LEC: GENERAL BIOLOGY

DR. Rissa Lasap

Preliminary Period

1st Year 1st Semester | Academic Year 2026-2027

Module 1: Lesson 1

CHARACTERISTICS OF LIFE

A CHARACTERISTICS OF LIVING THINGS

1. **Movement** - All living things move in some way. This may be obvious, such as animals that are able to walk, or less obvious, such as plants that have parts that move to track the movement of the sun. Living organisms can move or change position, either the whole body or parts of it.
2. **Respiration (Cell)** - Cells release energy from food through cellular respiration.
3. **Sensitivity (Respond)** - The ability to detect changes in the surrounding environment. Organisms detect and respond to changes in their environment.
4. **Growth** - All living things grow. Living things increase in size and develop over time.
5. **Reproduction** - The ability to reproduce and pass genetic information onto their offspring.Organisms produce offspring to ensure the continuation of their species.
6. **Nutrition (Metabolism)** - The intake and use of nutrients. This occurs in very different ways in different kinds of living things. Living things obtain and use nutrients for energy, growth, and repair.
7. **Excretion** - Getting rid of waste.Organisms remove metabolic waste products from their bodies.

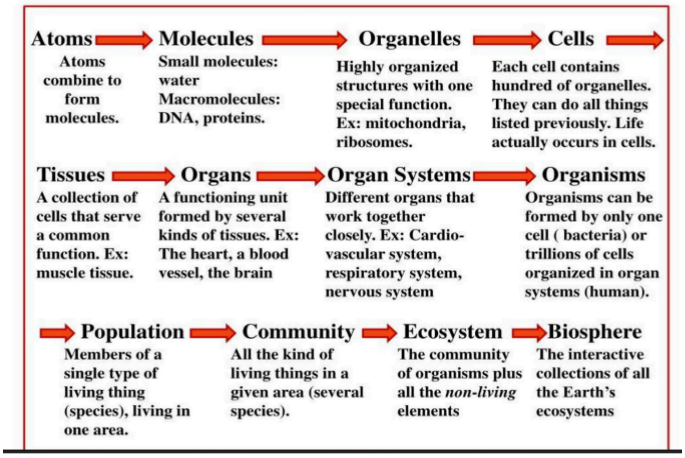
B Key Vocabulary

- **Cellular Organization** – All living organisms are made of one or more cells, the basic unit of life.
- **Homeostasis** – Living organisms maintain a stable internal environment despite external changes.
- **Heredity** – Genetic information (DNA) is passed from parents to offspring.
- **Adaptation and Evolution** – Populations evolve over time,allowing organisms to adapt to changing environments.

C Levels of Biological Organization

The organization of life refers to how living things are arranged from the smallest level to the largest.

1. Molecular Level
2. Cellular Level
3. Tissue Level
4. Organ Level
5. Organ System Level
6. Population Level
7. Community Level
8. Ecosystem Level
9. Biosphere Level



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1. **Atoms** - Smallest part of matter/particle of an element that retains the properties of an element. (NON-living)
2. **Molecules -** 2 or more bonded atoms. Form compounds. A combination of atoms. (NON-living)
3. **Macromolecule** - Very large molecules Proteins, fats, carbohydrates, nucleic acids. (NON-living)
4. **Organelles** - "Tiny organs" made of macromolecules. A structure within a cell that performs a specific function.
5. **Cell** - Made of organelles. Basic unit of structure & function of life/ smallest unit of life.
6. **Living Tissues** - The same kind of cell working together/a group of similar cells (Living).
    - Cartilage cell, Bone cell, Red blood cells
7. **Organs** - Tissues that work together · Living
8. **Systems** - Organs that work together.
9. **Organism** - May be a single cell. Entire living things (organisms). Usually made of systems (Living)
10. **Population** - Same type of organism living together
11. **Community** - Several populations living together. Population interacting together
12. **Ecosystem -** A biotic (living) community plus the abiotic (nonliving) features.
13. **Biome** - Similar ecosystems on earth together
14. **Biosphere** - Whole living layer around the globe. Includes abiotic features

Types of Biology

1. **Organismal Biology**
    - **Botany** - Study of plants
    - **Zoology** - Study of animals
2. **Cellular & Molecular Biology**
    - **Cell Biology** - Study of cells
    - **Microbiology** - Study of microorganisms
    - **Genetics** - Study of genes and heredity
    - **Molecular Biology** - Study of DNA, RNA, and proteins
    - **Biochemistry** - Study of the chemistry of living organisms
    - **Anatomy** - Study of body structures
    - **Physiology** - Study of body functions
3. **Environmental Biology**
    - **Ecology** - Study of interactions between organisms and their environment
    - **Evolutionary Biology** - Study of the evolution of species
    - **Marine Biology** - Study of marine organisms
    - **Taxonomy** - Classification and naming of organisms
    - **Paleontology** - Study of fossils and ancient life
    - **Embryology** - Study of organismal development
4. **Applied Biology**
    - **Medical Biology** - Human health and disease
    - **Agricultural Biology** - Cropimprovement andsustainablefarming
    - **Environmental Biology** - Conservation and environmental protection
    - **Forensic Biology** - Biological evidence in criminal investigations
    - **Bioinformatics** - Application of computing in biological research
    - **Biotechnology** - Application of biology in medicine, agriculture, and industry

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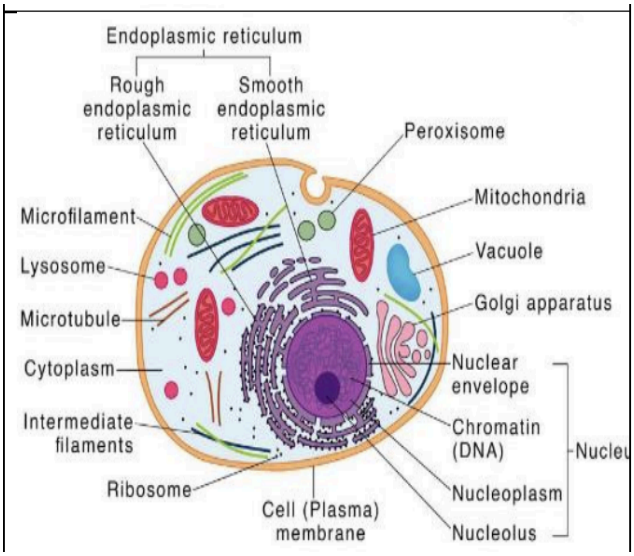
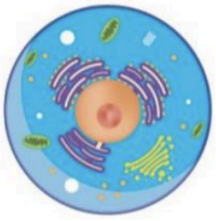
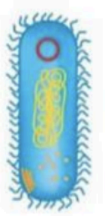
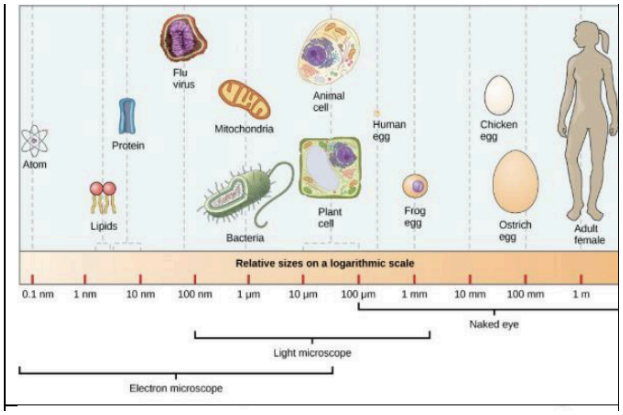
Module 1: Lesson 2

CELL STRUCTURE AND FUNCTION

Cells are the basic building blocks of all living things. The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.



	
EUKARYOTIC CELL Contain a nucleus and organelle bound by plasma membrane.	PROKARYOTIC CELL Do not have a membrane bound nucleus or organelles



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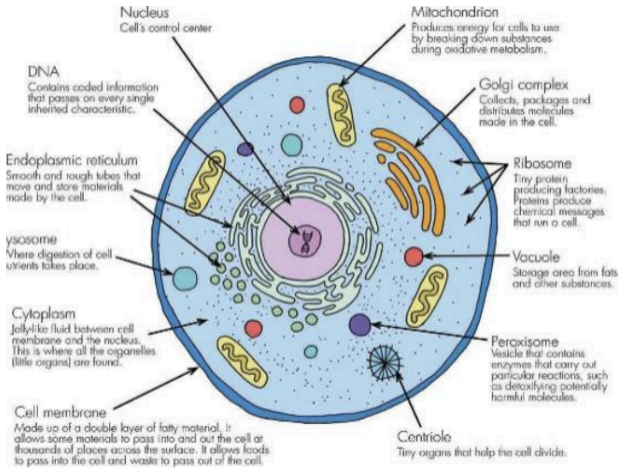

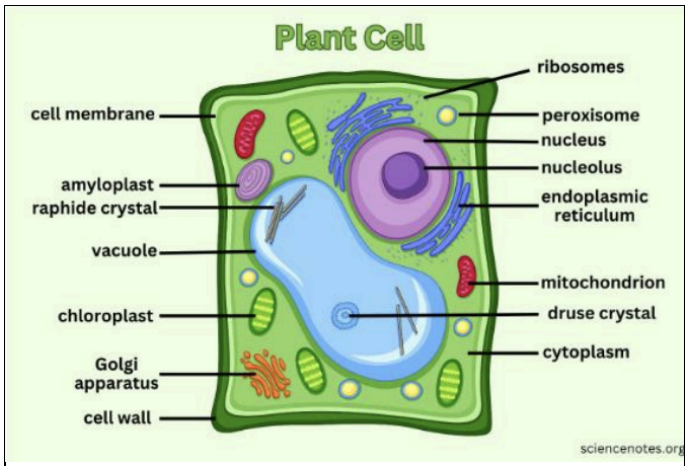

1. **Plasma membrane –** Controls what enters and leaves the cell.
2. **Cytoplasm –** Suspends organelles and is where many cell reactions occur.
3. **Nucleus –** Controls cell activities and contains DNA.
4. **Nuclear membrane –** Protects the nucleus and regulates material exchange.
5. **Nucleolus –** Produces ribosomes.
6. **Chromatin** – Contains the cell's genetic material (DNA).
7. **Centrosome –** Organizes microtubules and helps in cell division.
8. **Golgi apparatus –** Modifies, packages, and transports proteins and lipids.
9. **Rough Endoplasmic Reticulum (ER) –** Synthesizes and transports proteins.
10. **Smooth Endoplasmic Reticulum (ER) –** Produces lipids and detoxifies harmful substances.
11. **Mitochondrion –** Produces energy (ATP) for the cell.
12. **Lysosome –** Breaks down waste and worn-out organelles.
13. **Lipid droplet –** Stores fats for energy. Secretory granules – Store and release substances from the cell.

1. **Cell Wall –** Protects the cell and provides support and shape.
2. **Primary Pit Field and Plasmodesmata –** Allow transport and communication between neighboring plant cells.
3. **Nucleus –** Controls cell activities and contains DNA.
4. **Nucleolus** – Produces ribosomes.
5. **Nuclear Membrane** – Surrounds and protects the nucleus.
6. **Vacuole –** Stores water, nutrients, and wastes; maintains cell pressure (turgor).
7. **Golgi Apparatus –** Modifies, packages, and transports proteins and lipids.
8. **Mitochondrion –** Produces energy (ATP) through cellular respiration.
9. **Chloroplast –** Carries out photosynthesis to make food.
10. **Chromoplast –** Stores pigments that give fruits and flowers their color.
11. **Leucoplast –** Stores starch, oils, and proteins.
12. **Endoplasmic Reticulum (ER)** – Synthesizes and transports proteins (rough ER) and lipids (smooth ER).

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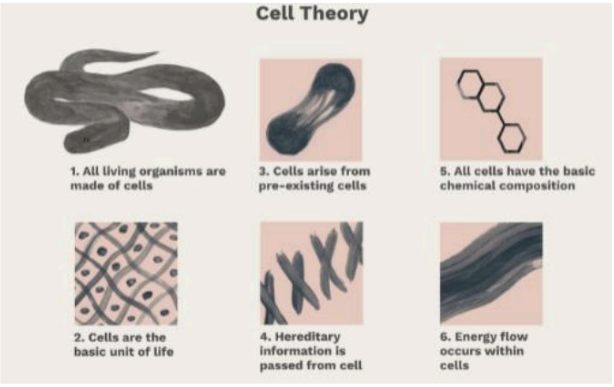
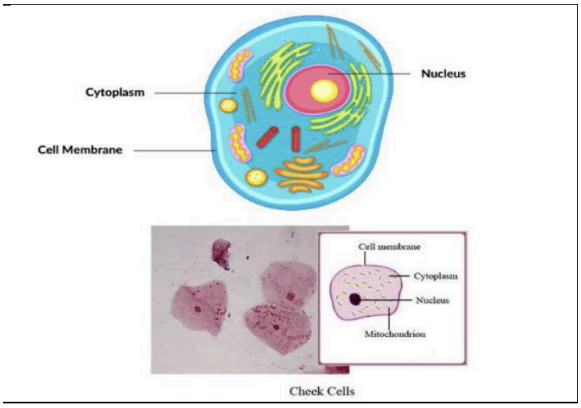
A CELL THEORY

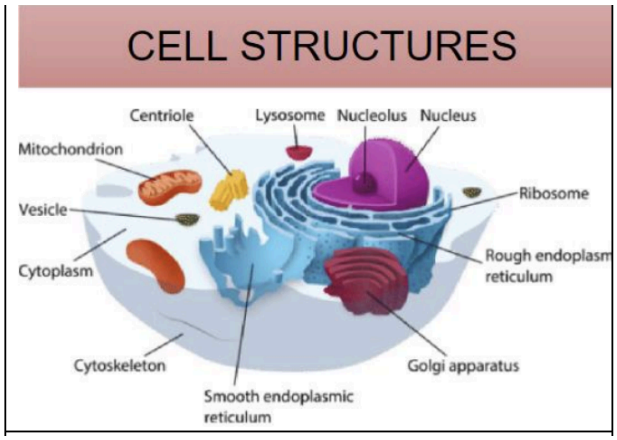
- Proposed by **Matthais Schleiden and Theodor Schwann** in 1839.
- "All living things are made up of cells."
- "Cells are the smallest working unit of all living things. "
- "All cells come from pre-existing cells through cell division."



- **Major Structures Present in a cell:** Cell Membrane, Cytoplasm and its Organelles, and Nucleus



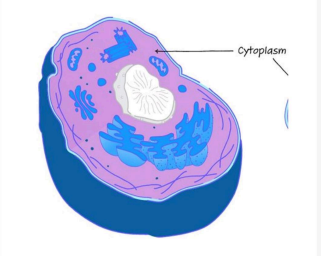
B CELL STRUCTURE



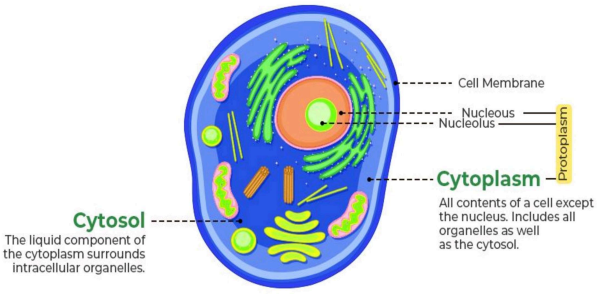
- **Cell Membrane-** Thin pliable elastic outermost structure which envelops the cell. It consists of a lipid bilayer that is semipermeable. The cell membrane regulates the transport of materials entering and exiting the cell.

Cytoplasm and its Organelles

1. **Cytoplasm**
   - Thick, gel-like semitransparent fluid that is found in both plant and animal cells.
   - The constituent parts of cytoplasm are cytosol, cell organelles and cytoplasmic inclusions. Bounded by the plasma membrane, and contains many organelles in a eukaryotic cell (cell containing membrane bounded nucleus).
   - All contents of a cell except the nucleus. Includes all organelles as well as the cytosol.



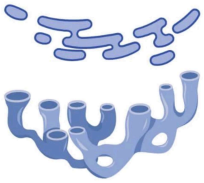
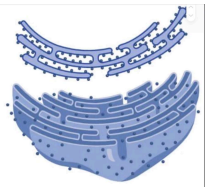
2. **Cytosol**
   - The liquid component of the cytoplasm surrounds intracellular organelles.
   - It accounts for almost 70% of the total cell volume.



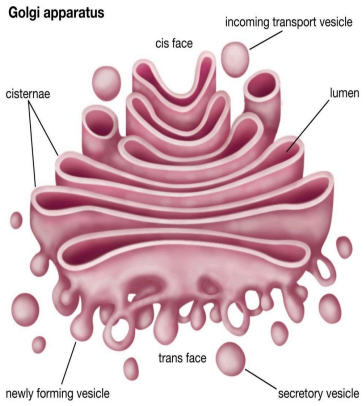
3. **Organelle** - An organelle is a subcellular structure that has one or more specific jobs to perform in the cell,much like an organ does in the body.

Organelle	Function	Found in prokaryotic or eukaryotic cells?	Number in picture
Nucleus	Control center, holds DNA	Eukaryotic	2
Ribosome	Build protein	Both	4
Smooth endoplasmic reticulum (SER)	Build lipids (fats)	Eukaryotic	8
Rough endoplasmic reticulum (RER)	Fold proteins	Eukaryotic	5
Golgi body	Sends "packages" to areas outside cell	Eukaryotic	6
Vacuole	Storage for food and water	Eukaryotic	10 (larger in plants)
Lysosome	Breaks down waste	Eukaryotic	12
Mitochondria	Produces energy	Eukaryotic	19
Chloroplast	Photosynthesis	Eukaryotic (plants only)	Not shown (image is animal cell)

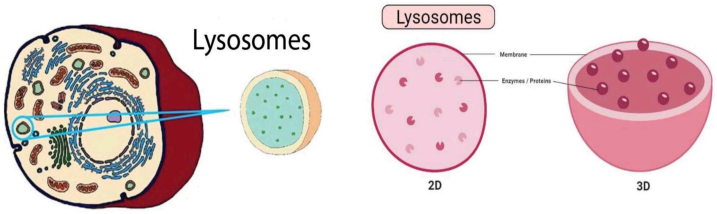
4. **Mitochondria**
   - Membrane-bound cell organelles (mitochondrion, singular) that generate most of the chemical energy needed to power the cell's biochemical reactions. Chemical energy produced by the mitochondria is stored in a small molecule called adenosine triphosphate(ATP). ***Power generating units of the cells***.
5. **Endoplasmic Reticulum**
   - A large, dynamic structure that serves many roles in the cell including calcium storage, protein synthesis and lipid metabolism. The diverse functions of the ER are performed by distinct domains;consisting of tubules, sheets and the nuclear envelope.

Smooth Endoplasmic Reticulum	**Rough Endoplasmic Reticulum**
	
- Ribosomes absent - Site of synthesis of lipid and steroid hormones. - Mainly present in lipid forming cells such as adipocytes, interstitial cells of testis, glycogen storing cells of liver, adrenal cortex cells, muscle cells, leucocytes etc.	- Contains ribosomes - Site of protein synthesis, processing and packaging. - Mainly present in protein forming cells such as pancreatic acinar cells, Goblet cells, antibodies producing plasma cells, Nissl's granules of nerve cells etc.

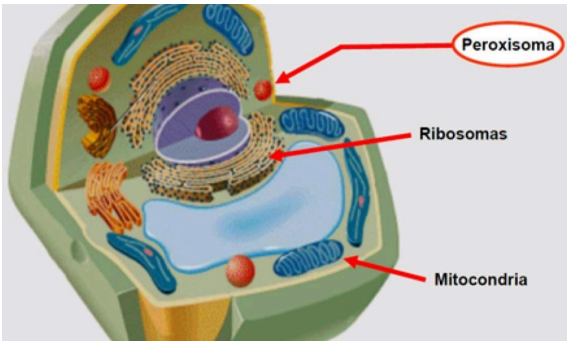
6. **Golgi Apparatus**
   - Golgi Bodies is a collection of membrane enclosed sacs composed of four or more stacked layers of thin, flat enclosed vessels lying near the side of the nucleus. Consist of multiple discrete compartments.
   - Wrapping and Packaging department of the cell.
   - Produces secretion granules i.e. membrane enclosed complexes, which store hormones and enzymes in the protein secreting cells, it packages proteins.
   - Site of formation of lysosomes i.e. large irregular structures surrounded by membranes which are present in the cytoplasm.
   - It adds certain carbohydrates to form glycoproteins, which play an important role in the association of the cells to form tissues



6. **Lysosome**
   - A membrane-bound cell organelle that contains digestive enzymes. Lysosomes are involved with various cell processes. They break down excess or worn- out cell parts. They may be used to destroy invadingvirusesandbacteria.
   - Acts as a form of *digestive (lytic)* system or the cell, because enzymes present in it can digest essentially all macromolecules. ? When a cell dies ,lysosomal enzymes cause autolysis of the remnant . Thats why lysosomes are called as ***Suicidal Bags.***



7. **Peroxisome**
   - Organelles that sequester diverse oxidative reactions and play important roles in metabolism, reactive oxygen species detoxification,andsignaling.
   - H2O2metabolism and detoxification
   - Helps in Photorespiration in plants
   - Biosynthesis of lipids
   - Cholesterol and dolichol are synthesized in animals.
   - Synthesis of bile acids in liver.
   - Synthesis of plasmalogens (myelinsheath).
   -



8. **Cytoskeleton** - A system of fibers that not only maintains the structure of the cell but also permits it to change shape and move.

The cytoskeleton is made up primarily of:

- **Microtubules** - These are long hollow structures approx. 25 nm in diameter. Determine shape of the cell, role in the contraction of the spindle and movement of chromosomes and centrioles as well as in ciliary and flagellar motion.
- **Intermediate Filaments** - They are 8-14nm in diameter and are made up of various subunits. They form a flexible scaffolding or cell and help it resist external pressure.
  In their absence cell ruptures more easily and when they are abnormal in humans, blistering in common. The proteins that make up intermediate filament are cell types specific and are thus frequently usedascellularmarkers.
  Microfilaments - They are long solid fibers 4-6 nm in diameter. They comprise the contractile protein actin and are responsible for cell motion.

9. **Nucleus**
   - The nucleus contains chromatin, RNAs, and nuclear proteins move freely in aqueous solution.
   - Nucleus has an internal structure that organizes the genetic material and localizes nuclear functions.
   - A loosely organized matrix of nuclear lamins extends from the nuclear lamina into the interior of the nucleus

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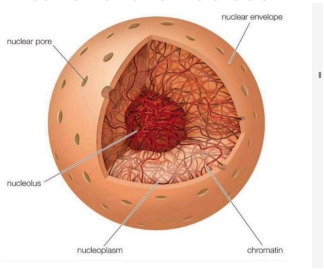


The cell nucleus is a membrane-bound organelle found in eukaryotic cells. The cell nucleus contains nearly all of the cell's genome. Nuclear DNA is often organized into multiple chromosome longstrands of DNA dotted with various proteins, such as histones, that protect and organize the DNA. The genes within these chromosomes are structured in such a way to promote cell function.

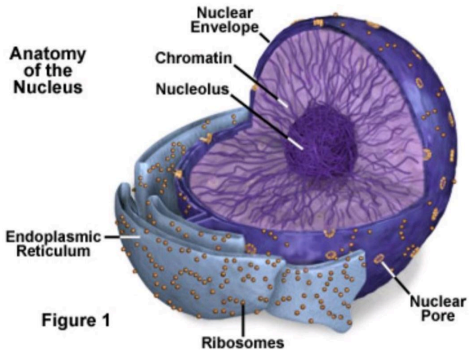
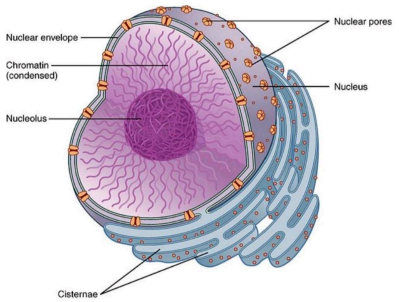


Figure 1

10. **Nuclear Envelope**
    - Complex structure consisting of two nuclear membranes, an underlying nuclear lamina, and nuclear pore complexes. The nuclear envelope separates the contents of the nucleus from the cytoplasm and provides the structural framework of the nucleus. The nuclear membranes, acting as barriers that prevent the free passage of molecules between the nucleus and the cytoplasm, maintain the nucleus as a distinct biochemical compartment.



THE SUMMARY

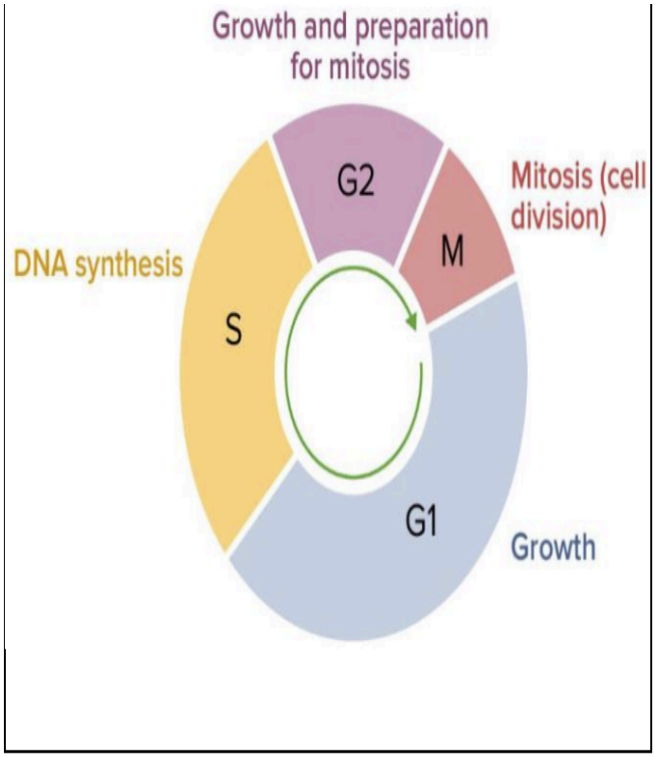
COMPARTMENTS	MAJOR FUNCTIONS
Plasma Membrane	Transport of ions and molecules
Cytosol	Metab. of carbohydrate, lipids and amino acids
Mitochondria	Energy production
Endoplasmic Reticulum	Synthesis of proteins and lipids
Golgi apparatus	Modification and sorting of proteins
Lysosomes	Cellular digestion
Peroxisomes	Utilisation of H2O2
Cytoskeleton	Cell Morphology and cell motility
Nucleus	DNA synthesis and Repair

Module 1: Lesson 3

CELL CYCLE AND DIVISION

What is a Cell Cycle?

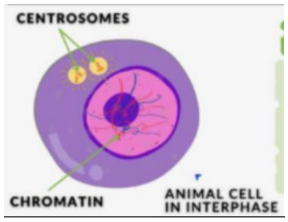
- A cell cycle is a series of events that takes place in a cell as it grows and divides. A cell spends most of its time in what is called interphase, and during this time it grows, replicates its chromosomes, and prepares for cell division. The cell then leaves interphase, undergoes mitosis, and completes its division.



A CELL CYCLE

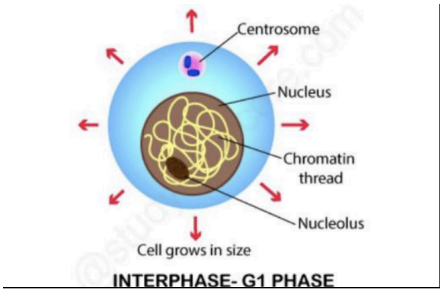
Interphase

- Period of the cell between cell divisions
- Preparatory stage of cell division
- Interphase is the phase in the cell cycle characterized by the increased cell size and DNA replication in preparation for cell division.



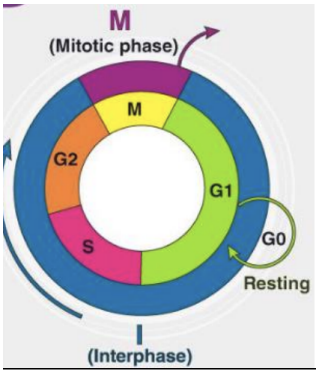
Interphase G1 Phase

- Between Mitosis and DNA synthesis Growing cell: organelles are duplicating Metabolically active cell Lasts up to 11 hrs.
- G1 phase is the phase of the cell between mitosis and initiation of replication of the genetic material of the cell.
- During this phase, the cell is metabolically active and continues to grow without replicating its DNA.



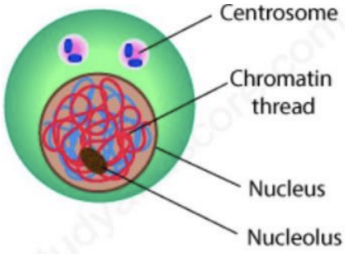
Interphase G0 Phase

- Quiescent stage Metabolically active cell not dividing cell Zero Phase
- It is a resting Phase - Cells enter the G0 phase from a cell cycle checkpoint in the G1 Phase.
- Cell reside in this phase until they receive appropriate signals



Interphase -S Phase

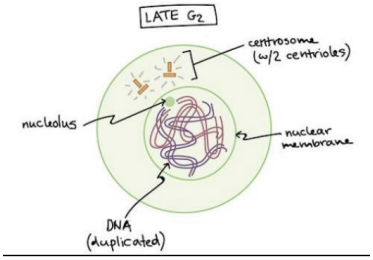
- DNA replication increase in DNA Content lasts up to 8 hours.
- The S phase of cell cycle occurs during interphase, before mitosis or meiosis, and is responsible for the synthesis or replication of DNA in this way, the genetic materials of a cell is doubled before it enters mitosis or meiosis, allowing there to be enough DNA to be split into daughter cells.



INTERPHASE- S PHASE

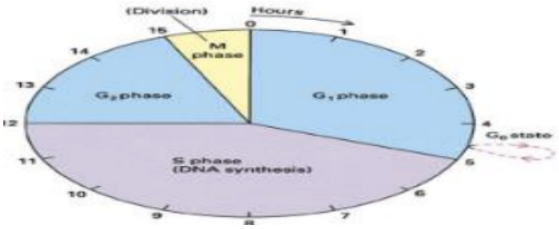
Interphase G2- Phase

- Protein synthesis
- Check point: damaged DNA unreplicated DNA last up to 4 Hours
- This last stage is all about prepping the cell for mitosis or meiosis. During G2, the cell has to grow some more and produce any molecules it still needs to divide.



Cell Cycle M-Phase

- Cell division: Mitosis Meiosis lasts for 1 hour

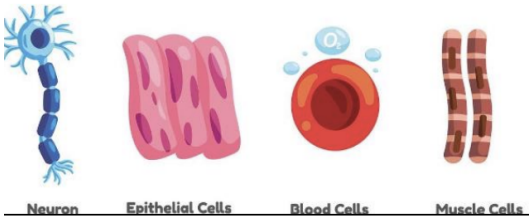


B CELL DIVISION

- **Biological Basis of life Reproduction:** to produce new individual of the same kind
- **Maintains the genome:** Keeps the genomic information consistent between generations
- **Cell Multiplication:** Increase in the number of cell for growth, development and repair

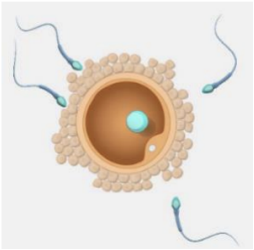
Somatic Cell

- Make up all the body tissues and organs
- Diploid Chromosomes
- Undergo Mitosis



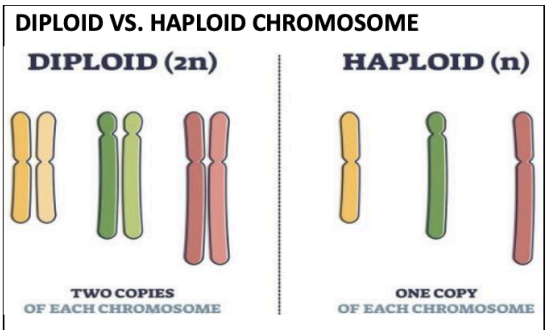
Germinal Cells

- Gamete reproductive cells haploid chromosomes undergo meiosis



The Chromosome

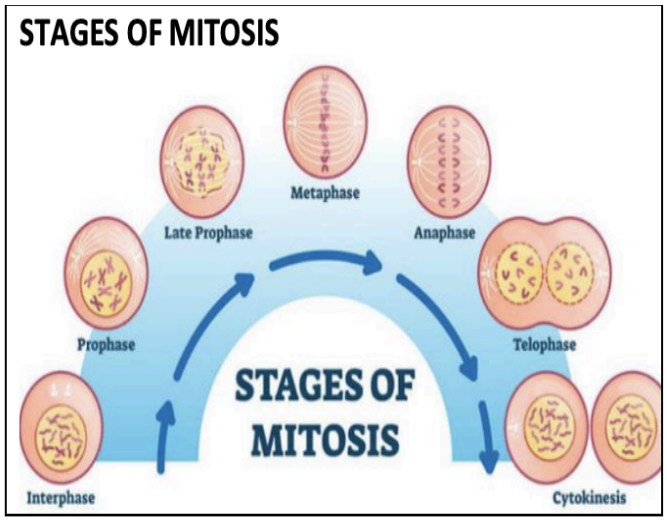
- Chromosomes are threadlike structures made of protein and a single molecule of DNA that serve to carry the genomic information from cell to cell. In plants and animals (including humans), chromosomes reside in the nucleus of cells

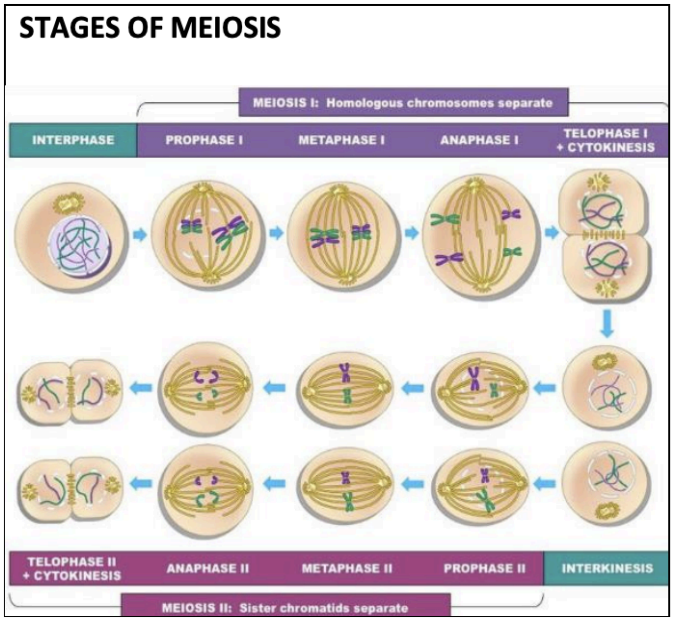


- Haploid refers to the presence of a single set of chromosomes in an organism's cells.
- Sexually reproducing organisms are diploid (having two sets of chromosomes, one from each parent).
- In humans, only the egg and sperm cell are haploid

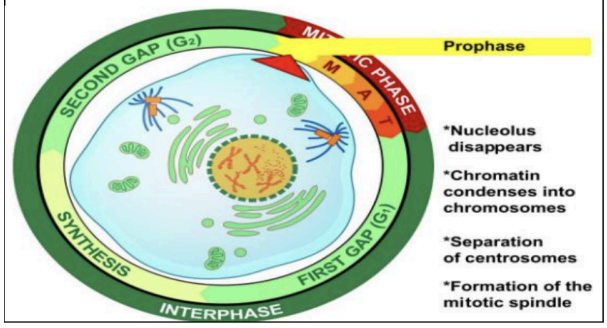
Mitosis

- Mitosis is the process by which a cell replicates its chromosomes and then segregates them, producing two identical nuclei in preparation for cell division.
- Mitosis is generally followed by equal division of the cell's content into two daughter cells that have identical genomes.



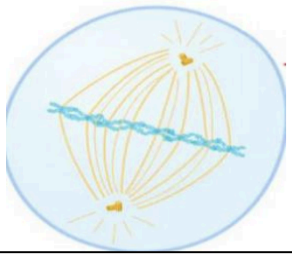


PROHASE

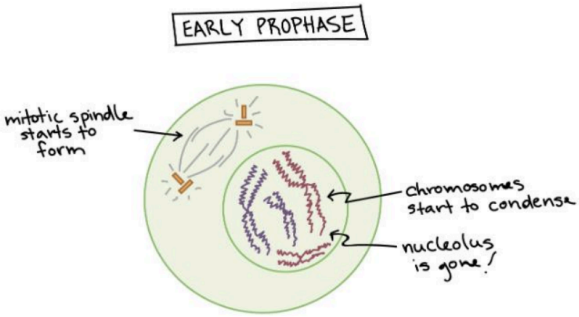


METAPHASE

- Chromosomes line up along metaphase plate (imaginary plane)

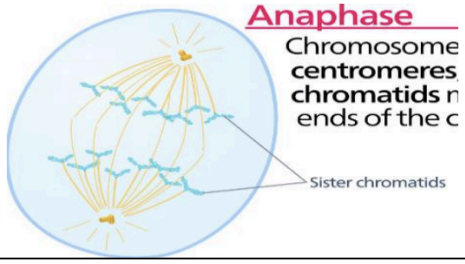


EARLY PROPHASE

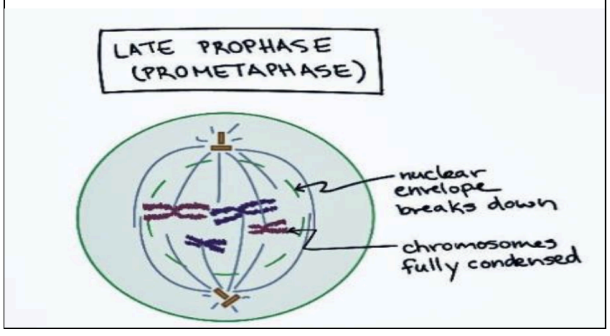


ANAPHASE

- Chromosomes break at **centromeres, and sister chromatids** moves to opposite ends of the cell

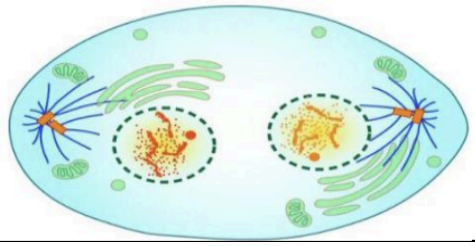


LATE PROPHASE



TELOPHASE

- Telophase is the stage of mitosis (or meiosis) wherein the chromosomes have arrived at opposite poles and nuclear envelope reforms.

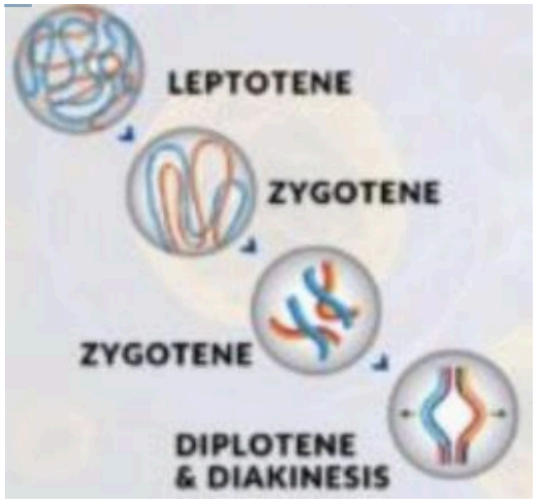


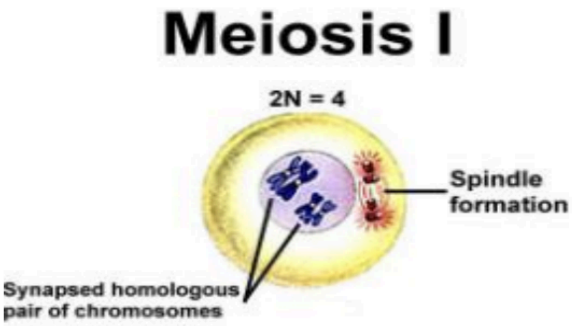
Meiosis

- Meiosis is a type of cell division in sexually reproducing organisms that reduces the number of chromosomes in gametes (the sex cells, or egg and sperm). In humans, body (or somatic) cells are diploid, containing two sets of chromosomes (one from each parent)

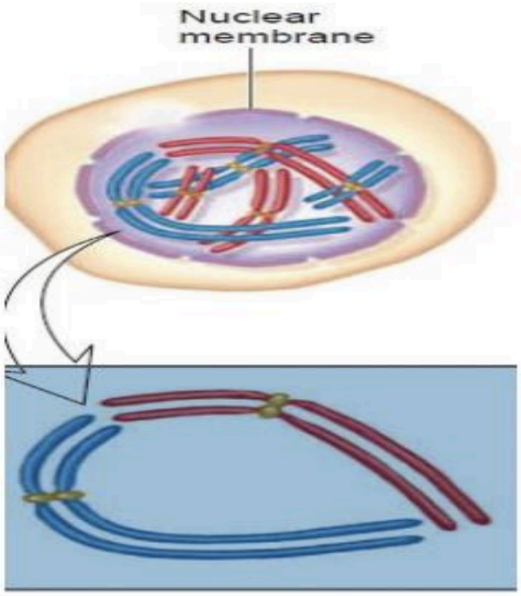
Meiosis I: Prophase I

- The first stage of the first meiotic division, where chromosomes are “bead” -like, and the nuclear membrane and nucleolus disintegrate.
- During prophase I, the complex of DNA and protein known as chromatin condenses to form chromosomes.
- The pairs of replicated chromosomes are known as sister chromatids, and they remain joined at a central point called the centromere.
- Condensation of chromosomes
- Shortening and thickening of chromosomes doubled chromosomes

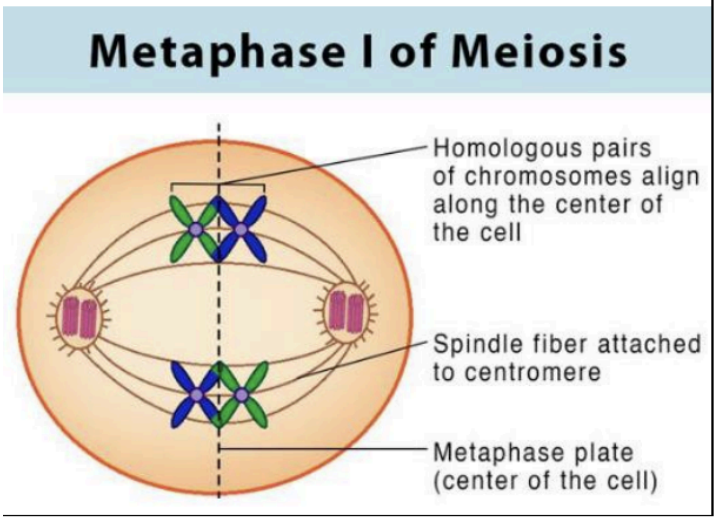




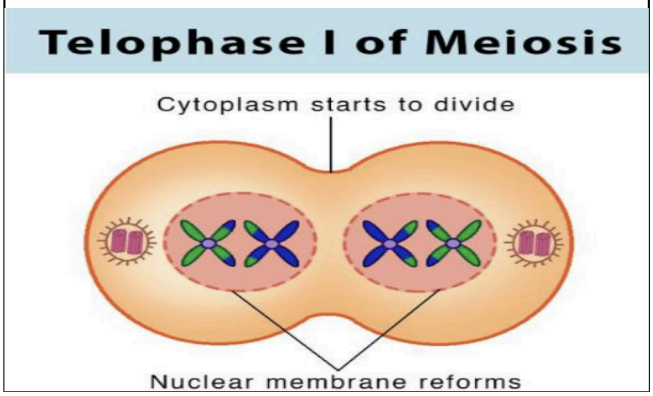
Prophase I



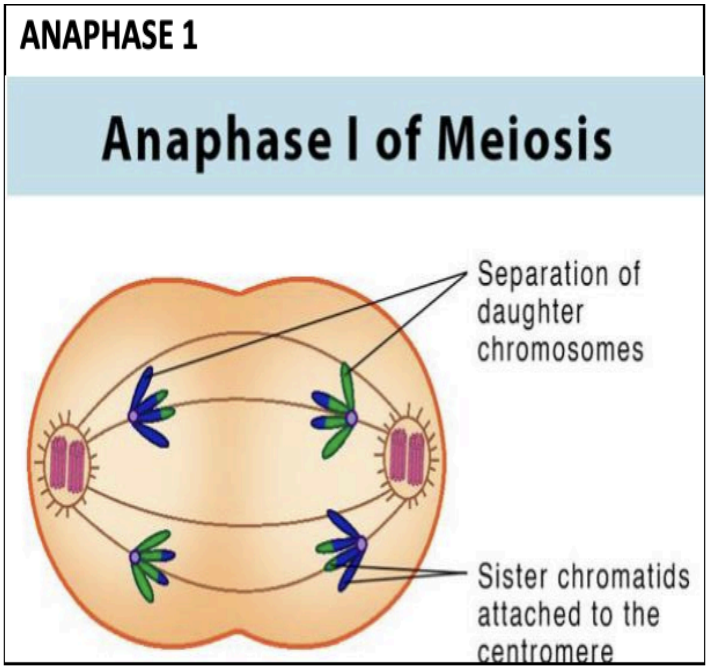
METAPHASE 1



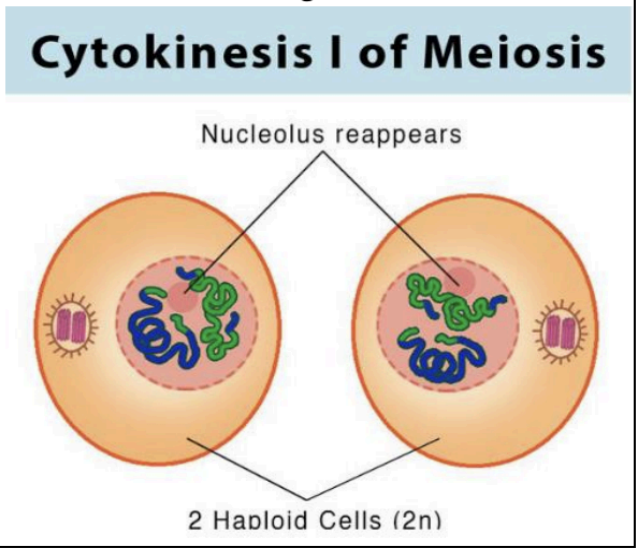
TELOPHASE 1
The cell now undergoes a process called cytokinesis that divides the cytoplasm of the original cell into two daughter cells. Each daughter cell is haploid and has only one set of chromosomes, or half the total number of chromosomes of the original cell.



ANAPHASE 1



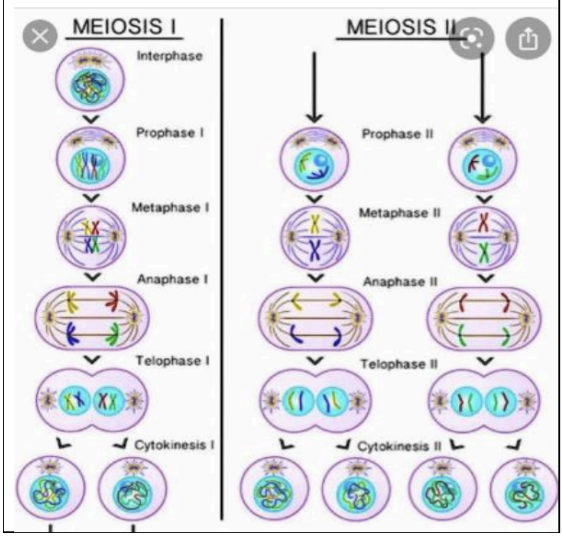
CYTOKINESES
Each daughter cell is haploid and has only one set of chromosomes, or half the total number of chromosomes of the original cell.



Meiosis II

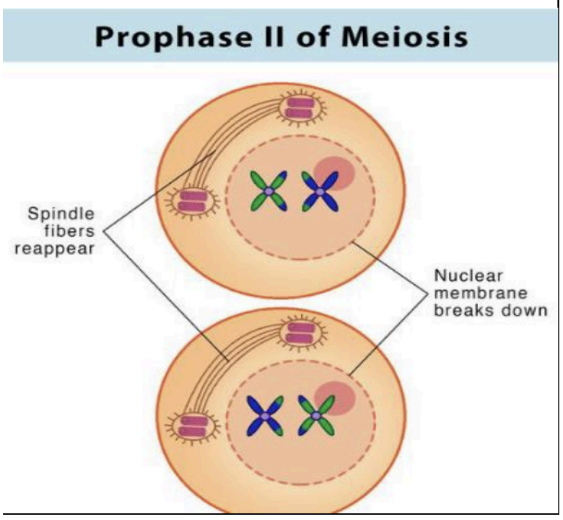
MEIOSIS II

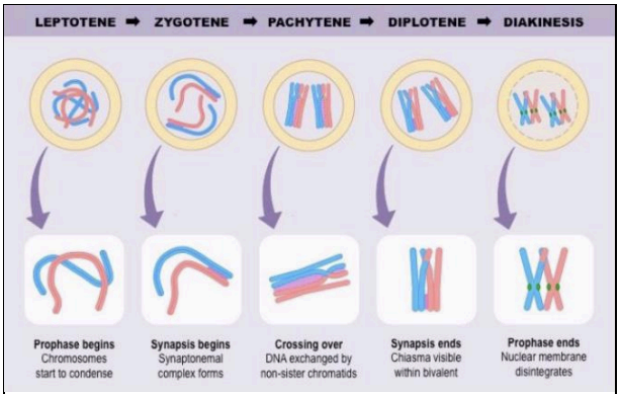
Meiosis II is a mitotic division of each of the haploid cells produced in meiosis I.



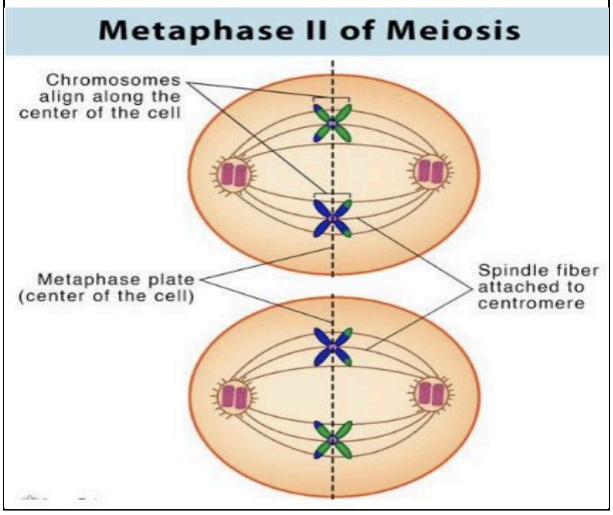
PROPHASE 2

The chromosomes condense, and a new set of spindle fibers forms. The chromosomes begin moving toward the equator of the cell.



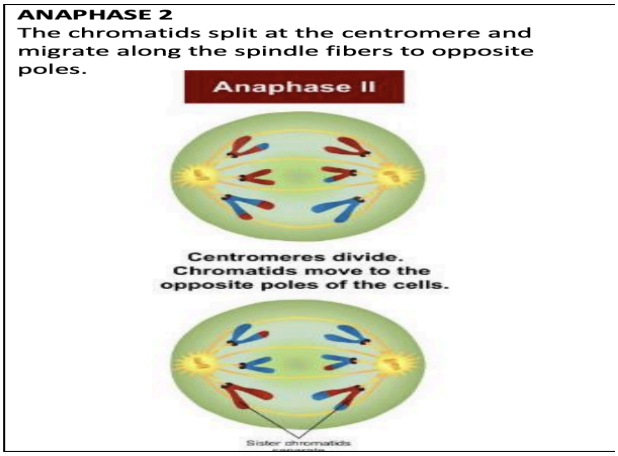


METAPHASE 1



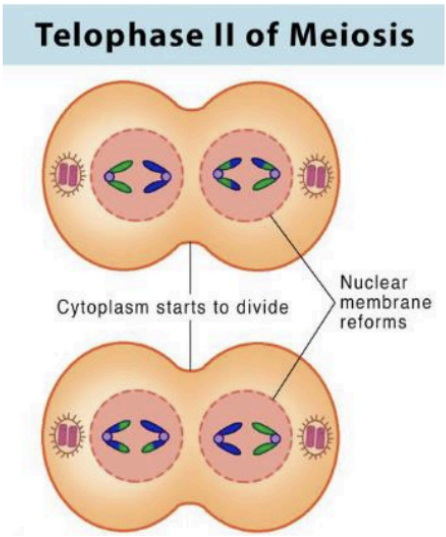
ANAPHASE 2

The chromatids split at the centromere and migrate along the spindle fibers to opposite poles.



TELOPHASE 2

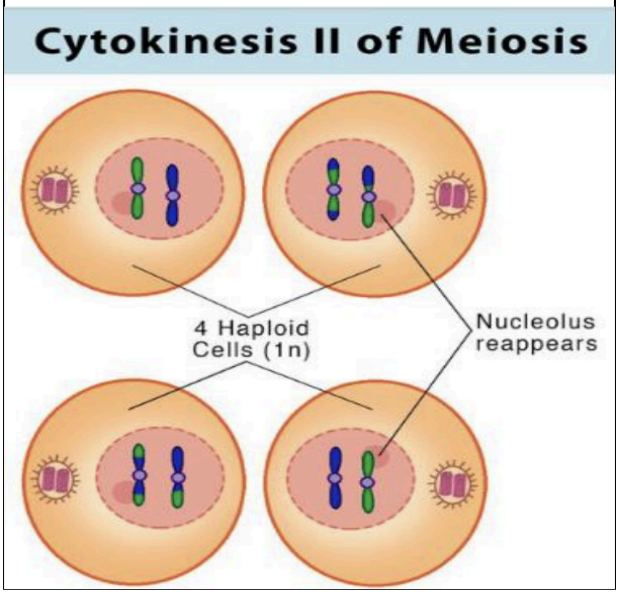
Nuclear membranes form around each set of chromosomes, and the chromosomes



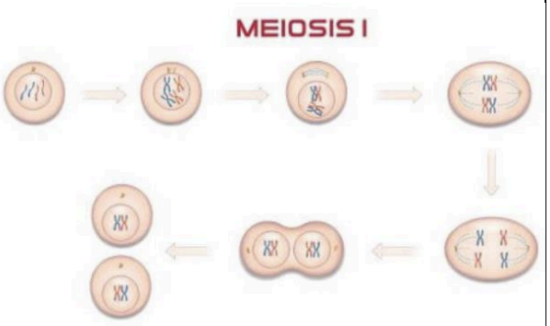
decondense

CYTOKINESIS 2

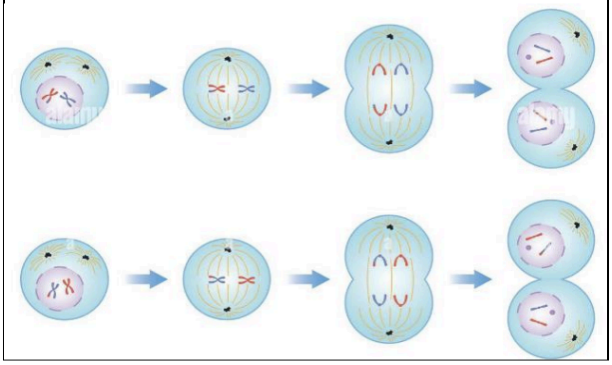
Cytokinesis splits the chromosome sets into new cells, forming the final products of meiosis: four haploid cells in which each chromosome has just one chromatid.



PRODUCT OF MEISIS 1



PRODUCT OF MEIOSIS 2



SUMMARY

Meiosis I (Reduction Division)

Prophase I: chromosomes paired up, crossing over
Metaphase I: align at the equator,Orientation is random(genetic variation)
Anaphase I: Homologous chromosomes pulled apart to opposite poles.
Telophase I: Cell divides into two haploid cells (n)

Meiosis II (Separation of Sister Chromatids)
Chromosome number remains haploid (n → n), but chromatids are separated.

Prophase II: Chromosomes condense (again)
Metaphase II: Chromosomes align at the equator in each cell.
Anaphase II: Sister chromatids are pulled apart to opposite poles.
Telophase II and Cytokinesis: Each of the two cells divide again, resulting in four haploid daughter cells.

- Meiosis I begins with one diploid parent cell and ends with two haploid daughter cells. This results in halving the number of chromosomes in each cell.
- Meiosis II resembles a mitotic division, except that the chromosome number has been reduced by half. Thus, the products of meiosis II are four haploid cells that contain a single copy of each chromosome
- These become sperm or egg cells in animals.

LEC: GENERAL BIOLOGY

DR. Rissa Lasap

Preliminary Period

1st Year 1st Semester | Academic Year 2026-2027

Module 1: Lesson 4

THE BASIC MOLECULES OF LIFE

★ Life is based on carbon-containing molecules. These molecules form the structure and function of living organisms. These are known as ***biomolecules*** or ***macromolecules***.

A 4 MAJOR BIOMOLECULES

1. CARBOHYDRATES

– **Elements:** C, H, O (1:2:1 ratio)
– **Function:** Primary energy source
– **Types:**

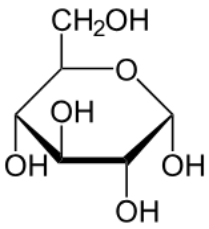
(a) ***Monosaccharides***
- e.g., glucose, fructose

(b) ***Disaccharides***
- e.g., sucrose (table sugar), lactose

(c) ***Oligosaccharides*** (3-10 sugar units)
- e.g., maltodextrin

(d) ***Polysaccharides***
- e.g., starch, glycogen, cellulose

– **Structure example:** ring structure of glucose



- Carbohydrates ***act as the primary source of energy***.
- The body breaks down carbs into glucose (sugar), which is used by cells for energy.
- Extra glucose is stored as glycogen in the liver and muscles for later use.
- Example: Eating rice gives your body glucose for energy.

2. PROTEINS

– **Elements:** Made of amino acids (C, H, O, N, sometimes S)
– **Function:** Build structures, enzymes, hormones
– **Structure Levels:** ***Primary***, ***Secondary***, ***Tertiary***, ***Quaternary***
– **Examples:** hemoglobin, enzymes, antibodies

- Protein ***acts as the building blocks of the body.***
- It is made of amino acids that repair and build tissues (muscles, skin, enzymes, hormones).
- Proteins also act as enzymes, which speed up chemical reactions in the body.
- Example: When you heal from a cut, proteins help build new cells.

3. LIPIDS

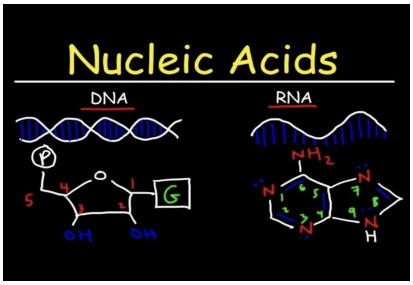
- **Elements:** C, H, O (more H, less O)
- **Function:** Energy storage, insulation, membranes
- **Types:**
  - (a) ***Fats, oils, waxes***
  - (b) ***Phospholipids*** (cell membrane)
  - (c) ***Steroids*** (cholesterol, hormones)

– **Structure:** Glycerol + fatty acids

- Lipids are ***used for energy storage, insulation. and cell membrane structure***.
- Fats are the body's long-term energy reserve.
- They protect organs and help absorb fat-soluble vitamins (A, D, E, K).
- Phospholipids are the main components of cell membranes.
- Some examples of healthy fats include avocado, coconut, whole eggs, fatty fish, cheese, nuts, chia seeds, dark chocolate, and olives.
- Example: Your body uses fats when carbs are low (e.g., during fasting).
-

4. NUCLEIC ACIDS

- **Elements:** Made of nucleotides (C, H, O, N, P)
- **Function:** Store and transmit genetic information
- **Types: *DNA*** and ***RNA***
- **Structure:** sugar + phosphate + nitrogen base
  - Nucleic acids (DNA and RNA) ***store and transmit genetic information***.
  - DNA contains instructions for making all proteins in your body.
  - RNA helps translate DNA instructions into actual protein production.
  - It is essential for growth, reproduction, and repair.
  - Example: Every time your cells divide, DNA is copied and passed on.



DNA VS. RNA:

DNA – like the master blueprint stored in the nucleus; it holds all genetic information
RNA – like the messenger and worker; it reads the DNA instructions and helps build proteins in the cytoplasm

SUMMARY:

- ★ All living things are made of 4 major types of biomolecules.
- ★ These molecules are essential for life's structure and function.
- ★ Understanding them helps explain how life works at a molecular level.

LEC: GENERAL BIOLOGY

DR. Rissa Lasap

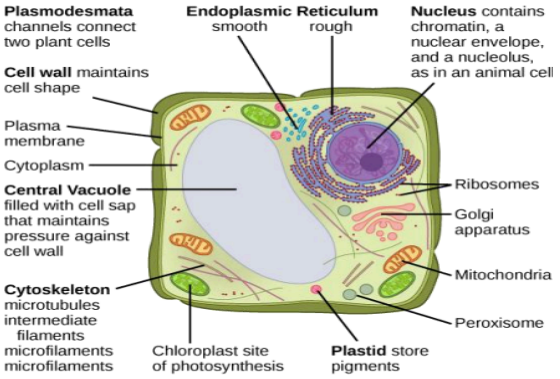
Preliminary Period

1st Year 1st Semester | Academic Year 2026-2027

Module 1: Lesson 5

CELL PHYSIOLOGY

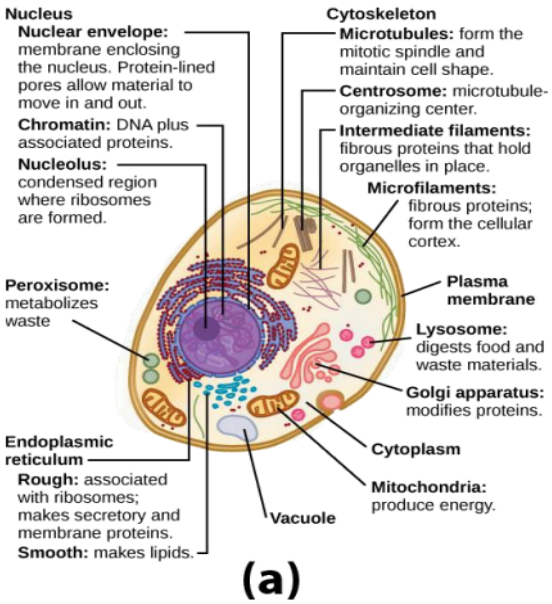
- The ***CELL*** is the structural and functional unit of all living things and is a complex entity.
- Cells are the basic building blocks of all living things.
- The human body is composed of trillions of cells.
- They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry our specialized functions.
- Cells also contain the body's genetic material and can make copies.



EUKARYOTIC CELLS – contain a nucleus and organelles bound by plasma membranes
PROKARYOTIC CELLS – do not have a membrane-bound nucleus or organelles

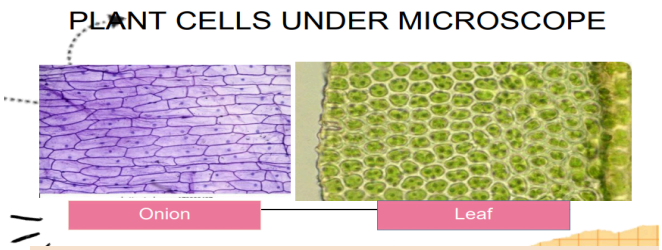
TYPES OF CELLS:

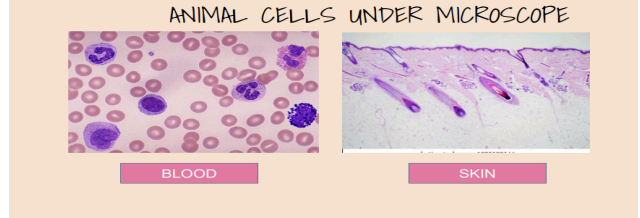
A. BACTERIAL CELL
B. PLANT CELL
C. ANIMAL CELL

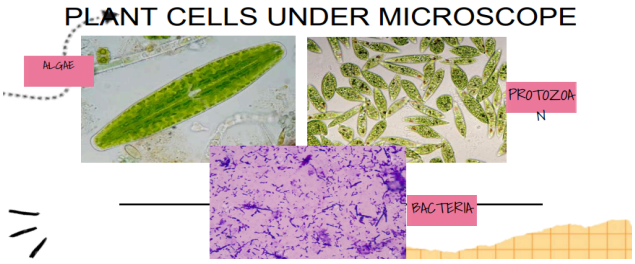


3 PARTS OF ANIMAL CELLS UNDER THE MICROSCOPE:

(1) Nucleus
(2) Cytoplasm
(3) Plasma membrane





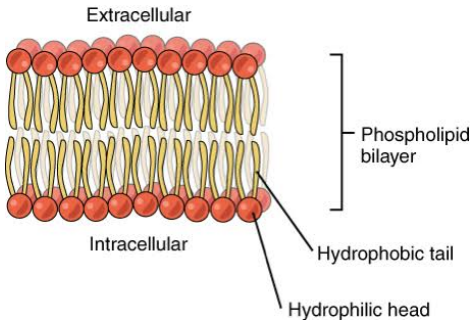


Module 1: Lesson 6

TRANSPORT THROUGH MEMBRANE

MEMBRANE – is a bilayer of phospholipid molecules in which protein molecules float.
– Plasma membrane is selective about what passes through it. It allows nutrients to enter the cell but keeps out undesirable substances.

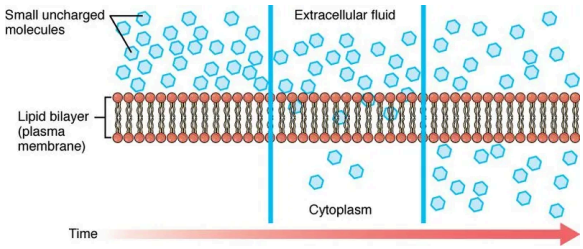
SEMIPERMEABLE MEMBRANES – (also known as ***selectively permeable membranes*** or ***partially permeable membranes***) allow certain molecules or ions to pass through by DIFFUSION



A MOVEMENT OF SUBSTANCES ACROSS THE CELL MEMBRANE:

- Two important functions of the cell membranes:
  (1) It must retain the dissolved materials of the cell so that they do not simply leak out into the environment.
  (2) It should also allow the necessary exchange of materials into and out of the cell.

Diffusion – process of passive transport in which molecules move from an area of higher concentration to one of lower concentration)



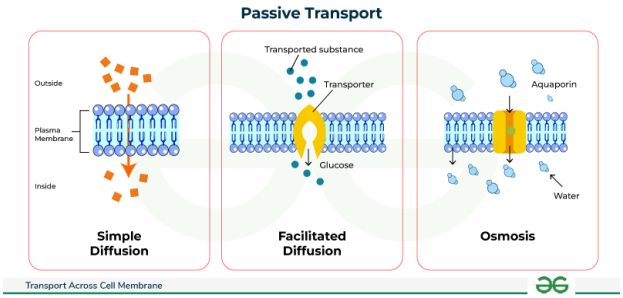
Different types of PASSIVE TRANSPORT mechanisms across the cell membrane:

- **SIMPLE DIFFUSION**
- **FACILITATED DIFFUSION**
- **OSMOSIS** - Water moves down its concentration gradient. Movement of water across a membrane from an area of low solute concentration to an area of high solute concentration
  - **Endosmosis** is If the water moves towards the inside of the cell.
  - **Exosmosis** is if the water moves outside the cell.

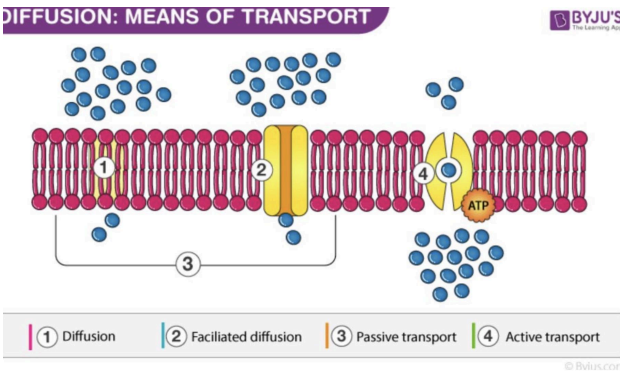
TWO IMPORTANT PASSIVE PROCESSES OF MEMBRANE TRANSPORT:

- **DIFFUSION** is an essential transport process for every cell in the body.
- **FILTRATION** usually occurs only across capillary walls.

PASSIVE TRANSPORT – does not require the cell to expand any energy and involves a substance diffusing down its concentration gradient across a membrane.



MOVEMENT OF SUBSTANCES ACROSS CELL MEMBRANE:



A TYPES OF DIFFUSION

1. **Simple Diffusion** – transport across the plasma membrane occurs unaided in simple diffusion
   - e.g., molecules of gases such as carbon dioxide and oxygen, as well as small molecules like ethanol, enter the cell by crossing the cell membrane without the assistance of any permease
2. **Facilitated Diffusion** – molecules diffuse across the plasma membrane with assistance from membrane proteins, such as channels and carriers
3. **Channel Proteins** – very selective and will accept only one type of molecule for transport
   - e.g., potassium channels and aquaporins
4. **Carrier Proteins** – proteins in the cell membrane that bind to a specific molecule, change shape, and carry it across the membrane

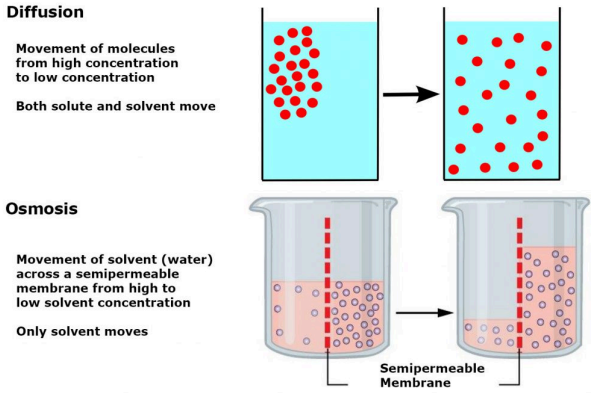
EXAMPLES OF DIFFUSION:

- ➔ Movement of oxygen and carbon dioxide in lungs
- ➔ Movement of amino acid from intestine into the blood
- ➔ When carbon dioxide from air enters then leaves

FACTORS THAT AFFECT DIFFUSION:

- Extent of the concentration gradient
- Mass of the molecules diffusing
- Temperature
- Solvent density
- Solubility
- Surface area and thickness of the plasma membrane
- Distance travelled

DIFFERENCE BETWEEN DIFFUSION AND OSMOSIS:



EXAMPLES OF OSMOSIS:

➔ Absorption of water from the ground
➔ Absorption of water in kidney

SOLVENTS AND SOLUTES:

- Osmosis deals with chemical solutions.
- Solutions have two parts: a ***SOLVENT*** and a ***SOLUTE***.
- **Solution-** when solute dissolves in a solvent
    - E.g., salt water (salt = solute, water = solvent)

ACTIVE TRANSPORT – the cell expands energy (e.g., in the form of ATP) to move a substance against its concentration gradient
– Living cells typically have what's called a ***MEMBRANE POTENTIAL***, an electrical potential difference (voltage) across their cell membrane,

LESSON: LABORATORY

ISOTONIC SOLUTION – has the same concentration of solutes both inside and outside the cell.

- e.g., normal slide (0.9% NaCl solution), lactated Ringer's solution
- A cell with the same concentration of salt inside it as the surrounding water/fluid would be said to be in an isotonic solution.
- There is no net movement of solvent; in this case, the amount of water entering and exiting the cell's membrane is equal.

HYPOTONIC SOLUTION – higher concentration of solutes inside the cell than outside the cell.

- e.g., pure water (has no solute)
- When this occurs, more solvent will enter the cell than leave it to balance out the concentration of solute.

HYPERTONIC SOLUTION – opposite of hypotonic solution; there is more solute outside the cell than inside it

- e.g., saline solution for medical care
- In this type of solution, more solvent will exit the cell than enter it in order to lower the concentration of solute outside the cell.