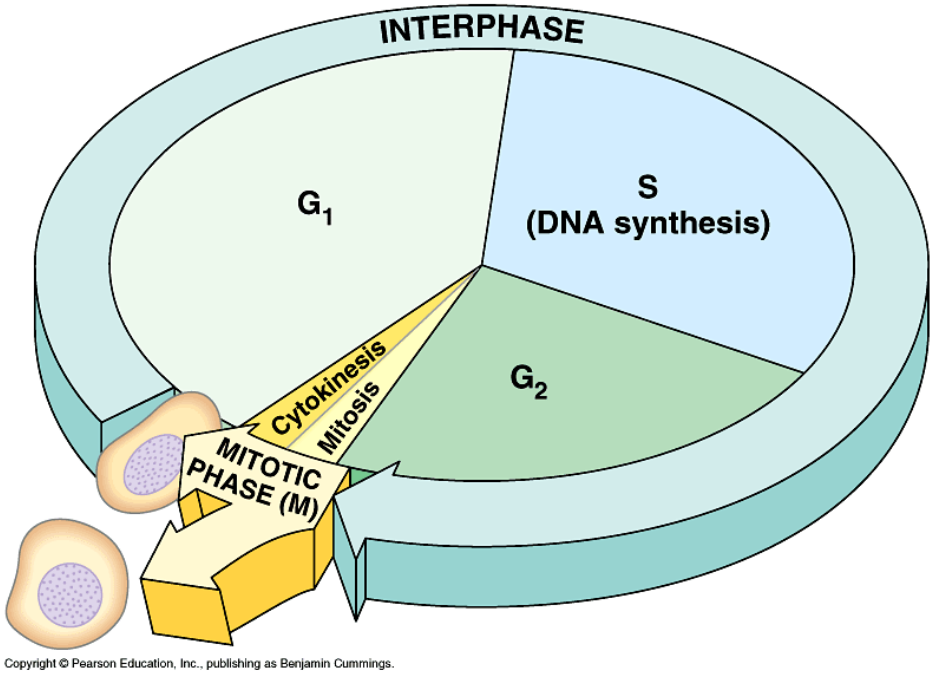
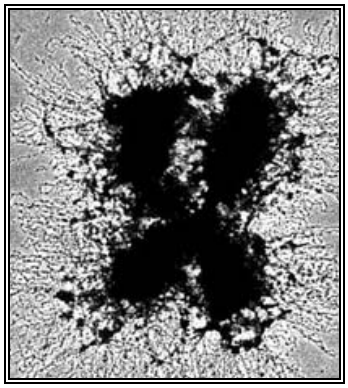
The Cell Cycle



The cell cycle is made up of several phases which include two growth phases (**G_1 & G_2**), a DNA synthesis phase (**S phase**) and a **M or mitotic** phase (includes **mitosis** or nuclear division and **cytokinesis** or cytoplasm division). The duration of the cell cycle varies among differents types of cells. In most mammalian cells the cell cycle lasts between 10 and 30 hours.

1. **Interphase:** Includes the G_1, G_2, and S phases. During interphase, chromosomes exist as **chromatin** (picture a nucleus filled with a bunch of strings or spaghetti that are indistinguishable).

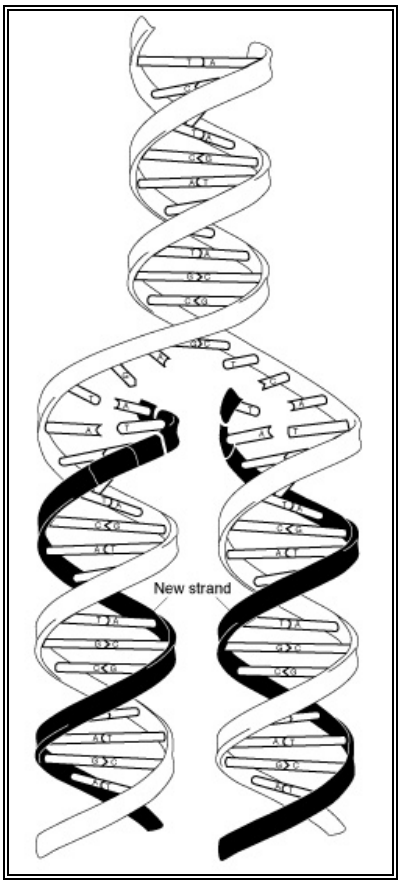


Chromatin Loops

2. **G_1 phase**: This is the part of the cell cycle where the cell spends a large part of its functional "life".
   - ♦ Cell grows to during this phase
   - ♦ Necessary organelles are synthesized (such as ribosomes and mitochondria)

3. **G_0 phase:** Cell decides if will enter another cell division. Reasons for cell division include:
    - Replace dead or dying cells
    - Produce new cells for growth
    - Repair of damaged tissues
    - Reproduction of unicellular organisms (i.e. ameba and paramecium)
    - **If the cell does not continue into another cell division, it will exit the cell cycle and remain in the G_0 resting phase.**

4. **S phase (DNA Synthesis):** chromosomes are copied as the cell readies itself for division.
    - Chromosomes go from single stranded chromosomes in G_1 to double stranded chromosomes in the S phase.
    - In animal cells, centrioles are also doubled.
    - **DNA Replication:**



DNA Replication

--the enzyme **helicase** unzips of the parent molecule by breaking the hydrogen bonds between the base pairs
--DNA polymerase binds to one strand of the DNA and starts to begin to synthesize a complimentary strand by joining DNA nucleotides together.

-- DNA polymerase also has a proofreading function, checking each newly synthesized DNA strand is a compliment of the original strand
-- The original DNA molecule acts as a template (plan or model) for the formation of the new DNA strands
--The result is two new daughter DNA molecules, each with one original DNA strand and one newly synthesized strand. **Therefore, DNA replication is semi-conservative.**

5. **G2 phase:**
    - ♦ Cell checks that DNA replication is completed
    - ♦ Cell goes through another period of growth
    - ♦ Spindle fibers are assembled

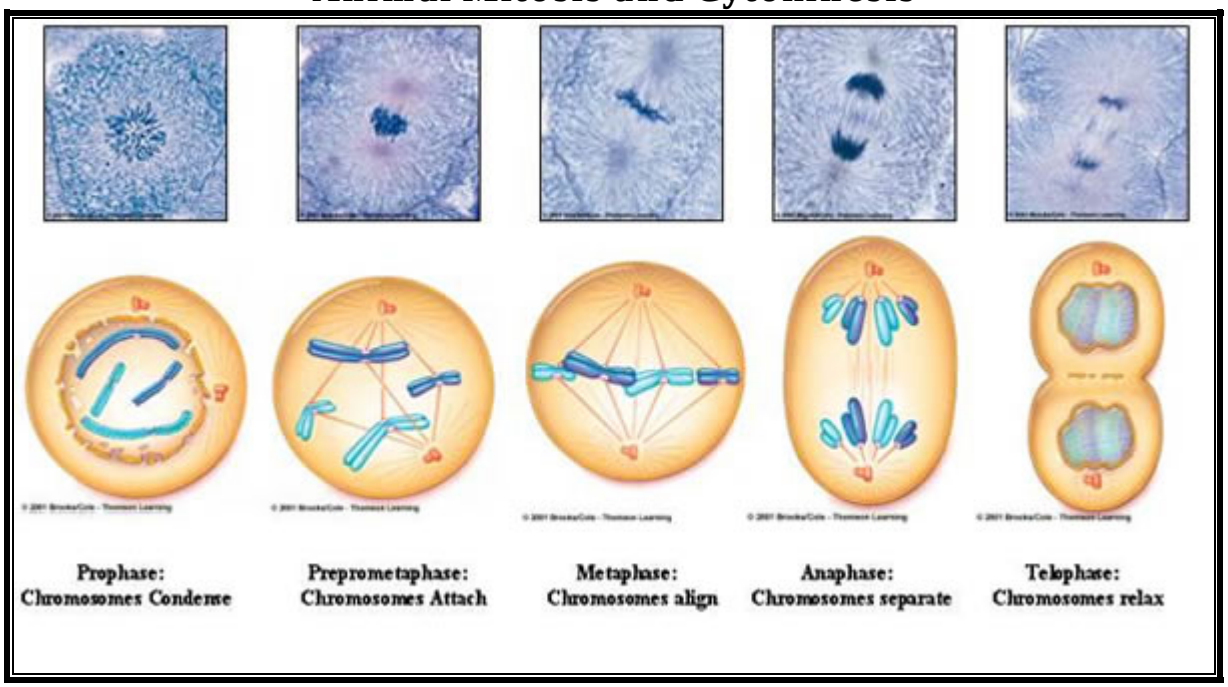
Questions:

1. Where does the cell spend most of its time during its life cycle?
2. Describe what happens to the cell when it enters the S phase?
3. Why is it important for DNA to replicate?
4. Summarize the process of DNA replication.
5. Identify the end products of DNA replication.
6. Why is DNA replication considered to be semi-conservative?
7. What happens to the cell if it does not begin another cell division?

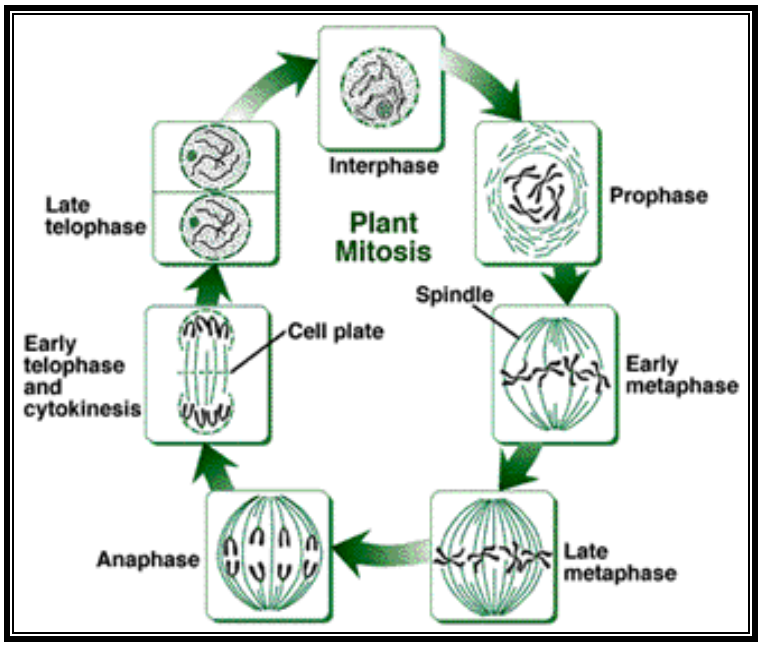
M Phase: Mitosis and Cytokinesis

The M phase of the cell cycle begins with Mitosis, which involves the division of the nuclear material. There are 4 phases to mitosis which include **Prophase, Metaphase, Anaphase, and Telophase.** A good way to remember the phases of mitosis including interphase is the acronym **IPMAT.**

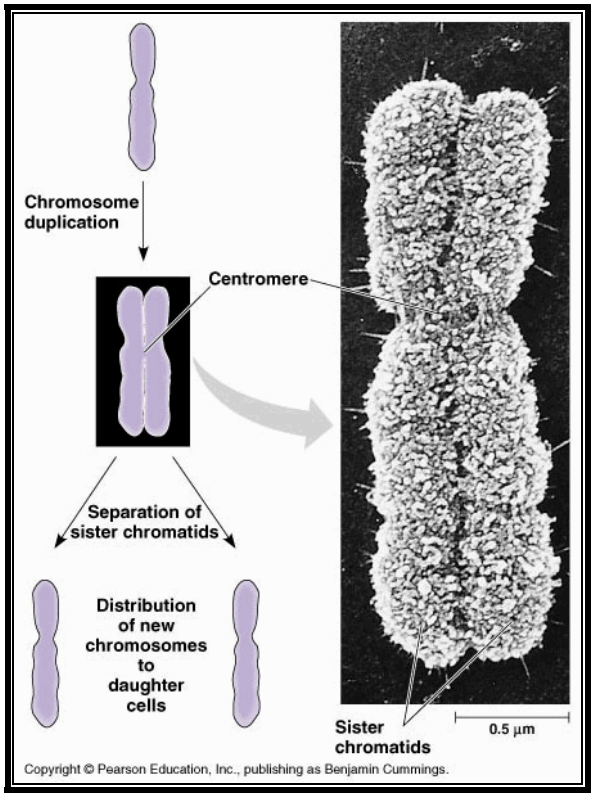
Animal Mitosis and Cytokinesis



Plant Cell Mitosis and Cytokinesis



1. **Prophase:**
   - Double stranded chromosomes become visible by condensing and thickening.
   - Double stranded or sister chromosomes are now called **chromatids.** They are held together by a **centromere.**
   - The nuclear membrane dissolves.
   - In animal cells, spindle fibers forms from the centrioles. In plant cells, spindle fibers are formed by enzymes in the cytoplasm.
   - Double stranded chromosomes start to move toward the equator of the cell.



2. **Metaphase:**
   - Centromeres of sister chromatids attach to the spindle fibers
   - Sister chromosomes line up along the equatorial plate of the cell
   - Centromeres replicate

3. **Anaphase:**
   - Spindle fibers shorten, pulling the sister chromatids to opposite poles of the cell

4. **Telophase:**
   - Nuclear membranes form around each set of chromatids (now called chromosomes)
   - Spindle fibers disappear
   - Chromosomes lengthen and thin to form chromatin again

Cytokinesis:

In Animal Cells:

- During anaphase, the cell begins to pinch inward forming a cleavage furrow.
- The cell continues to pinch inward until the cytoplasm completely divides.

In Plant Cells:

- A cell plate begins to form from the middle outward eventually forming a cell wall.

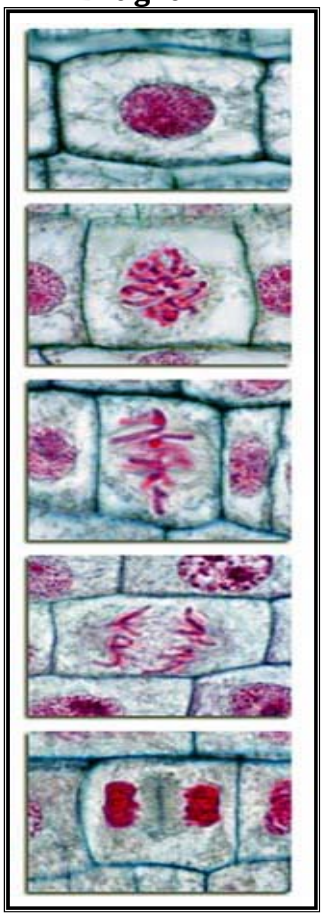
Results of Mitosis and Cytokinesis:

Two daughter cells that are genetically identical to the parent cell, only smaller in size.

Questions:

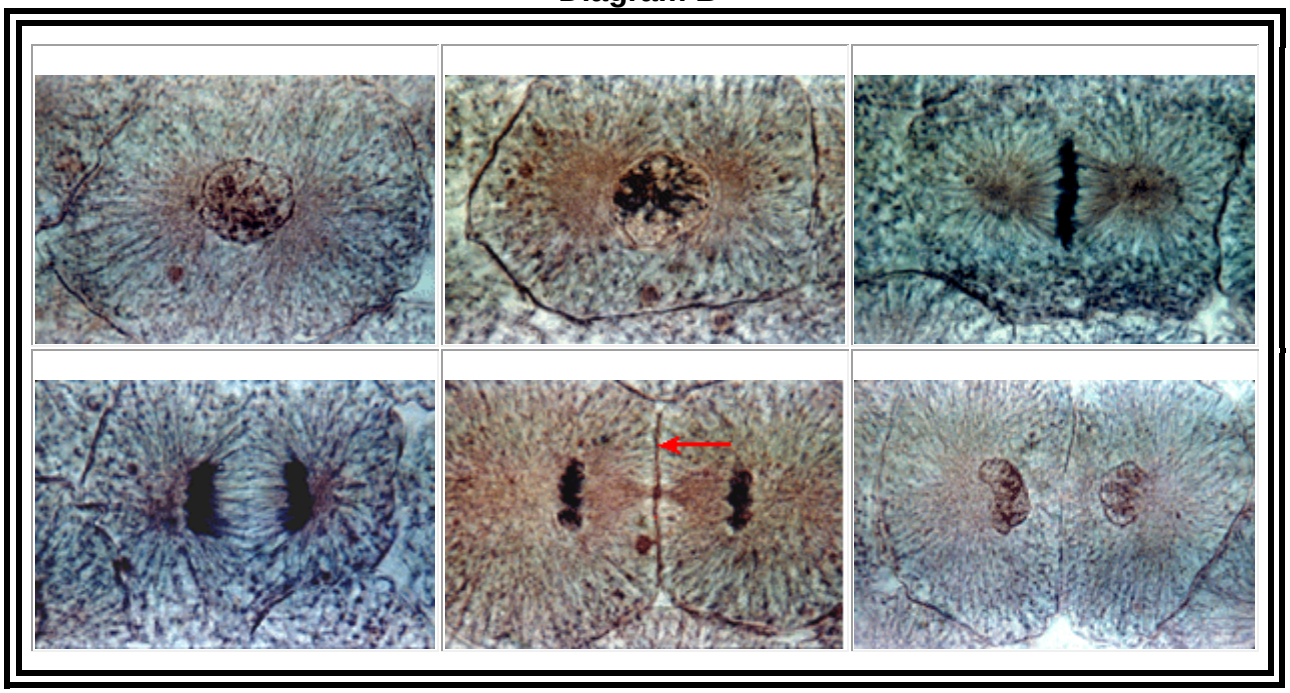
1. Label each mitotic cell phases in Diagram A below and briefly summarize the events that are occurring in each of these phases.
2. What type of cells are in Diagram A

Diagram A



3. Label the mitotic cell phases in Diagram B below.
4. What type of cells are depicted in Diagram B. How do you know?

Diagram B



5. Why must cells reproduce (list 3 reasons)?
6. Differentiate between mitosis and cytokinesis.
7. Compare plant cell mitosis to animal cell mitosis.
8. How do the products of mitosis compare to the parent cell?