

## 7. Study of meiosis in onion flower bud with the help of permanent slides.

Date :     /     /

**Aim :- To study and identify different stages of meiosis.**

**Principle :-**

Meiosis is a special type of cell division that occurs in the diploid reproductive or germ tissue (cells). It is a reduction division that results in the formation of four haploid daughter cells each receiving half of the total number of chromosomes than those present in the mother cell from which it is produced.

**Observation :-**

For the preparation of meiosis slides, generally anther of Lily or Onion is used. Meiosis can be studied with the help of stained permanent slides of T. S. of anther.

Permanent slides should be observed under high power of compound microscope.

Meiosis as a process occurs in two steps viz. A) Meiosis -I B) Meiosis -II

**I. Meiosis -I :** is a reduction division in which chromosome number is reduced to half of the number of chromosomes present in the parent cell. It is completed into two stages- A) Karyokinesis I and B) Cytokinesis I.

**A. Karyokinesis I:** It takes place in four sub stages.

**1. Prophase I :-** It is an initial and very lengthy phase, further divided into five sub-stages

**i. Leptotene :-** Chromosomes appear like long, thin, beaded threads.

**ii. Zygotene :-** It is characterised by pairing of homologous chromosomes called 'Synapsis'. Paired chromosomes are called **bivalents** or **tetrad**.

**iii. Pachytene :-** Each bivalent or tetrad consists of four chromatids (two pairs) and each pair is united by a centromere. In this stage crossing over (X shaped chiasmata) occurs in between two non-sister chromatids of bivalent. Exchange of genetic material or chromatid segments takes place which results in recombination that leads to variation and thus the evolution of the organism.

**iv. Diplotene :-** After crossing over, homologous chromosomes start repelling from each other but remain attached at the chiasmata.

**v. Diakinesis :-** Terminalisation i.e. shifting of chiasmata toward end of chromatid takes place. Nucleolus and nuclear membrane completely disorganize and disappear.

**2. Metaphase I :-**

**i.** An imaginary line (Equatorial plane) develops at the centre of the cell.

**ii.** The pair of chromosomes (Bivalents) arranged at the plane in such a way that they lie equidistant on either side of plane, their arms towards the equator and centromere towards the pole.

**iii.** At the end, spindle formation takes place which helps in arrangement and movements of chromosomes.

**iv.** Members of each bivalent are connected to only one of the two poles but opposite poles.

**3. Anaphase I :-**

**i.** It is an important stage of meiosis-I, as reduction division takes place in this stage i.e. chromosome number is reduced to half of the total number.

**ii.** Tactile (spindle) fibres start condensing, become shorter and pull chromosomes (homologues) toward opposite poles.

iii. It results in the separation and dragging of recombined homologous chromosomes towards opposite poles.

#### **4. Telophase I :-**

- i. In this phase chromosomes reach the opposite poles.
- ii. Nucleolus gets reorganized and then reappears.
- iii. Nuclear membrane gets developed around each set of chromosomes, forming two daughter nuclei. This is how Karyokinesis-I comes to an end.

#### **B) Cytokinesis I :-**

1. It occurs by formation of the cell plate in plant cell, which is formed at the equator of the dividing cell.
2. Two daughter cells formed are having single, haploid nucleus each.

This is the end of meiosis-I. At the end of meiosis-I, two daughter cells are formed which are qualitatively different from each other but are quantitatively identical. Both the cells now undergo meiosis-II simultaneously.

The interphase following meiosis-I does not involve duplication of genetic material.

### **II. Meiosis - II : It is also divided into A) Karyokinesis II and B) Cytokinesis II**

#### **A) Karyokinesis II :- It consists of four sub stages**

##### **1) Prophase II :-**

Events occurring in prophase-II are like mitotic prophase, however the chromosomes are recombinants.

- i. It is the initial phase.
- ii. The nucleus enlarges.
- iii. Chromosomes becomes prominent, shorter and thicker.
- iv. Nucleolus and nuclear membrane disappear.

##### **2) Metaphase II :-**

- i. In this stage, an imaginary line develops forming the equatorial plane which is at right angle to the previous division.
- ii. Chromosomes get arranged along the equatorial plane in such a way that the centromere lie on the plane the arms towards the poles.
- iii. At the end spindle formation takes place.

##### **3) Anaphase II-**

- i. Centromere divides and sister chromatids get separated which are now called as daughter chromosomes.
- ii. Tactile (spindle fibres) fibres start condensing becoming shorter and shorter pulling daughter chromosomes up to the opposite poles.

##### **4) Telophase II-**

- i. Daughter chromosomes get collected at the opposite poles.
- ii. Reappearance of nucleolus and nuclear membrane results in the formation of two daughter nuclei.

At the end of Karyonesis II, four nuclei are formed.

#### **B) Cytokinesis II :-**

1. In plant, cell plate formation takes place at the centre of the cell.

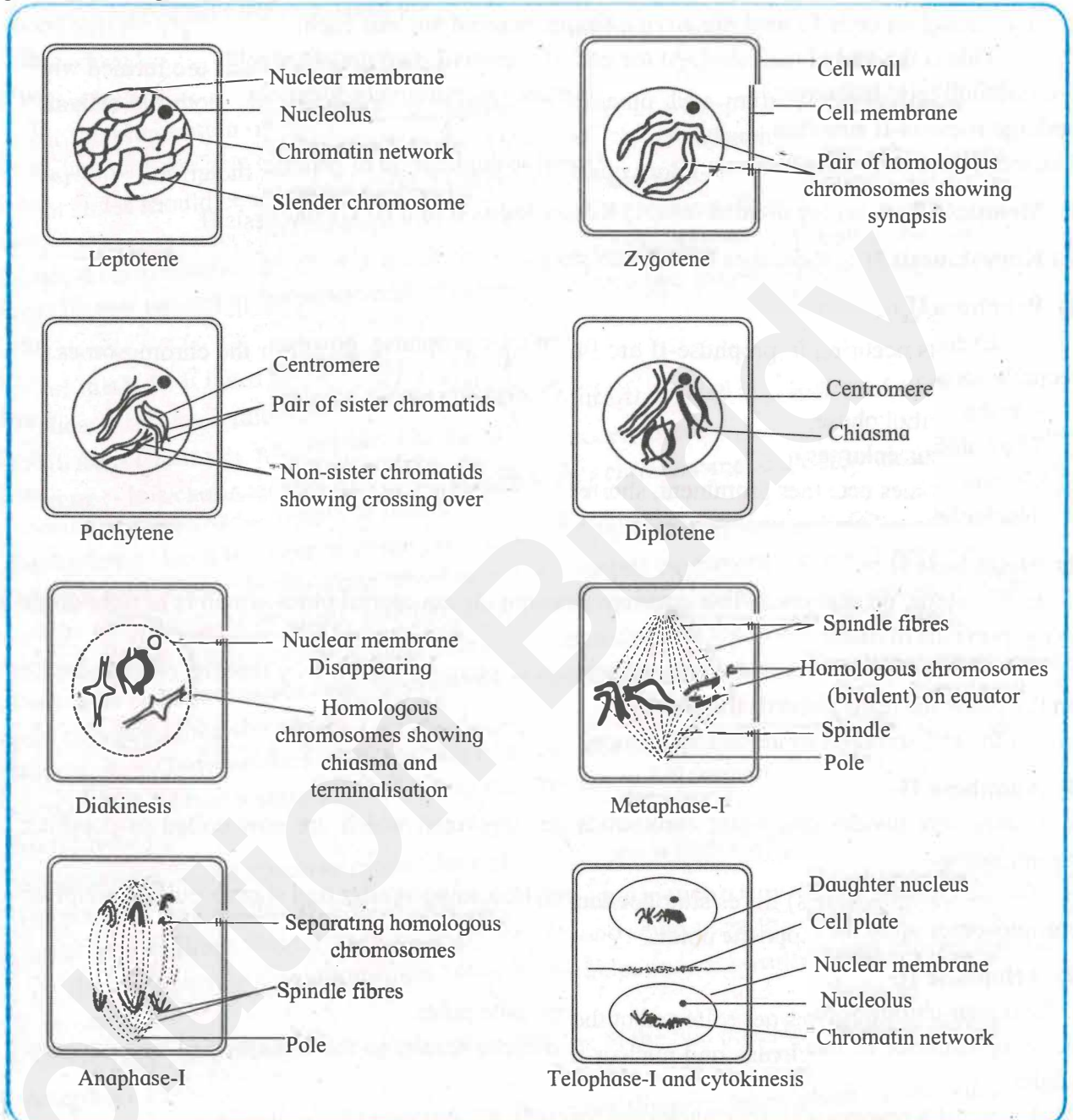
2. It forms four daughter cells called as tetrads.

Thus in the process of meiosis, single diploid cell gives rise to four daughter cells which later metamorphose to form either spores or gametes.

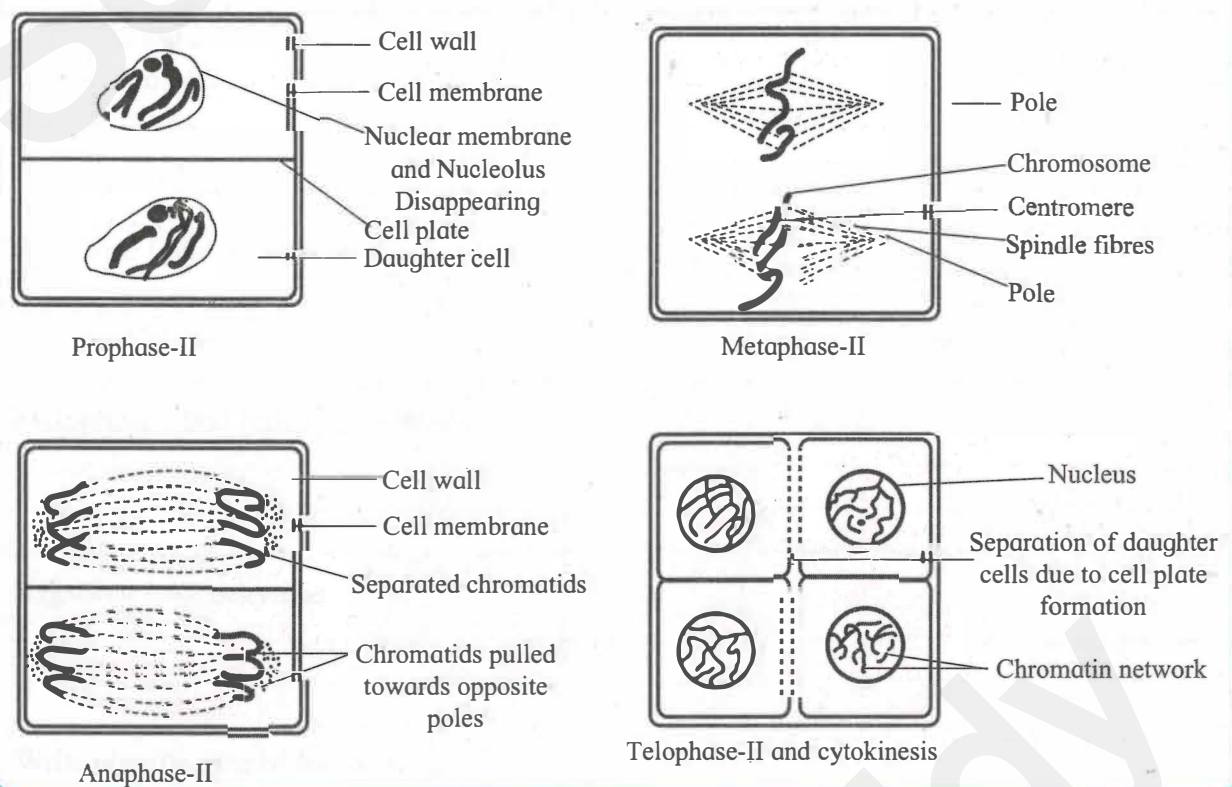
**\* Sometimes but rarely anaphase-I is directly followed by prophase-II so that telophase-I and cytokinesis-I are skipped.**

**Significance of Meiosis :-** Crossing over at pachytene, alignment of bivalents at the equator and the anaphasic-I separation, eventually lead to variations.

It helps in restoring the chromosome number of a species that remains constant from generation to generation.

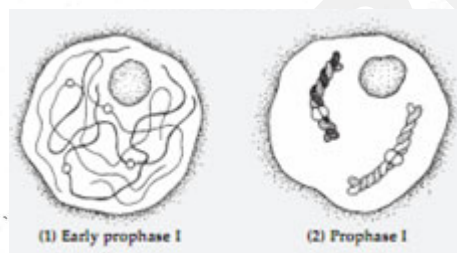


**Fig. (a) Stages of Meiosis I**



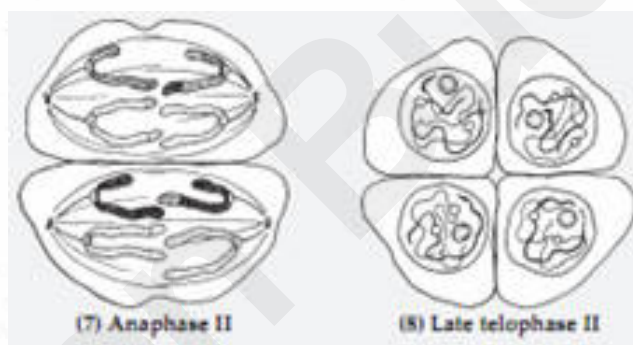
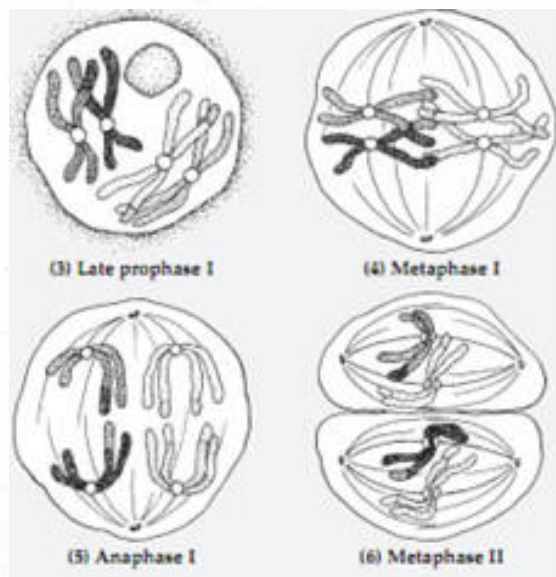
**Fig. (b) Stages of Meiosis II**

**Sketch diagram 1 & 2:**





**Sketch diagrams :**



## Questions

### 1. Differentiate :

#### a. Mitosis and Meiosis

Mitosis- type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus, typical of ordinary tissue growth.

Meiosis- a type of cell division that results in two daughter cells each having the same number and kind of chromosomes as the parent nucleus, typical of ordinary tissue growth.

#### b. Anaphase I and Anaphase II

##### Anaphase I

1. Anaphase I occurs in diploid cells
2. It results in the separation of chromosomes
3. In this one centromere remains intact.
4. In this chromosome separates to opposite poles and sister chromatid remains together

##### Anaphase II

1. Anaphase II occurs in haploid cells
2. It results in the separation of sister chromatids.
3. In this two centromeres gets split.
4. In this two chromosomes get separate splitting the centromere and sister chromatids.

#### c. Metaphase I and mitotic metaphase

##### Metaphase I of meiosis

1. Chromosomes form two parallel plates in metaphase I
2. On equatorial plate, chromosomes appear four threaded in metaphase I
3. Tetrads of chromosomes lie at the metaphase plate.
4. The chromosomes of two pairs are put together. Thus, crossing over occurs.
5. Centromeres of chromosomes remain undivided.
6. Chromosome forms loop.

##### Metaphase of mitosis

All chromosomes form a single plate in metaphase. On the equatorial plate, chromosomes appear two threaded.

Individual chromosome align at metaphase plate

The chromosome of only one pair are put together so, no crossing over occurs

Centromeres of chromosomes align at the equatorial plate.

Chromosome do not form loop

#### d. Zygotene and pachytene

##### Zygotene

1. is the second sub-stage of prophase during which homologous chromosomes pair with each other aligning their corresponding genetic information
2. third sub-stage of prophase 1
3. crossing over of genetic material occurs between non-sister chromatids

##### Pachytene

is the sub-stage of prophase-1 during which the genetic combination takes place between non-sister chromatids of homologous chromosomes.

second sub-stage of prophase-1  
synapsis begins with a synaptonemal complex, forming between homologous chromosomes.

### 2. Write significance of Meiosis.

Meiosis is responsible for the formation of sex cells or gametes that are responsible for sexual reproduction. It activates the genetic information for the development of sex cells and deactivates the sporophytic information. It maintains the constant number of chromosomes by halving the same.

### 3. Why should meiosis II occur, when a reduction in the chromosome number has already occurred in meiosis I ?

Meiosis comprises of two divisions- meiosis I and meiosis II. The meiosis I is reductional division in which the number of chromosomes are reduced to one half. Crossing over occurs during meiosis I. The meiosis II is simple division like mitosis and does not involve crossing over or reduction in number of chromosomes. The meiosis II serves to increase the number of daughter cells from 2 to 4.

### 4. What is crossing over ?

Crossing over is the exchange of genetic material between non-sister chromatids of homologous chromosomes during meiosis, which results in new allelic combinations in the daughter cells.

### 5. Enlist the different stages of prophase I.

Leptotene  
Zygotene  
Pachytene  
Diplotene  
Diakinesis.

Remark and Signature of Teacher .....