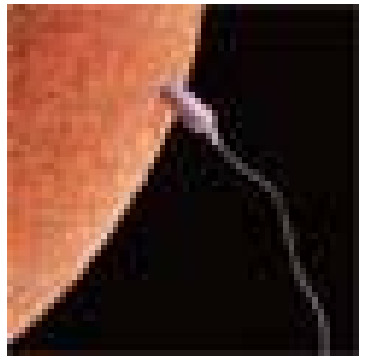
Types of Cells

- **Somatic Cells-** regular body cells (skin, muscle, etc)
  - **Diploid (2n)-** have two kinds of each chromosome
  - **Somatic cells undergo mitosis**

- **Germ Cells-** sex cells (sperm and egg)
  - **Haploid (n)-** have one kind of each chromosome.
  - Haploid cells will fuse to form a diploid zygote
  - Cells undergo meiosis to form germ cells



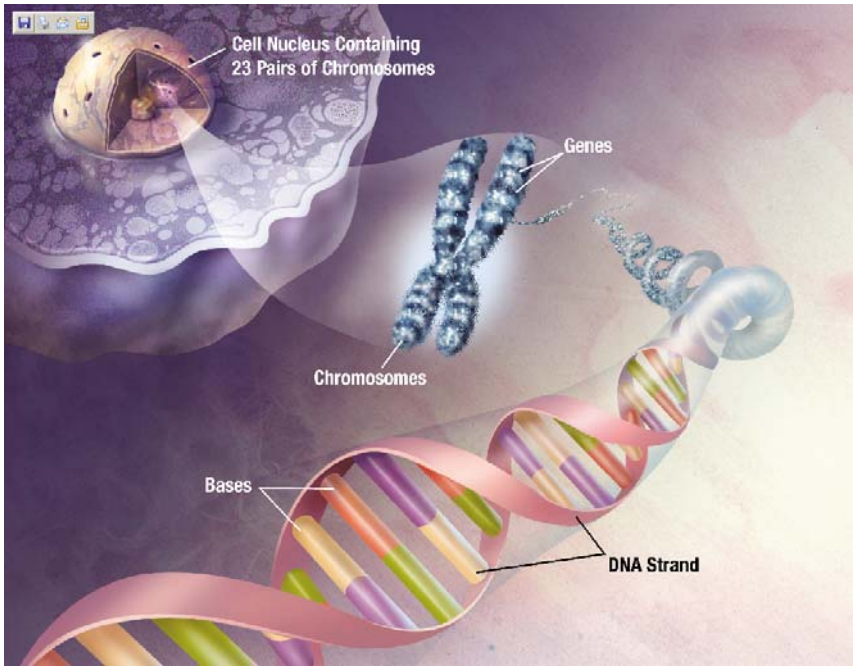
Why a Cell Divides

- The larger a cell divides the more demands the cell places on its DNA and the more trouble the cell has moving enough nutrients and wastes across the cell membrane

- **Specific issues a cell has:**
  - **DNA “Overload”**
  - **Trouble Exchanging Materials**
  - **Surface Area to Volume**

Why a Cell Divides

- DNA “Overload”
  - Information is stored in DNA
  - As a cell grows it usually does not make copies of DNA
  - If a cell grew too large an information crisis would occur (not enough DNA to instruct the cell as needed)



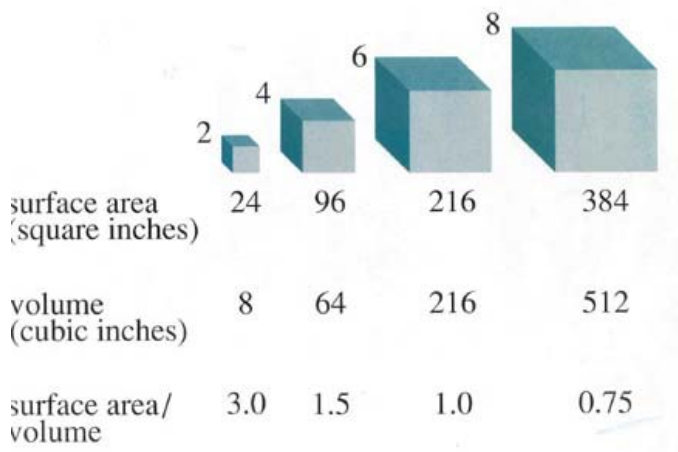
Why a Cell Divides

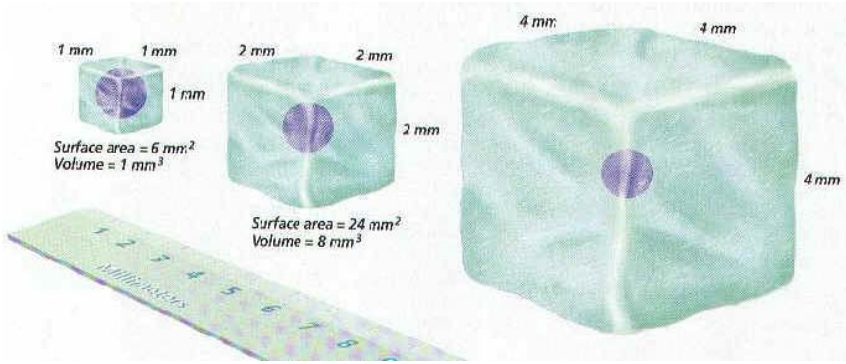
- **Trouble Exchanging Materials**
- The larger the cell volume:
  - the more food, water, and oxygen needed
  - The more wastes produced
  - The harder it is to get things in and out as needed
    - Ex. Further to travel

The bigger the cell the greater the distance and more material to get out and in

Why a Cell Divides

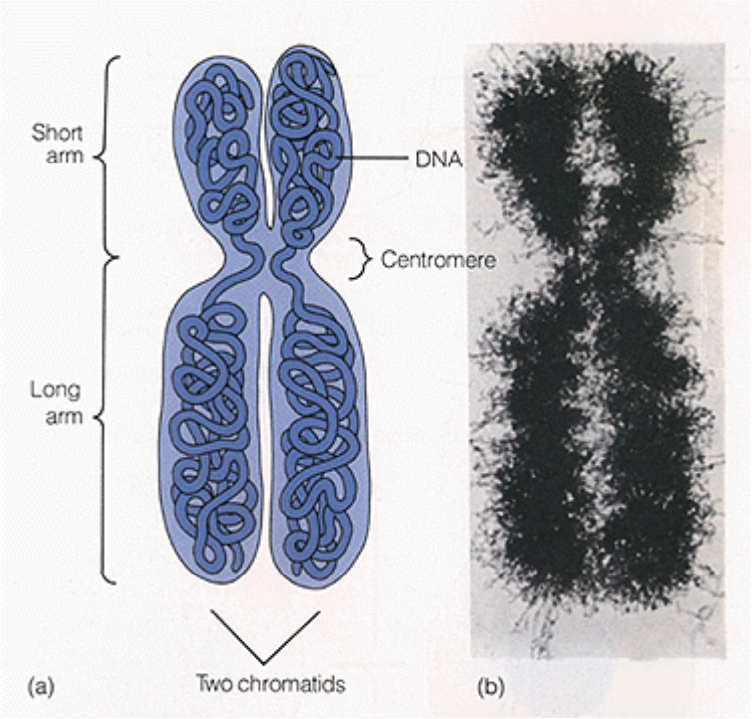
- Surface Area to Volume
  - Cell volume grows quicker than cell surface
  - At some point in time there is not enough surface area for material exchange (ex. food and waste)





The Chromosome

- **Chromosome-** DNA and proteins that contain genetic information
  - **46 human chromosomes or 23 pairs**
- **Sister Chromatids-** when chromosomes are replicated and there are 2 identical parts
- **Centromere-** part where sister chromatids are attached

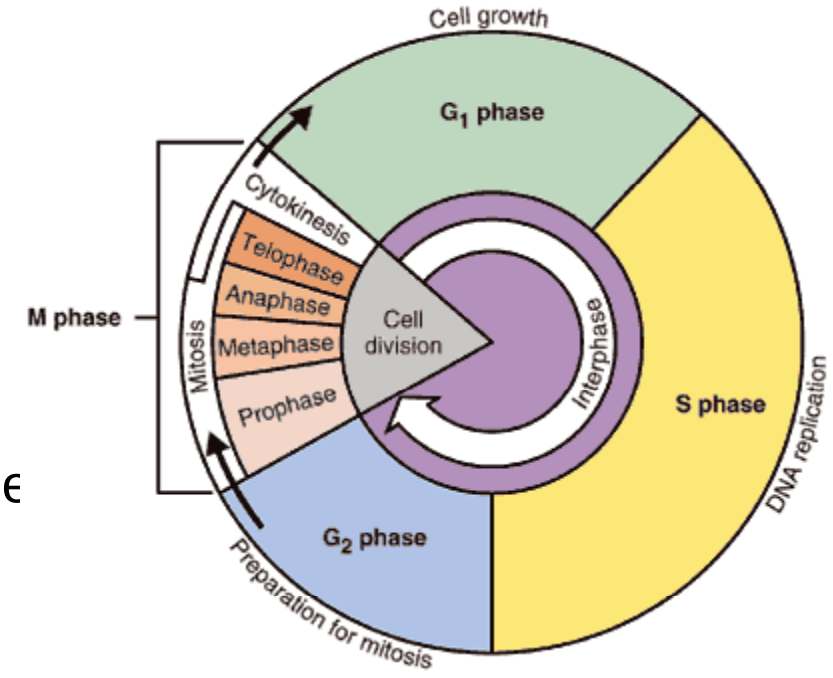


The Cell Cycle

- **The Cell Cycle-** During the cell cycle, the cell grows, replicates its DNA, and divides into two daughter cells.
- **Interphase-** Cell is growing and preparing for cell division
  - **G_1 phase**
  - **S phase**
  - **G_2 phase**

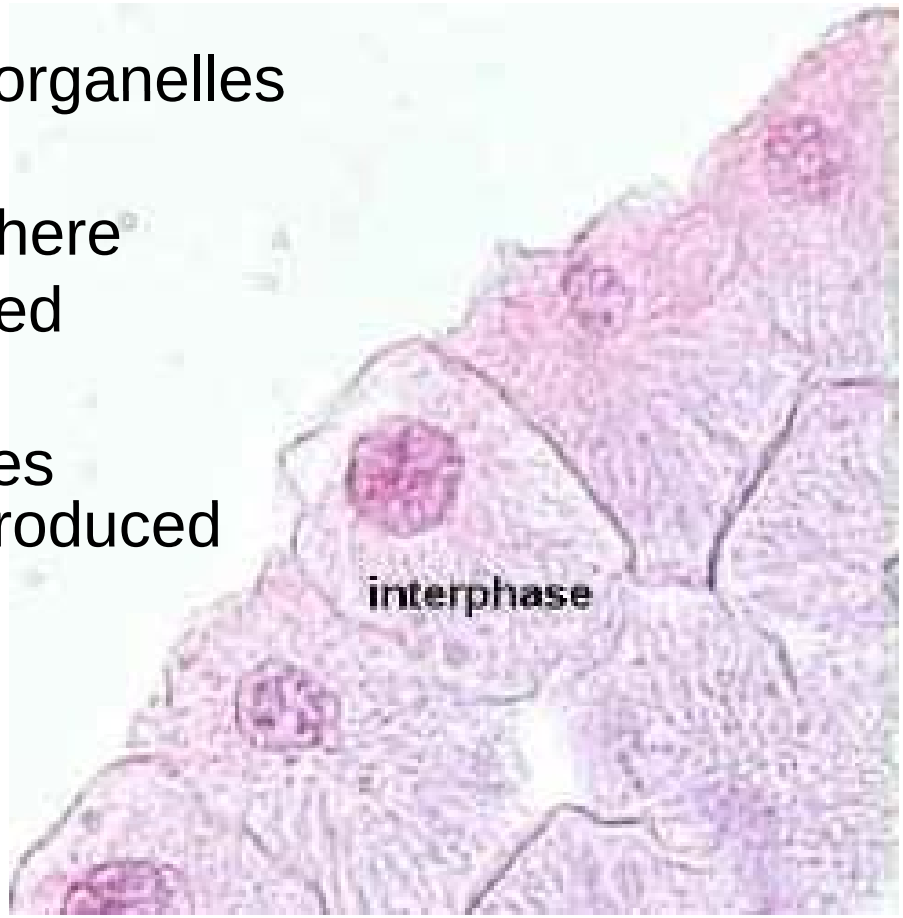
Cell Division- (M phase) process of one cell forming two daughter cells.

- **Mitosis-** Nuclear division
- **Cytokinesis-** cytoplasm division



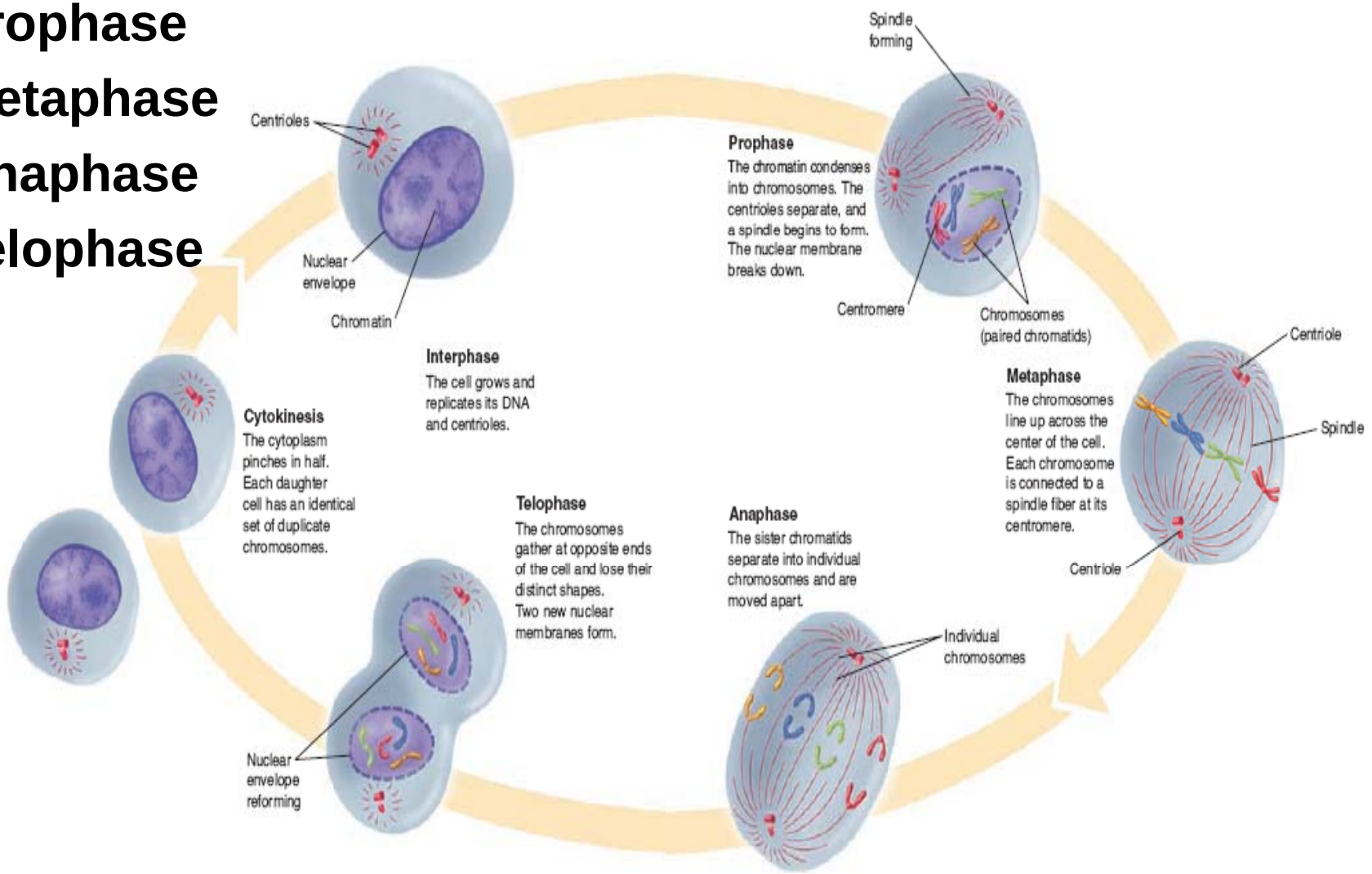
Interphase (Cell growth and Preparation for cell division)

- **G_1 phase**
  - Where most cell growth takes place
  - Cell increases in size
  - Synthesize new proteins and organelles
- **S phase**
  - Chromosomes are replicated here
    - DNA and proteins associated
- **G_2 phase**
  - Many organelles and molecules required for cell division are produced



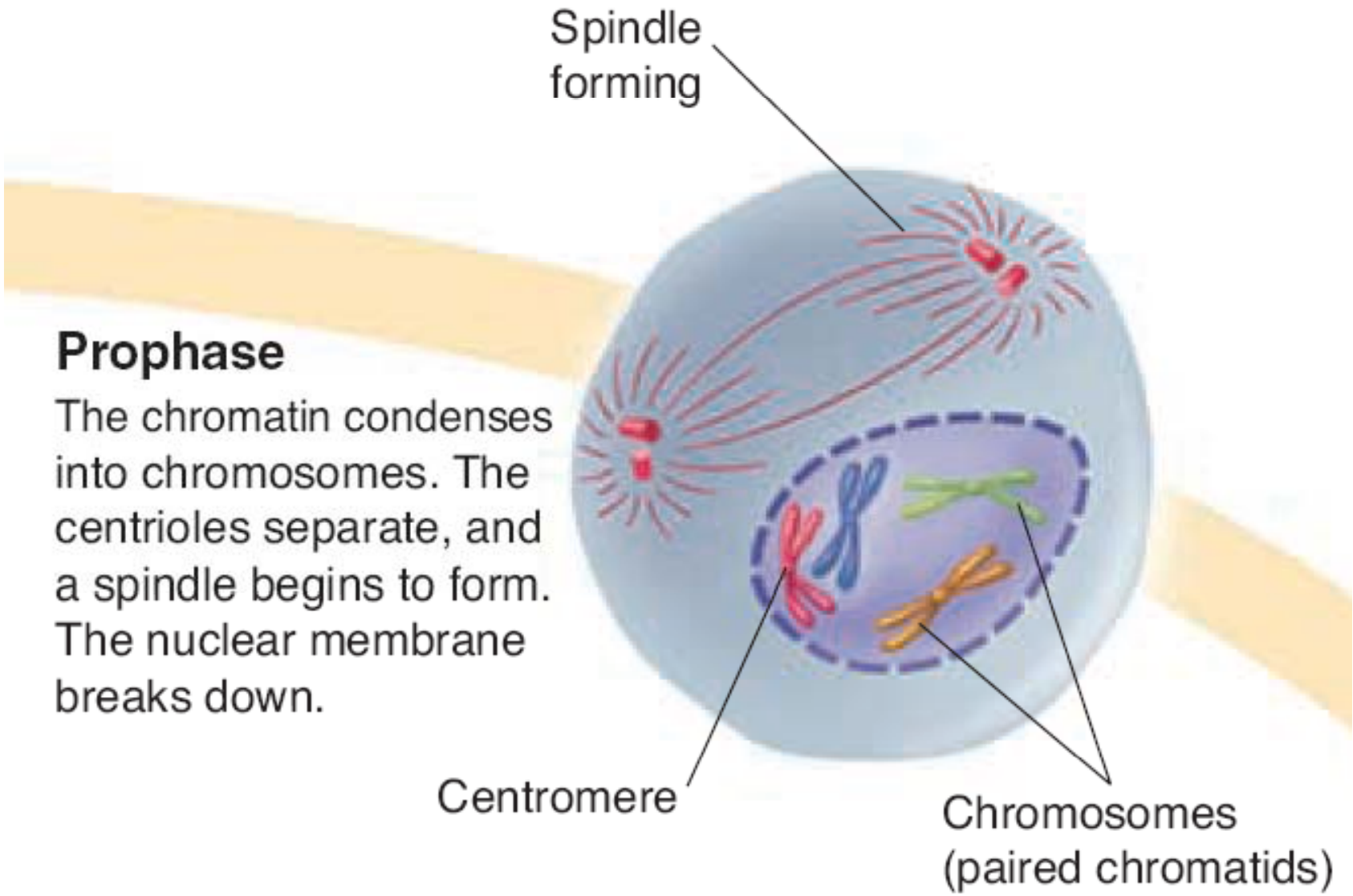
Cell Division (mitosis and cytokinesis)

- **Mitosis (P M A T)**
  - **Prophase**
  - **Metaphase**
  - **Anaphase**
  - **Telophase**



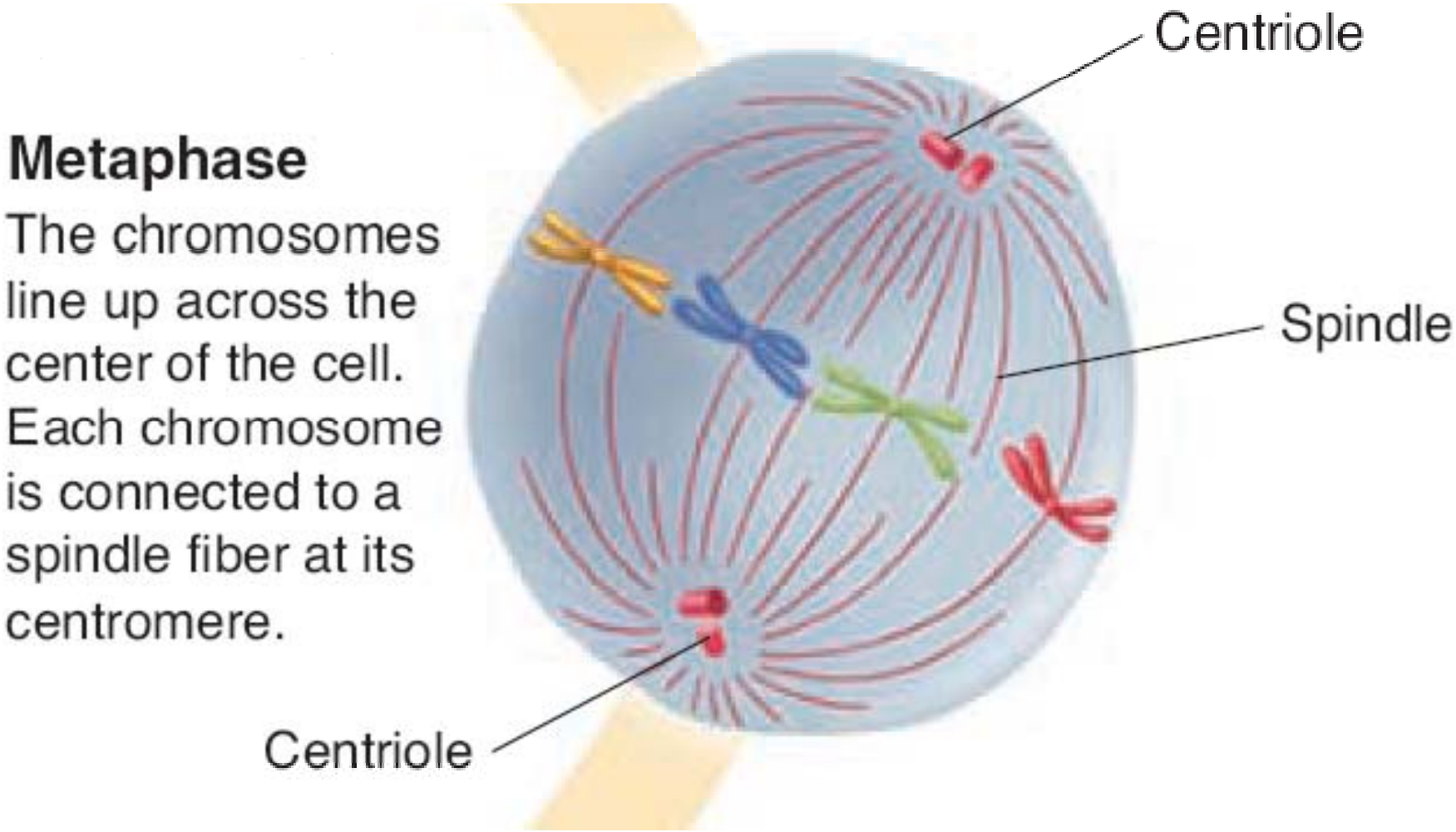
Mitosis

- **Prophase-** 1st and longest phase of mitosis



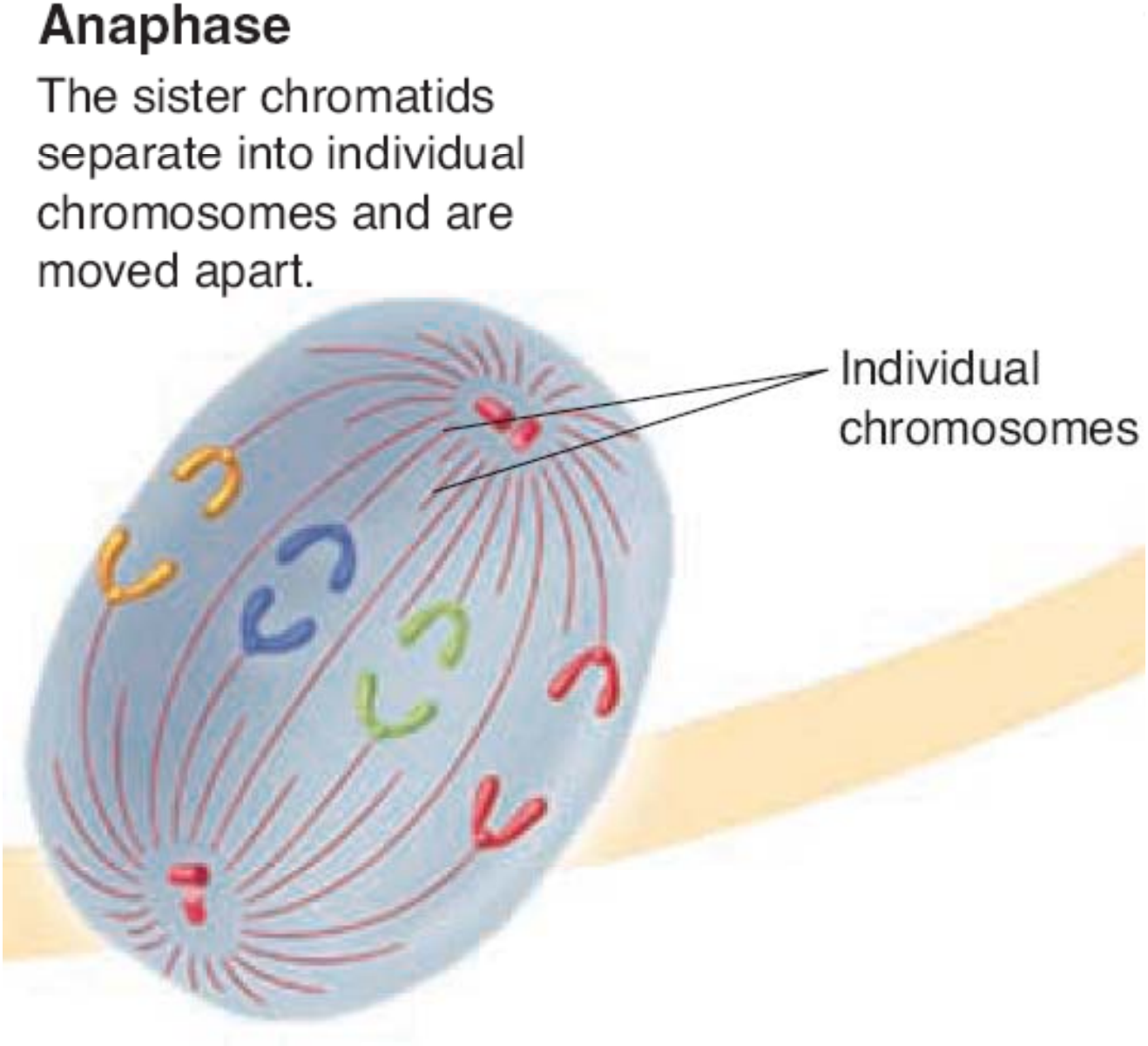
Mitosis

- **Metaphase-** 2nd stage of mitosis



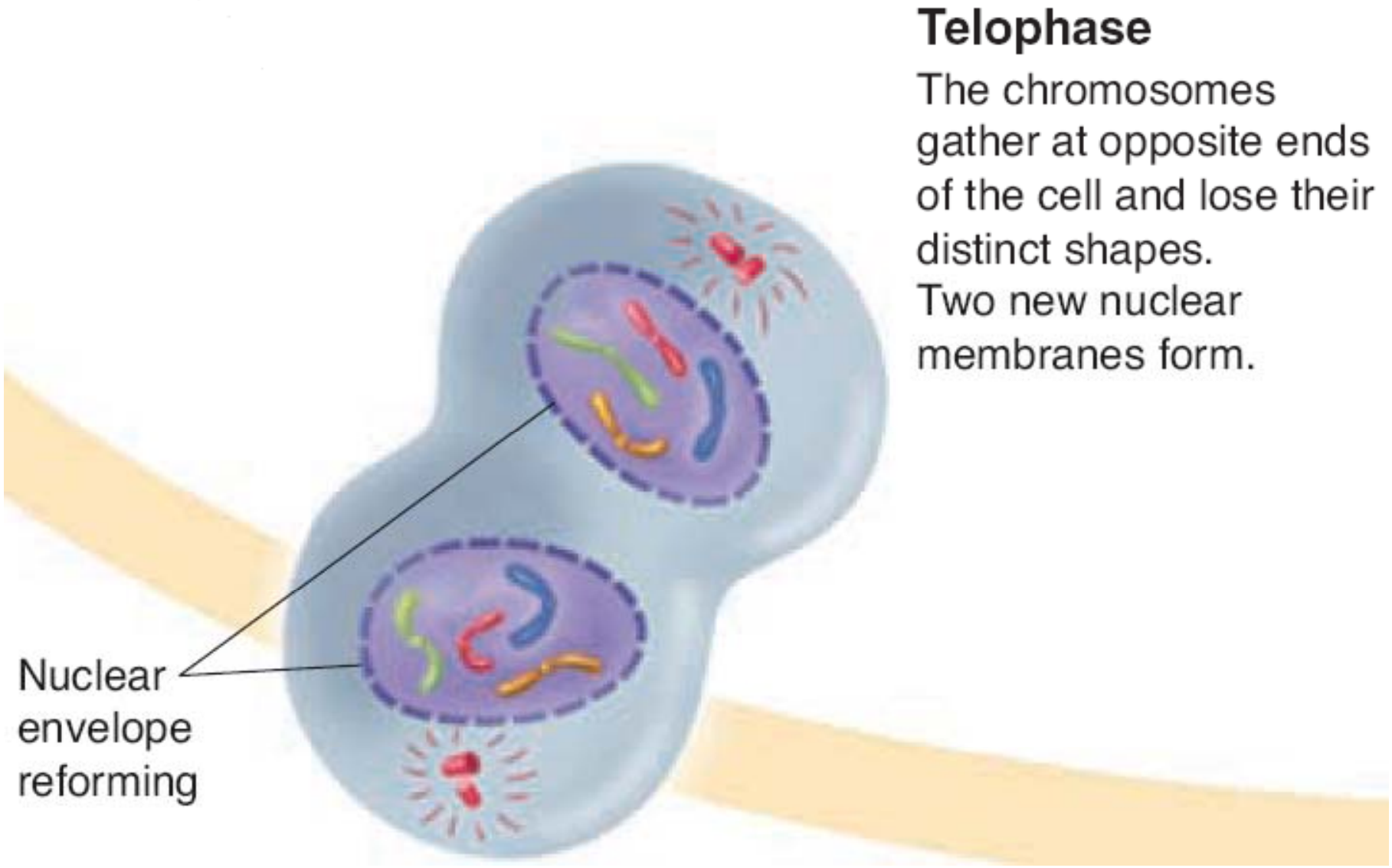
Mitosis

- **Anaphase-** 3rd stage of mitosis



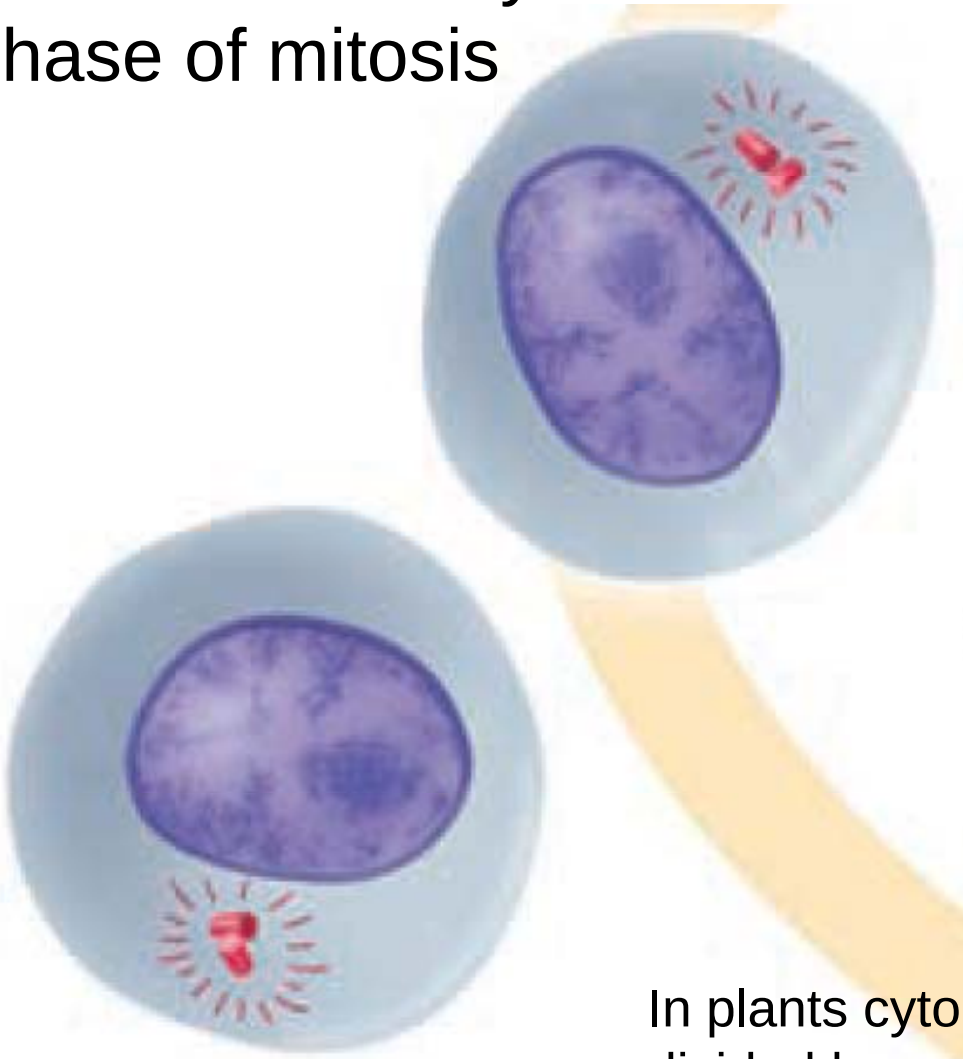
Mitosis

- **Telophase-** 4th stage of mitosis



Cell Division (mitosis and cytokinesis)

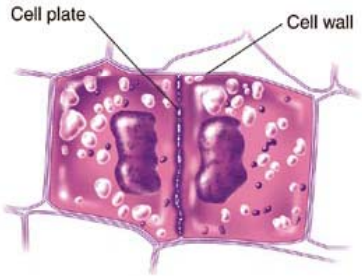
- **Cytokinesis-** usually occurs at the same time as telophase of mitosis



Cytokinesis

The cytoplasm pinches in half. Each daughter cell has an identical set of duplicate chromosomes.

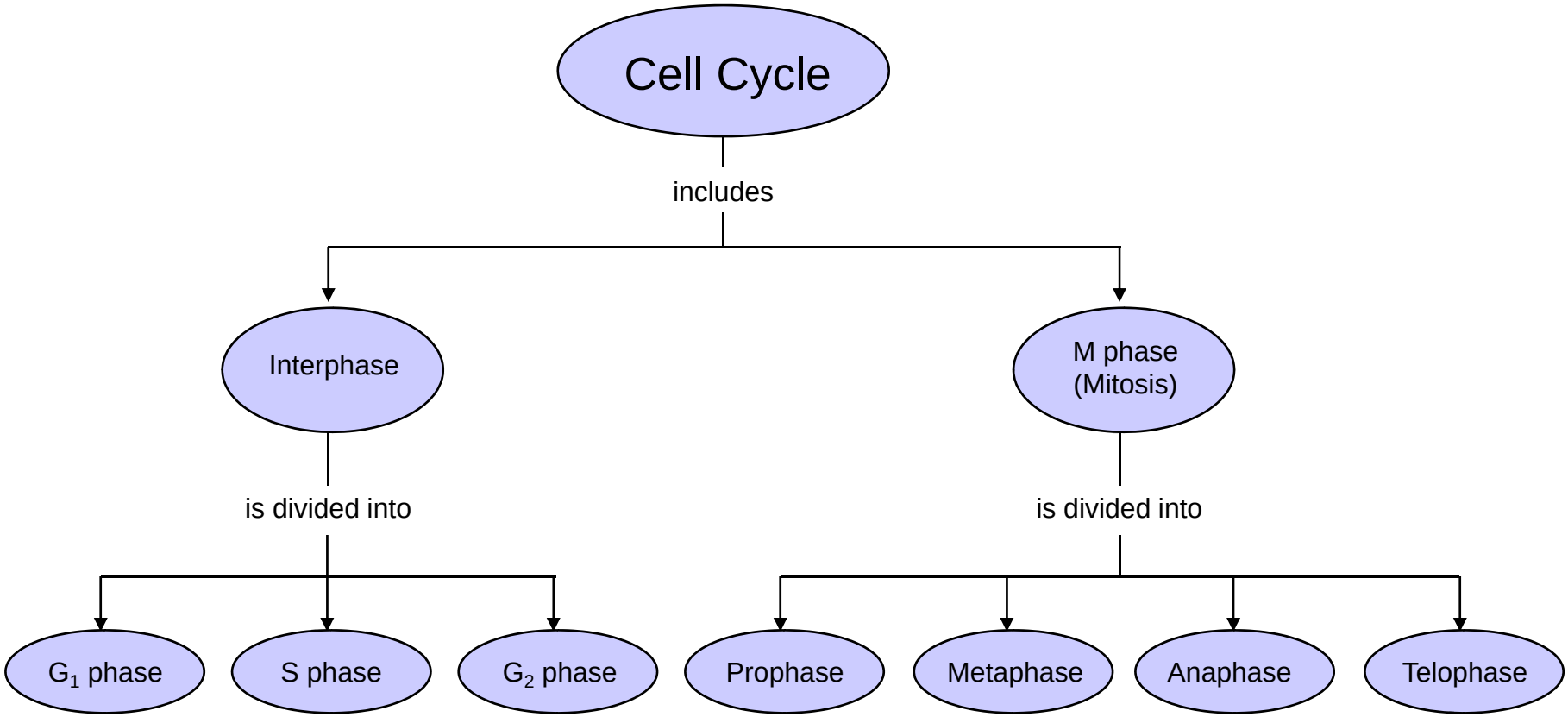
In plants cytoplasm is divided by a cell plate being formed



Life Spans of Various Human Cells

Cell Type	Life Span	Cell Division
Lining of esophagus	2–3 days	Can divide
Lining of small intestine	1–2 days	Can divide
Lining of large intestine	6 days	Can divide
Red blood cells	Less than 120 days	Cannot divide
White blood cells	10 hours to decades	Cannot divide
Smooth muscle	Long-lived	Can divide
Cardiac (heart) muscle	Long-lived	Cannot divide
Skeletal muscle	Long-lived	Cannot divide
Neuron (nerve cell)	Long-lived	Most do not divide

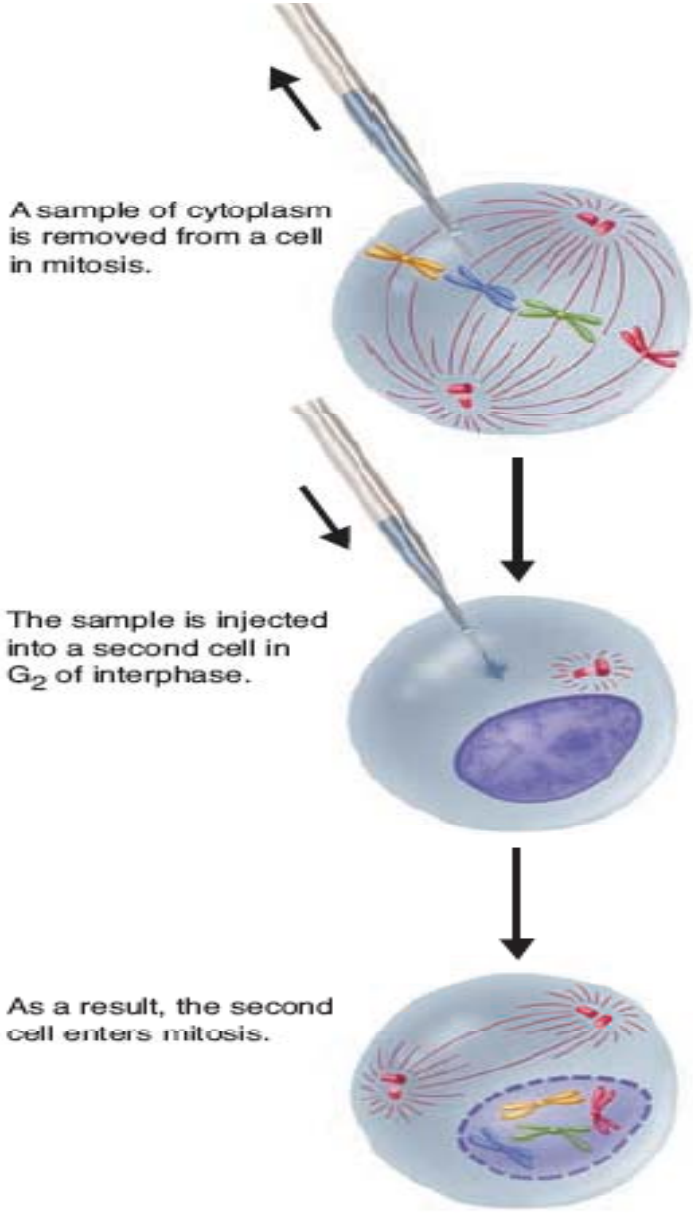
Concept Map of all events of Cell Cycle



Regulating Cell Division

- Internal regulators
  - Proteins that respond to events inside the cell
    - **Cyclins-** regulate the timing of the cell cycle in eukaryotic cells
    - Proteins regulate when mitosis and parts of mitosis begin
- External regulators
  - Closeness of neighboring cells slows growth
  - Proteins that respond to events outside the cell
  - Ex. Growth factors stimulate growth
  - Important in embryonic development and wound healing
  - Cells are stimulated to divide when someone has a wound and they return to normal after the wound heals

Effect of Cyclin on the cell cycle



The Effect of Cyclin on a Cell **The timing of the cell cycle is regulated by cyclins.** When cytoplasm from a cell in mitosis is injected into another cell, the second cell enters mitosis. The reason for this effect is a protein called cyclin, which triggers cell division.

Uncontrolled Cell Growth

- **Cancer**- a disorder in which some of the body's own cells lose the ability to control growth.

- Cancer cells do not respond to the signals that regulate the growth of most cells. As a result, they form masses of cells called tumors that can damage the surrounding tissues.

- Benign vs. malignant tumors – benign are localized and not spreading; malignancies are capable of breaking off and starting up in another location --

- An astonishing number of cancer cells have a defect in a gene called p53, which normally halts the cell cycle until all chromosomes have been properly replicated. As a result, chromosome damage builds up in such cells. This damage causes the cells to lose the information needed to respond to signals that would normally control their growth.