

Crossing Over

- Definition
- Types of crossing over
- Kinds of crossing over

Definition

- **Crossing over refers to the interchange of parts between non-sister chromatids of homologous chromosomes during meiotic prophase (pachytene).**
- **In other words, crossing over results from exchange of genetic material between non-sister chromatids involving breakage and reunion at precise point**

SOMATIC CROSSING OVER:

- “When the process of crossing over occur in the chromosomes of the body or somatic cells of an organism during the mitotic cell division is called somatic crossing over”.



Somatic or Mitotic Crossing Over

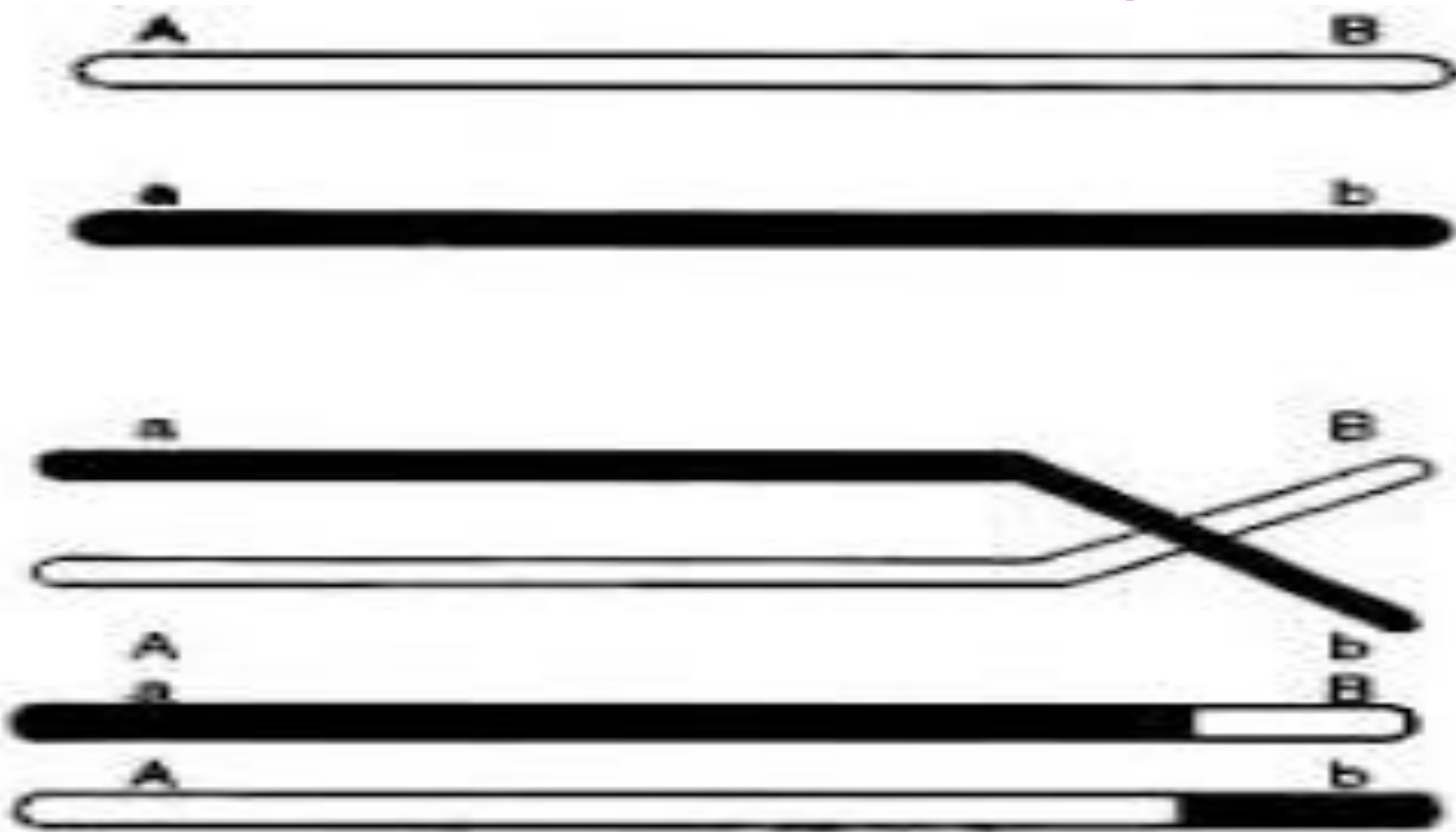


Fig. 59. Diagrammatic interpretation of crossing over between the two non-sister chromatids. Note how the alleles are interchanged between them.

Germinal & Meiotic Crossing Over

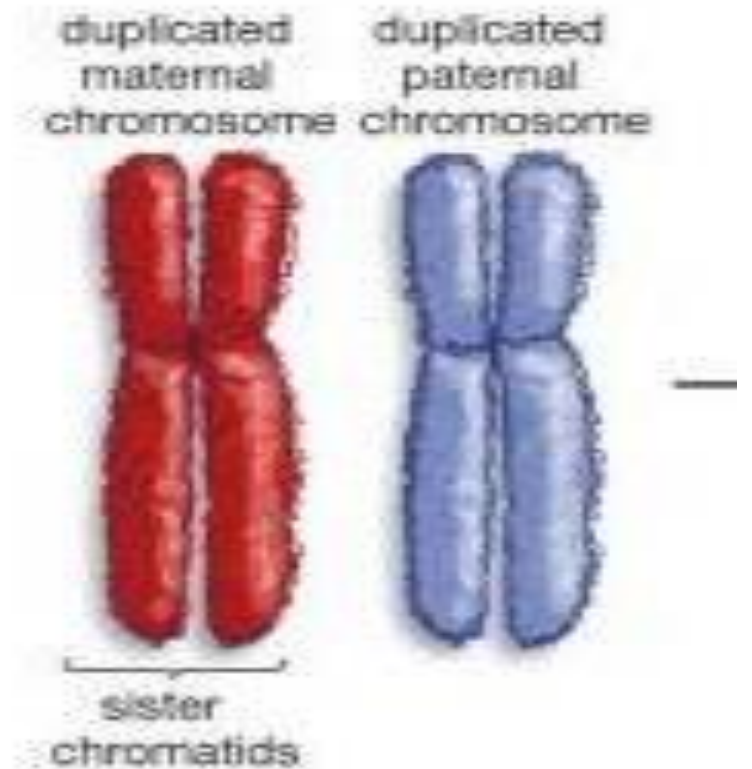
- **Mechanism of Meiotic Crossing over:**

Process of crossing over includes following steps:

- 1) Synapsis
- 2) Chromosome duplication
- 3) Crossing over by breakage and union
- 4) Terminalisation

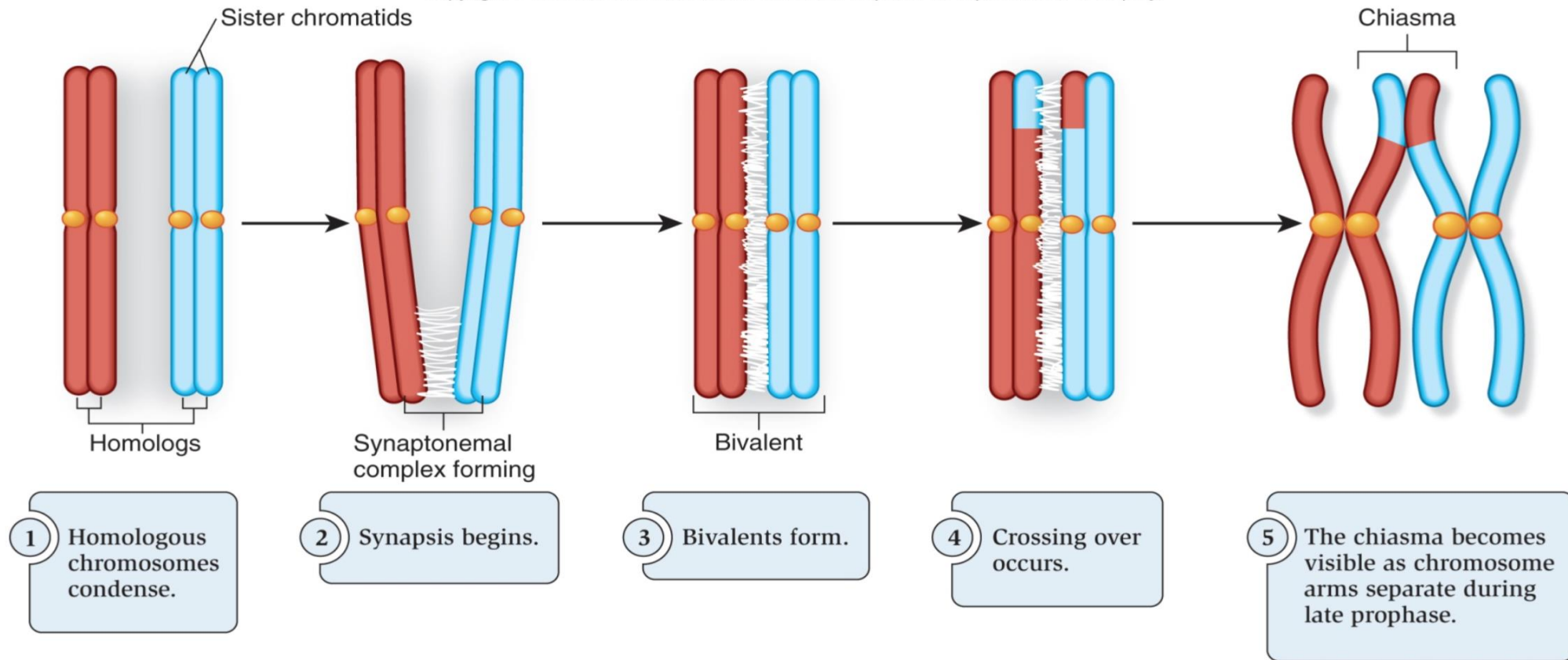
Synapsis

- Meiosis starts with one cell that contains a set of 23 chromosomes, giving a total of 46 chromosomes.
- Just before the start of meiosis, the chromosomes duplicated, so there are two copies of the mom's chromosomes and two copies of the dad's chromosomes.
- The two copies of each chromosome are referred to as **homologous chromosomes**.



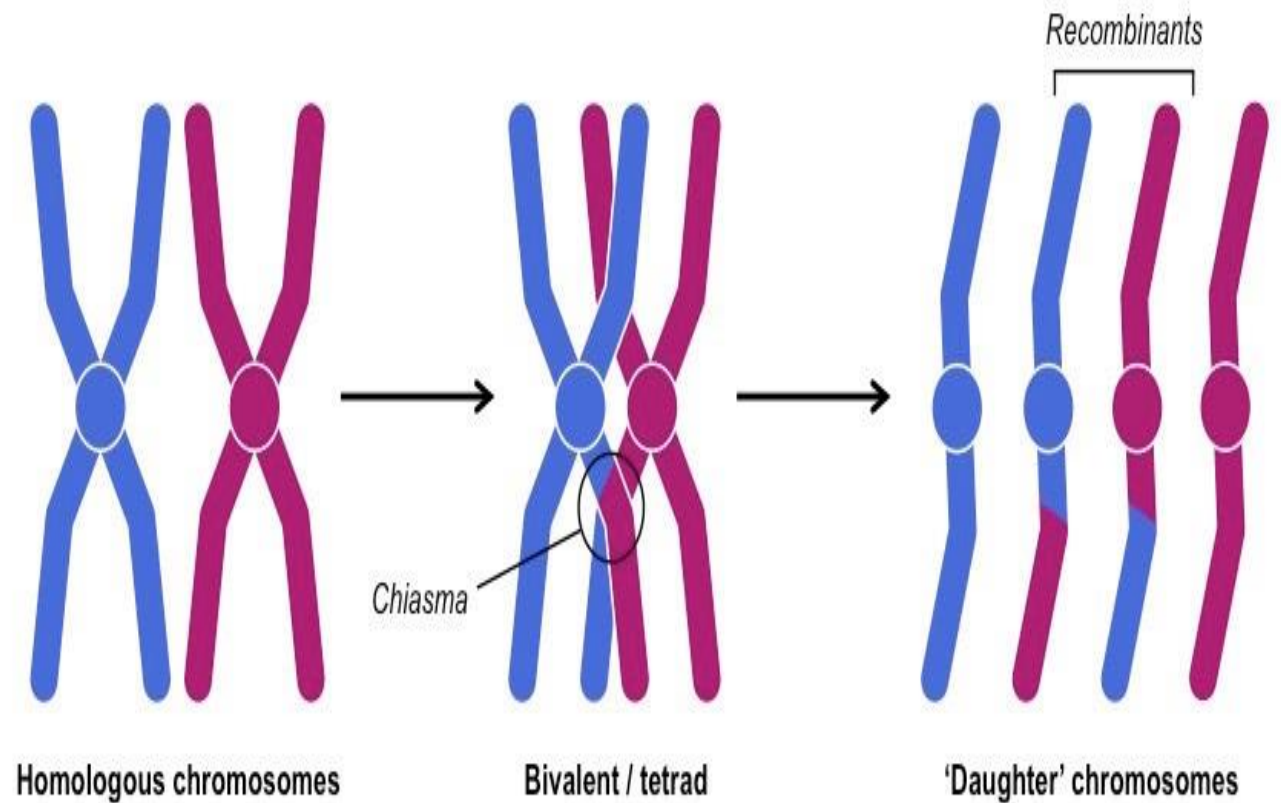
Synapsis

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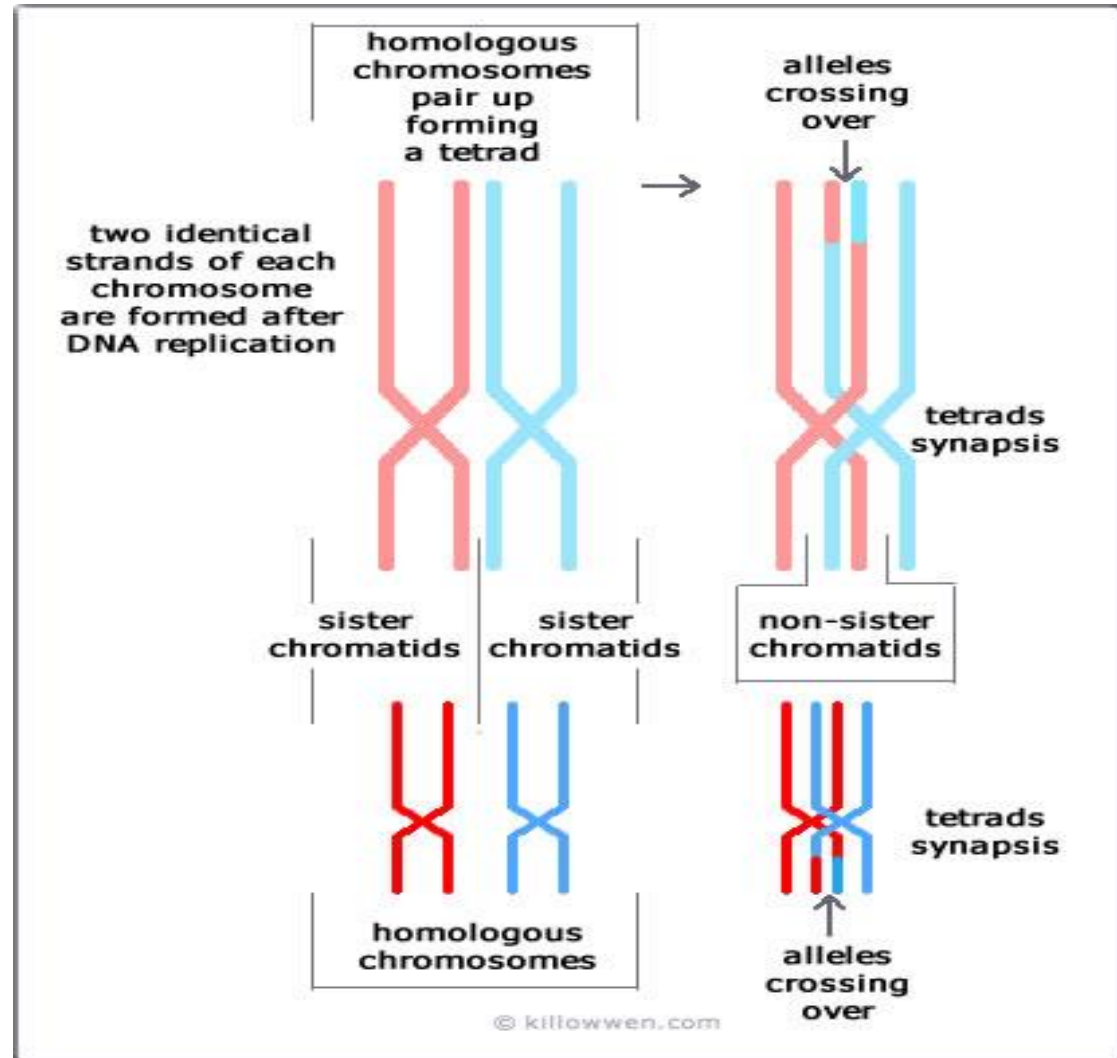
Chromosomal Duplication

A bivalent is one pair of **chromosomes** (sister chromatids) in a **tetrad**. A **tetrad** is the association of two pairs of homologous **chromosomes** (4 sister chromatids) physically held together by at least one DNA crossover.



Crossing over by Breakage and Union

- Crossing over of chromatid pair occurs in **PROPHASE-I**, it is the first phase of meiosis-1.
- In prophase-1, 3rd phase is of **PACHYTENE** in which crossing over takes place due to formation of recombinant nodules



Terminalization

- After the exchange of segments, the two chromosomes start moving away from each other as the synaptic force lapses.
- The separation begins from the centromere and moves towards the ends of the chromosomes.
- It is this uncoupling of chiasma that is called terminalization. During diakinesis the homologous chromosomes get separated except at their ends.

Diakinesis: "moving through"

- Is the last stage of prophase I.
- **Synaptonemal complex completely disappears**
- The chiasmata proceed to the end of the chromatids, then separate (**terminalization**). This leaves chromatids that engaged in crossing over with exchanged genetic material
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- The nucleolus and nuclear envelope break down.
- The centromeres of the chromosomes become attached to spindle fibers.

