

Chapter 5 Cell Reproduction Mitosis



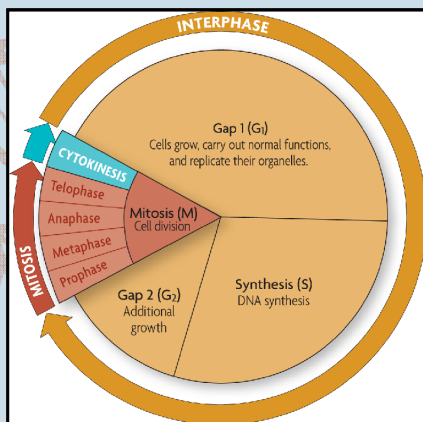
EQ: Why is cell division necessary for the growth & development of living organisms?

Think about this

Why do we have to cut our hair, nails, and lawn all the time?



Section 5.1: The Cell Cycle



Section 5.1: The Cell Cycle

Why do cells divide?

1. Growth of organisms.
2. Healing (cuts, burns, etc.).
3. Cells have size limits.
 - a. If too small, they cannot contain necessary organelles.
 - b. If too large they cannot take in enough materials (oxygen, nutrients) or get rid of waste adequately.

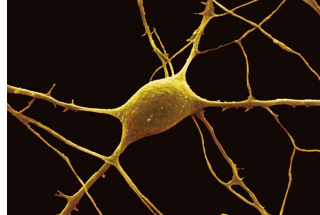
Section 5.1: The Cell Cycle

4. Volume increases faster than surface area so they must divide

Blood Cell



Neurons



Cell size is limited.

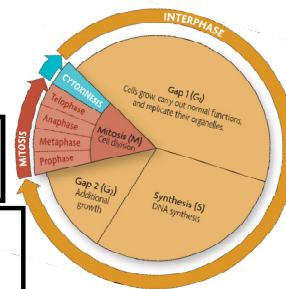
Relative size	1	2	3
Surface area (length × width × number of sides)	6	24	54
Volume (length × width × height)	1	8	27
Ratio of surface area to volume	$\frac{6}{1} = 6:1$	$\frac{24}{8} = 3:1$	$\frac{54}{27} = 2:1$

Section 5.1: The Cell Cycle

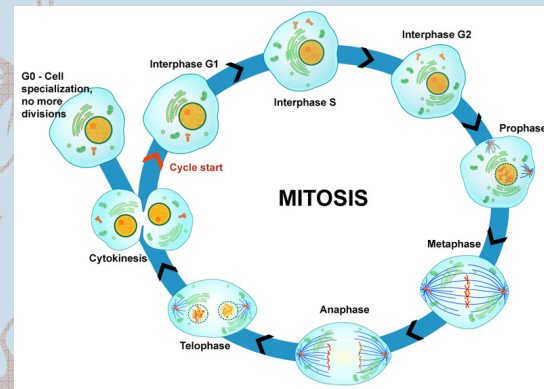
The Cell Cycle

- The cell cycle is the sequence of growth, DNA replication, and division of a cell.
- The cell cycle is divided into two periods:

- Interphase:** the period of growth (G1, S, G2 phases)
- M phase:** the period of division. (Mitosis and Cytokinesis)



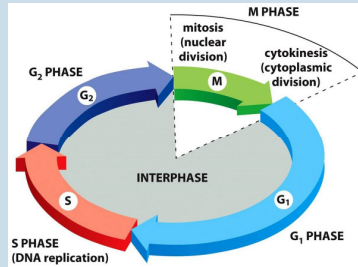
Section 5.1: The Cell Cycle



Section 5.1: The Cell Cycle

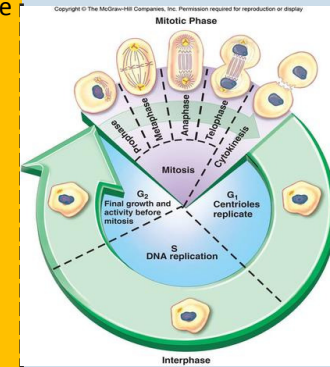
Interphase

- The period of growth.
- Busiest part of the cell cycle.
- Cell grows in size and carries on metabolism.

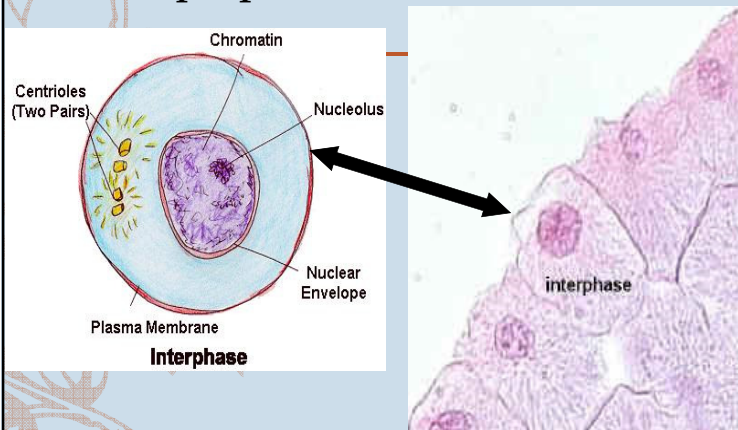


Interphase

- Three stages:
 - (1) **Gap 1 (G₁ phase)**- cell grows in size and proteins are produced. More organelles are produced.
 - (2) **Synthesis (S phase)**- chromosomes duplicate; this is the only time that DNA is produced. At the end of this stage, the cell has two complete sets of DNA.
 - (3) **Gap 2 (G₂ phase)**- short period of growth. Cell parts needed for cell division are assembled.



Interphase – the cell grows and prepares for division

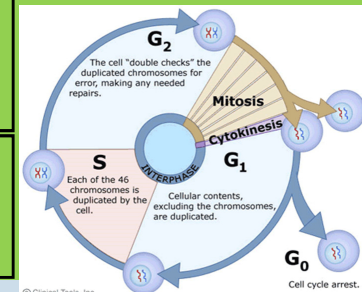


Section 5.1: The Cell Cycle

Mitosis (M phase)

✓ Two processes are involved in this stage:

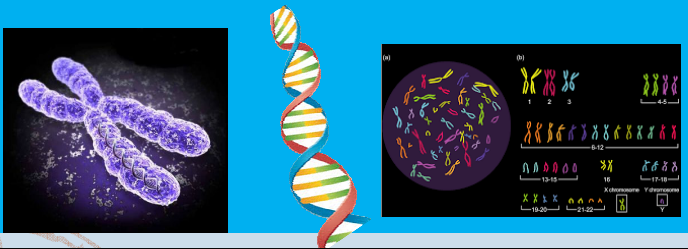
- (1) **mitosis**- division of the cell nucleus and its contents.
- (2) **cytokinesis**- the process that divides the cytoplasm.



Section 5.2: Mitosis and Cytokinesis

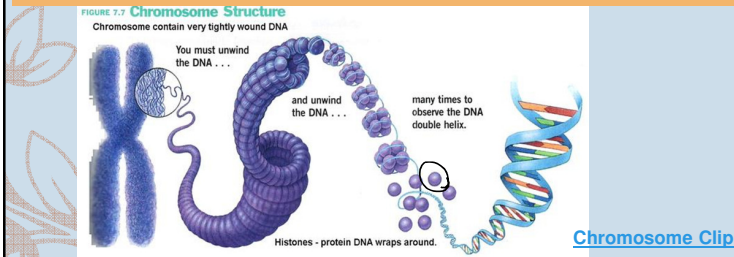
Chromosomes

- A chromosome is one long continuous thread of DNA that consists of numerous genes.
- Human have 46 chromosomes (23 pairs)



Section 5.2: Mitosis and Cytokinesis

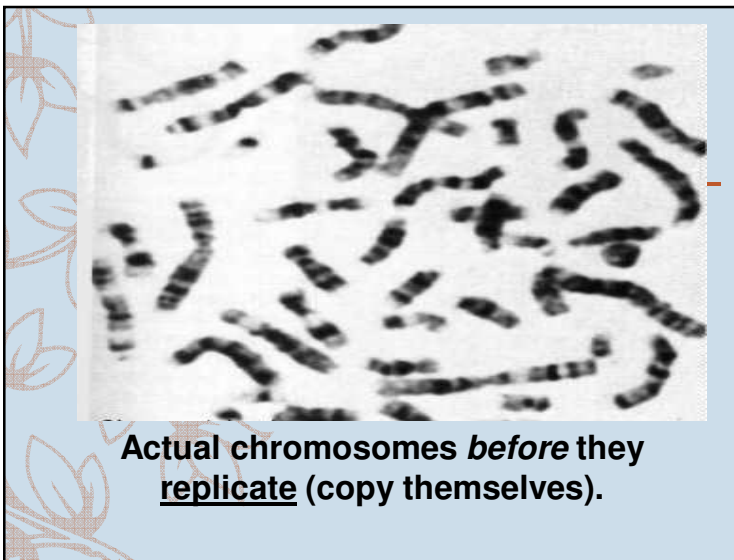
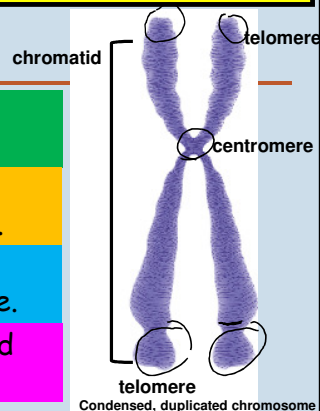
- DNA condenses into chromosomes at the start of mitosis.
- DNA wraps or coils tightly around proteins called histones causing it to condense.



Section 5.2: Mitosis and Cytokinesis

Chromosomes

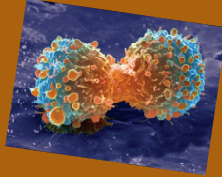
- DNA plus proteins is called chromatin.
- One half of a duplicated chromosome is a chromatid.
- Sister chromatids are held together at the centromere.
- Telomeres protect DNA and do not include genes.



Section 5.2: Mitosis and Cytokinesis

Mitosis

▪ Mitosis = division of the cell nucleus and its contents. Produces two genetically identical daughter cells.



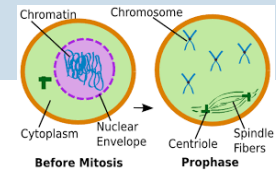
▪ Mitosis produces all of the cells in your body with the exception of gametes (egg and sperm)

▪ Mitosis is divided into 4 phases:

Prophase Metaphase Anaphase Telophase

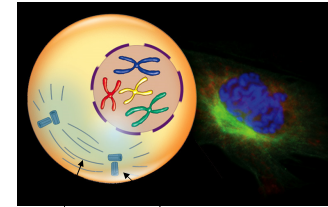
[Mitosis Video](#)

Prophase



- 1st and longest phase.
- Chromatin coils into chromosomes.
- Nuclear envelope breaks down.
- Nucleolus disappears.
- Centrioles begin to migrate to opposite sides (poles) of the cell.

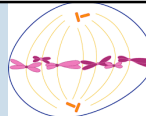
- Spindle fibers begin to form between the centrioles.
- Spindle = football shaped structure that chromosomes attach to by their centromeres.



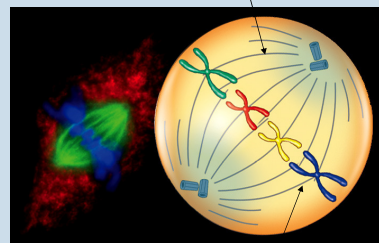
Spindle fibers centrioles

Metaphase

- 2nd phase of mitosis.
- The doubled chromosomes become attached to the spindle fibers by their centromeres.
- The chromosomes line up at the middle (equator) of the spindle.

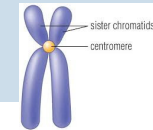


Spindle

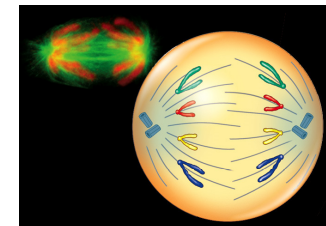
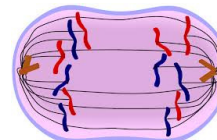


Doubled chromosomes at equator.

Anaphase

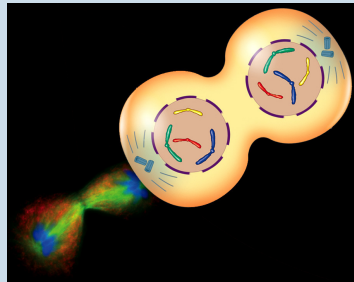
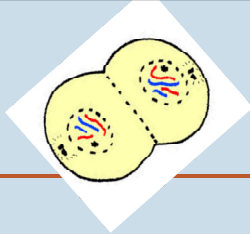


- 3rd phase of mitosis.
- The centromeres split apart, and the sister chromatids separate.
- The chromatids are pulled apart to opposite sides of the cell.



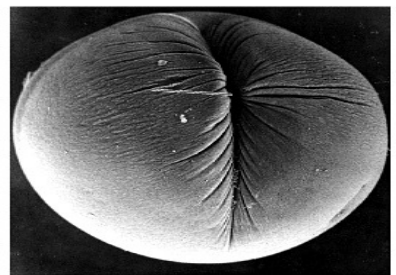
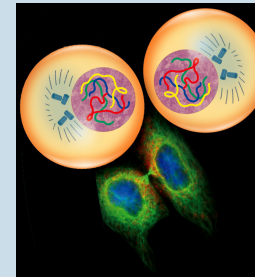
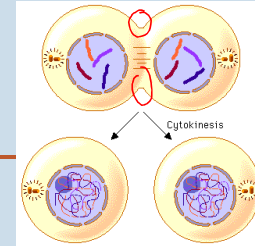
Telophase

- 4th and final phase.
- The chromatids reach the opposite poles of the cell.
- Chromosomes uncoil.
- Spindle breaks down.
- Nucleolus reappears.
- Nuclear envelope forms around each new set of chromosomes.

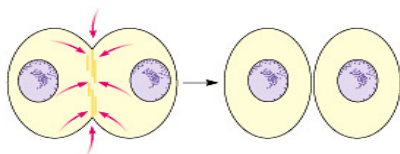


Cytokinesis

- Cytokinesis divides the cytoplasm into the two new cells.
- Different in animal and plant cells.
- Animal cells- the cell membrane pinches in to form a cleavage furrow.
- Plant cells- cell plate forms.

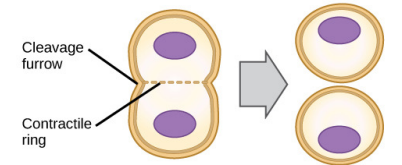


100 μm

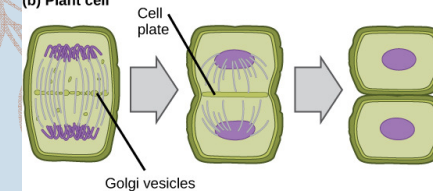


Cytokinesis in Animals vs. Plants

(a) Animal cell



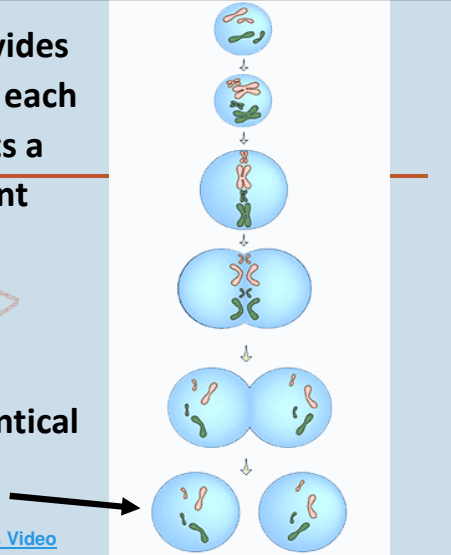
(b) Plant cell



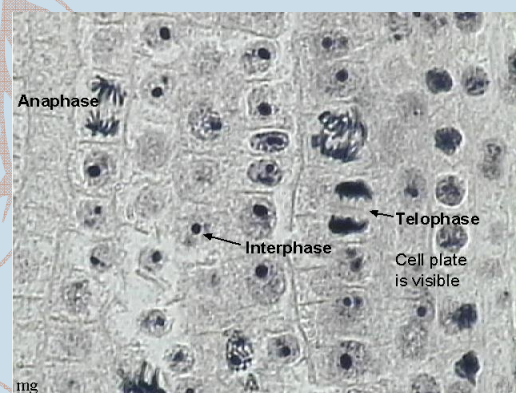
– When a cell divides through mitosis, each daughter cell gets a copy of the parent cell's DNA.

– End product:
2 genetically identical cells

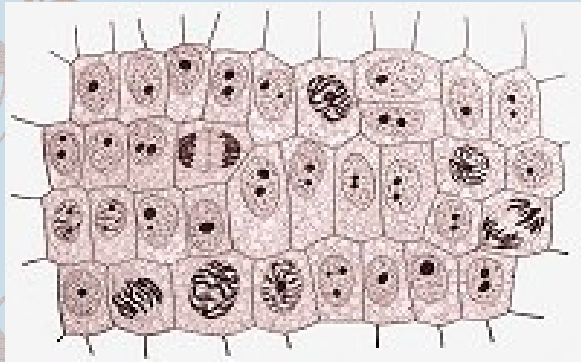
[Cell Cycle and Mitosis Video](#)



Remember:
Chromosomes become visible *only* during cell division (mitosis).

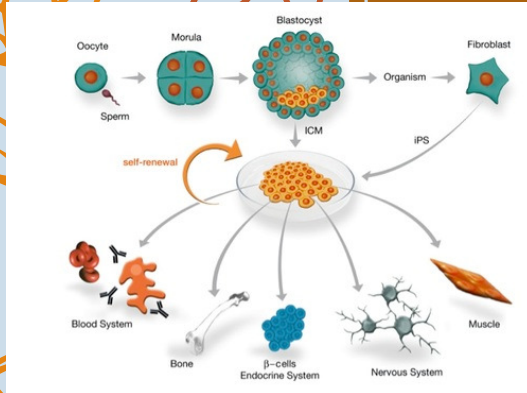


What part of the Cell Cycle?



Foldable

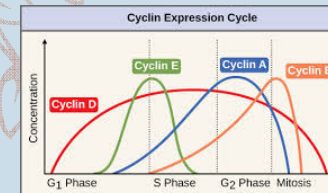
Section 5.3: Regulation of the Cell



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The cell cycle is regulated by 2 groups of proteins:

1. Growth factors: stimulate cell growth
2. Cyclins: help regulate cell growth



Section 5.3: Regulation of the Cell

Cancer

Carcinogens are substances known to promote cancer.

- Examples:
- 1) tobacco smoke
 - 2) air pollutants
 - 3) radiation



Section 5.3: Regulation of the Cell

Cancer

Cancer = when cells lose the ability to control their growth rate (uncontrolled mitosis)

Tumor = mass of cancerous cells

1. **Malignant tumors** - harmful; Spread
2. **Benign tumors** - not harmful; does not spread

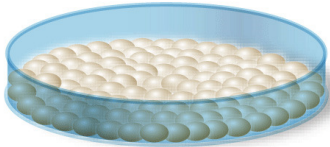


Section 5.3: Regulation of the Cell

Cancer

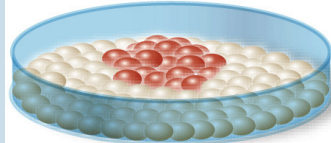
Normal animal cells stop dividing when they come in contact with one another

Normal cell growth



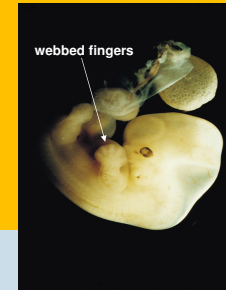
Cancer cells do not respond to cyclins and divide uncontrollably

Cancerous cell growth



Apoptosis

- Apoptosis is programmed cell death.
- a normal feature of healthy organisms (rids body of unhealthy cells)
- caused by a cell's production of self-destructive enzymes
- occurs in development of infants (webbed fingers and toes)



Section 5.4: Asexual Reproduction



All living things must reproduce

Why?

- Living things die
- To continue the species
- To prevent extinction

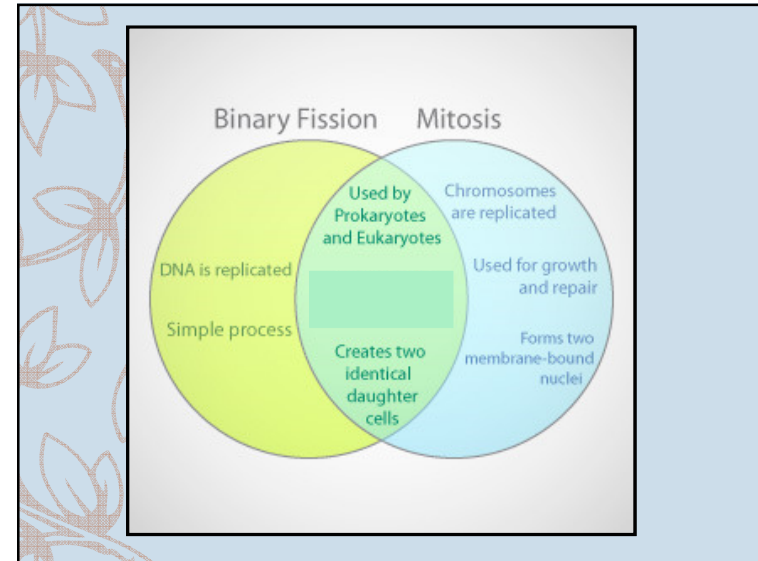
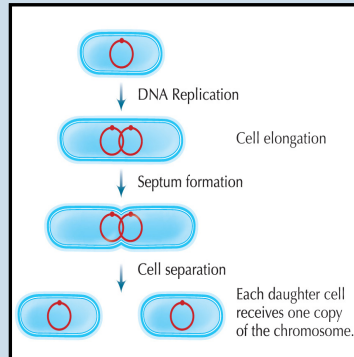
Section 5.4: Asexual Reproduction

- Asexual reproduction involves only one parent

- **Binary fission** is the reproduction of single-celled organisms

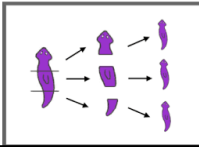
- It is like mitosis because the cell copies its DNA and divides to make 2 identical cells

- Occurs in prokaryotes



Advantages of Reproducing Asexually

- Produce more offspring faster
- Don't have to find a mate
- Less likely to make mistakes copying DNA



Disadvantages of Reproducing Asexually

- No genetic diversity
- One genetic disease could kill the whole population
- Species cannot evolve to become better-suited



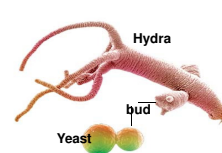
Section 5.4: Asexual Reproduction

Some eukaryotes can reproduce through mitosis.

- Budding: new organism is formed from a small projection growing on the surface of the parent (yeast)

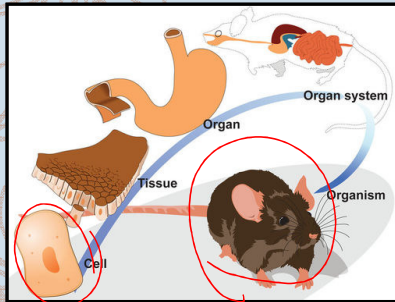
- Fragmentation: the splitting of the parent into pieces that each grow into a new organism (flatworms, sea stars)

- Vegetative reproduction: forms a new plant from the modification of a stem or underground structure on the parent plant (strawberries, potatoes)



Section 5.5: Multicellular Organization

Cells work together to carry out complex functions.



Levels of Organization



Section 5.5: Multicellular Organization

