



Aim

To study the mitosis in onion root tip cells and animal (grasshopper) cells from permanent slides.

THEORY

Somatic growth in plants and animals takes place by the increase in the number of cells. A cell divides mitotically to form two daughter cells wherein, the number of chromosomes remains the same (i.e. unchanged) as in the mother cell. In plants, such divisions rapidly take place in meristematic tissues of root and shoot apex, where the stages of mitosis can be easily observed. In animals, mitotically dividing cells can be easily viewed in the bone marrow tissue of a vertebrate, epithelial cells from gills in fishes or in the tail of growing tadpole larvae of frog. Cell cycle is the sequence of stages that a cell passes through between two consecutive cell divisions. It consists of four stages, i.e. G, S, G, and M or D-phase.

Cell division phase has two parts:

1. Karyokinesis (Division of Nucleus)
 - Prophase – Appearance of chromosomes
 - Metaphase – Spindle formation and arrangement of chromosomes towards poles.
 - Anaphase – Movement of daughter chromosomes towards poles.
 - Telophase – Formation of daughter nuclei.
2. Cytokinesis Division of cytoplasm to form two daughter cells.

MATERIAL REQUIRED

Permanent slides of mitosis in onion root tip cells and animal cells (grasshopper), compound microscope, pencil, eraser, sharpener, record file and a laboratory guide.

PROCEDURE

1. Place the permanent slide on the stage of a compound microscope.
2. Observe the slide initially under lower magnification (10X objective) to locate the dividing cells.
3. Now, observe it under higher magnification (40X objective) to examine different stages of mitosis.
4. Observe all the slides in the same way.

OBSERVATIONS

Under lower magnification, rectangular cells with pink nucleus are seen scattered. Most of the cells were in interphase. Under higher magnification, different stages become distinct which can be described as follows:

INTERPHASE

1. It is a non-dividing phase of the cell cycle between two successive cell divisions.
2. The cells are mostly rectangular, oval or even circular in shape.
3. Nuclear envelope is distinct and the nucleus is homogenous, situated at centre and granular.
4. Chromatin fibres appear in the form of an interconnected network within the nucleus.

5. Nucleolus is also observed inside the nucleus.

STAGES OF MITOSIS

(a) Prophase

1. Nucleus is enlarged and occupies most of the cell volume. Intact nuclear outline is seen.
2. Chromatin (seen as homogenous material in the nucleus at interphase) gets condensed and appears as long thread-like structures called chromosomes.
3. Nuclear membrane starts disappearing.
4. If the cell is in the early stage of prophase, then the chromatin fibres are very thin. However, in the cells observed at late prophase stage, comparatively thicker chromatin fibres would be visible with no nuclear membrane.

(b) Metaphase

1. Chromosomes become shorter and thicker and hence, become distinct and clearly visible under the compound microscope.
2. Nuclear membrane completely disappears.
3. Chromosomes orient themselves at the equator with their centromeres arranged on an equatorial line forming a metaphase plate. The two chromatids face the opposite poles which can be seen by changing the resolution of microscope.
4. A bipolar spindle made up of fine spindle fibres appears in the cell in this phase.
5. In animal cells, astral rays appear around the centriole pairs at opposite poles. These aid in spindle formation and orientation by accumulation of microtubules.
6. Series of spindle fibres attach the centromeres to the opposite poles. The points of attachment are known as kinetochores.

(c) Anaphase

1. The two sister chromatids of each chromosome separate from the centromere and move towards the opposite poles.
2. Chromatids separate due to splitting of the centromere. Each chromatid now represents a separate chromosome having its own centromere.
3. The daughter chromosomes (separated chromatids) appear in V, J, L and I shapes, depending upon the position of centromere on the chromosomes.
4. Anaphase is designated as early, mid and late, depending on the position of moving chromosomes with respect to the opposite poles.

(d) Telophase

1. Chromosomes reach the opposite poles, lose their individuality and look like a mass of chromatin again.
2. Nuclear membrane reappears to form the nuclei of two future daughter cells.
3. Nucleolus gets reconstituted.
4. Two daughter nuclei formed at the two poles of a cell, are similar to the parent nucleus both quantitatively and qualitatively.

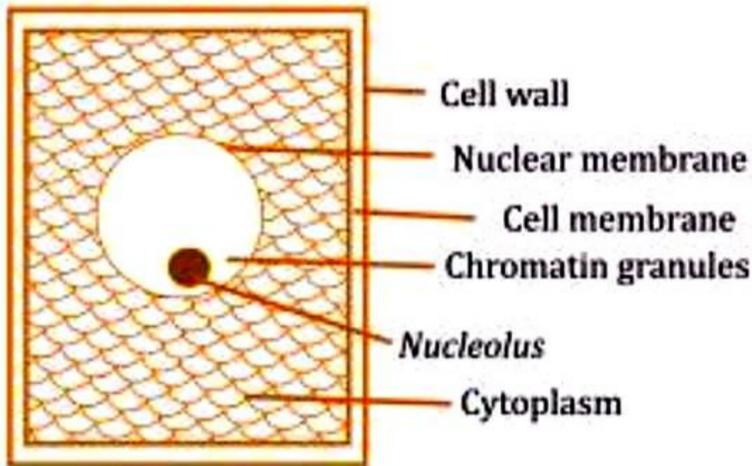
CYTOKINESIS

It is commonly known as division of the cytoplasm of parent cell into two daughter cells. Cytokinesis in plant cells is different from animal cells due to the presence of a rigid cell wall

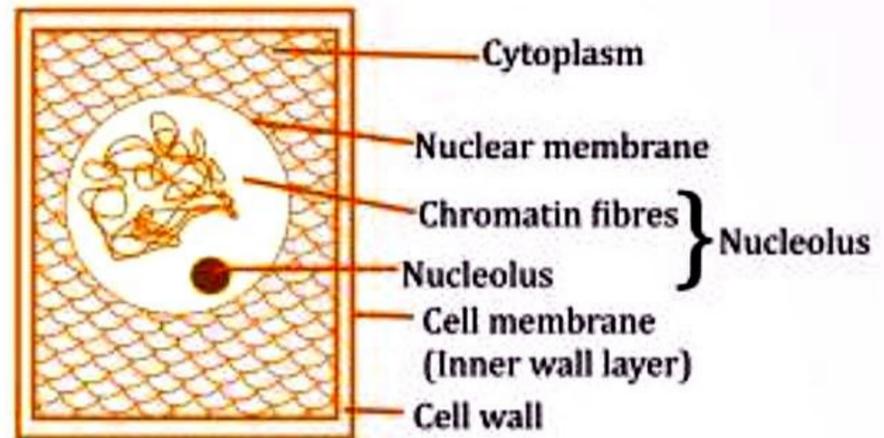
In Plant Cells

1. The cell plate is formed in the centre which extends laterally until it completely divides the cell into two halves.

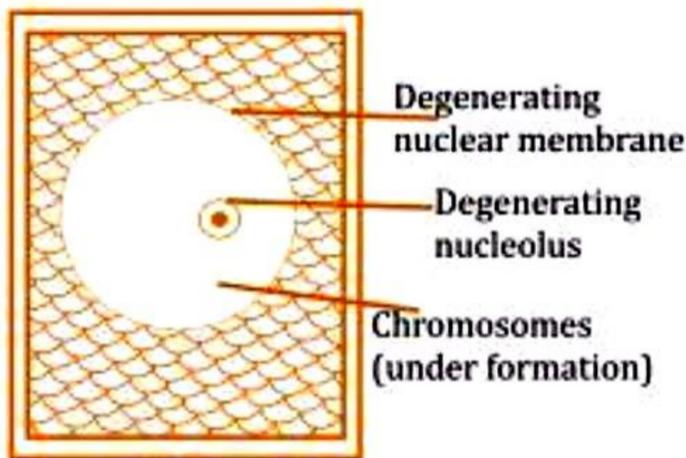
- The cell plate represents the middle lamella
- The cell wall is finally formed which produces two different cells.
- As a result of mitosis, two daughter cells are formed which are qualitatively and quantitatively similar to the parent nucleus.



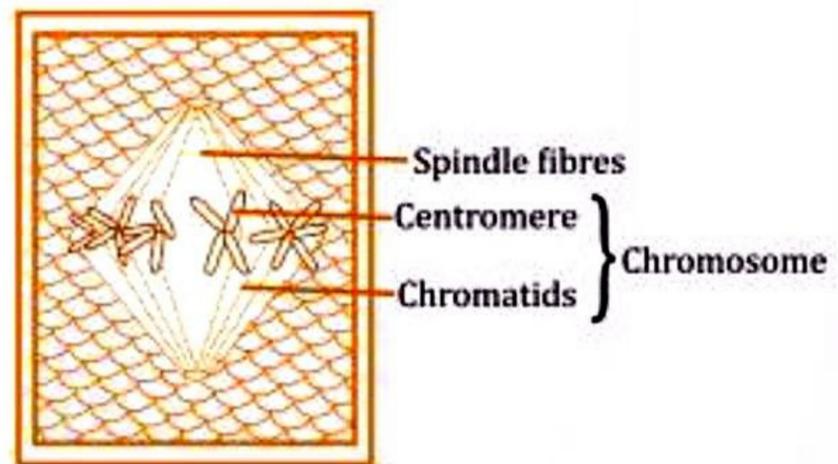
Cell at resting stage



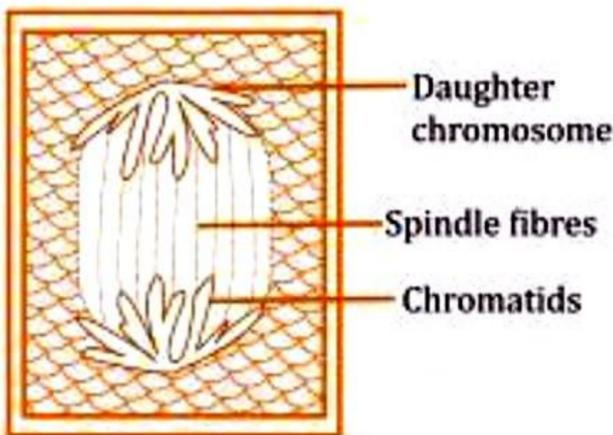
Interphase



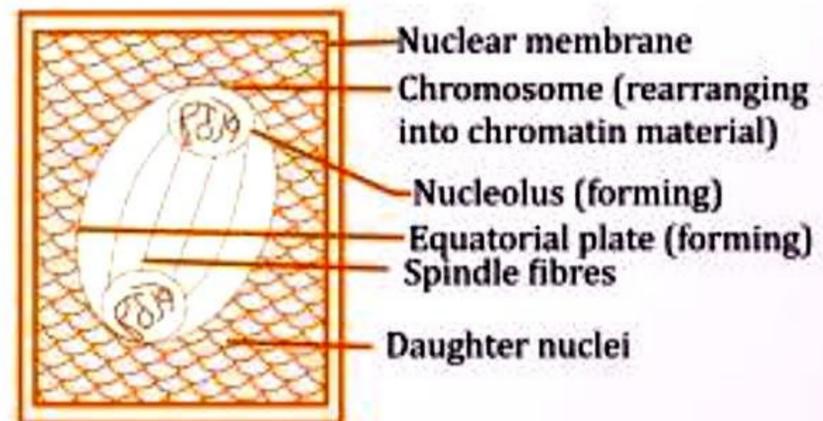
(i) Prophase



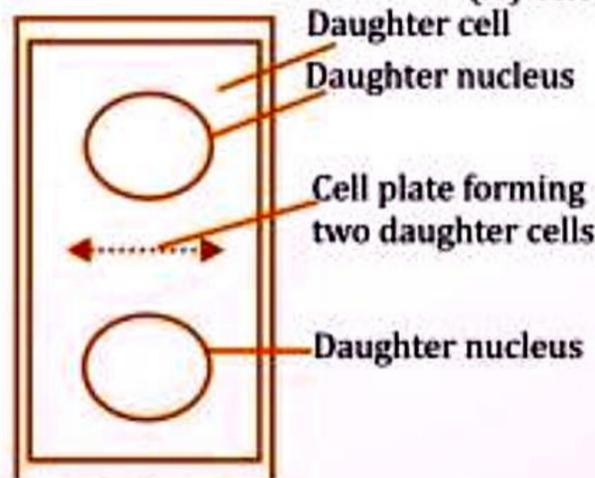
(ii) Metaphase



(iii) Anaphase



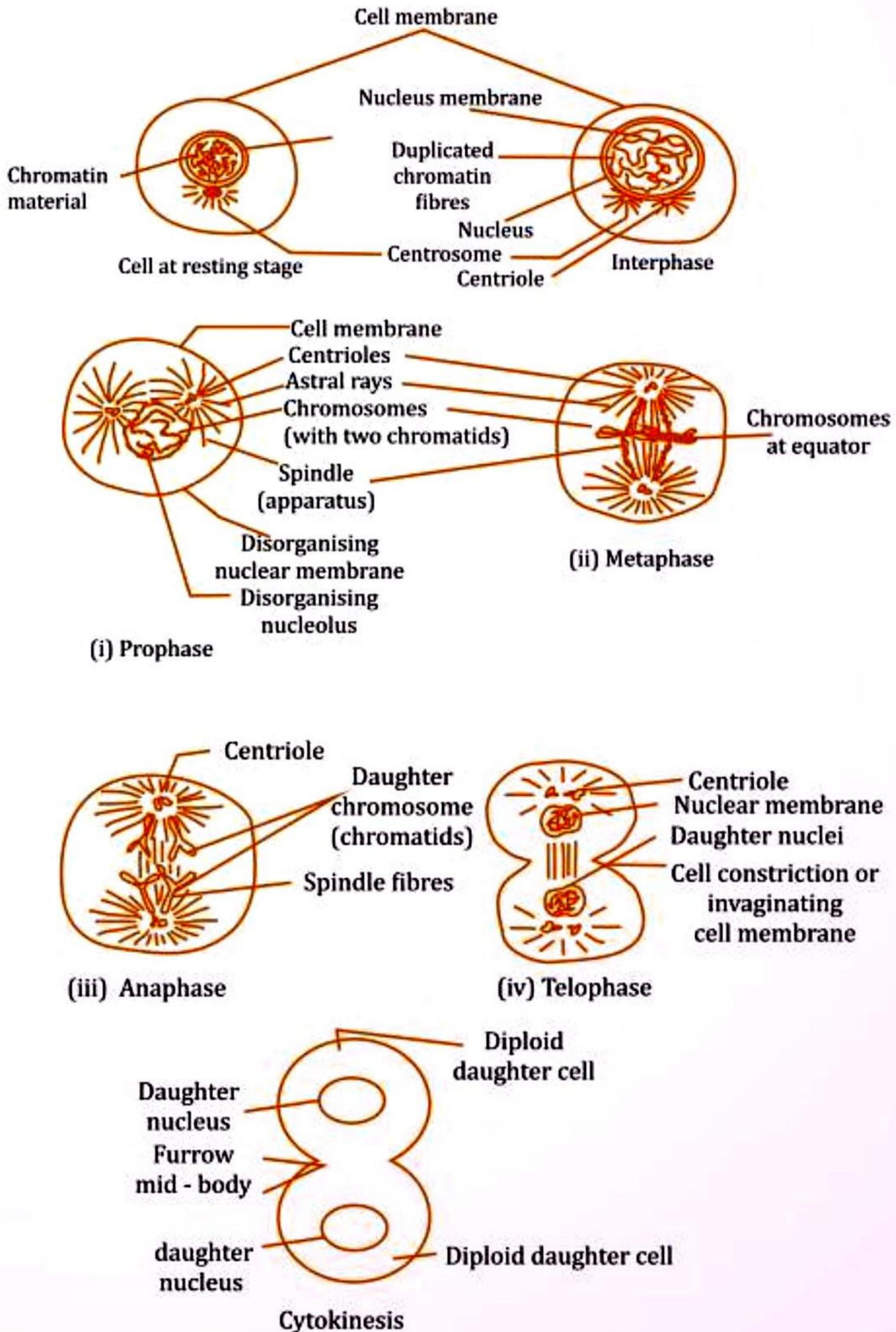
(iv) Telophase



Cytokinesis

In Animal Cells

1. In animal cells, a constriction starts developing between the two nuclei.
2. Cytokinesis in animals takes place by in folding or invagination of plasma membrane towards the middle of the parent cell and finally, the cell is pinched off into two daughter cells.



PRECAUTIONS

1. Proper care should be taken while handling the microscope.
2. Objective lens should not touch the slide.
3. Fine adjustment knob should be used, while focussing the slide under high power microscope

VIVA VOCE

Q1. Which type of cell division is seen in somatic cells?

Ans. Somatic cells show mitotic cell division.

Q2. Can we study the process of mitosis in leaf cells?

Ans. No, the process of mitosis cannot be studied in leaf cells because the cells of leaf do not divide.

Q3. To study the process of mitosis why do we use onion root tip or grasshopper larva cells?

Ans. Onion root tips and grasshopper larvae contain meristematic cells which are in dividing stage. Therefore, process of mitosis is better studied in these cells.

Q4. Name the stain which is used to study the chromosomes.

Ans. Acetocarmine is used to study the chromosomes because it stains them in deep red colour while the cytoplasm remains unstained.

Q5. Mitosis is referred as equational division. Explain why?

Ans. Mitosis is called as equational division because the two daughter cells produced as a result of mitosis, have equal number of chromosomes which are qualitatively and quantitatively similar to the parent cell.

Q6. At which stage of cell division do the chromatids start moving to opposite poles?

Ans. At anaphase stage, the chromatids start moving to opposite poles.

Q7. Where do the spindle fibres originate from?

Ans. Spindle fibres originate from centriole in animals and from cytoplasm in plants.

Q8. What is daughter chromosome?

Ans. At anaphase, each chromatid behaves as an independent chromosome and is known as daughter chromosome.

Q9. Who was the first to observe the process of mitosis in plant cell?

Ans. Strass burger was the first to observe the mitotic cell division in plant cell (1882).

Q10. What is the difference between karyokinesis and cytokinesis?

Ans. Karyokinesis is the division of nucleus into two daughter nuclei, while cytokinesis is the division of cytoplasm along with cell organelles into two daughter cells.

Q11. At which stage of cell division, chromosomes can be best seen?

Ans. Chromosomes can be best seen at metaphase stage of cell division.

Q12. Which cellular elements participate in anaphase movement?

Ans. Centromeres of each chromosome participate in anaphase movement. They divide and spindle fibres shorten, causing movement of chromatids towards respective poles.