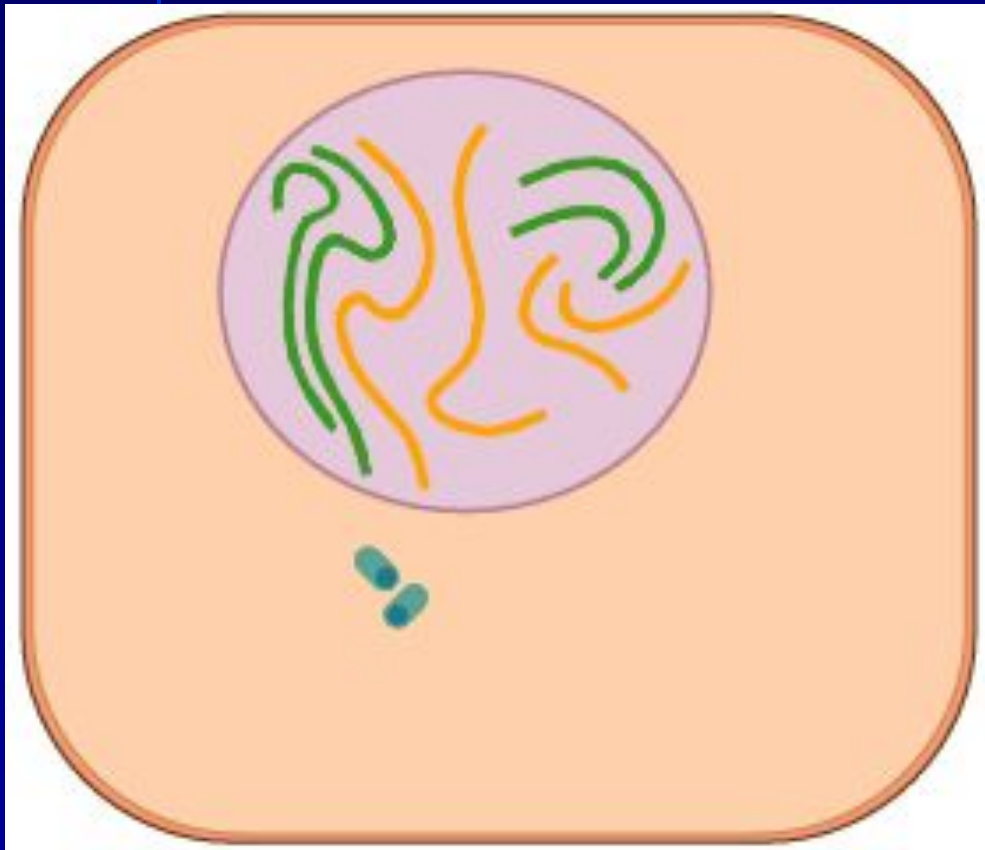


Cellular Growth, Division & Reproduction

Chapter 10

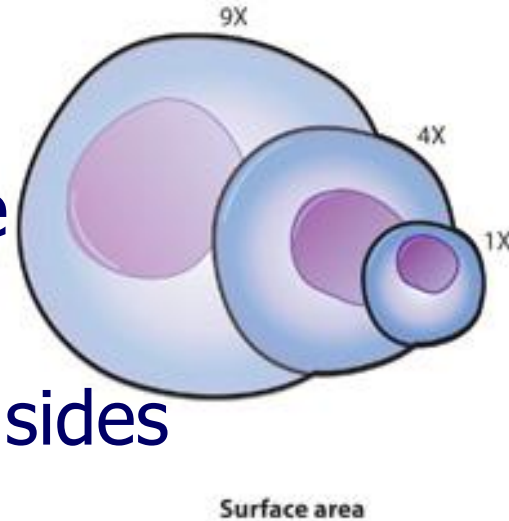


Reasons to divide

- The larger a cell becomes the more demands the cell places on its DNA
- Larger cells are less efficient in moving nutrients and waste

Ratio of Surface Area to Volume

- **Surface Area (SA)**
The area covered by the cell membrane
Calculated: $L \times W \times \text{\#of sides}$

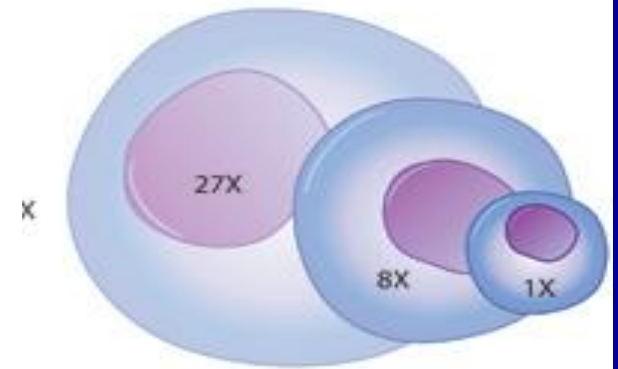


Ratio of Surface Area to Volume

■ Volume

The space taken up by the inner contents of the cell

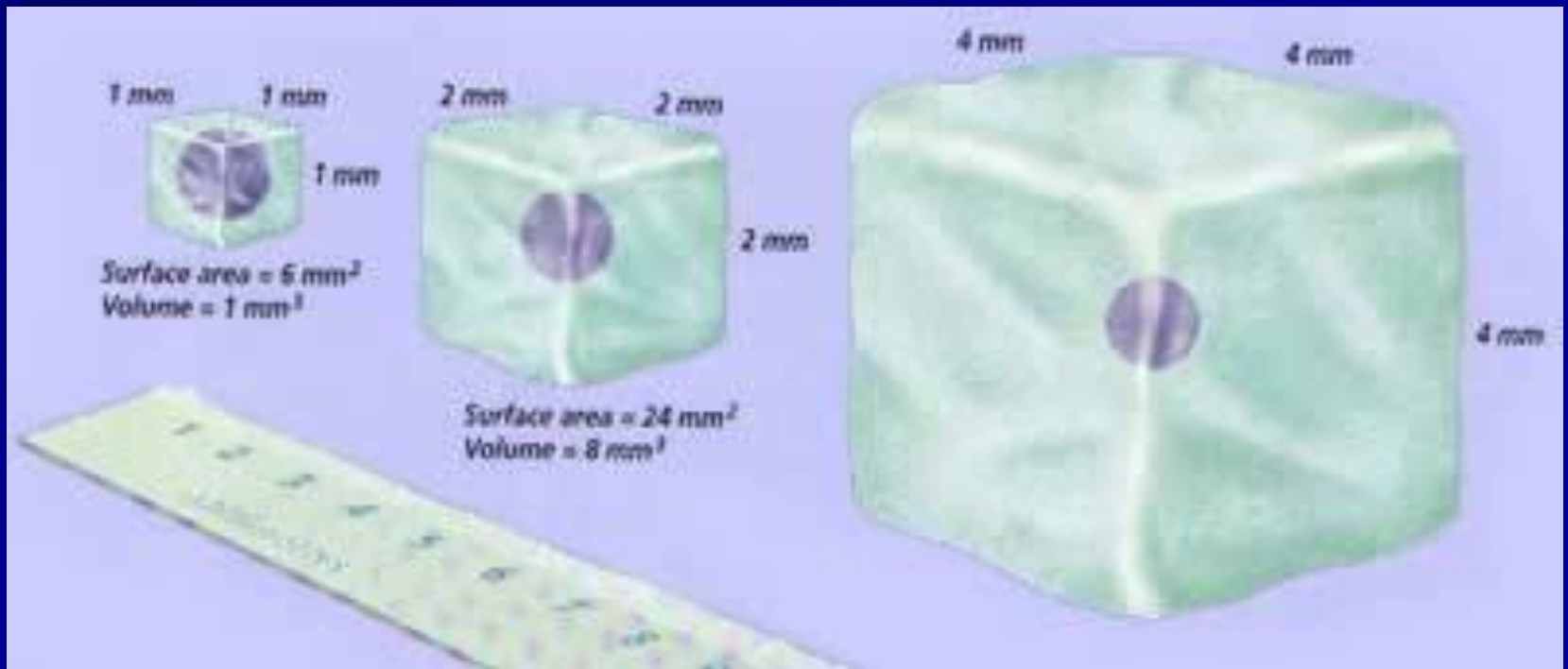
Calculated: $L \times W \times H$



Volume

Ratio of SA to V practice

- Each side = 1 6:1
- Each side = 2 3:1
- Each side = 3 2:1

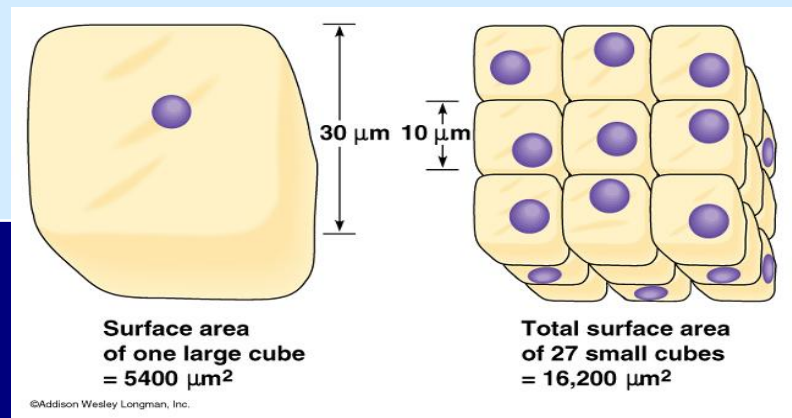


Small Cell

- SA greater than Volume
- Nutrients get in/out easily
- Wastes out easily
- Cytoskeleton can transport substances small distances
- Signal proteins can communicate instructions for cell functions quickly since only travel short distances

Large Cell

- Volume greater than SA
- Will have trouble with bring nutrients in since not as much surface area
- Hard to get wastes out
- Cytoskeleton has to transport nutrients far distances
- Signal proteins must travel large distances and may not get there in time



Cell Division

- The process by which a cell divides into 2 daughter cells
 - DNA must be copied first
 - This solves information overload
 - Since its daughter cells get 1 complete copy of genetic info
 - 2 types
 - **Asexual reproduction**
 - **Sexual reproduction**

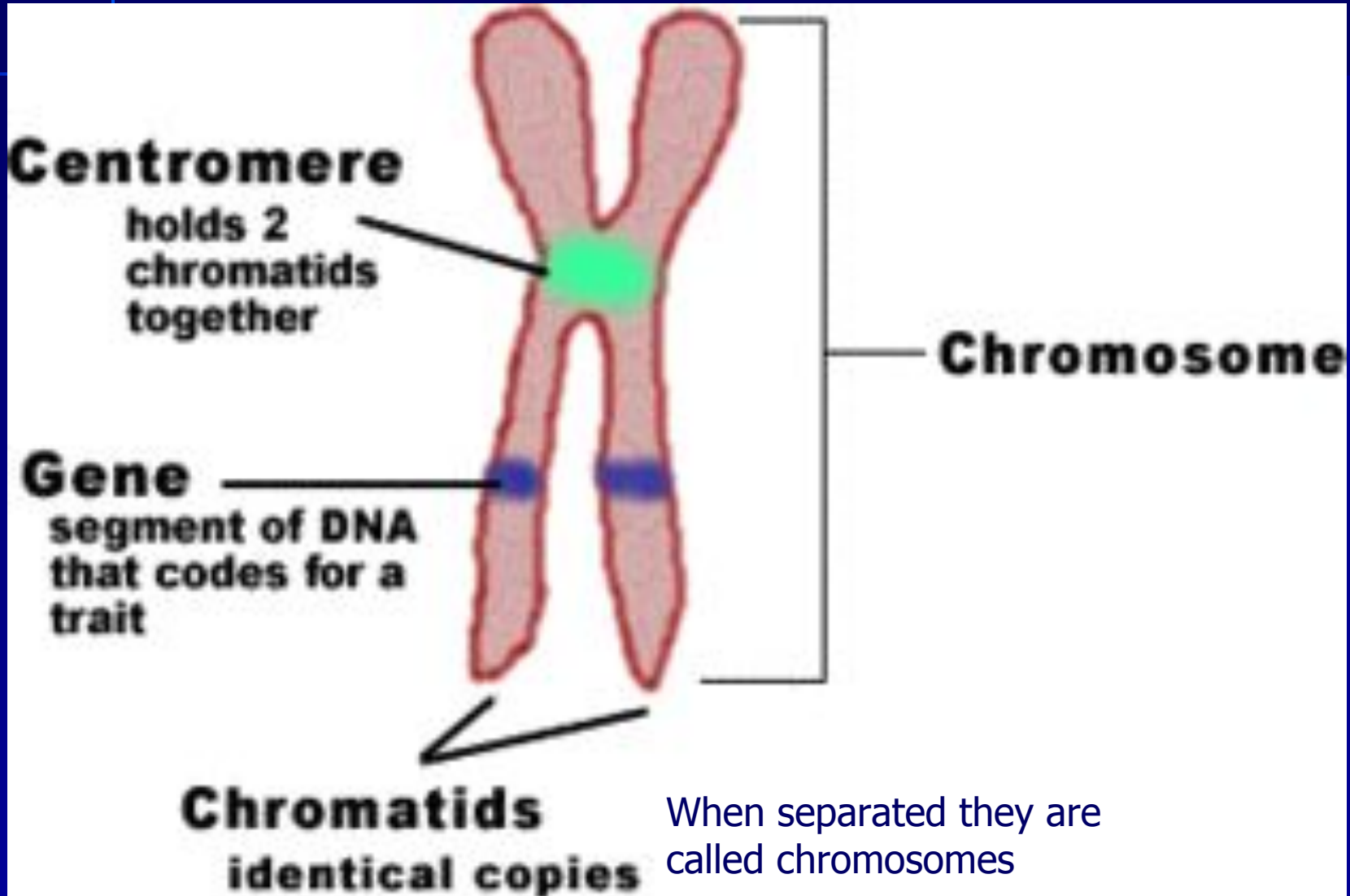
Asexual Reproduction

- Used mostly in unicellular organisms
- Very simple
- Efficient
- Populations increase quickly
- Each cell is genetically identical
- When conditions are perfect, the faster they can reproduce and increase survival
- **Disadvantage**: identical – easy to kill
- Examples: bacteria, yeast

Sexual Reproduction

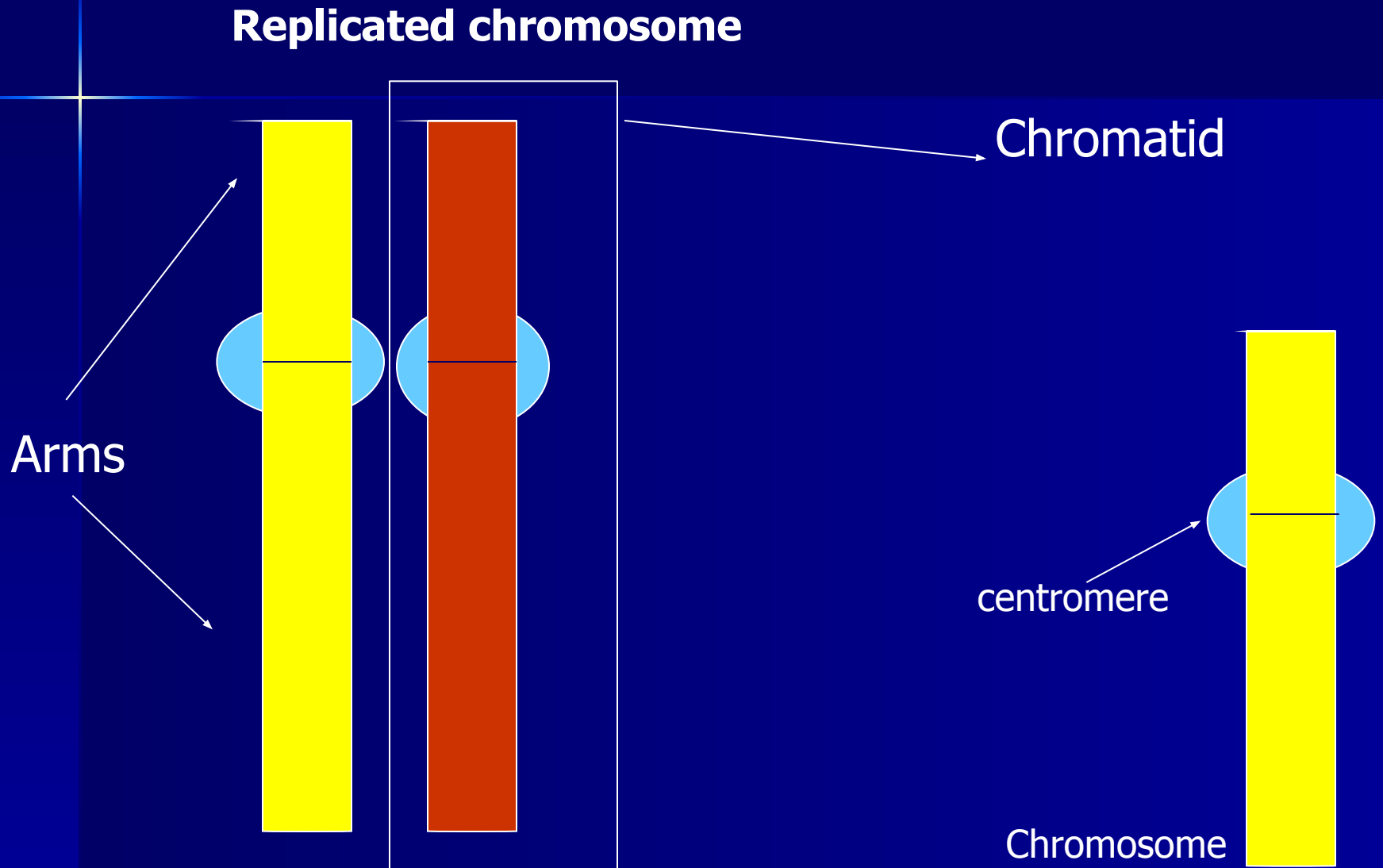
- Used mostly in multicellular organism
- More complex
- Fusion of 2 separate reproductive cells
- Each cell has some of the genetic info from parents (thus not identical)
- Requires more time
- Must have a female and male
- Provides genetic diversity
- Examples: animals, plants

Diagram of a chromosome



Chromosome parts?

- **Chromosome**: genetic info is bundled into packages of DNA
 - Short chromosome arm
 - Long chromosome arm
- **CHROMATID**: one of the 2 “sister” parts of a duplicated chromosome
- **Centromere**: region of a chromosome where 2 sister chromatids are attached
 - When the chromatids separate they are called chromosomes

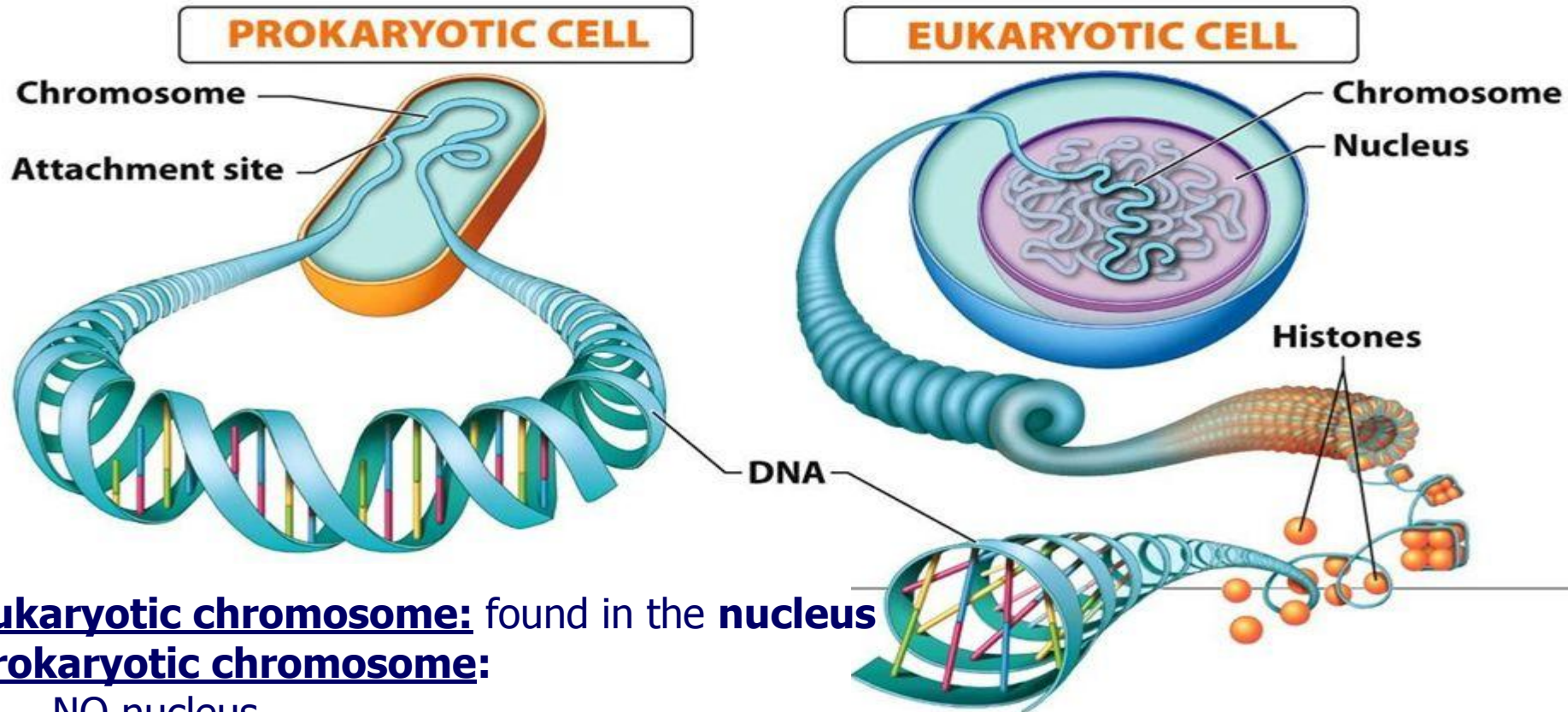


Chromosome reading journal

- Where is DNA normally found in the cell? *Nucleus*
- Most of the time, what form does DNA take in the cell? *Chromatin*
- Draw and label the following: chromatid, chromosome arms, centromere, chromosome.

Prokaryotic vs Eukaryotic

PROKARYOTIC AND EUKARYOTIC CHROMOSOMES



Eukaryotic chromosome: found in the **nucleus**

Prokaryotic chromosome:

NO nucleus

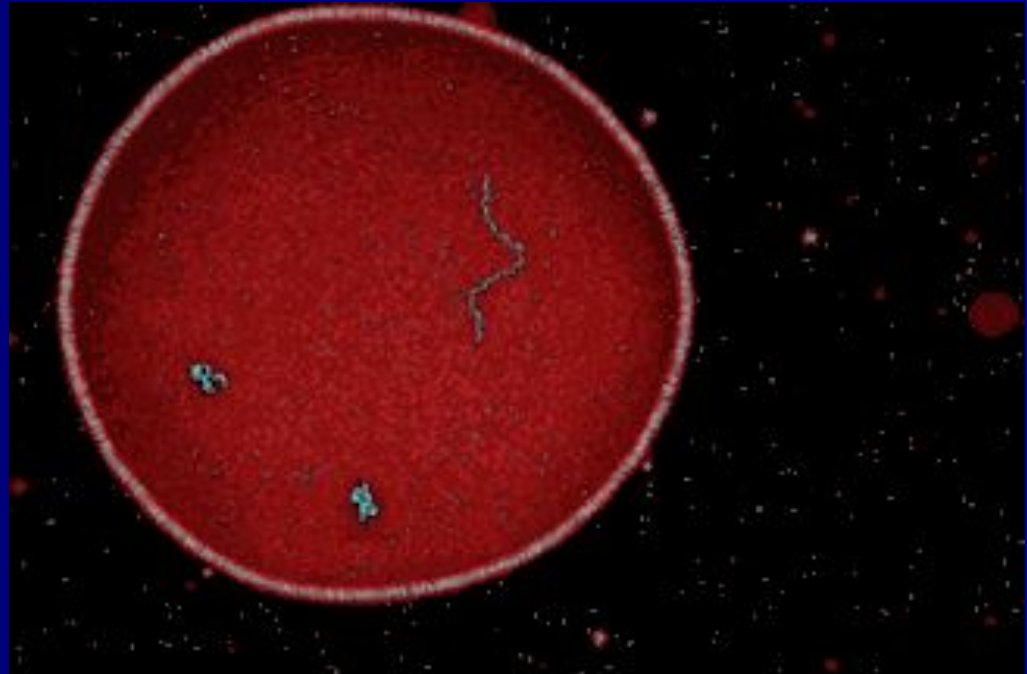
found in cytoplasm

shape of a ring

go thru Binary Fission

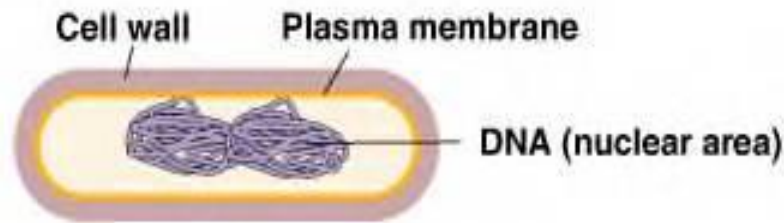
PROKARYOTIC Cells reproduce by

- **BINARY FISSION**
- A form of asexual reproduction that produces identical offspring
- Occurs in 2 stages
 - DNA is copied
 - Cell divides

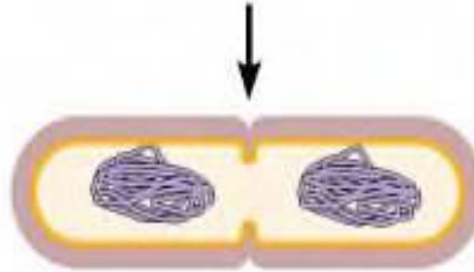


BINARY FISSION

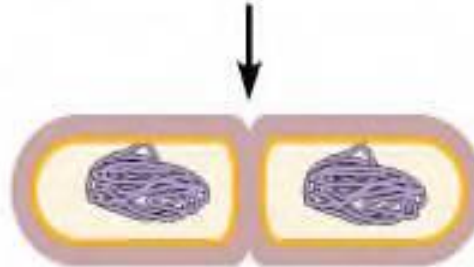
- 1 Cell elongates and DNA is replicated



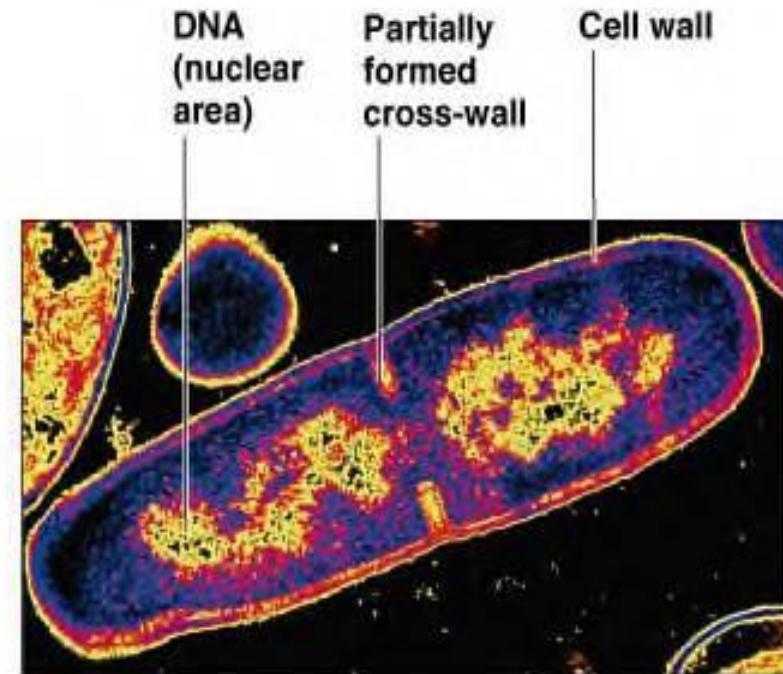
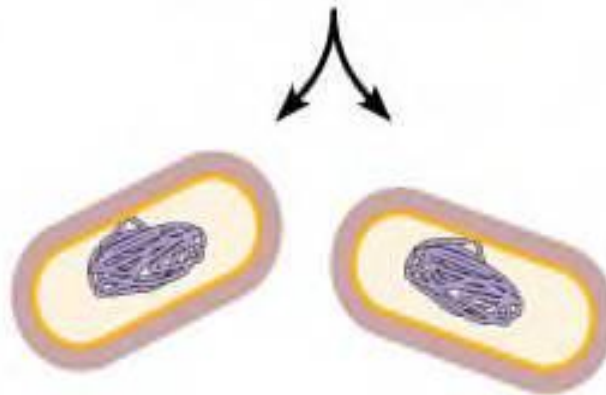
- 2 Cell wall and plasma membrane begin to divide



- 3 Cross-wall forms completely around divided DNA



- 4 Cells separate

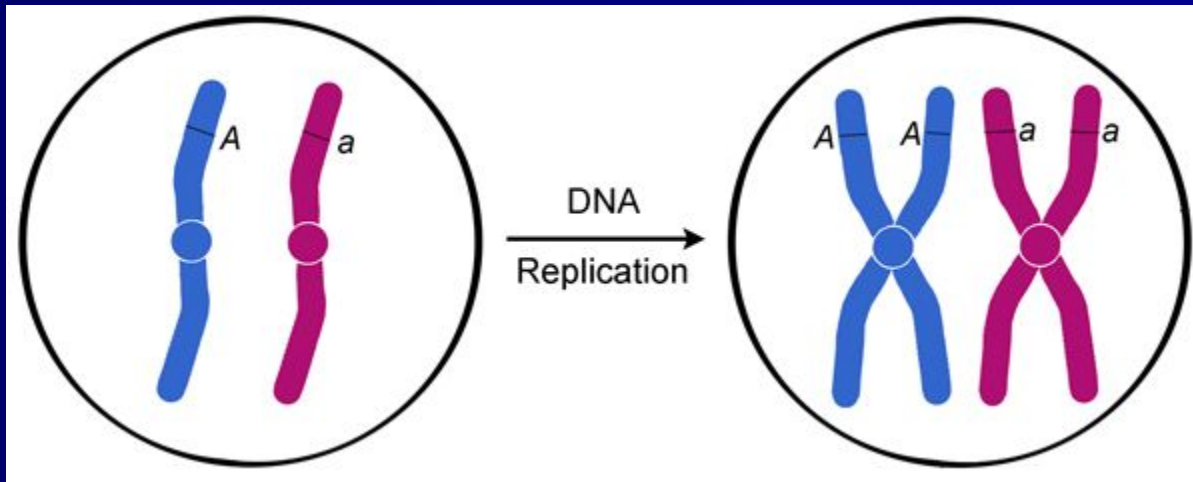


(a) A diagram of the sequence of cell division.

(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

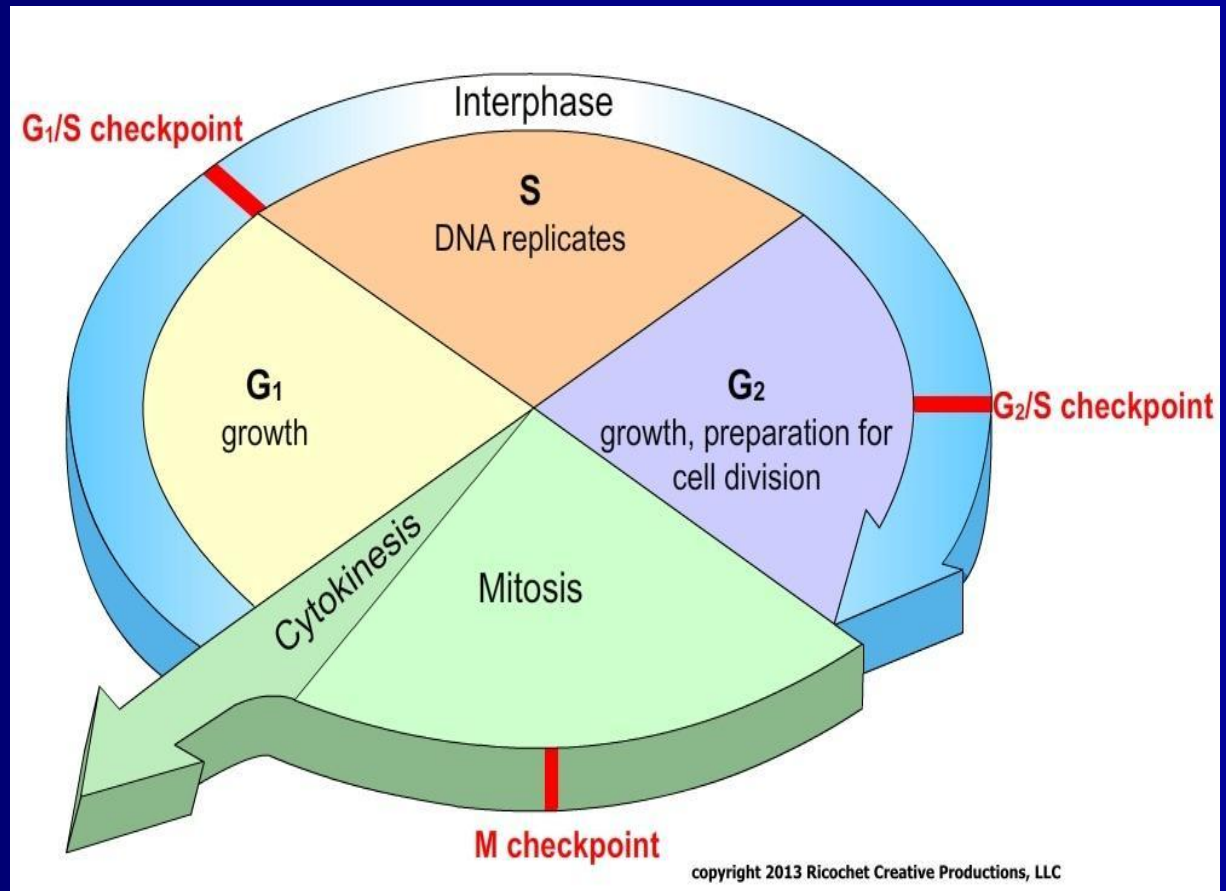
Chromosomes

- Make it possible to duplicate DNA precisely during cell division



The Cell Cycle

- Cells reproduce to
 - HEAL
 - GROWTH



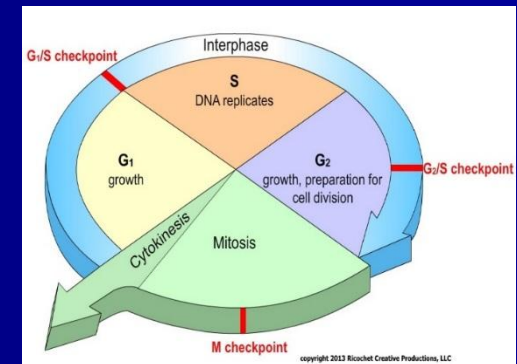
3 stages of the Cell Cycle

1) Interphase: the “in-between” period of growth

- *G1 phase OR Gap 1 phase*
- *S phase OR Synthesis Phase*
- *G2 phase OR Second Growth Phase*

■ 2) Mitosis: the division of the nucleus

- *Prophase*
- *Metaphase*
- *Anaphase*
- *Telophase*

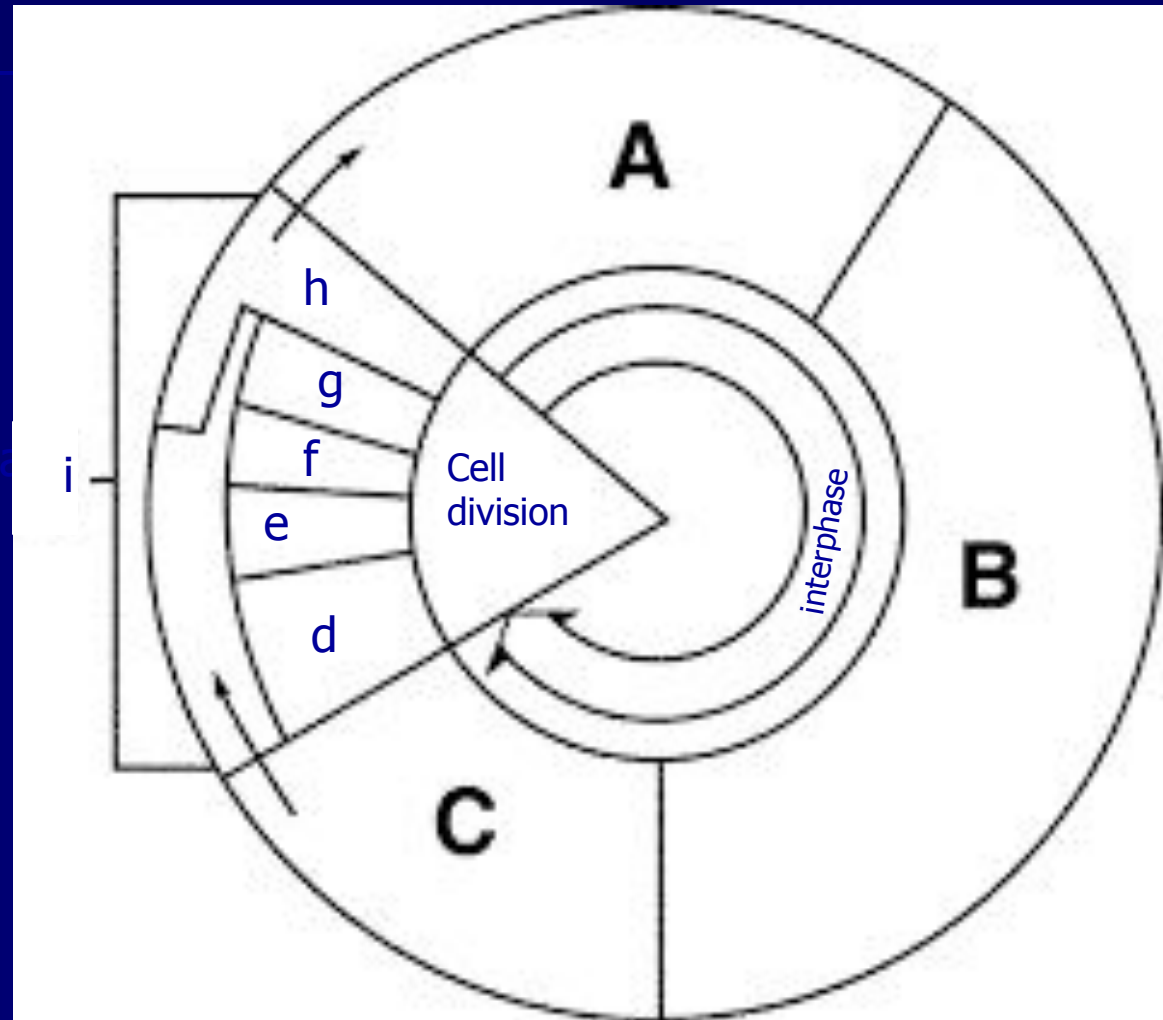


3) Cytokinesis: the division of the cytoplasm

The Cell Cycle

Fill in page 55

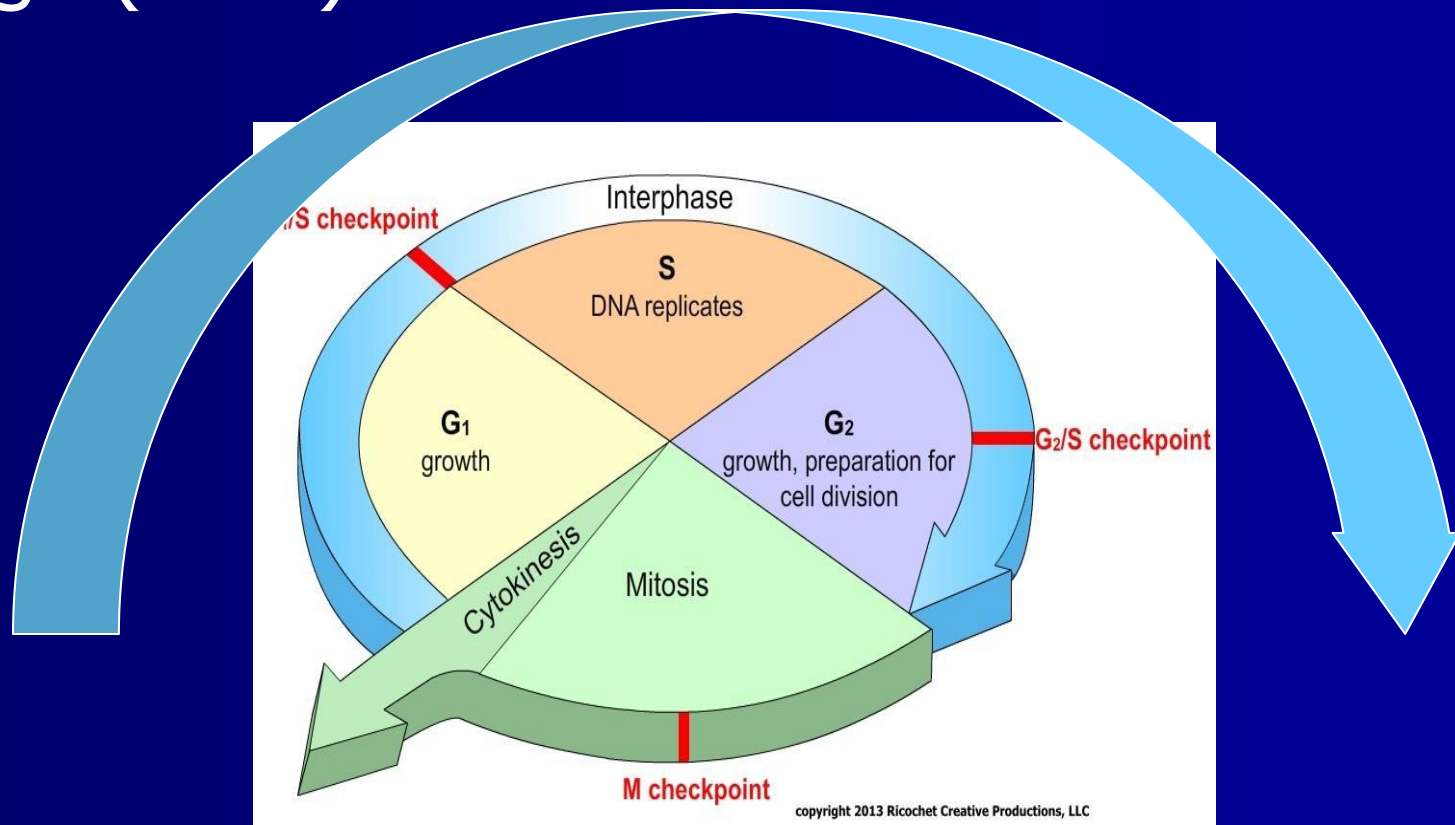
a.
b.
c.
d.
e.
f.
g.
h.
i.



Stage #1: INTERPHASE

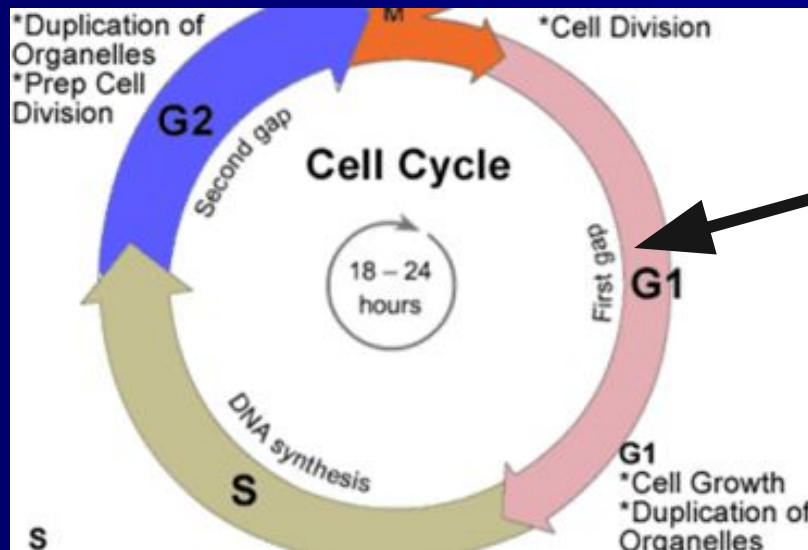
the in-between period of growth

- The cell spends most of its life in this stage (90%)



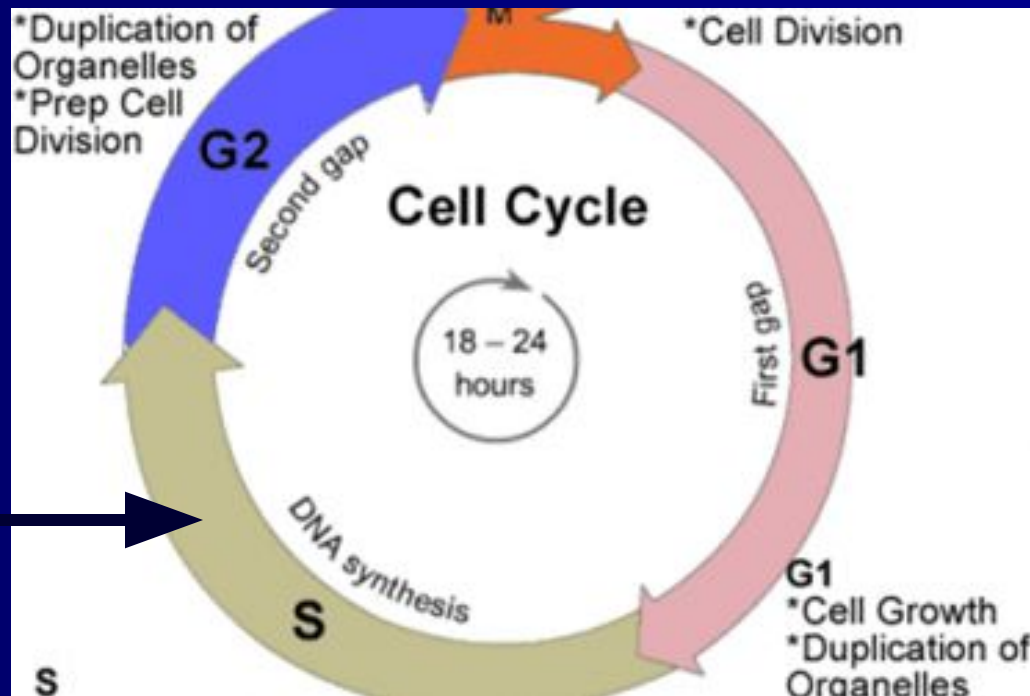
G1 or Gap 1 phase: Cell Growth

- Cells do most of their growing
- Cells increase in size
- Make new proteins and organelles



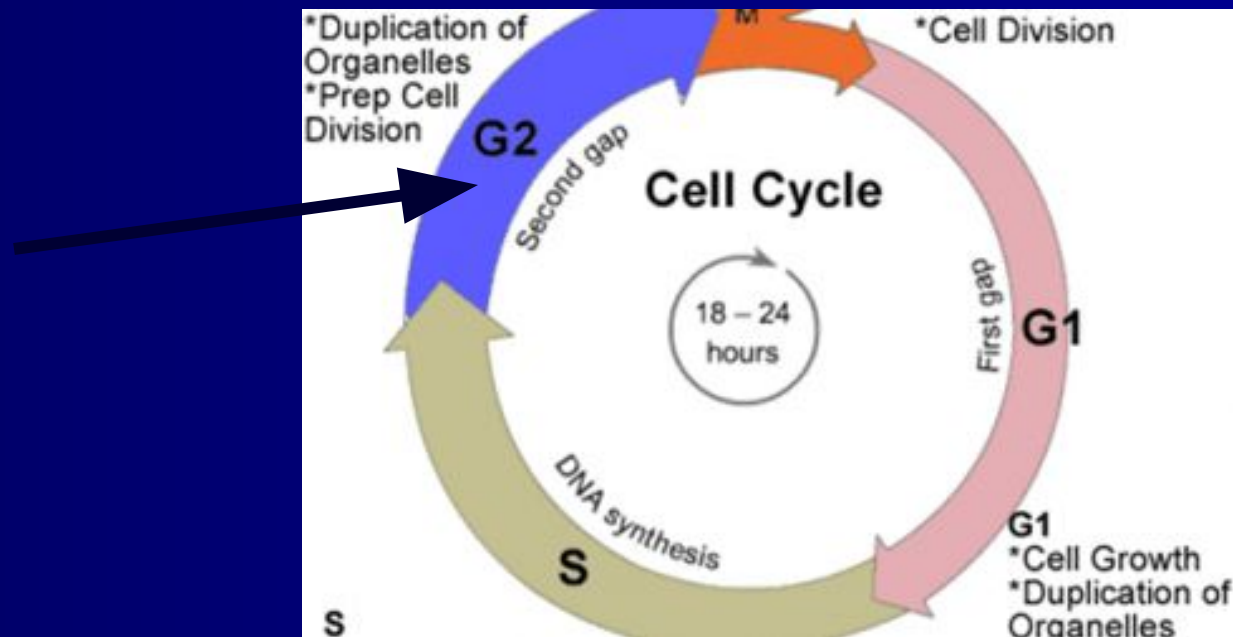
Synthesis Phase or S phase DNA replication

- DNA is synthesized when chromosomes are replicated
- Contains twice as much DNA as it did in the beginning



G2 or Gap 2 Phase Preparing for Cell Division

- Shortest part of interphase
- Prepares for mitosis
- Many organelles are produced

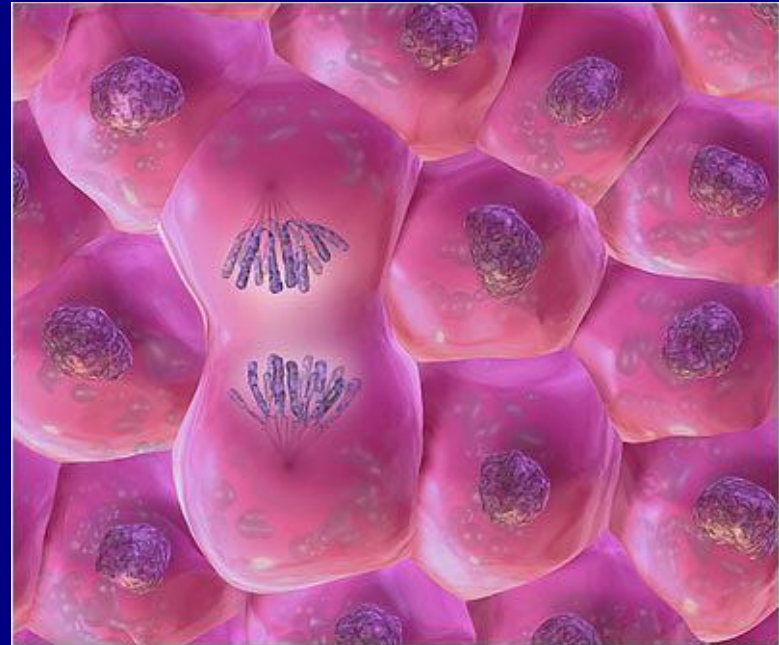


Essential Questions

- Why is it good for cells to be relatively small?
- What are the main stages of the cell cycle?
- Name and describe the steps in interphase.
- *Vocabulary: cell cycle, interphase, mitosis, cytokinesis, chromosome, chromatid, centromere*

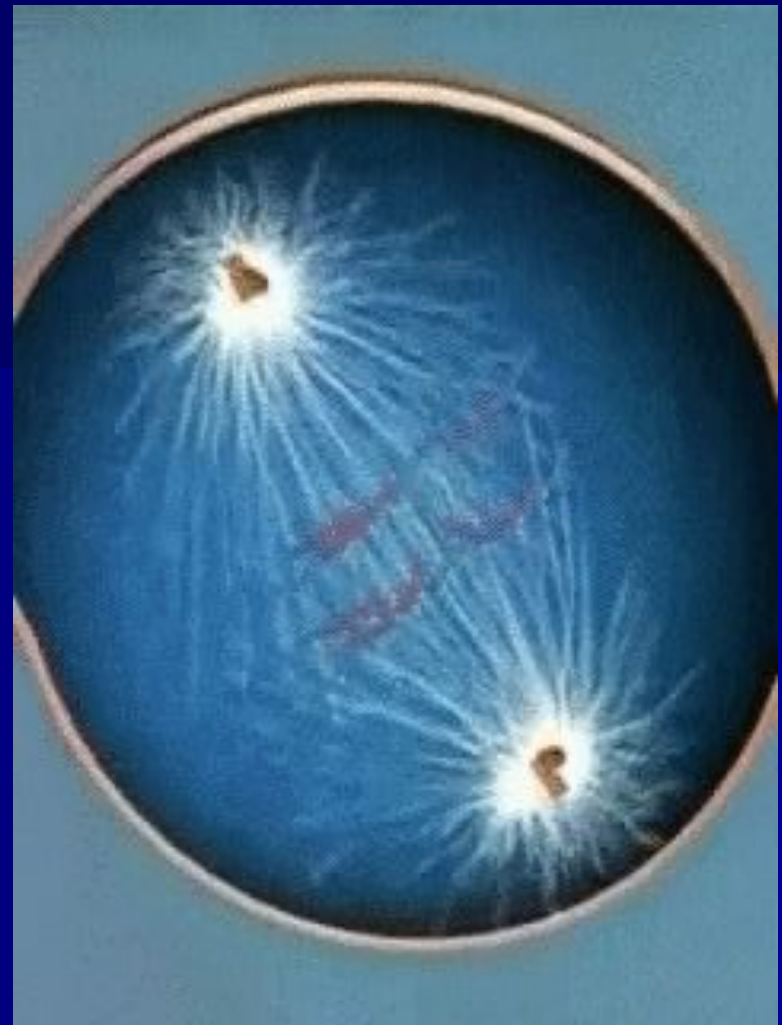
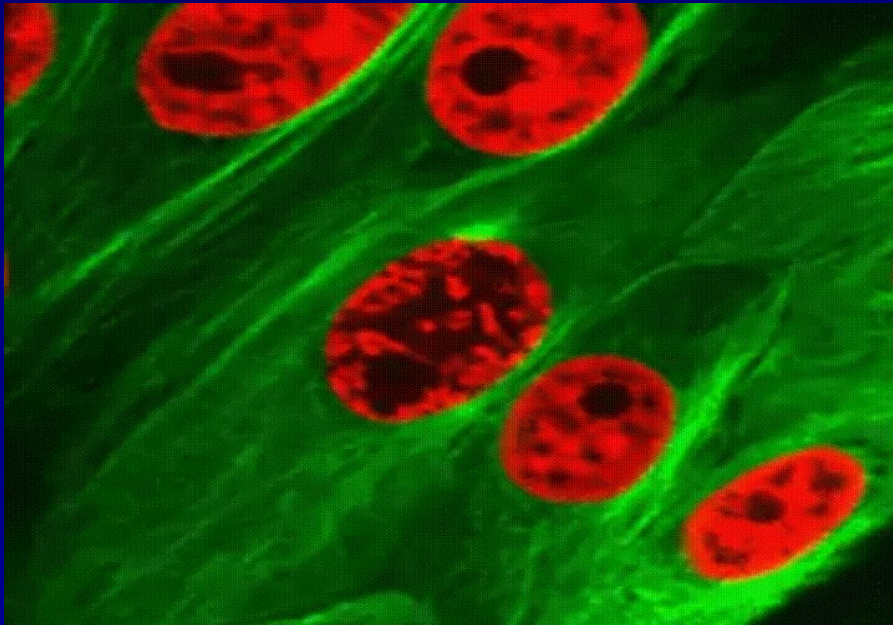
Sec 2: Mitosis & Cytokinesis

- 2 trillion cells are produced every day
 - Types of division
 - Prokaryotic Cells divide by:?
 - Eukaryotic Cells divide by:?



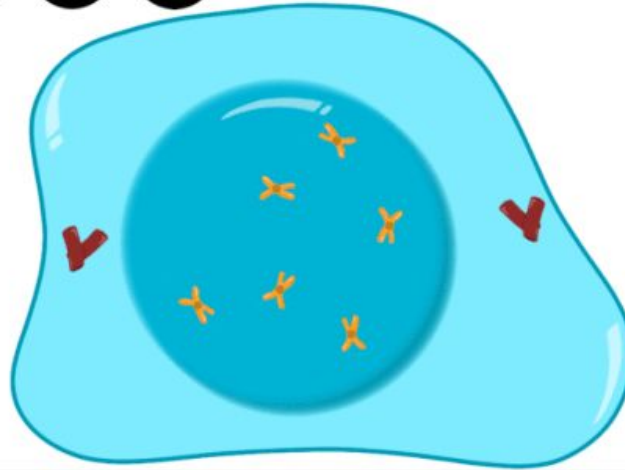
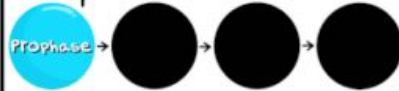
Mitosis

- Division of the nucleus
- 4 parts
 - PMAT

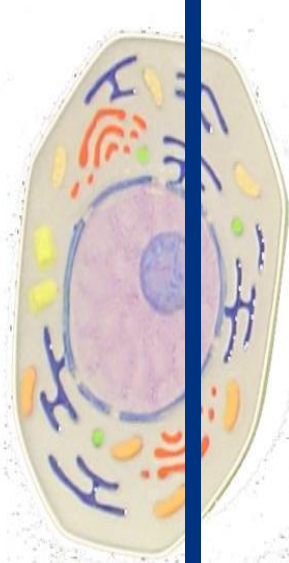


Stages of Mitosis

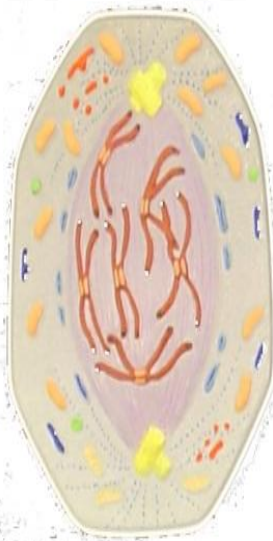
Prophase



©AmoebaSisters



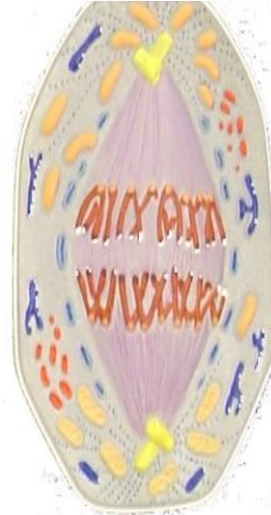
Interphase



Prophase



Metaphase

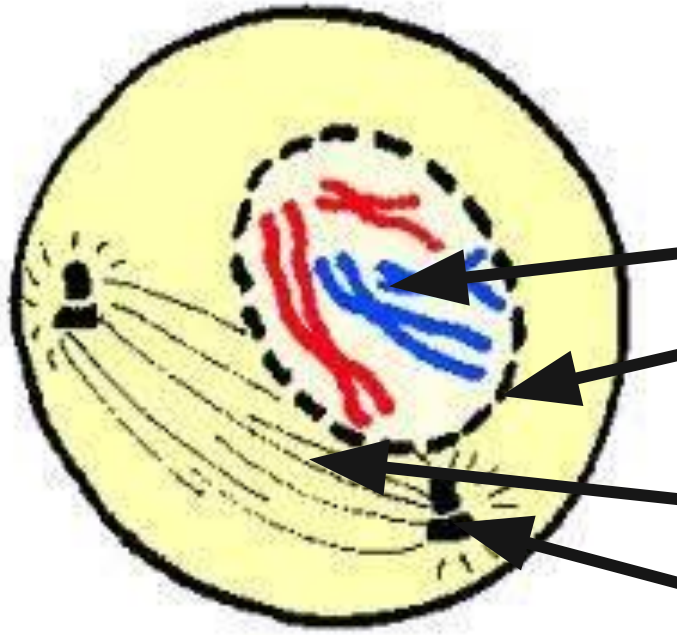


Anaphase



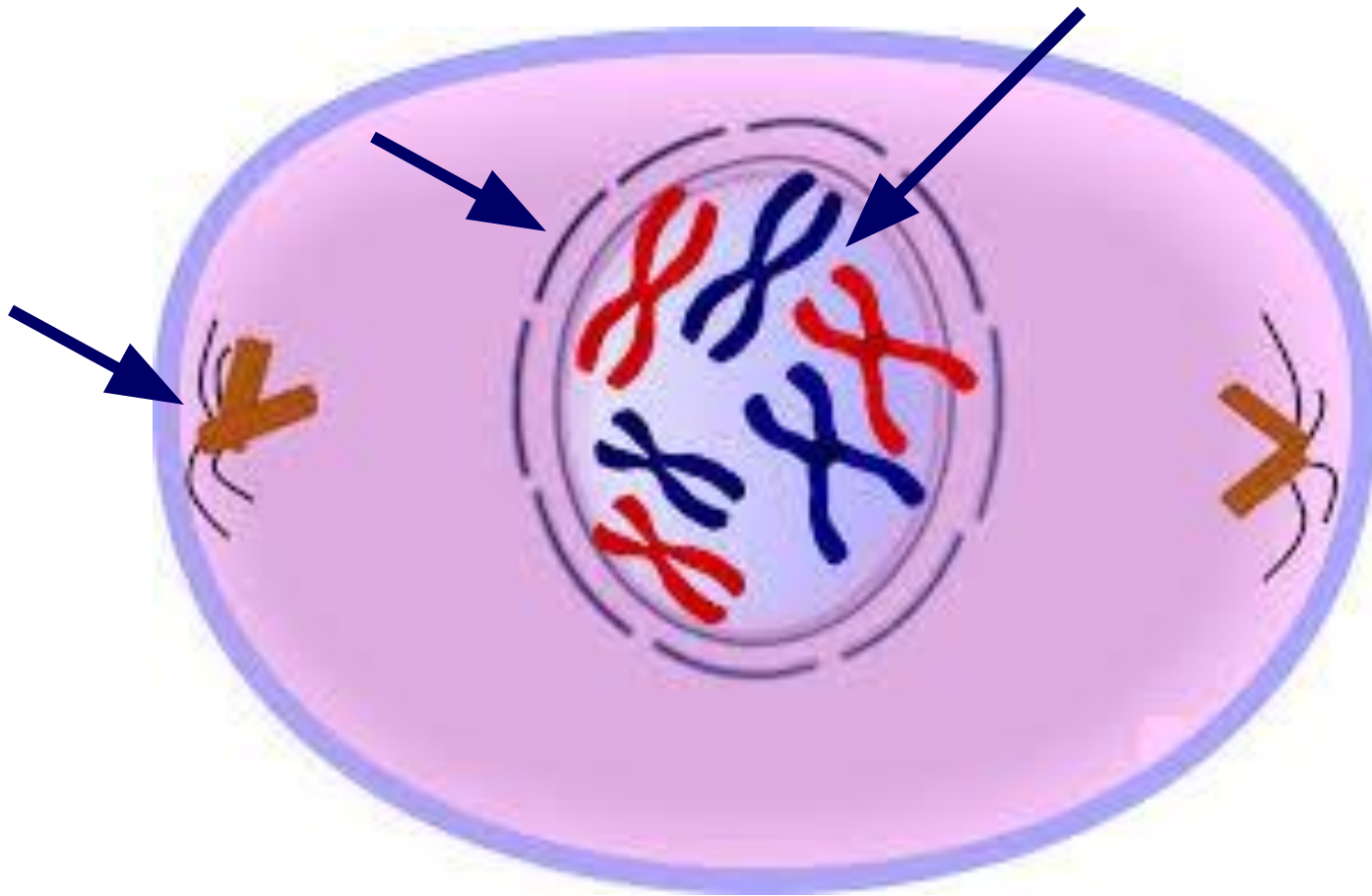
Telophase

PROPHASE



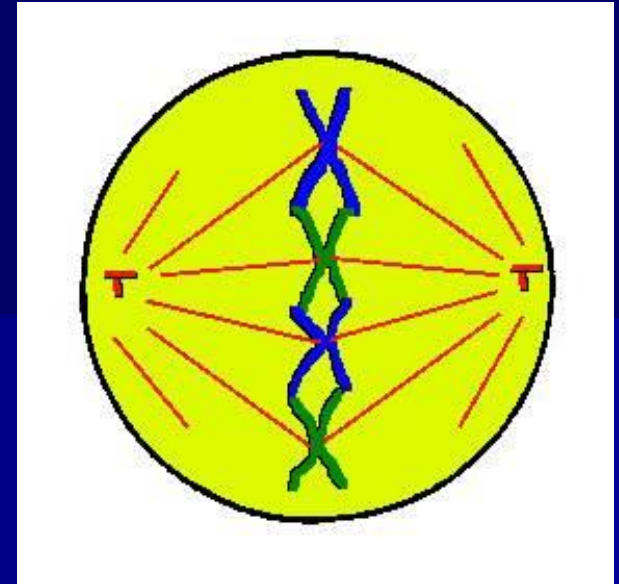
- First phase
- Longest part
- Genetic material in nucleus condenses
- Duplicated chromosomes are visible
- Nucleus & Nuclear envelope dissolves
- Spindle fibers form
- Centrioles move to ends of cell

Let's draw **PROPHASE**

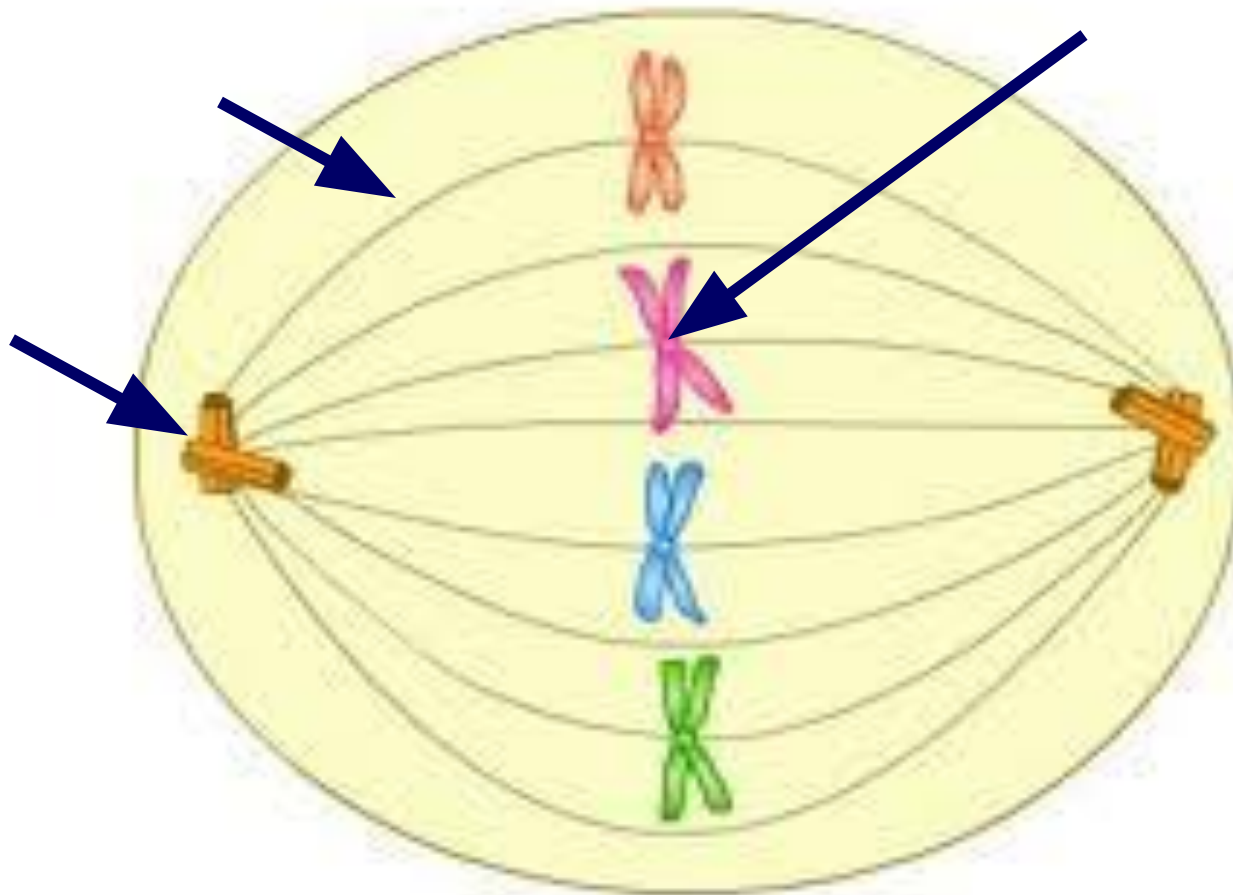


METAPHASE

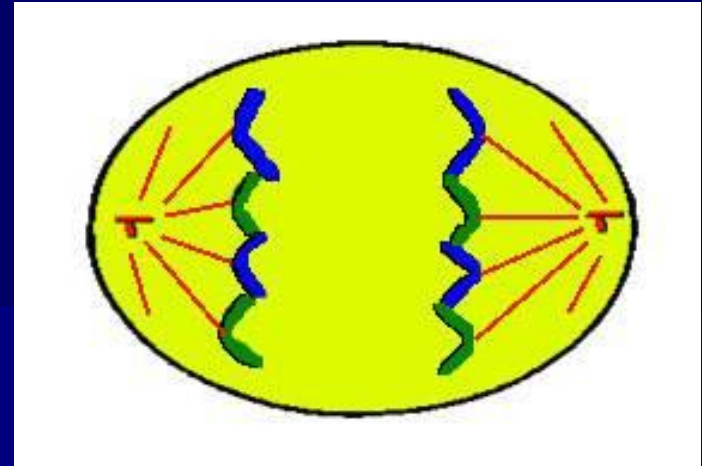
- Second phase
- Shortest part
- The centromere of the duplicated chromosomes line up across the center of the cell
- Each chromosome connected to spindle fibers at the centromere



Let's Draw METAPHASE

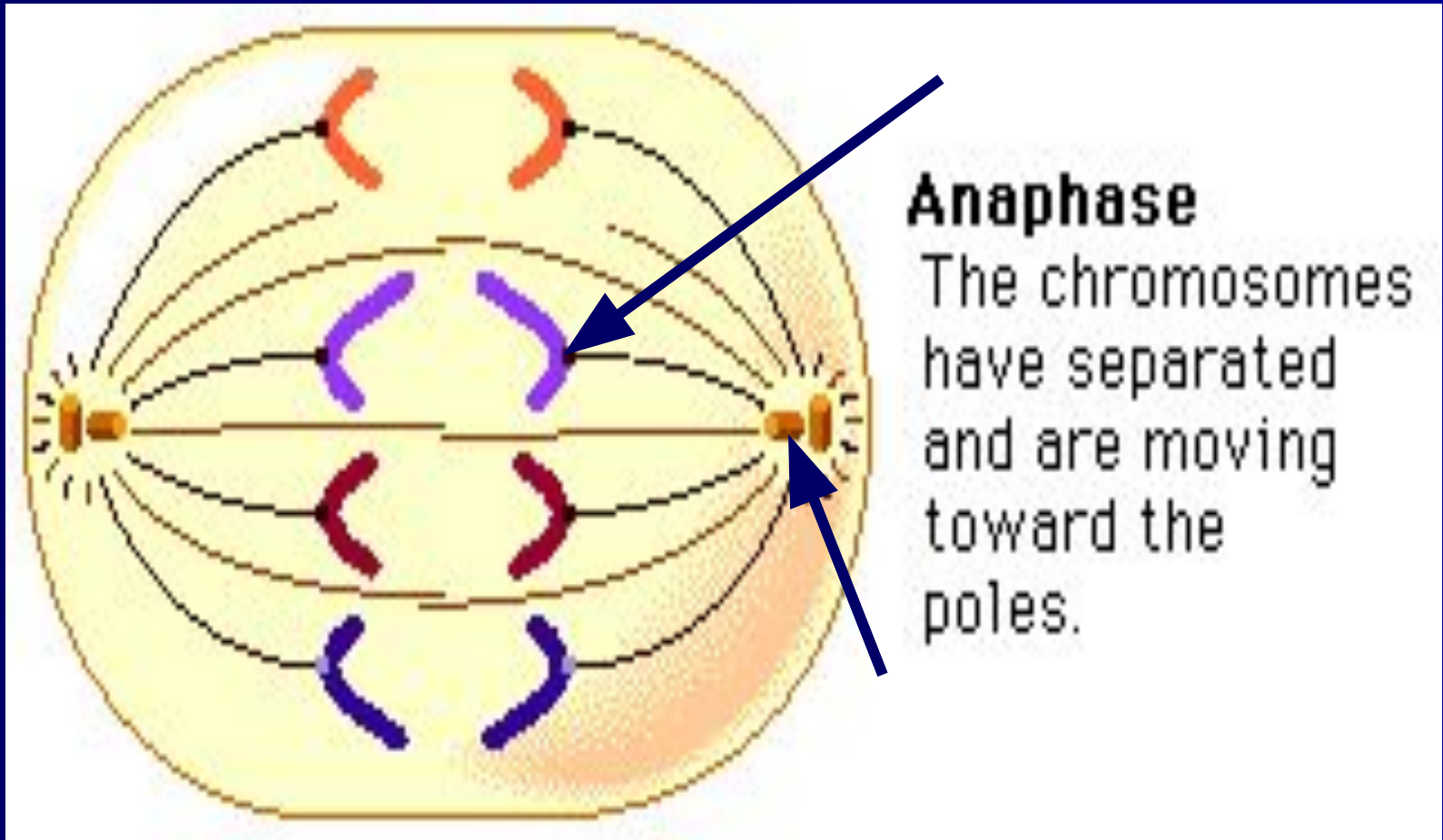


ANAPHASE



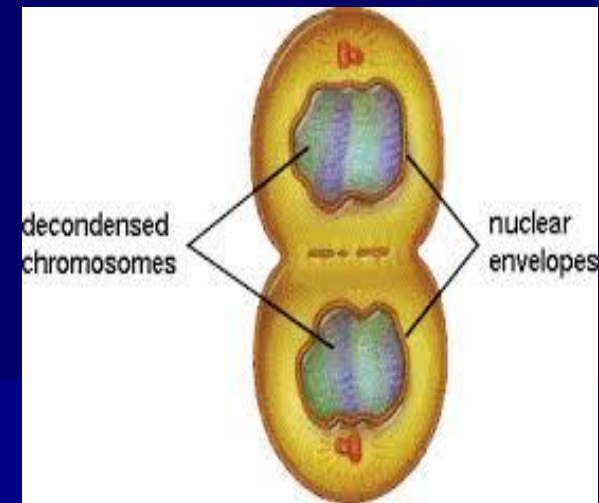
- Third phase
- The sister chromatids separate into individual chromosomes and moved apart
- The individual chromosomes move along the spindle fibers to the opposite end of the cell

Let's Draw **ANAPHASE**

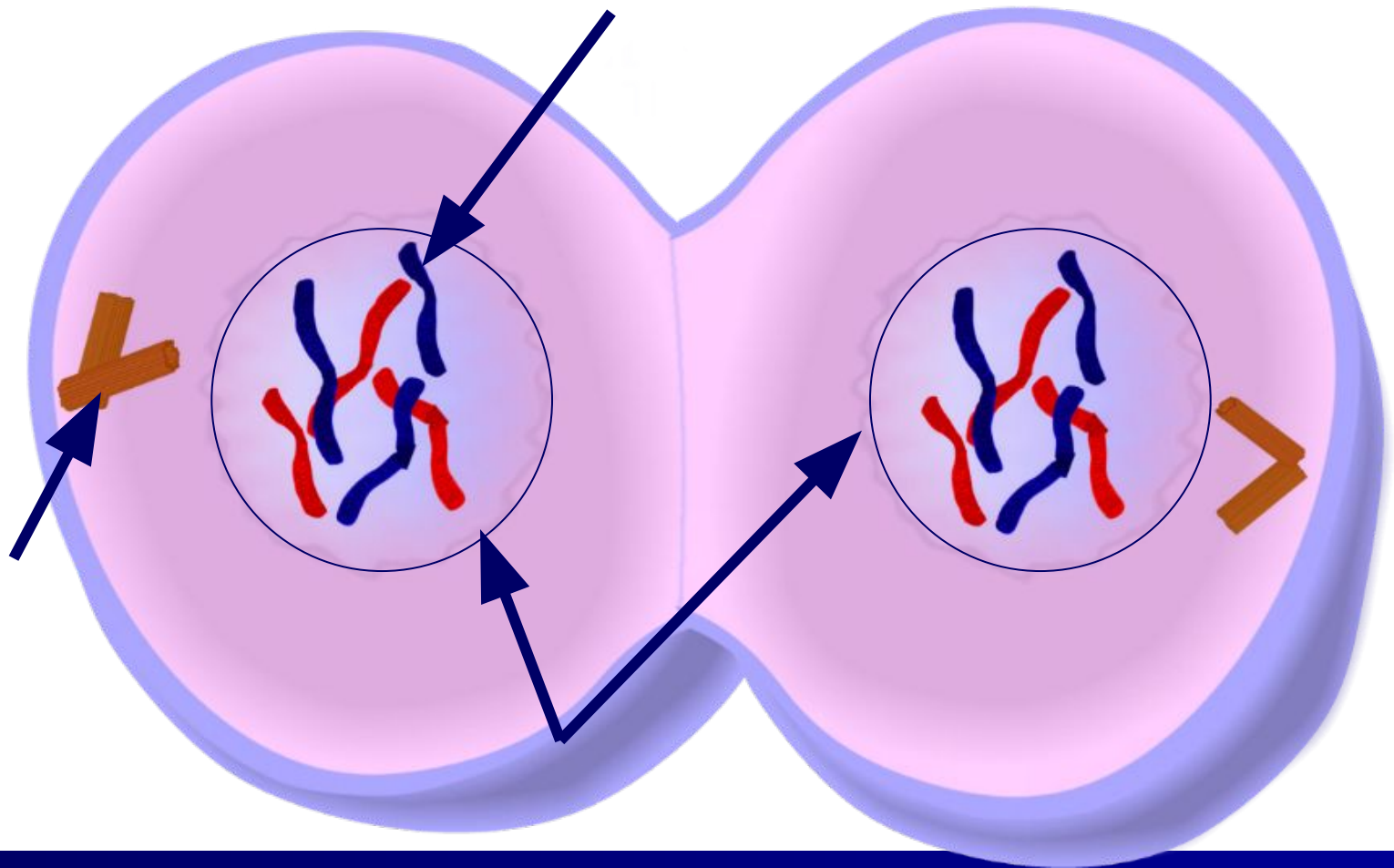


TELOPHASE

- Fourth phase
- Chromosomes gather at opposite ends of the cell losing their shape becoming chromatin
- 2 nuclear membranes form around each cluster of chromosomes
- Spindle fibers begin to dissolve
- Nucleus and nucleolus become visible

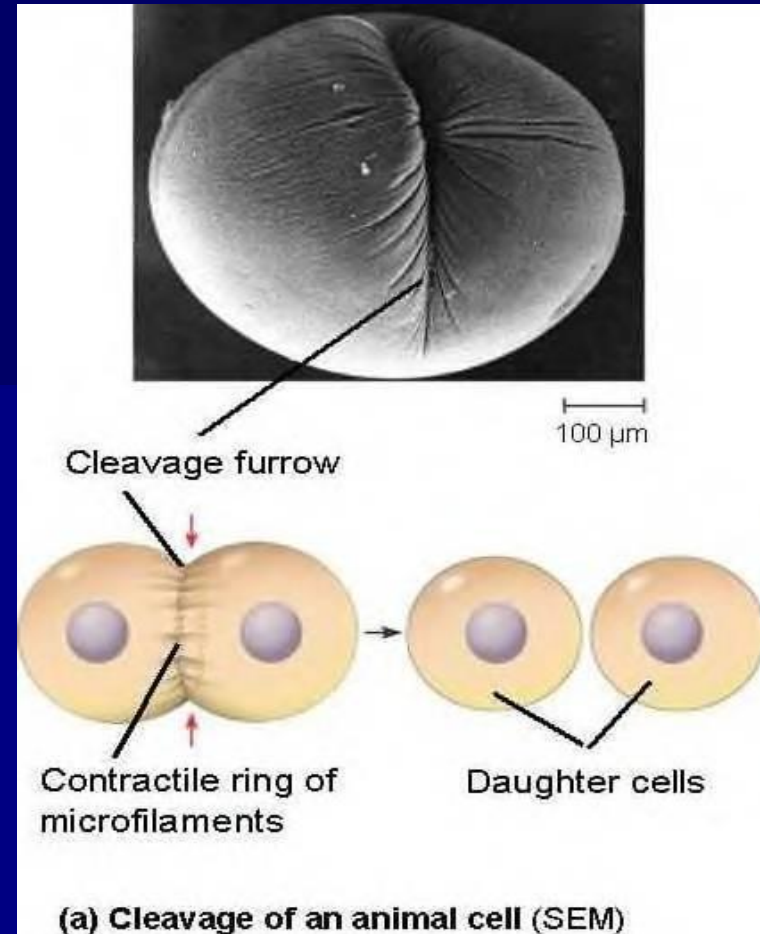


Let's Draw **TELOPHASE**

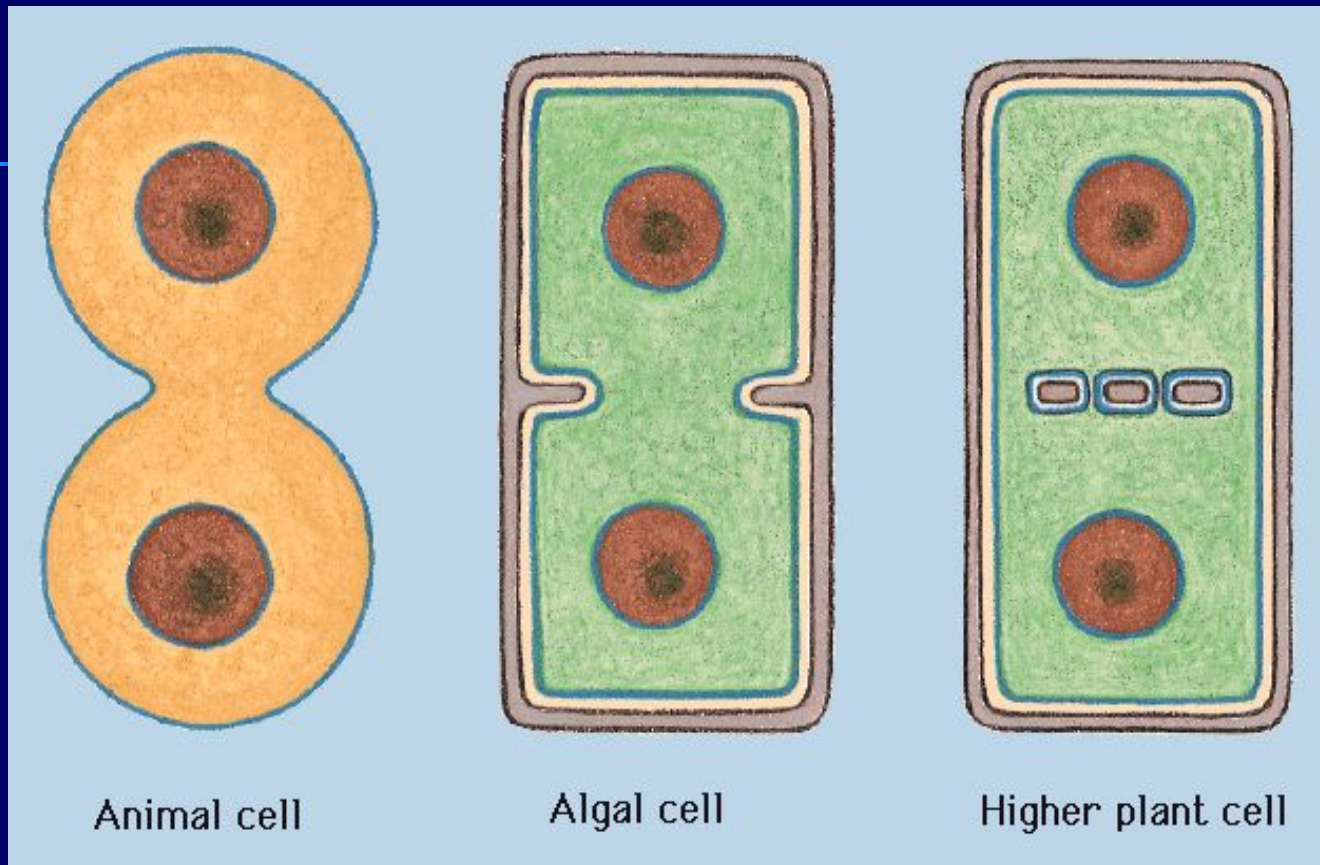


STAGE #3: CYTOKINESIS

- Usually occurs same time as telophase
- Cytoplasm pinches in half
- Each daughter cell has an identical set of duplicated chromosomes
- Process complete by splitting 1 cell into 2
- **Results in 2 identical daughter cells**



Cytokinesis (animal vs plant)



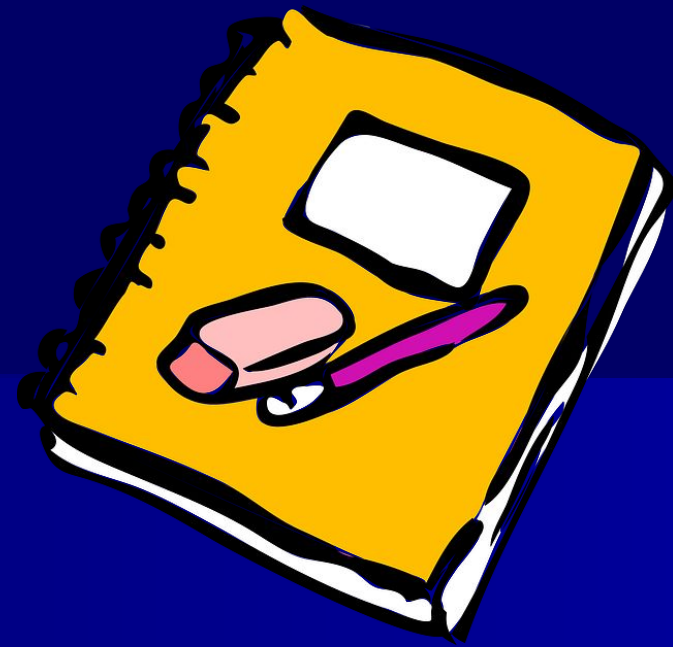
- **ANIMAL** = cytoplasm splits at furrow
- **PLANT** = Cell plate forms (*due to cell wall*)

Essential Questions

- List the steps in mitosis.
- Describe each step of mitosis.
- What is the final result at the end of cytokinesis?
- *Vocabulary: prophase, spindle fibers, metaphase, anaphase, telophase*

Mitosis Tri-fold

- Color the Mitotic process
- Fill in the descriptions
- Paste to the tri-fold pop out
- Glue in order into your journal book pg 56



Let's Practice (journals)

- 1) Draw what a cell would look like in prophase.
- 2) Name the 2 causes of why cells need to divide.
- 3) Draw what a plant cell would look like in cytokinesis.
- 4) Draw and label a chromosome.

Let's Practice

(journals)

- 5) Draw what a cell would look like in metaphase.
- 6) List the parts of the first phase of the cell cycle.
- 7) Define cancer, where does it occur, and what causes it?
- 8) Draw what a cell would look like in anaphase.

Section 3: Cell Cycle Regulation



Normal: regulated cell growth



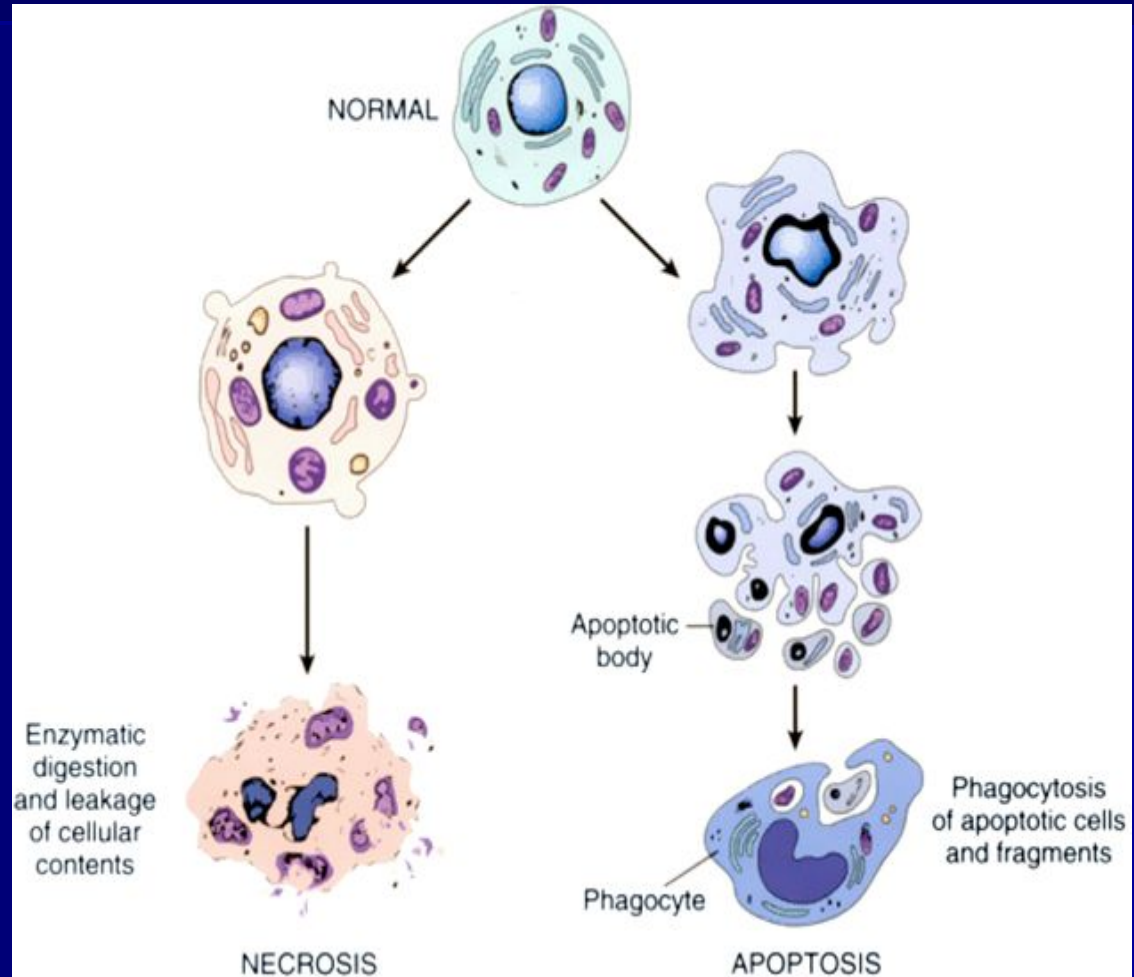
Cancer: uncontrolled cell growth

How does a cell know when to divide?

- Muscle and nerve cells do not divide once developed
- RBC, skin cells & digestive tract cells constantly grow
- Regulated by Cyclins
 - These tell the cell its time to go thru the cell cycle
 - Controlled by 2 types
 - **INTERNAL regulators**
 - Things can continue once certain events have happened inside the cell
 - **EXTERNAL regulators**
 - Direct the cell to speed up or slow down during cell cycle
 - **Growth factors** (these stimulate growth and division)

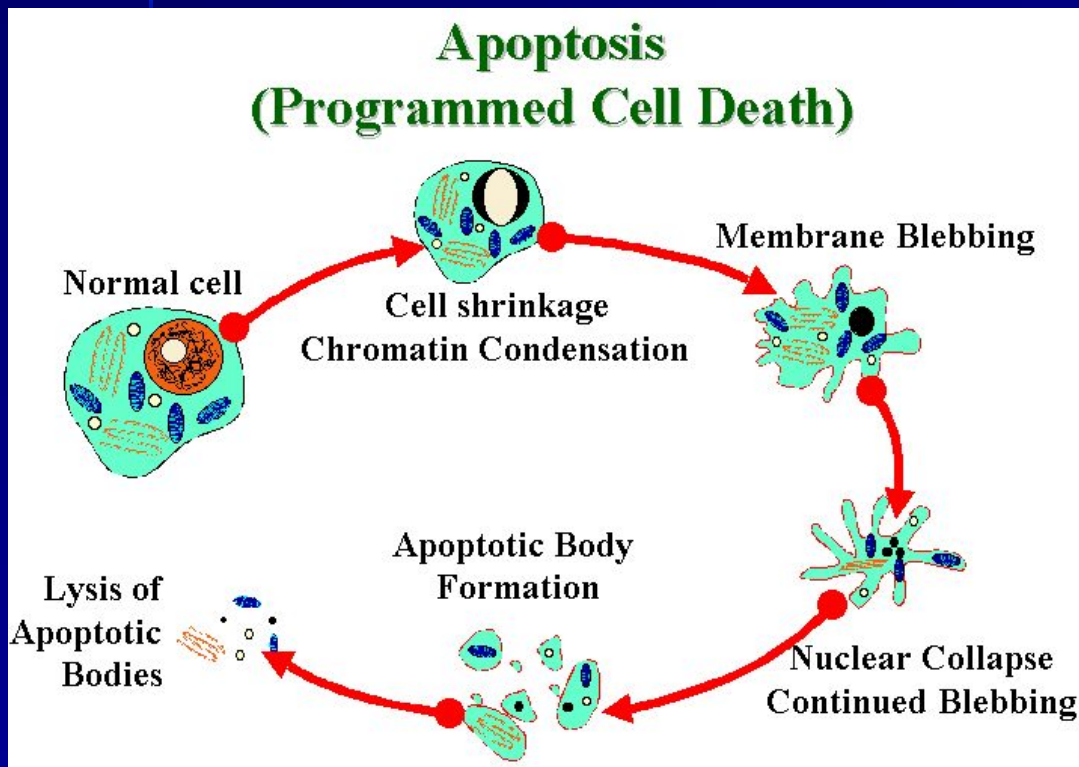
Cells can be BAD

- They can die by accident
 - In an injury or just damaged (old)
- Programmed to die
 - Called apoptosis



Apoptosis

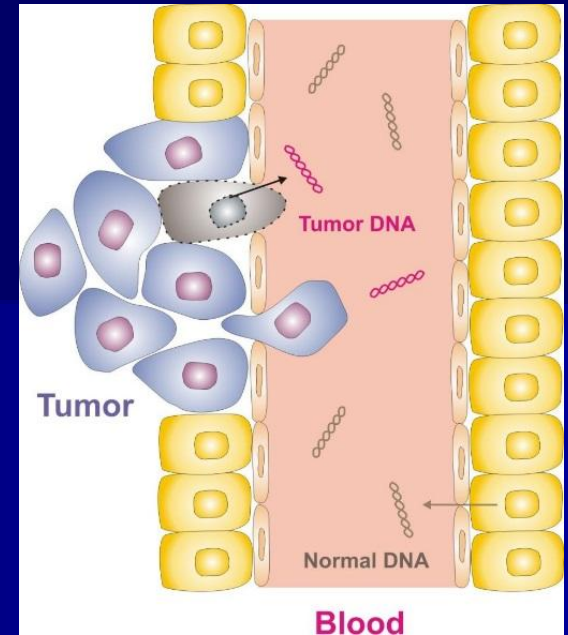
- Programmed cell death



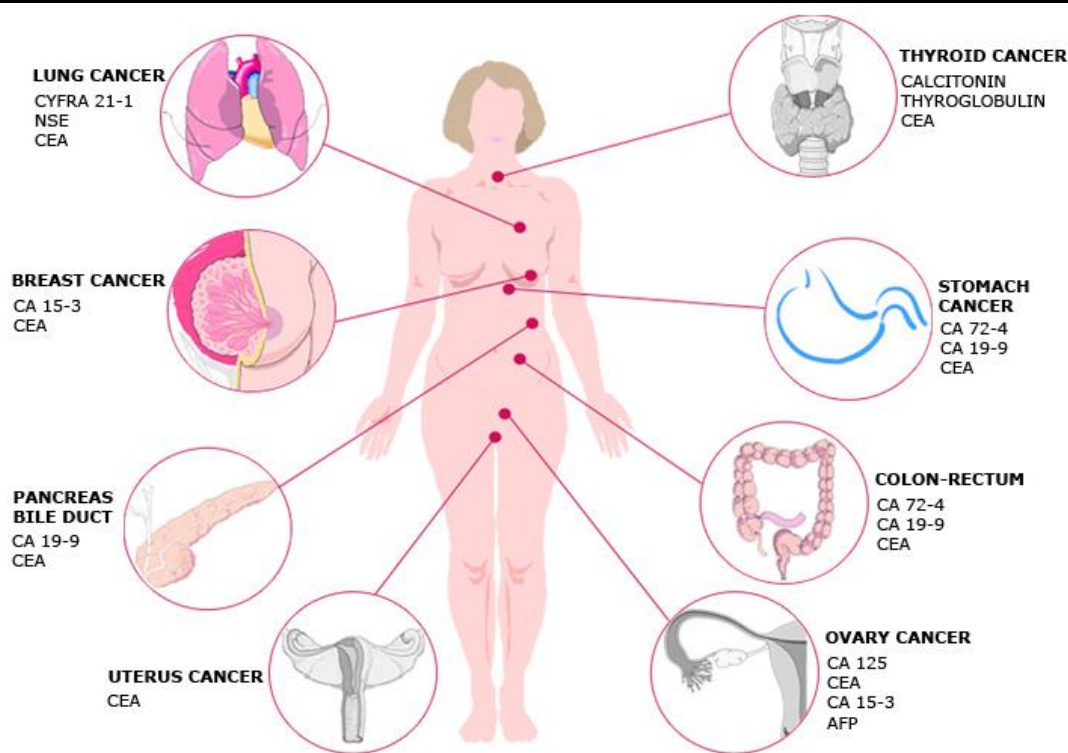
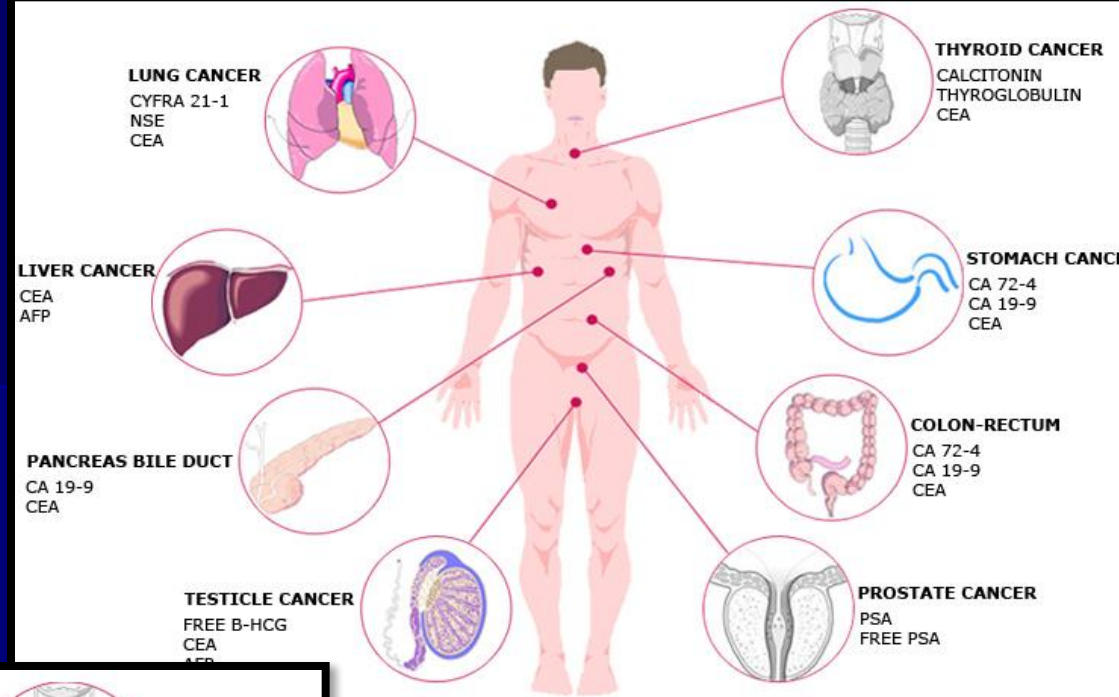
Can help to protect organisms from developing cancerous growths

Cancer

- A disorder in which body cells lose their ability to control growth
- Do not respond to the signals that regulate growth
- **Result:** the uncontrolled growth and division of cells



Types of Cancer



Where can it occur?

Carcinogens?

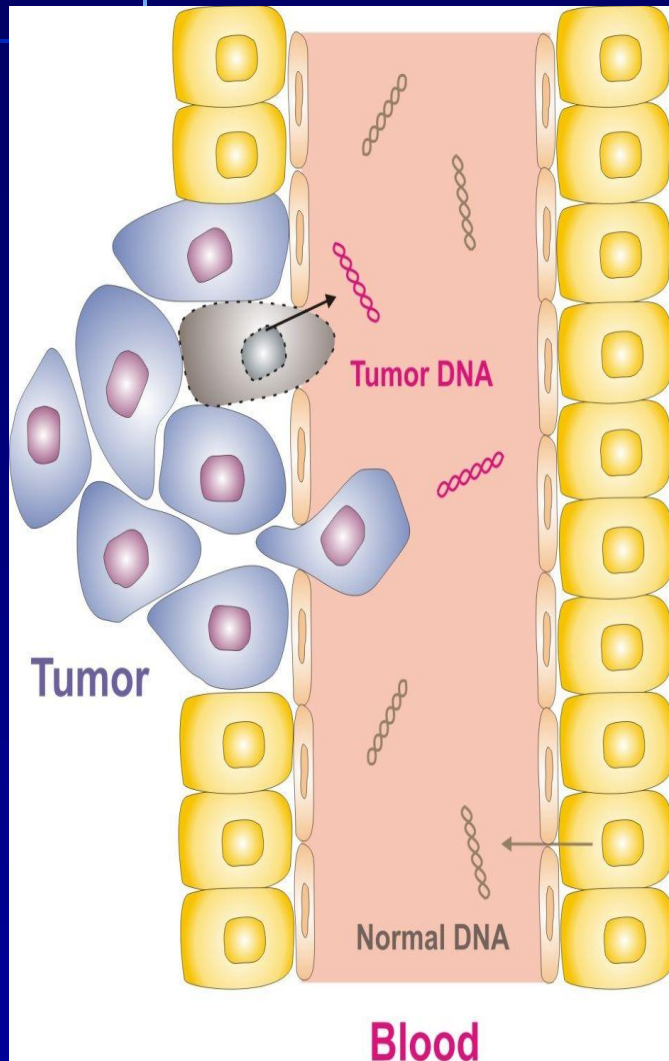
Carcinogens



- Substance/agent known to cause cancer
- Ex: smoking, UV rays, heredity



CANCER



- The body's immune system normally destroys cancer cells
- But, if they are not destroyed, the cells will continue to divide and divide and form a tumor
- **Tumor**: a mass of cancer cells within normal tissue

CANCER

■ Benign tumor

- Non-cancerous tumor
- Cancer cells remain at the original site
- Can usually be completely removed by surgery

■ Malignant tumor

- These are cancerous
- have spread to neighboring tissues and other body parts
 - Invade and destroy surrounding healthy tissue blocking and preventing organs from functioning properly

Stem Cells

- Unspecialized cells that develop into specialized cells under certain conditions
- 2 types
 - Embryonic stem cells
 - Adult stem cells



Cell game

- <http://www.nobelprize.org/educational/medicine/2001/cellcycle.html>

Cancer Lab

- You are going to “become” a person. Some of these individuals are old, middle-age, or led very interesting lives.
- Please play along with the role that you were given ... the more you get into it ... the more we have fun 😊

Cancer Lab Questions

- How does family history play a role with getting cancer?
- Does age have anything to do with cancer?
- Is there a certain “type” of cancer... explain.
- List some (3) risk factors
- What is the reasoning for the black dot?