SET 55

PLANT MITOSIS

Have you ever propagated a geranium plant by cutting it? You take a small stem on which a few leaves are growing and keep it well watered. When a few tiny roots begin to appear, you plant the stem in soil. After a few weeks, the cutting grows roots, which are just like the roots of the original plant. The new plant has the hereditary traits of the parent plant.

Many plants and shrubs are propagated this way. In each case, the new plants are just like the parent plants because in each cell there is a mechanism that operates to maintain the hereditary pattern from one cell to its daughter cells.

The process by which this occurs is known as cell division, or mitosis.

The following eight slides were photographed from a single onion root tip showing the phases of plant mitosis in sequence.

The terms "equatorial plate" and "poles", as they are used in the study of mitosis, refer to certain locations in the cell. The equatorial plate in these slides runs from the left side of the slide to the right; the poles are locations above and below the equatorial plate.

The magnification given, for example, 1,000x for Slide 1 - Early Prophase - means that the microscope was set at that power when the photograph was taken.

1 EARLY PROPHASE (1,000X)

The cell (A) is in a so-called resting stage or interphase. Actually, it is not resting but is carrying on all the functions of life except cell division. In the nucleus of cell (A,) you can see the very dark nucleoli and smaller granules of chromatin.

It is difficult to say exactly when the first part of the process of cell division begins.

Recent research with the electron microscope indicates that even in this interphase or "resting stage" the chromosomes are already beginning to make duplicates of themselves.

In cell (B) the chromosomes have become shorter and thicker, and for practical purposes, we say that cell division, or mitosis, begins with this phase. At this stage of development, they are called prophase chromosomes.

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2 PROPHASE (1,000X)

The large cell near the center of the slide shows that the chromosomes have continued to become thicker and shorter. They can now be seen very clearly inside the nucleus. Soon after they reach this stage, they begin to move toward the middle of the cell.

Compare this slide with slide 1. What is happening to the shape of the nucleus?

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3 METAPHASE (1,000X)

The cell at (C) has now reached the middle stage of mitosis called the metaphase. Characteristically, the chromosomes have developed into short, thick rods. They have moved to a position in the middle of the cell called the equatorial plate.

Examine the individual chromosomes carefully. They have become thick and at least two of them are doubling.

4 EARLY ANAPHASE (1,000X)

In cell (D,) each chromosome has doubled and the two parts are separating. As the split rods move away from each other, they shape themselves into what may be described as two Vs facing each other.

Spindle fibers are faint but visible at (S) in the lower part of the cell. Their function is to pull the newly formed chromosomes towards the pole. Electron microscopes show that spindle fibers are made up of extremely small structures called microtubules.

5 ANAPHASE (1,000X)

In cell (E,) every chromosome has now completed its separation. At this stage, the cell has achieved the main function of mitosis, which is the production of two duplicate sets of chromosomes.

There are three cells marked (B) in this slide. Are they in the same phase of mitosis? What phase is that? How do you know?

Compare this slide with slide 2 and with cell (B) in Slide 1.

6 LATE ANAPHASE (1,000X)

In cell F, the movement of the two complete sets of chromosomes toward the poles of the cell is much further advanced. Compare their position here with that shown in slide 5.

As soon as the two sets of chromosomes reach the region of the poles, they will begin to organize themselves into two complete nuclei.

The number and kind of chromosomes in each of the two sets is exactly the same as in the original cell at the beginning of mitosis.

There is as yet no sign of a cell wall developing between the two groups of chromosomes. The V shape of the chromosomes can still be seen in this slide.

7 TELOPHASE (1,000X)

The telophase is the final stage in the process of mitosis. The two sets of chromosomes in cell (G) have drawn in tightly to form a dense mass at each pole. Individual chromosomes can no longer be seen. Each mass will become the nucleus of a cell. Spindle fibers are clearly visible between the two masses.

In the middle of the space between the masses, across the spindle fibers, a faint line can be seen. On each side of this line, each new cell will secrete its own cellulose wall.

Go back to slide 2 and examine the cell at the extreme upper right side. How does it compare with the stage of development shown in cell (G) of slide 7? Compare both cell walls and the nuclei. Which cell is further advanced?

8 LATE TELOPHASE (1,000X)

The cells (H) show the very last stage of mitosis. The cell walls are not quite fully developed across the equator of the cell. The left side of the wall is a little more advanced than the right side. Some fibers still can be seen on the right side, though not too clearly.

The cells at (A) have finished mitosis. They are now in the interphase or resting stage. The new nuclei can be seen with nucleoli and some chromatin throughout. The cell walls have developed fully and divide the original cell into two complete cells. The two cells will now increase in size and, after a period of growth and assimilation, each will begin mitosis.