

## **PUC 1<sup>ST</sup> YEAR –SEMESTER-2**

### **UNIT III: Cell cycle and cell division**

#### **Module no. 15: Cell division – cell cycle**

##### **Cell division:**

Organisms grow and repair themselves through the medium of cell division. Every living cell has the capacity to grow. When the growth reaches to the maximum size which is the characteristic feature of all the living beings, the cell divides. These cells again grow and continue the process of division. According to the cell theory, new cells originate from the division of pre – existing cells.

**Cell division can be defined as a process by which the cell duplicates itself for growth and reproduction.**

The characters of an organism are largely an account of the genes, which it has inherited from its parents. These genes in an organism are found in thousands and are arranged in a linear fashion in the chromosomes. These are transmitted from parents to the off springs through the process of cell division and reproduction.

Three types of cell divisions are seen among animals. They are

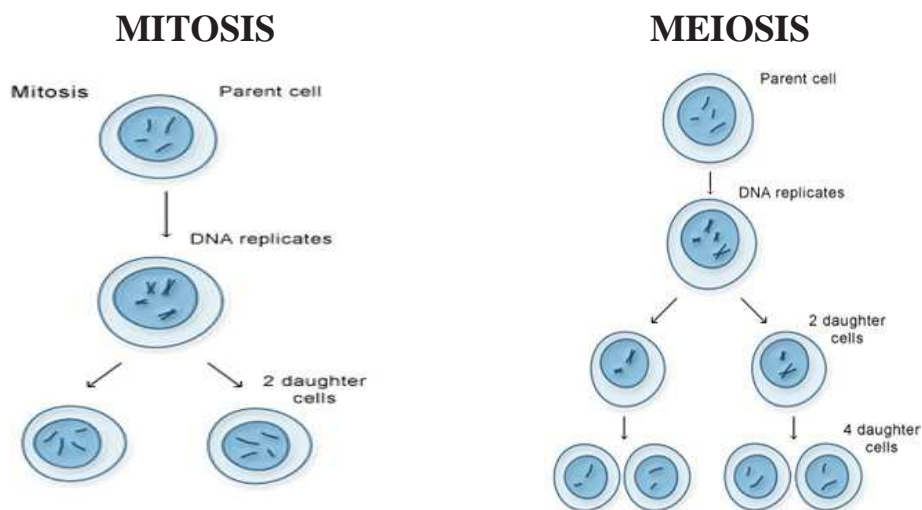
1. Amitosis
2. Mitosis and
3. Meiosis

Amitosis occurs in the acellular animals like protozoa, bacteria etc. It is a means of reproduction in unicellular organisms. It is the simplest division and in this division chromosomes do not undergo any kind of division. The nucleus first divides followed by the division of cytoplasm. As a result two daughter cells are formed.

Mitotic cell division occurs in all somatic cells. Hence mitosis is also called as somatic cell division. Due to mitotic cell division two daughter cells are

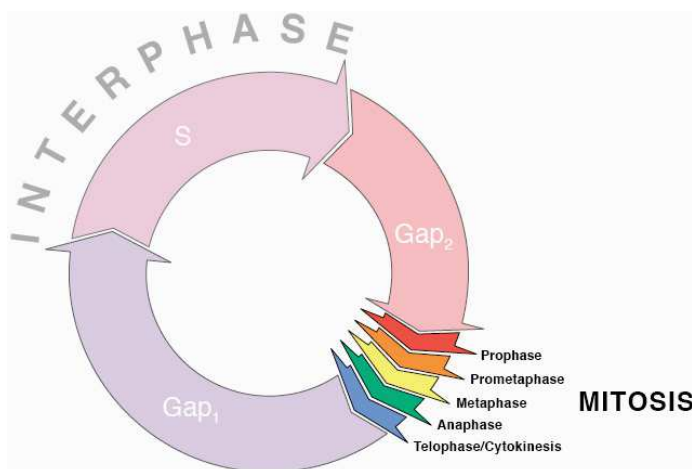
formed from one parent cell, which are endowed with identical genes arranged in an identical fashion on the identical number of chromosomes. The two cells resulting from mitosis have equal amounts of DNA, chromosomes and other substances. Hence it is also called equational division and duplication division.

The unicellular organisms reproduce asexually by mitosis. The multicellular organisms develop from a single cell, the zygote or the fertilized egg by the process of mitosis. The zygote is formed by the union as of gametes, which are produced by meiosis or reduction division in the germ cells of sexually mature parents. As a result of meiosis, the number of chromosomes in the gametes is reduced to half ( $n$ ). The number of chromosomes in the parent cell ( $2n$ ). Therefore the regular distribution of genes from cell to cell can be explained by mitosis and from generation to generation through meiosis.



### Cell cycle:

Cell cycle is an orderly series of changes that occurs in a cell by which it duplicates its contents and divides into two. Cell cycle consists of two phases – inter phase and M – phase. Both of them have a number of sub – stages.



### Inter phase:

When a cell divides, it is necessary that its chromosomes and genes also duplicate themselves. The duplication of genes occur during interphase, which is a period of interval between two successive cell divisions, when the cell prepares itself for the division.

During this stage nucleus and cytoplasm are very active metabolically, synthesizing and storing all these substances which are essential for cell division.

During interphase the following processes takes place

1. Replication of DNA and histone proteins
2. Synthesis of energy rich compounds and proteins
3. Duplication of centriole in animal cells.

The interphase lasts more than 95% of the duration of cell cycle. The interphase is divided into three sub stages namely  $G_1$  phase, S – phase and  $G_2$  phase.

### $G_1$ phase:

It comes immediately after the cell division and is characterised by the general growth of cell. The various substances (proteins and nucleotides) necessary for the synthesis of DNA are formed in this phase.

### **S – phase:**

S – phase is called synthesis phase. This phase is marked by the duplication of DNA and histone proteins. As a result of this the amount of DNA is doubled.

### **G<sub>2</sub> – phase:**

It is the second growth phase, also called post – synthetic phase or pre mitotic phase. Cell size increases. The nucleolus increases in size due to a accumulation of ribosomal RNA and proteins. Mitochondria and plastids undergo division. Microtubules and other substances directly involved in mitosis are produced. Multiplication of other cell organelles also occur. The chromosomes appear as diffused long coiled and indistinct chromatin fibres.

### **M – phase: (Mitotic phase)**

It is the actual phase of cell division. Division may occur by mitosis or meiosis. M – phase is the process of final separation of already duplicated molecular units. M – phase consists of two processes.

1. Karyokinesis or division of nucleus
2. Cytokinesis or division of cytoplasm

The duration of cell cycle and the different stages and substances varies in different types of cells. A typical animal cell cycle lasts roughly 24 hours, but depending on the type of cell, it can vary in length from less than 8 hours to more than a year. Most of the variability occurs in G<sub>1</sub> phase.

### **Check points:**

1. The cell duplicates itself for growth and representation is called cell division.
2. Three types of cell divisions are seen in animals. They are amitosis, mitosis and meiosis
3. In amitosis chromosomes do not undergo any kind of division.
4. Mitosis is also called as somatic cell division/equational division/duplication division.
5. Cell cycle consists of two phases – Inter phase and M– phase

6. Inter phase is divided into three sub phases –  $G_1$  phase, S – phase and  $G_2$  phase
7. Growth of the cell takes place during  $G_1$  and  $G_2$  phases
8. M – Phase consists of two processes – karyokinesis and cytokinesis.

### **Short answer questions:**

1. What is cell cycle?
2.  $G_1$  and  $G_2$  - What does the "G" stand for? (not Gap)
3. What happens during 'S' phase.
4. Name the stages of cell cycle associated with Interphase.
5. What is the purpose of mitosis?

### **Long answer questions**

1. Describe the cell cycle of a typical cell. Describe what happens at each phase.

### **Multiple choice questions**

1. Which process provides new cells for growth and replacement of body cells?
  - A. Metabolism
  - B. Respiration
  - C. Digestion
  - D. Cell division**
2. The mitosis is also called equational division because
  - A. It occurs in somatic cells
  - B. The chromosome number is same in parent and progeny after division**
  - C. The chromosomes are equally distributed to the daughter cells after division
  - D. The chromosome number is reduced to half after completion of mitosis

3. The stage of cell cycle where the cell is preparing to begin DNA replication is called
- A. G<sub>1</sub> phase
  - B. G<sub>2</sub> phase
  - C. S phase**
  - D. M phase
4. Which is of the following statement is correct for the S phase during cell division?
- A. The nucleus grows in size
  - B. The chromosome number doubles
  - C. The DNA replicates but the chromosome number remains same**
  - D. The centriole forms spindle fibers in plants
5. What occurs in the cell during the G<sub>2</sub> phase?
- A. Growth processes and synthesis of compounds other than DNA**
  - B. DNA composing the chromosomes is duplicated
  - C. Molecules and structures necessary for mitosis are synthesized
  - D. Division of the cell and cytoplasm
6. Interphase
- A. Is the same as prophase, metaphase anaphase and telophase
  - B. Include stages G<sub>1</sub>, S and G<sub>2</sub>**
  - C. Requires the use of polar fibers and kinetochore fibers
  - D. It is an optional phase during cell division
7. The interphase lasts more than \_\_\_\_\_ of the duration of cell cycle.
- A. 80%
  - B. 70%
  - C. 20%
  - D. 95%**

8. Karyokinesis
- A. Division of cytoplasm
  - B. Division of chromosomes
  - C. Division of nucleus**
  - D. Duplication of DNA