The Cell Cycle Lecture-3

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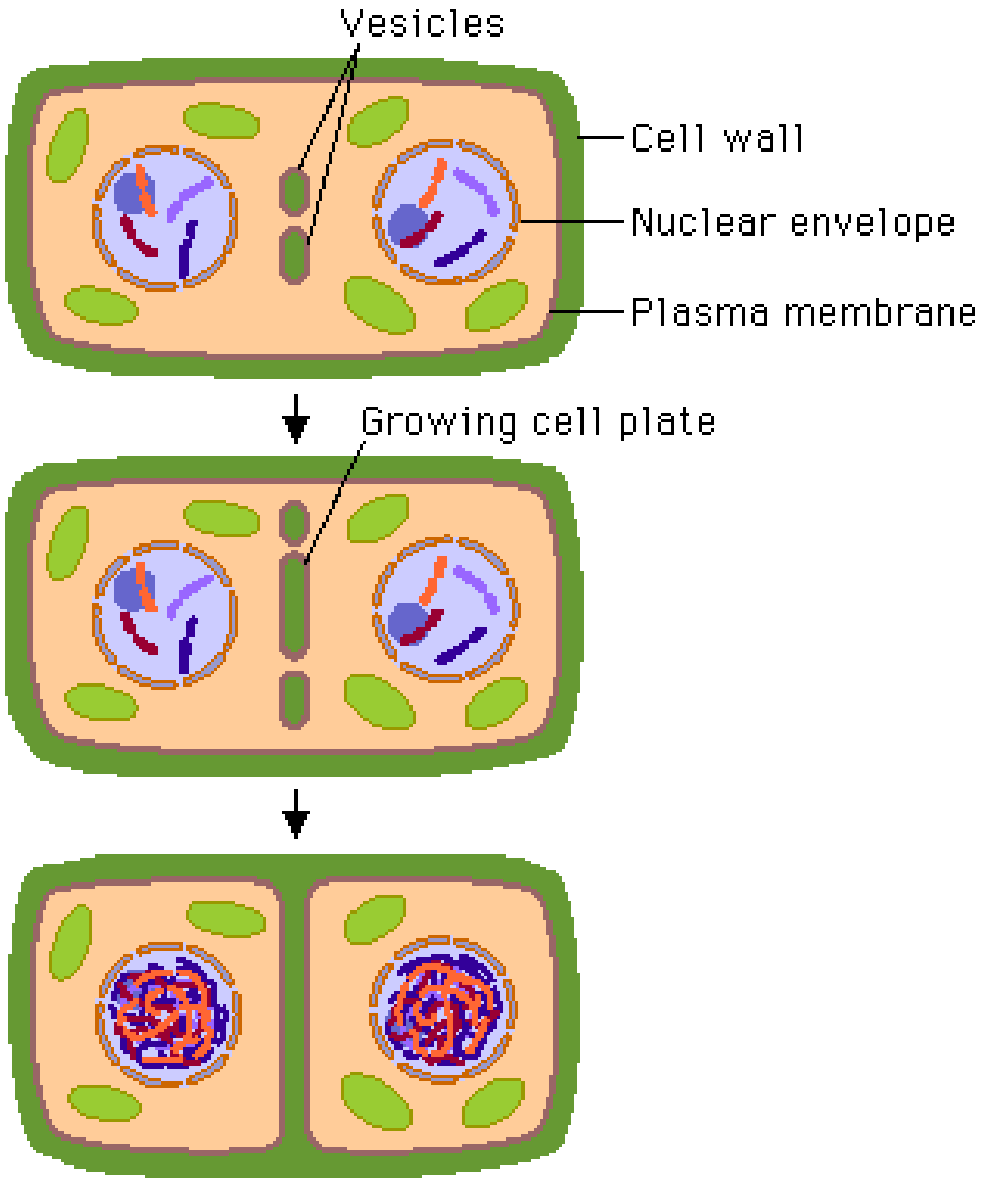
<u>In case of plant cells</u>, cytokinesis takes place by the process of cell plate formation.



- **Mitotic index:**
- The mitotic index is a measure of cell proliferation and can be used to measure the approximate length of cell cycle.
- It is defined as the percentage of cells undergoing mitosis in a given population of cells.
- It is calculated as given below:

- Mitotic index = (Number of cells undergoing mitosis/Total number of cell in the population) * 100.

$$\text{Mitotic I} = \frac{(\text{P}+\text{M}+\text{A}+\text{T})}{\text{N}} \cdot 100\%$$

P= number of cells in prophase.
M= number of cells in metaphase.
A= number of cells in anaphase.
T= number of cells in telophase

- Q. The frequency of cells in a population that are undergoing mitosis (the mitotic index) is a convenient way to estimate the length of the cell cycle. In order to measure the cell cycle in the liver of the adult mouse by measuring the mitotic index, liver slices are prepared and stained to easily identify cells undergoing mitosis. It was observed that only 3 out of 25000 cells are found to be undergoing mitosis. Assuming that M phase lasts 30 minutes, calculate the approximate length of the cell cycle in the liver of an adult mouse?

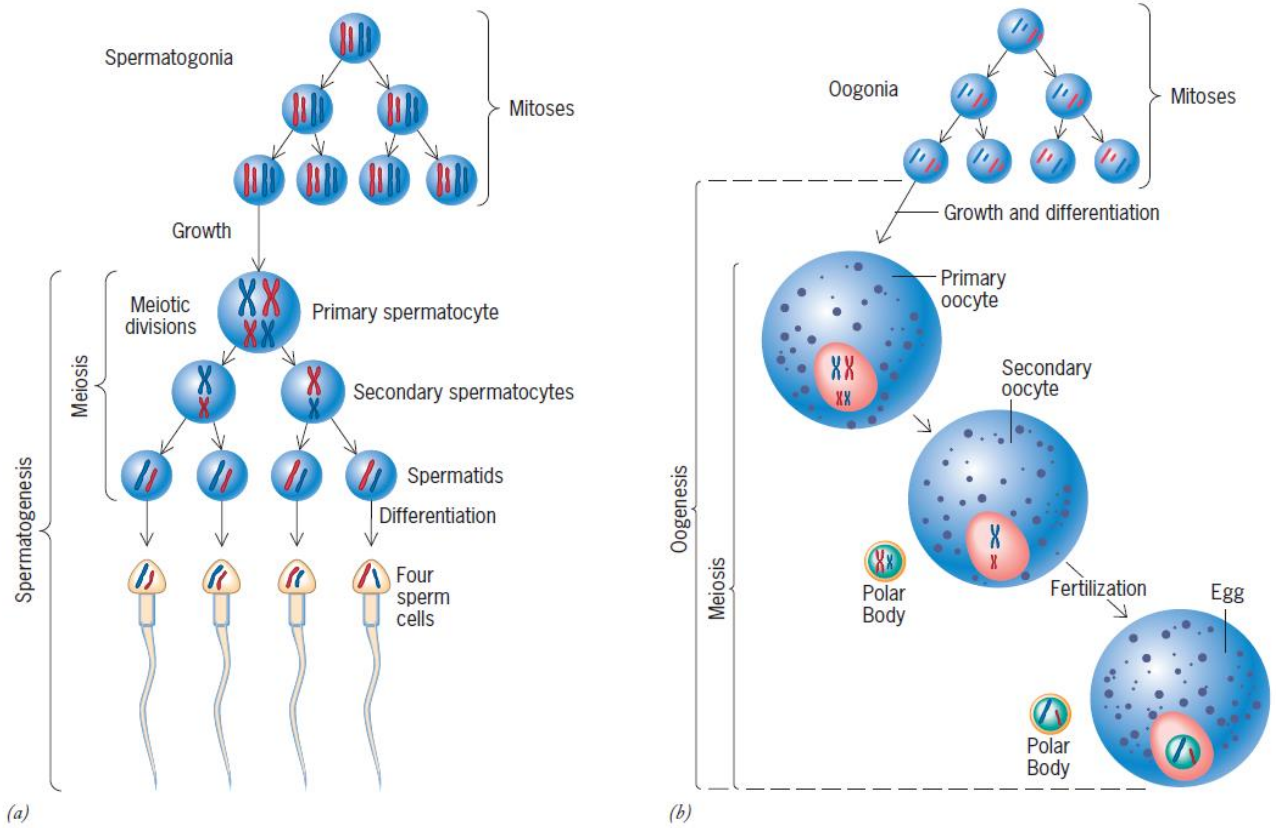
  (a) 76 hours

  (b) 50 hours

  (c) 42 hours

  (d) 21 hours

- **Meiosis:** It is a specialised type of cell division and is found to occur exclusively in the diploid cells. It has following types:
- ***Gametic or terminal meiosis.*** It is the most common type of meiosis.
- It is seen in all multicellular animals the meiotic divisions are closely linked to the formation of the gametes.
- Gametes are haploid cells that are derived from diploid cells.

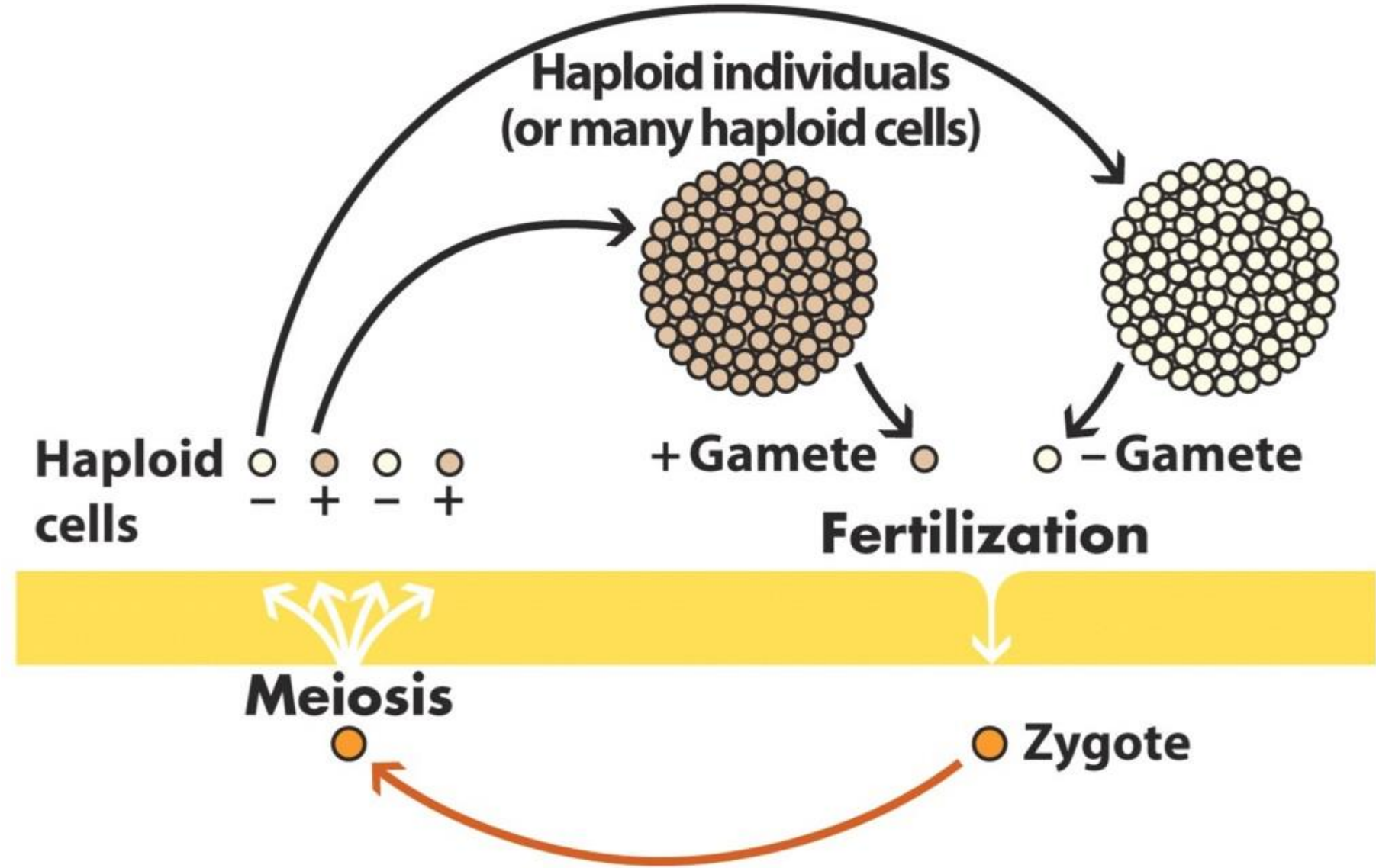


- ***Zygotic or initial meiosis.***

- It occurs only in protists and fungi, the meiotic divisions occur just after fertilization to produce haploid spores.

- The spores divide by mitosis to produce a haploid adult generation.

- Consequently, the diploid stage of the life cycle is restricted to a brief period after fertilization when the individual is still a zygote.

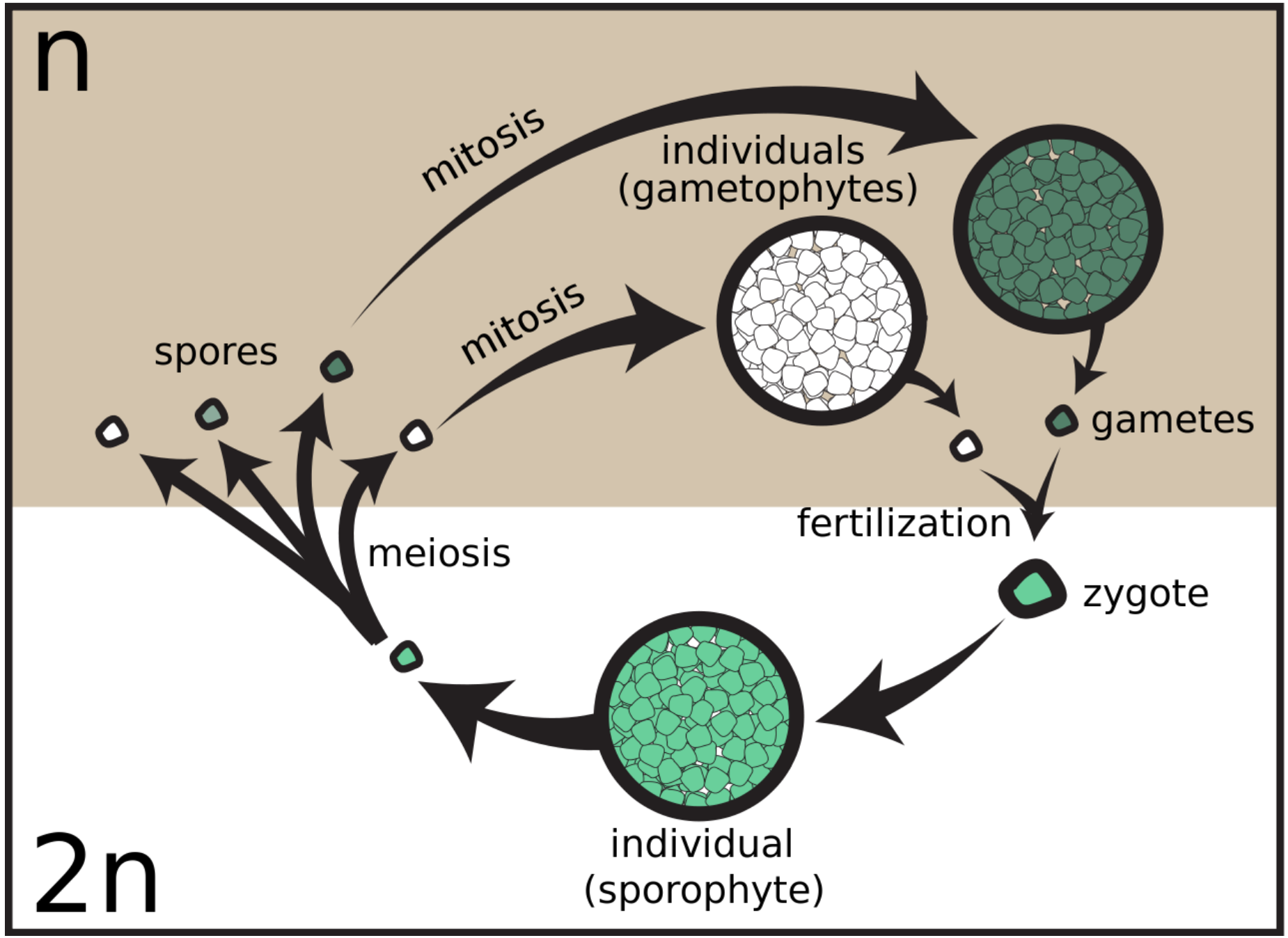

Haploid individuals
(or many haploid cells)
Haploid cells
− + − +
+ Gamete
− Gamete
Fertilization
Meiosis
Zygote

- ***Sporic or intermediate meiosis.***
- It is found in plants and some algae, the meiotic divisions take place at a stage unrelated to either gamete formation or fertilization.

- If we begin the life cycle with the union of a male gamete (the pollen grain) and a female gamete (the egg), the diploid zygote undergoes mitosis and develops into a diploid **sporophyte**.

- At some stage in the development of the sporophyte, *sporogenesis* (which includes meiosis) occurs, producing spores that germinate directly into a haploid **gametophyte**.

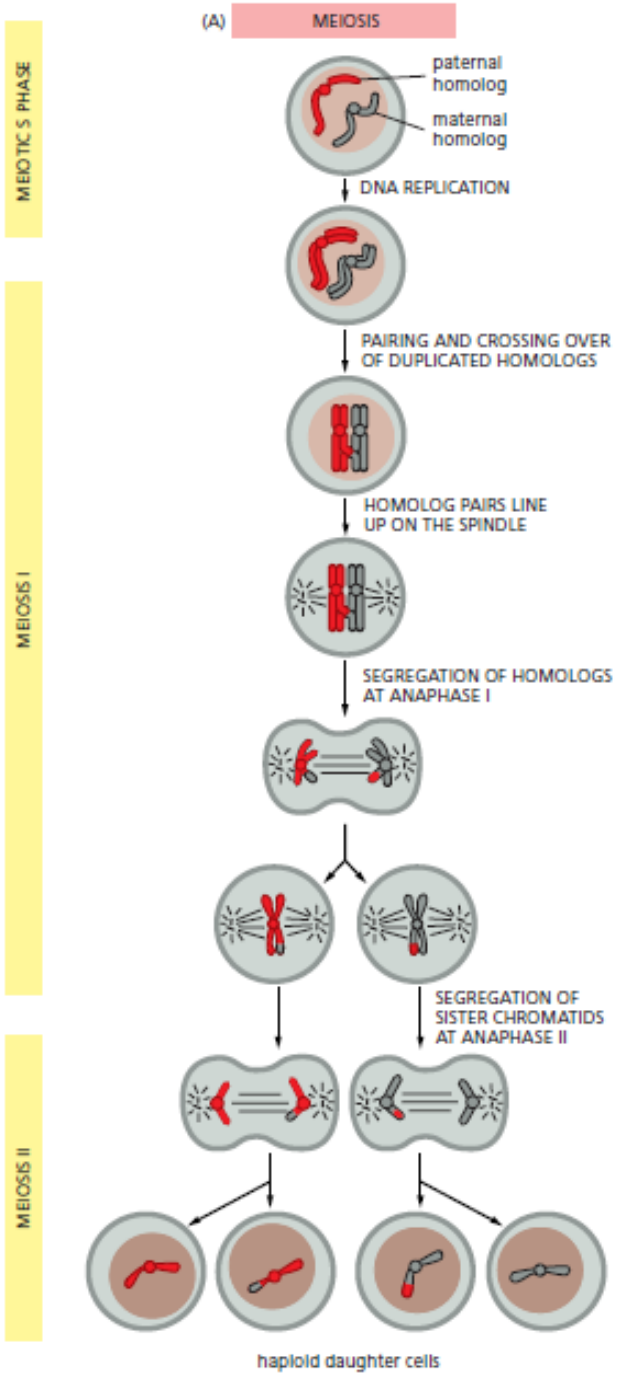
- The gametes are produced from the haploid gametophyte by *mitosis*.


n
mitosis
individuals
(gametophytes)
spores
mitosis
gametes
fertilization
meiosis
zygote
individual
(sporophyte)
2n

Stages in Meiosis:

- **Meiosis I is the stage where chromosome numbers are halved. Thus, it is the reduction division.**

- **Meiosis II is similar to mitosis and is used for separation of sister chromatids.**

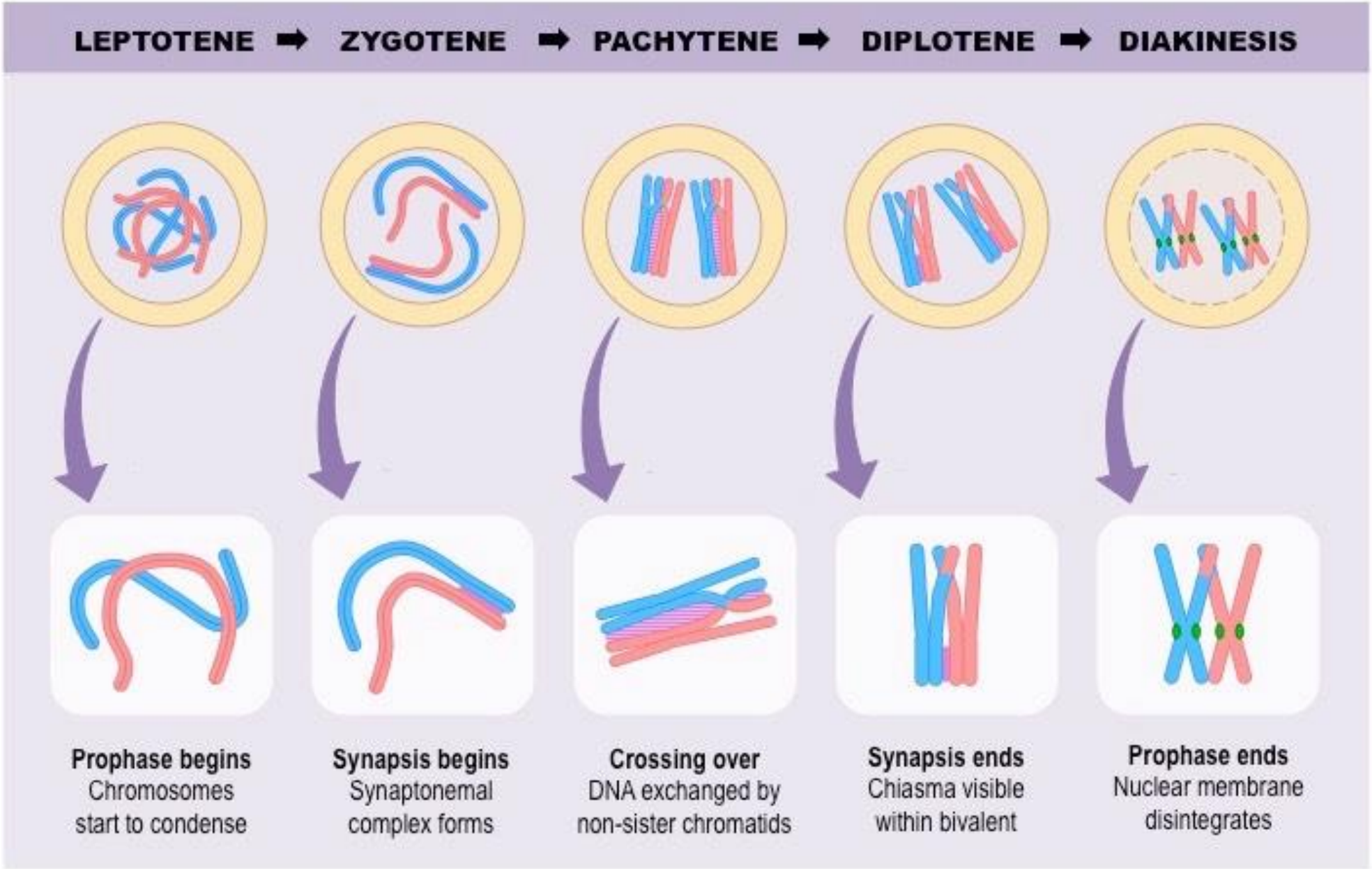


- **Stages in Meiosis I:**
- Its stages are Prophase-I, Metaphase-I, Anaphase-I and Telophase-I.

- The Prophase-I is the longest phase and has following stages in it:

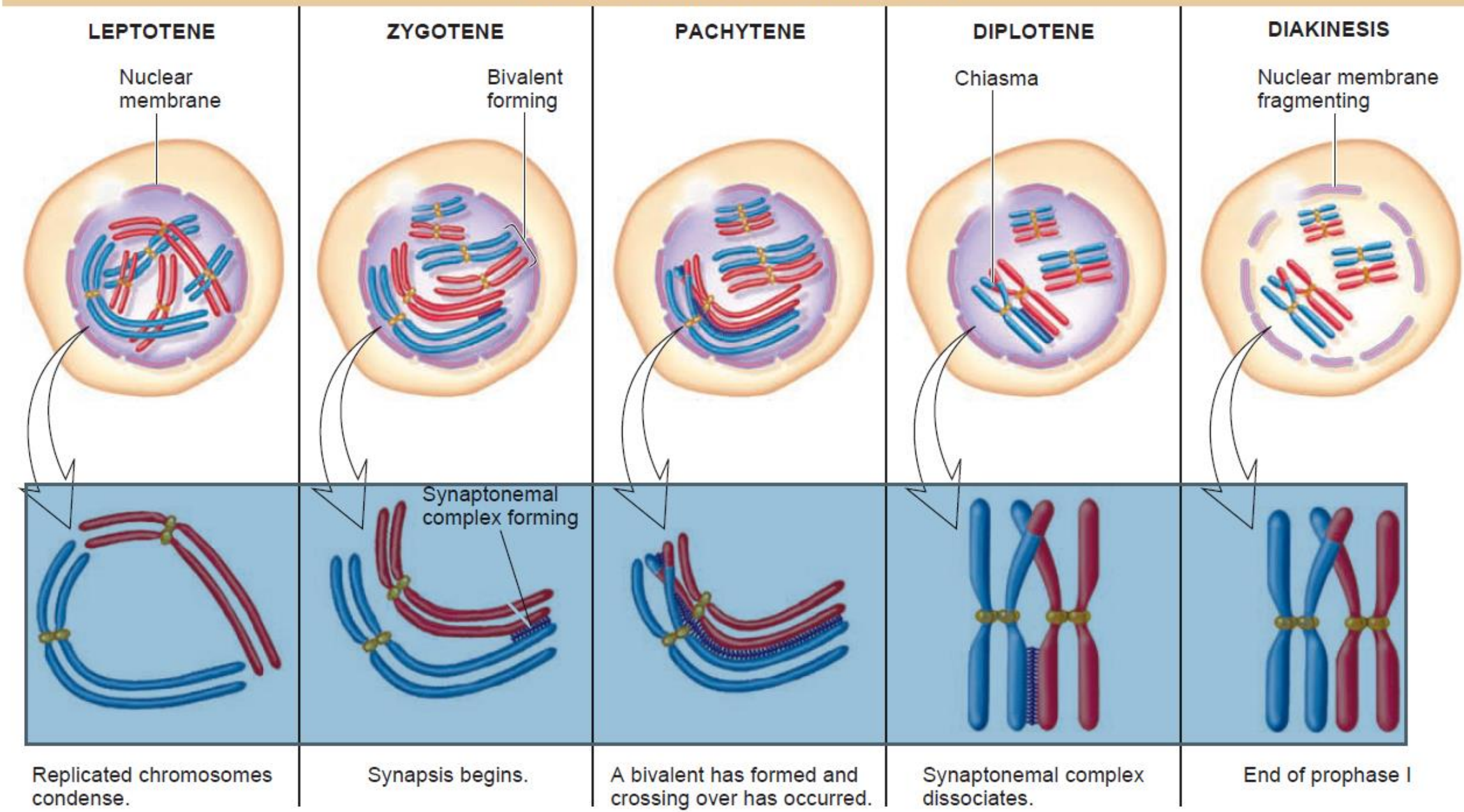
1. Leptotene
2. Zygotene
3. Pachytene
4. Diplotene
5. Diakinesis.

- These stages occur in this exact order.

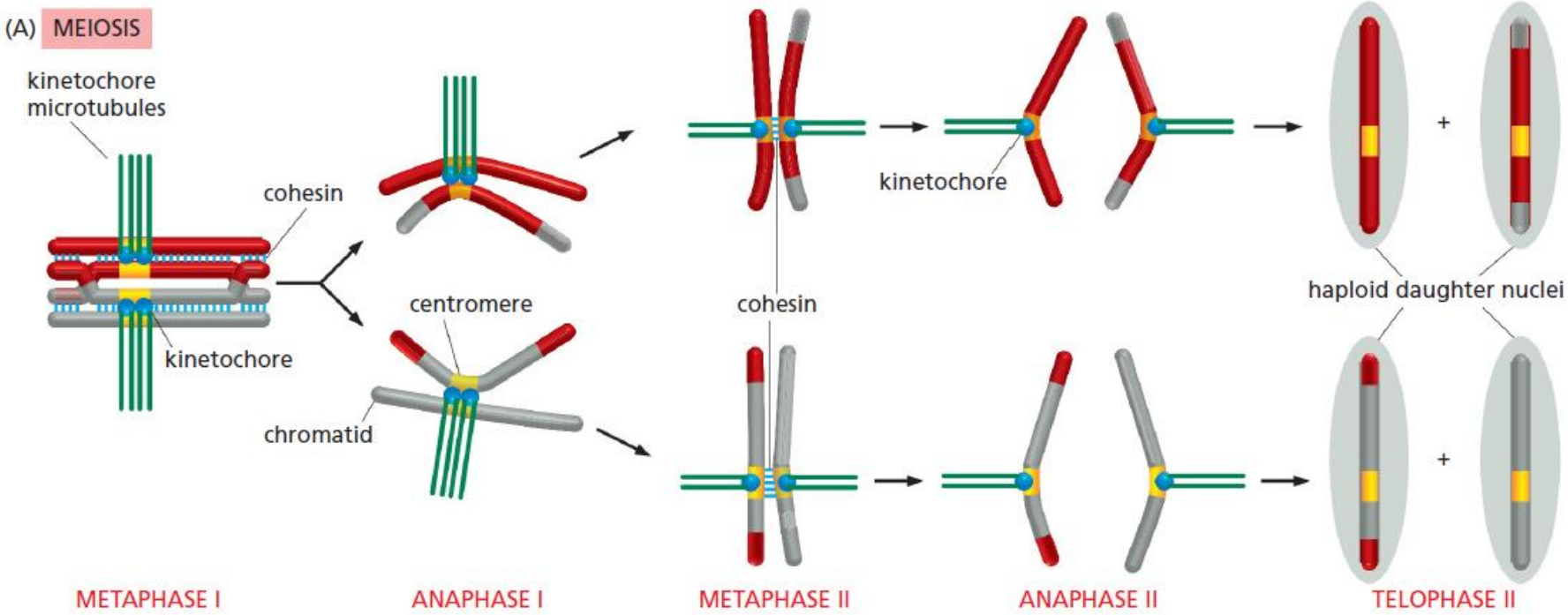


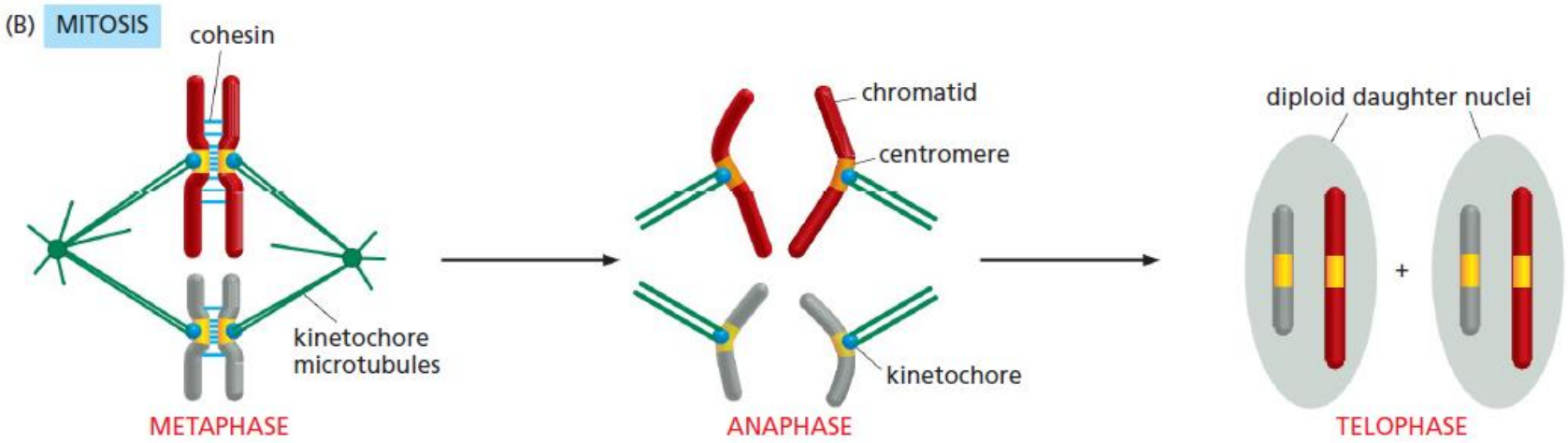
Note: The oocytes in human females are frozen at diplotene stage of prophase-I while in embryonic development. They begin to divide again and complete the meiosis only after onset of puberty.

STAGES OF PROPHASE OF MEIOSIS I



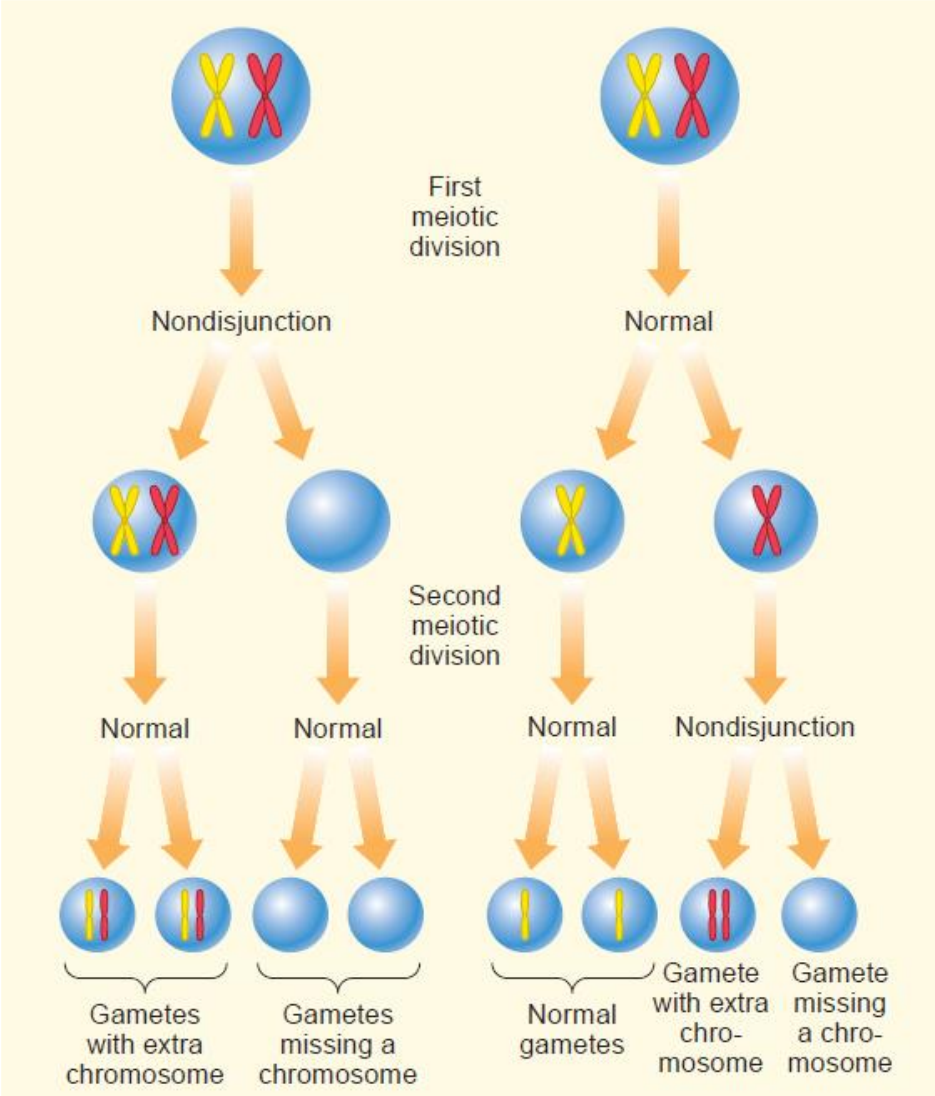
- **Metaphase-I and anaphase-I:** They differ from such phases during mitosis and meiosis-II.





During metaphase-I both the kinetochores on the chromosomes are bound to the spindle pole on the same side. It helps in the separation of the paired homologous chromosomes during anaphase-I.

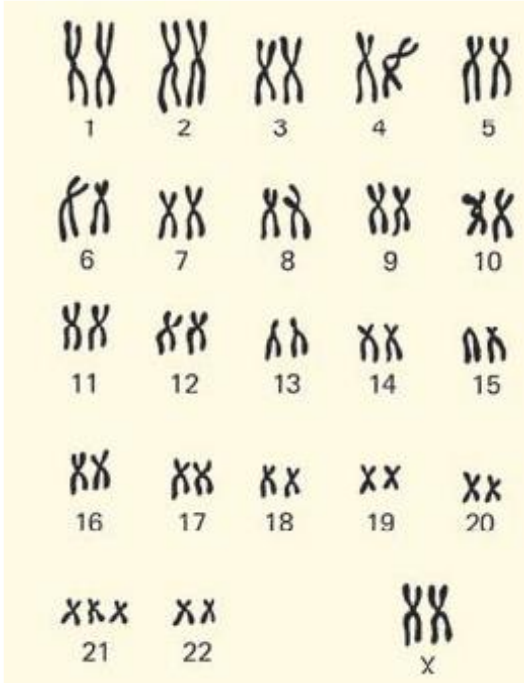
- **<u>Non-disjunction during meiosis:</u>** When homologs fail to separate properly either during meiosis-I or meiosis-II, it is called as non-disjunction.



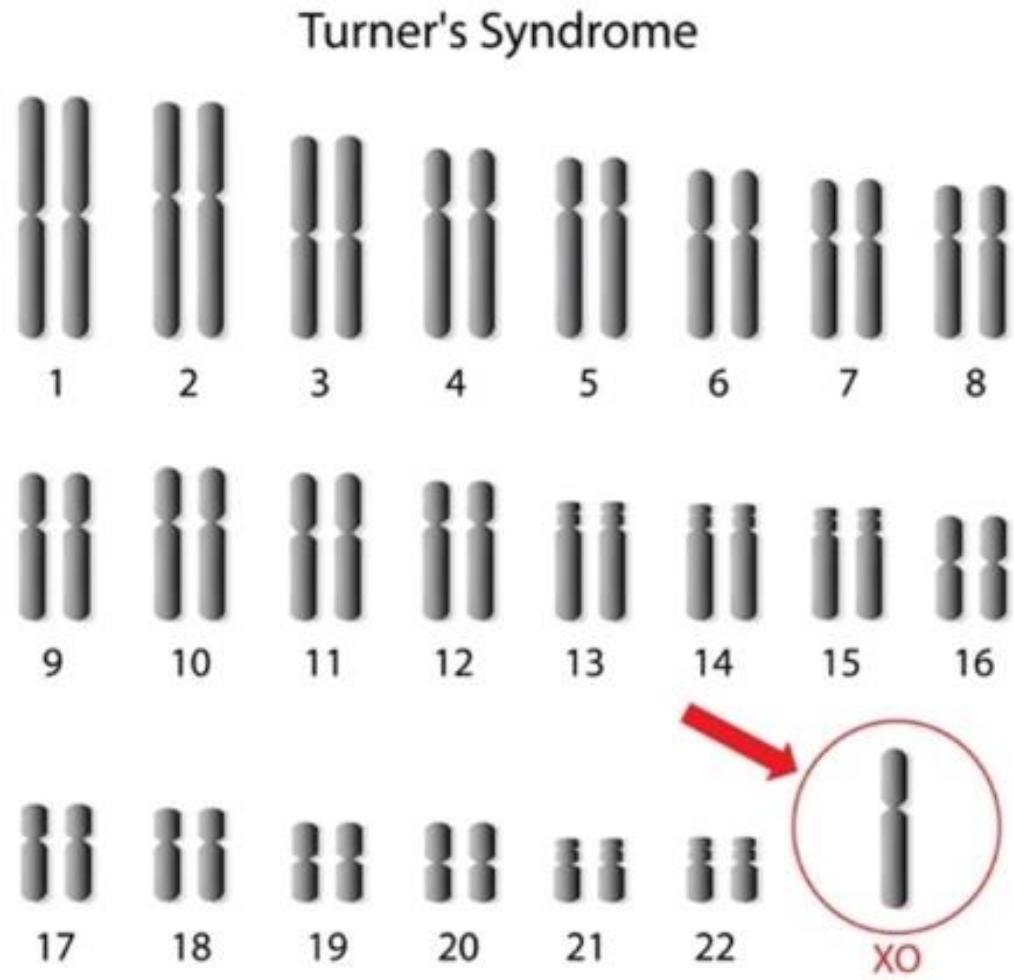
- The normal human chromosome complement is 46: 22 pairs of autosomes and one pair of sex chromosomes.

- An extra chromosome in any pair (producing a total of 47 chromosomes) creates a condition referred to as a *trisomy*.

- A person whose cells contain an extra chromosome 21, for example, has trisomy 21.



- A missing chromosome from any pair (producing a total of 45 chromosomes) produces a *monosomy*.



Thank you