6. Cell division

6.1.The Mitotic Phase

To make two daughter cells, the contents of the nucleus and the cytoplasm must be divided. The mitotic phase is a multistep process during which the duplicated chromosomes are aligned, separated, and moved to opposite poles of the cell, and then the cell is divided into two new identical daughter cells. The first portion of the mitotic phase, mitosis, is composed of five stages, which accomplish nuclear division. The second portion of the mitotic phase, called cytokinesis, is the physical separation of the cytoplasmic components into two daughter cells.

6.1.1. Mitosis

Mitosis is divided into a series of phase prophase, prometaphase, metaphase, anaphase, and telophase that result in the division of the cell nucleus.

1.prophase, the first phase, several events must occur to provide access to the chromosomes in the nucleus. The nuclear envelope starts to break into small vesicles, and the Golgi apparatus and endoplasmic reticulum fragment and disperse to the periphery of the cell. The nucleolus disappears. The centrosomes begin to move to opposite poles of the cell.

2.**prometaphase,** Chromosomes become more condensed and visually discrete.

3. metaphase, all of the chromosomes are aligned in a plane called the metaphase plate, or the equatorial plane, midway between the two poles of the cell. The sister chromatids are still tightly attached to each other. At this time, the chromosomes are maximally condensed**.**

4.anaphase, the sister chromatids at the equatorial plane are split apart at the centromere. Each chromatid, now called a chromosome, is pulled rapidly toward the centrosome to which its microtubule was attached. The cell becomes visibly elongated .

5.telophase, all of the events that set up the duplicated chromosomes for mitosis during the first three phases are reversed. The chromosomes reach the opposite poles and begin to decondense (unravel).

Nuclear envelopes form around chromosomes.

6.1.2.Cytokinesis

is the second part of the mitotic phase during which cell division is completed by the physical separation of the cytoplasmic components into two daughter cells. Although the stages of mitosis are similar for most eukaryotes, the process of cytokinesis is quite different for **eukaryotes that have cell walls, such as plant cells.**

6.2. meiosis and genetic variation

Sexual reproduction requires fertilization, a union of two haploid cells (i.e. gametes) from two individual organisms. Haploid cells contain one set of chromosomes. Cells containing two sets of chromosomes are called diploid. If the reproductive cycle is to continue, the diploid cell must somehow reduce its number of chromosome sets before fertilization can occur again, or there will be a continual doubling in the number of chromosome sets in every generation. So, in addition to fertilization, sexual reproduction includes a nuclear division, known as meiosis, that reduces the number of chromosome sets. Meiosis consists of two division events, called Meiosis I and Meiosis II. Most animals and plants are

diploid, containing two sets of chromosomes; in each somatic cell (the non-reproductive cells of a multicellular organism), the nucleus contains two copies of each chromosome that are referred to as **homologous** chromosomes. Somatic cells are sometimes referred to as body cells. Homologous chromosomes are matched pairs containing genes for the same traits in identical locations along their length. Diploid organisms inherit one copy of each homologous chromosome from each parent; all together, they are considered a full set of chromosomes. In animals, haploid cells containing a single copy of each homologous chromosome are found only within **gametes**. Gametes fuse with another haploid gamete to produce a diploid cell. The nuclear division that forms haploid cells, which is called meiosis, is related to mitosis. As you have learned, mitosis is part of a cell reproduction cycle that results in identical daughter nuclei that are also genetically identical to the original parent nucleus., meiosis I is the first round of meiotic division and consists of prophase I, prometaphase I, and so on. Meiosis I reduces the number of chromosome sets from two to one (i.e. reductional division) Meiosis II, in which the second round of meiotic division includes prophase II, prometaphase II, and . called (equational division).

Metaphase II (x 400 Å)	**Anaphase II (x 400 Å)**	**Telophase II (x 400 Å)**	**Tetrad (x 400 Å)**
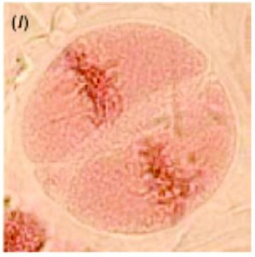	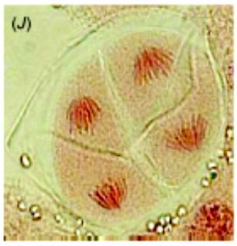	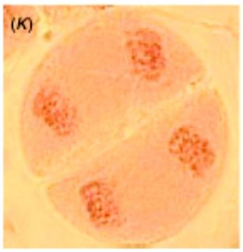	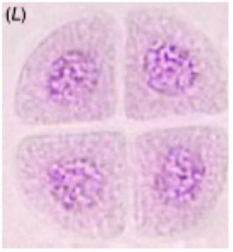
figure 17: Metaphase II where haploid chromosomes line up at the Metaphase plate	*figure 18: Anaphase II where sister chromatids split up into opposite ends of the cell*	*figure 19: Telophase II where new haploid gametes are in the process*	*figure 20: Tetrad formation is the state of gametes after cytokinesis*

Table 2: Stages of Meiosis under x 400 Å magnification

Zygotene (x 400 Å)	Pachytene (x 400 Å)	Diplotene (x 400 Å)	Diakinesis (x 400 Å)
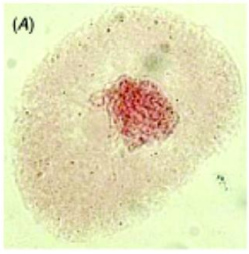	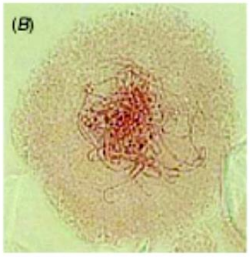	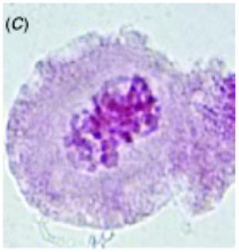	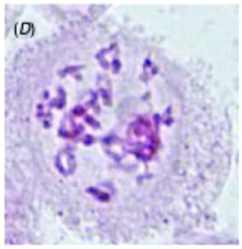
figure 9: the first stage of Prophase I where homologous chromosomes become closely associated (synapsis) to form pairs of chromosomes consisting of four chromatids (tetrads)	*figure 10: the second stage of Prophase I where crossing over between homolog chromosomes (chiasmata form) occurs*	*figure 11: the third stage of Prophase I where homolog chromosomes begin to split but remain the chiasmata form*	*figure 12: the fourth stage of Prophase I where chiasmata form moves towards*

Metaphase I (x 400 Å)	Anaphase I (x 400 Å)	Telophase I (x 400 Å)	Prophase II (x 400 Å)
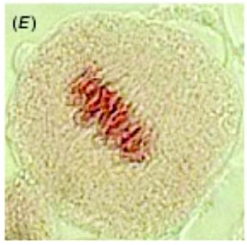	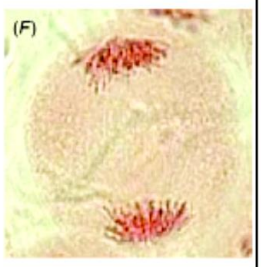	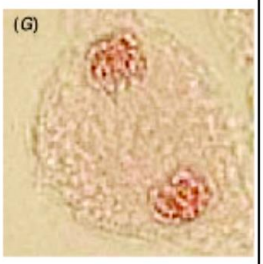	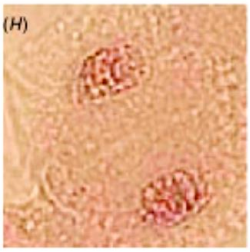
figure 13. Metaphase I where homolog pair line up at the metaphase plate	*figure 14. Anaphase I where homolog chromosomes are pulled towards to end of the cell.*	*figure 15: Telophase I where haploid and new cells are produced*	*figure 16: Prophase II where haploid chromosomes condense*

M.SC. MohammaD JawaD

mohammad.jawad.khadum@nomus.iq