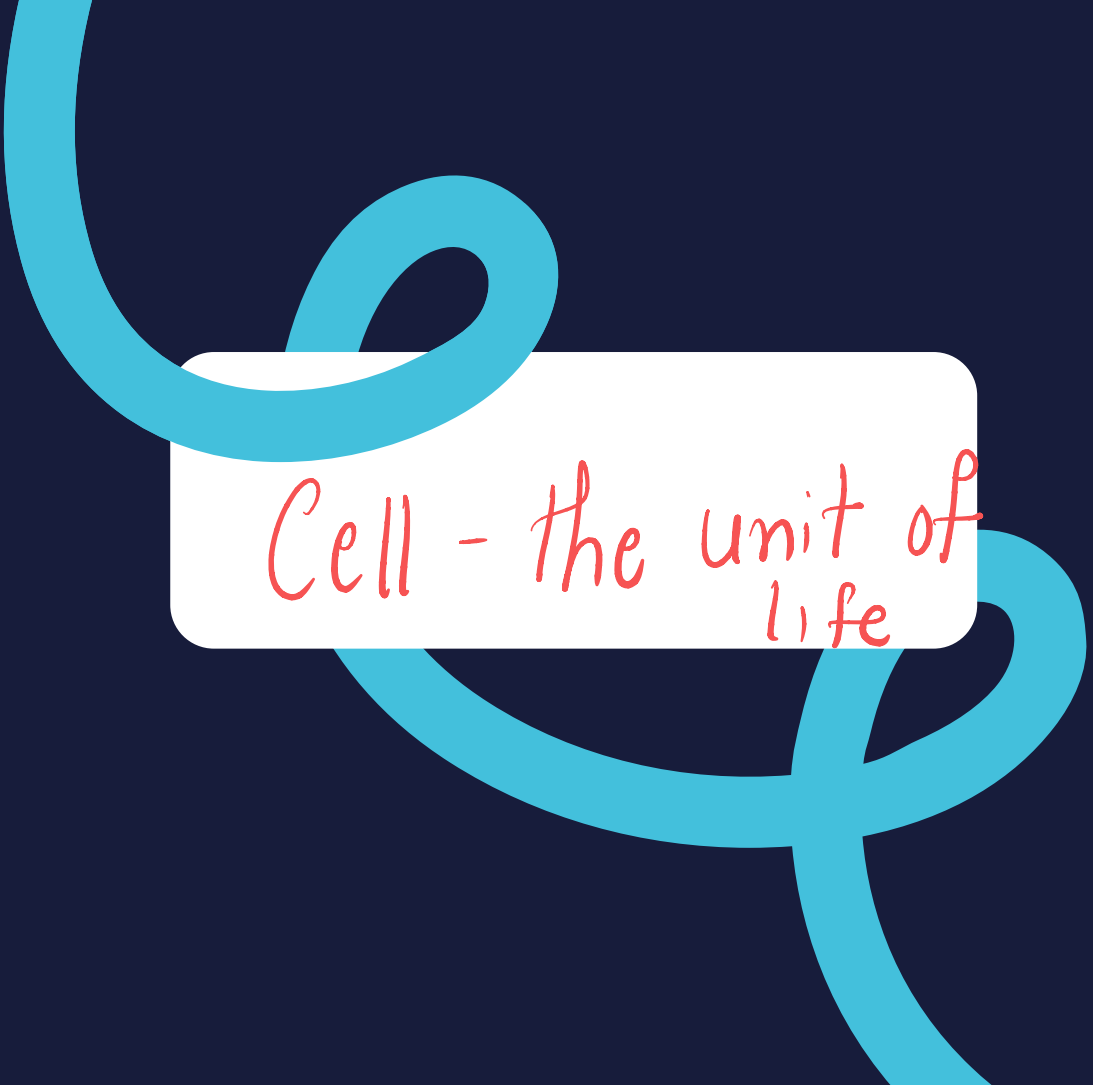




Cell - the unit of
life

Cell

Cytology → Branch of science that deals with study of cell

Cell → Structural & functional unit of life

Each & every str. in our body is made of cell.

Kidney → unit = Nephron

Nervous sys → unit = Neuron

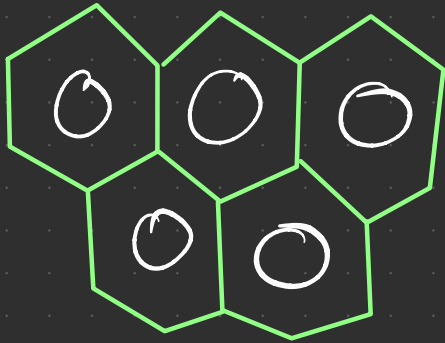
Robert hooke

= Cork cell (dead cell)

= Book - micrographia

= Self designed microscope

= Compartment → honey bee comb



A.V. Leeuwen hock

= 1st living cell

- mud water

- bacteria

- Protozoa

- RBC

Robert Brown → discovered
Nucleus

unicellular Organism

- * Independent Existence

- * Can perform all vital fns

- * Anything less than a cell doesnot show independent existence.

- * for structural detail of cell $\Rightarrow$ electron microscope

Cell theory

Schleiden
(Botanist)
German

Schwann
(Zoologist)
German

⊛ Cell form tissue

⊛ discovered PM

⊛ In plant cell → cell wall is unique feature

1. Each organism is made up of cell.
2. Activities of organism is outcome of interaction of diff constituent of cell

Robert Virchow → Omnis - cellula - e - cellula.

Every new cell arise from pre existing cell

Acellular → does not follow cell theory.

Exception of CT

- Mature RBC
- Mature Sieve tube
- Bacteria
- Virus
- Viroids

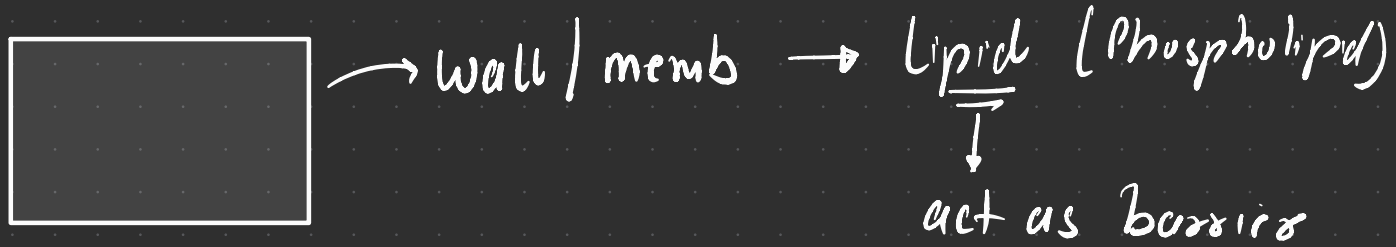
- oval - Mesophyll
 - Biconcave & oval - RBC
 - Amoeboid → WBC
 - Elongated → Tracheids
 - thread like branched cell - Nerve cells
- Largest isolated cell - ostrich egg

RBC → $7\mu m$

Bac. → $3.5\mu m$

Mycoplasma = $0.3\mu m$

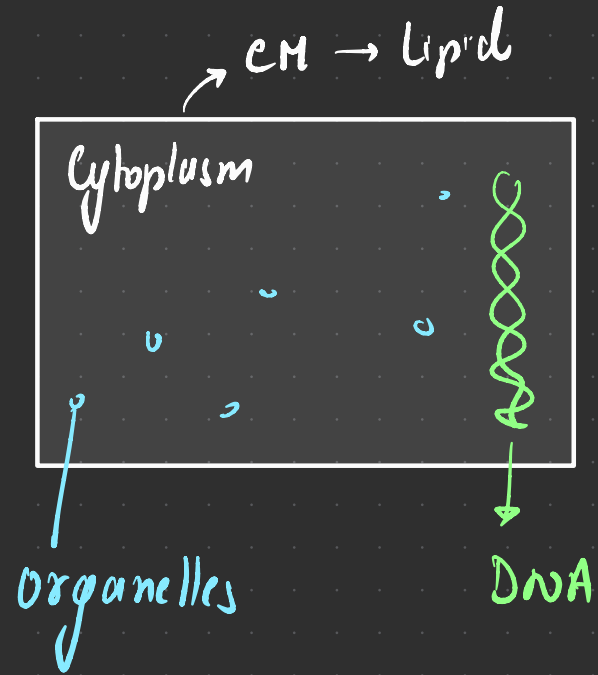
Compartment → Separate inner & outer envt.



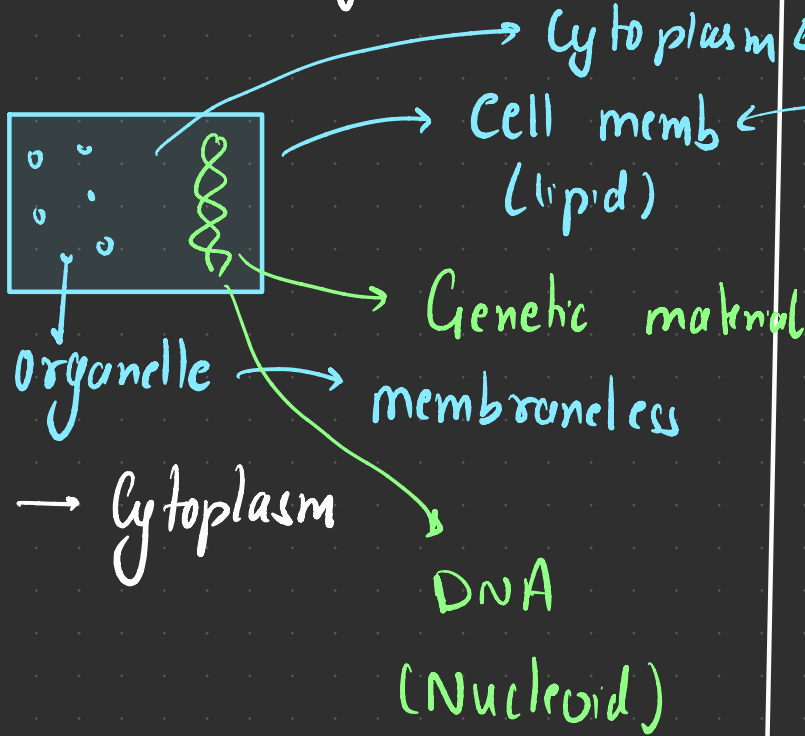
All living cell → contain Plasma memb.

≡ Requirement of cell

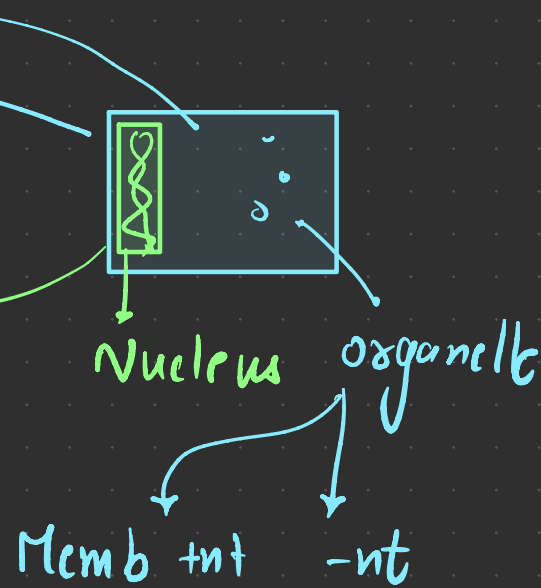
- Cell memb
- Cytoplasm
- organelles + nt
- DNA



Prokaryotes



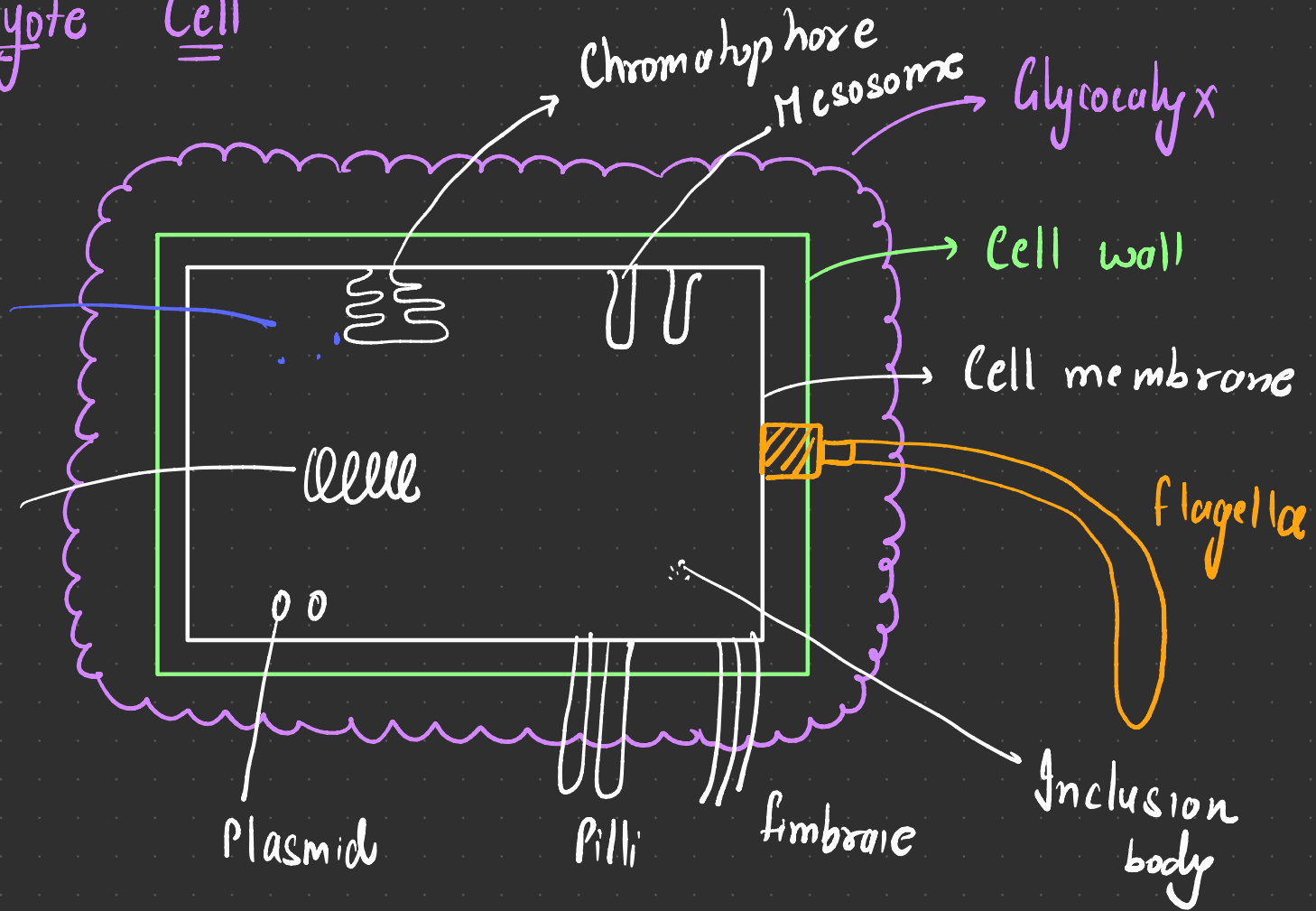
Eukaryotes

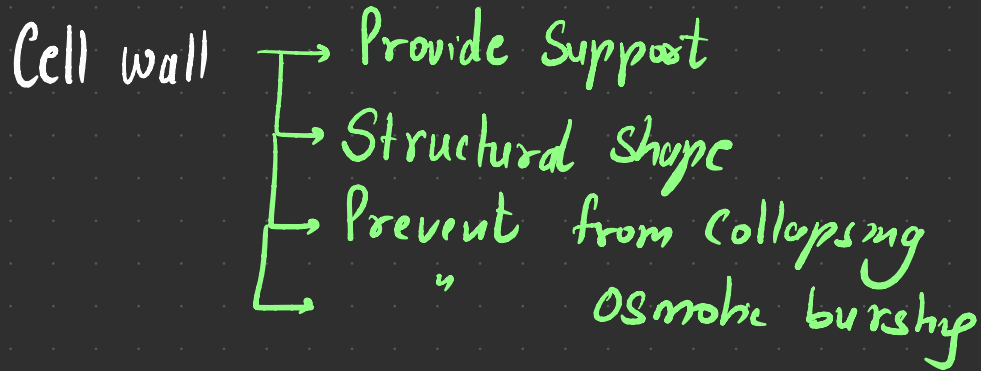
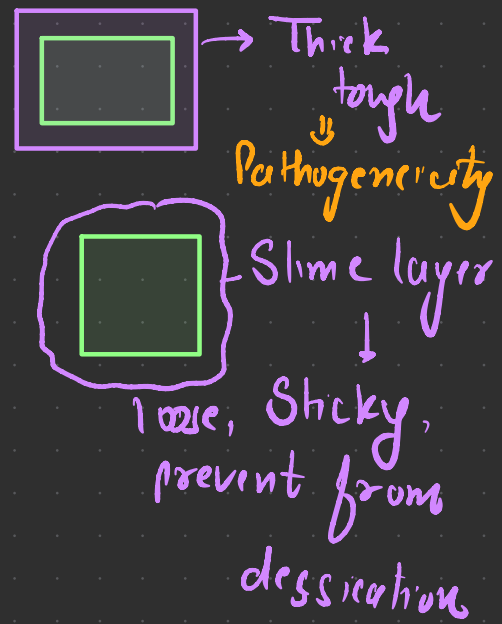
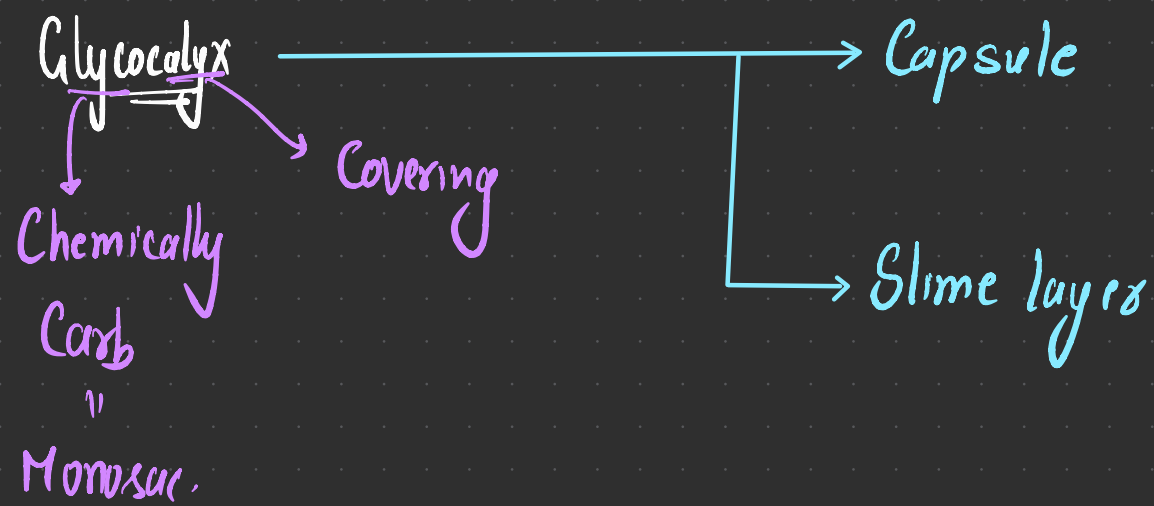


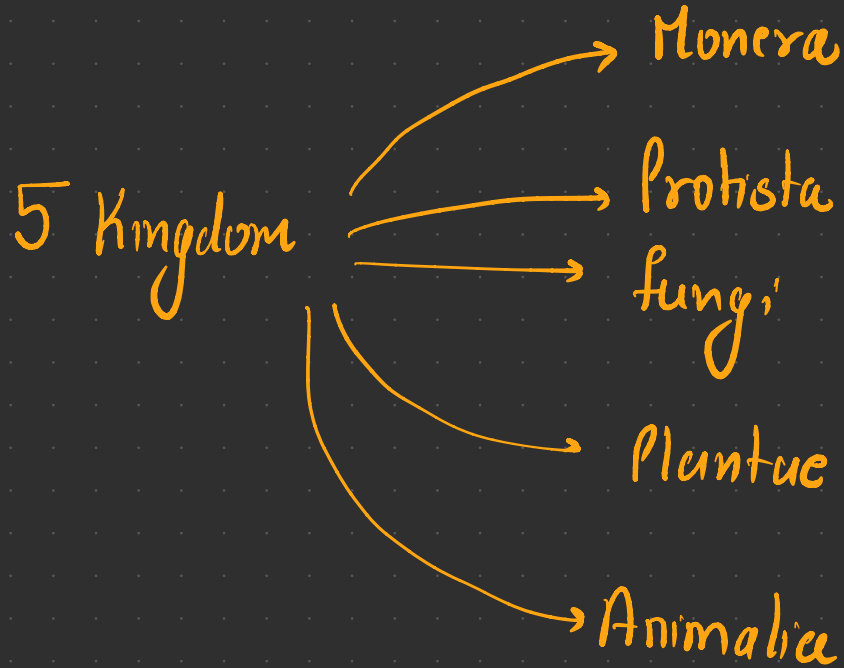
Prokaryote Cell

Ribosome
(70s)

Nucleoid







Cell wall	Made by
=	Peptidoglycane
Some	—
✓	Chitin
✓	Cellulose
x	

lysozyme → +nt in tears → Prevent bac. infection
↓
digest Cell wall
of Bacteria
↓
By breaking Glycosidic
bonds +nt b/w NAM
& NAM

→ Mycoplasma → No cell wall

Penicillin → cannot kill Mycoplasma

→ Archaea bac. → cell wall $\neq$ → (not made of
peptidoglycan)

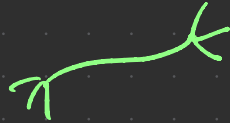
Cell envelope → Glycocalyx + Cell wall + Cell memb.

↓
Act as single protective unit



Type of bacteria

① Spirillum



② Vibrio



③ Coccus



④ Bacillus



Cell membrane

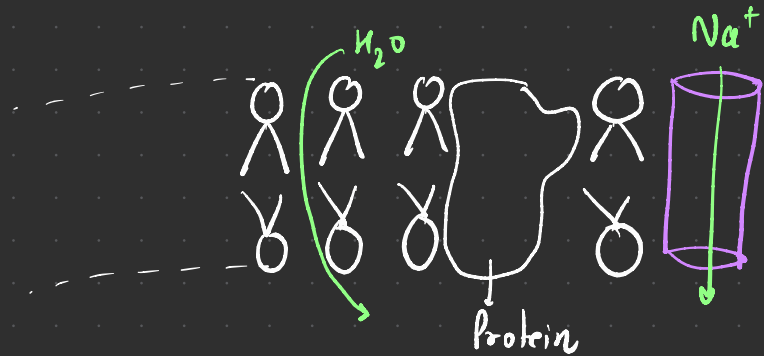
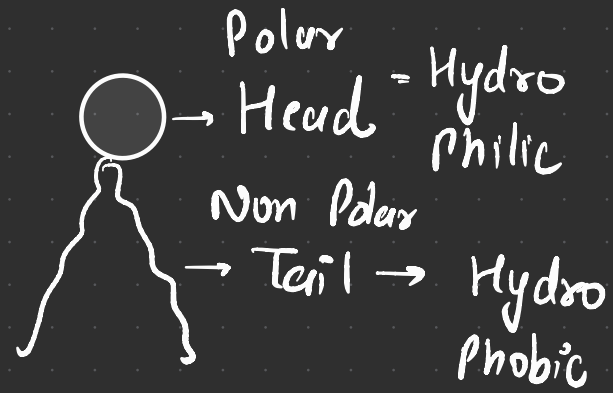
Made up of lipid (Phospholipid)

* Similar in both pro & Eukaryote
(fxn & Str.)

* Semi permeable

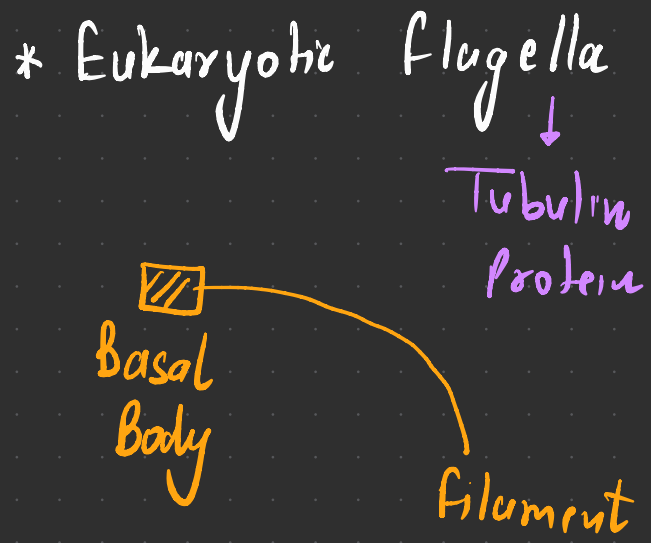
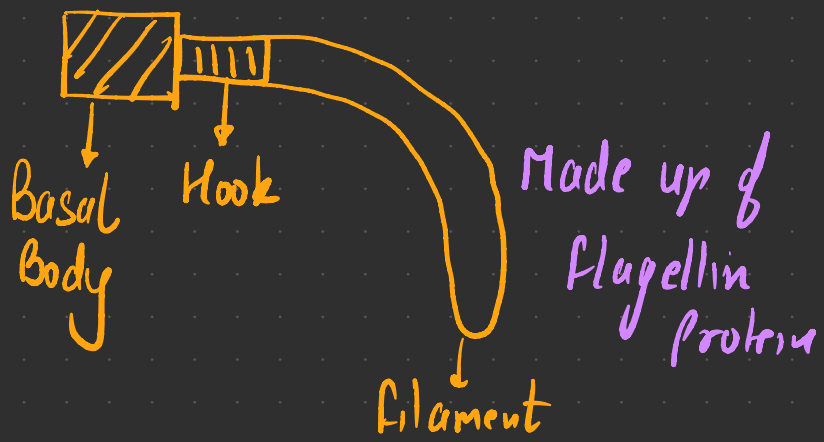


only H_2O passes
nothing else



Flagella

- * Extension of cell wall
- * Motile cell $\rightarrow$ Flagella $\equiv$
- * Prokaryote



* No. of flagella & position (arrangement)

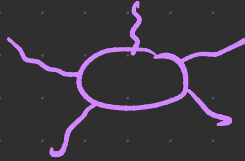
ab → Atrichous

 → Cyanobacteria, coccus, Mycoplasma

→ Monotrichous



→ Peritrichous



→ E. coli

→ Amphitrichous



→ Cephalotrichous



→ Lophotrichous



→ Spirillum

Pilli

→ No role
in motility ←

Fimbriae



Tubular

Made of pilin proteins

Role in sexual
Repro.



Bristle shape

Attachment in
rock / host

More in no.

Mesosome

In folding of Plasma membrane

Shape → vesicle 
lamellae 
Tubule 

↓ SA ↑

More developed in
gram +ve bacteria

- cell wall formation
- DNA Replication & cell division
- ↑ SA by folding → Enzyme attach (Respiration)
- Secretion

Chromatophore

colour bearing

extension of cell memb. → pigment attach

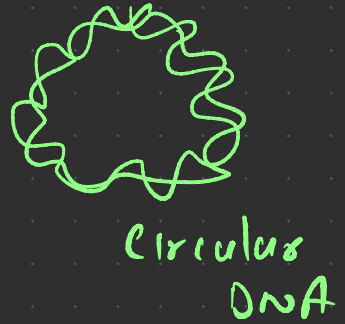
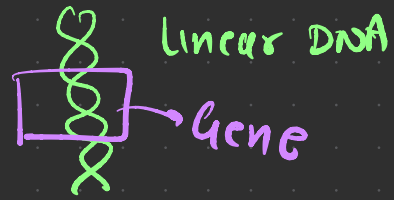
Help in photosyn

Not +nt in all bac.

+nt in Cyano bac. or BGA

Nucleoid (Genomic DNA)

- Prokaryotic DNA
- single DNA (Double Stranded)
- circular
- naked



It is packed with help of some protein in a region called Nucleoid.

- DNA + nt in Cytoplasm.
- All necessary gene + nt on DNA

Plasmid

* Extra chromosomal DNA

* DS circular

* Self Replicating (w/o Nucleoid it can replicate)

Additional gene
(Not necessary
for Survival)

f- Plasmid → Bac. Repro.

Ti Plasmid → Tumor inducing Plasmid → Agrobacterium

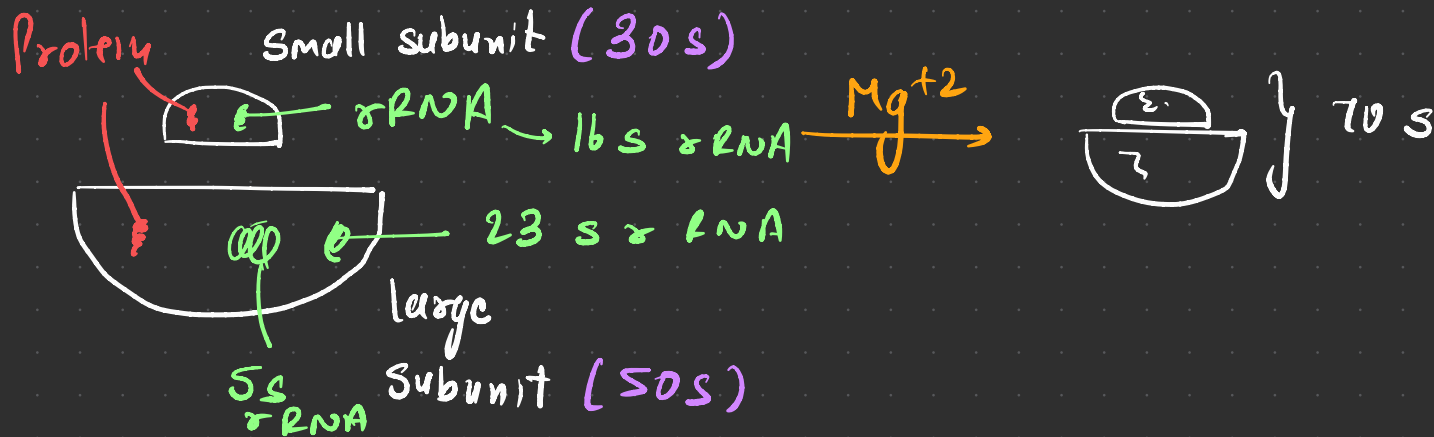
Ribosome (70s)

Size = 15-20 μm

w/o membrane

Granular

Chemically $\rightarrow$ rRNA + Protein } Also has Ribonucleoprotein



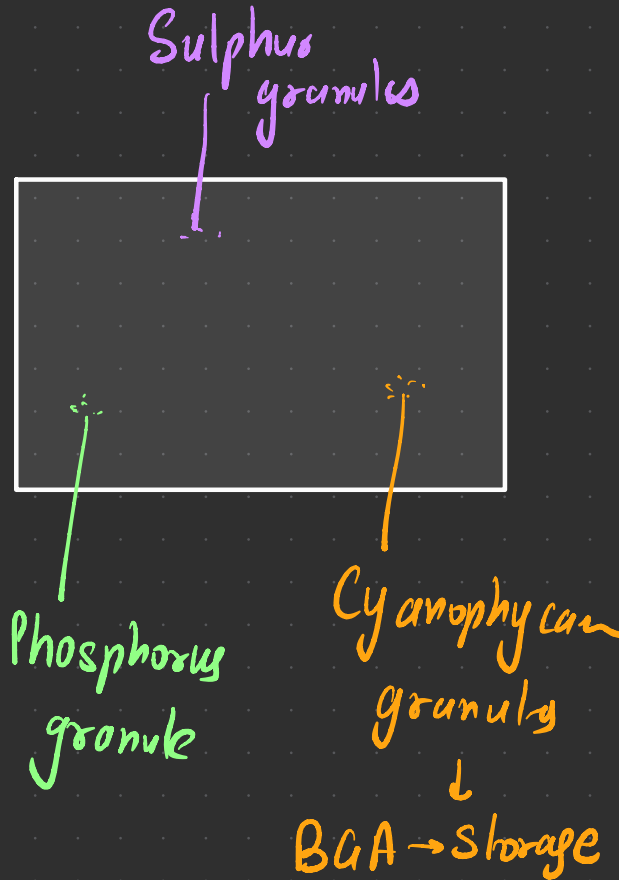
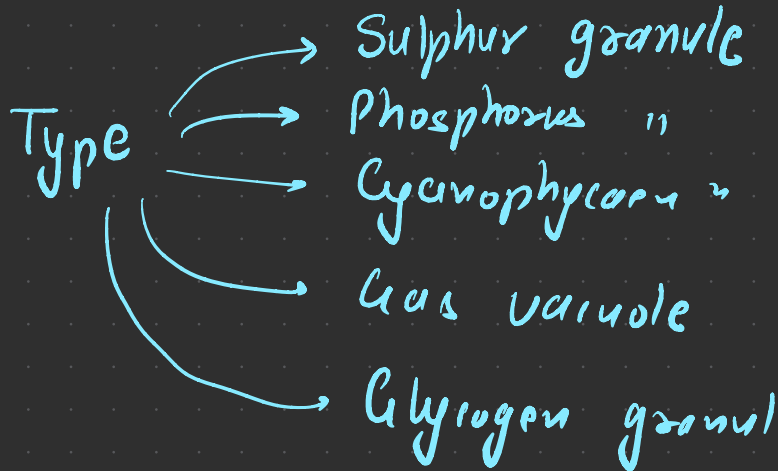
Inclusion Body

→ Storage Str.

w/o memb

→ in cytoplasm

Insoluble



Prokaryote

2 μm - 5 μm

Smaller size

DNA naked

organelle +nt (w/o memb)

Eukaryote

10-20 μm

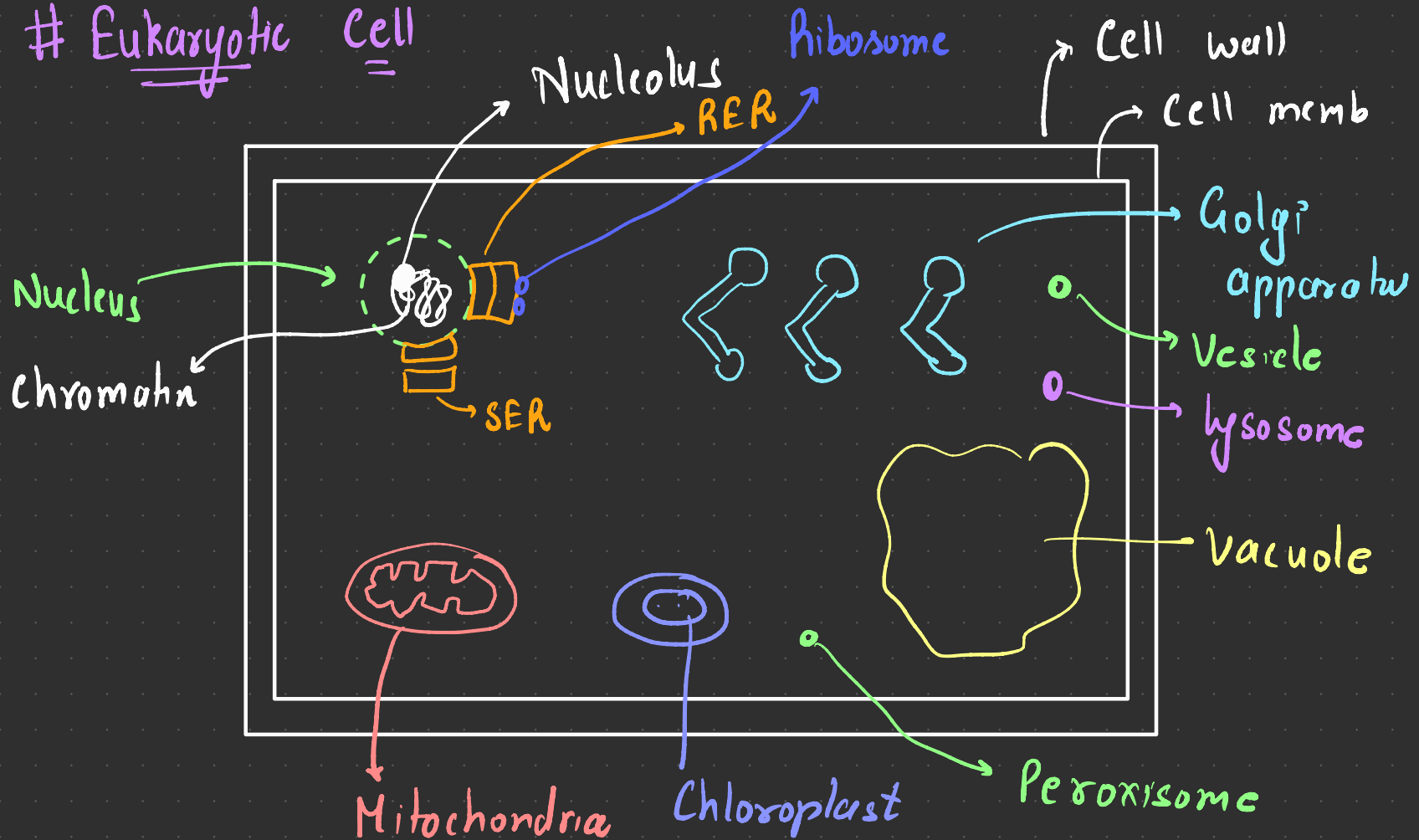
DNA +nt in nuclear envelope.

organelle

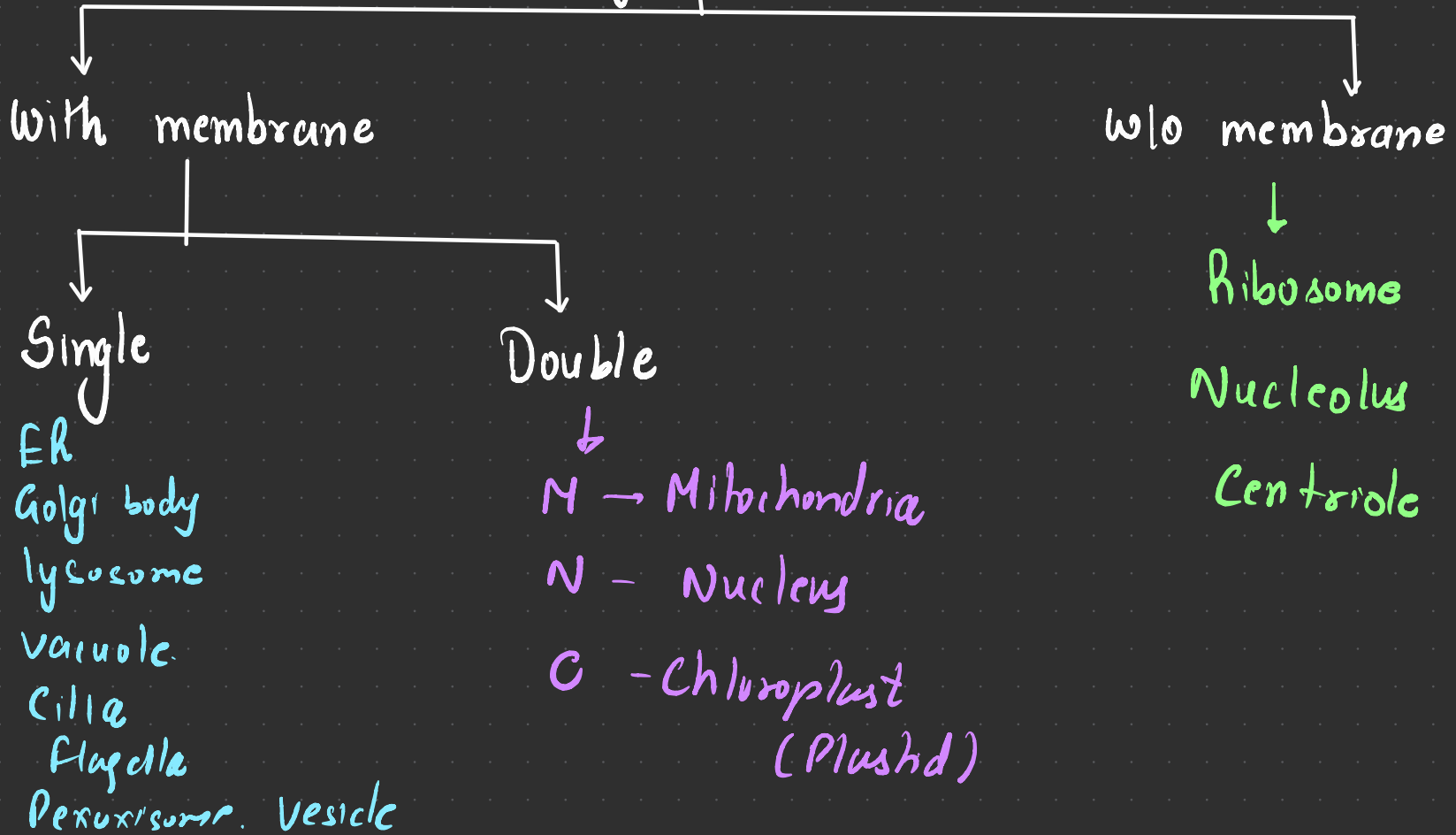
with w/o memb

Single double

Eukaryotic Cell



Organelles



Cell membrane

Discovery

In light microscope $\rightarrow$ Cell membrane is visible
but its detail str. after discovery of
e⁻ microscope (1950s)

Chemical analysis of RBC membrane

Why RBC $\rightarrow$ RBC no other memb $\rightarrow$ no nucleus
no mito
no Golgi
no ER



$\xrightarrow{\text{destroy}}$



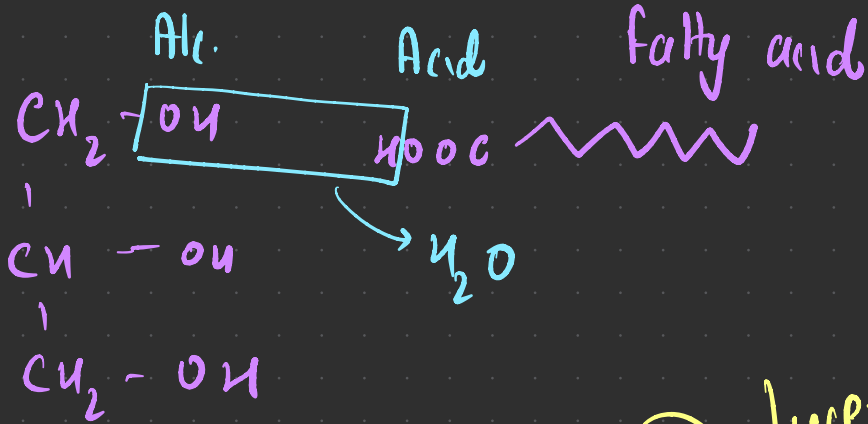
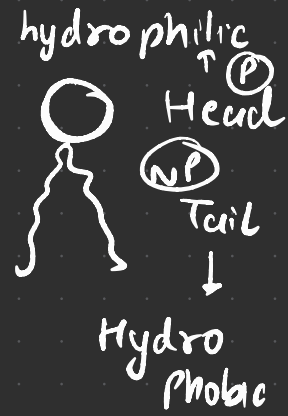
RBC
memb.



$\rightarrow$ Protein $\rightarrow$ 50%
 $\rightarrow$ Phospholipid $\rightarrow$ 42%

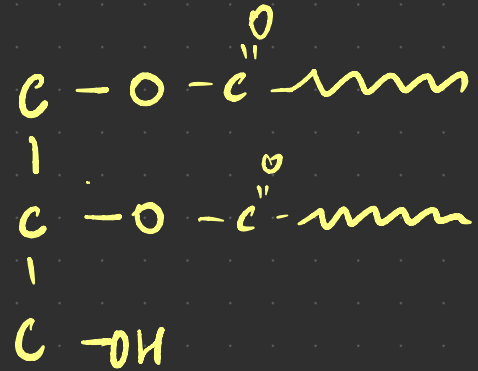
Cell membrane → lipid + protein

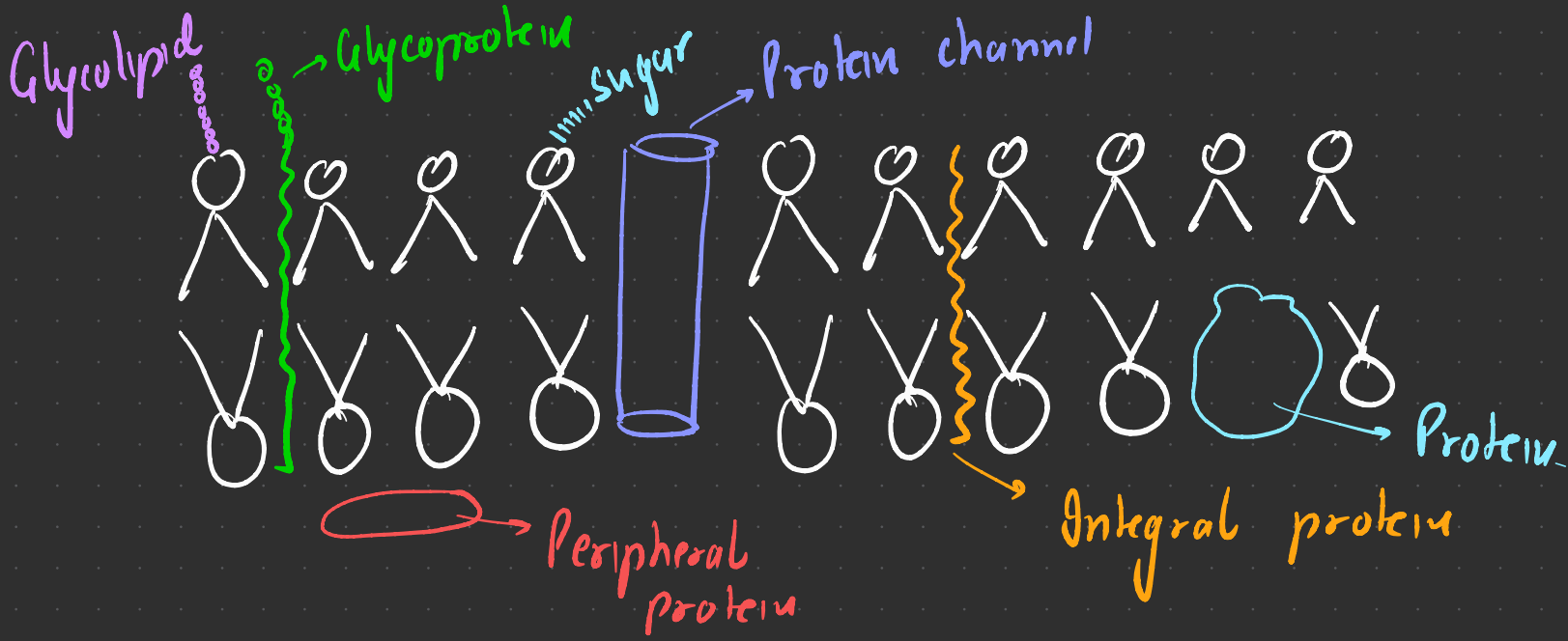
Main lipid = Phospholipid

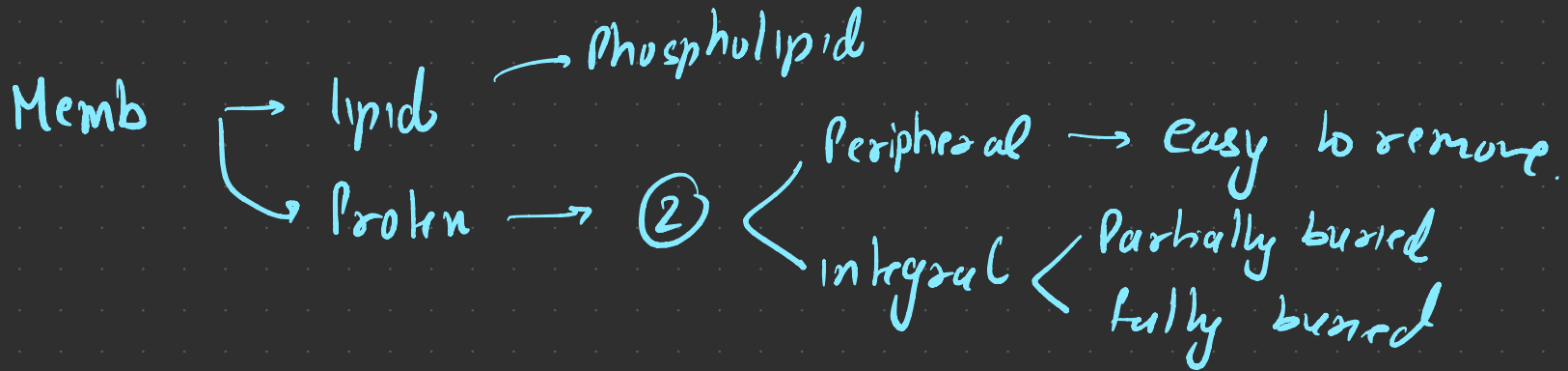
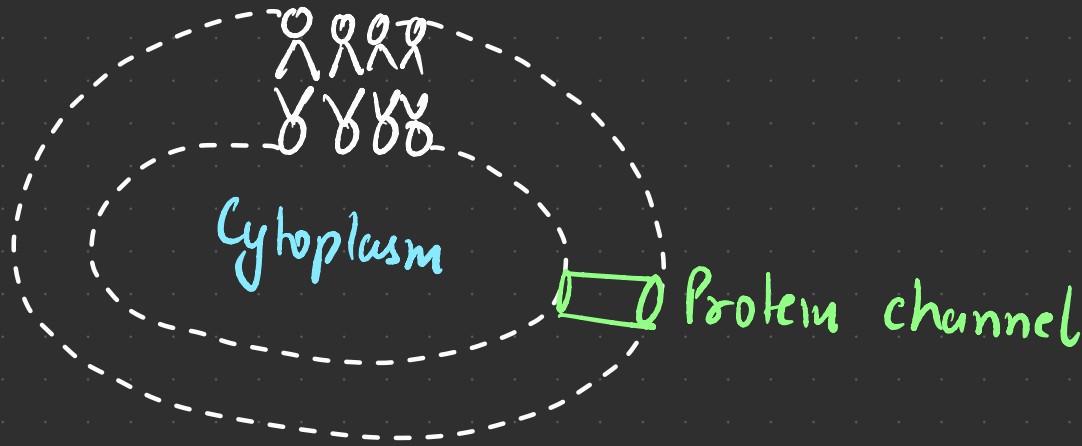


Glycerol

Diglyceride







Model of membrane Sys

Fluid Mosaic model (1972) → Singer & Nicolson

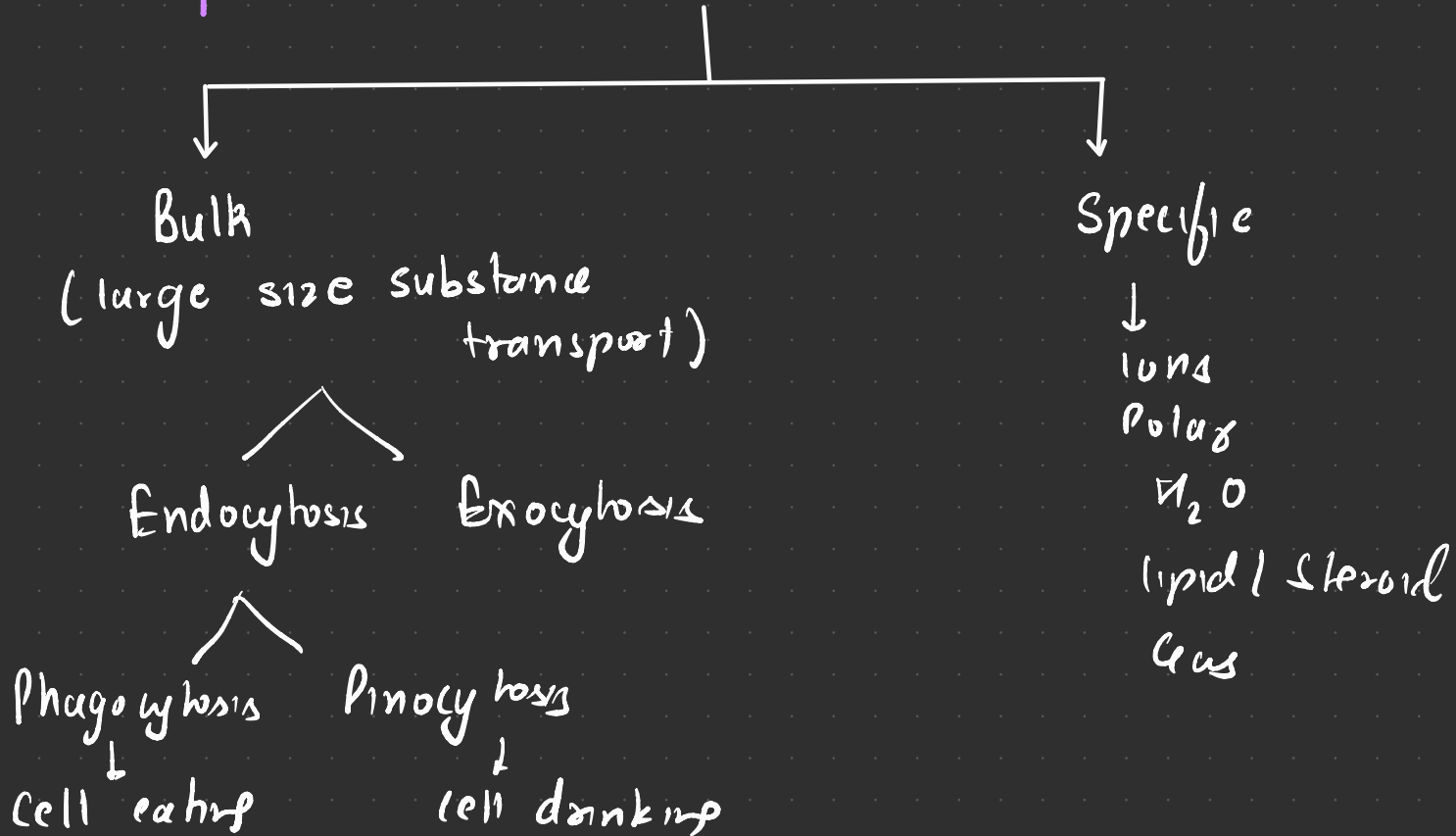
↳ Memb. is Quasifluid → not solid completely
↳ not fluid completely

Protein → lateral movement → class fluidity

OTBO fnn → type of protein → Channel Protein
→ Pump
→ Receptors

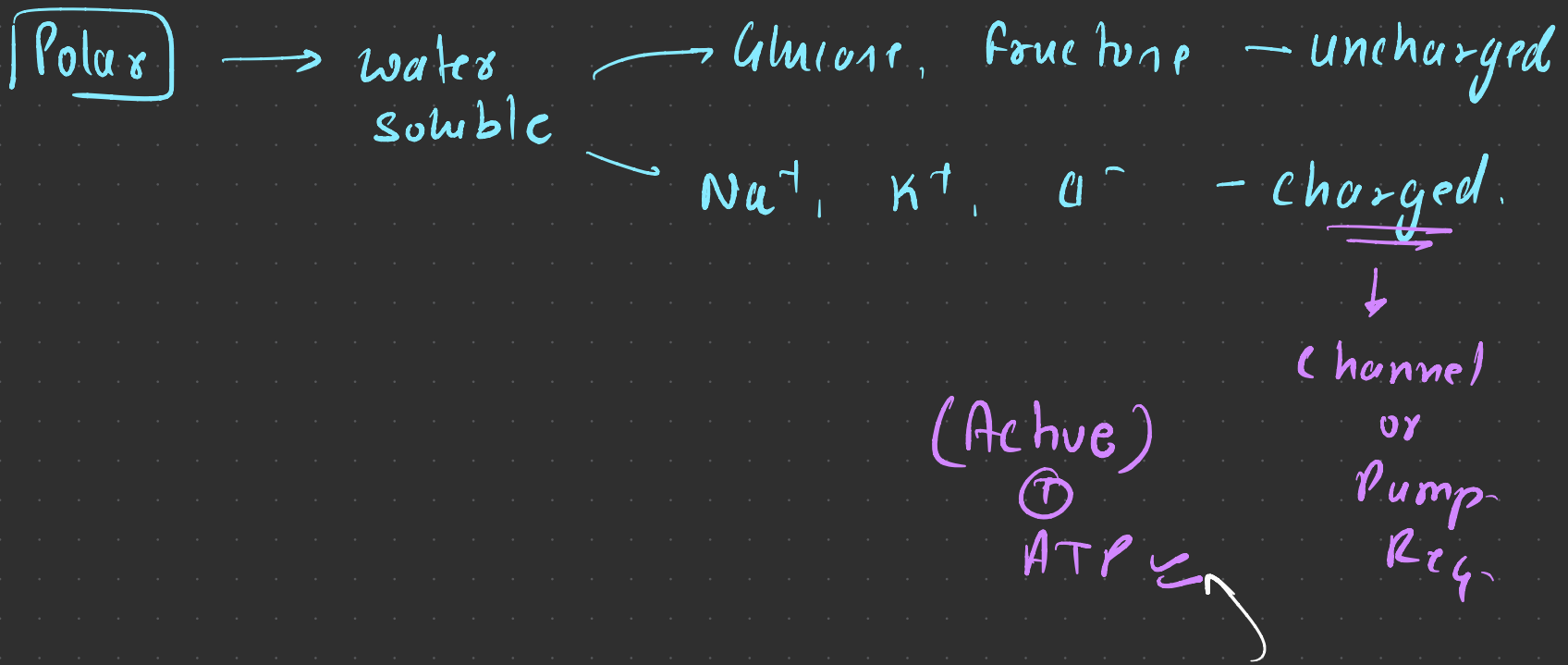
hole of membrane

Most imp. fnn → Transport on both side



Transport across membrane Non polar + Gas sub

- * Direction depend on diff. in gas
- * Water diffusion across memb $\Rightarrow$ osmosis
- * lipid / NP can cross memb. directly by diffusion



Direction → Movement

- low to high conc
- high to low conc

w/o ATP (Passive)

Cell wall

→ Dead

Protista → some

Fungi → +nt → Chitin

Plantae → cellulose

Animalia x x

Role → Provide shape
→ Structural supp.
→ Prevent macromolecule only
→ Infection prevent

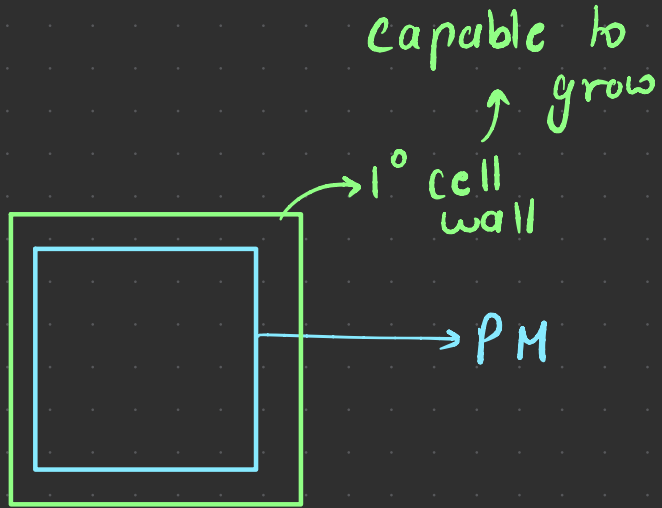
Algae → cell wall → Cellulose (Major)
Galactan
Mannan
Calu₂

→ Cellulose
→ Hemicellulose
→ Pectin
→ Protein

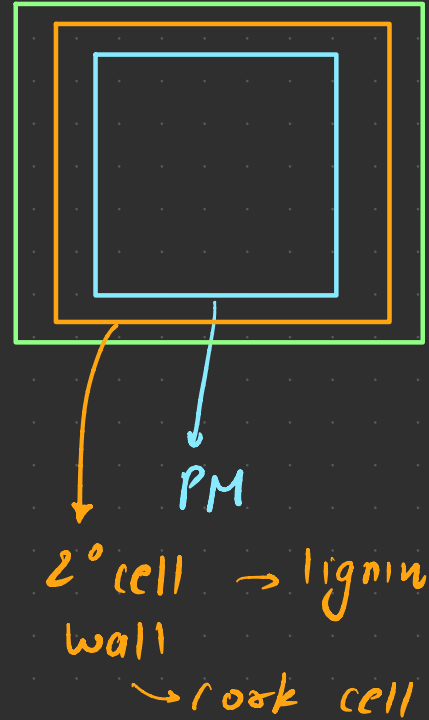
Plant → " → young plant → 1° cell wall

Plant cell → Meristematic cell
→ Parenchyma → young plant
→ Collenchyma
→ Sclerenchyma → Mature → 2° cell wall

1° cell wall



2° cell wall



Middle lamella $\rightarrow$ +nt b/w 2 neighbouring cell

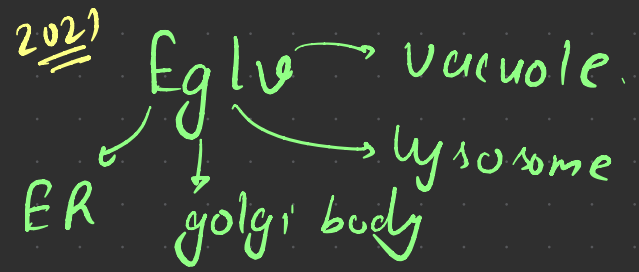
$\downarrow$
glue 2 cell
together

$\downarrow$
Made up of
Ca pectate

Endomembrane System

↓
inside
cytoplasm

made up of
memb. (lipid)

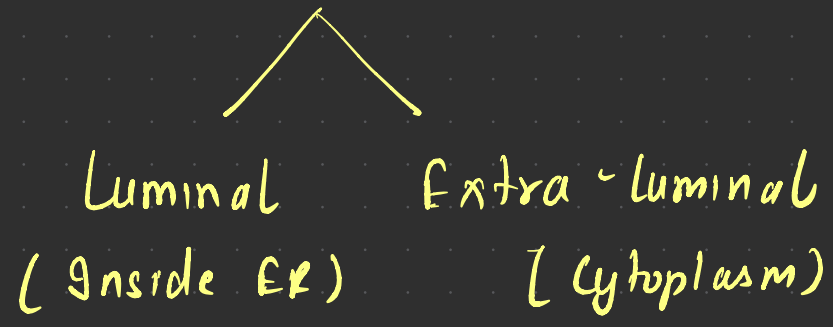


organelles made up of + act in
memb. coordinated
manner

ER

- Tube like & form network
- visible under e^- microscope

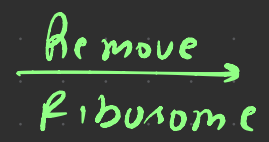
(now this membrane str. divide cytoplasm into 2 compartment)



Nucleus
envelope



RER



SER

RER

Ribosome attach

derive from → nuclear envelope

→ Protein Synthesis
&
Secretion

SER

x x

→ from RER

→ lipid synthesis

Steroid
(H)

Phospholipid
syn.

In muscle
cell

→ SER → Ca^{++} store
(Sarcoplasmic Reticulum)

Nissel
granule

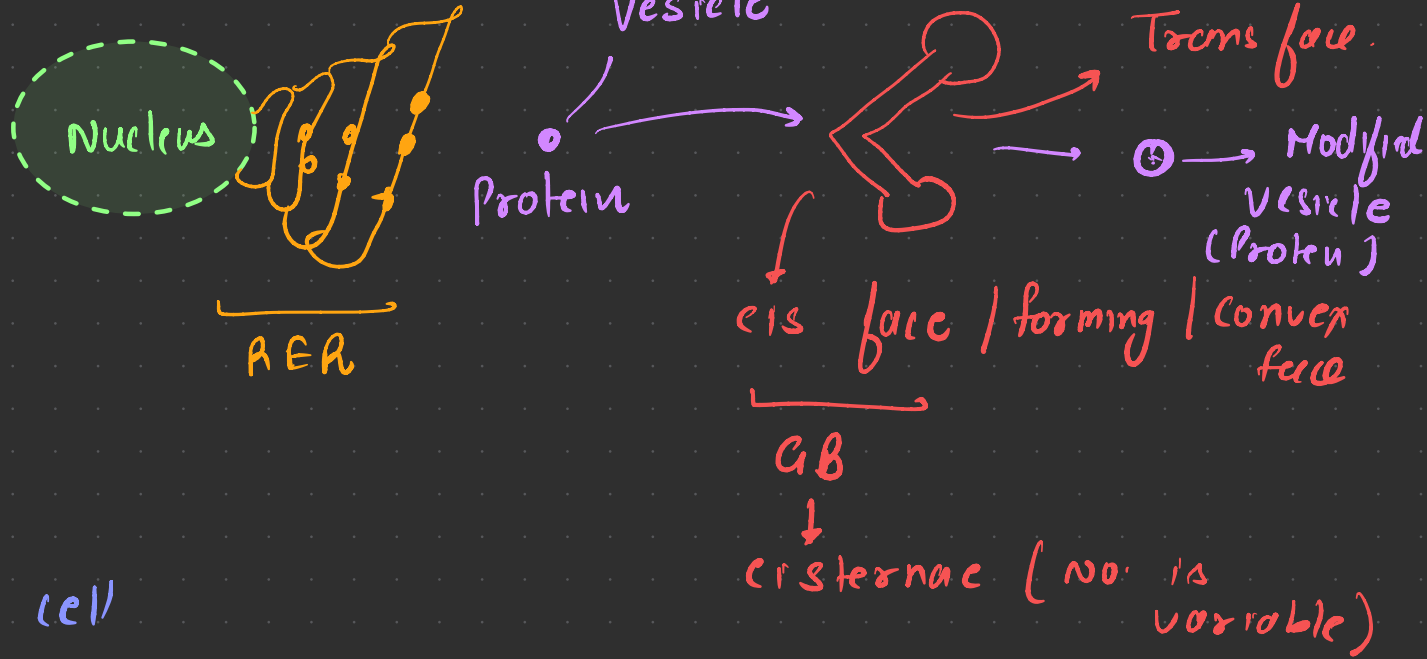


cell body
dendrite



RER

Golgi body



In Plant cell



unicisternal GB



Dic lysosome

Role

→ It modify protein - Glycoprotein
" " lipid - Glycolipid

→ Sorting of vesicle → extracellular
→ intracellular

→ Produce lysosome

Sperm → Acrosome → form by GB

Middle lamellae deposited by GB

Ribosome
(Polypeptide
syn)

→ ER lumen
(Protein
folding)

→ Protein pack
into
vesicle

↓
fuse with

cis face of
ER



Modification
in
ER/stroma



fully modified
vesicle



come out
of trans
face



Lysosome

Secrete out



intracellular
target

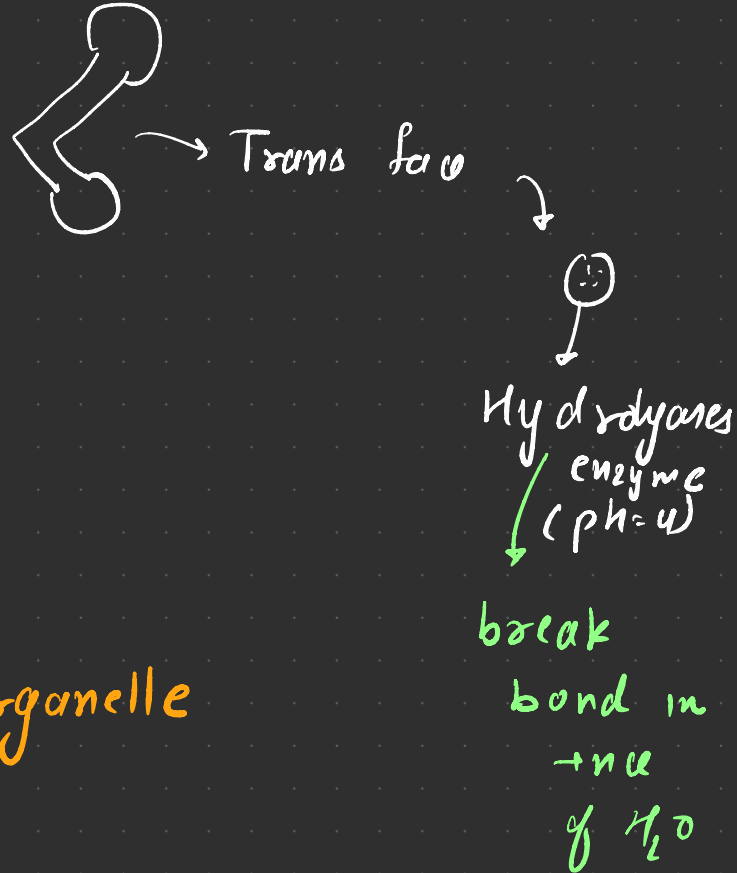
goes to
organelle



lysosome

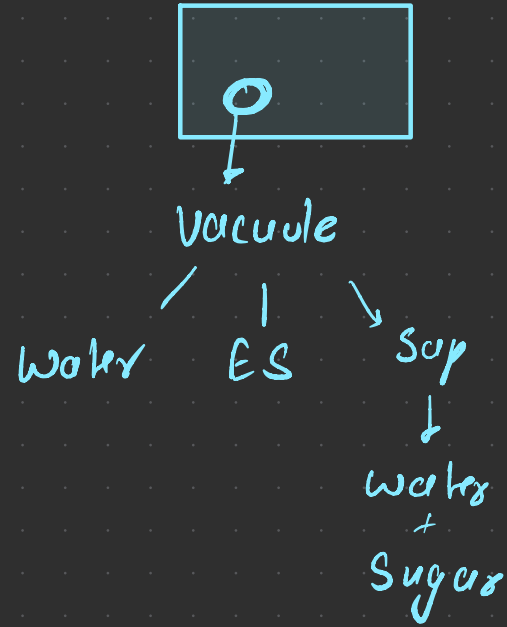
- from golgi apparatus
- Cytoplasm
- Show polymorphism

Role → Intracellular digestion
→ Recycling of old organelle



Vacuole

Membrane bound str. (lipid bilayer)
Role → Storage of excretory material



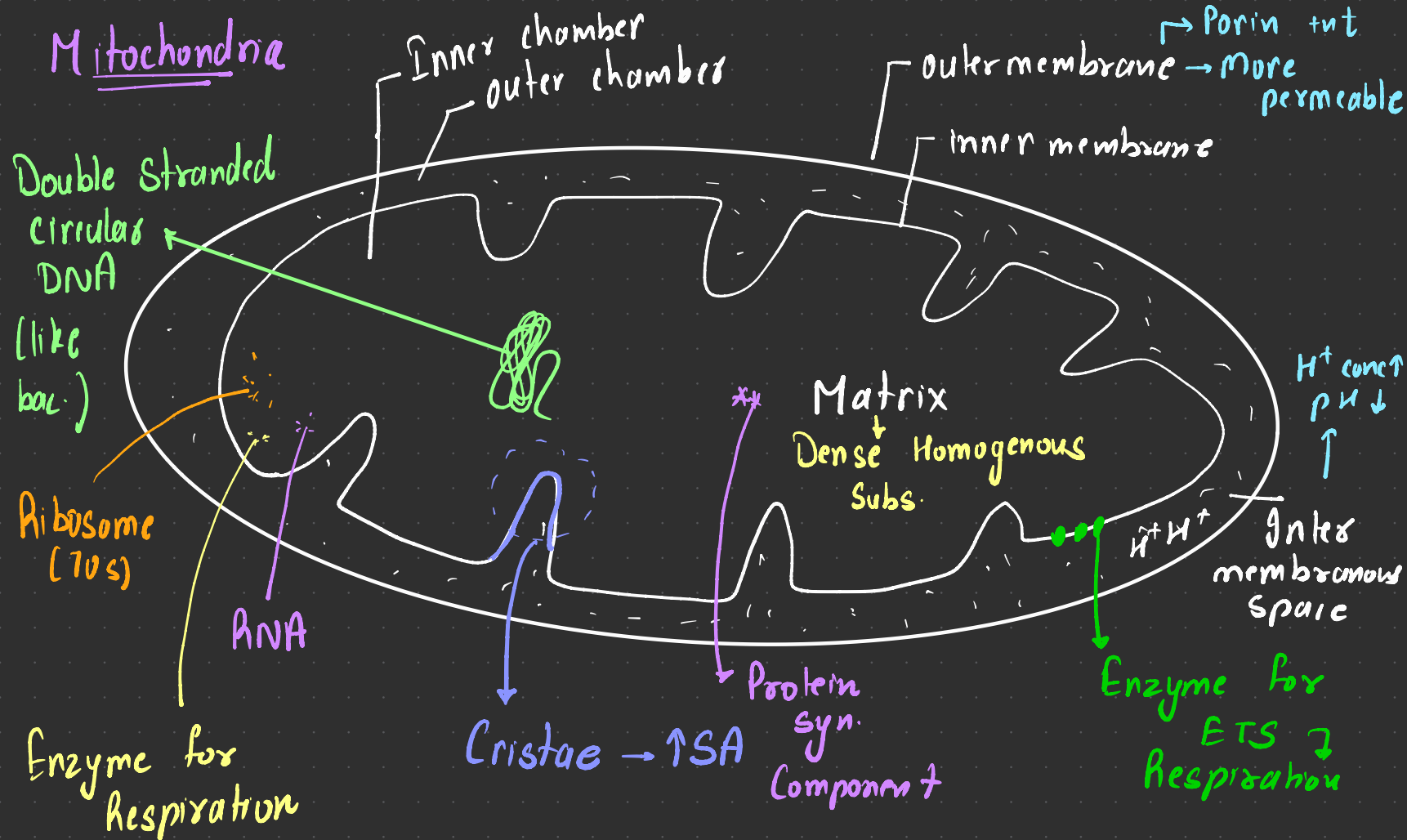
① Sap vacuole - layer - tonoplast

② Contractile - osmoregulation

③ Food "

④ Gas " - Bacteria (not in Eukaryotes)

Mitochondria

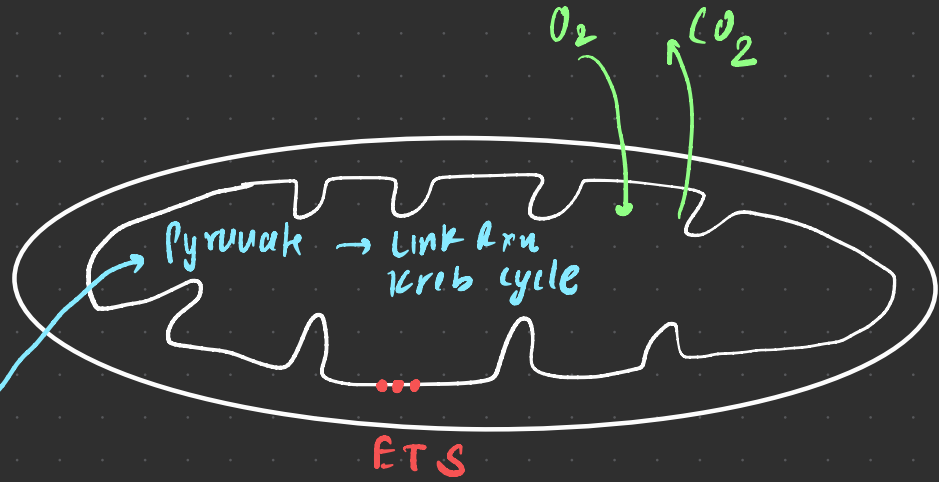


Cytoplasm

Glucose (6c)

Glycolysis

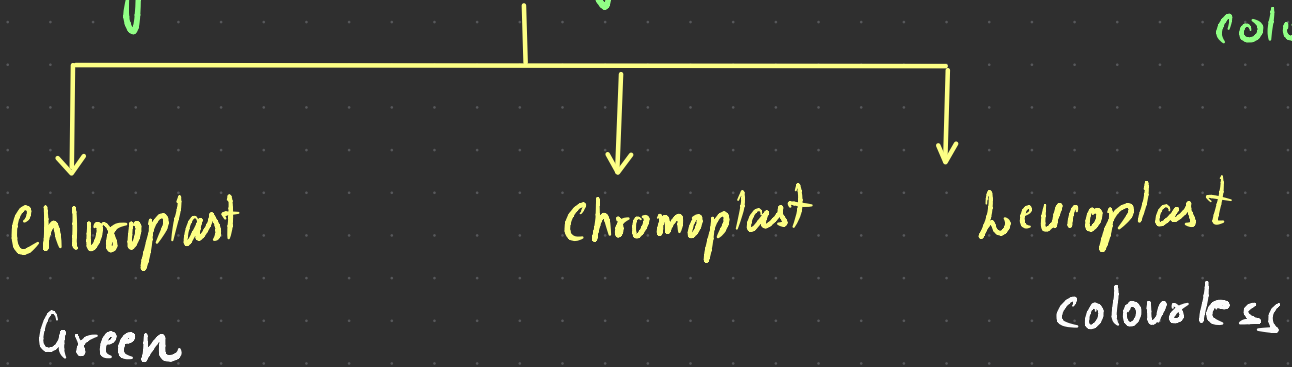
Pyruvate (3c)



Plastid

• found in all cell of Plant $\begin{cases} \text{Root} \\ \text{Stem} \\ \text{leaf} \end{cases}$

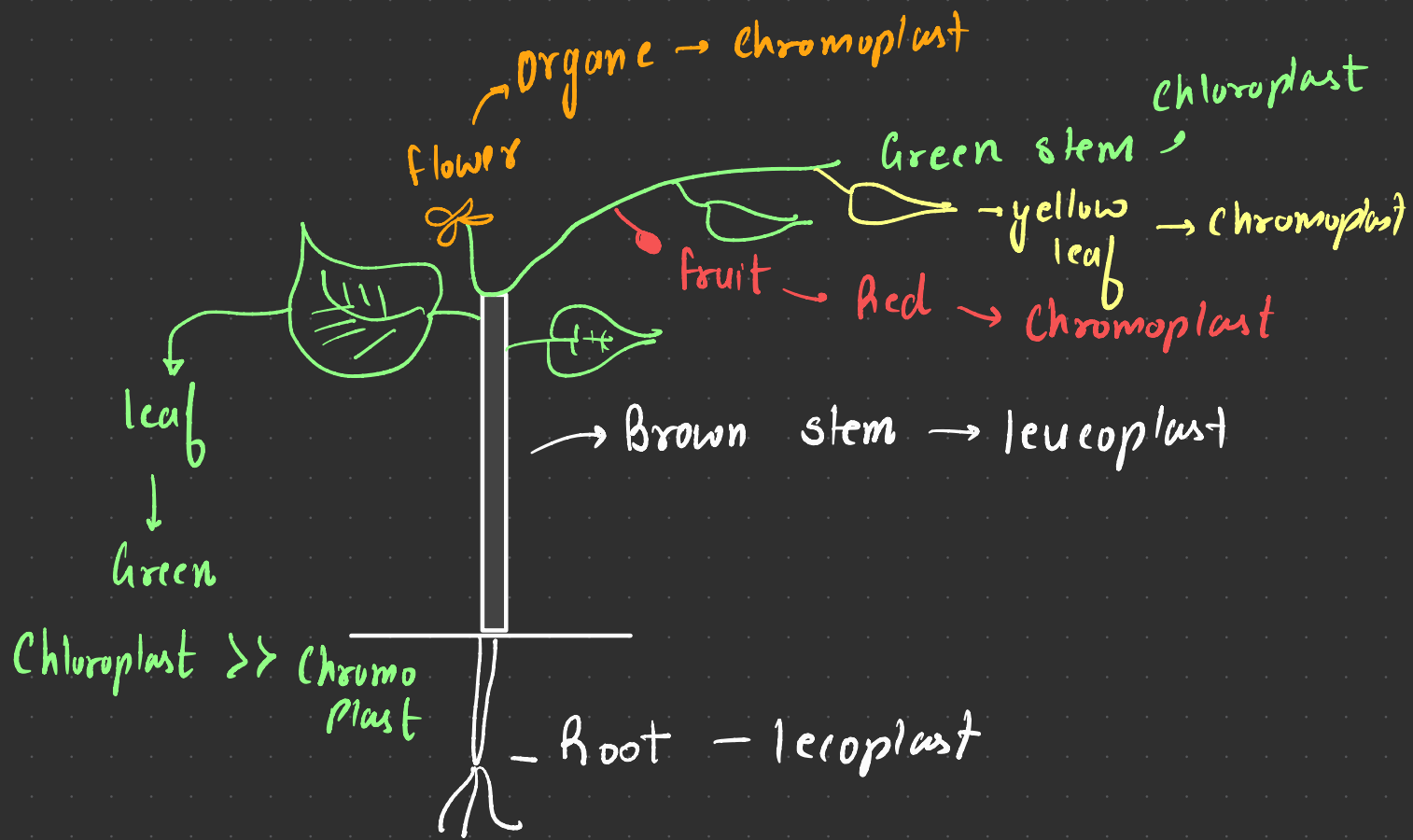
• size (Easily visible in light microscope) — large size + colour.



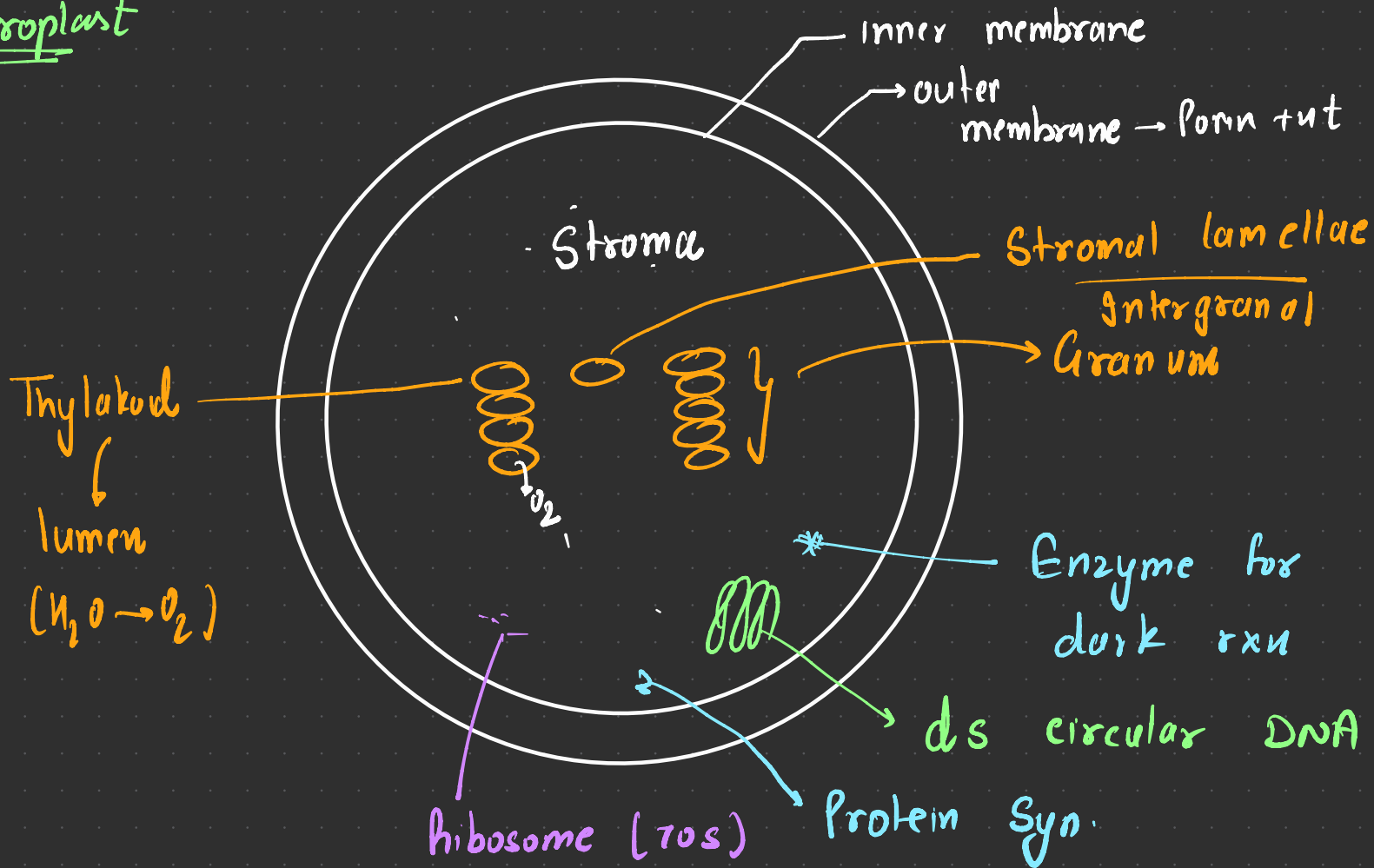
Pigment $\rightarrow$ Chlorophyll
Carotenoid

Carotenoid

x x



Chloroplast



Location - cytoplasm of mesophyll cell

Size



larger than
mitochondrion.

Shape → lens / flat

Algae → cup shape
→ ribbon shape
→ spiral

number

Green algae



one
chloroplast

Mesophyll cell



20-40 or more

Membrane

Sys



Pigment
+ nt

 Thylakoid

 Granum

light Rxn $\rightarrow$ H_2O Break. $\Rightarrow O_2$

Stroma $\rightarrow$ Enzyme for Dark Rxn

RUBISCO

Similarities b/w Mitochondria & Chloroplast

① Double Stranded Circular DNA

② 70s Ribosome

③ Protein syn

④ Double memb

⑤ Divide by fission

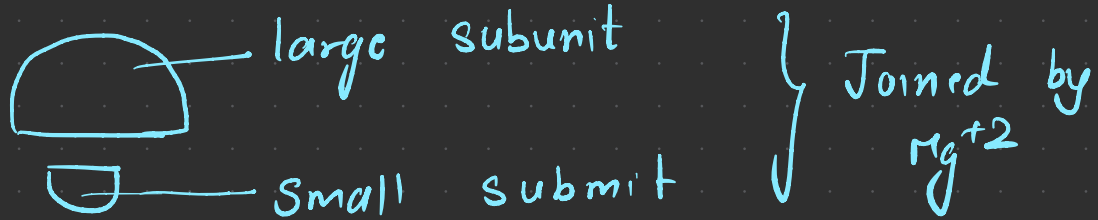
⑥ Semi autonomous

Ribosome

→ visible under e⁻ microscope

→ 1963 → Palade → granular str. in cytoplasm

Structure



W/o memb.

location → Cytoplasm, Mito, Chloro

70S 80S
Prokaryote Eukaryote

70S

Chemical
nature



Protein
+
rRNA

(Ribonucleoprotein)

Svedberg's const. / sedimentation coeff.

70 (S) → unit → indirect measure of
size & density

RER = Protein syn.

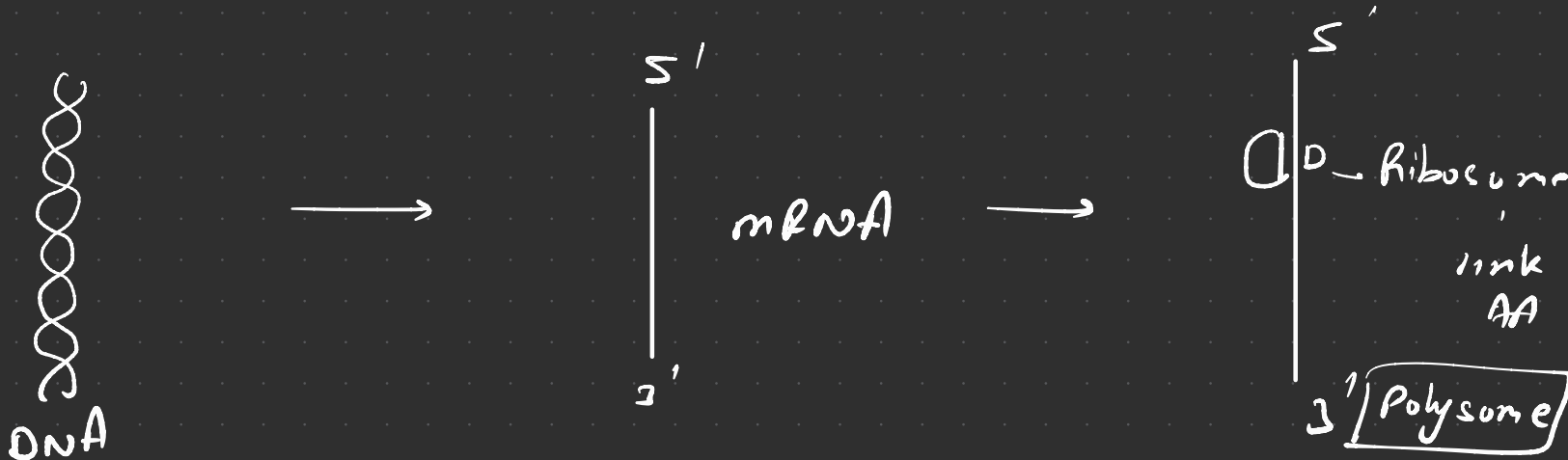
Ribosome = "

mRNA = "

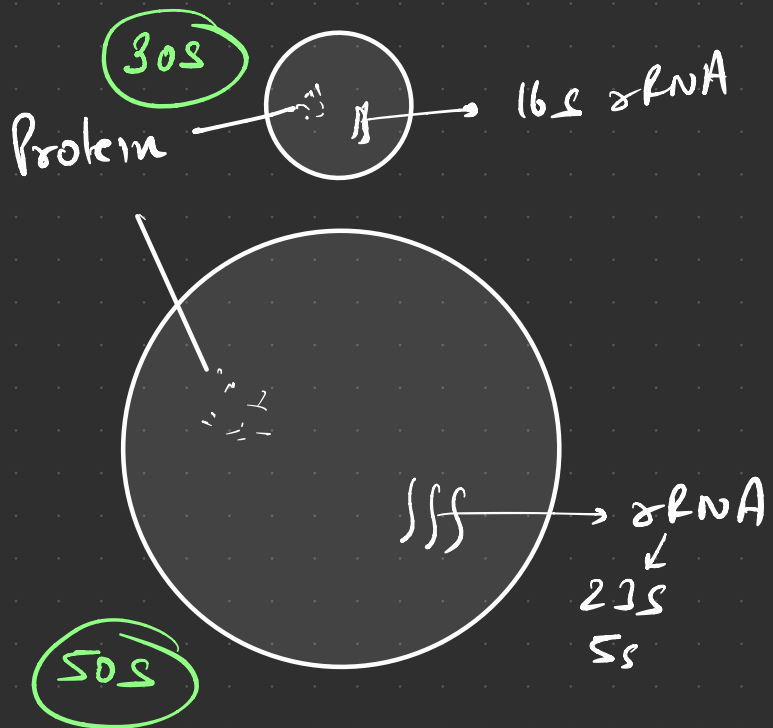
nucleolus = "

In eukaryotes Ribosome Synthesis

- (a) Site at which Ribosome subunit form $\rightarrow$ Nucleolus
- (b) from nucleus to cytoplasm move $\rightarrow$ Ribosome-subunit move
- (c) Ribosome subunit assembly occur $\rightarrow$ During protein syn.
- (d) Nucleolus $\rightarrow$ rRNA syn



70s



80s



Cytoskeletal element

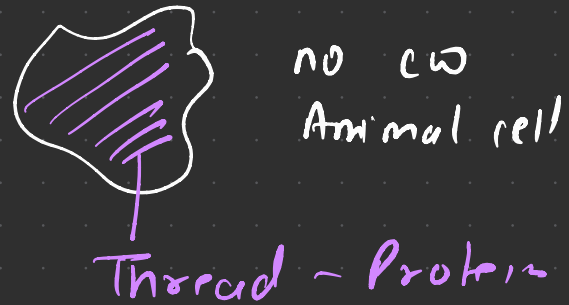
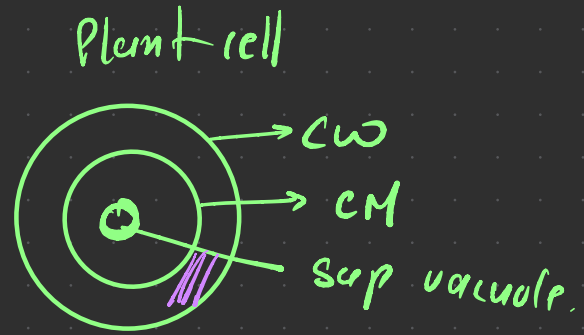
cell support

→ Inside Cytoplasm
Thread like str

→ Made up of protein.
filamentous

→ Role → Structural
Support
&
Mobility

-ve in prokaryote



Types

Microfilament



Actin

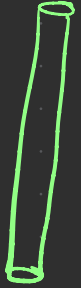
Muscle
Contraction

Intermediate



Give Support
to
Nuclear memb

Microtubule



- α tubulin
- β tubulin (protein)

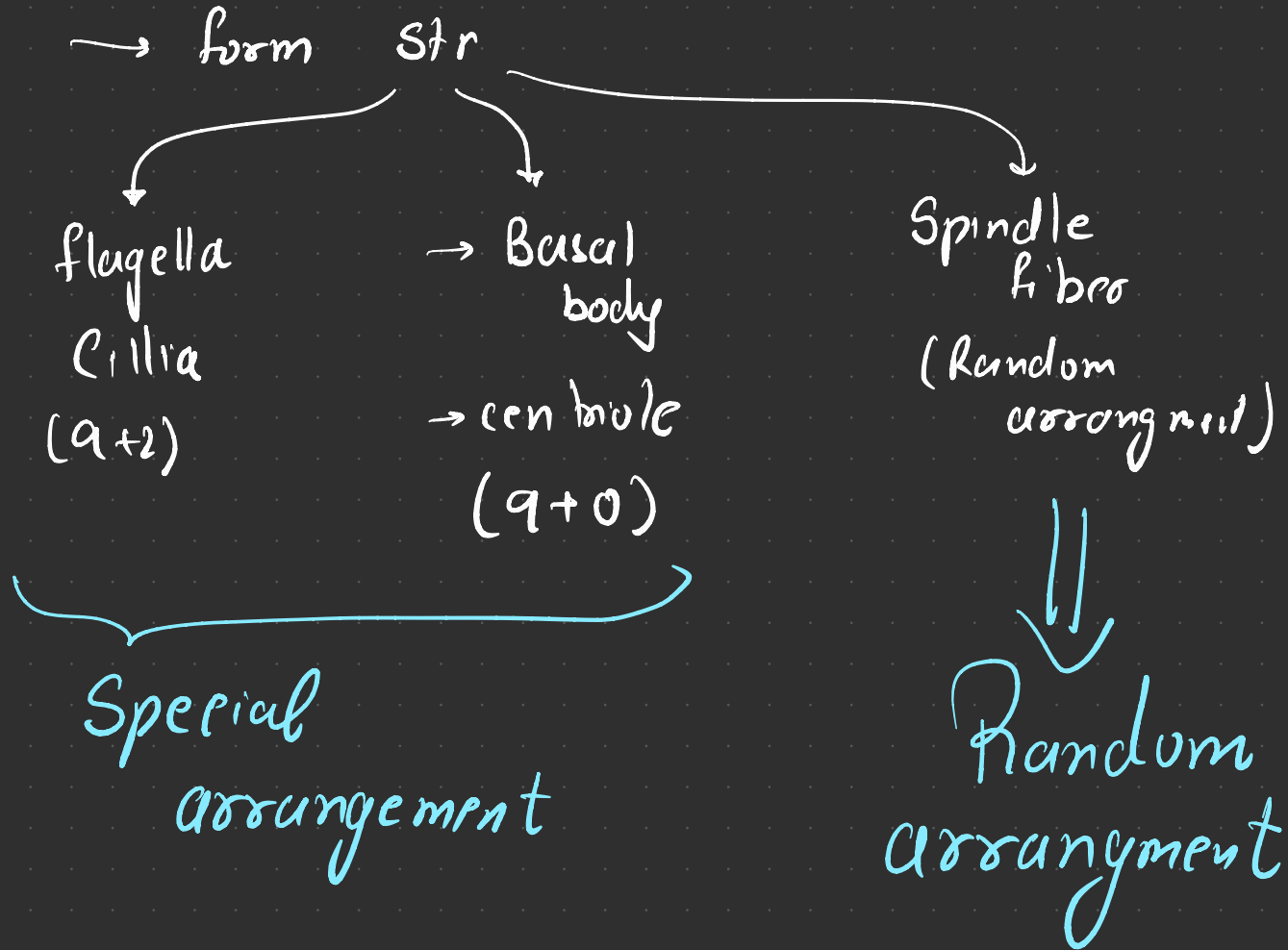
Microtubule
13 x
Protofilament

Protofilament

$\alpha + \beta$ filament

arrange
form microtubule

Microtubule

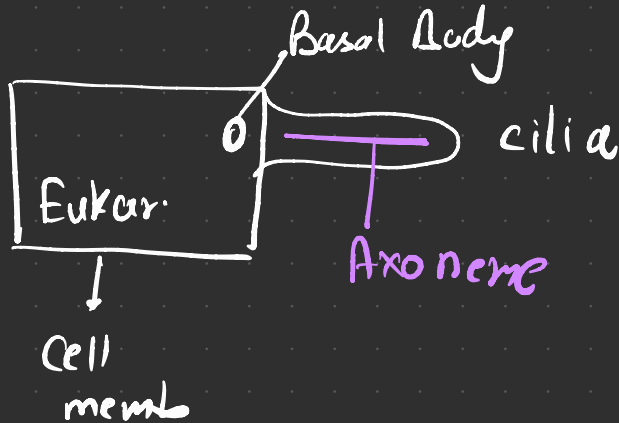


Cilia

not in Eukaryotic organisms

It act like oar

Either
move
medium or cell



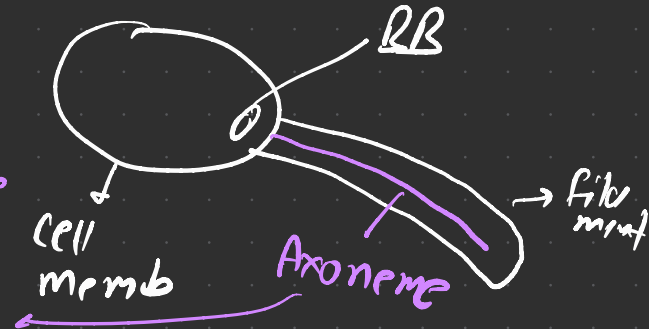
Flagellae

both pro & Eu

It move cell

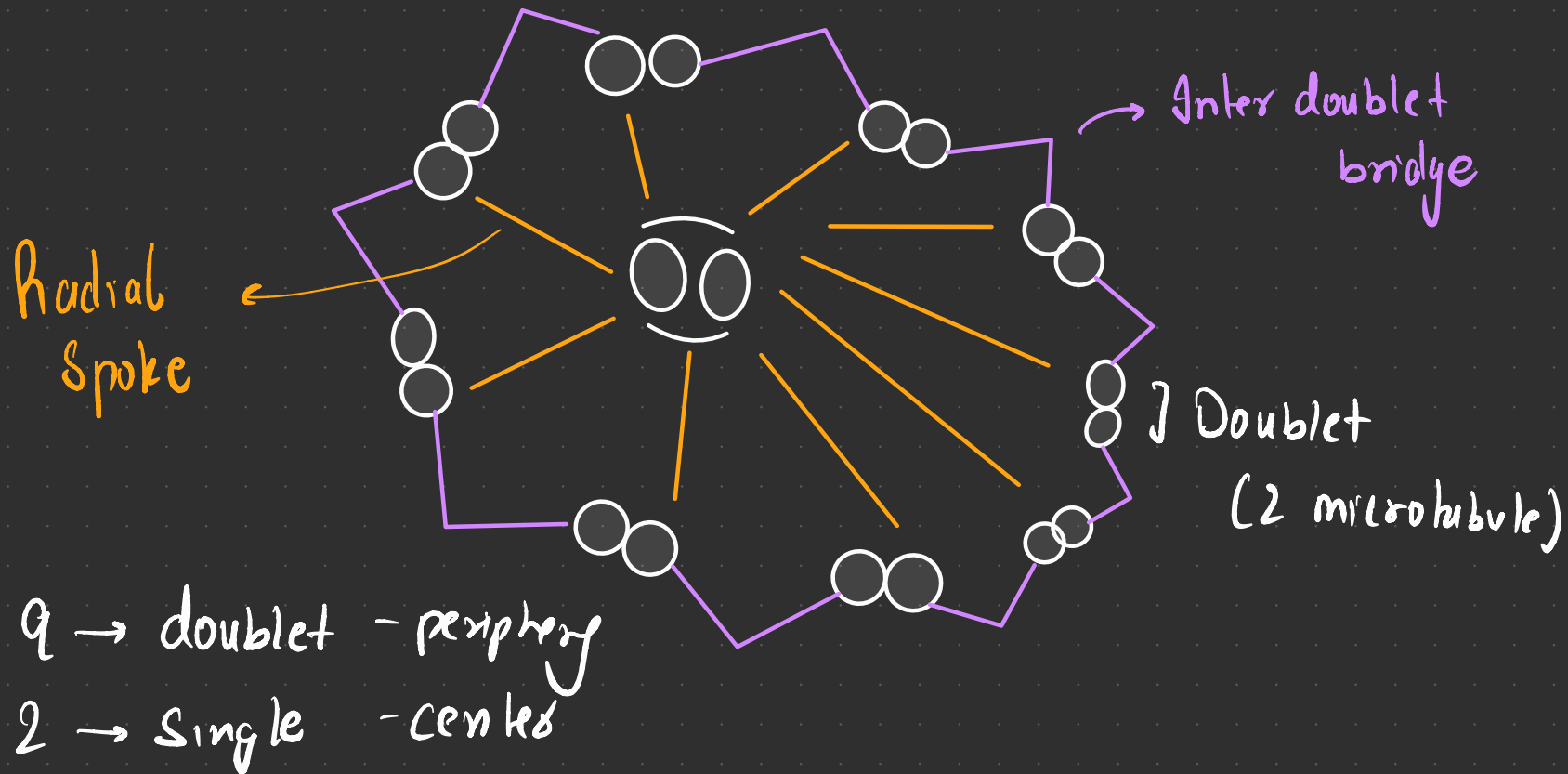
Pro	Eu
BB hook filament	BB filament

Made up of
Microtubule
not in
case



Structure of Axoneme

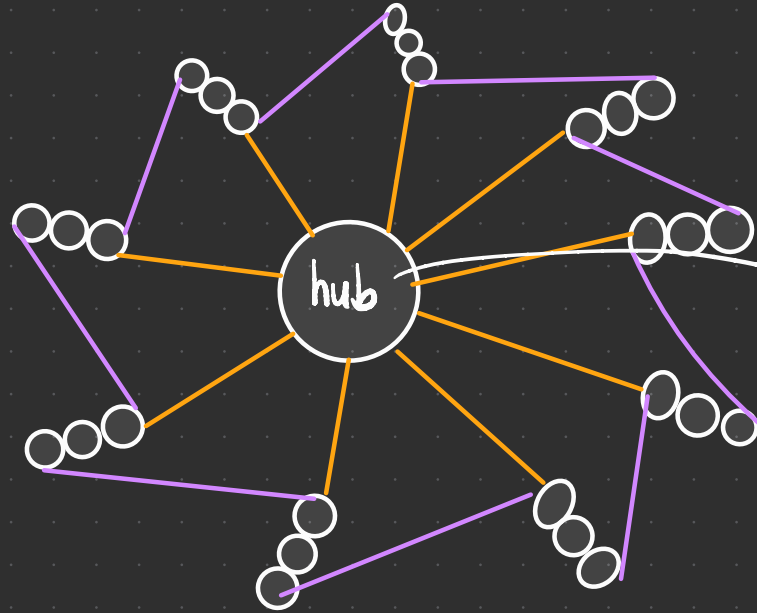
$q+2$



qto

Cartwheel

Centriol
Basal
body



Protein
hub
(No
Microtubule)

(q-triplet)

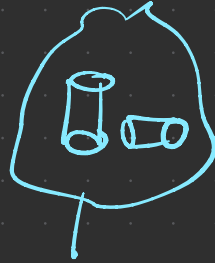
Centriole +nt in animal cell



Centriole



Centrosome
(2 centriole)
↓



Pericentriolar
matrix
↓

Microtubule



Aster

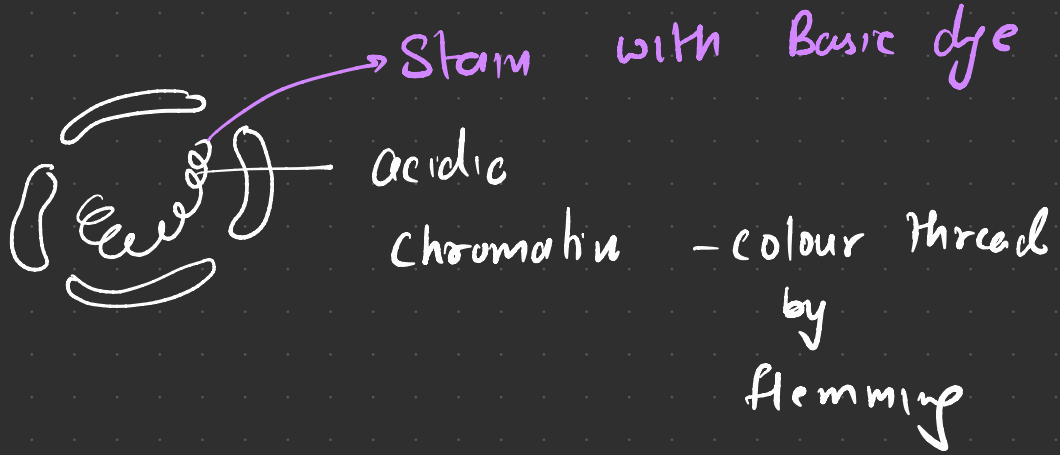


Nucleus

Discovery 1831 - Robert Brown - observe nucleus

Mature RBC
Sieve tube

||
No Nucleus



Normally 1 per cell

Some condition more than 1 nuclei

- tapetum
- Polar nuclei - ②
- Coconut water
↳ milk

Animal cell → center

Plant cell → Vacuole in center → Nucleus in side

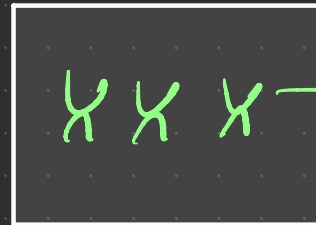
Nucleus str

OTBO phases

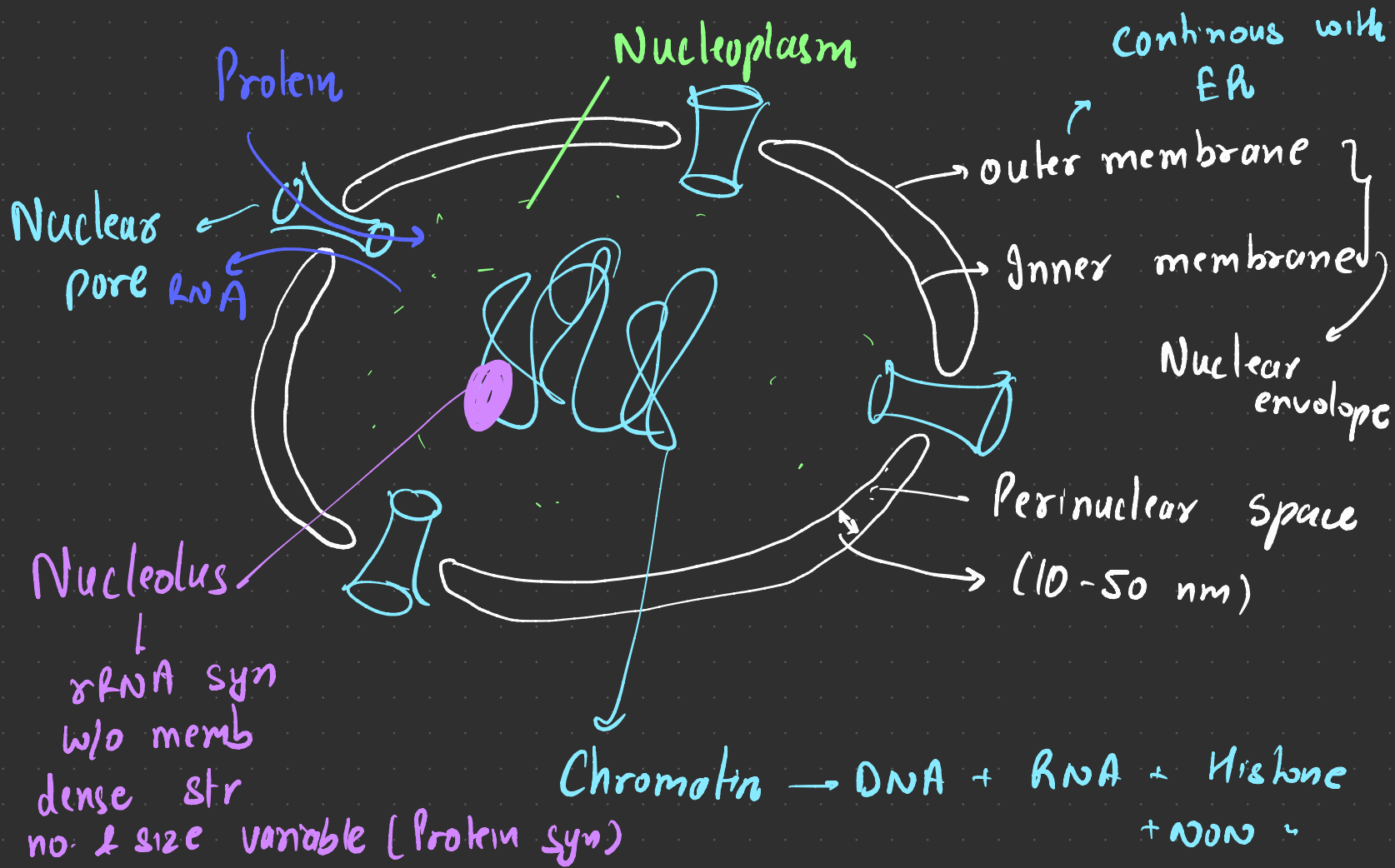
Interphase

M phase

dense str
in Nucleus
light microscope

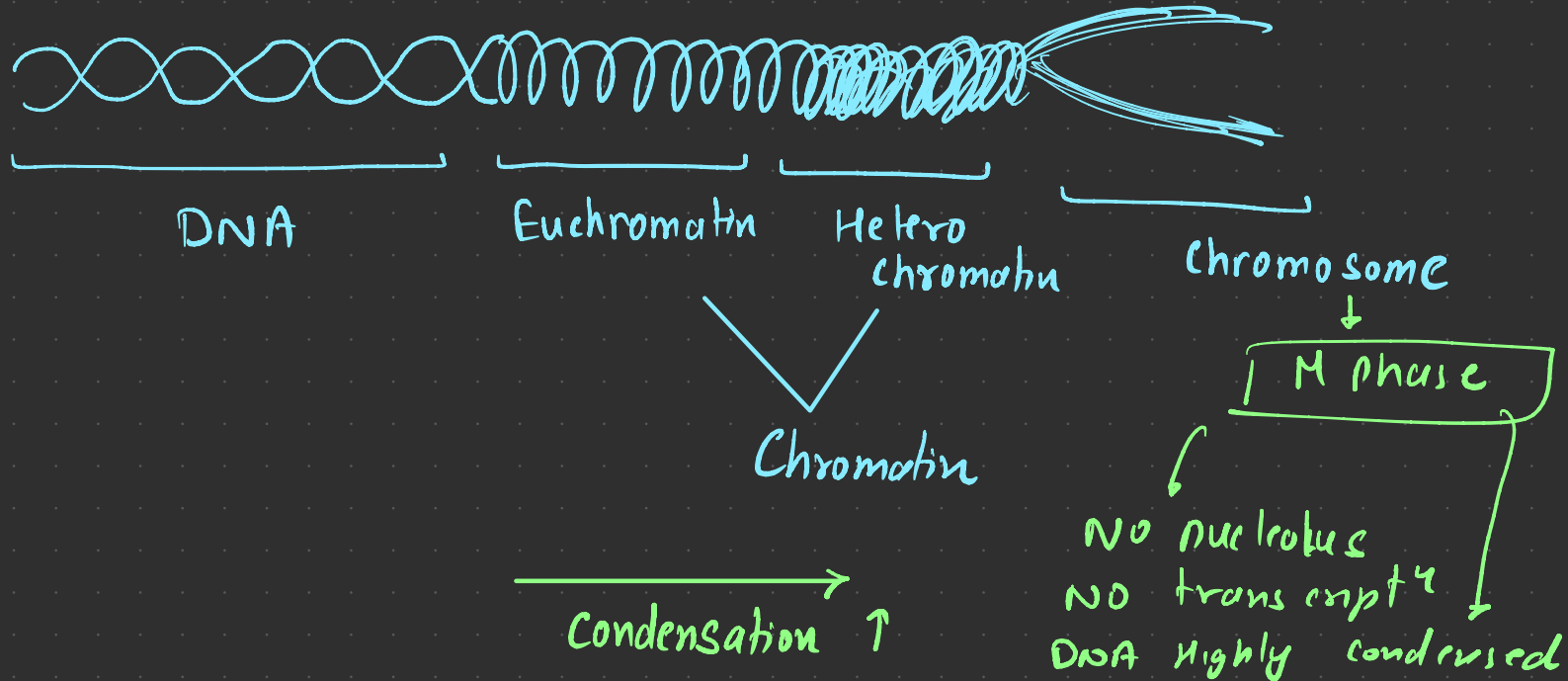


chromosome



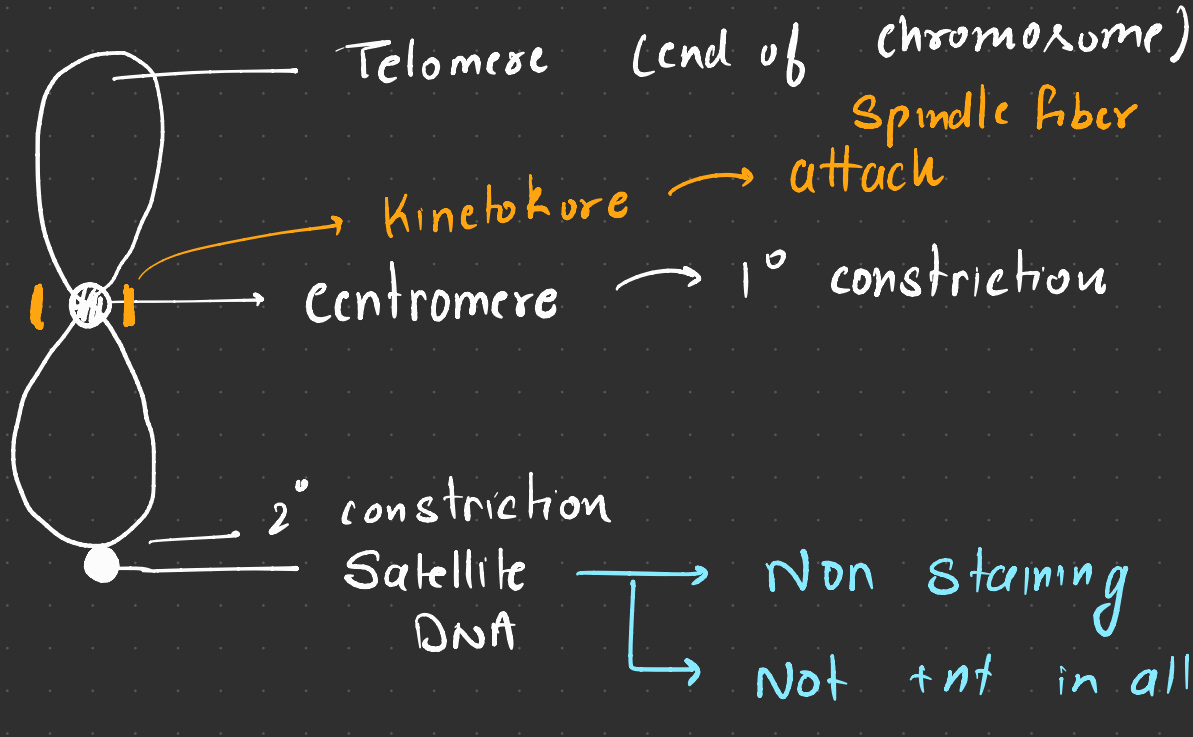
Chromosome

- * Visible in M-Phase
- * Most Condensed (Metaphase)



G₁

Chromatid



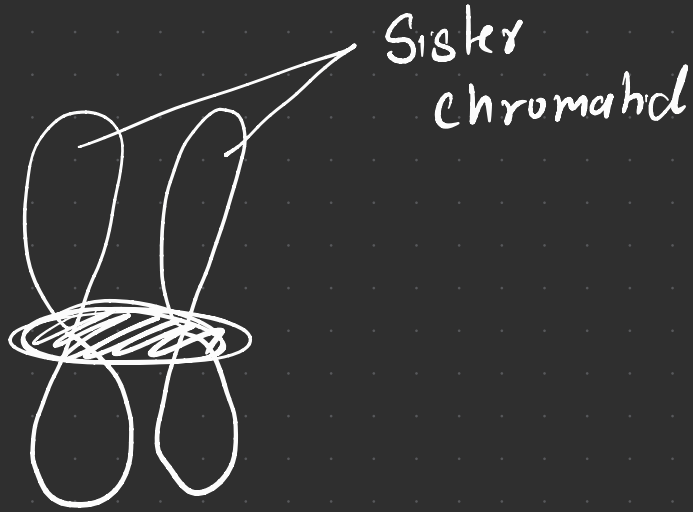
G₁ → 1 Chromosome - 2 Arm
1 Chromatid

Role in Nucleolus formation in interphase.

(G₂)

1 chromosome
2 chromatid

Arm = 4 arm

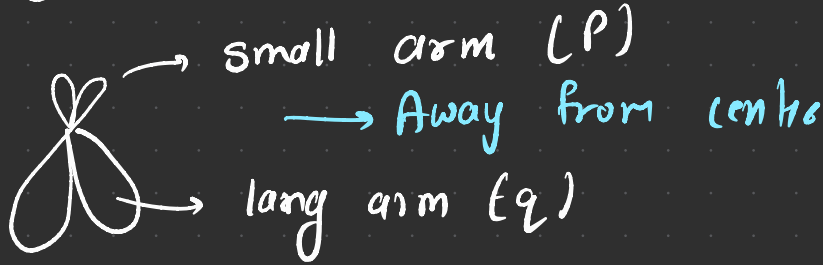


Metacentric



$$\text{Arm ratio} \rightarrow \frac{p}{q} < 1$$

Sub metacentric



small arm (p)

→ Away from centre

long arm (q)

↓
for
Sub
metacentric
chromosome

Acrocentric



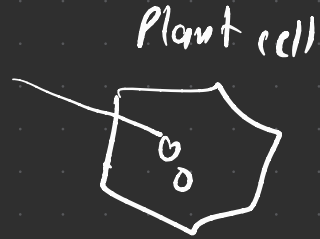
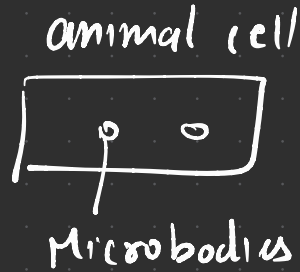
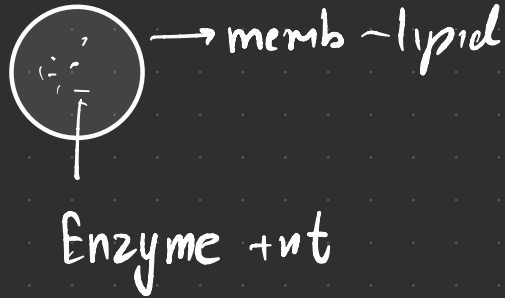
→ Close to end / telomere

Telocentric



→ at the end / telomere

Microbodies



Eg Peroxisome (catalase, Peroxidase)

$\Downarrow$
 H_2O_2 metabolise.

Glyoxysome

What is cell?

It is structural & functional unit of life

Anything less than a cell not have independent existence



Proof - Protista.

Inanimate (non living) → substance not made of cells.

A V leeuwenhoek. — 1st living cell

Robert Brown — 1831 nucleus

GN Ramachandran — Str. of collagen (Triple helix)

1838 → Schleiden (Bot.) → examined a large
no. of plant → observe that all plants
composed of diff kind of cell which
form tissue of plant

1839 → Schwann (Zoo)

animal cell



thin outer
layers



plasma
membr

plant cell

body of plant & animals
composed of cell &
parts of cells.

cell theory. → (S+S)

drawback → not able to tell how cell arise.

Rudolf Virchow (1855) $\rightarrow$ CT modify

"Omn-cellula -e- cellula" $\rightarrow$ All cell arise from
pre existing cell.

Cell theory except $\rightarrow$ Virus (not cell)

Viral
particles