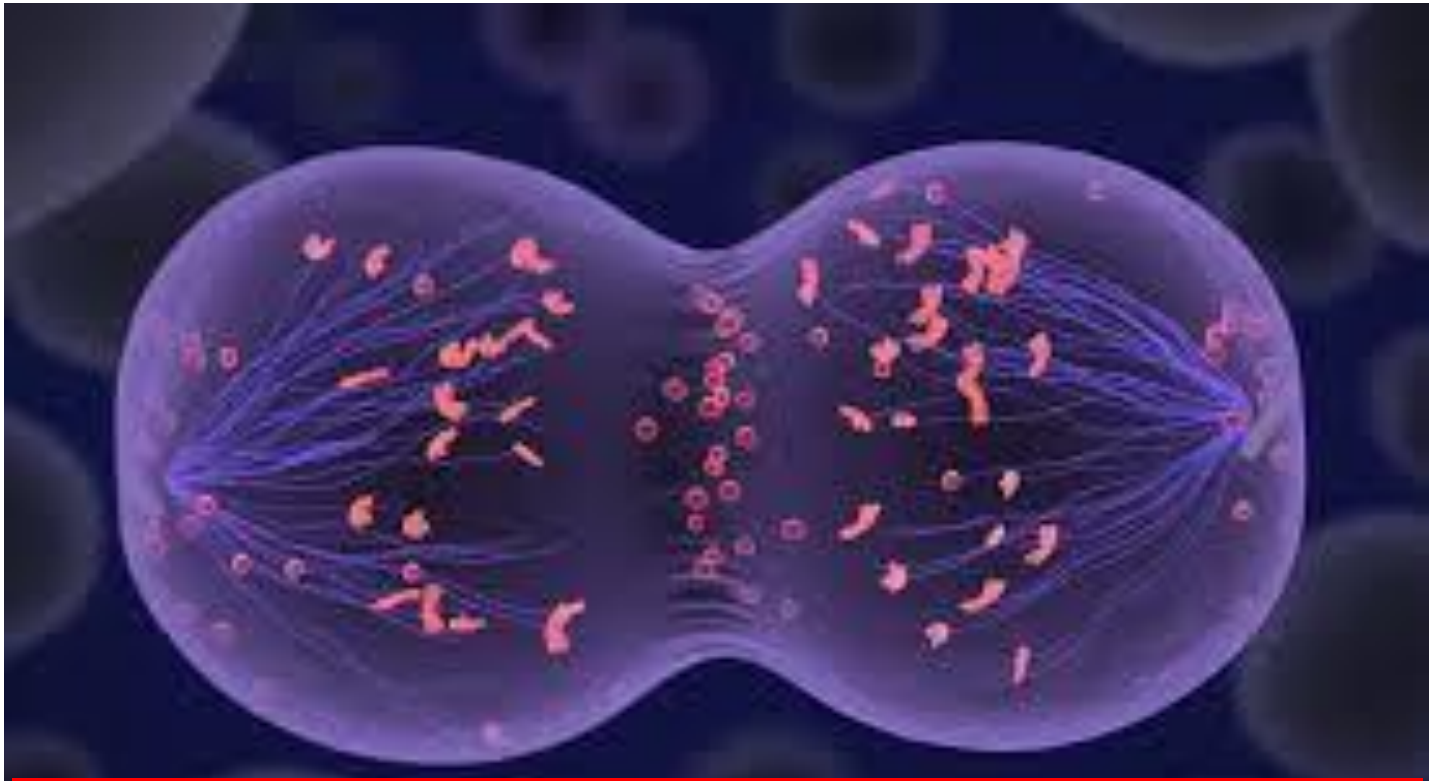
For B.Sc. Part I Students



CELL DIVISION: MEIOSIS

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Meiosis or Meiotic cell division or Reduction cell division

- Type of cell division in which a parent cell gives rise to **four daughter cells**, which are having half the chromosome number as compared to parent cell
- Meiosis occurs in germinal or reproductive cell
- In organisms having sexual reproduction a difficult situation may be created if the fusing gametes have same number of chromosome as somatic cells, because zygote resulting from such fusion will having the double the chromosome number. The cycle will be repeated from generation to generation and there will be doubling of chromosome again and again . To avoid this type of situation nature has provided a type of cell division by which chromosome number is reduced to half in sex cells are gametes.

Diploid (2n) → Haploid (n)

- In meiotic cell cycle Interphase is just like mitosis interphase but here G -2 phase is very short or absent.

Stages of Meiosis

Meiosis consist of two successive divisions as:

1. **First meiotic division or meiosis I:** It leads to chromosome number reduction without any division of chromosome

Plant cell (2n) —Meiosis- I→ Two cell (n)

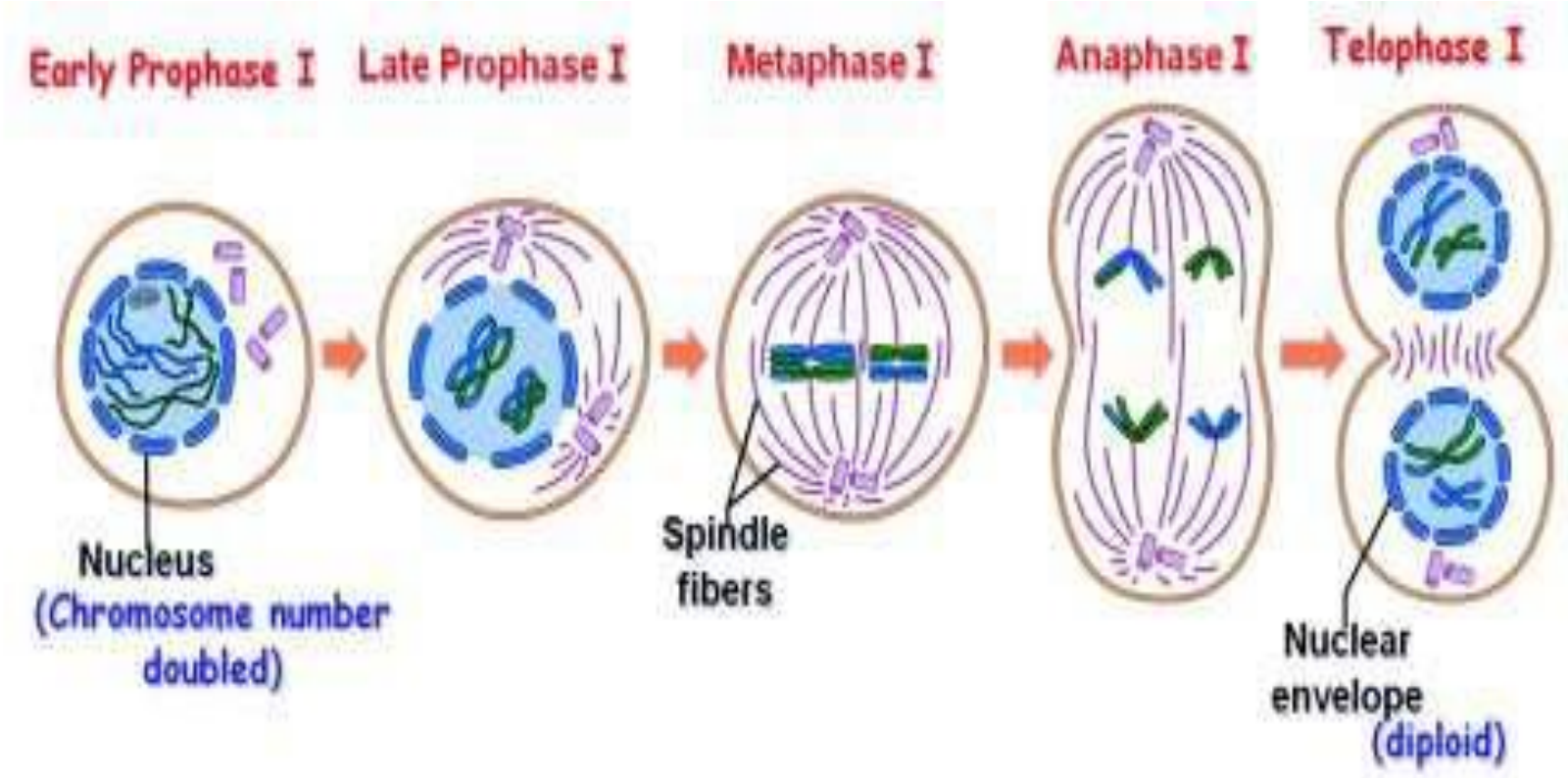
2. **Second meiotic division or meiosis II:** It involves the separation of chromatids of chromosome. Here four cells are produced from two cells and chromosome number remain constant

Two cells (n) —Meiosis -II→ Four cells (n)

First meiotic division or meiosis I

Meiosis I is actual reductional division and completed in four phases

1. Prophase I
2. Metaphase I
3. Anaphase I
4. Telophase I



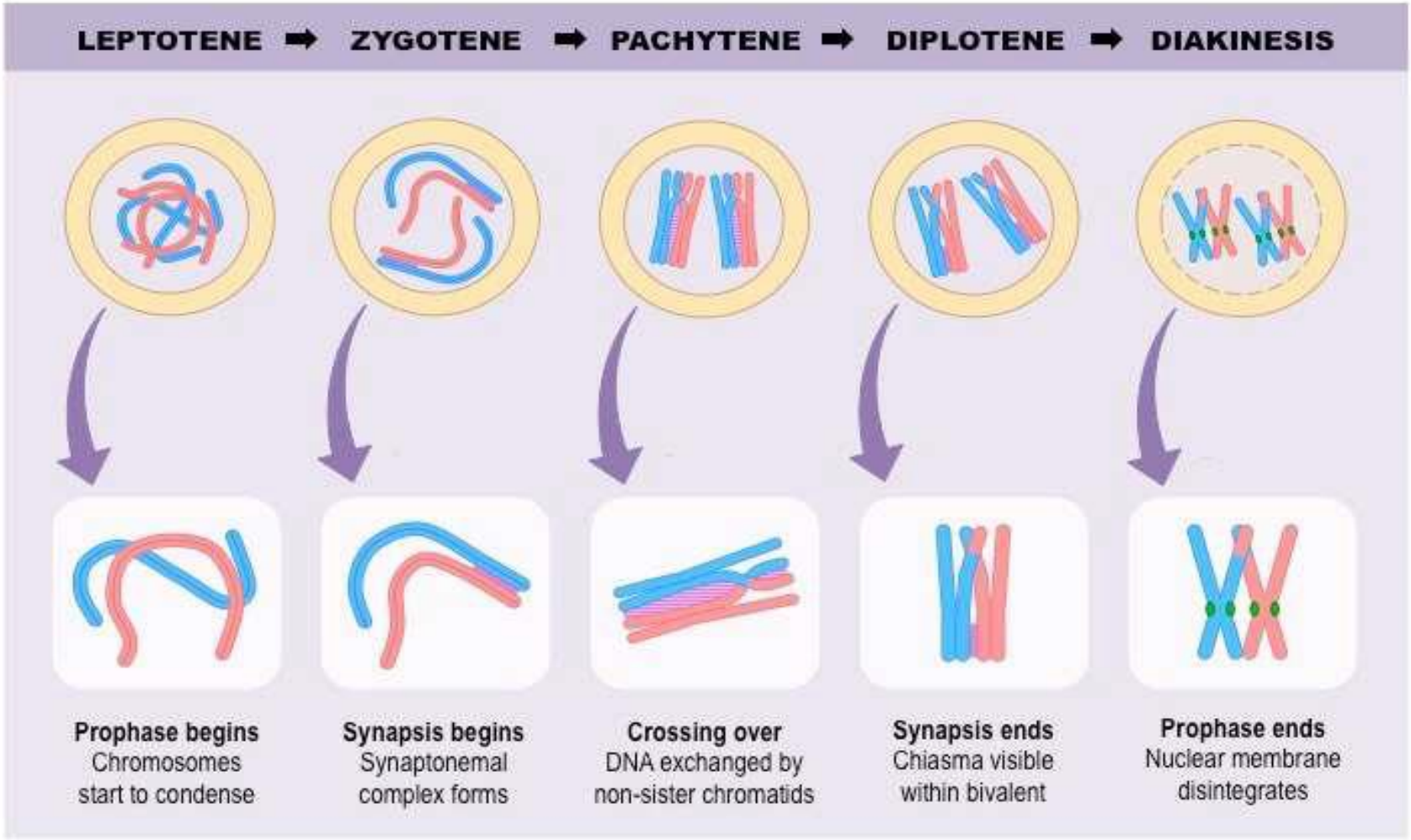
Prophase I

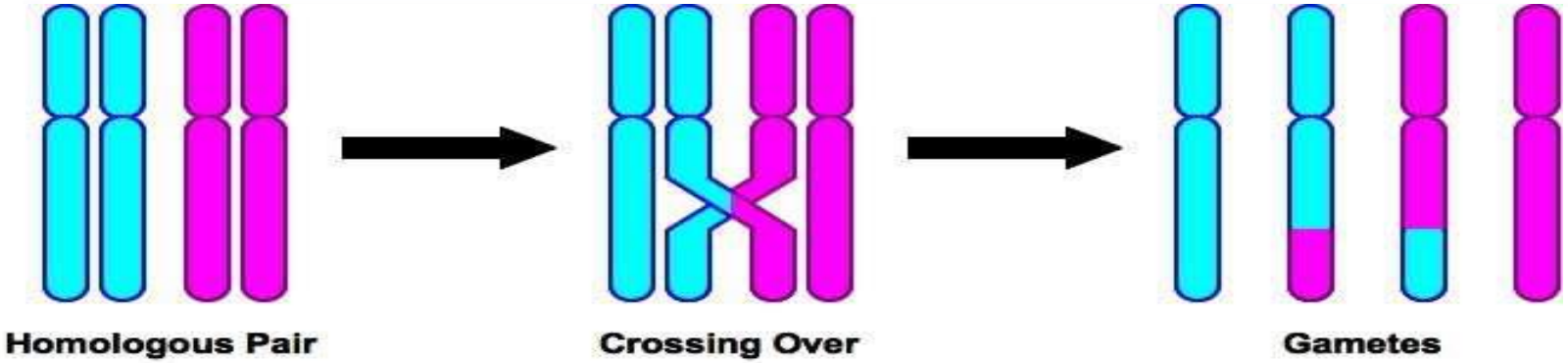
It is longest and most complex phase of meiosis I. It is furthure divided into 5 sub-stages

i- Leptotene ii- Zygotene

iii- Pachytene iv –Diplotene

v- Diakinesis


LEPTOTENE
ZYGOTENE
PACHYTENE
DIPLOTENE
DIAKINESIS
Prophase begins
Chromosomes start to condense
Synapsis begins
Synaptonemal complex forms
Crossing over
DNA exchanged by non-sister chromatids
Synapsis ends
Chiasma visible within bivalent
Prophase ends
Nuclear membrane disintegrates


Homologous Pair
Crossing Over
Gametes

Synaptonemal complex: It is the feature of meiotic prophase I

➢It is the tripartite(three layered) protein framework (made up of two lateral element and one central element) found between two layered homologous chromosomes

➢Ubiquitin is the characteristics protein forming synaptonemal complex (SC)

➢Synaptonemal complex appears in Zygotene persist in pachytene and disappears during diplotene.

➢Synaptonemal complex helps in proper pairing of homologous chromosomes and also in producing recombination.

Metaphase I

➢ The chromosome become more condensed and distinct

➢Spindle apparatus appears, the spindle fibers get attached to centromere of bivalents and are arranged on equator due to congression movements

➢The arrangement of chromosome on equatorial plate is such that centromeres are twoards pole and chromosome ends twoards equator

➢Independent assortment occurs

➢ Orientation of homologous pair to poles is random

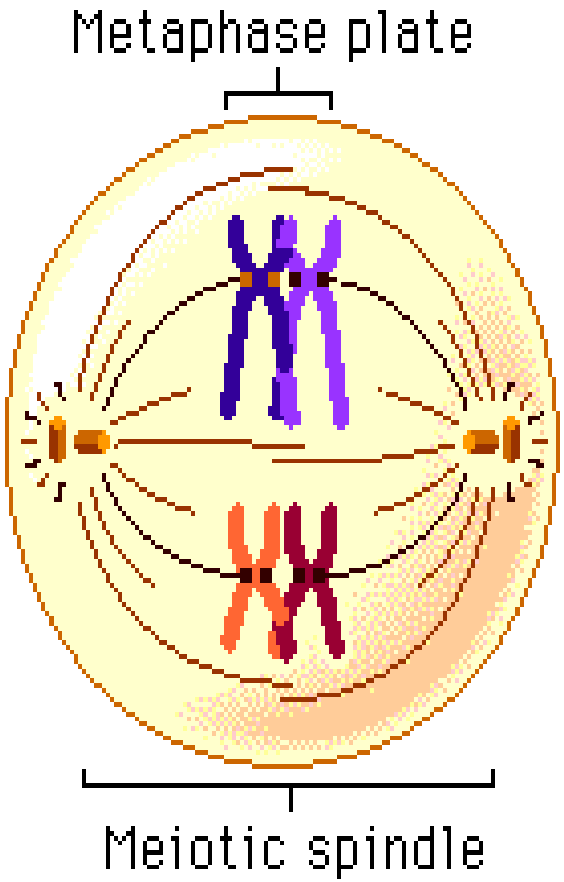
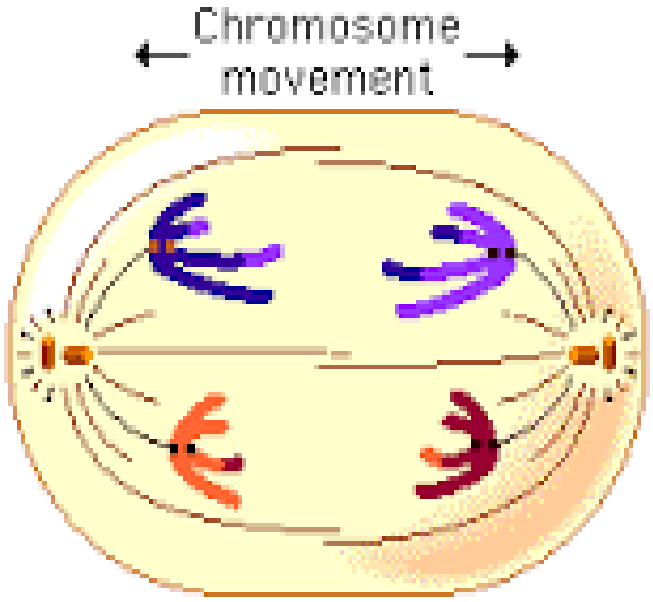


Fig: Metaphase I of Meiosis

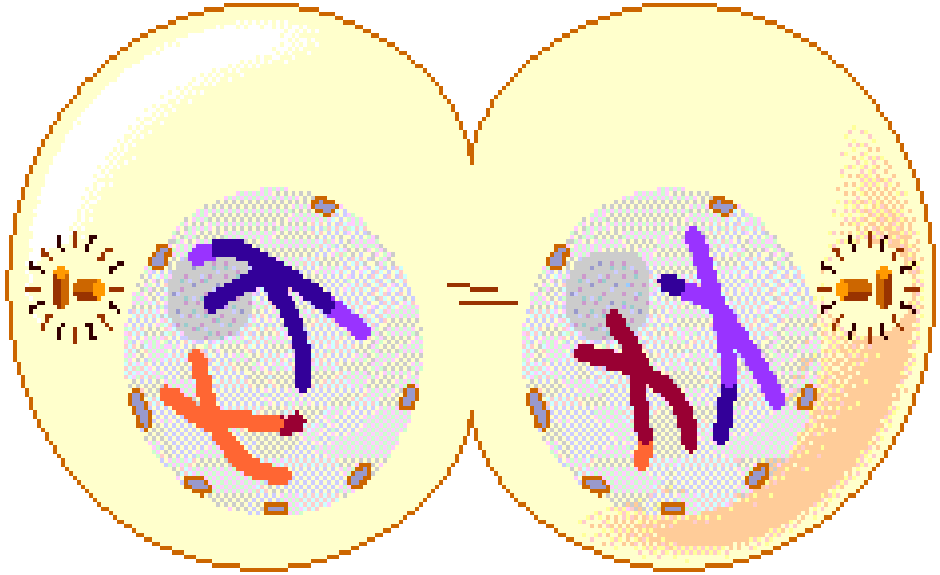
Anaphase - I

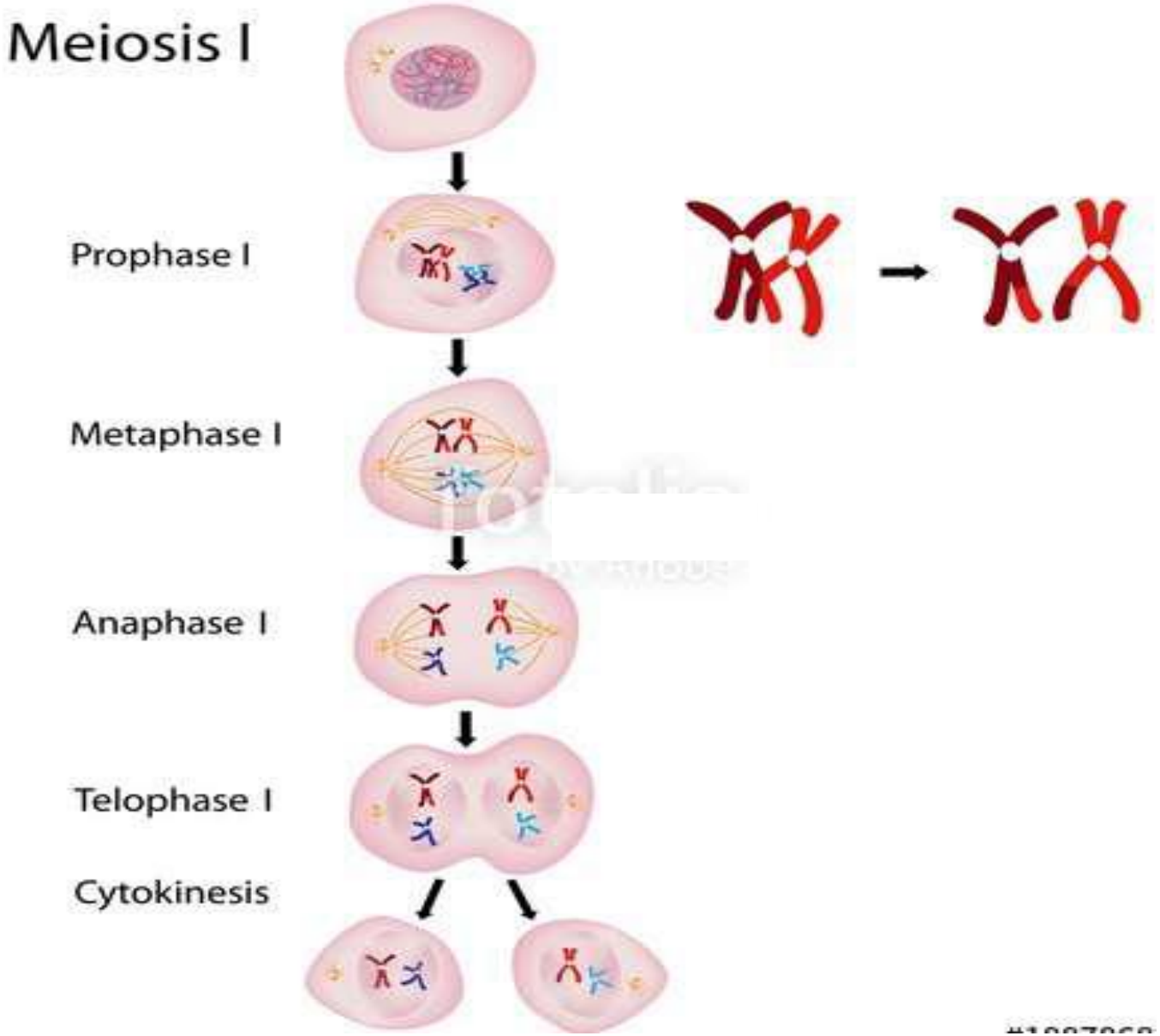
- Homologous chromosomes separate and move towards the poles.
- Sister chromatids remain attached at their centromeres.
- Half chromosomes move at one pole and half at another pole.



Telophase -I

➢ The homologous chromosome pairs reach the poles of the cell, nuclear envelopes form around them, and cytokinesis follows to produce two cells.



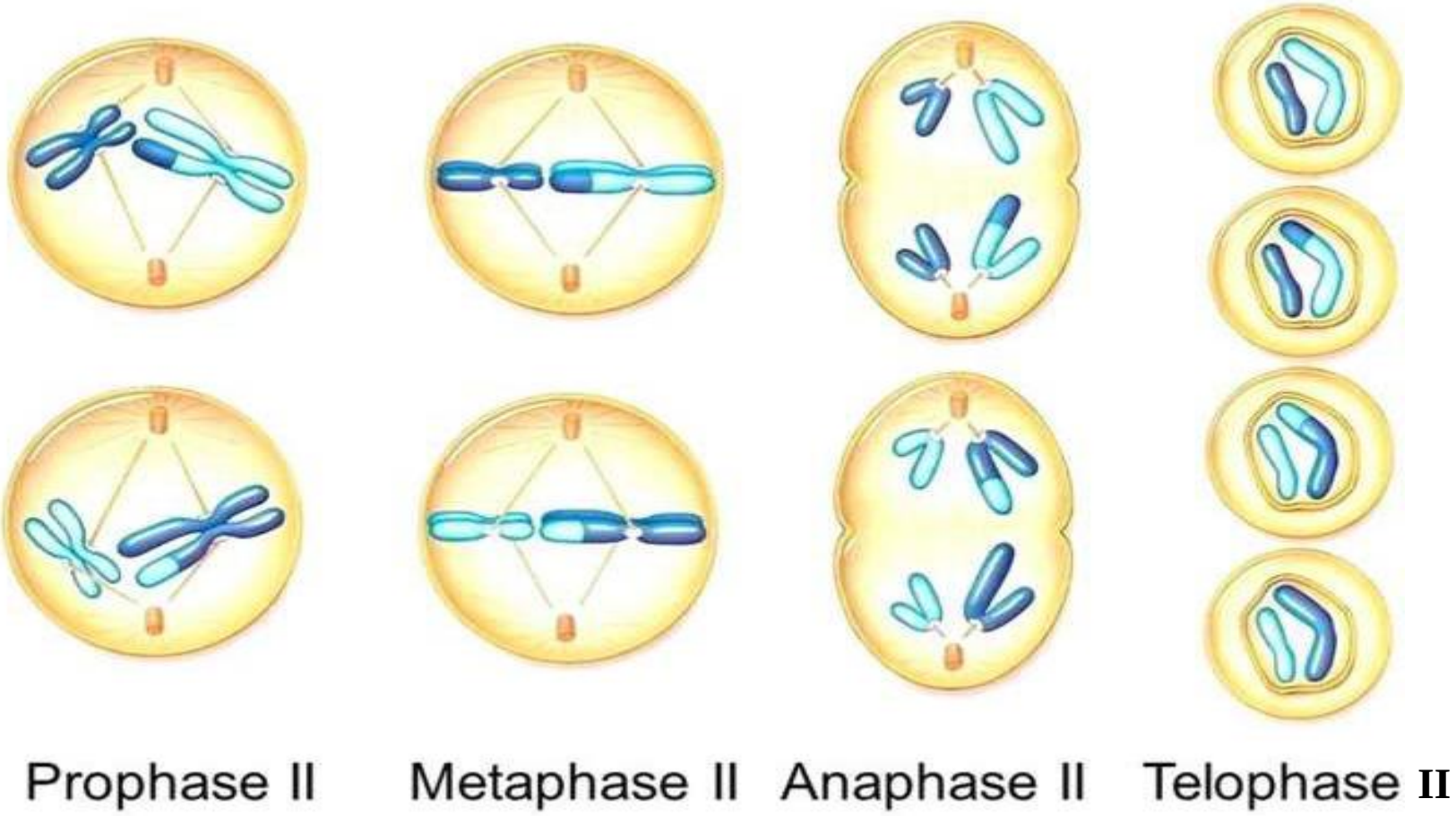


Overview of Mieosis -I

Meiosis II:

Meiosis is similar to mitosis. It consist of following phases

1. Prophase II
2. Metaphase II
3. Anaphase II
4. Telophase II



Prophase II

- Chromosomes coil and become compact(if uncoiled after telophase 1)
- Nuclear envelope and nucleolus, if reformed, disappears again.
- Centriole move to opposite poles, forming spindle fibers between them

Metaphase II

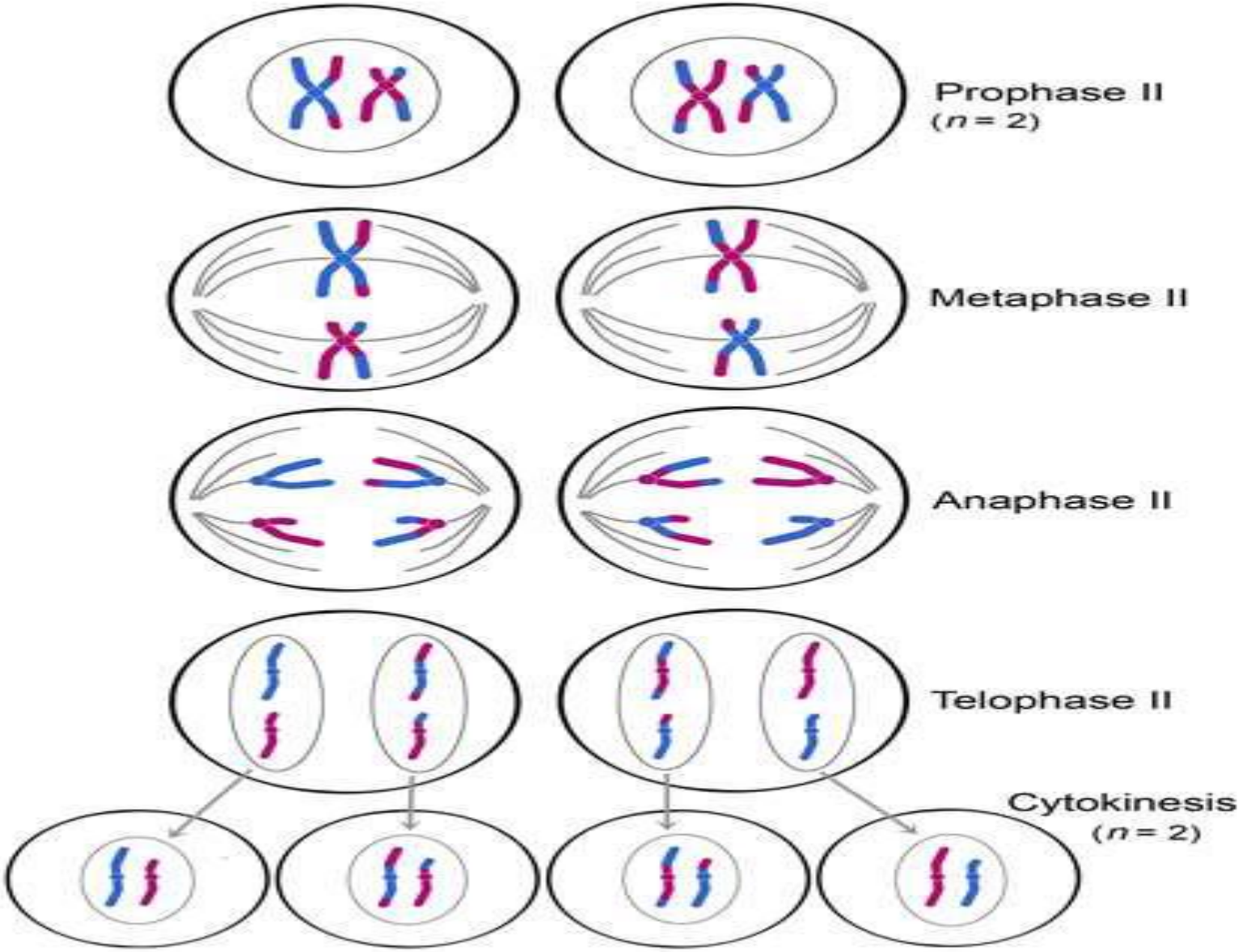
- Individual duplicated chromosomes align on the equator.
- One chromosome per spindle fiber attached by means of kinetochore of centromere.
- Centriole has reached the poles.

Anaphase II

- Spindle fibers contract.
- Duplicated chromosomes split in half (centromere dividing in two).
- Sister chromatids separate and move to opposite poles

Telophase II

- Daughter chromosomes has reached the poles.
- Two cells invaginate and form 4 daughter haploid cells
- They uncoil and form chromatin.
- Nuclear envelope and nucleolus form around chromatin again.



Overview of Meiosis II

Significance of Meiosis

- It maintains the chromosome number constant from genration to genration
- Meiosis leads to recombination's or new combinations of genes as a result of crossing over.
- Due to recombination's , variations are created which play key role in process of evolution.

Thank You !!