

# Cell:

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## Intro:

Fundamental unit of life → structure and function

## Discovery:

→ microscope invention, 1595

→ 1665 → R. Hook → coin cell.

↳ cork slice → tiny compartment

↳ Non living "microphagia"

→ 1667 → A.V. Leuwenhoek

↳ pond water → "Animalcules" → tiny crea

1805 → L. OKENZ

1809 → J.B.D Lamark } living organism → cell.

1881 → Robert brown → discovered nucleus in cell.

## Cell Theory:

→ M. Schiellen and J. Schawon

→ All living organisms → cell

→ Cell → structural and functional unit

→ cell → metabolism

→ Cell → genetic material

→ Cell → Divide → cell "Omnis cellula and cellula"

## Drawbacks:

→ First cell → origin?

→ Virus, viroids and prions!

→ Wood cells / xylem cells

→ RBC's → Don't divide.

## Structure:

### Generalized cell

↓  
Cytoplasm

↓  
organelles

↓  
Nucleus  
↓  
genetic material

P.M  
↓  
Cell wall

Eukaryotes

Prokaryotes

Prokaryotes		Eukaryotes
Flagella	Flagella	Tubulin
X	Nuclear envelop	✓
X	Nucleus	✓
✓	Nucleolus	X
X	Genetic material	enclosed
X	Chromosomes	✓
X	Histones proteins	✓
Circular	DNA	Linear
1000-2000	Okazaki fragments	100-200
1	DNA polymerases	3
TTGACA	Promoter	CAAT
TATAAT		TATA
X	Introns	✓
X	Post Trans modification	✓
1	RNA polymerase	3
Cytoplasm	Transcription	Nucleus
✓	Translation	Cytoplasm
	Pili	X
Cytogel	Cytoplasm	Cytosol + Cytogel
X	Cytoskeleton	✓
70S	Ribosomes	80S
X	Membrane bound	✓
38	ATP's	✓
X	Plasmids	36
X	Plasma membrane	✓ (yeast)
	steroids	✓
✓ (Respiratory process)	Mesosomes	X
peptidoglycan	Cell wall	cellulose or chitin
Binary fission	Division	Mitosis, meiosis
3.5 billion	Origin	1.2 billion
less	Complexity	more
Small	Size	large
bacteria, archae	Example	plants, animals
cyanobacteria		

# Eukaryotic cell

Plant

Animal

✓	Cell wall	X
✓	Plastids	X
X	Cytoskeletons	✓
Spindle fibers	Mitotic Apparatus	Spindle fibers + Aster
✓	Phragmoplast	X
Cell plate	Division	Cleavage furrow
Autotroph	Mode of Nutrition	Heterotroph
Larger	Size	Smaller
Rigid		Soft
Central large	Vacuole	many and small
Peripheral	Nucleus	Central
Starch	Storage	glycogen
X	Phagocytosis	✓
X	Cilia	✓
X except <sup>sperm</sup>	Flagella	<del>X except</del> ✓ sperm cell

# Cell Wall: → extracellular

→ Outermost covering → plant

→ Absent → Animals b/c animals do locomotion.

→ Secreted by protoplasm

→ Non-living and permeable.

→ Prokaryotes → peptidoglycan → Single, 1<sup>st</sup> layer

→ Fungi like → cellulose → True cell wall → present in all.

Plant like → Cellulose → Cellulose → Cellulose fibers

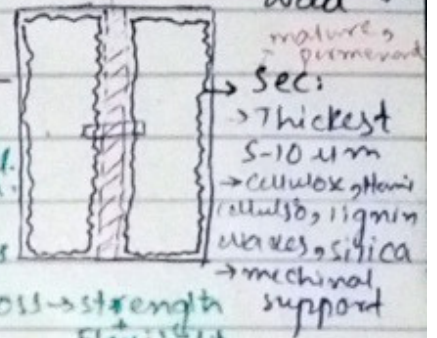
→ Plants → Cellulose

→ Fungi → Chitin

→ Elastic → plastic

→ Deposition → Pectin substance.

two adjacent cells → hold  
 → 1 μm → young → non-woody  
 → middle lamella → Pectin lignin  
 → mature → lignified wood  
 → mature → pectin



→ Criss cross → strength  
 Flexibility

→ mechanical support

## Functions:

→ Specific shape

→ Toughness and rigidity

→ Protection and support

↳ osmosis

→ Apoplastic pathway

→ Imbibition

→ Cytoplasm connection

↳ plasmodesmata

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# Cell Membrane:

↳ 1<sup>st</sup> living boundary

→ Thin, delicate, elastic, flexible

→ Repairable

→ 1<sup>st</sup> membrane → Animal cell

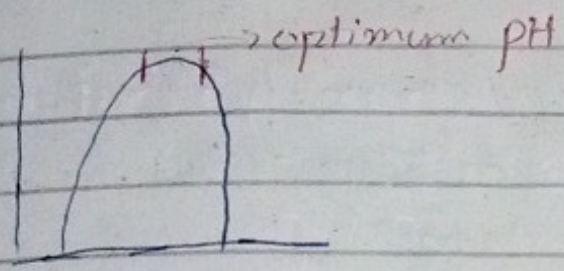
→ 2<sup>nd</sup> membrane → Plant cell

→ Surrounds → cytoplasm.

→ Barrier → controls what comes in and out.

→ Damage → Death.

pH:



Slight change  $\rightarrow$  Ionization substrate & Enzyme.

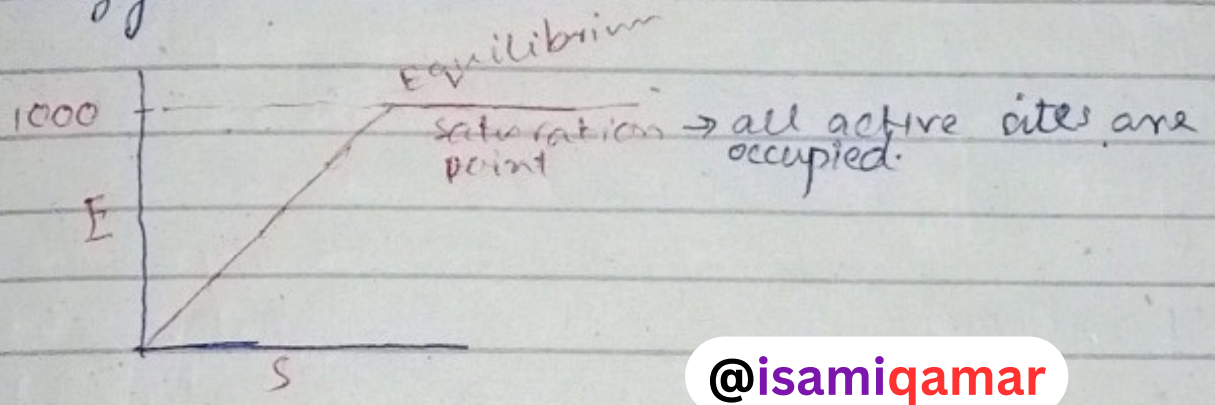
Greater change  $\rightarrow$  Denature (ionic bond)

Concentration:

Substrate:

Subs  $\rightarrow$  variable

Enzyme  $\rightarrow$  constant

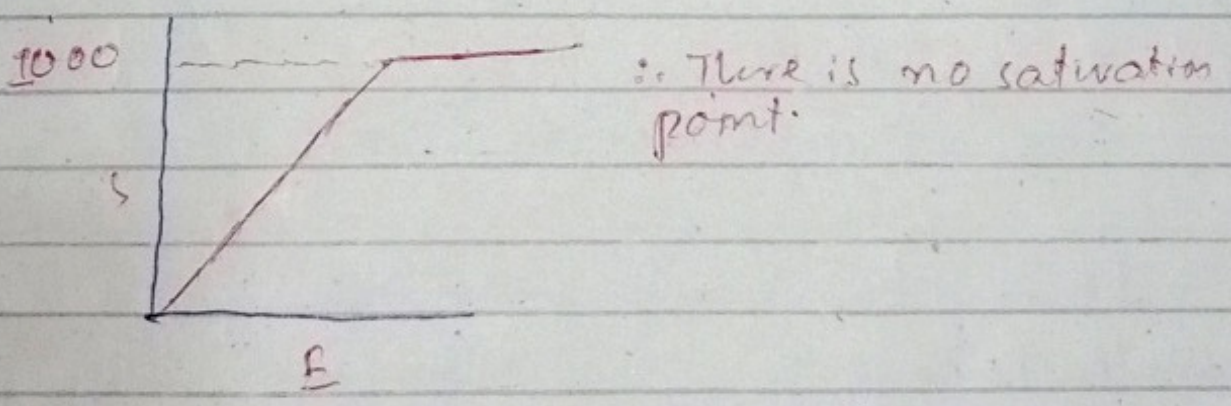


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Enzyme:

Subs  $\rightarrow$  constant

Enzyme  $\rightarrow$  variable



∴ When substrate is unlimited there will be no 'K<sub>e</sub>' or equilibrium attained.

# Composition:

## Biomolecules

### Proteins:

- 60-80%
- Globular proteins

### Lipids:

20-40%

Phospho  
→ more

→ fluidity

cholesterol  
→ less

→ rigidity

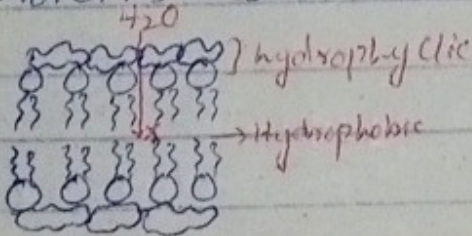
### Carbs:

- Few quantities
- Conjugate
  - ↳ glycoproteins
  - ↳ glycolipids

# Structure:

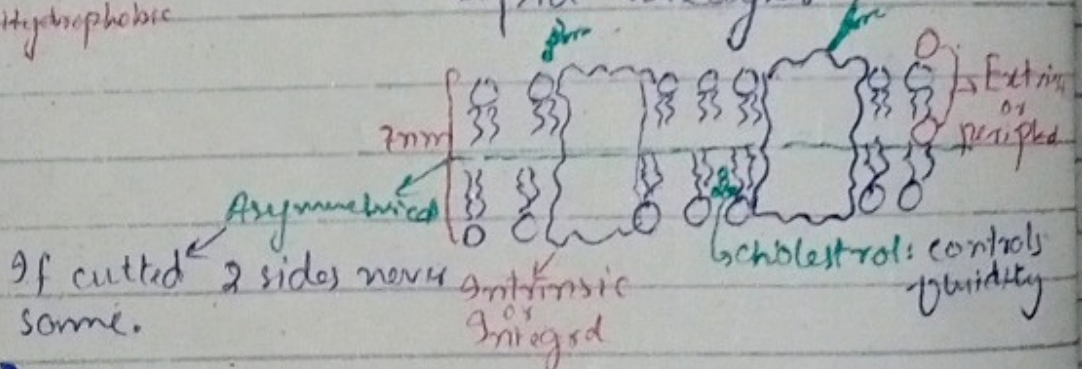
## → Unit membrane:

- Robertson
- Lipids → bilayer
- Proteins → Continuous sheet



## → Fluid mosaic

- Singer & Nicolson
- Lipids → bilayer
- Proteins → discontinuous
- Globes → embedded in lipid bilayer.



# Functions:

## → Semi permeable membrane:

- |                   |                      |
|-------------------|----------------------|
| selectively       | Differentiately      |
| → Small and large | → Small size         |
| → Charged, polar  | → Neutral, non polar |
| → Gases           | → Gases              |
| → Protein soluble | → Lipid soluble      |

## Transport:

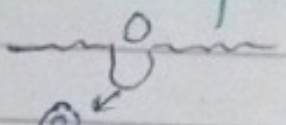


- ↳ small size
- Select
- Integral / Intrinsic
  - ↳ permeosis
  - ↳ Trans-memb

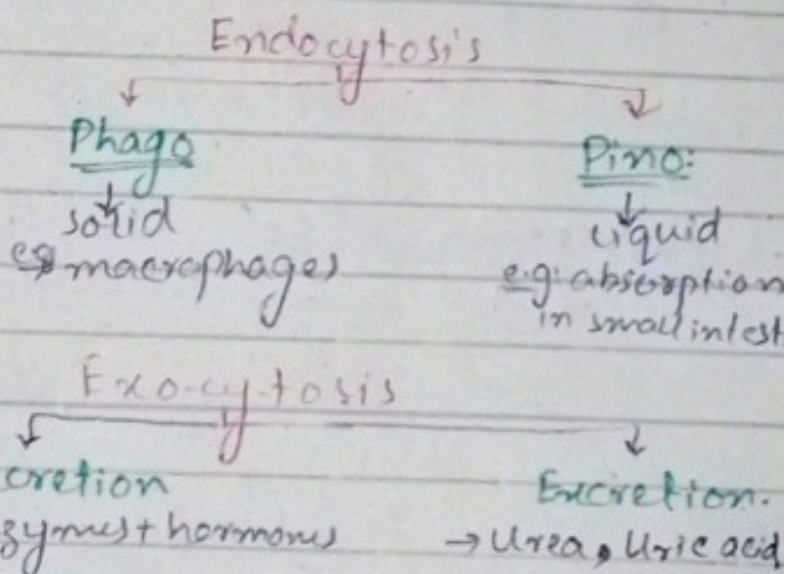
\* To pass out large polypeptides  
plasma membrane secretes  
second messengers that  
contains hormone Adenylate cyclase

→ Channel      → Carrier  
 free allow      configuration

- simple diffusion:
  - ↳ passive diffusion
- facilitated diffusion → by some proteins
- osmosis → through membrane
- Active transport → ATP
- Bulk transport:



→ inside → endocytosis  
 → outside → exocytosis



Act as defence mechanism:

- This membrane is ~~also~~ also act as a defense
  - ↳ antigens are present on its surface.

Act as receptor:

- This membrane also act as a receptor.

### Other Name:

- Sarcolemma → muscle membrane
- Neurolemma → neuron
- Cell surface membrane.

### Organelles:

\* Viruses don't have cell membrane.

Non-memb	Single	Double:
→ Ribosomes	→ E.R	→ Nucleus
→ Centrioles	→ G.B	→ Mitochondria
→ Cytoskeleton	→ lysosome	→ Plastid.
→ Nucleolus	→ Peroxisome	
→ Chromosomes	→ Glyoxisome	

# Cytoplasm: matrix of cell

cyto → cell

Location: present b/w cyto cell membrane & nuclear membrane

## Components:

Cytosol:	Inclusions	Organelles
→ soluble	→ Insoluble	→ E.R
→ 90% water + 10% salts	<ul style="list-style-type: none"> <li>storage: glycogen, starch</li> <li>waste: lipids</li> </ul>	→ G.A
<ul style="list-style-type: none"> <li>colloidal: larger salts</li> <li>True sol: small size salt</li> </ul>		→ lysosomes
		→ peroxisomes
<ul style="list-style-type: none"> <li>Sol: less dense</li> <li>→ Center</li> </ul>	<ul style="list-style-type: none"> <li>GEL: more dense</li> <li>→ peripheral</li> </ul>	

\* Prokaryotic cytoplasm have only gel.

## Functions:

- Site → metabolism
  - ↳ Glycolysis
  - ↳ Glycogenolysis
  - ↳ Gluconeogenesis
  - ↳ Translation.
- symplastic pathway.
- Cytosol: → active <sup>mass</sup> movement of organelles
- storage how



# Nucleus:

• stain of nucleus: Feulgin  
 "Brain of the cell"  
 (Karyon) → other name

• Occurrence: Eukaryotes

↳ Nucleated:

↳ Anucleated: disappear → RBC's & phloem

Mono

Bi

Multi

→ Egg

→ Hepatocytes

→ skeletal muscle cells

→ Paramecium

→ Osteoclast

## • Introduction:

Heaviest, Dense and prominent

• Size: 10 μm

• Shape: usually spherical: Irregular → WBC's

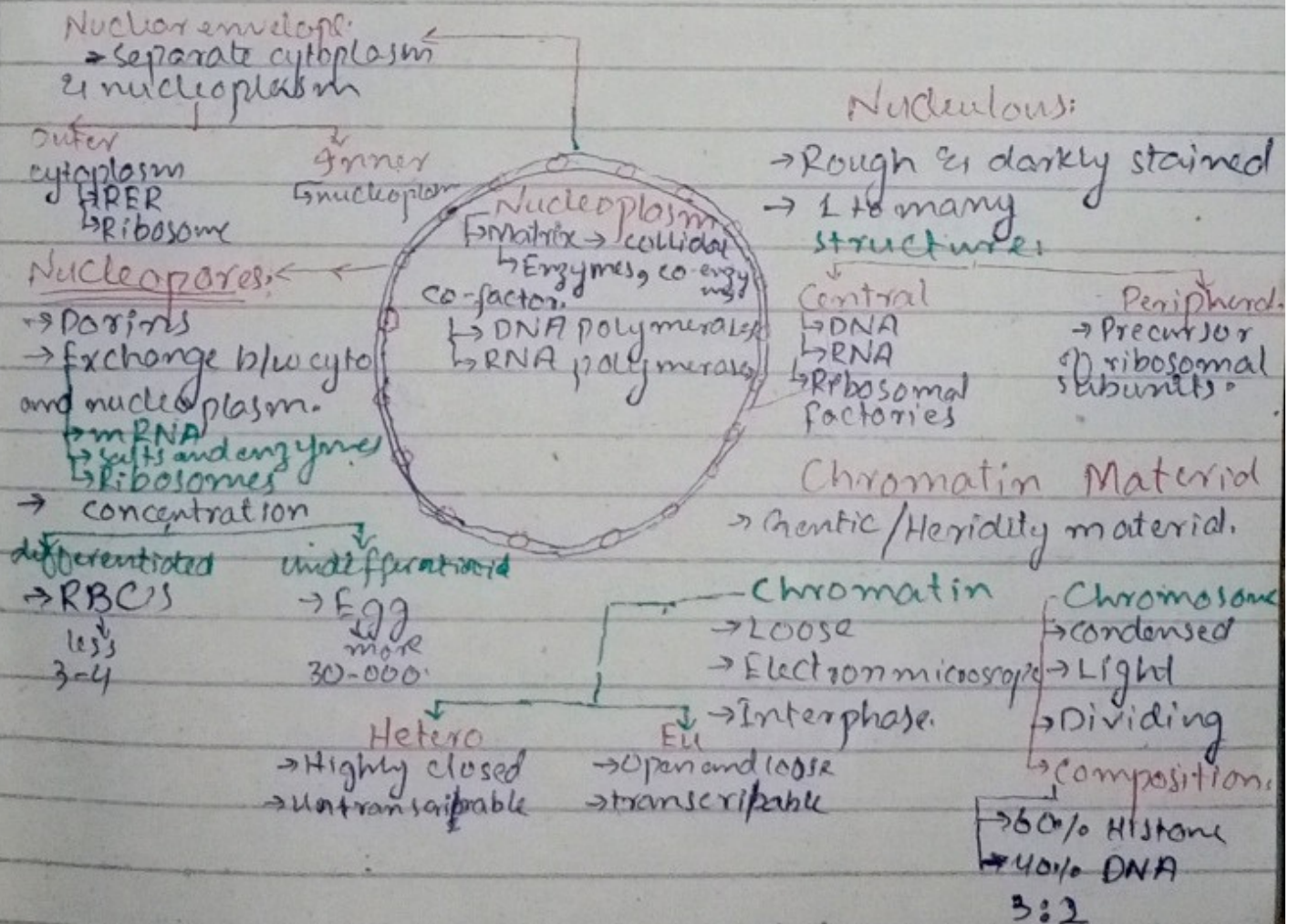
• Observation:

To observe → Non dividing stage / Interphase

## • Location:

↳ Central → Animal cell

↳ Peripheral → Adipose, skeletal muscle, plant cell



# Chromosome:

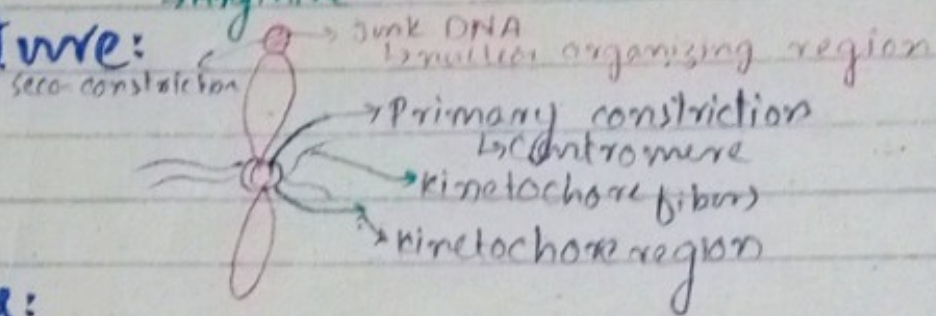
- Condensed
- Appear in dividing phase
- Can be visible with light microscope.

## Composition:

60% Histone + 40% DNA      Ratio: 3:2

Basic a.a  
↳ Lysine } +ve  
↳ Arginine }  
PO<sub>4</sub><sup>-2</sup>  
↓  
-ive

## Structure:



## Types:

On the base of centromere position:

- Meta centric → center
- Sub meta → Near to center
- Acro → Near to end
- Telo → At the end.

## Number:

↳ Specific to species.

- Drosophilla → 8
- Frog → 26      Haploid: n
- Human → 46      Diploid: 2n
- Chimpanzee → 48
- Pigeons → 80
- Pea plant → 14
- Onion → 16
- Potato → 48

Mechanical support

→ Animal: cytoskeleton + R.E.R

→ Plant: Cell wall, R.E.R, cytoskeleton

# Endoplasmic Reticulum:

Nuclear Envelop  
↓  
Plasma membrane

Endo → inside

plasmic → cytoplasm

Reticulum → Network.

"Network of interconnected channels."

## Morphological Forms:

Cisternal

- Parallel arranged
- Flattened sac
- Lamellar form

→ ribosome  
→ lumen

Tubular

- Tiny tubules
- Away from nucleus

Vesicular

- Tiny vesicles
- B/w E.R and G.A.

## Types:

RER:

→ ✓

→ Cisternal

→ Towards nucleus

\* Translation

RER of neuron is called → Nissl granules

\* Mechanical support

Ribosome

SER:

→ X

→ Tubular

→ Away from nucleus

\* Lipid metabolism

\* Cholesterol

→ Testosterone

→ Estrogen

→ Progesterone

\* CARB's metabolism

\* Detoxification

\* Transportation

\* Ca<sup>++</sup> storage (sarcoplasmic reticulum)  
↳ nerve impulse

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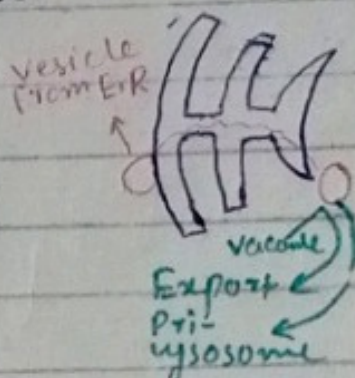
# Golgi Complex:

(Post office of the cell)

Discovered by Camilo Gorgi.

Proximal:

- Nucleus → Outer
- Convex
- Forming
- Cis



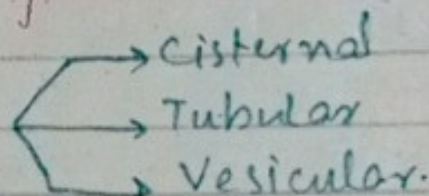
Distal

- Inner
- Concave
- Maturing
- Trans

E.R. Vs Golgi:

- lack of ribosomes
- Concave + convex
- not interconnected apparently
- not connected to nucleus

- Golgi body → Single cisterna
- Golgi Apparatus → All cisternae
- Golgi Complex → Cisterna + Vesicles.



All glands contain higher number of G.A.

## Functions:

### • Modification of molecules:

- Carbs + protein → glycoprotein
  - Lipids + protein → Lipoprotein
  - Polysaccharides.
- conjugated molecules  
↓  
"Glycosylation"

### • Storage:

### • Export

• Phragmoplast → formation of cell wall

• Acrosome

• Lysosome

• Membrane formation → cellular packaging

Enzyme formation → R.E.R. <sup>modification</sup> → G.A. <sup>secretion</sup> → Export

→ Unit of golgi apparatus is "dictyosome"

Ribosome + ER → SER → Forming face → Maturing face → Primary lysosome

# Lysosome:

soma → splitting

size:  $< 0.5 \mu\text{m}$

ph: work in acidic ph 4.5

→ spherical sacs

Origin: Originated from trans face of G.A

→ Hydrolytic enzymes: → 40 types

↳ Proteases

↳ Lipases

↳ Phosphatases

These enzymes synthesized in R.E.R and then sent to G.A for modification in the form of vesicles

Occurrence: → more than usual

→ Cells:

→ Lymphocytes & neutrophils

→ Osteoclasts

→ Sperm → Hyaluronidase

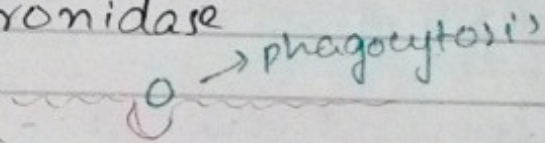
↳ Fluids:

→ tears

→ saliva

→ sweat

→ lysozyme



sec. lysosome

→ phagosome

→ Hetero-phagosome

→ pri-lysosome



## Types:

→ Pri-lysosome:

↳ Inactive / fresh

→ Sec-lysosome:

↳ Active lysosome

Pri-lysosome + Food vacuole

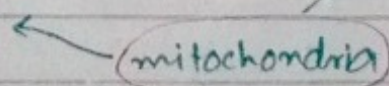
→ Ter-lysosome:

↳ Residual & waste

→ Quarternary:

↳ Autophagy

Autophagosome



This membrane comes from E.R

## Function:

→ Intercellular digestion:

RER → SER → F.F → M.F → Pri-lysosome.

→ Autophagy:

→ self eating

→ Recycle → starvation.

→ Autolysis:

→ Differentiation / Morphogenesis. <sup>change of one morphological form</sup>

→ Finger Separation

→ Tail removal

→ Tadpole → Frog

→ Apoptosis → suicidal bags (Accumulate and burst)

## Significance:

Absent → No digestion

→ storage or accumulatory disease

→ Congenital disease

→ Hereditary disease

20 types

①: Glycogenosis Type II: <sup>Absent</sup>

Glycogen  $\xrightarrow{\alpha\text{-glucosidase}}$  Glucose

Glycogen → Accumulate in liver & muscles

②: Tay Sachs: <sup>Absent</sup>

Lipids  $\xrightarrow{\text{Hexosaminase}}$  Fatty acid

lipids → myelin sheath → too much lipids will inhibit neuronal activity and in result brain retardation will occur → death.

# Vacuole

→ specialized vacuoles perform the function of lysosome

vacus → empty

→ Spherical sac

Origin:

- G.A
- E.R
- P.M

Membrane: single

Occurrence:

## ① Animals:

→ Small and many

→ Paramecium → Contractile vacuole

## ② Plants:

→ Meristematic: Absent

→ Young: Small

→ Mature: Single large vacuole.   
 Coalesce: many small vacuoles forms large vacuole.

# Ribosome:

→ 50% RNA + 50% Proteins.

Formation:

Nucleolus  $\xrightarrow{\text{Transported}}$  Cytoplasm

Forms:

Free

Attached.

RER

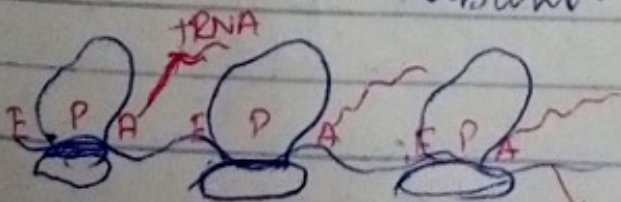
Structure:

Larger subunit.

$Mg^{++}$

Smaller subunit.

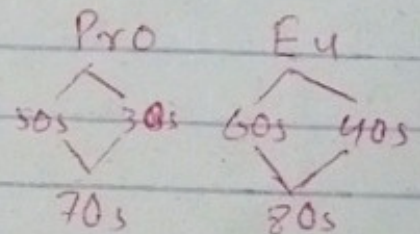
Translation.



Polysome: many ribosomes on mRNA.

mRNA

How many proteins will form from polysome?  
protein No. of ribosome



# Mitochondria: (Endosymbiotic organelles)

mito → thread

chondrion → Granules

Occurrence:

Aerobic Eukaryotes

Significance:

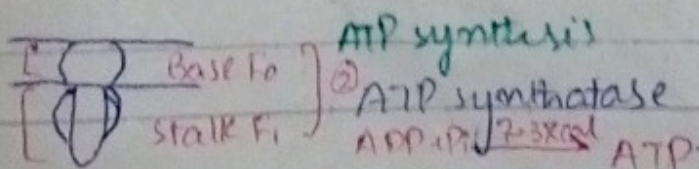
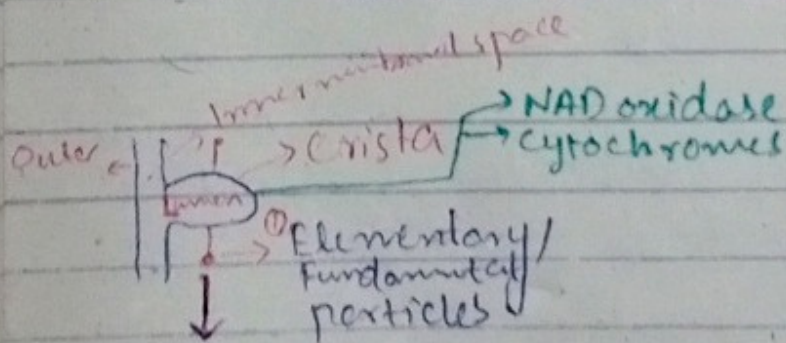
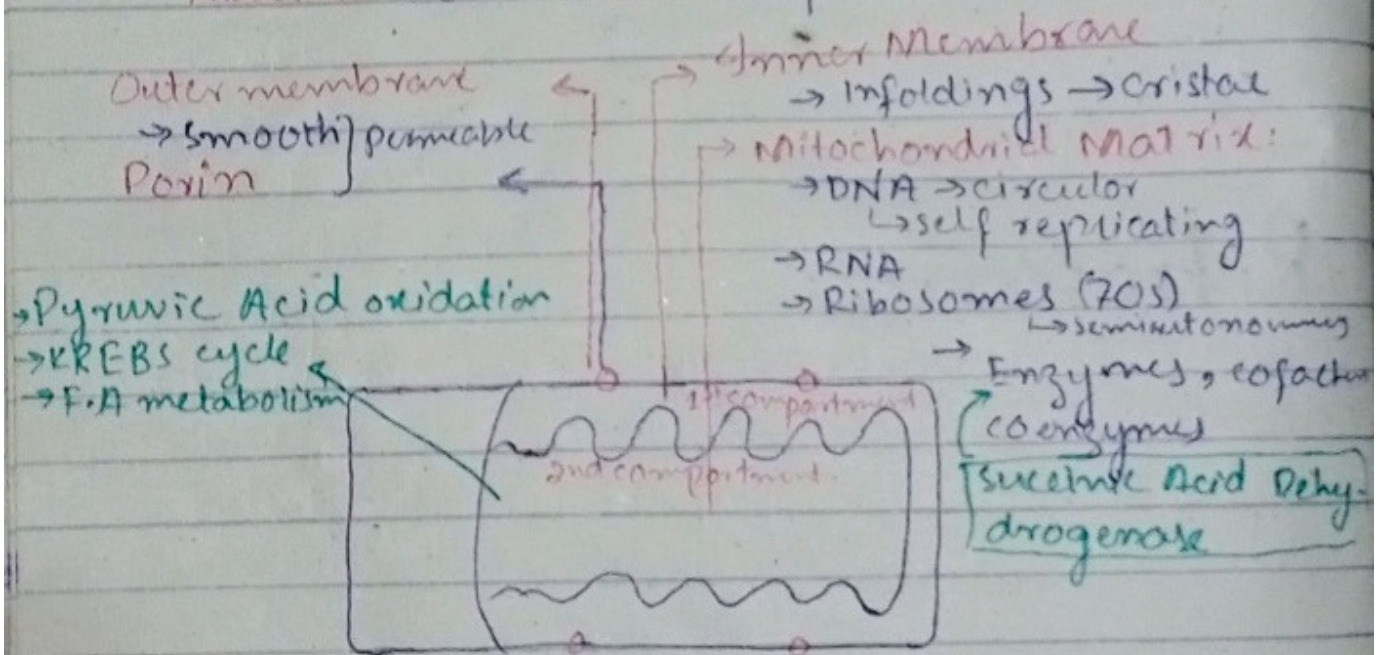
Cellular Respiration

Shape:

Round, Oval : spiral → sperm

Presence/Number:

Absent: RBC's    Less: Adipose tissue    More: Muscle



③ Oxysomes  
↳ oxidative phosphorylation



# Plastids:

Occurrence:

Plant's and algal cell

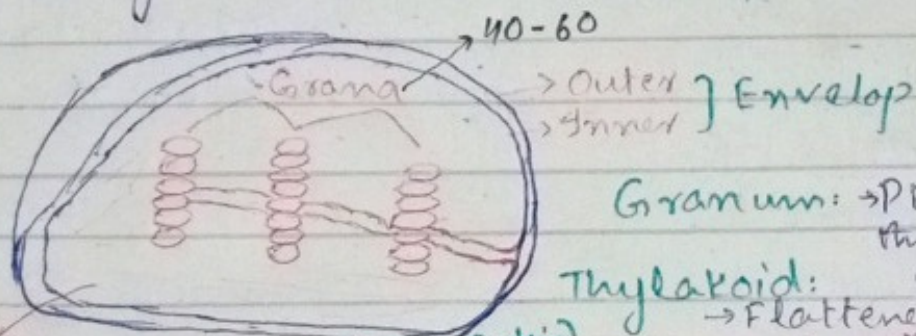
Proplastids:

↳ Immature Plastid (meristematic tissues)

↳ **Chloroplast:** (Endosymbiotic organelle)

↳ Green Colour

→ mesophyll cells → 20-100 chloroplast



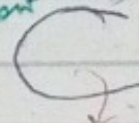
Stroma:  
(matrix)

- DNA (circular) → self replication
- RNA + Enzymes + co-enzymes
- Ribosome 70S → Semi-Autonomous

↳ Dark reaction

- ↳ Carbon Fixation
- ↳ Reduction
- ↳ Regeneration

Rubisco (most abundant protein)



Lumen:

- ↳ photolysis
- ↳ H<sup>+</sup> Accumulate

Granum: → Pile of Thylakoid.

Thylakoid:

- Flattened sacs.
- ↳ Thylakoid membrane:
  - ↳ Pigments
  - ↳ Light → capture
  - ↳ Z-scheme

## Functions:

- Green Colour
- Photosynthesis
- Storage of starch
- Stroma synthesis (ATP)
- Evolution of O<sub>2</sub> (photolysis)

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