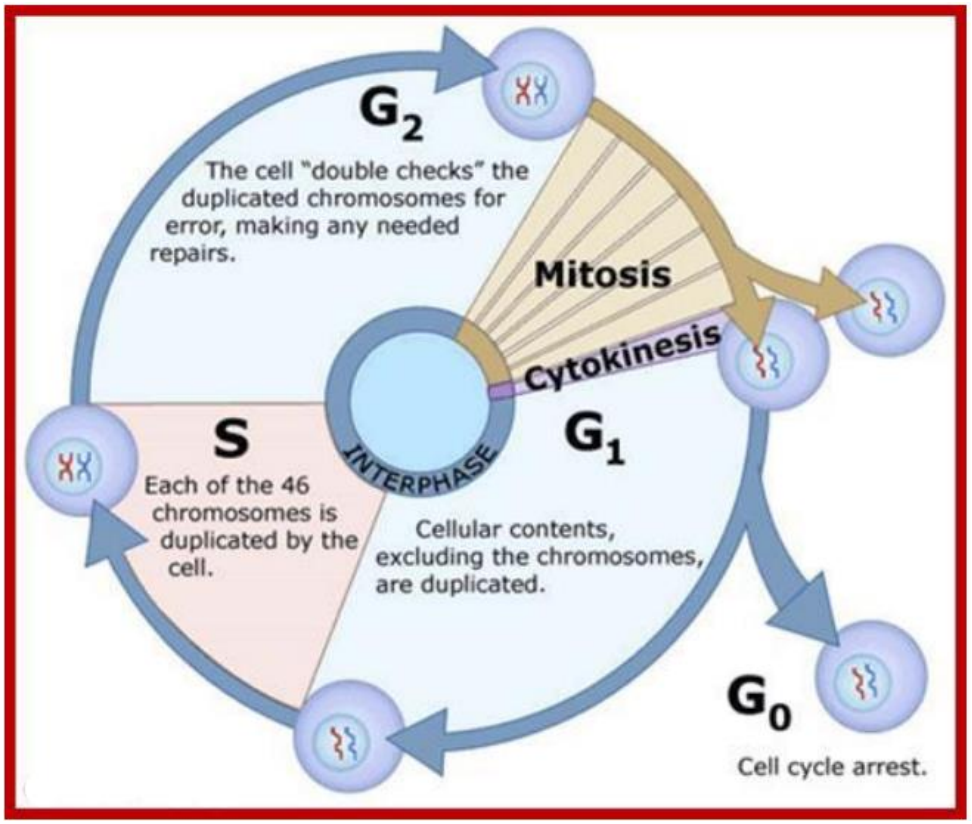
The Cell Division

The Cell cycle:

How do cells know when to divide?

There are hormones in an organism's body that sends signals to the cells to prepare for division when it is needed. This is all part of the cell cycle, which is made up of various phases, beginning at the start of one cell division and ending at the start of another. There are two main parts to this division:

Interphase, which is for growth and preparation, and **Cell division**, which includes mitosis and cytokinesis. Interphase occurs between divisions, and is the congest phase in the cell cycle. This usually makes up about 90% of the time spent in the cell cycle. This is not a "resting" period, but time for preparation. This is when the cell grows and prepares for division. There are three stages in interphase. G1 (or gap 1), S (or synthesis) and G2 (or gap 2).



G1 – this is the period where the cell grows and develops. Since some cells divide more actively than others, the time spent in the G1 phase will vary. There is no division that takes place in this phase. Just growth and development.

S – This is where the cell is committed to cell division. Inside the nucleus, the chromosomes (including the DNA) begin to replicate, the material makes a copy of itself (more on chromosomes in a minute). This results in two identical copies of chromosomes, called sister chromatids. The two sister chromatids are attached to each other at a point called the centromere. This replication is important, because it allows there to be two full sets of DNA in each of the new cells, at the end of the division.

G2 – Organelles and other material required for cell division are replicated or formed. For example, the centrioles in animal cells replicate themselves, to form 2 pairs.

Cell division: an important characteristic of living cells is their ability to divide , so cell division is happened in all living organism .

Cell division undergo a sequence that includes three stages :

1- Interphase
2- Karyokinesis or (mitosis) (nuclear division)
3- Cytokinesis (cytoplasmic division)

There are two kinds of division : mitosis and meiosis .

Mitosis: is nuclear division that results in two nuclei each having the same number of chromosomes as the original nucleus , and the resulting two cells are called daughter cell .

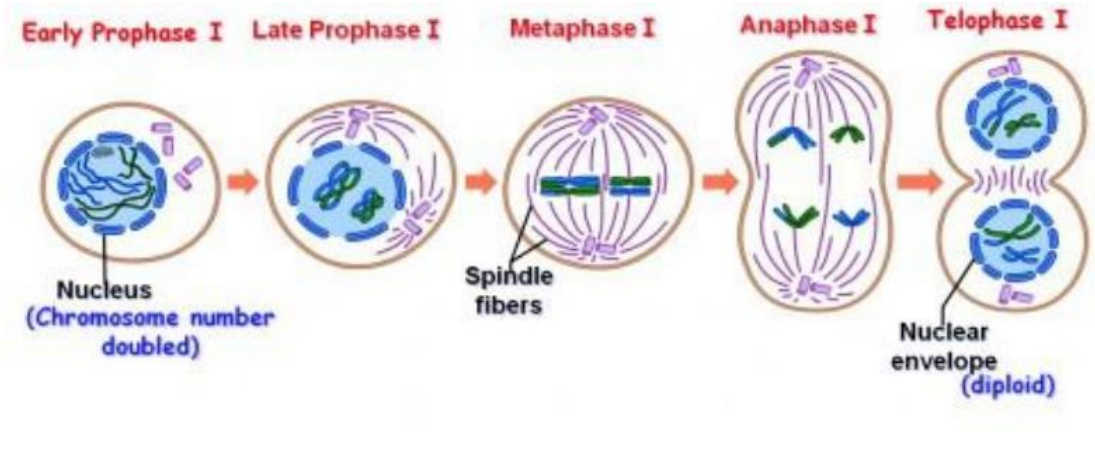
- In multicellular organisms mitosis permits growth and repair of tissues .
- In unicellular organisms mitosis is a form of an asexual reproduction .

There are 4 main phases in mitosis:

1- **Prophase :** this is the first stage of mitosis. In this stage the sister chromatids also condense to a visible form. The nuclear envelope also breaks up, exposing the chromosomes. The spindle fibers begin to form, extending from the centrioles. These are made up of microtubules and attach to the centromere of the sister chromatids.

The centrioles slowly migrate to opposite sides of the cell.

2- **Metaphase :** this is when the chromosomes are lined up along the metaphase or equatorial plate, an imaginary line in the center of the cell. The chromosomes are moved here with the help of the spindle fibers and the centrioles.
3- **Anaphase :** The centromere of each chromosome are pulled apart by the spindle fibers, causing the sister chromatids to separate, creating two daughter chromosomes. One of the daughter chromosomes is pulled to one side of the cell, while the other is pulled to the opposite pole. This process is critical, because it ensures that the soon to be daughter cells will each have full, identical sets of chromosomes, also being identical to the parent cell.
4- **Telophase** : The new nuclei begin to form around the new sets of chromosomes, at each end of the cell. The chromosomes also begin to unravel, back into their loose form. By the end of this phase, the spindle fibers are also disassembled. At the same time, cytokensis begins, and the cell is "pinched" into two new cells.

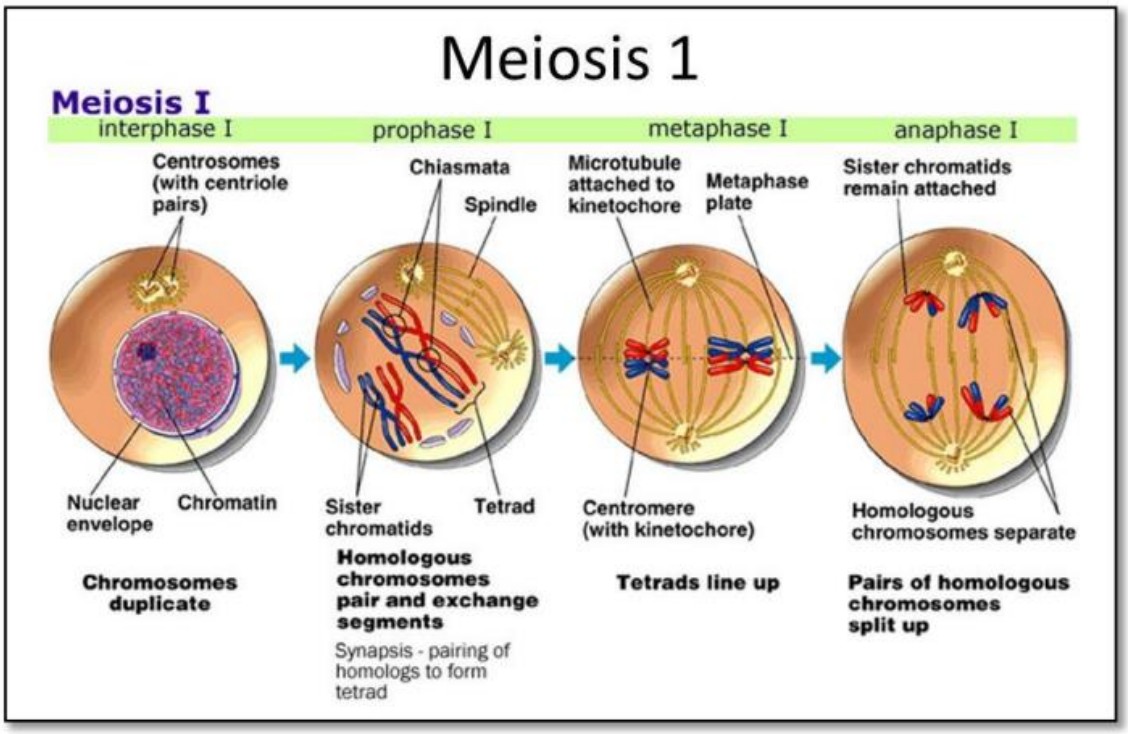


Meiosis: is a form of nuclear division in which the chromosome number is reduced by half . the same stage of nuclear division are present in meiosis as in mitosis , but these stage occur twice meiosis (1) and meiosis (2). Meiosis is a form of sexual reproduction in sexually reproducing organisms . It is the formation of gametes, performed by reproductive cells only. This will result in a **reduction of the chromosome number, forming haploid cells (n)**. So, unlike mitosis, which produces two daughter cells with identical chromosomes, meiosis produces 4 daughter cells, each with half the number of chromosomes, that are not identical to each other. This is again important because it keeps the chromosome number constant over generations, in the adult organism. When the egg (n) and the sperm (n) combine (n + n) in fertilization, the offspring is a diploid cell (2n).

Meiosis I is a 4 step process:

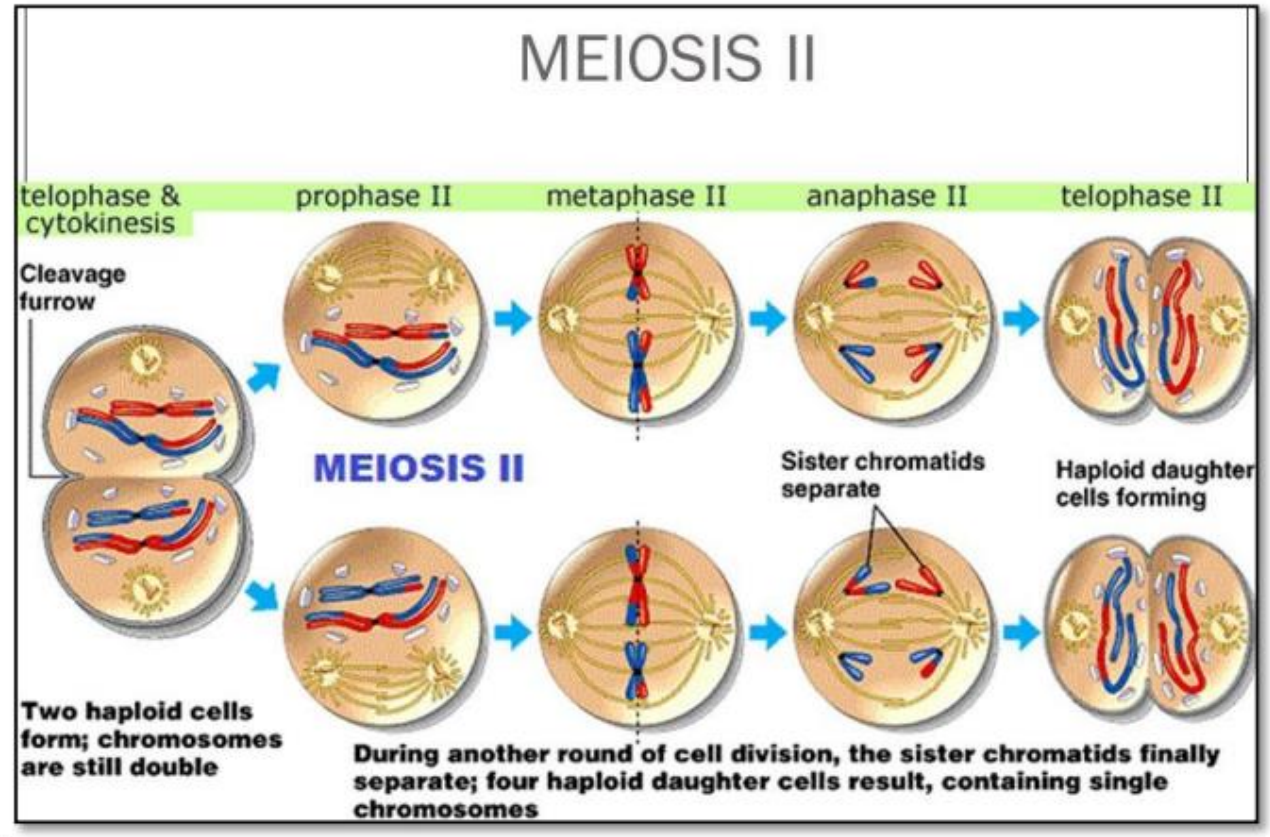
The start of this is much like mitosis, the cells have gone through the G1, S and G2 phases, thus the DNA has been replicated and are in the form of sister chromatids, connected at the centromere. The main difference here is that the homologous pairs of chromosomes pair up and then proceed as follows:

1- Prophase I: the chromosomes thicken and are visible under a microscope. The homologous pairs of chromosomes are tangled together and being to move towards the equatorial plate. This means that instead of two sister chromatids like in mitosis, there are now 4 sister chromatids that move together, this is called a tetrad. This is also where the nuclear envelope disappears and the spinal fibers begin to form. This is also the phase where crossing-over can occur. Due to the way the homologous pairs of chromosomes are tangled together, many times, they "swap" parts of their chromosomes. This is a major source to the addition to the variation between individuals. It is this variation that allows evolution to act on favorable traits, having those that are more favorable survive and the others die off.
2- Metaphase I: is where the homologous pairs are lined up next to each other, along the equatorial plate .
3- Anaphase I : the homologous pairs are now separated, due to the spindle fibers pulling them apart, from the centromere. Each chromosome still has two sister chromatids.
4- Telophase I : the nuclear membrane may or may not reform, depending on the species, but in any case, cytokinesis does occur, resulting in two new cells, each with the haploid number of chromosomes, which are still in the form of sister chromatids.



Meiosis II:

is what follows after telophase I and cytokinesis. The daughter cells from meiosis I are what go into this phase. The divide again, but this time occurring much the same as mitosis. The only difference is that there are (n) number of chromosomes rather than (2n), and we end up with a total of 4 daughter cells rather than 2. Again, since there were two daughter cells produced in meiosis I, and each of them divide again, the result of meiosis is 4 daughter cells, each with (n) number of chromosomes, which are not identical to the original parent cell or each other. This is done through 4 more steps: prophase II, metaphase II, anaphase II and telophase II, followed by the final cytokinesis.


MEIOSIS II
telophase & cytokinesis
prophase II
metaphase II
anaphase II
telophase II
Cleavage furrow
MEIOSIS II
Sister chromatids separate
Haploid daughter cells forming
Two haploid cells form; chromosomes are still double
During another round of cell division, the sister chromatids finally separate; four haploid daughter cells result, containing single chromosomes