

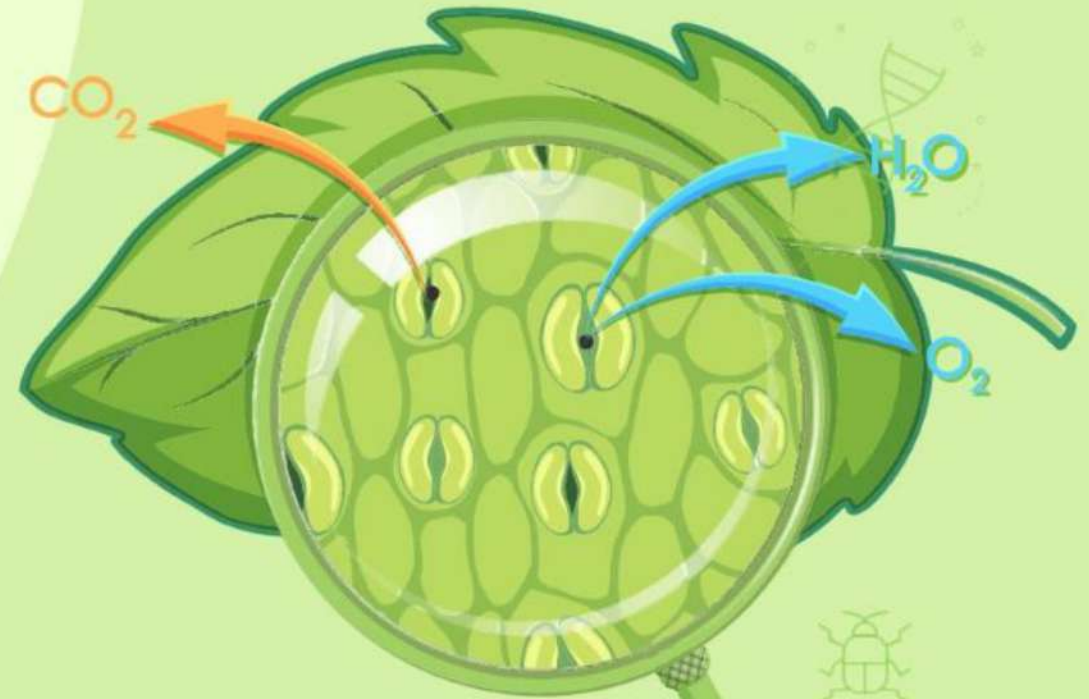


Engineering Admission Program 2020

BIOLOGY

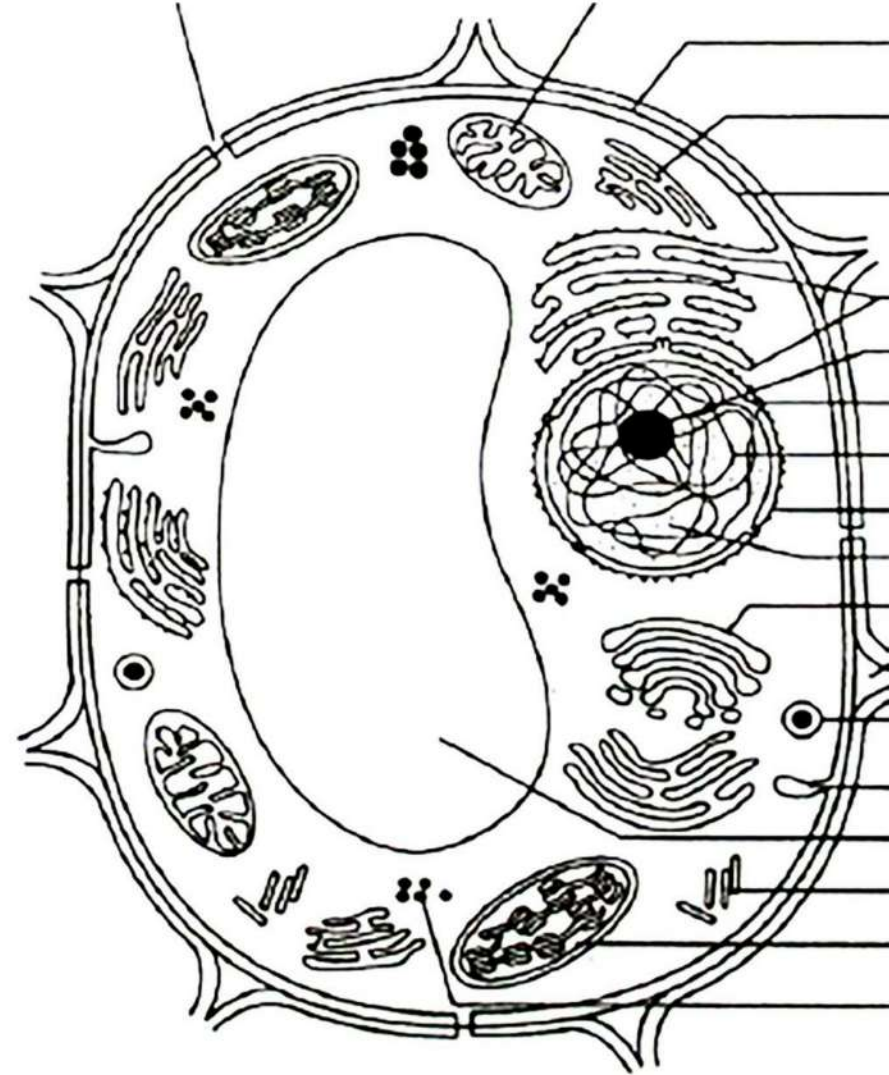
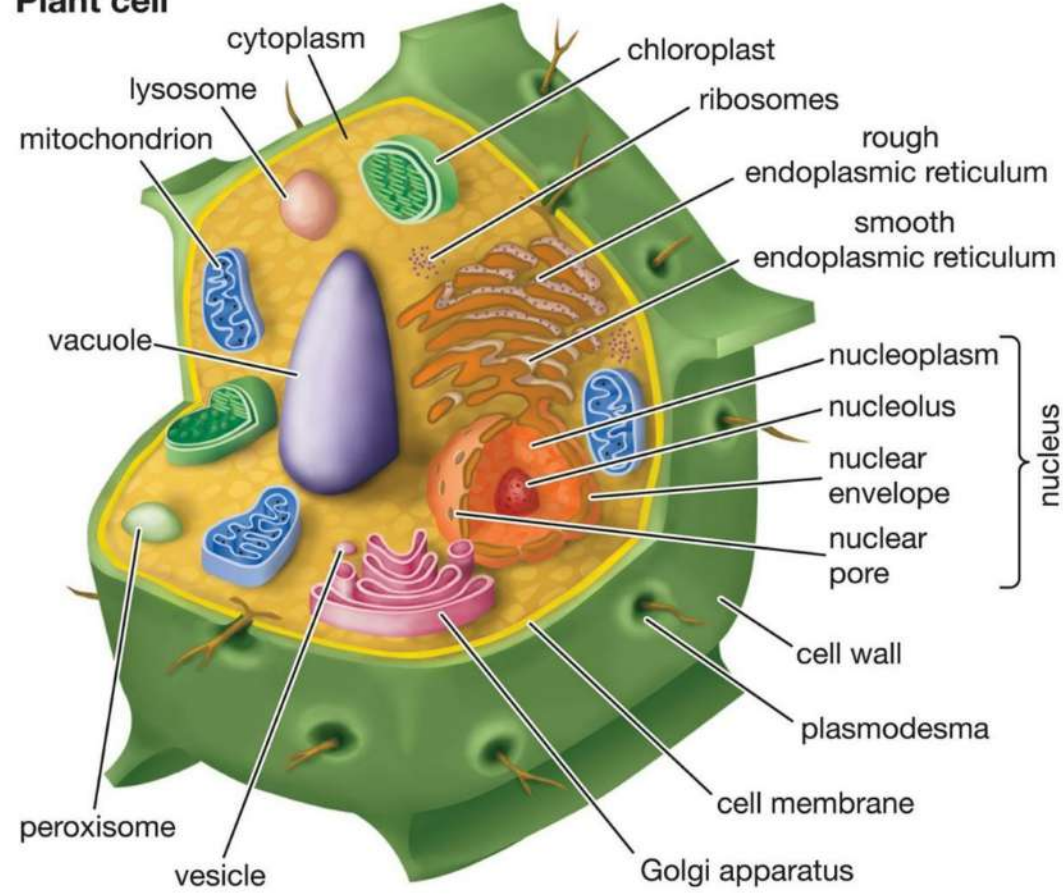
Lecture : B-01

Chapter 01 : Cell and its structure (Up to chromosome)



Cell

Plant cell

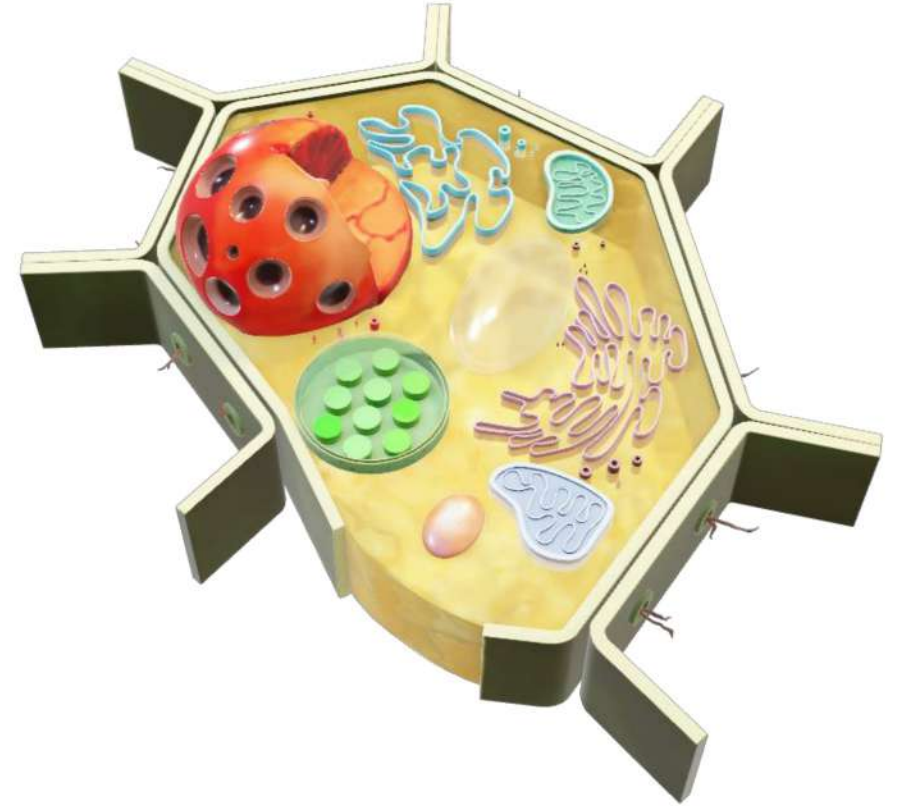


Cell

Cell nomenclature:

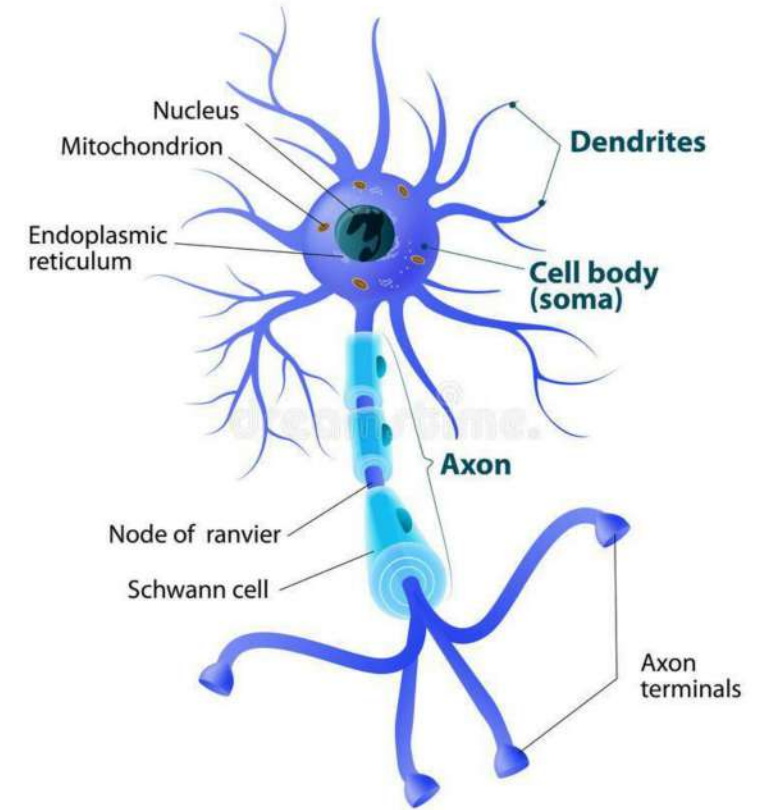
Robert Hooke first noticed the cell and cell wall in 1665 using a microscope. He reported his findings in his book, *Micrographia*.

Carl P. Swanson is the father of Modern Cytology.



NTK- (Need to Know)

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



Cell theory

Proponent	<ul style="list-style-type: none">• Mathias Jakob Schleiden• Theodor Schwann
Theory	<ol style="list-style-type: none">1. Cells are structural, functional and organizational units of living organisms.2. Cells are the fundamental units of life.3. Cells are genetic units.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

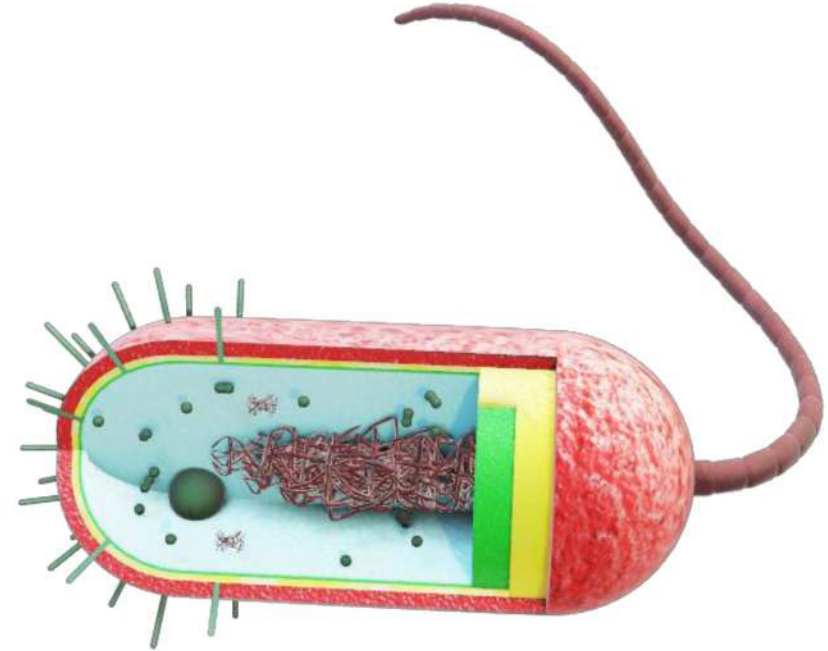
01. On the basis of physiological function

- (a) Somatic cell
- (b) Germ cell or gamete

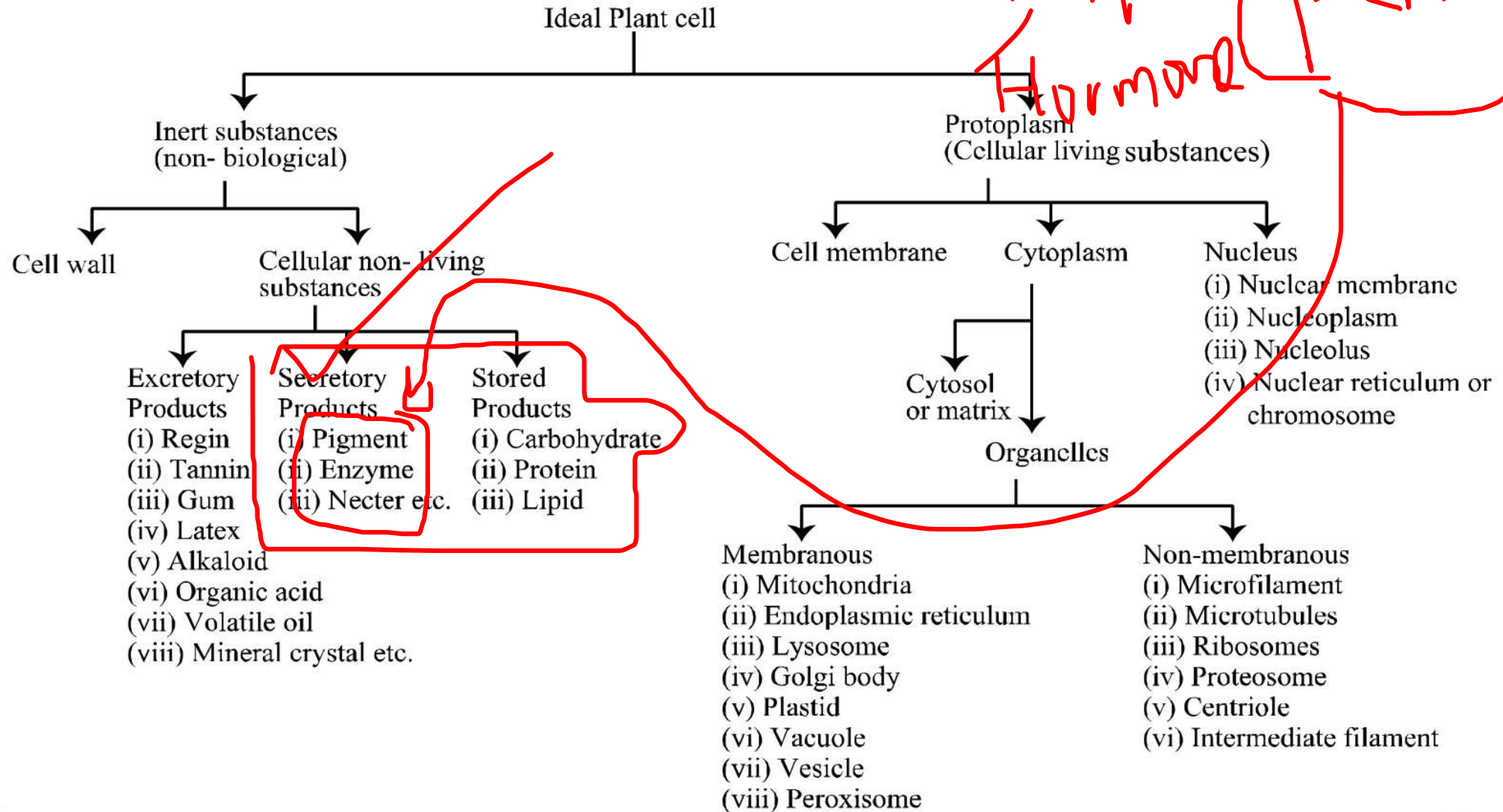
02. Based on the structure of nucleus

- (a) Prokaryotic cell
- (b) Eukaryotic cell

প্রকৃতিই তুমি (U) সুন্দর



Types of cell



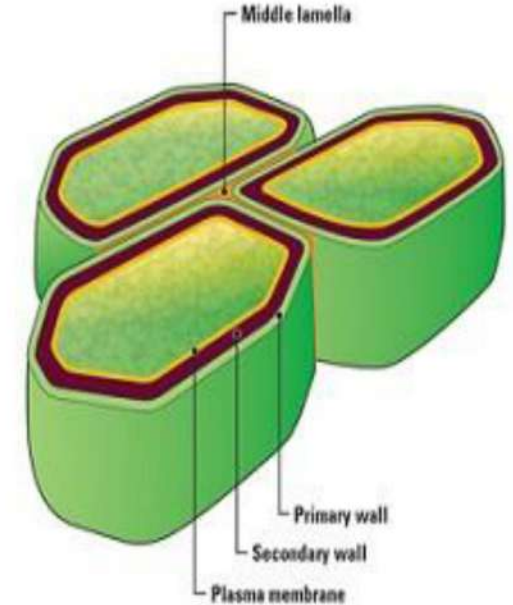
POLL QUESTION 1

In which of the following organisms primitive cell is present?

- (a) Bryophytes
- (b) Fungi
- (c) Algae
- (d) Bacteria

Cell wall

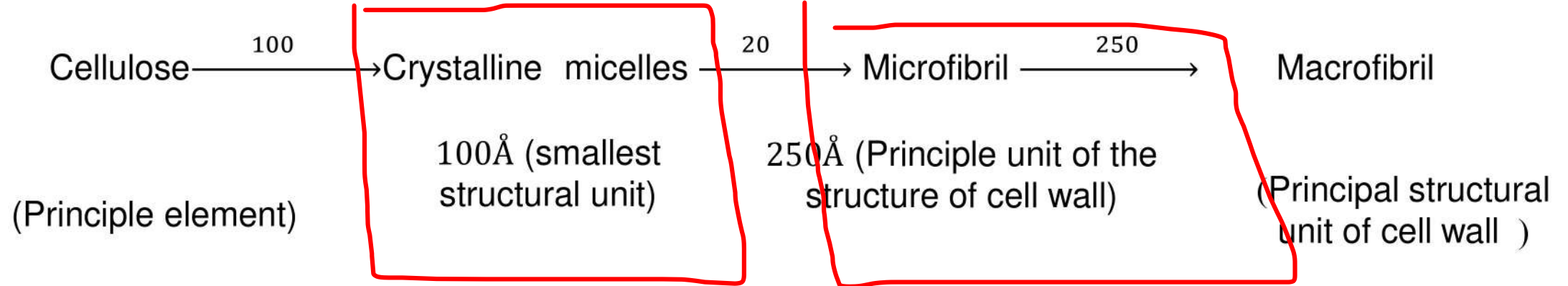
- Cell wall is a unique feature of plant cells.
- Primary cell wall **is not formed** around the pit area.
 - The middle lamella starts to form during telophase
- Middle lamella contains **large amounts of pectic acid**.
- Primary wall mainly contains cellulose, hemicellulose and glycoprotein.
- Secondary walls are found in following cells → Tracheid, Xylem and Phloem fibres.
 - 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** polymer.



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

The microscopic structure of cell wall

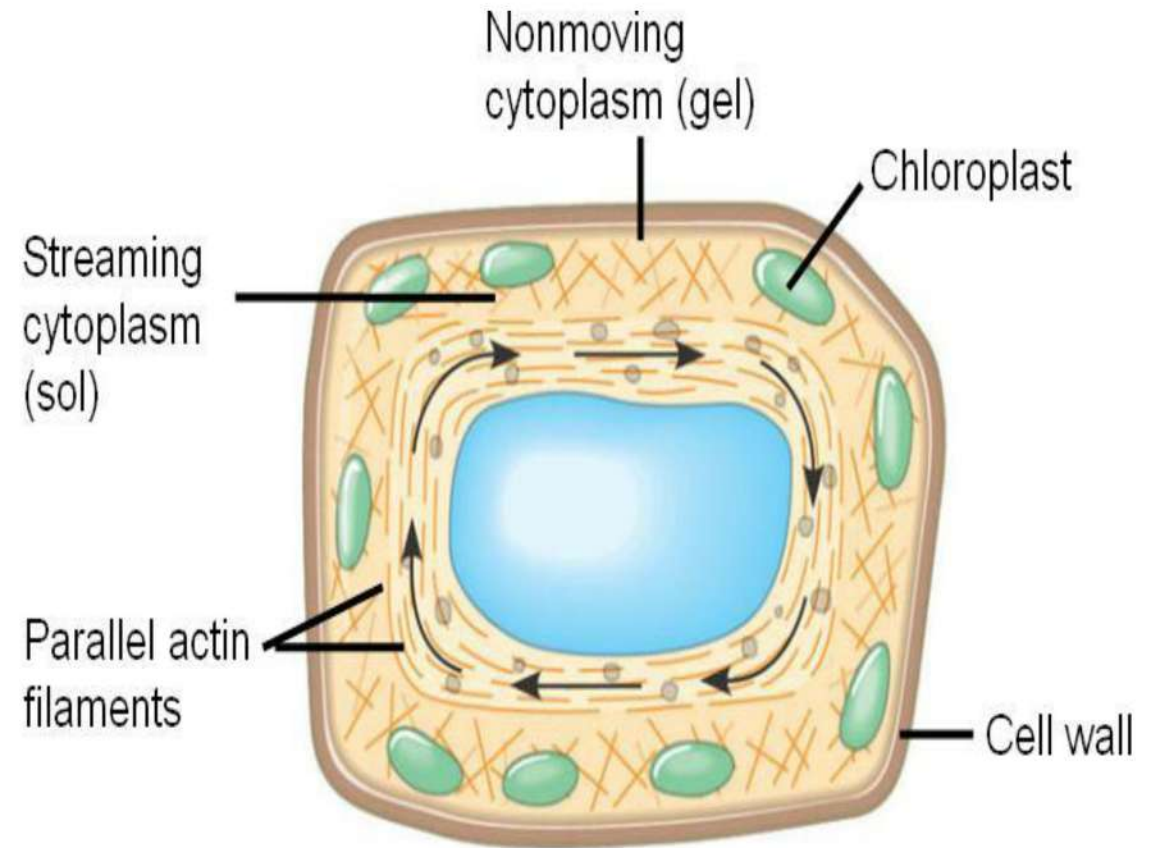


Locomotion of protoplasm

❑ Cyclosis

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

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

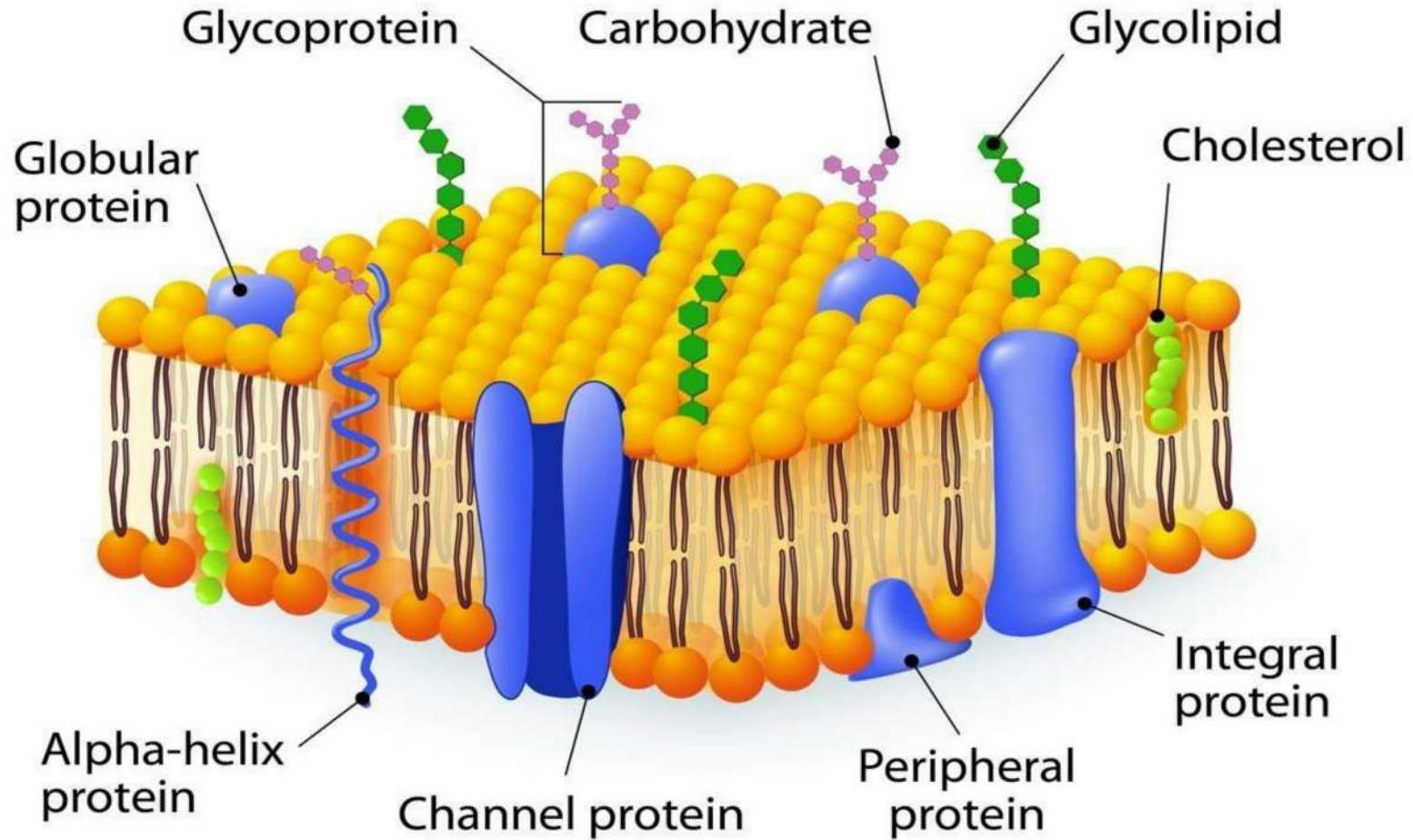


Plasma membrane or cell membrane

Different models related to structure and composition of plasma membrane:

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

Structure of plasma membrane according to Fluid mosaic model



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. Secretes enzymes and antigens.
7. Collects information as neurotransmitters, hormones, etc.
8. 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

- ✓ 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.
- ✓ When many ribosomes are arranged as pearl necklace in the cytoplasm is known as **Polyribosome or polysome**

Ribosome

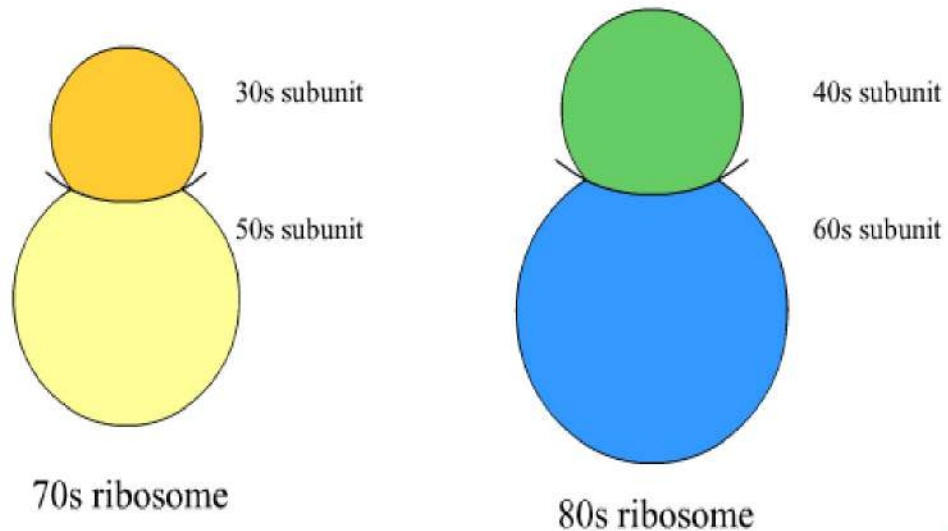
• 70S Ribosome (50S + 30S)

- ✓ 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 number of ribosome is almost 20 thousand



POLL QUESTION 03

Which synthesizes protein and metabolizes lipid?

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

Golgi body

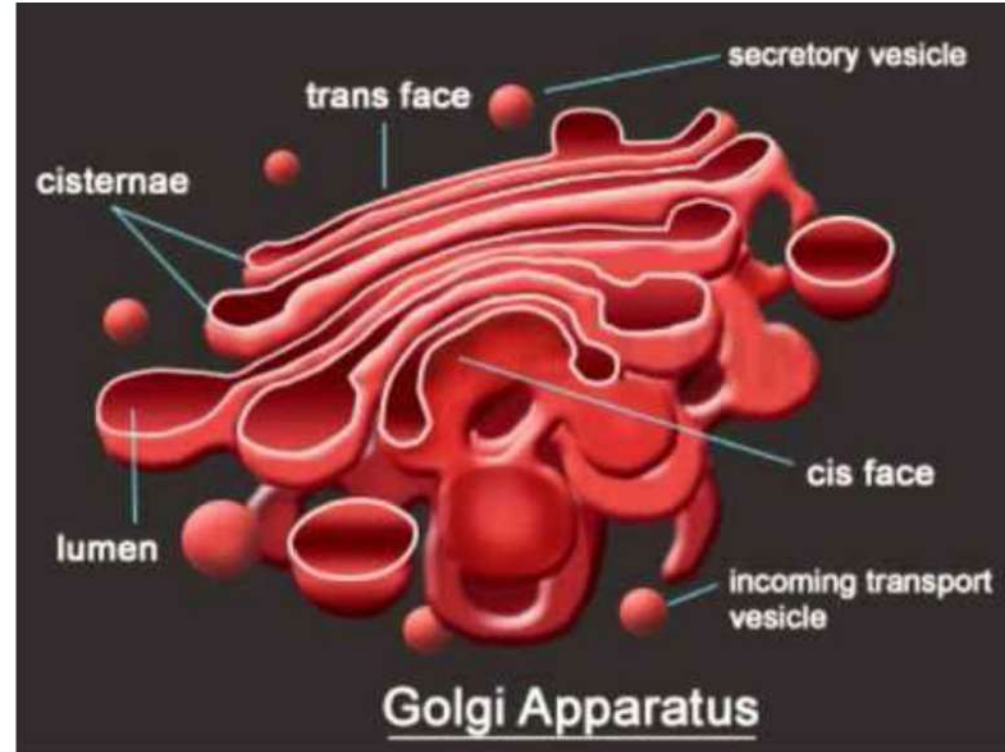
- ❑ Italian neurologist, Camillo Golgi, saw these in the neurons of owls and cats
- ❑ originated from smooth endoplasmic reticulum
- ❑ Golgi body membrane is 60% protein and 40% lipid. It contains fatty acid, vitamin-K and carotenoids

Types:

Cisternae

(1) Vesicle

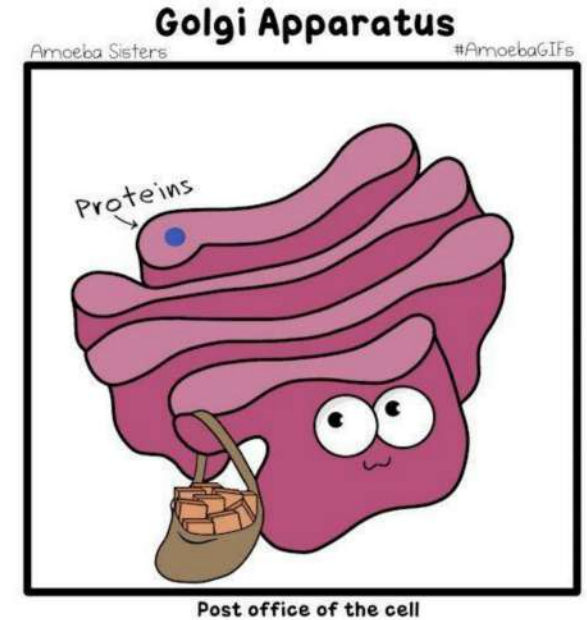
(2) Vacuole



Golgi Complex/ Lypochondria

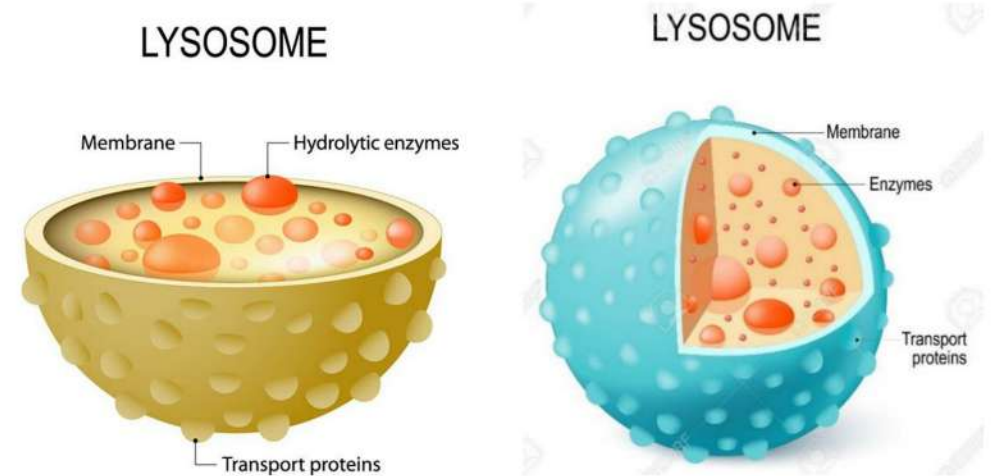
Function:-

- ✓ 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 endoplasmic reticulum.
 - ✓ 6. **Storage** of protein and **Vit-C**.
 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** (**L**iver, **I**ntestine, **N**erve, **K**idney)



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.

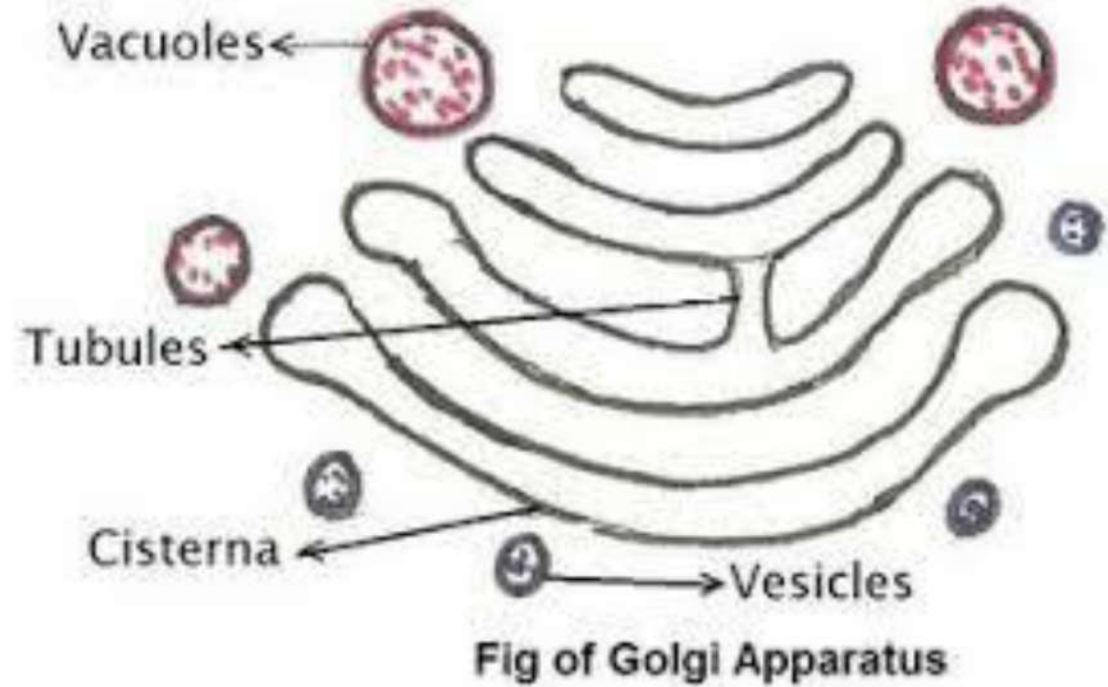
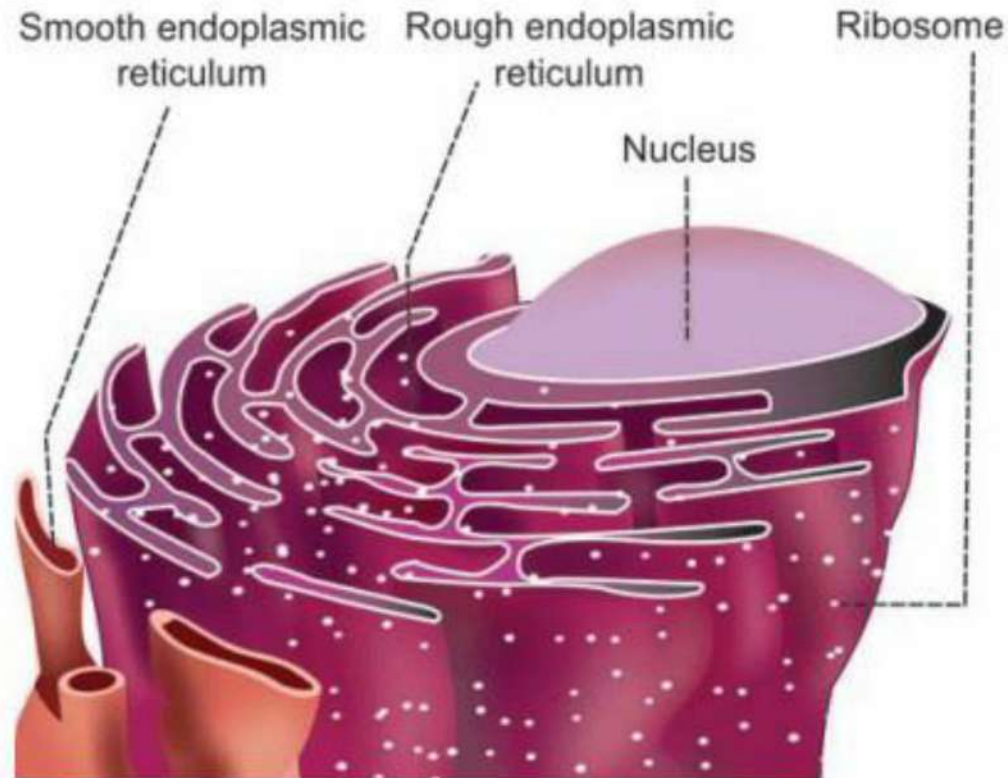


***They are called **sucidal squad** as they destroy useless cells by autolysis.

Endoplasmic reticulum

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

Endoplasmic reticulum



Endoplasmic reticulum

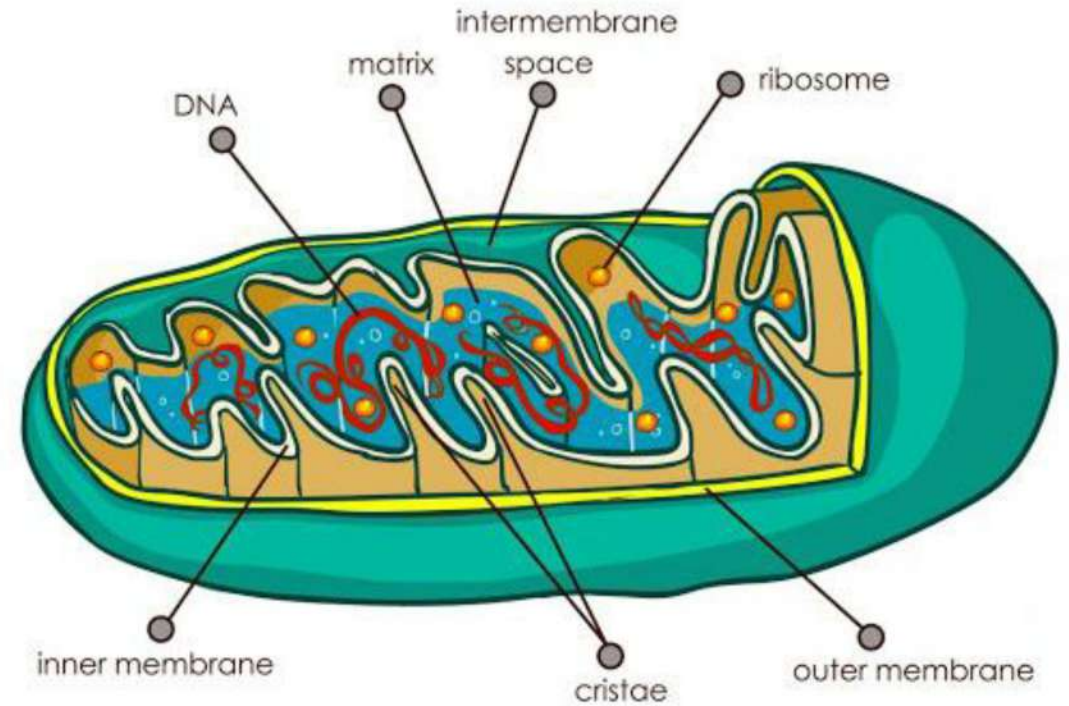
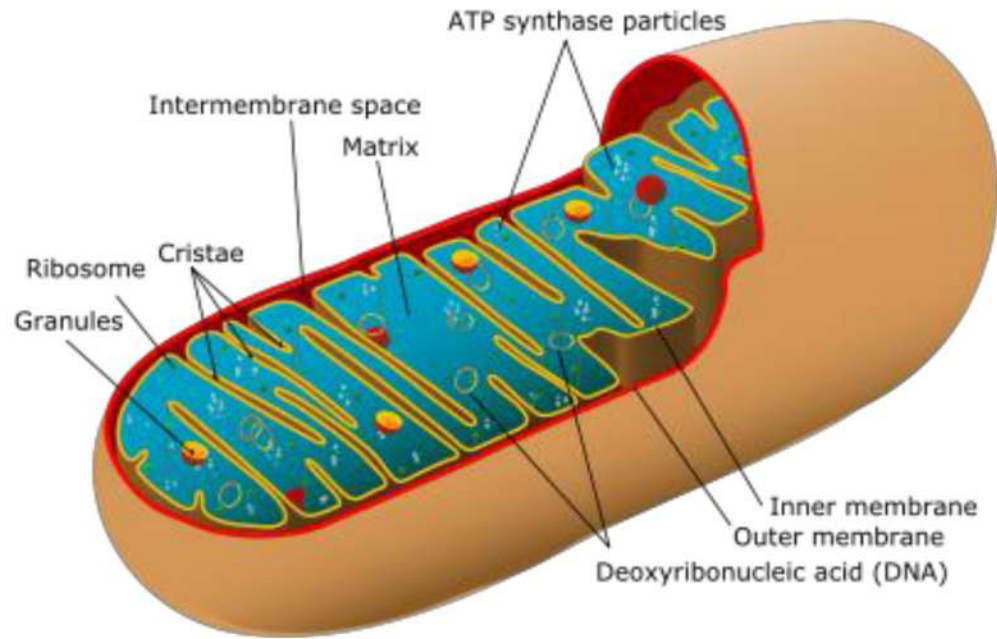
Functions:

1. Acts as frame of protoplasm.
- ✓ 2. Acts as **internal carrier** of lipids and proteins.
- ✓ 3. Proteins are synthesized in rough endoplasmic reticulum.
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**
7. Plays an important role in **transport of proteins** synthesized by ribosomes.

Mitochondria

- ✓ **Discovery** : Kolliker
 - Normally *300-400* per cell.
 - ✓ *1,000 or more in liver* cells.
 - More in *Amoeba*.
- ✓ *20 %* of cell volume is mitochondria.
- ✓ There are *100 types* of Enzymes and Co enzymes

Mitochondria



Mitochondria

Functions:

- ✓ 1. Produce energy.
- ✓ 2. Helps in lipid metabolism.
- ✓ 3. Produces its own RNA, DNA.
4. All the reactions of respiration (Krebs cycle, ETS, oxidative phosphorylation) except glycolysis occur in the mitochondria.
5. Stores different cations (Ca^{2+} , K^{+}) and capable of active transport.
- ✓ 6. Helps in sperm and ovum formation.
7. Maintains concentration of Ca^{2+} ions in cell.
- ✓ 8. Regulates apoptosis of cell.

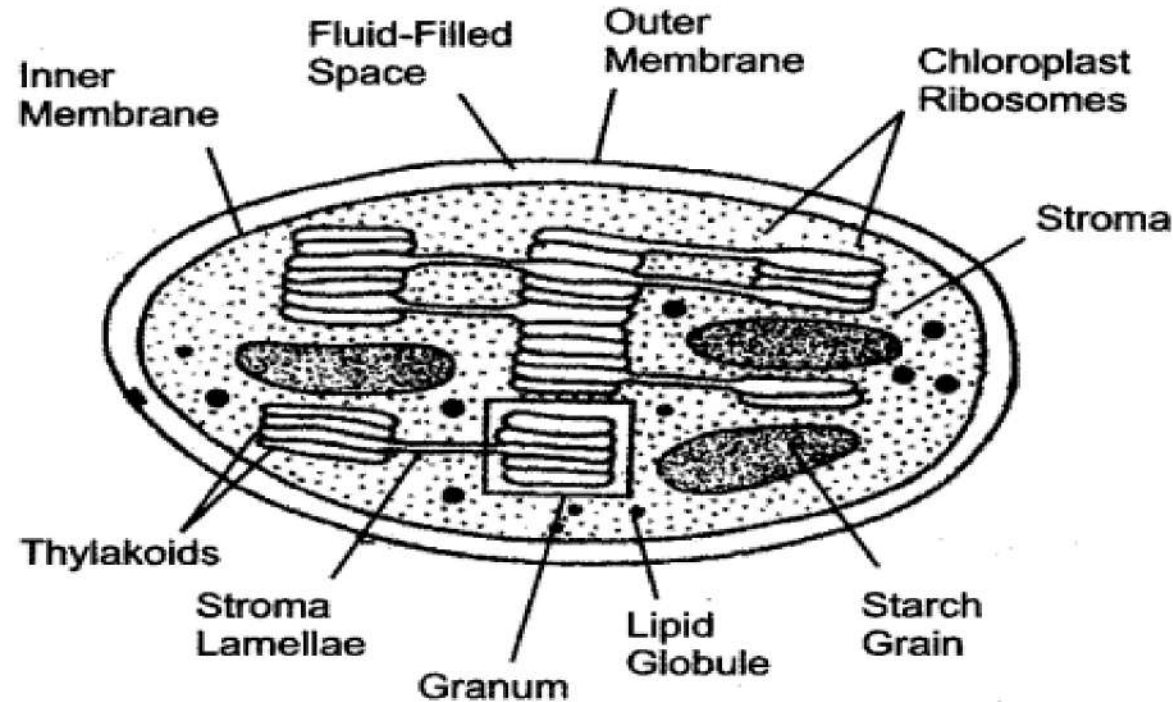
POLL QUESTION 04

Which of the following organ cells has more mitochondria?

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

Plastid

- ❑ 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



Structure of Chloroplast

Plastid

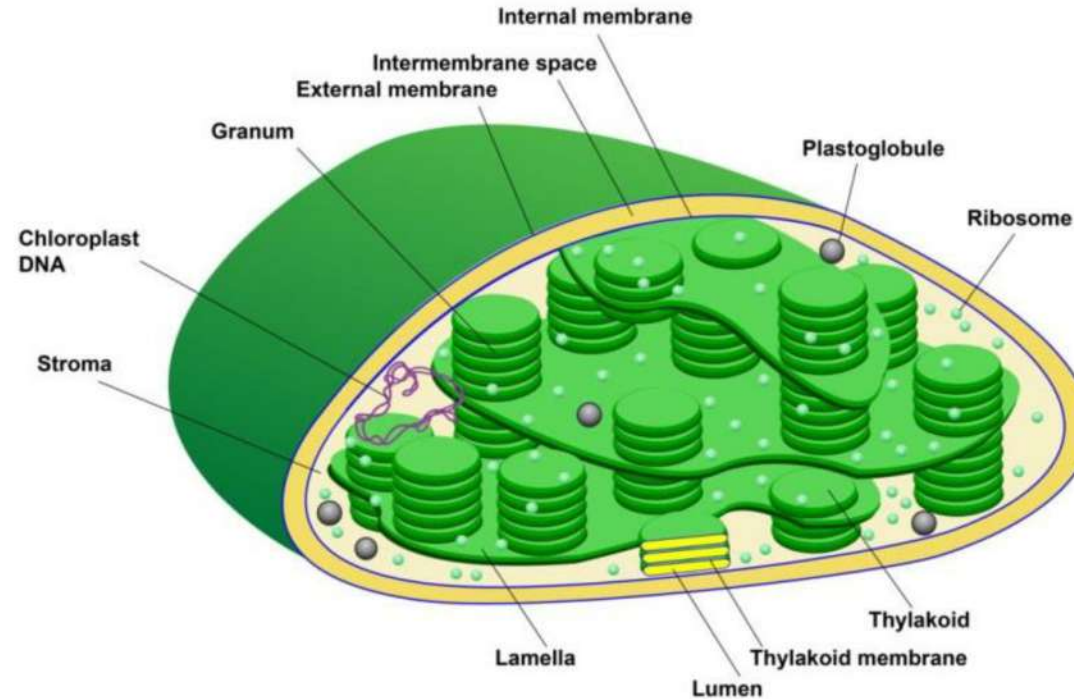
Types

- Chromoplast
- ~~Chloroplast~~
- Leucoplast

(i) Amyloplast:
storage of
starch.

(ii) Elaioplast:
storage of lipid.

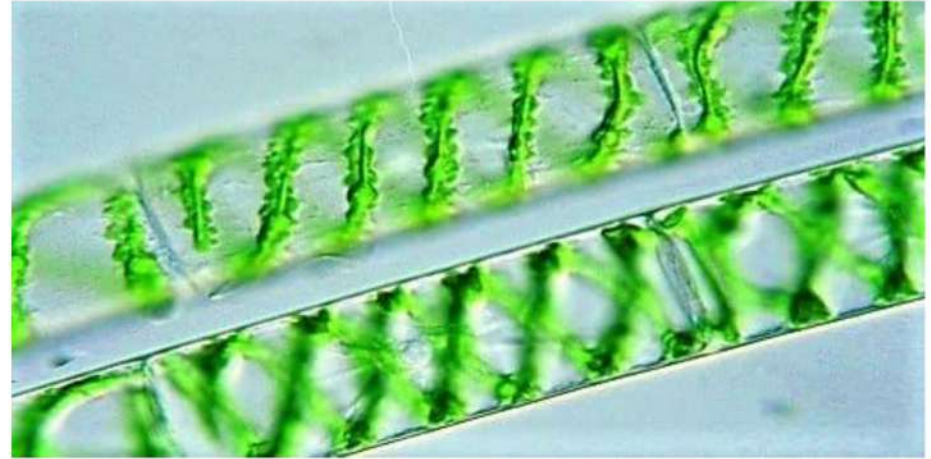
~~Aleuroplast/protein~~
~~oplast~~:
storage of protein.



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

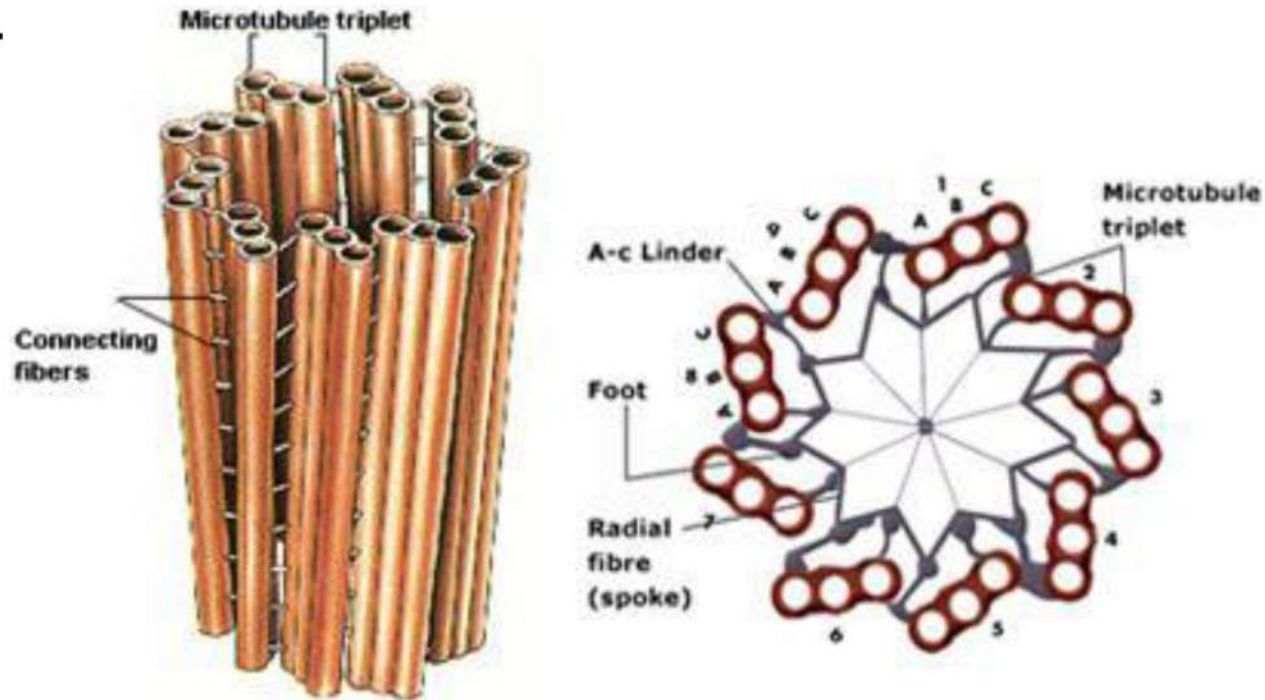
- Discovery:** Van Benden.
- Nomenclature:** Theodor Boveri
- Present in algae, fungi, bryophytes, pteridophytes, gymnosperm plants and most of the animal cells.

?? 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).



Cytoskeleton

- Microtubules
- Microfilament
- Intermediate Filament

Functions 100%



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.✓ Examples: <i>Vaucheria</i>, <i>Botrydium</i>, <i>Sphaeroplea</i> etc. algae and some fungi including <i>Penicillium</i>.
Shape	<ul style="list-style-type: none">• Nucleus can occupy 10-15% space of the cell. About 90% of sperm is nucleus.

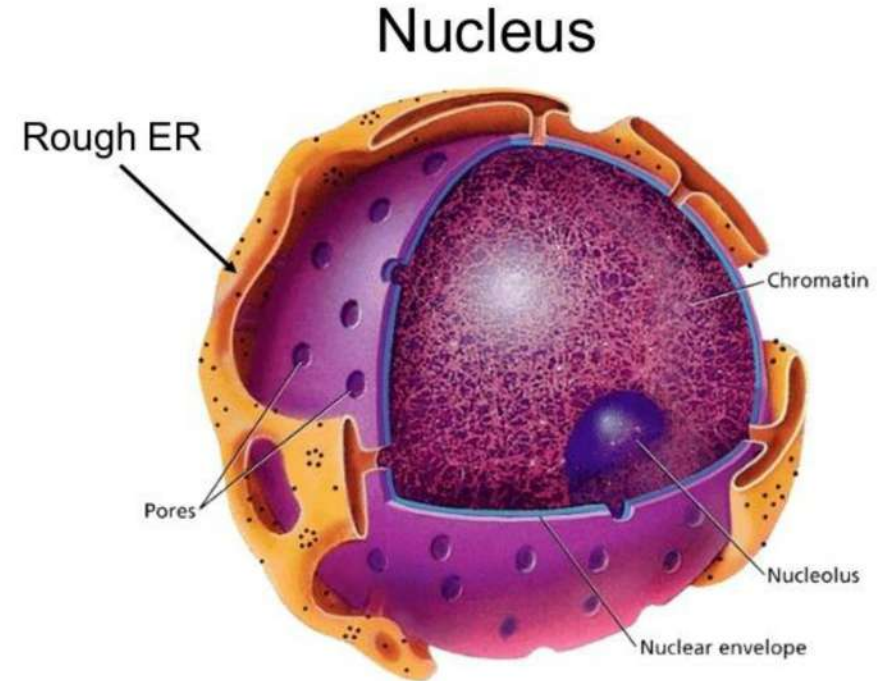
Nucleus

✓ 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

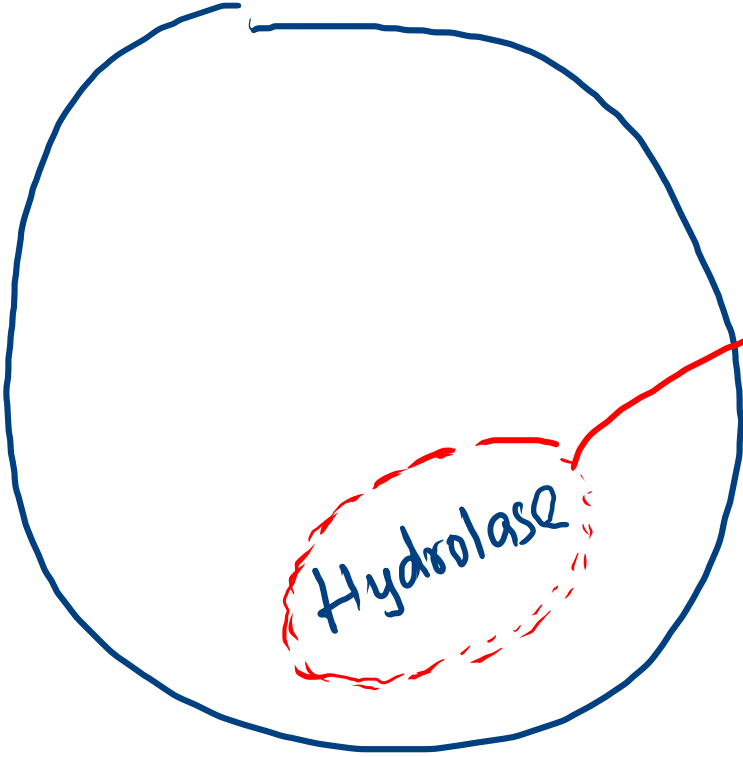
- Contains chromatin reticulum and nucleolus.
- Main site of enzymatic action.



Golgi bodies

cytoplasm

Lysosome



Hydrolase

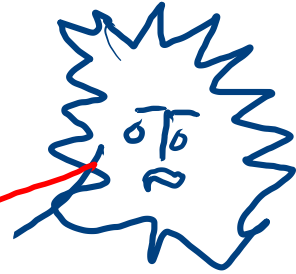
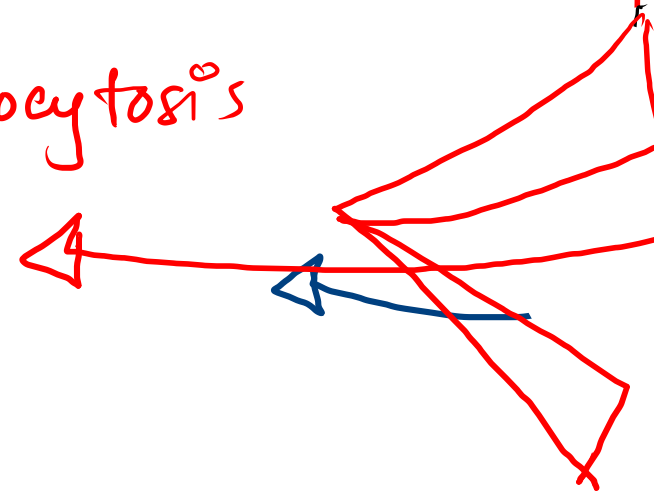
Hydrolase
+ various types of
E

WBC (MACROPHAGE)

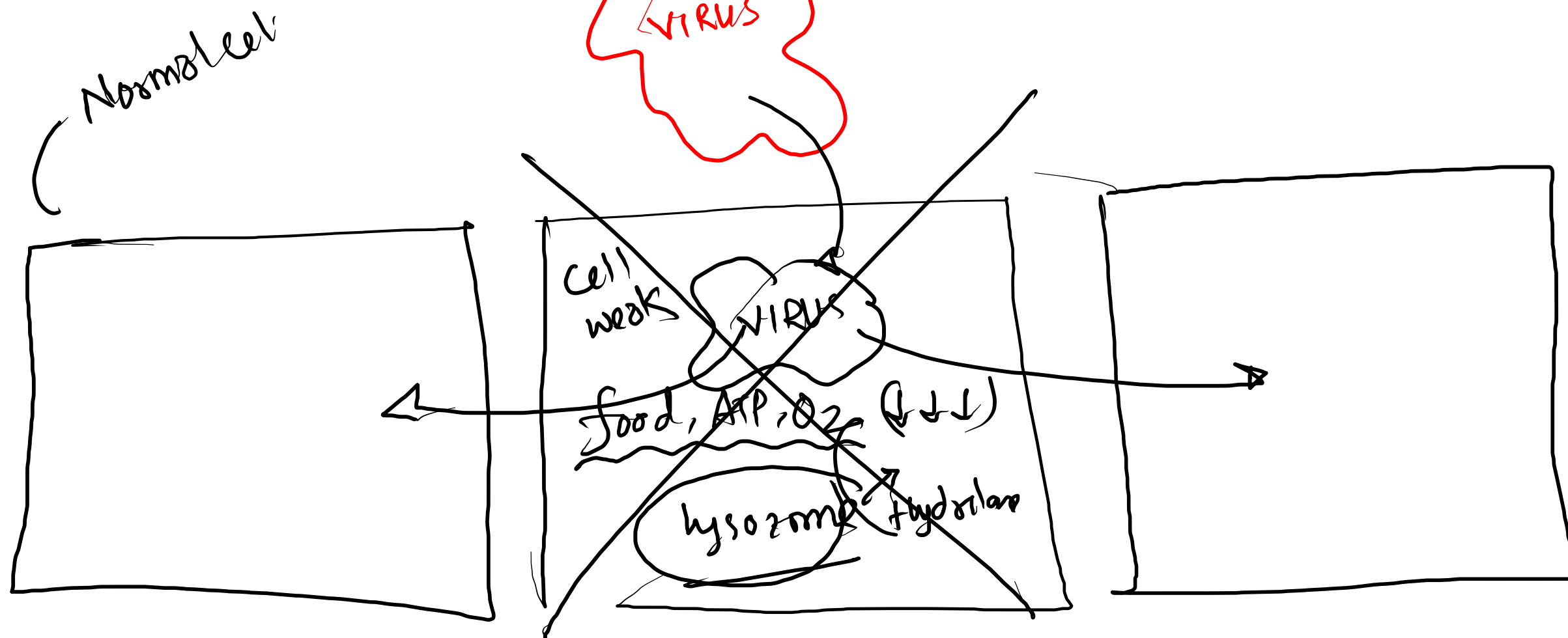
lysosome

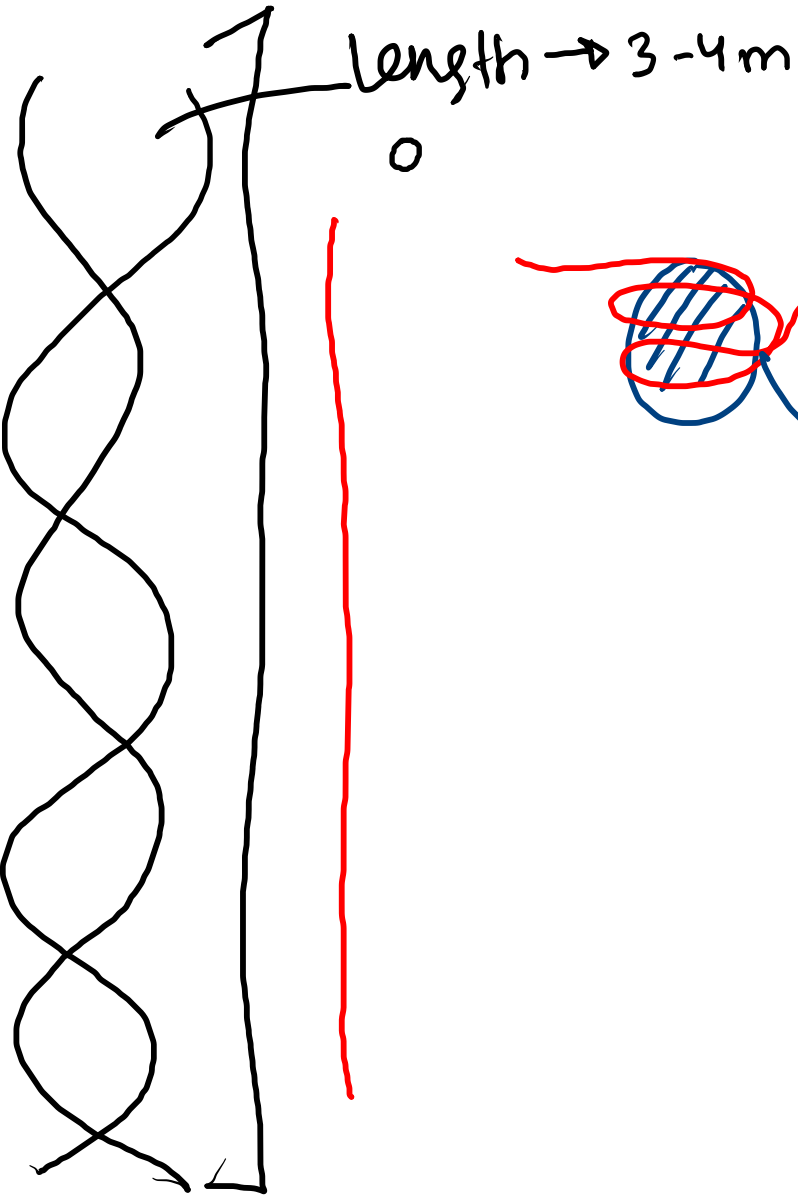


jail
phagocytosis

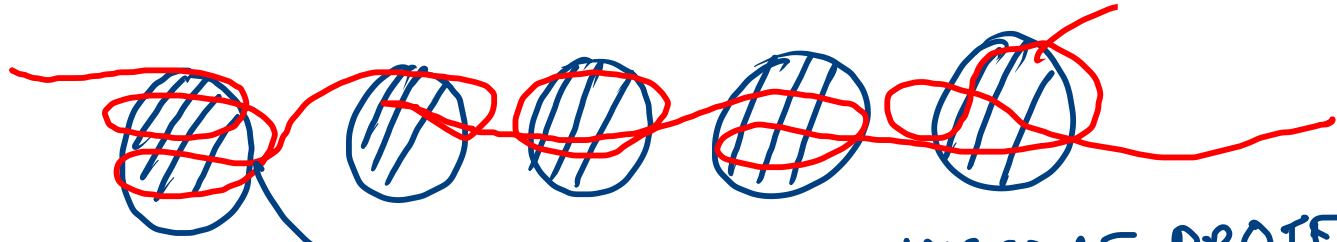


Autolysis / Autophagi / suicidal Squad





circles



DNA wrap → HISTONE PROTEIN

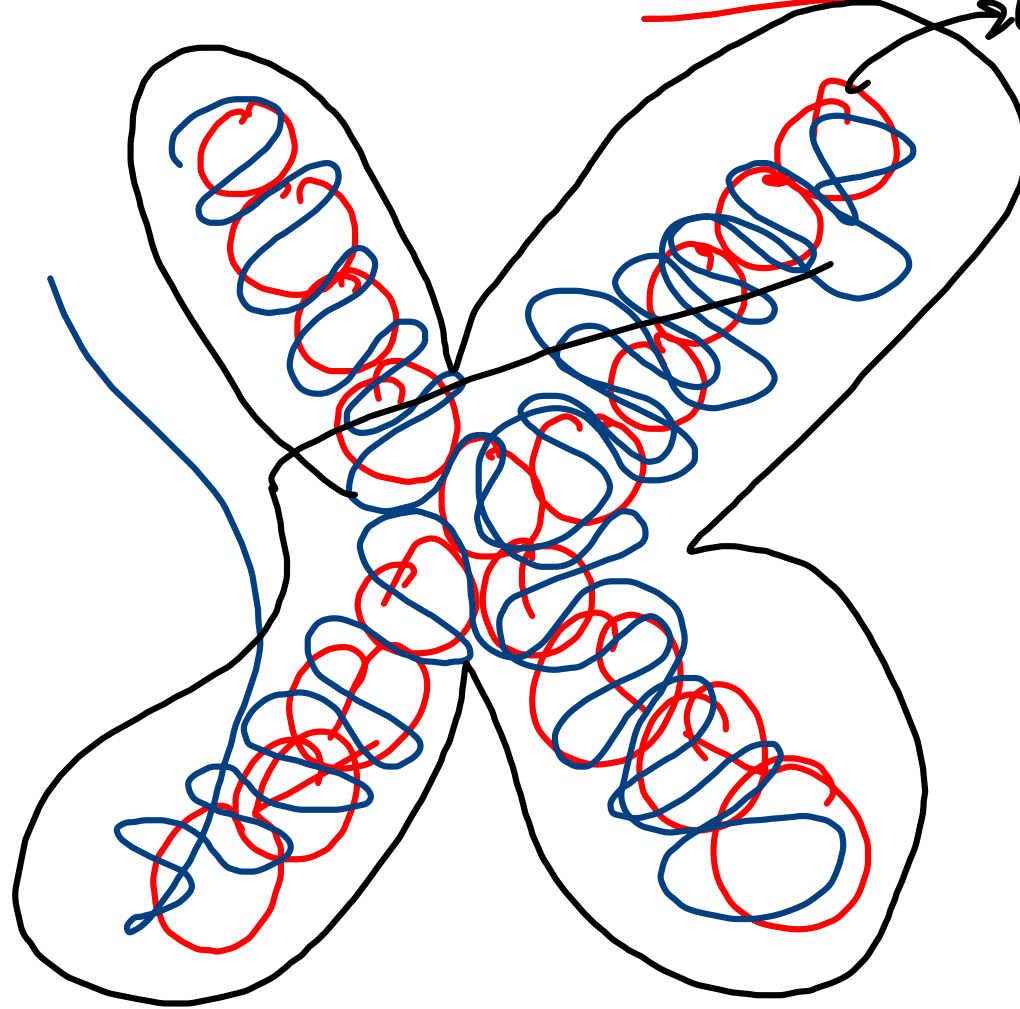
CHROMATIN

Chromatin

→ CHROMATINS

↓ stage 2

→ CHROMOSOME



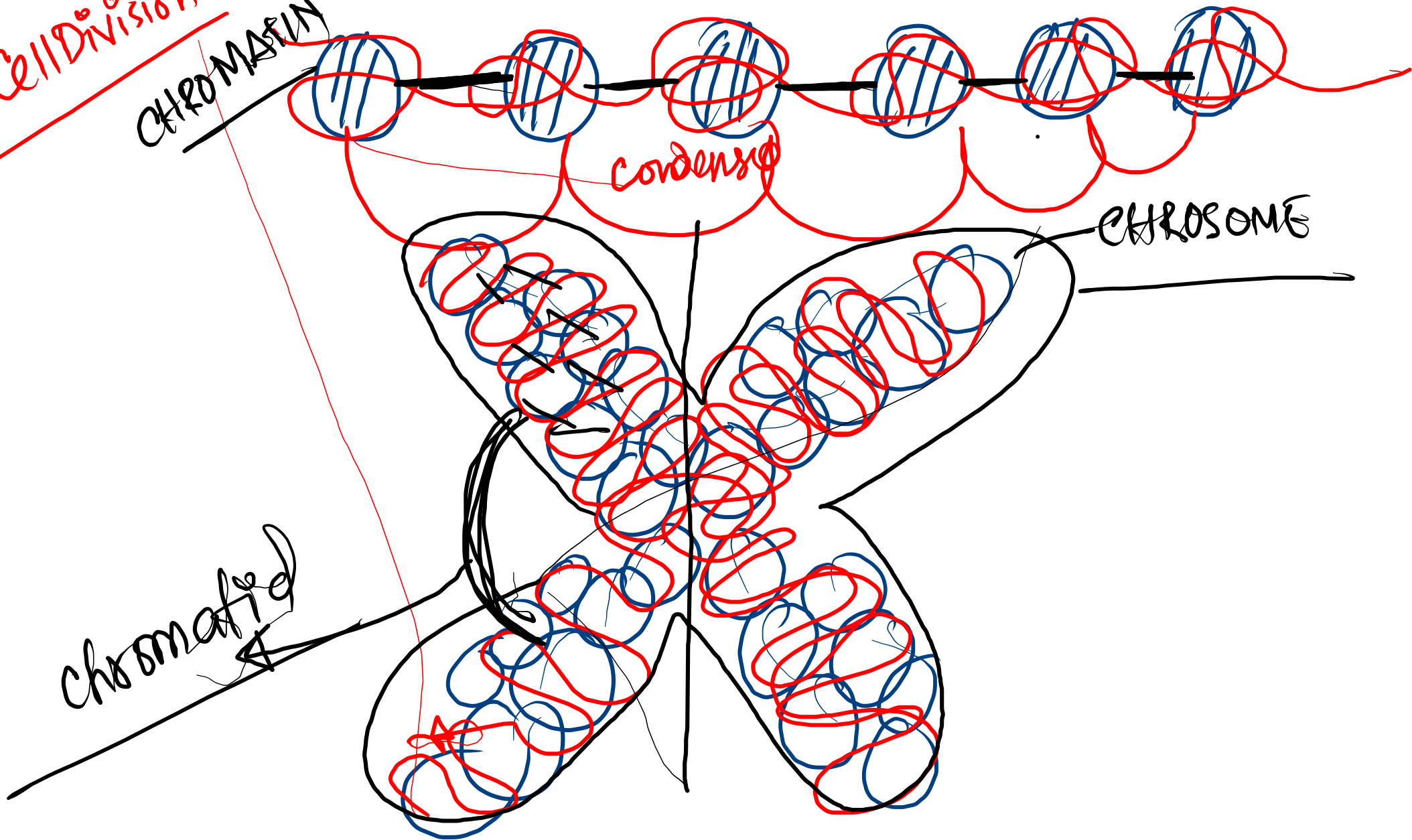
Cell Division

CHROMATIN

condensed

CHROMOSOME

chromatid



c. Nucleolus

- Nucleus is usually divided in 3 parts - fibrous, granular and matrix.
- 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

Peroxisome

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

Glyoxysome

- ❑ Converts lipid into sugar during germination of seed

Chromosome

- ❑ Observes some filamentous structures during cell division Strasburger
- ❑ 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

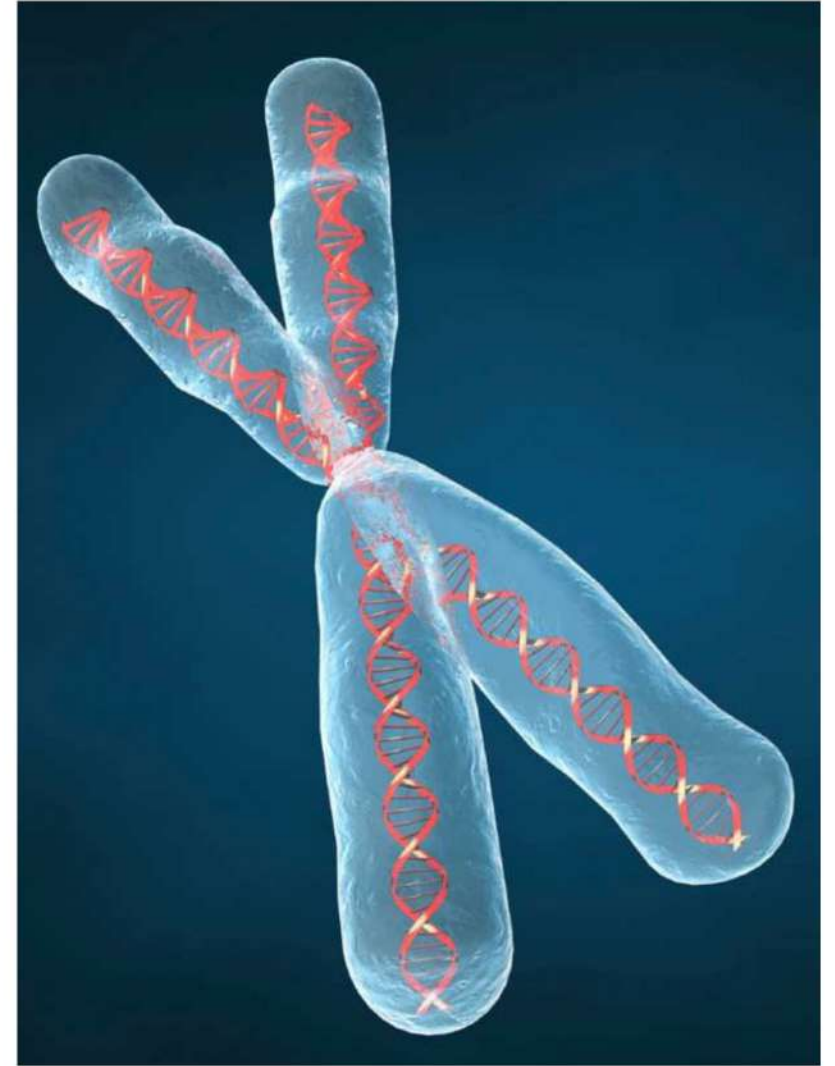
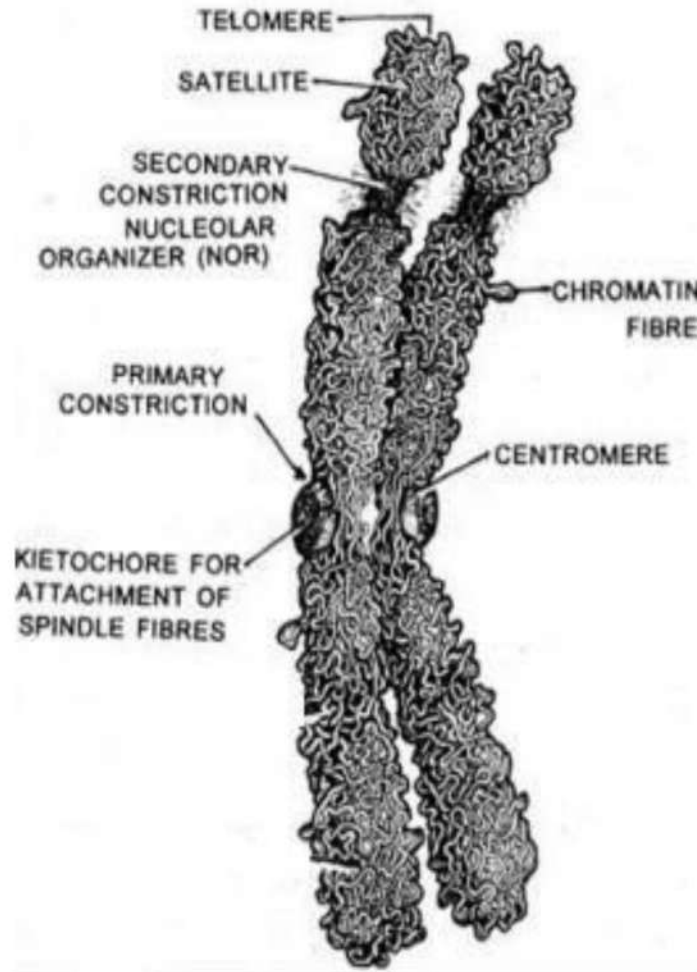
Chemical Components

- The proportion of DNA and histone protein in chromosomes is 1:1.
- The amount of DNA in various components of chromosomes is about 45 percent. Protein accounts for 55 percent.
- The amount of RNA in a chromosome is 0.2-1.4 percent.
- Almost 90% chromosome of organisms are present in DNA.

Structure of a Chromosome

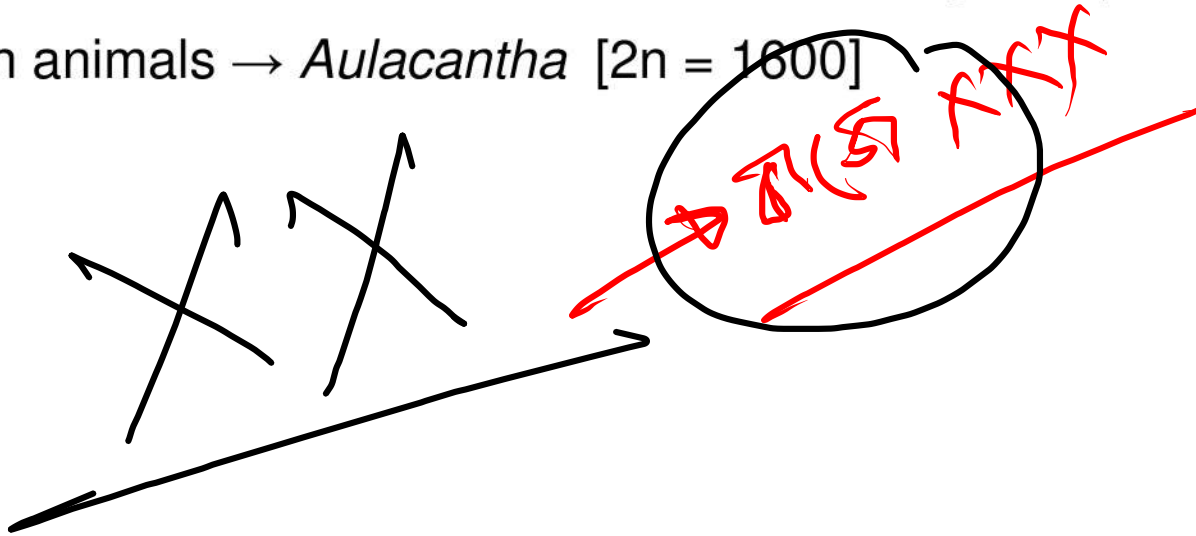
Parts of a chromosome

- Chromatin ✓
- Chromatid ✓
- Centromere
- Arms
- Kinetochore
- Chromomere
- Secondary Constriction
- Satellite
- Telomere
- Matrix
- Pellicle



Numerics

- ✓ In higher organisms, number of chromosomes is usually from 2 to 80 in every somatic cell.
- ✓ Minimum in flowering plants → *Haplopappus gracilis* [$2n = 4$]
- ✓ Maximum in flowering plants → *Poa littarosa* [$2n = 506-530$]
- ✓ Minimum in animals → Round worm = *Ascaris megalocephalas* [$2n = 2$]
- ✓ Maximum in animals → *Aulacantha* [$2n = 1600$]



~~Chromatin:~~

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

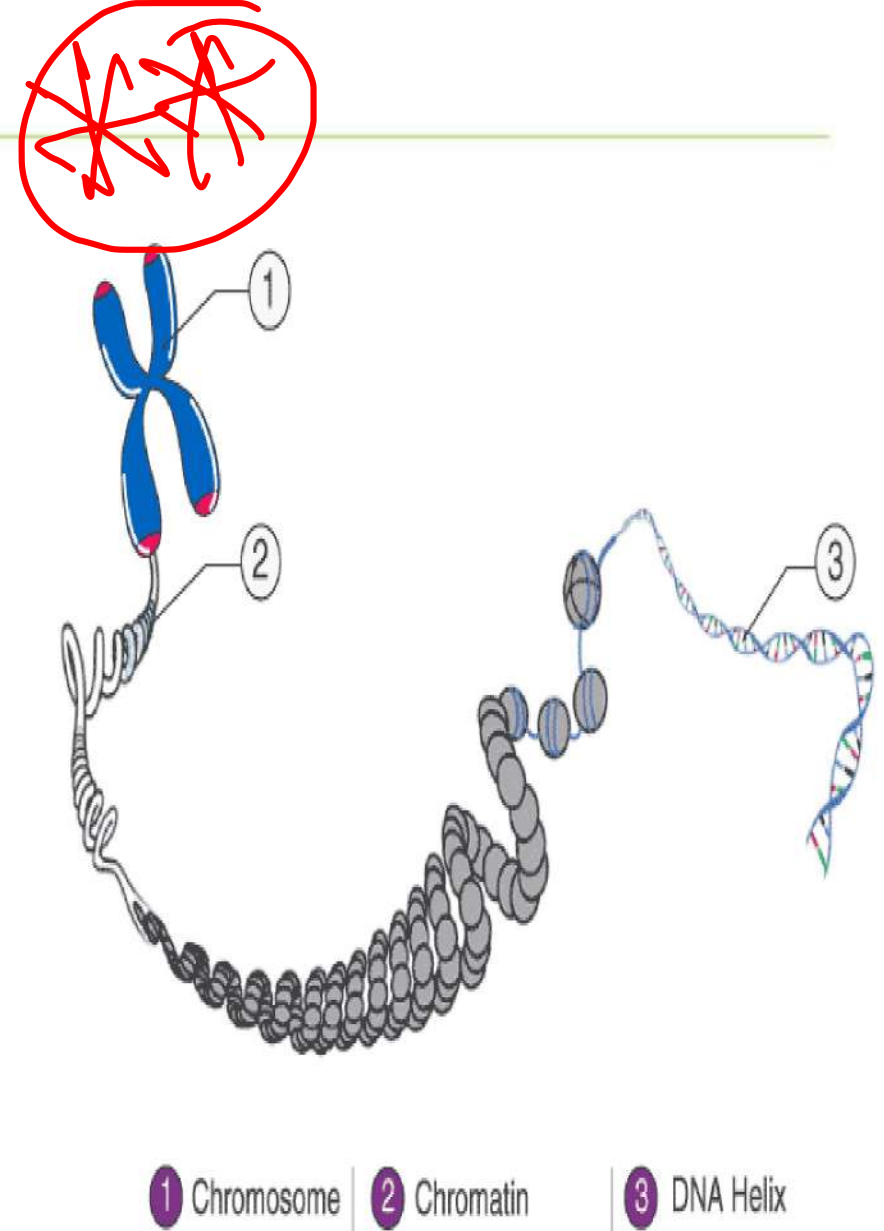
~~Chromatid:~~

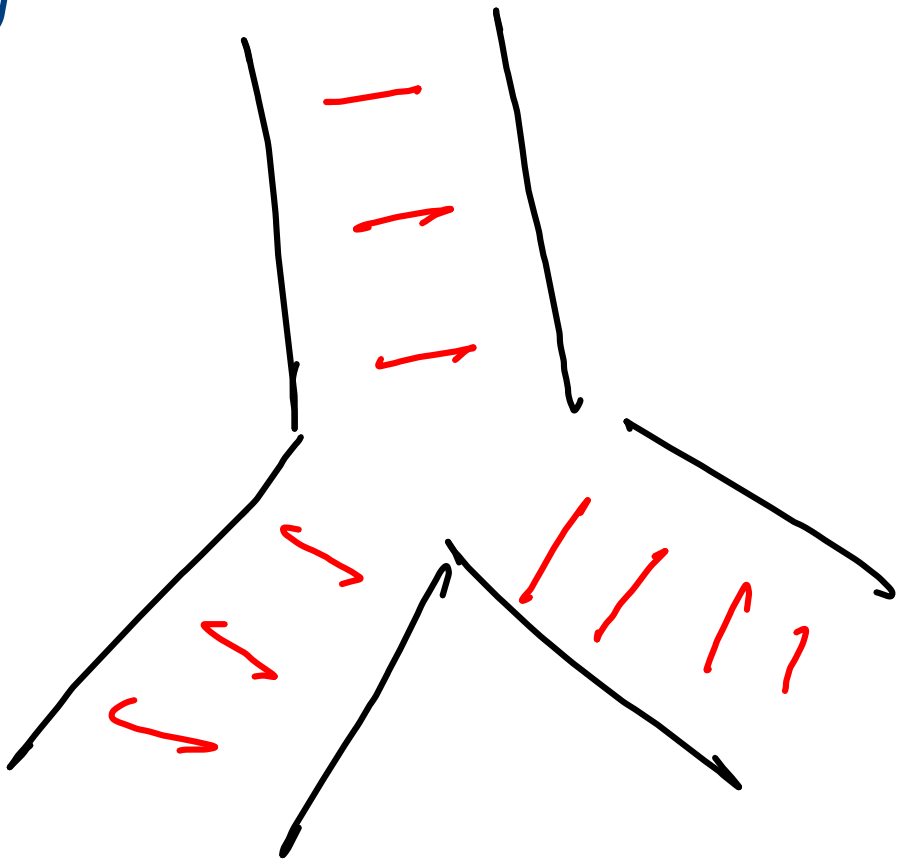
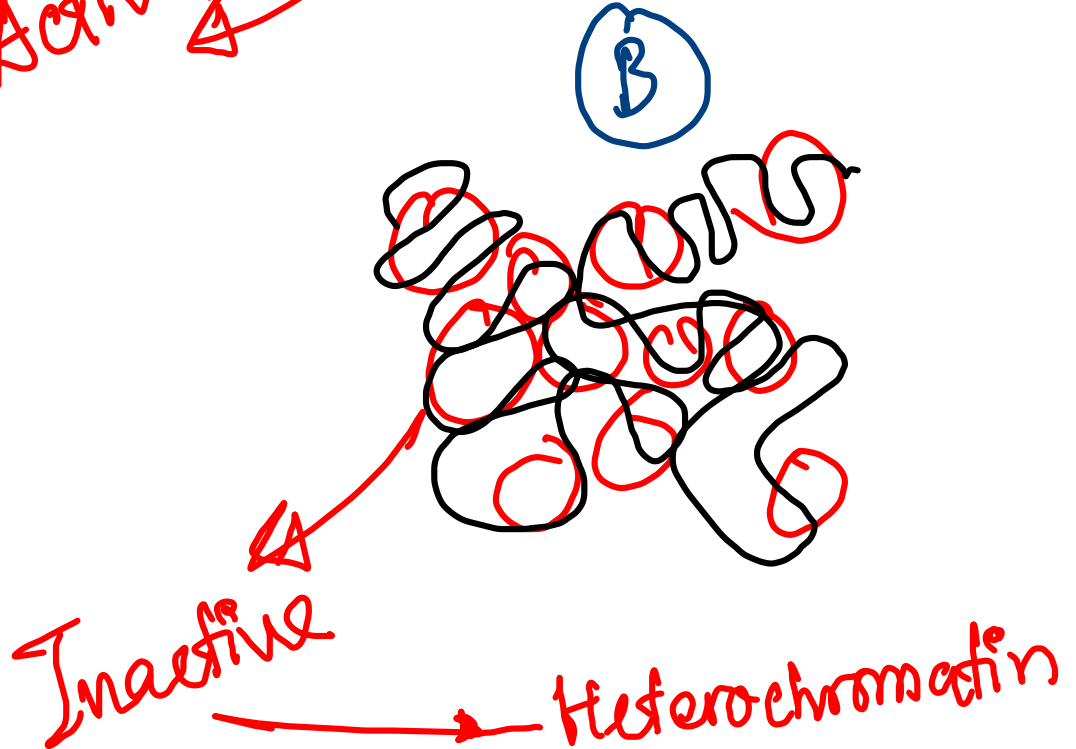
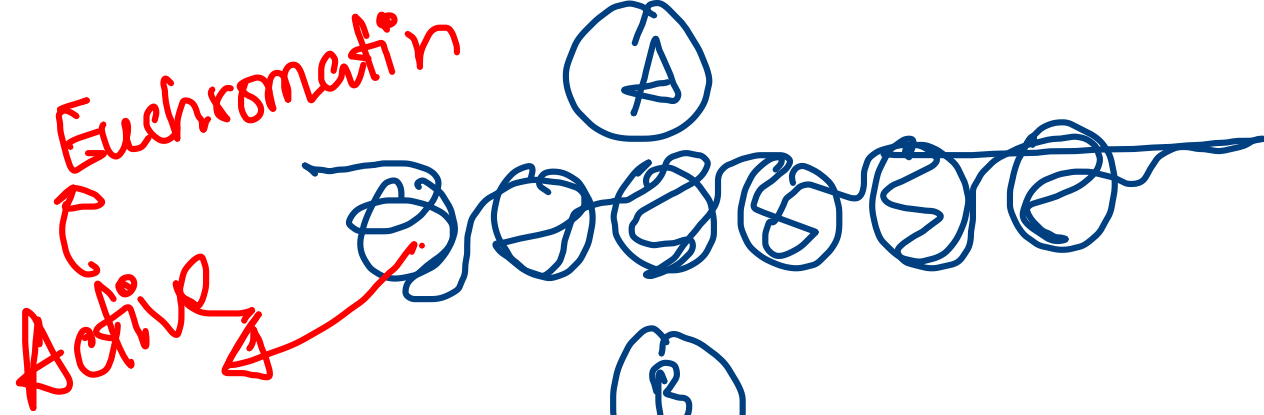
- In metaphase stage, the chromosome is seen longitudinally divided into two segments.
- Each segment is formed of single DNA molecule.

Centromere:

- An ideal chromosome contains only **one** centromere.

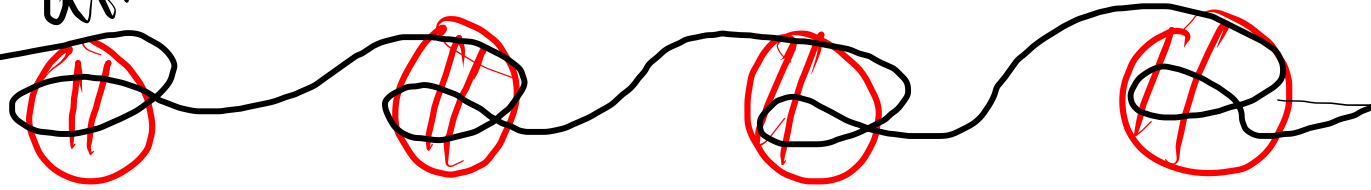
cell Division clear ✓





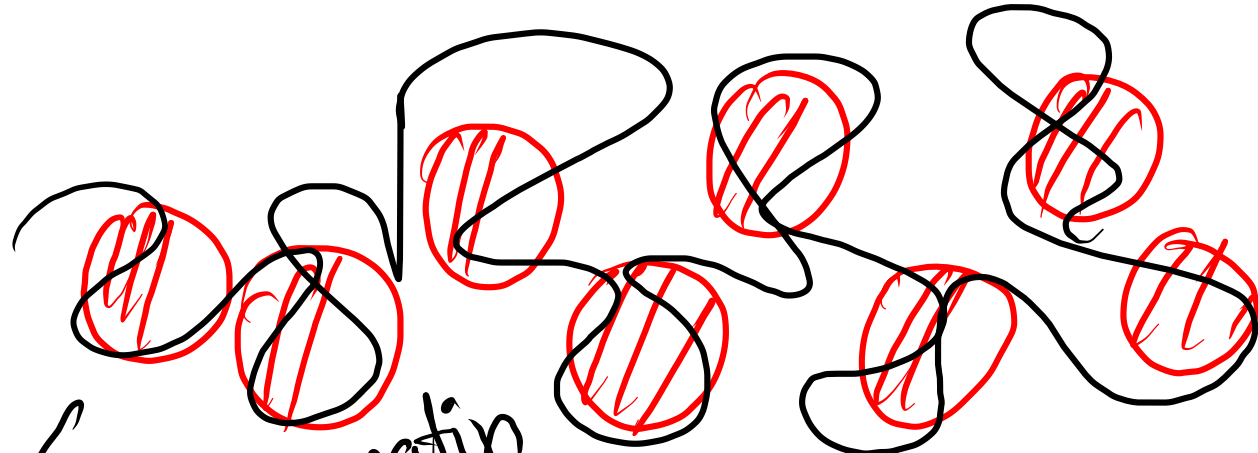
(A)

Euchromatin



(B)

Heterochromatin



Secondary Constriction

Another name → **Nucleolus reformation area**

Satellite

- The chromosome where satellite is present / Nucleolus containing chromosome is called → SAT chromosome .
- Cotton, jute, pea etc. plants** has some chromosomes containing satellite.
- 1st** chromosome of chickpea contains satellite.
- Secondary constriction called SAT helps in formation of nucleolus.

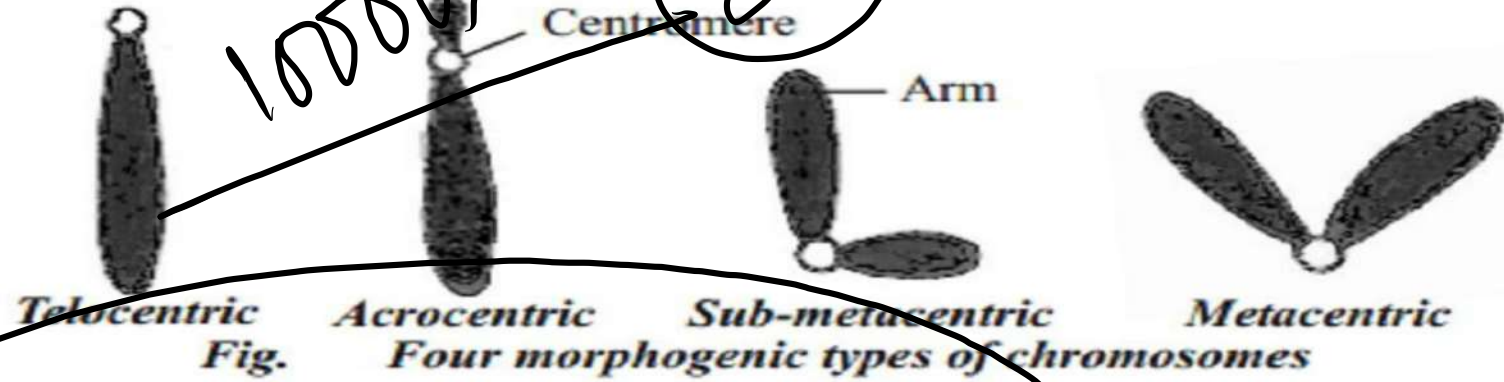
Telomere

- Repeated sequence of DNA in the head of chromosome is telomere.
- Protects the coding region of DNA from destruction during cell division.
- 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

Exam !!!

10000%



According to the position of centromere

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

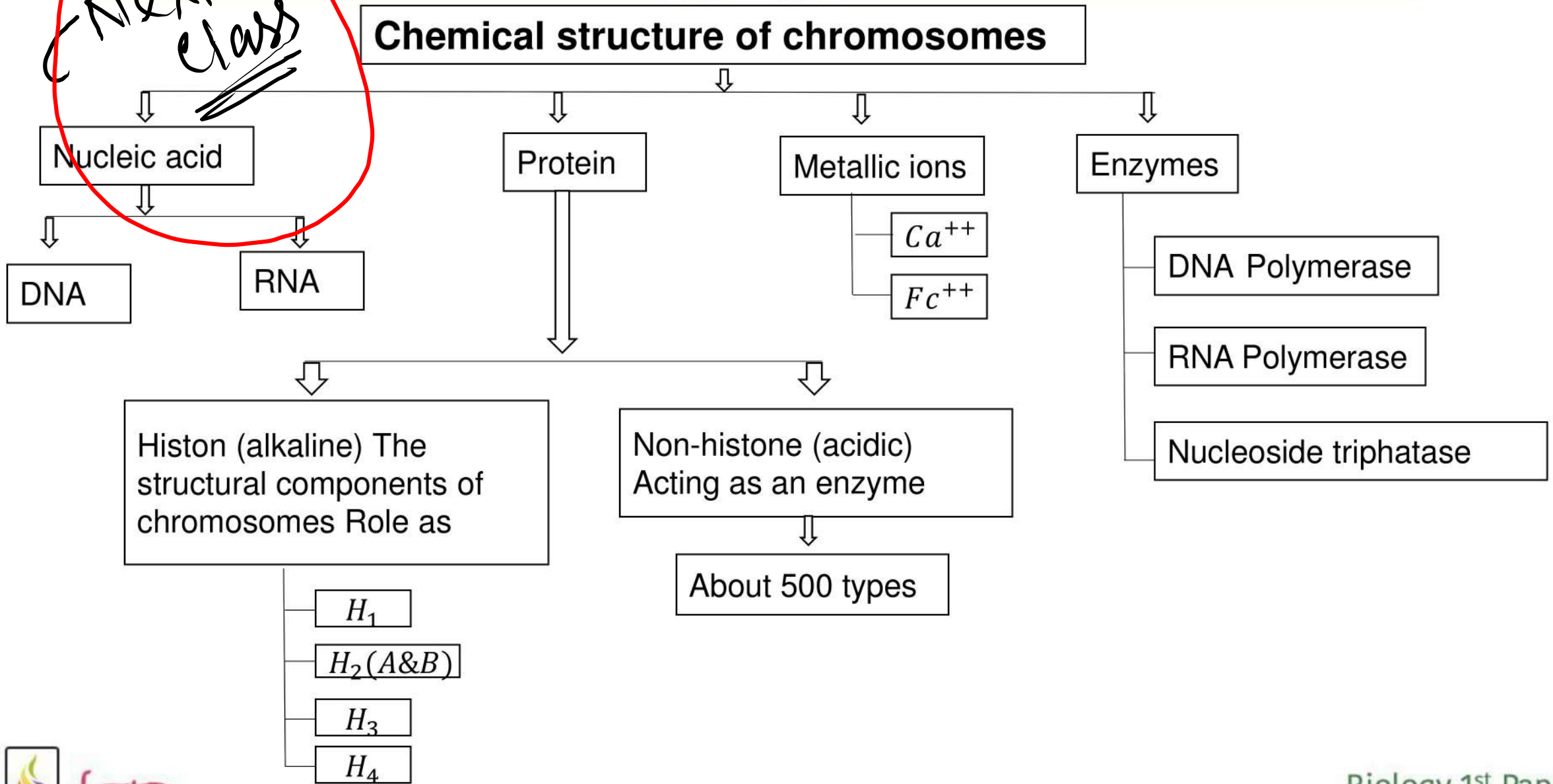


Classification

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.

Chemical structure of Chromosome



Functions of Chromosome

1. Contains DNA or gene molecule.

Next class

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.

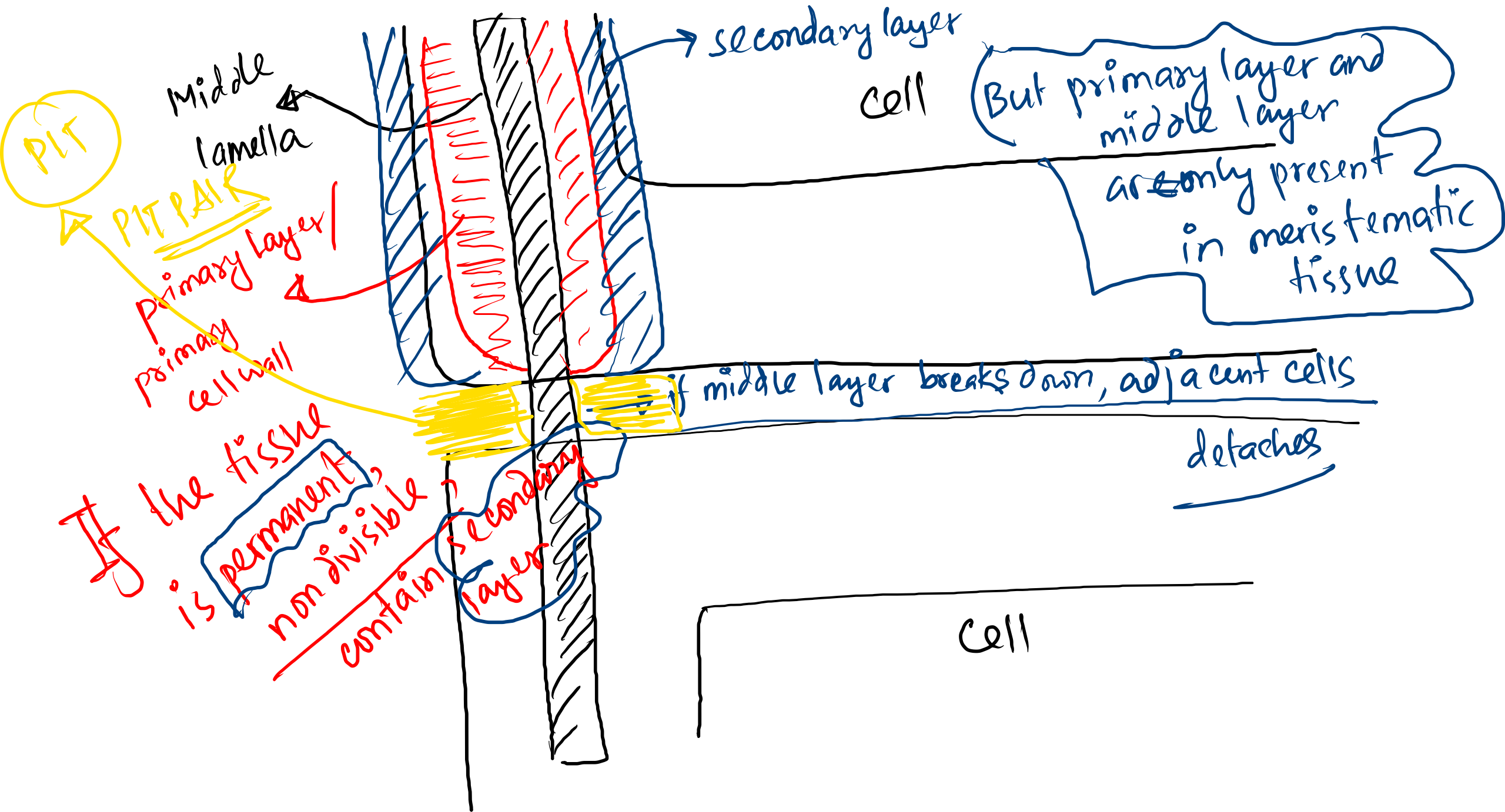
6. Carrier gene of inheritance works as a blueprint of life of organism

লেগে থাকো সৎ ভাবে,
স্বপ্ন জয় তোমারই হবে।



ডিম্বেশ

মেডিকেল এন্ড ডেন্টাল এডমিশন কোয়ার

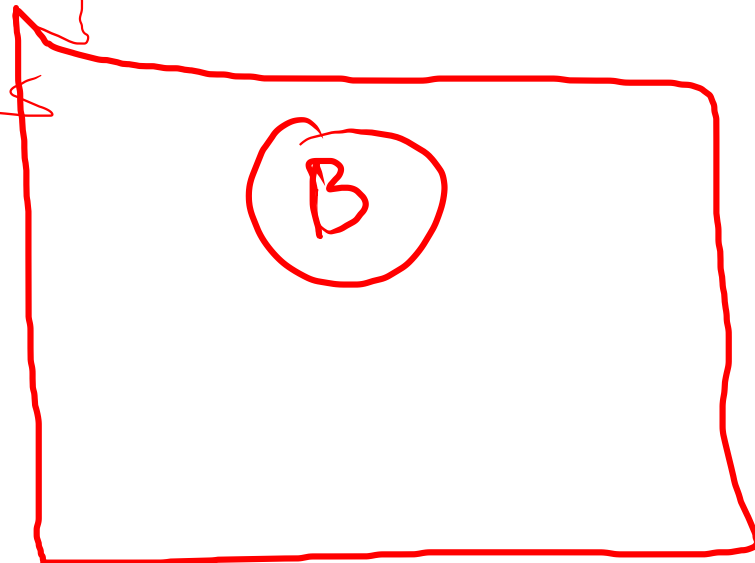
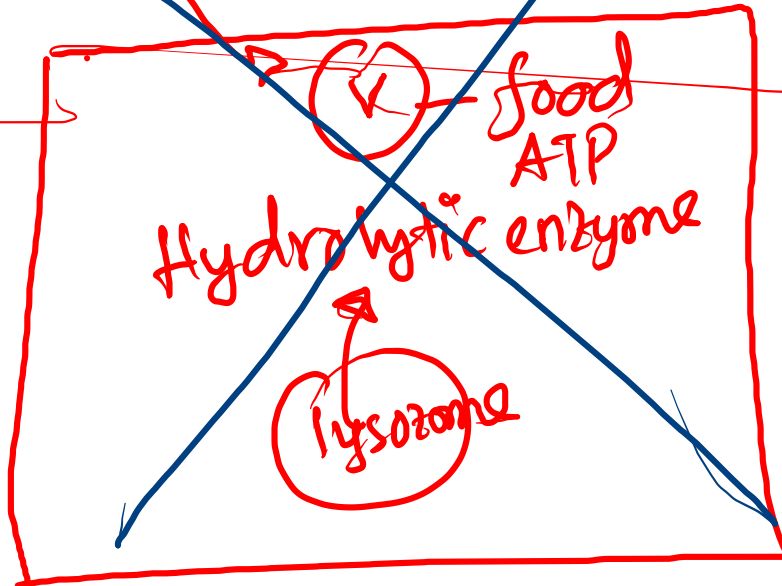
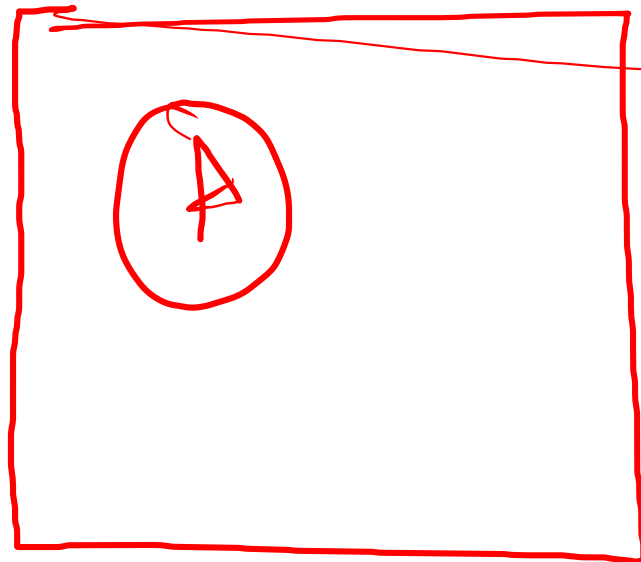


Autolysis / Autophagy / Suicidal Squad

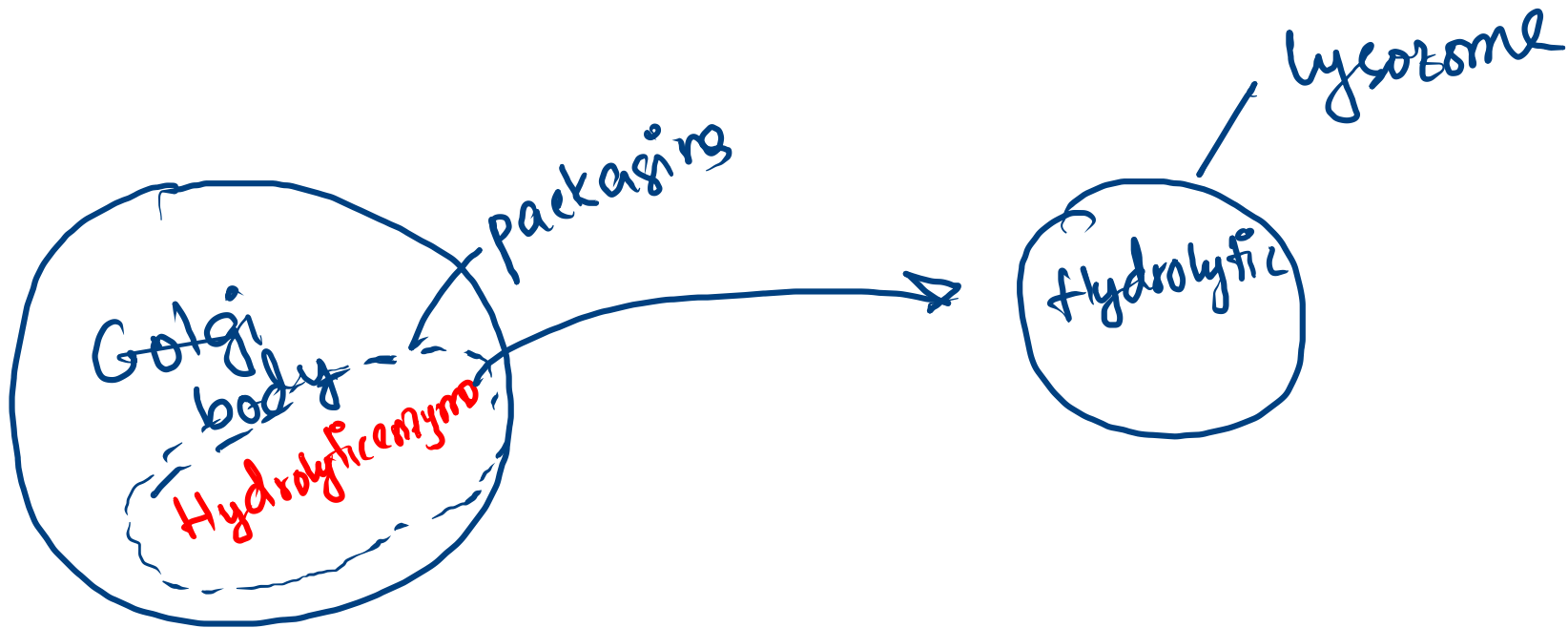
Autolysis

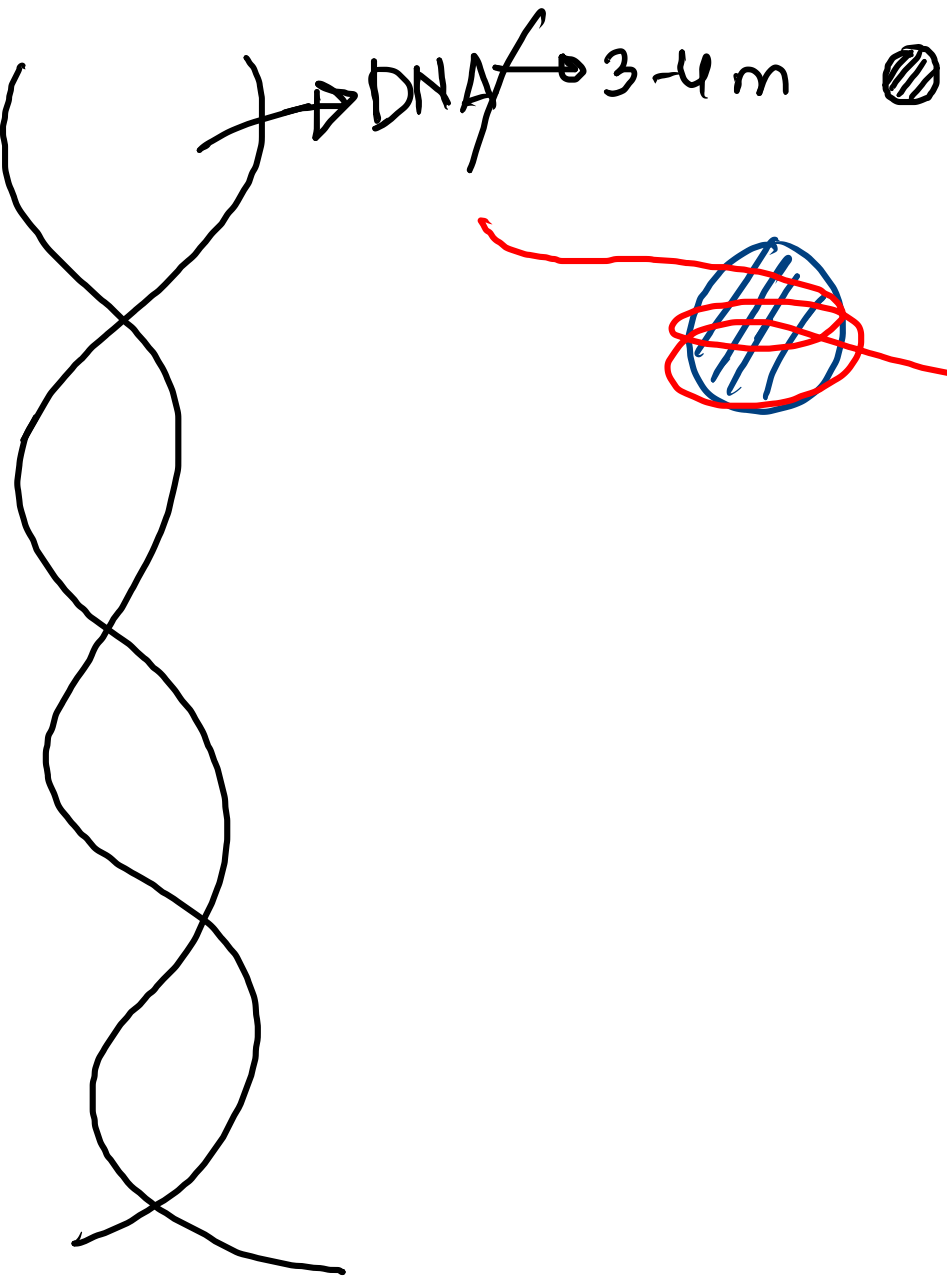
Autophagy
VIRUS

Suicidal Squad



cell





round → HISTONE protein

condense



DNA + Histone protein
→ condensed version

→ CHROMATIN

