

Topic 2

Pre-Class Reading

1. Read pgs 558, 560-563
2. Define the following terms
 - a. Cell cycle
 - b. Mitosis
 - c. Cytokinesis
 - d. Interphase
 - e. Centrioles
 - f. Spindle fibers
3. During interphase, what event must occur for the cell to be capable of undergoing future divisions?
4. Using a dictionary, look up the meaning of the prefixes used in the stages of mitosis: *pro-*, *meta-*, *ana-*, and *telo*. Why would they be used in the naming of the phases of mitosis?
5. A cell from a tissue culture has 38 chromosomes. After mitosis and cytokinesis, one daughter cell has 39 chromosomes and the other has 37. What might have occurred to cause the abnormal chromosome numbers?

Topic 2 – Cell Cycle

- Cells in our body grow, reproduce and die in a cycle called the cell cycle.

- Somatic cell – body cells

■ There are different types of cells in our body and their lives are different based on their type and their environment

■ Blood cells and skin cells die quickly so the cells that produce them must divide often. Nerve cells divide rarely or not at all

Cell cycle – the events in the life of a typical cell from its production to the time it produces two identical daughter cells

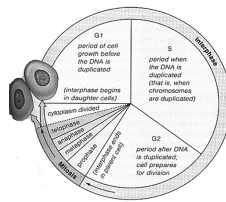
- Has 2 parts

■ Interphase - cell growth and preparation for mitosis. Has 3 parts

- G₁ or Gap 1
- S or Synthesis
- G₂ or Gap 2

■ Mitosis - process of creating two identical daughter cells from a parent cell.

- Also includes cytokinesis (splitting of the cell)



Interphase – usually takes 90% of the time for a cell cycle

- G₁ – cell grows and increases in size and mass

- S – a copy of the cells DNA is made

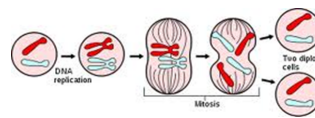
- Each chromosome is duplicated creating two chromatids (copies of the chromosome)
- The two chromatids are joined at the centromere

- G₂ – cell manufactures materials needed for mitosis



Mitosis – broken into 4 phases

- Prophase
- Metaphase
- Anaphase
- Telephase



http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter2/animation__mitosis_and_cytokinesis.html

The screenshot shows an interactive animation window titled 'Mitosis & Cytokinesis' from McGraw-Hill. It features a central image of a cell in the process of dividing. Below the image is a control bar with 'Play', 'Pause', 'Audio', and 'Text' buttons. A text box at the bottom explains: 'Mitosis is a process of nuclear division by which replicated copies of a cell's DNA are organized into chromosomes. The identical copies of the DNA are then divided equally between two daughter cells.' The copyright notice at the bottom reads 'Copyright © The McGraw-Hill Companies, Inc.'

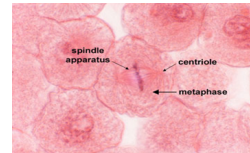
Prophase –

- Begins as long threads of chromatin begin to coil up into chromosomes
- Nucleolus and nuclear membrane break down
- Spindle fibers form near the ends (poles) of the cell



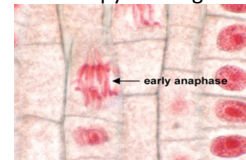
Metaphase

- Sister chromatids line up at the middle (equatorial plate) of the cell
- The equatorial plate is an imaginary line that represents the middle of the cell



Anaphase

- Centromeres holding sister chromatids together divide
- Separated chromatids, now called daughter chromosomes, move towards opposite poles of the cell
- Spindle fibers pull the centromere
- This results in each new cell that will be produced having an exact copy of the genetic "blue print" of the parent cell



Telophase

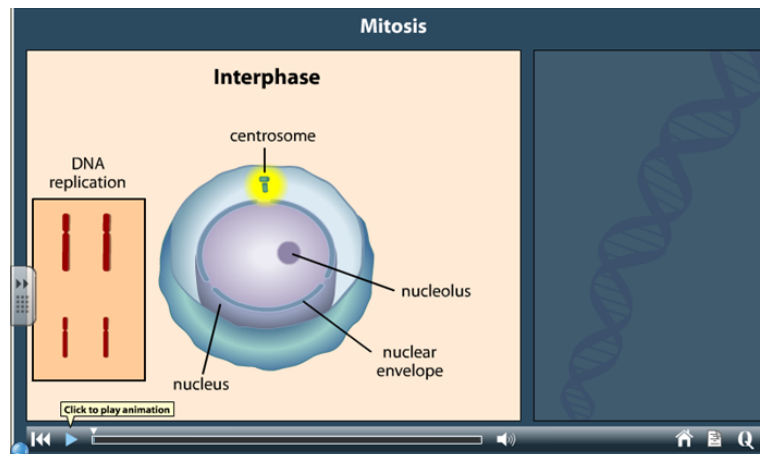
- Chromosomes reach opposite poles of the cell
- They lengthen and unwind
- Spindle fibers dissolve
- Nuclear membrane reforms around the mass of chromatin

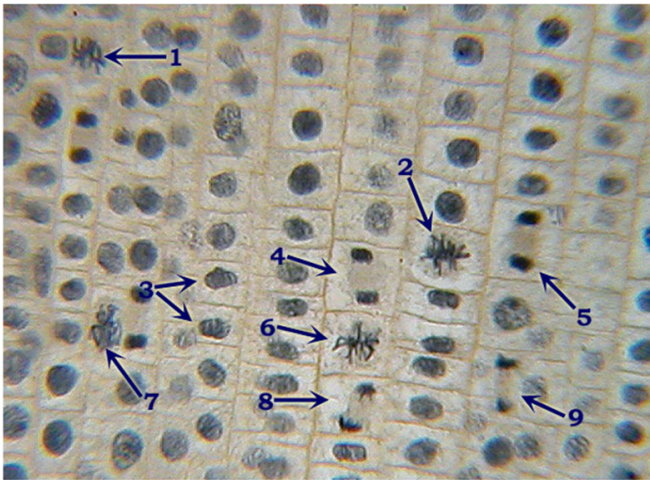


Cytokinesis

- Means division of the cytoplasm
 - Cell organelles are equally distributed between the two new cells
- In plant cells, a cell plate forms between the two newly created nuclei
 - A cell wall eventually forms along the cell plate
 - In animal cells a cleavage furrow forms near the middle of the parent cell and pinches the cell into two equal parts

<http://www.sumanasinc.com/webcontent/animals/content/mitosis.html>

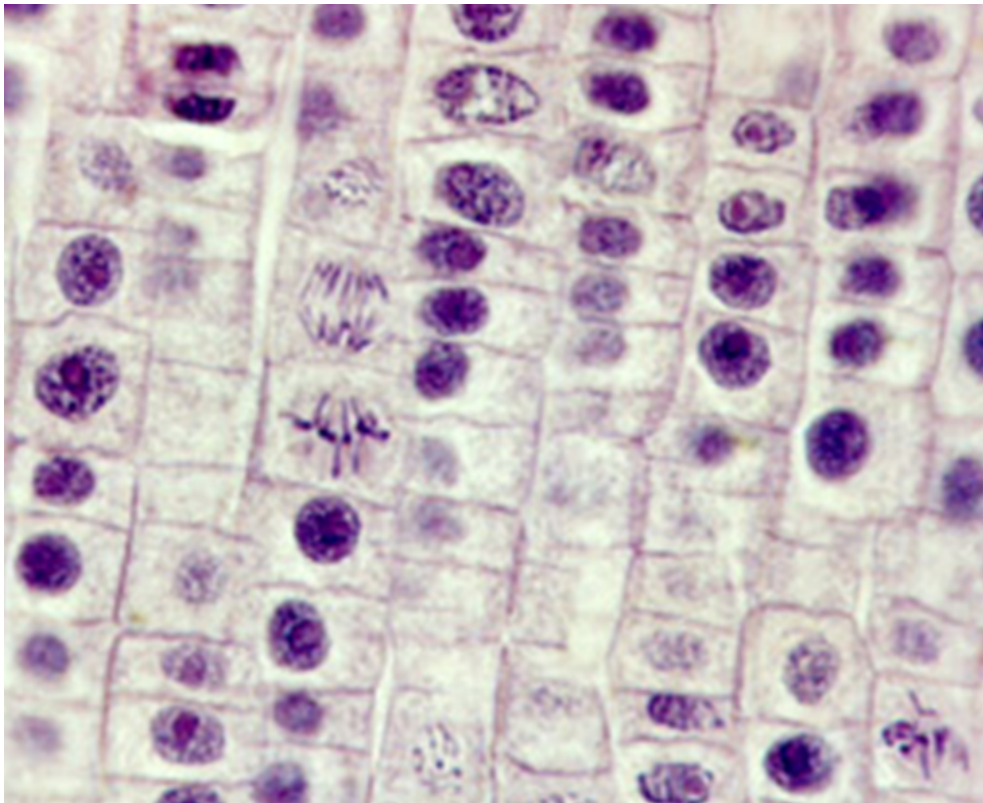




Key:

1. late Prophase/early Metaphase
2. Metaphase
3. Telophase
4. early Telophase
5. early Telophase
6. Metaphase
7. Prophase
8. Anaphase
9. late Anaphase

In the picture below, identify a cell in interphase and a cell from each phase of mitosis

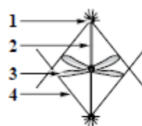


Online Quiz – User Name: LA01 Password: 7616
<http://www.learnalberta.ca/content/seboq/MitosisStages/index.html>

Use the following information to answer the next three questions.

Investigators were interested in determining the role chromosomes play in the formation of the mitotic spindle. Using extracts of eggs from the African frog *Xenopus laevis*, they monitored spindle assembly in a test tube. The researchers replaced the chromosomes with beads coated with random sequences of DNA. The beads served as substitute genetic material, but centrosomes (centrioles) were absent. As well, a part of the centromere was missing.

Simplified Diagram of Normal Mitotic Cell



—from Travis, 1996

1. Which of the structures numbered above was replaced by the beads in the experimental setup?
- 1
 - 2
 - 3
 - 4

Use the following additional information to answer the next question.

The investigators observed that the genetic material on the beads condensed and microtubules began to form. Within 90 minutes, the microtubules formed a spindle-like structure that lined up the beads along the centre of the cell.

—from Travis, 1996

2. Based on the results of this research, the structure or molecule that does **not** appear to be necessary for mitosis is
- DNA
 - a spindle
 - centrosomes
 - microtubules

Use the following additional information to answer the next question.

Other studies showed that the phase that involves pulling chromosomes to the two poles of mitotic cells can be delayed for up to 4.5 h by pulling a chromosome out of line from the centre of the cell.

—from Travis, 1996

3. The phase that is delayed and the phase where the chromosomes line up at the equator are, respectively,
- telophase and anaphase
 - metaphase and prophase
 - interphase and telophase
 - anaphase and metaphase

Use the following information to answer the next question.

Phases of Mitosis

- Anaphase
- Metaphase
- Prophase
- Telophase

4. The phases of mitosis in the sequence in which they occur are _____, _____, _____, and _____.

Use the following information to answer the next two questions.

Biologists using light microscopes to study mitosis noticed that the nuclear membrane of a cell disappeared and then re-formed during the process. They could not explain this disappearance until they used electron microscopes to view mitotic cells. These observations revealed a large number of vesicles (small bubble-shaped structures bounded by membranes) that appeared in the cytoplasm during mitosis and then disappeared when mitosis was nearly complete. During mitosis, the nuclear membrane appeared to disintegrate and form these tiny vesicles. The vesicles disappeared when new nuclear membranes formed.

5. The vesicles observed with the aid of an electron microscope appeared and disappeared, **respectively**, during
- prophase and anaphase
 - prophase and telophase
 - interphase and anaphase
 - interphase and telophase
6. During mitosis, the chromosomes
- are located at the cell equator during prophase
 - are located at the cell equator during telophase
 - move toward the poles of the cell during anaphase
 - move toward the poles of the cell during metaphase
7. It is believed that weed killers like 2,4-D and 2,4,5-T may work by stimulating cell division. Why would the stimulation of cell division make these chemicals effective weed killers?