Cell cycle and cell divison

• Every organism begins its life as a single cell. The cell divides repeatedly to produce a cluster of cells. These cells form tissues and the tissues form organs to perform different activities of life. Cell division is essential for growth, replacement of old cells, repair of injury and reproduction of living organisms.

• Cell cycle is the sequence of events occurring between the cell formation and its division. It consists of two phases – Interphase and Mitotic phase (M-phase).

• **Interphase** is the interval between two successive cell division. It is divided into G1 phase, Sphase, G2 phase.

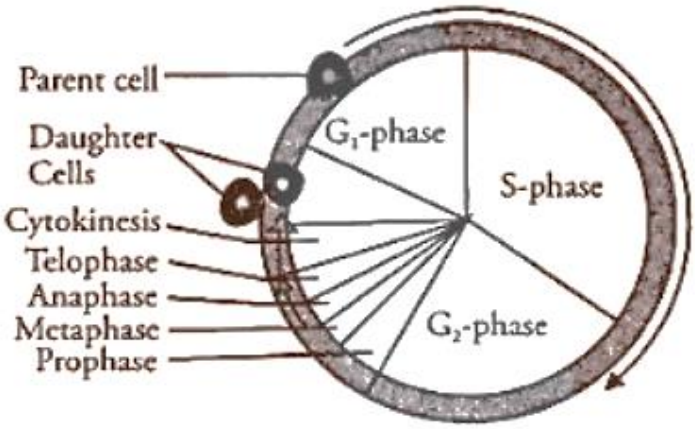


Fig. 1.1 Cell cycle

• The cell division involves three major steps. They include replication of DNA, division of nucleus or karyokinesis and division of cytoplasm or cytokinesis.

• Cell division is also essential for repair of injuries and reproduction.

• There are two types of cell division – Mitosis and Meiosis. The cell division leading to growth, development, repair and replacement is called mitosis. The cell division leading to production of gametes is called meiosis.

• **Mitosis** is the cell division which occurs in four phases namely prophase, metaphase, anaphase and telophase.

♣ In **prophase**, the chromosomes become short and thick which move towards the equator of the cell. Each chromosome gets duplicated to form two chromatids which are attached to each other at a small region called centromere.

♣ In **metaphase**, the chromosomes arrange themselves on the equatorial plane. Each chromosome gets attached to a spindle fibre at its centromere.

♣ In **anaphase**, the centromere divides and the two sister chromatids of each chromosome separate and are drawn apart towards opposite poles and form two groups of chromosomes.

♣ **Telophase** is the last phase in which the chromatid becomes thinner and the nuclear membrane reappears. Nucleolus also reappears in each daughter nucleus.

• Mitosis is followed by the division of cytoplasm (cytokinesis). At the end of telophase, a furrow appears in the cell membrane at the centre, which deepens and finally splits the cytoplasm into two, thus producing two new cells.

• **Meiosis** is the kind of cell division that produces sex cells or the gametes. In this division, the number of chromosomes in the cells is halved.

• Meiosis is also called reduction cell division since the four daughter cells formed have half the number of chromosomes than the mother cell.

• There are two divisions of meiosis – meiosis I (reduction division) and meiosis II (equational division).

• **Significance of Mitosis**

♣ Mitosis plays an important role in vegetative growth, wound healing, repair and regeneration.

♣ It maintains the same chromosome number in the daughter cells as well.

♣ It maintains the proper size of a cell.

♣ It helps in asexual reproduction, e.g. binary fission in Amoeba. It helps in asexual reproduction in unicellular organisms.

• Significance of Meiosis

♣ It plays an important role in sexual reproduction, i.e., in the formation of gametes (sperms and ova).

♣ It maintains the constant number of chromosomes in a species.

♣ It brings about recombination between maternal and paternal genes thereby bringing in genetic variations are responsible for evolution.

• Chromosomes are long thread-like structures made of DNA and proteins.

• DNA molecule is made up of a double chain of nucleotides in the form of a helix. A nucleotide is a sugar molecule joined to a phosphate group and an organic base.

Differences between mitosis and meiosis Mitosis Meiosis

MITOSIS (Equational division)	Meiosis(Reductional division)
It occurs in vegetative cell/somatic cell/body cell	It occurs in reproductive cells (production of gametes)
The cell divides only once	It involves two successive divisions.

Two daughter cells are formed from a parent cell on completion of the division	Four daughter cells are formed from parent cell on completion of division.
The daughter cells are genetically similar to the parent cells	The daughter cells formed are different from parent cells.
The number of chromosomes in the daughter cells is equal to that found in the parent cell.	The number of chromosomes in daughter cells is half of that in the parent cell.

Difference between mitosis in animal cell and plant cell.

Mitosis in animal cell	Mitosis in plant cell
1. The spindle formed is amphiastral.	1. The spindle formed is anastral.
2. Cytokinesis occurs by constriction or furrow method	. 2. Cytokinesis occurs by the formation of cell plate.
3. Cytokinesis proceeds from outside to centre.	3. Cytokinesis proceeds from centre to the periphery
4. Centrosome is present	4. Centrosome is absent
5.Two asters are formed.	5.No asters are formed.

The specific part of the chromosomes, which are composed of DNA are called genes. They determine hereditary characters. Genes are responsible for transmission of characters from one generation to another.

There are four types of chromosomes – metacentric, sub metacentric, acrocentric, telocentric.

- Metacentric: Centromere lies in the centre and two arms of chromatid are equal.
- Telocentric: Centromere is present at one end of chromosome.
- Sub metacentric: Centromere slightly away from centre and one arm of chromatid isslightly larger than other.
- Acrocentric: Centromere is present near one end of chromatid and one arm is very large than the other.

Questions -

Q.1Multiple choice question

1. Chromosomes get aligned at centre of cell divison during
a. Metaphase
b. Anaphase
c. Prophase
d. Telophase
2. The cell component visible only during cell division is:
a. Mitochondria
b. Chloroplast
c. Chromosome
d. Chromatin

Q.2 Identify whetehr the following statements are true or false. Rewrite the correct statement if its false

a. Centromere is an organelle in cell that initiates cell division.
b. Mitosis is a type of cell division occuring in the cells of injured parts of the body.

c. The resting stage of mitosis is Interphase.
d. Duplicated chromosme remain attached art the point called as centrosome.

Q.3 Identify the terms or process or location from following :

a. Centrosome location
b. Chromosome appear thread like called as

Q.4Given below are five groups of terms. In each group , arrange and rewrite the terms in the correct order so as to be in a logical sequence.

a. Metaphase ,Telophase, Prophase, Amaphase , Cytokinesis.
b. Karyokinesis,S pahse,Cytokinesis, G1 phase, G2 phase (cell cycle).
c. Anaphase, Telophase, Metaphase,Prophase,Interphase

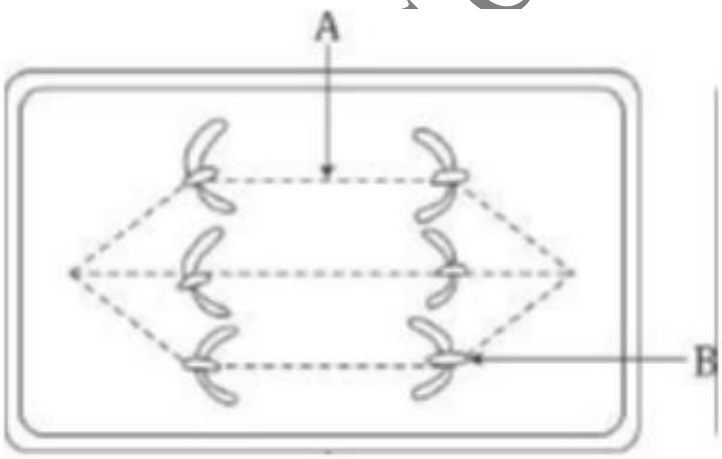
Q.5 Breifly explain

a. Cytokinensis in plant cells
b. Homologus chromosmes

Q.6Give point of difference bwteen

a. Karokinensis and cytokinensis (explain the terms)

Q.7 The digram represents certain stage of mitosis.



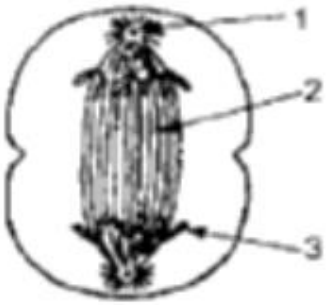
a. Identify the stage of cell division
b. Name the parts labelled A and B
c. What is unique feature observed in this stage ?
d. How many daughter cells are formed from this type of ell division? (5)

Q.8Given below is a diagram representing a stage during mitotic cell division , Study it carefully and answer the questions which follow:

a. Is it a plant cell or animal cell? Give reason to support your answer.
b. Identify the stage shown
c. Name the stage which follows the one shown here. How is that stage identified ?
d. How will you differentiate between mitosis and meiosis on basis of the chromosome number in daughter cells?
e. Draw a duplicated chromosome and label its parts.

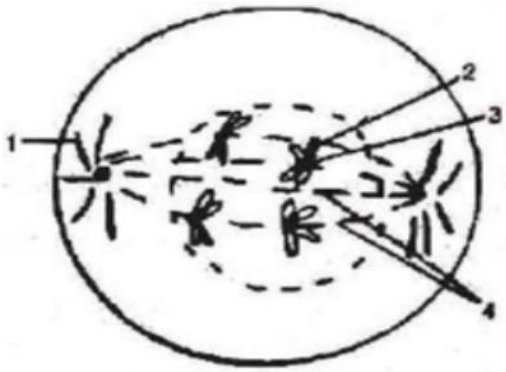
Q.9 Draw a neat labelled diagram of Metaphase of cell division in animal cell having 4 chromosomes. (1)

Q.10 The diagram shows a stage during cell division. Study the diagram and answer the following questions:



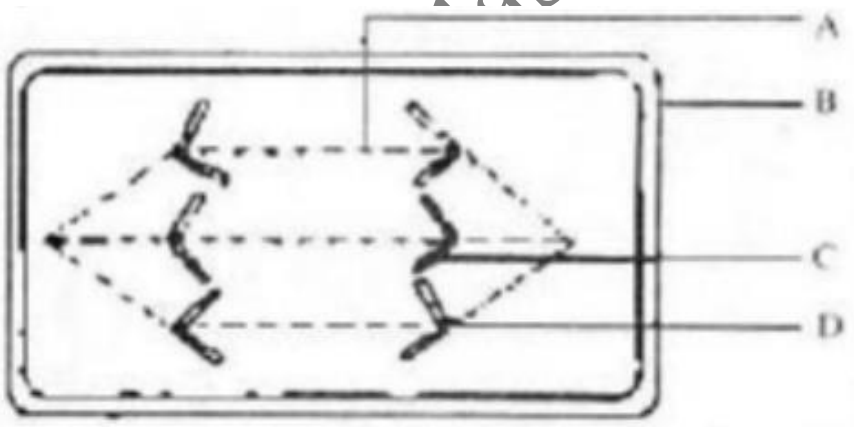
a. Name the parts labelled 1,2,3.
b. Identify the stage shown here by giving one reason.
c. Where in the body does this type of cell division occur?
d. Name the stage prior to this stage and draw a diagram to represent the same.

Q.11 Given below is a diagram representing a stage during mitotic cell division in an animal cell.



a. Identify the above stage, Give reason to support the answer.
b. Nmae the parts labelled 1,2,3 and 4
c. What is the function of part 3?
d. Name the stage which comes just after the stage shown in the diagram.Draw a well-labelled diagram of this stage.

Q.12 Diagram below represents a stage of cell division.Study the same and answer the following question.



a. Identify the stage of cell division
b. Name the parts labelled A, B,C and D
c. What is the unique feature observed in this stage?
d. Where does this type of cell division usually occur?
e. How many daughter cells are formed from this type of cell division ?
f. Is this dividing cell shown a palnt or animal cell ? Give reason to support your answer.

Q.13 ADraw a diagram of the nucleus of a cell, having a chromosome number 6, as it would appear in the metaphase stage of mitosis and label the following parts in the diagram :

a. ASTER
b. Achromatic spindle

c. Chromatid
d. Centrosome

B Mention the difference between Mitosis and meiosis with reference to

1. Number of daughter cells formed at the end of the division.
2. The chromosome number of daughter cells formed.