Exercise 7

Aim: Study of stages of meiosis using permanent slides

Principle: Meiosis is a type of cell division in which the number of chromosomes is halved (from diploid to haploid) in the daughter cells, i.e., the gametes. The division is completed in two phases, meiosis I and meiosis II. Meiosis I is a reductional division in which the chromosomes of homologous pairs separate from each other. Meiosis II is equational division resulting in the formation of four daughter cells. Stages of meiosis can be observed in a cytological preparation of the cells of testis tubules or in the pollen mother cells of the anthers of flower buds.

Requirement: Permanent slides of meiosis and compound microscope

Procedure

Place the slide on the stage of the microscope and search for the dividing cells using lower magnification. When dividing cells are located observe them under higher magnification.

Observation

Observe various stages of meiosis and identify them on the basis of the specific features given in the table 7.1. A significant number of cells will be in the Interphase. These cells have a centrally positioned densely stained nucleus. In case of slide of animal tissue a few mitotically dividing spermatogonial cells may also be seen.

Table 7.1 Different stages of meiosis and their features

Meiosis I	
1. Prophase I	Unlike the prophase of mitosis, it is a comparatively complex phase characterised by a number of events. Five sub-phases can be identified in it. **(a) Leptotene** (*leptos* = slender *tene* = band or thread) (i) The nuclear membrane and nucleolus are not distinctly observable (Fig. 7.1 a). (ii) Fine network of thin threads are seen uniformly distributed in the nucleus.These are chromatin threads, which may be observed as more prominent structures in the later stages.

(a) Leptotene

(b) Zygotene

(c) Pachytene

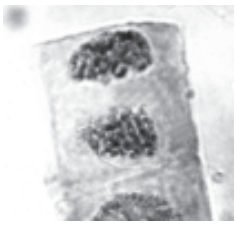
(d) Diplotene-Diakinesis

Fig. 7.1 Sub-phase of Prophase I (a-d) – actual microscopic view on left side and its diagrammatic representation on the right hand side

	(b) Zygotene (*Zygon* = paired) This stage is characterised by the pairing of the homologous chromosomes, which can be seen as paired chromatin threads (**bivalents**) (Fig. 7.1b). **(c) Pachytene** (*pachy* = thick) The chromatin threads get condensed and appear shortened and thick. Pairs of homologous chromosomes can be seen. Each chromosome has two chromatids and thus each bivalent consists of four chromatids. This configuration is called tetrad (Fig. 7.1c). **(d) Diplotene** (*diplos* = double) The homologous chromosomes (each made up of two chromatids) show distinct separation from each other except at few regions where attachments are seen (Fig. 7.1d). These are **chiasmata** (sing. chiasma) representing the site of exchange of the parts between two homologous chromosomes (i.e. crossing over). **(e) Diakinesis** *(Dia = opposite; kinesis= separation or movement)* (i) The homologous pair of chromosomes appear more shortened, thick and prominent (Fig. 7.1d). (ii) Chiasmata can be still observed. (iii) All the homologous pairs appear scattered in the cell.
2. Metaphase I	Homologous chromosomes are still in pairs, and are arranged along the equatorial plane of the cell (Fig. 7.2a). At this stage, the number of bivalents can be counted. Chiasmata may still be seen in a few bivalents.
3. Anaphase I	The chromosome pairs appear to have moved towards the two opposite poles of the cell. At the later stage, the anaphase - I may show the assembly of chromosomes at two poles (Fig. 7.2b). This results into the reduction of number of chromosomes to half. This stage can be identified by the presence of two chromatids in each chromosome.
4. Telophase I	The chromosomes present at the two poles appear decondensed and form two distinct nuclei (Fig. 7.2c). **Note**: *After the telophase I stage there may or may not be cytokinesis. Thereafter the cell enters into the second meiotic division.*
Meiosis II	
1. Prophase II	(i) Distinct thread- like chromatin fibres or rod- shaped chromosome are seen.

(a) Metaphase I

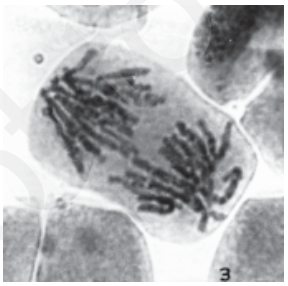
(b) Anaphase I



(c) Telophase I

Fig. 7.2 Phases of Meosis I (a-c) – actual microscopic view on left side and its diagrammatic representation on the right hand side.

(a) Metaphase II



(b) Anaphase II

Fig.7.3 Phases of Meosis II (a,b) – actual microscopic view on left side and its diagrammatic representation on the right hand side.

2. Metaphase II	This phase is similar to that of mitotic division (i) The chromosomes having two chromatids attached at the centromere are observed arranged at the equatorial plane of the cell.
	Note: *Metaphase II of meiosis can be differentiated from metaphase-I on the basis of the following features:* (ii) Each chromosome of metaphase II has two chromatid (Fig. 7.3a) whereas in metaphase I these are paired homologous chromosomes each having two chromatids thus forming tetrad. (iii) In the metaphase I of meiosis, a few chiasmata are observed, where as no chiasmata are observed during metaphase II.
3. Anaphase II	The two chromatids of each chromosome after separation appear to lie at the two poles of the cell (Fig. 7.3b).
	Note: *Anaphase II can also be distinguished from the anaphase I of meiotic division on the basis of chromatids: In anaphase I, each chromosome has two distinct chromatids, but in anaphase II, each chromosome is represented by one chromatid only.*
4. Telophase II	The separated chromosomes appear decondensed and form nuclei (Fig. 7.3c).

Questions

1. What is the significance of meiosis?
2. What is synapsis and crossing over?
3. How can anaphase I and anaphase II be distinguished from each other?
4. Indicate distinguishing feature of metaphase I of meiosis and metaphase of mitosis.
5. How many daughter cells are produced at the end of meiosis?
6. The daughter cells produced at the end of meiosis are genetically different. Explain.
7. What is the significance of synapsis?