

Unit-1 ⇒ Introduction to living world

⇒ Concept & definition of biology:-

The term, Biology by combining two Greek words - bios meaning "life" and logia meaning "study of".

Thus Biology is the natural science concerned with the study of life & living organisms. Following are the various sub-disciplines of Biology :-

- 1) Anatomy - Branch of biology concerned with the study of structure of organisms and their parts.
- 2) Biochemistry - Study of chemical reactions required for life to exist & function.
- 3) Botany - Study of plants.
- 4) Zoology - Study of animals, including classification.
- 5) Virology - Study of viruses & virus like agents.
- 6) Pathology - Study of diseases, including their cause, processes & development.
- 7) Physiology - Study of functioning of living organisms.
- 8) Microbiology - Study of micro-organisms.

9) Proteomics - Study of proteins, particularly their structure & function.

10) Biotechnology:- Exploitation of biological processes for industrial & other purposes. especially the genetic manipulation of micro-organisms for the production of antibiotics, hormones etc.

⇒ Characteristics features of living organisms:-

1) Definite form & size - Every living organism has definite form & size with little variance.

2) Cell as basic unit of life - All living organisms are made up of basic structural & functional unit of life known as cell.

3) Metabolism - It refers to sum total of all the reaction that takes place inside living organism.

There are two categories of metabolism : catabolism and anabolism.

a) Catabolism is the breakdown of organic matter.

b) Anabolism uses energy to construct components of cells, such as proteins and nucleic acids.

4) Nutrition - The way by which organisms produce food to be used for energy and as carbon source is called nutrition.

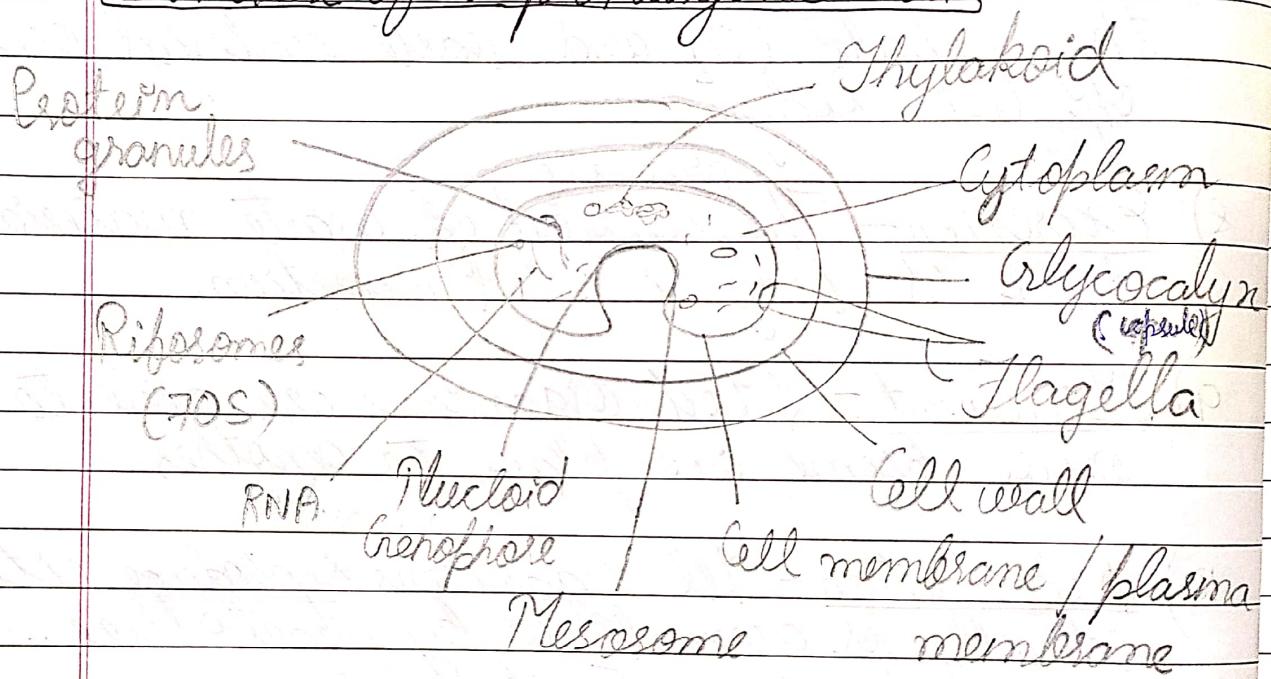
- 5) Respiration - Stepwise oxidation of food to release energy. However some organism respire an-aerobically.
- 6) Growth & development - Irreversible increase in the size and weight of an organisms is called growth.
- 7) Exchange of materials - All living organisms inhale oxygen and take nutrition, whereas they exhale CO_2 and waste material out of their body.
- 8) Excretion - The removal of waste material from the body is called excretion.
process of
- 9) Movement - Most organisms are able to move from one place to another.
- 10) Reproduction - All organisms reproduce either sexually or asexually or by vegetative means to form off-springs.
- 11) Adaptation - Physiological or Behavioural changes in the body of organisms to make it better suited to the environment for its survival.
- 12) Life span - All living organisms have a definite life span with a certain range after which they die.

⇒ PROKARYOTIC CELL :-

It is that cell which lacks a well-defined nucleus and membrane-bound organelles.

Eg:- i) Bacteria ii) Cyanobacteria
 iii) PPLO [Pleuro-Pneumonia like organism]

Structure of a prokaryotic cell:-



- 1) Cell wall - Cell wall in Bacteria is made up of peptido-glycan, which is a polymer of $\text{NAG} \rightarrow \text{N}-\text{acetylglucosamine}$ & $\text{NAM} \rightarrow \text{N}-\text{acetylmuramic acid}$. It provides shape & rigidity to cell.

- 2) Glycocalyx - It is made up of polysaccharides or proteins or both. Function → Helps in the attachment of Bacterial cell of various

surfaces. For some bacteria, it also contributes to pathogenicity [disease causing ability].

3) Flagella - It is present in some bacteria. It is a locomotory structure that helps in the movement of bacteria. It is made up of protein called flagellin.

Flagella is single stranded in bacteria.
→ forward movement, (→ backward movement)

4) Plasma membrane - Plasma membrane is a selectively permeable membrane present around cell. also known as cell membrane.

5) Vesosome - They are invagination or infolding of plasma membrane.

- 1) It has a role in DNA replication.
- 2) It has a role in the formation of cell septum for cell division.
- 3) Also help in respiration, secretion process and to increase the surface area of plasma membrane.

6) Nucleoid - The naked DNA of prokaryotes which is not enclosed inside the nucleus is called nucleoid / genophore. In addition to genomic DNA, many bacteria have small circular DNA outside genomic DNA called plasmids, which confers traits like anti-biotic resistance to bacteria.

7) Ribosomes - They are the protein-factory of cell. In prokaryot's ribosomes lie

freely in the cytoplasm and are of 70S type, which has two sub-units - 50S & 30S

8) Thylakoid - They are present in some bacteria of blue-green algae which are auto-trophic. They lie in cytoplasm and contain pigments, such as Bacterio chlorophyll.

9) Protein granules / fat / lipid globules - They lie freely in the cytoplasm.

10) Gas vacuoles - They are not true vacuoles and are present in some bacteria to provide buoyancy. For eg:- these gas vacuoles are present in purple & green photosynthetic bacteria.

11) Ribosome -

- a) They are made up of RNA & protein.
- b) Protein factory of the cell.
- c) Nucleo-protein membrane-less organelles which are the sites for protein synthesis.
Consists of two unequal sub-units.

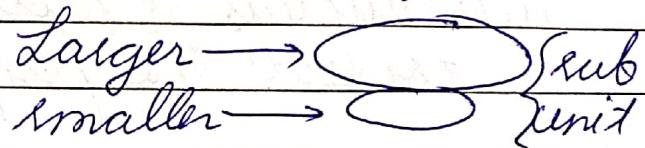
Larger sub-unit is dome-shaped & smaller sub-unit ellipsoid and fits like a cap over the larger sub-unit.

Depending upon their place of occurrence; Ribosomes are of two types.

i) Cyttoplasmic ribosomes - These are found in cytoplasm of prokaryotes and eukaryotes (80S) as well as endoplasmic reticulum (RER of eukaryotes).

ii) Organelles ribosomes - They are found in ~~micro~~ - mitochondria and chloroplast of eukaryotes.

Depending upon size :-



70S ribosomes

i) They are smaller in size.

ii) They are lighter found in:-

a) cytoplasm of prokaryotes

b) chloroplast of eukaryotes & mitochondria

iii) RNA : Protein ratio

60 : 40

iv) Sub units \rightarrow 50S & 30S

80S ribosomes

i) They are larger in size

ii) They are lighter found in:-

a) Cytoplasm of eukaryotes.

iii) RNA : Protein ratio

40 : 60

iv) Sub-units \rightarrow 60S & 40S

EUKARYOTIC CELL:-

Contains a well-defined nucleus & membrane bound organelles such as mito-chondria.

For eg:- Animal cell & plant cell.

⇒ Differences:-

<u>① Plant cell</u>	<u>Animal cell</u>
i) Cell wall is present & made up of cellulose	i) Absent.
ii) Large central vacuole is present.	ii) Absent small vacuole may be present.
iii) Nucleus is present towards the periphery	iii) Nucleus is present in the center.
iv) Chloroplast is present	iv) Absent.
v) Glyoxosomes are present	v) Absent.
vi) Lysosomes are generally absent.	vi) Present.
vii) Dictyosomes are present.	vii) Well developed Golgi bodies are present.
viii) Starch is the reserve food.	viii) Glycogen is the reserve food.
ix) Regular in shape	ix) Not regular in shape
x) Centriole is absent	x) Centriole is present.

② Difference b/w Prokaryotic cell and Eukaryotic cell

P.T.O.

Prokaryotic cell

i) Well-defined nucleus is absent.

ii) Endoplasmic reticulum is absent in prokaryotic cell.

iii) Golgi body is absent.

iv) Lysosomes are absent.

v) Ribosomes - 70S

vi) Flagella is single stranded

vii) Flagella, if present is made of protein flagellin

viii) DNA is circular

ix) Amount of DNA is lesser

x) Histones are absent

xi) Transcription & translation occurs in the cytoplasm

xii) Cytoplasmic streaming (cytolysis is absent)

xiii) Endocytosis & exocytosis are rare.

Eukaryotic cell

i) Present.

ii) Present.

iii) Present.

iv) Present in animal cell.

v) 80S.

vi) Eleven (9+2) stranded.

vii) Flagella, if present is made up of protein tubulin.

viii) Generally linear.

ix) Higher.

x) Present & have role in packaging of protein

xi) Transcription occurs inside the nucleus & translation occurs in the cytoplasm

xii) Cytolysis occurs.

xiii) Endo-cytosis & exocytosis are common.

- | | |
|--|---|
| xiv) Respiratory enzymes are present on plasma membrane. | xiv) Respiratory enzymes are present in mitochondria and cytoplasm. |
| xv) Cell wall is made up of peptidoglycan | xv) Cell wall absent in animal cell. |
| xvi) Eg:- Bacteria | Xvi) Eg:- Animal & plant cell |

* \Rightarrow Endoplasmic reticulum - It is an extensive network of membrane lined channels within the cytoplasm. The ER network is continuous with nuclear envelope. ER can exist in following three forms.

- 1) CISTERNAE - These are inter-connected flattened stacks that mainly form RER.
- 2) TUBULES - These are branched or un-branched tube like structures that mainly form SER.
- 3) VESICLES - These are spherical or oval element of ER that exist along cisternae & tubules.

There are two types of ER:-

- 1) RER - The endoplasmic reticulum that ribosomes on its surface & concern with the synthesis of

proteins is called RER (Rough ER)

2) SER - The ER that don't have ribosomes & mainly concern with synthesis of lipids called SER (Smooth ER).

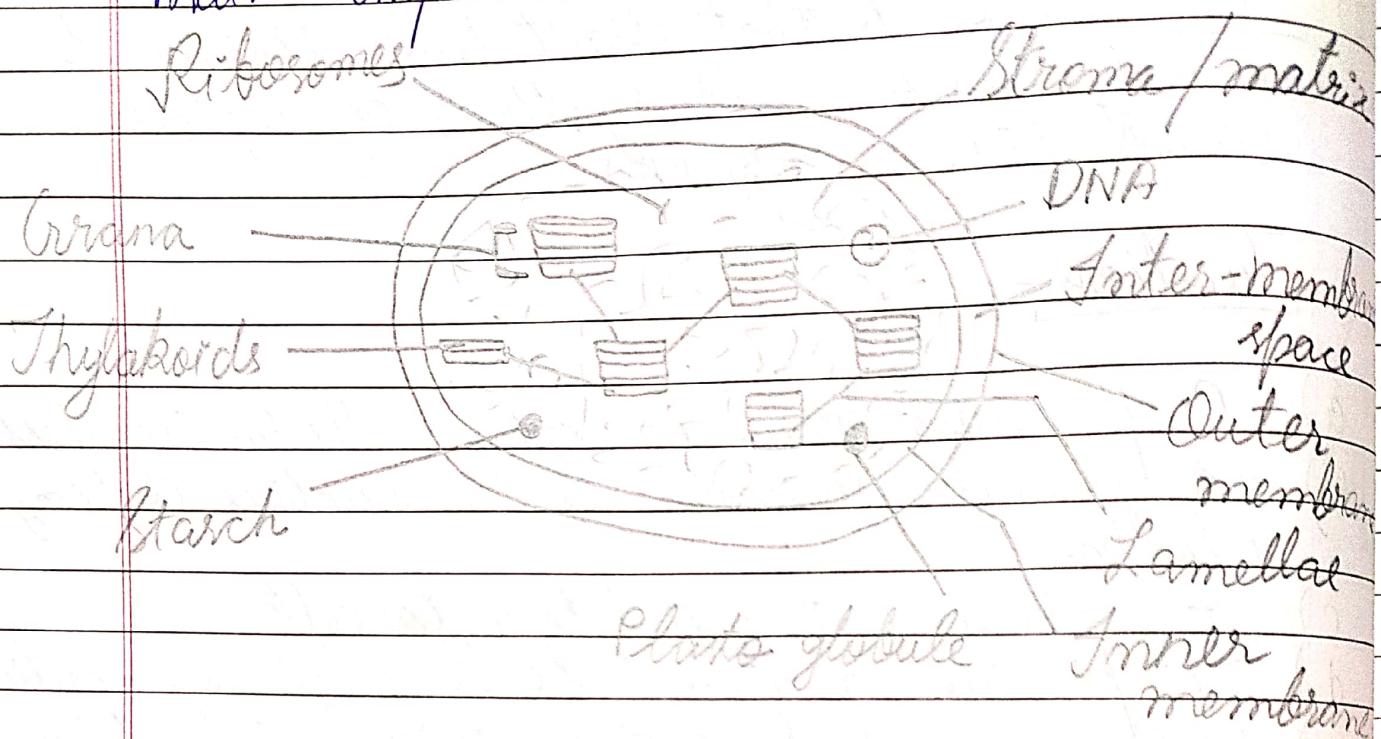
Functions:-

- a) ER provides mean for intra-cellular transport.
- b) It provides membrane to the nucleus during telophase.
- c) It acts as cyto-skeleton to cell.
- d) It provides material to the golgi for secretion.
- e) RER is concerned with synthesis of protein.
- f) The ER of muscle cell is modified to store calcium which is released at the time of muscle contraction. This modified ER is called sarcoplasmic reticulum.
- g) SER helps in detoxification of harmful drugs.
- h) SER helps in glucogen metabolism.
- i) SER provides surface for the synthesis of lipids, steroids & visual pigments.

→ Chloroplasts:- They are green plastids

that take part in photosynthesis. They are double-membrane bound organelles that contain chlorophyll as well as enzymes required for light reaction of photosynthesis. They are found in algae & green plants.

Structure:- A chloroplast comprises following main components.



1) Envelope - Chloroplast is enclosed by 2 membrane.

- Outer membrane, which may be continuous with endoplasmic reticulum.
- Inner membrane, which is attached with Thylakoids at various places. The space b/w 2 membrane is called Inter-membrane space.

2) Stroma - The ground substance enclosed by inner membrane of chloroplast is called stroma / matrix. It contains Grana, DNA, 70 S ribosome, plastoglobuli of some enzymes.

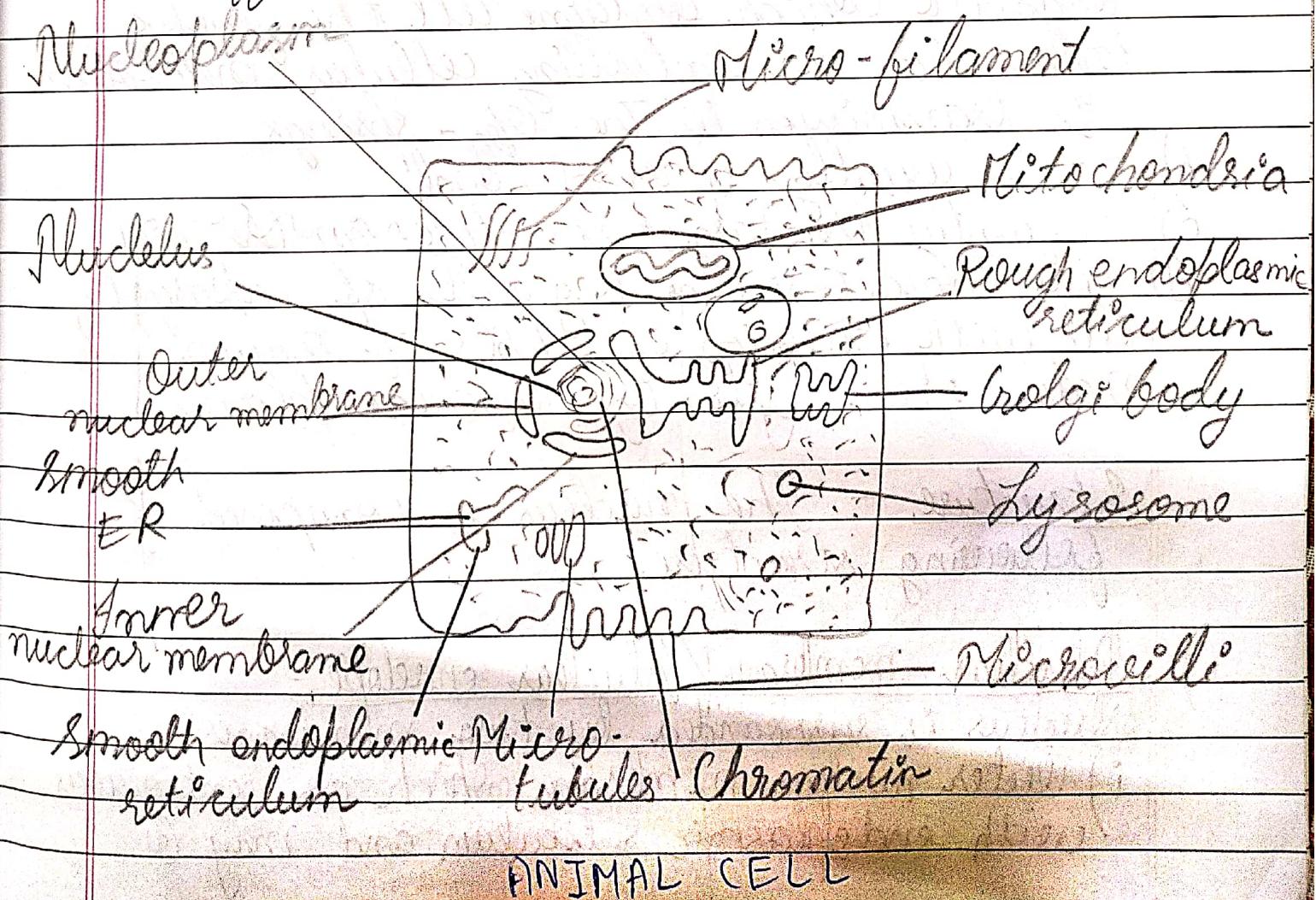
3) Thylakoids - The flattened sac like structures with pigmented membrane consisting of chlorophyll is called Thylakoid. Stack of Thylakoid is called Grana. Each

Graana contain 2 to 100 thylakoid.

Functions:-

- a) Chloroplast carry out photosynthesis i.e. conversion of solar energy into chemical energy of food.
- b) They carry out the synthesis of amino acids.
- c) They carry out the synthesis of fatty acids.
- d) They maintain CO_2 - oxygen balance of the atmosphere.
- e) They store starch.
- f) They store fat in the form of plasto-globuli.

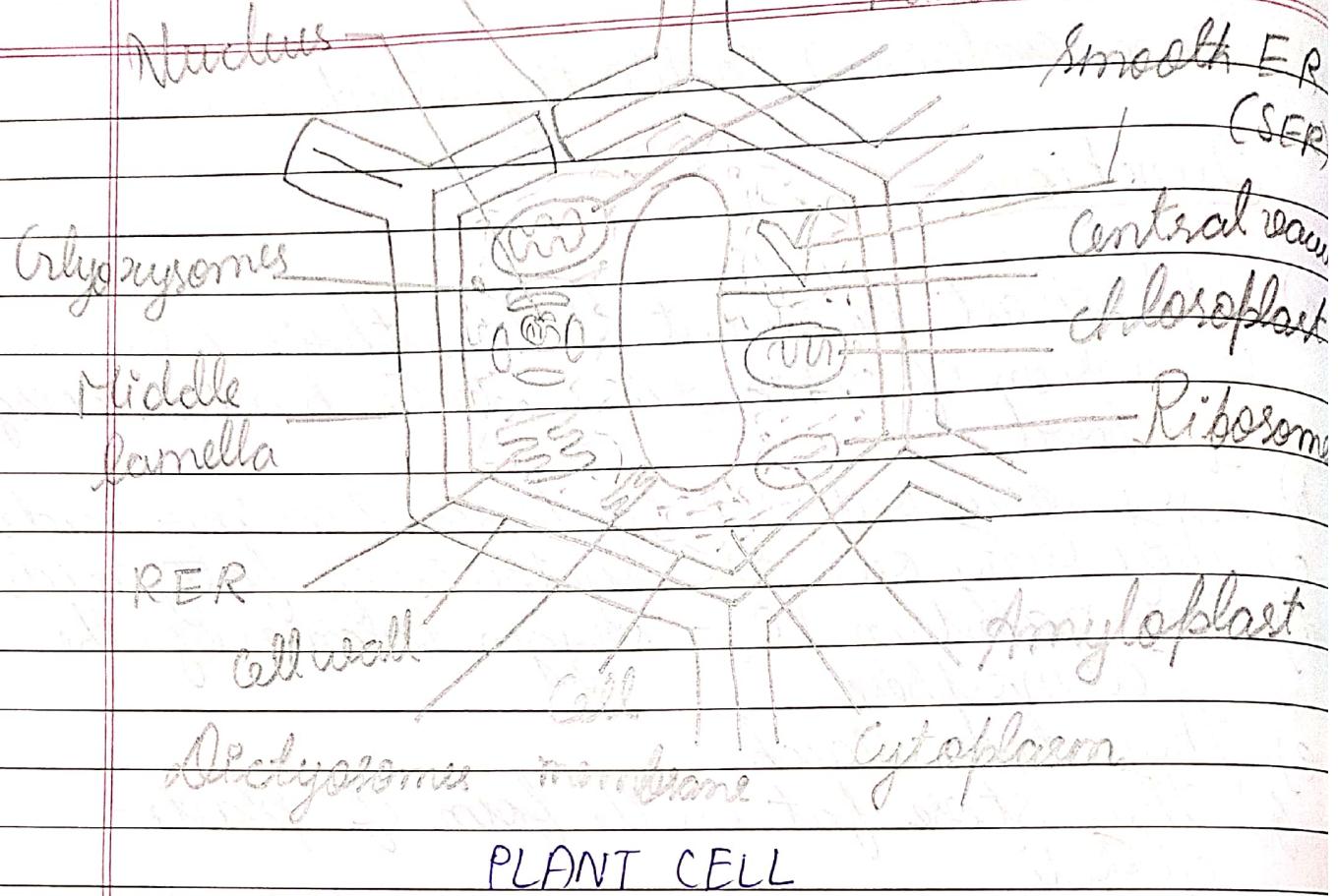
*- Difference b/w Animal & Plant cell: (Diagram)



Plasmodesmata

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Mitochondria



- * \Rightarrow Nucleus - a) It is double-membrane bound organelle which contains all the genetic information for controlling cellular metabolism & transmission to the off-springs.
- b) It is usually spherical / oval.
 - c) Frequently the largest structure in the cell.
 - d) Has characteristics organelles of eukaryotic cell with exception of RBC's of mammals & mature stem cells of vascular plants.

Structure - The nucleus is composed of following structure.

- 1) Nuclear membrane / Nuclear envelope:-
Nucleus is surrounded by two membranes.
 - i) Outer nuclear membrane which is continuous with endoplasmic reticulum and may be

studded with ribosomes

ii) Inner nuclear membrane - The space b/w the 2 membranes is called peri-nuclear space.

2) Nucleoplasm - The jelly like matrix that is present inside nucleus is called Nucleoplasm. It has contents similar to those present in cytoplasm. In addition, it contains NTPs as well as enzymes replication and transcription.

3) Chromatin - It refers to the DNA which is packed with help of protein (2 types).

a) Euchromatin → The DNA which is active i.e., which expresses itself to form proteins is called euchromatin.

b) Heterochromatin → The DNA which is silent i.e., doesn't express is called heterochromatin.

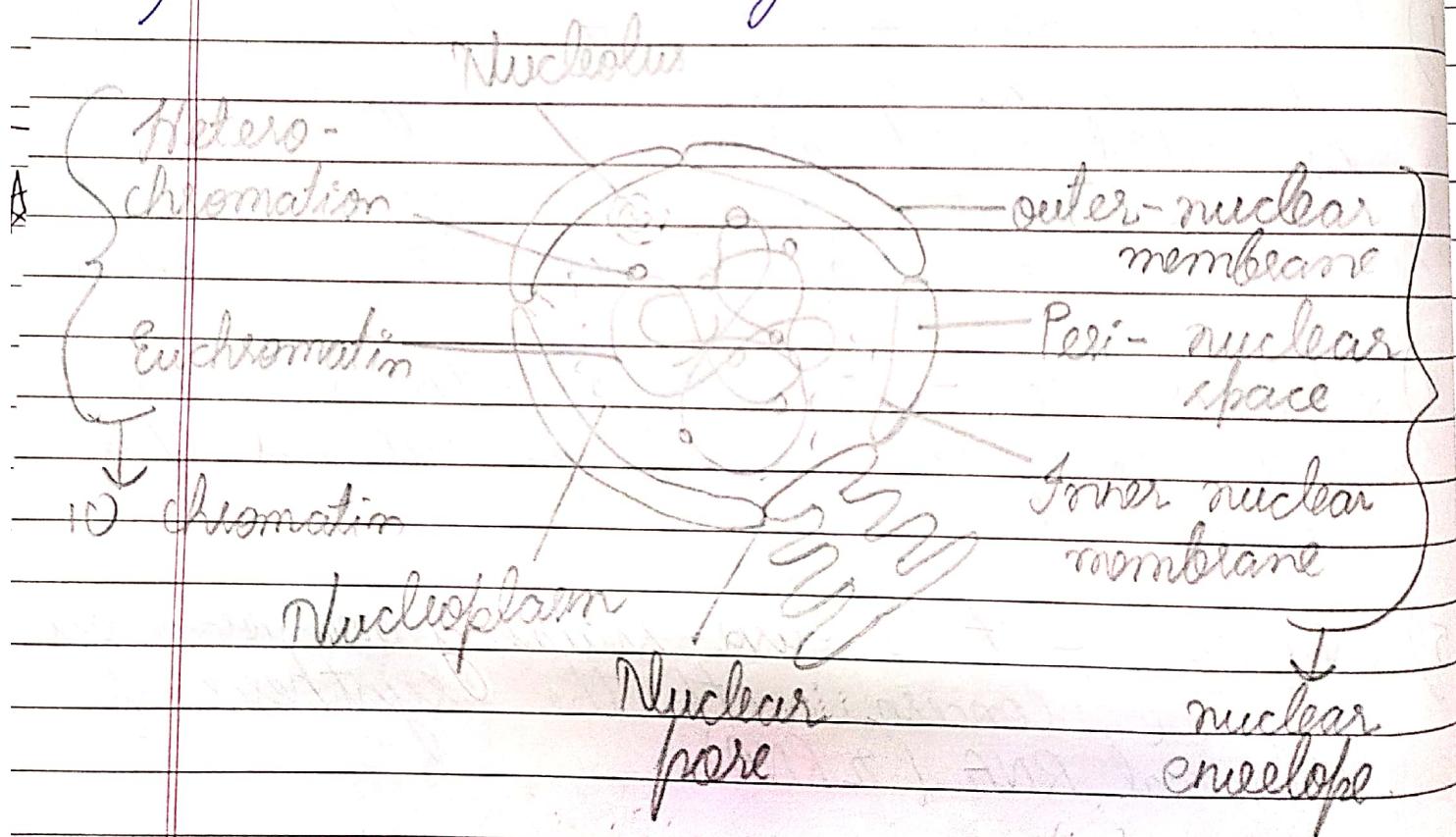
4) Nuclear pores - The gaps b/w the membranes that allows the exchange of material b/w nucleus and cytoplasm.

5) Nucleolus - It is dark-staining membraneless body i.e., concern with the synthesis of ribosomal RNA (rRNA).

Functions:-
i) Nucleus store all the hereditary information in the form of DNA

ii) It passes on hereditary information to the next generation.

- iii) It controls cellular metabolism by guiding the synthesis of enzymes.
- iv) It controls cell differentiation by activating certain genes & silencing others.
- v) It maintains the cytoplasm by guiding the synthesis of proteins.
- vi) It controls cell division.
- vii) It has role in the synthesis ribosomal RNA



⇒ Mitochondria — They are generally sausagelike cylindrical shaped organelles of aerobic eukaryotes

- i) Each mitochondria is a double - membrane bound structure with the outer membrane and

inner membrane dividing its lumen into two compartments :-

→ the outer compartment is called inter-membrane space.

→ the inner compartment is called matrix.

ii) The outer membrane forms the continuous limiting boundary of the organelle while inner membrane forms a number of infoldings called cristae. The cristae increase the surface area.

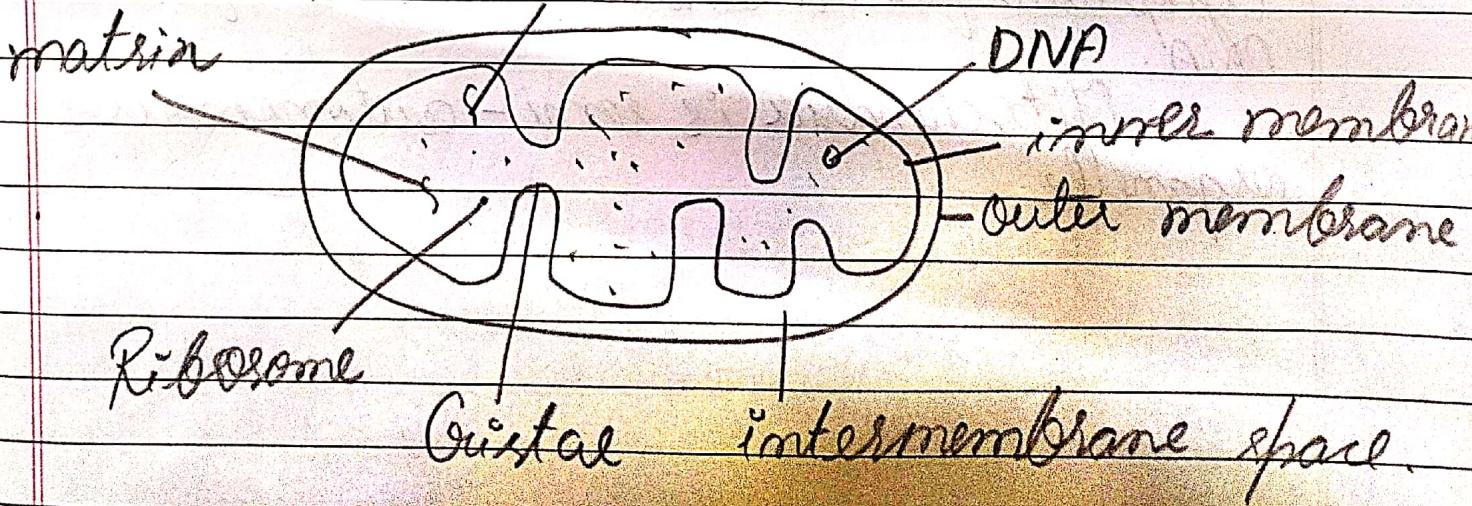
ATP synthase

iii) Cristae as well as inner membrane possess small particles called elementary particles or oxyomes that contain enzyme ATPase & some coupling factors.

iv) The membranes bear their own specific enzymes associated with mitochondrial function.

v) Many steps of cellular respiration (citric acid cycle) occur inside matrix, that also contains DNA, 70S ribosomes, RNA etc.

RNA



Function:-

- i) Oxidize respiratory substrates to CO_2 & H_2O & generate energy in the form of ATP.
- ii) Provide intermediate for the synthesis of various chemicals like chlorophyll, etc.
- iii) Matrix has enzymes of fatty acids synthesis.
- iv) Synthesis of many amino acids.
- v) Cellular proliferation regulation.
- vi) Regulation of cellular metabolism.
- vii) Regulation of cellular metabolism.
- viii) Apoptosis - programmed cell death.

Mitochondria has its own circular DNA & 70S ribosomes and can synthesize some of its proteins. They get other proteins from cytoplasm formed under directions of nuclear DNA.

Mitochondria is semi-autonomous organelle