



### ❖ The Cell and Chromosome

All living organisms on earth are divided into cells. The main concept of cell theory is that cells are the basic structural unit for all organisms. Cells are small compartments that hold the biological equipment necessary to keep an organism alive. Living things may be single-celled or they may be very complex such as a human. Cells can connect to form larger structures. They might group together to form the tissues of the stomach and eventually the entire digestive system. Cells can be defined as the basic unit for biology and organisms.

In larger organisms, the main purpose of a cell is to organize. Cells hold a variety of pieces and each cell type has a different purpose. By dividing responsibilities among different groups of cells, it is easier for an organism to survive and grow.

Humans have hundreds of different cell types. You have red blood cells that are used to carry oxygen (O<sub>2</sub>) through the body and other cells specific to your heart muscle. Even though cells can be very different, they are basically compartments surrounded by some type of membrane.

Cells are fundamental to the study of biology. Every living thing is composed of cells; they are the building blocks of life. All cells share similar characteristics and can be defined by the cell theory.

1. All living things are composed of cells
2. All cells arise from preexisting cells through cell division
3. Cells contain hereditary material, which they pass to daughter cells during cell division.
4. The chemical composition of all cells is quite similar
5. The metabolic processes associated with life occur within cells.

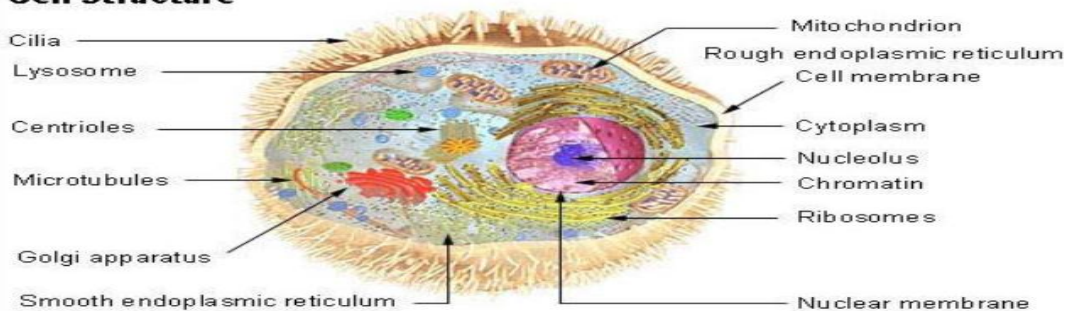
### ❖ Cell size and contents

Cell size varied according to the type and shape of the living animals, so we see oval cell and semi-polygonal cells and there are some nerve cell may reach their length to many meters, and In opposite to that some cells may have a diameter may reach one micron, and also the hen egg consider as a one cell.

### ❖ Animal Cell Structure

Animal cells are eukaryotic cells, the nucleus and other organelles of the cell are bound by membrane.

#### Cell Structure



❖ **Cell membrane:** (also known as the plasma membrane or cytoplasmic membrane) is a biological membrane that separates the interior of all cells from the outside environment (the extracellular space). It consists of a lipid bilayer with embedded proteins. The basic function of the cell membrane is to protect the cell from its surroundings and allowing only a few molecules to move across it.

### ❖ Cytoplasm:

- The fluid that fills the cell.
- The cellular organelles are suspended the cytoplasm.
- This maintains the pressure of the cell, ensures the cell doesn't shrink or burst.

❖ **Nucleus:**

- Nucleus is the house for most of the cells genetic material- the DNA and RNA.
- The nucleus is surrounded by a porous membrane known as the nuclear membrane.
- The nucleus controls the activity of the cell and is known as the control center.
- The nucleolus is the dark spot in the nucleus, and it is the location for ribosome formation.

❖ **Ribosomes:** Ribosome's is the site for protein synthesis where the translation of the RNA takes place.

❖ **Endoplasmic reticulum**

- ER is the transport system of the cell. It transports molecules that need certain changes.
- ER is of two types, rough and smooth.

❖ **Lysosomes:**

- It is the digestive system of the cell.
- They have digestive enzymes helps in breakdown the waste molecules and also help in detoxification of the cell.

❖ **Centrosomes:**

- It is located near the nucleus of the cell.
- During mitosis the centrosome aids in dividing of the cell and moving of the chromosome to the opposite sides of the cell.

❖ **Vacuoles:**

- In many organisms vacuoles are storage organelles.
- Vesicles are smaller vacuoles which function for transport in/out of the cell.

❖ **Golgi bodies:** Golgi bodies are the packaging center of the cell.

❖ **Mitochondria:**

- Mitochondria are the main energy source of the cell.
- They are called the power house of the cell because energy (ATP) is created

here.

- Mitochondria consist of inner and outer membrane.

❖ Cytoskeleton: They give structural support and maintain the shape of the cell.

❖ Cilia and Flagella:

- Cilia and flagella are structurally identical structures.
- They are different based on the function they perform and their length.
- Cilia are short and are in large number per cell while flagella are longer and are fewer in number.

❖ **Prokaryotic and Eukaryotic Cells:**

There are two major categories or types of cells: prokaryotic and eukaryotic. Prokaryotic cells are less organized and less dynamic than eukaryotic cells. Prokaryotes lack the organelles that are found in eukaryotic cells. Organelles are small, membranous bodies, each with a specific structure and function. Prokaryotes do have cytoplasm, the material contained by a plasma membrane and cell wall. The cytoplasm includes ribosomes (the site of protein synthesis) and enzymes. Prokaryotes also have a nucleoid, a region in the bacterial cell interior in which the DNA is physically organized but not enclosed by a membrane. Bacteria and archaeobacteria are prokaryotic.

Plant, animal and fungal cells are eukaryotic cells. The nucleus in a eukaryotic cell is bound by a nuclear envelope and contains nucleoplasm. The cytoplasm, found between the plasma membrane and the nucleus, consists of fluid and the organelles. Many organelles have membranes, such as the nucleolus, endoplasmic reticulum, Golgi apparatus, lysosomes, and chloroplast.

❖ **Plant and Animal Cells:**

Now, that you know some important cell organelles let us identify those that distinguish plant cells from animal cells. From the descriptions above, we can identify three organelles unique to plant cells:

1. Cell wall (versus a cell membrane in animal cells).
2. Central vacuole (regular vacuoles are found in animal cells).
3. Chloroplasts (animals do not perform photosynthesis).

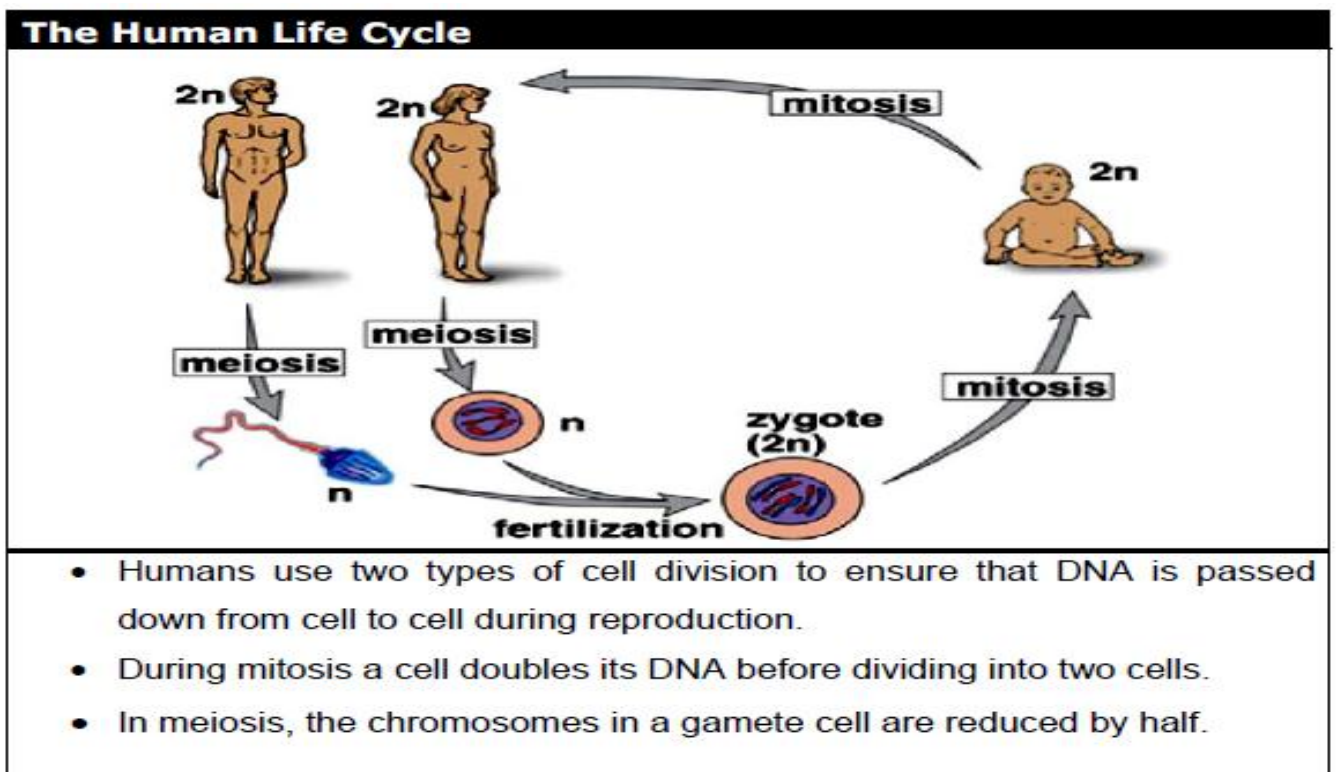
### ❖ Cell Division and Reproduction

-Organisms use two types of cell division to ensure that DNA is passed down from cell to cell during reproduction.

-Simple one-celled organisms reproduce by a process called mitosis. During mitosis a cell doubles its DNA before dividing into two cells and distributing the DNA evenly to each resulting cell.

-Organisms that reproduce sexually produce special cells called gametes, egg and sperm.

-During sexual reproduction, an egg and sperm unite to form a zygote, in which the full number of chromosomes is restored.



❖ **There are Two types of cell division :**

- 1- **Karyokinesis:** include nucleus division.
- 2- **Cytokinesis:** it is begin after beginning nucleus division and sometime begin after finish nucleus division or never happen.

❖ **There are two types of Karyokinesis:**

1. **Mitosis:** Occurs in five stages:

**1- Interphase:** the start of mitosis, the DNA of each chromosome replicates, each chromosome then reorganizes into paired structures called sister chromatid, with each member of the pair containing a full copy of the DNA sequence.

**2- Prophase:** the sister chromatids condense, thickening until they appear joined at a single site, known as the centromere.

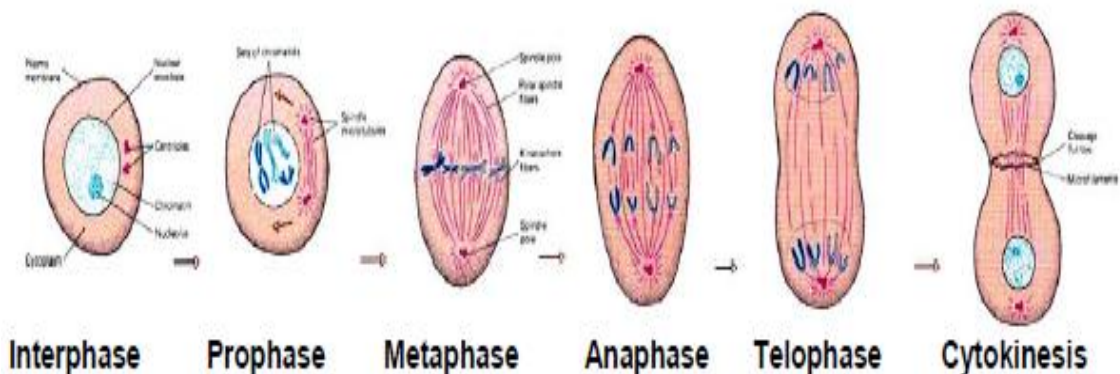
**3- Metaphase:** the sister chromatids line up in the middle of the cell.

**4- Anaphase:** the chromatid pairs split apart at the centromere, and each half of the pair then moves toward opposite poles of the cells.

**5- Telophase:** the final stage of mitosis, a nuclear membrane forms around the chromosomes at each pole of the cell.

- Mitosis ends with the formation of two new cells, each with matching full set of chromosomes.

-The cytoplasm divides; the cell membrane pinches inward ultimately producing two daughter cells (**Cytokinesis**)



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❖ **The purpose of mitosis:**

- 1- Growth
- 2- Cellular prosthesis during wounds
- 3- A sexual reproduction.
- 4- The mitosis lead to production two new corresponding cell exactly in its chromosomal content quality and quantity.

**2- Meiosis:** comprises two successive nuclear divisions.

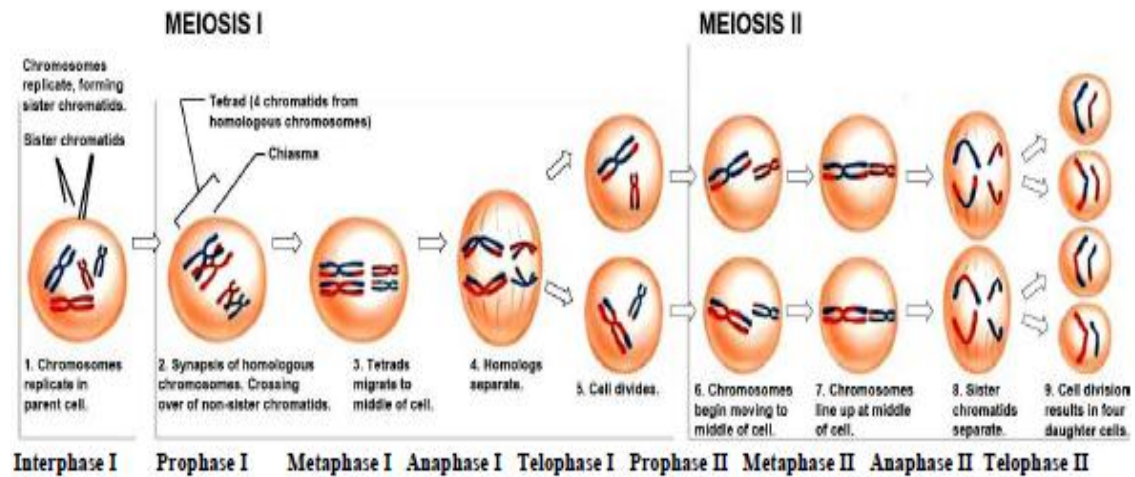
**A-First division of meiosis:**

- 1- Prophase I: Each chromosome duplicates and remains closely associated. These are called sister chromatids.
- 2- Metaphase I: Homologous chromosomes align at the equatorial plate.
- 3- Anaphase I: Homologous pairs separate with sister chromatids remaining together.
- 4- Telophase I: Two daughter cells are formed with each daughter containing only one chromosome of the homologous pair.

5- **B-Second division of meiosis:**

- 1- Prophase II: DNA does not replicate.
- 2- Metaphase II: Chromosomes align at the equatorial plate.
- 3- Anaphase II: Centromeres divide and sister chromatids migrate separately to each pole.
- 4- Telophase II: Cell division is complete. Four haploid (n) daughter cells are obtained.

-Meiosis ensures that reproduction will produce a zygote that has received one set of chromosomes ( $n$ ) from each parent to form a fullset of chromosomes known as the diploid number ( $2n$ ).



#### ❖ The importance of meiosis

Meiosis is important because it ensures that all organisms produced via sexual reproduction contain the correct number of chromosomes. Meiosis also produces genetic variation by way of the process of recombination. Later, this variation is increased even further when two gametes unite during fertilization, thereby creating offspring with unique combinations of DNA. This constant mixing of parental DNA in sexual reproduction helps fuel the incredible diversity of life on Earth.

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