

GHSGT Review: Biology (Day 4)

Prepared by: Jill Tucker

OBJECTIVE: Describes the process of cell division, mitosis, and meiosis in sperm and egg formation.

MITOSIS

Mitosis is a type of cell division, which generates two daughter cells with identical components, and DNA of the mother cell. Growth occurs when multicellular organisms increase their number of cells through cell division. Mitosis maintains the chromosome number and generates cell replacement, maintenance, and repair of the organism.

There are several words that you should know:

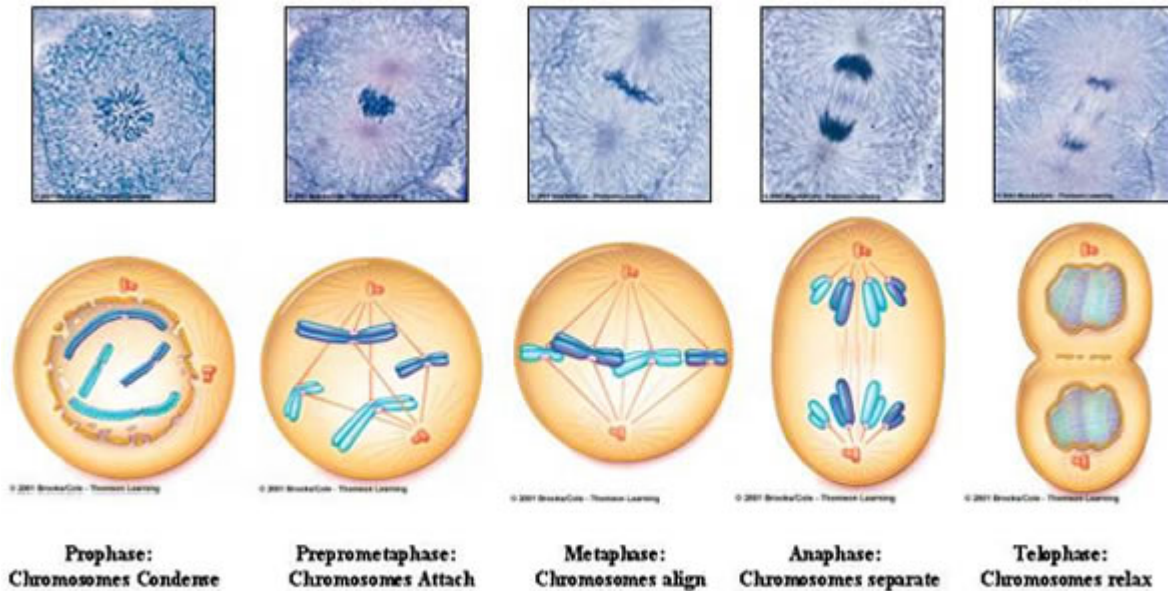
- Centriole: Cylindrical structures, which exist in pairs that are attached to spindle fibers. They only appear during cell division and are only in animal cells.
- Centromere: The point at which the chromatids are held together.
- Chromatid: Each chromosome is composed of two joined strands called chromatids. Each chromatid is a duplicate of its partner.
- Spindle Fibers: These are long rigid tubes (microtubules) that appear during cell division. Temporary structures that help more chromosomes move through the cytoplasm.

There are several stages involved in cell division:

1. **INTERPHASE** – this is the time between the formation of a cell through cell division and the beginning of the next mitosis. The cell prepares for division by duplicating DNA, producing the necessary organelles, and putting together any structures needed for mitosis.
2. **PROPHASE** – this phase takes up 60% of the total time for mitosis. During this stage, the chromosomes coil up into short rods called chromatids. The nuclear membrane breaks down and disappears. Spindle fibers appear between the centrioles and the chromosomes attach to the spindle fibers at their centromere.
3. **METAPHASE** – Chromosomes become arranged along the cell's equator or middle. Each centromere is attached to a separate spindle fiber.
4. **ANAPHASE** – Each chromatid separates in each pair. Spindle fibers shorten and pull the two chromatids apart. The single chromatids move to the opposite ends of the cell.
5. **TELOPHASE** – After the chromosomes have reached opposite ends of the cell, the spindle fibers disappear. The nuclear membrane reforms and the chromosomes uncoil. The cell membrane pinches together and a groove or furrow forms. The cell then separates into two daughter cells. This portion of cell division is called cytokinesis. In plant cells, a cell wall forms in the middle of the cell and extends outward to the cell membrane until it separates the two daughter cells.

RESULT: Two identical daughter cells are formed.

Phases of Mitosis:



MEIOSIS

Meiosis is a process in which the normal number of chromosomes in a cell is reduced by half or a HAPLOID number. Chromosomes in cells occur in pairs called homologous chromosomes. Cells that have homologous chromosomes are said to have DIPLOID ($2n$) number of chromosomes.

Sex cells or gametes must have a haploid number of chromosomes. When two gametes combine (sperm fertilizes egg), then the cell has a full complement of needed chromosomes.

Meiosis requires two subsequent cell divisions – two nuclear divisions and one DNA replication. In Meiosis I, the homologous (paired) chromosomes separate. During Meiosis II, the chromatids of each chromosome separate.

INTERPHASE I: DNA replicates so there are twice as many chromosomes ($2n$).

PROPHASE I: The chromosomes coil up into short rods called chromatids. The nuclear membrane breaks down and disappears. Spindle fibers appear between the centrioles and the chromosomes attach to the spindle fibers at their centromere.

METAPHASE I: Chromosomes line up along the cell's equator. Each centromere is attached to a separate spindle fiber. There are four chromatids and two centromeres to each pair of chromosomes.

ANAPHASE I: Pairs of homologous chromosomes separate. The centromeres DO NOT divide. Paired chromatids are moving to opposite ends of the cell.

TELOPHASE I: The cell then separates into two daughter cells. Chromosomes are still joined by centromeres. Both cells under further division in Meiosis II.

INTERPHASE II: Nothing happens. DNA does not replicate. This is a resting stage.

- PROPHASE II:** Centrioles replicate in animal cells and move to opposite ends of the cell. Spindle fibers re-form between the centrioles and the chromosomes attach to the spindle fibers at their centromere. The nuclear membrane breaks up if it formed during interphase II.
- METAPHASE II:** Chromatids line up along the cell's equator. Each centromere is attached to a separate spindle fiber. There are two chromatids and one centromere.
- ANAPHASE II:** The chromatids separate and the centromeres divide. Chromatids move to opposite ends of the cell.
- TELOPHASE II:** The second cytoplasm division occurs. Each cell separates into two daughter cells. So there are now four cells. The nuclear membrane re-forms and the spindle fibers dissolve.
- RESULT:** **Four cells are formed. Each has half the number of chromosomes (haploid).**

Phases of Meiosis:

