Cell Division

Mitosis & Meiosis

- Your body is composed of more than a billion cells.
- Cells are continually dying, and new cells are continually being formed.
- An identical copy of your hereditary material is found in the **nucleus** of each and every somatic cell.
- A **somatic cell** is any cell in the body except for the reproductive cells in the reproductive system.

- This genetic blueprint is organized into 46 chapters or parts known as **chromosomes**.
- It is estimated that, on average, each chromosome contains between **one and two thousand genes**.
- A gene contains the information for making a single **protein** or **RNA product**.

- Every time a cell divides, each chromosome must be carefully **replicated** (copied) and then distributed to assure that each daughter cell gets a complete and accurate set of information.
- Thus, nuclear division includes successive processes of chromosome replication, separation, and distribution.

- Cell division is essential to growth, repair and reproduction. The process of dividing the genetic material among the daughter cells is imperative to both types of cell division (mitosis & meiosis).
- In **mitosis**, the daughter cells receive the same number of chromosomes as the parent cell.
- **They are exact copies!**
- In **meiosis**, a reductive cell division occurs such that the daughter cells are **haploid (or half)** with respect to the parent cell.

Meiosis

- In meiosis, two successive cell divisions after one round of DNA replication give rise to **four haploid cells from a single diploid cell**.
- This process is necessary to the formation of **gametes** so that the resulting zygote is a product of the fusion of haploid maternal and paternal genes.

- **With the exception of the sex chromosomes, a diploid nucleus contains two similar versions of each chromosome.**
- During DNA replication the two copies of the fully replicated chromosome remain closely associated and are called sister chromatids.
- A **haploid cell** resulting from meiosis must **contain only one member** of each pair of chromosomes and therefore only **half of the original number** of chromosomes

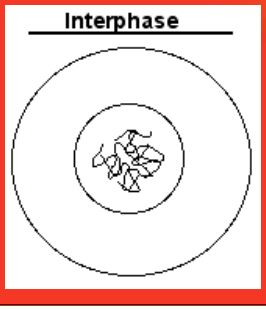
- To accomplish this, the chromosomes duplicate themselves then must pair up before they line up on the spindle.
- This will results in four chromatids with each daughter cell receiving two copies of the chromosome sets when the meiotic cell divides for the first time.
- The formation of haploid cells occurs when a **second cell division(division II)** occurs.
- In this way each haploid cell gets only 1 set of chromosomal instructions not the complete double set.

- No two offspring of the same parents are genetically the same unless they are identical twins.
- This is because genetic reassortment occurs during meiosis.
- Random genetic shuffling of **maternal (mom's)** and **paternal (dad's**) chromosomes to daughter haploid cells in meiosis allows for some mixing.

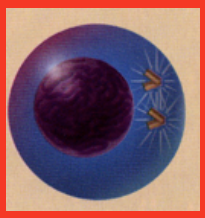
Stages of: Mitosis

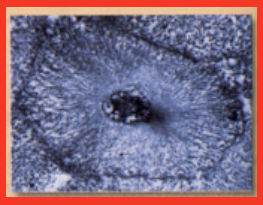
Interphase:

- The time before mitosis. The cells may appear inactive during this stage, but they are quite the opposite:
- This is the longest period of the complete cell cycle.
- The cells enlarge, preparing for mitosis.
- **The DNA replicates, or copies itself.**
- The cell grows & makes structures to use during the rest of the cell cycle



Before mitosis begins, the chromosomes and other cell materials are copied. The pair of *centrioles*, which are two cylindrical structures, are also copied. Each chromosome now consists of two chromatids.



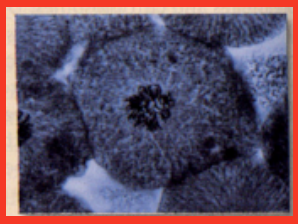


Early Prophase:

- During this first mitotic stage:
- The chromatin in the nucleus condenses and becomes visible chromosomes.
- Each replicated (copied) chromosome is made of two chromatids, both with the same genetic information.
- **Spindle fibers begin to form around the centrioles.**

Mitosis Phase 1

Mitosis begins. The nuclear membrane breaks apart. Chromosomes condense into rodlike structures. The two pairs of centrioles move to opposite sides of the cell. Fibers form between the two pairs of centrioles and attach to the centromeres.

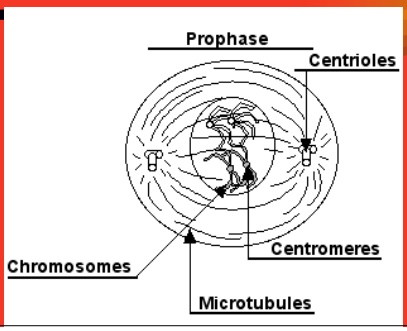


Middle Prophase:

- The nuclear membrane breaks down.
- **The centrioles are moving to opposite ends of the cell.**

Late Prophase:

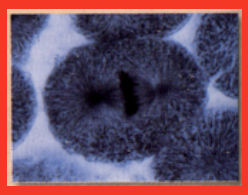
- The nuclear membrane is completely gone.
- **The chromosomes have doubled, and are moving toward the middle.**
- The centrioles are a little further apart.

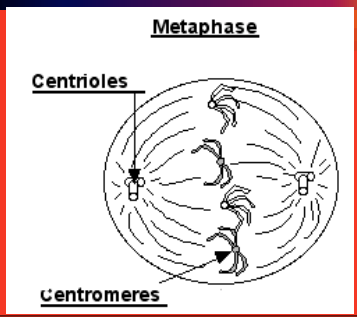


Metaphase:

- The 'middle' phase:
- **The centromere attaches the chromatids to the spindle fibers.**
- Tension applied by the spindle fibers aligns all chromosomes at the center of the cell.

Mitosis Phase 2
The chromosomes line up along the equator of the cell.





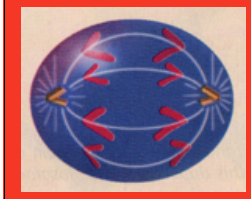
Anaphase:

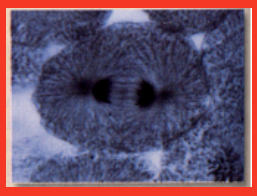
- The chromatids (daughter chromosomes) separate,
- the **spindle fibers shorten & the chromatids are pulled apart & begin moving to the cell poles.**

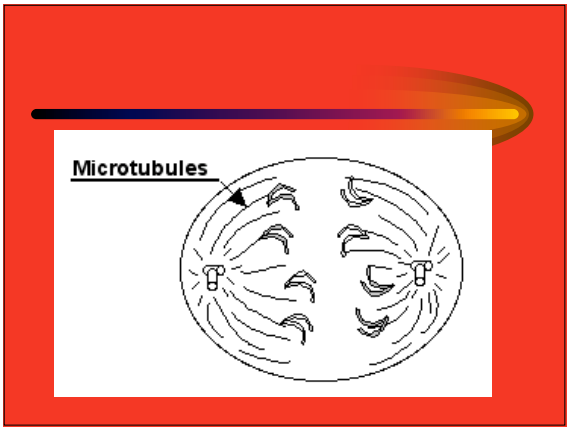
Late Anaphase:

- The spindle fibers are getting shorter.
- **The daughter chromosomes arrive at the poles (opposite ends of the cell).**

Mitosis Phase 3
The chromatids separate and are pulled to opposite sides of the cell by the fibers attached to the centrioles.

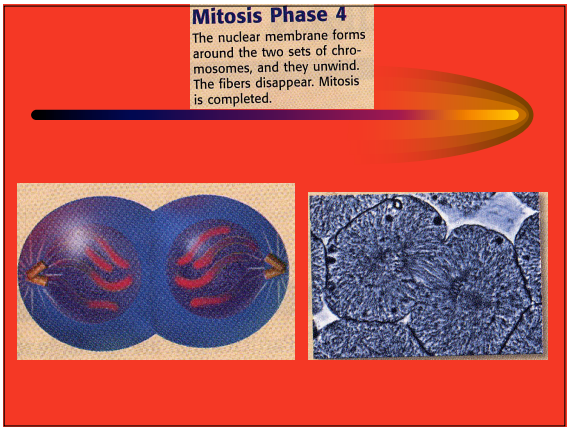


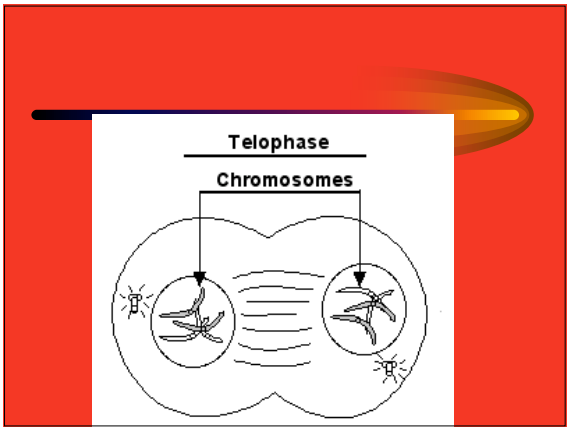




Telophase:

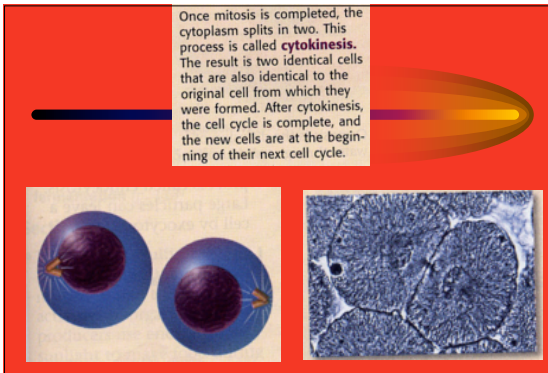
- The nuclear membrane forms around the chromosomes.
- The spindle fibers that have pulled them apart disappear.
- **The cell membrane is beginning to pinch the cytoplasm (pinocytosis).**

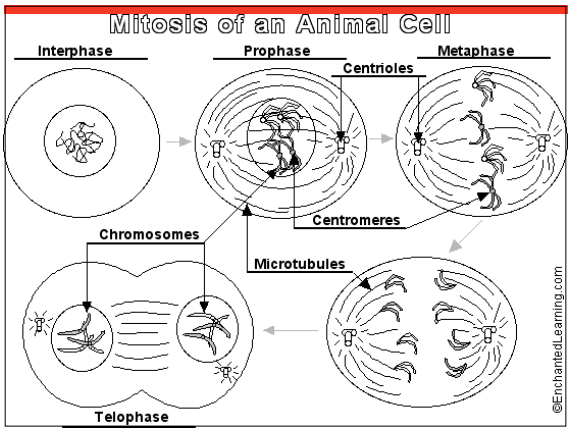




Late Telophase/Cytokinesis:

- **The middle of the 'cell' cleaves the cell into two cells.**
- The chromosomes thicken and become longer.
- The result is two identical daughter cells that are also identical to the original parent cell.





See Cell Division!

- http://www.cellsalive.com/mitosis.htm