CELL CYCLE AND CELL DIVISION

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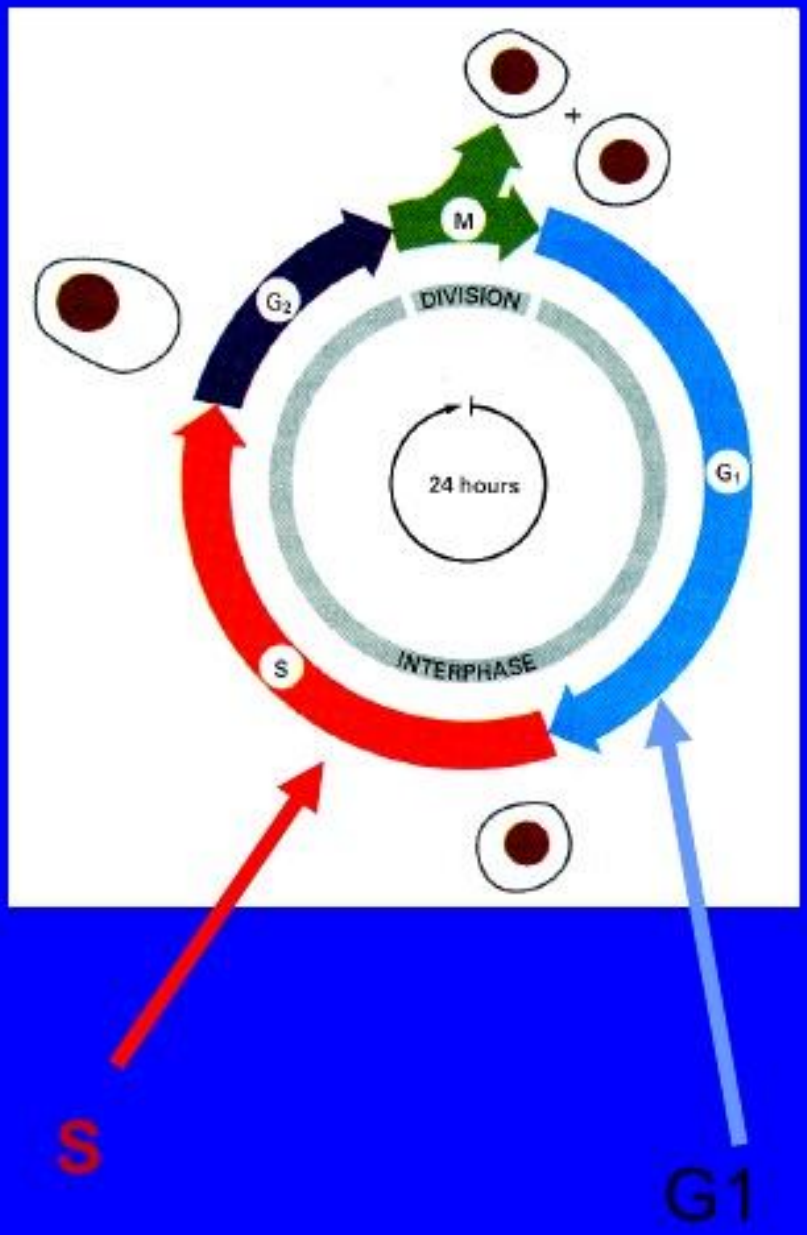
The Cell Cycle is an ordered set of events.

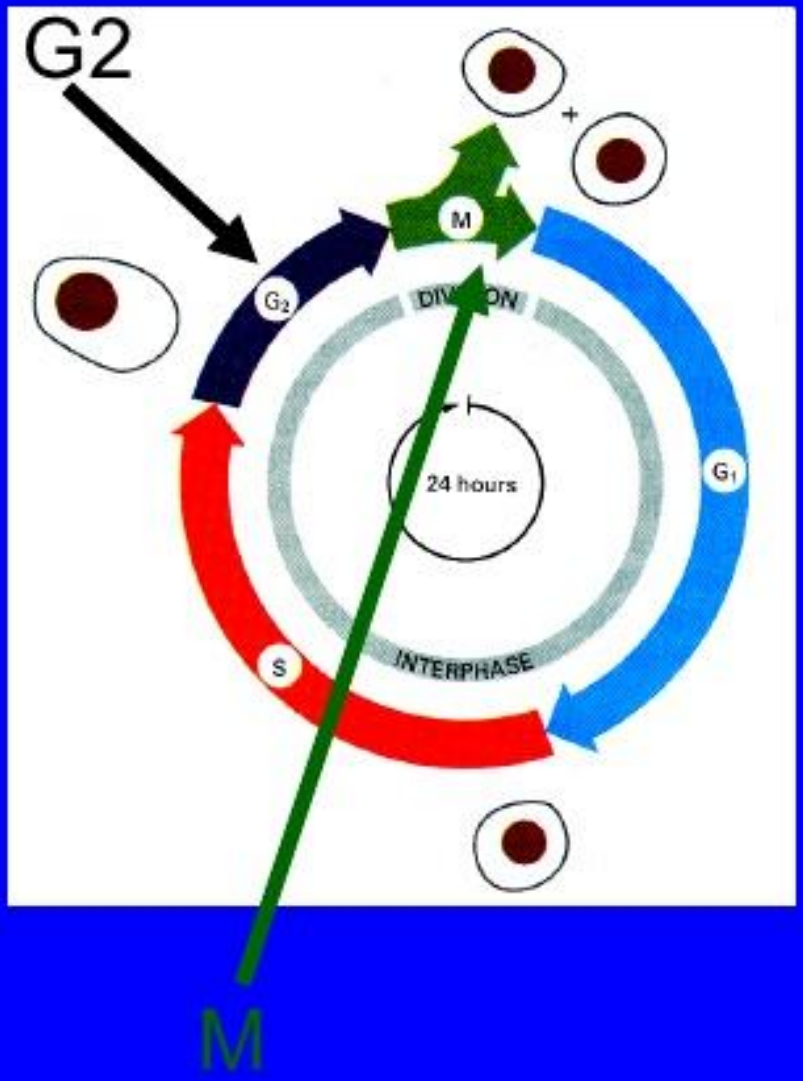
- The **G1** phase stands for "GAP-1" and is required for cell growth and preparation of DNA synthesis.

- The **S**-phase stands for "Synthesis" and replicates the DNA (genome).



The **G2** phase is "GAP-2" and is needed for cell growth and preparation for mitosis.

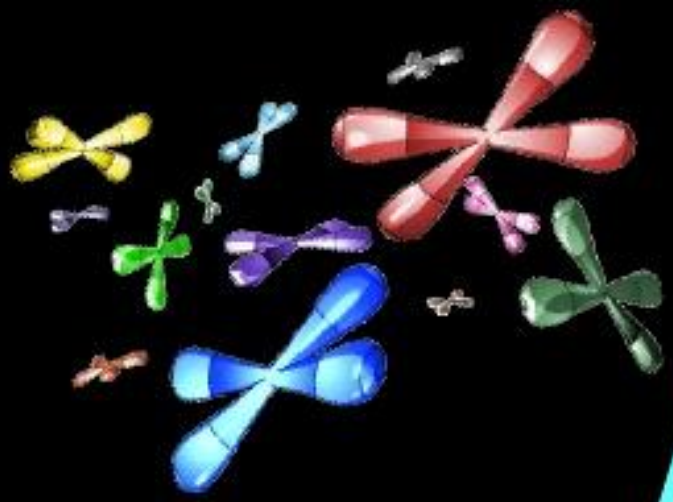
The last phase is **M.**
It stands for "Mitosis" where cells separate duplicated chromosomes

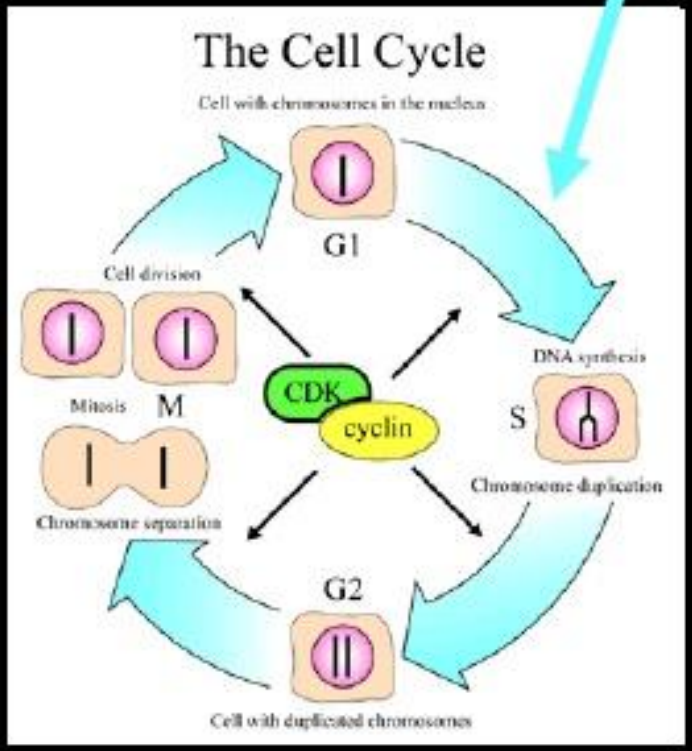


In the G1 Phase, the cell is doing its everyday job, regardless of what type of cell it is.

At this time the chromosomes each have just one molecule of DNA.

Chromosomes with one strand of DNA are called unduplicated or unreplicated chromosomes.

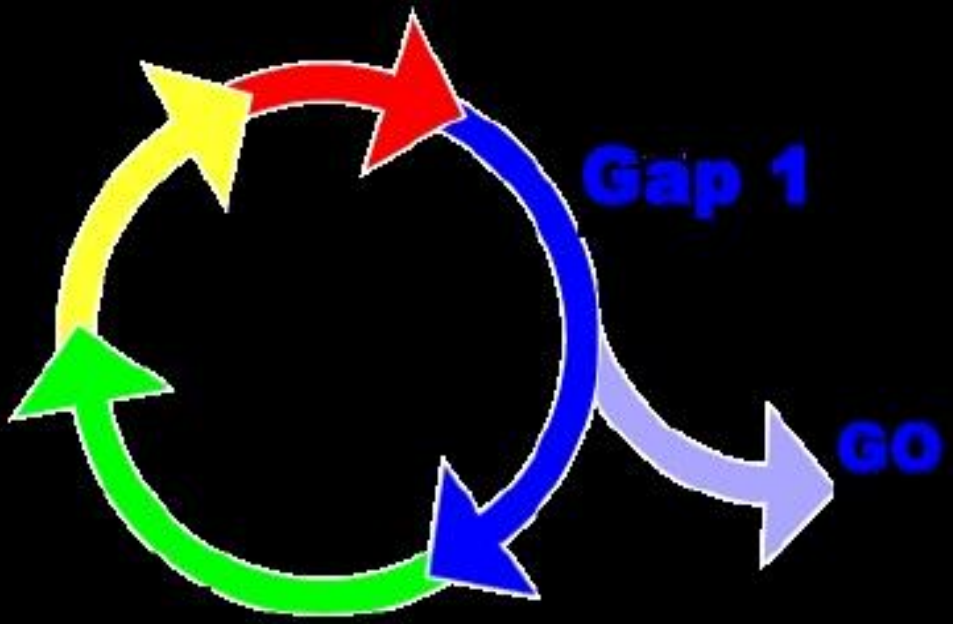




Gap 1 Phase begins at the end of mitosis and cytokinesis and lasts until the beginning of S phase.

It is the longest of the four cell cycle phases and varies in length.

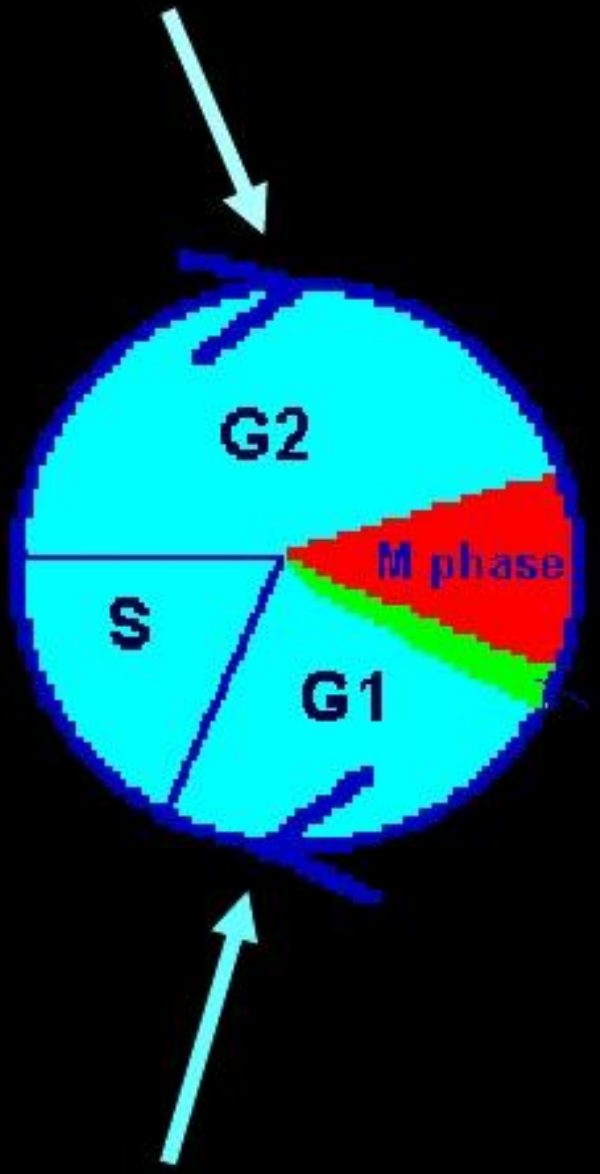
During G1 Phase the cell grows and chooses to replicate its DNA or to exit the cell cycle and enter a quiescent state



Control of the Cell Cycle
During the G1 and G2 phases, cells grow and make sure that conditions are proper for DNA replication and cell division.

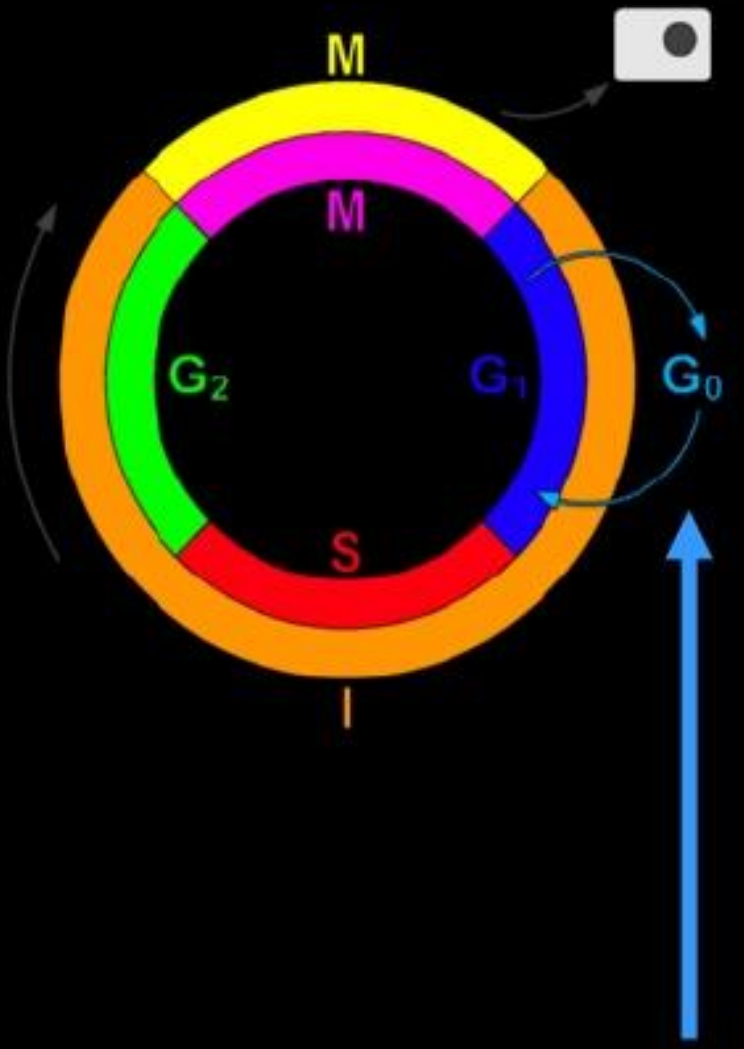
During the G1 phase, cells monitor their environment and determine if conditions, including the availability of nutrients, growth factors and hormones, justify DNA replication.

The decision to begin replication is made at a specific "checkpoint" in G1 called the "restriction point."



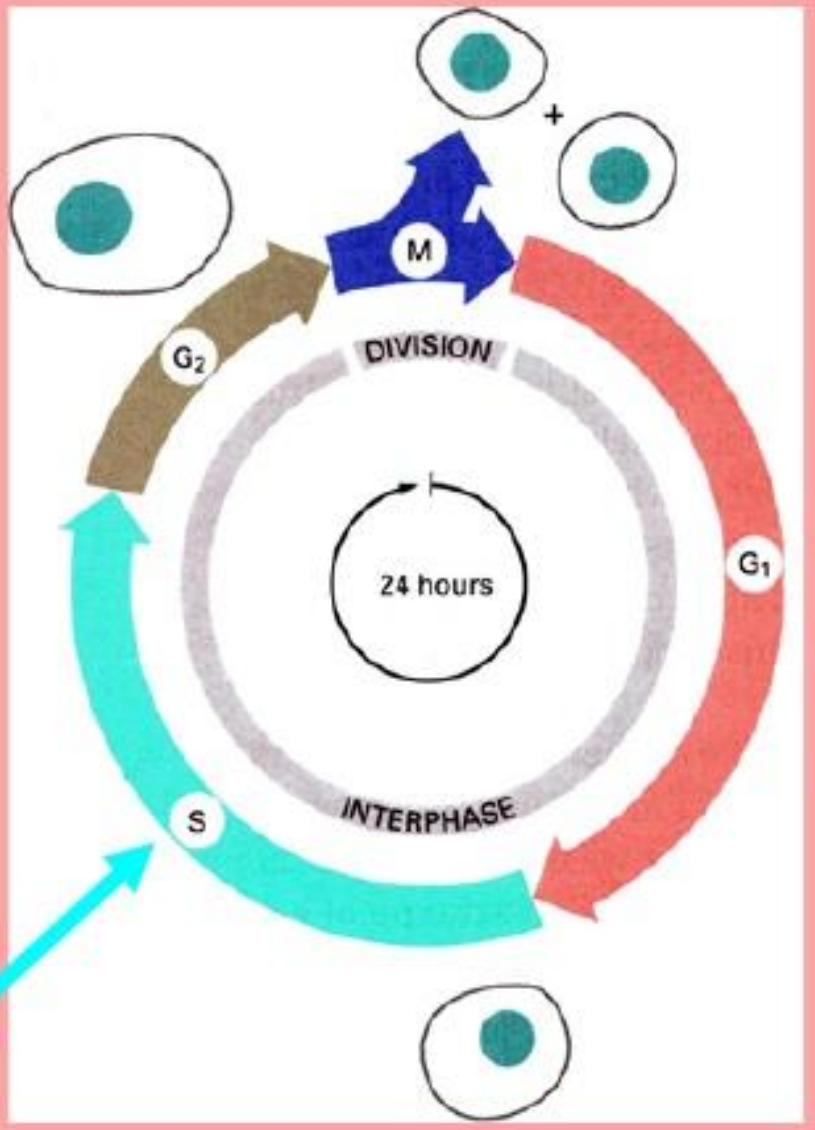
If, prior to the restriction point, cells sense inadequate growth conditions or receive negative signals from other cells, they enter G0 (G-zero) phase, also called quiescence. (quiet time)

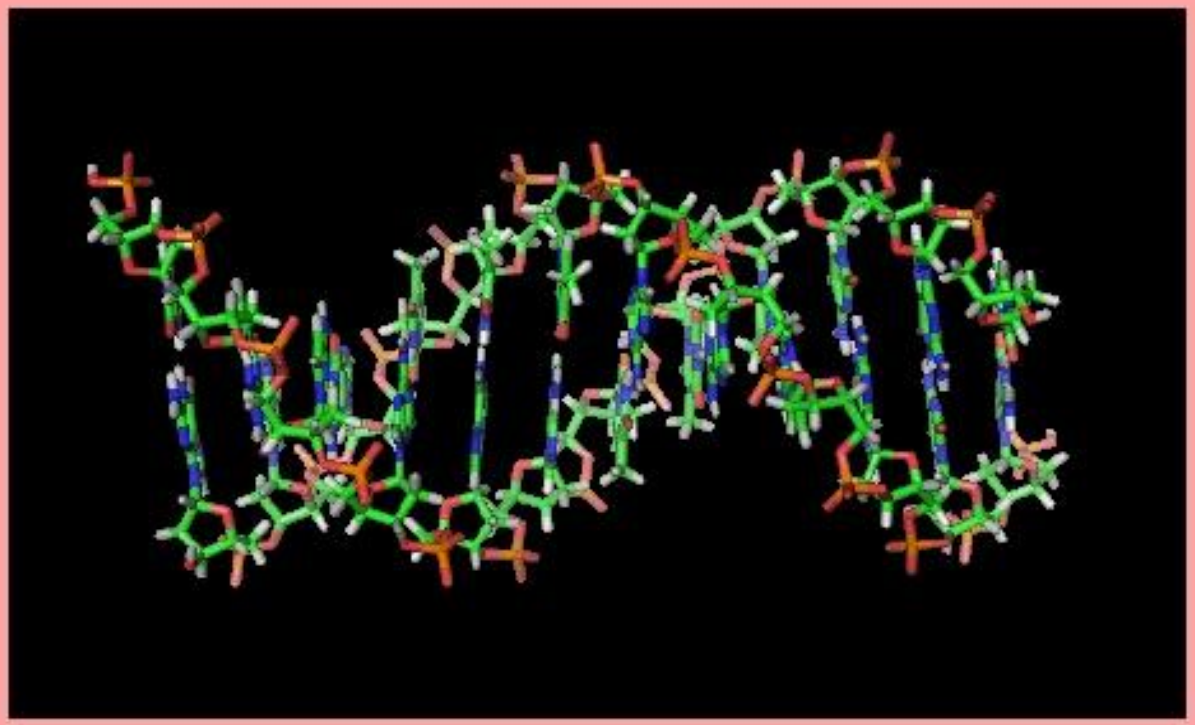
In the G0 phase, they are maintained for prolonged periods in a nondividing state.



A eukaryotic cell cannot divide unless it replicates its DNA (genome) and then separates the duplicated DNA.

To do this cells must perform **DNA synthesis** and **mitosis**.

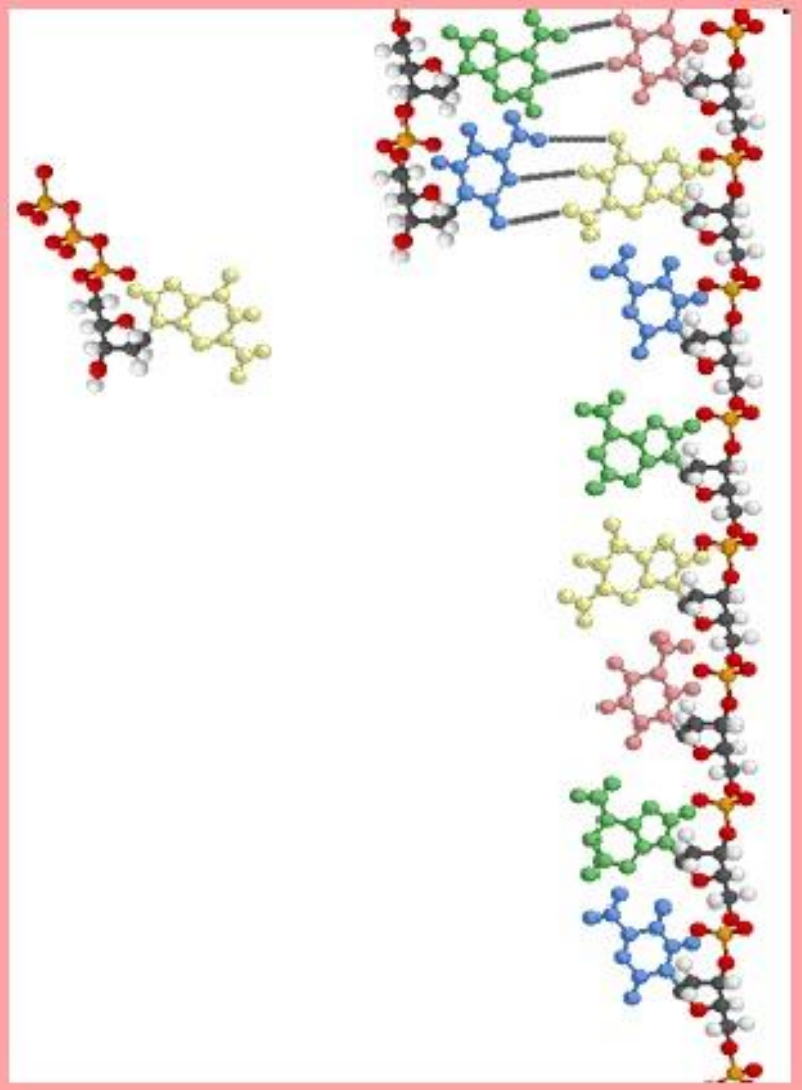




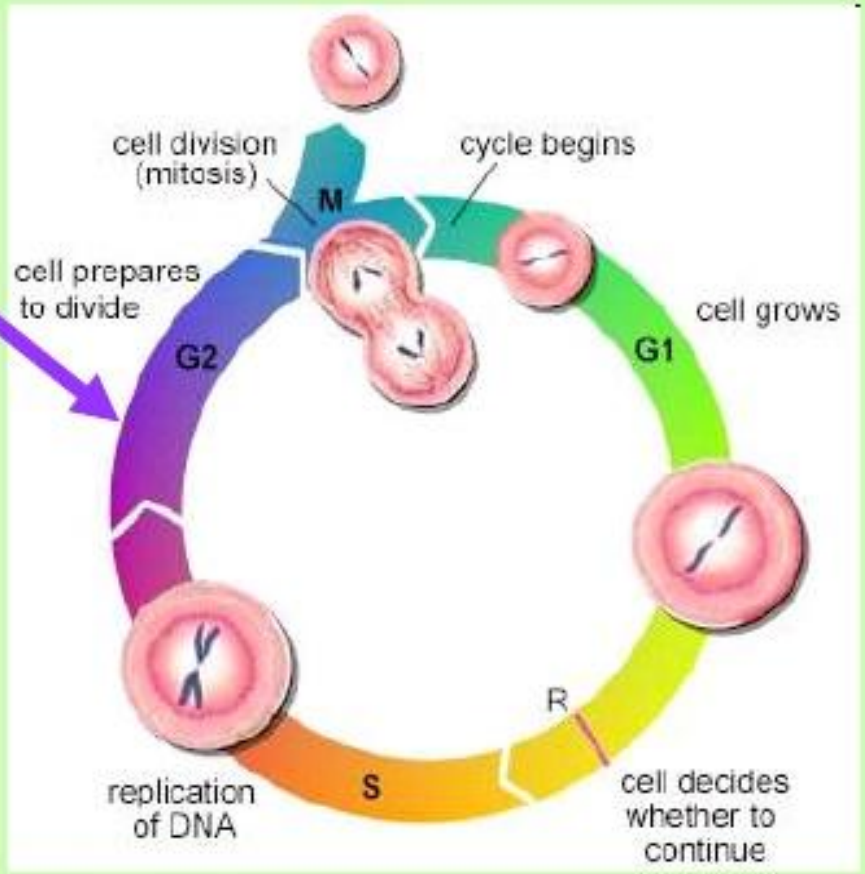
In the S Phase, the DNA replicates or duplicates. The chromosomes that result have two molecules of DNA and are called duplicated or replicated chromosomes.

The S phase (DNA synthesis phase), typically lasts about 6 hours.

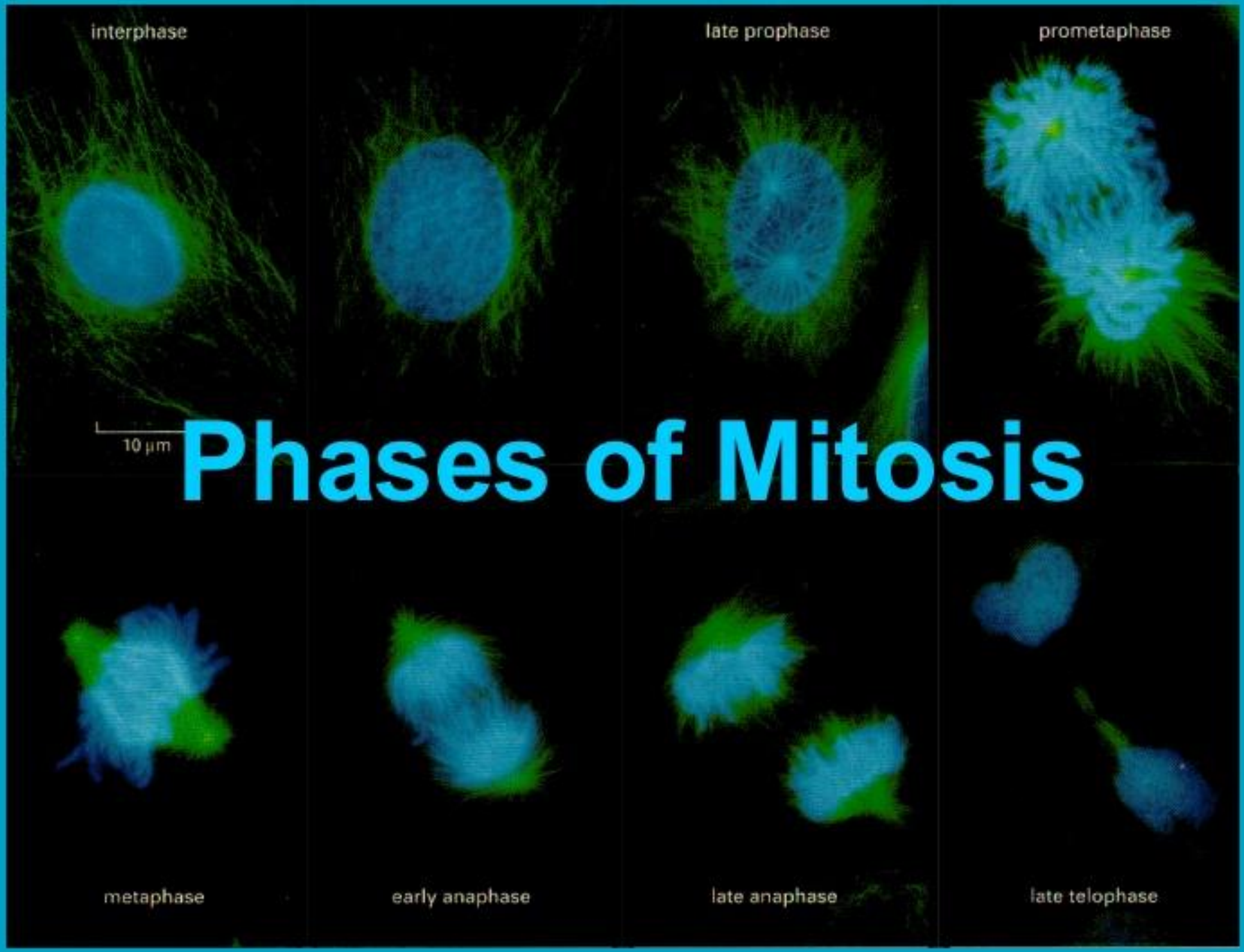
In mammalian cells, the start of S phase (when DNA synthesis begins) takes place several hours after the cell has committed to carrying out DNA synthesis.

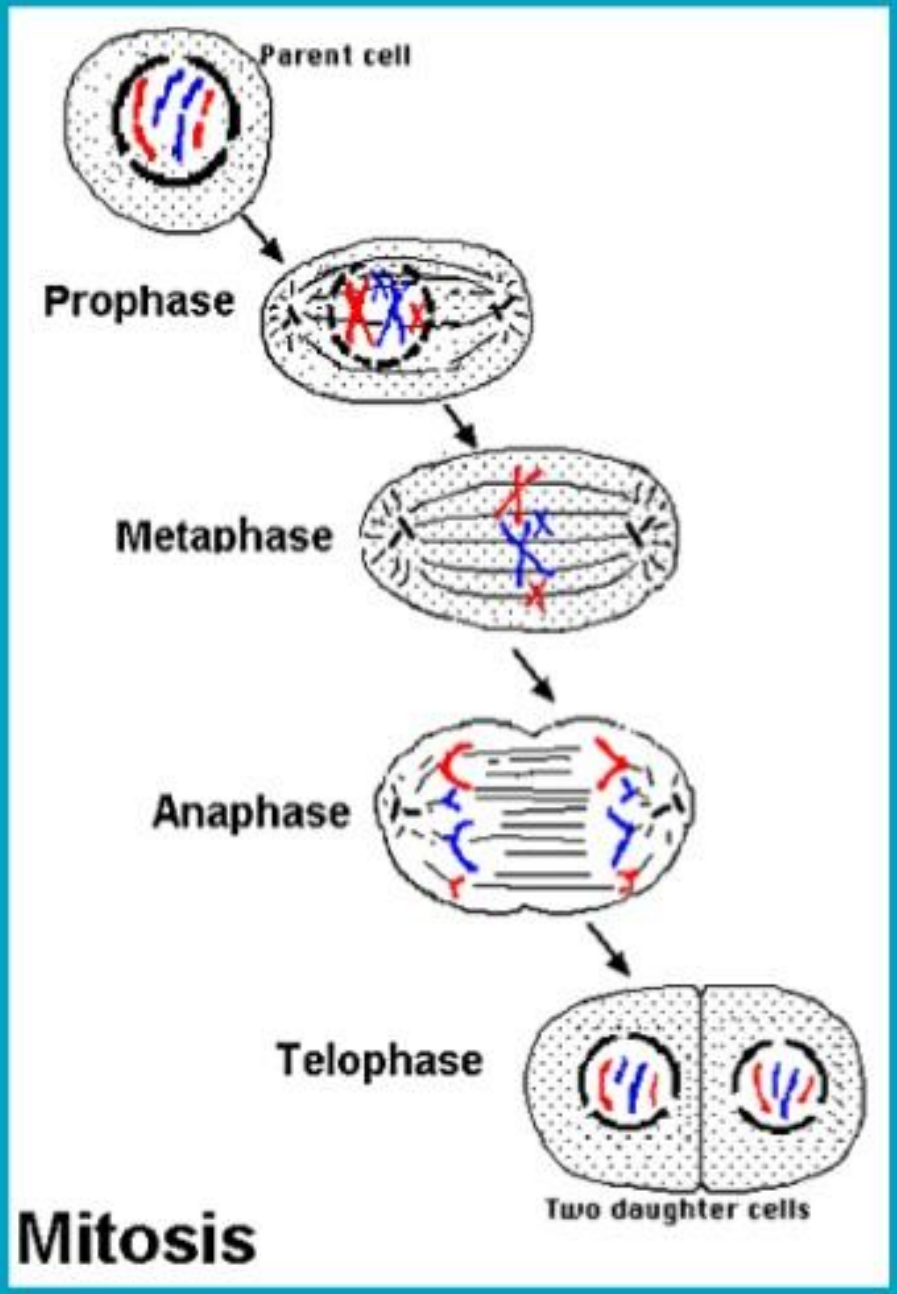


The portion of Interphase that follows S phase is called Gap 2 Phase. Some cells can exit the cell cycle from G2 phase, just as they can from G1 phase.



In G2 Phase, the cell is carrying out processes necessary for mitosis to begin.

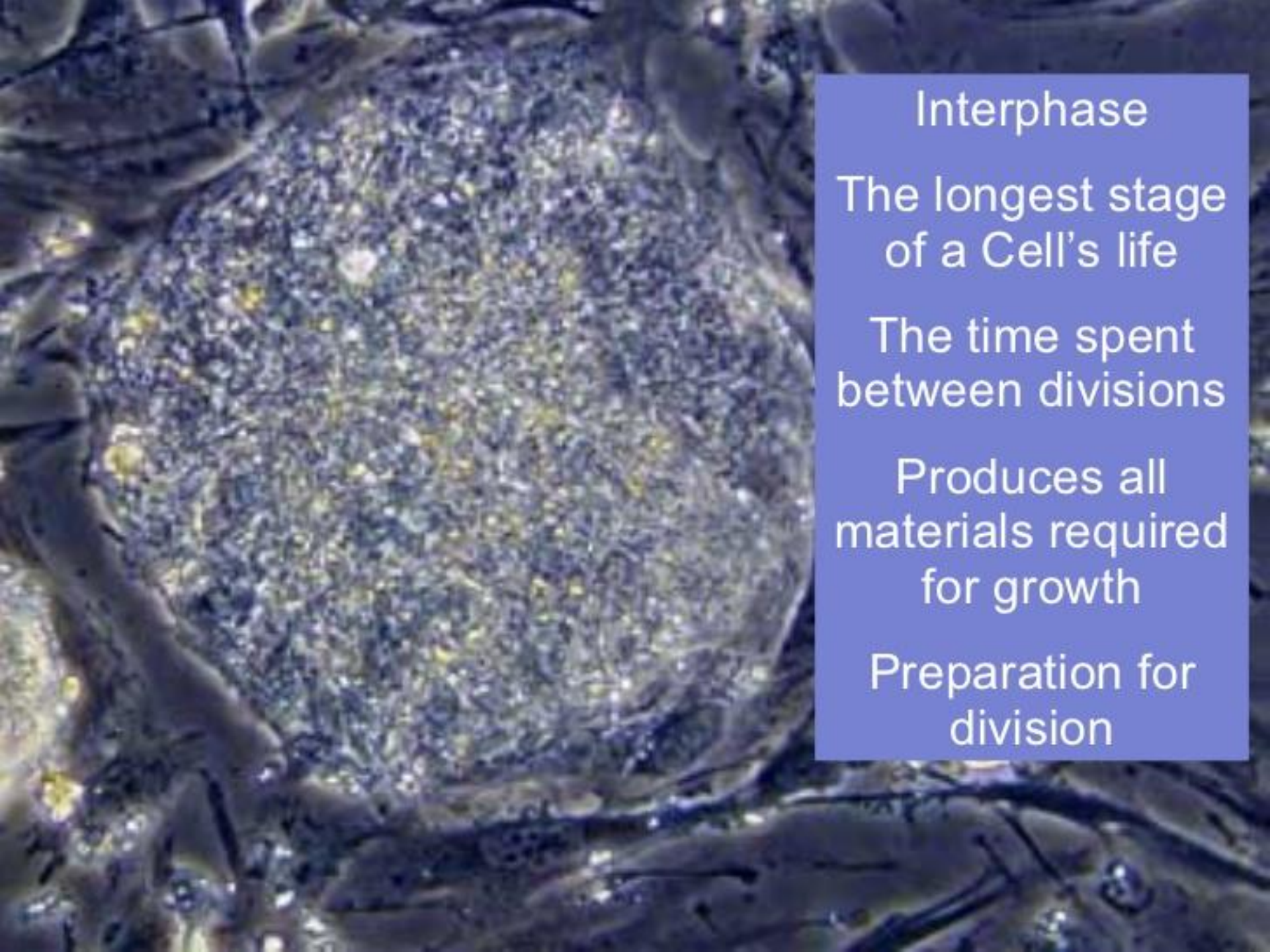

interphase
late prophase
prometaphase
10 µm
Phases of Mitosis
metaphase
early anaphase
late anaphase
late telophase



Mitosis

The Basic Phases of a Cell's Life:

- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Cytokinesis



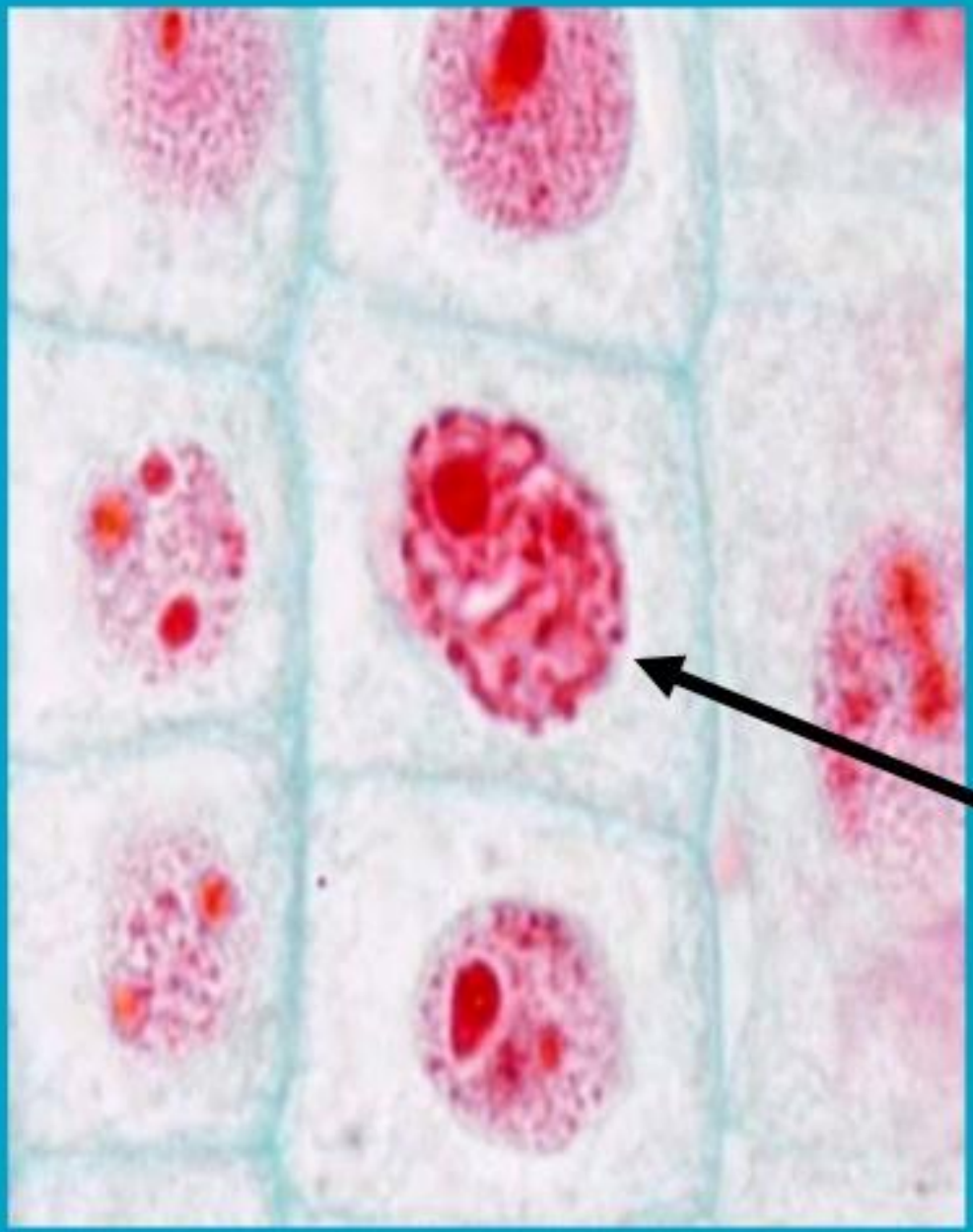
Interphase

The longest stage of a Cell's life

The time spent between divisions

Produces all materials required for growth

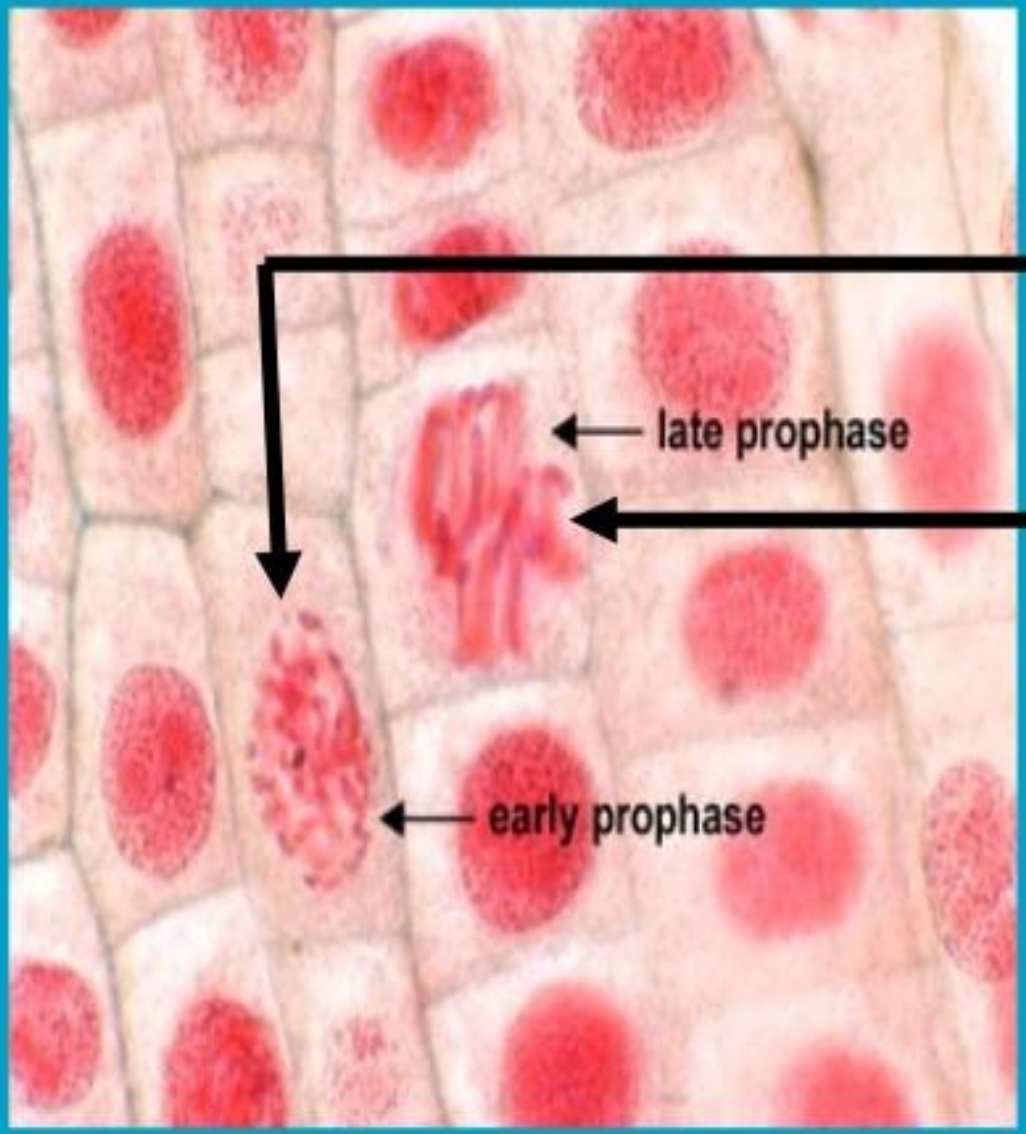
Preparation for division



Prophase

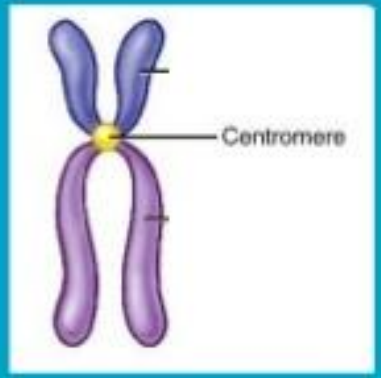
The Cell begins the division process

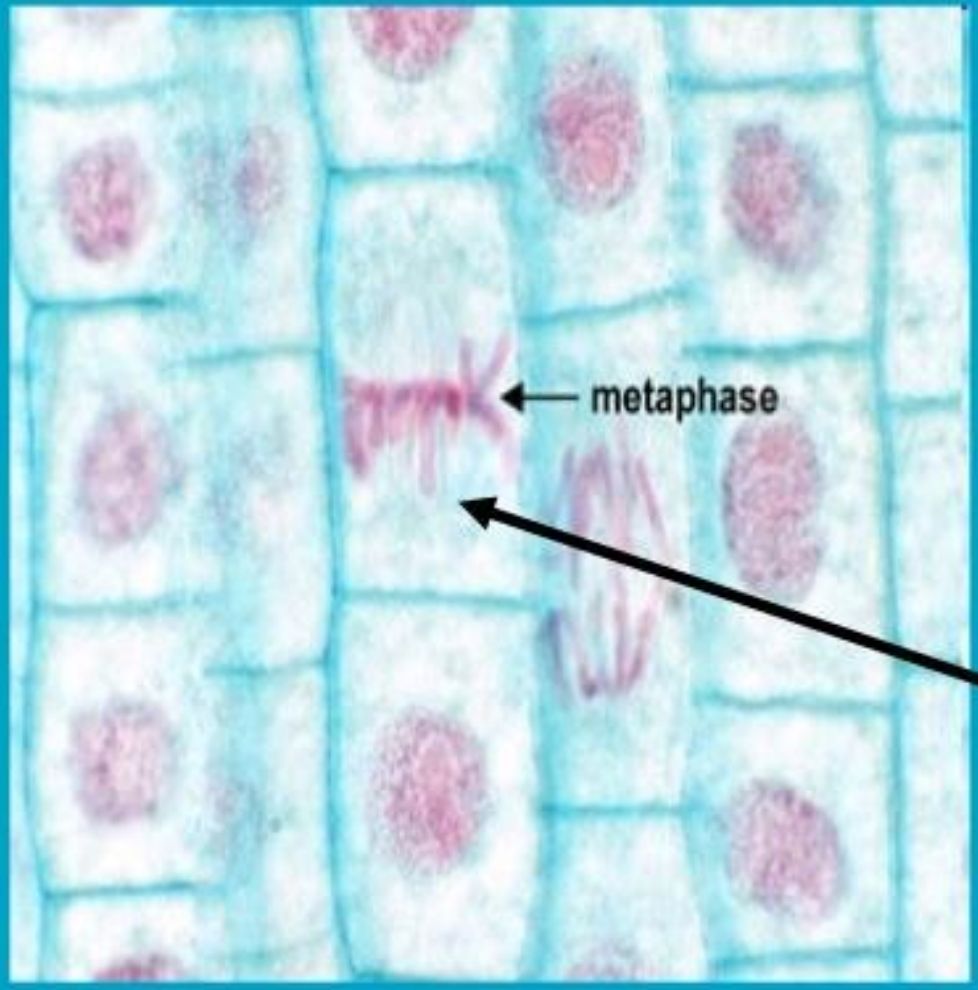
4. The nucleolus disappears,
5. The nuclear membrane breaks apart



3. The chromosomes become visible

4. The spindle apparatus forms and attaches to the centromeres of the chromosomes

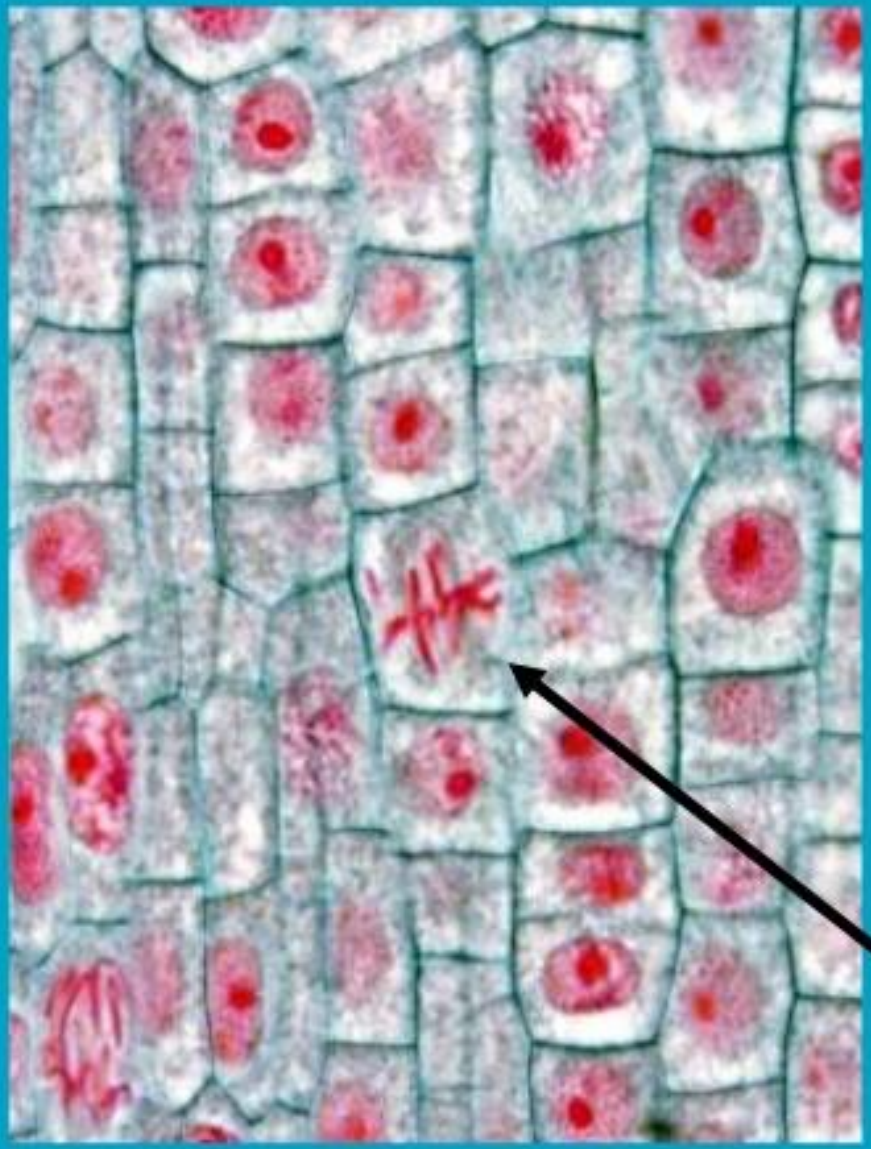




Metaphase

The Second Phase of Mitosis

4. The Nuclear Membrane is completely gone
2. The duplicated chromosomes line up along the cell's equator.



Anaphase

The third phase of Mitosis

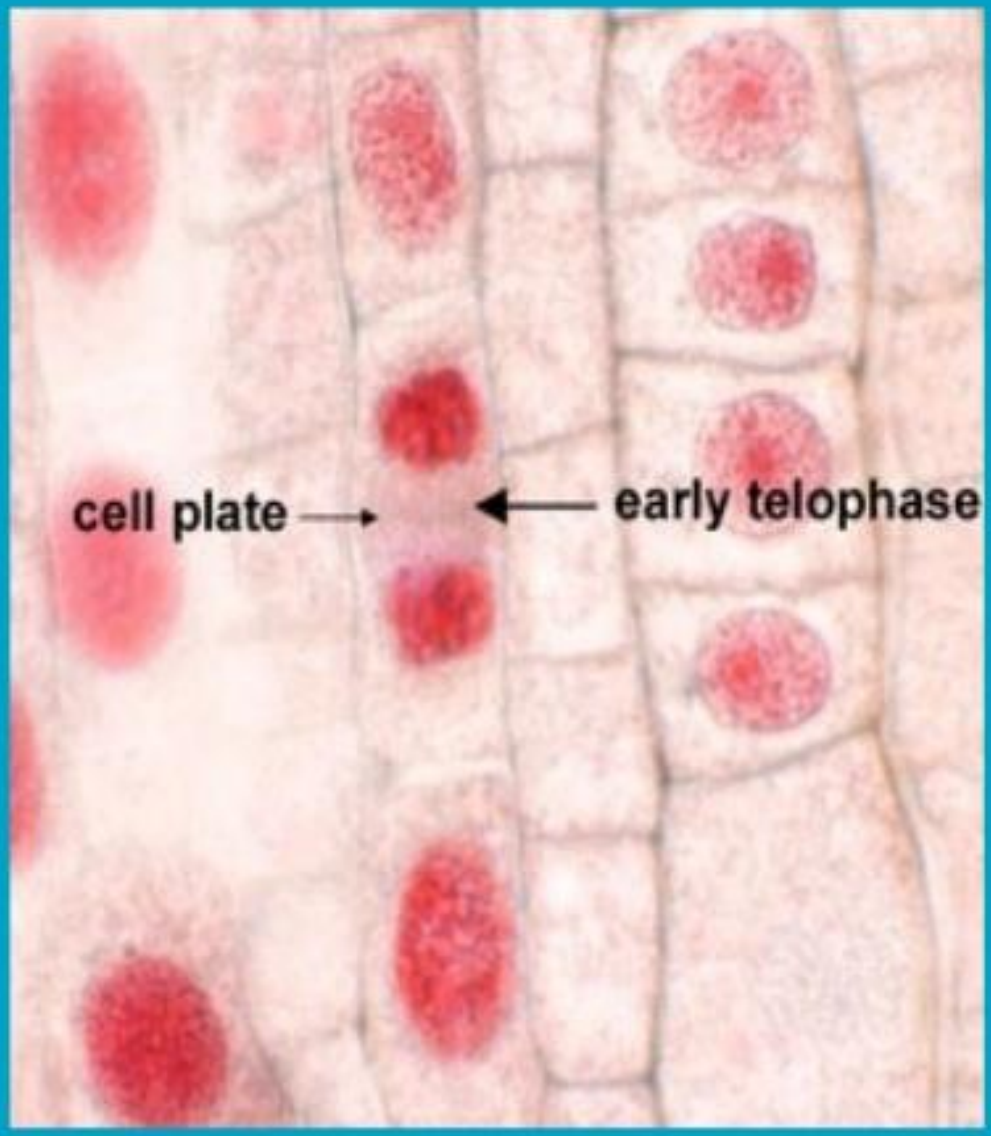
Diploid sets of daughter chromosomes separate

They are pushed and pulled toward opposite poles of the cell by the spindle fibers

Telophase

The nuclear membrane and nucleoli (nucleus) reform.

Cytokinesis is nearly complete,

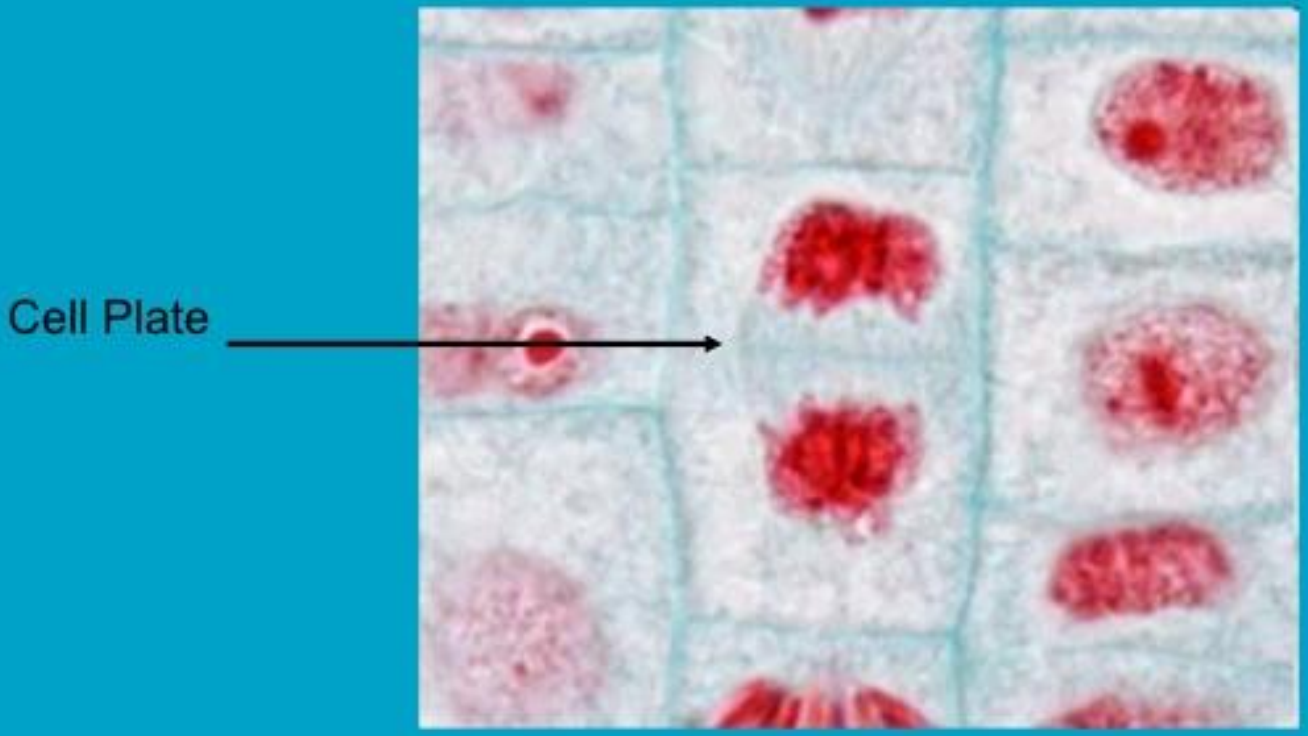


The Cell Plate begins to form

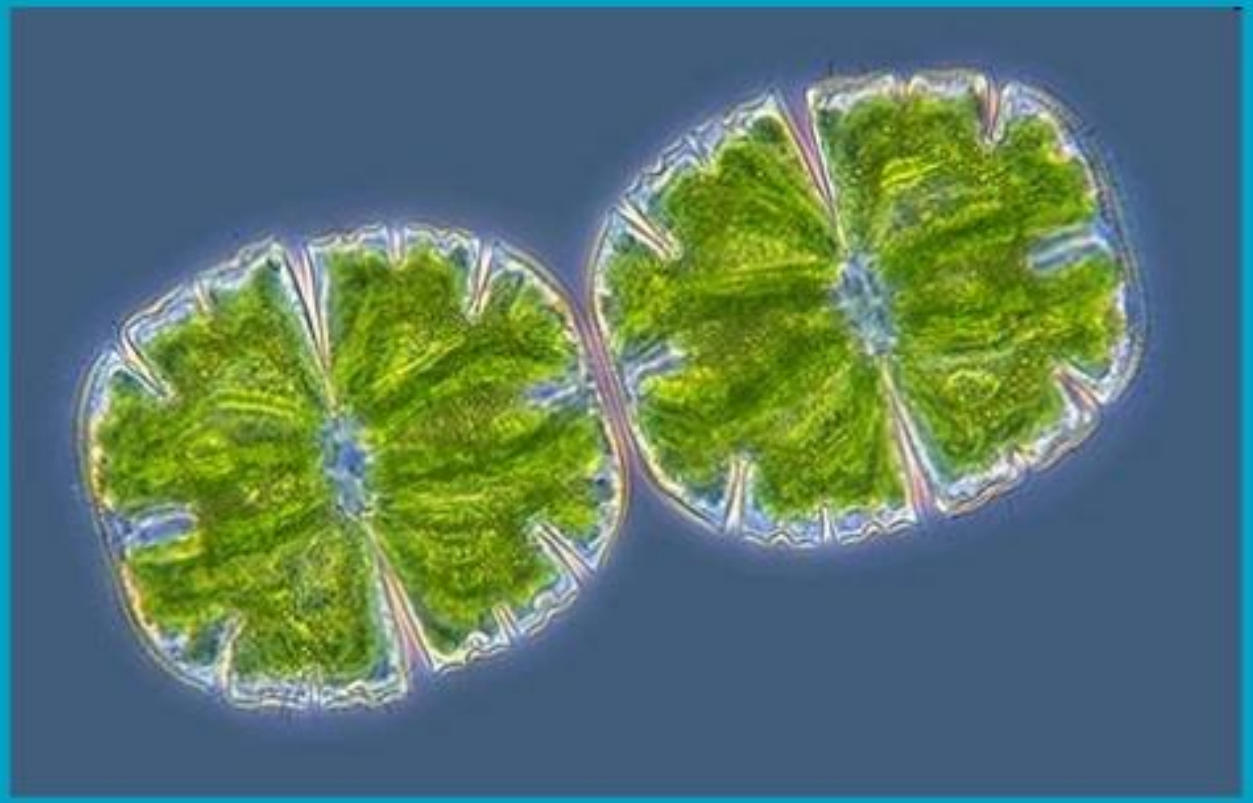
The Cell prepares for finial division

Cytokinesis – The final stage of Mitosis

The cytoplasm, organelles, and nuclear material are evenly split and two new cells are formed.



The two new cells – each exactly like the other – are called Daughter Cells



MEIOSIS

Meiosis

- Specialized form of cell division with two successive rounds (MEIOSIS I + MEIOSIS II) of cell division without DNA replication in between.

- Produces **haploid** cells (n)

Meiosis

- Start with 46 double stranded chromosomes (2n)
  - After 1st division - 23 double stranded chromosomes (n)
  - After 2nd division - 23 single stranded chromosomes (n)
- Occurs in our germ cells
  - cells that produce our gametes
  - egg and sperm

MEIOSIS = MEIOSIS I + MEIOSIS II

- Meiosis I : the reduction division
- Meiosis II : the equational division

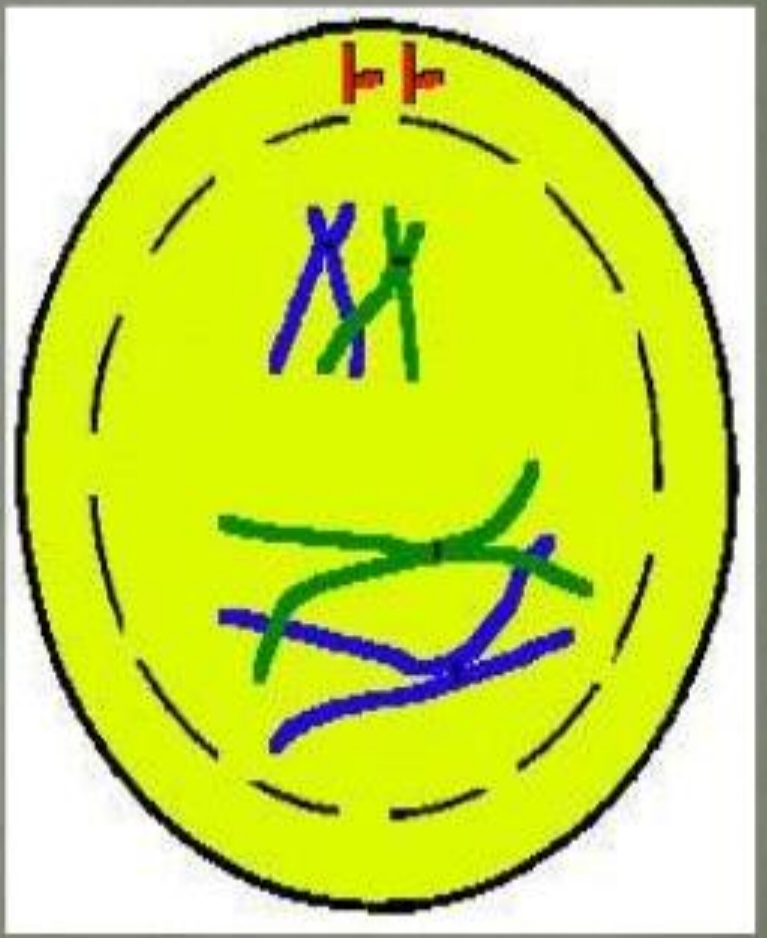
Meiosis

- •The Role of Sexual Reproduction in Evolution Sexual reproduction in a population should decline in frequency relative to asexual reproduction. Asexual reproduction? No males are needed, all individuals can produce offspring.
- Sexual reproduction? Only females can produce offspring, therefore fewer are produced.

- Sexual reproduction may exist because it provides genetic variability that reduces susceptibility of a population to pathogen attack.

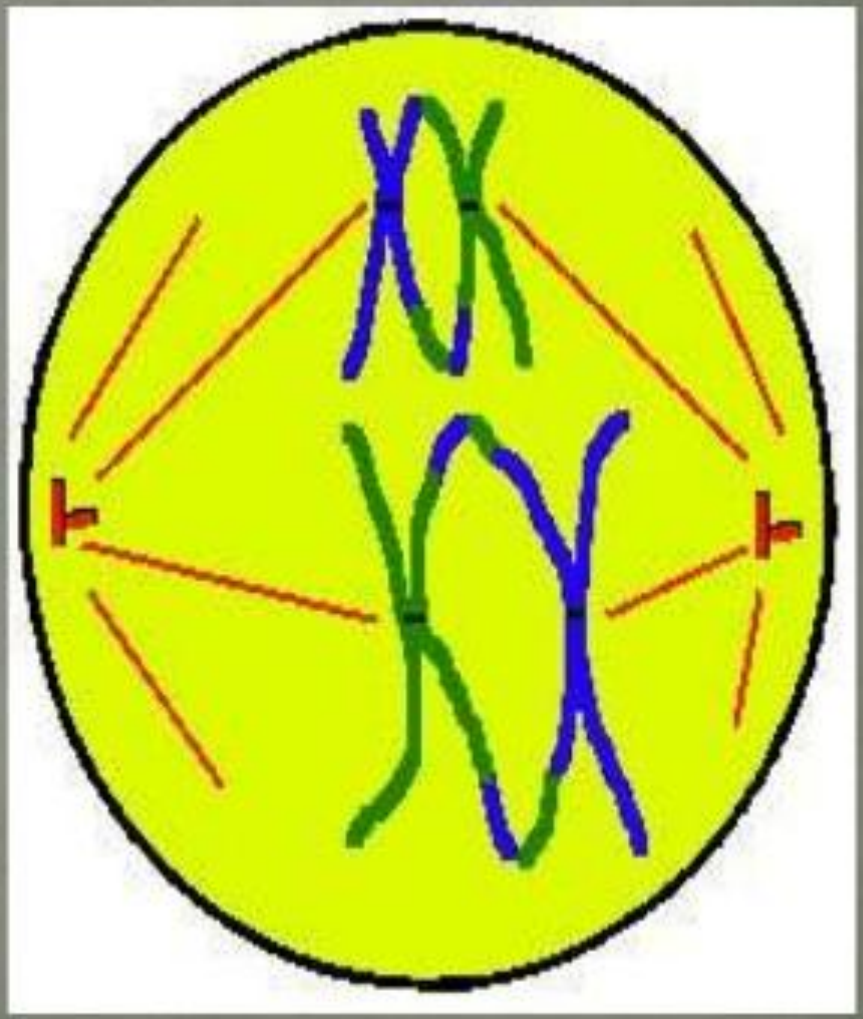
Prophase 1

- The chromosomes condense and become visible
- The centrioles form and move toward the poles
- The nuclear membrane begins to dissolve
- The homologs pair up, forming a tetrad
  - Each tetrad is comprised of four chromotids - the two homologs, each with their sister chromatid
- Homologous chromosomes will swap genetic material in a process known as **crossing over** (abbreviated as XO)
  - Crossing over serves to **increase genetic diversity** by creating four unique chromatids



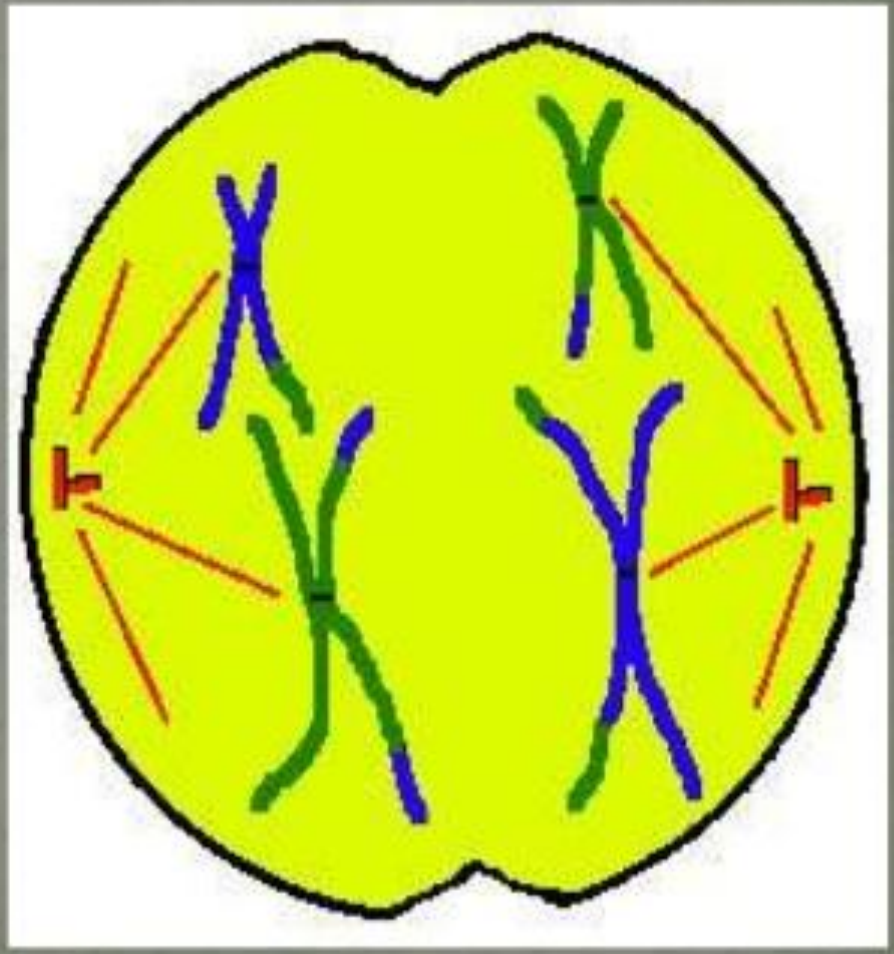
Metaphase 1

- •Microtubules grow from the centrioles and attach to the centromeres
- •The tetrads line up along the cell equator



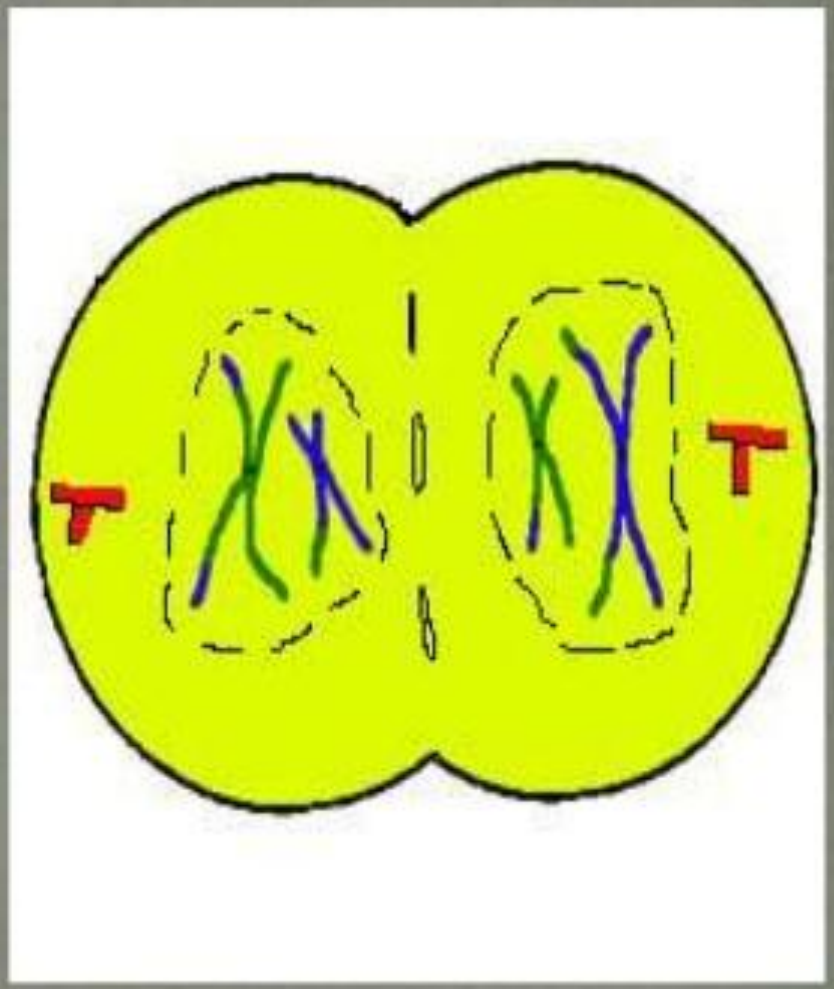
Anaphase 1

- Anaphase I •The centromeres break and homologous chromosomes separate (note that the sister chromatids are still attached)
- •Cytokinesis begins



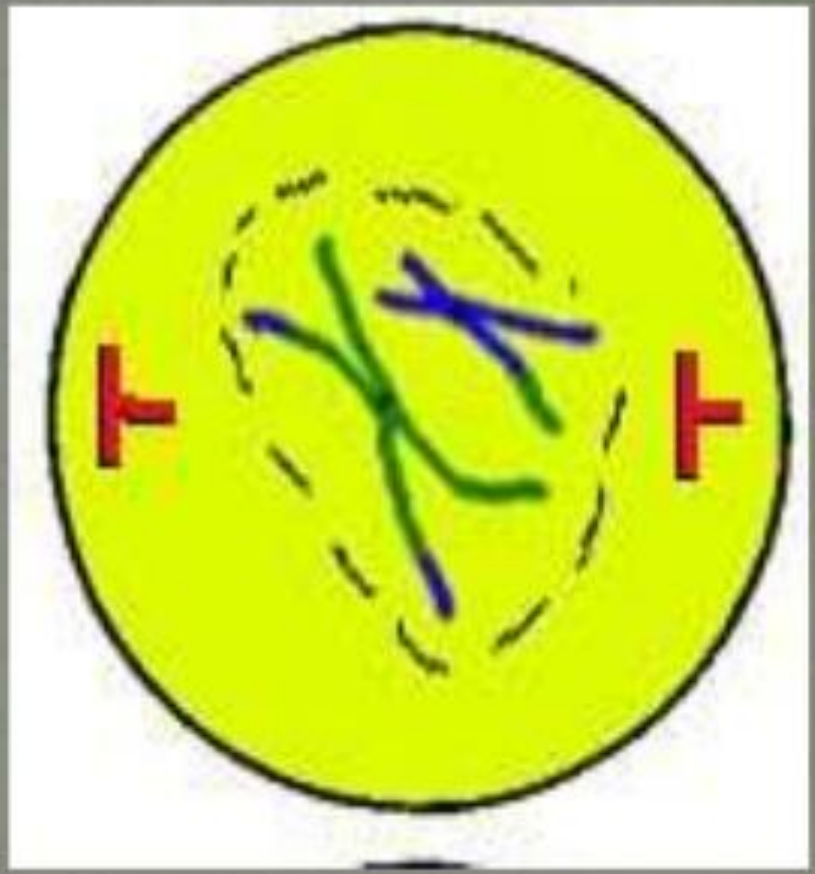
Telophase 1

- •The chromosomes may decondense (depends on species)
- •Cytokinesis reaches completion, creating two haploid daughter cells



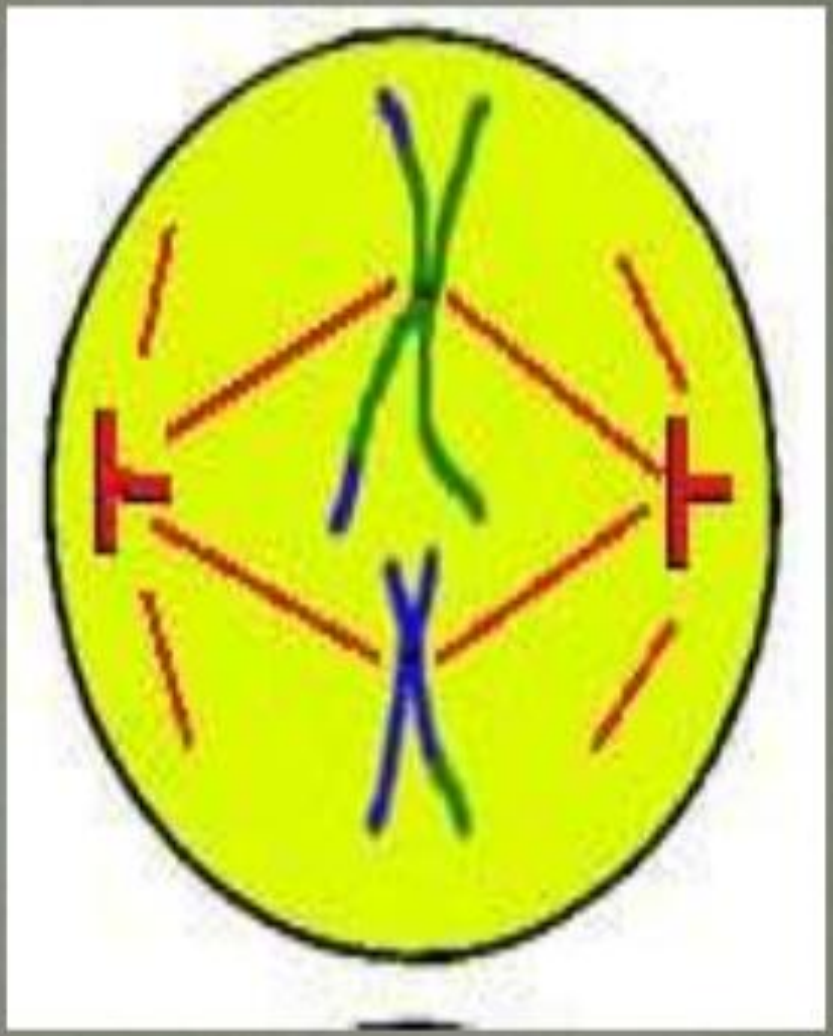
Meiosis II

- Prophase II •Centrioles form and move toward the poles
- •The nuclear membrane dissolves



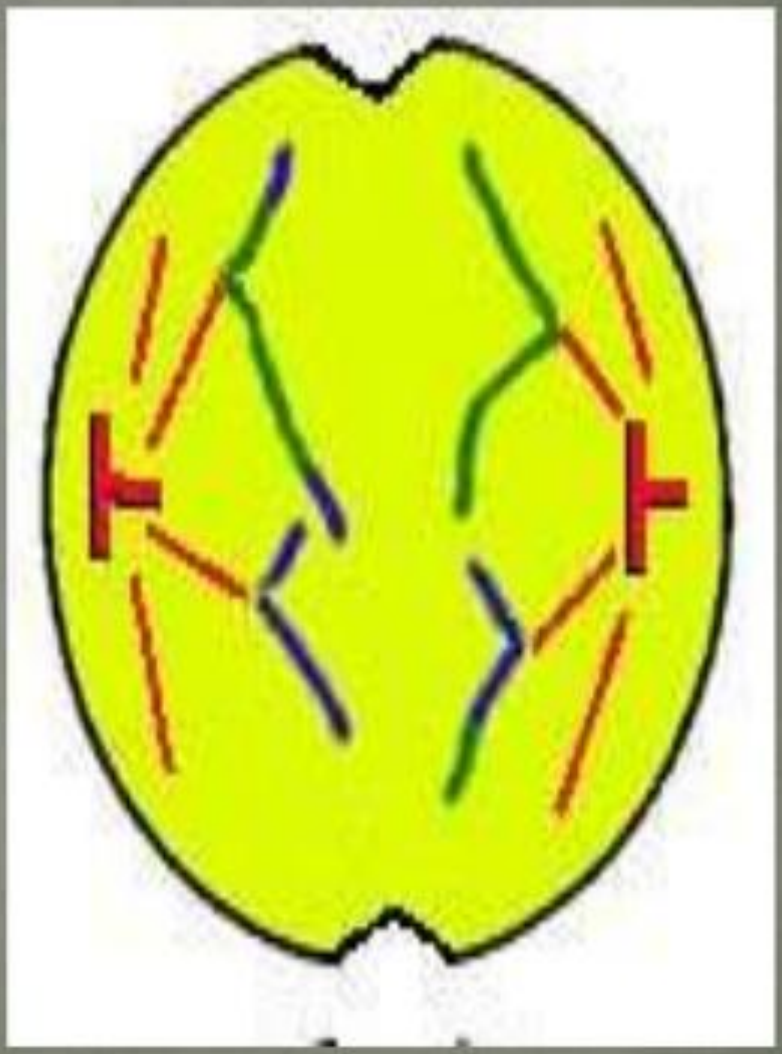
Meiosis II

- Metaphase II
- •Microtubules grow from the centrioles and attach to the centromeres
- •The sister chromatids line up along the cell equator



Meiosis II

- Anaphase II •The centromeres break and sister chromatids separate
- •Cytokinesis begins



Meiosis II

- Telophase II
- •The chromosomes may decondense (depends on species)
- •Cytokinesis reaches completion, creating four haploid daughter cells

THANK YOU