NCERT Solutions for Class-XI Biology

Chapter-10

1. What is the average cell cycle span for a mammalian cell?

1. The average cell cycle span for a mammalian cell is approximately 24 hours.

2. Distinguish cytokinesis from karyokinesis.

2. Differences between cytokinesis and karyokinesis are:

Cytokinesis	Karyokinesis
Cytokinesis is the division of the cytoplasm of a cell	Karyokinesis is the division of the nucleus of a cell.
It occurs at the end of M-phase, after the nuclear division is over.	It occurs during M-phase of cell cycle before the cytokinesis begins to proceed.

3. Describe the events taking place during interphase.

3. Interphase involves a series of changes that prepare a cell for division. It is the period during which the cell experiences growth and DNA replication in an orderly manner. Interphase is divided into three phases.

- G_1 phase
- S phase
- G_2 phase

G_1 phase – It is the stage during which the cell grows and prepares its DNA for replication. In this phase, the cell is metabolically active.

S phase – It is the stage during which DNA synthesis occurs. In this phase, the amount of DNA (per cell) doubles, but the chromosome number remains the same.

G_2 phase – In this phase, the cell continues to grow and prepares itself for division. The proteins and RNA required for mitosis are synthesised during this stage.

4. What is G_0 (quiescent phase) of cell cycle?

4. G_0 phase is the phase of inactivation of cell cycle due to non-availability of mitogens and energy rich compounds. Cells in this stage remain metabolically active but no longer proliferate i.e., do not grow or differentiate unless called on to do so depending on the requirement of the organism. E.g., Nerve and heart cells of chordates are in permanent G0 phase.

5. Why is mitosis called equational division?

5. Mitosis is the process of cell division wherein the chromosomes replicate and get equally distributed into two daughter cells. The chromosome number in each daughter cell is equal to that in the parent cell, i.e., diploid. Hence, mitosis is known as equational division.

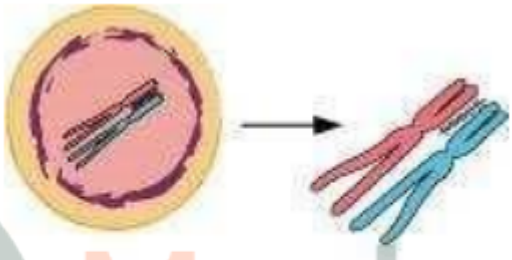
6. Name the stage of cell cycle at which one of the following events occur:
(i) Chromosomes are moved to spindle equator

(ii) Centromere splits and chromatids separate
(iii) Pairing between homologous chromosomes takes place
(iv) Crossing over between homologous chromosomes takes place

6. (i) Metaphase
(ii) Anaphase
(iii) Zygotene of prophase I of meiosis 1
(iv) Pachytene of prophase I of meiosis I

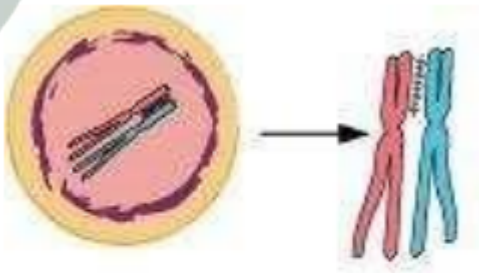
7. Describe the following:
(a) synapsis (b) bivalent (c) chiasmata
Draw a diagram to illustrate your answer.

7. (a) Synapsis
The pairing of homologous chromosomes is called synapsis. This occurs during the second stage of prophase I or zygotene.



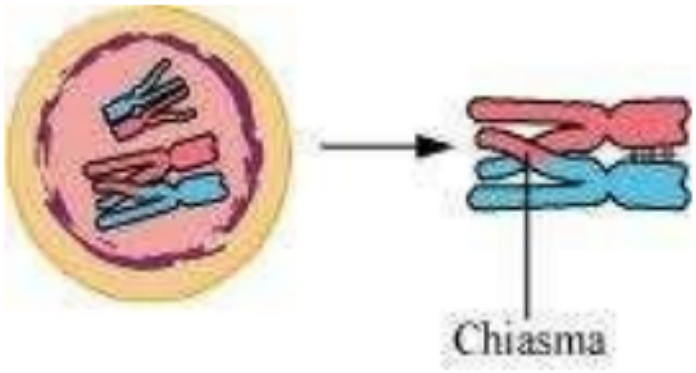
Synapsis: pairing of homologous chromosomes

(b) Bivalent Bivalent or tetrad is a pair of synapsed homologous chromosomes. They are formed during the zygotene stage of prophase I of meiosis.



4 Homologous chromatids
or 2 Homologous chromosomes

(c) Chiasmata Chiasmata is the site where two sister chromatids have crossed over. It represents the site of cross-over. It is formed during the diplotene stage of prophase I of meiosis.



8. How does cytokinesis in plant cells differ from that in animal cells?

8. The process of cytokinesis differs in plant and animal cells

Cytokinesis in plants	Cytokinesis in animals
It occurs by cell plate method	It takes place by cleavage method
The spindle persists during cytokinesis	The spindle starts to degenerate after anaphase
Cell plate grows centrifugally	Cleavage takes place centripetally
The new cell membrane is derived from vesicles of the Golgi apparatus	The new cell wall is derived from the endoplasmic reticulum

9. Find examples where the four daughter cells from meiosis are equal in size and where they are found unequal in size.

9. (a) Spermatogenesis or the formation of sperms in human beings occurs by the process of meiosis. It results in the formation of four equal-sized daughter cells.
(b) Oogenesis or the formation of ovum in human beings occurs by the process of meiosis. It results in the formation of four daughter cells which are unequal in size.

10. Distinguish anaphase of mitosis from anaphase I of meiosis.

10. Anaphase of mitosis : It is the phase of shortest duration. APC (anaphase promoting complex) develops. It degenerates proteins -binding the two chromatids in the region of centromere. As a result, the centromere of each chromosome divides. This converts the two chromatids into daughter chromosomes each being attached to the spindle pole of its side by independent chromosomal fibre. The chromosomes move towards the spindle poles with the centromeres projecting towards the poles and the limbs trailing behind. There is corresponding shortening of chromosome fibres. The two pole-ward moving chromosomes of each type remain attached to each other by interzonal fibres. Ultimately, two groups of chromosomes come to lie at the spindle poles.

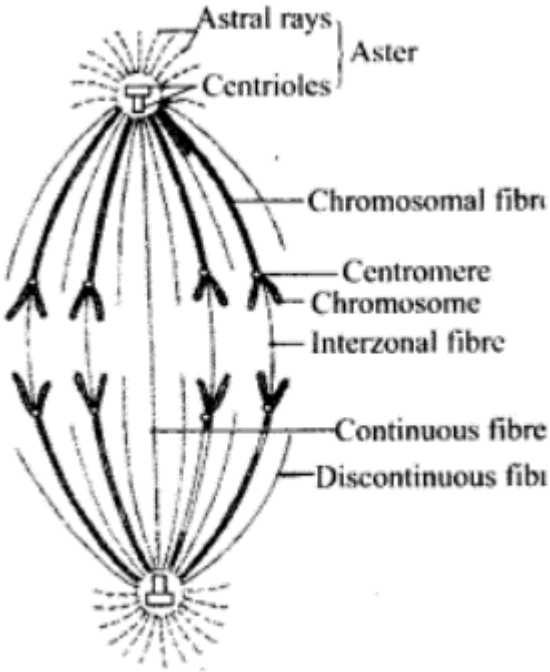


Fig.: Mitotic anaphase.

Anaphase I of meiosis : Chiasmata disappear completely and the homologous chromosomes separate. The process is called disjunction. The separated chromosomes (univalents) show divergent chromatids and are called dyads. They move towards the spindle poles and ultimately form two groups of haploid chromosomes.

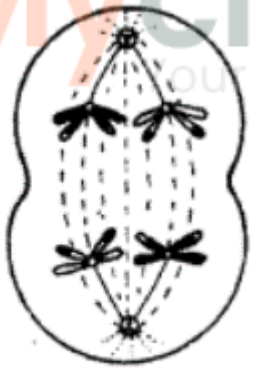


Fig.: Meiotic anaphase I

11. List the main differences between mitosis and meiosis.

11.

Mitosis		Meiosis	
1.	In mitotic division, a single division results in two daughter cells.	**1.**	Meiotic division involves two successive divisions – meiosis I and meiosis II. These divisions result in four daughter cells.
2.	Mitosis is known as equational division. This is because the daughter cells have the same diploid number of chromosomes as the parent.	**2.**	Meiosis I is known as reductional division. This is because the chromosome number is reduced to half. Meiosis II is known as equational division. This is because the sister chromatids separate and the chromosome number remains the same.
3.	Prophase is short and does not comprise any	**3.**	Prophase I is very long and comprises 5

	phase.		phases –leptotene, zygotene, pachytene, diplotene, and diakinesis.
4.	There is no pairing of chromosomes, crossing-over, or chiasmata-formation during prophase.	**4.**	In the zygotene stage of prophase, the pairing of chromosomes occurs. During pachytene, the crossing-over occurs. The chiasmata are formed in the diplotene stage.
5.	Synaptonemal complex is not formed.	**5.**	Synaptonemal complex is formed during the zygotene stage of prophase I.
6.	Anaphase involves the separation of the chromatids of each chromosome.	**6.**	During anaphase I, the homologous chromosomes separate, while the chromatids remain attached at their centromeres. During anaphase II, the chromatids separate as a result of the splitting of the centromere.
7.	Mitosis plays a significant role in the healing, repair, and growth of a cell.	**7.**	Meiosis brings about variation and maintains the chromosome number from generation to generation.

12. What is the significance of meiosis?

12. The significance of meiosis is given below:

(i) Formation of gametes – Meiosis forms gametes that are essential for sexual reproduction.

(ii) Genetic information – It switches on the genetic information for the development of gametes or gametophytes and switches off the sporophytic information. ‘

(iii) Maintenance of chromosome number – Meiosis maintains the fixed number of chromosomes in sexually reproducing organisms by halving the same. It is essential since the chromosome number becomes double after fertilisation.

(iv) Assortment of chromosomes – In meiosis paternal and maternal chromosomes assort independently. It causes reshuffling of chromosomes and the traits controlled by them. The variations help the breeders in improving the races of useful plants and animals.

(v) Crossing over – It introduces new combination of traits or variations.

(vi) Mutations – Chromosomal and genomic mutations can take place by irregularities of meiotic divisions. Some of these mutations are useful to the organism and are perpetuated by natural selection.

(vii) Evidence of basic relationship of organisms – Details of meiosis are essentially similar in the majority of organisms showing their basic similarity and relationship.

13. Discuss with your teacher about

(i) haploid insects and lower plants where cell-division occurs, and

(ii)some haploid cells in higher plants where cell-division does not occur.

13. (i) In some insects and lower plants, fertilization is immediately followed by zygotic meiosis, which leads to the production of haploid organisms. This type of life cycle is known as haplontic life cycle.

(ii) The phenomenon of polyploidy can be observed in some haploid cells in higher plants in which cell division does not occur. Polyploidy is a state in which cells contain

multiple pairs of chromosomes than the basic set. Polyploidy can be artificially induced in plants by applying colichine to cell culture.

14. Can there be mitosis without DNA replication in S phase?

14. No there cannot be any mitotic division without-DNA replication in 'S' phase.

15. Can there be DNA replication without cell division?

15. There can be DNA replication without cell division. During cell division, the parent cell gets divided into two daughter cells. However, if there is a repeated replication of DNA without any cell division, then this DNA will keep accumulating inside the cell. This would increase the volume of the cell nucleus, thereby causing cell expansion. An example of DNA duplication without cell division is commonly observed in the salivary glands of Drosophila. The chromosome undergoing repeated DNA duplication is known as polytene chromosome.

16. Analyse the events during every stage of cell cycle and notice how the following two parameters change

(i) Number of chromosomes (N) per cell

(ii) Amount of DNA content (C) per cell

16. Number of chromosomes and amount of DNA change during S-phase and anaphase of cell cycle. S or synthesis phase marks the period during which DNA synthesis or replication takes place. During this time the amount of DNA per cell doubles. If the initial amount of DNA is denoted as 2C then it increases to 4C. However, there is no increase in the chromosome number; if the cell had diploid or 2N number of chromosomes at G,, even after S phase the number of chromosomes remains the same, i.e., 2N.

In mitotic anaphase, number of chromosomes remains the same. It is only sister chromatids which move towards their respective poles. DNA content remains unchanged. In anaphase I of meiosis, number of chromosomes are reduced to half, i.e., from 2N to IN and also DNA content decrease to one half i.e., from 4C to 2C. In anaphase II of meiosis II DNA content decreases to one half from 2C to 1C but chromosome number remain same.