Learning Mantras

Biology Handwritten Notes

On

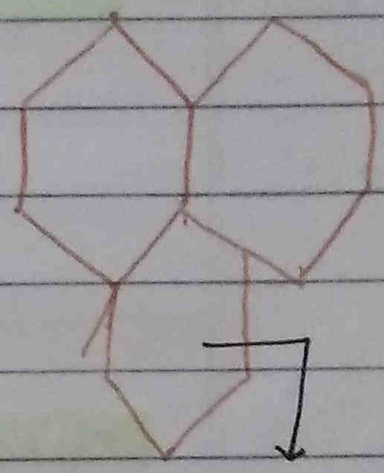
Cell - The Unit of Life

Date ___/___/___
Page ___

Cell – The unit of life

Historical account.

- Robert Hook → Thin slice of cork
  (He observed dead cells)



- Leeuwen Hook → Living cells
  → Bacteria
  → Protozoa
  • Spermatozoa
  • RBC.

  cellular (cellula) cells

- Robert Brown — nucleus — Orchid root cells

- Fontana — Nucleolus — Skin cells of eel

- Schleiden (1838) German Botanist : All plants are composed of cells

- Schwann (1839) German Zoologist : All animals are made up of cells ✓
  ↳ => cell membrane ✓
  -> cell wall ✗

Date __/__/__
Page

Cell theory → Schleiden & Schwann:

i) All living organisms are composed of cells and their products.
(Structural Unit of life).

2:

cyto → Cell membrane

Cytoplasm + Cell membrane = Protoplasm

Each cell consist of mass of protoplasm

Plants ⇒ C.W ✓ Animals = C.W ✗

3 All cells are basically same in structure and activities.

4 All the activities occuring inside an organism is the sum total of all activities occuring inside the cell
(Functional Units of life)

• Drawback:

+ How new cells arise? (Could not explain).

Rudolf Virchow: new cells arise from pre existing cells.
(Omnis cellula e cellula)
⇒ Law of cell lineage

Date : / /
Page

- **Cell size :**

Bacteria – 3 – 5 µm (length)

Smallest cell → Mycoplasma (0.3 µm) ✱

Largest cell → Egg (Ostrich)

RBCs → Humans → Diameter 7 µm

Longest → nerve cell – 90 cm

- **Cell Shape**

→ Disc
→ Columnar
→ Cuboidal
→ Polygonal
→ Thread like
→ Irregular

- **Metabolically Active Cells**

are ↓

Generally Smaller Size

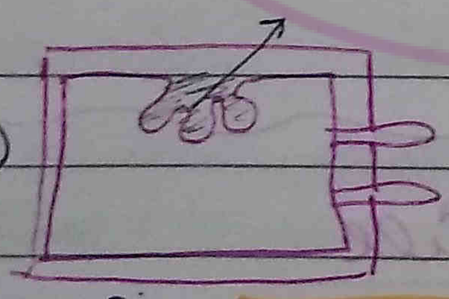
↓ Two Reasons

(i) Nucleus / Cytoplasmic ratio high
⇒ Better control of metabolic activities

(ii) Surface area / Volume ratio high
⇒ Increase exchange of materials between cells and environment.

Plasma membrane: consists of both lipids and proteins.

- Cyclosis: movement of cytoplasm around the vacuole.

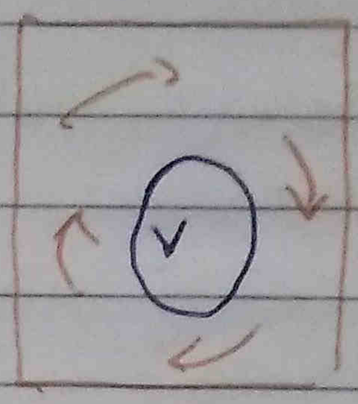
	Prokaryotic Cell	Eukaryotic Cell
Cell wall (C.W)	non-cellulosic cell wall Mycoplasma (CW-nt)	Plants → cellulosic C.W Protists → C.W ✓ Fungi → C.W ✓ Animals → C.W X
Plasma Membrane (P.M)	✓	✓
Membrane bound organelles	X Single envelope system	✓ Two envelope system
Non-Membranous organelles	70S Ribosome Cytoplasm	Cytoplasm → 80S ribosome Mitochondria, Chloroplast → 70S ribosome
Mesosomes (ingrowth of P.M)	mesosome.  - Help in DNA replication → Respiratory enzyme	X
★ Pili and Fimbriae (Outgrowth of P.M)	→ made up of Pilin protein → Help in attachment	X

- Gas vacuole is not a true vacuole because it is not surrounded by true membrane i.e having lipid bilayer and protein.

Date __/__/__
Page

True vacuole = membrane bound vacuole (i.e by lipi bilayer)

Vacuole
→ True Vacuole ×
⇒ Gas Vacuole +nt
⇒ covered by proteinaceous membrane
⇓
Pseudo vacuole



Cytosis -nt

Cytosis +nt

Genetic Material
not surrounded by membrane
⇓ known as
Nucleoid, genophore, prochromosome, incipient nucleus, chromonema

nuclear membrane +nt

Nucleolus -nt

Nucleolous +nt

DNA

→ Cytoplasm	ds.
→ ds. ↑ Circular	Linear
→ Coiled with the help of Polyamines	

→ Nucleus	ds. Linear
→ Mitochondria	
→ Chloroplast.	
→ Coiled by histones protein	

Transcription & translation. → also in Mito and chloro

DNA ⟶ RNA ⟶ Protein

occurs in
→ Cytoplasm

Transcription → Nucleus
Translation → Cytoplasm.

Because in eukaryotes DNA is also +nt in chloroplast and mitochondria hence they too perform transcription, translation.

Date __/__/__
Page

Flagella	Flagellin protein	Tubulin protein [9+2]
Cytoskeleton		Structural framework of Proteinaceous tubules and fibres
	-nt	+nt
Spindle formation	x	✓
	(Amitotic cell division)	
Sexual Reproduction	x ↓ DNA recombination +nt also called as Parasexual reproduction	✓

(Gymno → means naked → cell wall - ae).

Cell Wall

Discovery → Robert Hooke

Present in → Plants, Fungi
Prokaryotes,
Protists

C.W-ae
- Gymno - gametes
- Gymno - zoospores

Thickness → 0.1 mm to 10 mm

Components

- → Matrix
- → Microfibrils
- → Depositions

(i) Matrix : Gel like ground substance.

H_2O →	30-60%
Hemicellulose →	Heteropolysaccharide → Galactose → Arabinose → Manose → Xylose 5 - 15%
Pectin	Heteropolysaccharide → Galactose; → galacturonic → Arabinose acid

	→ Arabinose 2 - 8 %
Lipids	0.5 - 3 %
Proteins	1 - 2 %

(ii) Microfibrils : Structural elements of cell wall
↓
fibril Bars of cell wall.

20 - 40 %
↓
Plants → Cellulose
Fungus → Chitin.

(iii) Depositions (0 - 25 %) : can be +nt or -nt

1	Lignin	Sclerenchyma cells, Tracheids, Vessels.	Non-polysaccharide → Hardness, Stiffness
2	Suberin Ribic (Hydrophic)	• Cork cells • Endodermis → Casparian strips	Prevents / reduces water loss.

- Chara → multicellular and jacketted sex organs + rt.

' Protein + sugar → glycoprotein.

3	Cutin (Hydrophobic)	Epidermal cells	reduces water loss from leaves
4	Silica	Grasses, Equisetum	- Protection - Hardness
5	*Ca, Fe	Chara	

- Layers → Cell wall.

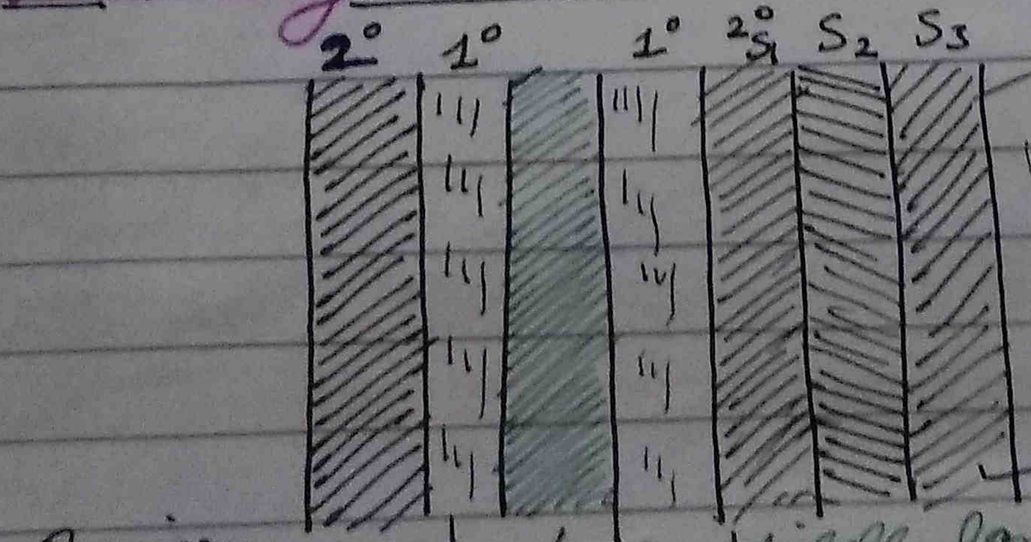
(i) Middle lamella / cementing layer

→ Composed of → Ca Pectate ↑ (more)
Mg Pectate ↓ (less)
of cell wall

- First structure formed during cytokinesis.
from Cell plate which was formed by.
→ Gr.B (Golgi Bodies)

→ Ripening of fruits → Dissolution of pectate by
(i.e) PGrV → Polygalactosseranase
(enzyme)

- Primary wall.



- Orientation of Microfibril are different and decided By Glyco proteins.

- Pectin has high tensile strength, hence greater elasticity.

	Primary wall	Secondary wall
Cellulose	↓ 20%. Small microfibril wavy and loosely arranged	More 40%. Long microfibril straight and Tightly arranged
Hemicellulose	↑ Lipids ↑ Proteins	less hemicellulose, lipids and proteins.
Lignin	✗	✓
Pectin	more ↑ Provides Hydration and Elasticity. Hydration capacity 60%	↓ less 30-40%
=>	Young Cell	not in old cell which have stopped growing
Sub layers	✗	✓ S_1, S_2, S_3 3 or more

- Warp and weft = interweaving

Date __/__/__
Page

Growth of cell wall

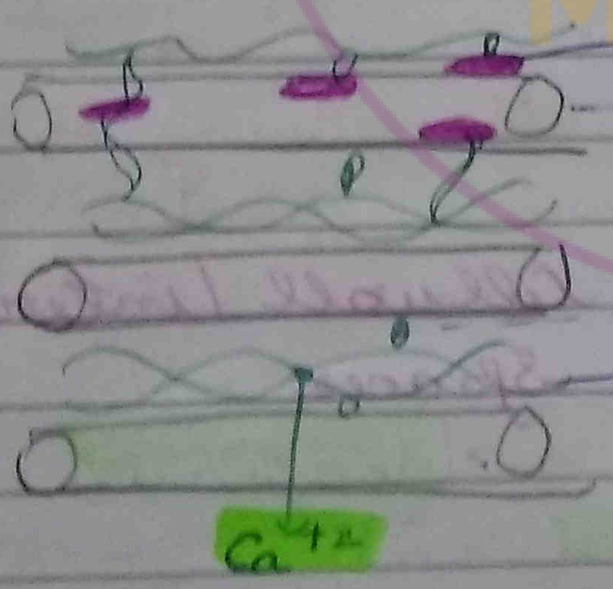
Primary | Secondary

Secondary Wall

Secretion growths:
deposition of materials over the surface of existing membrane

- Microfibrils
- Pectin fibres
- Proteins → interweaving b/w pectin and microfibril

form 3 independent network



- Pectin fibres join with Hemicelus with the help of Ca^{2+}
- Cellulose microfibrils attached with hemicellulose with the help of H-bonds.

Primary Wall

Intussusception growth
addition of materials within existing wall.

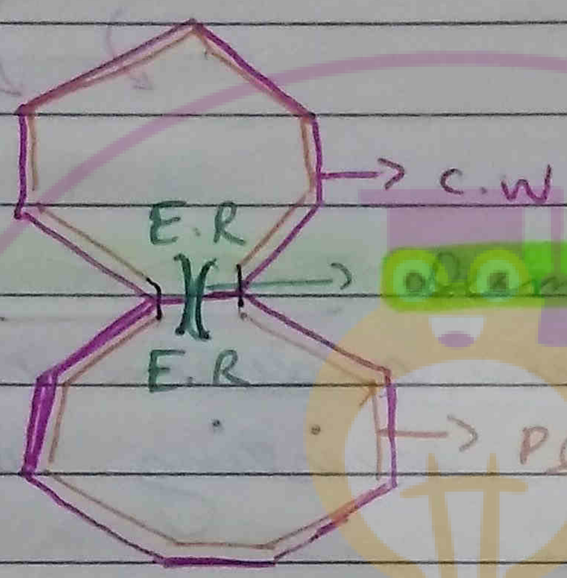
Warp & Weft structure

- Desmotubule is the extension of endoplasmic reticulum and connects (E.R) of two cells.

Date __/__/__
Page

Plasmodesmata

- Cell wall → minute pores
- Cytoplasmic bridges b/w adjacent cells.



tubule (E.R):

- Diameter of Plasmodesmata - 40-50 mm
- Function → transport of chemicals
- Present only in Plants.

Continuity	Continuity
↓	↓
Living Material	Non-living Material
↓	↓
Plasmodesmata	Cell wall / intercellular Spaces
Symplast	Apoplast

*Munch (Term)

- Cephalin, Lecithin are both phospholipids
- Cholesterol provides stability to membrane.
- Lipids and proteins are main components of plasma membrane. | Glycocalyx/Glycolipids = lipids + carbohydrates

Date ___/___/___

Cell Membrane :

Thin, elastic, dynamic, semifluid

covering (present) inside and outside cytoplasm
↓ ↓
cell organelles cell membrane
↓
Plasma

→ Components :

Proteins	Lipids	Carbohydrates	Enzyme	H_2O
20 - 70 %	20 - 79 %	1 - 5 %	30 types of enzymes in plasma membrane	20%

Ease of extraction
- Integral / Intrinsic — difficult
- Peripheral / Extrinsic — Easier

Function
- Structural: backbone
- Carrier: Transport
- Enzymatic / Catalytic

- Cephalen || P.L
- Lecithin
- Cholesterol
- Galactolipids / Glycolipids.

- Hexoses: fructose
- Hexamine
- sialic acid

☆ P.Y.Q AIIMS
Human Erythrocyte cell membrane.
52% Protein
40% Lipid

- β-pleated 2° structure = β-proteins
- Proteins showing association with carbohydrate (C.H) are called mucoid proteins.

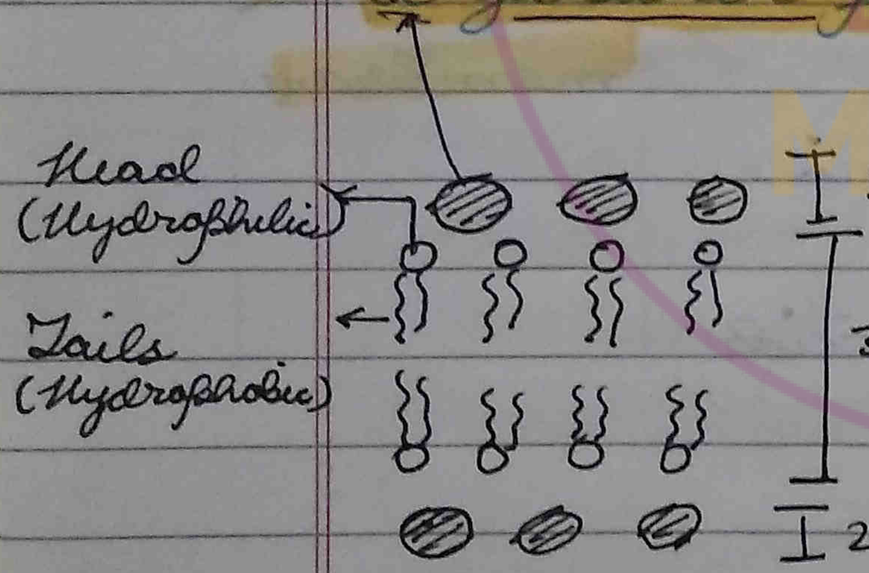
Different Models → Structure of P.M

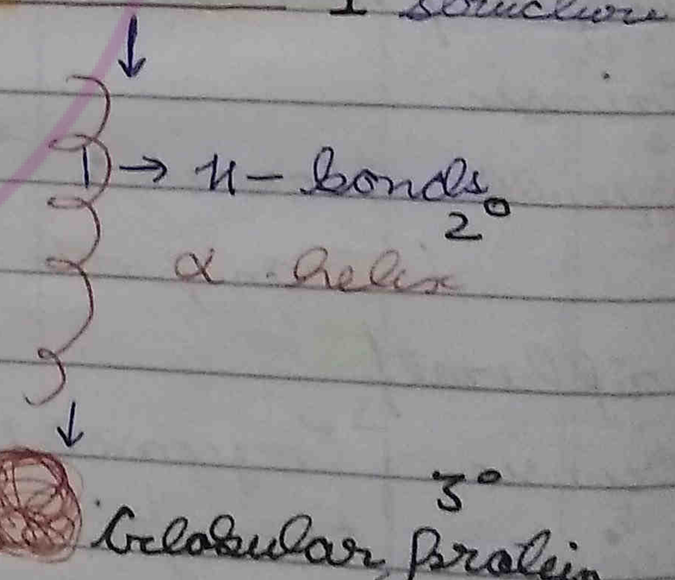
★ Sandwich / Trilamellar	Danielli & Dawson
★ Unit Membrane	Robertson
★ Fluid - Mosaic	Singer - Nicolson

(i) **Trilamellar** (PLLP model)

→ Lipids, Proteins arranged in distinct layers

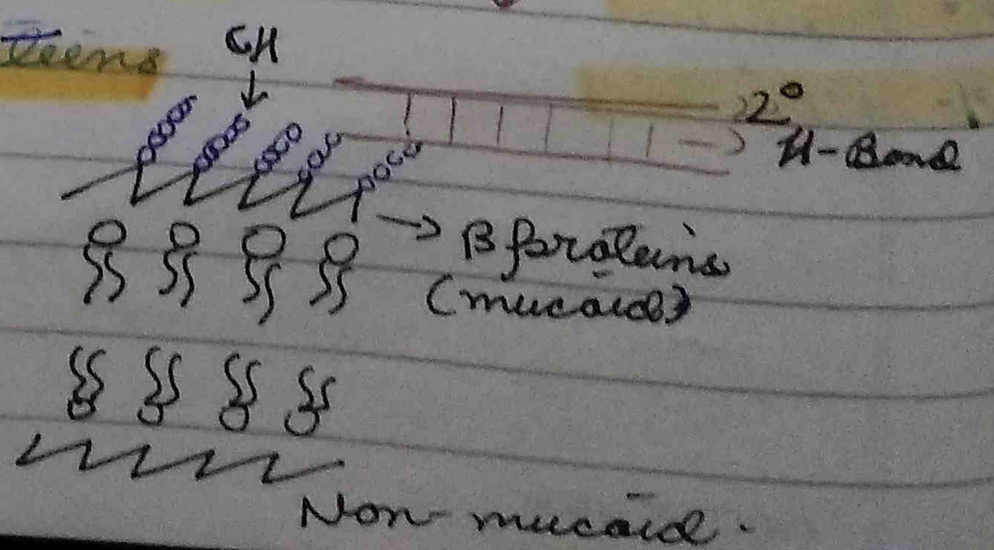
- 75 A°
- **Symmetrical**: two sides of membrane is same.
- **α-globular proteins** (hydrated)





(ii) **Unit Membrane** (PLLP model)

→ Asymmetrical membrane
→ outer mucoid proteins
→ inner Non-mucoid protein



. Hopnoids (Cholestrol like). : membrane stabalisir in bacteria
. Cholestrol: membrne stabalisir, more in upper layer.

→ **Drawbacks:**

(i) [50° – 100°A]: Thickness of membrane shows variation

(ii) Could not explain movement of polar compounds through the membrane.

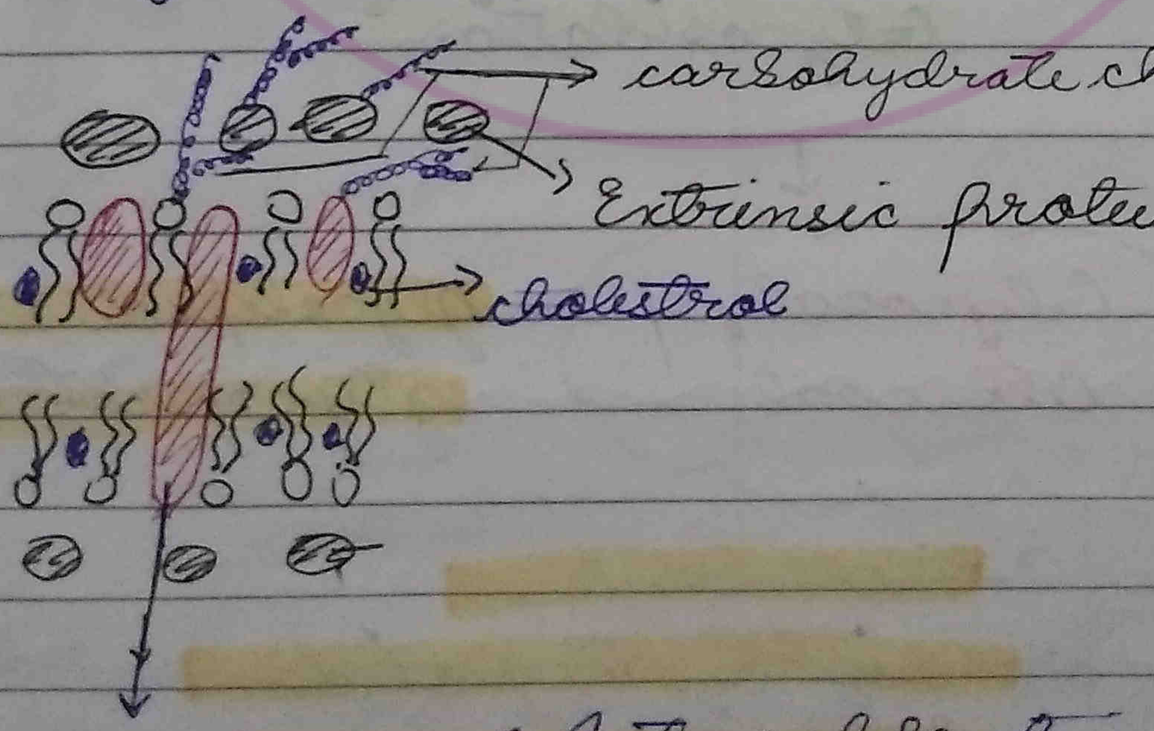
(iii) Membrane → static

Cut Repair
Contraction + nt
Relaxation + nt
Transport + nt
Secretion + nt
Growth + nt

→ Membrane is Dynamic

(iii) **Fluid → Mosaic model**: (1972)

Singer and Nicalson



Proteins are icebergs in a sea of lipids.

Transmembrane protein or Tunnel Protein: Integral protein spanning the whole membrane

** Glycolipids and Glycoproteins are present only on the outer surface of cell membrane

Date __/__/__
Page

	Extrinsic / External / Peripheral Proteins	Integral / Intrinsic proteins
Amount	30% (less)	70% (more)
Attachment	Head of lipids	Head / tails of lipids
Removal	Easier slight change of pH e.g Spectrin. ~~RBC membrane~~ Spectrin + nt in inner side of RBC membrane.	Difficult Detergents e.g Glycophorin (RBC) Glucose Transport

Glycosylation

* Protein + C.H ⟶ Glycoproteins

* Lipids + C.H ⟶ Glycolipid

Glycosidation

Glycocalyx / cell coat = glycolipids + glycoproteins

-> Attachment
-> Antigenic Properties
-> Recognition centre

• quality and quantity of extrinsic proteins is different on either side of plasma membrane which shows asymmetrical nature of plasma membrane.

Date ___/___/___
Page _____

★ Asymmetrical nature of plasma membrane:

(i) Glycocalyx → Outer ✓
Inner ✗

(ii) Cholestrol → outer ↑ more
inner ↓ less

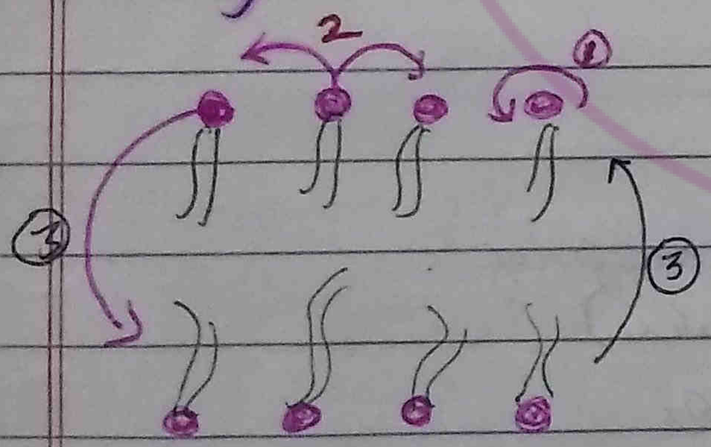
(iii) Extrinsic proteins → outer ↓
inner ↑

(iv) Type of extrinsic proteins are deffert on outer / inner surface.

(v) Phospholipids are different on either side.

→ Semifluid Nature:

→ Fluidity ≃ Movement within the Membrane

Lipids	Proteins
	
(i) Rotational Movement	✓
(ii) Lateral diffusion movement	✓
(iii) Flip flop Movement / Transversion movement (Rarely ↓ once in every month)	✗ flip-flop movement nt

Q★
• Proteins can undergo rotational movement and lateral diffusion but cannot do flip-flop movement.

Date ___/___/___
Page ___

→ Function of fluidity →

(i) Cell growth
(ii) Cell division
(iii) Secretion
(iv) Endocytosis
(v) Intercellular junctions formation.

→ Channel :-

one Transmembrane Helix

Transmembrane Proteins
↓
Helix
↓
Cluster
↓
Pore (H₂O soluble compounds)

Helps in transfer of

cluster of transmembrane helix → results in pore formation

Mitochondria

circular ds DNA

Inner chamber (Matrix)

Inner membrane

Outer membrane

Ribosomes (70S)

Outer chamber / Intermembrane space

• Mitochondria has double membrane envelope.

Exception: Cardiolipin is lipid which has 7 (seven) times the concentration in innner membrane as compared to outer membrane.

Date __/__/__
Page

• **Mitochondria** : (Bacterial endosymbionts)

also called - Bio plast
- Chondriosome
- Sarcosome (mitochondria in muscle fibre)

Discovery → Kolliker → Striated muscles of insect.

All - chondriome ← mitochondria collectively called

→ **Shape** :

→ Cylindrical (Most common)
→ Spherical
→ Filamentous
→ Racket
→ Club.

Occurence

Pro ✗ Eu ✓

★ RBC → Lost.

	Outer membrane	Inner membrane
Lipid	↑ (40%)	↓ (20%)
		★ Cardiolipin +nt (7 times)
Protein	↓ (60%)	↑ (80%)
Enzymes	↓	↑
Expansion/ Shrinkage capacity	↓ Greater	↑ Less
		Infolding (cristae)
☆ Permeability	↑ Because of ★ Porins	★ Selectively Permeable

Semi Autonomous

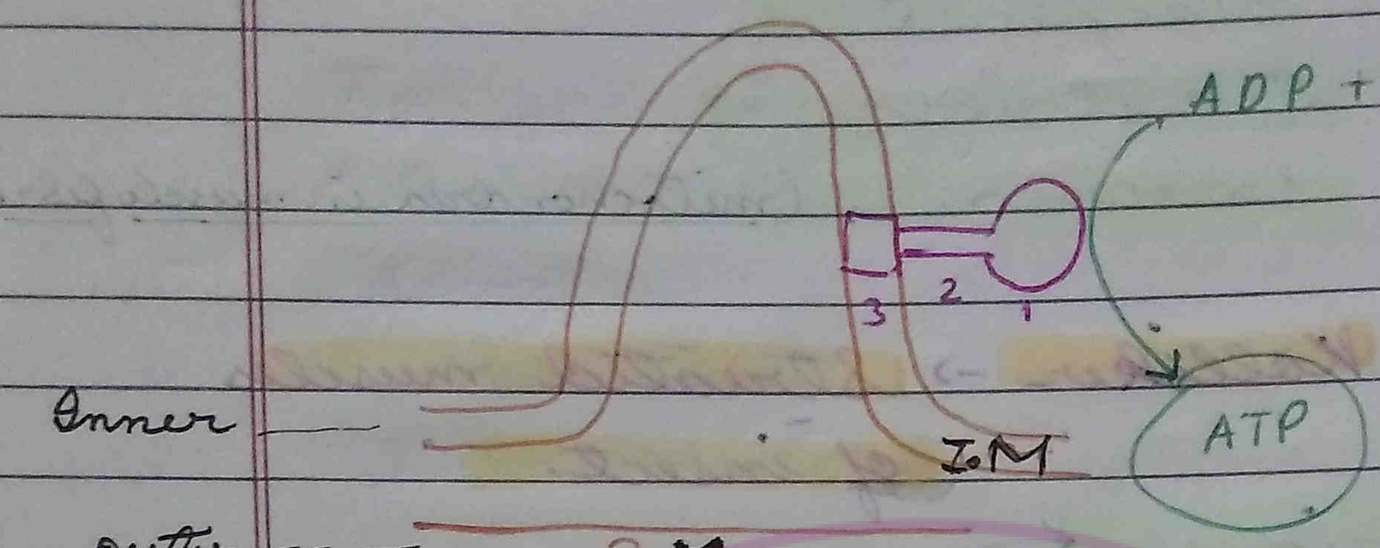
(my COMPANION never) (LMW protein) can be transferred from Porins

Outer membrane has greater permeability because it has porins.

- ds DNA, 70s ribosome, presence of porins and binary fission are characteristics of bacteria in mitochondria.

Date
Page

- Cristae:



also called
- $F_0 - F_1$ particles
- Fernandez-Moran bodies
- Oxysomes
- Elementary particles

1- Head → ATP synthetase
2- Stalk (oxidative phosphorylation)
3- Base

→ Functions of Mitochondria:

(i) Oxidation of proteins, sugars and fats.
Aerobic respiration
↓
Glycolysis → Cytoplasm
Kreb Cycle → Mitochondria (Matrix)

ETS - Oxidative phosphorylation - Inner Mitochondrial Membrane.

(ii) Synthesis and elongation of fatty acids

CAPS
- C → Chlorophyll, Cytochrome
- A → Alkaloids, Amino acids
- P → Pyrimidines
- S → Steroids

MY COMPANION

(iii) Storage of Ca^{2+} ions in sarcosome

- Proplastids are precursor of plastids.
* can form by replicating, but this ability is absent in chromoplast.

Plastid

Term → Hackel

Semi autonomous

as DNA

- Envelope → Two membranes.
- Storage and Synthesis of Organic compounds

Proplastids (Precursor of plastids).

→ Leucoplast ⇌ L

→ Chloroplast ⇌ Ch

→ Chromoplast

Leucoplast

- Colourless plastids
- Pigments ×

→ Amyloplast
Starch storage —
Potato tubers, wheat

→ Aleuroplast / Proteoplast:
Storage of Proteins
Maize - Aleurone cells

→ Elaioplast / Oleoplast
Storage of fats
Castor — Endosperm

Chromoplast

- Coloured plastids
Yellow to reddish
Carotenoids

→ Colour of flower
: Pollination

→ Colour to fruits
: Seed dispersal

★ Synthesis of lipids

Chloroplast

- Coloured plastids
: Green
Photosynthetic pigments →
Chlorophyll ✓
carotenoids ✓

- Photosynthetic plastids

Date / /
Page

Chloroplast :

Term → Schimper

→ Shape

a Algae (Green)

- Spirogyra : Ribbon
- Chlamydomonas : Cup
- Ulothrix : Collar
- Zygnema : Star
- Oedogonium : Reticulate

b Higher Plants

→ Spheroid
→ Ovoid
→ Disc
→ Lens ✓ Most common

Dimensions

length - 5-10 μm
width - 2-4 μm

Envelope

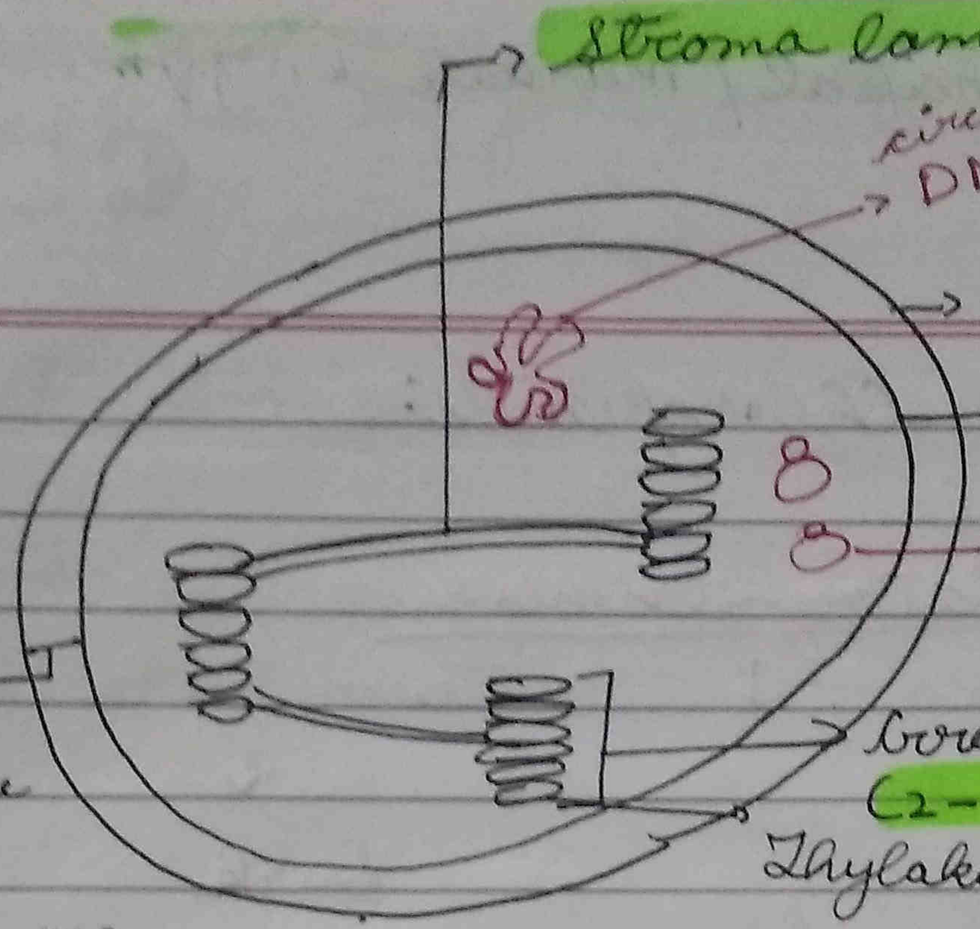
Outer
Permeable ↑
Porins + nt

Inner
Selectively membrane
×

Inner part of chloroplast

Stroma
Protein complex

Thylakoids
Membranous structure



Date __/__/__
Page

Lumen (2-100)

Semiautonomous organelles
Bacterial endo-symbionts

Thylakoids:
- No. of grana - 40-60
- Membrane contains - Pigments.
- Light Reaction occurs.

Stroma / Matrix (Proteinaceous complex)
- d/s DNA: circular
- Ribosomes
- Dark Reaction (Rubisco): Most abundant protein.

Chloroplast

+nt ↓ Grana formation ↑ -nt

Granal Chloroplast — Agranal Chloroplast
- B, P, G, A
- Green alga

A → C4 → Granal
- A → C4 plants
- Leaf: bundle sheath cells
- angiosperm

Phylo: Algae, Bryophyta, Pteridophyta, Gymnosperm, Angiosperm

★ Thylakoids are loose and sac like hence called Baggy Stacks

- Rubisco is principal / marker enzyme of chloroplast.

Date __/__/__
Page

→ Functions of Chloroplasts:

(1) Photosynthesis

Light
- Thylakoids

Photosynthetic Pigments
Light Energy
Chemical Energy
ATP, NADPH

Dark
Stroma

CO_2 fixation
Calvin Cycle
Rubisco
Sugar
Marker

(2) Storage → Starch.

→ Transformations → Plastids

(i) Tomato - Young Ovary (colourless) → Leucoplast
Young fruit (Green) → Chloroplast
Mature fruit (Red) → Chromoplast

(ii) Chilli : Chloroplast (green) → Chromoplast (red)

- Network of membrane of E.R has high surface area hence called one of the best site for metabolic activities in cell.

Date ___/___/___
Page _____

- **Endomembrane System**

--> Membranous cell organelles

⇒ Functionally co-ordinated i.e close association

1 ER: Endoplasmic Reticulum
2: G.B: Golgi Bodies
3: Lysosomes
4: Vacuole

- **Endoplasmic reticulum**

- Term → Porter
- Discovery → Porter & Thompson.

- Interconnecting - membrane bound structures
- Extends from nucleus to plasma membrane

Intercellular Space:

-> Two Components

ER (Luminal) — Rest of Cytoplasm (Extra luminal)

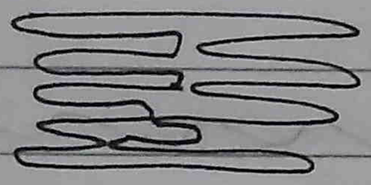
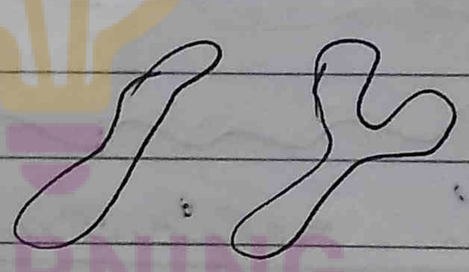
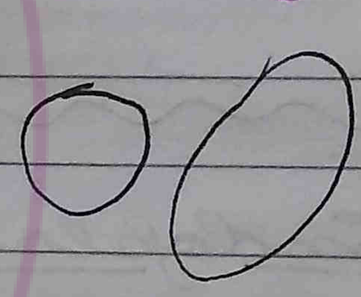
- attachment of ribosome with RER is by larger subunit with the help of proteins Ribophorins.
- Protein formed by attached Ribosome is sent to lumen of RER

Date __/__/__ Page

Occurence

- well developed
  - Plasma cells
  - Liver cells
  - Pancreatic cells
  - Interstitial cells (Testis)
- Poorly developed
  - Spermatocytes
- absent
  - *RBC's (mature)
  - egg

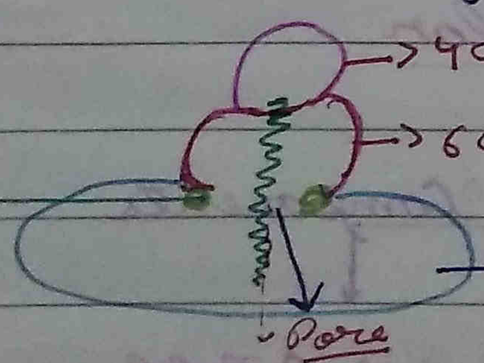
Components →

Cisternae	Tubules	Vesicles
		

RER

Ribosomes +nt

Granular type



Pores ✓

* Mainly → Cisternae
  Few → Tubules

SER

-nt

Agranular type

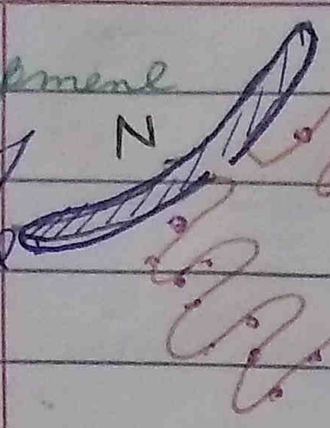
Ribophorins ×
⇒ attachment of ribosome absent.

×

Mainly → Tubules, Vesicles.

• Glycosylation starts in R.E.R but finishes & ends in golgi bodies

Date __/__/__
Page

Development from / formed by		Outer — Nuclear membrane.
Connected / Location	Nucleus	R E R ← (develops from)
Location	Internal	Plasma Membrane Peripheral.
Function / Location	In cells involved in ↑ Protein Synthesis • Pancreatic • Liver cells	Fat, glycogen & Steroids • Adipose • Interstitial cells • Liver cells • Adrenal cortex • Leucocytes • Muscle cells • Retinal cells

R.E.R Function

Protein synthesises → Protein modification

Lysosomal Protein / P.M proteins | Cytoplasmic (-ne) Protein formed by Free ribosomes

Secretory Pr. | 80S

Proteins formed by ribosomes on E R | Protein formed by free ribosomes

protein → addition of Oligosaccharides → Glycoprotein

Glycosylation

- Metabolism of foreign compound is called xenobiotics.
- Cytochrome P450 utilised by SER for breakdown of foreign compounds.

Date __/__/__

SER - Functions :

1. Synthesis of fats & steroids.
2. Metabolism Glycogen
   - → Form (Glu → Glycogen) - Glycogeneses
   - → Breakdown (Glycogen → Glu) ⇓ Glycogenolysis
3. ★ Formation of Microbodies → Sphaerosome, Glyoxysomes
4. Breakdown of Alcohol, Drugs, Pollutants ⇓ Xenobiotics

★ ⇒ Cytochrome P450 (Protein complex)

acts on → Lipid soluble compounds —Hydroxylation→ water soluble compounds —excretion through→ Kidney

Muscle contraction (Release Ca^{+2}) and Relaxation (uptake Ca^{+2})

★

Retinal cells	Myeloid bodies	SER
Nerve cells	Nissil granules	RER
Muscle cells	Sarcoplasmic reticulum	SER
Plasmodesmata	Desmotubule	SER & RER

★ Few cell organelles are absent around golgi bodies.
- cis face near the E.R, trans face near plasma membrane.
- Some of the golgian vacuoles are transformed into lysosomes.

- Golgi Bodies / Dalton's complex / Golgi apparatus / Baker's bodies (Golgi = police)

- Discovery → Camillo golgi
  Nerve cell of owl / cat.

- Metallic Impregnation technique:
  Osmium tetraoxide
  Silver nitrate

Occurence
- Pro ✗
- Eu ✓
  - Except Mature RBC ✗
  - Mature Sieve tube ✗
  - Sperm cells of Bryophyta / Pteridophyta ✗

- Components:
  - Cisternae
  - Tubules
  - Vesicles
  - Golgian vacuoles → Lysosomes

★ Zone of exclusion
- all organelles - nt
- Ribosome, Mito, Chloro

★ Interconnection
- A ✓
- P ✗

★ Dictyosomes

In plants dictyosomes are known as middle man of cell and COMPANION

E.R → Transitional vesicle
- Convex / cis / Formative / Proximal
- Concave / trans / Maturation / Distal → Secretory vesicle → P.M

- Vitellogenesis → yolk formation
- They can change one type of membrane to another type of membrane.

Date __/__/__
Page

Functions :

i Lipids + CH → Glycosidation → Glycolipids

Protein + CH → Glycoprotein
↓
Glycosylation

ii form
Acrosome → Tip of sperm
↓
break membrane of egg.

iii Vitellogenesis → Oocyte
(yolk formation)

iv Secretion - Mucus
Wax
Gums
Enzyme
antibodies

ER
↓
G. B (cis)
↓
G. B trans
↓
vesicles
↓
P.M
↓
Pass out

- Processing
- Packaging
- Transported

☆ Included in

(v) Cell wall formation

not formed → Cellulose ✗

form → Pectin, HC ; Mucopolysaccharides
↓
Hemicellulose

(vi) Lysosomes

vii ★ Root hair formation

viii Transformation of membranes

→ ER → ① Lysosome
② Plasma membrane.

~~Glycosylation~~ membrane of

- Phosphatase are the principal enzyme in lysosome

Date __/__/__
Page _____

Lysosomes

Discovery → Christian de Duve

Occurence

↓ AV
RBC × (mature)

↓ Plants
vacuoles
spherosome
Aleurone grains
] show lysosomal activities

Single membrane

0.2 - 0.8 μm

Hydrolytic enzymes : breakdown of substrate by addition of H_2O.
↓
Acid pH (4-5)
↓
(Acid hydrolases)
Hydrolytic

About 50 enzymes + nt.

4-5 pH ——→ Stabalisers

Low H^+ —ATP*→ High H^+ Against conc gradient

Acid hydrolases.
→ DNA Nucleases (Deoxyribonuclease)
→ RNA (Ribonuclease)
Proteases → Proteins
Lipases → Lipids
Glycosidases → Carbohydrates
Phosphatases → Principal
Sulphatases
Lysozyme
Cathepsin

- Cholestrol
- Heparin
- Cortisone

Destabalisers

- UV rays
- X rays
- Liposoluble vitamins (A, E)
- Bile salts
- Steroidal sex Hormones
- O_2 deficiency

- Autophagy: digestion of dead cell organelles
- Autolysis: digestion of dead cell By breakdown of lysosome
- Cathepsin digests tail of tadpole.

Date / / Page

- **Functions →**

- Intracellular digestion → Heterophagy

Extracellular Digestion

Autophagy / Intracellular scavenging.
(organelles dead)
≡
Autolyses: digestion of dead cells.

Difence: - WBC → Kill, Bacteria, Viruses

★ Metamorphosis of frog

Tadpole ⟶ Adult
(Tail) ✓ ↑ Tail ×
(Cathepsin)

↓ Diseases due to improper functioning:

Ephagy ×: Polymyositis
→ residual vacuoles will increase Hepatitis

Lysosome ⟹ Storage diseases
↓ Enzyme ×
↓
Substrate ↑
↓
Substrate (stored) → Vesicles
↓
storage leads to
Neurological disorders

Hurlers
Hunters
Fabers
Tay Sach
Nieman Pick

- True membrane is made up of phospholipid bilayer.
- Tonoplast has channels which take ions and other materials actively by use of ATP.

- **Vacuoles →**

- non-cytoplasmic areas present in the cytoplasm.
- from cytoplasm.
- seperated with the help of specific membrane.

- **Origin - ER**

Contractile V	Sap	Digestive / Food Vacuole	Gas / Pseudo. V
occurence			
F.W Protozoans	Plants	1°L + Phagosome	
Algae	Young - Small	Protists	B G A.
	Mature - large, central	Higher animals	
	↓ (90-1)% of volume of cell		
Function	• Tonoplast (membrane) ions and other material against ↑ concent. gradient. ATP	• Digestive enzyme	★ regulate buoyancy
• Osmoregulation	• Storage of	• Digestion - food	• Membrane ↓ Proteinaceous (not true)
• Excretion	• Amino acid → sugar		
	• Waste material		
	• Pigments - Anthocyanin		
	• Esters		

★★★ Anthocyanin is water soluble pigment which gives colour to flower / fruit

GERL

- GERL → A complex formed by golgi bodies, endoplasmic reticulum and lysosomes.

☆ Microbodies are related with oxidation which are not used for respiration.

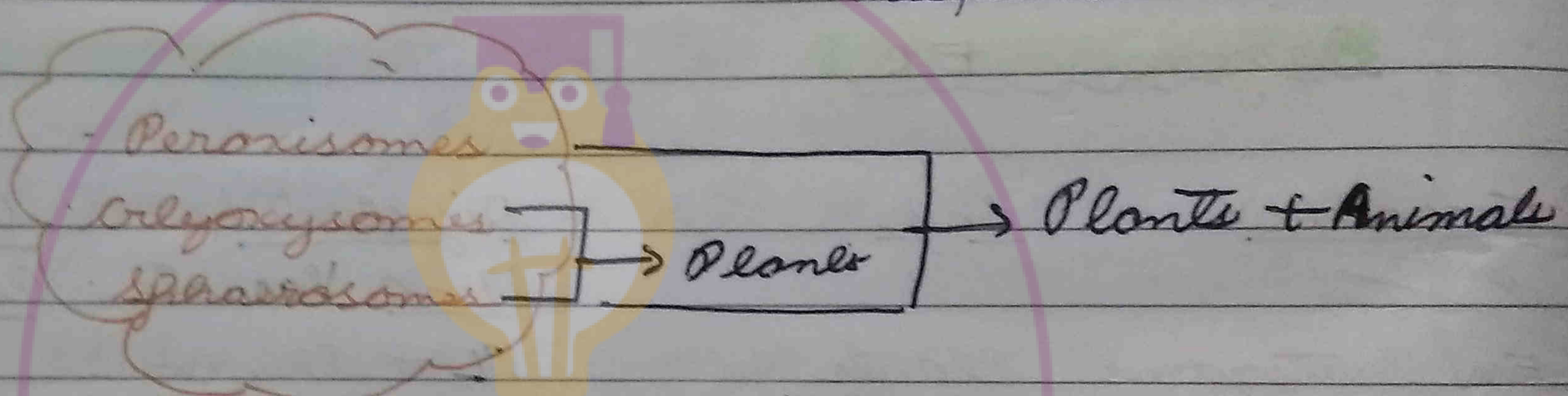
Date __/__/__
Page

Microbodies :

single membrane bound organelles

0.2 — 1.5 μm (Diameter)

- Oxidation reactions not associated with respiration



	Peroxisomes or Microsome	Glyoxysomes	Sphaerosomes
Discovery	de Duve	Briedin Bach	Perner
Occurrence	A ✓ P ✓	P ✓	P ✓
	Long lived	short lived	short lived

- Peroxisomes

Animals ↓ P

Metabolism / Breakdown of fatty acids, amino acids, alcohol, drugs. Toxins

- peroxisome is concerncend with smallest and largest enzyme.
- Both formation and breakdown of H_2O_2 occurs in peroxisome.

Smallest enzyme

Oxidase enzymes

Byproduct

- α Hydroxy acid oxidase
- β Hydroxy acid oxidase
- Amino acid oxidase
- Urate oxidase

H_2O_2
Hydrogen peroxide

Catalase

Breakdown of H_2O_2

Largest enzyme

- Plants

Photorespiration: (light dependent)

→ O_2 uptake and release of CO_2 by green parts of plants.

→ Involvement of 3 organelles

P — peroxisomes
C → chloroplast
M → mitochondria

— glycolate oxidation in plants.

- Glyoxysomes

glyoxylate enzymes

Fats → C.H (sugar)

Gluconeogenesis

Glyoxylate pathway

found in endosperm of

→ Fatty seed
→ Castor
→ Groundnut

- Sphaerosomes

Synthesis and storage of fats in fatty seeds.

- Palade discovered the ribosomes are made from RNA.
- Higher the rate of sedimentation, larger the size of protein.

Date / / Page

Ribosomes / Palade particles

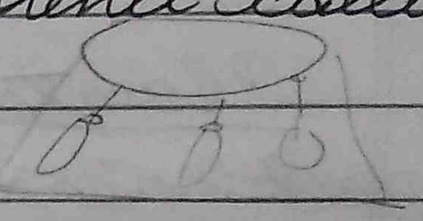
I studied
- Brown & Robinson → Plant cell
- Palade → animal cell

→ rRNA (ribosomal) + Proteins | Made up of

⇒ ribo-nucleoprotein organelles | Hence called

→ non-membranous

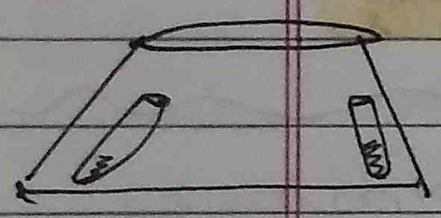
→ +ve in Eu & Pro (-ve in RBC)



Ribosomes

↓

Sedimentation Co-eff.
(rate of sedimentation)
(Svedberg unit - S)

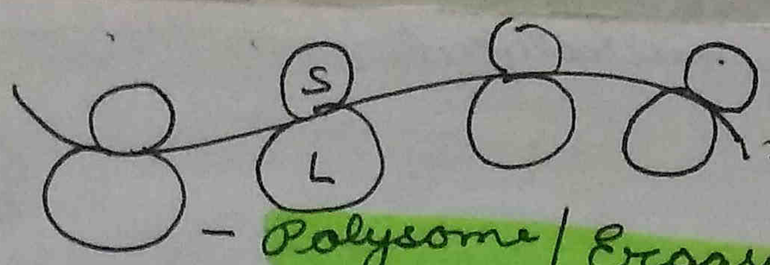


70 S (<) 80 S (larger)

→ Centrifugation machine puts an object in rotation.

- Prokaryotes → Cytoplasm → 70S (my COMPANION)
- Eukaryotes → Cytoribosomes (80S) → Freely / Bounded ER
- Eukaryotes → Organelles.
  - → Mitoribosomes 70S
  - → Chloroplastic ribosomes 70S

• Peptidyl-transferase is a RNA based enzyme.

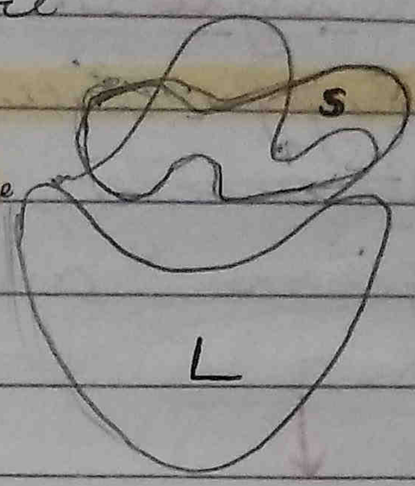


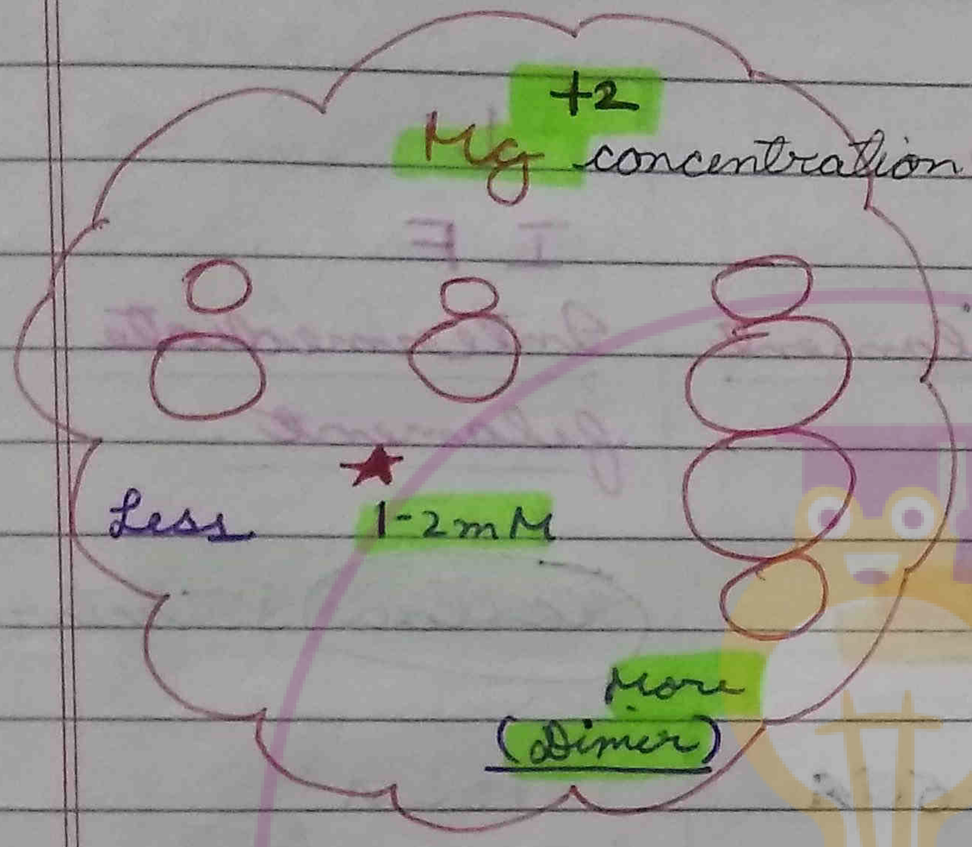
- Polysome / Ergasome / Polyribosome

Date __/__/__
Page

• Larger subunit dome structure

• Smaller subunit cap structure





→ Passage of mRNA
→ codied information
→ sequence of amino acids

70 S		80 S
30 S	16 S rRNA 21 protein	40 S	18 S rRNA 33 protein
	23 S rRNA		28 S rRNA
50 S	5 S rRNA 34 protein	60 S	5.8 S rRNA 5 S rRNA 40 protein
RNA : Protein 60 : 40 more RNA less protein		RNA : Protein 40 : 60 less RNA more protein.

Common

Peptide bond ← (Ribozyme)

Peptidetransferase (associated with larger subunit)

Larger subunit

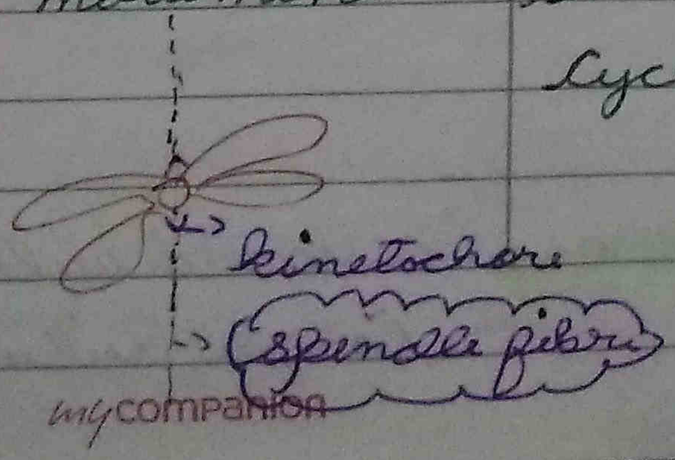
• Spindle fibre are made up of microtubule.

Date / /
Page

Cytoskeleton :

P.Y.Q

Supportive framework of protein fibres and tubules.

	↓ MT microtubule	↓ MF microfilament	↓ IF Intermediate filament
	Hollow structure	P.Y.Q Solid	Hollow structure
Diameter	250 A°	50-60 A°	100 A°
	Globular-Tubulin	Globular-Actin	Rod - Keratin like protein P.Y.Q Lamin protein
	Non-Contractile	Contractile	Non-contractile
location	Cytoplasm	Cytoplasm	Cytoplasm + nucleus
Functions : (i)	Cytokinesis ↓ Plants ↓ Cell plate	Cytokinesis ↓ Animals cell furrow	Maintain shape of cell.
(ii)	Chromosome movement 	Cytoplasmic streaming / Cyclosis.	Hold cell organelles / maintain position of cell organelles.

- microfilament help plasma membrane to counteract different kinds of stress.

Date __/__/__
Page _____

*** activate GTP dependent Kinase.

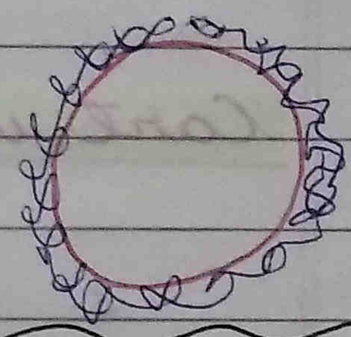
- Cell-Movement
  - flagella
  - cilia

☆ Intracellular transport i.e transport of vesicles etc.

Support to plasma membrane.
↑
~~[illegible]~~
⇓
'stress fibre'

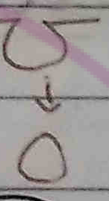
- Part of cell-cell junction.

★ form Basket around Nucleus

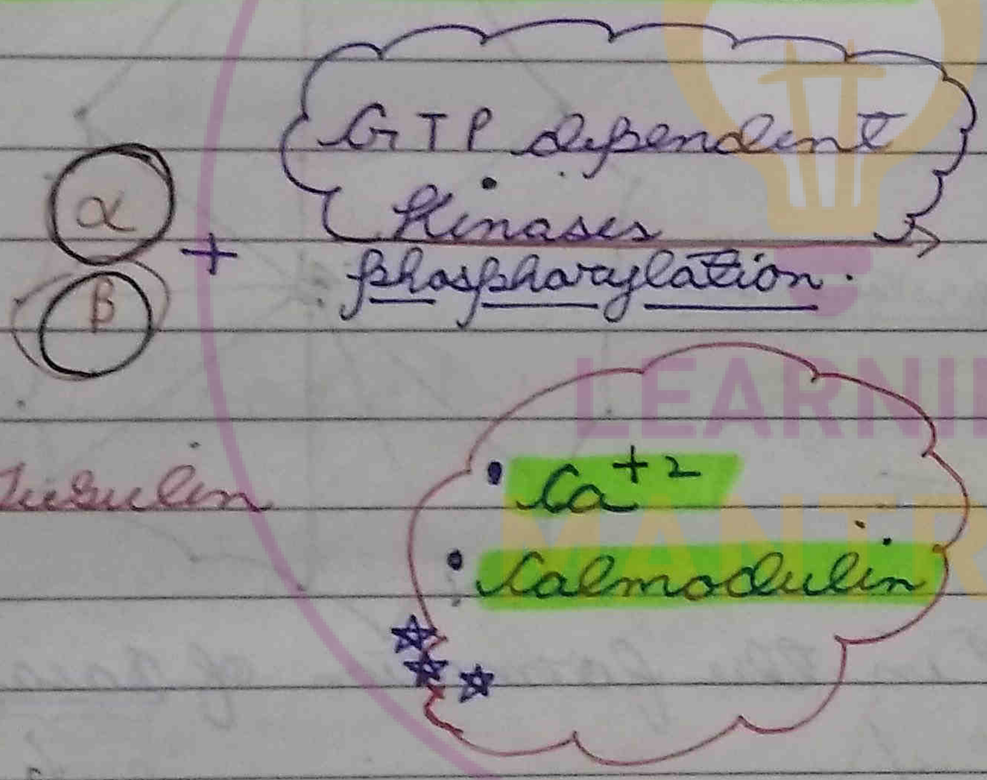


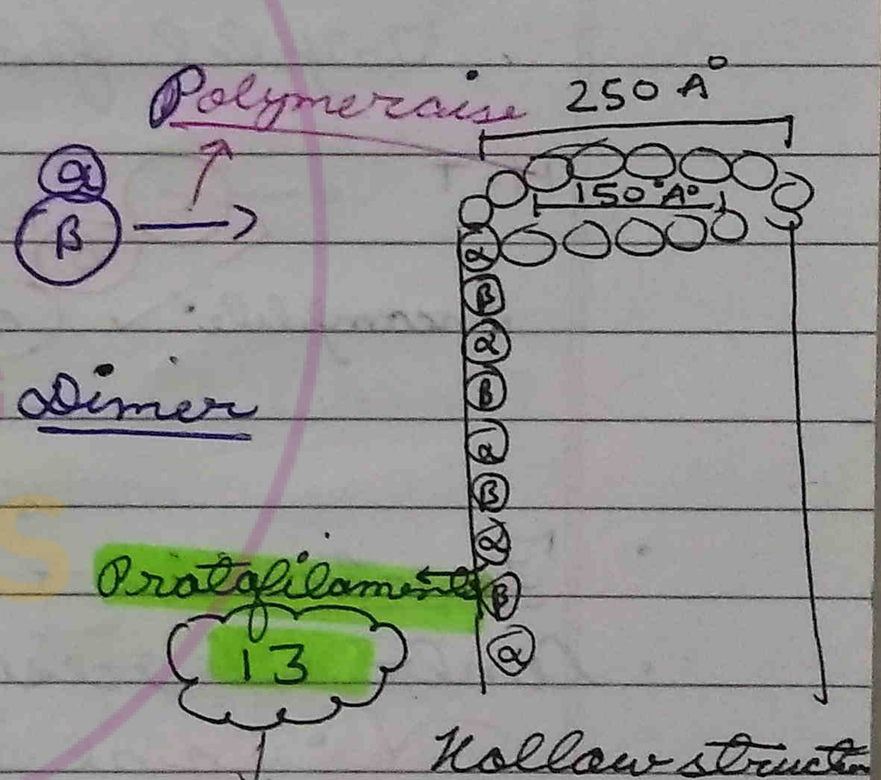
- Amoeboid movement

- Endocytosis



Microtubules in detail





13 strands which together form microtubule

Names

- MTOC: Microtubule Organising Centre.
  OR
- MTG → Micro tubule Generators
- Nucleating Centre

areas where micro-tubule formation occurs

Function of MTOC performed By:
- Basal Bodies
- Kinetochore
- Satellites / Massules
- centriole

- Centriole result in formation of Basal body.
- Zone of exclusion in centrosome surrounded by limiting membrane.

Centriole

Non-membranous

Hollow microcylinder

M.T (made up of)

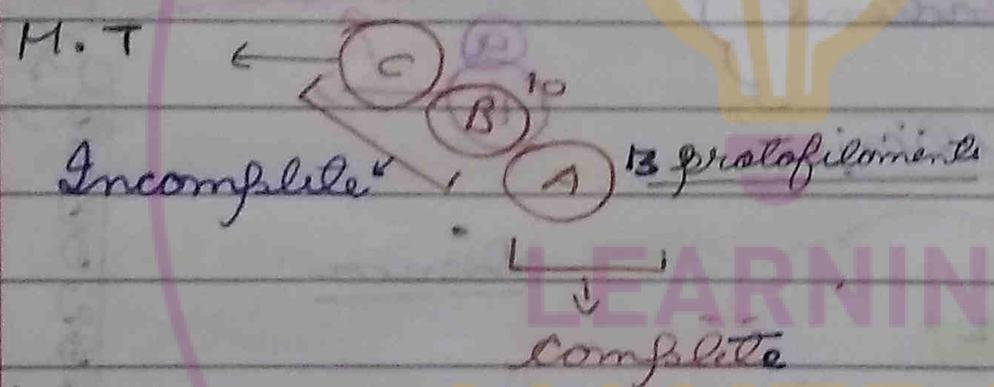
Animal cell

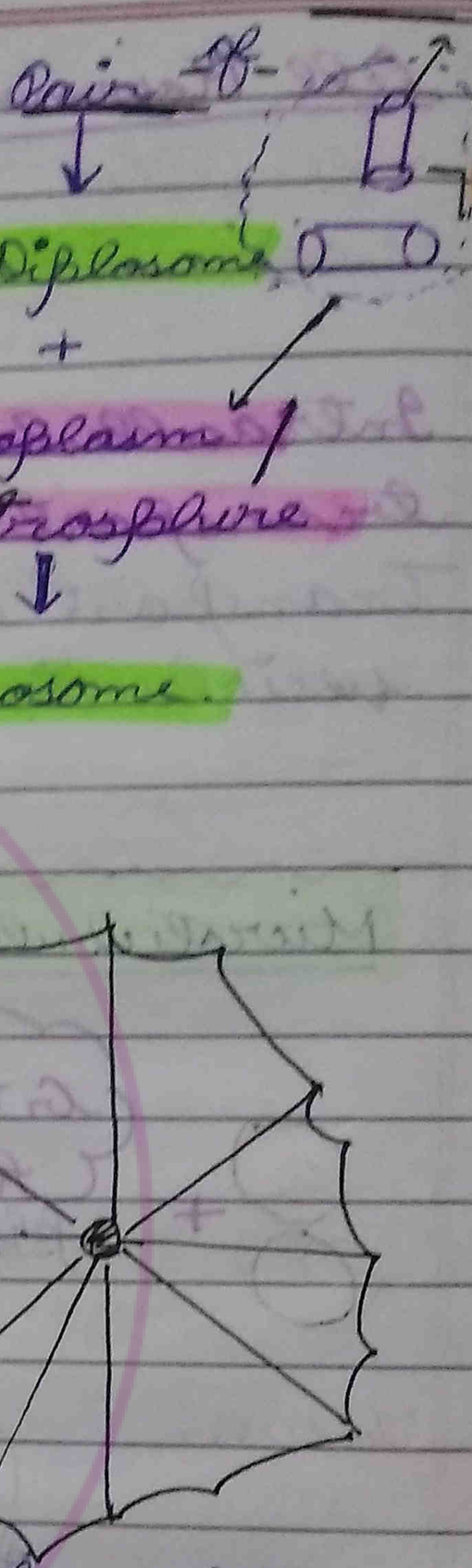
Cart wheel structure:

3 M.T

↓ Join

Triplet fibril





- Functions:
  - Centrioles result in the formation of Basal bodies
    - Basal bodies / Basal granules / Blepharoplast
    - ↓
    - cilia & flagella
  - ↓ & ↑
  - result in the formation of cilia and flagella

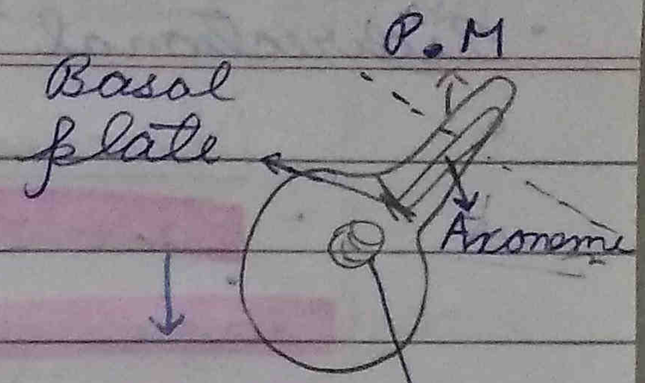
- Centrioles are organelles lacking DNA but capable of replication in S phase.

• shaft = axoneme + plasma membrane.

• cilia and flagella are formed from proteins dynein, tubulin, nexin.

Date 1/1/17
Page

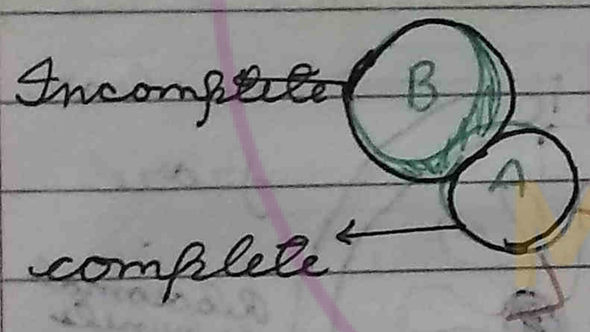
Cilia and Flagella.



3 Parts

- **Basal Body** — 9 + 0
- **Basal plate** → Triplet fibrils transformed to doublet fibrils
  ✱ Fibrils singlet present in (centre)
- **Shaft** — 9 + 2

2 M.T ↓ Join → Doublet fibril



Dynein protein (arm)
↓
ATPase
↓
ATP Hydrolysis
↓
Energy
↓
cilia and flagella movement

Centriole	Axoneme	
9 × 3	9 × 2	
2 ⁽¹¹⁾/₇ M.T	= 18	
	+ 2	
	= 20 M.T	

↳ No. of microtubules

• Dynein and mysoin protein are analogus as both utilise ATP for contraction. (My conclusion)

- Intermediate Filaments (I.F) form a fibrous structure called Fibrous Lamina which holds ends of chromatin.
- Nuclear envelope consists of two membranes.
- Bidirectional transport occurs through nuclear pore.

Date : __/__/__
Page

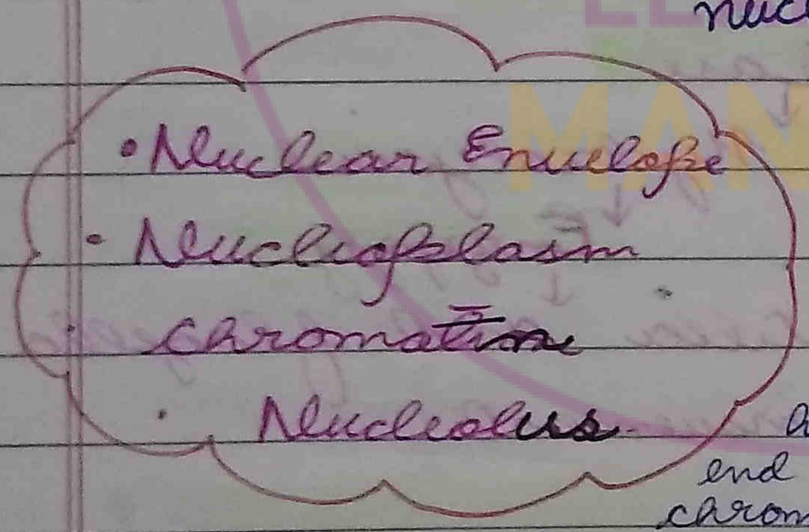
Nucleus

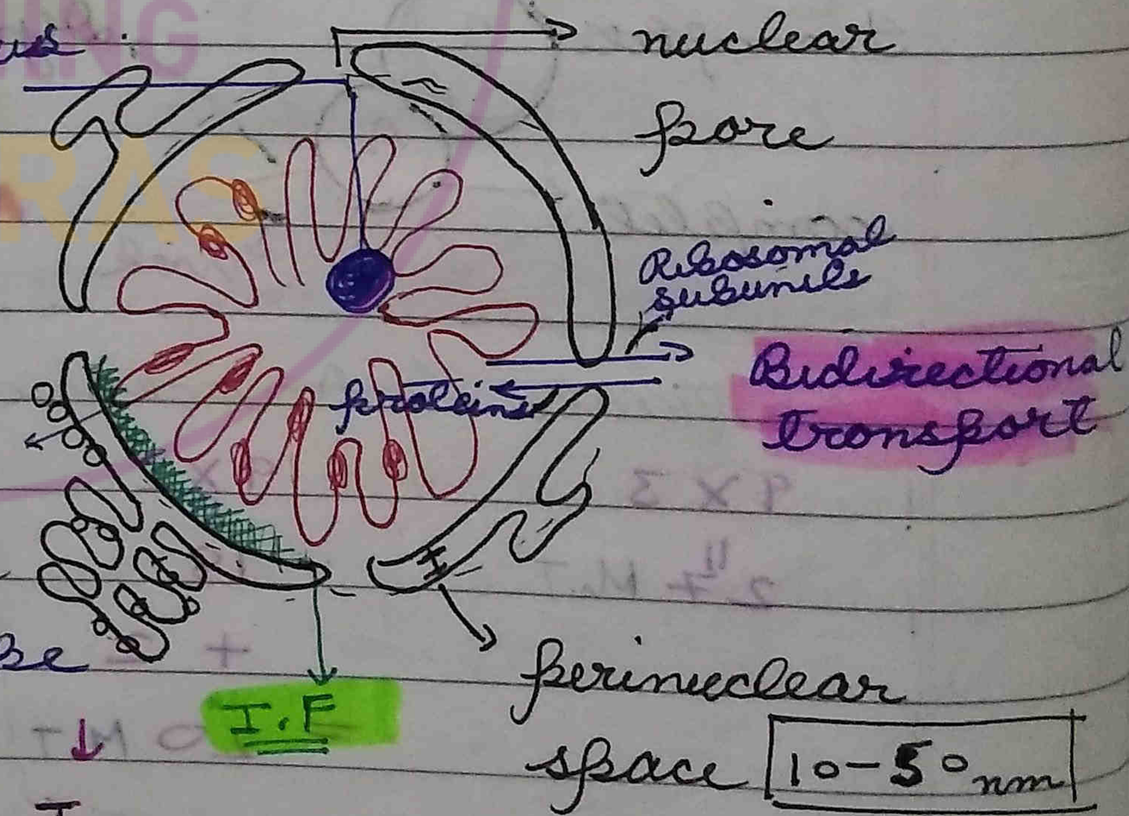
- Robert Brown (1831) discovered.
- Discovery → orchid root cell.
- also coined the term Nucleus

Cell

- Uninucleated
  - Pro ✗
  - Eu ✓ (Except RBC, sieve tubes)
- Multinucleated
  - Syncitium — due to joining of several cell
  - Coenocytic — cytokinesis - ✗

Occurrence





Nuclear Envelope

Outer membrane	Inner membrane.
Ectokaryotheca	Endokarya
Ribosomes + R.E.R	Smooth.

☆ Chromatin is seen during interphase nucleus.
Chromosomes are seen during mitotic phase.
☆ Majority of the chromatin is euchromatin.

• **Nucleoplasm / Nuclear Sap:**
Transparent colloidal complex
AIIMS ☆ Raw Material → DNA RNA (for synthesis)
Nucleotide → DNAP, RNAP

• **Chromatin** - Flemming
→ Thread, coiled elongated structure

Cell cycle

Interphase	M
cell division ✗	✓
chromatin ✓	→ chromosomes

Chromatin

Heterochromatin	Euchromatin
darkly stained	lightly stained
Compact DNA ↑	Loosely packed
crossing over ↓	✓
transcriptionally inactive	Active
10% of chromatin	90% of chromatin

Intermediate filament → forms fibrous lamina
↓
holds the ends of chromatin

- The telomeres seals the end of chromosome and maintains its structural identity.
- A chromosome consists of two chromatids.
- centromere is non-stainable

Date __/__/__
Page

Chromosomes

- Condensation of chromatin fibres

- gamete = 1 set = n
(haploid)

- Somatic cells = 2 sets = 2n
diploid.

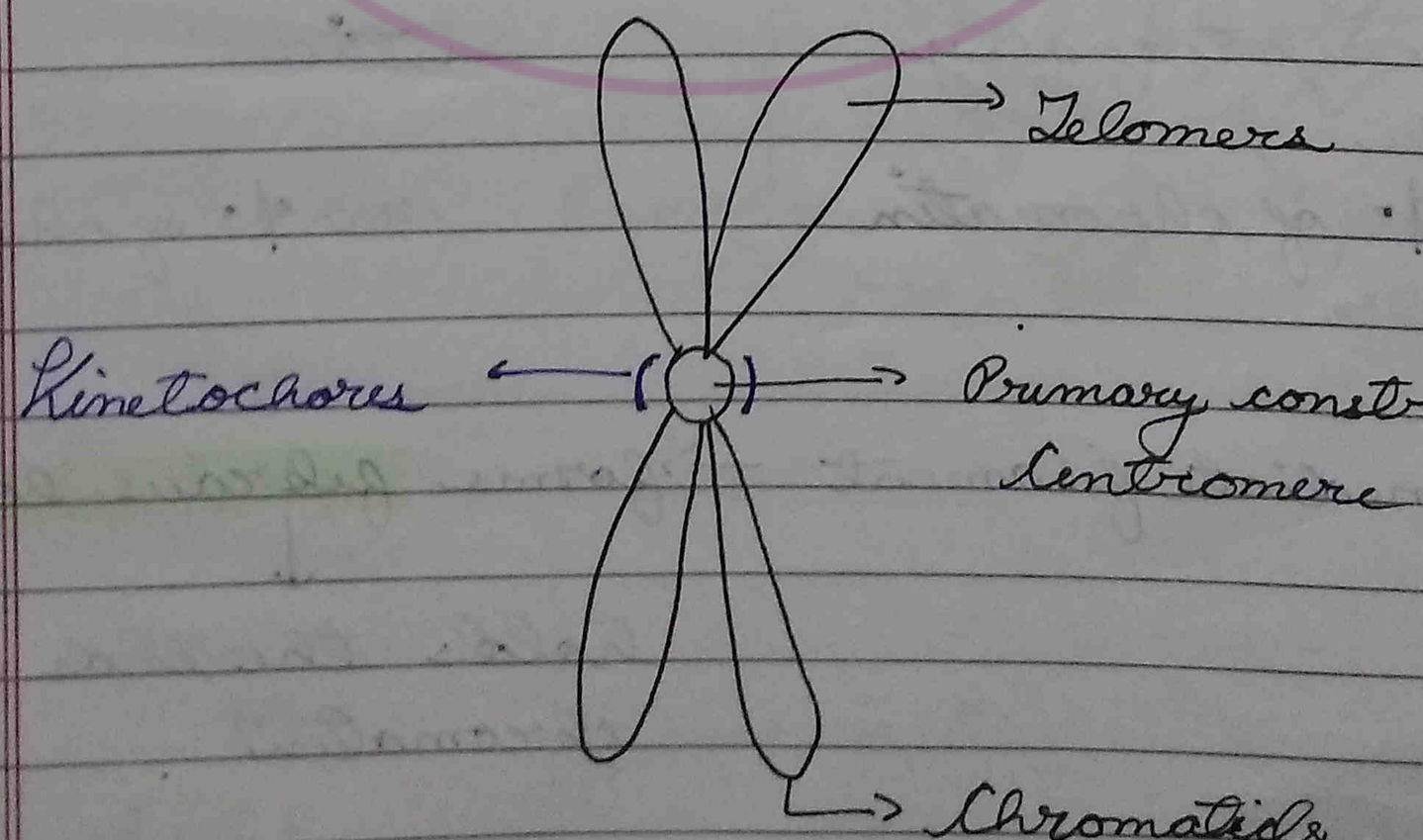
n	2n
1	1 - 1
2	2 - 2
3	3 - 3

3 pair Homologous chromosome

Humans 2n = 46 = 23 pairs

44 → Somatic / autosomes

2 → Sex chromosomes / allosomes

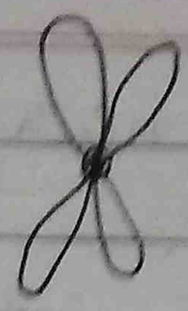


Chromosome

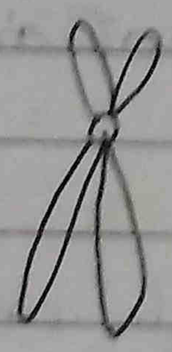
(In a typical chromosome 4 telomers are present)

- Secondary constriction forms nucleolus.
- Satellite chromosome acts as marking.
- Humans have 5 pair SAT. chromosomes.

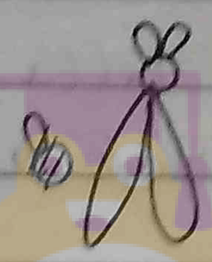
- Median (Metacentric)



- Near centre (sub-metacentric)



- Near End Acrocentric



- Telocentric at the end
  - not in Humans.

→ Satellite (SAT-chromosome)

→ Secondary Constriction / NOR (Nuclear organiser Region)

↓

Nucleolar chromosome (chromosomes having NOR)

13, 14, 15, 20, 21 — In humans

Primary constriction

- nucleolus is known as ribosome factory.

NOR

↓

13, 14, 15, 20, 21

↓ form

nucleolus

→ Membrane ✗

→ Ca^{+2} (maintenance) of nucleolus

Ribosome factories

Date __/__/__
Page

Similarity of mitochondria with Bacteria

1. Porins
2. Ds DNA - circular
3. self replication → binary fission
4. Porins

=> Bacterial endosymbionts.

- Bundle sheath cells of C_4 plants have agranal chloroplast.

  Hence C_4 plants have both granal and agranal condition.

- Initiation of glycosylation occurs in the cytop. Rough endoplasmic reticulum but termination occurs in golgi bodies.

- cytochrome P450 cause conversion of lipid soluble compounds to water soluble compounds through hydroxylation, to be excreted through kidney.

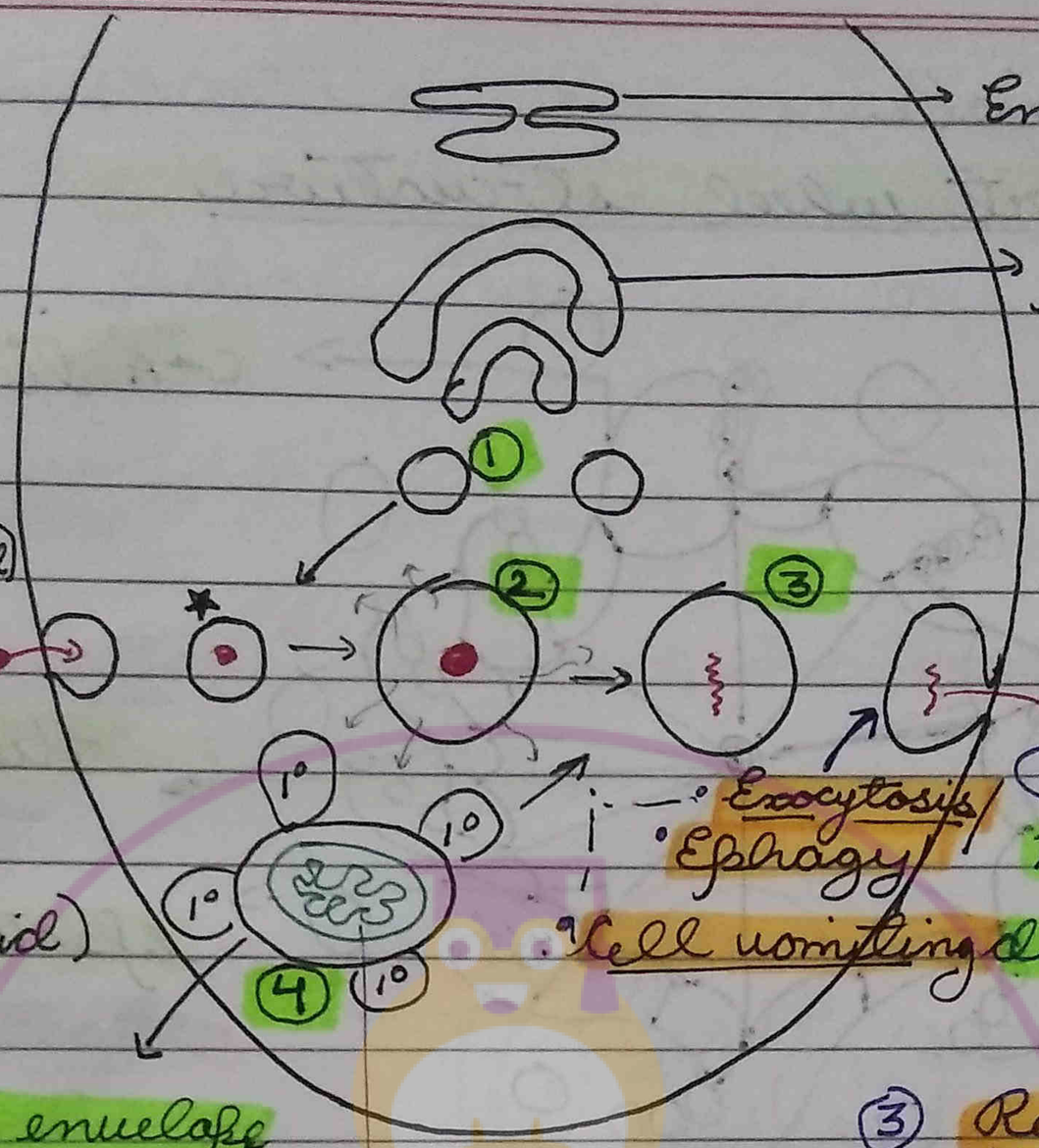
• Lysosomes allow the movement of simpler substances but ~~not~~ the complex ones.

Date ___/___/___
Page _____

Endocytosis

• ★ Food (cell eating) → Phagosomes (solid food)

• ★ Liquid (cell drinking) Pinosomes (liquid)



① Primary / Virgin lysosome

② Secondary / Heterophagosome / digestive vacuole

③ Residual vacuole / Telo lysosome : undigested material

★ P, Y, Q

④ Autophagosome / Autolysosome / Cytolysosome.

∴ Lysosome can exist in more than one form, it shows ∴ Polymorphism.

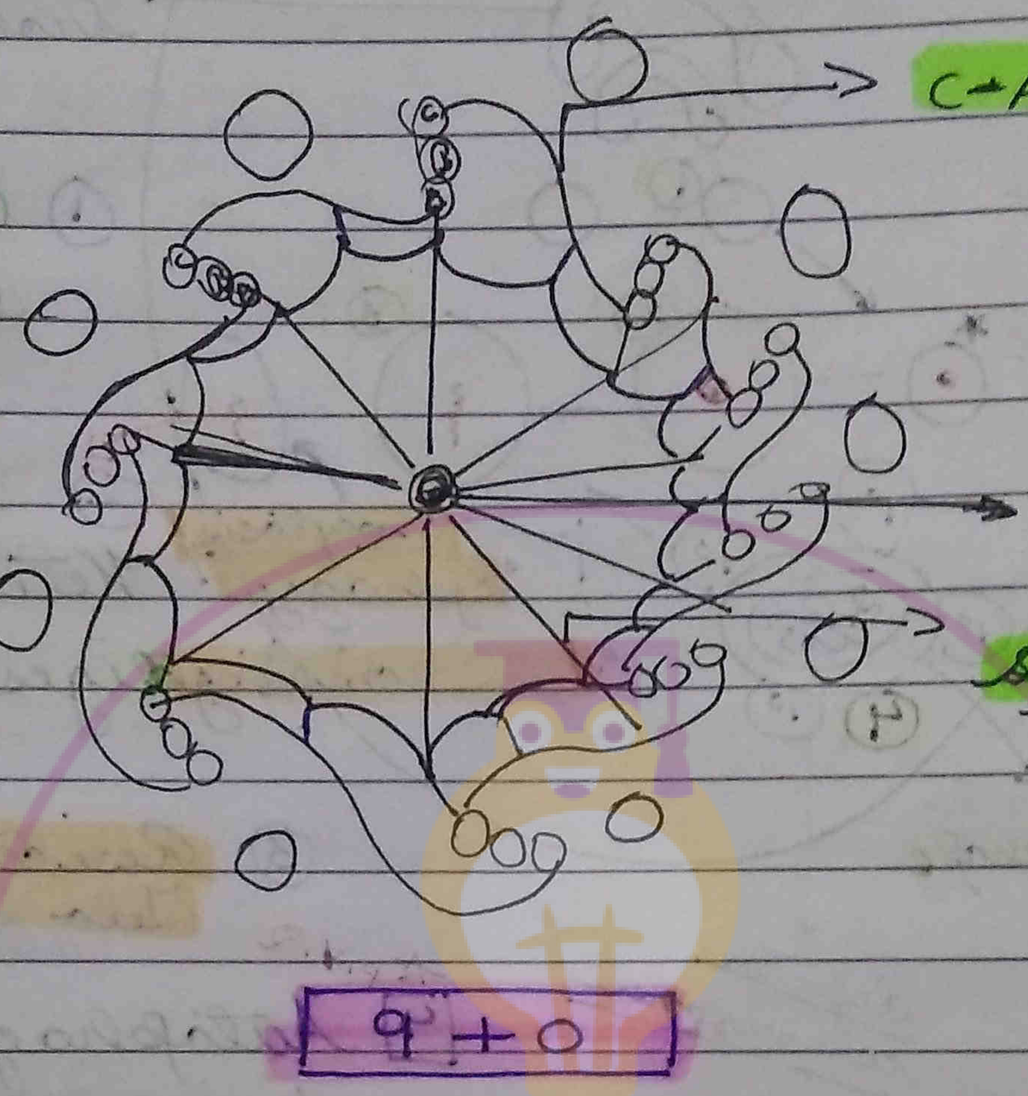
• With increase in age no. of lysosome will increase but no. of mitochondria will decrease.

• Exocytosis = Ephagy = cell vomiting.

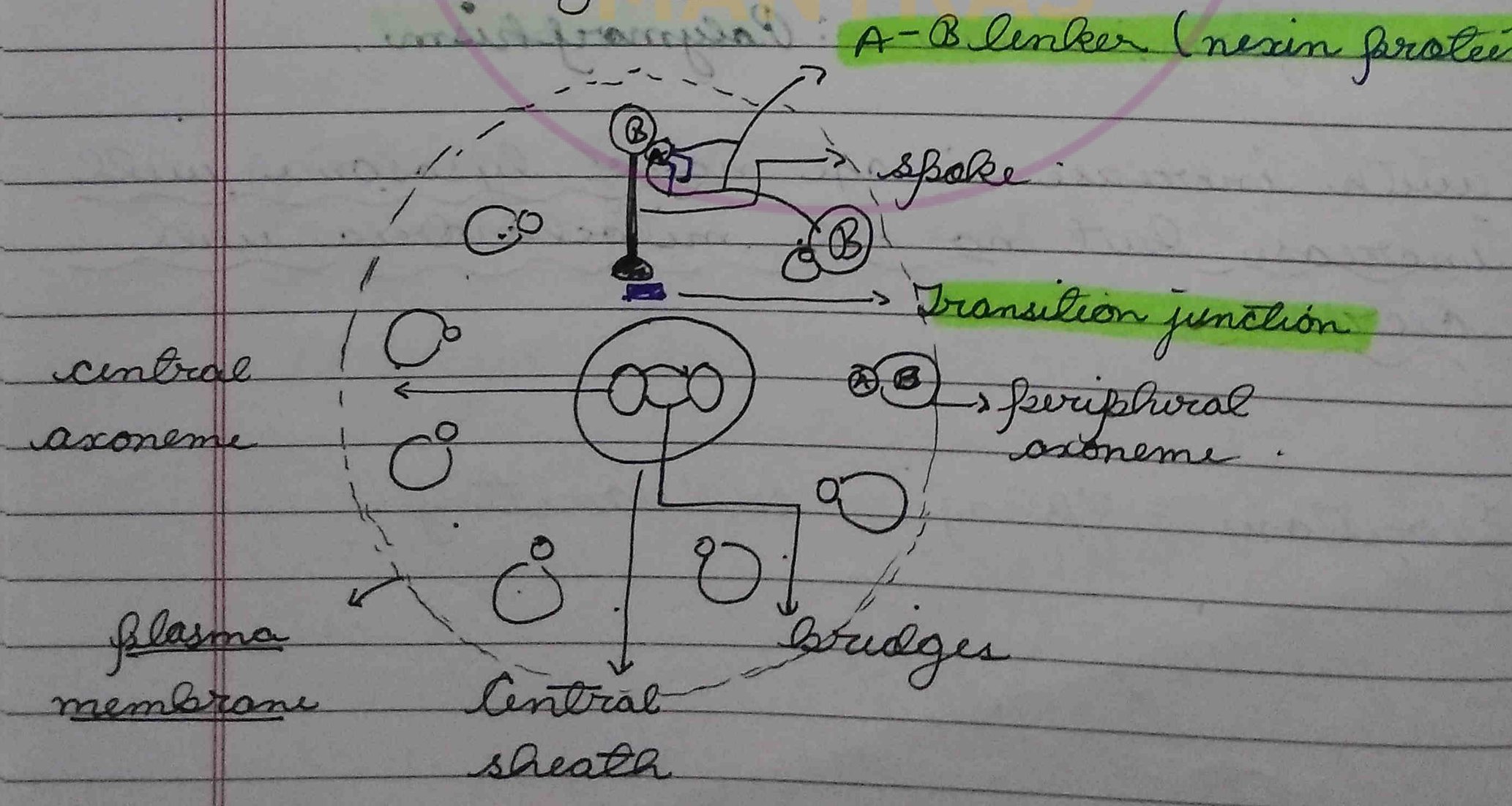
MTOC : Help in ☆ New centrioles will arise from Masules / Satellite

Centriole

→ cart wheel structure



Cilia Flagella

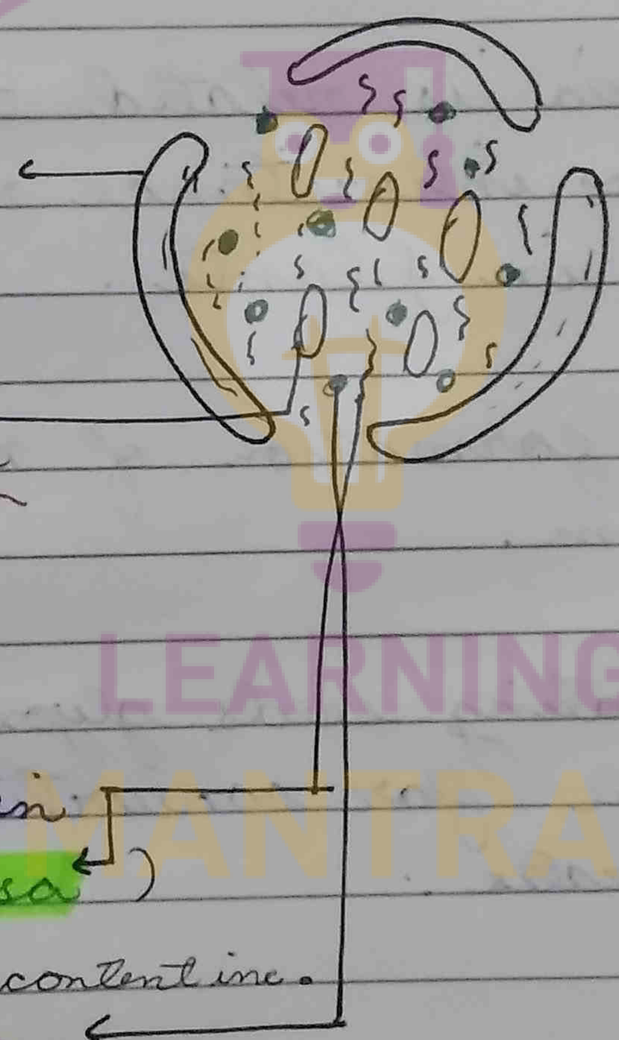


animals contain two non-membranous organelles i.e centriole and ribosome whereas plants have only one i.e ribosome

- Nucleolus (Ribosome factories)

non-membranous

- Perinucleolar chromatin
- Intranucleolar chromatin



DNA
↓ forms
rRNA + protein
(Pars Fibrillosa)
↓ protein content inc.
Pars granulosa
↓
Ribosomal Subunit.

☆ Ribosomes of nucleolus are non-functional.

- Protein factory = ribosome
- Ribosome factories = nucleolous

Date ___/___/___
Page ___

- Janus Green stain is used to observe mitochondria.

- Ideogram → photographic / diagramatic representation of karyotype of a species.

- Hemicellulose is absent in bacteria? algal cell wall.

- Mitochondria is related to maternal / cytoplasmic inheritance related to male sterility in plants.

- Maximum formation of mRNA occurs in nucleoplasm.

- In germinating seeds glyoxysomes are responsible for converting fats into carbohydrates.

☆ In maturing fatty seed sphaerosomes are responsible for ~~converting~~ forming fat.