

# Exercise 6

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**Aim:** Study of mitosis.

**Principle:** Somatic growth of both plants and animals takes place by increase in the number of cells. The cells divide mitotically wherein number of chromosomes remains unchanged in the daughter cells from that in the maternal cells. Cells from the growing root-tips and apex of shoot buds are suitable for mitotically dividing cells. In animals mitotically dividing cells can be easily scored from the bone marrow of a vertebrate. The cell from the epithelium of gills in fishes and from the tail of growing tadpole larvae of frog are also good sources for scoring the mitotically dividing cells.

**Requirement:** Permanent slides available in the laboratory, compound microscope.

## Procedure

Place the slide on the stage of a good quality compound microscope. First observe it under the lower magnification (10X objective) to search the dividing cells. Observe the dividing cell under higher magnification (40X objective) of the microscope.

## Observation

The stages of mitosis can be broadly put into two events: karyokinesis (division of nucleus) followed by cytokinesis (division of cytoplasm, and ultimately of the cell). Those cells, which are not in the phases of cell division are considered to be in interphase.

You will observe that most of the cells in a particular microscopic field are in interphase.

## Interphase

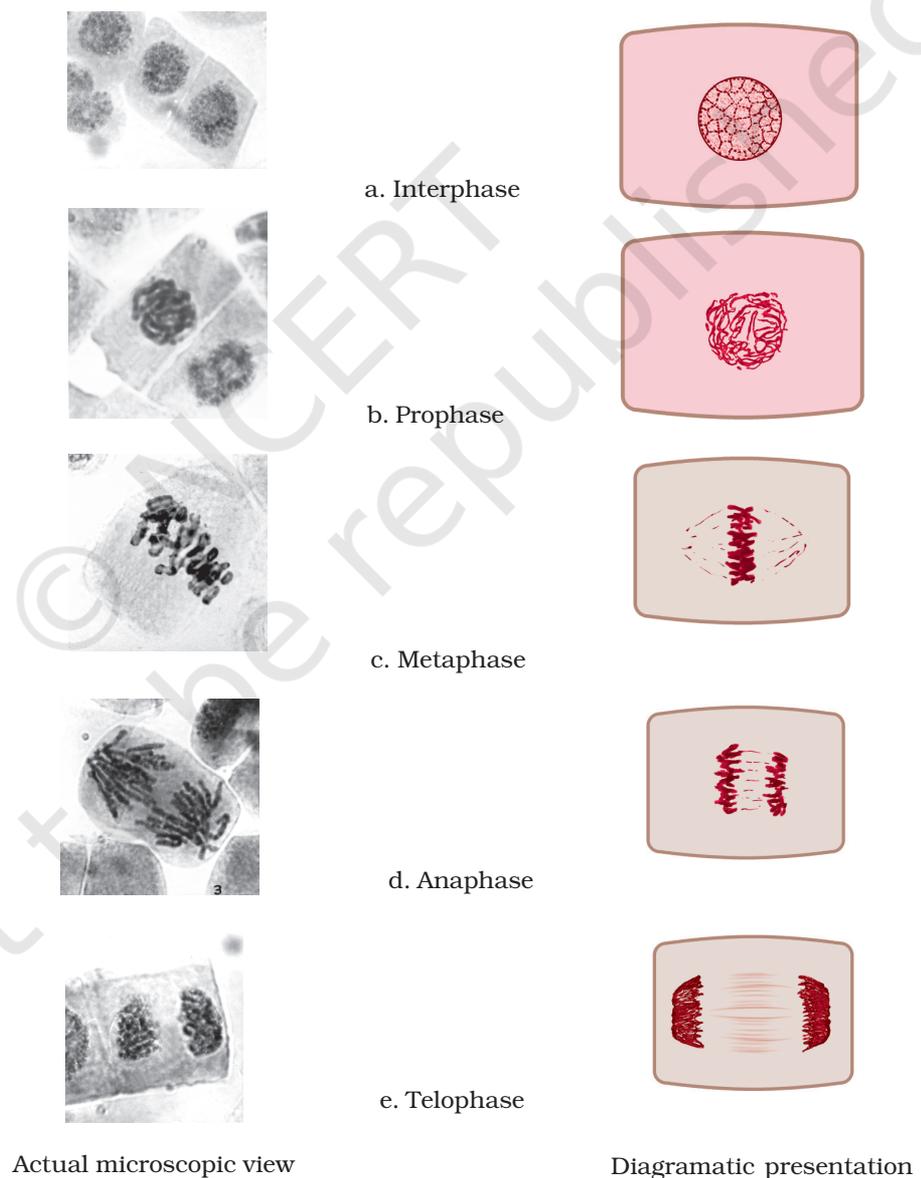
The cells are mostly rectangular, oval or even circular in shape, with almost centrally situated densely stained nucleus. The chromatic (coloured) material of the nucleus is homogeneous and looks granular. The boundary of the nucleus is distinct. One or few nucleoli (*Sing:* nucleolus) can also be observed inside the nucleus (Fig. 6.1a).

## STAGES OF MITOSIS

### (a) Prophase

Intact nuclear outline is seen. The chromatin (seen as a homogeneous material in the nucleus at interphase) appears as a network of fine threads (chromosomes). Nucleoli may or may not be visible (Fig. 6.1b).

If the cell under observation is in the early stage of prophase then the chromatin fibres (chromosomes) are very thin. However, in the cells at late prophase, comparatively thicker chromatin fibres would be visible. Besides this, in the late prophase the nuclear membrane may not be noticed.



**Fig. 6.1** Interphase (a) and stages of mitosis (b - e)

## Exercise 6

### (b) Metaphase

The nuclear membrane disappears. Chromosomes are thick and are seen arranged at the equatorial plane of the cell (Fig. 6.1c). Each chromosome at this stage has two chromatids joined together at the centromere, which can be seen by changing the resolution of the microscope. Nucleolus is not observed during metaphase.

### (c) Anaphase

This stage shows the separation of the chromatids of each chromosome. The chromatids separate due to the splitting of the centromere. Each chromatid now represents a separate chromosome as it has its own centromere. The chromosomes are found as if they have moved towards the two poles of the cell. The chromosomes at this stage may look like the shape of alphabets 'V', 'J' or 'I' depending upon the position of centromere in them. Different anaphase cells show different stages of movement of chromosomes to opposite poles, and they are designated to represent early, mid and late anaphase (Fig. 6.1d).

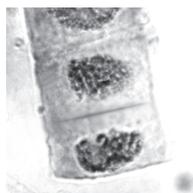
### (d) Telophase

Chromosomes reach the opposite poles, lose their individuality, and look like a mass of chromatin (Fig. 6.1e). Nuclear membrane appears to form the nuclei of the two future daughter cells.

## CYTOKINESIS

In plants, a cell plate is formed in the middle after telophase. The plate can be seen to extend outwards to ultimately reach the margin of the cell and divide the cell into two. Such cell plates are characteristic of plant cells (Fig. 6.2). However, in an animal cell, the two sides of the cell show constrictions formed from the peripheral region in the middle of the cell, which grow inward and meet to divide the cell into two daughter cells.

Draw labelled diagrams of all the phases of mitosis.



**Fig.6.2** Cytokinesis

## Questions

1. What would happen if the chromosomes fail to move during anaphase?
2. What would happen if cytokinesis does not take place after karyokinesis?
3. Which cellular elements participate in anaphase movement?
4. What would happen if mitosis  
(a) does not take place at all?  
(b) takes place at a rate faster than the normal rate?
5. Why is chromatin network seen during the prophase stage of mitosis ?

# Exercise 7

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**Aim:** To study modifications of root.

**Principle:** Roots of plants are generally meant for anchorage and absorption of water and nutrients from soil. However, in certain plants, roots perform additional functions, particularly as storage organs of photosynthates. Roots are also modified to provide additional support to weak stems or to trees which are massive. In some cases roots may help in gaseous exchange or for floating (aquatic plants). Consequently, the root morphology and structure undergoes certain modifications to perform these additional functions.

**Requirement:** Samples/charts of radish, carrot, beet, turnip, *Asparagus*, sweet potato, pneumatophores, stilt roots, climbing roots, leguminous plants showing root nodules.

## Procedure

- Carefully observe the shape and external morphology of each specimen.
- Draw diagrams and observe the morphological differences between the samples.

## Observation

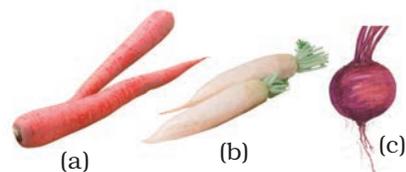
Some modifications of roots are discussed below:

### (i) For storage of food

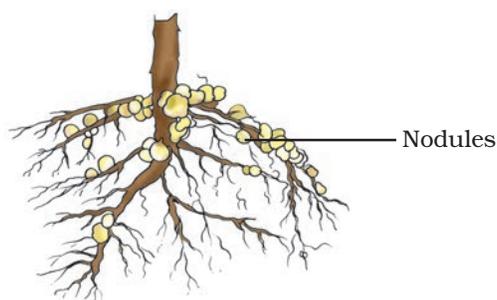
Roots are modified in some plants for storing reserve food materials. These modified roots usually are swollen and assume different forms such as spindle shaped, e.g., radish; top shaped, e.g., beet, turnip; conelike, e.g., carrot; indefinite shape, e.g., sweet potatoes (Fig. 7.1). *Dahlia*, *Asparagus*, *Portulaca* are some other examples of plants with modified roots for food storage.

### (ii) Nodulated roots

The roots of pea and other leguminous plants have numerous swollen nodules on fine branches of roots. These nodules are formed due to symbiotic association of *Rhizobium* (bacterium) that live inside the root cortical cells of the roots. They fix nitrogen. An active nodule is pink in colour (Fig. 7.2).



**Fig. 7.1** Roots modified for storage of food (a) Carrot (b) Radish (c) Turnip



**Fig. 7.2** Nodulated roots

## Exercise 7

### (iii) For mechanical support

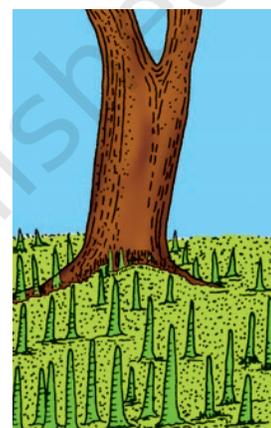
Roots are modified to provide mechanical support as seen in banyan tree which has roots growing vertically/obliquely downwards (prop roots); sugarcane/maize in which roots arise from the nodes in cluster at the base of the stem (stilt roots) and betel/black pepper in which nodes and internodes bear roots which help in climbing (Fig. 7.3).



**Fig. 7.3** Prop root of banyan tree

### (iv) For gaseous exchange

Pneumatophores or breathing roots are found in plants growing in mangroves or swamps with saline water for exchange of gases. They are erect peg like structures with numerous pores through which air circulates e.g., *Rhizophora mangle* (Fig. 7.4).



**Fig. 7.4** Pneumatophores of *Rhizophora*

## Questions

1. Why are healthy root nodules pink in colour?
2. Mention characteristics by which we can identify the modified roots as roots?
3. Prop and stilt roots are aerial in origin yet they are called roots. Why?

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