

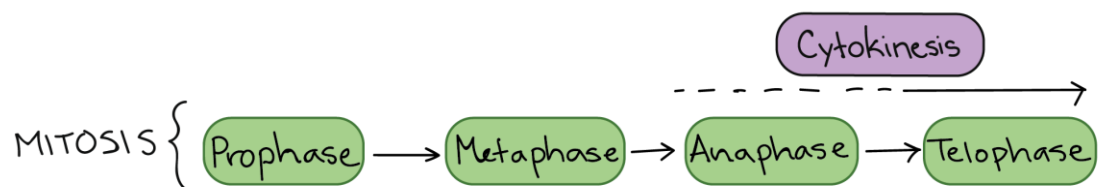
Mitosis

Mitosis is a type of cell division in which one cell (the **mother**) divides to produce two new cells (the **daughters**) that are genetically identical to itself.

In all of these cases, the “goal” of mitosis is to make sure that each daughter cell gets a perfect, full set of chromosomes.

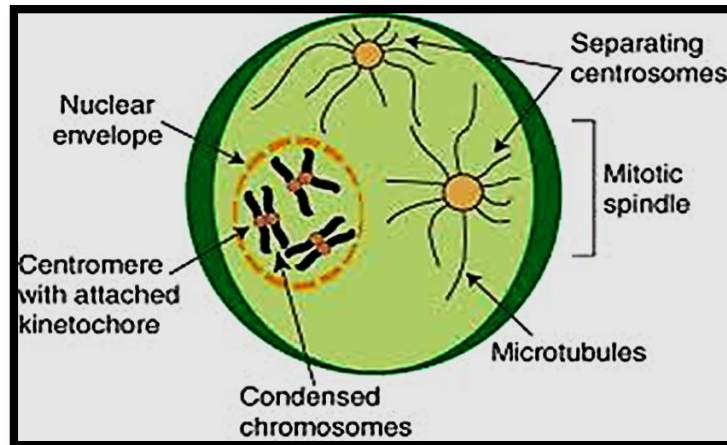
Phases of mitosis

Mitosis consists of four basic phases: (prophase, metaphase, anaphase, and telophase. These phases occur in strict sequential order, and cytokinesis - the process of dividing the cell contents to make two new cells - starts in anaphase or telophase.

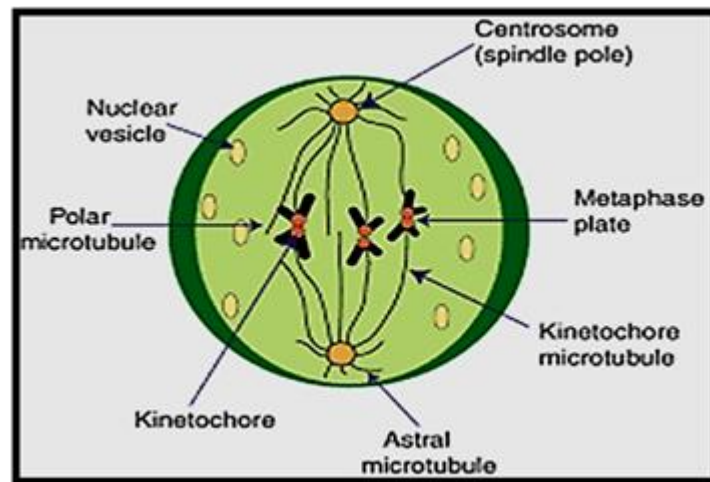


Stages of mitosis: prophase, metaphase, anaphase, telophase. Cytokinesis typically overlaps with anaphase and/or telophase.

1-Prophase: the chromosomes start to coil, shorten, and become distinct. **In animals only**, the centrioles begin to migrate to the poles of the cell. The **mitotic spindle** or **polar fibers** begin to form from the poles of the cell towards the equator, this starts as asters around the centrioles. Also at this time, the nuclear envelope starts to disintegrate.



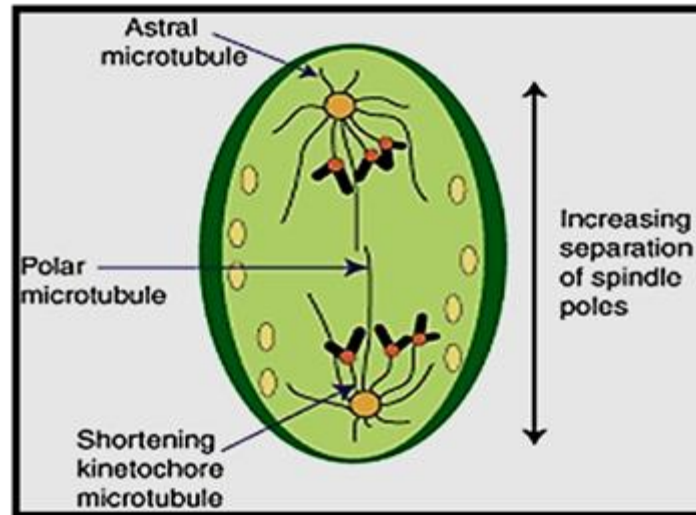
2- Metaphase : is characterized by the lining up of the chromosomes along the equator of the cell or what is called the **metaphase plate**. The nuclear envelope has totally disintegrated and the polar fibers have reached the centromeres of the chromosomes and have begun interacting with them.



In **metaphase**, the spindle has captured all the chromosomes and lined them up at the middle of the cell, ready to divide.

- All the chromosomes align at the **metaphase plate** (not a physical structure, just a term for the plane where the chromosomes line up).
- At this stage, the two kinetochores of each chromosome should be attached to microtubules from opposite spindle poles.

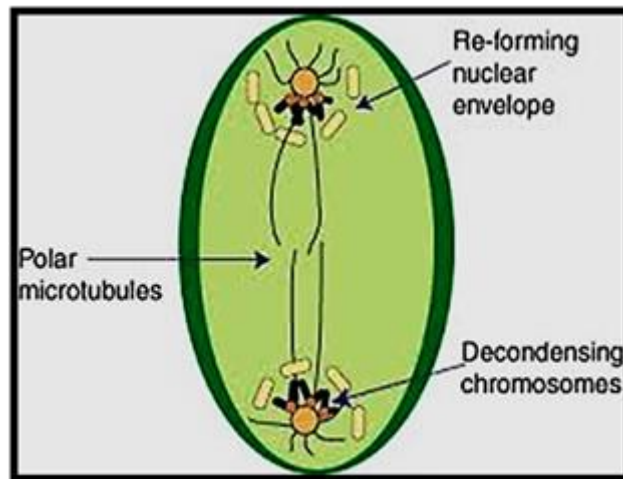
3- Anaphase : the sister chromatids separate at the centromeres, thus can now be called chromosomes. These are pulled to the poles of the cell by the mitotic spindle.



In **anaphase**, The protein “glue” that holds the sister chromatids together is broken down, allowing them to separate. Each is now its own chromosome. The chromosomes of each pair are pulled towards opposite ends of the cell.

- Microtubules not attached to chromosomes elongate and push apart, separating the poles and making the cell longer.

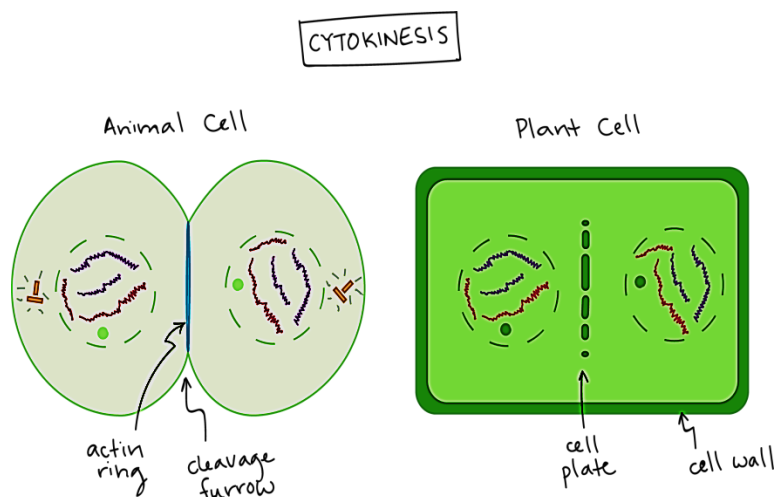
4- Telophase : the new daughter nuclei and nuclear envelopes start to reform and the chromosomes uncoil. Telophase frequently includes the start of cytokinesis. In **telophase**, the cell is nearly done dividing, and it starts to re-establish its normal structures as cytokinesis (division of the cell contents) takes place.



- The mitotic spindle is broken down into its building blocks.
- Two new nuclei form, one for each set of chromosomes. Nuclear membranes and nucleoli reappear.
- The chromosomes begin to decondense and return to their “stringy” form.

Cytokinesis: the division of the cytoplasm to form two new cells, overlaps with the final stages of mitosis. It may start in either anaphase or telophase, depending on the cell, and finishes shortly after telophase.

- **In animal cells** , an actin ring around the middle of the cell pinches inward, creating an indentation called the **cleavage furrow** . cytokinesis starts with a, dividing the cell in two. **In plant cells** , the cell plate forms down the middle of the cell, creating a new wall that partitions it in two.



- When division is complete, it produces two daughter cells. Each daughter cell has a complete set of chromosomes, identical to that of its sister (and that of the mother cell). The daughter cells enter the cell cycle in G₁.
- When cytokinesis finishes, we end up with two new cells, each with a complete set of chromosomes identical to those of the mother cell. The daughter cells can now begin their own cellular “lives,” and – depending on what they decide to be when they grow up – may undergo mitosis themselves, repeating the cycle.

