

Chapter 1: Structure of Chromosome, Cell Cycle & Cell Division

1. Cell Cycle and Cell Division

The cell cycle is a series of events that cells go through as they grow and divide. It consists of two main phases:

A. Interphase:

This is the preparatory phase where the cell grows, replicates its DNA, and gets ready for division. It is divided into three stages:

- **G1 Phase (Gap 1):** The cell grows in size and synthesizes proteins and organelles.
- **S Phase (Synthesis):** DNA replication occurs, resulting in the duplication of chromosomes.
- **G2 Phase (Gap 2):** The cell continues to grow and prepares for mitosis by synthesizing the necessary proteins.

B. Mitotic Phase (M Phase):

This phase involves the division of the nucleus (mitosis) followed by the division of the cytoplasm (cytokinesis).

2. Cell Division

Cell division is crucial for growth, repair, and reproduction. It occurs in two types:

A. Mitosis:

- A process of nuclear division that results in two identical daughter cells.
- It occurs in somatic (body) cells and involves four stages:
 1. **Prophase:** Chromatin condenses into chromosomes, spindle fibers form, and the nuclear membrane disappears.
 2. **Metaphase:** Chromosomes align at the cell's equator.
 3. **Anaphase:** Sister chromatids separate and move toward opposite poles.
 4. **Telophase:** Chromosomes de-condense, nuclear membranes reappear, and cytokinesis follows.

B. Meiosis:

- A type of reduction division that reduces the chromosome number by half, forming four genetically different haploid cells.
- Occurs in germ cells to produce gametes (sperm and eggs).
- Involves two rounds of division (Meiosis I and II), leading to genetic variation due to homologous chromosome pairing and crossing over.

3. Differences between Mitosis and Meiosis:

Feature	Mitosis	Meiosis
Number of Divisions	One	Two
Number of Daughter Cells	Two	Four
Chromosome Number	Diploid (same as parent)	Haploid (half of parent)
Genetic Variation	No	Yes (due to crossing over)
Occurs in	Somatic cells	Germ cells (for gamete formation)

4. Structure of Chromosome

Chromosomes are thread-like structures composed of DNA and proteins.

Key Components:

- **Chromatin:** DNA wound around histone proteins, forming a complex structure.
- **Chromatid:** Each half of a duplicated chromosome.
- **Centromere:** The region where sister chromatids are attached.
- **Gene:** A specific DNA segment that codes for a protein.
- **DNA Structure:** Double helix consisting of nucleotides (A, T, C, G).

Homologous Chromosomes and Crossing Over:

- Homologous chromosomes are pairs of chromosomes with similar genes.
 - During meiosis, crossing over between homologous chromosomes introduces genetic variation.
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5. Difference between DNA and RNA:

Feature	DNA	RNA
Full Form	Deoxyribonucleic Acid	Ribonucleic Acid
Structure	Double-stranded helix	Single-stranded
Sugar	Deoxyribose	Ribose
Nitrogen Bases	Adenine (A), Thymine (T), Cytosine (C), Guanine (G)	Adenine (A), Uracil (U), Cytosine (C), Guanine (G)
Function	Stores genetic information	Transfers genetic code for protein synthesis
Location	Nucleus (mainly)	Nucleus and cytoplasm
Stability	Stable, long-lasting	Less stable, short-lived

6. Significance:

- **Mitosis:** Essential for growth, repair, and asexual reproduction.
- **Meiosis:** Maintains chromosome number and promotes genetic diversity through crossing over.