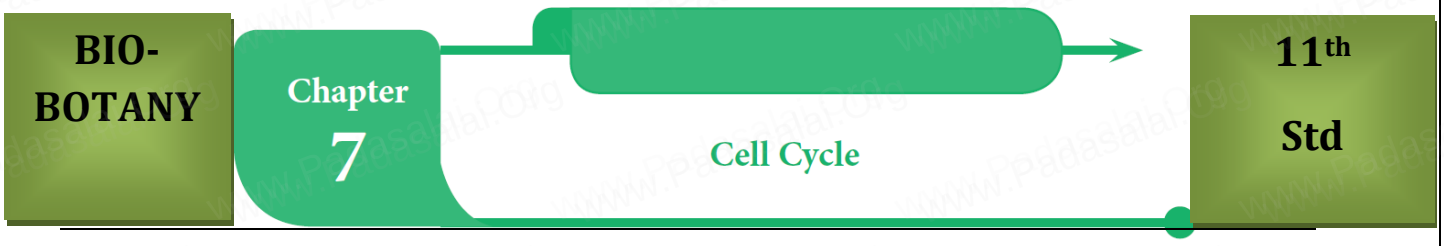
A.VINOTH KUMAR., DGD., M.Sc., M.Phil. Ph.D (Botany)




## Book Back Questions

**Write any three significance of mitosis**

1. **Genetic stability** – daughter cells are genetically identical to parent cells.

2. **Growth** – as multicellular organisms grow, the number of cells making up their tissue increases. The new cells must be identical to the existing ones.

3. **Repair of tissues** - damaged cells must be replaced by identical new cells by mitosis.

4. **Asexual reproduction** – asexual reproduction results in offspring that are identical to the parent. Example: Yeast and Amoeba.

5. **Regeneration** – Arms of star fish

**2. Differentiate between mitosis and meiosis?**

| **Mitosis** | **Meiosis** |
|---|---|
| One division | Two divisions |
| Number of chromosomes remains the same | Number of chromosomes is halved |

| | |
|---|---|
| Homologous chromosomes line up separately on the metaphase plate | Homologous chromosomes line up in pairs at the metaphase plate |
| Homologous chromosome do not pair up | Homologous chromosome pairup to form bivalent |
| Chiasmata do not form and crossing over never occurs | Chiasmata form and crossingover occurs |
| Daughter cells are genetically identical | Daughter cells are genetically different from the parent cells |
| Two daughter cells are formed | Four daughter cells are formed |

**3.Given an account of G0 phase?**

❖ Some cells exit G1 and enter a quiescent stage called **G0**, where the cells remain metabolically active without proliferation.

❖ Cells can exist for long periods in G0 phase.

❖ In G0 cells cease growth with reduced rate of RNA and protein synthesis.

❖ The G0 phase is not permanent.

❖ Mature neuron and skeletal muscle cell remain permanently in G0.

❖ Many cells in animals remain in G0 unless called on to proliferate by appropriate growth factors or other extracellular signals.

- G**0** cells are not dormant.

4.**Differentiate cytokinesis in plant cells and animal cells**

| **Plant Cytokinesis** | **Animal Cytokinesis** |
|---|---|
| It usually occurs by cell plate method. | It takes place by cleavage. |
| The spindle usually persists during cytokinesis. | The spindle begins to degenerate soon after anaphase. |
| Central part of spindle grows in size and forms an interdigited complex called phragmoplast. | A mid body of dense fibrous and vesicular material is formed in the middle. |
| Vesicles derived from Golgi apparatus reach the equator of the phragmoplast and fuse to form cell plate and new cell membranes. | The event is absent in animal cytokinesis. |
| Cell plate grows centrifugally. | Cleavage progresses centripetally. |
| The new cell membrane is derived from vesicles of Golgi apparatus. | The new cell membrane is usually derived from endoplasmic reticulum. |

**5. Write about Pachytene and Diplotene of Prophase I?**

**Pachytene (Pachus-thick):** The chromosomes are visible as long paired twisted threads. The pairs so formed are called **bivalents**.

Each bivalent now contains four chromatids (**tetrad stage**). Homologous chromosomes of each pair begin to separate.

They do not completely separate, but remain attached together at one or more points by X- shaped arrangements known as **chiasmata**.

The chromatids break at these points and the broken segments may be interchanged (crossing over). As a result, the **genetic recombination** takes place.

**Diplotene:** Each individual chromosome of each bivalent begins to split longitudinally into two similar chromatids.

The homologous chromosomes repel each other and separate. Chiasmata begin to move along the length of the chromosome from the centromere towards the end resulting in **terminalization**.

---

## Creative Questions

**1. List out the unique futures of the chromosome?**

- Control activities of the cell.
- Genetic information copied from cell to cell while the cell divides.
- Hereditary characters are passed on to new individuals when gametic cells fuse together in sexual reproduction.

**2.Different time duration of the cell cycle?**

| Phase | Time duration (in hrs) |
|---|---|
| G1 | 11 |

| | |
|---|---|
| S | 8 |
| G2 | 4 |
| M | 1 |

**3.What do you mean by understand the diploid and haploid state?**

In mitosis, the daughter cells formed will have the same number of chromosomes as the parent cell, typically **diploid** (**2n**) **state**.

Mitosis is the nuclear division that occurs when cells grow or when cells need to be replaced and when organism reproduces asexually.

In meiosis, the daughter cell contains half the number of chromosomes of the parent cell and is known as **haploid state (n)**.

**4.What is the Amitosis (Direct Cell Division)?**

Amitosis is also called **direct** or **incipient cell division**. Here there is no spindle formation and chromatin material does not condense. It consists of **two** steps.

**Karyokinesis:**

Involves division of nucleus.

Nucleus develops a constriction at the center and becomes dumbell shaped.

Constriction deepens and divides the nucleus into two.

**Cytokinesis:**

Involves division of cytoplasm.

Plasma membrane develops a constriction along nuclear constriction.

It deepens centripetally and finally divides the cell into two cells.

Example: Cells of mammalian cartilage, macronucleus of *Paramecium* and old degenerating cells of higher plants.

**5.Define equational division**?

The number of chromosomes in the parent and the daughter (Progeny) cells remain the same so it is also called as **equational division**.

**6.What is the Closed and Open Mitosis?**

In closed mitosis, the nuclear envelope remains intact and chromosomes migrate to opposite poles of a spindle within the nucleus.

Example: Many single celled eukaryotes including yeast and slime molds.

**7.Write about the few lines of lampbrush chromosome?**

The chromosomes are very actively transcribed in females as the egg stores up materials for use during embryonic development. In animals, the chromosomes have prominent loops called **lampbrush chromosome**.

**8.List out the Difference between mitosis in Plants and Animals?**

| **Plants** | **Animals** |
|---|---|

| | |
|---|---|
| Centrioles are absent | Centrioles are present |
| Asters are not formed | Asters are formed |
| Cell division involves formation of a cell plate | Cell division involves furrowing and cleavage of cytoplasm |
| Occurs mainly at meristem | Occurs in tissues throughout the body |

**9.What is the Mitotic Poisons (Mitotic Inhibitors)?**

Certain chemical components act as inhibitors of the mitotic cell division and they are called **mitotic poisons**.

**10.What is the Endomitosis?**

The replication of chromosomes in the absence of nuclear division and cytoplasmic division resulting in numerous copies within each cell is called **endomitosis**.

**11.Give a detailed account on Mitosis? (5 mark)**

It was first discovered by Fleming in 1879. In this cell division one parent cell divides into two identical daughter cells, each with a nucleus having the same amount of DNA, same number of chromosomes and genes as the parent cells. It is also called as **equational division**. Mitosis consists of two events, they are: 1. Karyokinesis 2. Cytokinesis

**Interphase:** It is the **resting phase** of the nucleus. It is the interval between two successive cell divisions. The cell prepares itself for the next cell division.

**1. Karyokinesis**

The division of the nucleus into two daughter nuclei is called Karyokinesis. It consists of four phases. They are: Prophase, Metaphase, Anaphase and Telophase.

**Prophase (pro-first):** During this stage chromosomes become short and thick and are clearly visible inside the nucleus. Centrosome splits into centrioles and occupy opposite poles of the cell. Each centriole is surrounded by **aster rays**. Spindle fibres appear between the two centrioles. Nuclear membrane and nucleolus disappear gradually.

**Metaphase (meta – after):** The duplicated chromosomes arrange on the equatorial plane and form the metaphase plate. Each chromosome gets attached to a spindle fibre by its centromere. The centromere of each chromosome divides into two each being associated with a chromatid.

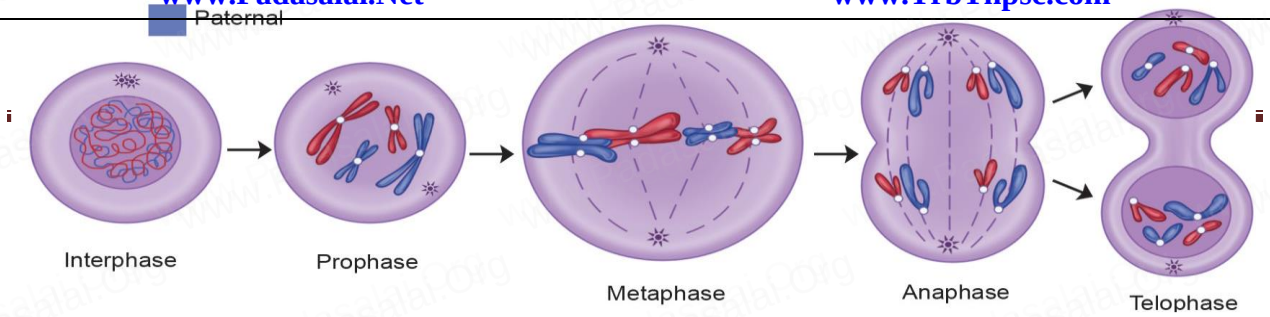
**Anaphase (ana – up, back):** The centromeres attaching the two chromatids divide and the two daughter chromatids of each chromosome separate and migrate towards the two opposite poles.

**Telophase (tele – end):** Each chromatid (or) daughter chromosome lengthens, becomes

thinner and turns into a network of chromatin threads. Spindle fibres breakdown and disappear. Nuclear membrane and nucleolus reappear in each daughter nucleus.

**2. Cytokinesis**

The division of the cytoplasm into two daughter cells by constriction of the cell membrane is called cytokinesis.




**Significance of Mitosis**

1. This equational division results in the production of diploid daughter cells (2n) with equal distribution of genetic material (DNA).

2. In multicellular organisms' growth, organ development and increase in body size are accomplished through the process of mitosis

3. Mitosis helps in repair of damaged and wounded tissues by renewal of the lost cells.

**12.Describe the Meiosis cell division? (5 Mark)**

The term meiosis was coined by Farmer in 1905. It is the kind of cell division that produces the sex cells or the gametes. It is also called reduction division because the chromosome number is reduced to haploid (n) from diploid (2n). Meiosis produces four daughter cells from a parent cell. Meiosis consists of two divisions. They are:

**Heterotypic Division** or First Meiotic Division

**Homotypic Division** or Second Meiotic Division

**A. Heterotypic division**

It divides the diploid cell into two haploid cells. The daughter cells resulting from this division are different from the parent cell in the chromosome number (Heterotypic). This consists of 5 stages:

a. Prophase I b. Metaphase I

c. Anaphase I d. Telophase I

e. Cytokinesis I

**a. Prophase I**

Prophase I takes a longer duration and is sub divided into five stages. They are: Leptotene, Zygotene, Pachytene, Diplotene and Diakinesis.

**Leptotene:** The chromosomes become uncoiled and assume long thread like structures and take up a specific orientation inside the nucleus. They form a **bouquet stage**.

**Zygotene (Zygon-adjoining):** Two homologous chromosomes approach each other and begin to pair. Pairing of homologous chromosomes is called as **synapsis**.

**Pachytene (Pachus-thick):** The chromosomes are visible as long paired twisted threads. The pairs so formed are called **bivalents**. Each bivalent now contains four chromatids (**tetrad stage**). Homologous chromosomes of each pair begin to separate. They do not completely separate, but remain attached together at one or more points by X- shaped arrangements known as **chiasmata**. The chromatids break at these points and the broken segments may be interchanged (crossing over). As a result, the **genetic recombination** takes place.

**Diplotene:** Each individual chromosome of each bivalent begins to split longitudinally into two similar chromatids. The homologous chromosomes repel each other and separate. Chiasmata begin to move along the length of the chromosome from the centromere towards the end resulting in **terminalization**.

**Diakinesis:** The paired chromosomes are shortened and thickened. The nuclear membrane and nucleolus begin to disappear. Spindle fibres make their appearance.

**b. Metaphase I**

The chromosomes move towards the equator and finally they orient themselves on the equator. The two chromatids of each chromosome do not separate. The centromere does not divide.

**c. Anaphase I**

Each homologous chromosome with its two chromatids and undivided centromere move towards the opposite poles of the cell. This stage of the chromosome is called **Diad**.

**d. Telophase I**

The haploid number of chromosomes after reaching their respective poles becomes uncoiled and elongated. The nuclear membrane and the nucleolus reappear and thus two daughter nuclei are formed.

**e. Cytokinesis I:** The cytoplasmic division occurs and two haploid cells are formed.

**B. Homotypic Division**

In this division, the two haploid cells formed during first meiotic division divide into four haploid cells. The daughter cells are similar to parent cell in the chromosome number (Homotypic). It consists of five stages.

a. Prophase – II b. Metaphase – II

c. Anaphase – II d. Telophase – II

e. Cytokinesis – II

**a. Prophase II:** The centriole divides into two, each one moves to opposite poles. Asters and spindle fibres appear. Nuclear membrane and nucleolus disappear.

**b. Metaphase II:** The chromosomes get arranged on the equator. Two chromatids are separated.

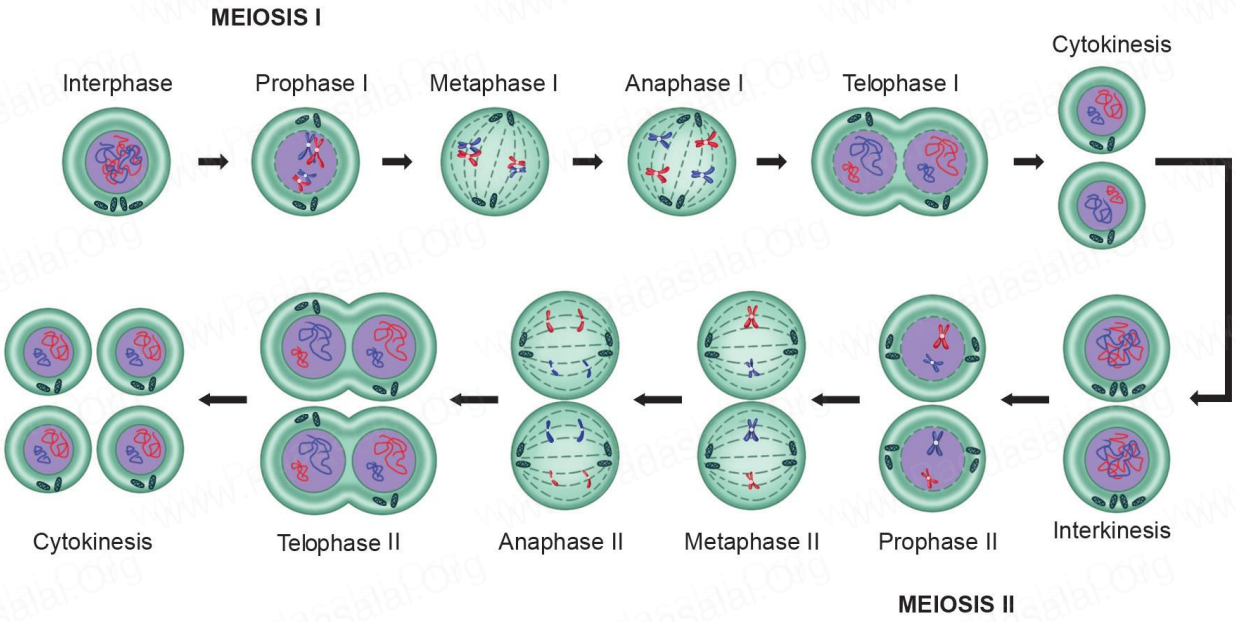
**c. Anaphase II:** The separated chromatids become daughter chromosomes and move to opposite poles

**d. Telophase II:** The daughter chromosomes are centered. The nuclear membrane and the nucleolus appear.

**e. Cytokinesis II:** Two cells are formed from each haploid daughter cell, resulting in the formation of four cells with haploid number of chromosomes.

**Significance of Meiosis**

The constant number of chromosomes in a given species is maintained by meiotic division.



# A.VINOTH KUMAR., DGD., M.Sc., M.Phil. Ph.D (Botany)

Notes Prepared By

**Mr.A.VINOTH KUMAR**. DGD, M.Sc., M.Phil.,Ph.D

PG. Assistant in Botany

Jai Sakthi Matric Higher Secondary School

Palacode. Dharmapuri Dt.,

Cell No-6369060979