1 ⟶ 2: Copy of a cell through mitosis

Many living beings are not monocellular, but made of a huge amount of cells. These usually all started as an individual cell that multiplied. This multiplication, producing "exact copies" of the initial cell, happens through a process called mitosis.

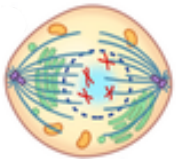
Everything starts after a phase called **interphase**, during which a cell has grown, and at the end of which the genetic information, found as the sequence of nucleotides in DNA, has been replicated.

At the end of this phase, genetic information is present twice, in form of chromosomes (2 identical chromatids linked by a centromere). It forms a bundle in the nucleus of the cell.

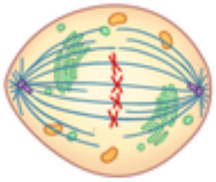
Note: In the meanwhile, an organelle called centrosome duplicates, playing an essential role during mitosis.

1. Prophase:

The bundle of genetic information separates into the individual chromosomes, and the nuclear membrane is breaking down
At the same time, the centrosomes move to 2 opposite sides of the cell, while microtubes/fibres appear around them.



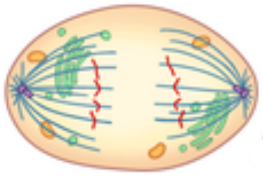
2. Prometaphase:



2 kinetochores appear on the centromere of each chromosome, attracting the fibres of what becomes a mitotic spindle.

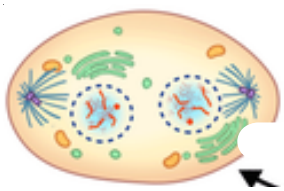
⇒ Once connected to the chromosomes, the spindle then displaces them to the median plane of the cell: **3. Metaphase**

4. Anaphase:

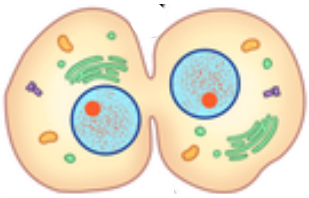


The cell lengthens ⇒ The tension on the mitotic spindle and therefore on the kinetochores increases ⇒ The centromeres break apart, separating the 2-strand chromosomes into 2 sets of 1-strand chromatids, each being attracted towards a centrosome.
⇒ Each centrosome is surrounded by an identical set of chromatids

5. Telophase:



The chromatids "rebundle", and a new nuclear membrane forms around each of these bundles.
In the meanwhile, the mitotic spindle disappears, and a new plasmic membrane forms in the middle of the cell, growing until **cytokinesis** (separation of the cell in 2): 1 ⟶ 2



Note: In animal cells, cytokinesis starts with the formation of a cleavage furrow, while in plant cells, a cell plate forms, leading to the formation of the new cell wall

6. Interphase:

Each cell grows and evolves until it is ready for the next mitosis.

Mitotic index

The mitotic index of a population, MI, is defined as the ration of cells undergoing mitosis to the total cells of the population:

$$MI = \frac{number\ of\ cells\ undergoing\ mitosis}{total\ number\ of\ cells}$$

$$MI = \frac{N_{prophase} + N_{prometaphase} + N_{metaphase} + N_{anaphase} + N_{telophase}}{N_{prophase} + N_{prometaphase} + N_{metaphase} + N_{anaphase} + N_{telophase} + N_{interphase}}$$

Note: The higher the mitotic index, the faster a population will grow through mitosis.

What about the organelles?

Most organelles are present in an important amount:

- Mitochondria $\sim 10^3$ per cell
- Ribosomes $\sim 10^7$ per cell
- Chloroplasts $\sim 10^2$ per cell
- Lysosomes $\sim 10^2$ per cell

These numbers are important enough to let statistics play their role, with an approximately even repartition of the organelles between the 2 daughter cells.
They then multiply during interphase to reach their initial level.

Note: A plant cell has a unique vacuole instead of the multiple lysosomes of animal cells. It fragments during the prometaphase to allow the mitotic spindle to grow, before reforming and growing back to their initial size during interphase.

- There is only 1 Endoplasmic Reticulum and 1 Golgi Apparatus in a cell. These disassemble during prophase, and reform around the protonucleus during telophase.