

NCERT Exemplar Solutions of Class 11 Biology – Chapter 10: Cell Cycle and Cell Division**LONG ANSWER TYPE QUESTIONS****1. Comment on the statement – Telophase is reverse of prophase.**

Solution: In Prophase: Chromosome condenses, nuclear membrane disintegrates, organelles like mitochondria, endoplasmic reticulum, and Golgi apparatus disappear. Cells at the end of prophase do not show Golgi complexes, endoplasmic reticulum and nucleolus. The chromosome clusters will be surrounded by the nuclear envelope at the telophase stage.

Enhanced Explanation: Prophase events:

- Chromatin condenses into visible chromosomes
- Nuclear envelope fragments and disappears
- Nucleolus disintegrates
- Centrioles move to opposite poles
- Mitotic spindle begins to form

Telophase events (reverse of prophase):

- Chromosomes decondense back to chromatin
- Nuclear envelopes reform around each set of chromosomes
- Nucleoli reappear
- Spindle apparatus disassembles
- Organelles redistribute

2. What are the various stages of meiotic prophase-I? Enumerate the chromosomal events during each stage.

Solution:

a. Leptotene stage:

- Nuclear membrane starts to disappear
- Chromatin material starts condensing
- Centrioles reach opposite poles
- In some members of Liliaceae, chromosomes remain attached to the nuclear membrane (bouquet stage)

b. Zygotene:

- Pairing of homologous chromosomes starts (synapsis)
- Synaptonemal complex develops to hold homologous chromosomes together

c. Pachytene:

- Bivalent (homologous chromosomes) or tetrad becomes visible
- Crossing over takes place resulting in genetic recombination
- Enzyme recombinase for crossing over comes from recombination nodules of synaptonemal complex

d. Diplotene:

- Synaptonemal complex dissolves
- Homologous chromosomes are still held by X-like structures called chiasmata

- Chiasmata develop at points of crossing over

e. Diakinesis:

- Terminalization of chiasmata: Chiasmata start opening in zipper-like fashion towards periphery
- Nuclear membrane and nucleolus nearly disappear

3. Differentiate between the events of mitosis and meiosis.

Solution:

MITOSIS:

1. Prophase is of short duration
2. Only a single metaphase plate is formed during metaphase
3. Sister chromatids move to opposite poles during anaphase
4. Cytokinesis occurs after mitosis

MEIOSIS:

1. Prophase I is of long duration, prophase II is of short duration
2. Metaphase I has two metaphase plates, Metaphase II has single metaphase plate
3. Two homologous chromatids separate during anaphase I
4. Cytokinesis doesn't occur after meiosis I, occurs after meiosis II

Enhanced Comparison:

Feature	Mitosis	Meiosis
Purpose	Growth, repair	Gamete production
Divisions	One	Two
Daughter cells	2 diploid (identical)	4 haploid (different)
Crossing over	No	Yes (prophase I)
Duration	Short	Long
Chromosome pairing	No	Yes (prophase I)

4. Write a brief note on the following:

a. Synaptonemal complex: It is made up of protein formed between two homologous chromosomes. The complex forms during zygotene, which is a substage of Prophase I. It contains recombination nodules which consist of enzyme recombinase involved in crossing over.

b. Metaphase plate: The metaphase plate is an imaginary line formed in the center of the cell during metaphase. The chromosomes align close to the spindle fibers on this plate. The movement of chromosomes towards the metaphase plate is called congression.

Enhanced Explanation: Synaptonemal complex structure:

- **Central element:** Protein backbone
- **Lateral elements:** Attached to chromosome axes

- **Recombination nodules:** Sites of crossing over
- **Function:** Holds homologous chromosomes together during meiosis I

Metaphase plate significance:

- **Location:** Cell equator
- **Function:** Ensures equal chromosome distribution
- **Checkpoint:** Spindle checkpoint monitors proper attachment
- **Congression:** Active process requiring motor proteins

5. Write briefly the significance of mitosis and meiosis in a multicellular organism.

Solution: Mitosis creates cells necessary to add more mass to the body, as well as more cells to cope with growth, such as new blood cells. In case of injury, mitosis is involved in healing of tissues. Meiosis produces genetic variation by way of the process of recombination. It helps conserve the number of chromosomes in a species.

Enhanced Explanation:

Significance of Mitosis:

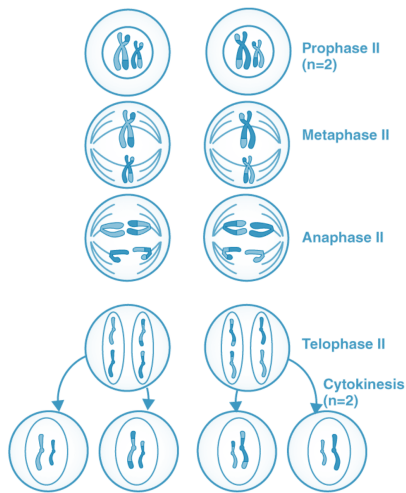
- **Growth:** Increases cell number for organism growth
- **Repair:** Replaces damaged or dead cells
- **Maintenance:** Continuous cell replacement (skin, blood cells)
- **Asexual reproduction:** In some organisms
- **Genetic stability:** Maintains identical genetic material

Significance of Meiosis:

- **Gamete production:** Produces haploid reproductive cells
- **Genetic diversity:** Through crossing over and independent assortment
- **Species survival:** Adapts populations to environmental changes
- **Chromosome conservation:** Maintains species chromosome number
- **Evolution:** Provides raw material for natural selection

6. An organism has two pairs of chromosomes (i.e., chromosome number = 4).

Diagrammatically represent the chromosomal arrangement during different phases of meiosis-II.



Solution: [The document shows a detailed diagram illustrating:]

Prophase II (n=2): Two cells, each with 2 chromosomes consisting of sister chromatids

Metaphase II: Chromosomes align at the metaphase plate with spindle fibers attached

Anaphase II: Sister chromatids separate and move to opposite poles

Telophase II & Cytokinesis (n=2): Four haploid cells are formed, each with 2 single chromatids

Enhanced Explanation:

- **Starting point:** Two haploid cells from meiosis I
- **Process:** Similar to mitosis but with haploid number
- **Result:** Four genetically different haploid gametes
- **Chromosome behavior:** Sister chromatids separate (not homologous pairs)

SUMMARY

Cell Cycle and Cell Division Overview:

The cell cycle consists of two main phases:

- **Interphase:** G₁, S, and G₂ phases (growth and DNA synthesis)
- **M Phase:** Mitosis (nuclear division) and cytokinesis (cytoplasmic division)

Mitosis Stages:

- **Prophase:** Chromosome condensation, nuclear envelope breakdown
- **Metaphase:** Chromosome alignment at metaphase plate
- **Anaphase:** Sister chromatid separation
- **Telophase:** Nuclear envelope reformation, chromosome decondensation

Meiosis: Consists of two divisions (meiosis I and II) producing four haploid gametes from one diploid cell, essential for sexual reproduction and genetic diversity.