

Objective

Study of stages of meiosis using permanent slides.

Theory

What is meiosis?

Meiosis is the process of cell division that occurs in sexually reproducing organisms, resulting in the formation of gametes (sperm and egg cells). It consists of two successive divisions: meiosis I and meiosis II. Each of these divisions involves specific stages.

Meiosis I:

Interphase I is a stage in meiosis, which is the process of cell division that produces haploid cells (gametes) from diploid cells. Interphase I occurs before the start of Meiosis I and includes three subphases: G1 phase, S phase, and G2 phase.

- G1 Phase (Gap 1): This is the first subphase of interphase, where the cell undergoes normal growth and metabolic activities. The cell accumulates the necessary resources and energy for the upcoming cell division.
- S Phase (Synthesis): In this subphase, DNA replication takes place. The cell's DNA is duplicated to ensure that each resulting daughter cell will have a complete set of genetic information.
- G2 Phase (Gap 2): After DNA replication in the S phase, the cell enters the G2 phase. During G2, the cell continues to grow and prepares for the upcoming division. This includes the synthesis of proteins and organelles needed for cell division.

Following interphase, the cell enters Meiosis I, which consists of prophase I, metaphase I, anaphase I, and telophase I. Notably, meiosis results in the production of four non-identical haploid cells, each with half the number of chromosomes as the original diploid cell. This is crucial for sexual reproduction, as it ensures genetic diversity among offspring.

Prophase I:

It is the longest phase of meiosis I.

In this stage, the chromosomes condense and move toward the center of the cell. It consists of five different sub-phases:

Leptotene

Zygotene

Pachytene

Diplotene

Diakinesis

- Leptotene: Chromosomes condense and become visible. Homologous chromosomes start pairing up.
- Zygotene: Homologous chromosomes undergo synapsis (pairing) and form structures called tetrads, which consist of four chromatids.
- Pachytene: Crossing-over occurs, where genetic material is exchanged between homologous chromatids, promoting genetic diversity.
- Diplotene: Chromatids may partially separate, and chiasmata (sites of crossing-over) become visible.
- Diakinesis: Chromosomes complete condensation, and nuclear envelope starts to break down.

Metaphase I:

Homologous chromosome pairs align along the metaphase plate.

Spindle fibers from opposite poles attach to each homologous chromosome.

Anaphase I:

Homologous chromosomes are pulled apart, moving towards opposite poles of the cell.

Sister chromatids remain attached at this stage.

Telophase I:

Chromosomes reach the poles and de-condense.

Nuclear envelopes may form, and the cell undergoes cytokinesis, resulting in two haploid daughter cells.

Cytokinesis I:

Process Initiation: Begins following the completion of Telophase I.

Division of Cytoplasm: The cytoplasm of the parent cell is divided into two, yielding two haploid daughter cells.

Chromosome Number: Each daughter cell contains half of the original chromosome number.

Genetic Diversity: The resulting cells are genetically distinct due to the recombination events during Prophase I and the independent assortment of homologous chromosomes during Metaphase I.

Interkinesis (Interphase II):

A brief interphase between meiosis I and meiosis II.

No DNA replication occurs during this phase.

Meiosis II:

Prophase II:

If nuclear envelopes were formed in Telophase I, they may break down again.

Chromosomes condense, and spindle fibers reappear.

Metaphase II:

Chromosomes align along the metaphase plate in both daughter cells.

Anaphase II:

Sister chromatids are finally separated and pulled towards opposite poles of each cell.

Telophase II:

Chromatids reach the poles and de-condense into chromosomes.

Nuclear envelopes reform around each set of chromosomes.

Cytokinesis occurs, resulting in four haploid daughter cells.

Cytokinesis II:

Process Commencement: Takes place after Telophase II.

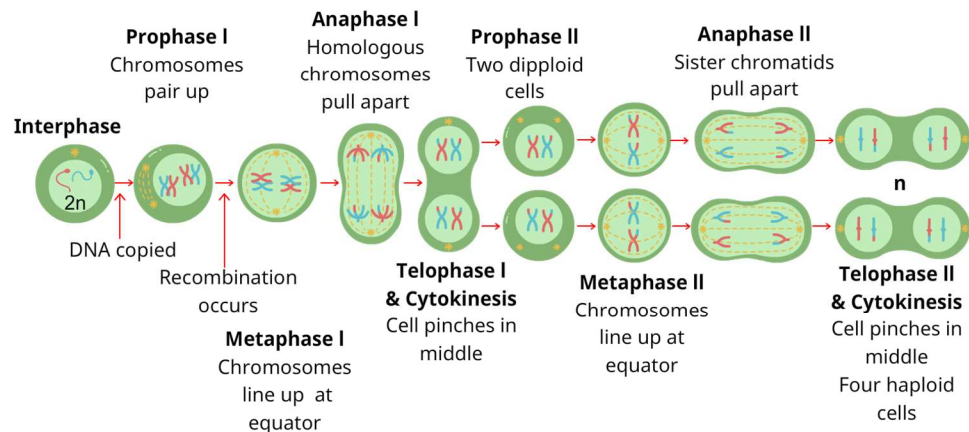
Cytoplasmic Division: The two cells produced during Meiosis I undergo a second round of cytokinesis.

Daughter Cells Formation: Each cell from Meiosis I is further divided, resulting in four haploid daughter cells.

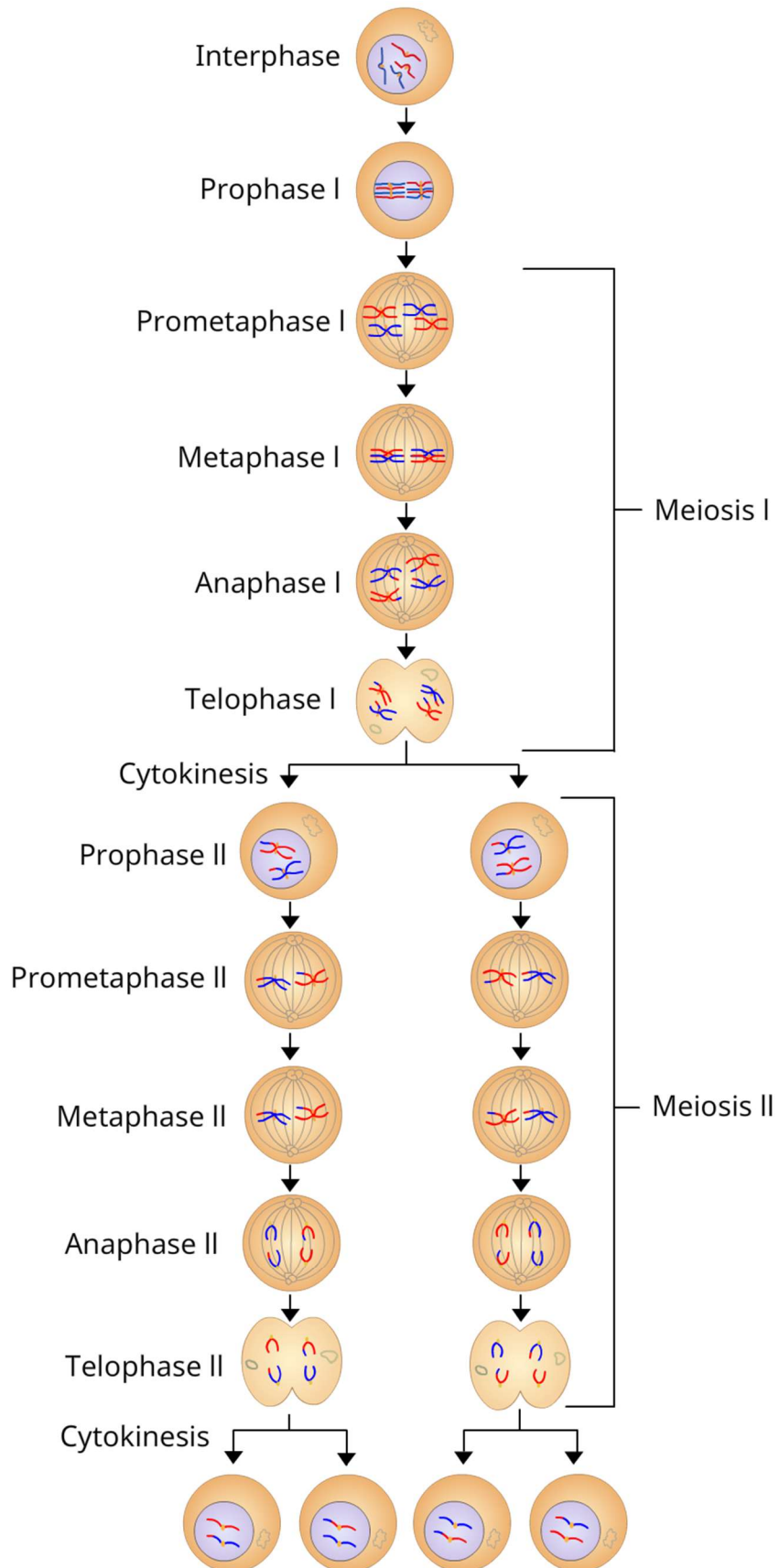
Chromosome Number: The daughter cells maintain their haploid state, containing a single set of chromosomes.

Genetic Variation: The four daughter cells are genetically unique, exhibiting diversity due to the independent assortment of chromatids during Metaphase II.

MEIOSIS



Meiosis forms sperm and egg (sex cells or gametes)



The picture shows the phases of meiosis 1 and meiosis 2 and the formation of four haploid cells from a single diploid cell.

Learning Outcomes

Students can understand,

- The concept of meiosis.
- Different stages of meiosis.
- The theory of crossing over and cell division.