Biology

Unit - 03

CELL : STRUCTURE AND FUNCTIONS

8. Cell : The Unit of life

★ Cell – Cell is the structural and functional unit of life.

- Cell (Derived) from "Cella" = meaning = Hollow Space.
- 1st time Cell Seen by – Robert Hooke (1665).
- Study of Cell is Called Cytology.
- Only Structure and function –

★ In recent time Study of Cell is not enough with Structure and function but now we have to Study whole function related to Cell like –

Structure | function | Physiology | Biochemistry | Reproduction | Digestion.

So, Now Study of Cell is Cell - Biology.

★ How Cell is Structural Unit of life ?

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Structural Organisation

Cell
↓
Cells/Tissue
↓
Organ
↓
Organ System
↓
Organism

We Can See here =

- from Cell – group of Cells formed (i.e. Tissue)
- from Tissues – Organ
- from Organ – Organ System
- from Organ System – Organism

Ultimately from Cell – Organism formed.

★ How Cell is functional Unit of life?

For live a Cell he has to perform (Physiological; biochemistry; genetics; & other metabolic functions).

Like – Respiration
Digestion
Reproduction
Absorption – Excretion

- All the Organism are made up of Cell and Cell products.
- Cell is the basic Structural and functional Unit of life.
- Or, Cell is the fondamental Unit of

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an Organism.

- Or. Cell is the building blocks material of Organism.

★ On the basis of number of Cell Organism Classified in to two group —

1. UNICELLULAR ORGANISM
2. MULTICELLULAR ORGANISM.

- Unicellular Organism — Organism Composed of Only One Cell.

Ex :- Monera kingdom — Bacteria.
Protista kingdom etc.

Unicellular Organism Specification -

- Organism should have independent existence.
- Organism should be able to perform all his essential activity by self for Survival of his life.
- Less than a Cell Can't Consider a uni-Cellular Organism.

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• Multicellular Organism — Organism Composed of two or more than two Cell.

Ex:- Plant, animal, fungie etc.

★ Discovery

* Cell discoverd by — Robert Hooke (1665) Using microscope
(i.e. – Robert Hook is father of CYTOLOGY).

* Written Book "Micrographia".

* Anton Von leeuwenhoek (Dutch Scientist) first Saw and describe a live Cell (1674) in Algae – Spirogyra.

(i.e. father of microbiology – Anton Von leeuwenhoek).

* later on he Studies live Cell of RBC, Sperm Cell, Muscle fiber etc.

* Robert Brown (Scottish Botanist) later discover the 'NUCLEUS' in Orchid (1831/1833).

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CELL THEORY :

★ In 1838 Matthias Schleidon (German Scientist botanist).
Book – "Contribution to Our knowledge of phytogenesis."

★ 1839 Theodore Schwann (British Scientist Zoologist / Physiologist) together given the Cell theory.
– Copley medel (1845).

According to Cell theory :-

1. All living Organism are made up of Cell or Cell products.

2. Cell is the Structural and functional Unit of life.

? But they were fail to explain :- How new Cell arrises.

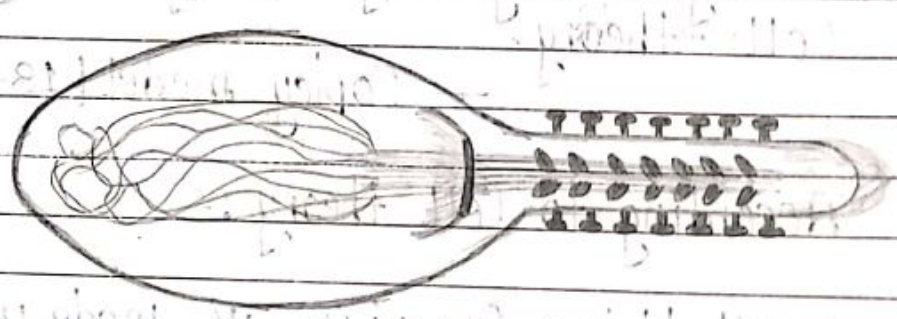
In 1855 Rudolf Virchow explain after lots of experiment and observation that – "Omnie-Cellula-e-Cellula."

Meaning is :- A new Cell arrises from pre-existing Cell by the Cell division.

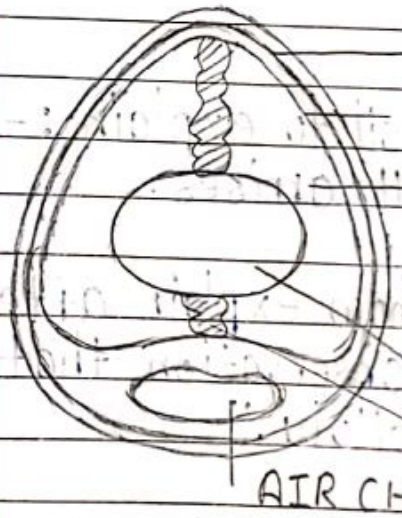
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Cell Size & Shape

- Cell size ranges from – 0·3 micrometere – 0·7 micrometere (μm).
- **Smallest Cell** – Mycoplasma / pplo (Pleuro (Pneumonia like Organism) / mycoplasma gallisepticum (0·3 mm).



- **Biggest Cell** :– Ostrich Egg (3 inch Without Cell).

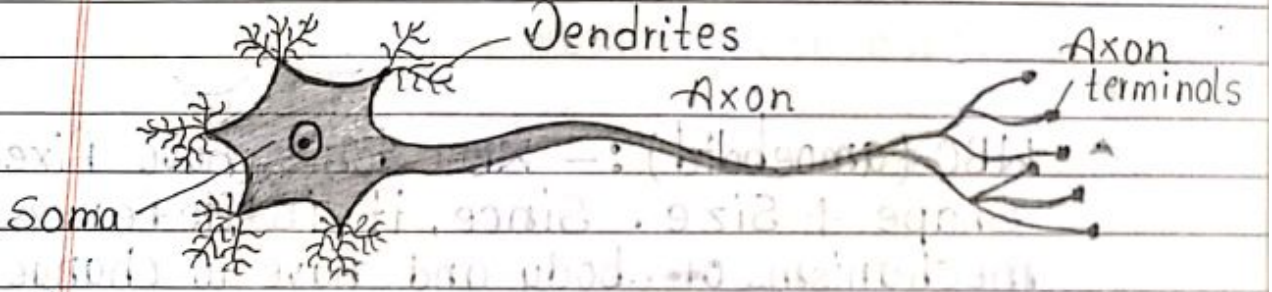


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> Largest Cell — Nerve Cell (neuron)

> Human Red blood Cells are about 7.0 µm in Diametere.



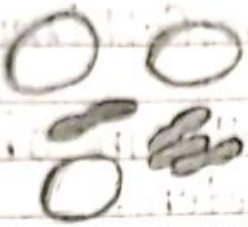
Shape :—

> Shape of Cell is related to its position

- flat in Surface Cell
- Polygonal in Cortex
- Round & Biconcave of blood Cell
- Long & Narrow — Columnar Epithilum
- Round & Oval — Mesophyll Cells
- Elongated — Tracheid.
- Branched & long — Nerve Cell.

★ RBC (round & biconcave) :- Since it has pass through blood Capillary and Can Carry maximum number of Oxygen that is Why blood become biconcave.

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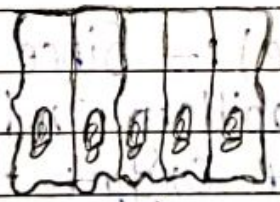
Red blood Cells
(round and biconcave)

* WBC (amoeboid) :- WBC don't have fixed Shape & Size. Since, it is defence mechanism of body and have to change their shape according to ~~faccocysts~~ (Bacteria and Virus). Phagocytosis



White blood Cells
(amoeboid)

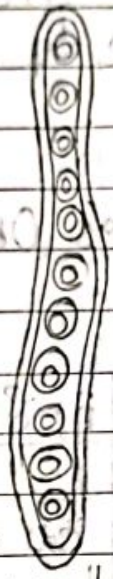
* Columnar epithelial Cells (long & narrow) :- According to Cell Surface and position.



Columnar epithelial Cells
(long and narrow)

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★ A tracheid (elongated) :- Used in xylem and phloem.



A tracheid (elongated)

★ Mesophyll Cells (round and oval) :- Since activity envolved in photosynthesis.

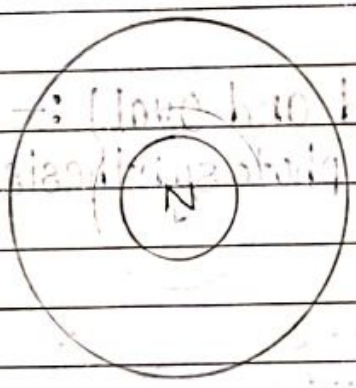
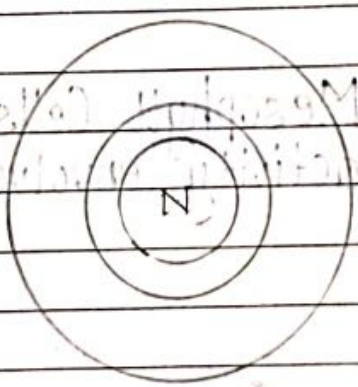


Mesophyll Cells (round and oval)

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Cell having some particular shape like - Polygonal, disc-like, Columnar, Cuboid, thread like or even irregular also. Cell shape may vary due to function they perform.

★ Cell is the two types On the basic of nucleus :—

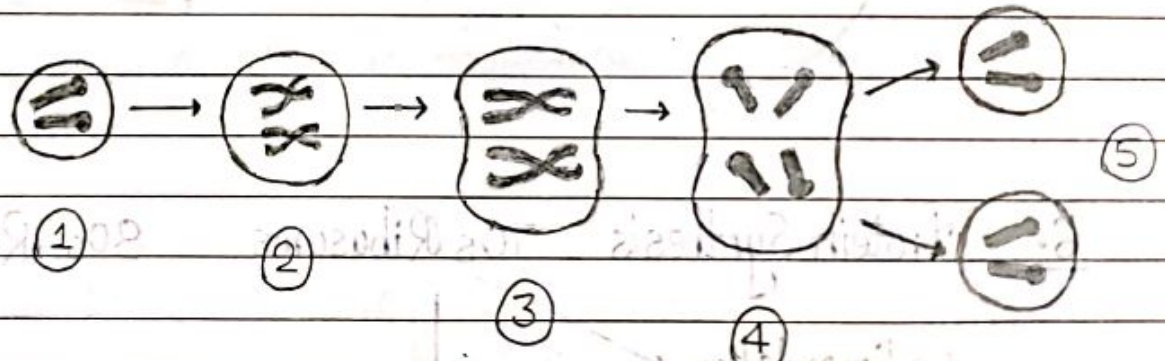
i) Prokaryotic Cell	ii) Eukaryotic Cell
Pro - Before primitive karyotic - Nucleus	Eu — True karyotic — Nucleus
	
Membrane bound Structure is absent.	Membrane bound Structure is present. Membrane around the nucleus.
Example :- Bacteria (Monera kingdom)	Example :- Protista, fungi, plant, animal.

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> Differances between prokaryotic and Eukaryotic Organism :-

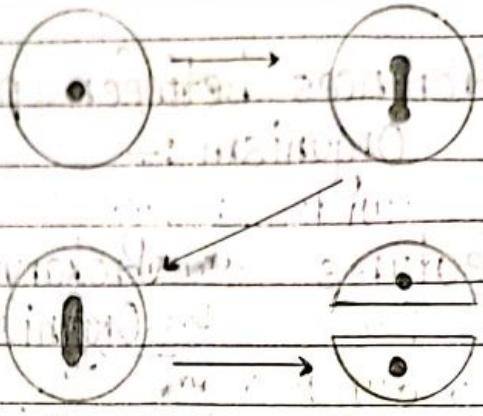
S.No	Features	Prokaryotic Organism	Eukaryotic Organism
1.	Organism	Monera kingdom – Bacteria	Protista, fungi, plant, animal.
2.	Cellular form	Mostly Uni-Cellular Ex:- Bacteria, Algae etc.	Mostly multi-Cellular except - protista.
3.	Cell Division	Mitosis, Amitosis	Mitosis, meiosis ↓ Germ Cell

Mitosis : Equational Division



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Amitosis :

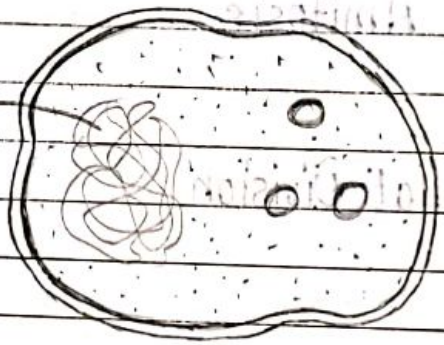


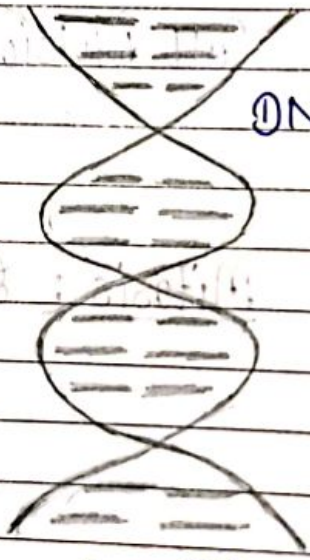
4. Reproduction — Asexual — Sexual, Asexual

5. Genetic material — Circular DNA Without Histone — Linear DNA With Histone Protein

Ordering + Packeging ←

Coiled ←





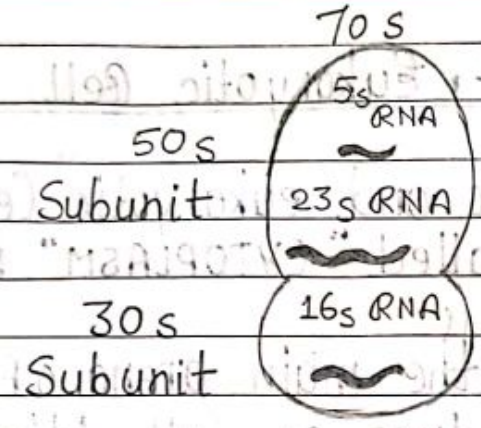
6. Protein Synthesis — 70s Ribosome — 80s Ribosome

Sedimentation Coefficient ←

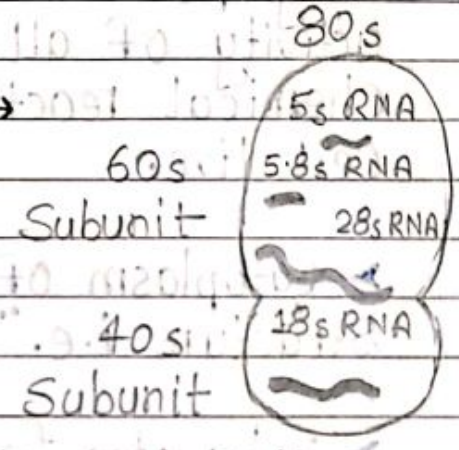
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Prokaryotic Ribosome

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Eukaryotic Ribosome →



7.	Cell Wall	Peptidoglycon/ muramic acid	fungi – chitine Plant – Cellulose
8.	Respiration	Mesosome	mitochondria
9.	Photosynthesis	No choloroplast	Within Cholorophst
10.	N_2 fixation	Some Bacteria	None
11.	Organells	No membrane bound	membrane bound

Note :-

Histone protein :- Ordering and packeging of DNA.

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Prokaryotic & Eukaryotic Cell

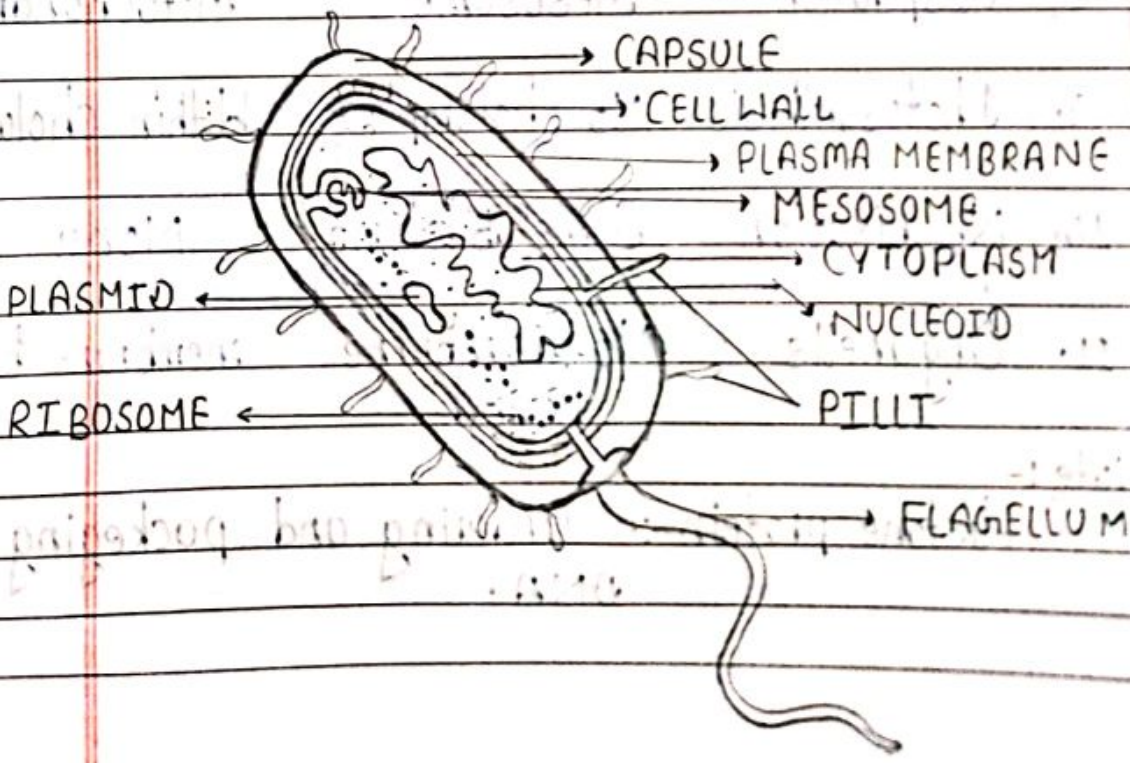
➤ In prokaryotic and eukaryotic Cell Semi-fluid matrix Called "CYTOPLASM" found.

➤ Cytoplasm is the main arena of Cellular activity of all type of Cell, Where Various chemical reaction take place to keep the Cell live.

➤ Cytoplasm of Cell having Various distinct Structure i.e. "Cell-Organells" found.

➤ Eukaryotes have more Cell-Organells then prokaryotic Cell.

★ Prokaryotic Cell :



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Different type of Cell Organells are found in prokaryotic Cell that —

1. Cell – Envelope
   i) Glycocalyx
   ii) Cell – Wall
   iii) Cell – Membrane
2. Flagella
3. Fimbriae & pilli
4. Mesosome
5. Nucleoid
6. Plasmid
7. Ribosome
8. Inclusion Body
9. Chromotophore.

CELL – ENVELOPE

➤ Cell Envelope is Outermost Covering of prokaryotic Organism like bacteria.

➤ It is a Complex chemical Structure which is Combination of —

- Glycocalyx — Outermost
- Cell Wall — middle layer
- Cell membrane — Inner most.

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➤ All three layers have distinct function.
➤ They act together as a

- Protection to the bacterial
- Structural Integrity
- Transportation.

▣ Glacocalyx

- Glacocalyx is outer most Covering of prokaryotic Cell and bacteria.
- It provide protection from other ~~facco~~ cy~~sts~~ and other foreign Organism. Phago-cytes
- It is a discontinuous structure.
- It is sheathe in nature.
- It is made up of poly-peptide and poly saccharide.
- Glacocalyx is gealatineous in nature.
- Glacocalyx further classified in to two type -

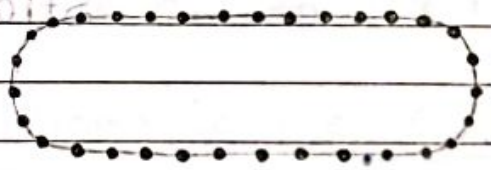
1. Slime layer: 2. Capsule

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★ **Slime layer :**

- It is outermost layer with bit flexible.
- Their sheath layer is thin and discontinued due to this they can't protect from host immune system much time.
- Slime layer type mostly found in Gram+ Bacteria.



Slime layer

★ **Capsule :**

- It is outermost layer and not flexible.
- Their sheath layer is thick and Continued which protect from host immune system more time.
- Capsule layer mostly found in Gram – Bacteria.



Capsule

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Slime layer (found in Gram+ Bacteria)	Capsule (found in Gram-Bacteria)
→ Provide protection	→ Provide protection
→ discontinuous	→ discontinuous
→ Loose sheath	→ Hard sheath
→ Composed of poly peptide and poly Saccharide.	→ Composed of poly peptide and poly Saccharide.
→ thin and less Strength.	→ thick and Very Strong.

▣ Cell Wall

- It is provide protection and shape to the prokaryotic cell.
- Cell Wall of prokaryotic Cell is made of peptidoglycon / muramic acid / murein / mucopeptide.

Peptidoglycon

Polypeptide (Protein)	Polysacchride (sugar)
• Made up 4 type of Amino Acid.	• Made up of

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1. L-Alanine
2. D-Alamine
3. L-Lysine
4. D-Glutamic Acid

1. Glucose
2. Glactose
3. mannose

With two Amino Sugar

1. NAG - N - Acetyl Glucosamine
2. NAM - N - Acetyl Muramic Acid.

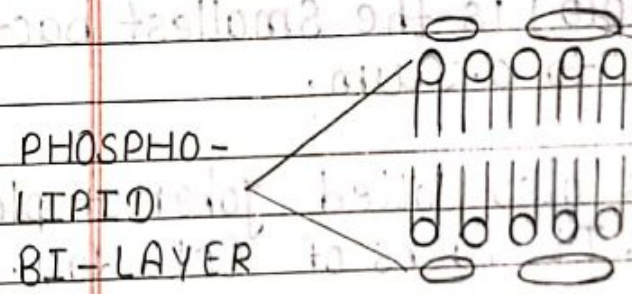
- Mycoplasma (pplo) is the smallest bacteria having size 0.1 to 0.3 um.
- Mycoplasma is also called joker of plant kingdom since, It lacks of cell wall.
- Bacteria is sole member of prokaryotic cell.

▣ Cell membrane

- Cell membrane is the common connection between all type of cell.
- Cell membrane is also called — Plasma membrane, Bio-membrane, plasmo lemma.
- Cell membrane is made up phospholipid and protein.

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- Cell membrane is made up phospholipid and protein.
- Cell membrane is thin, flexible and living cell organells.
- Cell membrane shows elasticity and flexibility.



- Same type of cell membrane found in all living organism.
- Cell membrane is "Selectively permeable" structure.
- Cell membrane perform transportation.

➤ Type of Permeability :-

i) Permeable membrane
ii) Impermeable membrane
iii) Semipermeable membrane
iv) Selective permeable membrane.

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Permeable membrane :- Membrane through which everything can cross.

Impermeable membrane :- Membrane through which nothing can cross.

Semi permeable membrane :- Membrane through half of the material cross by their characteristics.

Ex :- In a Water Solution Sand, Sugar, Salt is present. In which Only Water Soluble material can cross.

Selective permeable membrane :- Membrane through which Only Selected material can cross the membrane.

Ex :- In a Water Soluble mixture Only Selected Soluble material can cross.

★ Staining of Bacteria :- Why

➤ Based On differences in Cell - Envelope / Cell Wall bacteria is Classified in to two group.

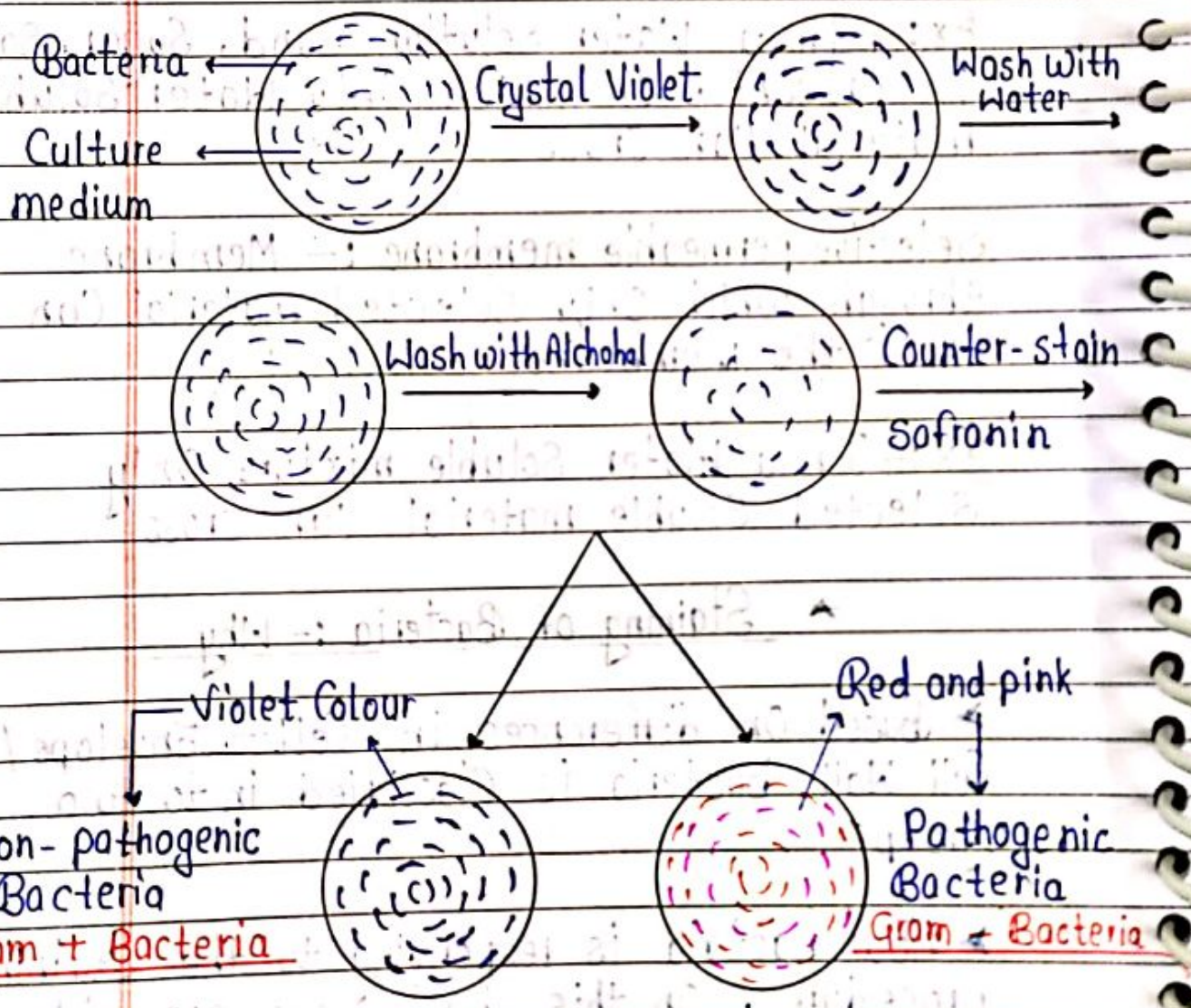
➤ How bacteria is responding to the staining procedure, On this basis we are able

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to know which bacteria is pathogenic (Disease causing) and which one is Non-pathogenic (Not disease causing).

➤ Developed by :- Christian Gram.

➤ Result :- Some bacteria are pathogenic & some are non-pathogenic.



i.e. Not disease causing Bacteria.

i.e. Disease causing Bacteria.

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- The bacteria which cause disease or pathogenic bacteria consider Gram negative (−) bacteria.
- The bacteria which are non-pathogenic are consider Gram positive (+) bacteria.

* Difference between Gram + & Gram − bacteria −

Gram +	Gram −
• Cell Wall arranged in longitudinaly, vertically as well as transversely	• Cell Wall arranged in either transversely or longitudinaly
	
• Thick Cell Wall With double layer.	• Thin Cell Wall With Single layer.
• Non − pathogenic	• pathogenic
• low lipid Content 1 to 2 %.	• High lipid Content 10 to 20 %.
• Ex:- lactobacillus,	• Ex:- Pneumonia etc.

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FLAGELLA

➤ Bacteria is a prokaryotic Organism that shows locomotion and movement with the help of flagella.

i.e. flagella is a locomotory Organ.

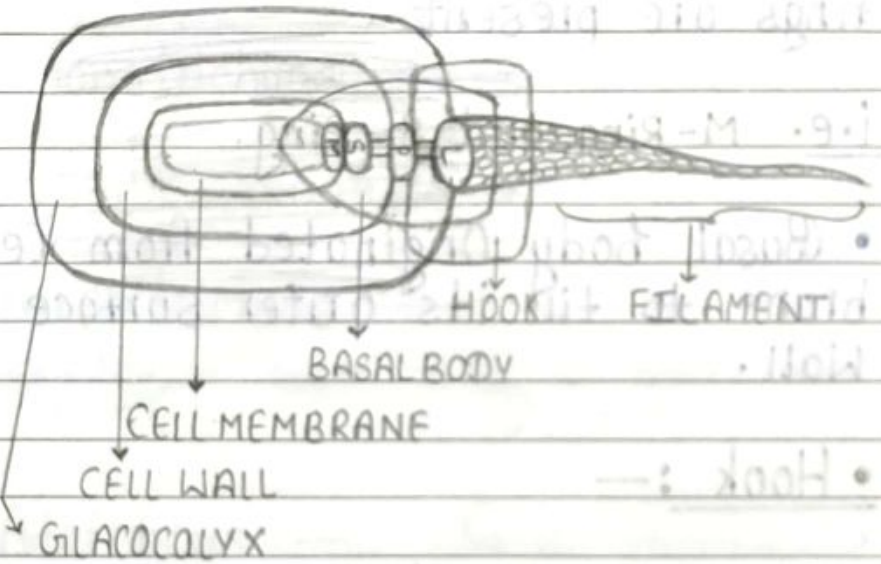
- If in a bacteria flagella is present that it is called flagellated bacteria and motile bacteria.
- If in a bacteria flagella is not present than it is called Non-flagellated and immotile bacteria.
- flagella is Outermost exposer that originated from its cell membrane.
- flagella is long, thin and filamentous structure.
- flagella is made up of 100 % protein.
- That protein name is flagellin protein which is made up of 163 different Amino acid.

Flagella is Composed of three Components

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:—

i) Basal body
ii) Hook
iii) filament.



FLAGELLA

- **Basal body :—**

> Basal body is Composed of ring and rod.

> In bacteria four types of rings are present —

M-Ring - Membraneous ring
S-Ring - Supra - membraneous ring

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P-Ring – Peptidoglycon ring
L-Ring – Lipopolysaccheride ring.

» In Gram negative (-) bacteria all four rings are present.

» In Gram positive (+) bacteria only two rings are present.

i.e. M-Ring and S-Ring.

• Basal body originated from cell membrane to till its outer surface of cell wall.

• Hook :—

• It is coupling between filament and basal body.

• It is also called junction between filament and basal body.

• Filament :—

• filament is the outer exposer.

• filament is composed of flagellin protein that arrange in helical chain

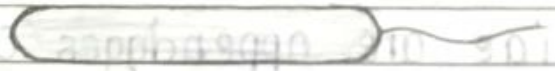
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to form hollow core.

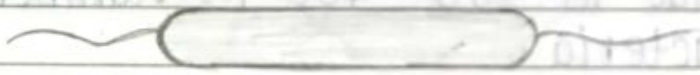
Note :- In human male germ cell (sperm) is motile due to presence of flagella.

On the basis of No. of flagella bacteria is a six type :—

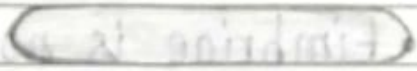
ⓐ Monotrichous —



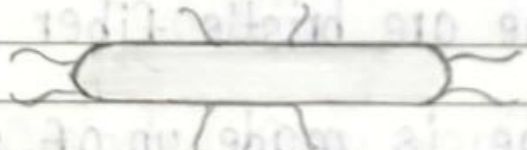
ⓑ Amphitrichous —



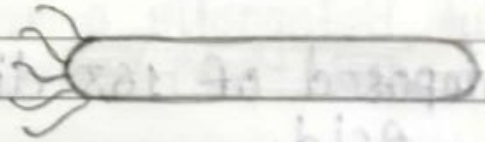
ⓒ Atrichous —



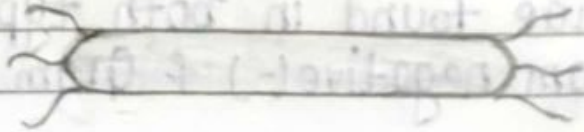
ⓓ Peritrichous —



ⓔ Cepholotrichous —



ⓕ Lophotrichous —



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FIMBRIAE & PILLI

Fimbriae

➤ Fimbriae Originated from Word "fringe".

• Fimbriae is thin, Small, Hair like structure found in bacteria.

• Fimbriae are appendages Or Cell Wall On bacteria.

• Fimbriae is 200 - 400 in number in are bacteria.

• Fimbriae is not responsible for locomotion and movement (Motility).

• Fimbriae are bristle fiber like structure.

• Fimbriae is made up of 100% protein that protein name is fimbrillin protein.

• It is Composed of 163 different type of Amino - Acid.

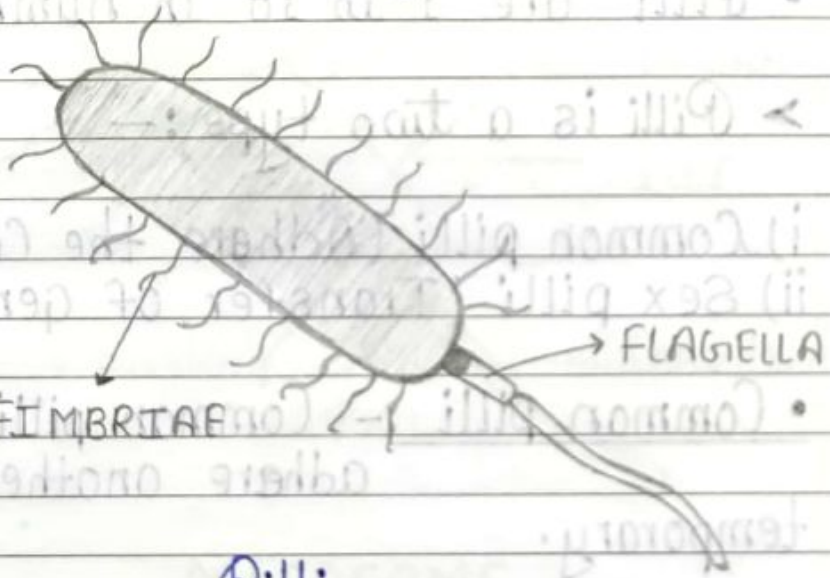
• fimbriae found in both type of bacteria i.e. Gram negative(-) & Gram positive(+).

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Function of fimbriae :

- It adhere or attach to another bacteria.
- It adhere to animal.
- It adhere to inanimate object like - Rock, streams of water, soil etc.

Note :- Fimbriae helps in agglutination of blood (Erythrocytes).



Pilli

- Pilli originated from word "Pilus".
- Pilli is a ellongated tubular appendages on bacterial cell wall.
- It is thick and hard compare to fimbriae.
- Pilli only found in Gram negative (-) bacteria.

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• Pilli is not responsible for locomotion & movement (Motility).

• Pilli is Composed of 100 % protein.

• That protein name is pillin protein Composed of 163 different type of Amino - Acid.

• Pilli are 1 to 10 in number.

➤ Pilli is a two type :-

i) Common pilli (Adhere the Cell).
ii) Sex pilli (Transfer of Genome).

• Common pilli :- Common pilli is used to adhere another organism temporary.

• Sex pilli :- Sex pilli is used to transfer Gene.

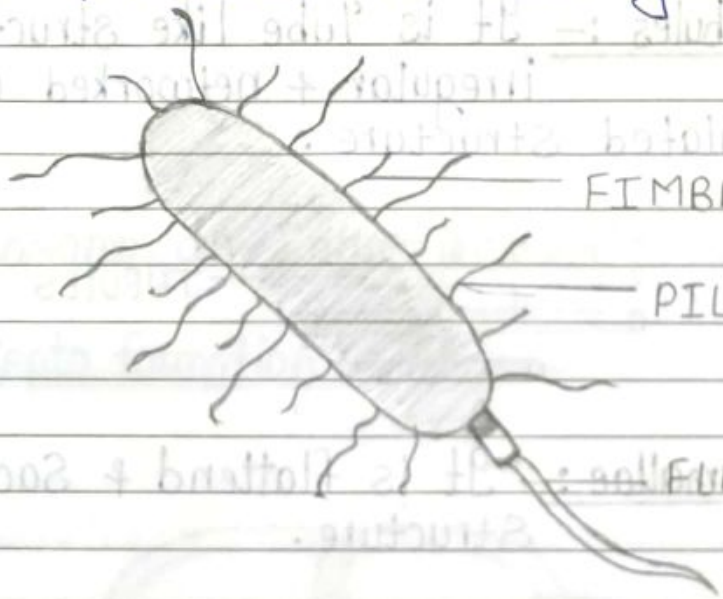
Function of Pilli :

• Pilli is used to transfer Gene.
• It provide resistivity.
• It is used for Gene or Genome transfer.

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• **Conjugation :-** It is a type of sexual reproduction that found in bacteria.

• **Gene :-** Gene is a Sigment of DNA which Carry biological information from One Generation to other generation.



MESOSOME

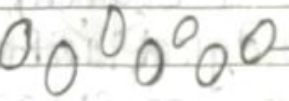
★ Invagination of Cell membrane toward Cytoplasm of Bacterial Cell.



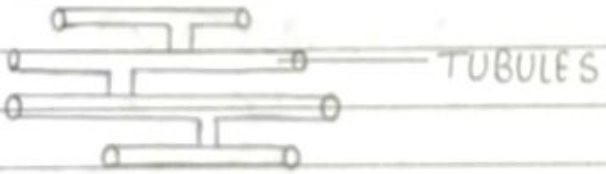
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- Mesosome is Composed of 3 Components :-

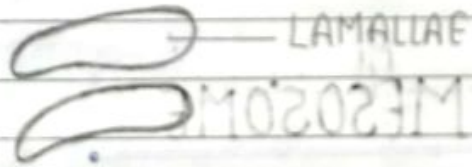
i) Vesicles :- It is Small, Spherical, Sac like Structure.



ii) Tubules :- It is Tube like structure, irregular & networked or reticulated structure.



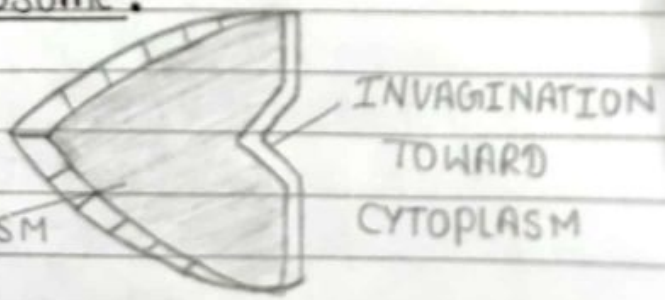
iii) Lamallae :- It is flattend & Sac like Structure.



- Mesosome is a two type :-

i) Orthogonal mesosome :

Straight

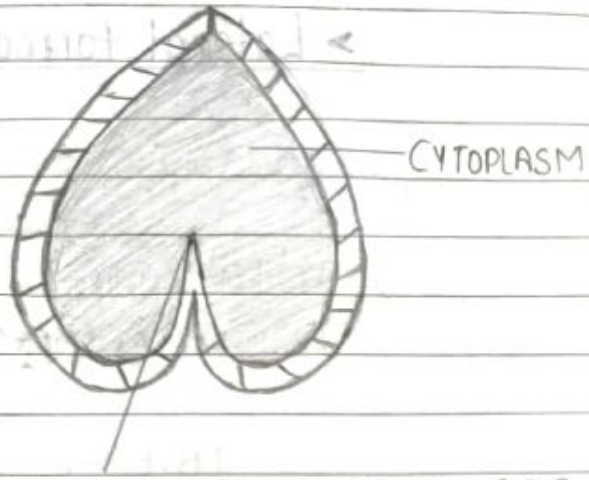


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ii) Axial mesosome :

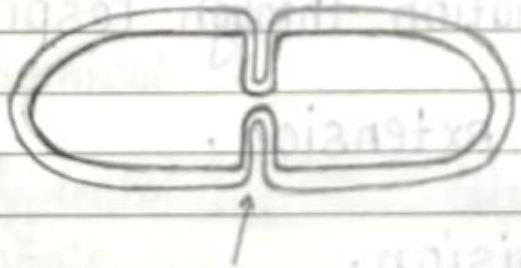
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Axis / Angle



- Mesosome do Some activities like :-

> Septa formation :

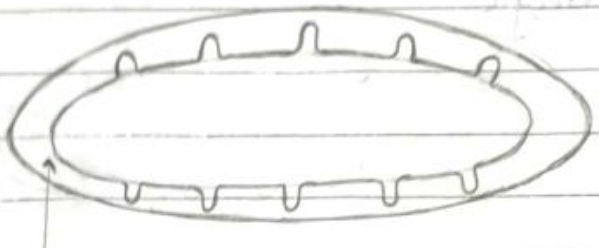


- Whenever Septa is form due to modification of mesosome in bacteria. Then, A new Cell Wall is form.

- New Cell Wall form due to multiplication of bacteria.

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> Lateral formation:



LATERAL FORMATION

- Whenever lateral is form due to modification of mesosome in bacteria. Then, ATP formation takes place using the respiration process.

★ Function of Mesosome :-

- ATP formation through respiration process.
- Surface extension.
- Cell Division.
- Cell Wall formation.
- DNA Replication.
- Enzymatic Activity.

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INCLUSION BODY

- It is also Called "Elementory body."
- Inclusion body found in prokaryotic Organism.
- Inclusion body is reserve food material in prokaryotic Organism in their Cytoplasm.
- Inclusion body is membrane less Structure.
- It provide Site for Viral multiplication for Bacterium.
- It store Various materials in the form of Granules and Vacuoles.

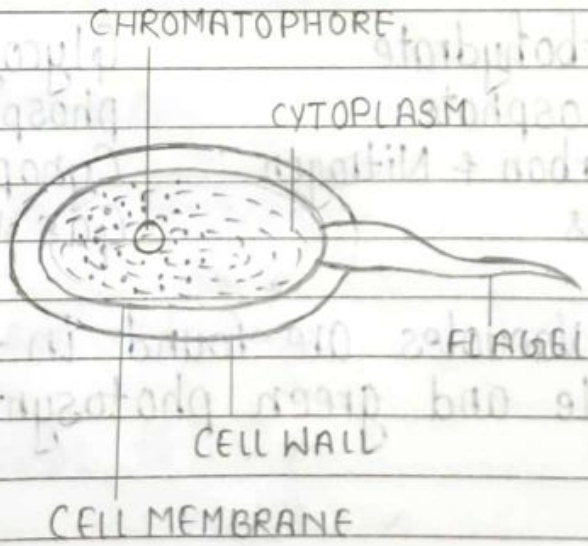
Chemical	Stored form
① Carbohydrate	Glycogen granules
② Phosphate	phosphate granules
③ Carbon & Nitrogen	Cynophycean Granules
④ Gas	Gas Vacuoles.

- Gas Vacuoles are found in — Blue green, purple and green photosynthetic bacteria.

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CHROMATOPHORE

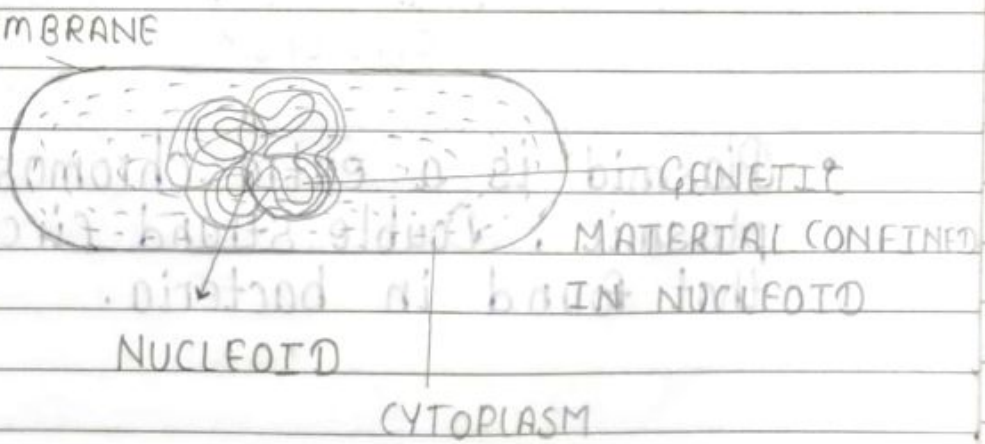
- Chromatophore is found in prokaryotic Organism.
- Chromatophore is derived & Originated from Cell membrane.
- Chromatophore is pigment storing structure in bacteria.
- These pigments are use for trapping light energy.
- Later, on this light energy Convert in to Sugar.
- It is found in Only photosynthetic bacteria.



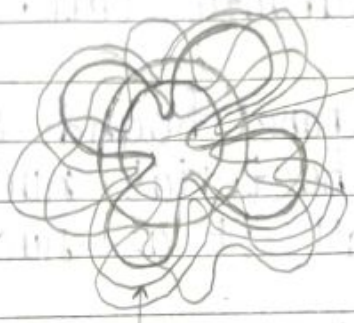
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NUCLEOID

- Nucleoid in actual is nucleus of bacterial Cell or prokaryotic Cell.
- Since, Membrane bound Structure is absent in bacterial nucleus that is Why we Call it as nucleoid.
- There nucleoid is naked and free floating in Cytoplasm.
- In bacterial Cell Histone protein is absent due to which there DNA are not in Order and proper packedge.
- The genetic material of bacteria is Confined in nucleoid.
- In bacteria they have Single Circular DNA but with Double Strand.

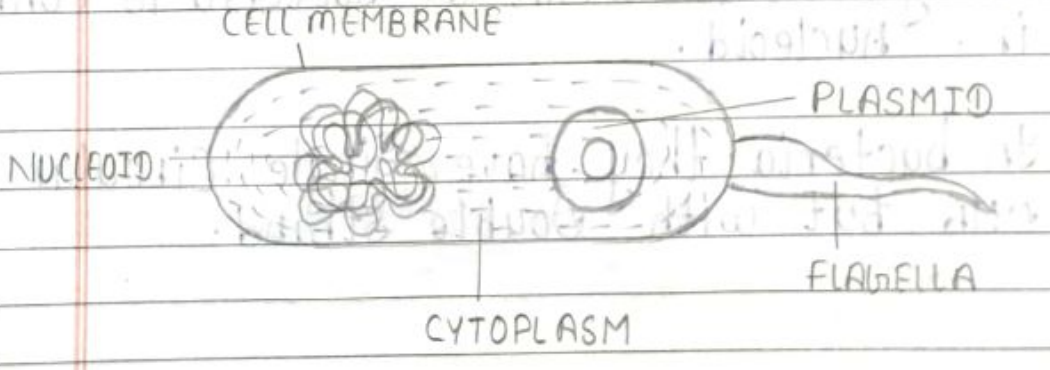


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Nucleoid ← Chromosome ← DNA ← Gene.

PLASMID



- Plasmid is a extra chromosomal, Cytoplasmic, Double strand circular DNA that found in bacteria.

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- It is also called —

i) Vector DNA
ii) Carrier DNA
iii) Recombinent DNA / r-DNA

- It is self replicating structure.

★ Function of plasmid :

- It monitor bacterial transformation.
- It provide resistivity.
- It regulate phenotypic character due to changing genotypic character.

★ Eukaryotic Cell :

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★ CELL WALL

- Cell Wall was discovered by 'Robert hooke'.
- Cell Wall is a thick, hard Outer most layer & Dead boundary of Cell.
- Cell Wall is made up of Cellulose, Hemicellulose & pectin.
- Cell Wall is of three types :-

(i) Primary Cell Wall :

- It is thin & elastic Structure.
- Made up of — Cellulose, Hemicellulose & pectin.

(ii) Secondary Cell Wall :

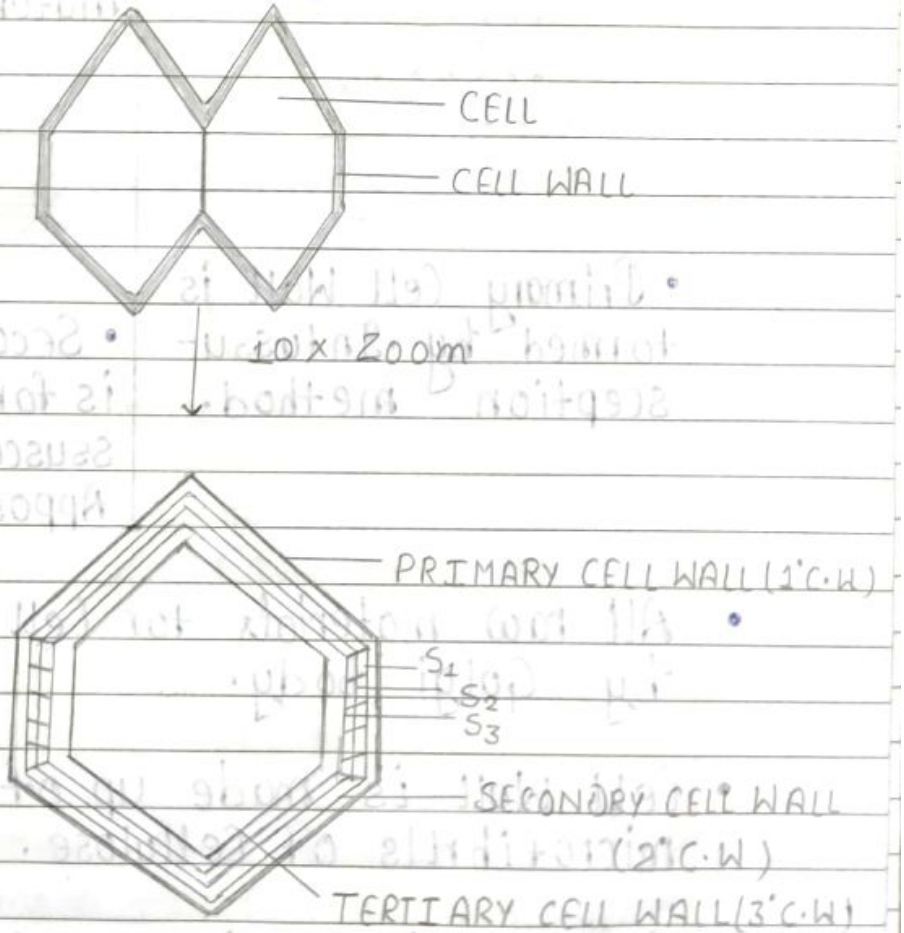
- It is thick & hard Structure.
- It is of three layer. → S_1, → S_2, → S_3
- Made up of — Cellulose, Hemicellulose & pectin.
- Absent in Meristematic Cell.

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- Present in Permanent Cell.

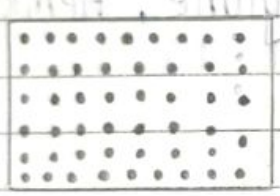
(iii) Tertiary Cell Wall :

- It is thin Structure.
- It is present Only in Tracheids of Gymnosperm.
- Made up of — Xylane, Hemicellulose.



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* Cell Wall formation method :

① Intussusception Method	② Apposition Method
• Cell Wall is formed by granular material. 	• In Apposition method Cell Wall is formed by layer-by-layer method of material. 
• Primary Cell Wall is formed by Intussusception method.	• Secondary Cell Wall is formed by Intussusception method & Apposition method.

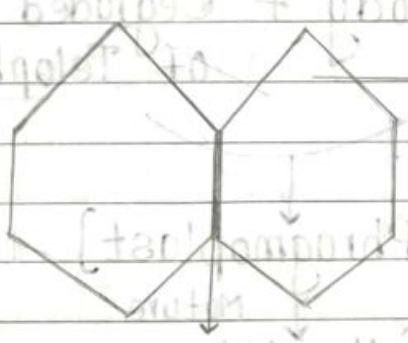
- All raw materials for Cell Wall is formed by Golgi body.
- Cell Wall is made up of macro & microfibrils of Cellulose.

➤ Cell Wall is made up of many material that are Categories into three part :-

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① Matrix	② fibrils	③ Depositors
• Hemicellularse • Pectin	• Cellulose	• Lignin • Cutine • Suberin • Mucilage • Silica

MIDDLE LAMELLA



Ca
Mg
+
Pectate

→ Calcium pectate
→ plant Cement

- Middle lamella is a Common layer or Common wall between two Cell.
- Middle lamella is Composed of Ca, Mg & pectate.

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- Since, Amount of Calcium is more. So, It is also Called Calcium pectate.
- It is also Called plant Cement.
- fruit become Soft and juicy after ripening is due to dissolve of middle lamella.
- <u>formation of middle lamella:-</u>

Golgi body + Degraded Spindle of Telophase

↓

[Phragmoplast]

↓ Mature

Cell plate

↓ Mature

Middle lamella

➤ <u>Specialization of depositors :</u>

1. Lignin ⟶ Lignification
2. Cutine ⟶ Cutinization
3. Suberin ⟶ Suberization
4. Mucilage ⟶ Mucilage Deposition
5. Silica ⟶ Silica Deposition.

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LIGNIFICATION

- On the Cell Wall of Tracheids, Vesseles & Sclerenchymatissue deposition of lignin is called lignification.
- Lignification provide rigidness & hardness.
- In actual lignin is Coniferyl Alcohol Which derived from Cellulose.
- Excess deposition of lignin decrease the economic importance of product.
- Ex:- Guava & Pears.

CUTINIZATION

- On leaf Epidermis deposition of Cutine is called Cutinization.
- Cutine is a waxy Substance and it is Hydrophobic (Water hating).
- It is mostly found in Xerophytic plant (Desert plant).
- Cutine Control the rate of transpiration.
- Ex:- Cactus, Alovera, Oxalis etc.

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SUBERIZATION

- Deposition of Suberin On Cork and Casparian strip Cell Wall than it is Called suberization.
- Suberin is impermeable for Water & Air also.
- Excess deposition of Suberin Cause death of Cell.

MUCILAGE DEPOSITION

- Deposition of mucilage On aquatic plants that prevent from Water Cause Rottening effect.
- Mucilage deposition mostly found On aquatic plant (Water Chest nut, pistia, Eicchornia, Lotus etc).

SILICA DEPOSITION

- On the leaf of plants there edge are sharp due to deposition of Silica.
- These Silica deposition are due to protection against leaf eating insect &

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animal.

- Ex:- Cereals (Rice, Wheat, maise)
  Diatoms
  Equisetum
  Grassel
  Sugarcane etc.

PIT

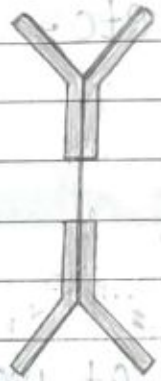
- On the Cell Wall of plant if deposition of lignin absent that it is Called PIT.
- Pit always formed in pair.
- Pit is Seperated by pit-membrane.



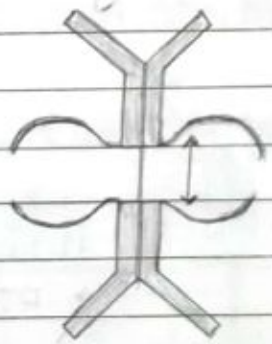
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➤ Pit is two type :-

i) Simple pit :- In Simple pit from inside to Outside uniform diametere is present.

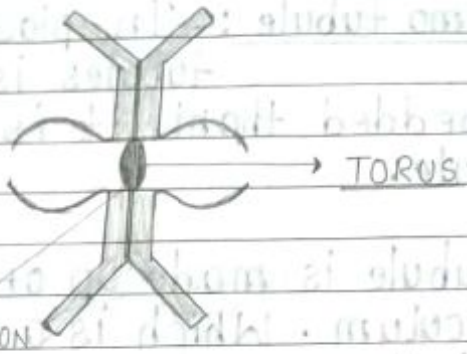


ii) Bordered pit :- In Border pit from inside to Outside non-uniform diametere is present.



- On border pit if Suberin deposition is Occur than it is Called TORUS.

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PLASMODESMATA

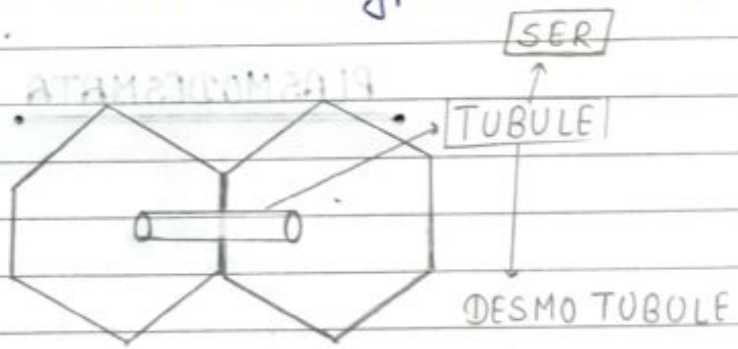


- Since, Cell Wall is dead boundary. So, for Connection of one Cell to another Cell is Only possible if pore is present in their Cell Wall.
- Cell Wall of plant having many pores. i.e. many perforated Structure.
- Living Connection between two Cell is Called plasmodesmata.

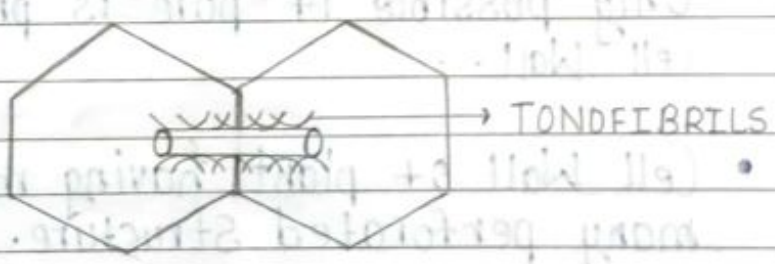
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- **Desmo tubule** :- In plasmodesmata if tubules is incorporated or Embedded thant it is Called Desmo tubule.

  - Tubule is made up of Smooth Endoplasmic reticulum. Which is a type of endoplasmic reticulum.



- **Tonofibrils** :- Between two Cells transportation is occur and it is Control by various fibrils Structure than it is Called ~~tonob~~ Tonofibrils.



★ **Function of Cell Wall** :-

- It provide Endoskeleton of Cell.
- It provide Shape of the Cell.

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- It provide Cell to Cell Communication.
- Prevent from entry of Un-Wanted material.
- Provide mechanical Support.

★ CELL MEMBRANE

- Cell membrane is also Called plasma membrane / Bio – membrane / plasmolemma.
- Cell membrane is thin, elastic, Selective permeable and living Structure.
- Cell membrane is the Common Connection between prokaryotic & Eukaryotic Cell.

➤ To Study Cell membrane we have to Study 3 model of Cell membrane :-

- Sand-witch / Tri-lamellar model
- Unit-membrane model / Robertson model
- Fluid-Mosaic model.

★ Sand-witch / Tri-lamellar model – 1935

- Given by Danielli & Davison.
- According to tri-lamellar model between

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protein layer and phospholipid ~~bi-layer~~ bi-layer is present.

- Since, It behaves like Sand-witch that is between two Similar layer a different layer is present.
- According to this model each protein layer is of 20 A° and One phospholipid bi-layer of 35 A°.
- So, Total thickness of plasma membrane is 75 A°.

i.e. $(20 + 35 + 20)\,A^\circ = 75\,A^\circ$

- phospholipid and protein are attach to each other in which between phosphate and protein layer Hydrogen & Ionic bond is present.
- In phospholipid, phosphate & lipid are attached to each other using "Vander Wall force."
- In phospholipid phosphate is Consider Head & lipid is Tail.

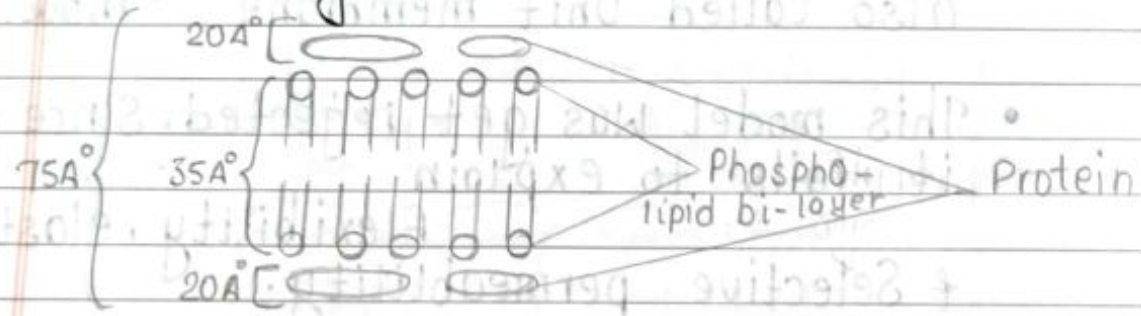
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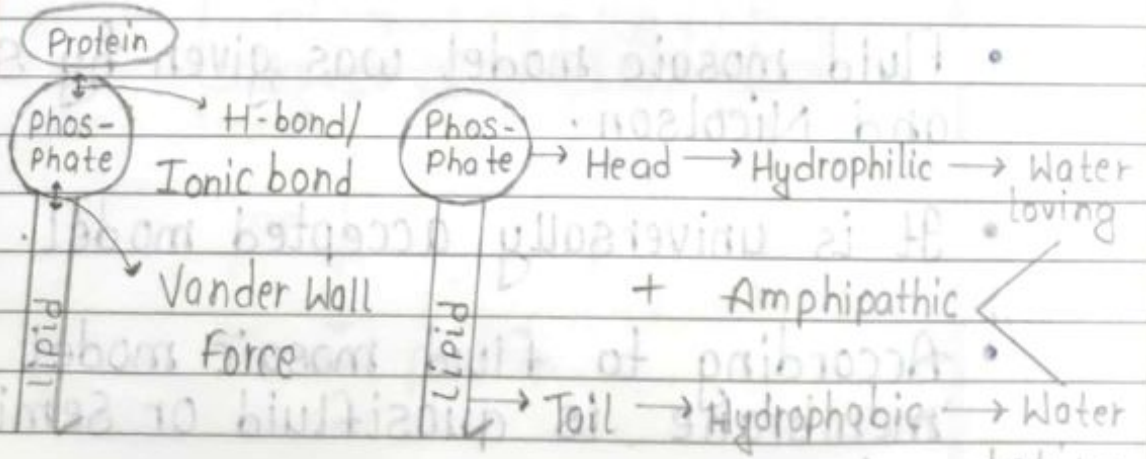
- Head is hydrophilic (Water loving) While Tail is hydrophobic (Water hating).

Hydrophilic + Hydrophobic = Amphipathic.

- This tri-lamellar model / Sand-witch layer get rejected. Since, they fail to explain its

Flexibility, Elasticity & Selective permeability.





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★ Unit - membrane model / Robertson model - 1959

- Given by Robertson.
- According to Unit membrane model All Organism (prokaryotic & Eukaryotic) having same type of cell membrane.
- Since, Every Organism have same type of cell membrane that's why it is also called Unit membrane model.
- This model was get rejected. Since, it fails to explain Flexibility, elasticity & Selective permeability.

★ Fluid Mosaic model - 1972

- Fluid mosaic model was given by Singer and Nicolson.
- It is universally accepted model.
- According to fluid mosaic model cell membrane is quasifluid or semi-liquid nature.
- According to this model protein shows

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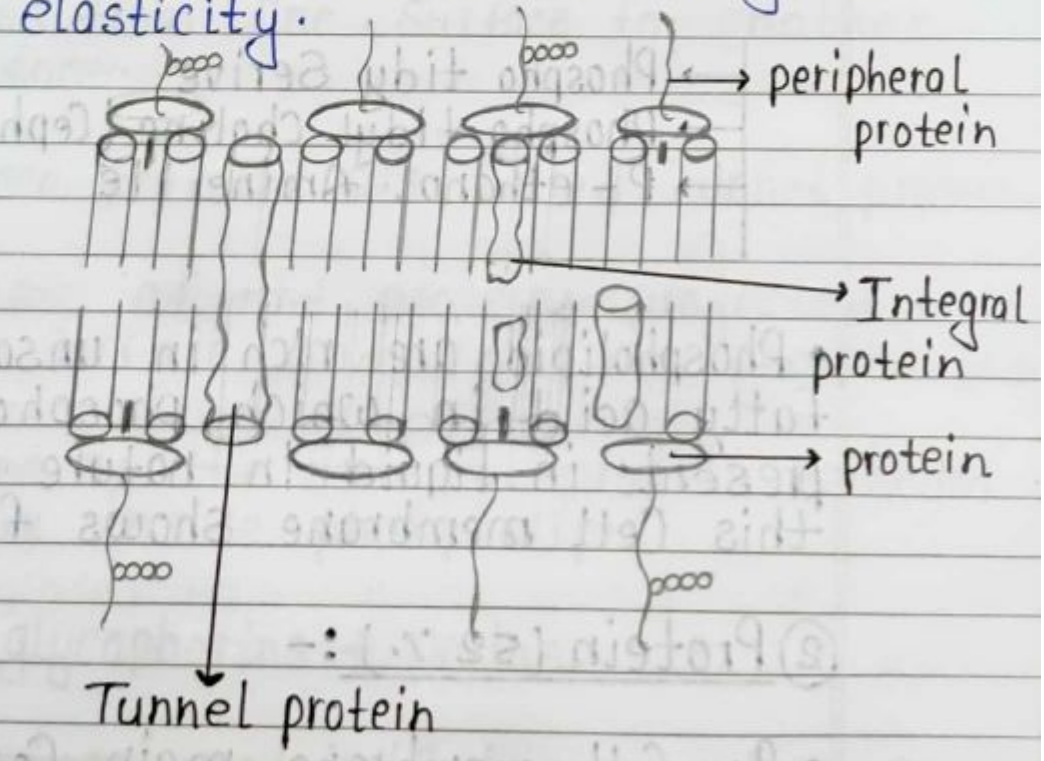
mosaic pattern while phospholipid is in liquid form.

- Phospholipid shows Flip-Flop & Zig-Zag motion while protein shows no motion that is stacked.

➤ For this model a statement Comes :-

⇒ Protein ice berg in the Sea of lipid.

⇒ This model shows flexibility & elasticity.



Fluid mosaic model

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➤ Chemical Composition of Cell membrane :

① Phospholipid (40 %) :-

- Phospholipid is main structural Component of cell membrane.
- Phospholipid is the skeleton of Cell membrane.
- Various type of phospholipid are found in Cell membrane.

  - → Phospho tidy Serive
  - → Phospho tidyl Choline (Cephaline)
  - → P-ethanol Amine (le

- Phospholipid are rich in unsaturated fatty acid in which phospholipid is present in liquid in nature. Due to this Cell membrane shows fludity.

② Protein (52 %) :-

- In Cell membrane main Component is protein.
- There are two type of protein found

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in Cell membrane :—

i) Integral protein (Intrinsic protein – 70%):-

- These proteins are tightly bind with Surface of Cell membrane.
- These proteins Can't be easily removed.
- These proteins are projected from One Surface to another Surface through Which water Soluble material Can Cross from One Surface to another Surface.
- These proteins are Called Tunnel protein.
- Some of the proteins projected from One Surface and end at phospholipid.
- Some of the integral protein embeded or fix inside phospholipid.

e.g. glycophorins & porins.

ii) Peripheral protein (Extrinsic protein – 30 %):-

- These proteins are loosely bind with plasma membrane.

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- These Can easily remove from Cell membrane Surface.

- These are present on Surface of plasma membrane and perform enzymatic activities.

Ex:- Permease & Translocase.

- These are more than 30 types of protein but most important is ATPASE and other Carrier proteins.

③ Carbohydrate (1 to 2 %) :-

- Oligo Saccheride is a type of Carbohydrate that present in plasma membrane in the form of Glycoprotein and Glycolipid.

- It helps as Cell to Cell recognization.

Ex:- Blood antigen, Antibody and fertillizing Cell.

④ Cholesterol (Trace amount) :-

- It is help the maintaining the Cellular during temperature variation.

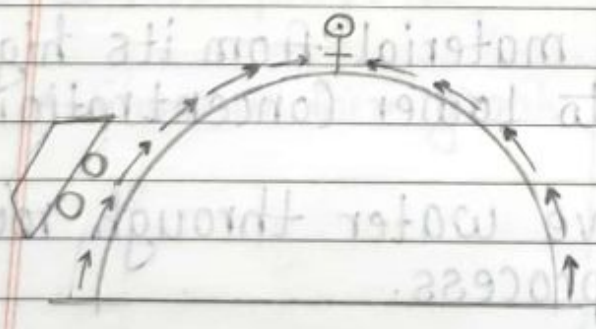
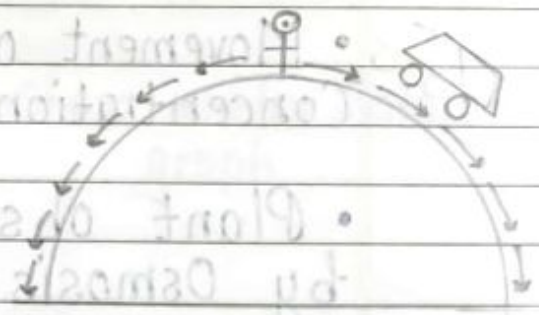
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• It provide rigidness of the cell.

★ Transportation Across the Cell membrane :

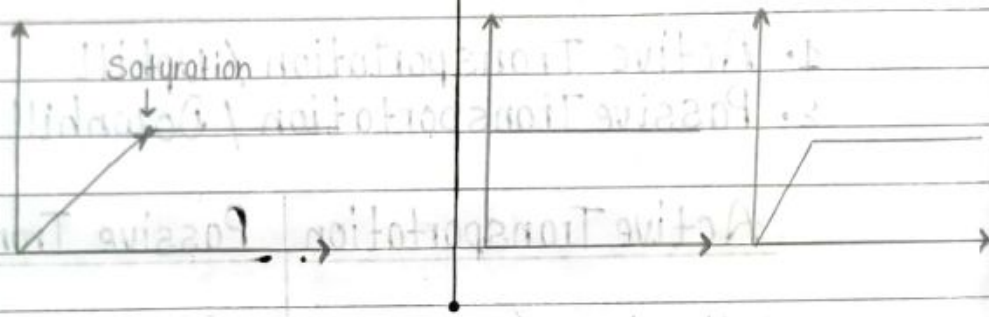
▪ Transportation in plant

1. Active Transportation / Uphill
2. Passive Transportation / Downhill

Active Transportation	Passive Transportation
• Active transportation also called Uphill transport.	• Passive transportation also called Downhill transport.
• Movement of material from Lower Concentration to Higher Concentration.	• Movement of material from Higher Concentration to Lower Concentration.
	
• It required energy.	• It not required energy.
• It required Carrier proteins.	• It not required Carrier protein except in facilitative diffusion.

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• It is Specific type of transportation.	• It is non Specific type of transportation.
• Show Saturation Graph.	• Show uniform Graph.



• Passive transportation is of two type :-

i) Osmosis
ii) Diffusion.

➤ **Osmosis :**

• Movement of material from its higher Concentration to lower Concentration.

• Plant observe water through root by Osmosis process.

➤ **Diffusion :**

• Movement of material from its higher Concentration to its lower Concentration

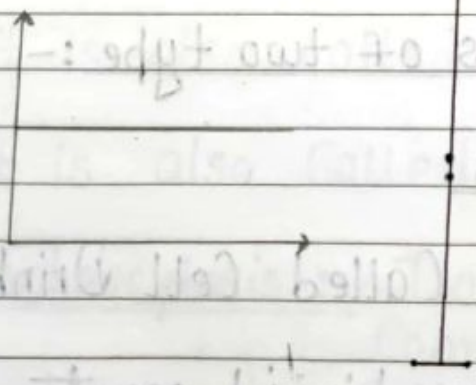
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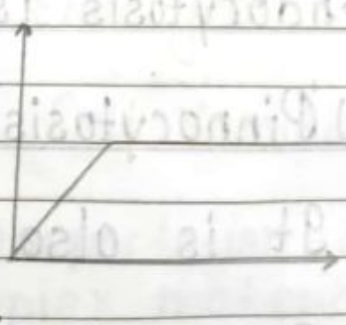
but randomly.

- Diffusion is of two type :-

i) Simple Diffusion
ii) Facilitative Diffusion

Simple diffusion	Facilitative diffusion
• Passive	• Passive
• Higher to lower	• Higher to lower
• No Energy required	• No Energy required
• Non - Specific	• Specific
• Doesn't required Carrier protein	• Required Carrier protein
• Show uniform graph	• Show ~~unifor~~ Saturation graph.





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- **Factor affecting Rate of Diffusion:**

  → Pressure
  → Temperature
  → Gradient
  → Concentration

- **Effect of Diffusion:**

  Gas > liquid > Solid

➤ **Bulk Transport in Cell membrane:**

i) Endocytosis
ii) Exocytosis
iii) Ropheocytosis

- **Endocytosis** :- Some of the waste material ingulf by Cell membrane is called Endocytosis.

Endocytosis is of two type :-

i) Pinnocytosis:

- It is also called Cell Drinking.
- Some of the liquid waste material

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is ingulf by ingusted by Cell membrane in the form of Small sac like Structure (pinnosome) is Called pinnocytosis.

- This Concept given by Lewis.

ii) Phagocytosis :

- It is also Called Cell-eating.
- Some of the Solid waste material is ingusted by Cell membrane in the form of Small sac like Structure that is Called phagocytosis.
- This Concept given by Metch-ni-koff.

- Exocytosis :- Some of the waste material either liquid or Solid (Emiosome) are remove out from the Cell is Called Exocytosis.
- It is also Called Emiocytosis.
- It is also Called Cell Vomiting.

- Ropheocytosis :- Transportation of Complex material from Cell to another Cell is Called Ropheocyotis.

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Ex:- Transfer of Hemoglobin from bone marrow to mature R.B.C Cell.

- **Function of Cell membrane**

- Transportation of material through selection.
- Provide protection from foreign material.
- It provide site for various chemicals and Horm
- It allows of some ions through its Selective permeable membrane.
- Almost all Cell membrane are Covered by Cell-membrane.

★ ENDO MEMBRANE SYSTEM

- Endo membrane System is also Called. "System of membrane".
- In endo membrane System four Cell Organells are Consider

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i) Endoplasmic Reticulum
ii) Golgi body
iii) Lysosome
iv) Vacuoles.

- These four are Consider Cell endo membrane System. Since, All work togetherly but in Coordinative manner and Complete a task.

- Some of the Cell Organells like Mitochondria, peroxisomes and chloroplast all perform a Same task that is photo respiration but they are not Consider as endomembrane System.

- Since, All these three Cell Organells (Mitochondria, peroxisomes & chloroplast) not perform together Coordinatively. So, they are not Considerly endo membrane System.

1. Endoplasmic Reticulum (ER):

- It is discovered by "PORTER" in 1945.
- It is Complex System of membranous Sac like Structure.

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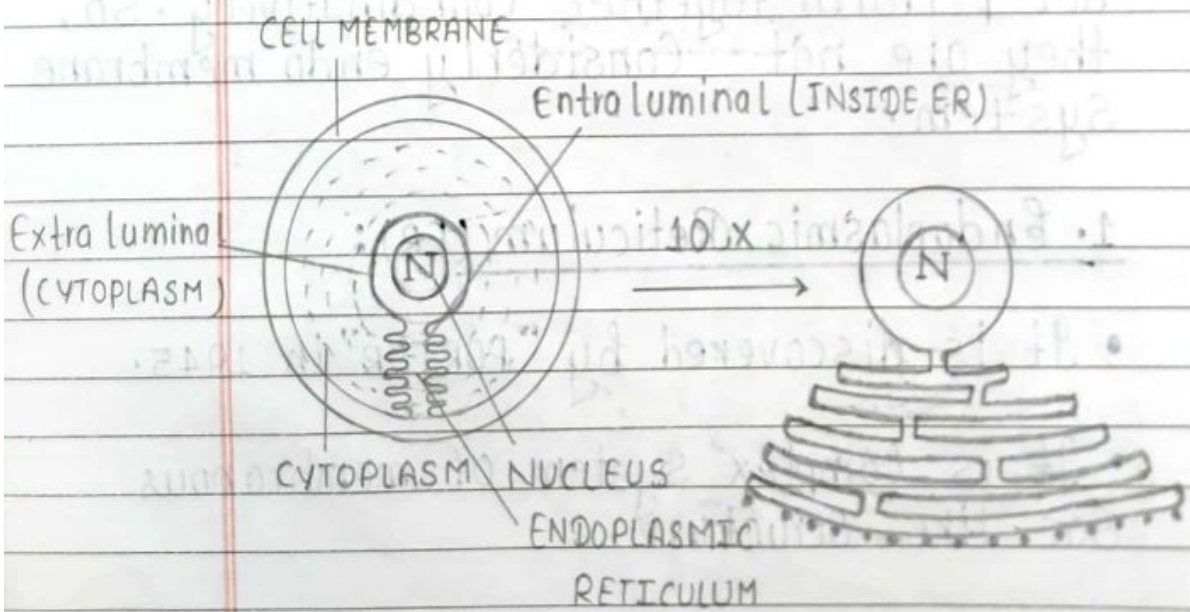
- Endoplasmic reticulum runs through-out the Cytoplasm of eukaryotic cell and divide in to two Compartment:

i) Entra luminal – cytoplasm
ii) Extra luminal – Inside

- One end of endoplasmic reticulum is attached with Outer membrane of nucleus & another end is attached With Cell membrane.

- ER Consists of 3 Component

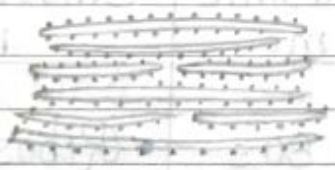
1. Cisternae
2. Tubules
3. Vesicles.



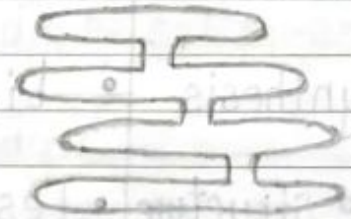
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• Endoplasmic reticulum found in all Cell type everywhere of eukaryotic Cell, except Embryonic Cell, Egg Cell + Mature R·B·C Cell.

* Cisternae :- These are long flattened and Unbranched Unit arranged in Stacks.



* Tubules :- These are branched irregular Structure.



* Vesicles :- These are Oval membrane bound Structure.



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- Endoplasmic reticulum is composed of protein and lipid.

➤ Endoplasmic reticulum is of two type:

- Rough Endoplasmic reticulum
- Smooth Endoplasmic reticulum.

Rough endoplasmic reticulum	Smooth endoplasmic reticulum
• Ribosomes - 80s	• Ribosomes absent
• Glycoprotein - ① Ribophorin - I ② Ribophorin - II	• Absent
• Protein - Synthesis	• Lipid
• More stable structure	• Less stable structure
• Cisternae and Vesicles	• Tubules
• Ex:- Liver Cell Pancrease Cell Goblet Cell	• Ex:- Adipose tissue Adrenelin Cortex leyding Cell / interstitial Cell Cordic Cell

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- **Sacroplasmic :**
  - It is a type of Smooth endoplasmic reticulum.
  - It is found in Cardic and Skeletal muscle.
  - It Stores Calcium ions and ATP for muscle Contraction.
- **Ergastoplasm :**
  - Ribosome accumulated or Small parallel arranged Cisternae of endoplasmic reticulum. Than it forms ergastoplasm.
  - Ergastoplasm found on Nerve Cell that is Called Nissl's granules.
- **Myoid body :**
  - It is a type of Smooth endoplasmic reticulum.
  - It is Very light Senstive.
  - It Carry pigment epithellial tissue of retina.
  - It helps in pigment migration.

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- **Microsomes :**

  - Microsomes are fragment of rough endoplasmic reticulum with mitochondria.

  - It is small inclusions.

  - It is exist in living cell.

- **Desmo tubule :**

  - In plasmodesmata smooth endoplasmic derive tubules is embeded in plasmodesmata.

★ **Function of endoplasmic reticulum :**

  - It helps in formation of nuclear membrane.

  - It helps in Detoxification.

  - Endoplasmic reticulum Contains whereas enzyme to regulate metabolism.

  Like, i) Glucose – 6 – Phosphate Synthetase
  ii) Ascorbic acid Synthetase.

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- Endoplasmic reticulum found in all cell of eukaryotes except mitochondria and plastids.

2. Golgi Body :

- It is discovered by "Camillo Golgi" (1898) in Nerve Cell of Born (White) OWL.

- It is also Called —
  i) Golgi apparatus
  ii) Golgi Complex
  iii) Lipochondria
  iv) Glycochondria
  v) Dalton's Complex
  vi) Idiosome
  vii) Dictyosome (plant).

- It is made up of protein (60%) and lipid (40%).

- Its main function is Secretion and export of material.

- Golgi body is also Called director of molecular traffic or middle man of Cell.

- It is made up of Cisternae, tubules,

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Vesicles & Vacuoles.

but

> Vacuoles: These are Small^ flattened Spherical structure.

• It forms in three steps :-

① From Cis-face it received material from endoplasmic reticulum.

② Received material get modified/Altered. Like

(i) Protein Can Convert into Glycoprotein by the Glycosylation process.

Protein $\xrightarrow{\text{Glycosylation}}$ Glycoprotein

(ii) Lipid Can Convert into Glycolipid by the Glycosidation process.

Lipid $\xrightarrow{\text{Glycosidation}}$ Glycolipid

③ Modified material get packed into Vesicles and delivered or pinnched off from transface/maturing face/ Concave face.

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- Golgi body helps in Secretion of endocrine gland.
- Golgi body also helps in Secretion of Zymogen Granules through
- Zymogen Granules Secreted during exocytosis process.
- Golgi body help in Secretion of Lacto-protein from memory gland.

★ **Function of golgi body :**

- Golgi body is Synthesis of cell wall material.
- Golgi body helps in cell plate formation.
- Golgi body helps in formation of acro-some of sperm head.
- Golgi body helps in formation of vitaline membrane of ovum (egg cell).
- Golgi body helps in formation of Corticle granules is the Cytoplasm of ovum.
- Lysosome formed by golgi body.

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- Plant root-Cap formed by Golgi body.

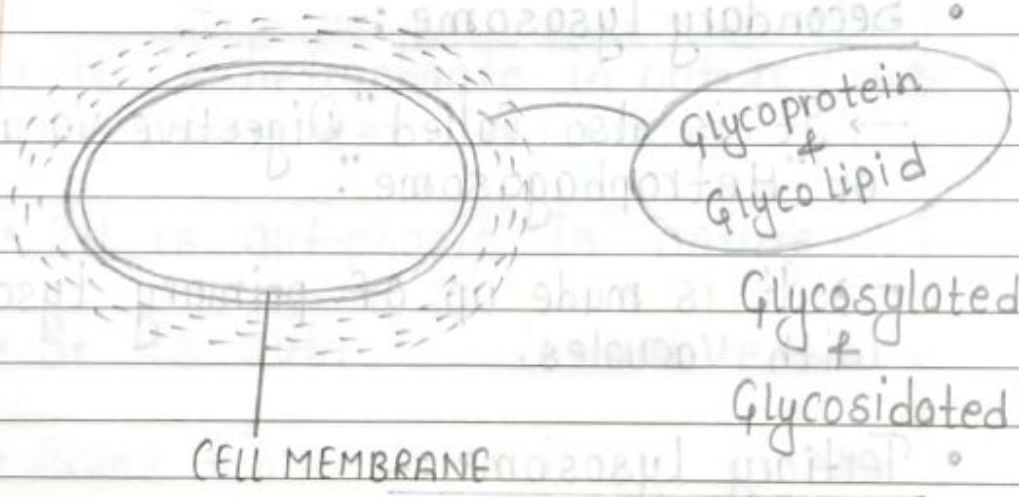


3. Lysosome :

- Lysosome is also Called "Sucidial bag of Cell" or "Scavengers of Cell."
- It is discovered by "De-Duve" and name was given by "Novikoff."
- Lysosome is present in every where of eukaryotic Cell except Mature RBC.
- Lysosome is Spherical bag like Str.
- Lysosome is Covered by Single unit membrane.

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- Lysosome are irregular in Size and shape.
- Lysosome store more than 50 different type of digestive enzyme that is Called ACID HYDROLASES.
- In plant Vacuoles act as lysosome.
- It's PH Value is 5.



- Lysosome is polymorphic in nature (Single object having different from at different location).

➤ Lysosome is of four type :-

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(i) Primary lysosome
(ii) Secondary lysosome
(iii) Tertiary lysosome
(iv) Autophagic lysosome

- **Primary lysosome :-**

→ It is newly formed lysosomes.

→ It stored acid hydrolases in inactive form.

- **Secondary lysosome :-**

→ It is also called "Digestive Vacuoles" or "Hetrophagosome".

→ It is made up of primary lysosome with vacuoles.

- **Tertiary lysosome :-**

→ It is also called residual matter or body.

→ It is undigested materials.

→ It is remove out by exocytosis.

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- **Autophagic lysosome :-**

→ It is formed by primary lysosome with its own cell dead & decay cell organells.

→ It is also called autophagosome.

★ **Function of Lysosome :**

- It shows intracellular & extracellular digestion.
- It is hetrophagic in nature (digestion of different materials).
- It is autophagic in nature.
- It is auto in nature.
- Some time cell brust itself and shows dead of its own cell.
- It shows metamorphosis in frog using Cathepsin enzyme.

➤ **Metamorphosis :-**

- From tadpole (pre mature frog) removal

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of their tail using the lysosanic enzyme Cathepsin is called meta-morphosis.

- After metamorphosis frog became tailess.

Carbohydrate – Carbohydrace
Nucleic acid –

4. Vacuoles :

- It is a Single membranous Cell Organells.
- It is discovered by "Anton Von Leeuwenhoek."
- In plant Cell 90 % Space is Occupied by Vacuoles.
- Membrane of Vacuoles is Called Tonoplast.
- Tonoplast facilitated the transportation of materials.

➤ **Vacuoles is of four type :**

(i) SAP Vacuoles
(ii) Contractile Vacuoles

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(iii) Food Vacuoles
(iv) Gas / Air Vacuoles.

- **SAP Vacuoles :-**

→ It is Contains Water, minerals, Salt and nutrients.

- **Contractile Vacuoles :-**

→ It helps in Osmoregulation (Means Controlled of water & Salt Concertation itself).

→ It helps in excretion of some protozons Like Amoeba in the form of Pseud

- **Food Vacuoles :-**

→ It Contains digestive enzyme.

→ It helps in digestion of nutrients.

- **Gas/Air Vacuoles :-**

→ It present Only in prokaryotic Organism.

→ It store metabolic gases.

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- It helps in buoyancy of cell.

Buoyancy :- Control of shrink of cell mainly for equatic Organism.

★ Function of Vacuoles :-

- It stores function of Vacuoles.
- It stores waste material.
- It stores reserve food material it Vacuoles.
- It Control the Concertation of water & salt.
- It helps in digestion of food.

★ MITOCHONDRIA

- Mitochondria found in strip muscle of insect.
- It is discovered by "Kollicer".
- Kollicer given the term Sacrosome for mitochondria.

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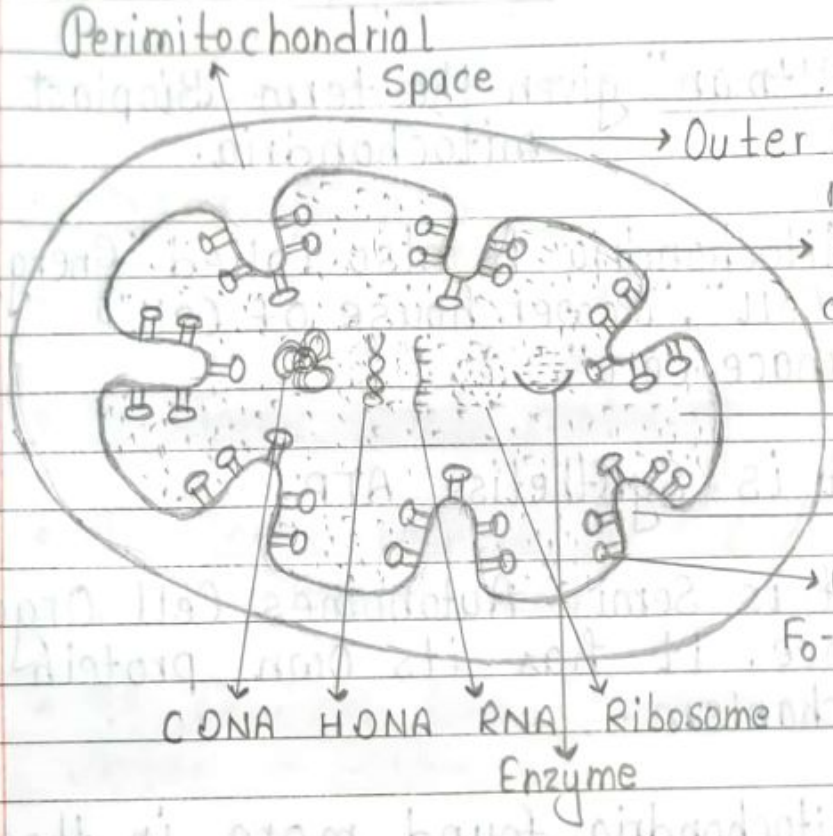
- Term mitochondria was given by "C-Benda".
- "Altman" given the term Bioplast for mitochondria.
- Mitochondria is also called "Energy house of cell", "Power house of cell" or. "Furnace cell".
- It is Synthetise ATP.
- It is Semi-Autonomes Cell Organells. Since, it has its own protein Synthesis mechanism.
- Mitochondria found more in those cell who are active.
- Flying birds have more mitochondria.
- Plant have less mitochondria Compore to animal.

➤ Number of Mitochondria :-

- 1 Cell — 1 mitochondria in -
  Micrasteris
  Chlorolla fusuca] Algae

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• 1 cell — 5 lakh mitochondria in —
Chaos-Chaos] Algae



➤ **Mitochondria have two layer :-**

(i) Outer mitochondrial membrane → Composed of → phospholipid + cholesterol

(ii) Inner mitochondrial membrane → Composed of → protein

➤ **Mitochondria have three Compart :-**

(i) Outer mitochondrial membrane

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(ii) Inner mitochondrial membrane
(iii) Matrix

- **Outer mitochondrial membrane :-**
  - It is fully permeable.
  - It is permeable due to porins (protein).
  - It is Continuous structure or Continuous limiting boundary.
- **Inner mitochondrial membrane :-**
  - It is highly Selective permeable membrane.
  - It is highly Selective permeable due to Cardiolipins.
  - It is discontinuous layer and inner mitochondrial membrane finger like projection are present i.e. Called Cristae.
  - It is invaginated towards matrix of mitochondria.
  - On the Cristae of mitochondria many Tennis racket like structure are

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present that is Called Oxysome of F_0-F_1 particle.

- Oxysome involve in ATP formation.
- On inner mitochondrial membrane ETS (Electron transport System moves).
- In inner mitochondrial membrane of Oxysome $NADH_2$ & $FADH_2$ Oxidation takes place.

$NADH_2$ ⟶ Nicotinamine Adenosine Dinucleotide.

$FADH_2$ ⟶ Flavin Adenosine Dinucleotide.

- **Matrix :-**
  - It is ground substance of mitochondria.
  - It Contains DNA, HDNA, RNA, Ribosome, Enzyme.
  - It is the site for link reaction & kred Cycle.
  - Enzyme Succinate dehydrogenase is not occur in matrix that is used

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in kreb cycle, except these all enzyme occur at matrix.

- Succinate dehydrogenase is used in kreb cycle.

- In matrix Mn + $Ca_3(PO_4)_2$ are also occur in matrix.

★ Biogenesis of mitochondria :

① Not Denovo
(i.e. not newly formed)

② By fission

- In this process cytoplasmic inheritance occur.

★ Function of mitochondria :

- It shows aerobic respiration.
- It Synthesize ATP.
- In Sperm Cell mitochondria provide energy.
- Vitaline membrane is formed with the help of mitochondria.

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• In mitochondria protein & Carbohydrate Oxidation occur while β-Oxidation of fat occur.

★ PLASTIDS

• It is discovered by "Ernst Haeckle."

• Plastid is double membranous bound Cell Organells.

• Plastid is found in Cytoplasm of plant cell & Euglenoid cell.

• It is a 2nd largest Cell Organells. (1st largest - Nucleus & 3rd largest is mitochondria).

• It is Semi-Autonomous Cell Organells.

• It is Semi-Autonomous. Since, it has its own protein synthesis mechanism.

➤ In there protein Synthesis mechanism they have

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→ DNA → C DNA
→ H DNA
→ RNA
→ Ribosome
→ Enzyme.

> Plastid is of three type :-

Features	(I) CHLOROPLAST	(II) CHROMOPLAST	(III) LEUCOPLAST
Colour	Green	Other than Green like – Pink, yellow, Red, Black, Purple, White, Orange etc.	Colourless
Function	Photosynthesis	Provide Colour (Pericarp, Petals)	Storage: Amyloplast – Carbohydrate; Aleuroplast – Protein; Elaioplast – fat / oil.
Location	leaf, Green stem	Petals, fruit & flower.	Seed and stem.
Pigment	Chlorophyll	→ Water insoluble → Carotenoid (2): Carotein (→ α Carotein, → β Carotein, → γ Carotein, → lycopene); xanthin / Xanthophyll (→ Zea Xanthophyll, → Viola .., → fuco ..)	No pigment.

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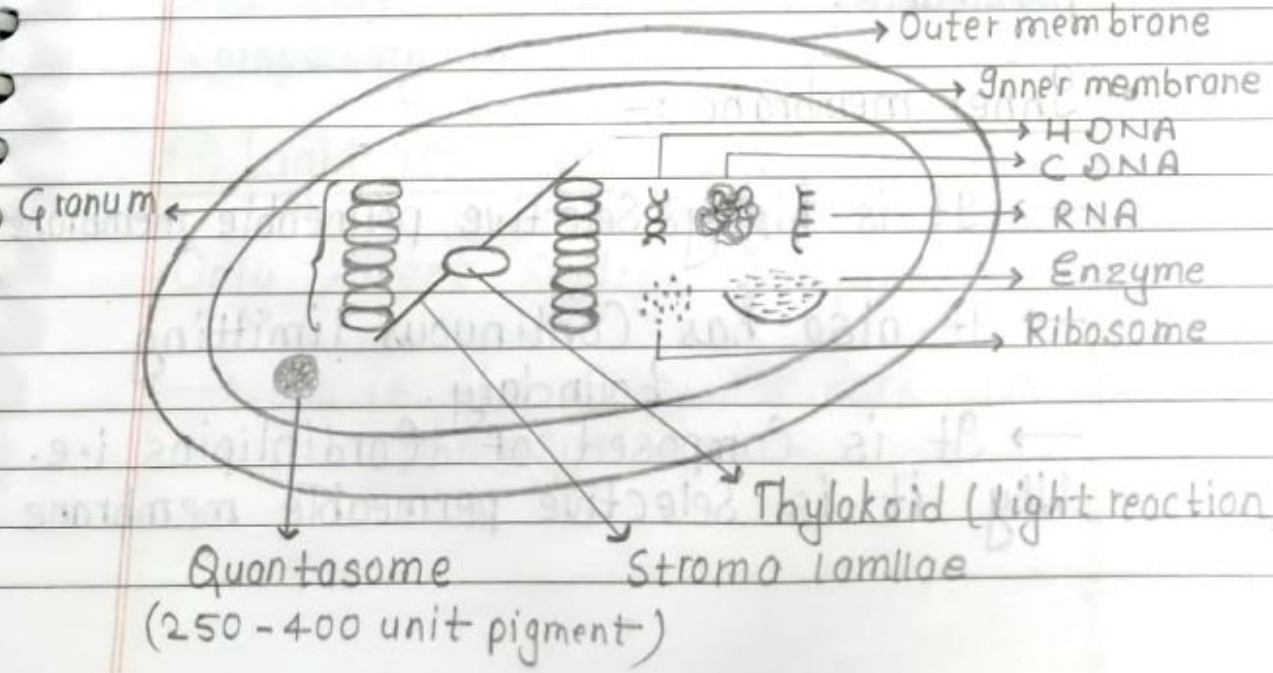
- β - Carotein is precursor (source) of Vitamine - A.
- Along with β - Carotein, ∝ Carotein & γ Carotein also present bud and there least (minimum) participation.
- Due to lycopene tomato & chilli colour become red.
- Lycopene is strong antioxidant.
- Golden or yellow colour of maize is due to Zea - xanthophyll.
- Viola - xanthophyll is the precursor of Abscisic acid.
- Brown colour of algae due to fuco - xanthophyll.

Note :- Chromoplast is occur in flower but colour of petal is due to presence of two water soluble pigment i.e. Anthocyanin & Anthochlor.

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★ CHLOROPLAST

- It is Spherical, Discoid, Oval & Ribbon like structure.
- It is double membranous structure.
- It is found in Cytoplasm of plant cell.
- Number of chloroplast varies from cell to cell.
- A cell having Only 1 chloroplast — "Chlomydomonas"
- A cell having 20-40 chloroplast — "Mesophyll Cell"



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➤ Chloroplast having two layer :

(i) Outer membrane
(ii) Inner membrane

➤ Chloroplast having three Compart :

(i) Outer membrane
(ii) Inner membrane
(iii) Stroma.

- **Outer membrane :-**

→ It is fully permeable.

→ It has Continuous limitting boundary.

→ It is due to porins that it is fully permeable.

- **Inner membrane :-**

→ It is highly Selective permeable membrane.

→ It also has Continuous limitting boundary.

→ It is Composed of Cardiolipins i.e. Why it is Selective permeable membrane.

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- **Stroma :-**

→ It is ground substance of chloroplast.

→ Chloroplast is a region whereas photosynthesis activities takes place.

→ In Stroma dark reaction of photosynthesis takes place.

- **Photosynthesis having two phase :-**

(i) **Dark reaction :-** The photosynthesis activities takes place wheather light is present or not.

OR

For dark reaction presence of light is not compulsory or mandatory or necessary.

(ii) **Light reaction :-** Light phase is photosynthesis is possible Only direct Sunlight is present.

→ It is the Site for dark reaction of photosynthesis.

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→ In dark reaction Whereas enzymes are use i.e. found in Stroma.

Ex:- Rubisco, pepcase etc.

RUBISCO :- It is the most abundant enzyme found on this earth.

→ In Stroma protein Synthesis mechanism are present. like cDNA, HDNA, RNA, enzyme, ribosome (70s) etc.

→ In Chloroplast 14 % chloroplastial DNA are present of total Cell DNA.

Note :- In Stroma quantasome are present.

- **Quantasome :-**

• It is 250 - 400 unit pigments Collecting unit structure.

• It is used to initiate photosynthetic activity.

→ In Stroma Thylakoid and Granum are present.

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- **Thylakoid :-**
  - It is used to trap light energy.
  - It is site for light reaction.
- **Stroma lamalloe :-**
  - It is used to transport electrons during light reaction.

Note :- Space between inner and outer membrane of chloroplast is called "Chloroplastial space" or "peri-chloroplastial space."

★ **Function of Chloroplast :-**

- Involve in photosynthesis.
- Help in glucose formation.
- It helps in balance of O_2, CO_2 in environment.
- Greeneries on this earth is due to photosynthesis.

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- It also help in Control of humidity in environment.
- Chloroplast having chlorophyll pigment i.e. green pigment.
- It also help in photorespiration.

★ Biogenesis of Chloroplast :-

① Endo - Symbiotic

- chloroplast is formed by prokaryotic bacteria.

② Chloroplast is formed by fission i.e. One chloroplast is break down and form two chloroplast.

③ It is formed by pre-plastid.

★ RIBOSOME

- Ribosome is discovered by "George Emil palade" in animal in 1953.
- "Robinson" & "Brown" discovered the Ribosome in plant.

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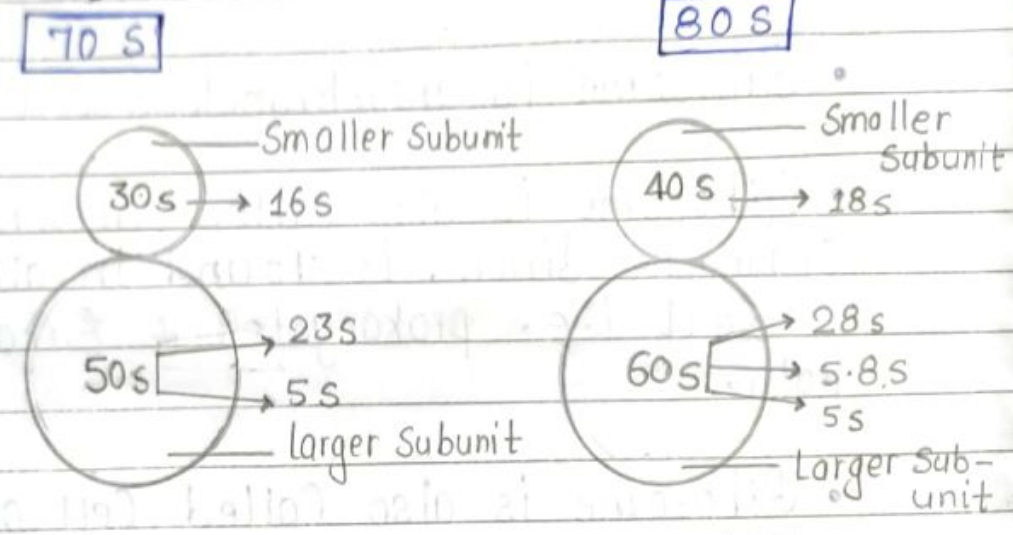
- Ribosome is the Smallest Cell Organells.
- It is Smaller than bacteria.
- Ribosome is membraneless Cell Organells.
- Ribosome is also called universal Cell Organells since, it found in all type of Cell i.e. prokaryotes & Eukaryotes both.
- Ribosome is also called Cell organells within Cell Organells.
- Ribosome is produce protein.
- Ribosome is also called "Engine of Cell".
- Ribosome is Synthetise by nucleolus of nucleus.
- Ribosome is of two type:-

(i) 70 S

(ii) 80 S

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Ribosome



- It is found in Prokaryotes & Eukaryotes.

rRNA = 60%.
Protein = 40%.

- It is found in Eukaryotes.

rRNA = 40%
Protein = 60%.

S = Svedberg Unit / Sedimentation Coefficient

$S = 1 \times 10^{13}$ gm / cm^2 / dyne / second

gm → Wt. ; cm^2 → S.A ; dyne → Force ; second → Time

➤ **RNA is of three type :-**

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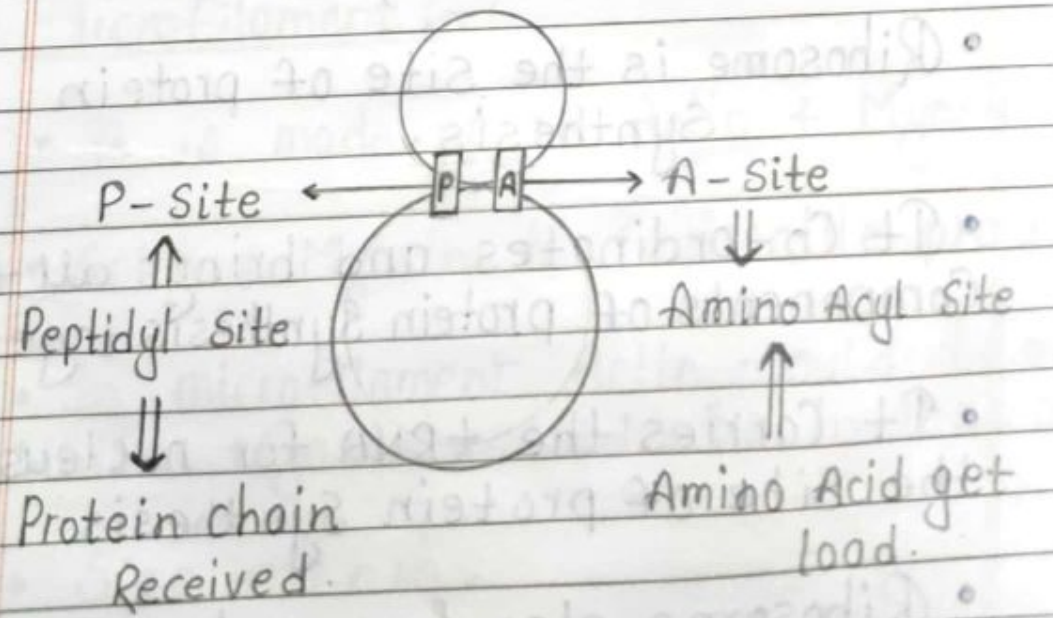
(i) mRNA → For message passing or carry template.

(ii) rRNA → It produce protein according to requirement.

(iii) tRNA → It transfer the require protein i.e. Synthetise by rRNA.

- Ribosomal subunits are attached to each other for protein Synthesis.
- Both the units are attached to each other due to association factor.

★ **Association factor :-** $Mg = 0.001$ molar



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Important points :-

- If association factor i.e. mg = 0.001 molar. if increased by 10%. than it form dimer.

70 s + 70 s = 100 s
80 s + 80 s = 120 s

- Mitochondria is ~~found~~ formed by 55s type of ribosomes i.e. formed by 25s + 35s.

➤ Poly Ribosome :- On the string of ribosome if many ribosomes are arranged than it is called polyribosome.

★ Function of Ribosome :-

- Ribosome is the site of protein Synthesis.
- It Co-ordinates and brings all the Components of protein Synthesis together.
- It Carries the tRNA for nucleus to the site of protein Synthesis.
- Ribosome also have protective function.

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★ CYTOSKELETON

• An Elabrate net work of filamentous Proteinaceous Structure that found in Cytoplasm of eukaryotes.

➤ Cytoskeleton main function is :-

(i) Provide mechanical Support.
(ii) Maintenance of the Shape of the Cell.
(iii) Movement and locomotion.

➤ Cytoskeleton Structure made up of

• Microfilament
• Microtubule
• Intermediate filament

• Microfilament :-

• It is made up of Actin + Myosin.

• Actin + Myosin is Contractile protein.

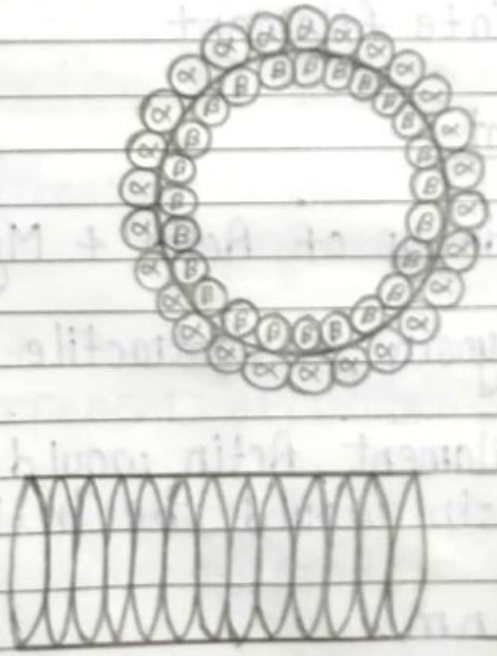
• In microfilament Actin would be maximum While Myosin would be in less amount.

• Size – 7 nm.

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- **Microtubule :**

  - It is made up of tubulin protein.
  - Tubulin is made up of α and β tubulin.
  - α tubulin & β tubulin are protubulin before formation of tubulin protein.
  - α & β tubulin form dimer using the help of association factor i.e. Mg^{++} = 0.001 molar that is increased by 10%.
  - Size — 25 nm.



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- 1 unit microtubule is formed by 13 parallel arrangement of α, β dimer structure.

- **Intermediate filament :-**
  - It is made up of Acidic protein.
  - Size — 10 nm.
  - It shows intermediatory effect.

➤ **Cytoskeleton is of four type :-**

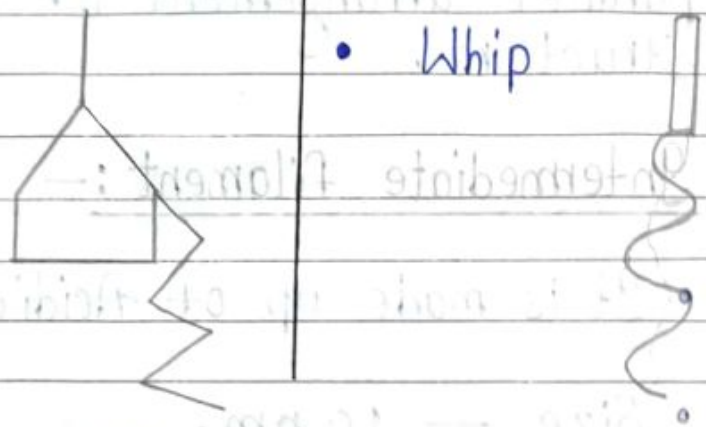
(I) Cilia and flagella
(II) Centrosome and Centromere.

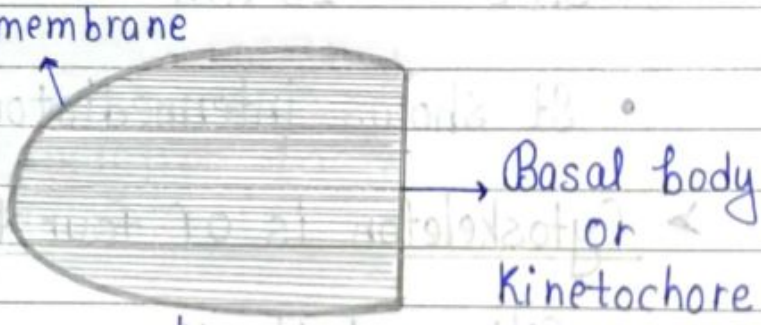
(I) CILIA AND FLAGELLA :

Cilia	flagella
• locomotion, movement & Spreading of fluid on surface.	• locomotion & Movement.
• Eukaryotic organism.	• Both Eukaryotic & prokaryotic organism.
• Larger in size.	• Smaller in size.

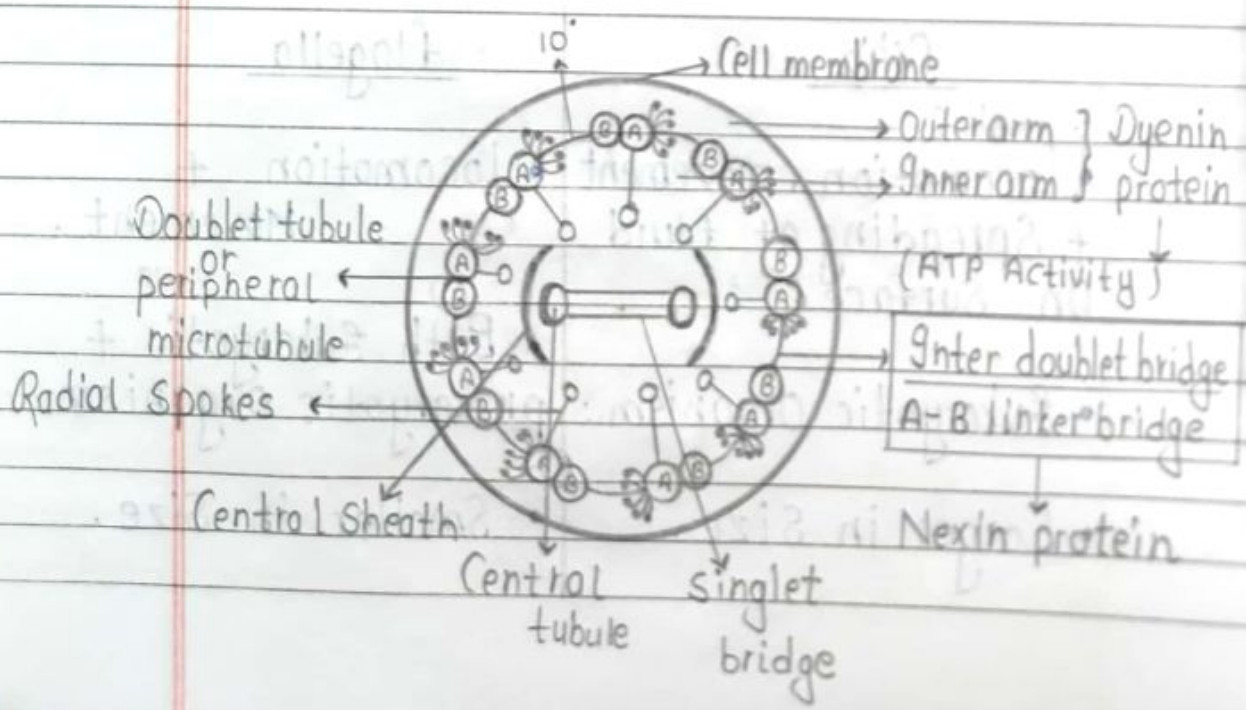
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• More in number	• Less in number
• Oars	• Whip





T.S of Axoneme 50x



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- There is a Central sheath present in between the structure.
- There is two Central microtubule present inside central sheath.
- Central microtubules (singlet) are attached to each other using central bridge.
- Inter doublet tubules are also called A-B microtubule.
- Between both the peripheral microtubules bridge is present i.e. called "Inter doublet bridge" or "A-B linker bridge".
- On each doublet microtubules two arm is present
  (i) Outer arm
  (ii) Inner arm.
- Outer arm is also called Outer microtubule i.e. made up of Dyenin protein.
- Inter doublet protein is made up of Nexin protein.
- These microtubules arrangement are covered with cell membrane.

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- If Cilia & Flagella shows 9+0 arrangement.

  9+0 ⟶ Signaling & Sensation

- If it shows 9+2 arrangement.

  9+2 ⟶ Locomotion & Movement

(11) CENTROSOME AND CENTRIOLES :

- It was discovered by "Von Beneden" in 1876.
- Term given by "Boveri".
- Centrosome = Central sphere + 2 perpendicular Centriole.
- Centrosome is Compose stucture of Central sphere with 2 1^{s} Centriole.

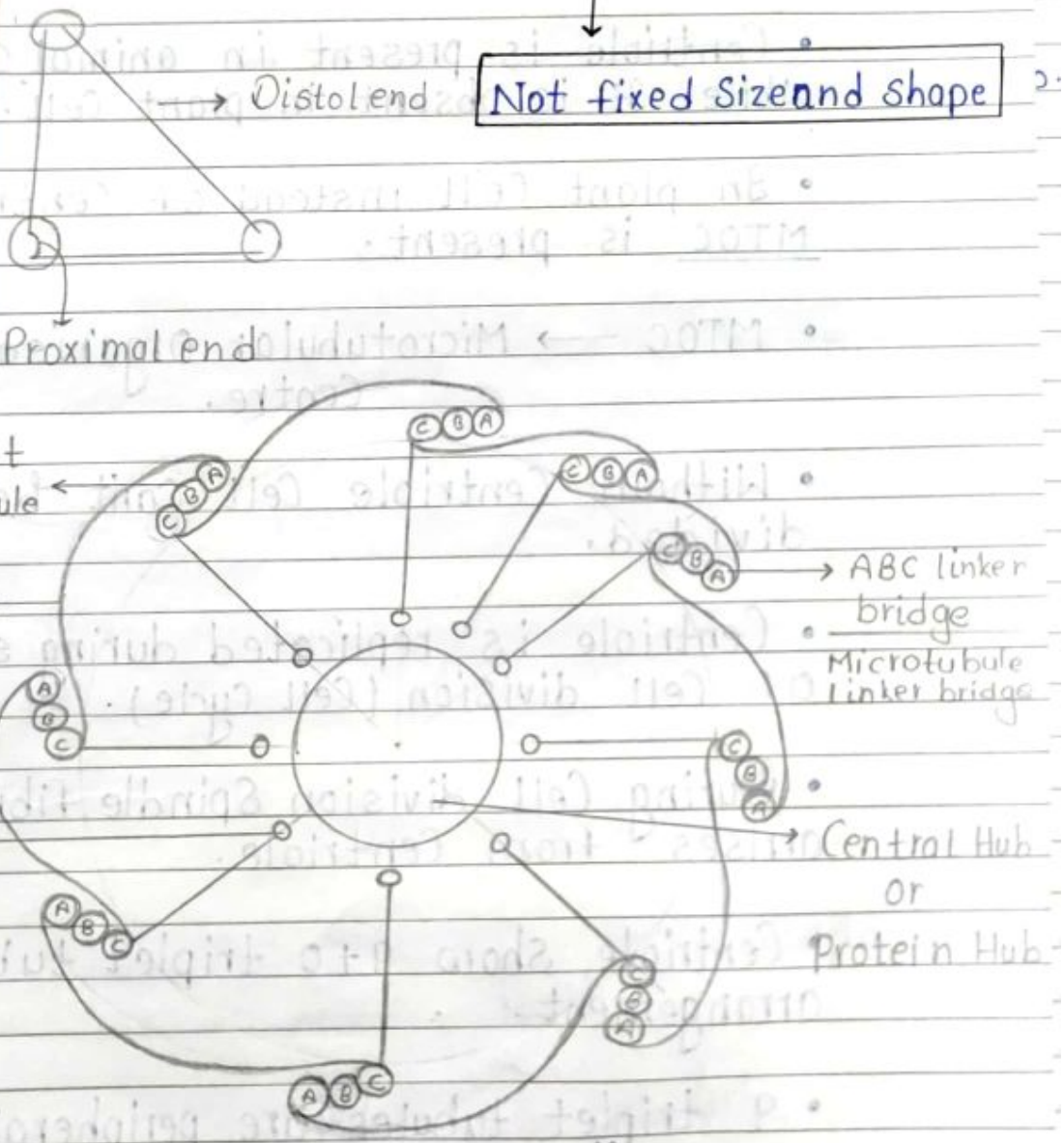


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➤ It is Composed of

(i) γ - tubulin
(ii) Nonein (Ninine)
(iii) Pericentrin (With amorphous material)

Not fixed Size and Shape



Know as "Cartwheel Model"

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- It is Cylindrical Structure.
- It shows 9+0 arrangement.
- Centriole is membraneless structure.
- Centriole is present in animal cell while it is absent in plant cell.
- In plant cell instead of Centriole MTOC is present.
- MTOC ⟶ Microtubular Organisation Centre.
- Without Centriole Cell can't be divided.
- Centriole is replicated during s-phase of Cell division (Cell Cycle).
- During Cell division Spindle fibres arrises from Centriole.
- Centriole show 9+0 triplet tubular arrangement.
- 9 triplet tubules are peripherally arrangement.

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- From each Triplets a radial Spokes is arises & end at protein Hub or Central Hub.
- At the Centre protein hub is present.
- Protein hub is also called Central hub.
- All triplets microtubules are attached to each other at the angle of 40°

★ **Function of Centrosome & Centrioles :-**

- formation of Spindle fibres.
- formation of nucleolus.
- Initiation of cell division.
- formation of cell plate.

★ MICROBODIES

- Microbodies are derived by Endoplasmic reticulum.
- **Microbodies having Varies type -**

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(i) Sphaerosome
(ii) Peroxisome
(iii) Glyoxysome
(iv) Lomasome

- **Sphaerosome :-**

- It is also Called "Oleosome".
- It is discovered by "Hanstein" & term given by "perner."
- It is found in plant only.
- It is also Called plant lysosome.
- It was first time observed in Ground nut.
- It is used to store and Synthesis of fat or lipid.



Phospholipid monolayer

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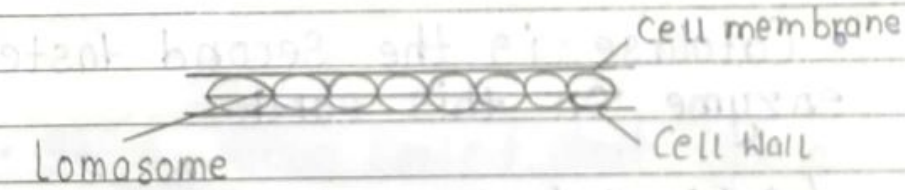
- **Peroxisome :-**
  - It is also called "Uricosome".
  - It contain glycolate Oxidase or peroxidase producing.
  - It is found in plant & animal both.
  - It stores various enzyme like Catalase & peroxidase.
  - Catalase is the second fastest known enzyme on this earth.

    (Acid Anhydrase is the most fastest known enzyme on this earth.)
  - It helps in detoxification of Hydrogen peroxide.
- **Glyoxysomes :-**
  - It was discovered by "Tolbertsand Beevers."
  - It was first time found in fatty sheet of plant.

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- It is used to Convert lipid into Carbohydrate i.e. Glyconeogenesis.

- Lomasome :-
  - It is discovered by "Mcalear."
  - It is Vascular body.
  - It is present between Cell Wall and Cell membrane.



★ NUCLEUS

- Nucleus was discovered by "Robert Brown."
- New nucleus derived from pre-existing Nucleus is experimentally proven by "Straws Burner."
- "Hammer Ling" prove that nucleus is the Controller Of Cell in 'Acetabularia'.

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• Study of nucleus is called "karilogy."

➤ On the basis of number of nucleus cell is of four type —

(i) If nucleus is absent in cell i.e. called 'unnucleated cell'.

Ex:- RBC, Lamb of Camel, Seive tube.

(ii) In a cell only 1 nucleus i.e. called 'uninucleated or mononucleated'.

Ex:- Most of the cell.

(iii) In a cell 2 nucleus is present i.e. called 'Bi/di nucleated.'

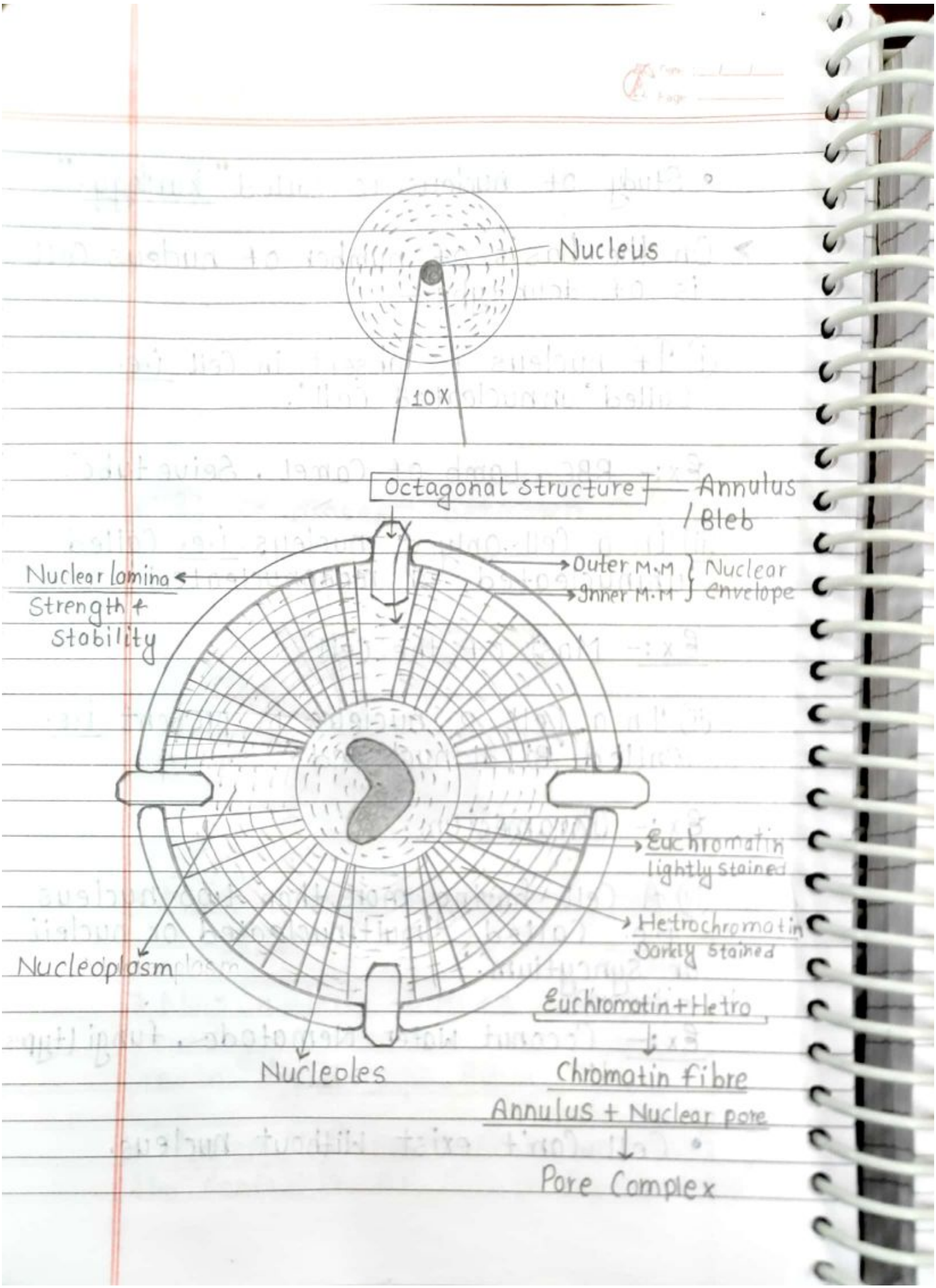
Ex:- Paramecium.

(iv) A cell having more than two nucleus i.e. called 'multinucleated or nucleii or syncytium.'

Ex:- Coconut Water, Nematode, fungi (types)

• Cell can't exist Without nucleus.

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1. Nuclear membrane
2. Nucleolus
3. Nuclear lamina
4. Nucleoplasm
5. Chromatin thread / fibre

Nuclear membrane :-

- It is surrounded by two layer :

i) Outer membrane
ii) Inner membrane

- Inner and Outer membrane is collectively called "Nuclear envelope."
- Nuclear membrane is not a continuous layer.
- Nuclear membrane is discontinuous layer & form a pore that pore is called Nuclear pore.
- At each nuclear pore an Octagonal structure is present i.e. called Annulus or Bleb.
- It is made up of a special type of protein i.e. called Nucleoplasmin.

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- Nuclear pore + Annulus = Pore Complex

- Through pore Complex material is transported between Cytoplasm and Nucleoplasm.

Nucleolus :-

- It is a Spherical (irregular), Naked, membraneless surrounded by amorphous material. Usually in a nucleus only One nucleolus is present. While in mamalions it found five in number.

- Nucleolus is mainly made up of DNA, RNA and protein.

- Nucleolus formed by chromosome or Chromatin fiber. At their Specific site and that site name is Called NOR.

NOR - Nucleolus Organizing reason.

- It is the Site of protein Synthesis.

- In nucleolus Only protein get fused but in actual protein

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is Synthesized in Cytoplasm.

- Nucleolus is the Site for ribosome Synthesis. So, it is also Called Ribosome factory or protein factory.

Nuclear Lamina :-

- It is a another layer of fibrous layer.
- It provide Strength and Stability.
- It is made up of Lamin protein.
- In the absence of Nuclear lamina a disease progeria is happen. (Early ageing)

Nucleoplasm :-

- It is also Called "karioplasm."
- Ground Substance of Nucleus is filled with Nucleoplasm.
- It Contain DNA, RNA, Nucleotide + Chromatin fiber.
- Nucleoplasm Contain Various type of

Scanned with CamSca

enzyme that is associated with DNA to DNA formation then DNA to RNA then RNA to DNA formation.

Chromatin fiber :-

- It was discovered by flaming.
- Chromatin fiber is thread like structure.
- Chromatin fiber is made up of DNA and Histone protein.
- DNA is a type of Nucleic Acid.

➤ Nucleic acid is of two type :-

(i) RNA
(ii) DNA

DNA

- DNA is made up of Nitrogeneous base (N-base) + Pentose Sugar + Phosphate.

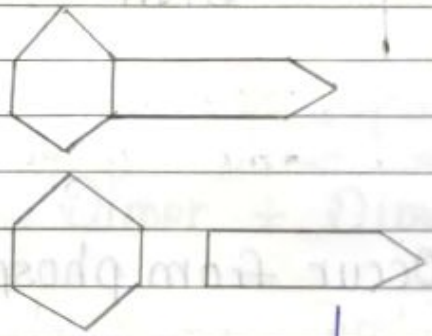
➤ Nitrogenous base is of two type:-

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(i) Purin
(ii) Pyrimidine

Purin

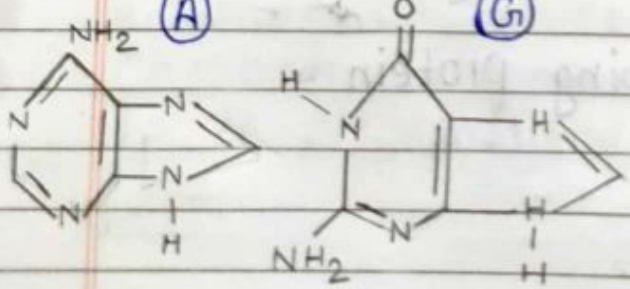
- It is made up of Pyrimidine ring & Imidazole ring.



Pyrimidine ring | Imidazole ring

- Purin is of two type –

Adenin (A) | Guanine (G)



Pyrimidine

- It is made up of Pyrimidine ring.



Pyrimidine ring.

- Pyrimidine is of three type –

Cytosine (C) | Thymine (T) | Uracil (U)

It is only found in RNA at the place of thymine.

Scanned with CamSca

➤ Pentose Sugar is of two type :-

(i) Ribose Sugar
(ii) Deoxyribose Sugar

Ribose Sugar	Deoxyribose Sugar
• It is found in RNA.	• It is found in DNA.

➤ Phosphate

• Phosphate is Occur from phospheric Acid.

• DNA is Acidic and Negatively charge.

• Histone protein is +vely charge & basic in nature.

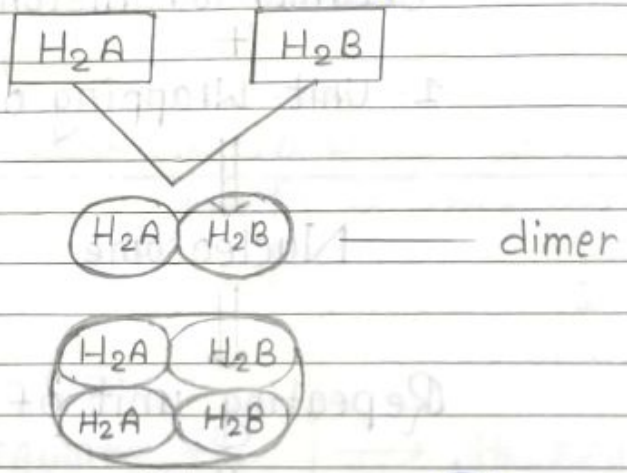
• It is used in Ordering & Packeging.

➤ It is of four type :-

(i) H_1 ⟶ Cliping protein
(ii) H_2 → H_2A, H_2B
(iii) H_3
(iv) H_4

Scanned with CamSca

- H_2A & H_2B Combine & form dimer & tetramer respectively.



Dimer + Dimer ⟶ Tetramer

- H_3 & H_4 Combines form dimer & tetramer respectively.
- Both tetramer mixed together and form Octamer i.e. called Octamer of Histone.
- On Octamer unit Wrapping of DNA is Occur i.e. called Nucleosome.
- Sucessive Structure nucleosome form Chromatin thread & further it Convert in to chromatin fiber.

Scanned with CamSca

Chromatin fiber

→ Octamer of Histone
+
1 Unit Wrapping of DNA

⇓

Nucleosome

⇓

Repeating unit of Nucleosome

⇓

Chromatid
+
Centromere

⇓

Chromosome

★ **Euchromatin**

→ Lightly stained

Transcriptionally & Genetically more Active

Scanned with CamSca

★ Hetrochromatin

→ Darkly stained

Transcriptionally & Genetically less Active

Constitative	Facultative
→ It regulate the regular type of Gene.	→ It regulate the Special type of Gene.
Ex:- Lac Operon.	Ex:- Bar body.

★ Bar body = Total number of x-chromosome − 1 x-chromosome

Female	Male
XX	XY
2X − 1X	2X − 1X
Bar body = 1	Bar body = 0

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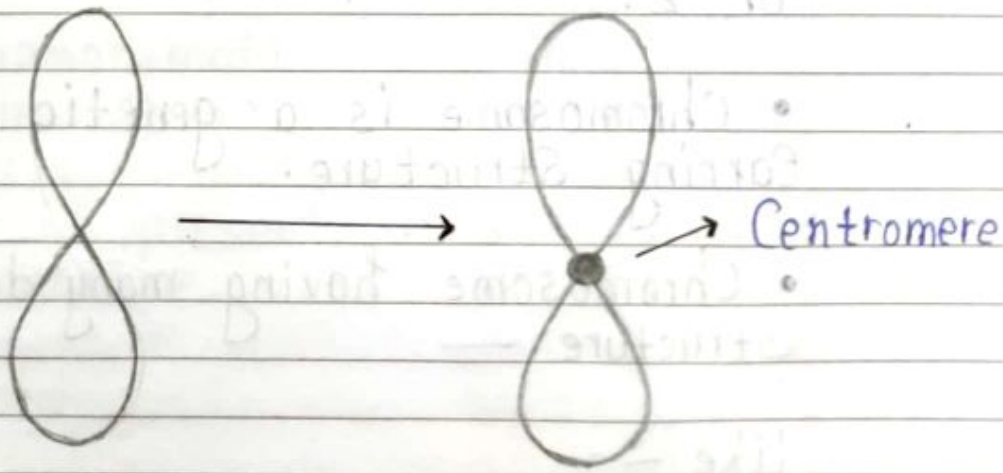
★ CHROMOSOME

- Chromosome Was discovered by "Straws Burger."
- Term chromosome Was given by "Waldeyer" & "Hertz."
- Chromosome is Composed of DNA & Histone protein.
- Number of chromosome Varies from Species to Species.
- Usually in Animal more number of chromosome are found Compare to plant.
- Size of chromosome is larger in plant Compare to plant.
- Size and Complexity of an organism is not depend On Chromosome.

➤ Number of Chromosome in different Organism :-

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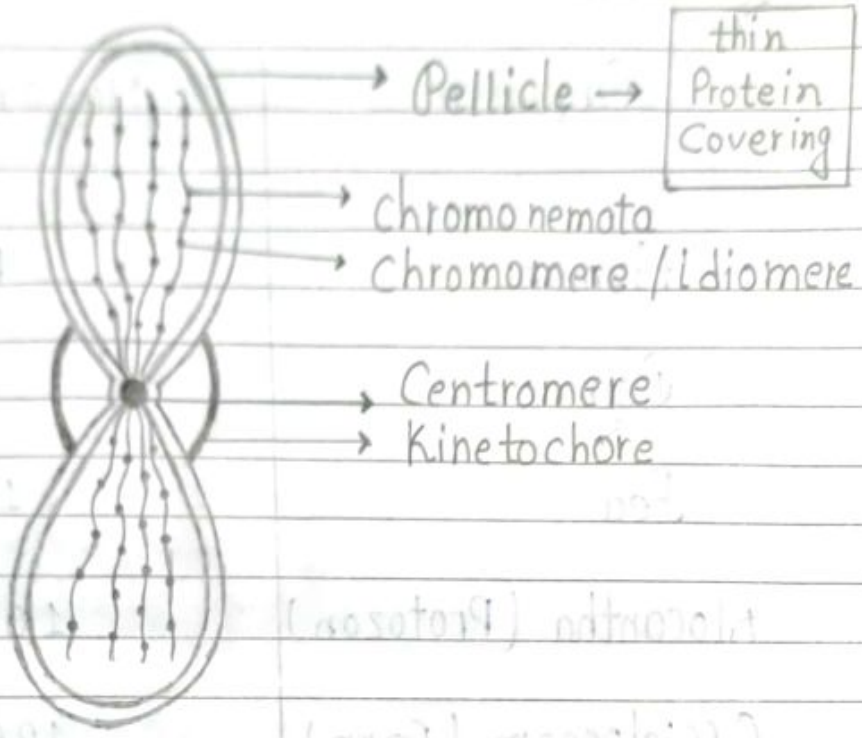
Organism	No. of chromosome
Human	46
Dog	78
Pea	14
Alocantha (Protozon)	1600
Offiglossom (fern)	1262
House fly or fruit fly (Drosophilla melanogaster)	8



Chromatid — Chromosome

10 x

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- Chromatin is a Cylindrical structure of Chromosome.
- It is main part of chromosome.
- In which it's number may be 1 or 2.
- Chromosome is a genetic material Carring structure.
- Chromosome having many distinct structure —

Like —

Scanned with CamSca

(i) Pellicle

- Thin Proteinaceous Covering of chromatid of chromosome.
- It is Achromatic (Colourless & Stained resistant).

(ii) Kinetochore

- A disc like proteinaceous structure Surrounded to the Centromere of Chromosome.
- During Cell division microtubular Spindle fiber it attach with kinetochore.

(iii) Chromonemata

- Chromonemata are Spiraly Coilled filamentous structure.
- It is present in to matrix of chromosome.

(iv) Matrix

- It is Ground Substance of chromosome.

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• It is non-genetic material & a chromatid substance.

(v) Chromomere

• It is also called idiomere.

• It is Spiraly arranged on chromonemata as a matrix or granular substance.

(vi) Centromere

• It is also called primary constriction.

• It is present at centre of both the arm. Which is used to constrict both arm.

• It is attached with both arm of chromosome rather there no. may be two or more.

• Primary constriction is centre of chromosome but there location may be change and chromosome formed different type of structure.

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- Tip of the chromosome is Called Telomere.
- Telomeric end is rich of Guanine.
- Guanine is used to prevent from attachment of other chromosome or other material.

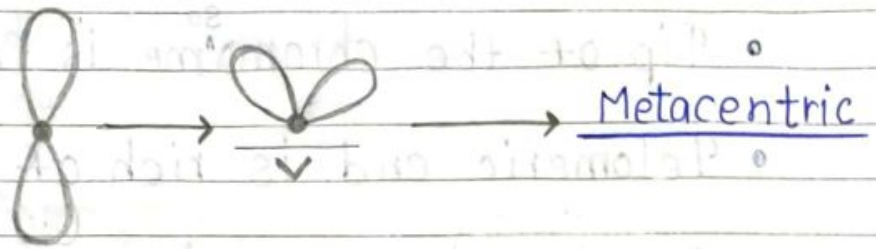
SAT Chromosome

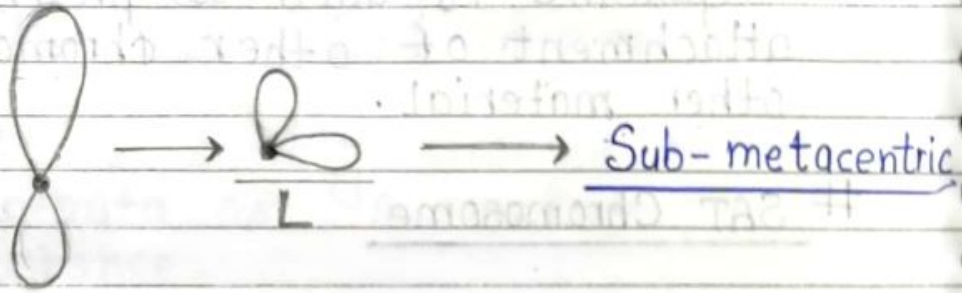


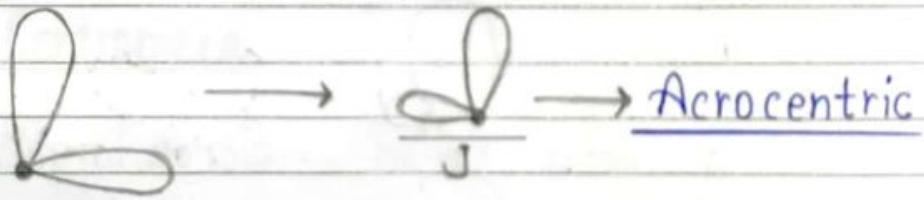
- A chromosome having Secondary Constriction Where Satellite chromosome formed.
- Secondary Constriction is formed due to absence or lack of Guanine.

> On the basis of position of Centromere Chromosome is of five type :-

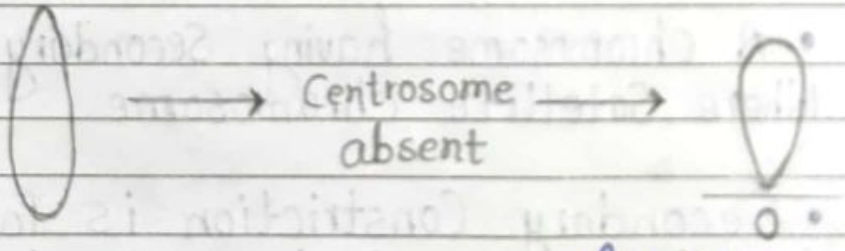
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