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Paper: III Group – A

Topic: Cell division - Meiosis

Meiosis

- ❖ The term meiosis was coined by **Farmer** and **Moore** in **1905**.
- ❖ The cell which undergoes meiosis is known as **meiocyte**.
- ❖ Meiosis causes reduction in chromosome number, so also known as **reduction division**.

Phases of Meiosis

Two successive nuclear divisions occur, Meiosis I (Reduction) and Meiosis II (Division).

Meiosis produces 4 haploid cells. Mitosis produces 2 diploid cells. The old name for meiosis was reduction/ division.

Meiosis I reduces the ploidy level from $2n$ to n (reduction) while Meiosis II divides the remaining set of chromosomes in a mitosis-like process (division). Most of the differences between the processes occur during Meiosis I.

Prophase I

Prophase I has a unique event - the pairing of homologous chromosomes. Synapsis is the process of linking of the replicated homologous chromosomes.

The resulting chromosome is termed a tetrad, being composed of two chromatids from each chromosome, forming a thick (4-strand) structure. Crossing-over may occur at this point.

During crossing-over chromatids break and may be reattached to a **different** homologous chromosome.

Thus, instead of producing only two types of chromosome four different chromosomes are produced. This doubles the variability of gamete genotypes.

The occurrence of a crossing-over is indicated by a special structure, a chiasma (plural chiasmata) since the recombined inner alleles will align more with others of the same type.

Near the end of Prophase I, the homologous chromosomes begin to separate slightly, although they remain attached at chiasmata.

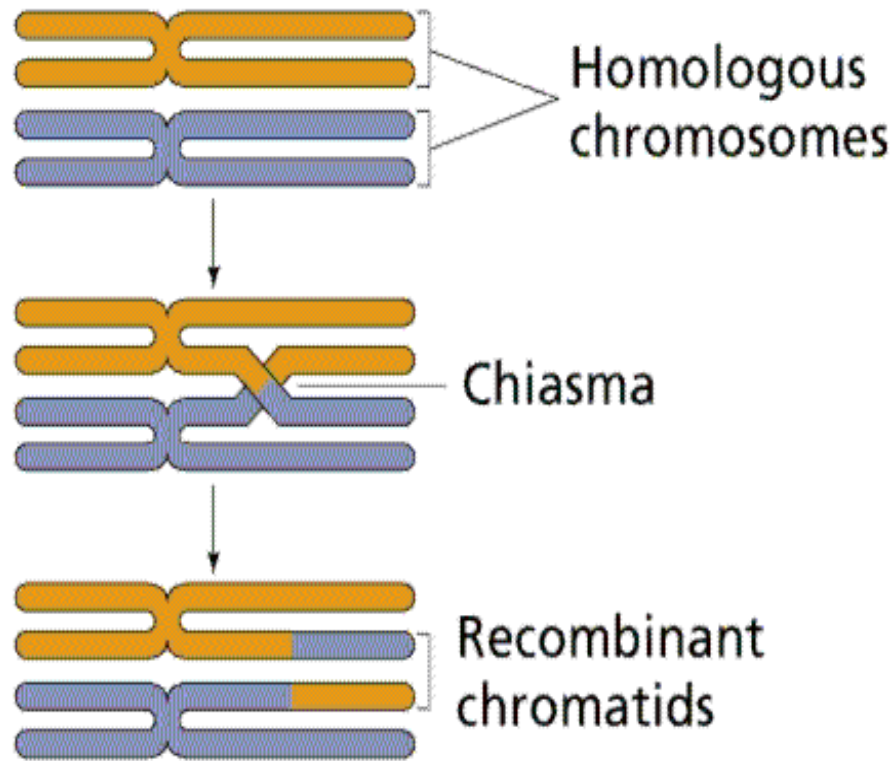


Fig. Crossing-over between homologous chromosomes produces chromosomes with new associations of genes and alleles

Prophase – I

Prophase I (save for synapsis and crossing over) are similar to those in Prophase of mitosis: chromatin condenses into chromosomes, the nucleolus dissolves, nuclear membrane is disassembled, and the spindle apparatus forms.

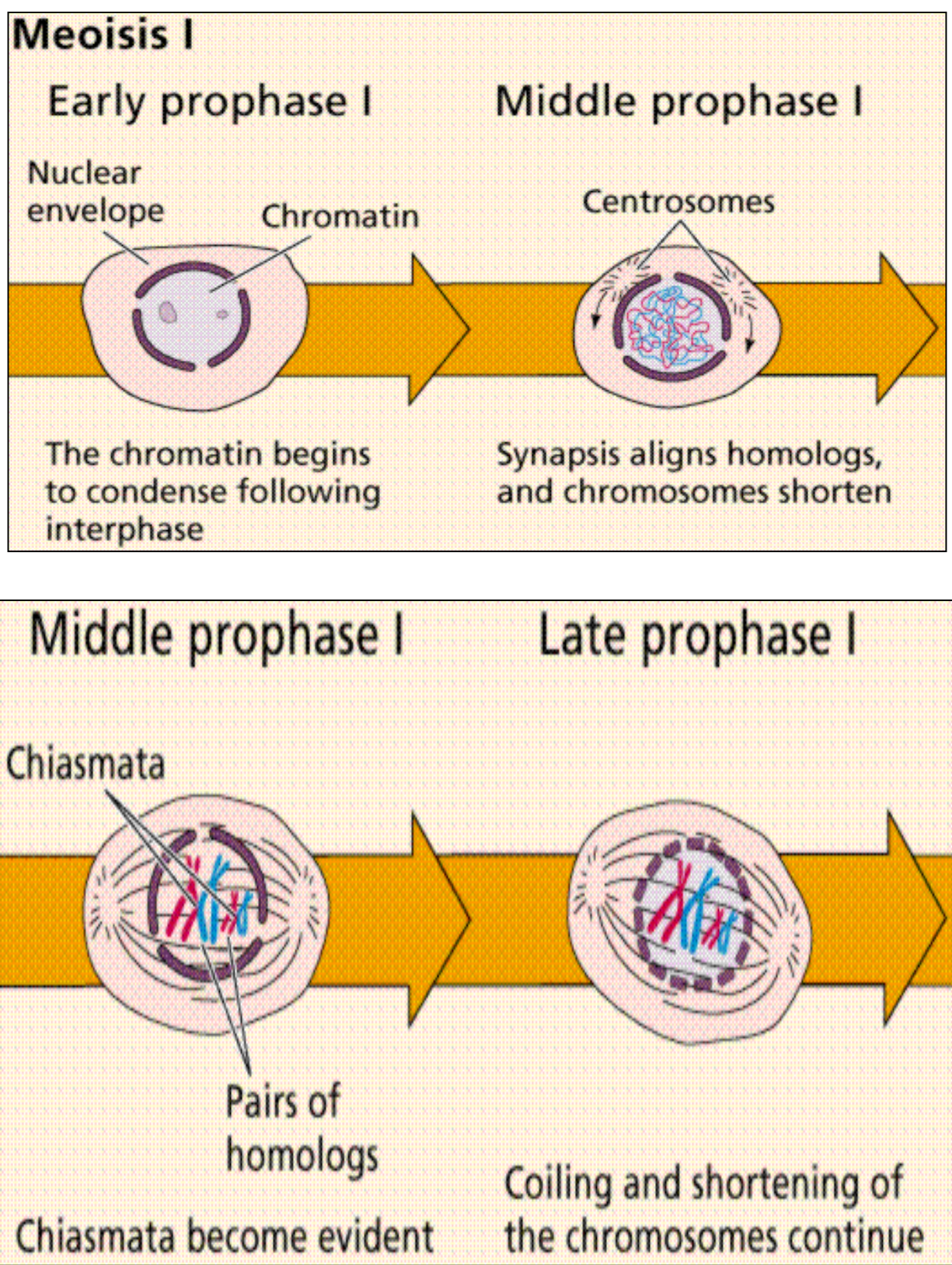


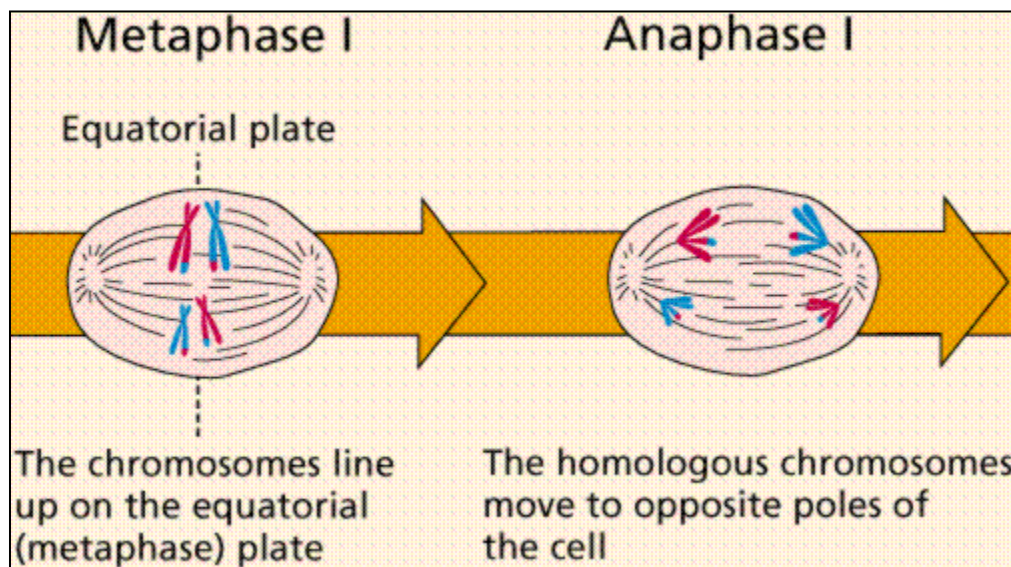
Fig. Prophase I.

Metaphase I

Metaphase I is when tetrads line-up along the equator of the spindle. Spindle fibers attach to the centromere region of each homologous chromosome pair.

Anaphase I

Anaphase I is when the tetrads separate, and are drawn to opposite poles by the spindle fibers. The centromeres in Anaphase I remain intact.



Fig; Prophase and Metaphse I

Telophase I

Telophase I is similar to Telophase of mitosis, except that only one set of (replicated) chromosomes is in each "cell". Depending on species, new nuclear envelopes may or may not form. Some animal cells may have division of the centrioles during this phase.

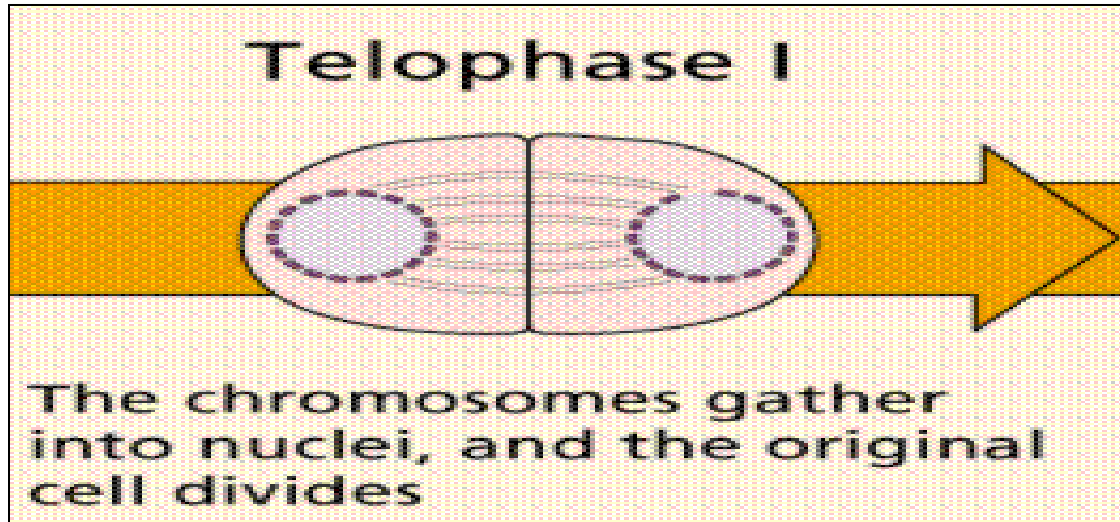


Fig. Telophase I

Prophase II

During Prophase II, nuclear envelopes (they formed during Telophase I) dissolve, and spindle fibers reform. All else is as in Prophase of mitosis. Indeed Meiosis II is very similar to mitosis.

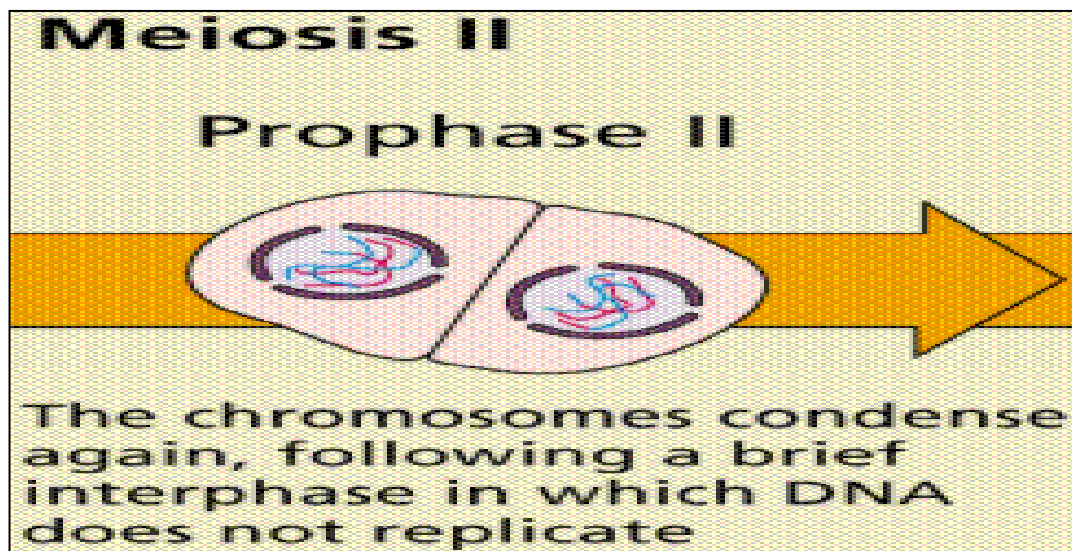


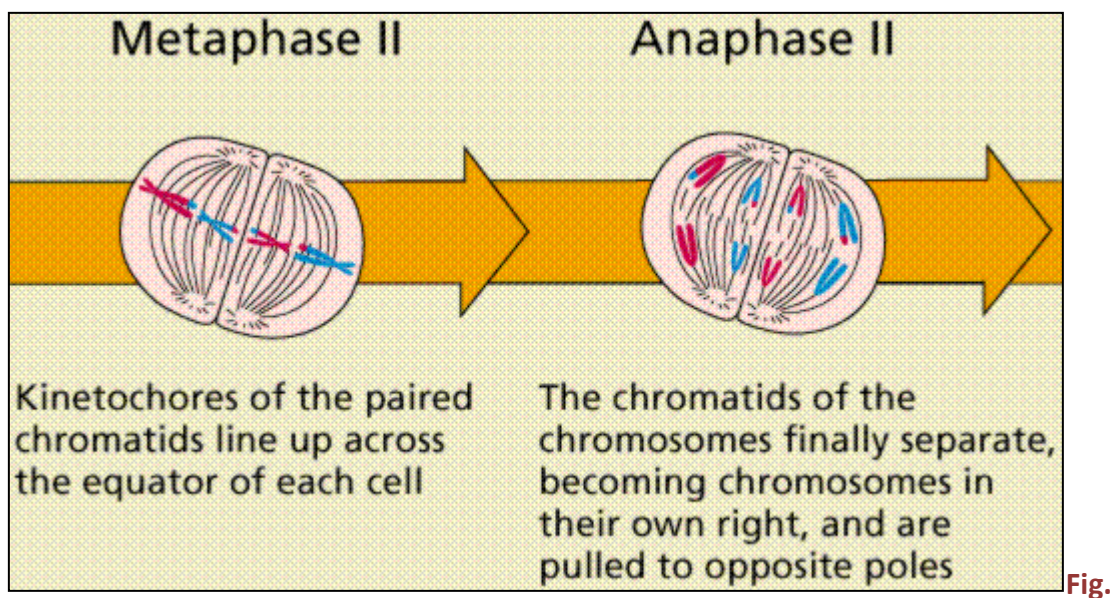
Fig. Prophase II.

Metaphase II

Metaphase II is similar to mitosis, with spindles moving chromosomes into equatorial area and attaching to the opposite sides of the centromeres in the kinetochore region.

Anaphase II

During Anaphase II, the centromeres split and the former chromatids (now chromosomes) are segregated into opposite sides of the cell.



Metaphase II and Anaphase II.

Telophase II

Telophase II is identical to telophase of mitosis. Cytokinesis separates the cells.

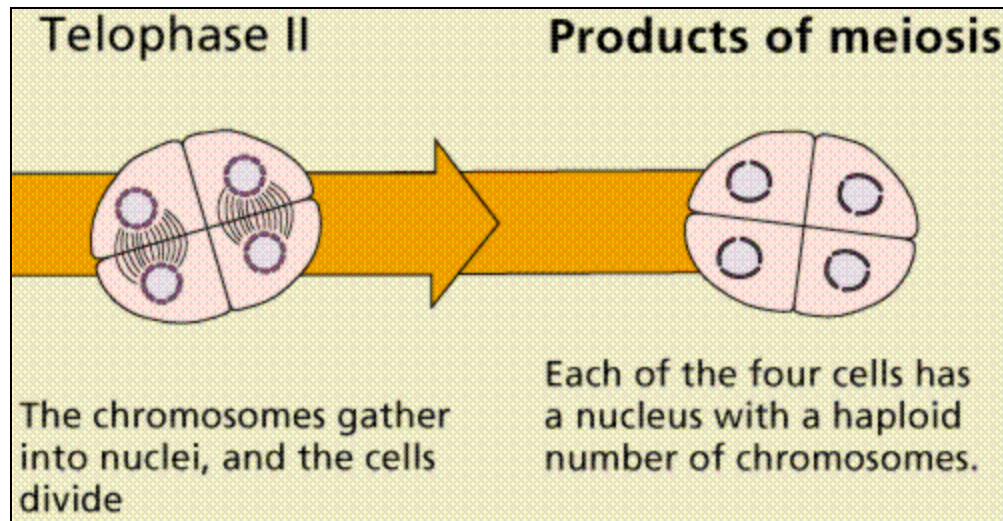


Fig. Telophase II

Significance of meiosis

- ❖ Meiosis is the process that ensures the maintenance of constant number of chromosomes from generation to generation in a species.
- ❖ Meiosis is significant because it restores original number of chromosomes.
- ❖ The crossing over and the interchange of segments enables the exchange and recombination of parental characteristics in the offspring and there is a possibility of hereditary variation.
- ❖ Daughter cells formed as a result of meiosis are not similar to that of parent cell because crossing over takes place and number of chromosomes becomes half.