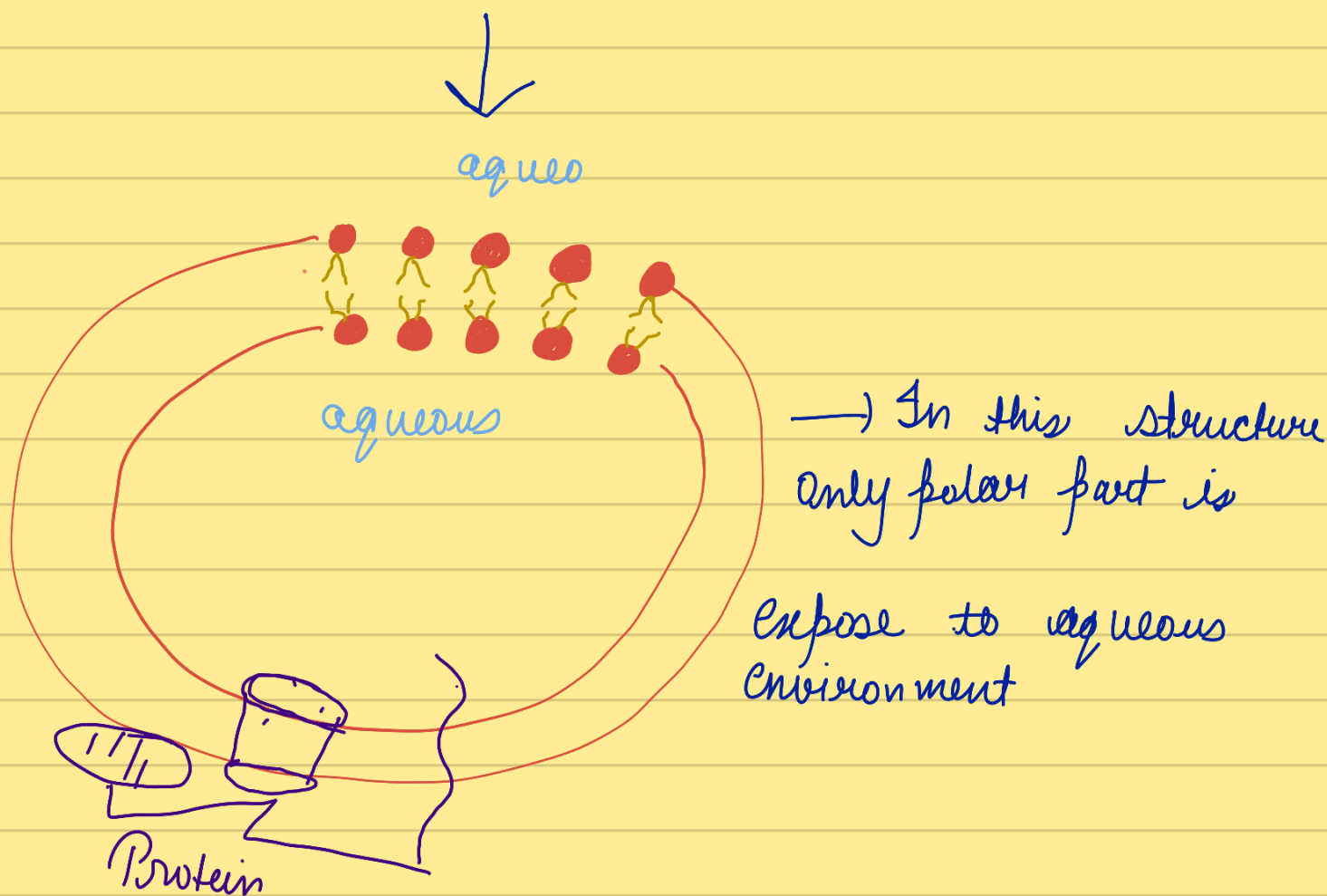
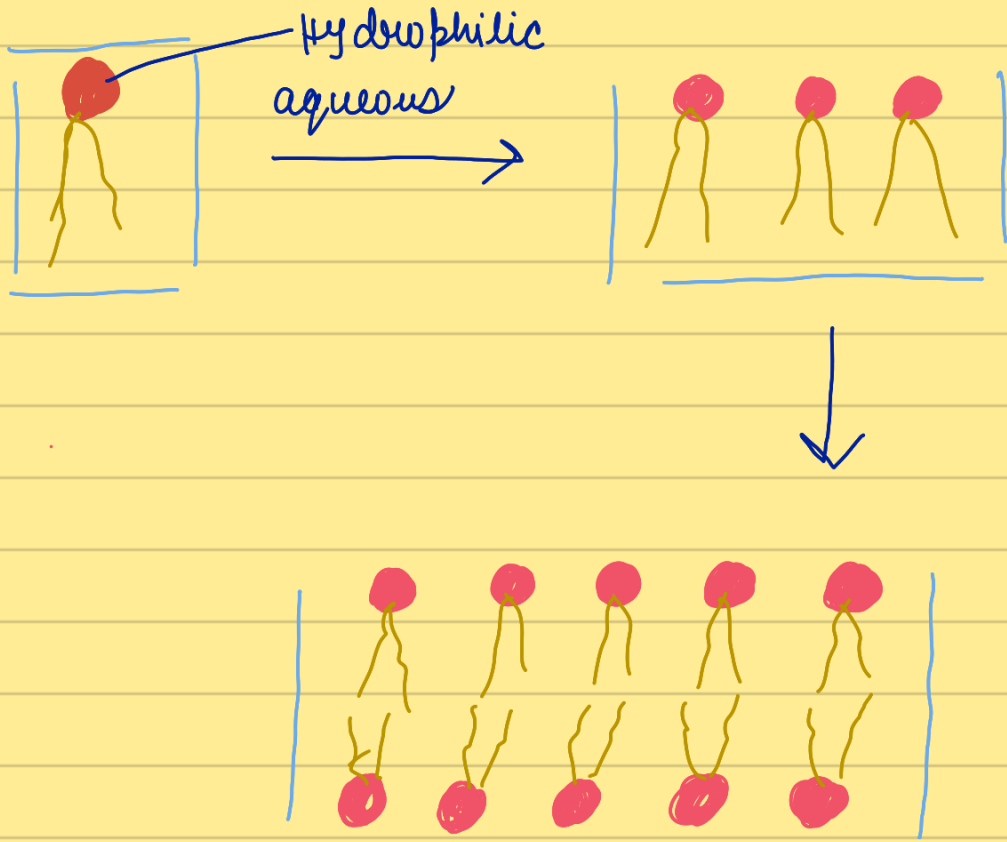
- ↳ Nucleus
- ↳ Mitochondria
- ↳ Plastids (chloroplast)

Plasma membrane

- ↳ Present in all type of cells
- ↳ living structure → consider (active role in transport)
(cell wall = non-living)
- ↳ Structure → chemical structure
analyse - similarity in different cell.
 - ↳ chemically - phospholipid (Bilayer) + proteins + oligosaccharide
+ cholesterol glycolipid, glycoprotein

Glycolipid + glycoprotein = antigen





Structure of membrane

1) Lipid present → phospholipid → hydrophobic tail (Fatty acid) present inside & polar head expose to aqueous environment.

2. Proteins → On the basis of ease of extraction →

Two types of protein

(a) Extrinsic (less amount) — on both surface (Extracellular cytoplasmic)

(b) Intrinsic → difficult to remove

- partially buried
- completely buried

channel pump receptors

(c) Glycolipid → oligosaccharide attach on surface of lipid

(d) Glycoprotein → oligosaccharide attach on surface of protein

(e) cholesterol (animal cell)

Discovery of structure

↳ Detail structure - study only after discovery of electron microscope (1950s)

↳ To study plasma membrane, you need to isolate plasma membrane

↳ chemical analysis of RBC → ER X
mitochondria X
Nucleus X
(no other membrane)

Membrane analysis

↳ 40% lipid

↳ 52% Protein

↳ 8% other carbohydrate

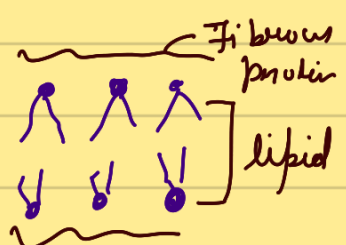
Note:- amount of lipid & protein vary according to cell & organelles

Membrane model → Explain how lipid & protein are arranged

1. Daniel Davison → Sandwich model - Protein - lipid - protein



2. Robertson → unit membrane → P-L-P



3. Fluid mosaic model → 1972 Singer & Nicholson

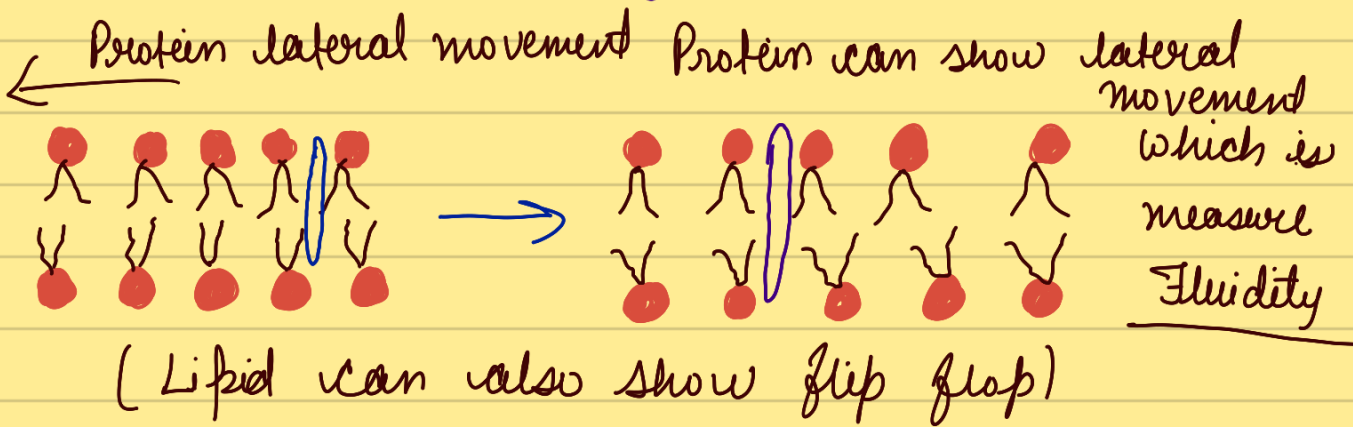
Fluid mosaic model

arrangement of lipid & protein

↳ Lipid bilayer + proteins are in form of ice bergs in form present oceans of lipid

↳ Nature of lipid is → Quasifluid (not solid)

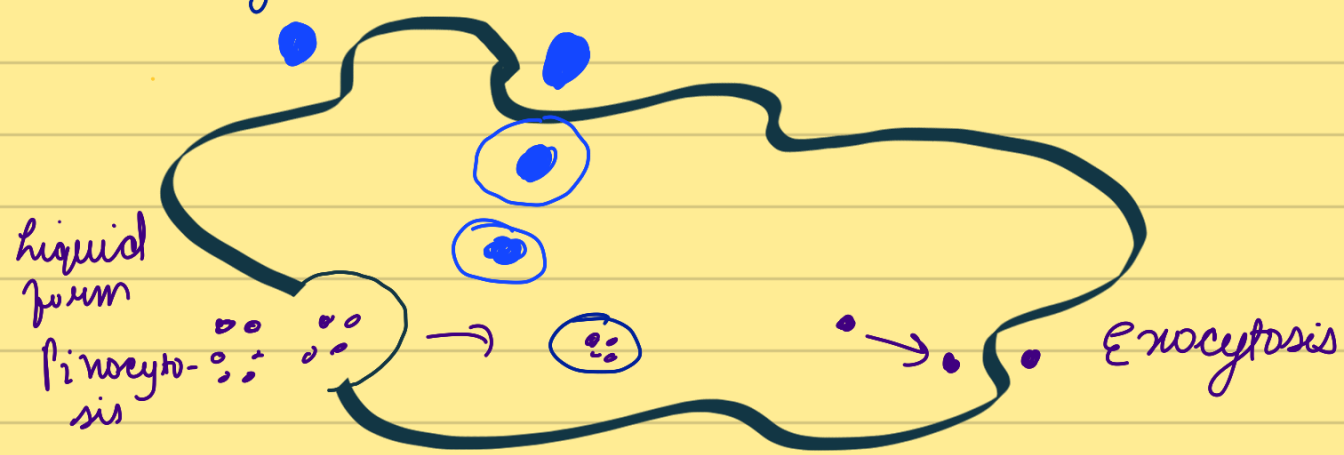
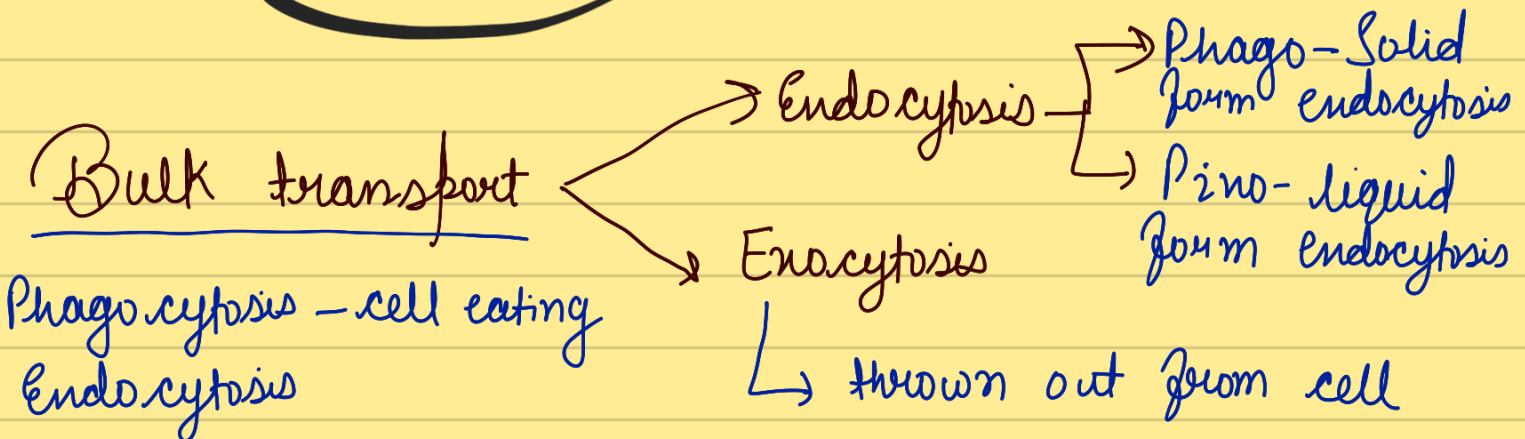
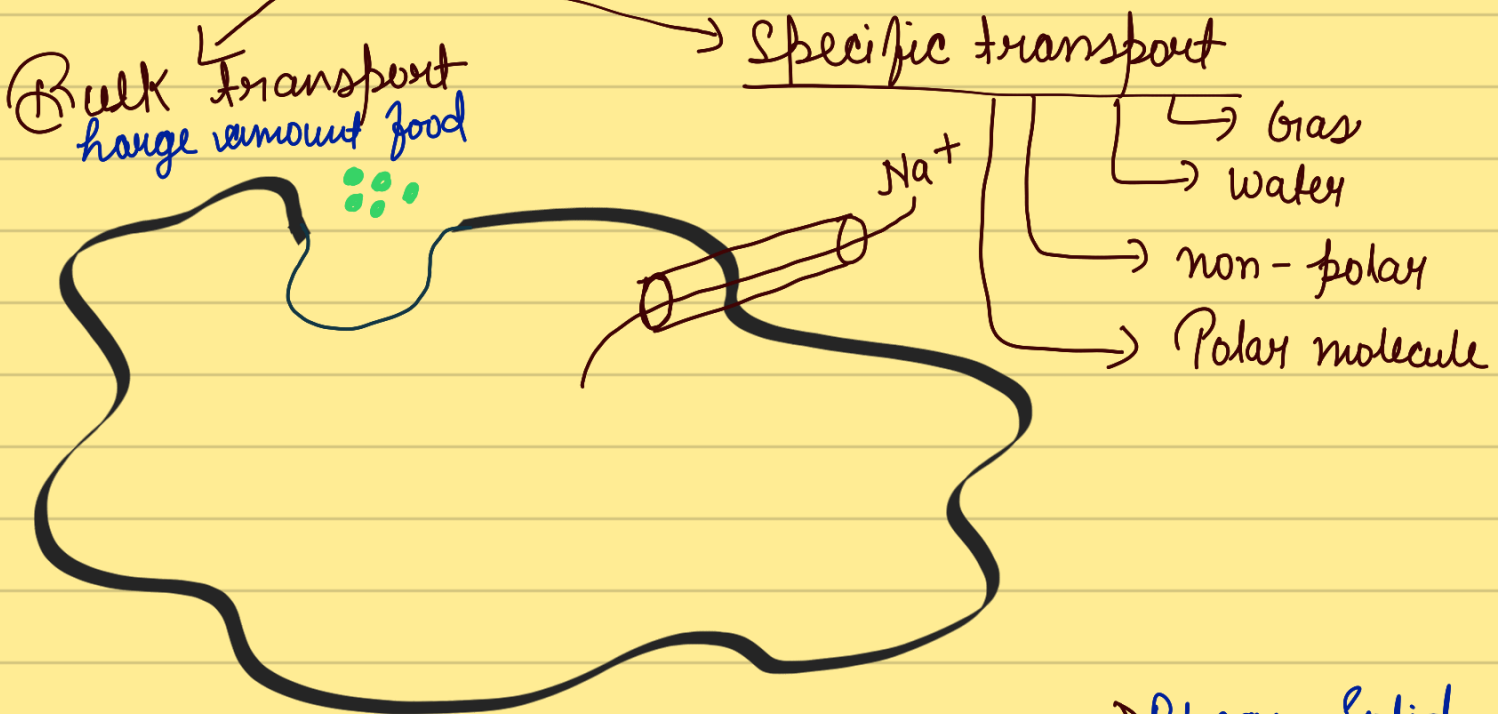
↳ This quasifluid nature able to explain many functions (secretions, Endocytosis, Growth & cell division)

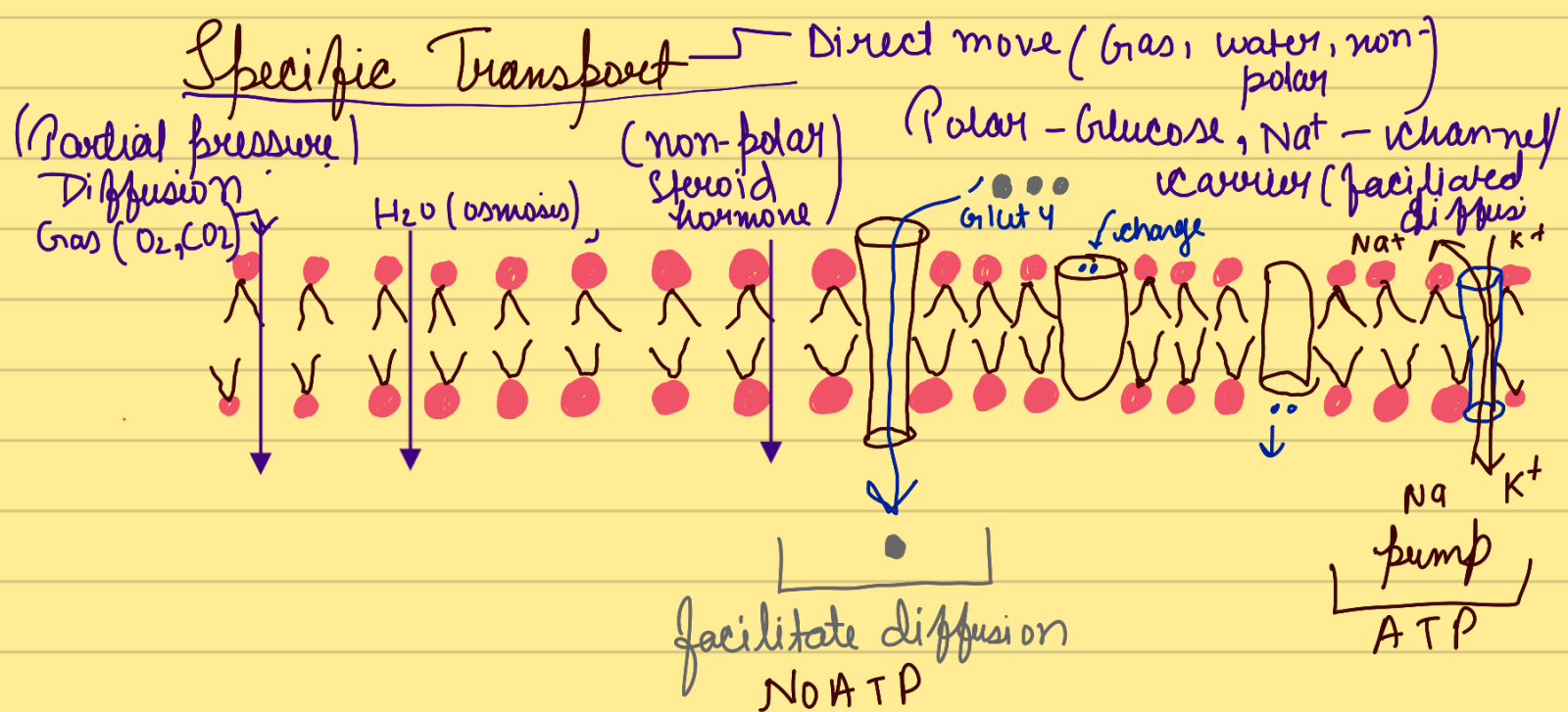


Note:- For best fluidity unsaturated fat is perfect.

Function of membrane → Explain with the help of Quasi fluid model
Secretion, Endocytosis, Growth, cell division, Interaction

Transport across membrane





Summary

Name of transporting molecule	type of transport
1. Gas	→
2. Water	→
3. Non-polar	→
4. Na ⁺	→
5. Glucose	→
6. Na ⁺ - K ⁺	→ pump

Facilitated diffusion

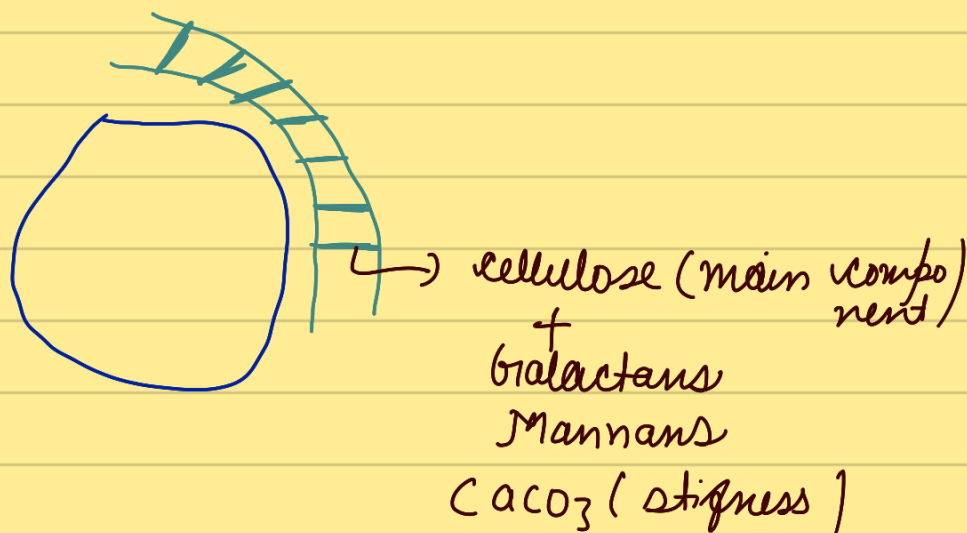
cell wall

Present in cell → Fungi & plant cell
 (chitin) (major component of cell)
 (polymer of NAG)

Other cell also have cell wall (Bacteria, protista)

living or non-living → cell wall is a non-living part of cell (secreted by cellulose).

Algae cell wall

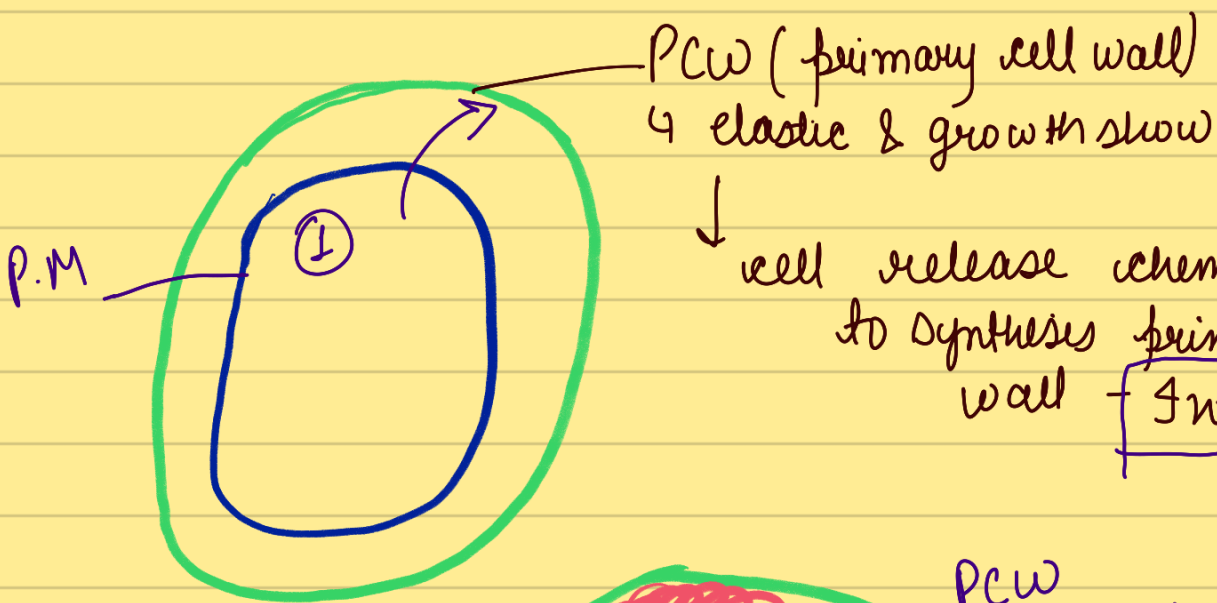
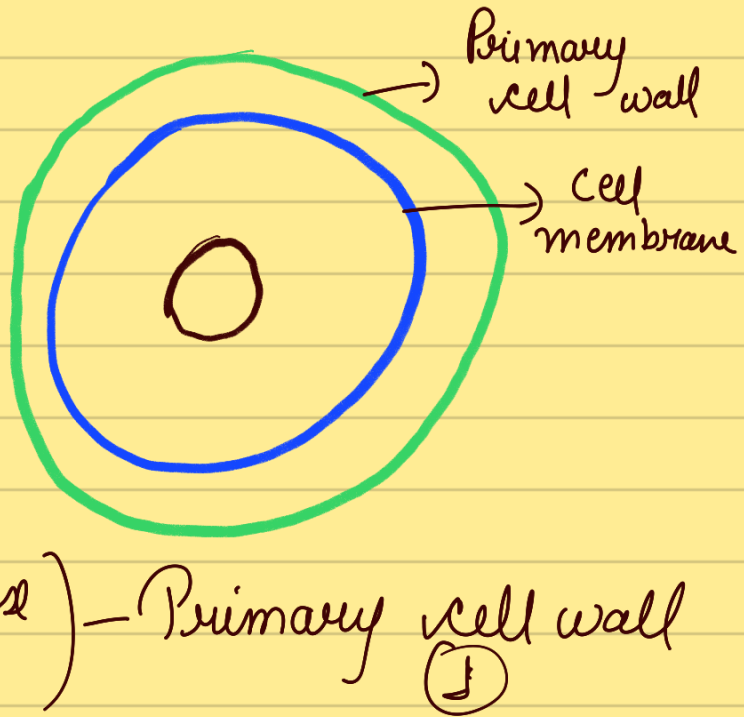


Plant cell wall

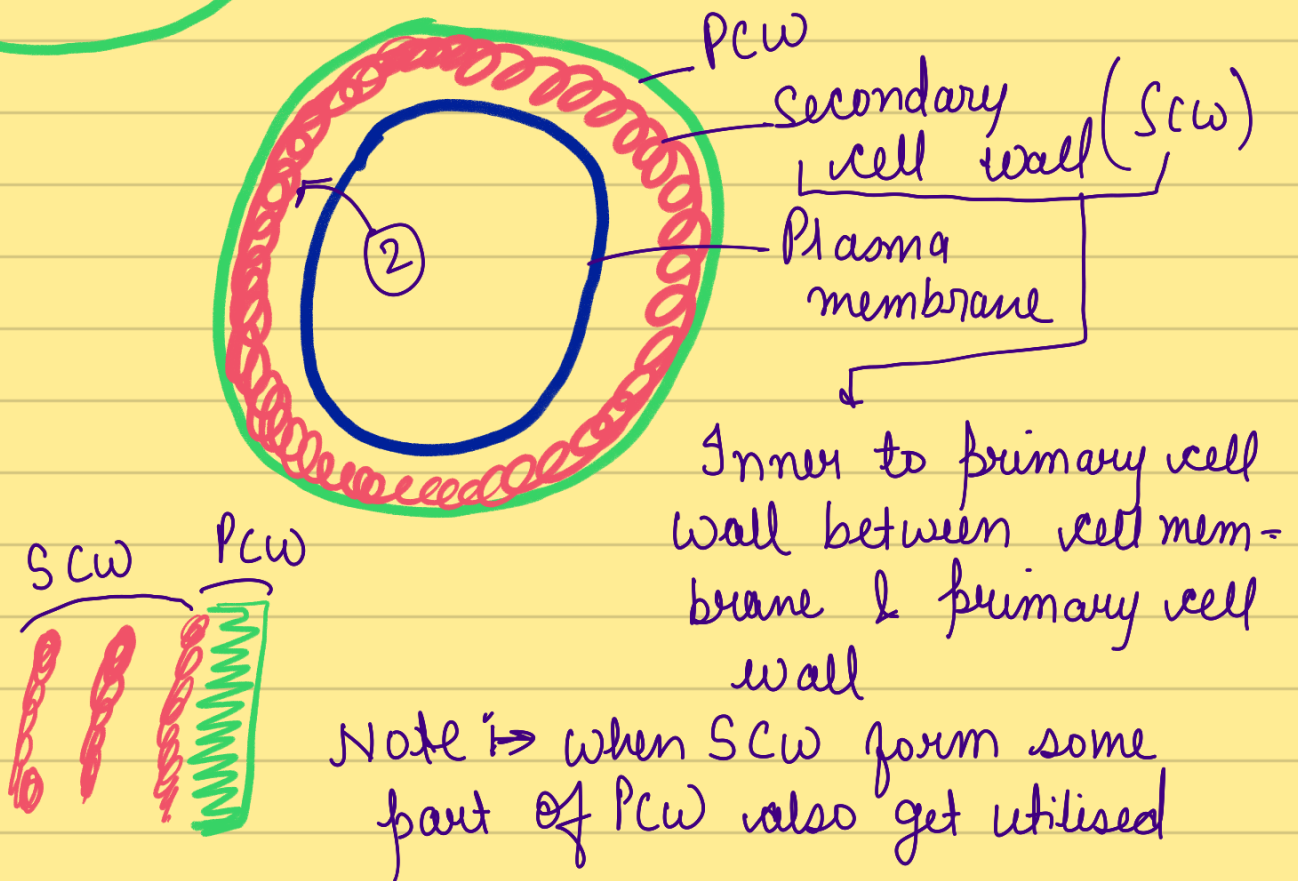
Chemical composition



(pectin + Hemicellulose + protein)



cell release chemical to synthesize primary cell wall - Intusuction



(some material deposit in PCW - Accretion)

(2) Secondary cell wall → chemically → cellulose + Pectin or lignin or cutin

example of cell with PCW → meristematic parenchyma

SCW → Fibre vessels, tracheids, collenchyma sclerenchyma

Role of cell wall

- (1) Provide shape
- (2) Give rigidity
- (3) Give protection from macromolecule & infection
- (4) Prevent from osmotic lysis

Comparison

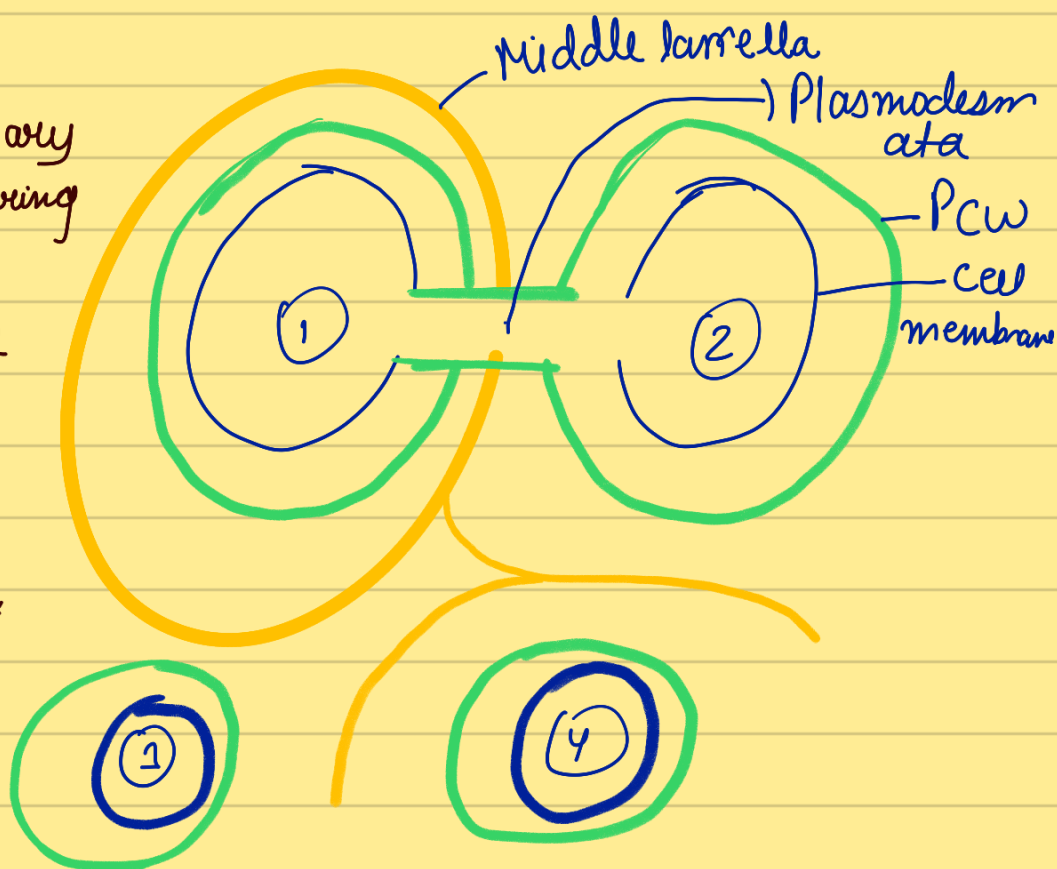
PCW	SCW
Location → Inner to middle lamellae	Inner PCW & cell membrane
chemical → cellulose, hemicellulose, pectin, protein	cellulose + lignin or cutin
Growth occur or not Yes	No
Pits No	Yes (deposition absent)
Present	less water
Amount of water (Antisepsional) Growth	Accretion - deposition in already form structure

Middle lamellae

Location → B/w two primary cell wall of neighbouring cell.
It is absent on free surface

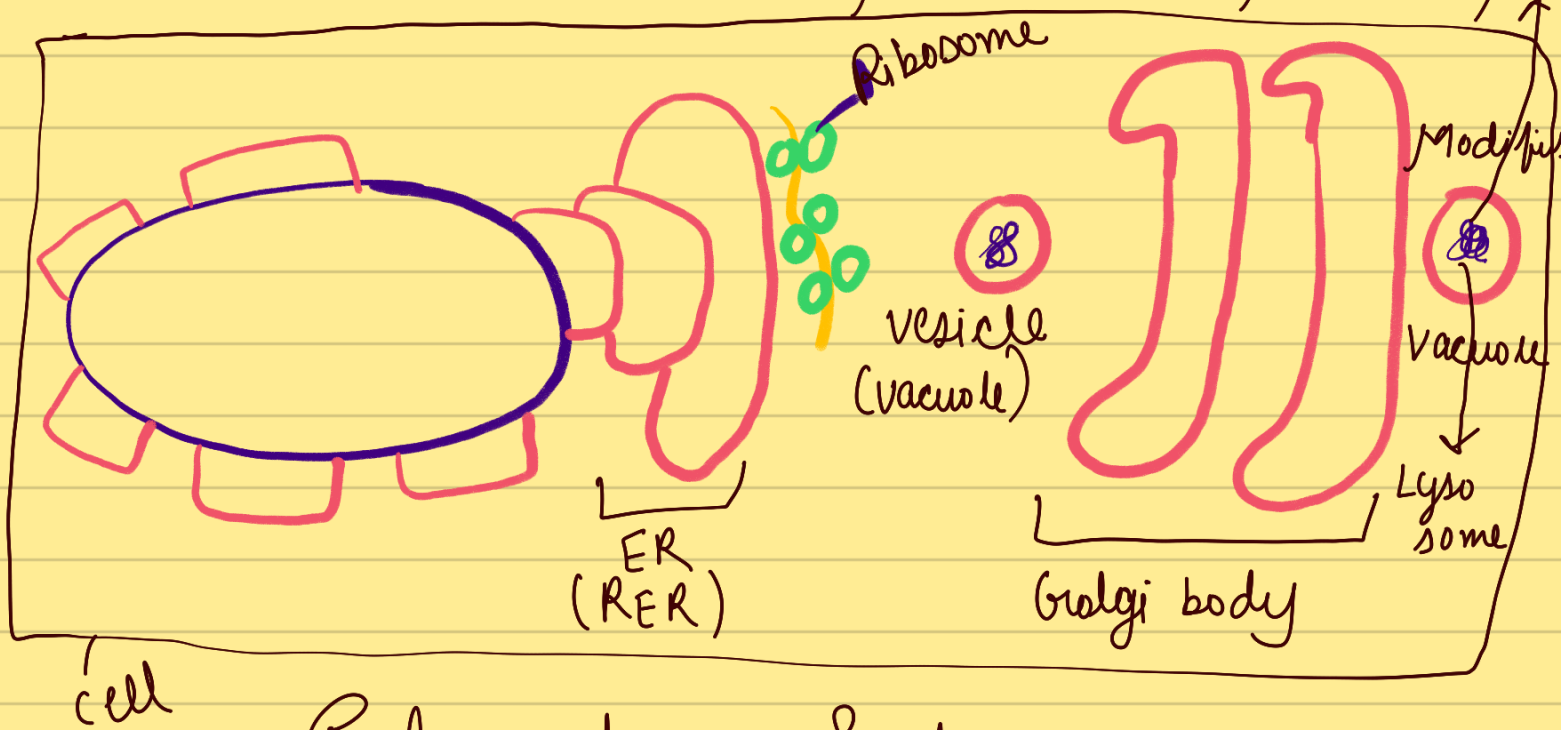
chemically - calcium pectate & Magnesium pectate

Role - It glue / attach neighbouring cell



Enzyme = Polygalacturonase - Digest middle lamellae (Ripening of fruit)

middle lamellae - absent in plasmodesmata (plant cell)



Endomembrane System

- ↳ Eukaryotic cell $\rightarrow$ membrane bound organelle present
- ↳ Some organelle have membrane + function coordinated

Organelles = membrane + function coordinated

- ↳ ER
- ↳ Golgi body
- ↳ Lysosome
- ↳ vacuole / vesicles

Endomembrane system

Note:- Mitochondria, plastids, peroxisome - is not part because work is not coordinated

Ribosome is also not part $\rightarrow$ No membrane

Endoplasmic Reticulum [Inside cell membrane system]
 Inside ↓ Protoplasm
 membrane

Visible in → Electron microscope

Type → RER → Rough Endoplasmic reticulum (Ribosome)
 SER → Smooth endoplasmic reticulum

Compartment → ER divide cytoplasm into two compartment
 (a) luminal compartment → Inside lumen of ER
 (b) cytoplasmic compartment.

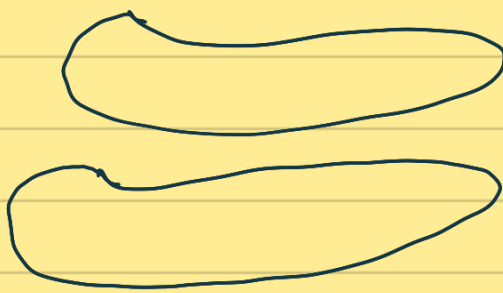
Biosynthesis

↳ Nuclear membrane → RER → SER

Structure → RER → mainly tubule [RER can have - vesicles, cisternae, tubule]
 SER → mainly cisternae [SER can have - vesicles, cisternae, tubules]

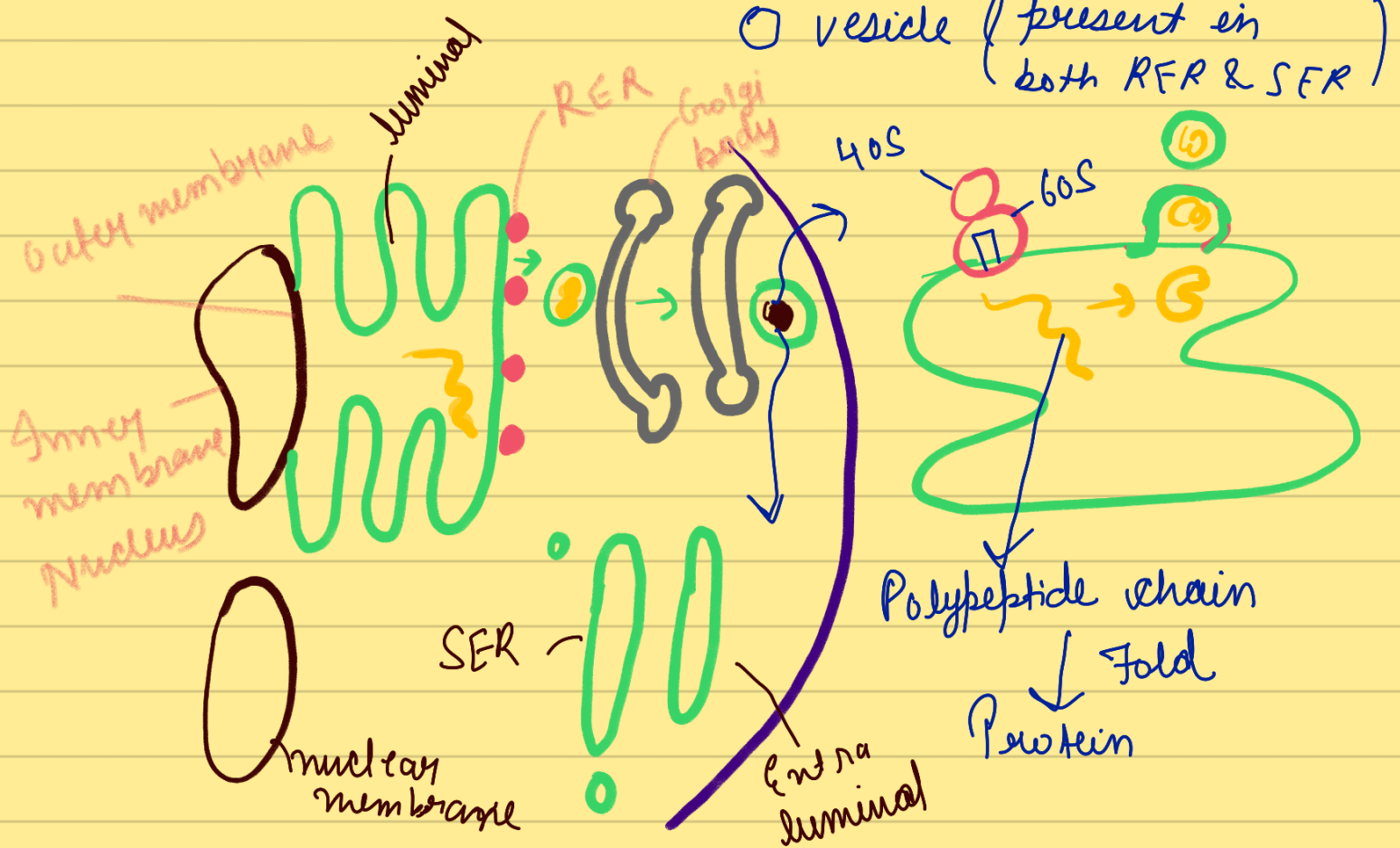


Tubule



cisternal

○ vesicle (present in both RER & SER)



Role of ER

① RER → (a) protein folding inside lumen of RER
(Ribosome large subunit bind on ER)

[large no. of RER present in those cells which involve in protein synthesis] →

Enzyme form

② SER - Lipid synthesis in cell

- ↳ Steroid hormone produce inside SER (testosterone, progesterone, estrogen)
- ↳ Liver cell → have large no. of SER
 - (a) detoxification (cytochrome P₄₅₀)
 - (b) Glycogen synthesis
 - (c) muscle cell → sarcoplasmic reticulum

Golgi body

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