



Varsity 'Ka' admission Program 2020

BIOLOGY

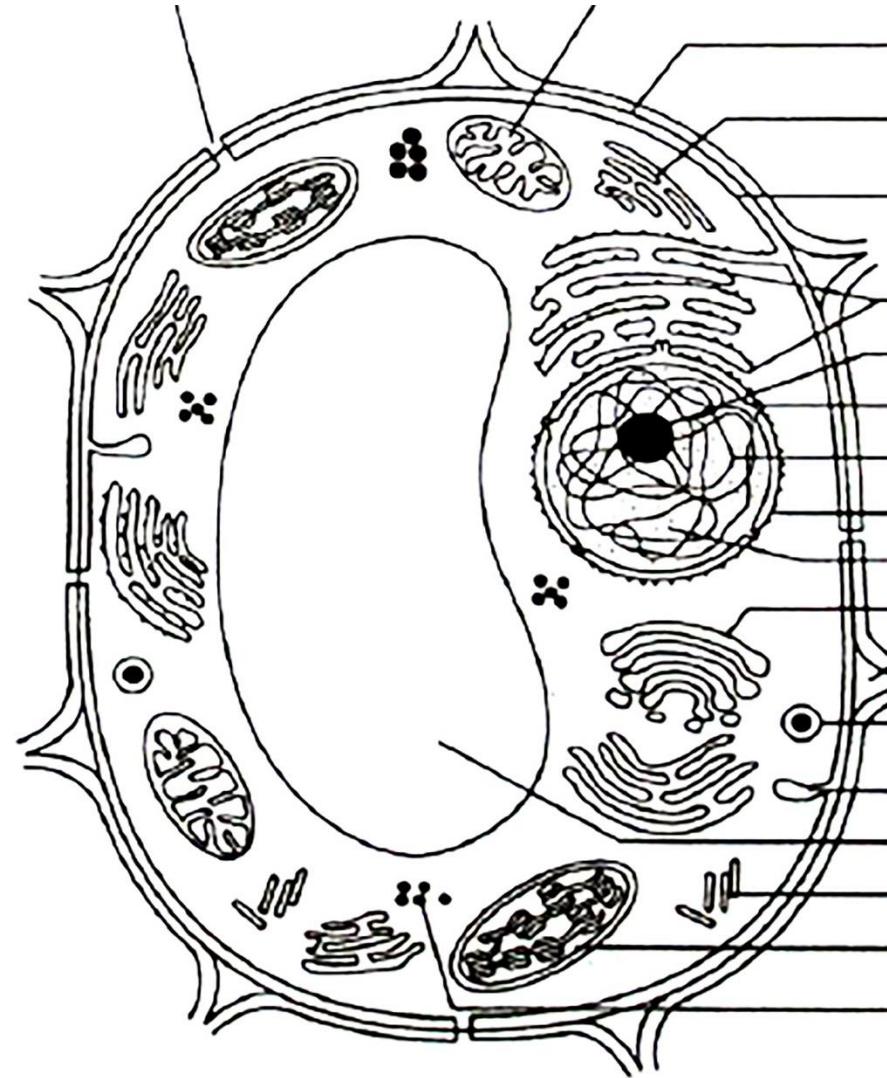
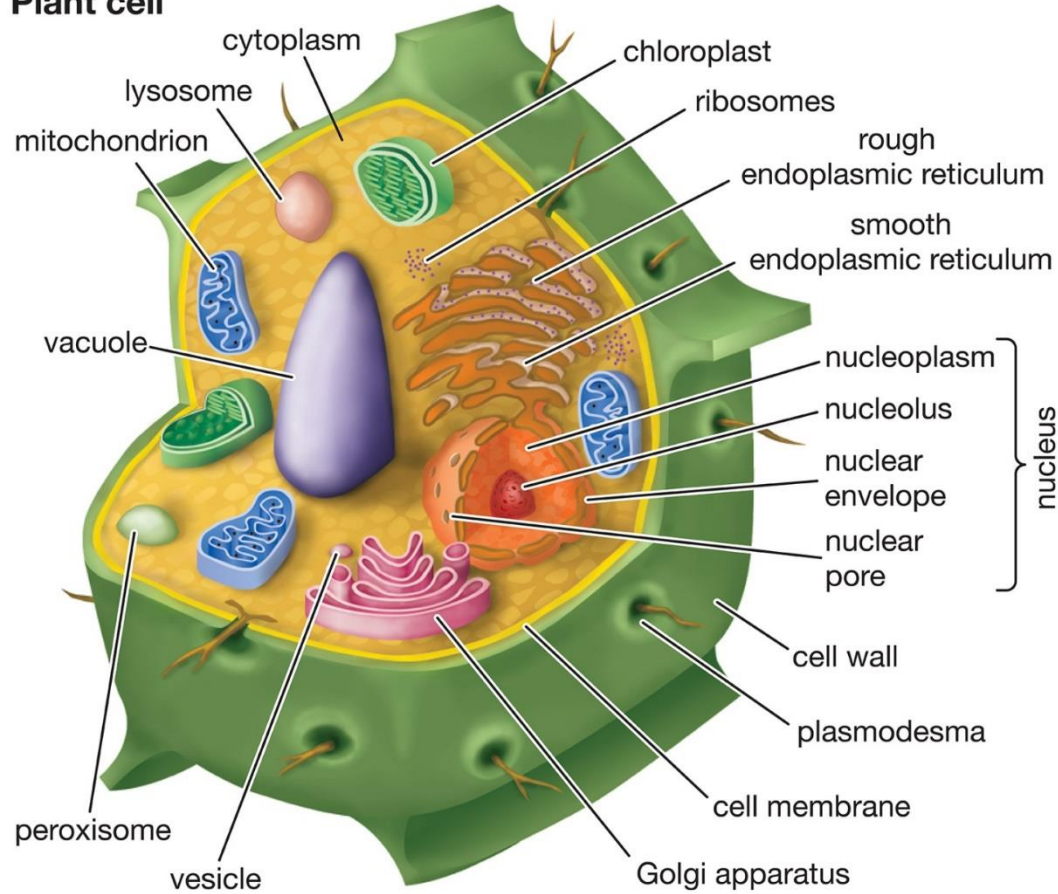
Lecture : B-01

Chapter 1 : Cell and its structure (up to chromosome)



Cell

Plant cell



First things First

MCO,
✓ Admission

- Chanee ✓
- Multiple names ✓
- Invention & Discovery ✓
- Functions of organelles ✓

CO
✓ HSC

- fluid mosaic
- Mitochondria
- Plastid
- Centriole
- Nucleus
- Chromosome
- Lysosomes

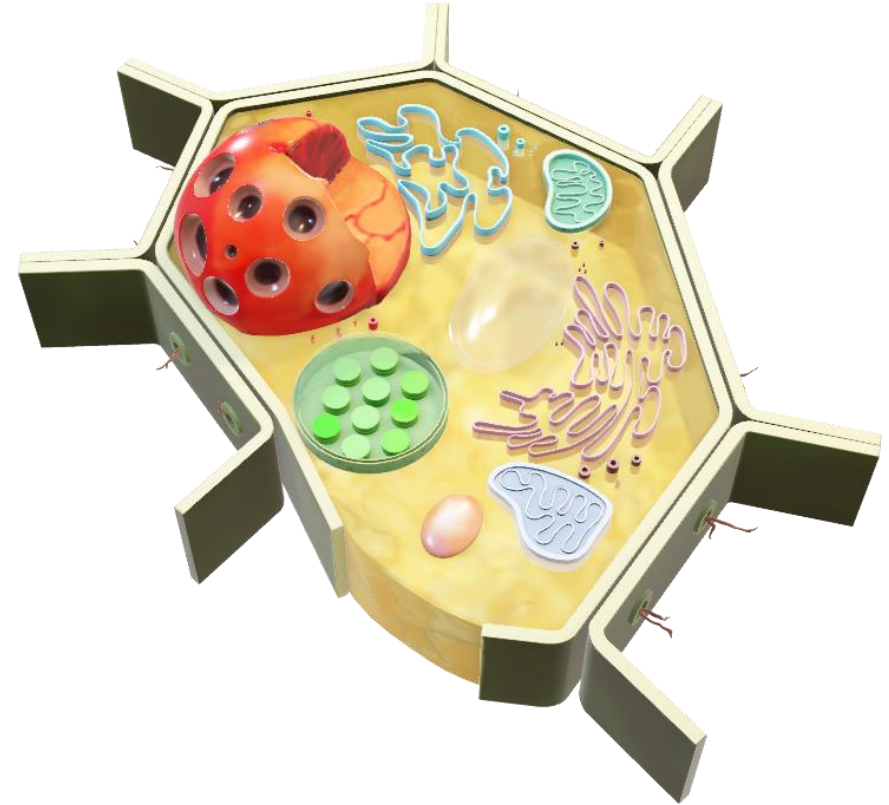
Cell

Cell nomenclature:

- Robert Hooke first noticed the cell and cell wall in 1665 using a microscope. He reported his findings in his book,

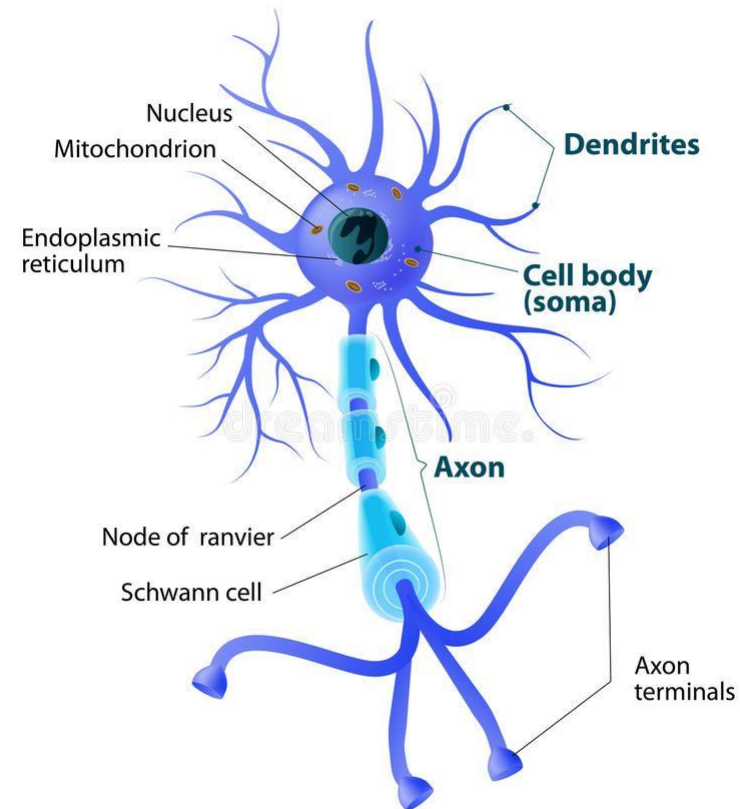
✓ Micrographia.
small = cell is small

- Carl P. Swanson is the father of Modern Cytology.



NTK- (Need to Know)

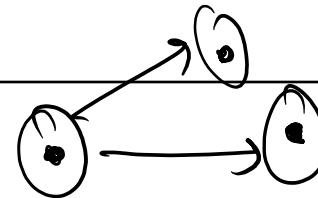
- Ostrich egg is the **largest cell** (17 cm × 12.5 cm). mca
- The **smallest cell** - Mycoplasma. Its name is PPLO (Pleuro Pneumonia Like Organism) mca
- Human neuron cells are around 1.37 m long mca
✓ (**longest cell** of the human body).



Cell theory

$$(a+b)^2 = a^2 + 2ab + b^2$$

Proponent	<ul style="list-style-type: none">• Mathias Jakob Schleiden• Theodor Schwann <i>mca</i>
Theory	<ol style="list-style-type: none">1. Cells are <u>structural</u>, <u>functional</u> and <u>organizational</u> units of living <u>organisms</u>.2. Cells are the fundamental units of life.3. Cells are <u>genetic</u> units. ✓ <i>Cell → Nucleus → Chromosome → DNA → Gene.</i>4. All types of organisms are made up of one or more cells, and new cells are formed from the previously formed cells. ✓



Types of cell

01. On the basis of physiological function

(a) Somatic cell ✓✓ → (2n)

(b) Germ cell or gamete

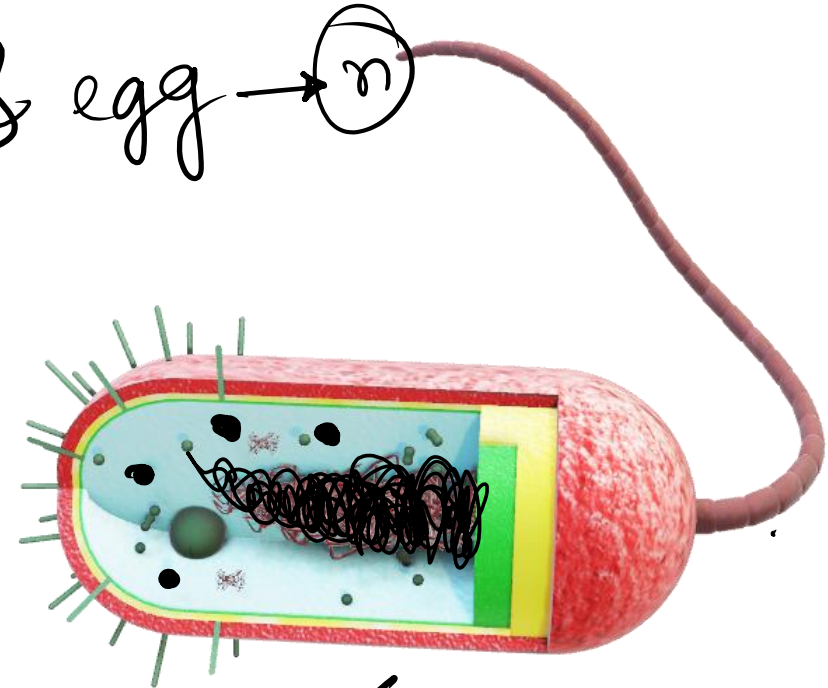
sperm & egg → (n)

02. Based on the structure of nucleus

(a) Prokaryotic cell ✓✓

(b) Eukaryotic cell ✓✓

(স্নাই & স্নাই)



✓✓ Bacteria = Unicellular
1 cell

POLL QUESTION 1

In which of the following organisms primitive cell is present?

(a) Bryophytes

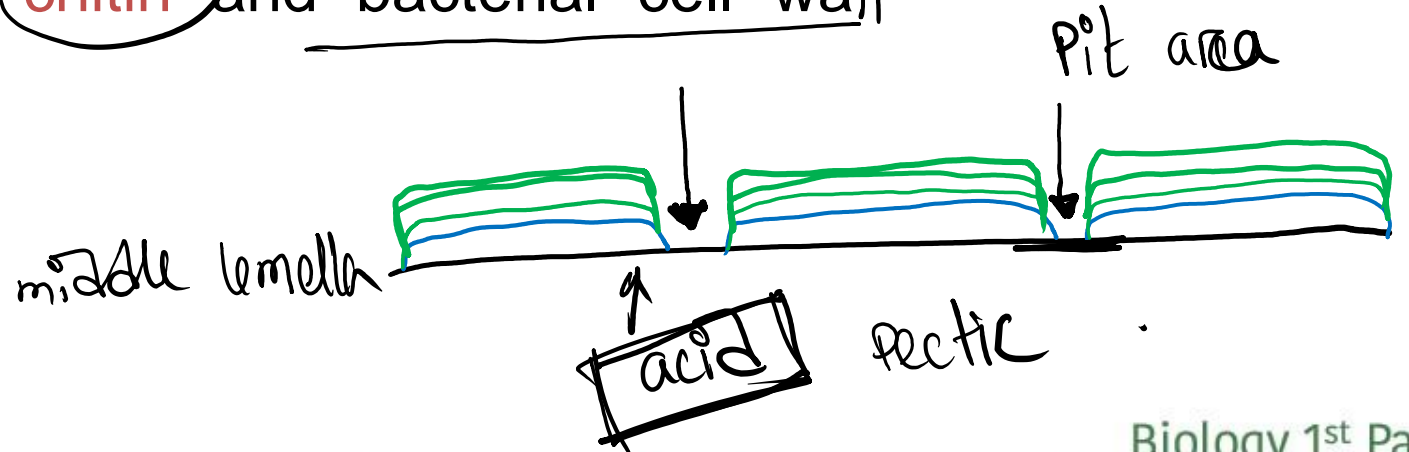
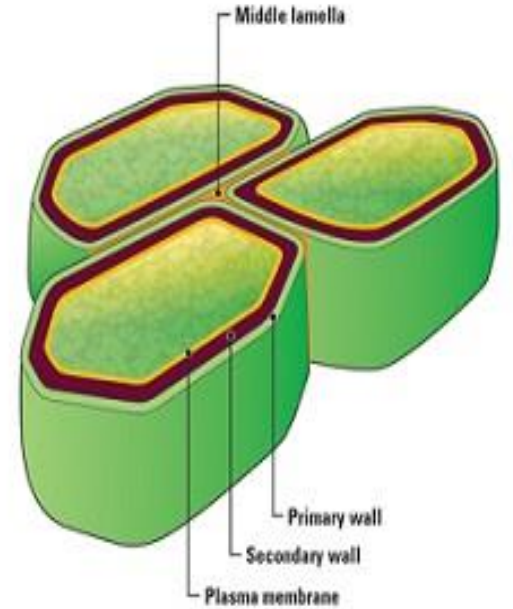
(b) Fungi

(c) Algae

(d) Bacteria

Cell wall

- Cell wall is a unique feature of plant cells. ✓✓
- Primary cell wall is not formed around the pit area.
- The middle lamella starts to form during telophase
- Middle lamella contains large amounts of pectic acid
- Primary wall mainly contains cellulose, hemicellulose a glycoprotein.
- Lignin and pectin accumulate in the secondary cell wall it consists of **3 layers**.
- Fungal cell wall is made of chitin and bacterial cell wall is made of a lipid-protein

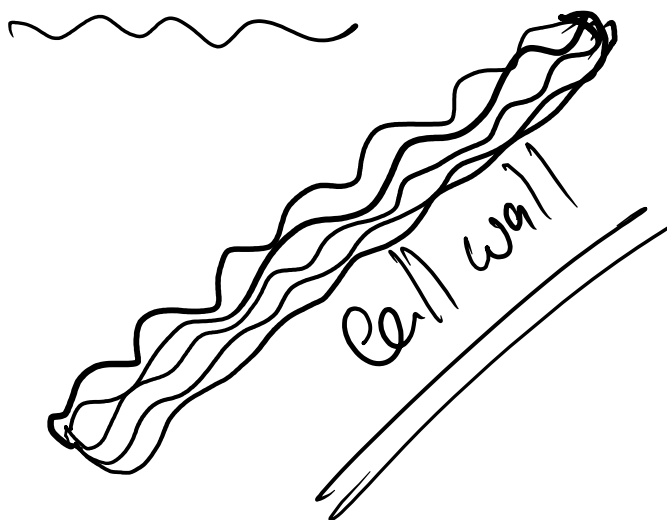


The microscopic structure of cell wall

- ❖ Many β - D glucose molecules = Cellulose
- ❖ 1-3 thousand Cellulose molecules = Cellulose chain
- ❖ Around 100 Cellulose chain = Crystalline Micelles
 (Smallest structural unit of Cell wall.)
- ❖ 20 micelles = Microfibril (This is the main structural unit of cell wall)
- ❖ 250 microfibril = Macrofibril
- ❖ Many macrofibrils = Fibre

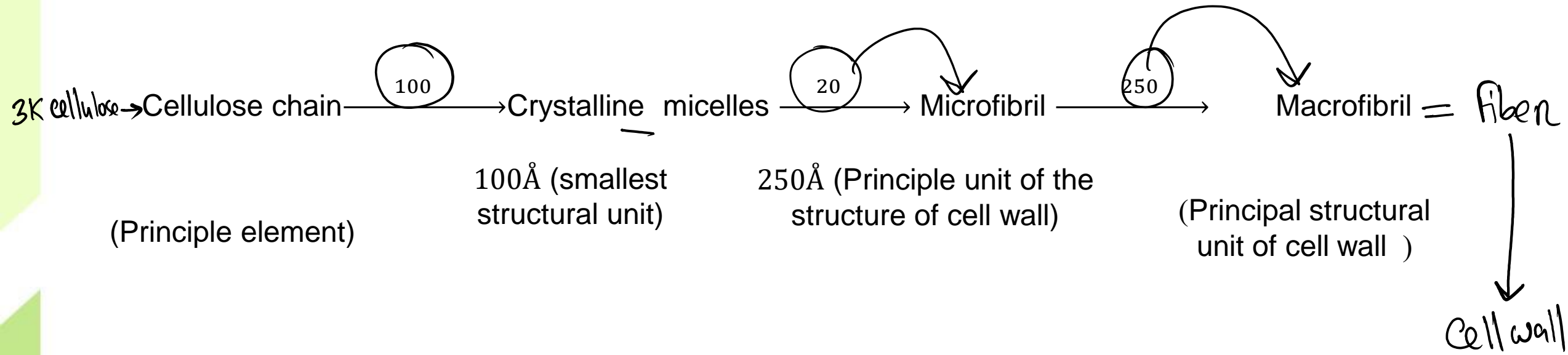
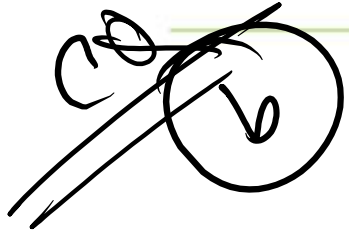
MCA
S.I.
↑↑

mca mca



-C-C-C-C-C- = chain
 (1-3K)
 100 chain = micelle.
 20 micelles = microfibril
 250 microfibril = macrofibril

The microscopic structure of cell wall



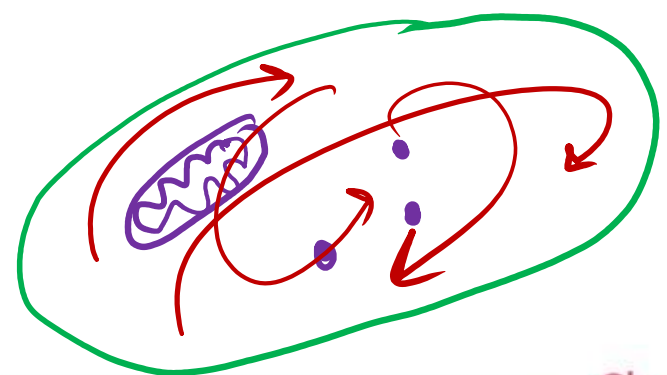
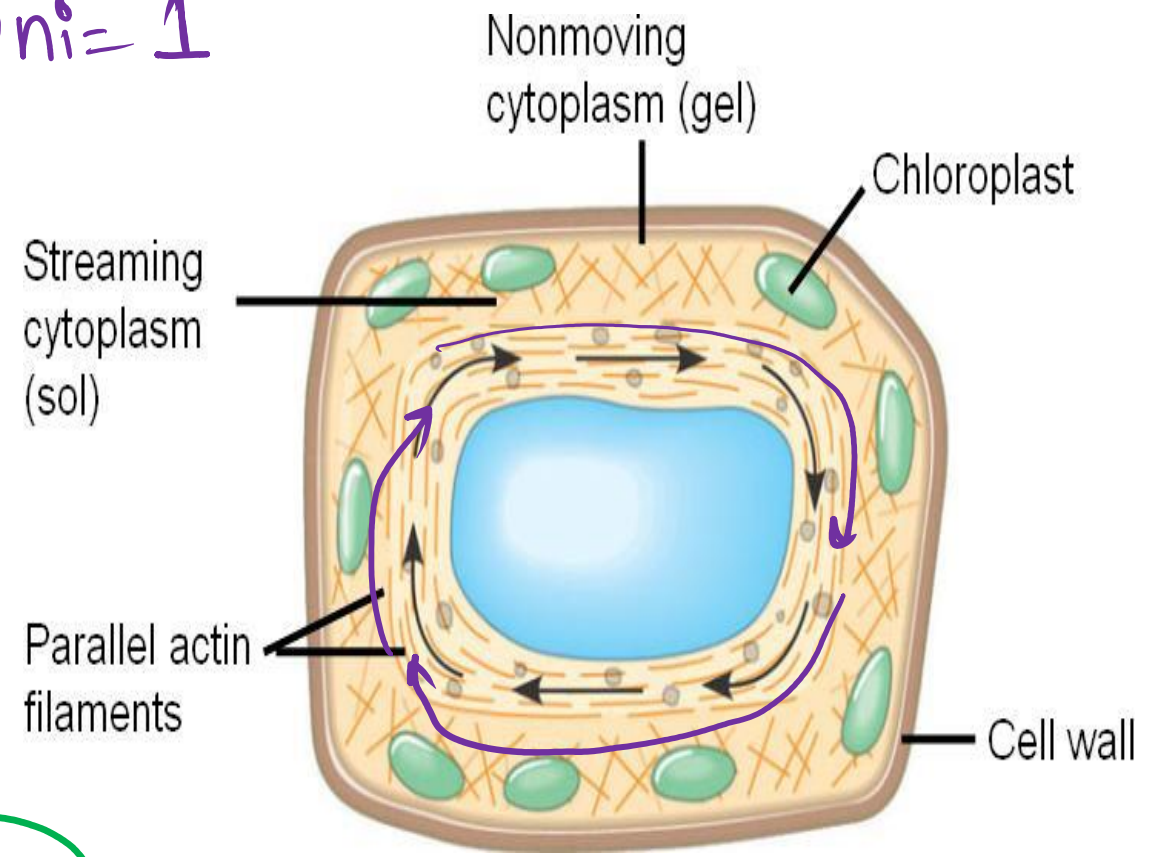
Locomotion of protoplasm = 2 mcq

Uni = 1

□ Cyclosis

a. Unidirectional movement or rotation:
cellular protoplasm of *Pata jhaji/Chara corallina*.

b. Multidirectional movement or circulation:
cellular protoplasm of *Tradescantia*.



Plasma membrane or cell membrane

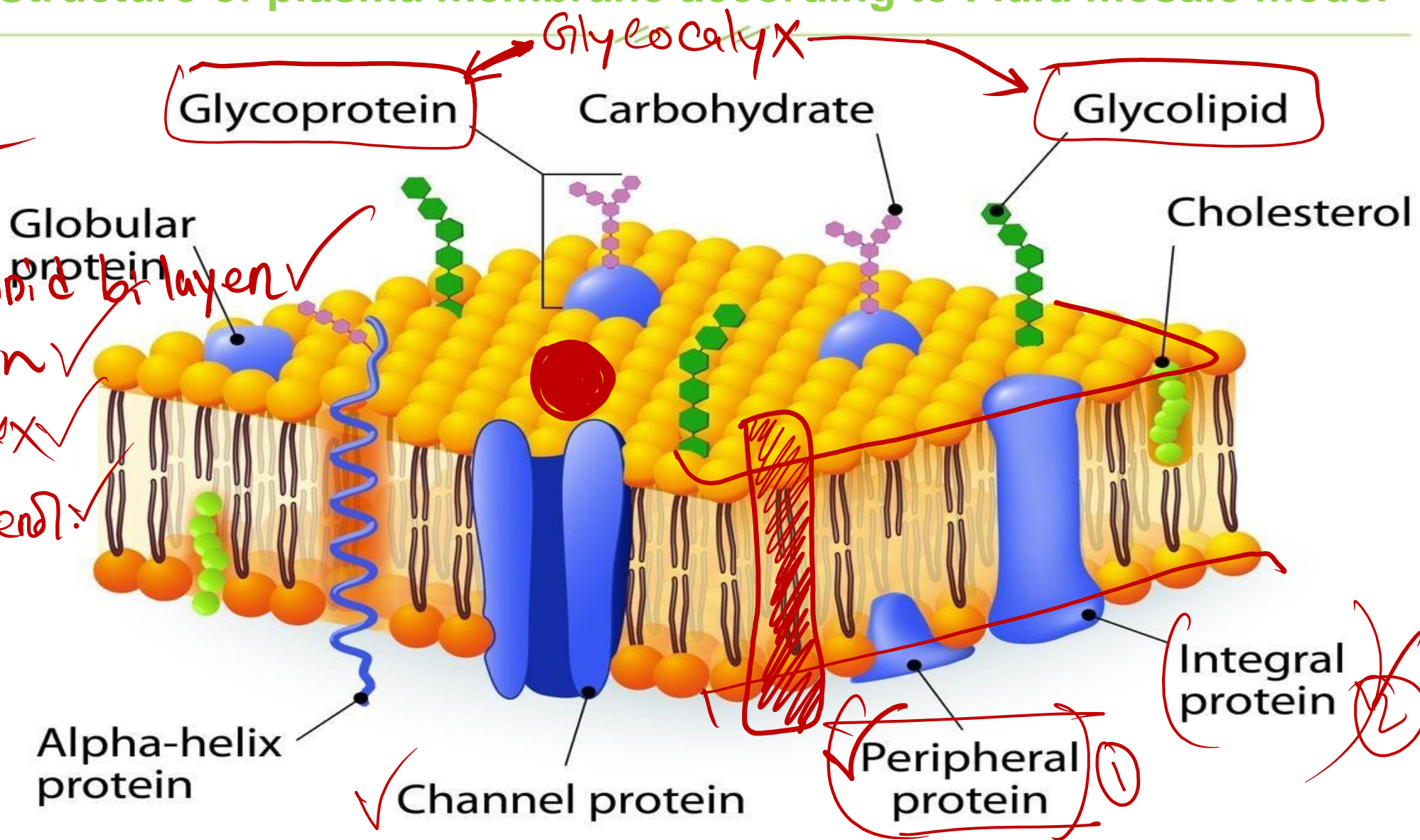
Different models related to structure and composition of plasma membrane:

Name of the model	Scientist
• Sandwich model (bilayer model) - first definite model	<u>Danielli</u> & <u>Davson</u> ✓
• Lipid-protein trilayer model	Danielli & Schmitt
• Unit membrane hypothesis	Robertson
• Fluid mosaic model or Iceberg model	<u>Singer</u> & <u>Nicolson</u> ✓
• Protein crystal model	Vanderkoff & Green

Structure of plasma membrane according to Fluid mosaic model

L.P.
bi=2

1. Phospholipid bilayer ✓
2. Protein ✓
3. Glycocalyx ✓
4. Cholesterol ✓



Functions of cell membrane

1. This surrounds everything in the cell.
2. Protects the internal contents of the cell from outer adverse environment.
3. Transfer of substances occurs through cells ✓
4. Can synthesize various macro-molecules.
5. Also has a role in mutual bonding, growth and locomotion.
6. Transmits nerve stimuli.

POLL QUESTION 02

According to fluid mosaic model, which is not a structural ingredient of cell membrane?

- (a) Starch
- (b) Cholesterol
- (c) Lipid bilayer
- (d) Membrane protein

Ribosome = Protein

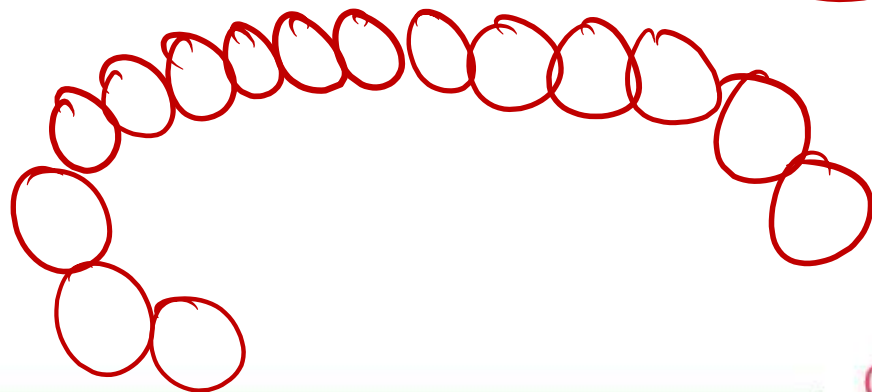
mca

- Albert Claude noticed organelles containing RNA after centrifuging cytoplasm of liver cells and named them microsomes.
- Richard B. Roberts named it ribosome
- Protein synthesis is the main function of ribosome. Also metabolize Lipids
- When many ribosomes are arranged as pearl necklace in the cytoplasm is known as Polyribosome or polysome

mca

mca

mca



Production = Protein
Use = Lipid

Ribosome

- **70S Ribosome (50S + 30S)**

- ✓ Found in prokaryotes

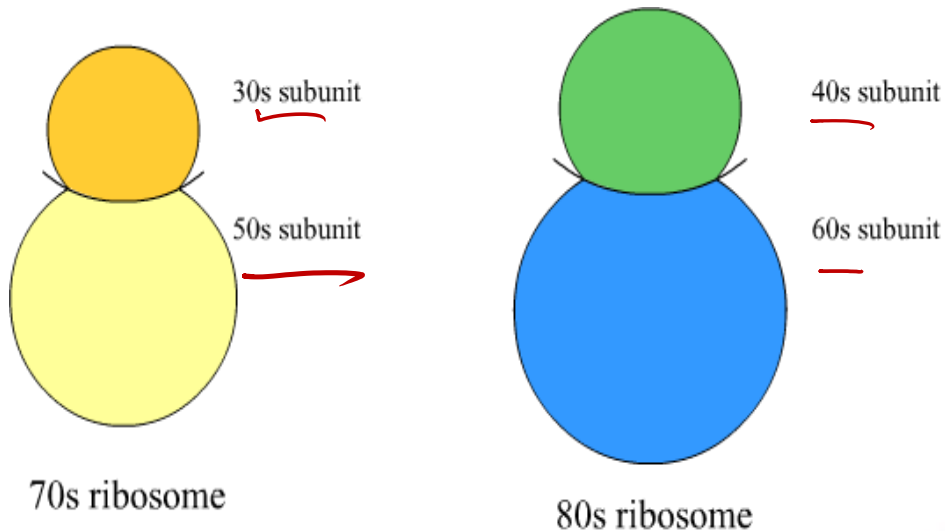
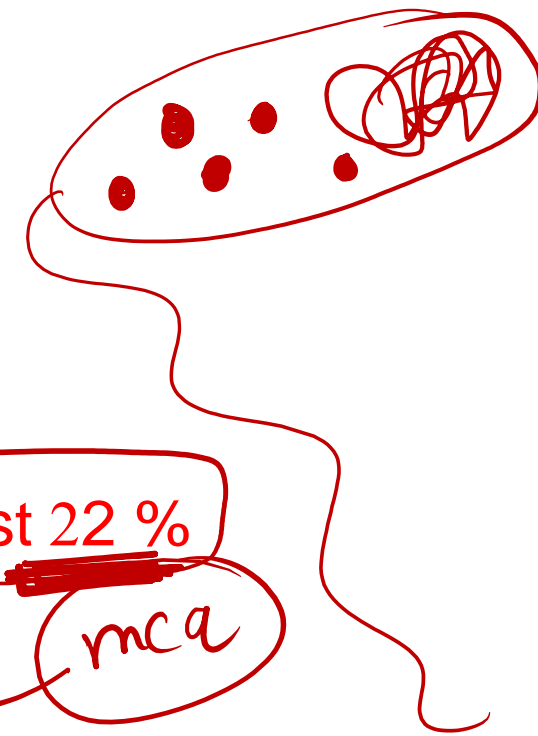
- ✓ Made of 3 rRNA molecules and 52 types of proteins.

- **80S Ribosome (60S + 40S)**

- ✓ Found in eukaryotes.

- ✓ Made of 4 rRNA molecules and 80 types of proteins.

In bacterial cell (*E. coli*) the amount of ribosome is almost 22 %



POLL QUESTION 03

Which synthesizes protein and metabolizes lipid?

- (a) Golgi body
- (b) Ribosome
- (c) Mitochondria
- (d) Endoplasmic reticulum

Golgi body

- ❑ Italian neurologist, **Camillo Golgi**, saw these in the **neurons** of owls and cats
- ❑ originated from smooth endoplasmic reticulum
- ❑ Golgi body membrane is 60% protein and 40% lipid. It contains fatty acids and Carotenoids

mca

mca

vitamin-K

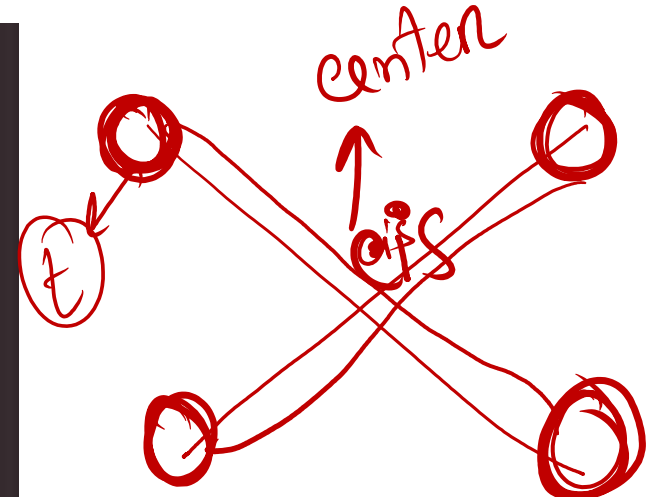
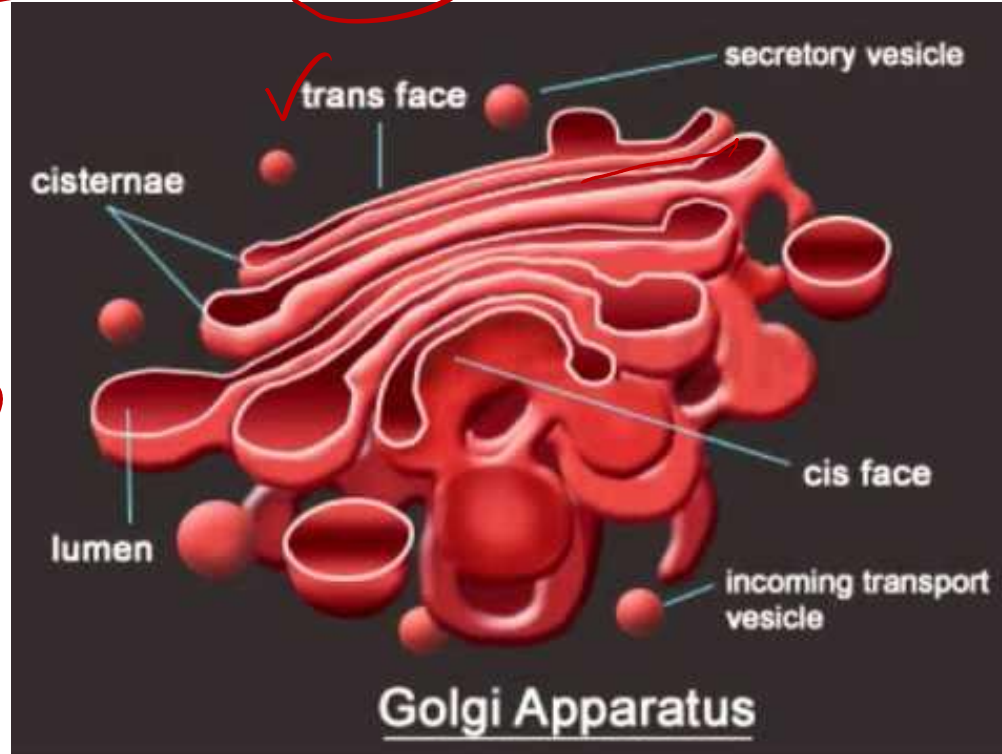
L.P.

Flat

Cis
Trans

Types:

- 1. Cisternae
- 2. Vesicle
- 3. Vacuole

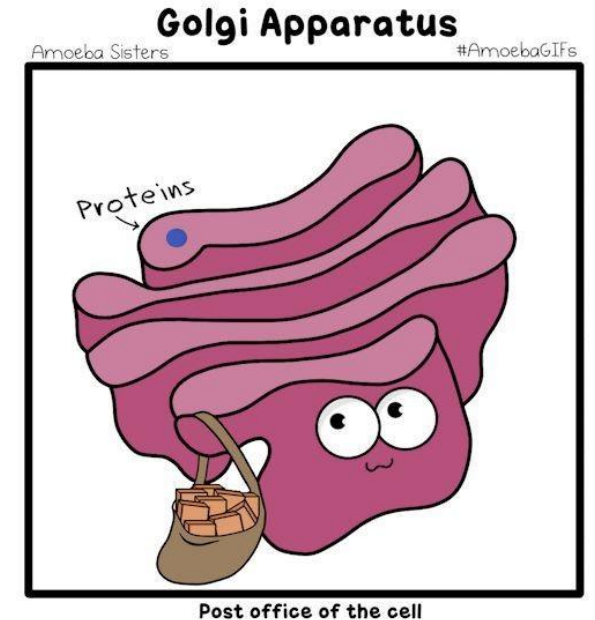
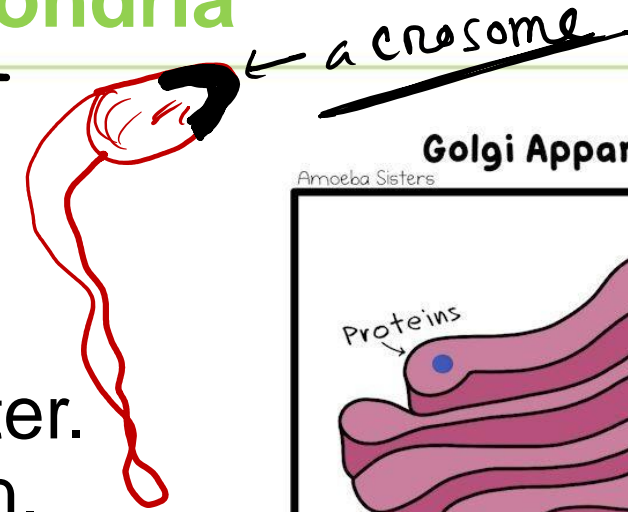


Golgi Complex/ Lypochondria

Function:-

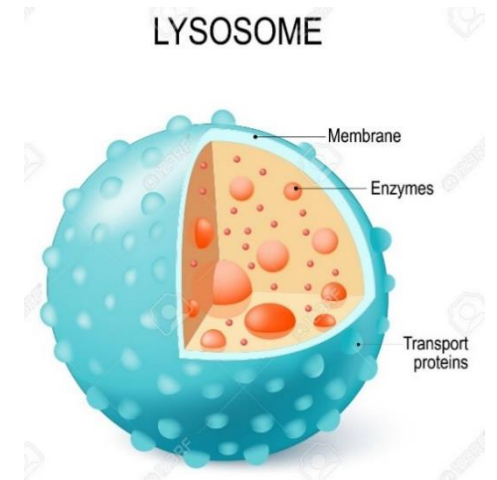
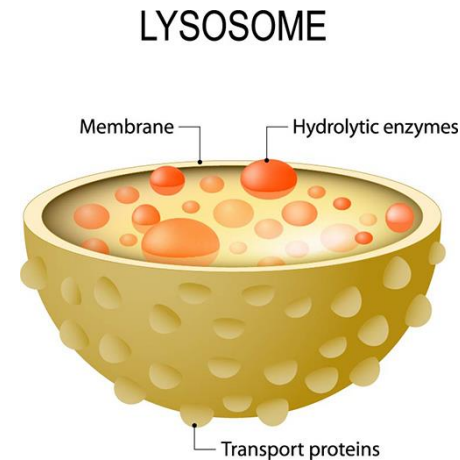
1. Synthesis of lysosomes and vitamins.
2. Synthesis of non-protein substances.
3. Secretion of enzymes, hormones and water.
4. Formation of cell plate during cell division.
5. Packaging of prepared food particles in reticulum.
6. Storage of protein and Vit-K
7. Secretion of substances necessary for cell wall synthesis.
8. Helps to form acrosome in sperm.

***Golgi body in plant cells is called carbohydrate factory.



Lysosome

- ❑ Named by de Duve.
- ❑ Originated from endoplasmic reticulum and packaged by golgi bodies.
- ❑ WBCs of animals have plenty of lysosomes
- ~~❑ RBC do not have lysosomes~~
- ❑ Lysosomes of plant cells → Spherosome/ Oleosome
- ❑ Contains **40 types** of enzymes while being enclosed by membrane |
- ❑ Found in LINK (Liver, Intestine, Nerve, Kidney)



Lysosome

Sucidal squad

Functions:

1. Does phagocytosis and pinocytosis.
2. Encloses digestive enzymes and protects other cell organelles.
3. **Autolysis**
4. Can cause cancer //
5. **Hyaluronidase** enzyme secreted by lysosomes of sperm degrades the outer covering of ovum.

✓ O₂ ↓
✓ Hit / injured
✓ Toxic
✓ H₂O ↓

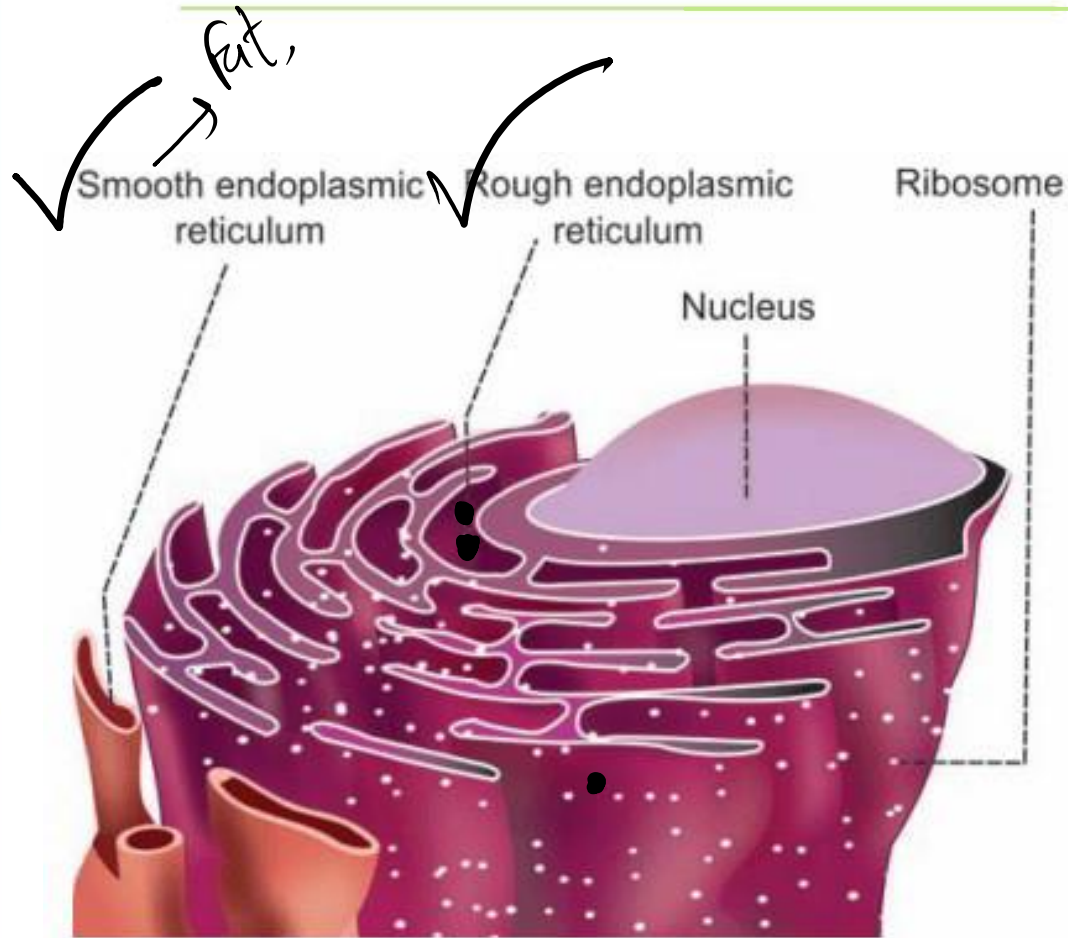


***They are called **sucidal squad** as they destroy useless cells by autolysis.

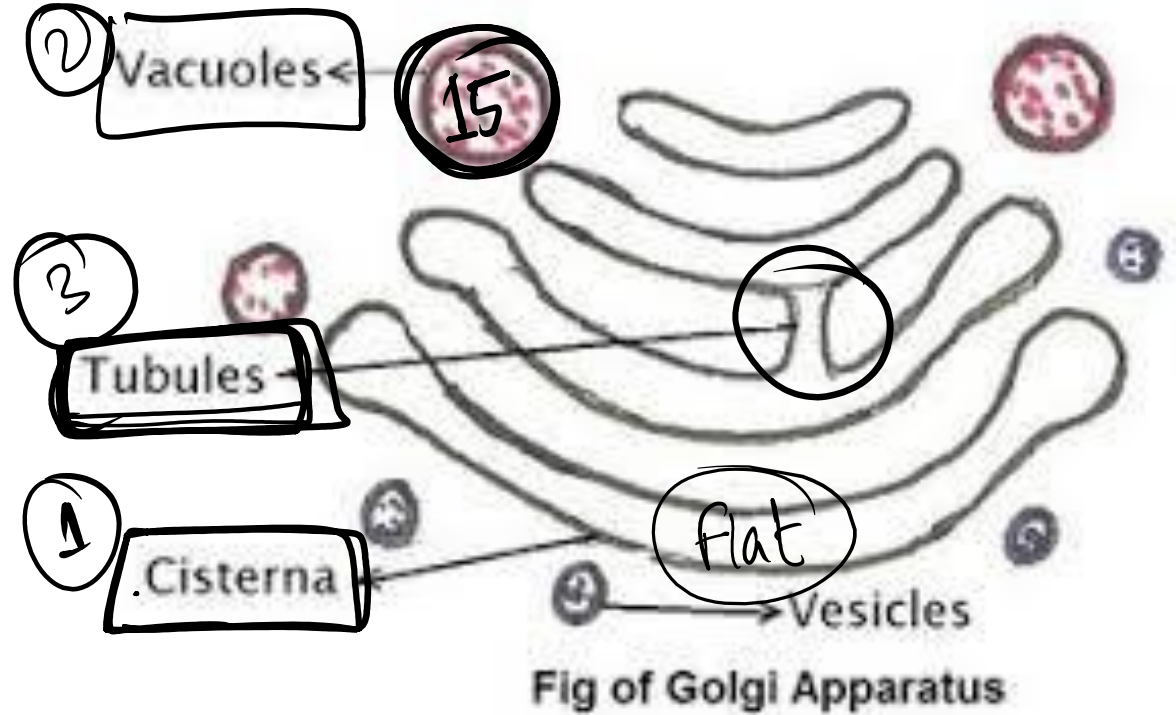
Endoplasmic reticulum

- **K. R. Porter** and his associates first discovered it in liver cells and named it. mca
- **Albert Claude** and Keith Porter discovered from cytoplasm of chicken embryonic cells. mca
- Principal chemical elements are- protein (60-70%) and lipid (30-40%).
- **Almost 15 types of enzymes are found here.** mca
- Small discrete parts of the rough endoplasmic reticulum are called **microsome.** mca

Endoplasmic reticulum



✓ RER = Protein
Ribosome



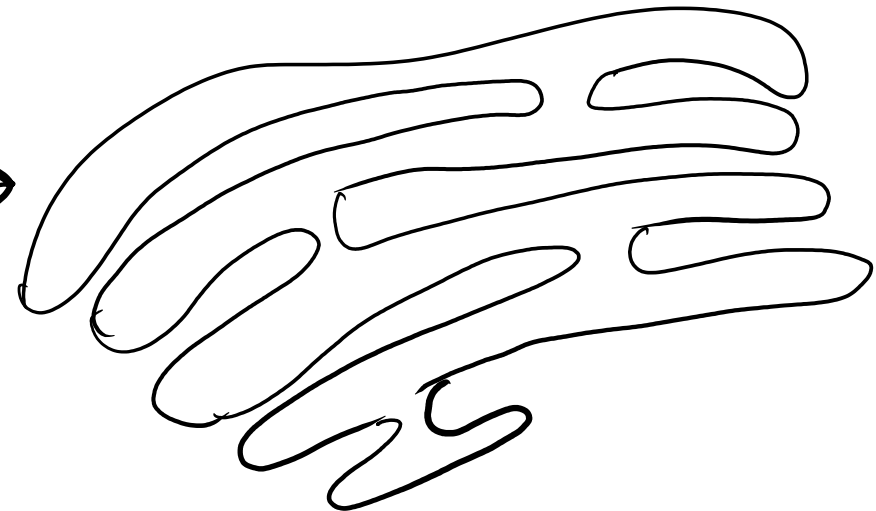
Endoplasmic reticulum

Functions:

1. Acts as frame of protoplasm.
2. Acts as **internal carrier** of lipids and proteins. *mca*
3. **Proteins are synthesized in rough endoplasmic reticulum.** *mca*
4. Lipid, hormone, glycogen, vitamin and steroid are synthesized in smooth endoplasmic reticulum.

5. Neutralizes toxins entering the body.

6. Described as **transport system of cell** *mca*



Mitochondria

❑ **Discovery** **Kolliker**

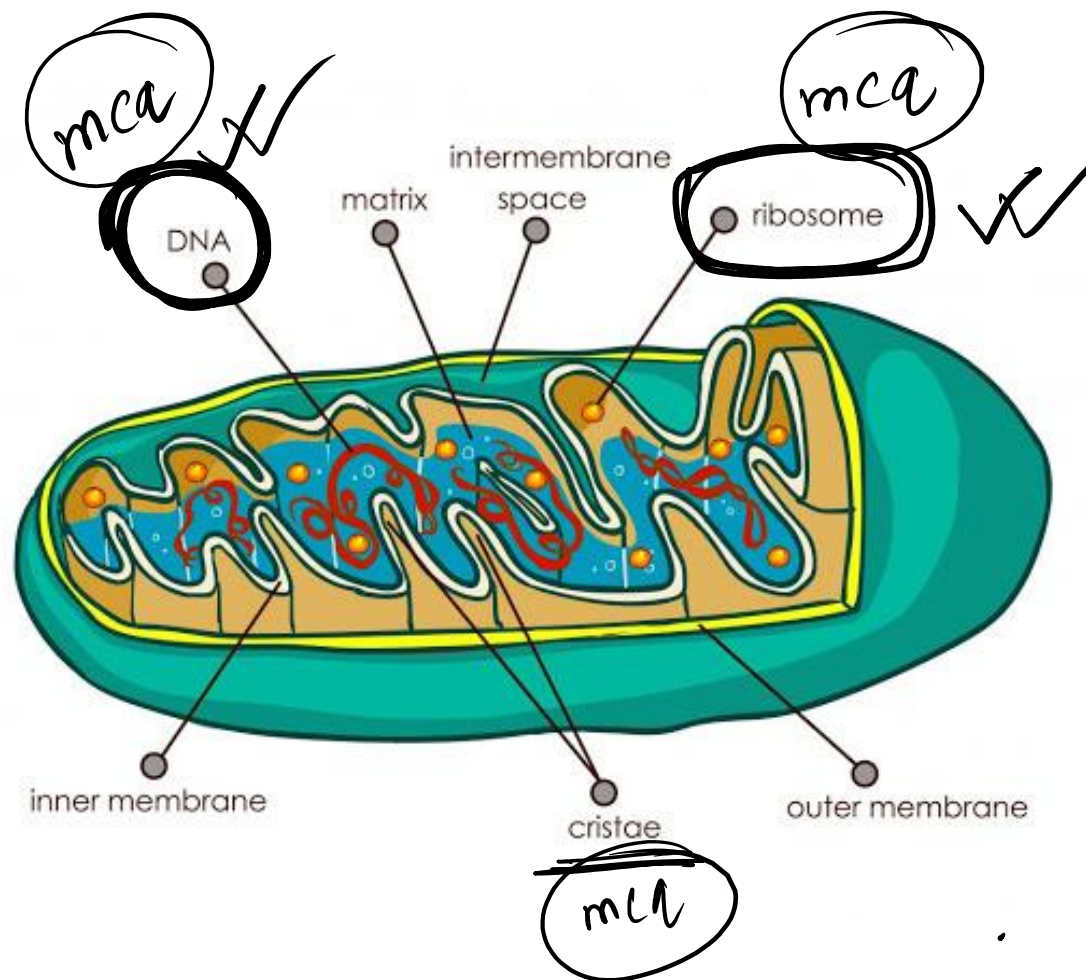
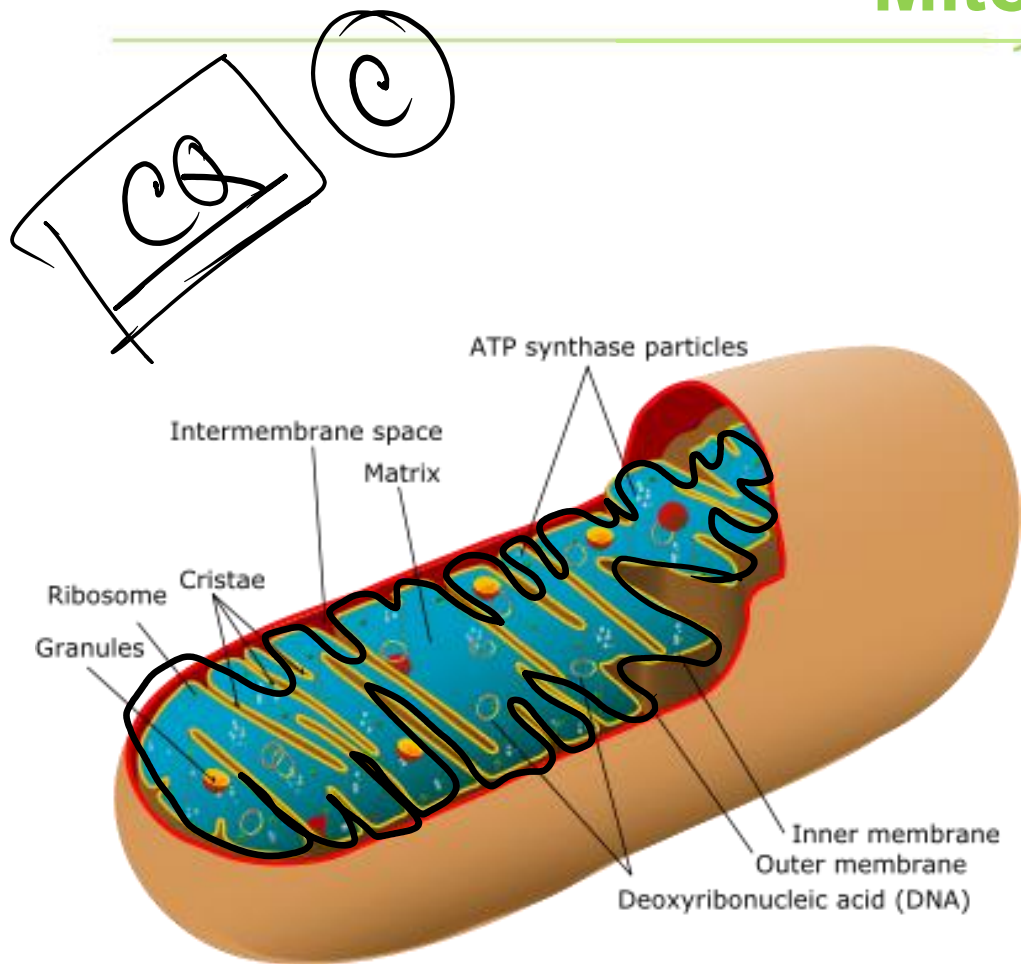
- Normally **300-400** per cell. ✓
- **1,000 or more in liver** cells. ✓
- More in *Amoeba*. ✓

✓ **20 %** of cell volume is mitochondria. **mcl**

❑ There are **100 types** of Enzymes and Co enzymes

This slide mca
S.I. *ARK

Mitochondria



S.I. Slide
~~***~~

Mitochondria

Functions:

1. Produce energy. ✓
2. Helps in lipid metabolism. ✓✓
3. Produces its own RNA, DNA, Ribosome ✓
4. All the reactions of respiration (Krebs cycle, ETS, oxidative phosphorylation) except glycolysis occur in the mitochondria.
5. Helps in sperm and ovum formation.

POLL QUESTION 04

Which of the following organ cells has more mitochondria?

- (a) Skin
- (b) Liver
- (c) Stomach
- (d) Eyes

Plastid

S.T - slide

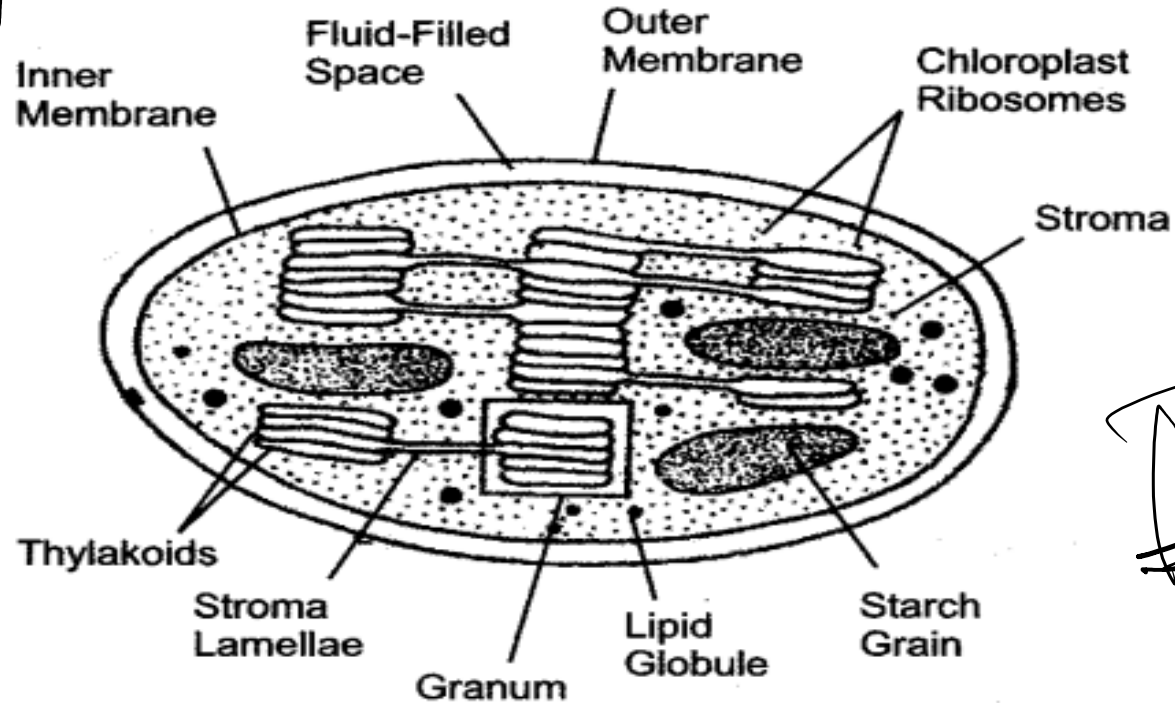
- Discovery and nomenclature : **W. Schimper**
- Numbers: **10 to 40** per cell of higher plants.
- Fungi, bacteria, cyanobacteria etc. **do not have** plastids.
- Largest** cellular organelle

mca

mca

mca

mca



CO (c)

Structure of Chloroplast

Plastid

Types

➤ Chromoplast ✓

✓ ➤ Chloroplast ✓

➤ Leucoplast

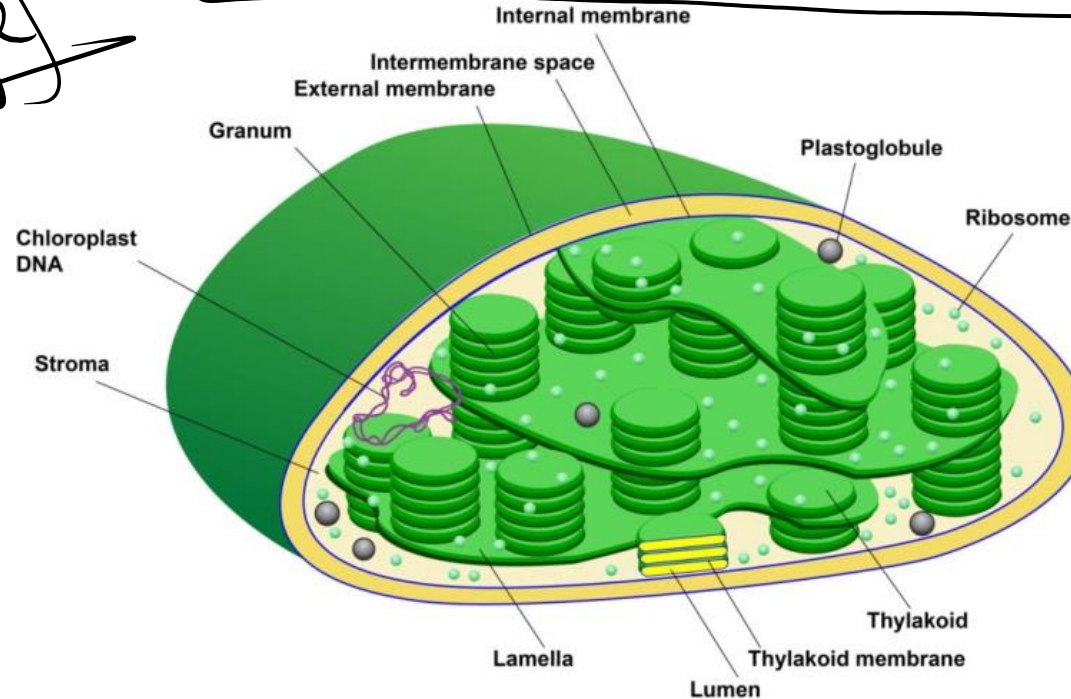
||
/ food storage

(i) Amyloplast:
storage of starch.

Yellow = fat color
(ii) Elaioplast:
storage of lipid.

Aleuroplast/protein
oplast:
storage of protein.

mca SI.



Plastid

Different shapes of Plastid

- Cup shaped → *Chlamydomonas*

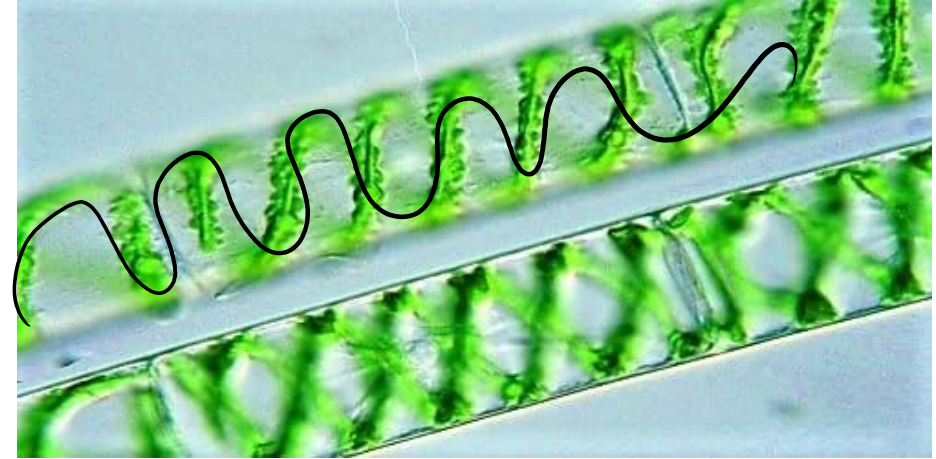
- Spiral → *Spirogyra* ✓✓

- Reticular → *Oedogonium*

- Stellar → *Zygnema* ★

- Ring shaped/Girdle shaped → *Ulothrix*

- Spherical → *Pithophora*



POLL QUESTION 05

Which is the largest organelle in the cytoplasm of plant cells?

- (a) Golgi body
- (b) Mitochondria
- (c) Centriole
- (d) Chloroplasts

Centriole

- ❑ **Discovery:** Van Benden
- ❑ **Nomenclature:** Theodor Boveri
- ❑ Present in algae, fungi, bryophytes, pteridophytes, gymnosperm plants and most of the animal cells.

?? Then where centriole is absent ?



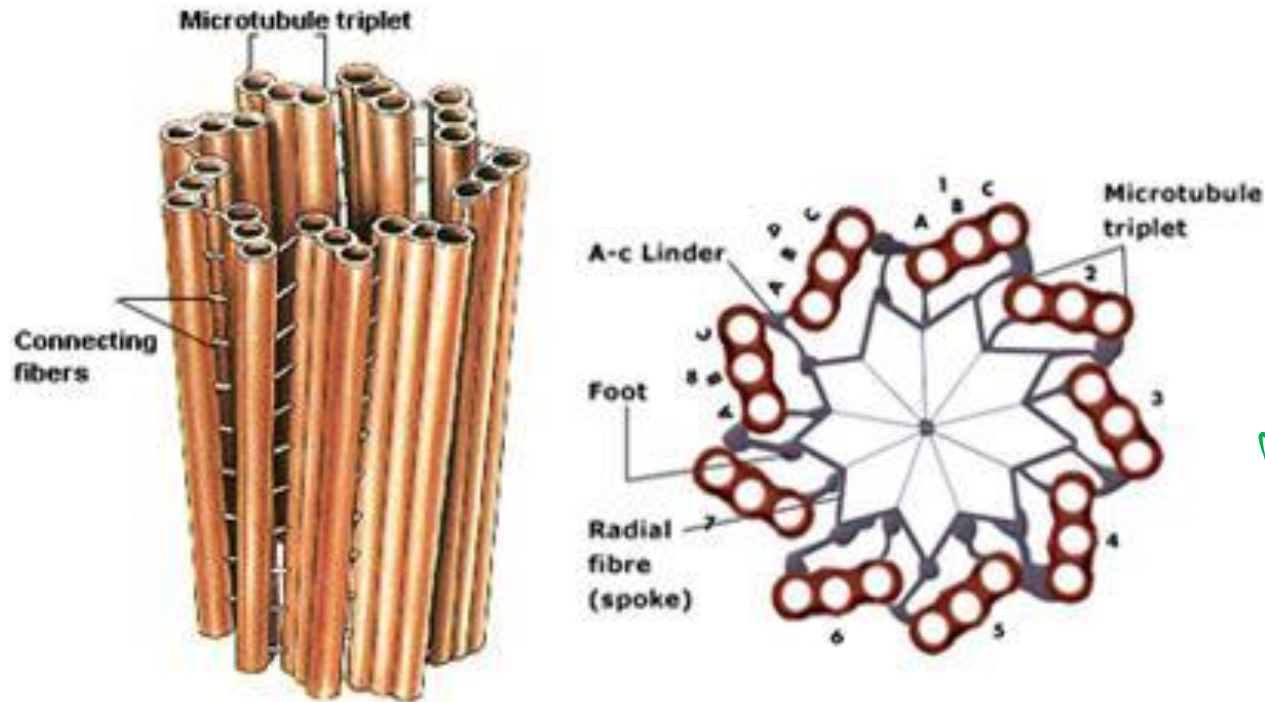
Centriole

There are three parts. E.g.-

- Cylinder wall
- Triplets

[There are 9 triplets, each formed of three subtubules]

- Linkers.

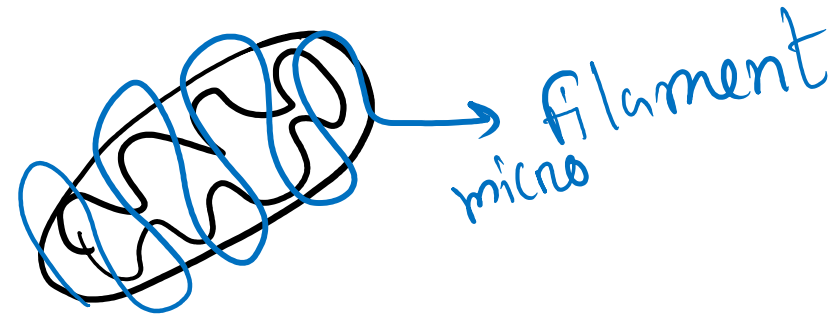
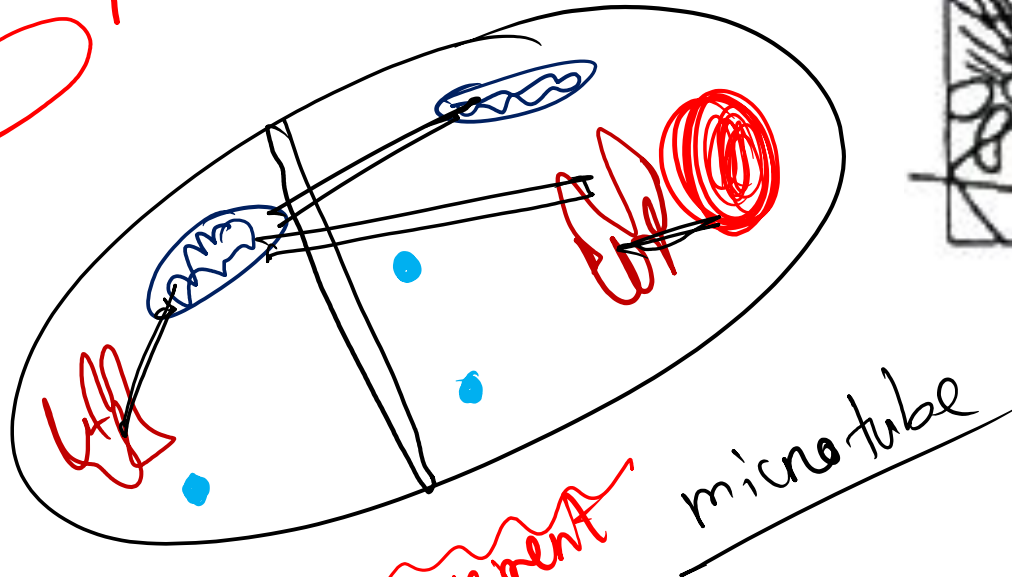
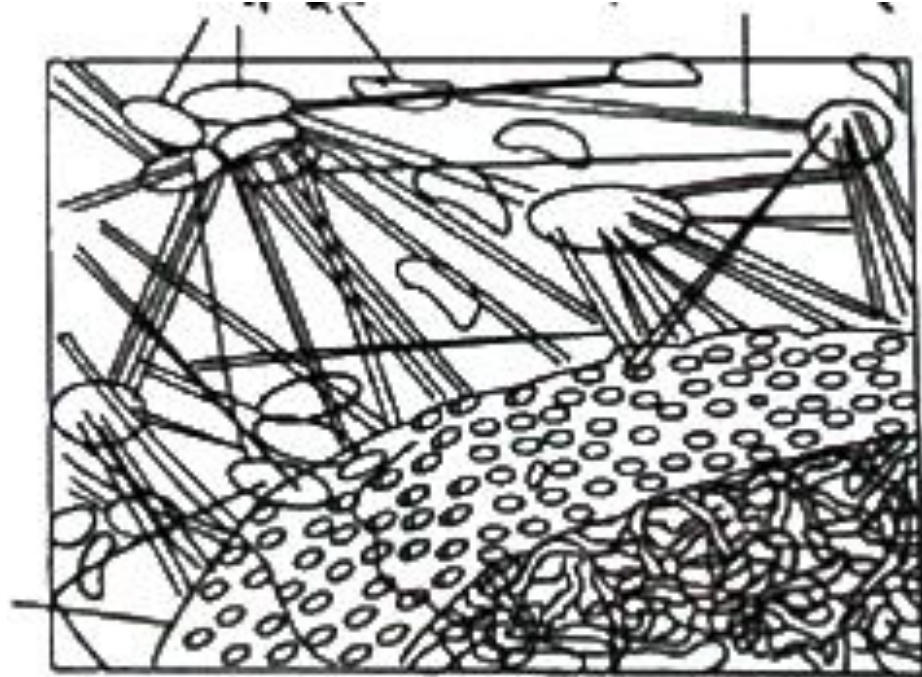
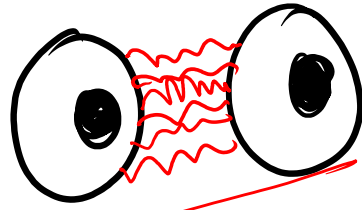


functions
✓ Cell division &
✓ tail of sperm

Cytoskeleton

Cytoskeleton

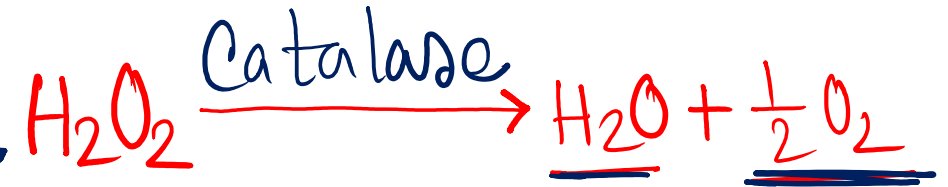
- Microtubules ✓
- Microfilament ✓
- Intermediate Filament ✓



Peroxisome & Glyoxysome

MCQ

- ❑ Another name → Microsome.
- ❑ Mostly present in kidney and liver cell of animals.
- ❑ Main enzyme is catalase.



Glyoxysome

স্তানো

- ❑ Converts lipid into sugar during germination of seed

energy

Nucleus

Discovery and nomenclature	<ul style="list-style-type: none">• 1831, Robert Brown discovered nucleus in leaf cell of orchid and named it.
Origin or name	<ul style="list-style-type: none">• Latin 'NUX' means nut, from which the word 'Nucleus' was originated.
Multinucleated cells	<ul style="list-style-type: none">✓ Multinucleated cells are called coenocyte. mca✓ Examples: <i>Vaucheria</i>, <i>Botrydium</i>, <i>Sphaeroplea</i> etc. algae and some fungi including Penicillium. mca✓ Non nucleated cells- matured RBC, Platelets, Lens of Eyes mca
Shape	<ul style="list-style-type: none">• Nucleus can occupy 10-15% space of the cell. About 90% of sperm is nucleus. mca

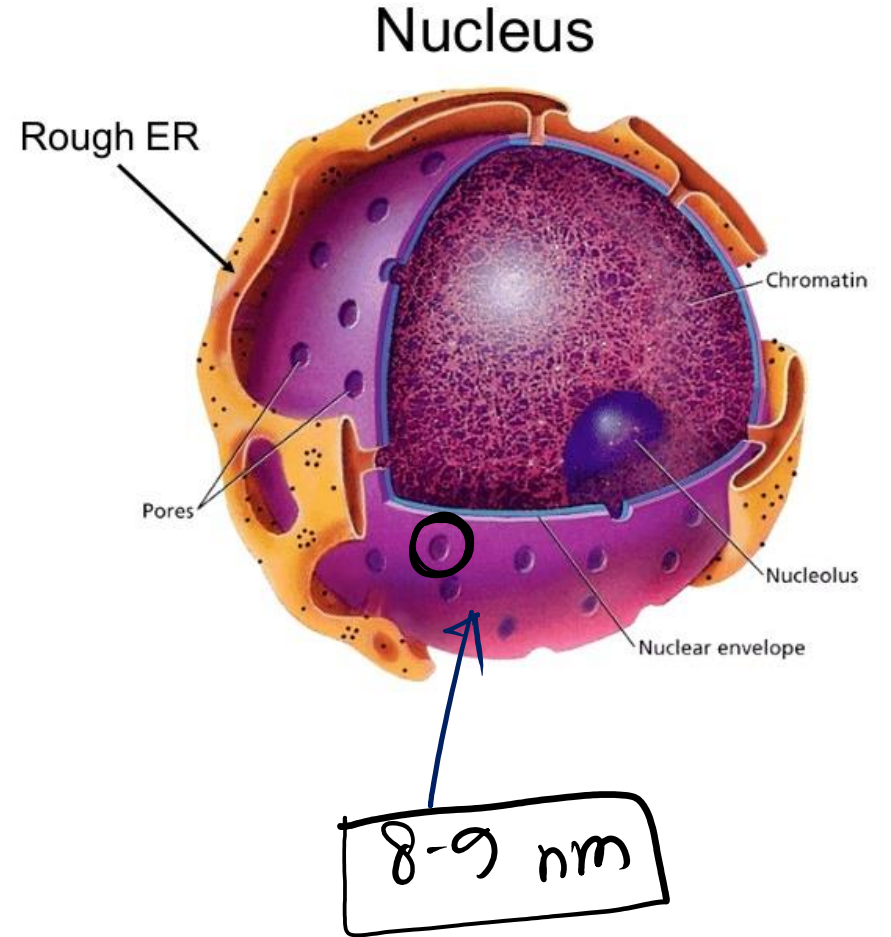
Nucleus

a. Nuclear envelope

- Composed of **lipid protein** bilayer.
- **Diameter of nuclear pore is 8-9 nm.** The pore is controlled by total 8 protein granules.

b. Nucleoplasm or karyolymph

- Contains chromatin reticulum and nucleolu
- Main site of enzymatic action.



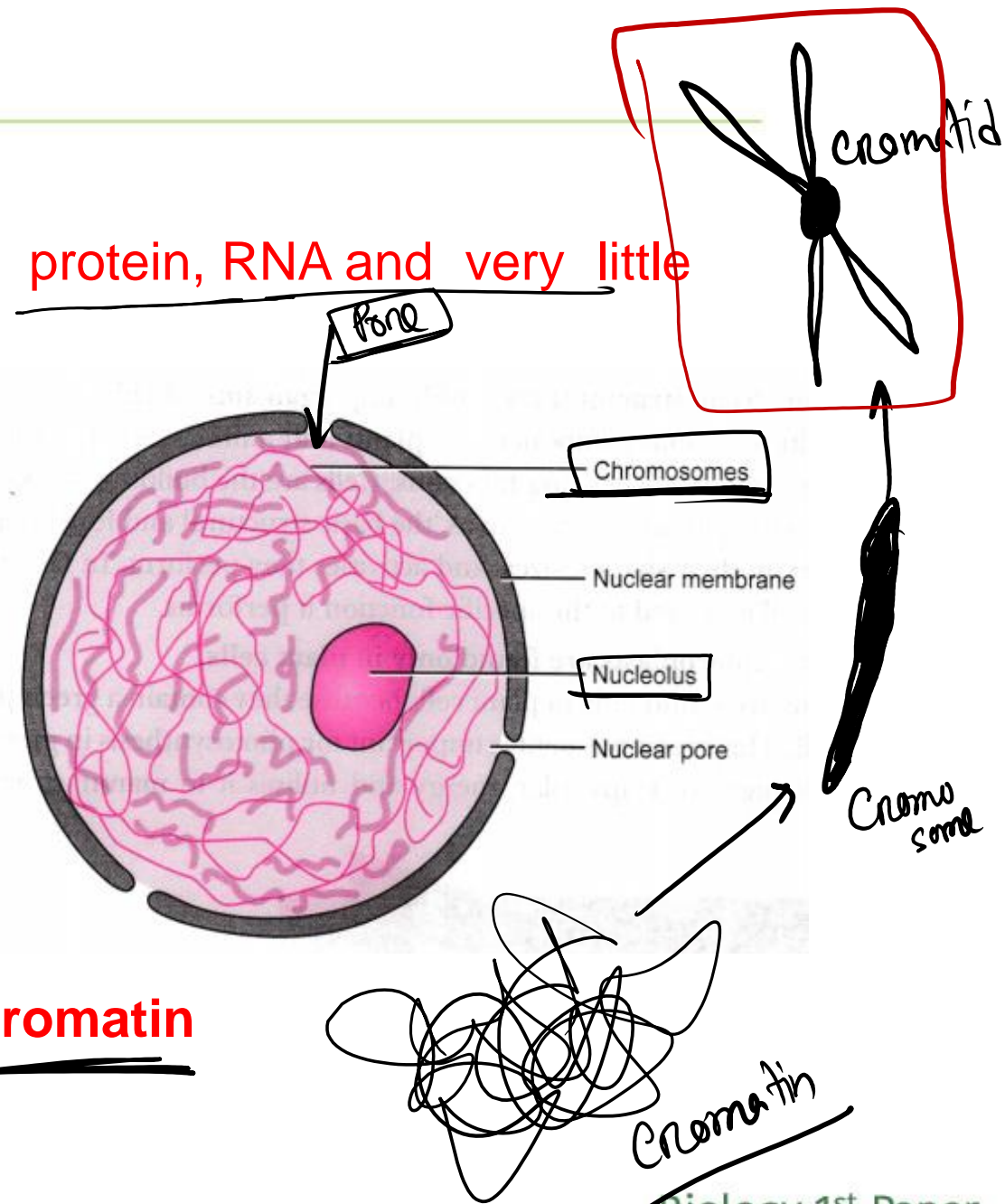
c. Nucleolus

- Principal chemical elements of nucleolus are protein, RNA and very little amount of DNA.
- Synthesizes RNA and proteins.
- No membrane has been discovered.

d. Nuclear reticulum or chromatin fibers

- ✓ Carrier of genetic materials
- In fact,

✓ DNA + protein (histone and non-histone) = chromatin



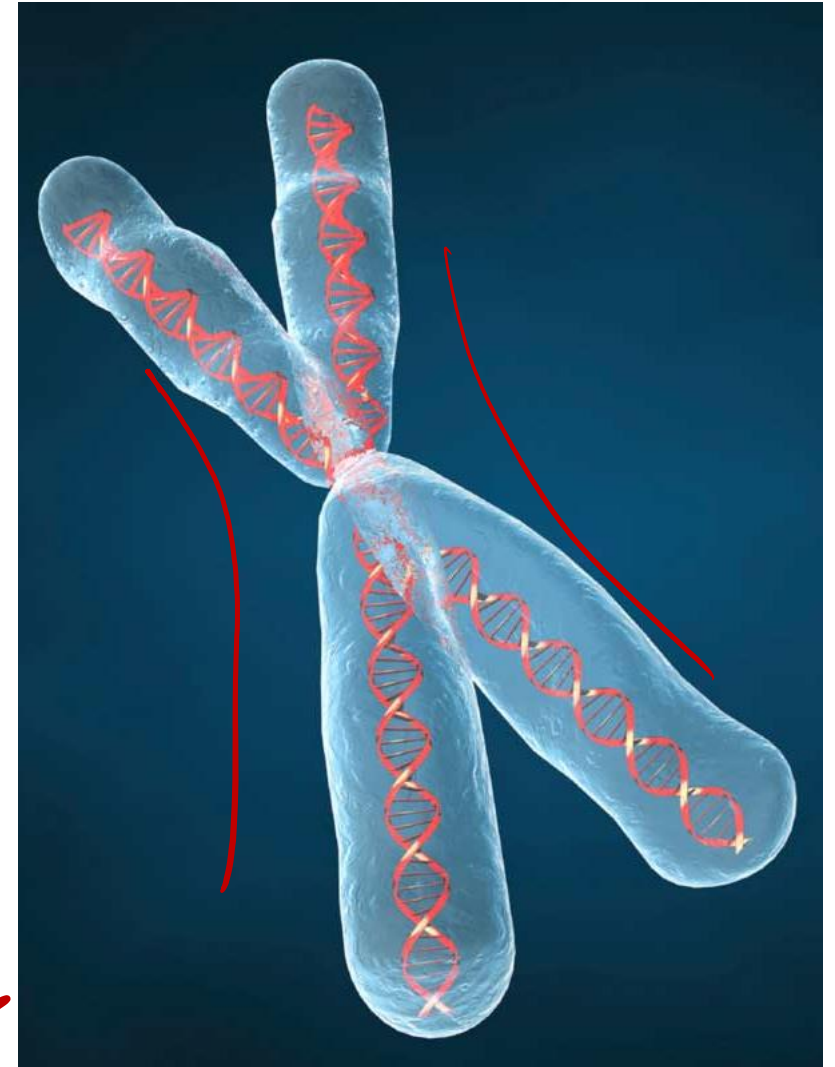
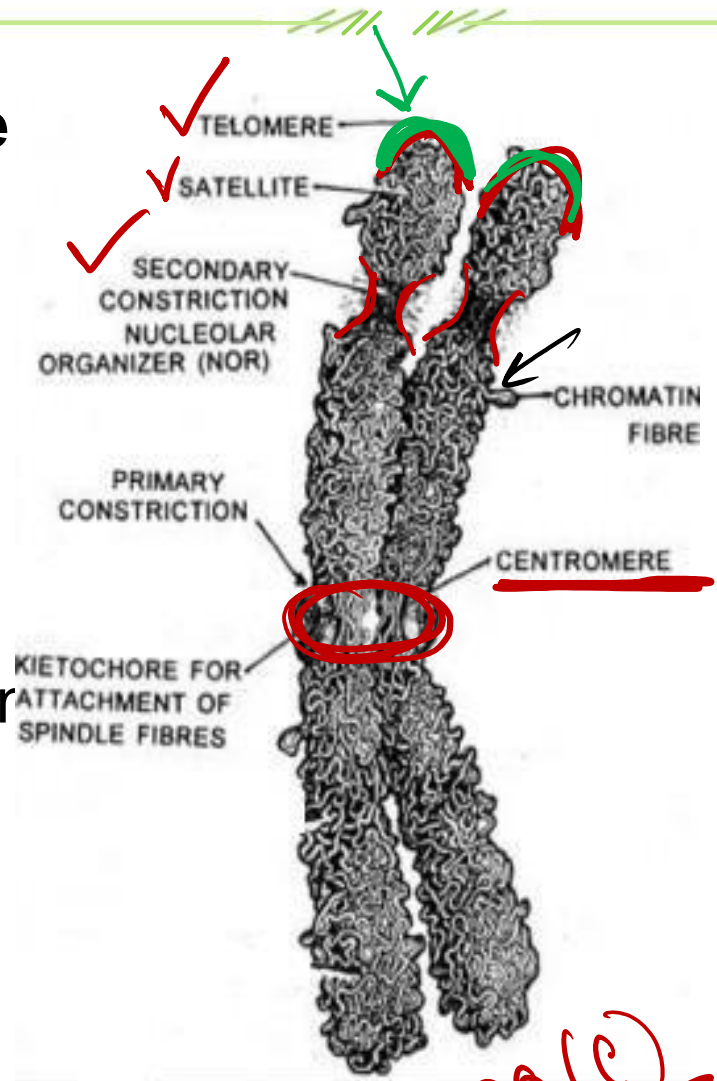
Chromosome

- Observes some filamentous structures during cell division Strasburger*** mca
- Observed chromosome in the nucleus of plant cell Karl Nageli
- Named chromatin Walter Flemming
- Described as a container & carrier of hereditary traits Sutton & Boveri
- Named chromosome W. Waldeyer*** mca

Structure of a Chromosome

Parts of a chromosome

- Chromatin
- Chromatid
- Centromere
- Arms
- Chromomere
- Secondary Constriction
- Satellite
- Telomere
- Matrix



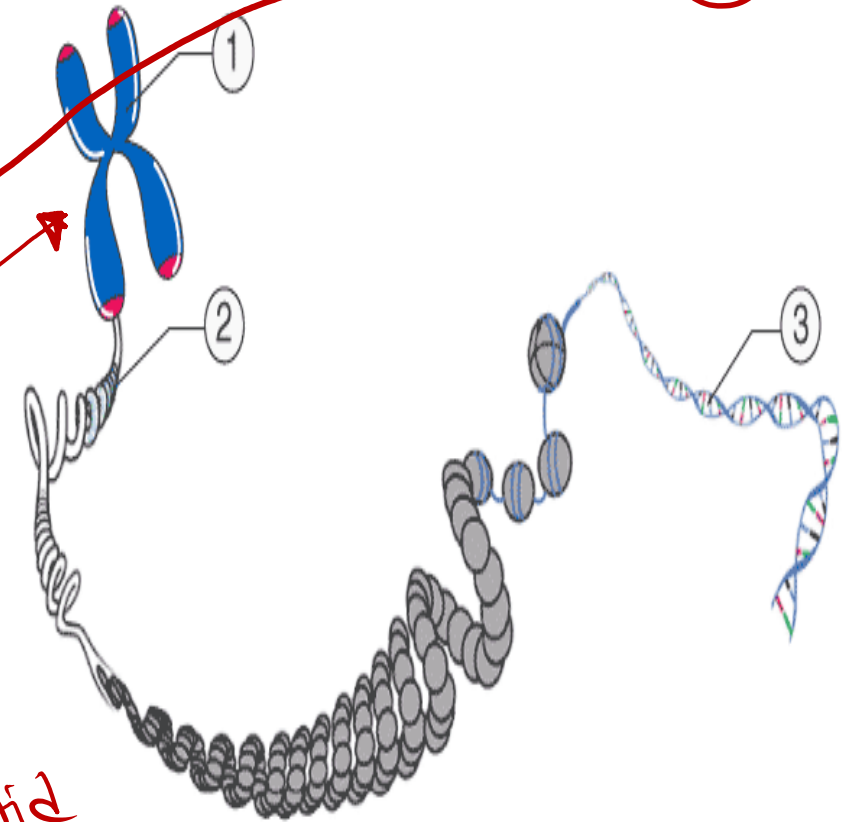
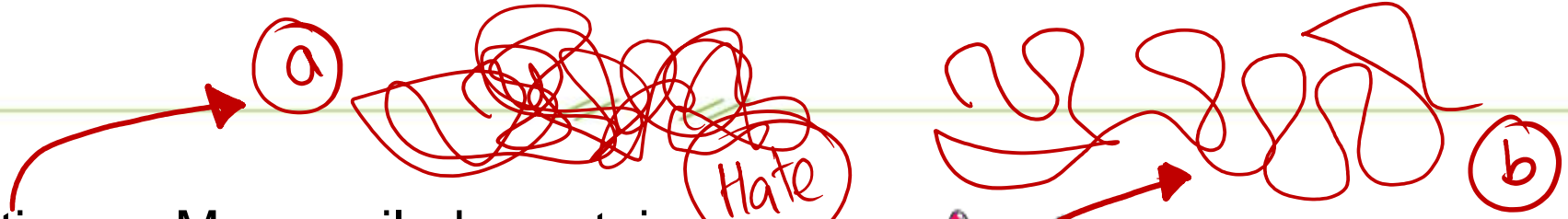
CA(c)

Chromatin:

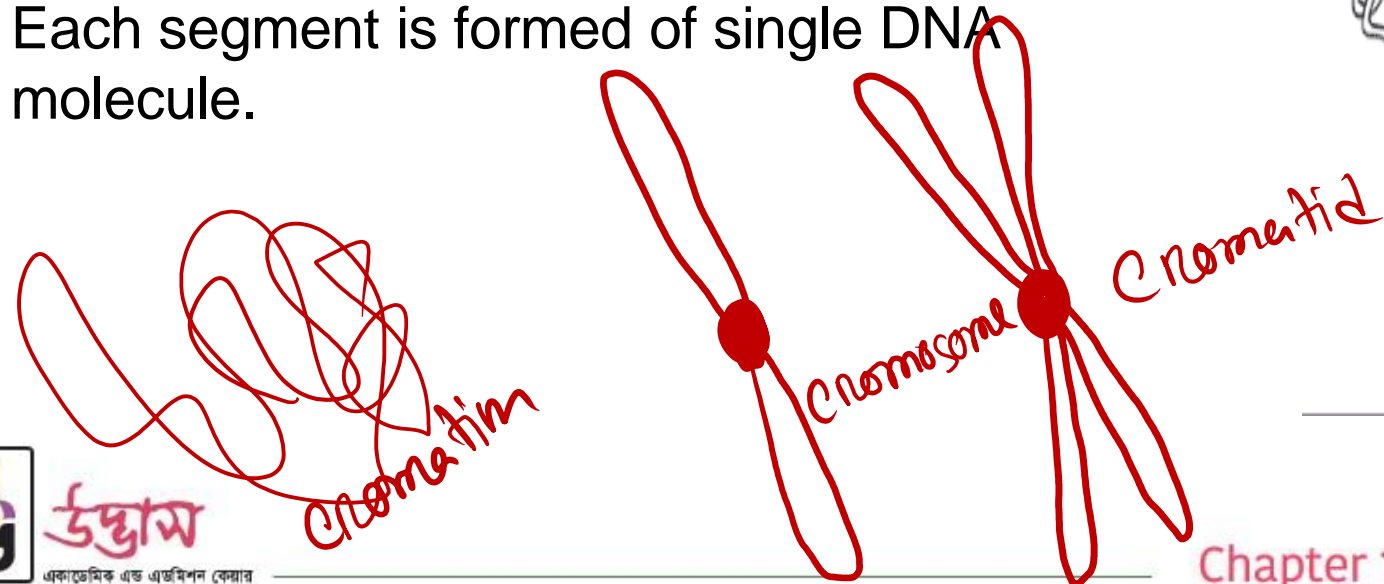
- Heterochromatin → More coiled, contains **inactive DNA**.
- Euchromatin → Less coiled, contains **active DNA**.

Chromatid:

- In **metaphase stage**, the chromosome is seen longitudinally divided into two segments.
- Each segment is formed of single DNA molecule.



1 Chromosome | 2 Chromatin | 3 DNA Helix



Centromere:

An ideal chromosome contains only one centromere. *mcq*

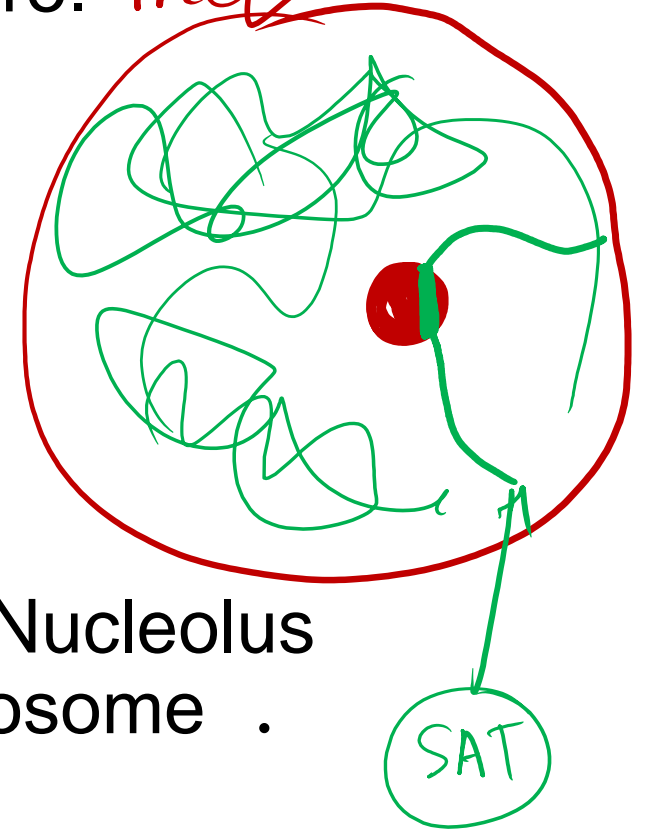
Secondary Constriction

Another name → Nucleolus reformation area

Satellite ✓

❑ The chromosome where satellite is present / Nucleolus containing chromosome is called → SAT chromosome .

❑ 1st chromosome of chickpea contains satellite.

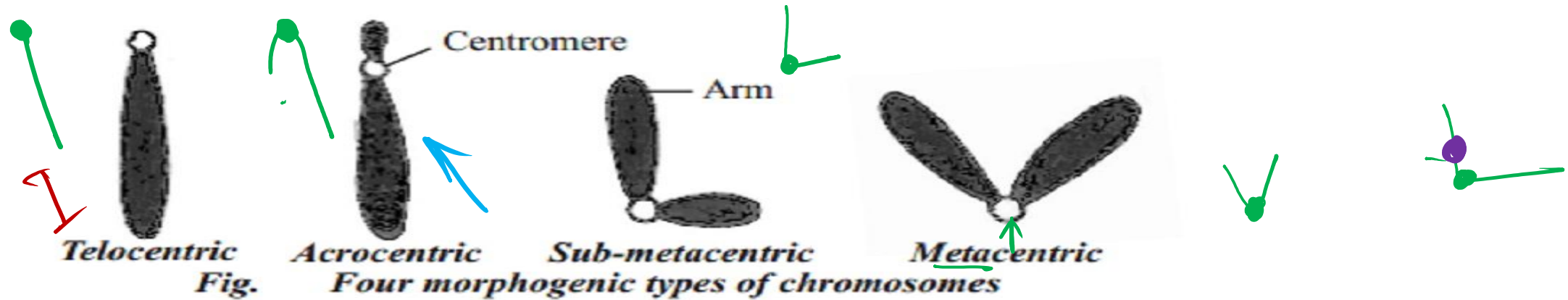


Telomere

- ❑ Repeated sequence of DNA in the head of chromosome is telomere.
- ❑ According to H. J. Muller- the specially characterized area of both ends of the chromosomes is called telomere.
- ❑ Telomerase enzyme helps to prevent aging process in human.

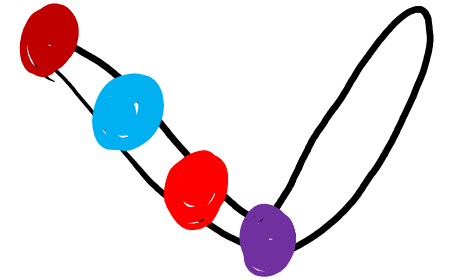


Classification



According to the position of centromere **(During Anaphase)**

- (i) Metacentric → V shaped.
- (ii) Sub-metacentric → L shaped.
- (iii) Acrocentric → J shaped.
- (iv) Telocentric → I shaped.

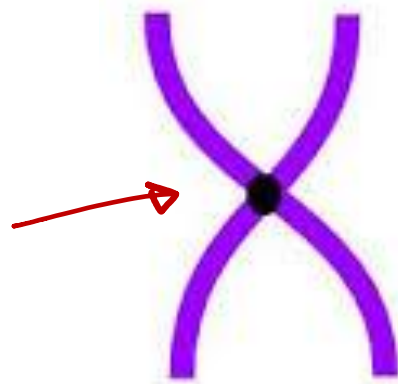
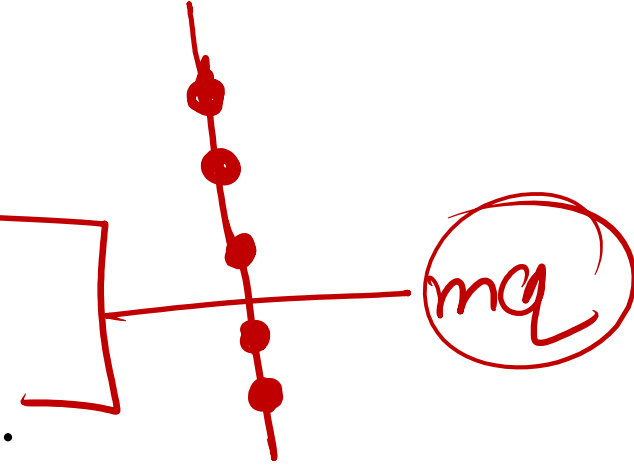


mea S.I - Slide

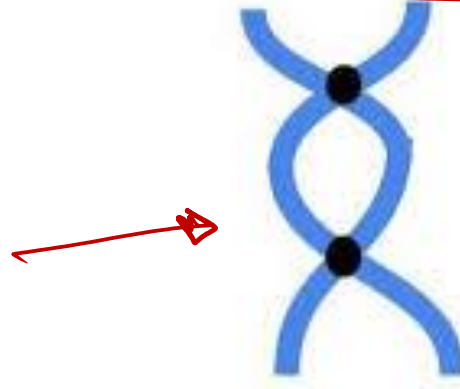
Classification

According to the number of centromere

- (i) ~~Monocentric~~ → In most of the plant species.
- (ii) ~~Dicentric~~ → In some species of wheat.
- (iii) ~~Polycentric~~ → In some species of banana (Musa sp.).
- (iv) ~~Diffused~~ → No centromere is distinctly visible.



Normal
Chromosome



Dicentric
Chromosome

Classifications

$$23 P = 46$$

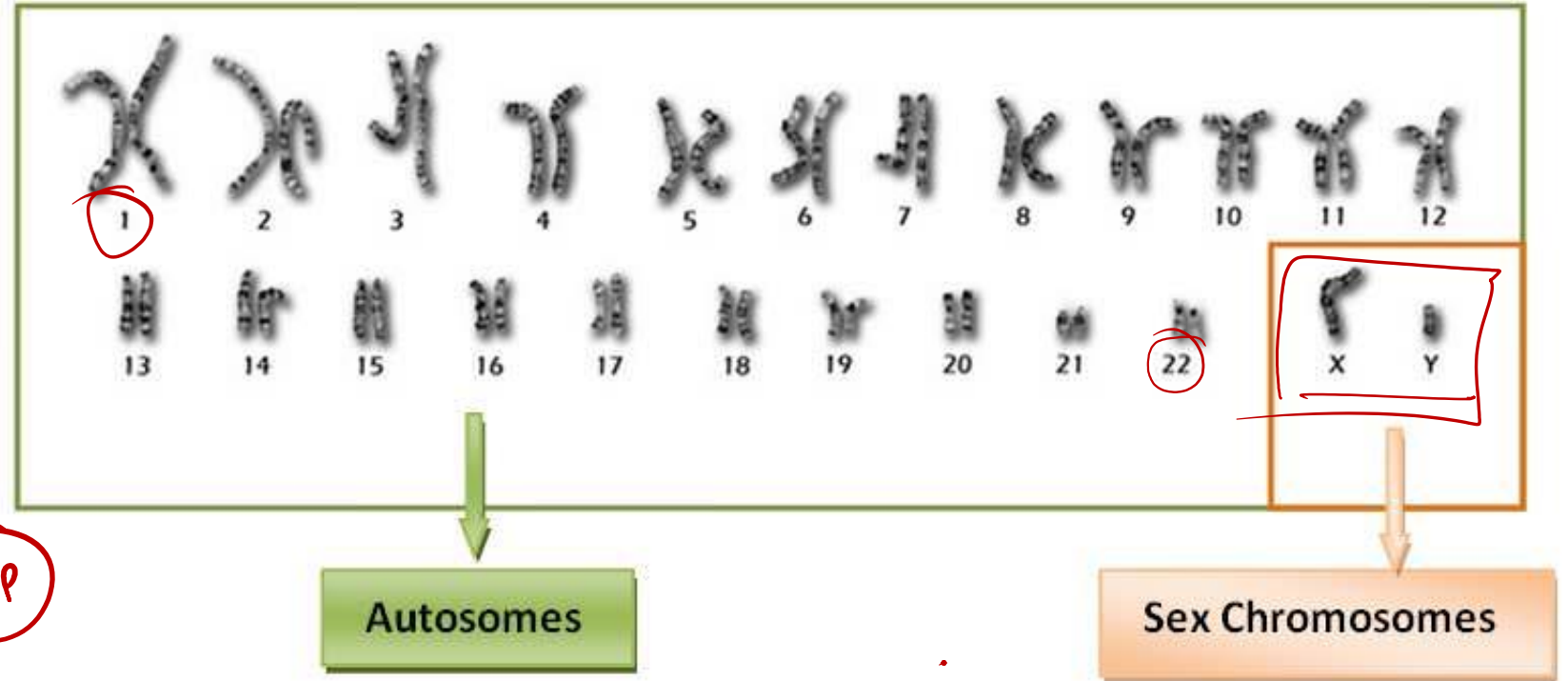
According to Gender
determination and
size:

(i) Autosome

22P

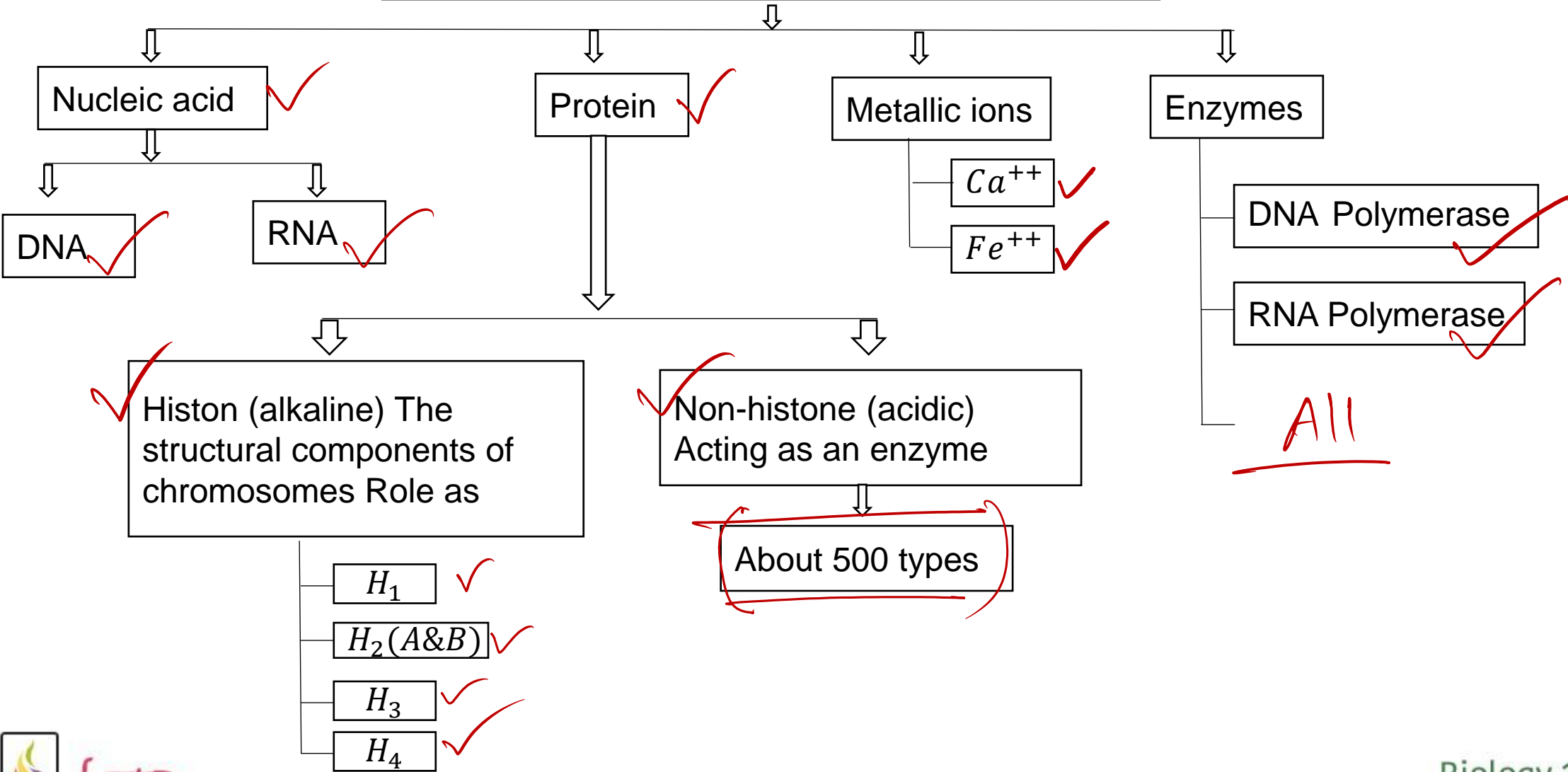
(ii) Sex Chromosome

1P



Chemical structure of Chromosome

Chemical structure of chromosomes



Functions of Chromosome

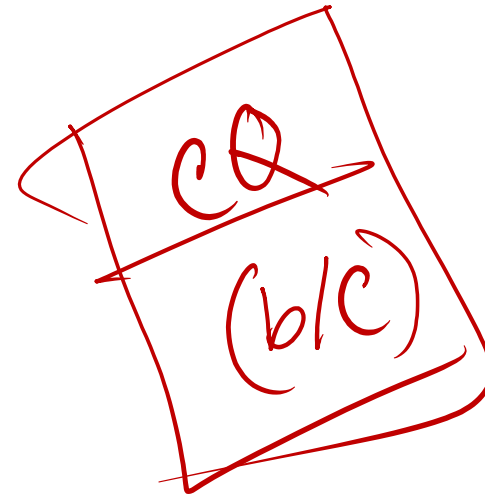
1. **Contains DNA** or gene molecule. ✓
2. Chromosome is the **carrier of heredity**. ✓
3. Chromosome plays a special role in cell division by dividing itself.
4. Protein synthesis by mRNA produced according to the template of DNA.
5. Sex chromosome plays special role to **determine sex** of organisms. ✓
6. Carrier gene of inheritance works as a **blueprint of life** of organism

Cell → Nucleus → Chromosome → DNA → Gene.

Summary

CA special tips # Major differences

- Prokaryotic and Eukaryotic cell / Plant cell and animal cell
- Cell wall and Cell membrane
- Ribosome and Lysosome
- Smooth and Rough ER
- All 3 plastids ✓
- Nucleus and Nucleolus ✓
- Centrosome and Centromere ✓



All special names-

Name	Also known as-
Cell membrane	Plasma membrane / plasmalemma/Cytomembrane
Golgi Body	Golgi filed /Dictayosome / lypocondria/idiosome / Traffic police of cell/Carbohydrate factory/PACKING house
Mitochondria	Biological Powerhouse
Ribosome	Protein factory
ER	Road of a Cell
Protoplasm	Base line of life
Secondary Constriction	Nucleolus reformation area

All special names-

Name	Also known as-
Matrix of Cytoplasm	Hyaloplasm / Cytosol
Lysosome	Bag of hydrolytic enzymes/ Stomach of a cell/Suicidal squad or bag
Chloroplast	Kitchen of cell / Factory of synthesis of sugar
Chromosome	Base of heredity , Carrier of heredity
Microtubules	Skeleton of a cell
Proteasome	Main switch of a cell
Nucleus	Cell brain/ Center of a cell /Cell center

লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।



ডিম্বেশ

মেডিকেল এন্ড ডেন্টাল এডমিশন কেন্দ্র

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