

## Notes: Mitosis and Meiosis



Every organism, including you, begins as a single cell. Some organisms remain a single-cell their entire lives. Each single-celled organism reproduces by forming two new offspring cells. Usually these cells separate. However, in some types of single-celled organisms, the offspring cells stick together and form a colony of many cells.

A many-celled organism begins as a single cell that divides and forms two new cells that stay together. Those two cells divide and form four new cells. The cells continue to divide, forming many new cells. Groups of cells become specialized forming tissues, organs and systems that carry out the life processes.

Your body is constantly making new cells. Cell division plays a very important role in the life cycle of a cell. Without cell division, all living organisms would fail to reproduce, eventually dying out. The new cells replace old cells that have died. The new cells also allow you to grow in size. Like many things, cells wear out and die. If an organism is to live and grow, it must reproduce. Therefore cell division serves an important role in an organism's health and growth. Cell division occurs rapidly in living organisms. For example, in an adult human, millions of cells divide each second to maintain homeostasis.

### Mitosis:

Organisms have a certain number of chromosomes in their cells. Before a cell divides into two cells, it must make copies of all its chromosomes. After the cell makes copies of its chromosomes, it goes through the process of mitosis.

**Mitosis** is the process by which a cell duplicates its chromosomes and divides them between two new cells in one division. The new cells produced by this division have the exactly same chromosomes as the parent cell. This division keeps the chromosome number equal also – thus every human body cell has 46 chromosomes. There are five stages of mitosis – each with their own functions and characteristics.

- **Interphase:** During this phase, the membrane around the nucleus disappears and the chromosomes become visible. These chromosomes make exact copies of themselves producing thin, long strands of DNA.
- **Prophase:** During this phase, the doubled chromosomes are now visible as short rods of various shapes providing the first sign of mitosis.
- **Metaphase:** During this phase, the doubled chromosomes move to the center of the cell. Each doubled chromosome is attached to the spindle fiber.
- **Anaphase:** Each doubled chromosome becomes two separate chromosomes during this phase. The cytoplasm now starts to divide and the cell membrane begins to pinch off to form two new cells.
- **Telophase:** During telophase, new nuclear membrane forms around the chromosomes. Finally, the cell membrane pinches off and forms **two** new daughter cells.

The process of mitosis is called asexual reproduction because the two daughter cells produced are identical to the parent cell. **Asexual reproduction** is the reproduction by one parent – the offspring are identical to the parent. Many-celled organisms make new cells through the process of mitosis. These new cells have the exact copy of the chromosomes as the parent.

**Sexual reproduction** is the reproduction by two parents – the offspring is a blending of the traits of both parents. Organisms that reproduce sexually have special cells. The male sex cell is called the **sperm** and the female sex cell is called the **egg**. These sex cells, however, have half the number of chromosomes as the parent cells. The process that makes sex cells is called **meiosis**.

## Meiosis:

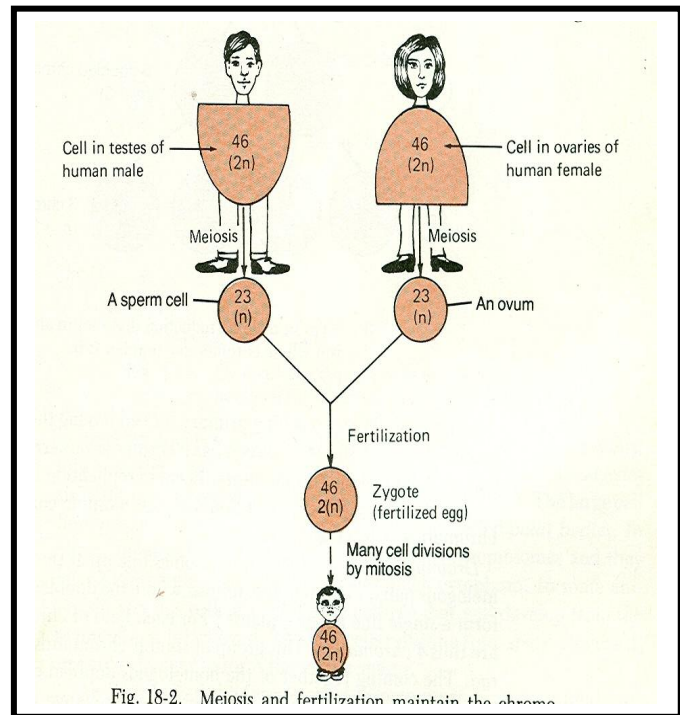
Meiosis starts with diploid cells - cells that have two sets of chromosomes from their parents. Haploid cells only have one set of chromosome from their parents. In meiosis, the diploid cell eventually forms four germ cells that have half the chromosomes. Since meiosis involves two divisions and only one replication of DNA, it leaves new cells with only half the amount of chromosomes as the parent cells. Thus it is also called reduction-division.

In meiosis, two sets of nuclear division occur. In the first division of meiosis, diploid cell is changed into two diploid cells. Then, during the second division, the two diploid cells are split into four haploid cells - each with different sets of chromosomes. Mitosis produces two identical diploids or cells with two sets of chromosomes.

The purpose of meiosis is to increase the genetic variation. Meiosis is used in sexual reproduction, since to reproduce; an egg and a sperm have to come together during fertilization to form a new organism. This further increases the genetic variation which allows for evolution and the adaptation of organisms to different environments.

Meiosis is often called the reduction division because it reduces the number of chromosomes in the cells produced by half.

- Before meiosis begins, the parent cell makes copies of its chromosomes.
- Then meiosis takes place in two stages – during the first stage the cells divide and the offspring cells have the same number of chromosomes.
- During the second division, the chromosomes do not replicate and the offspring cells only have half the number of chromosomes as the parent.
- When the sperm fertilizes the egg during sexual reproduction a **zygote** is produced. The zygote has the same number of chromosomes as in the original parent cells. In the case of humans, each cell has 46 chromosomes – 23 from the mother and 23 from the father.
- Meiosis and fertilization maintain the chromosome number from generation to generation.



Mitosis and meiosis are similar processes in that they both result in the separation of existing cells into new ones. They differ, however, in their specific processes as well as in their products. The reason for these differences lies in the difference in the class of cells that each process creates. Mitosis is the process in which a parent cell splits into two daughter cells that are exactly alike.

Meiosis produces daughter cells with half the information contained in the parent cell. Mitosis can occur in either haploid or diploid cells, whereas meiosis occurs only in cells with the diploid or polyploidy number of chromosomes. Another difference between the two is that during meiosis each diploid nucleus divides twice, producing a total of four nuclei, while in mitosis each nucleus divides only once producing only two new cells.