Module - 1

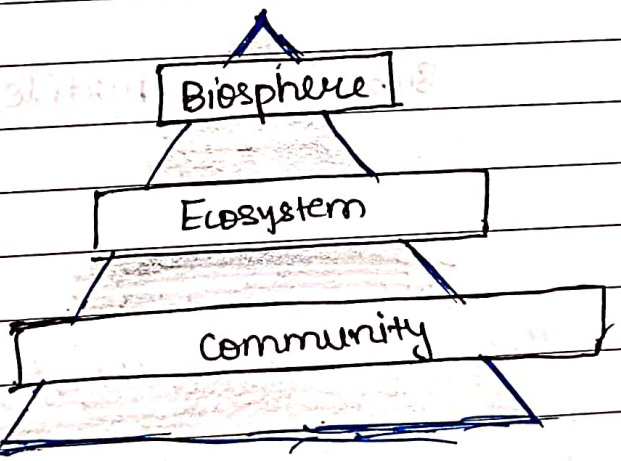
Peacock
Page No.
Date / /

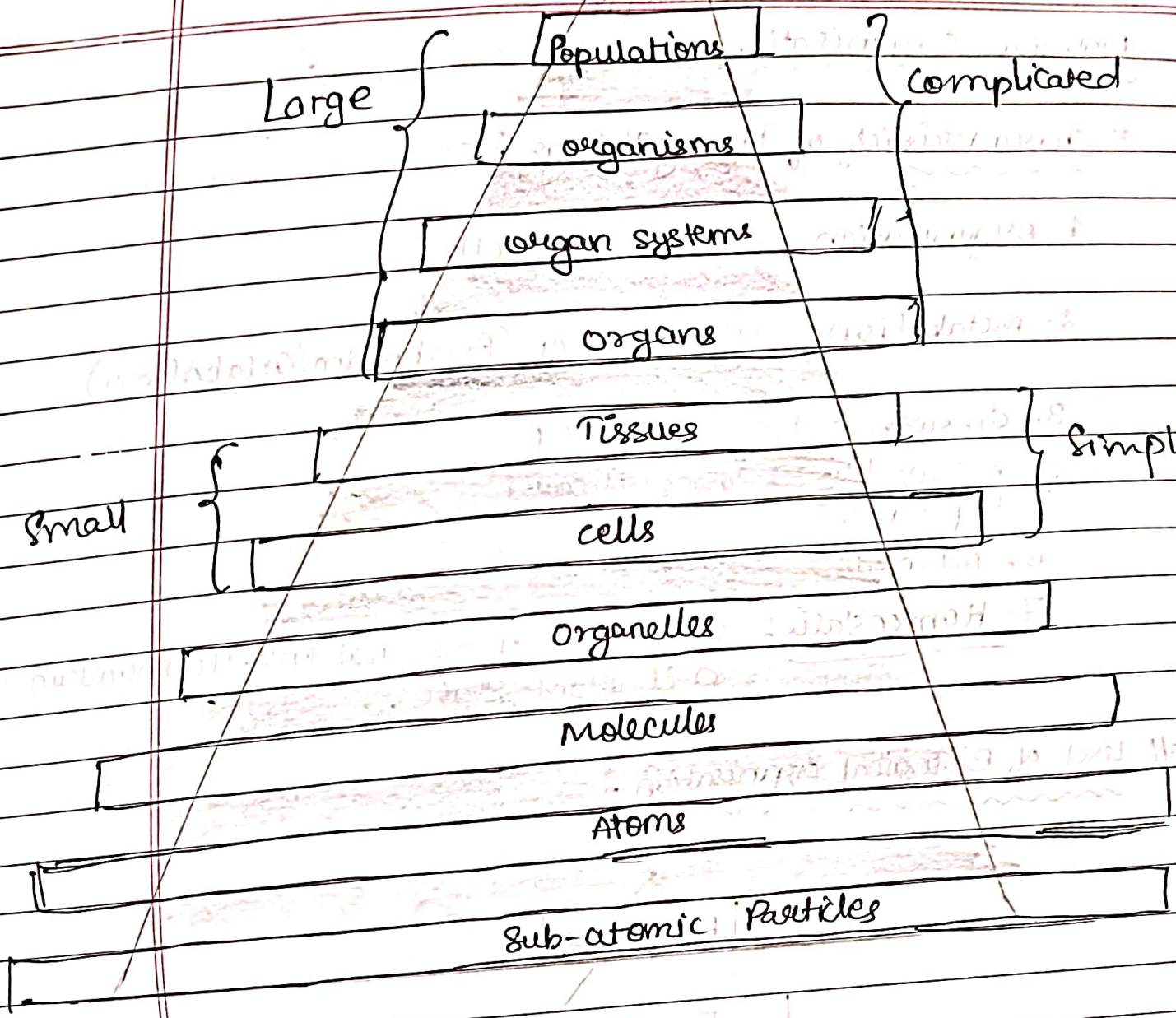
Biological organisation

Characteristics of Living Things :-

1. organisation - are made of cells
2. Metabolism - use energy (Anabolism/Catabolism)
3. Growth - grow & develop
4. Respond to changes/stimuli
5. Reproduce
6. Adaptation
7. **Homeostasis** :- regulation of internal env. To maintain a constant state.

Level of Biological organisation :-





Cells

A cell is the most basic unit of structure

Cell is the basic structural & functional unit of living organisms.

In other words, cells make up living things & carry out activities that keep a living thing alive

Teacher's Signature.....

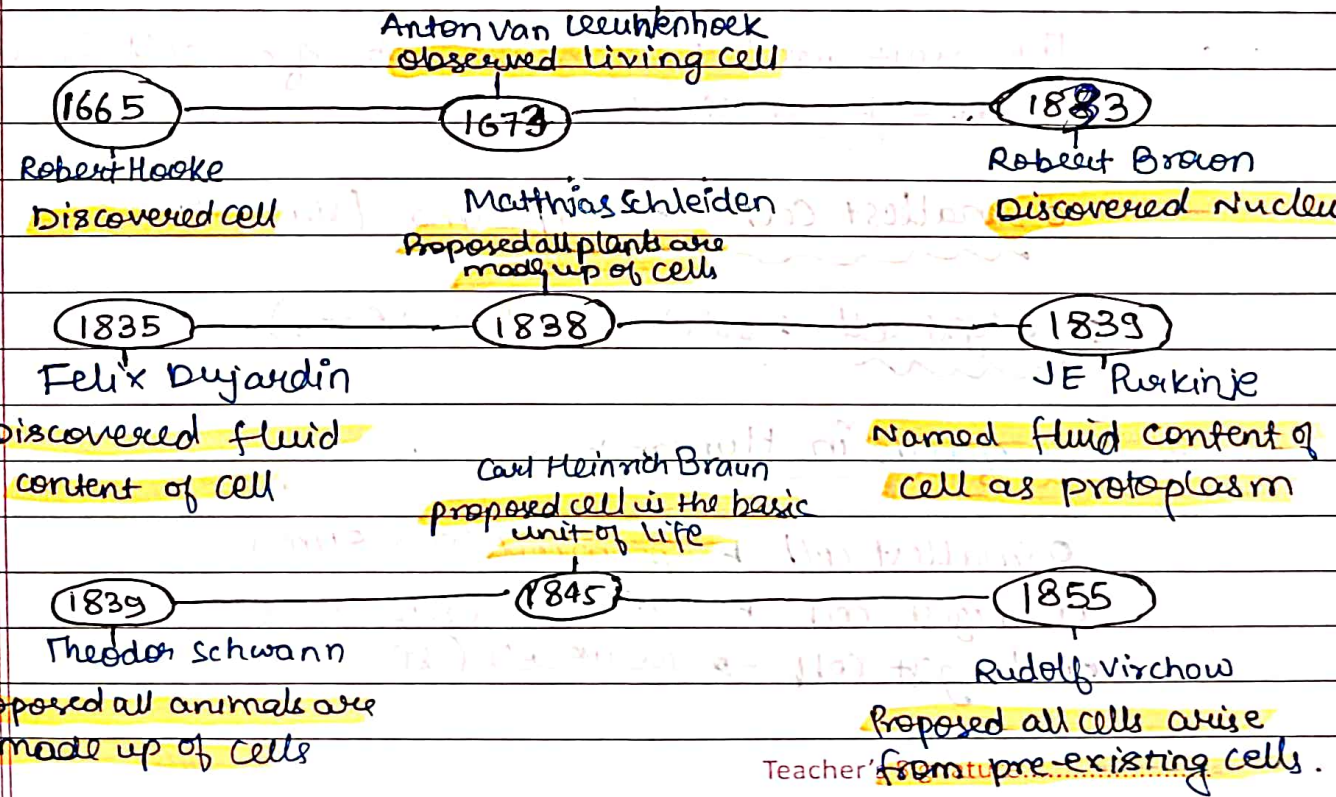
Cell Theory

Cell Theory is a collection of ideas & conclusions from many different scientists over time that describes cells & how cells operate.

Mathias Schleiden (Germany) & Theodor Schwann

1. All known living things are made up of one or more cells.
2. All living cells arise from pre-existing cells by division.
3. The cell is the basic unit of structure & function in all living organisms.

Cell Theory Timeline



Unicellular organisms

An organism that is made up of only one cell is called as unicellular organism.
eg. Euglena, Paramecium, Yeast

Multicellular organisms

An organism that is made up of more than one cell is called as multicellular organism.
eg. plants, animals, fungus

Size of cells :-

Cells vary in size.
Most cells are very small (microscopic) Some may be very large (macroscopic).

The unit used to measure size of a cell is micro
$1 \mu m = \frac{1}{1000}$ millimeter

- Smallest cell → Mycoplasma [size - 0.1 µm]
- Largest cell → ostrich Egg [size 18 cm]

Size of cells in Human :-

- Smallest cell → sperm cell (size 5 µm)
- largest cell → Ovum cell (size 120 µm)
- Longest cell → Nerve cell (size 1 m)

Teacher's Signature.....

Peacock
Page No.
Date / /

Shape of cells.

Cells vary in shape
Variation depends mainly upon the function of cells.

→ Some cells like Euglena & Amoeba can change their shape, but most cells have a fixed shape.

→ Human RBCs are circular biconcave for easy passage through human capillaries.

→ Nerve cells are branched to conduct impulses from one point to another.

→ Human WBCs can change their shape to engulf the microorganisms that enter the body.

Structure of cell :-

The detailed structure of a cell has been studied under compound microscope & electron microscope.

certain structures can be seen only under an electron microscope

The structure of a cell as seen under an electron microscope is called ultrastructure.

- Compound Microscope [Magnification: 2000X]
- Electron Microscope [Magnification 500000X]

Teacher's Signature.....

Peacock
Page No. 8
Date / /

Animal Cell

1. Nucleus
2. Golgi Bodies
3. Vesicle
4. Plasma Membrane
5. Mitochondria
6. Cytoskeleton
7. Centriole.
8. Lysosome
9. cytoplasm
10. Rough Endoplasmic reticulum.
11. Smooth Endoplasmic reticulum.
12. Nucleolus.

Plant cell

1. Nucleus
2. Golgi Body
3. Vesicle
4. Lysosome
5. Plasma membrane
6. Mitochondria
7. Chloroplast
8. Cell wall
9. Vacuole.
10. Smooth endoplasmic reticulum
11. Rough endoplasmic reticulum
12. Nucleolus.

Bacterial cell

1. capsule
2. Cell wall
3. Plasma Membrane
4. cytoplasm
5. Flagellum
6. Food granule
7. Plasmid (DNA)
8. Ribosomes
9. Nucleoid
10. Pili

Teacher's Signature.....

Peacock
Page No.
Date / /

Structure of Cell :—

If we study a cell under a microscope we would come across three features, in almost every cell : plasma membrane, nucleus & cytoplasm.

All activities inside the cell and interactions of the cell with its environment are possible due to these features.

1. Plasma Membrane
2. Nucleus
3. Cytoplasm
    - A. Cytosol
    - B. Cell organelles.
        - a) Endoplasmic Reticulum
        - b) Golgi Body
        - c) Lysosomes
        - d) Vacuoles
        - e) Mitochondria
        - f) Plastids
        - g) Centrosome
        - h) Cytoskeleton

Teacher's Signature.....

1. Plasma Membrane :—

→ Extremely delicate, thin, elastic, living and semi-pe membrane.
→ Made up of two layers of lipid molecules in which protein molecules are floating.
→ Thickness varies from 75-110Å
→ can be observed under an electron microscope on

Functions

- Maintains shape & size of the cell.
- Protects internal contents of the cell
- Regulates entry and exit of substances in & out of the cell.
- Maintains homeostasis

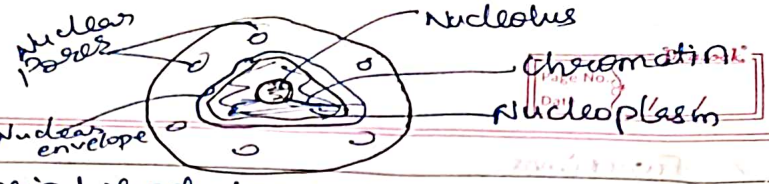
2. Cell wall

→ Non-living & outermost covering of a cell (plants & b
→ Can be tough, rigid and sometime flexible.
→ Made up of cellulose, hemicellulose & pectin.
→ May be thin or thick, multilayered structure.
→ Thickness varies from 50 - 4000 Å

Function

- Provide definite shape, strength & rigidity.
- Prevents drying up (desiccation) of cells.
- Helps in controlling cell expansion.
- Protects cell from external pathogens

Teacher's Signature.....



3. Nucleus

- Dense spherical body located near the centre of the cell.
- Diameter varies from 10-25 μm
- Present in all the cells except red blood cells & sieve tube cells.
- well developed in plant & animal cells.
- undeveloped in bacteria & blue-green algae (Cyanobacteria)
- Most of the cells are uninucleated (having only one nucleus).
- few types of cells have more than one nucleus (skeletal muscle cells)

- Nucleus has a double layered covering called nuclear membrane.
- Nuclear membrane has pores of diameter about 80-100nm.
- Colourless dense sap present inside the nucleus known as nucleoplasm.
- Nucleoplasm contains round shaped nucleolus and network of chromatin fibres.
- fibres are composed of deoxyribonucleic acid (DNA) & protein histone.
- These fibres condense to form chromosomes during cell division.
- chromosomes contain stretches of DNA called gen
- Genes transfer the hereditary information from one generation to the next.

Teacher's Signature.....

// Functions
- controls all the cell activities like metabolism, protein synthesis, growth & cell division.
- Nucleolus synthesizes ribonucleic acid (RNA) to constitutes ribosomes.
- Store hereditary information in genes.

4. Cytoplasm
- Jelly-like material formed by 80% of water
- Present b/w the plasma membrane & the nucleus
- Contains a clear liquid portion called cytosol & various particles.
- Particles are proteins, carbohydrates, nucleic acids, lipids and inorganic ions.
- Also contains many organelles are visible only under an electron microscopes.
- Granular & dense in animal cells & thin in plant cells.

5. Endoplasmic Reticulum (ER)
- Network of tubular & vesicular structures which are interconnected with one another.
- Some parts are connected to the nuclear membrane while others are connected to cell membrane.
- Two types: Smooth (lacks ribsomes) & rough (Studded with ribosomes)

Teacher's Signature.....

Function

- Gives internal support to the cytoplasm.
- RER synthesizes secretory proteins & membrane proteins.
- SER synthesizes lipids for cell membrane.
- In liver cells SER detoxify drugs & poisons.
- In muscle cells, SER store calcium ions.

6. Golgi Bodies

- Discovered by Camillo Golgi
- formed by stacks of 5-8 membranous sacs.
- sacs are usually flattened and are called cisternae.
- Has two ends: Cis face situated near the endoplasmic reticulum & trans face situated near the cell membrane

Functions

- Modifies, sorts & packs materials, synthesized in the cell.
- Delivers synthesized materials to various targets inside the cell and outside the cell.
- Produces vacuoles & secretory vesides
- forms Plasma membrane & Lysosomes.

7. Lysosomes

- small, spherical, single membrane sac.
- found throughout the cytoplasm.
- filled with hydrolytic enzymes
- occur in most animal cells & in few type of plant cells

Functions

- Helps in digesting of large molecules
- Protect cell by destroying foreign invaders like bacteria & viruses
- Degradation of worn out organelles
- In dead cells perform autolysis.

8. Vacuoles:

→ Single membrane sac filled with liquid or sap (water, sugar & ions)

→ In animal cells, vacuoles are temporary, small in size & few in numbers.

→ In plant cells, vacuoles are large & more in numbers

→ May be contractile or non-contractile.

Functions:

- store various substances including waste products.
- maintain osmotic pressure of the cell.
- store food particles in Amoeba cells.
- Provide turgidity & rigidity to plant cells.

Peacock
Page No.
Date / /

9. Mitochondria

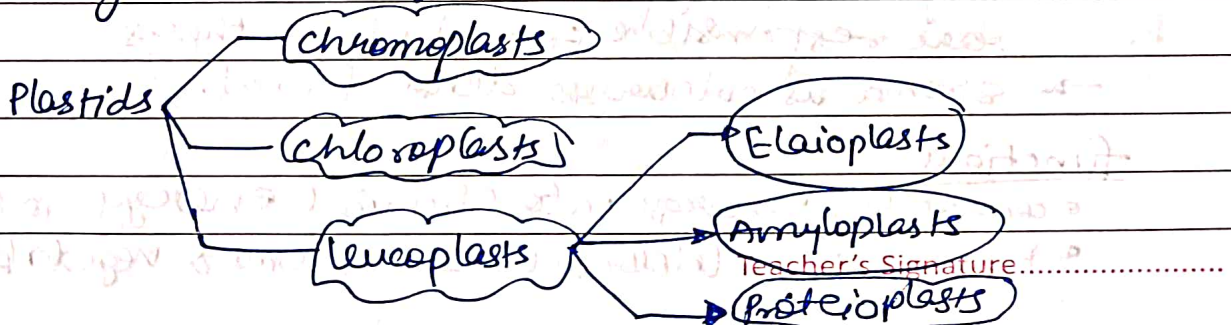
- → Small, rod shaped organelles bounded by two membranes- inner & outer.
- → Outer membrane is smooth & encloses the contents of mitochondria
- → Inner membrane is folded in the form of shelf like inward projections called cristae.
- → Inner cavity is filled with matrix which contains many enzymes.
- → Contain their own DNA which are responsible for many enzymatic actions.

Functions:-

- o Synthesise energy rich compound ATP.
- o ATP molecules provide energy for the vital activities of living cells

10. Plastids

- → Plastids are double membrane bound organelles found inside plants & some algae.
- → They are responsible for activities related to making and storing food.
- → They often contain different types of pigments that can change the colour of the cell.



Teacher's Signature.....

Chromoplasts

→ Chromoplasts are plastids that produce & store pigments
→ They are responsible for different colours found in leaves, fruits, flowers & vegetables.

eg.	(Pigments)
Carrot	→ Carotene
Mango	→ xanthophyll
Tomato	→ Lycopene

Leucoplasts

→ Leucoplasts are colourless plastids that store foods
→ They are found in storage organs such as fruits, tubers & seeds

eg.	Food
Potato tubers	starch
Maize grains	Protein
Castor seeds	oil

Chloroplasts

→ double membrane bound organelles found mainly in plant cells.
→ usually spherical or discoidal in shape
→ shows two distinct regions - grana & stroma.
→ grana are stacks of thylakoids (membrane-bound flattened discs)
→ Thylakoids contain chlorophyll molecules which are responsible for photosynthesis
→ stroma is colourless dense fluid.

functions

- convert light energy into chemical energy in the form
- Provide green colour to leaves, stems & vegetables.....

Peacock
Page No.
Date / /

11. Centrosome
→ Centrosome is the membrane bound organelle present near the nucleus.
→ Consists of two structures called centrioles
→ centrioles are hollow, cylindrical structures made of microtubules
→ Centrioles are arranged at right angles to each other.

Functions:
- form spindle fibres which help in the movement of chromosomes during cell division.
- Help in the formation of Cilia & Flagella.

12. Cytoskeleton
→ formed by microtubules & microfilaments
→ Microtubules are hollow tubules made up of protein called tubulin.
→ Microfilaments are rod shaped thin filaments made up of protein called actin.

Functions:
- Determine the shape of the cell.
- Give structural strength to the cell.
- Responsible for cellular movements

Difference b/w Prokaryotic & Eukaryotic cell.

Prokaryotic cell	Eukaryotic cell
1. Nucleus is undeveloped	1. Nucleus is well developed
2. only one chromosome is present	2. More than one chromosomes are present
3. membrane bound organelles are absent	3. membrane bound organelles are present
4. Size ranges from 0.5-5 μm	4. Size ranges from 5-100 μm
5. Ex- Bacteria & Blue green algae.	5. Examples: All other organisms

Teacher's Signature.....

Peacock
Page No.
Date / /

Difference b/w Animal cell & Plant cell

Animal cell	Plant cell
1. Generally small in size	1. Generally large in size
2. Cell wall is absent	2. Cell wall is present
3. Plastids are absent	3. Plastids are present
4. Vacuoles are smaller in size & less in number	4. Vacuoles are larger in size & more in number
5. Centrioles are present	5. Centrioles are absent

—o—

Topic - Cell cycle & cell Division

Peacock
Page No.
Date / /

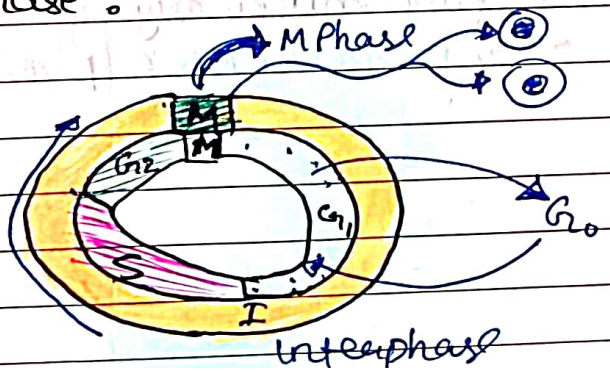
- Growth & reproduction of all organisms depend on the division & enlargement of cells.
- The mechanisms of division and multiplication of cells together constitute cell reproduction.

Cell cycle

- It is the life Period of a cell during which a cell synthesizes DNA (replication), grows & divides into two daughter cells.
- cell growth (cytoplasmic increase) is a continuous process
- DNA synthesis occurs only at a specific stage
- Duration of cell cycle varies in each organism & each cell type.
- Duration of a typical eukaryotic cell cycle (eg Human cell) is about 24 hrs.
- In yeasts, it is only about 90 minutes

cell cycle has 2 basic phase :

1. Interphase
2. M Phase



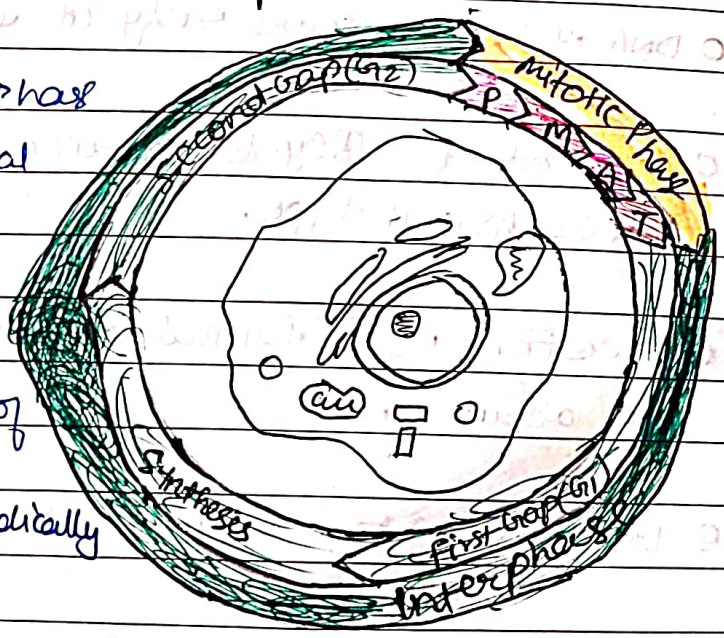
1. Interphase [Resting Phase]

- It is the phase b/w two successive M phases
- It includes cell growth & DNA synthesis.
- It lasts more than 95% of the duration of cell cycle.

Interphase has 3 phases:

a. G_1 phase (Gap 1 or Antephase)
b. S (Synthetic) phase
c. G_2 (Gap 2) phase

a. G_1 Phase (Gap 1 or Antephase)



- First growth phase
- It is the interval b/w mitosis & DNA replication

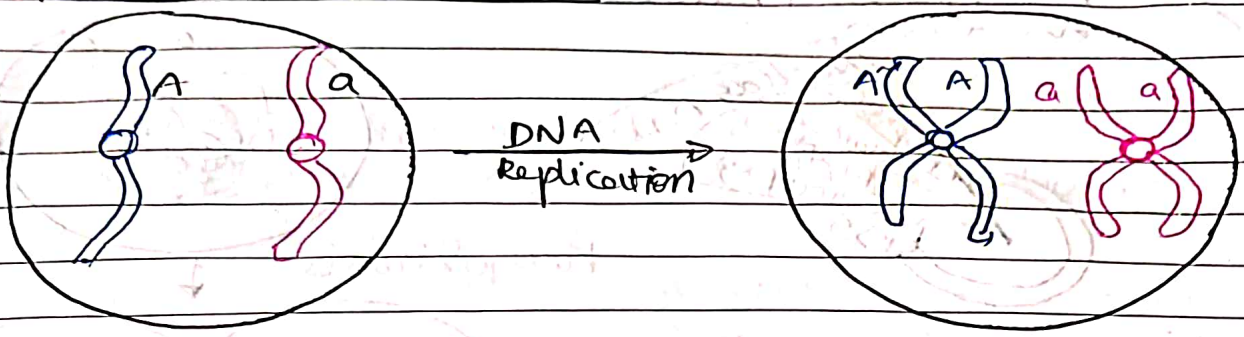
Main events

- Continuous growth of cell.
- Cell become metabolically active.
- Prepares machinery for DNA replication
- Synthesizes RNA & proteins

Teacher's Signature.....

Peacock
Page No.
Date / /

b. S (Synthetic) Phase



- In this, DNA replication takes place.
- Amount of DNA per cell doubles. But, chromosom number is not increased.
- In animal cells, replication begins in the nucle & the centriole duplicates in the cytoplasm

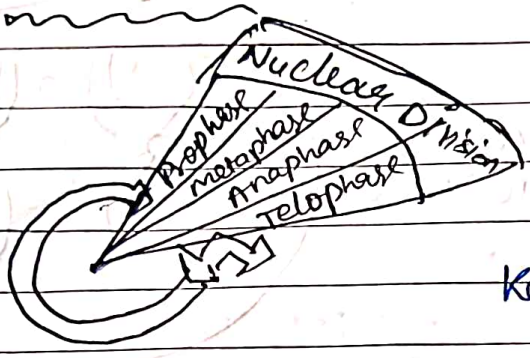
C. G_2 phase (Grap2)

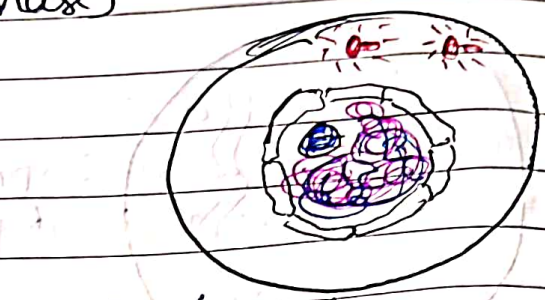
- second growth phase
- cell growth continues
- Synthesis of RNA & protein continues
- Cell is prepared for mitosis.

Teacher's Signature.....

Peacock
Page No.
Date / /

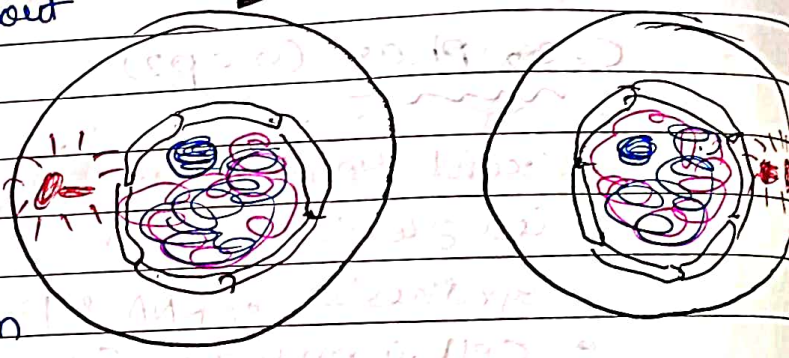
2. M-Phase [Mitosis Phase]





Karyokinesis

Cytokinesis



- It represents the actual cell division (Mitosis)
- In human cell cycle, it lasts for only about an hour.
- M phase includes
  - Karyokinesis – Nuclear division
  - Cytokinesis – Division of Cytoplasm

- some cells do not show division eg- heart cells
- many other cells divide only occasionally to replace damaged or dead cells.

- The cells that do not divide further exit G_1 phase & enter an inactive stage called quiescent stage (G_0)
- such cells remain metabolically active but do not proliferate.

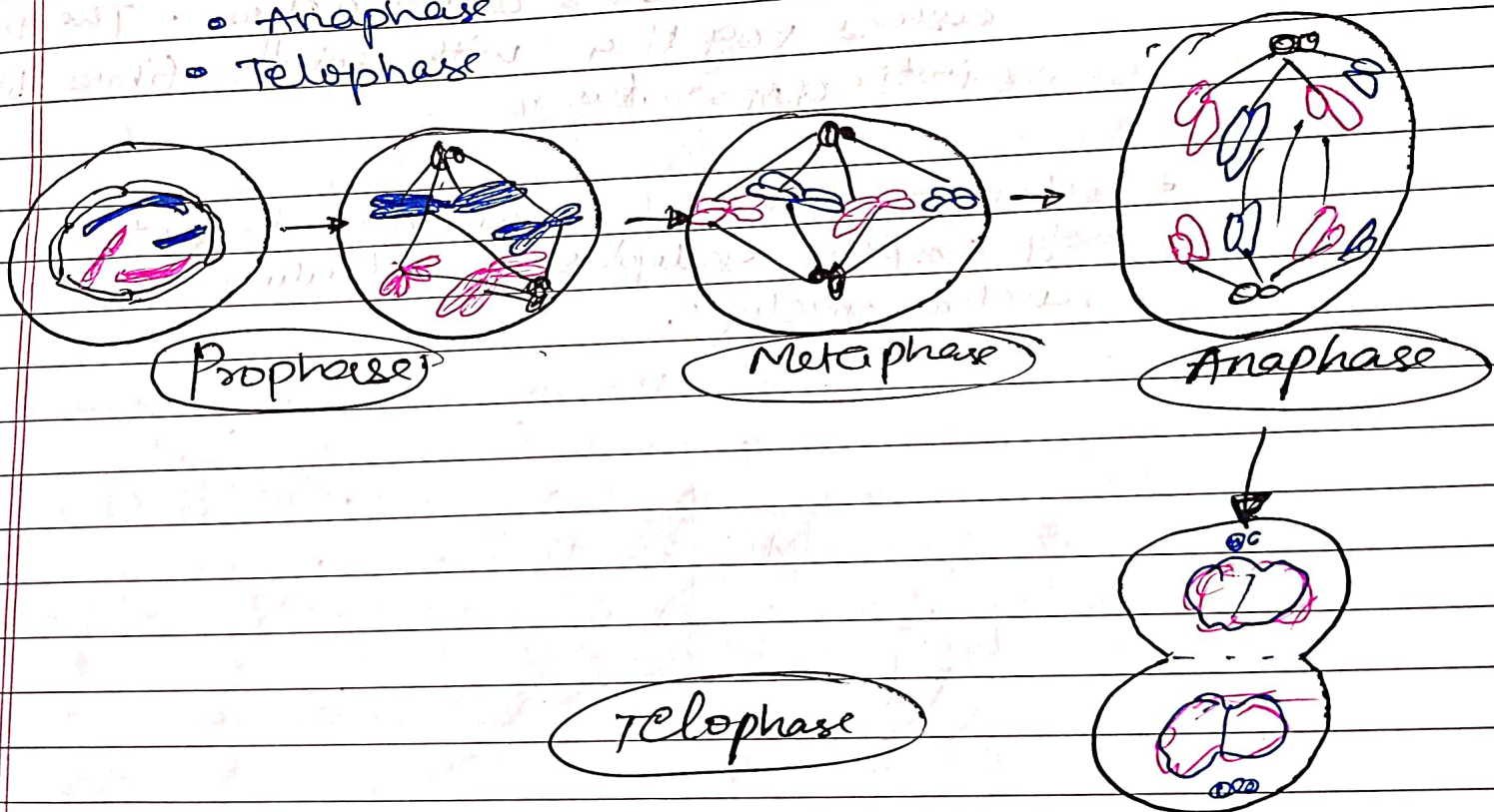
Teacher's Signature.....

Mitosis

- It is the cell division occuring in somatic cells it is also called as equational division as the number of chromosomes in the parent & progeny cells is same.
- Mitosis is generally seen in diploid cells. It also occurs in haploid cells of some lower plants & some social insects.
- It involves major recognization of all cell components.

The Karyokinesis of Mitosis has 4 stages

- Prophase.
- Metaphase
- Anaphase
- Telophase



Teacher's Signature.....

1. Prophase

- It is the longest phase in mitosis
- It follows the S & G_2 phases of interphase
- In the S & G_2 phases, DNA molecules are intertwined

Characteristic events

- Chromosomal materials ("chromatin fibres) are untangled & condensed to form mitotic chromosomes. They are seen to be composed of two chromatids attached together at the centromere.
- Centrosomes begin to move towards opposite poles of the cell. Each centrosome radiates out microtubules called asters. The two asters together with spindle fibres forms mitotic apparatus.
- cells at the end of prophase do not show Golgi complexes, endoplasmic reticulum nucleolus & nuclear envelope.

Teacher's Signature.....

2. Metaphase

- The nuclear envelope completely disintegrates. Hence the chromosomes spread through the cytoplasm of the cell.
- Chromosome condensation is completed. They can be studied easily under the microscope. They will have two sister chromatids.
- chromosomes come to lie at the equator. The plane of alignment of the chromosomes at metaphase is called *Metaphase plate*.
- The *spindle fibres* from both poles are connected to chromatids by their kinetochores in the centromere.

3. Anaphase

- It is the shortest phase in the mitosis
- centromere of each chromosome divides longitudinally resulting in the formation of two daughter chromatids (chromosomes of the future daughter nuclei)
- As the spindle fibres contract, the chromatids move from the equator to the opposite poles.

4. Telophase

- chromosomes cluster at opposite poles & uncoil into chromatin fibres
- Nuclear envelope assembles around the chromatin fibres. Thus 2 daughter nuclei are formed.
- Nucleolus, Golgi complex & ER reappear
- The spindle fibres disappear

Teacher's Signature.....

Cytokinesis

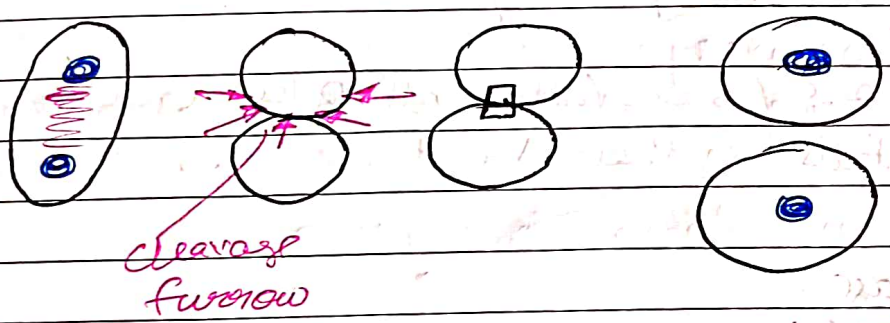
→ It is the division of cytoplasm resulting in the formation of 2 daughter cells

→ It starts when telophase is in progress.

Cytokinesis in animal cell

→ Here, a cleavage furrow is appeared in plasma membrane.

→ It gradually deepens & joins in the centre dividing the cytoplasm into two.



Cytokinesis in Plant cell

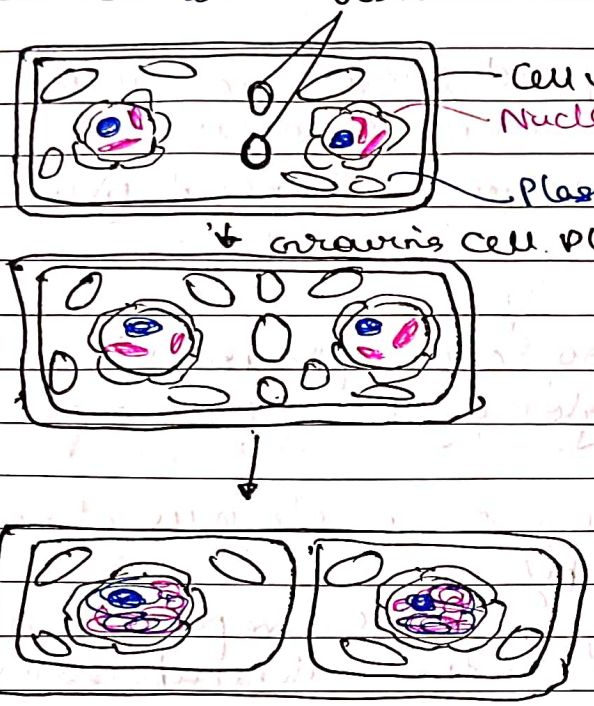
→ It is different from cytokinesis in animal cells due to presence of cell wall.

→ In Plant cells, the vesicles formed from Golgi bodies accumulate at the Equator. It grows outward & meets the lateral walls. They fuse together to form the cell plate. It separates the 2-daughter cells. Later the cell-plate becomes the middle lamella.

Peacock
Page No.
Date / /

→ During cytokinesis, organelles like mitochondria & plastids get distributed between the daughter cells.

→ In some organisms, karyokinesis is not followed by cytokinesis. As a result multinucleate condition (syncytium) arises. eg. liquid endosperm in coconut vesicles



Significance of mitosis

- ✓ It produces diploid daughter cells with identical genome.
- ✓ It helps to retain the same chromosome number in all somatic cells.
- ✓ It helps in the body growth of multicellular organisms. Mitosis in the meristematic tissues help in a continuous growth of plants throughout the life.
- ✓ It restores the nucleoplasmic ratio that disturbed due to cell growth
- ✓ It helps in cell repair & replacement eg- cells of upper layer of the epidermis, lining of the gut & blood cells

Teacher's Signature.....

Meiosis

- It is the division of diploid germ cells that reduces the chromosome number by half forming haploid daughter cells (gametes)
- It occurs during gametogenesis.
- It leads to haploid phase in the life cycle of sexually reproducing organisms. Fertilization restores the diploid phase.
- It involves two cycles [Meiosis I & meiosis II] but only a single cycle of DNA replication.
- It involves pairing of homologous chromosomes & recombination b/w them.
- Meiosis I begins after replication of parental chromosomes to form identical sister chromatids at the S phase
- 4 haploid cells are formed at the end of meiosis II.

Stages of meiosis	
Meiosis - I	Meiosis II
Prophase - I	Prophase II
Metaphase - I	Metaphase II
Anaphase - I	Anaphase II
Telophase - I	Telophase II

Teacher's Signature.....

Peacock
Page No
Date / /

Meiosis-1

Prophase-1

- It is typically longer & more complex
- It includes 5 phases based on chromosomal behaviour.
  - ☐ Leptotene
  - ☐ Zygotene
  - ☐ Pachytene
  - ☐ Diplotene
  - ☐ Diakinesis

✓ Leptotene (leptonema)

- Chromatin fibres become long & slender chromosome
- Nucleus enlarges

✓ Zygotene (zygonema)

- Chromosomes become more condensed. Similar chromosomes start pairing together (Synapsis) with the help of a complex structure called synaptonemal complex
- The paired chromosomes are called homologous chromosomes. Each pair of homologous chromosomes is called a bivalent

✓ Pachytene (Pachynema)

- Comparatively longer phase
- Bivalent chromosomes split into similar chromatids. This stage is called tetrade.
- Appearance of recombination nodules at which crossing over occurs. It leads to recombination of genetic materials on the homologous chromosomes.
- Recombination is completed by the end of pachytene

Teacher's Signature.....

✓ Diplotene (Diplonema)

↳ Dissolution of the synaptonemal complex occurs. The recombined homologous chromosomes of the bivalents separate from each other except at the sites of crossovers. These X-shaped structures are called Chiasmata

↳ In oocytes of some vertebrates, diplotene lasts for months or years.

✓ Diakinesis

↳ Terminalisation of chiasmata

↳ Chromosomes are fully condensed

↳ The meiotic spindle fibres originate from the poles to prepare the homologous chromosomes for separation.

↳ Nucleolus & Nuclear envelope disappear.

Metaphase I

↳ Spindle formation completed

↳ The chromosomes align on the equatorial plate.

↳ The microtubules from the spindle attach to pair of homologous chromosomes.

Anaphase I

↳ The homologous chromosomes separate, while sister chromatids remain associated at their centromeres

Peacock
Page No.
Date / /

Telophase - I

↳ the nuclear membrane & nucleolus reappear and 2 haploid daughter nuclei are formed. This is called diad.

↳ After this cytokinesis may or may not occur.

↳ After a short interphase, it is followed by meiosis II. This short stage b/w the meiotic divisions is called interkinesis.

↳ DNA replication does not occur in this phase

- **Meiosis - II**

It resembles the mitosis

It has 4 phases

- Prophase - II
- Metaphase - II
- Anaphase - II
- Telophase II

Prophase - II

↳ It is initiated immediately after cytokinesis. The chromosomes again become compact

↳ Nucleolus & nuclear membrane disappear in both nuclei

Metaphase - II

↳ The chromosomes align at the equator and microtubules from opposite poles of the spindle get attached to the kinetochores of sister chromatids.

Peacock
Page No.
Date / /

Anaphase - II

↳ It begins with the simultaneous splitting of the centromere of each chromosome (which was holding sister chromatids together) Thus they move toward opposite poles of the cell.

Telophase

↳ The two groups of chromosomes once again get enclosed by a nuclear envelope. Cytokinesis follows resulting in the formation of tetrad of cells i.e. 4 haploid daughter cell

Significance of Meiosis

↳ It conserves the chromosome number of each species.

↳ It causes genetic variation (due to crossing over) in the population of organisms. It is important for evolution.

=o=

Teacher's Signature.....

Peacock
Page No. 8
Date / /

Topic – Origin of Life

Life: It is a characteristic that distinguishes objects that have signaling & self-sustaining process from those that do not (dead).

Any living system is called an organism.
An organism undergoes metabolism, maintain homeostesis, power and capacity to grow, respond to stimuli, reproduce & adapt to their environment.

→ Complex living organisms can communicate through various means

Origin of Life: - oldest fossils, dating back 3.4 billion years

Most accepted scientific models build in one way or another on the following hypothesis.

↳ The Miller-Urey Experiment, and the work of Sidney Fox, suggest that conditions on primitive earth may have favoured chemical reactions that synthesized amino acids & other organic compounds from inorganic precursors

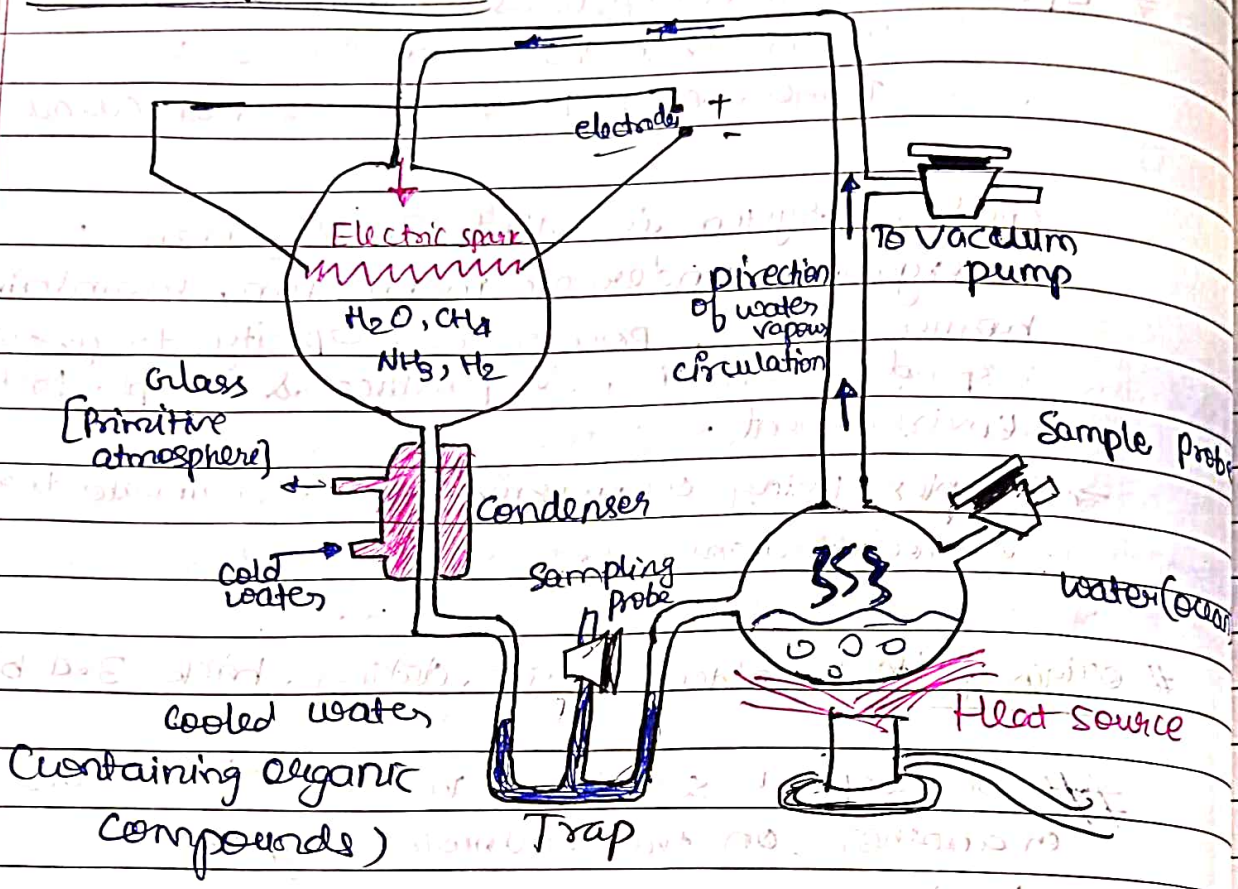
↳ Life synthesizes proteins (Polymer of amino acids)
Protein synthesizer RNA (Ribonucleic acid.)

↳ Francis Crick: First life was based on RNA.
RNA has DNA like replication and the catalytic properties of some proteins → RNA First

↳ Gerald Joyce suggested RNA world.

↳ However, RNA synthesis experiment was not as successful as miller-urey experiment

Miller-Urey Experiment



- To conclusively support the chemical theory, miller & urey conducted experiment in mimicking primitive earth environment. the experimental setup consists of a glass flask, a condenser & a liquid flask interconnected with tubes & a source of electric spark to provide energy. He introduced a mixture of methane (CH_4), ammonia (NH_3) & hydrogen (H_2) in the ratio of 2:2:1 & water (H_2O vapour) at 800°C, he allowed to circulate the mixture into the closed glass apparatus for 18 days continuously. He provided

Teacher's Signature.....

energy in the form of spark by supplying electricity of 75K volts through two electrodes. The electric sparks mimicks the lightning in the primitive earth atmosphere. While passing the mixture gases were passed through a liquid flask to stimulate the volcano. The mixture was collected from the stop cock & analyzed using chromatographic & colorimetric techniques. The analyses of mixture indicates the presence of amino acids such as glycine, alanine aspartic acid, nitrogen base, adenine acid. simple sugar ribose. In addition, the found hydrogen cynide (HCN) formaldehyde (CHCHO) & other active intermediate compounds such as acetylene & cyanoacetylene

Formation of HCN, HCHO etc:

$$CO_2 \rightarrow CO + [O] \text{ (atomic oxygen)}$$
$$CH_4 + 2[O] \rightarrow CH_2O + H_2O$$
$$CO + NH_3 \rightarrow HCN + H_2O$$
$$CH_4 + NH_3 \rightarrow HCN + 3H_2$$

Formation of Glycine

$$CH_2O + HCN + NH_3 \rightarrow NH_2\text{-}CH_2\text{-}CN + H_2O$$
$$NH_2\text{-}CH_2\text{-}CN + 2H_2O \rightarrow NH_3 + NH_2\text{-}CH_2\text{-}COOH$$

Steps proposed in origin of life:

1) Formation of inorganic molecules
2) spontaneous formation of monomeric organic compounds eg. sugar, fatty acids, glycerol, aminoacids & organic bases
3) spontaneous formation of complex organic compounds eg. polypeptides, large sugar molecules, fat.

Teacher's Signature.....

4) Spontaneous formation of molecular aggregates: [Coacervates]

5) formation of eobionts or protocells.

6) formation of first cells

UV radiation or Electric discharge is synthesizing new organic molecules but these presence of oxygen is either destroying these molecules & not allowing condensation ~~for~~ Hence organic evolution is not possible in the current Earth atmosphere.

— o —

In 1953, Oparin & Haldane suggested that life originated from non-living organic molecules like proteins & RNA. This was followed by the theory of chemical evolution which suggested that atmospheric conditions of earth led to the formation of organic molecules from inorganic molecules. Few scientists conducted experiments regarding same. However once 1st life came into existence, they started to evolve in different ways & forms. This laid a stepping stone to the theory of evolution

Teacher's Signature.....

Peacock
Page No. 5
Date 7 / /

Biomolecules

What are the biomolecules?
- → Carbohydrates
- → Lipids
- → Nucleic Acids
- → Proteins
- → Vitamins

* we typically get biomolecules from food
This is why we must Eat in the 1st place.
The Biomolecules serve to keep organisms alive.

Protein: Structure & function :—

Proteins:
1. Make up about 15% of the cell.
2. Have many functions in the cell
3. Enzymes, Structural, Transport, motor, storage, signaling, Receptors, Gene regulation, special functions.

Proteins are large biomolecules, or macromolecules, consisting of one or more long chains of amino acids residues.

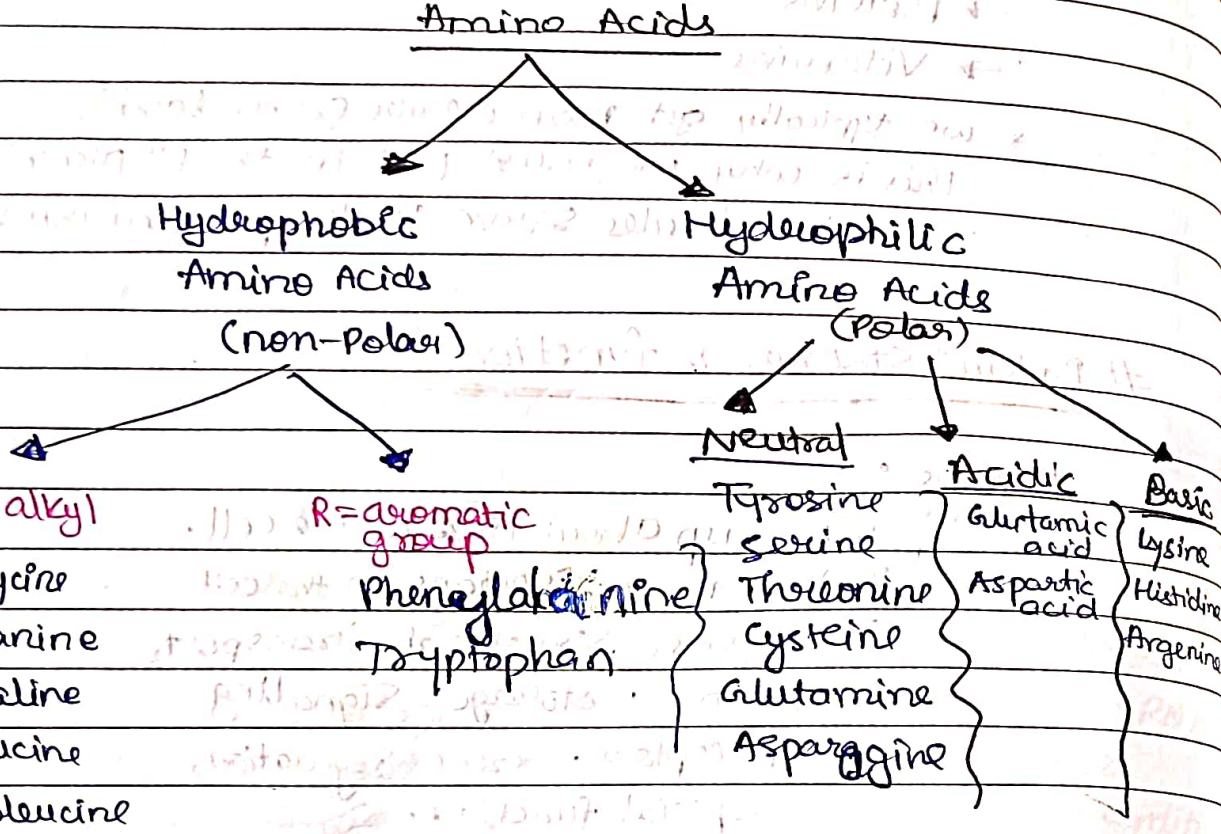
- Elements: C-H-O-N.
- Monomer (Building Block): amino acids (20 different ones!)
- Polymer: Proteins (tons)
- Examples of Protein: Haemoglobin in RBCs, albumin in eggs, enzymes that control rxns in the body & antibodies
- Found in: fish, eggs, meat

Teacher's Signature.....

Peacock
Page No.
Date / /

Classification of amino acids:

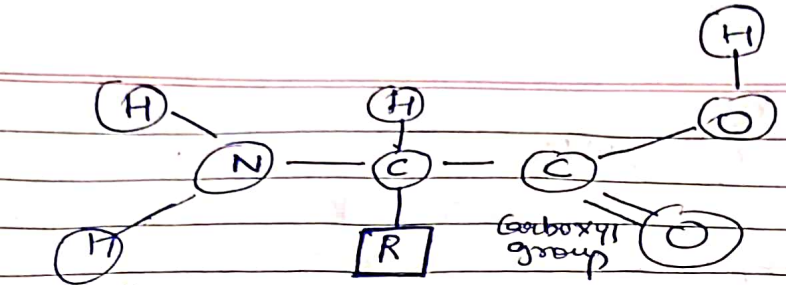
- There are 20 amino acids Based on the nature of their 'R' group, they are classified based on their polarity as:



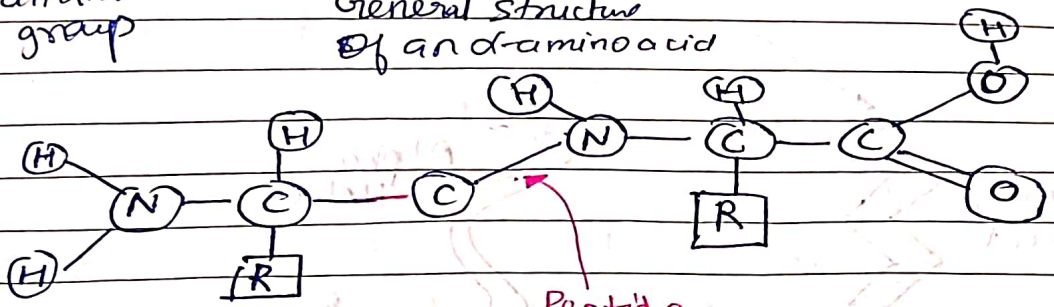
Protein structure

- Remember: Elements are C, H, O & N.
- "R" groups represent one of the 20 amino acids! (so each amino acid has something different in that spot)

Teacher's Signature.....



General Structure of an α-amino acid



Dipeptide

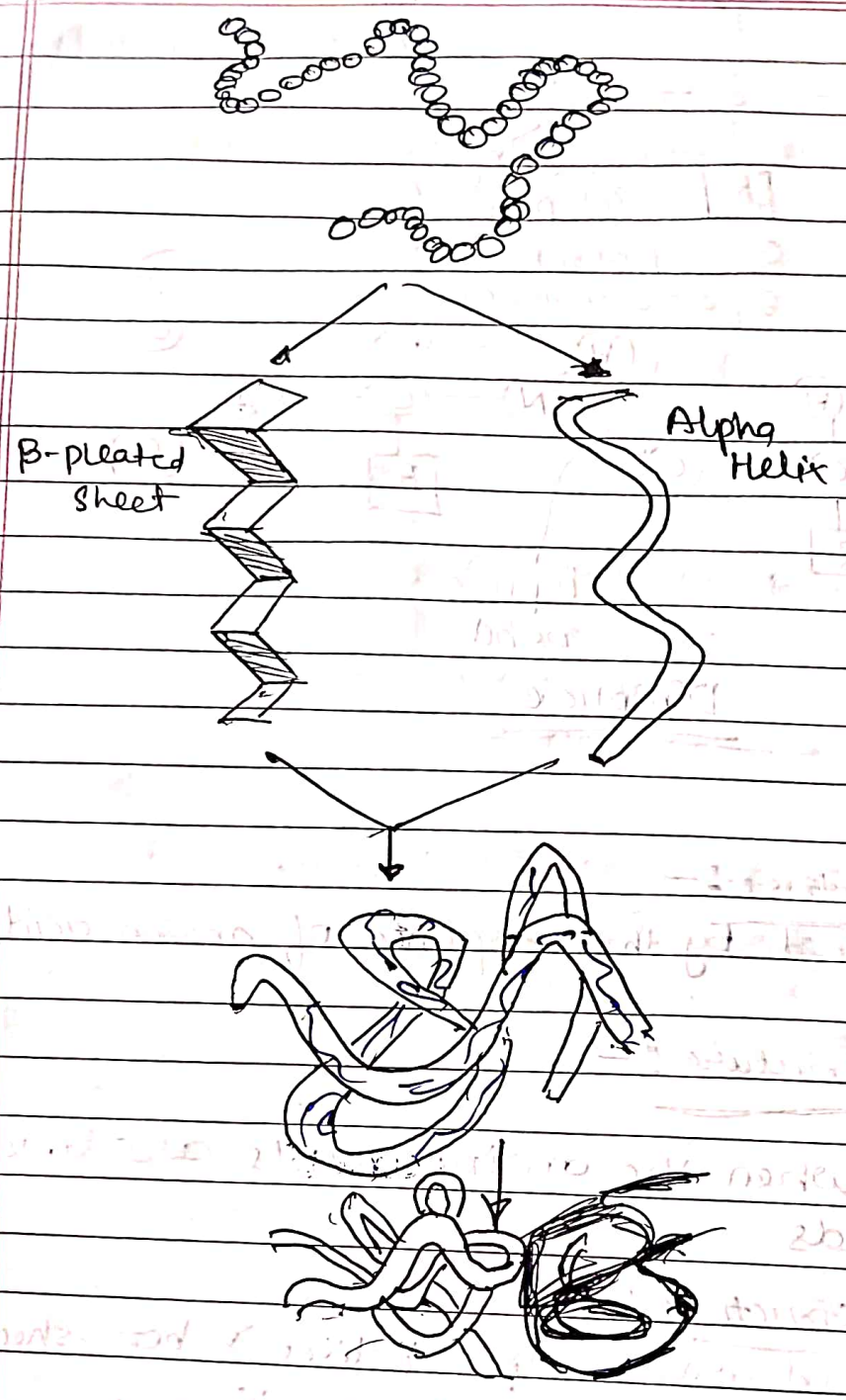
Primary structure :-
is determined by the sequence of amino acids.

Secondary structure :-

It occurs when the amino acids are linked by H-bonds

Tertiary structure :-
It is formed when alpha helices & beta sheets are held together by weak interactions.

Quaternary structure
It consists of more than one peptide chain


B-pleated sheet
Alpha Helix

A protein domain is a conserved part of a given protein sequence and tertiary structure that can evolve, function & exist independently of the rest of the protein chain. Each domain forms a compact three-dimensional structure & often can be independently stable and folded

Denaturation of protein :-

Each protein has its own unique shape. If the temperature or pH of a protein's environment is changed or if it is exposed to chemicals, these interactions may be disrupted causing the protein to lose its 3D structure & turning back into an unstructured string of amino acids.

When a protein loses its higher order structure but not its primary sequence it is said to be denatured. Denatured proteins are usually non-functional.

Nucleic Acids

- **function** : ① Provide our genetic information
  ② Holds the instructions to make proteins

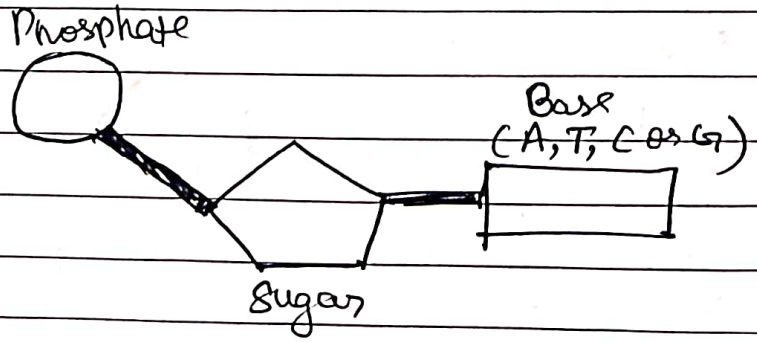
- **Elements** C-H-O-N-P

- **Monomer** nucleotides

  A nucleotides is made up of :
  → Sugar,
  → Phosphate
  → Nitrogen Base A, T, G, C or U

- **Polymer** : DNA , RNA & ATP
  - DNA → Genetic code!
  - RNA → Recipe for Protein
  - ATP → Energy carrier

5 types of nucleotides
- → Cytosine
- → Guanine
- → Adenine
- → Thymine (in DNA only)
- → Uracil (in RNA only)

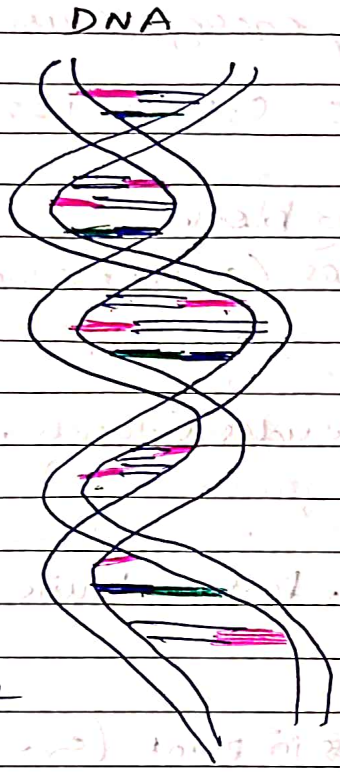


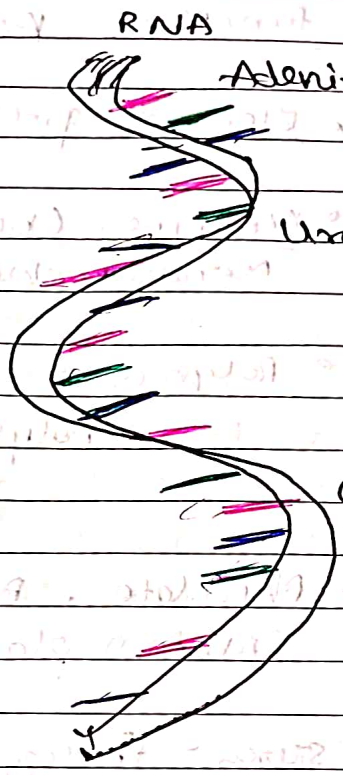
Teacher's Signature.....

Peacock
Page No.
Date / /

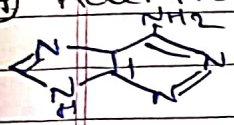
Nucleic Acids

The two classes of nucleic acids are DNA & RNA



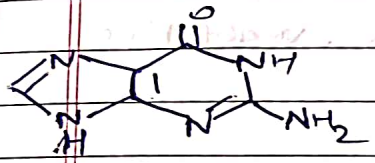


(A) Adenine

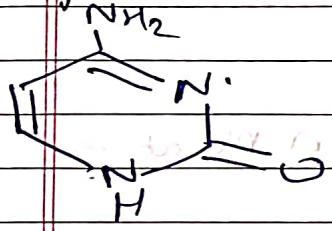


(T) Thymine

(G) Guanine

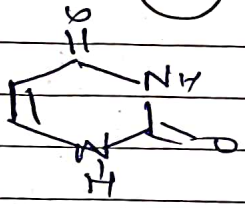


(C) Cytosine



Adenine (A)

Uracil (U)

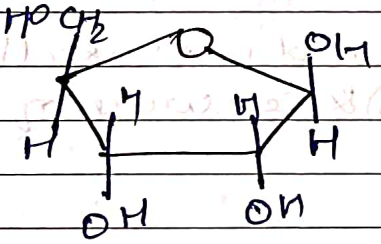


Guanine (G)

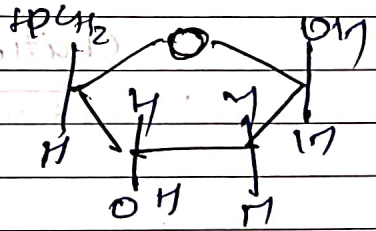
Cytosine (C)

2 types of Sugars

Ribose



Deoxy Ribose



Teacher's Signature.....

Peacock
Page No.
Date / /

What are carbohydrates?

- Most common organic molecule.
- Function: Primary energy source our body needs
- Elements present: C, H, O (1:2:1 ratio)
- Monomer (building block)
  Monosaccharides (Glucose is most common
- Polymer:
  Polysaccharides (Starch, Glycogen, Cellulose, Chitin)

eg. Chocolate, Bread, Pasta, Fruits, vegetables (All from plants)

Starch - Energy storage in plant (eg. Potatoes, Pasta & rice)

Glycogen - Energy storage in Animal

Cellulose - cell wall component in plant

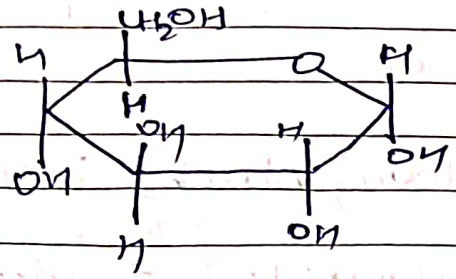
Chitin: found in exoskeletons of arthropods (insects, spiders) & cell walls of some fungi

Teacher's Signature.....

Peacock
Page No.
Date / /

Structure of Carbohydrates

- Remember elements are C, H & O.
- Primarily in a Ring shape



Carbohydrates
- Simple
  - Monosaccharides (1 sugar)
    - glucose
    - fructose
    - galactose
  - Disaccharides (2 sugars)
    - Maltose
    - Sucrose
    - Lactose
- Complex (many sugars)
  - Starch
  - Glycogen
  - fiber

- **Polysaccharide**
  eg. Starch, Glycogen, cellulose & chitin.

Teacher's Signature.....

Peacock
Page No.
Date / /

Lipids

function: store energy, insulates your body & make up cell membrane

Elements: C-H-O

Monomers (Building block): glycerol & 3 fatty acids

Polymer: Phospholipids, triglycerides

eg. steroids, cholesterol, fats
oils Nuts, waxes & make up part of the cell membrane.

Lipids are Hydrophobic (water fearing) and do not dissolve in water.

Lipids can be
① Saturated (single bond)
→ Solid at RT
→ Mainly animal fats (bacon grease lard)

② Unsaturated (double-triple bond.
→ Liquid at RT
→ Mainly plant based fats (olive oil peanut oil) as well as oily fish (Tuna, Sardines)

Teacher's Signature.....

Page No.
Date / /

functions

- made mainly of C & H (few O)
- fat best method of storing
- forms cell membranes
- insulates nerve cells (myelin)
- insulates body (maintains homeostasis)

Vitamins

These are organic substances that are generally classified as either fat soluble or water soluble.

→ Fat soluble [Vitamin - A, Vitamin D, Vitamin E, Vitamin K] & tend to accumulate in the body.

→ Water soluble vitamins [Vitamin C & B-complex vitamins]
- must dissolve in water before they can be absorbed by body & can't be stored.

Vitamin	sources	functions	Deficiency / Disease
Vitamin A (Retinol)	liver oil, fish oil, carrot milk, spinach, Papaya, mango	Vision & growth	Night blindness, xeropthalmia keratinisation of skin
Vitamin B_1 (Thiamine)	Yeast, milk, cereals Green vegetables, liver, pork	Co-enzyme in the form of thiamine Pyrophosphate (TPP) in glycolysis	Beri-Beri (Peripheral nerve damage)
Vitamin B_2 (Riboflavin)	Soybean, Green vegetable Yeast Egg white, milk, liver kidney	Co-enzyme in the form of FMN (Flavin mono nucleotide) & FAD) in redox rxns	Cheilosis (lesions of corner of mouth, lips & tongue)

Teacher's Signature.....

Peacock
Page No.
Date / /

Vitamin	Sources	Function	Deficiency/Disease
Vitamin B_3 (Niacin)	Cereals, Green leafy vegetables, Liver, kidney	Coenzyme in the form of NAD & NADP+ in redox rxn	Pellagra (photosensitive dermatitis)
Vitamin B_5 (Pantothenic acid)	Mushroom. Avocado Egg yolk	Part of Co-enzyme A in Carbohydrate protein & fat metabolism	Inadequate growth.
Vitamin B_6 (Pyridoxine)	Meat, Cereals Milk, whole grains egg	Co-enzyme in Amino acids metabolism formation of Heme in Hemoglobin	Convulsion
Vitamin B_7 (Biotin)	Liver, kidney, milk egg yolk, vegetables	Co. enzyme in fatty acid	Depression Hair loss muscle pain
Vitamin B_9 (Folic acid)	Egg meat, Beet root, leafy vegetables Cereals, Yeast	Nucleic acid synthesis maturation of RBC	Megaloblastic Anaemia
Vitamin B_{12} (Cyanocobalamine)			Megaloblastic anemia,
Vitamin C (Ascorbic acid)	citrus fruits, tomato, Cashew, almonds		Scurvy
Vitamin D (Ergocalciferol) D_2	sunlight		Rickets & osteomalacia
Vitamin E (Tocopherol)			Mild hemolytic anemia in newborn infants
Vitamin K (Phylloquinone)			Bleeding

Teacher's Signature

Peacock
Page No.
Date / /

Minerals

Major Minerals

- Sodium
- Potassium
- chloride
- calcium
- Phosphorus
- Magnesium
- Sulfur

Trace Minerals

- Iron
- Copper
- Zinc
- Selenium
- Iodine
- chromium
- fluoride
- Manganese
- Molybdenum

Iron deficiency : Anaemia

copper deficiency : Faded hair colour.
Heart & bone disorders.

Iodine deficiency : Goitre, severe hair loss.
diarrhea, infertility

Zinc deficiency : Hair loss, dermatitis,
lameness, infertility.
stunted growth

Manganese deficiency : Lack of balance.

Teacher's Signature.....