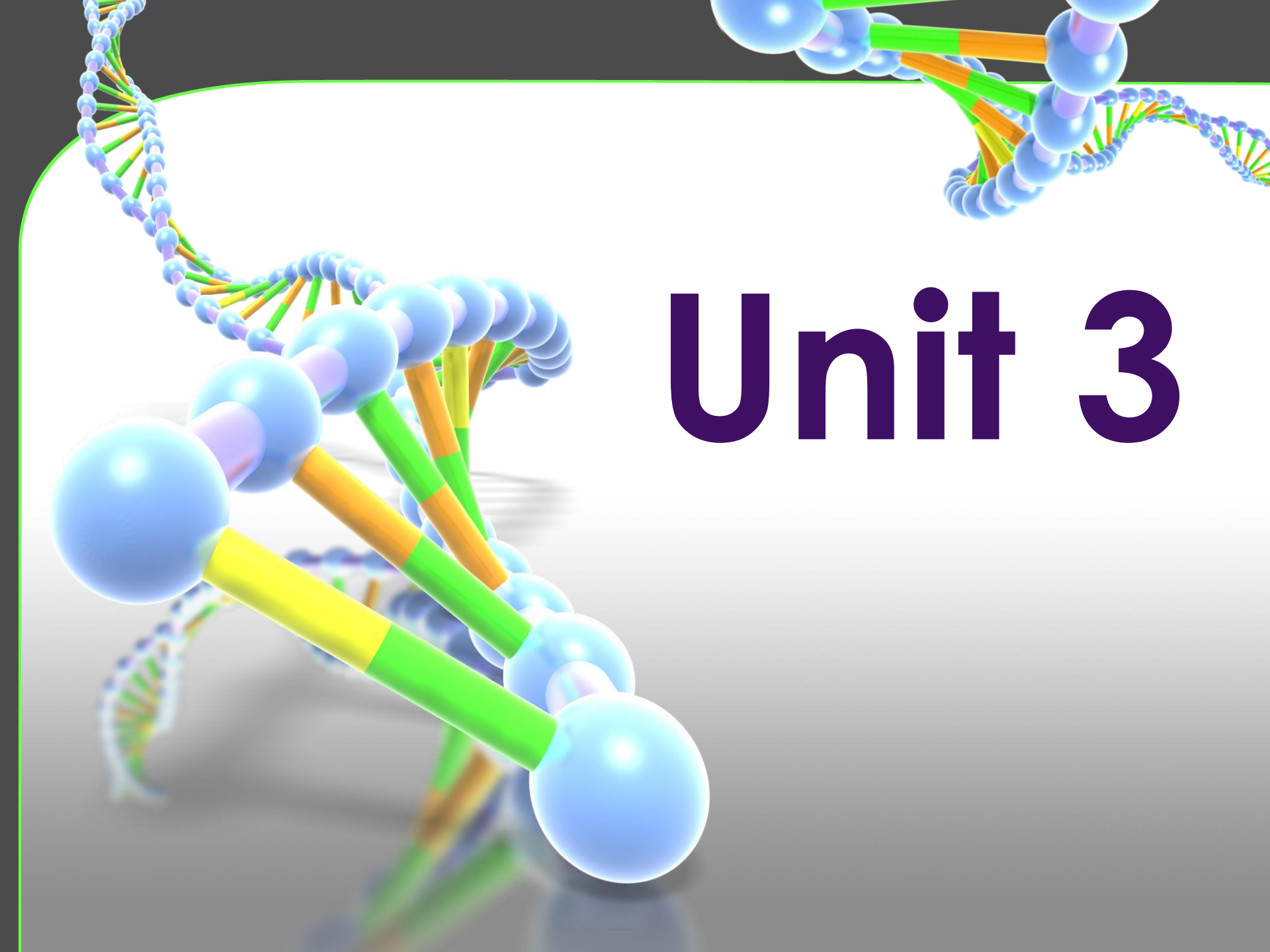
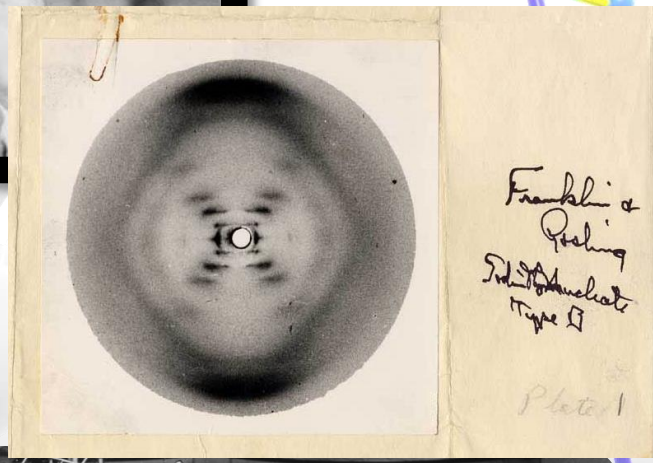
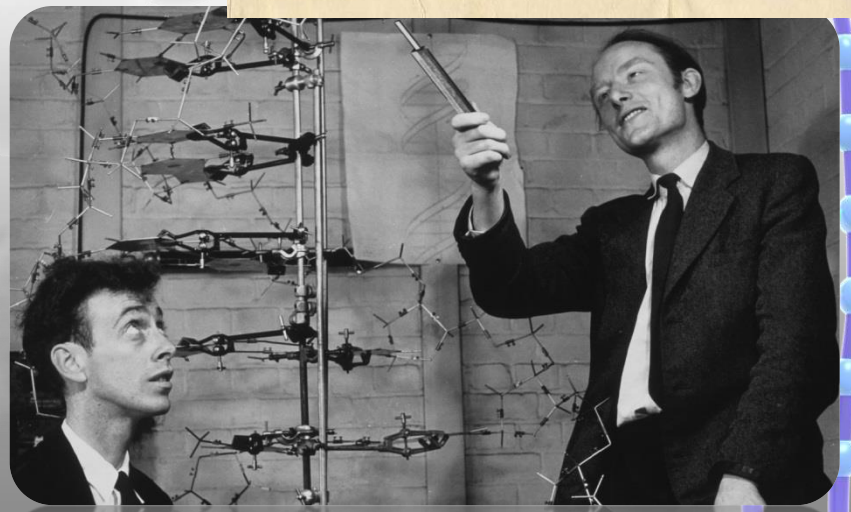

Unit 3

I. DNA History

1.) Rosalind <u>Franklin</u>- (Early 1950's) Used **<u>X-ray diffraction</u>** to get an image of a DNA molecule



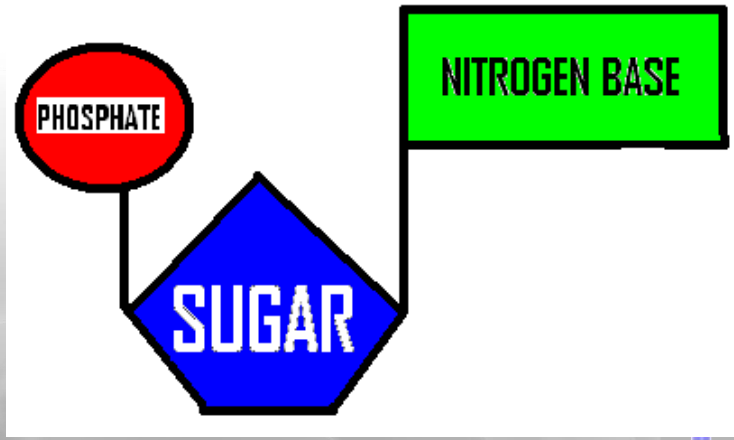
2.) Francis Crick and James Watson- (1953) Shown Franklin's X-ray pattern and used it to **<u>build a model of DNA- "Double Helix"</u>**



II. DNA Structure

1. Nucleic Acid is the **polymer**
2. **Nucleotide** is the **monomer** of DNA and is made of 3 parts:
   a) 5 carbon sugar- **Deoxyribose**
   b) **Phosphate** molecule
   c) Nitrogenous **base**
      I. **Adenine- A**
      II. **Thymine- T**
      III. **Cytosine- C**
      IV. **Guanine- G**
   d) Elements of DNA: **CHONP**

Carbon, Hydrogen, Oxygen, Nitrogen & Phosphorus!

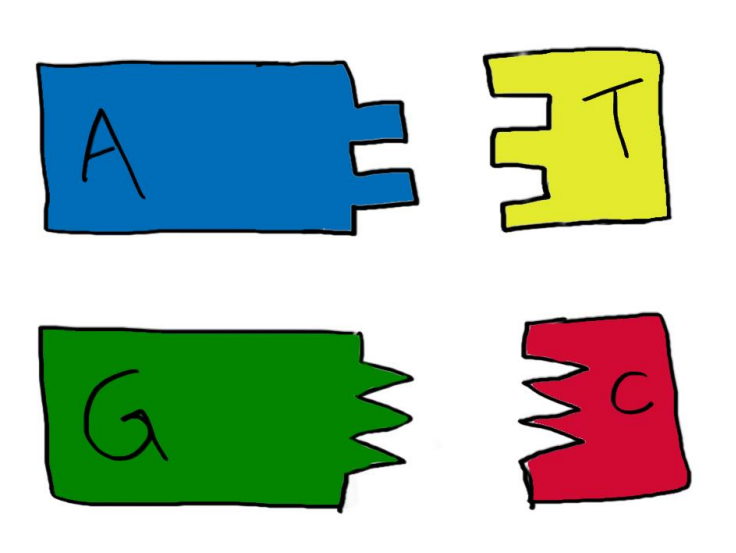


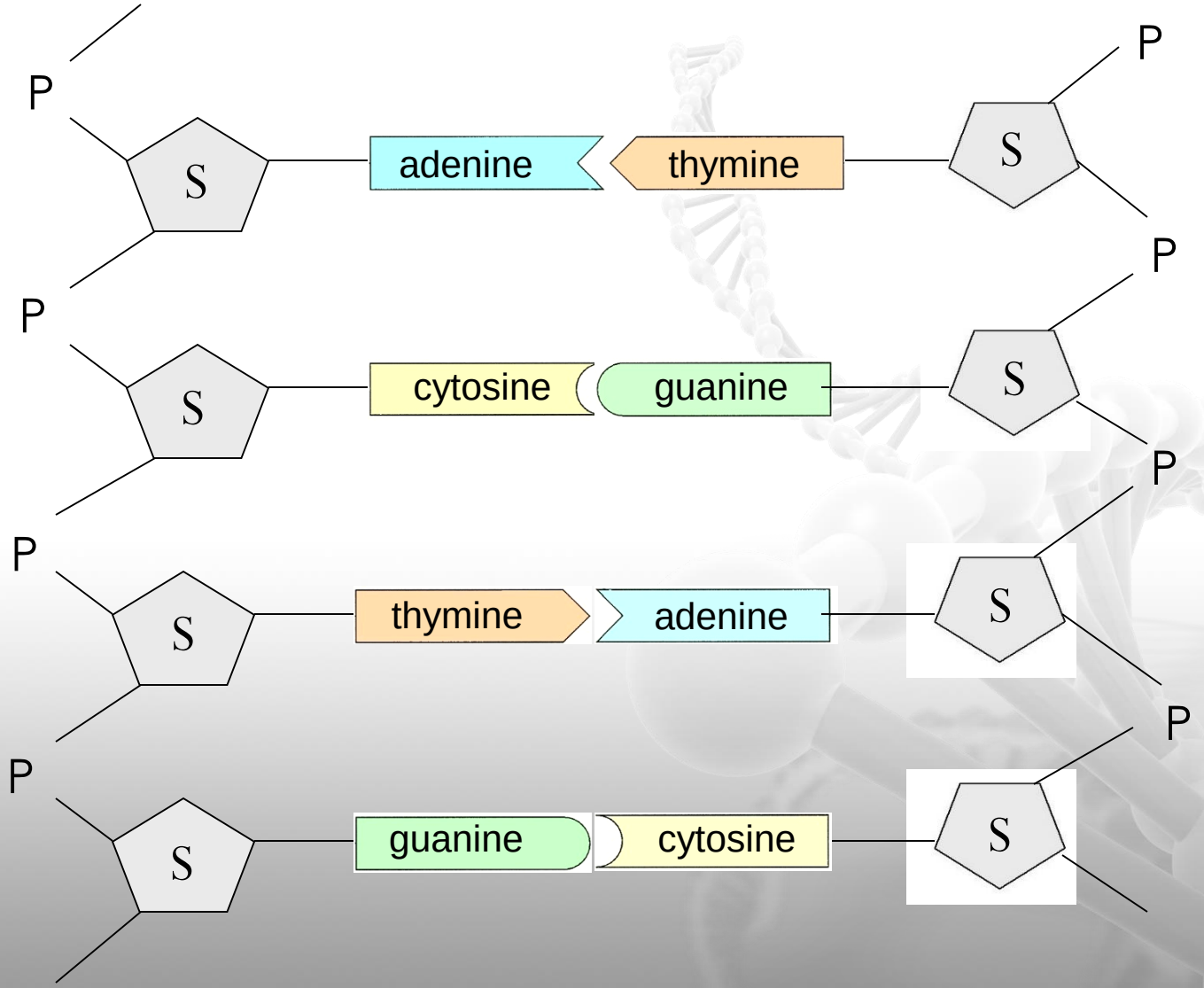
3. Base Paring Rule

a) Adenine – Thymine (A-T)
   - **A**pples grow on **T**rees

b) Cytosine – Guanine (C-G)
   - **C**ars go in **G**arages

c) *Nitrogen bases directly code for an organism's **traits**

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cytosine
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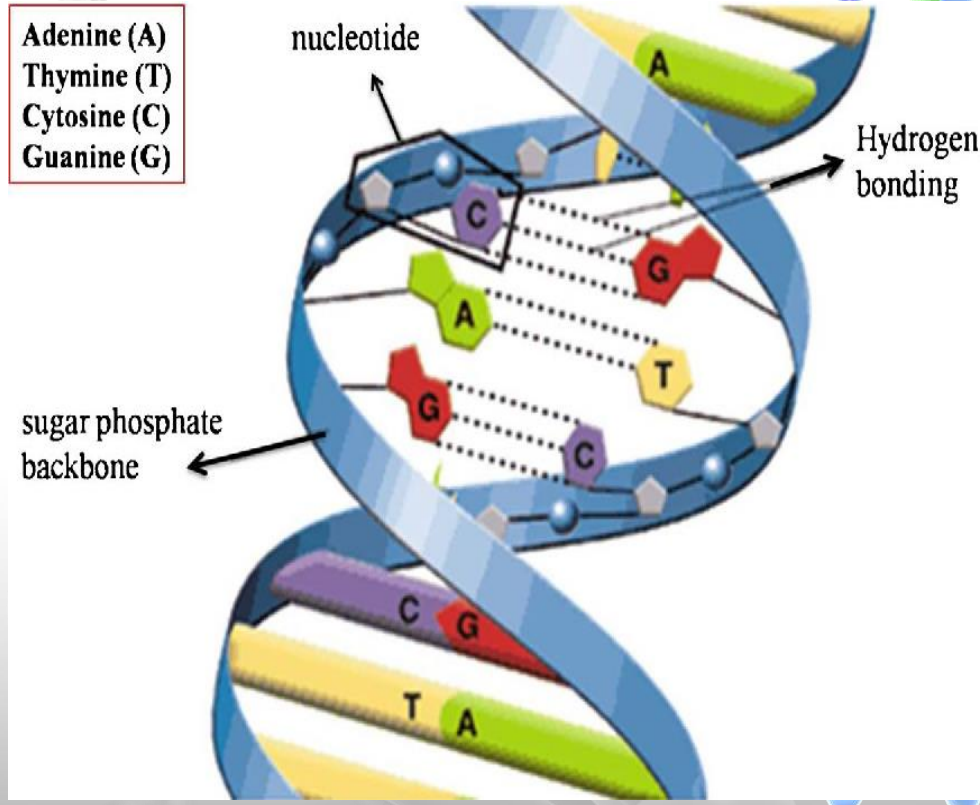
guanine
cytosine
S
P

4. Shape of DNA is a **double helix** "looks like a **twisted ladder**"

a) **Deoxyribose sugar** and **phosphate** molecules make up the outside of the ladder

b) **Nitrogen bases** make up the inside of the ladder (steps)

c) Paired bases are held together by **weak hydrogen bonds**



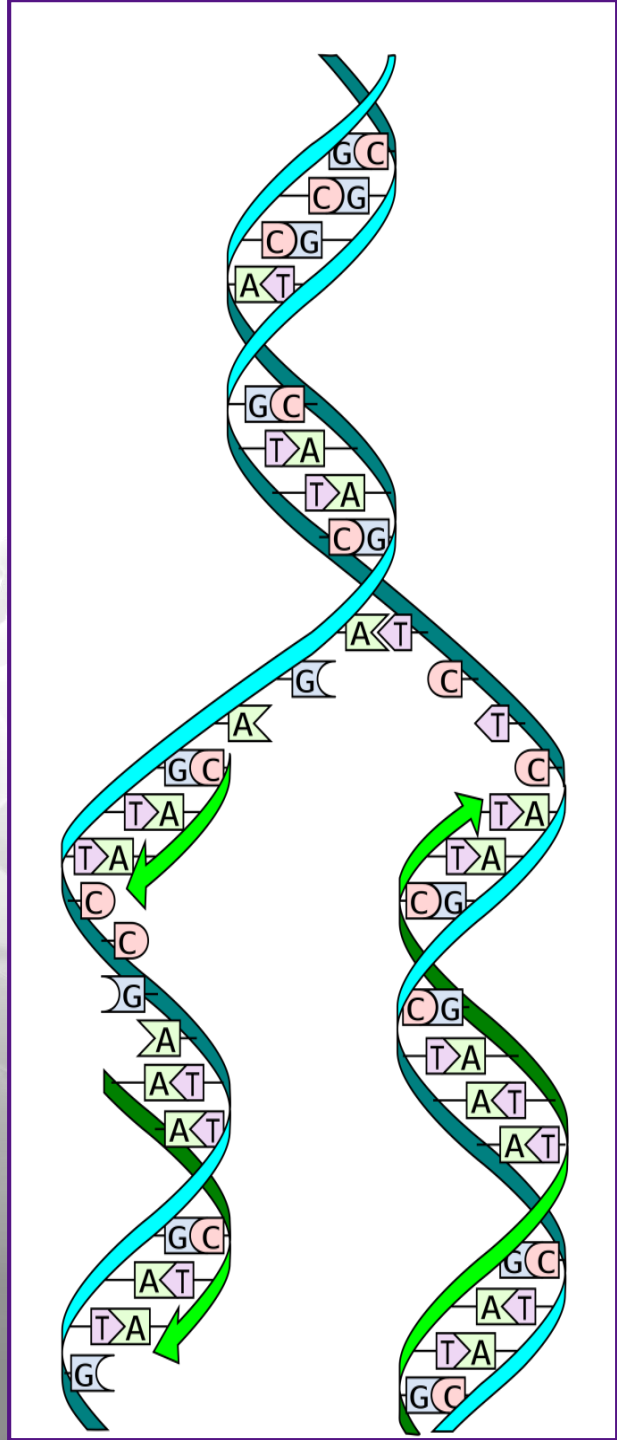
DNA Function

1. Stores **genetic information**
2. Genetic information is **passed** to each **generation**

III. DNA Replication

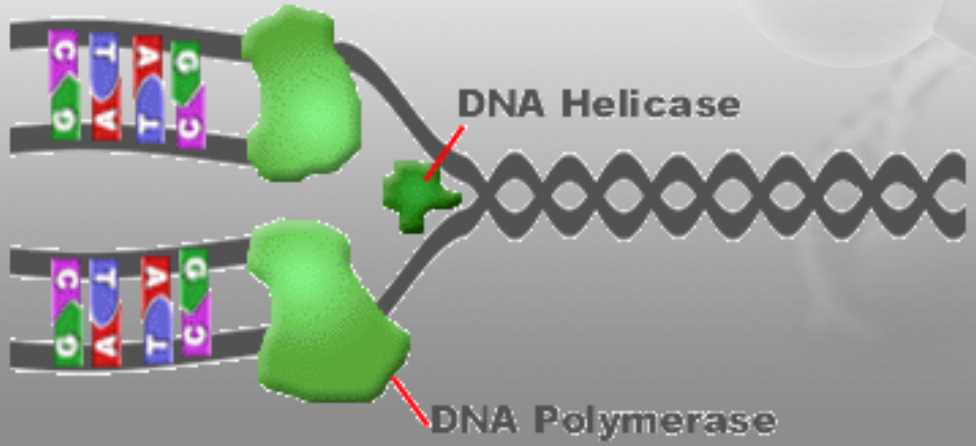
1. DNA must replicate before the cell divides. WHY?

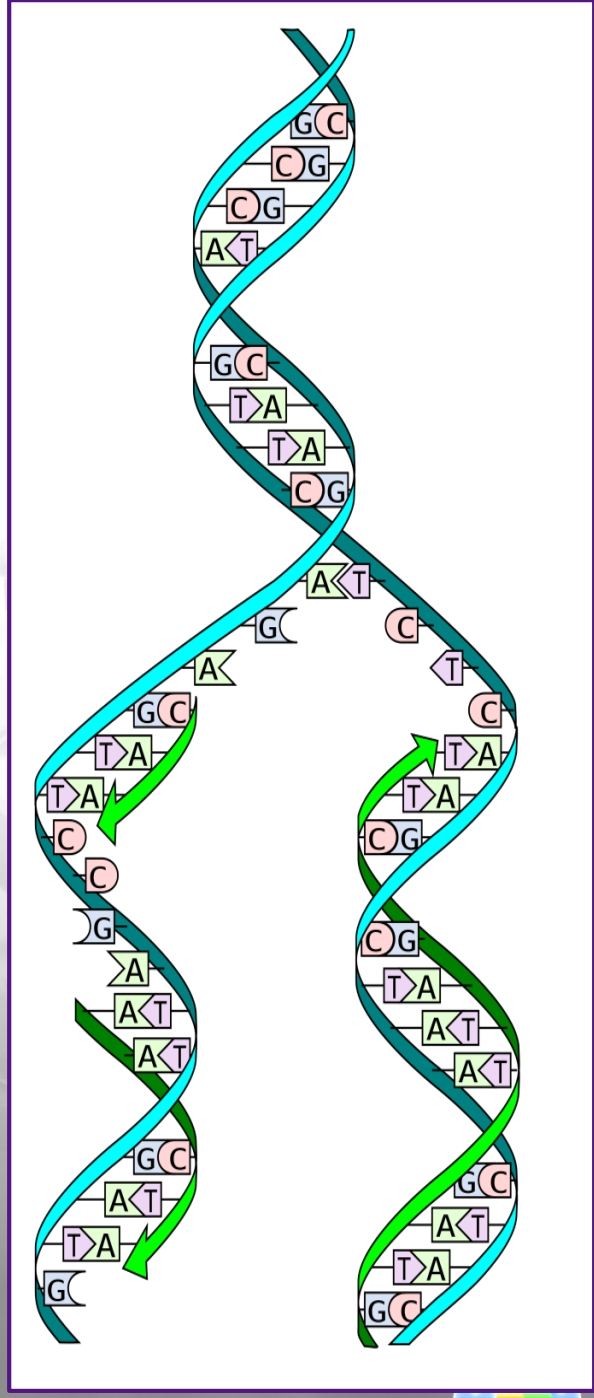
   a) If it didn't the resulting cells would **only have half of the original needed DNA**



DNA Replication Steps

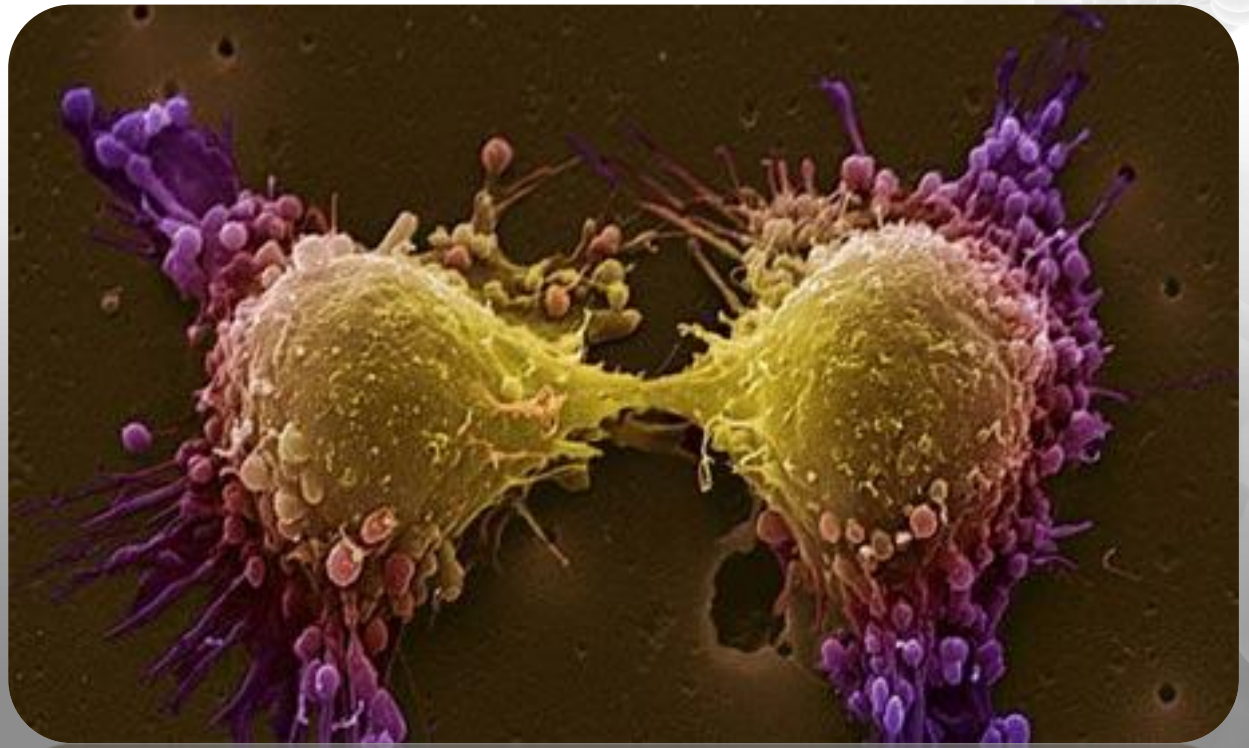
1. DNA **unwinds**
2. DNA **unzips** with the help of an enzyme (protein) called **DNA Helicase** (*Helicase breaks the weak hydrogen bonds between paired bases)
3. An enzyme called **DNA Polymerase** joins many **nucleotides** back together
4. End result is **2** complementary strands (one **original** strand, one **new** strand)





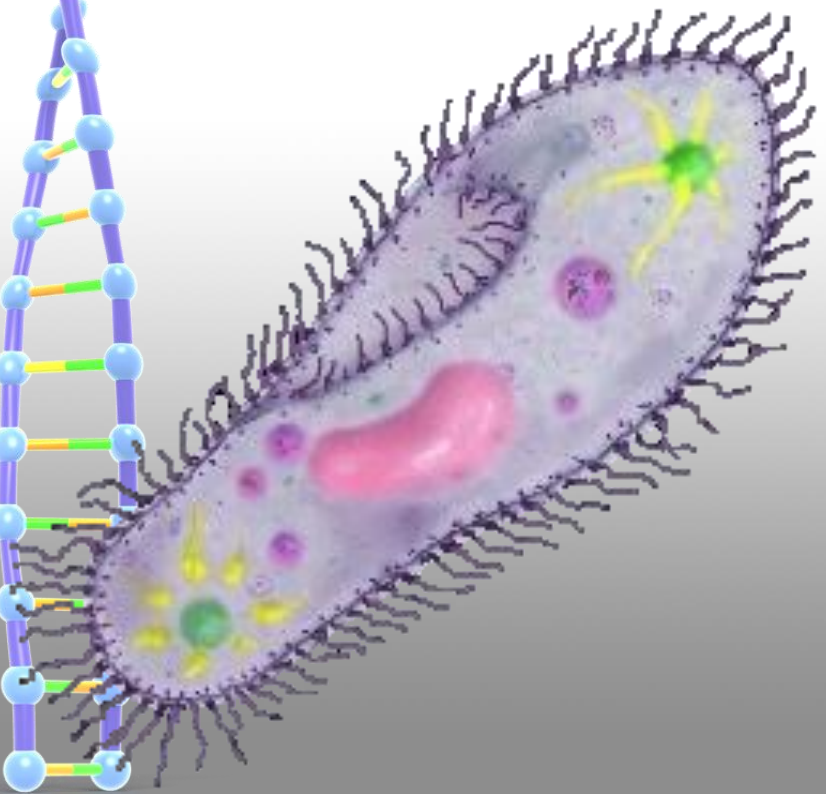
IV. Cell Limits in Prokaryotes & Eukaryotes

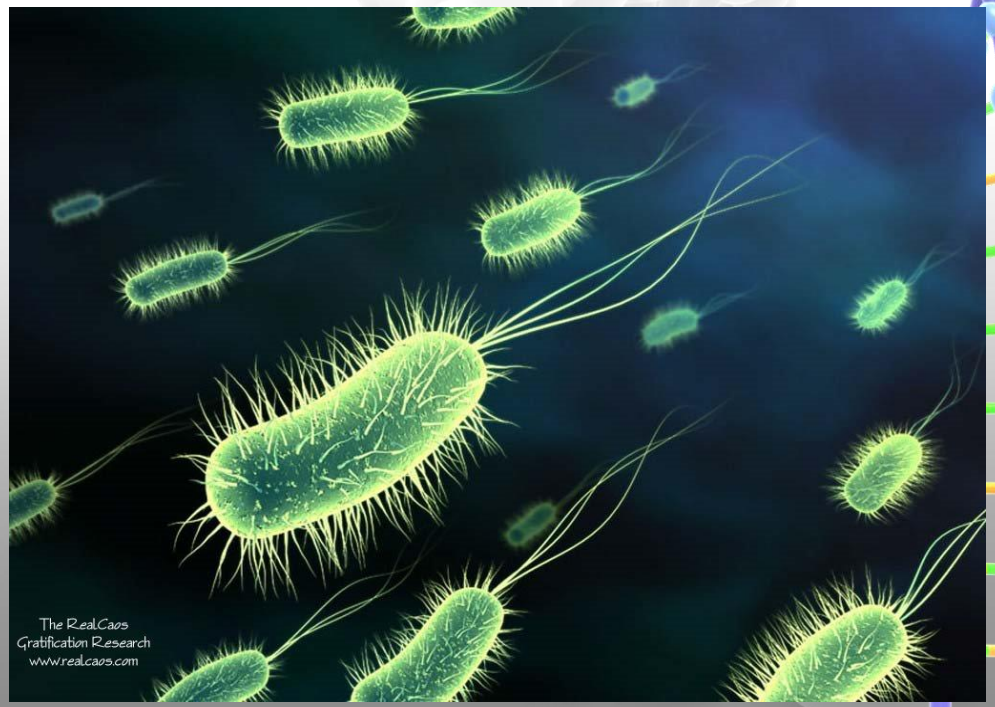
1. Problems with cell growth:
   a) Most cells have to **divide**… WHY?
      i. **DNA Overload** (Too much demand on DNA)
      ii. **Expelling wastes** (Difficult to get ride of wastes)
      iii. **Obtaining nutrients** (Nutrients have to travel farther)



V. Unicellular Life - Prokaryotes

1. A **single cell** makes up the entire organism
   a) ALL **prokaryotes** (Archaebacteria & Eubacteria)
   b) High rates of **reproduction**





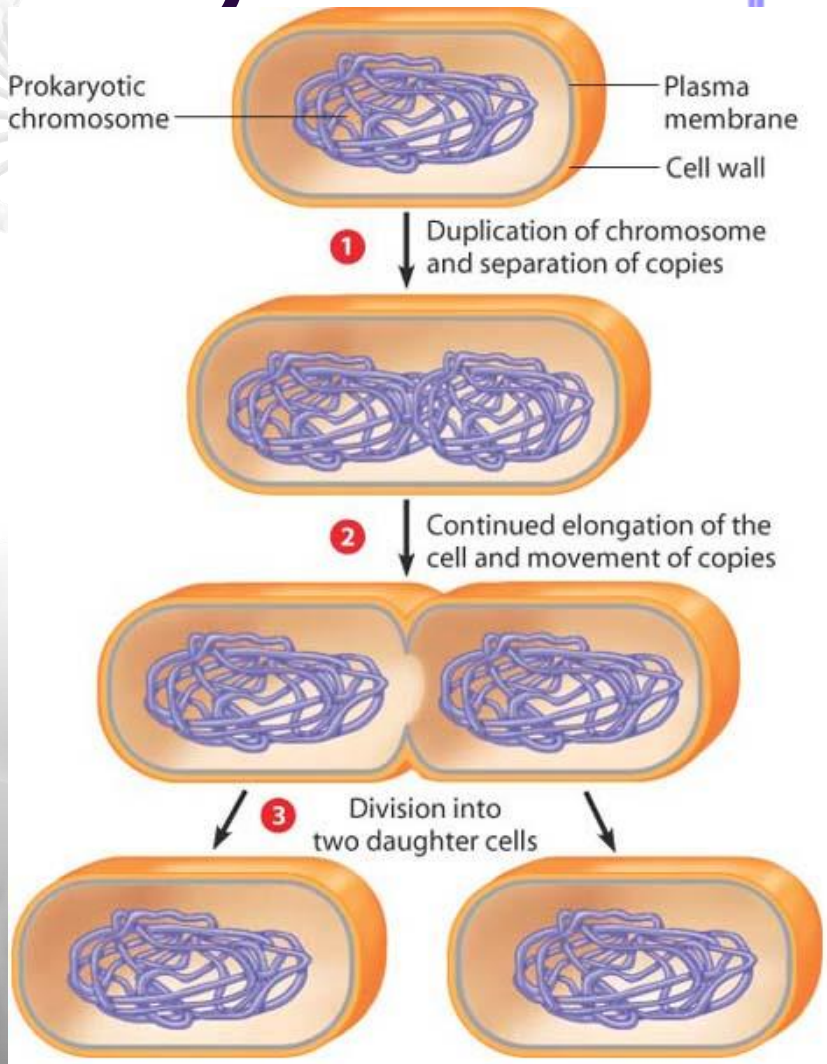
Classification of Living Things

DOMAIN	Bacteria	Archaea	Eukarya			
KINGDOM	Eubacteria	Archaebacteria	Protista	Fungi	Plantae	Animalia
CELL TYPE	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
CELL STRUCTURES	Cell walls with peptidoglycan	Cell walls without peptidoglycan	Cell walls of cellulose in some; some have chloroplasts	Cell walls of chitin	Cell walls of cellulose; chloroplasts	No cell walls or chloroplasts
NUMBER OF CELLS	Unicellular	Unicellular	Most unicellular; some colonial; some multicellular	Most multicellular; some unicellular	Multicellular	Multicellular
MODE OF NUTRITION	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or heterotroph	Heterotroph	Autotroph	Heterotroph
EXAMPLES	*Streptococcus*, *Escherichia coli*	Methanogens, halophiles	*Amoeba*, *Paramecium*, slime molds, giant kelp	Mushrooms, yeasts	Mosses, ferns, flowering plants	Sponges, worms, insects, fishes, mammals

Unicelluar

Binary Fission – Prokaryotes (Asexual Reproduction)

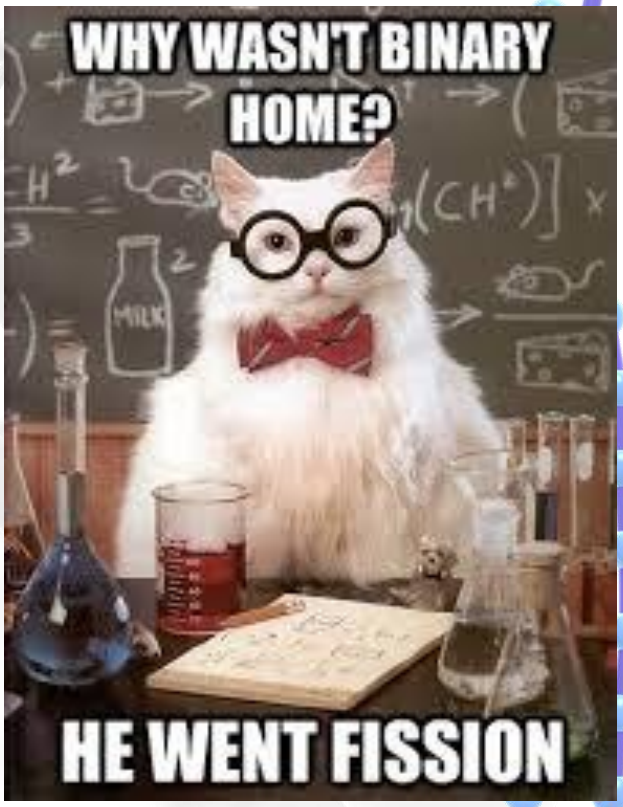
1. Bacteria make identical cells through a process called **binary fission**
2. Circular DNA is replicated & exchanged through **conjugation**
3. Cell divides in **half**
4. Results are **2** identical bacterial cells (daughter cells) with the **SAME DNA**



Binary Fission… Continued

Advantages:

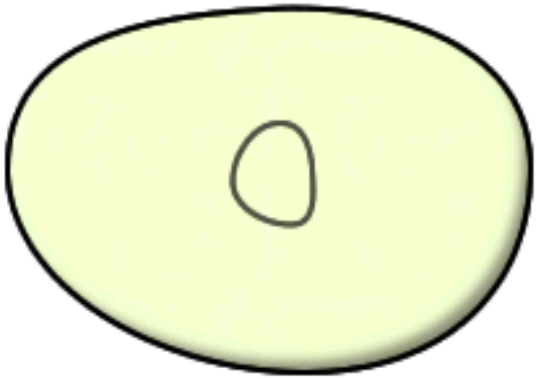
a.) Only requires a **single** organism
b.) Reproduce **quickly** and increases population numbers
c.) Less **energy** usage

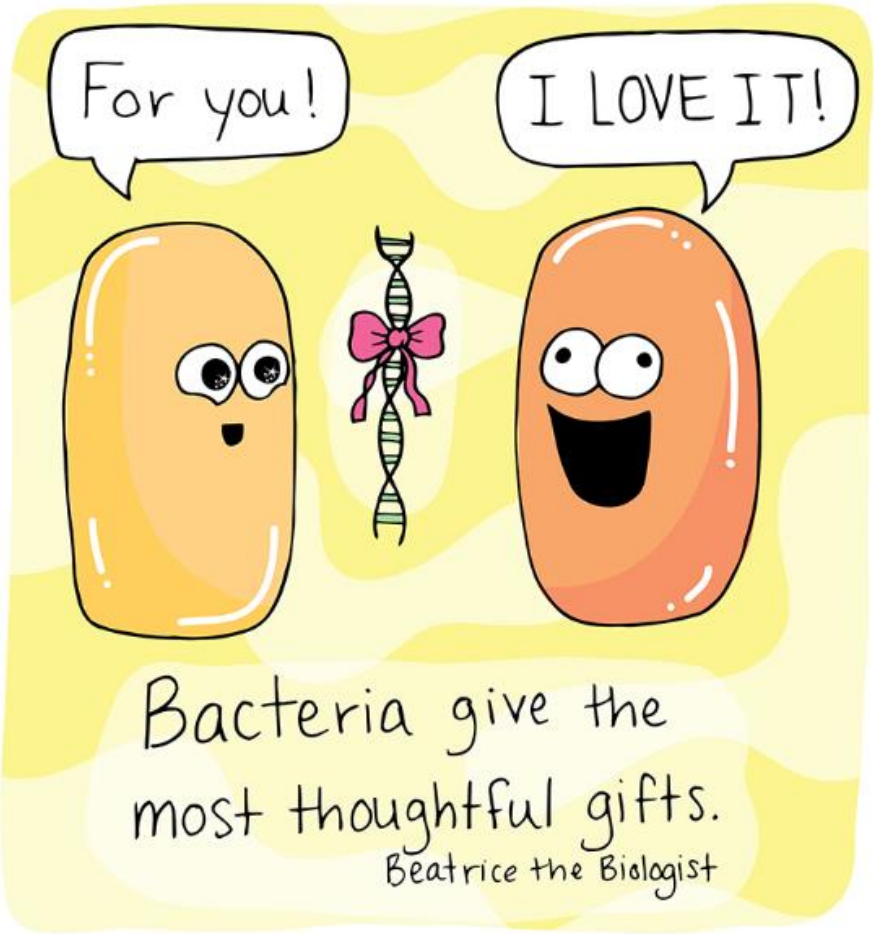


Disadvantages:

a.) All new cells are identical, so the only source of genetic variation are **mutations**

Animation of Binary Fission





Cell Cycle & Cancer

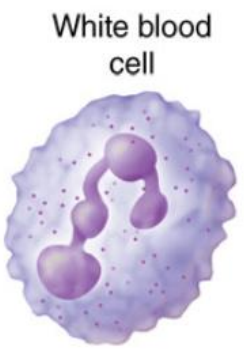
I. Multicellular Life-Eukaryotes

1. Organisms composed of <u>two or more</u> cells (up to trillions of cells)

Classification of Living Things

DOMAIN	Bacteria	Archaea	Eukarya			
KINGDOM	Eubacteria	Archaebacteria	Protista	Fungi	Plantae	Animalia
CELL TYPE	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
CELL STRUCTURES	Cell walls with peptidoglycan	Cell walls without peptidoglyca	Cell walls of cellulose in some; some have chlo pla s	Cell walls of chitin	Cell walls of cellulose; chloroplasts	No cell walls or chloroplasts
NUMBER OF CELLS	Unicellular	Unicellular	Most unicellular; some colonial; some multicellular	Most multicellular; some unicellular	Multicellular	Multicellular
MODE OF NUTRITION	Autotroph or heterotroph	Autotroph or heterotroph	Autotroph or terotroph	Heterotroph	Autotroph	Heterotroph
EXAMPLES	*Streptococcus*, *Escherichia coli*	Methanogens, halophiles	*Amo ba*, *Parame ium*, slime molds, giant kelp	Mushrooms, yeasts	Mosses, ferns, flowering plants	Sponge , wor s, sects, fishes, mammals

Multicellular

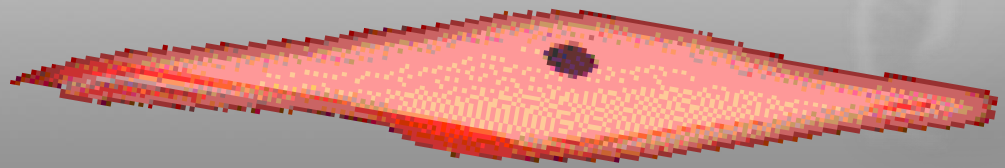


2. Cell Specialization:

a) Cells become efficient in performing tasks and are **dependent** on other cells

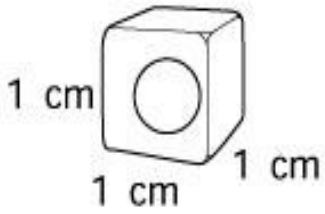
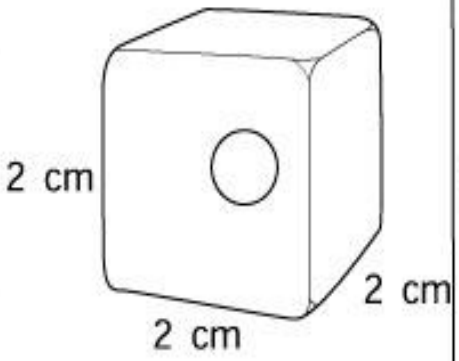
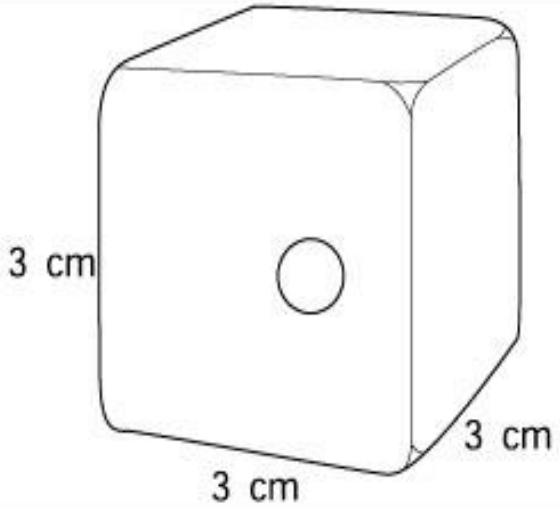
b) Only found in **multicellular** organisms.

-All multicellular organisms have a COMPLETE SET of **DNA** in them!



3. Limits to Cell Growth:

Volume **<u>increases</u>** more rapidly than surface area as the cell grows

Cell Size			
Surface Area (length x width x 6)	1 cm x 1 cm x 6 = 6 cm^2	2 cm x 2 cm x 6 = 24 cm^2	3 cm x 3 cm x 6 = 54 cm^2
Volume (length x width x height)	1 cm x 1 cm x 1 cm = 1 cm^3	2 cm x 2 cm x 2 cm = 8 cm^3	3 cm x 3 cm x 3 cm = 27 cm^3
Ratio of Surface Area to Volume	6 / 1 = 6 : 1	24 / 8 = 3 : 1	54 / 27 = 2 : 1

Multicellular Life - Eukaryotes

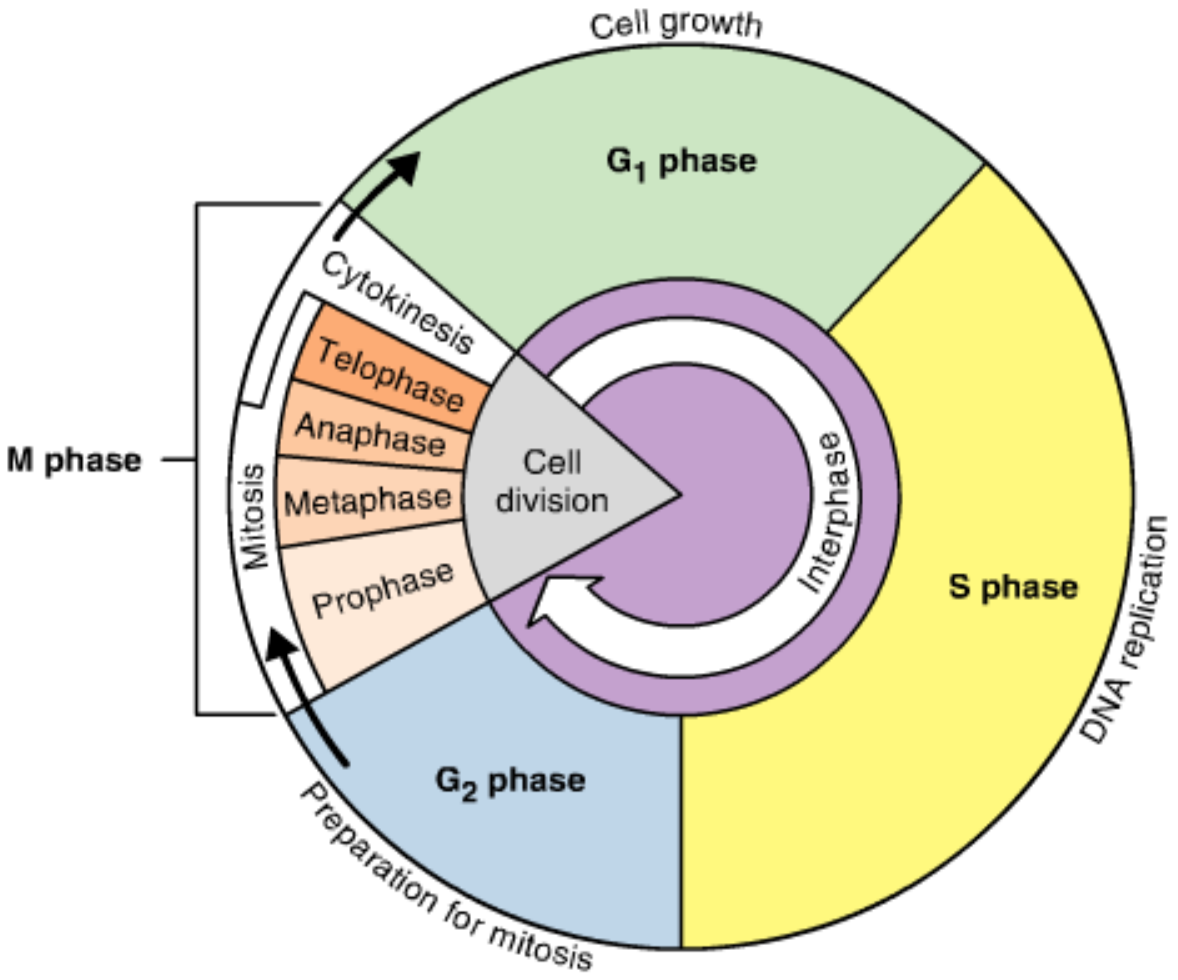
4. Solution:

a) When cells become too large they must **divide** forming two "**daughter**" cells

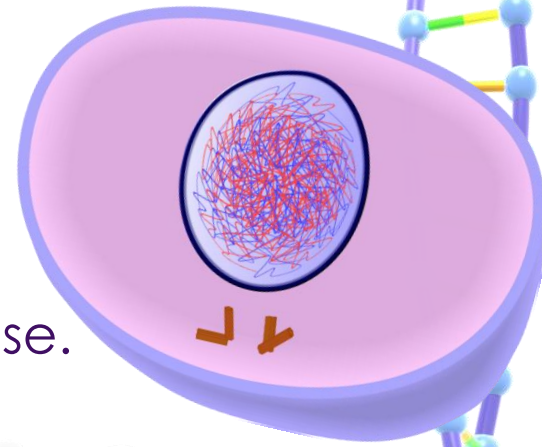
b) DNA must **replicate** first in order for each daughter cell to have a **complete** copy of DNA

Cell Cycle – Eukaryotes (Asexual Reproduction)

1. There are three main phases of the cell cycle:
   a) **Interphase**
   b) **M - Phase**
   c) **Cytokinesis**



Cell Cycle - Eukaryotes

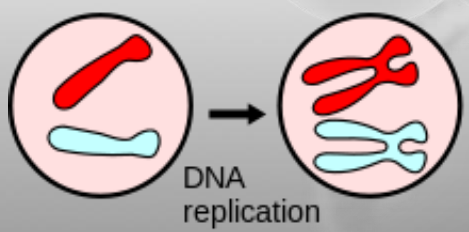


Interphase

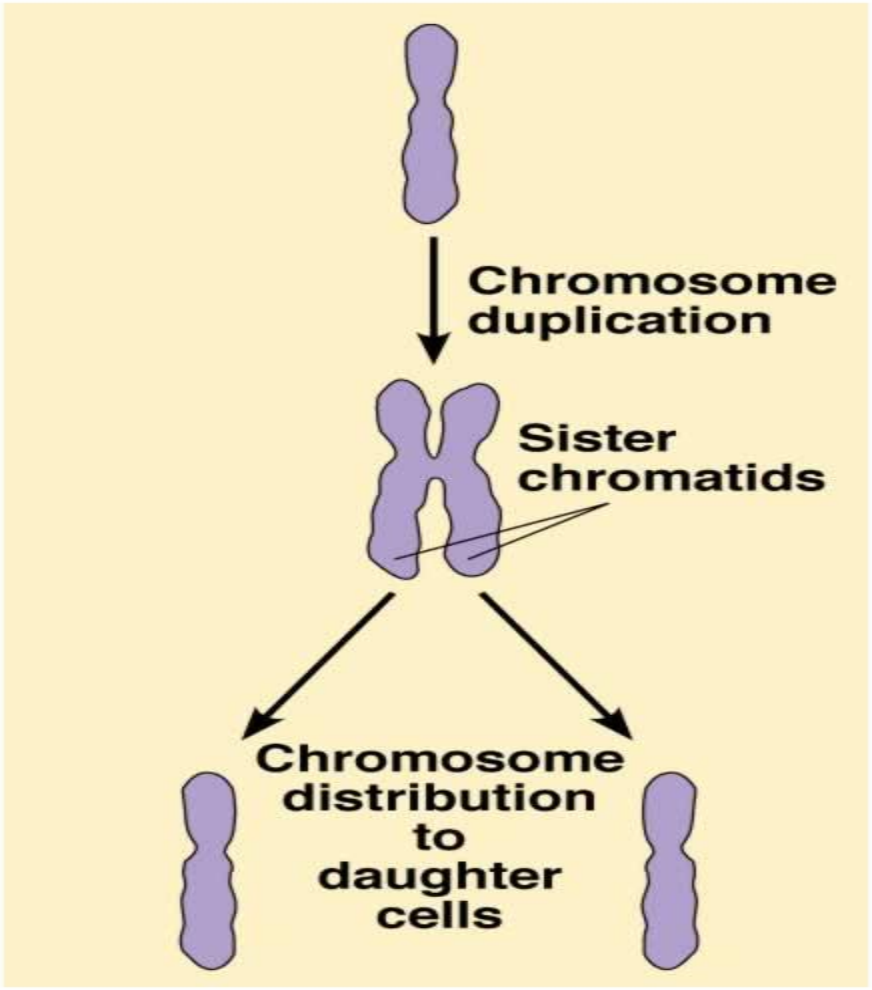
Longest phase of the cell cycle.
Cells spend the **majority** of their lives in this phase.
DNA is called **chromatin**

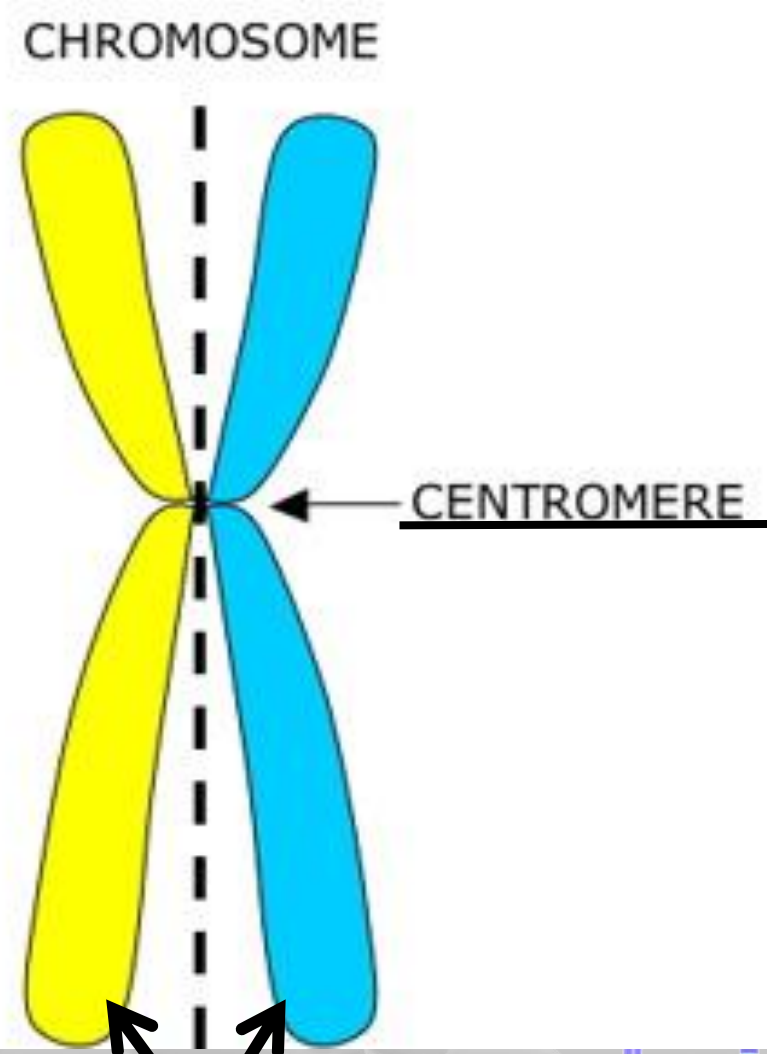
1. G_1- 1st Growth: Cell increases in **size**

2. S - DNA Replication: **DNA** is copied. Eukaryotes have **linear** DNA



3. G_2 - 2nd Growth: Prepares to divide and **copies organelles**





Sister Chromatids are held together by a Centromere

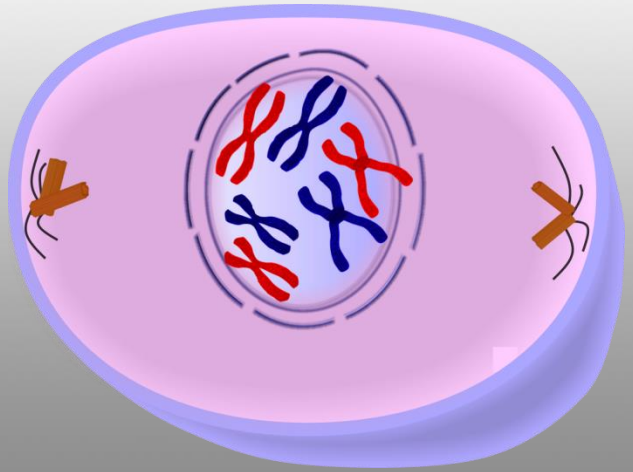
Cell Cycle - Eukaryotes

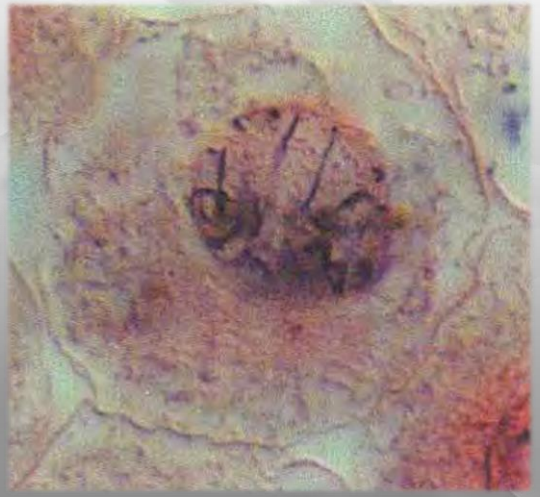
Prophase - PREPARE

-Chromatin condenses into **chromosomes**

-Centrioles separate & spindle fibers begins to form

-Nuclear envelope breaks down



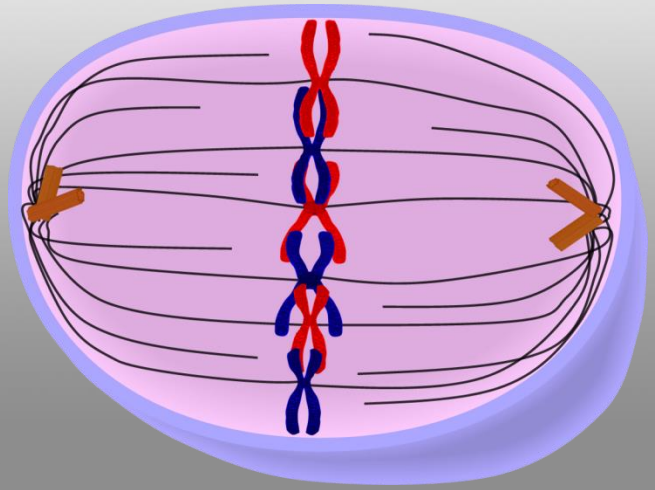


Cell Cycle - Eukaryotes

Metaphase - MIDDLE

-Chromosomes line up in the **middle**

-Chromosomes connect to **spindle fibers** at centromere

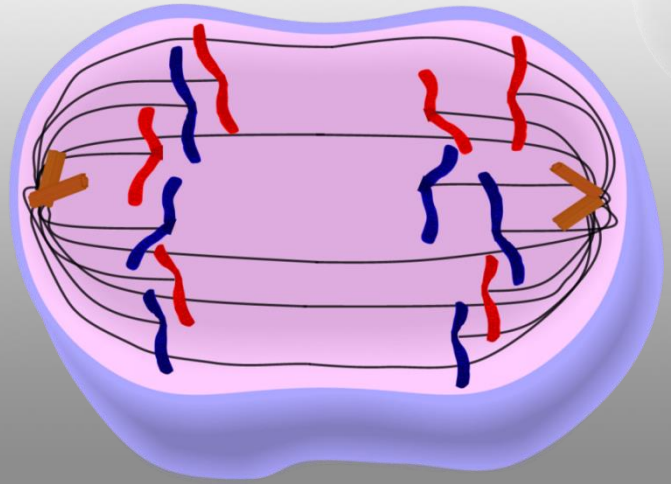


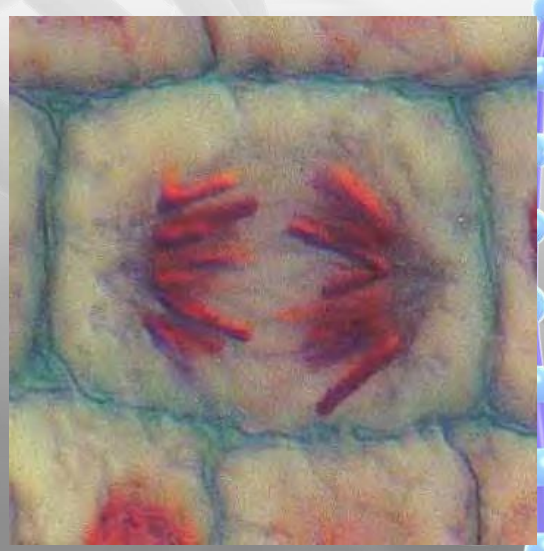
Cell Cycle - Eukaryotes

Anaphase - AWAY

-Spindle fibers pull sister chromatids **apart**

-Sister chromatids are pulled to **opposite** sides of the cell



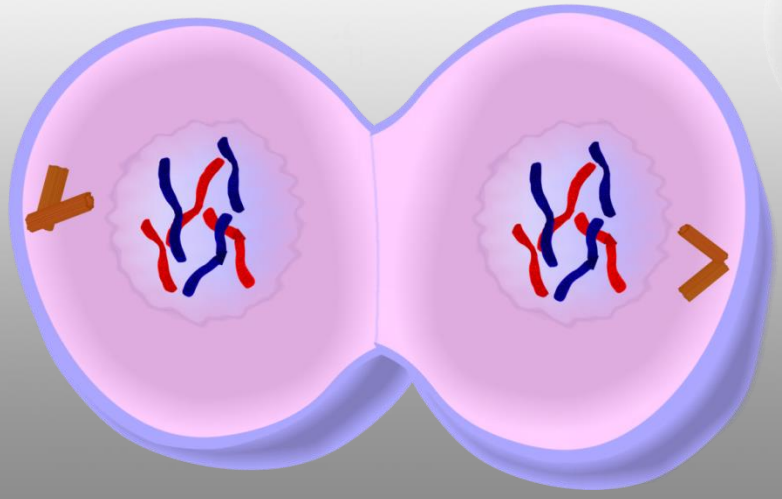


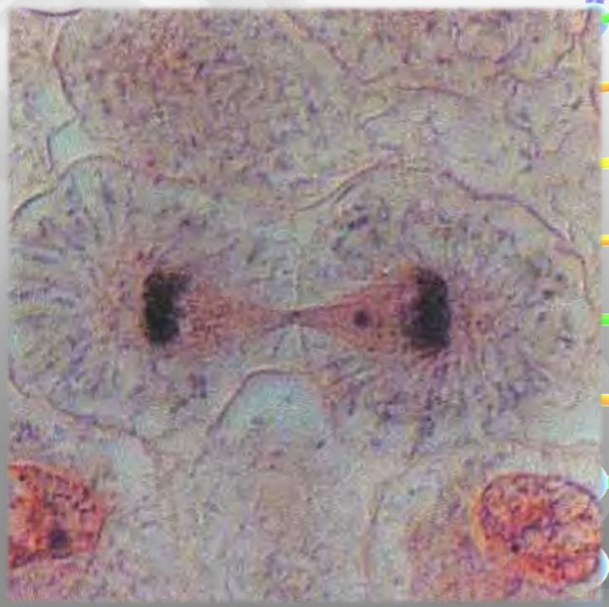
Cell Cycle - Eukaryotes

Telophase - TWO

-Chromosomes gather at opposite ends

-Two new **<u>nuclear envelopes</u>** form





Cell Cycle - Eukaryotes

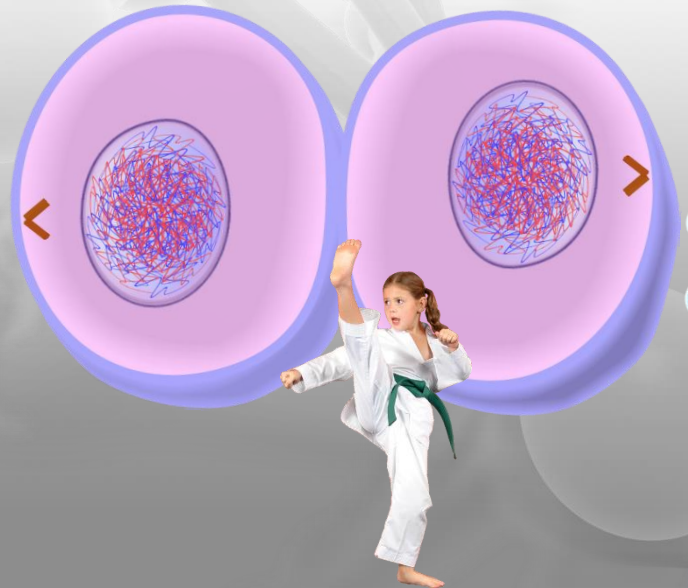
Cytokinesis

-Cytoplasm pinches in **half**

-Each newly formed daughter cell has **equal** numbers of chromosomes

-Cell membrane pinches in the **center**

-*In plant cells: a **cell plate** forms to separate the 2 cells



Stages of mitosis

Is that why it's called a cell phone?

Get it? ☺

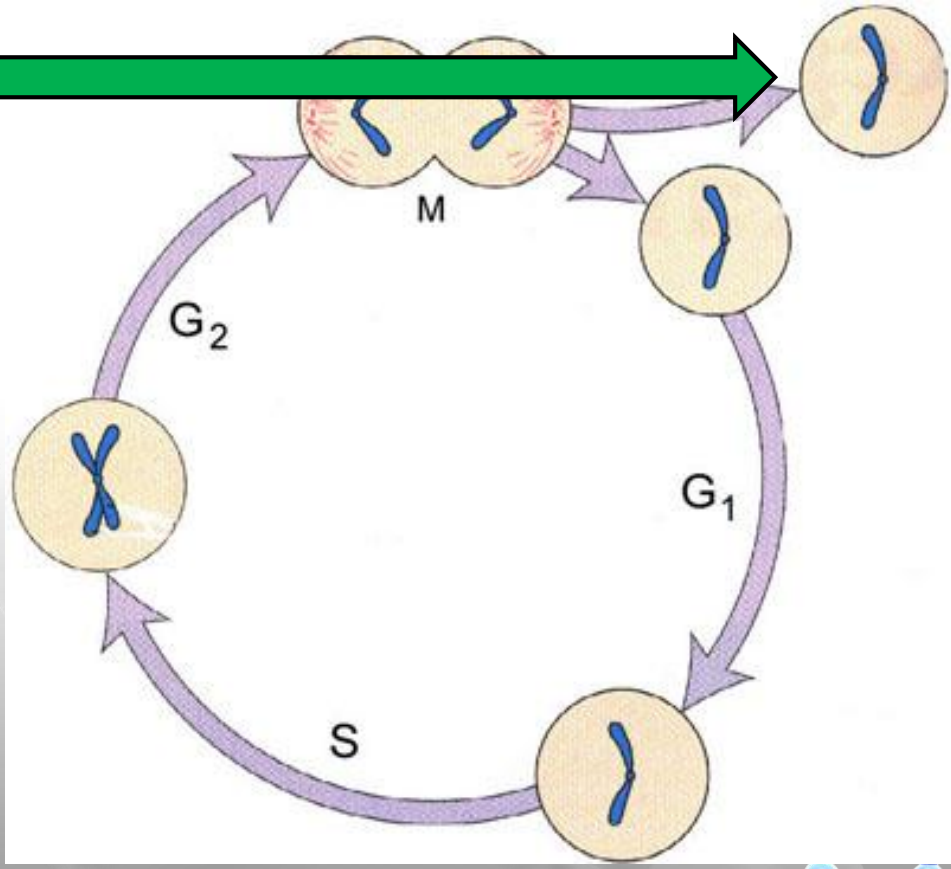
Let's watch the whole process now.

Cell Cycle - Eukaryotes

G_0 Phase

Resting phase

- -**No** cell division
- -Some cells never **leave** this phase
  - Nerve cells
- -Some cells never **enter** this phase
  - Skin cells



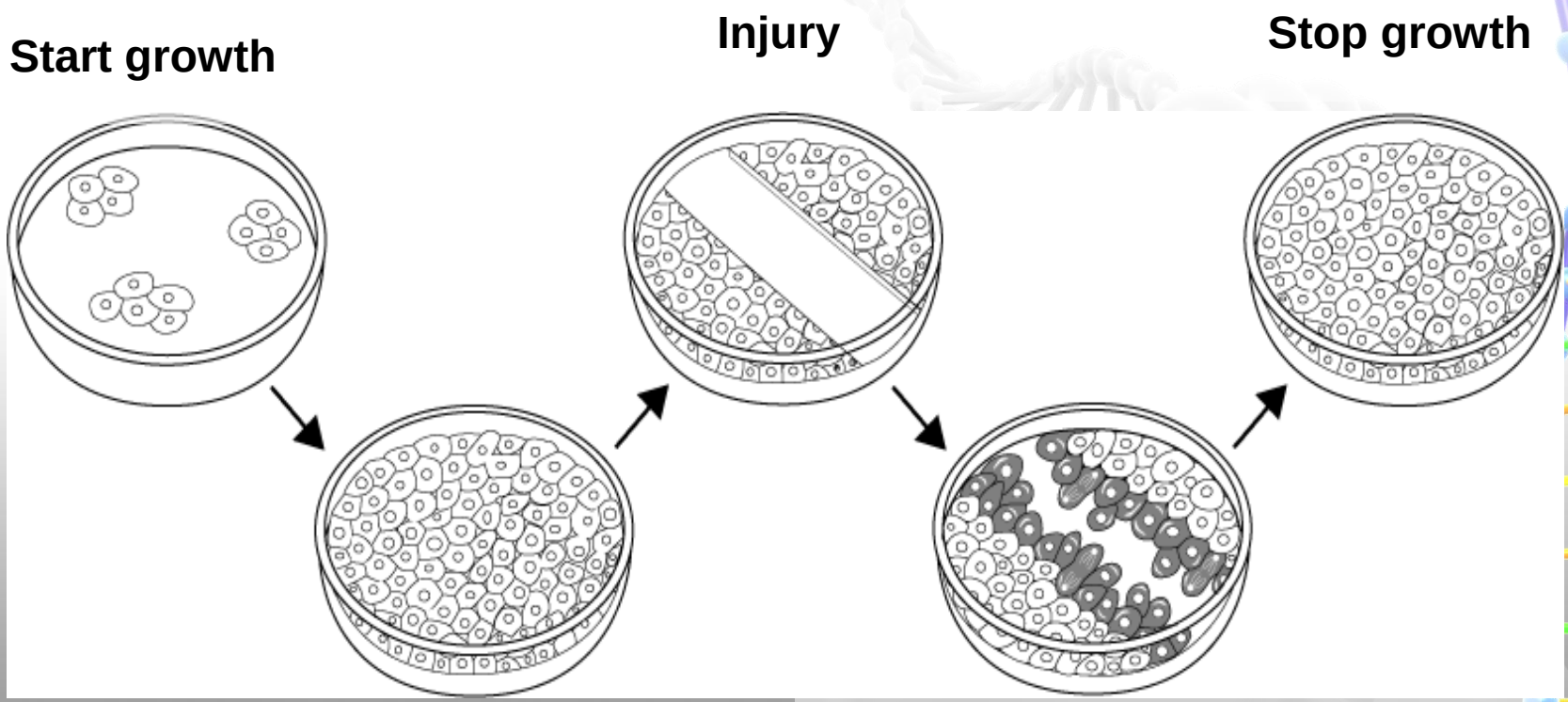
II. Regulating the Cell Cycle

To ensure each proper steps have been taken, the cell cycle is 'checked' or regulated by:

1. Cyclins
   - Proteins that regulate the **timing** of the cell cycle & jumpstart **cell division**
     - Internal Cyclins (cell won't divide unless DNA is copied)
     - External Cyclins (cells stop growing when they touch one other)
2. p53 gene (internal regulator)
3. Growth Factors (proteins)

Regulating the Cell Cycle

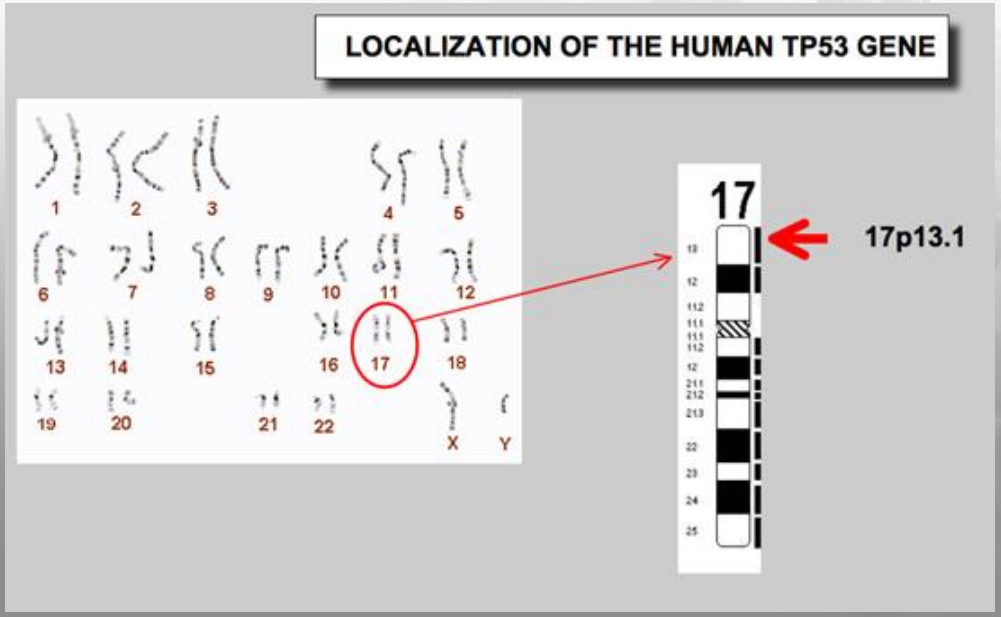
Example of an external cyclin with skin cells



III. Cancer

Uncontrolled Cell Growth is called **cancer**

1. Cells **lose the ability** to control growth
2. Cells **stop responding** to signals that control growth
3. Cancer cells may have a defect in the **p53** gene



Types of Cancer:

1. Malignant – **invades** and destroys surrounding healthy tissue.

    Metastasis – cell detaches from tumor and **spreads** to other body parts

2. Benign – does **not** spread

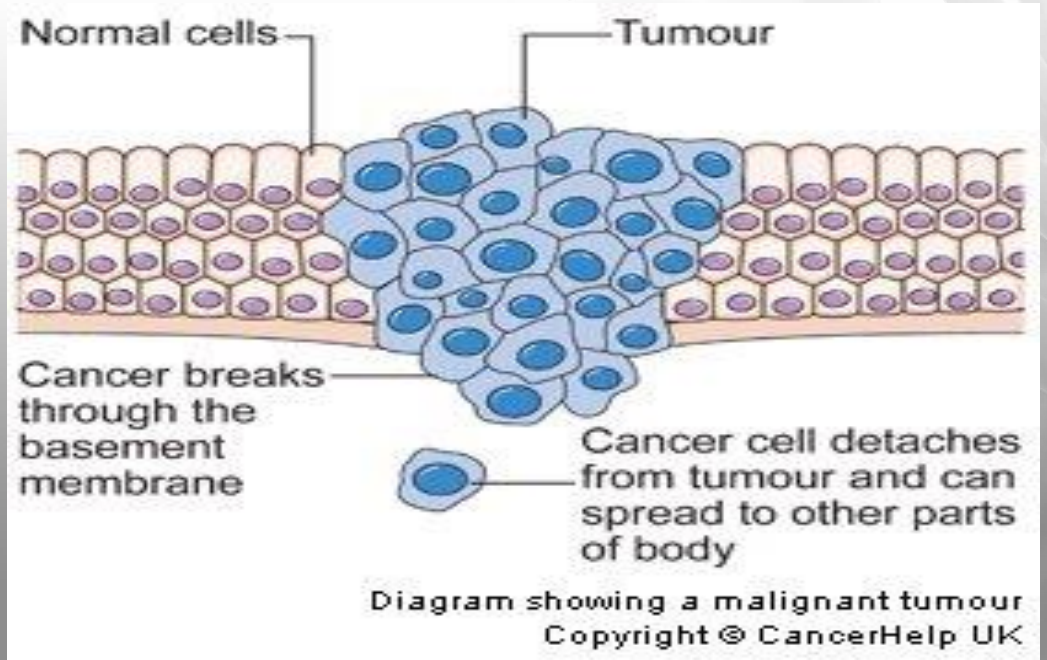


Diagram showing a malignant tumour

IV. Treatment of Cancer

1. Radiation – gamma rays **damage DNA** in quickly reproducing cells
2. Chemotherapy- **Chemicals** that target rapidly dividing cells.
3. Surgery – removal of tumor (**mass** of cells)

Kills healthy and cancer cells