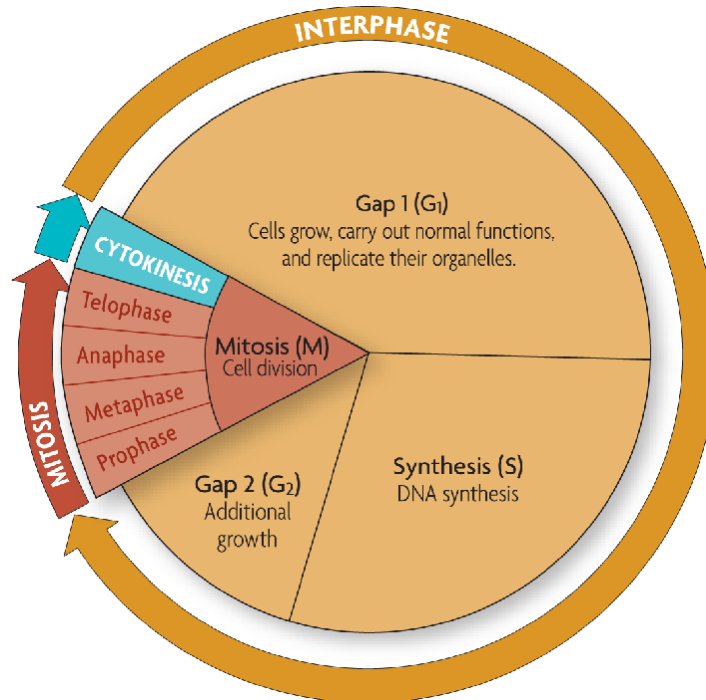


The cell cycle or cell-division cycle:

Is the series of events that take place in a cell leading to its division and duplication of its DNA (DNA replication) to produce two daughter cells.

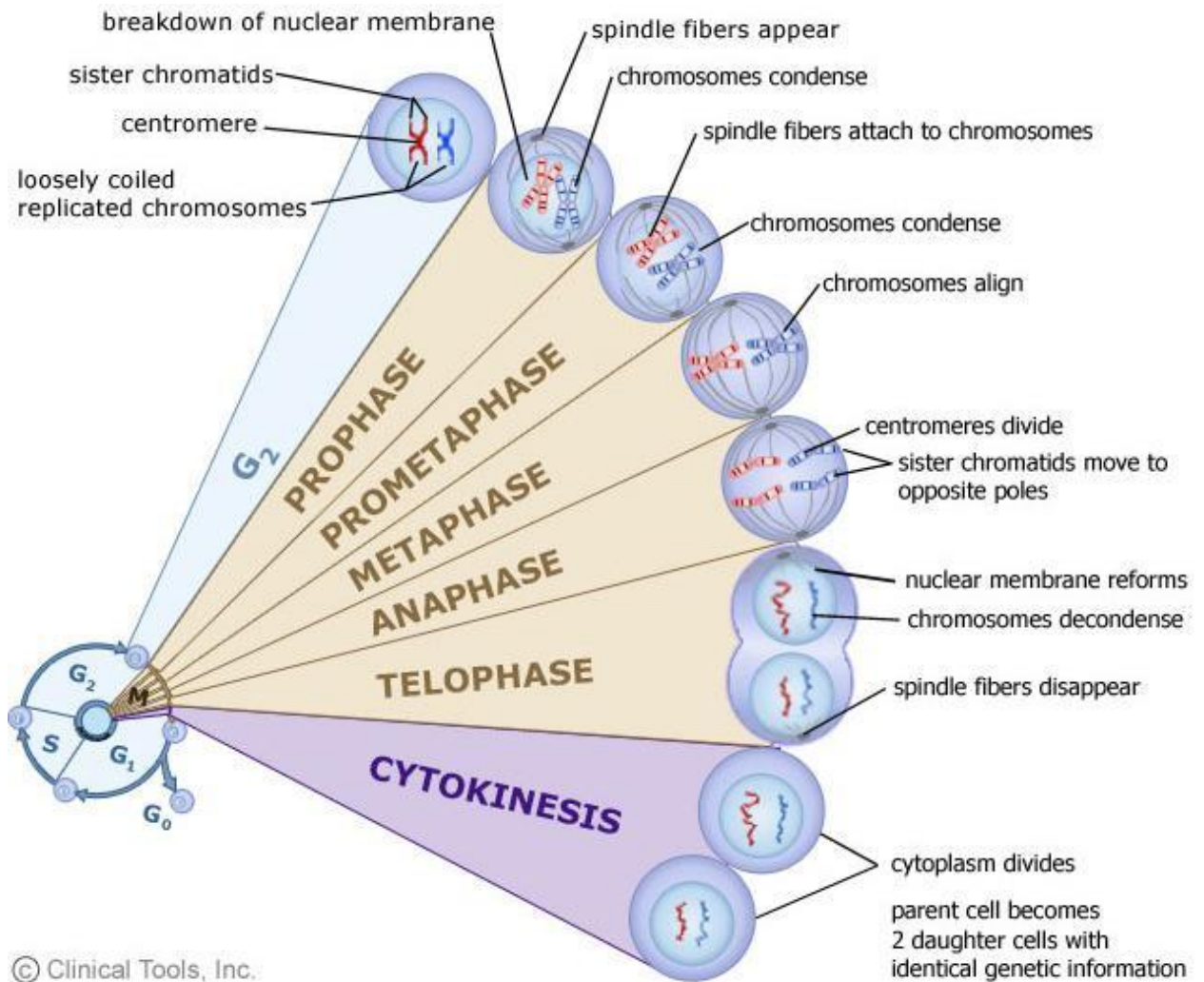


- The main stages of the cell cycle are gap 1, synthesis, gap 2, and mitosis.
- Gap 1 (G₁): cell growth and normal functions
- DNA synthesis (S): copies DNA
- ***Sister chromatids***- identical structures that result from chromosome replication, formed during S phase
- Gap 2 (G₂): additional growth (chromatids become replicated chromosomes)
- Mitosis (M): includes division of the cell nucleus (mitosis) and division of the cell cytoplasm (cytokinesis)
- Mitosis occurs only if the cell is large enough and the DNA undamaged.
- **Interphase**
- Cells spend the majority of their cell cycle in interphase.
- The purpose of interphase is for cell growth.

- By the end of interphase a cell has two full sets of DNA (chromosomes) and is large enough to begin the division process.

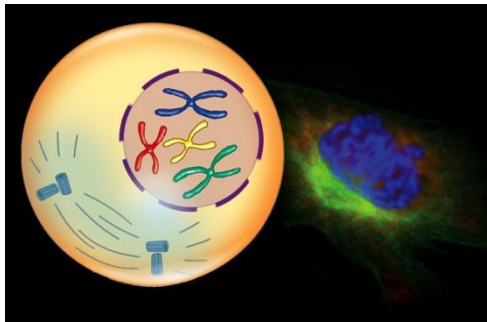
Mitosis

- The purpose of mitosis is cell division: making two cells out of one.
- Each cell has to have its own cytoplasm and DNA.
- The DNA is replicated in interphase when two chromosome strands became four strands (two strands per chromatid).
- In mitosis the four strands (two sister chromatid) have to break apart so that each new cell only has one double-stranded chromosome.
- Two sister chromatids together make a chromosome



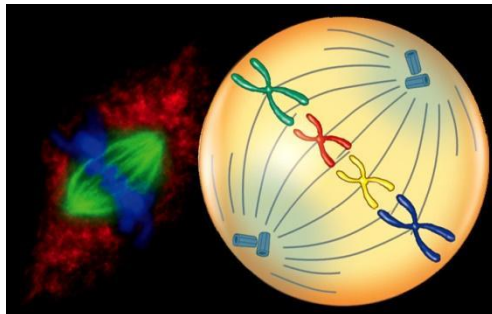
Prophase is characterized by four events:

1. Chromosomes condense and are more visible.
2. The nuclear membrane (envelope) disappears.
3. Centrioles have separated and taken positions on the opposite poles of the cell.
4. Spindle fibers form and radiate toward the center of the cell.



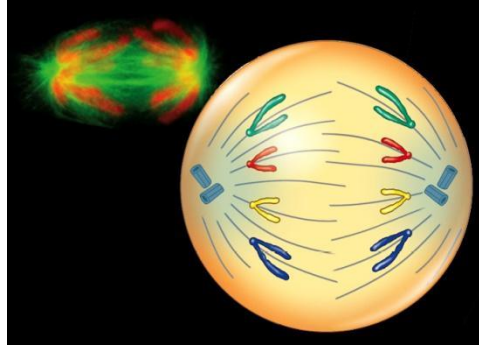
Metaphase (the shortest phase of mitosis) is characterized by two events:

1. Chromosomes line up across the middle of the cell.
2. Spindle fibers connect the centromere of each sister chromatid to the poles of the cell.
3. During metaphase, chromosomes line up in the middle of the cell.



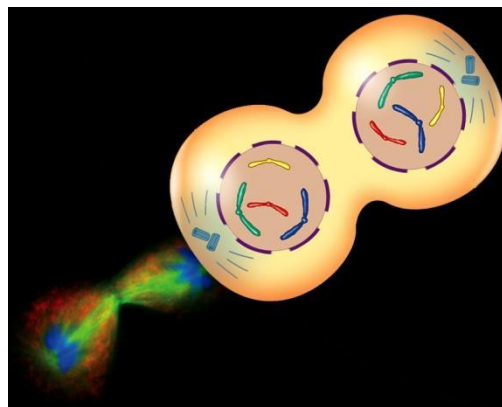
Anaphase is characterized by three events:

1. Centromeres that join the sister chromatids split.
2. Sister chromatids separate becoming individual chromosomes.
3. Separated chromatids move to opposite poles of the cell.



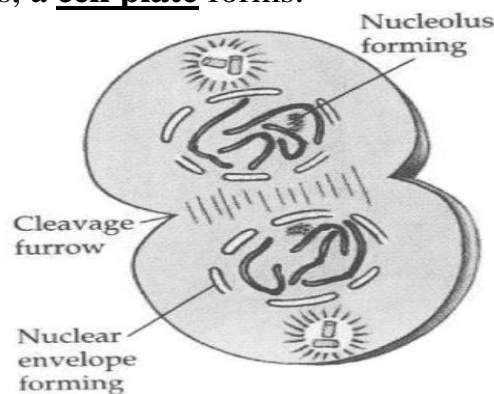
Telophase (the last phase of mitosis) consists of four events:

1. Chromosomes (each consisting of a single chromatid) uncoil.
2. A nuclear envelope forms around the chromosomes at each pole of the cell.
3. Spindle fibers break down and dissolve.
4. Cytokinesis begins.

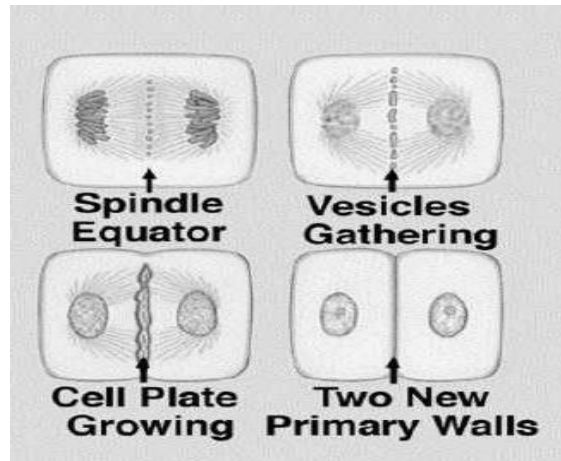


Cytokinesis

- Cytokinesis is the division of the cytoplasm into two individual cells.
- Cytokinesis differs in animal and plant cells
 - In animal cells, the membrane pinches closed.
 - In plant cells, a **cell plate** forms.



Animal Cell Telophase/Cytokinesis



Plant Cell Telophase/Cytokinesis

Meiosis

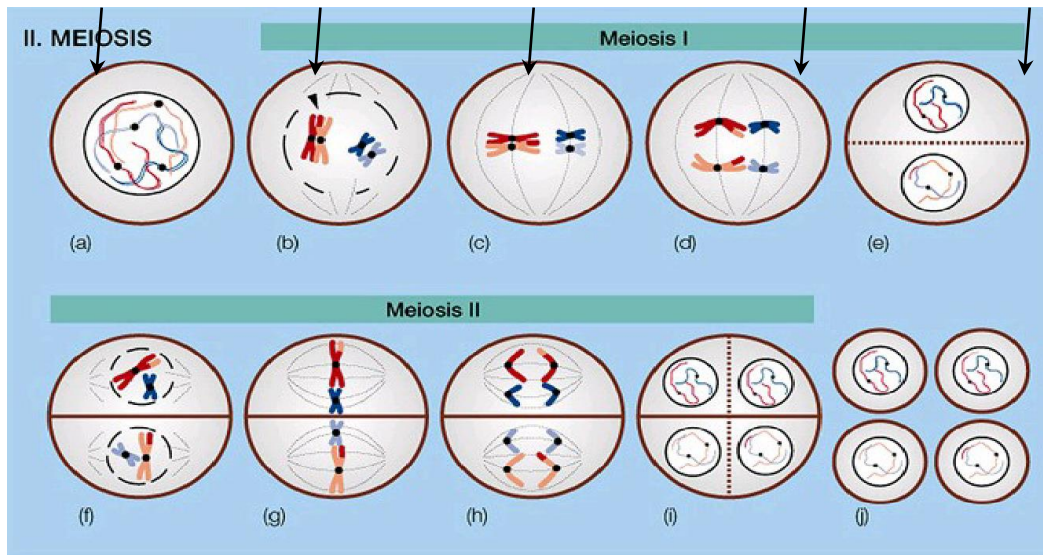
A division of the nucleus that reduces chromosome number by half.

- Important in sexual reproduction
- Involves combining the genetic information of one parent with that of the other parent to produce a genetically distinct individual
- **Diploid** - two sets of chromosomes ($2n$), in humans 23 pairs or 46 total
- **Haploid** - one set of chromosomes (n) - gametes or sex cells, in humans 23 chromosomes
- **Homologous pair**
 - each chromosome in pair are identical to the other (carry genes for same trait)
 - only one pair differs - sex chromosomes X or Y

Phases of Meiosis

- A diploid cell replicates its chromosomes
- Two stages of meiosis
 - Meiosis I and Meiosis II
 - Only 1 replication

Original Gamete Metaphase Anaphase Telophase Cytokinesis



2 Daughter Cells Metaphase 2 Anaphase 2 Telophase 2 Cytokinesis – 4 Gametes

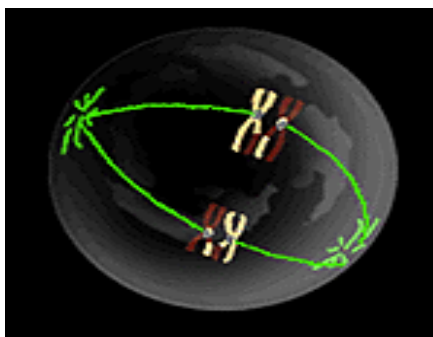
Meiosis I ↑ ↑ ↑ ↑ ↑

➤ **Prophase I**

- Chromosomes condense
- Homologous chromosomes pair w/ each other
- Each pair contains four sister chromatids – tetrad

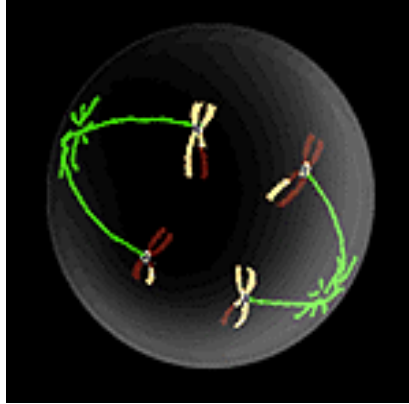
➤ **Metaphase I**

- Tetrads or homologous chromosomes move to center of cell



➤ **Anaphase I**

- Homologous chromosomes pulled to opposite poles

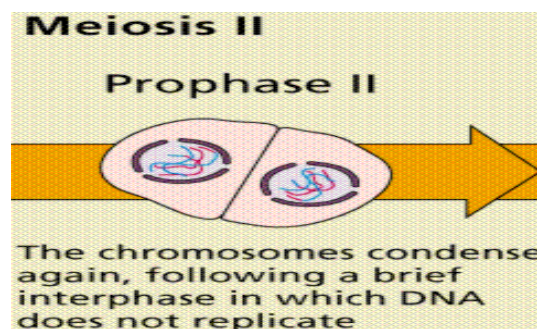


- Telophase I
- Daughter nuclei formed ,These are haploid (1n)



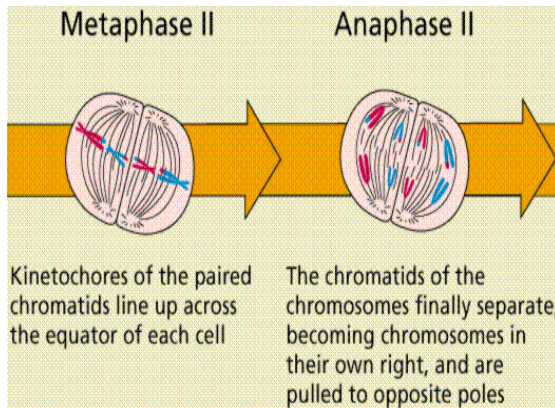
Meiosis II:

- Daughter cells undergo a second division; much like mitosis
- No additional replication occurs
- **Prophase II**
 - Spindle fibers form again



- **Metaphase II**

- Sister chromatids move to the center

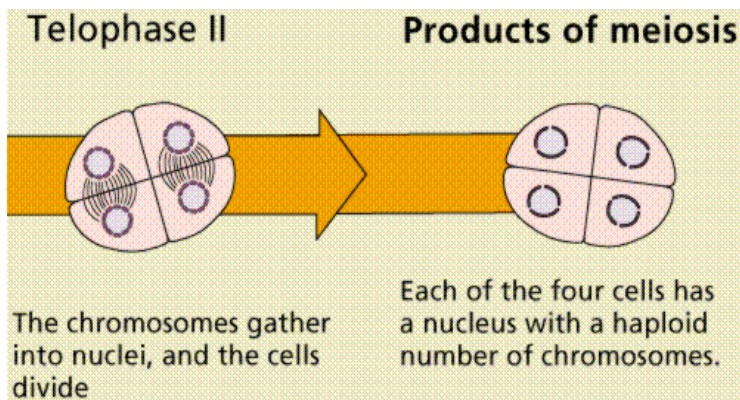


➤ **Anaphase II**

- Centromeres split
- Individual chromosomes are pulled to poles

➤ **Telophase II & Cytokinesis**

- Four haploid daughter cells results from one original diploid cell
-



Review Mitosis & Meiosis

- Both are forms of nuclear division
- Both involve replication
- Both involve disappearance of the nucleus, and nucleolus, nuclear membrane
- Both involve formation of spindle fibers
- **DIFFERENCES**
- **Meiosis** produces daughter cells that have **1/2** the number of chromosomes as the parent. Go from $2n$ to $1n$.
- **Daughter cells** produced by meiosis are **not** genetically **identical** to one another.
- In **meiosis** cell division takes place **twice** but replication occurs only **once**.