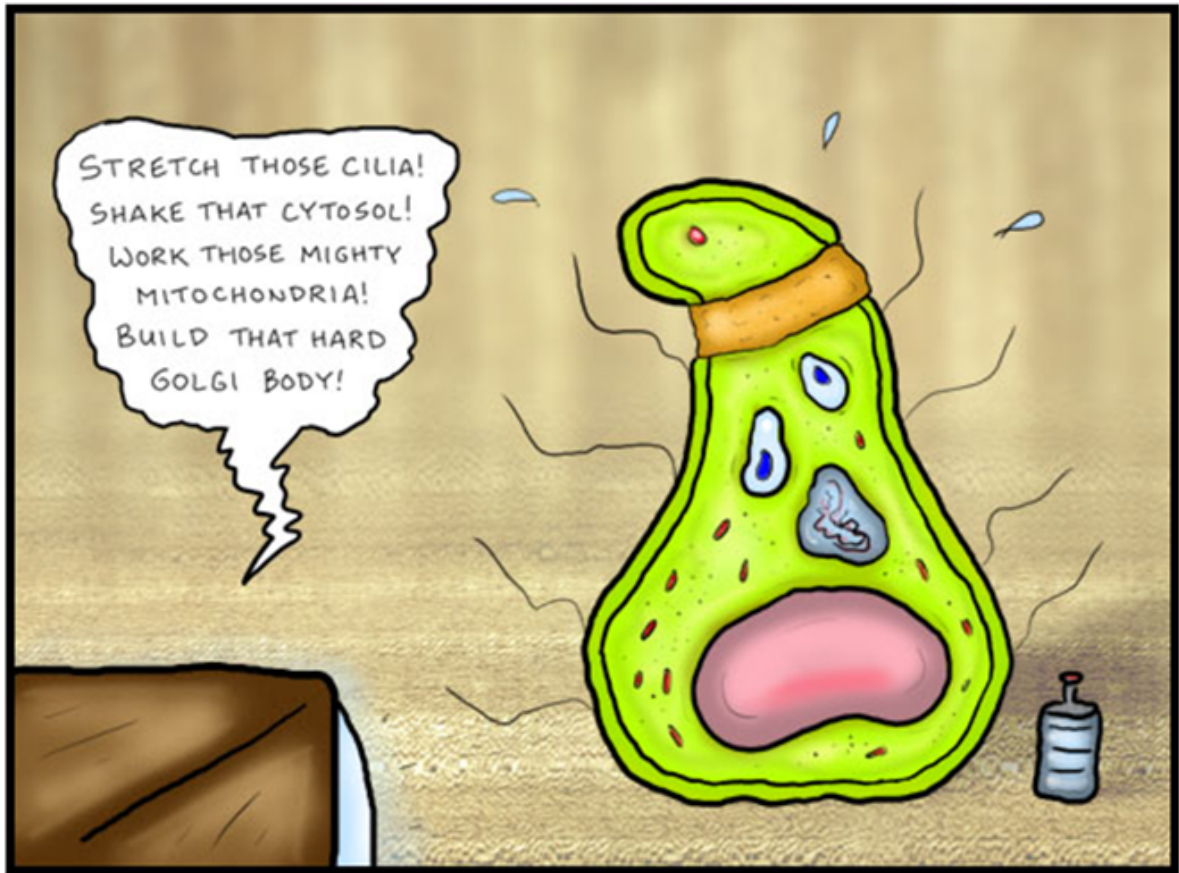


# Introduction to Cell Division

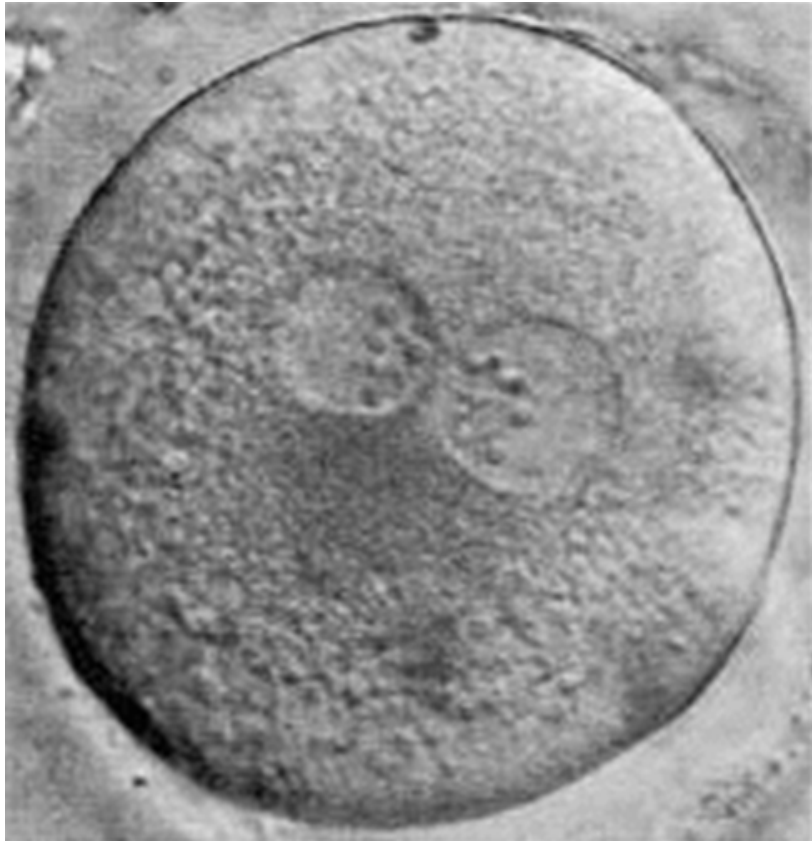
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The morning routine for the single single cell





# THE DIVISION OF CELLS I

## WHY DIVIDE?

- To reproduce and create a new organism.
- To allow an organism to grow and develop.
- To repair damaged or worn out tissues.
- To sustain the health of the cell.
  - There would not be enough exchange of materials through the cell membrane to uphold the cell's life if it continued to increase in size; the volume of the cell increases faster than the surface area of its cell membrane.
  - If the cell volume was too large, the nucleus could not relay important information to the organelles quickly enough.

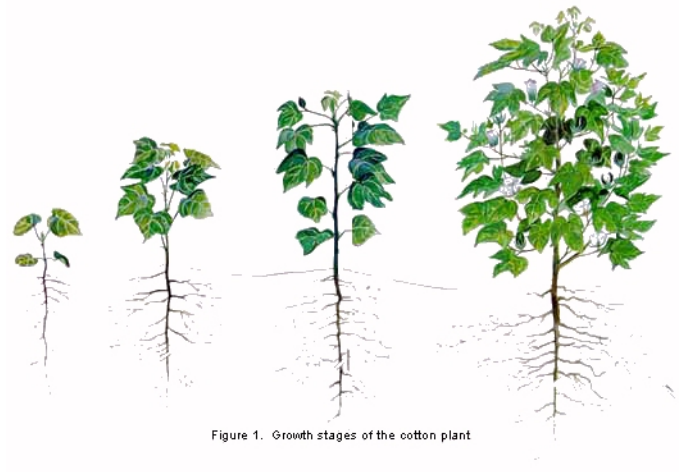
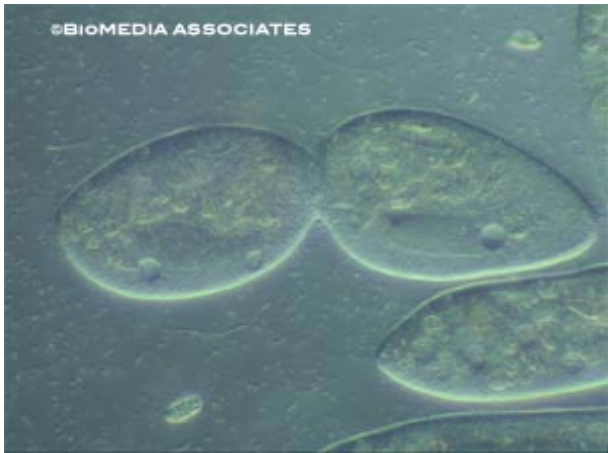
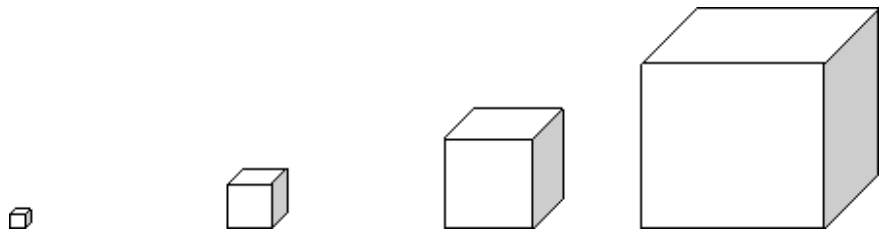


Figure 1. Growth stages of the cotton plant



# Why Divide?

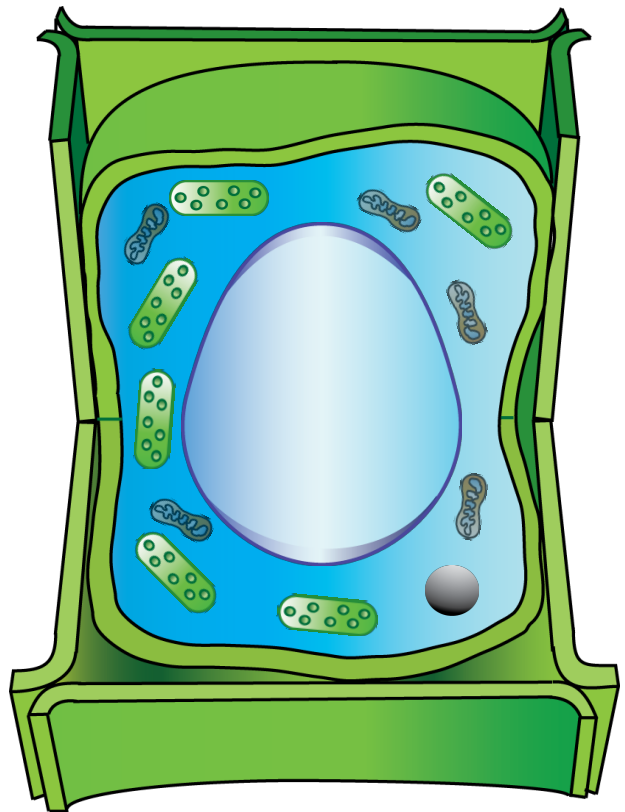
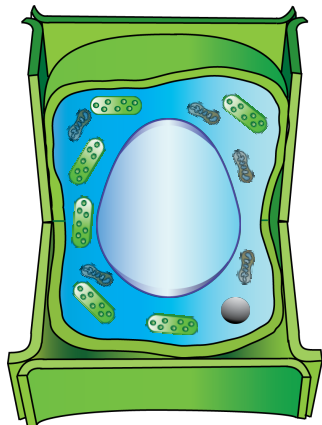
Surface Area/Volume Ratio of a growing cell...

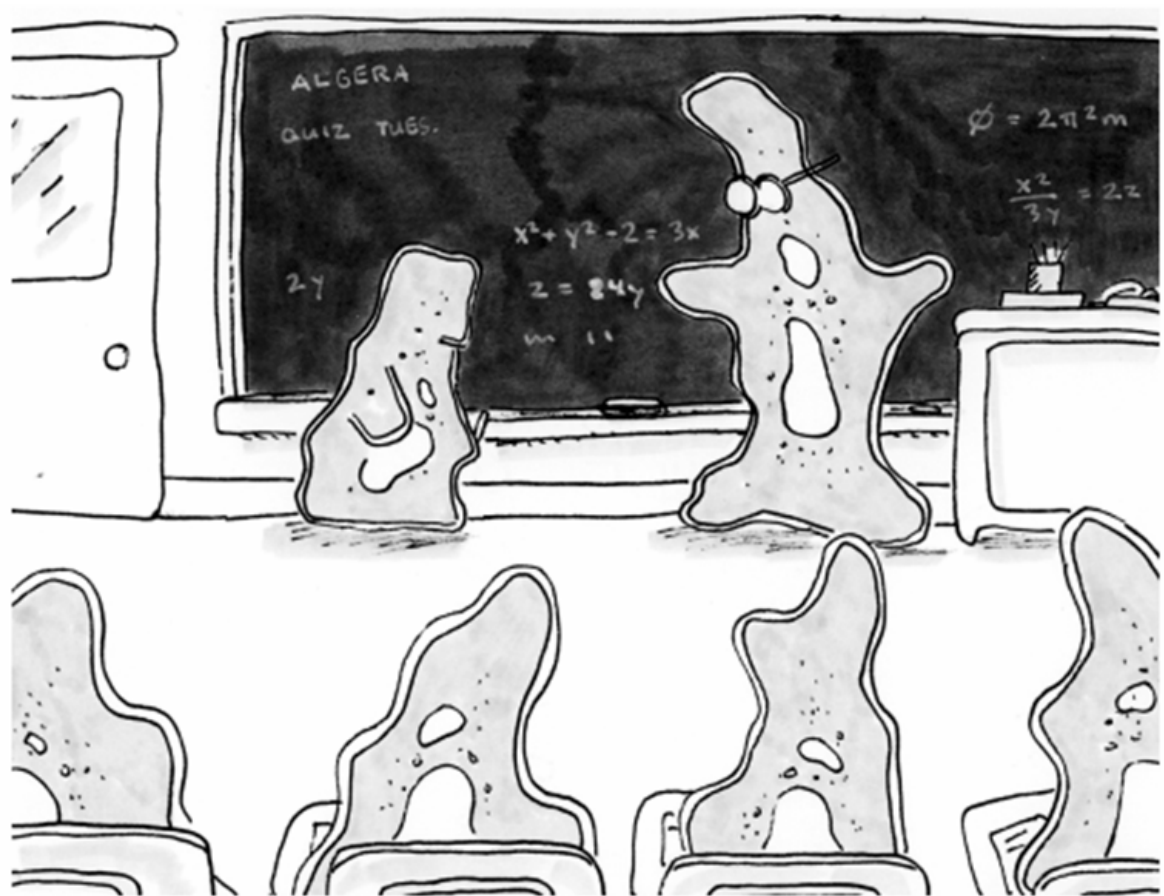


	1 cm Cube	2 cm Cube	3 cm Cube	4 cm Cube
Surface Area	= $\text{cm}^2$	= $\text{cm}^2$	= $\text{cm}^2$	= $\text{cm}^2$
Volume	= $\text{cm}^3$	= $\text{cm}^3$	= $\text{cm}^3$	= $\text{cm}^3$
$\frac{\text{SA}}{\text{V}}$ Ratio	_____ =	_____ =	_____ =	_____ =

# Why Divide?

Nuclear messages in a growing cell...





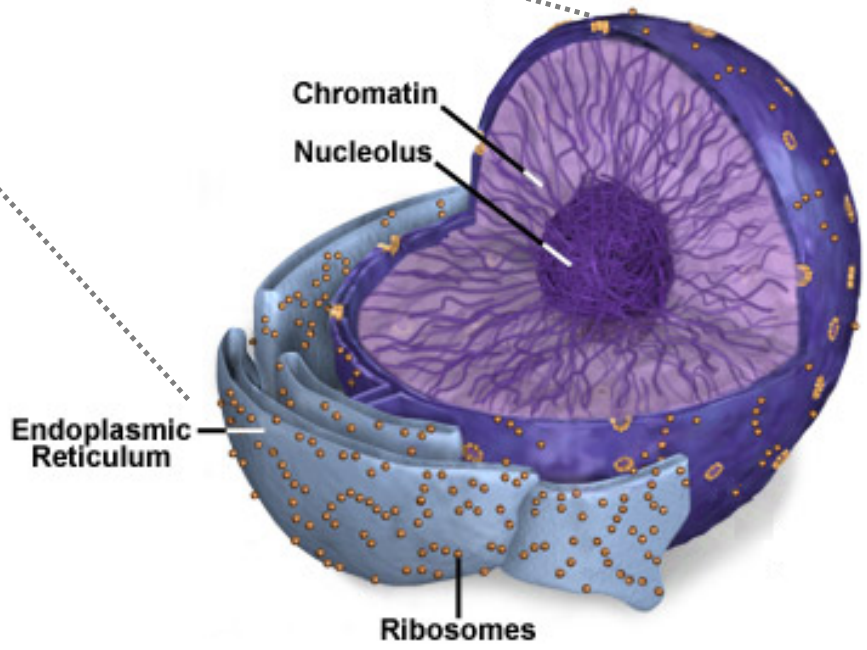
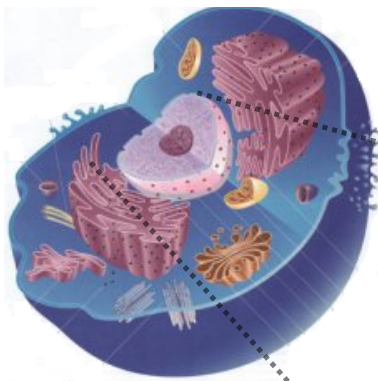
"Oh, come on, Alan - think. Use your nucleus!"

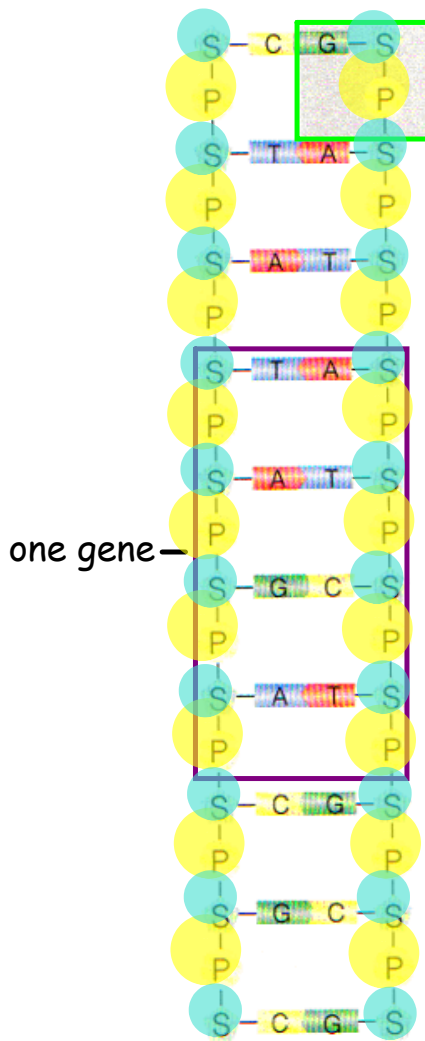


## THE IMPORTANCE OF THE NUCLEUS

- In order to better understand the life of a cell and the division process, different experiments on the cell and its organelles were performed. By removing and replacing different organelles, it was proved that the nucleus had to be present for a cell to fully function.
  - It controls the cell by coordinating and managing its various functions.
  - It stores all of the genetic information that creates instructions for the organelles.
    - The genetic information is a type of **nucleic acid** called **DNA (deoxyribonucleic acid)**.
      - Nucleic acids are responsible for the transmission of inherited information.
    - It is made up of repeating units called **nucleotides** that are linked together to form long strands that curl into a **double helix**. Each nucleotide is composed of a phosphate group, a sugar, and a base.
      - There are two types of sugars seen in nucleic acid; DNA has the sugar called **deoxyribose**.
      - There are four types of possible bases: **adenine, thymine, cytosine, and guanine**. In short, **A, T, C, and G**. A links with T, and C links with G, creating what are called **nitrogen base pairs**. The base pair sequence of a series of nucleotides is what makes up the genetic code.
        - A **gene** is a specific segment of DNA; it is a specific number and sequence of base pairs along a strand of DNA. One or more genes determine a characteristic of an individual.
          - Genes can be as short as 1000 base pairs or as long as several hundred thousand.
          - The exact number of genes in humans is unknown. It is estimated that there are 20,000 to 25,000.













one nucleotide

DNA includes nucleotides, each made of a phosphate, sugar, and a nitrogen base.

 P phosphate  
 S sugar

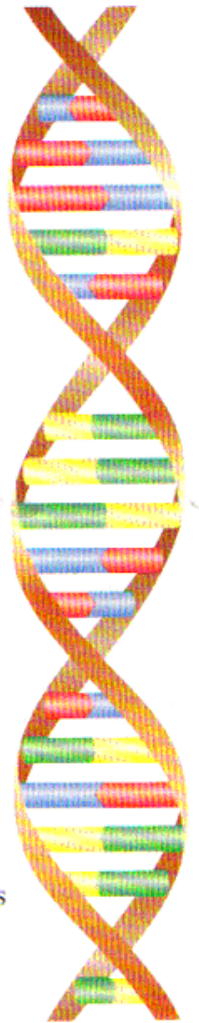
There are four kinds of nucleotides, each named for the base it contains: adenine (A), thymine (T), cytosine (C), and guanine (G).

Nitrogen Bases

 = adenine  
 = thymine  
 = cytosine  
 = guanine

The shapes of A and T fit together, as do the shapes of C and G.

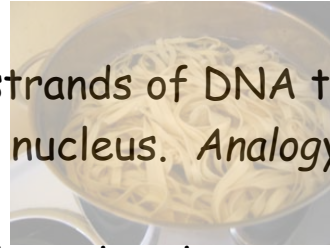
The number of A and T nucleotides is always equal, and the number of C and of G nucleotides is always equal.



## IMPORTANT FORMS OF DNA

- DNA takes on different forms during different stages of a cell's life. Each form has a different, yet related, name.

- **Chromatin** - long skinny strands of DNA that are scattered inside the nucleus. *Analogy: a pot of cooked spaghetti.*



- **Chromosome** - formed when the chromatin condenses inside the nucleus. Chromosomes form when the cell is preparing to divide. *Analogy: think about each spaghetti strand now wrapped tightly around itself to form thicker, more compact pieces.*

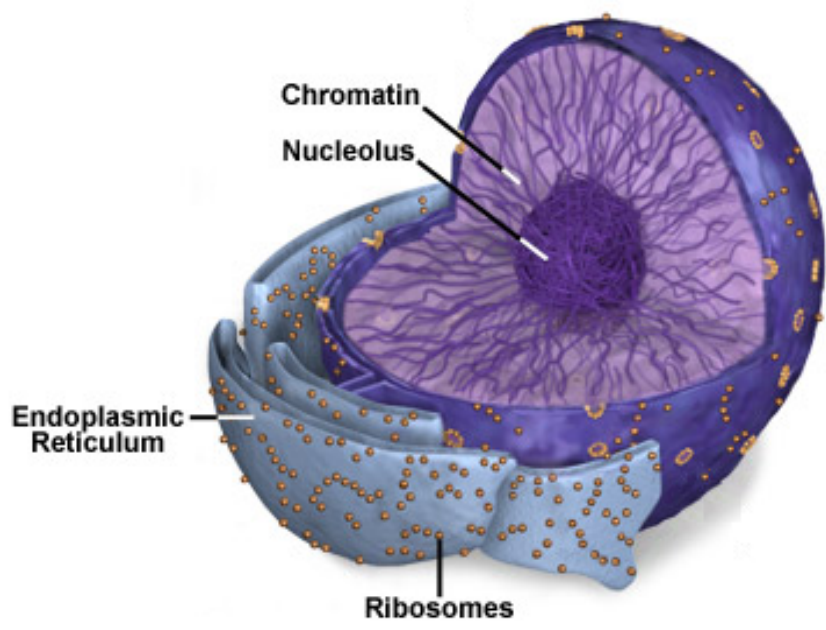
- When it comes to genes, think of the analogy that each strand of spaghetti being multi-colored like a rocket popsicle, and each color is a different gene!

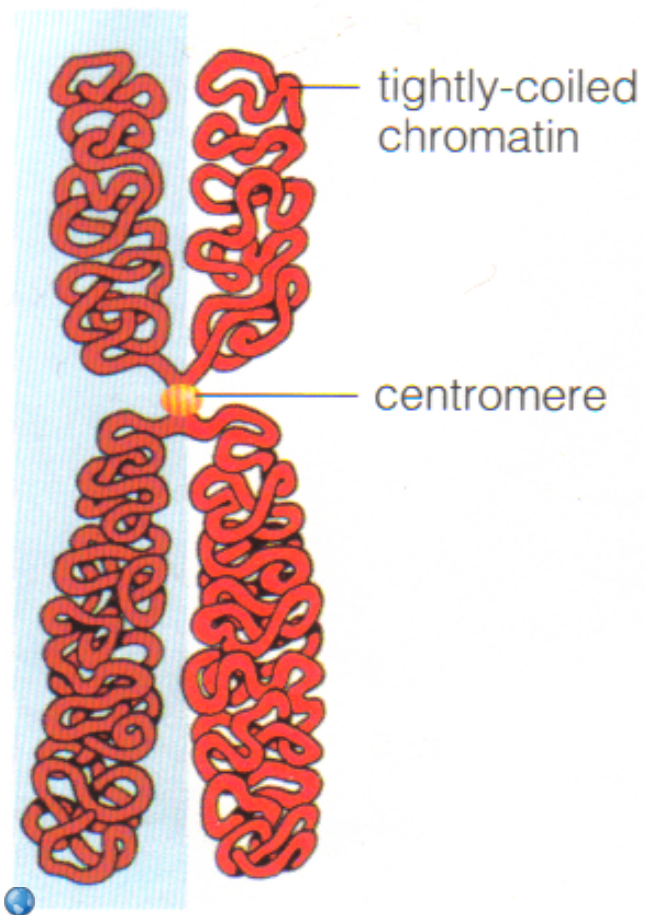


- Humans have 46 chromosomes; 23 come from the mother and 23 come from the father.

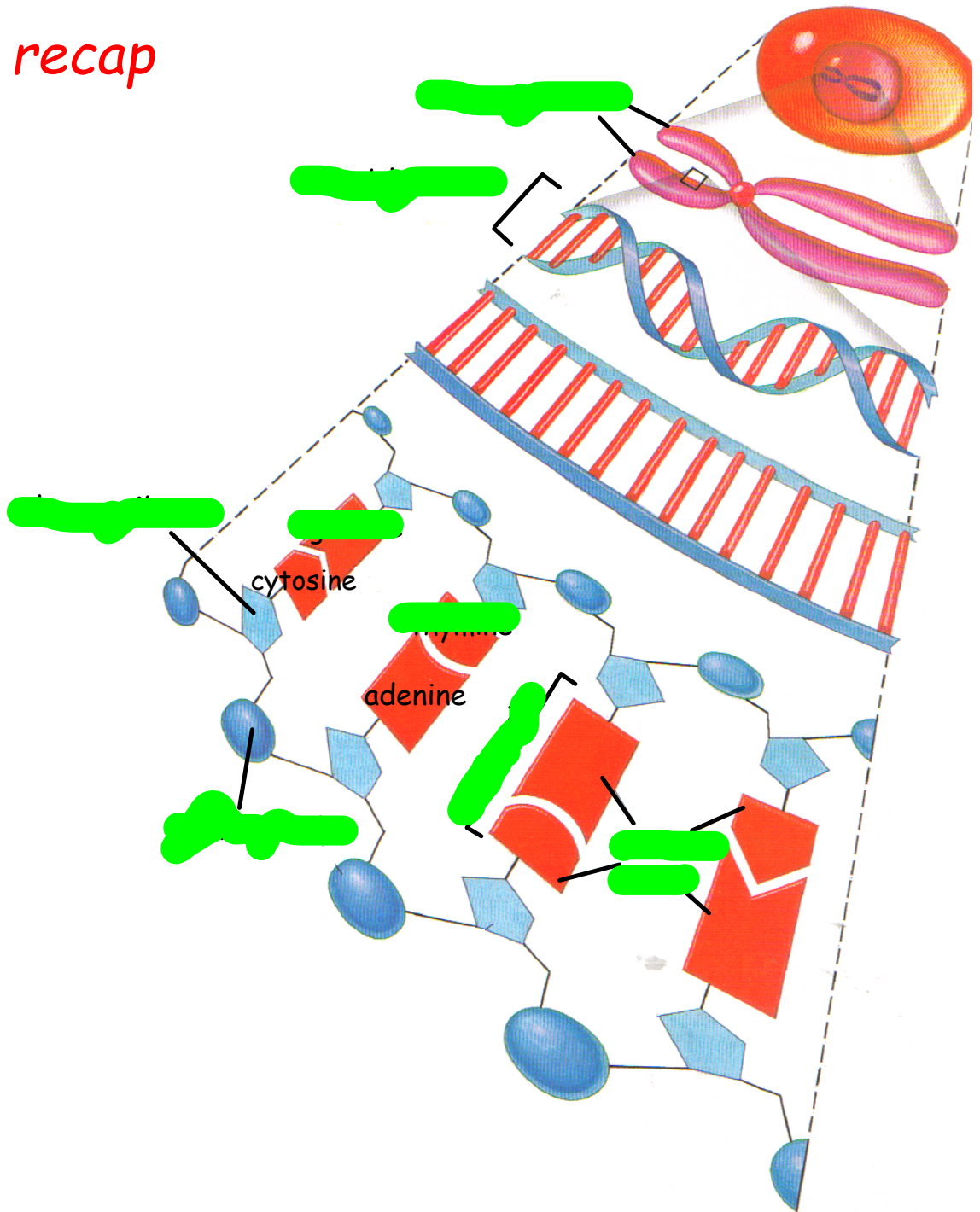
- **Chromatids** - during a certain phase of cell division, each chromosome replicates and remains attached to its copy. *Analogy: picture identical twins, wearing identical clothes, holding hands.*



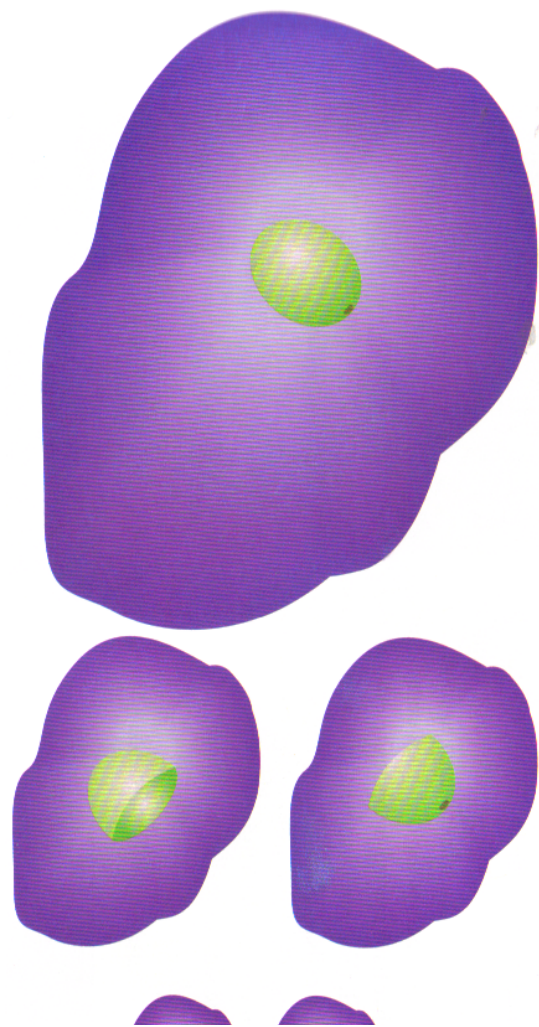




# DNA recap





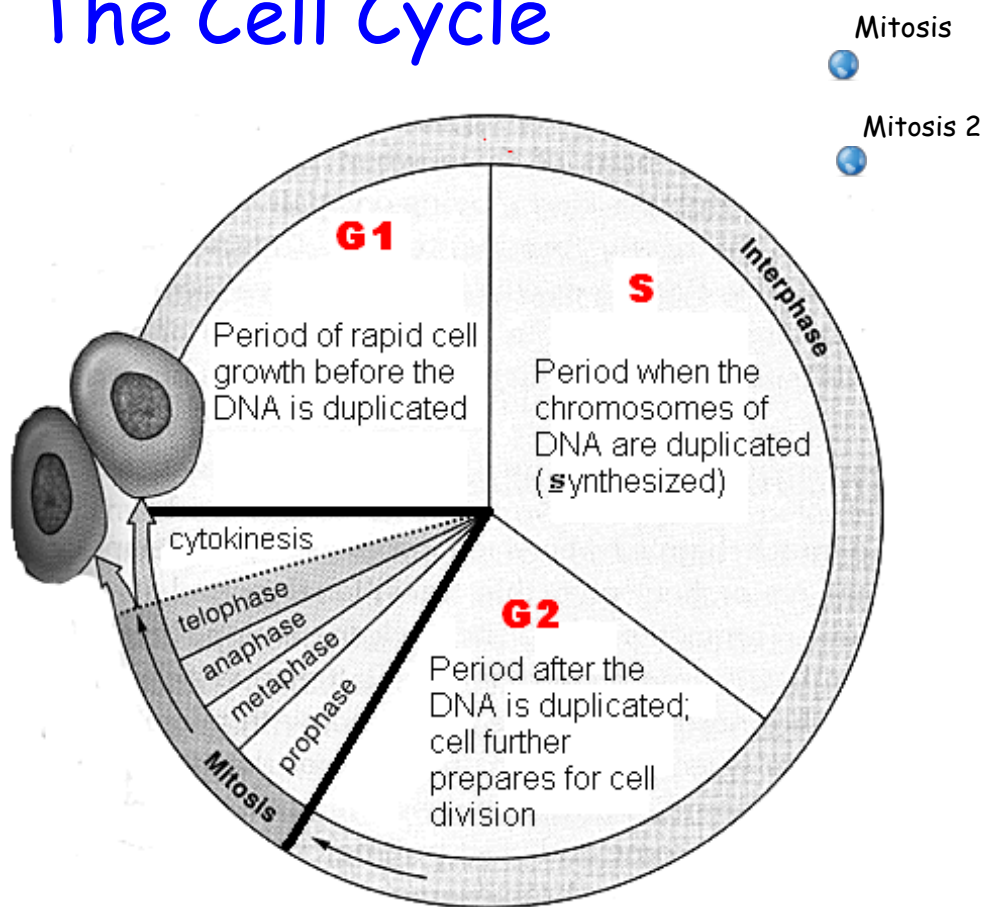




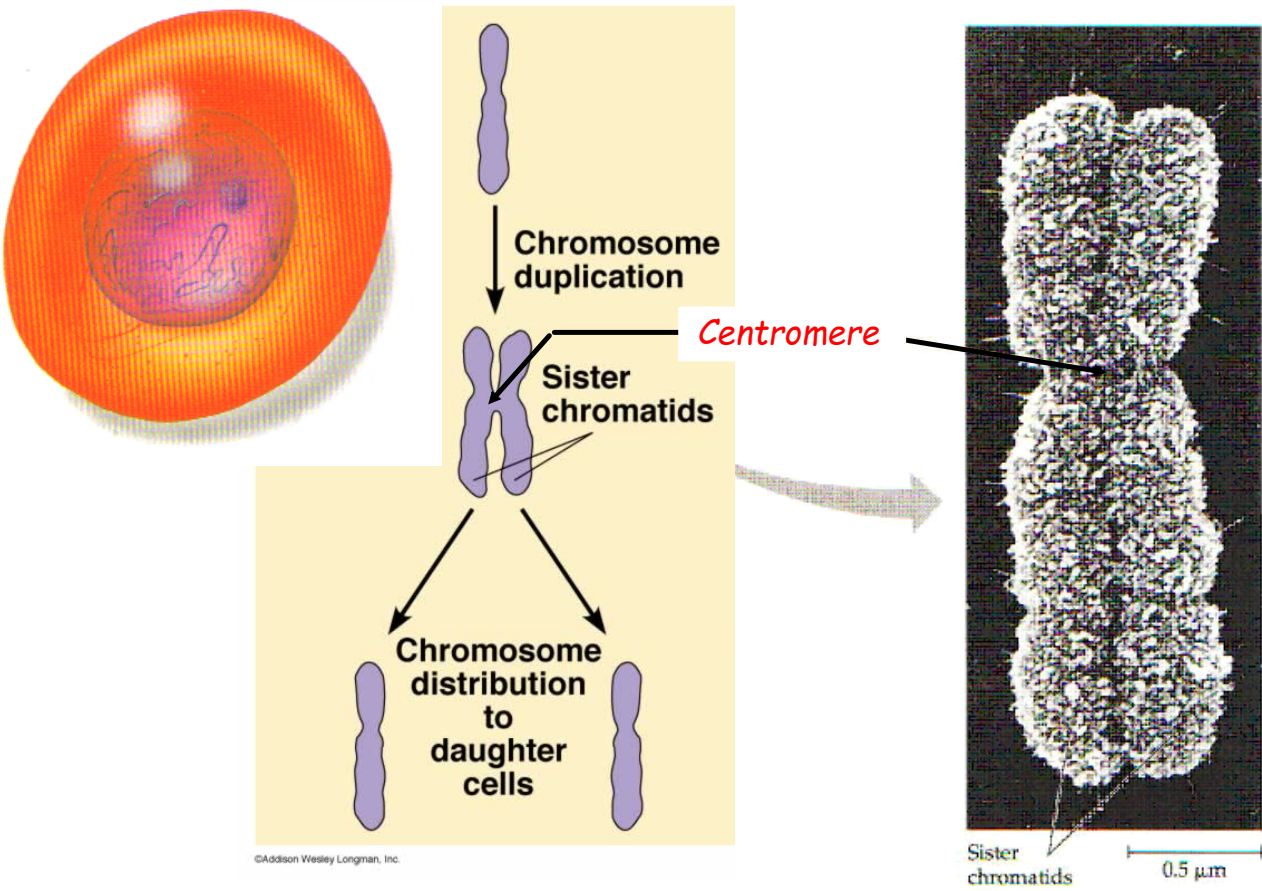
## THE CELL CYCLE

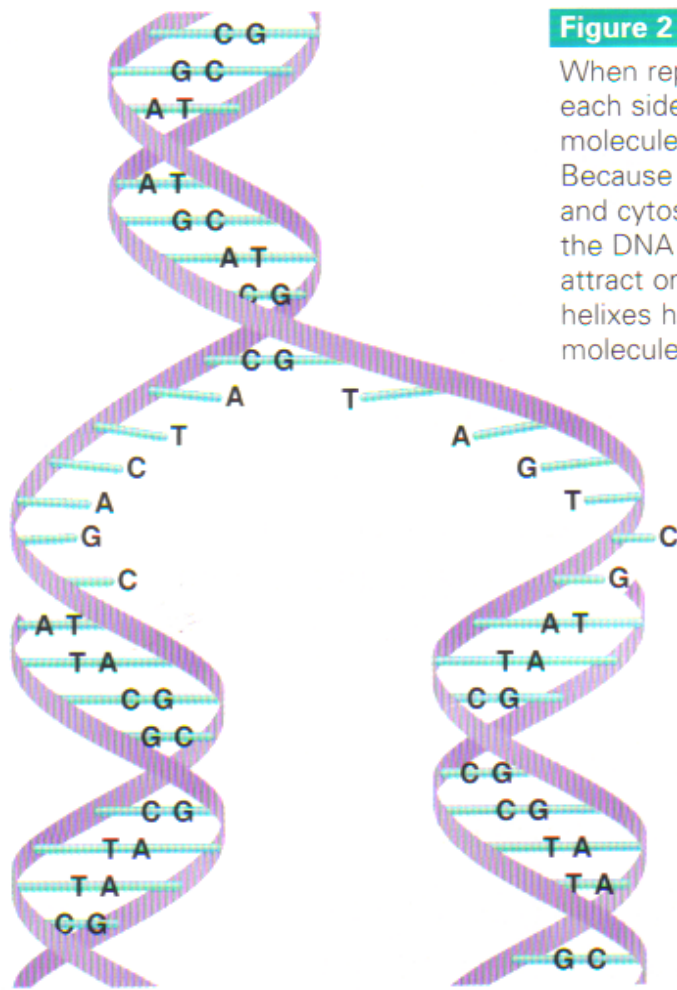
- The cell cycle is the complete life cycle of a cell.
- It is made up of two parts:
  - 1) Interphase
    - During interphase the cell grows, produces more organelles, and duplicates its chromosomes to produce two chromatids.
      - The chromatids are attached at the **centromere** and are also referred to as **sister chromatids**.
    - The prefix *inter* means *between*, hence *interphase* occupies the time *between* every cell division.
  - 2) Mitosis
    - Mitosis is the actual process of cell division.
    - It ensures that each new cell has a nucleus with a complete set of DNA.
      - After being duplicated, the DNA divides into two identical sets of chromosomes.
    - There are four phases of Mitosis:

# The Cell Cycle



# Interphase





**Figure 2**

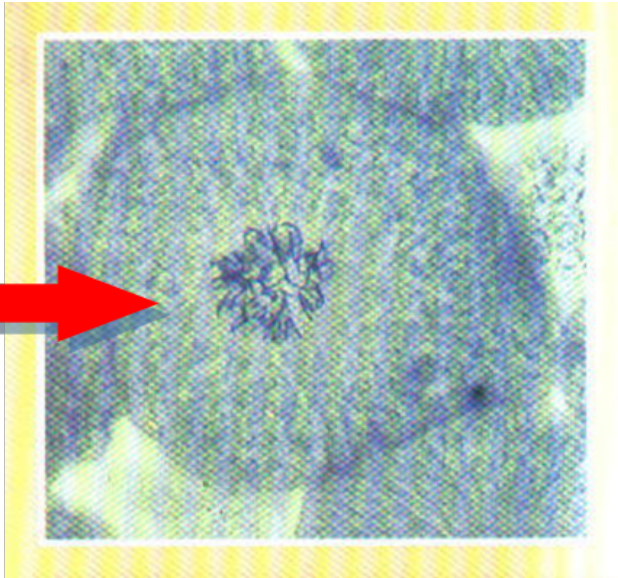
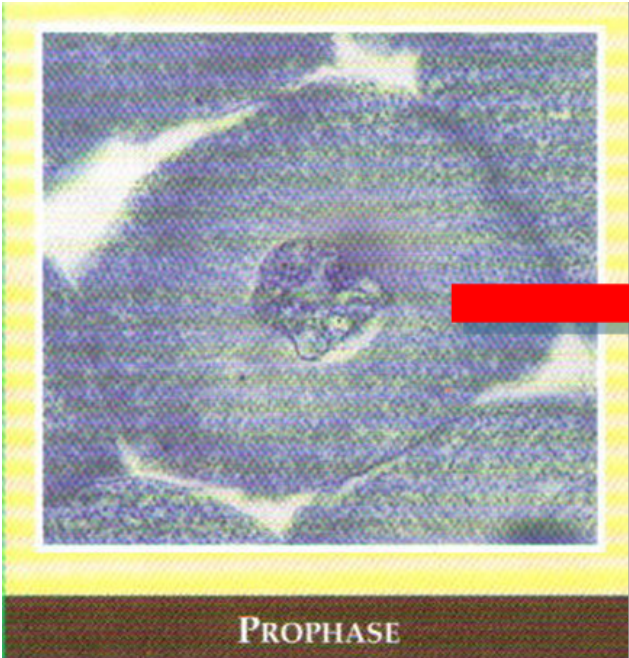
When replicating, the DNA molecule “unzips,” and each side serves as a template. On each half of the molecule, a new complementary half is built. Because adenine (A) always pairs with thymine (T), and cytosine (C) always pairs with guanine (G), when the DNA unzips, any As attract only Ts, and Cs attract only Gs. By the end of the process, two helices have been formed. The two new DNA molecules are identical to each other!

1. **Prophase** - the sister chromatids shorten and thicken some more. The nuclear membrane dissolves.
2. **Metaphase** - the sister chromatids line up in the middle of the cell and form the *metaphase plate*.
  - **Metaphase Plate** - an imaginary line that is created when the sister chromatids line up in the middle of the cell during mitosis.
3. **Anaphase** - the sister chromatids are separated by *spindle fibers* and move to opposite poles of the cell. If anaphase proceeds correctly, each of the daughter cells will have a complete set of DNA.
  - **Spindle Fibers** - fibers that are responsible for physically ripping the sister chromatids apart. In an *animal cell*, the other ends of the spindle fibers are attached to the **centrioles**.
4. **Telophase** - the daughter chromosomes reach opposite poles of the cell and new nuclear membranes begin to form around each set. *Cytokinesis* begins.
  - **Cytokinesis** - the division of the cytoplasm. The cytoplasm separates into roughly two equal parts and the two daughter cells are formed.



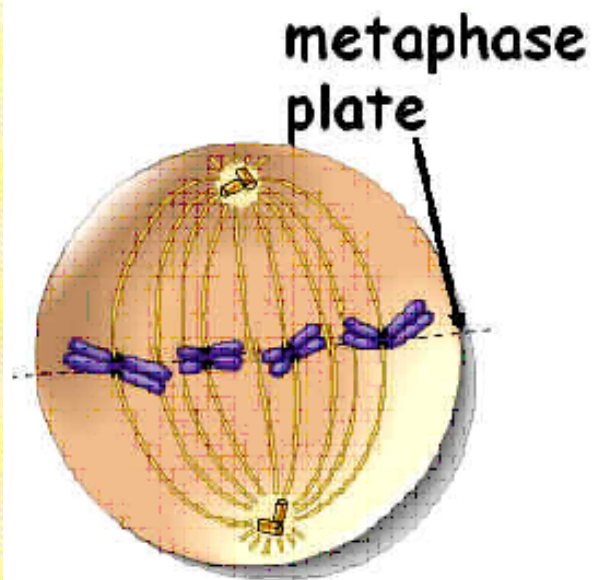
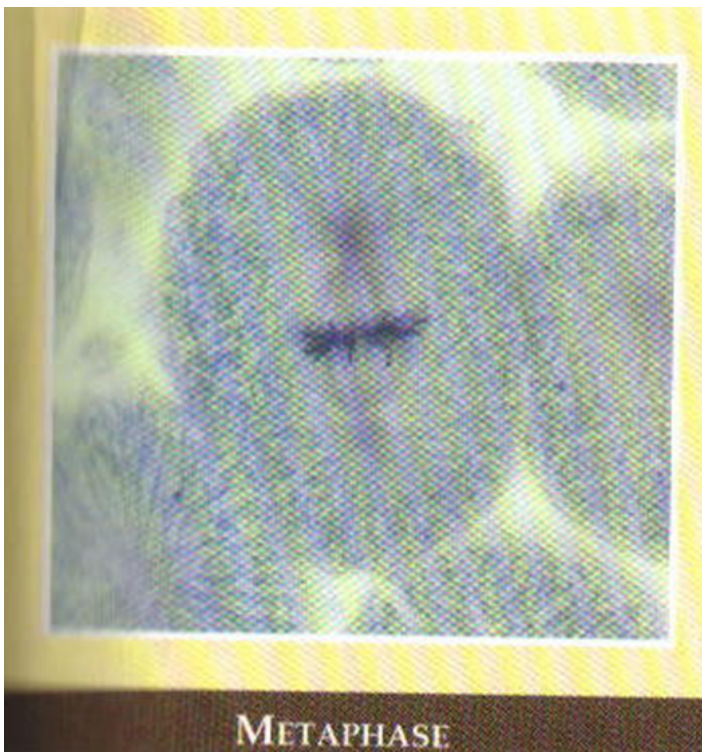
# Prophase

Prophase - The First Stage of Mitosis.aspx



# Metaphase

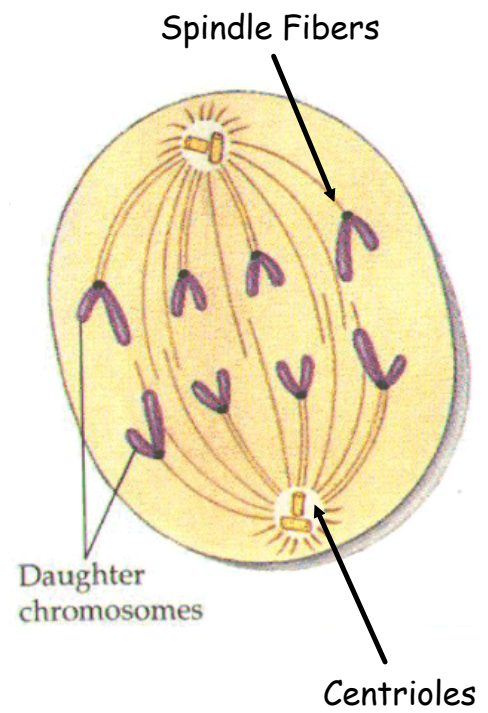
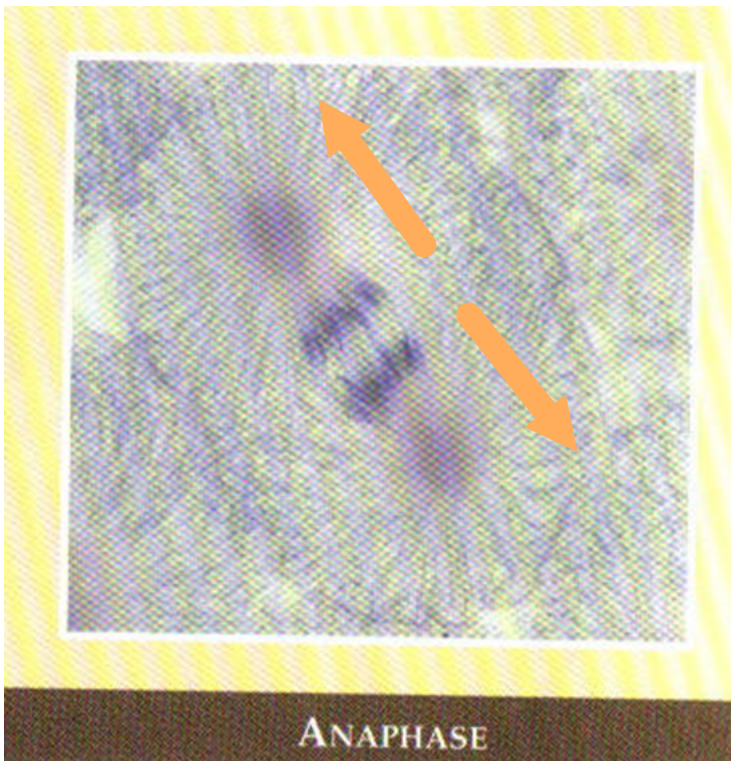
Metaphase - The Second Stage of Mitosis.aspx





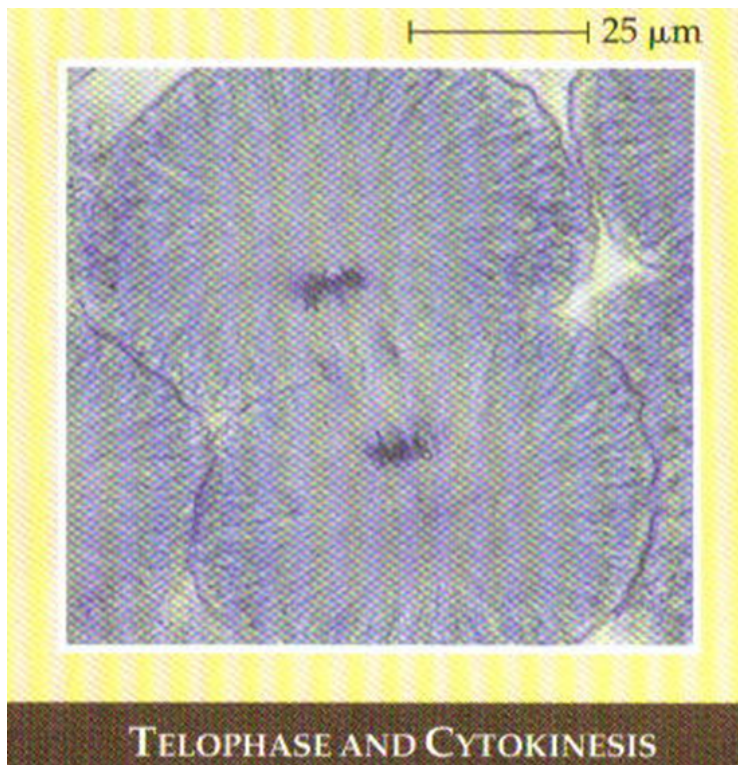
# Anaphase

Anaphase - The Third Stage of Mitosis.aspx



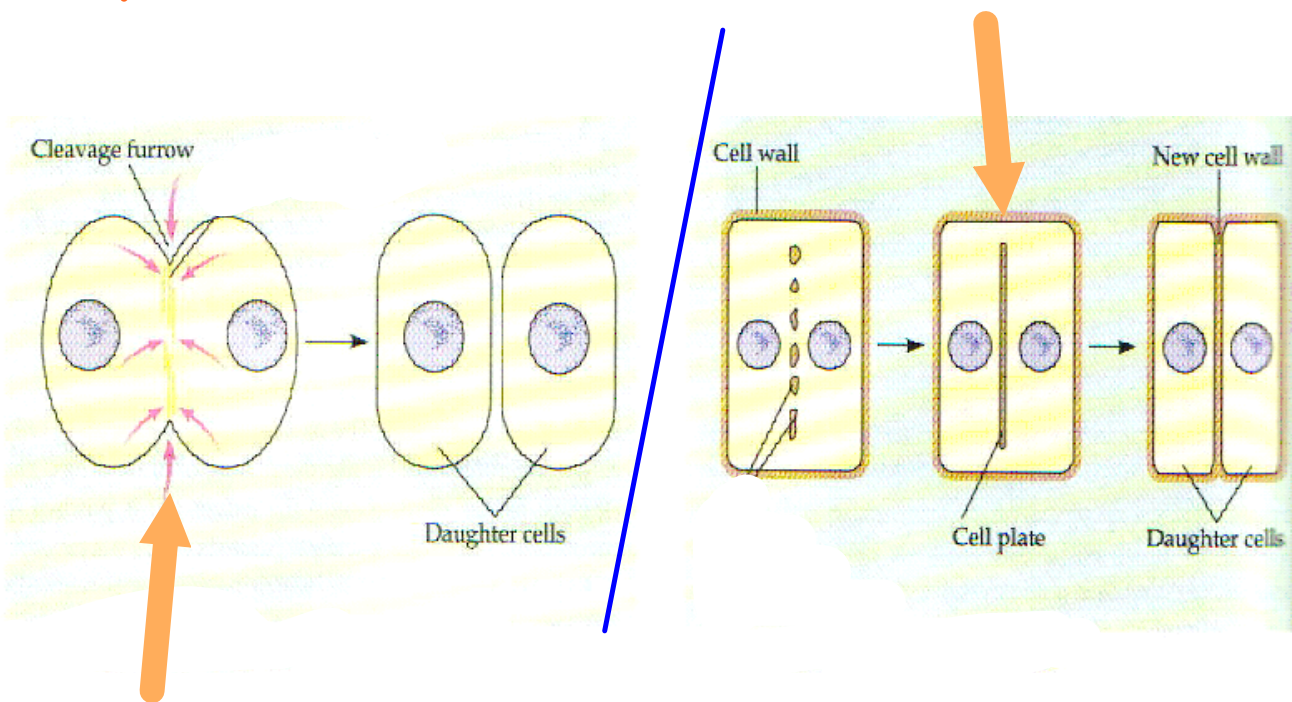
# Telophase and *Cytokinesis*

Telophase - The Fourth Stage of Mitosis.asx

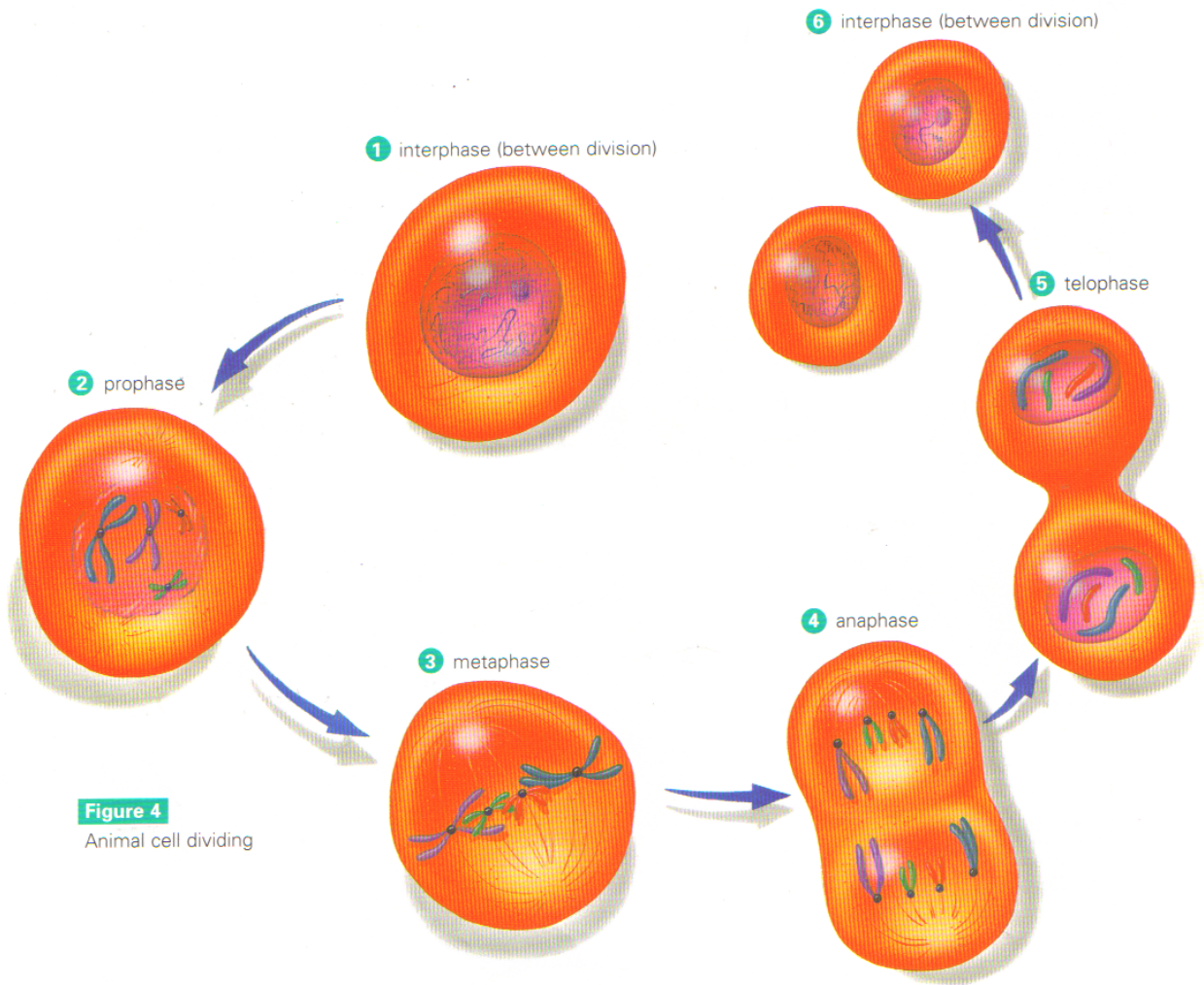


- During cytokinesis of an *animal cell*, the formation of the *cleavage furrow* is observed.
  - **Cleavage Furrow** - The region of an animal cell that pinches inward when the cell is in the process of dividing. A shallow groove forms in the cell surface near the old metaphase plate.
- During cytokinesis of a *plant cell*, the formation of the *cell plate* is observed.
  - **Cell Plate** - Small additional segments of the cell wall come together in the middle of the dividing plant cell; these pieces will fuse and form the new cell wall between the two daughter plant cells.

# Cytokinesis







**Figure 4**  
Animal cell dividing

## THE RESULT OF MITOSIS

What conclusion can you make about the genetic makeup of the daughter cells?

## Attachments

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Introduction to Cell Division.aspx

Introduction to Interphase.aspx

Introduction to Mitosis.aspx

Prophase - The First Stage of Mitosis.aspx

Metaphase - The Second Stage of Mitosis.aspx

Anaphase - The Third Stage of Mitosis.aspx

Telophase - The Fourth Stage of Mitosis.aspx

Cancer Cells.aspx