

Cell Division—Mitosis Notes

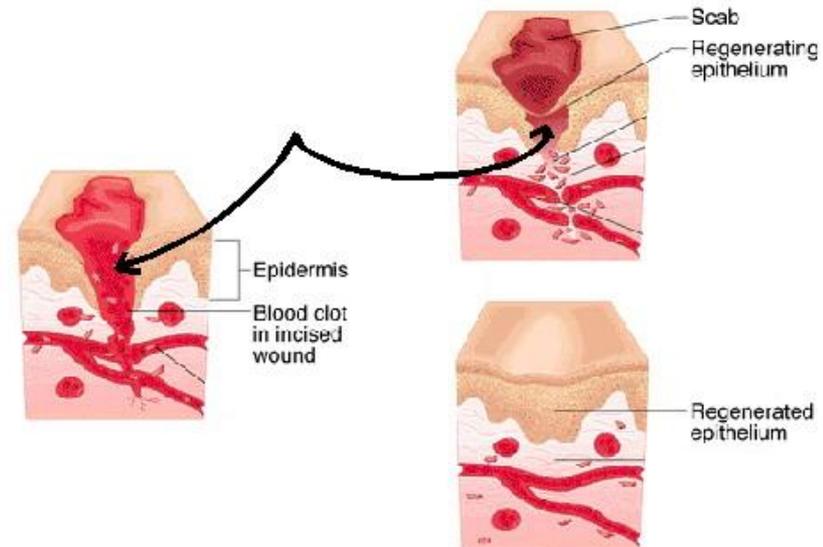
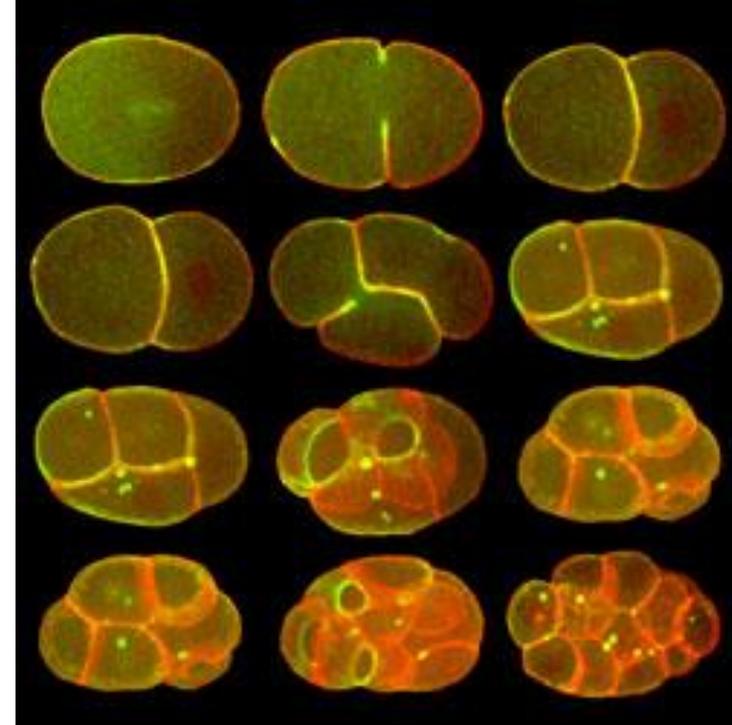
Cell Division — process by which a cell divides into 2 new cells

- Why do cells need to divide?

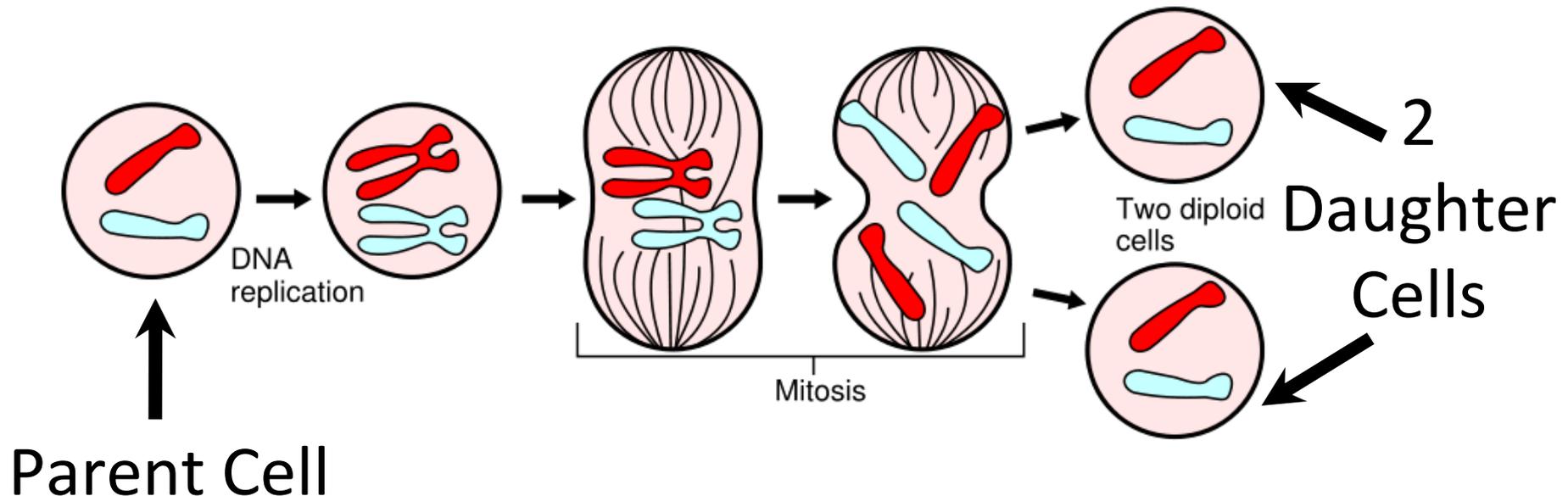
1. Living things grow by producing more cells, NOT because each cell increases in size

2. Repair of damaged tissue

3. If cell gets too big, it cannot get enough nutrients into the cell and wastes out of the cell



- The **original** cell is called the **parent** cell; 2 **new** cells are called **daughter** cells
- Before cell division occurs, the cell **replicates** (copies) all of its **DNA**, so each daughter cell gets complete set of **genetic information** from parent cell
- Each daughter cell is **exactly** like the parent cell – **same** kind and number of **chromosomes** as the original cell



- Many organisms, especially **unicellular** organisms, reproduce by means of cell division – called **asexual reproduction** – Ex: bacteria

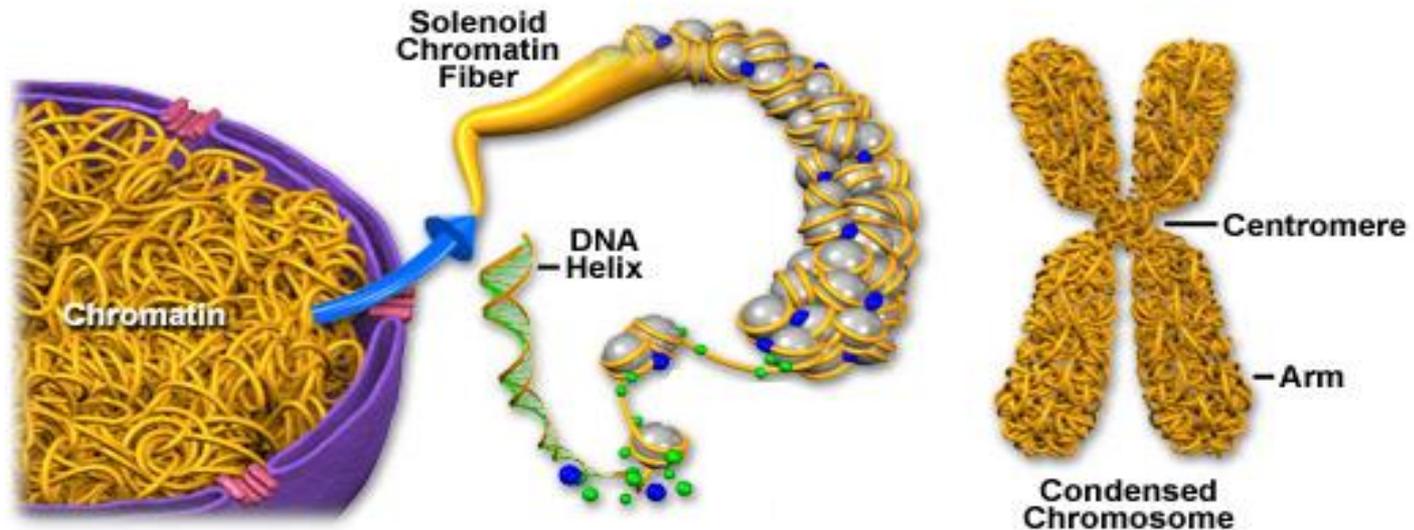


DNA

- DNA is located in the **nucleus** and controls all cell **activities** including cell division
- Long and **thread-like** DNA in a **non-dividing** cell is called **chromatin**
- **Doubled**, **coiled**, short DNA in a **dividing** cell is called **chromosome**

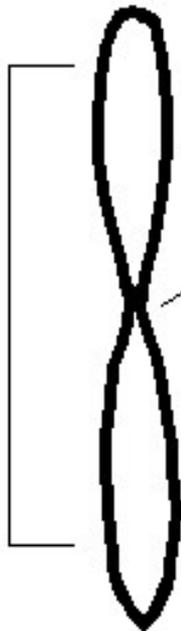
Consists of 2 parts: **chromatid** and **centromere**

Chromatin and Condensed Chromosome Structure



CHROMOSOME STRUCTURE

"unduplicated"



chromatid

centromere or
primary constriction

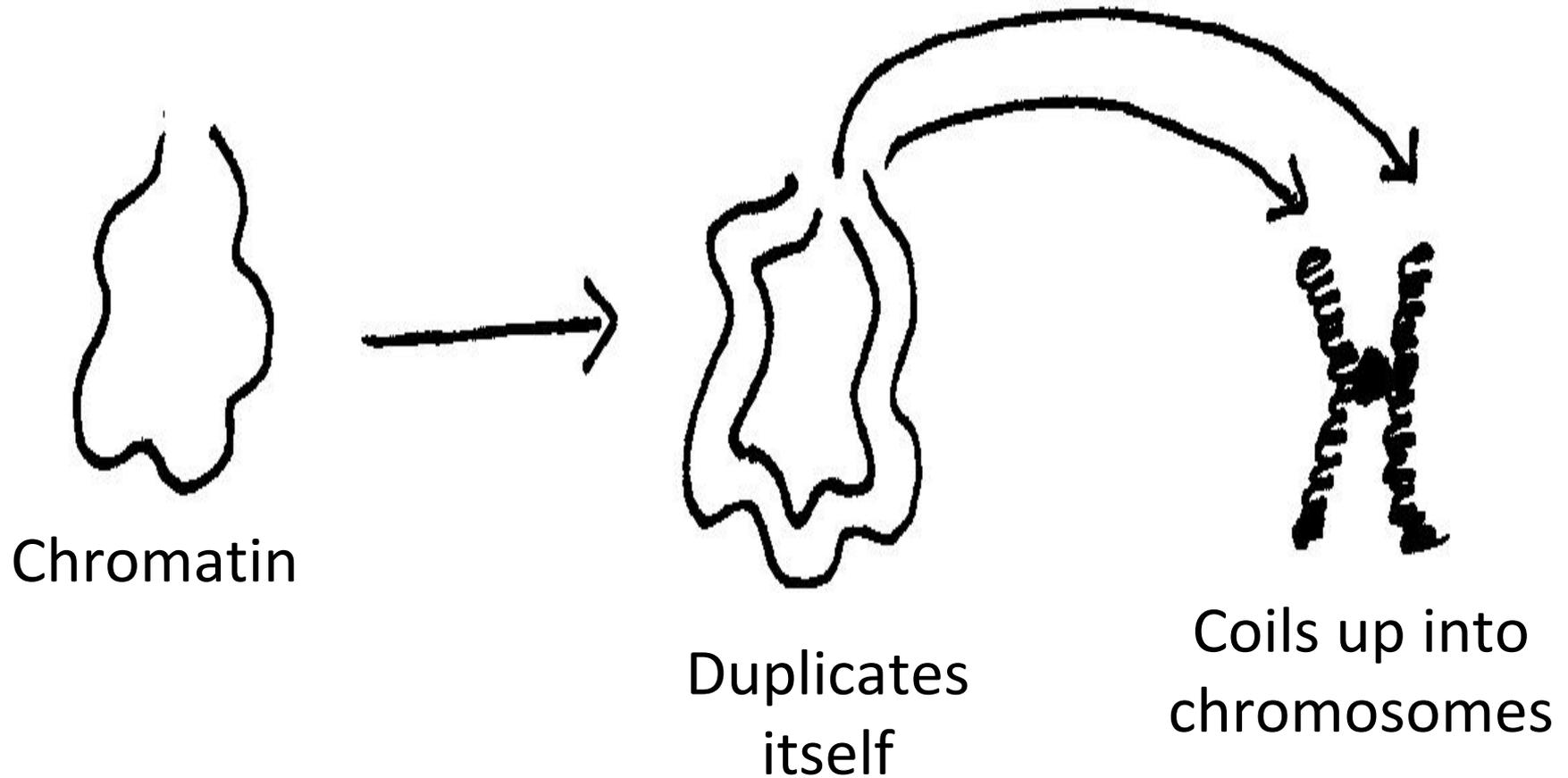
"duplicated"



identical sister chromatids

- 2 identical "sister" chromatids attached at an area in the middle called a **centromere**
- When cells divide, "sister" **chromatids** separate and 1 goes to each new cell

- Chromatin to chromosomes illustration:



Why does DNA need to change from chromatin to chromosome?

More efficient division

Chromosome number

- Every organism has its own specific number of chromosomes

Examples: Human = 46 chromosomes or 23 pairs

Dog = 78 chromosomes or 39 pairs

Goldfish = 94 chromosomes or 47 pairs

Lettuce = 18 chromosomes or 9 pairs



Kind and number of chromosomes

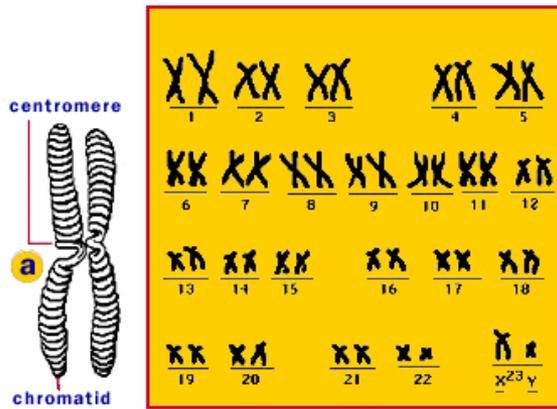
Examples: Human = 46 chromosomes

Human skin cell = 46 chromosomes

Human heart cell = 46 chromosomes

Human muscle cell = 46 chromosomes

Human chromosomes!

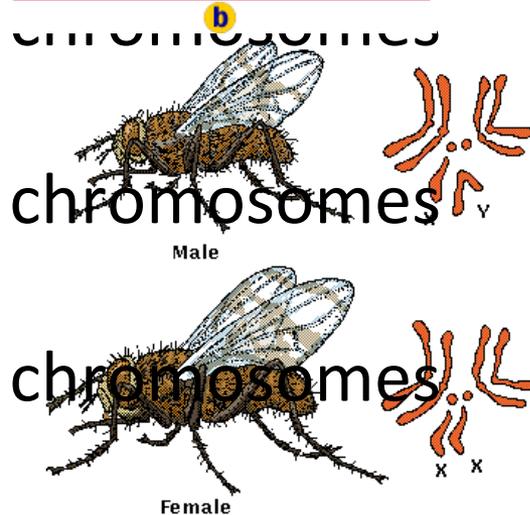


Fruit fly = 8

Fruit fly skin cell = 8

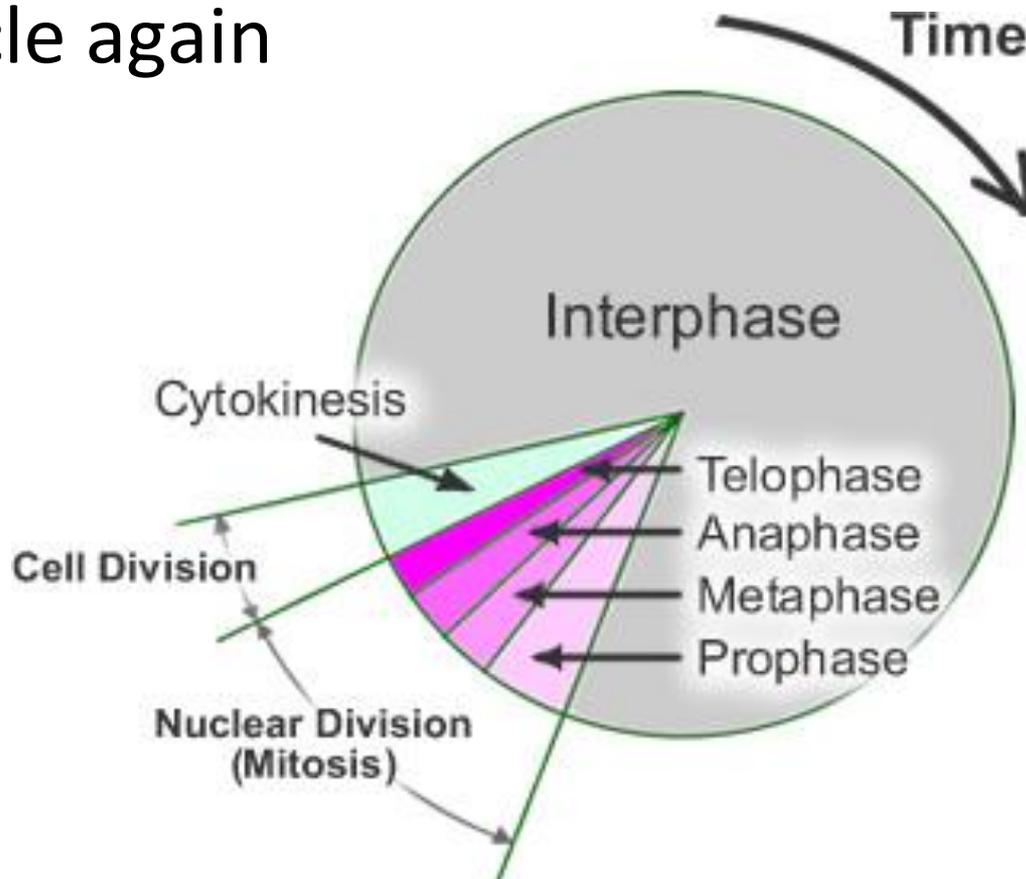
Fruit fly heart cell = 8

Fruit fly muscle cell = 8



Cell Cycle -- series of events cells go through as they **grow** and **divide**

- Cell **grows**, prepares for division, then **divides** to form 2 **daughter** cells – each of which then begins the cycle again



Interphase—period of cell growth and development

- DNA replication (copying) occurs during Interphase
- During Interphase the cell also grows, carries out normal cell activities, replicates all other organelles
- The cell spends most of its life cycle in Interphase

Interphase

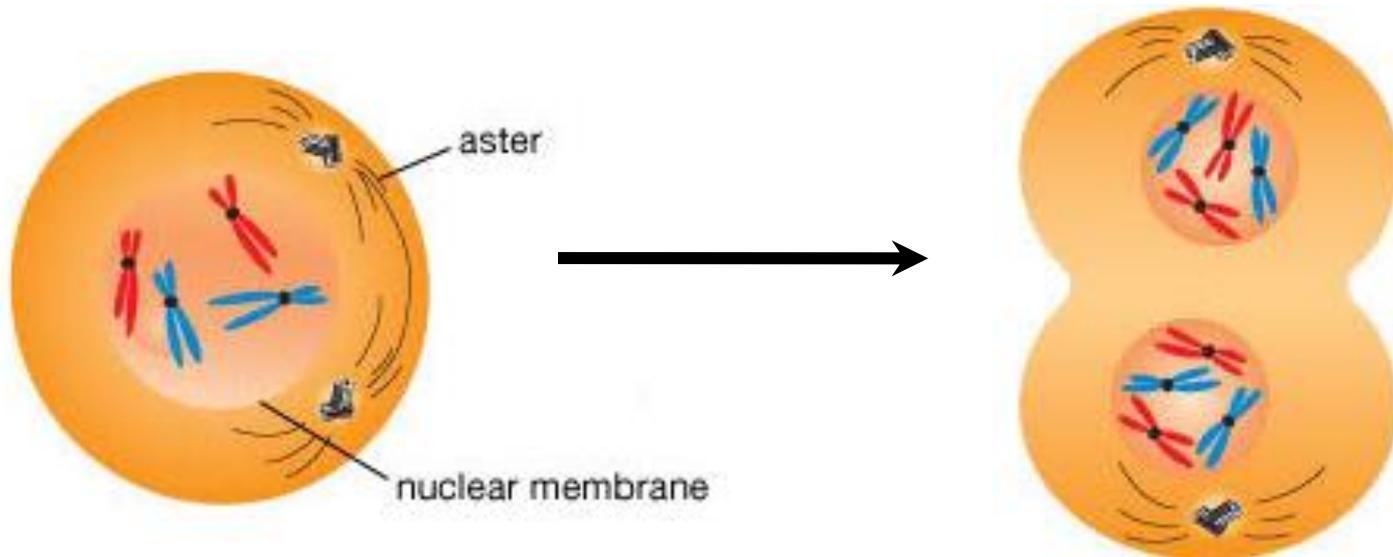


Mitosis – division of the nucleus into 2 nuclei, each with the same number of chromosomes

- Mitosis occurs in all the somatic (body) cells

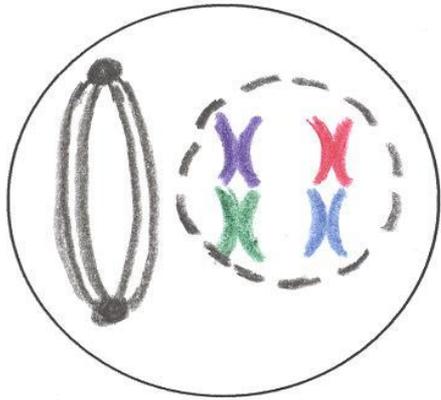
Why does mitosis occur?

So each new daughter cell has nucleus with a complete set of chromosomes

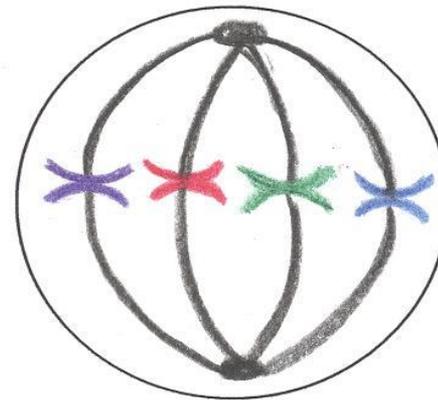


- 4 phases of nuclear division (mitosis), directed by the cell's DNA (**PMAT**)

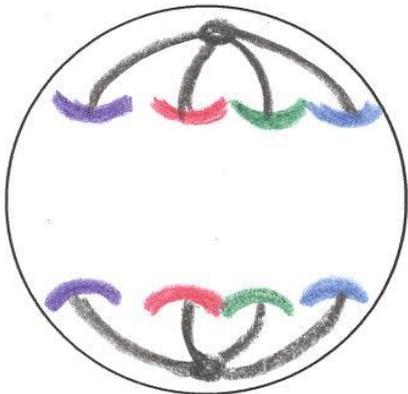
1. **Prophase**



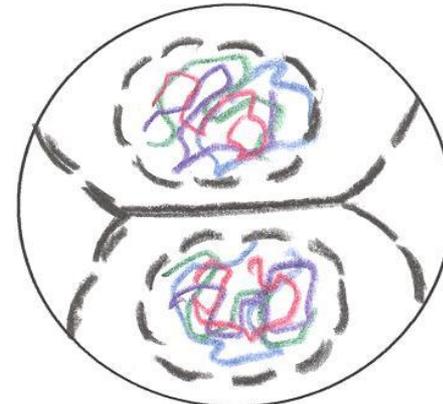
2. **Metaphase**—(Middle)



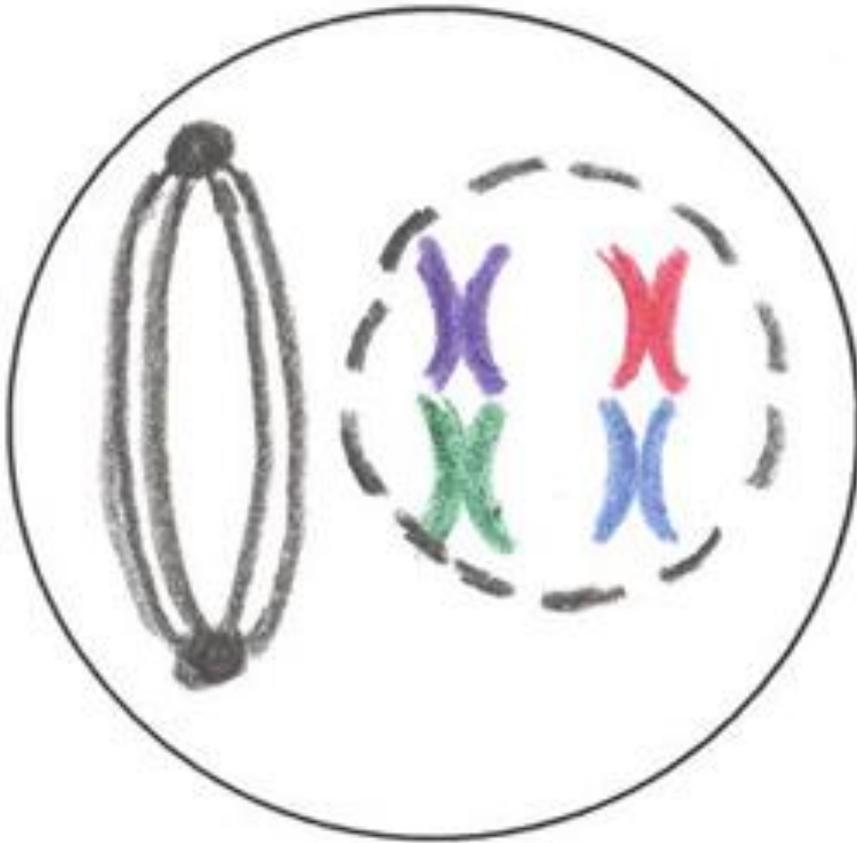
3. **Anaphase**—(Apart)



4. **Telophase**—(Two)

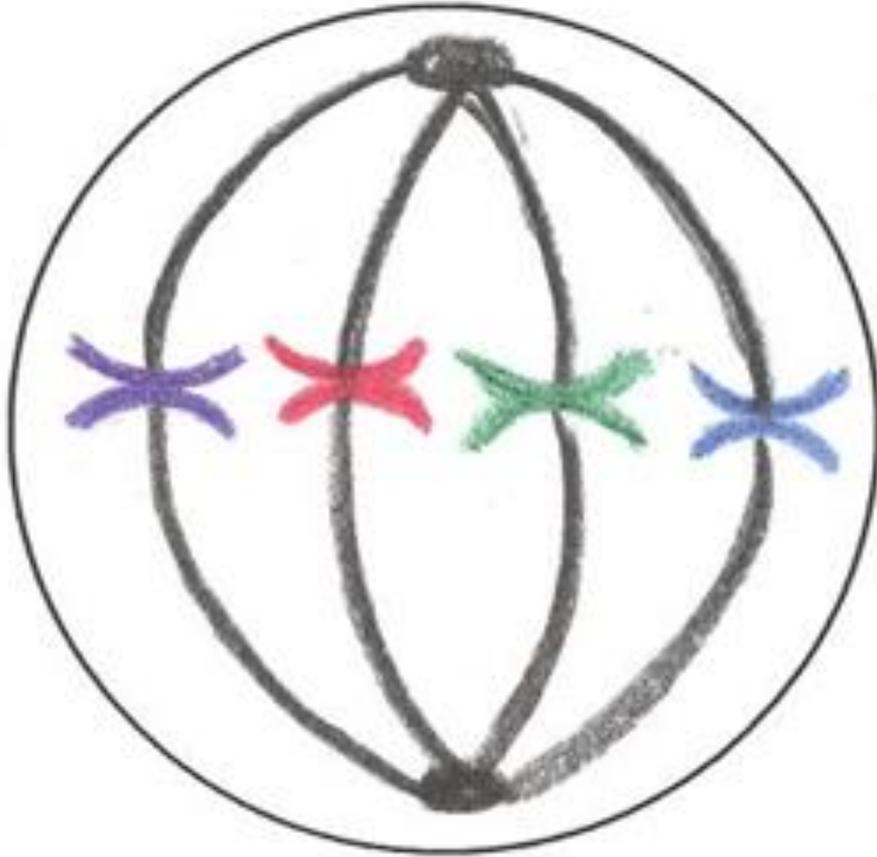


1. Prophase



- Chromosomes coil up
- Nuclear envelope disappears
- Spindle fibers form

2. Metaphase—(Middle)



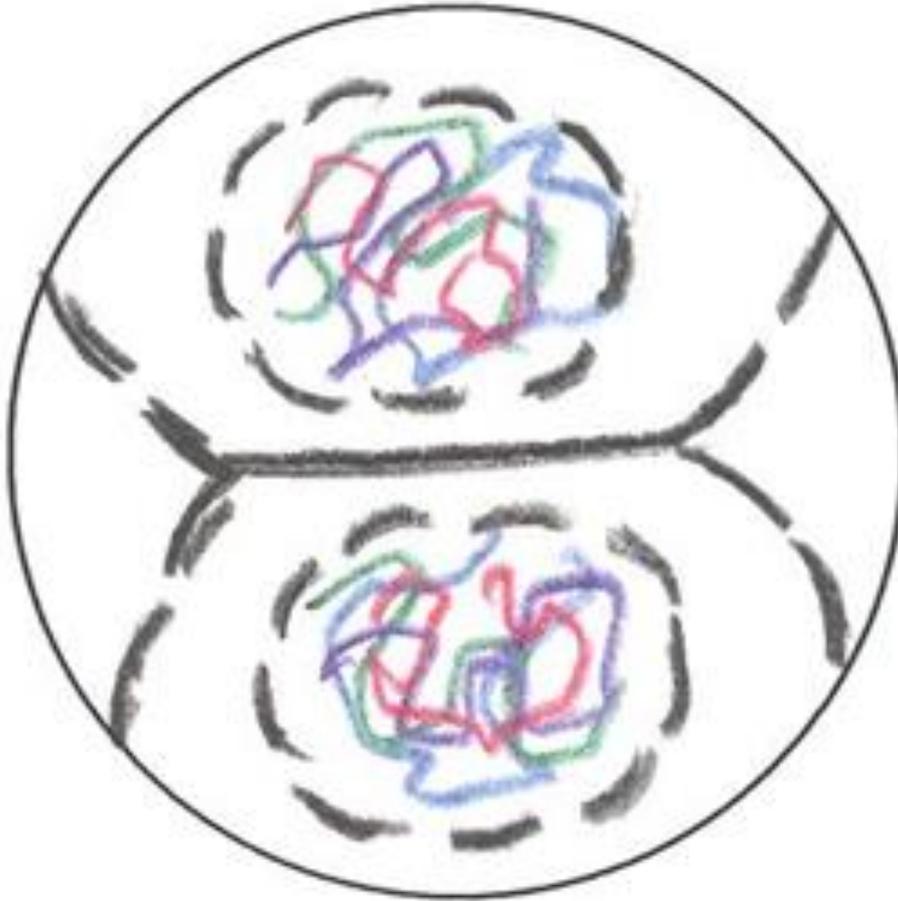
- Chromosomes line up in middle of cell
- Spindle fibers connect to chromosomes

3. Anaphase—(Apart)



- Chromosome copies divide
- Spindle fibers pull chromosomes to opposite poles

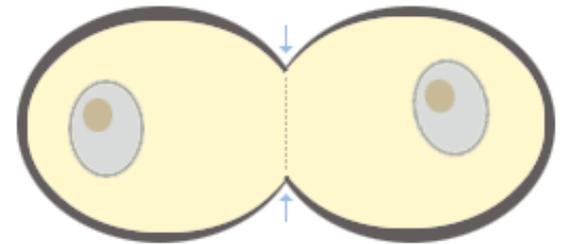
4. Telophase—(Two)



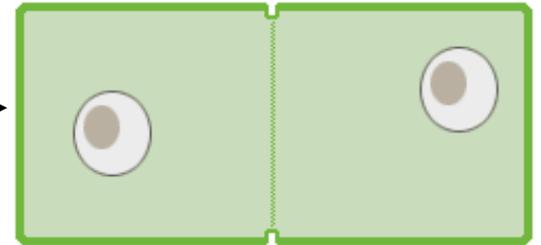
- Chromosomes uncoil
- Nuclear envelopes form
- 2 new nuclei are formed
- Spindle fibers disappear

Cytokinesis — the division of the rest of the cell (cytoplasm and organelles) after the nucleus divides

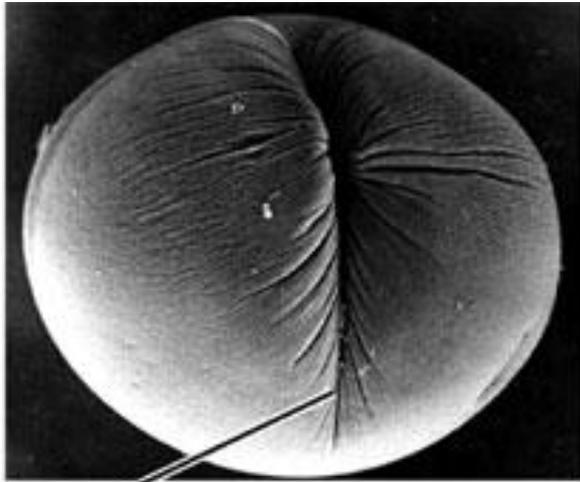
In animal cells the cytoplasm pinches in



In plant cells a cell plate forms

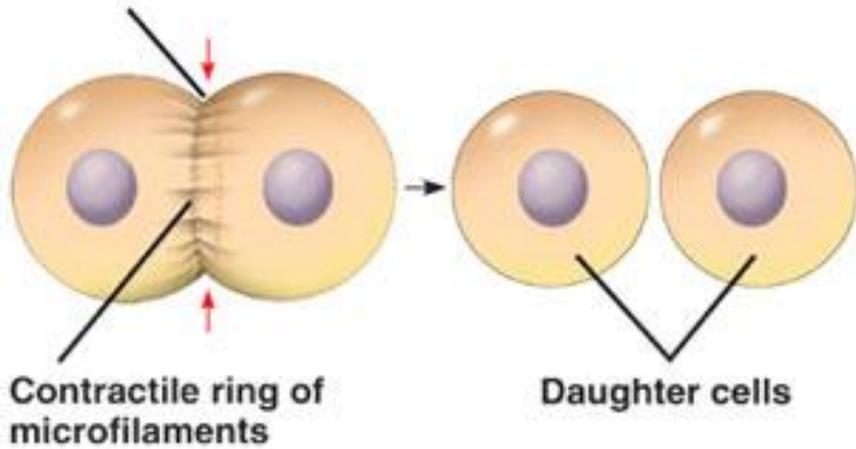


- After mitosis and cytokinesis, the cell returns to Interphase to continue to grow and perform regular cell activities

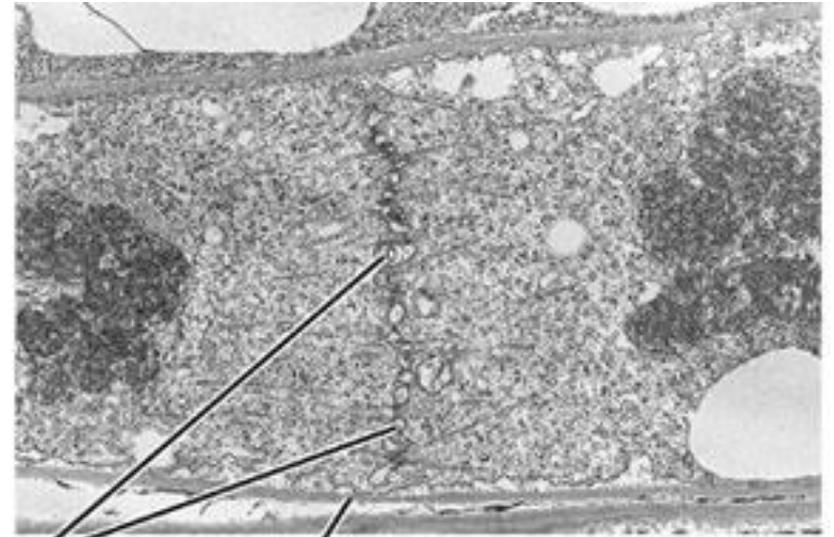


100 μm

Cleavage furrow



(a) Cleavage of an animal cell (SEM)



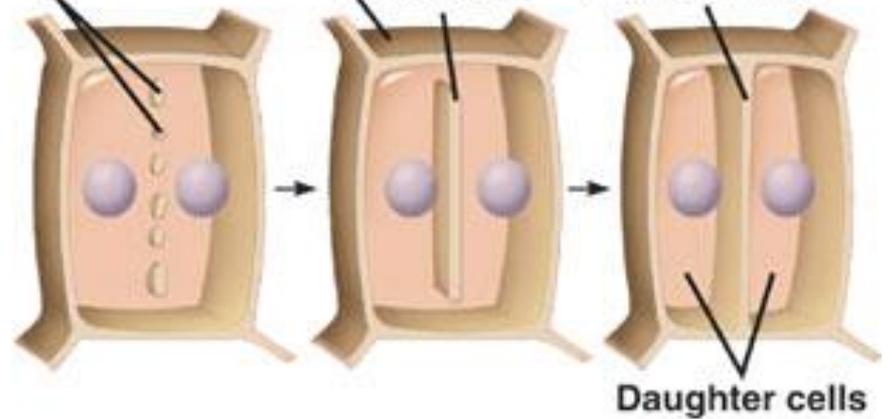
1 μm

Vesicles forming cell plate

Wall of parent cell

Cell plate

New cell wall



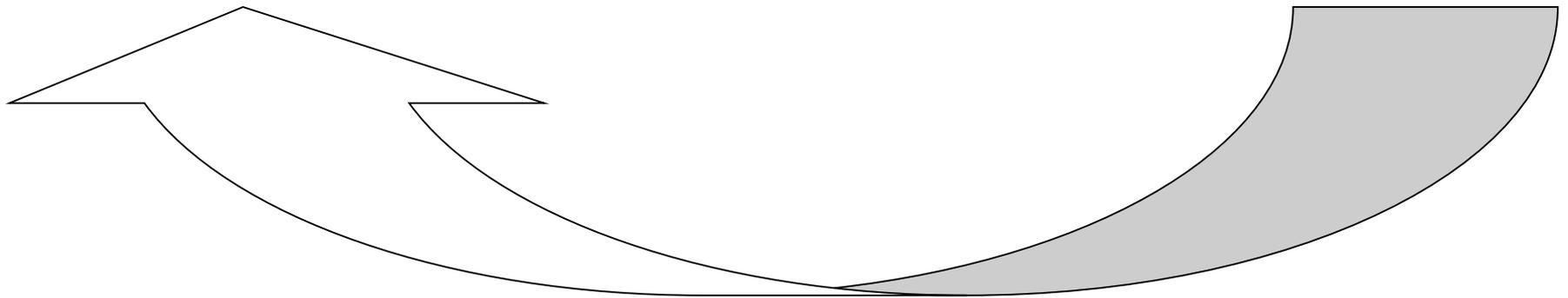
(b) Cell plate formation in a plant cell (TEM)

Summary: Cell Cycle

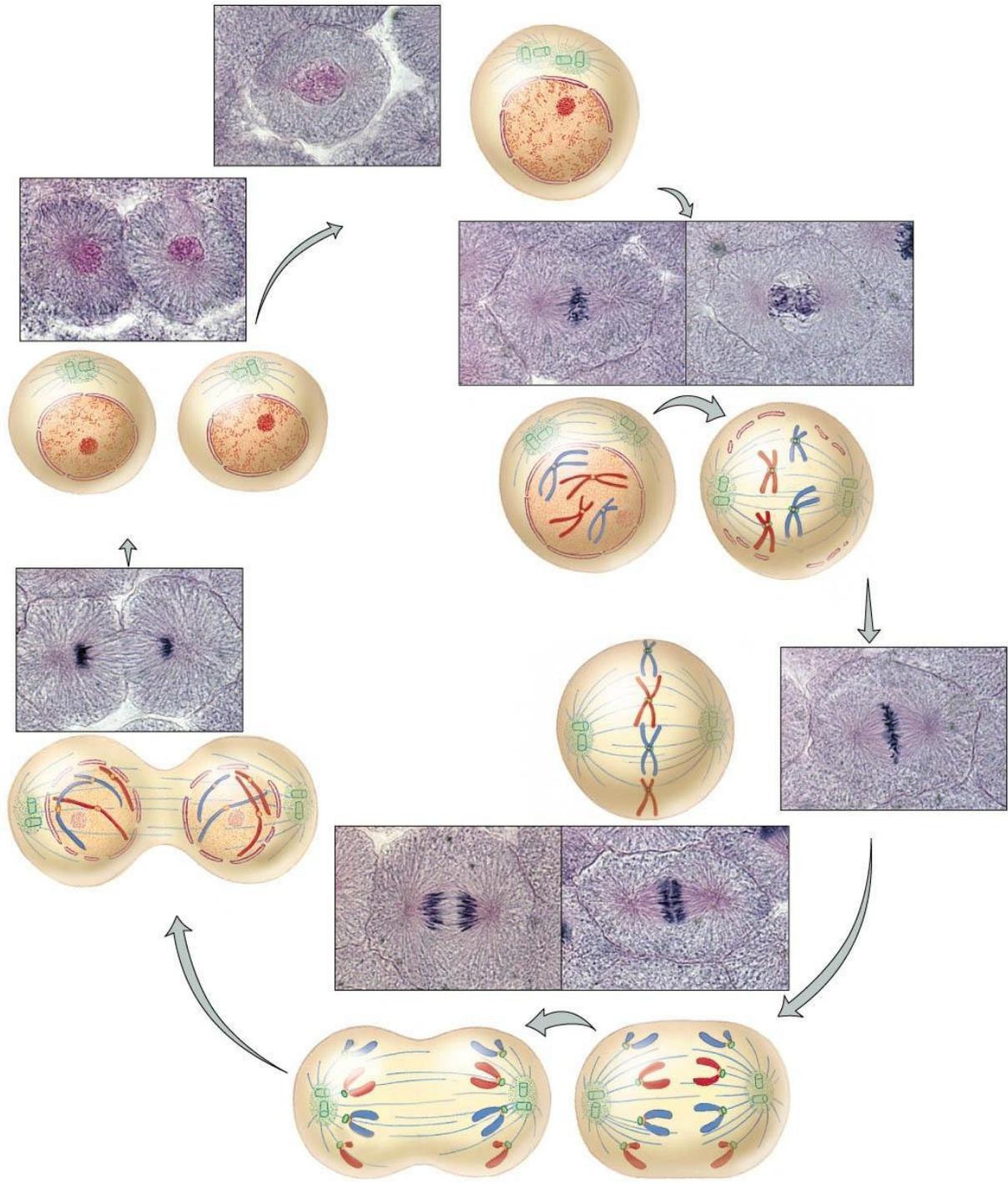
Interphase

Cytokinesis

Mitosis (PMAT)

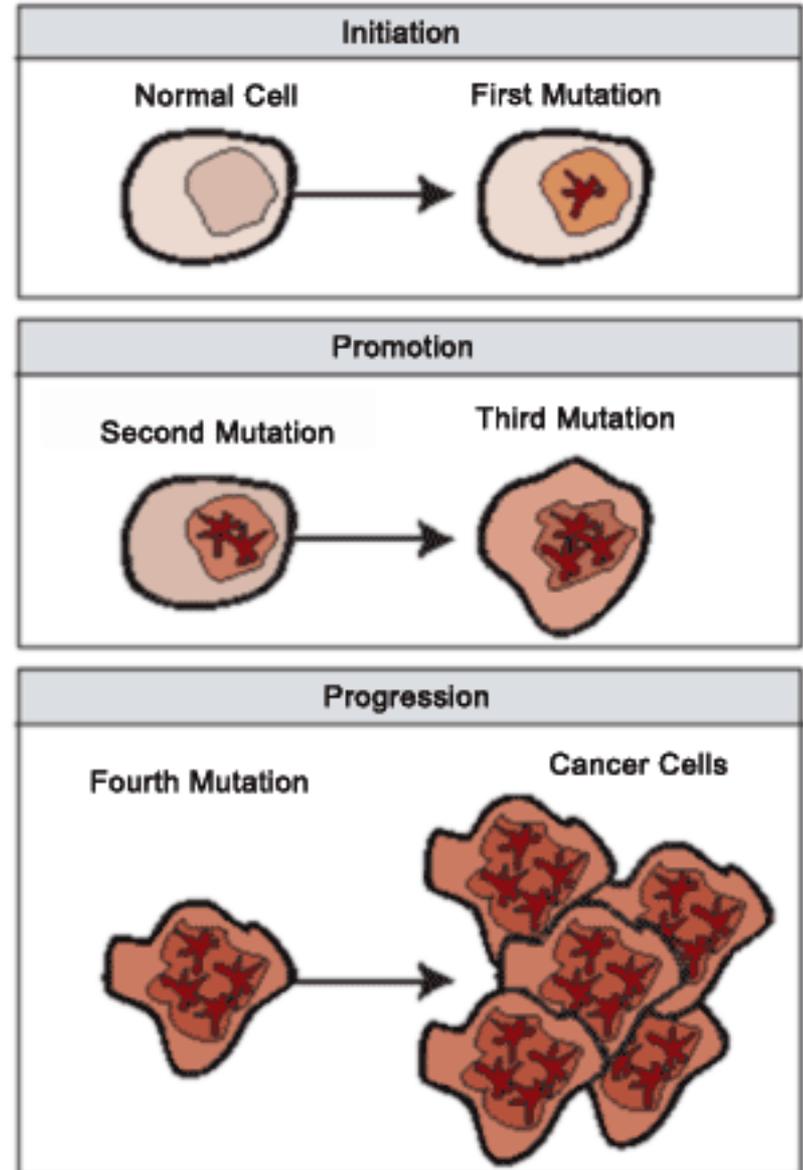


- When cells become old or damaged, they die and are replaced with new cells

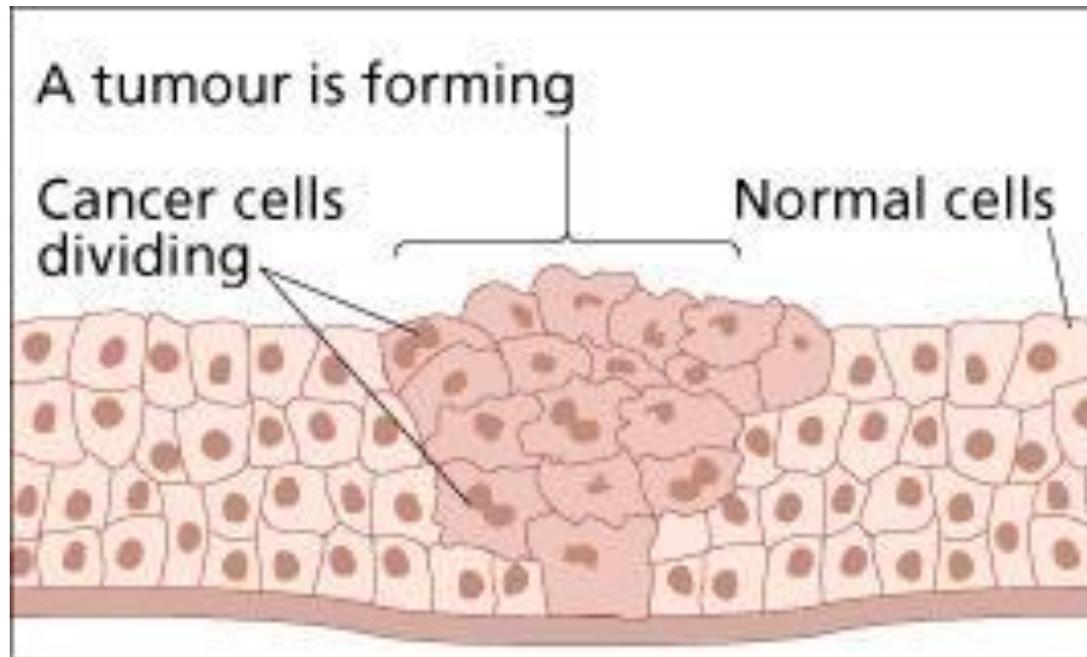


Cell Division Control

- DNA controls all cell activities including cell division
- Some cells lose their ability to control their rate of cell division – the DNA of these cells has become damaged or changed (mutated)
- These super-dividing cells form masses called tumors

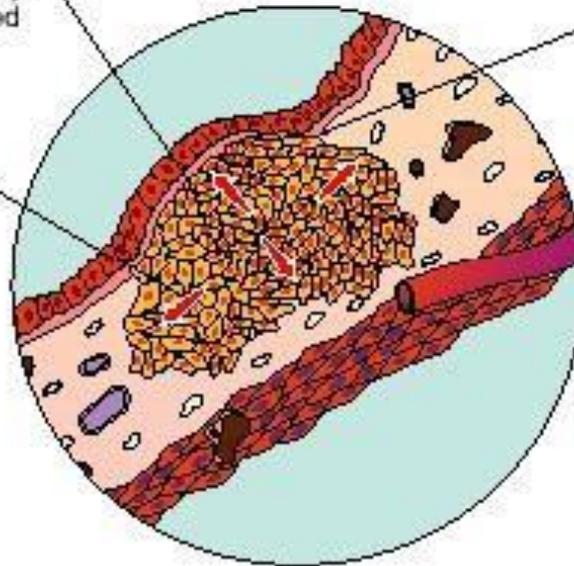


- **Benign** tumors are **not cancerous** – these cells **do not spread** to other parts of the body
- **Malignant** tumors are **cancerous** – these cells break loose and can invade and **destroy healthy tissue** in other parts of the body (called **metastasis**)



Benign tumors are generally self-contained and localized and have a well-defined perimeter.

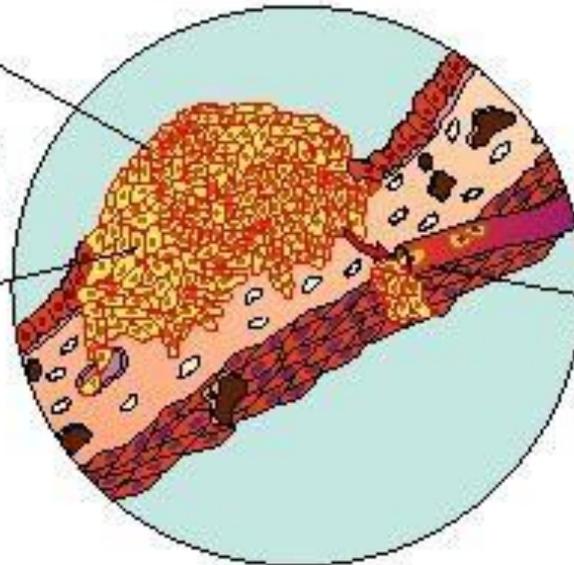
They grow slowly, expanding outward from a central mass.



They are dangerous when they compress surrounding tissues. A benign tumor near a blood vessel could restrict the flow of blood; in the abdomen it could impair digestion; in the brain it could cause paralysis.

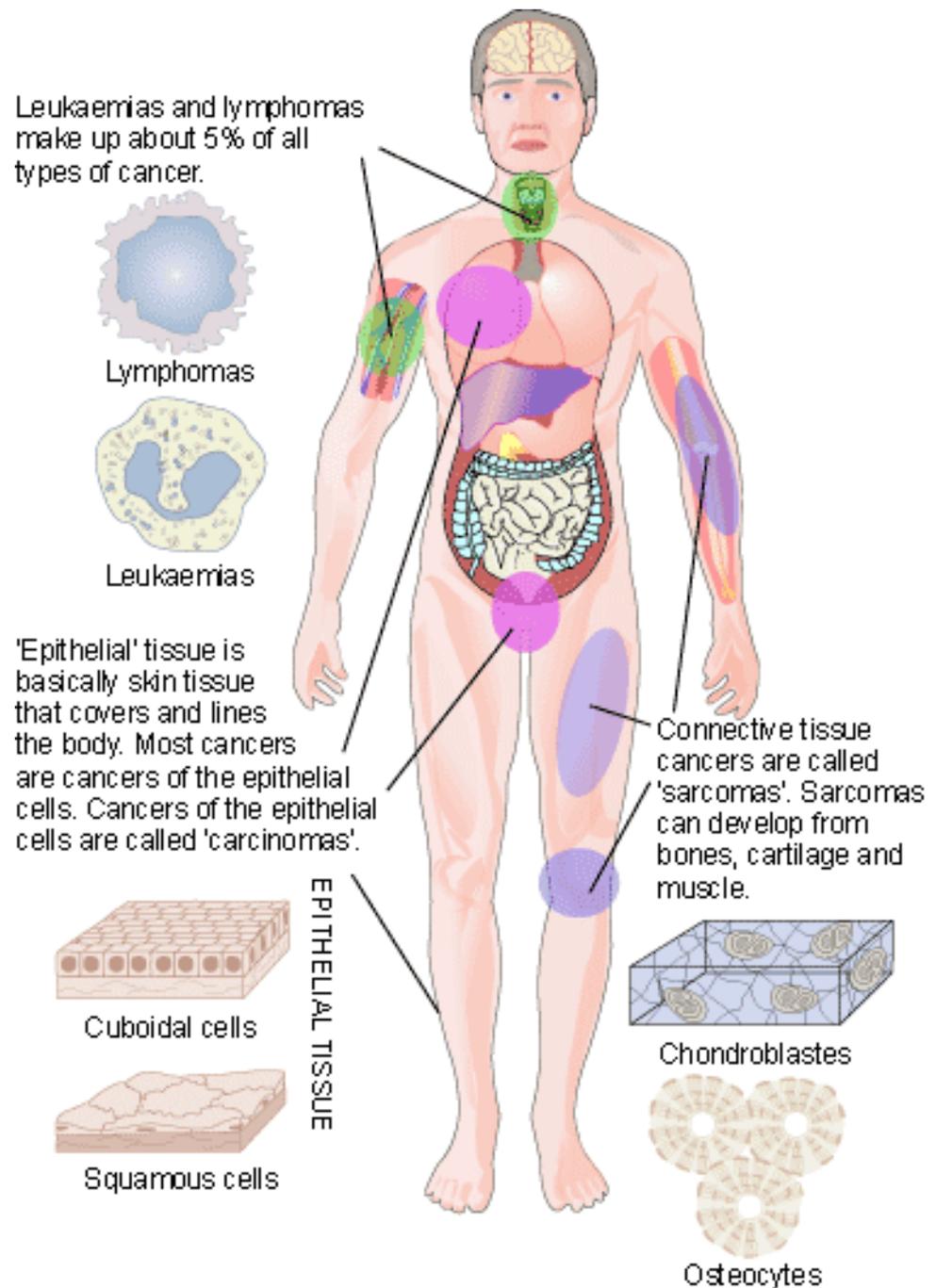
Malignant tumors are not self-contained, and usually do not compress surrounding tissues. Their growth is an irregular invasion of adjacent cells.

Although they may grow slowly, they are also capable of very rapid growth.

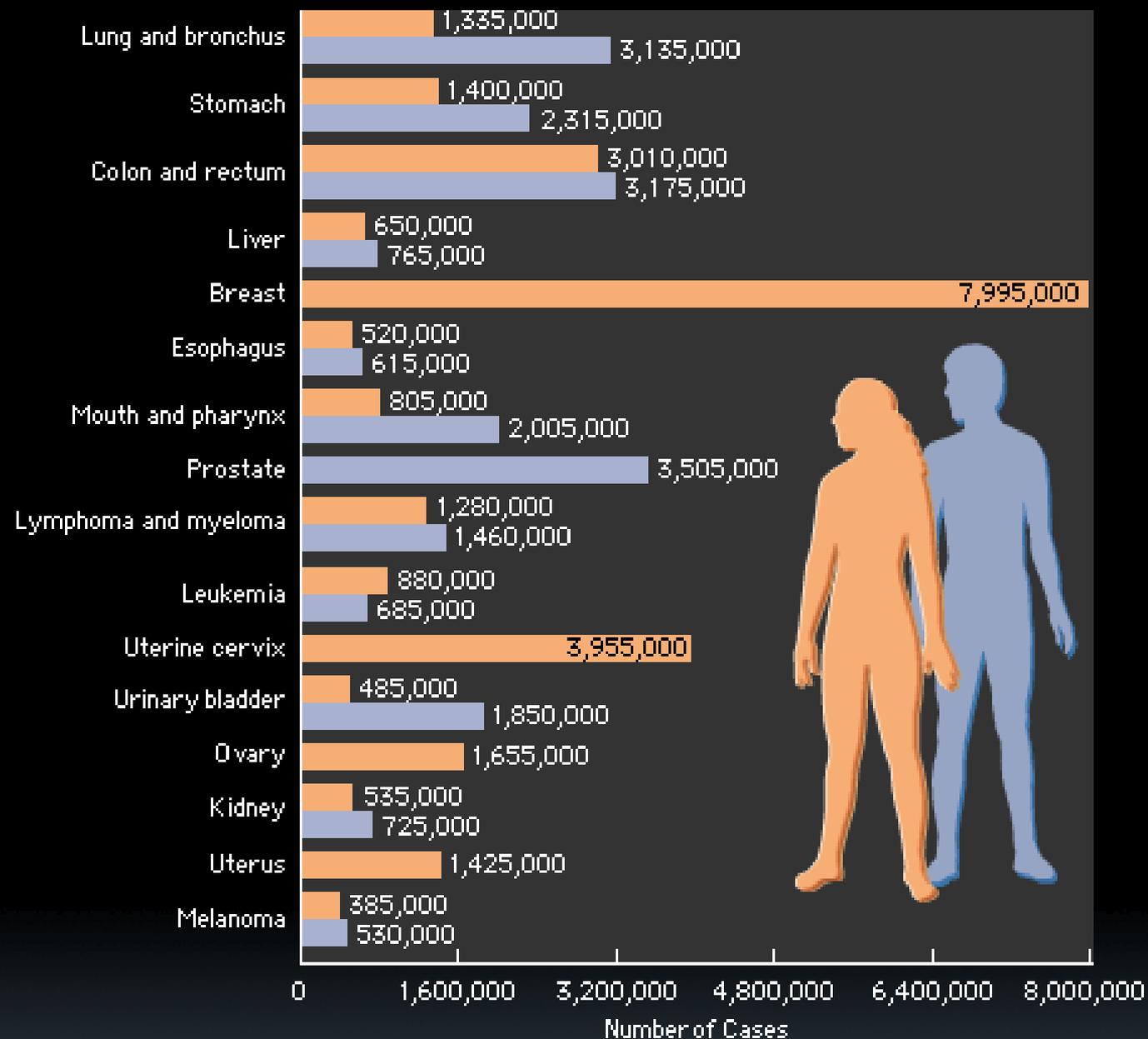


They are not localized; in a process called metastasis they shed cells that travel through the bloodstream and infect tissues at other locations. They can even establish malignant growth in a different type of tissue; a breast cancer can spread to bone tissue, for example.

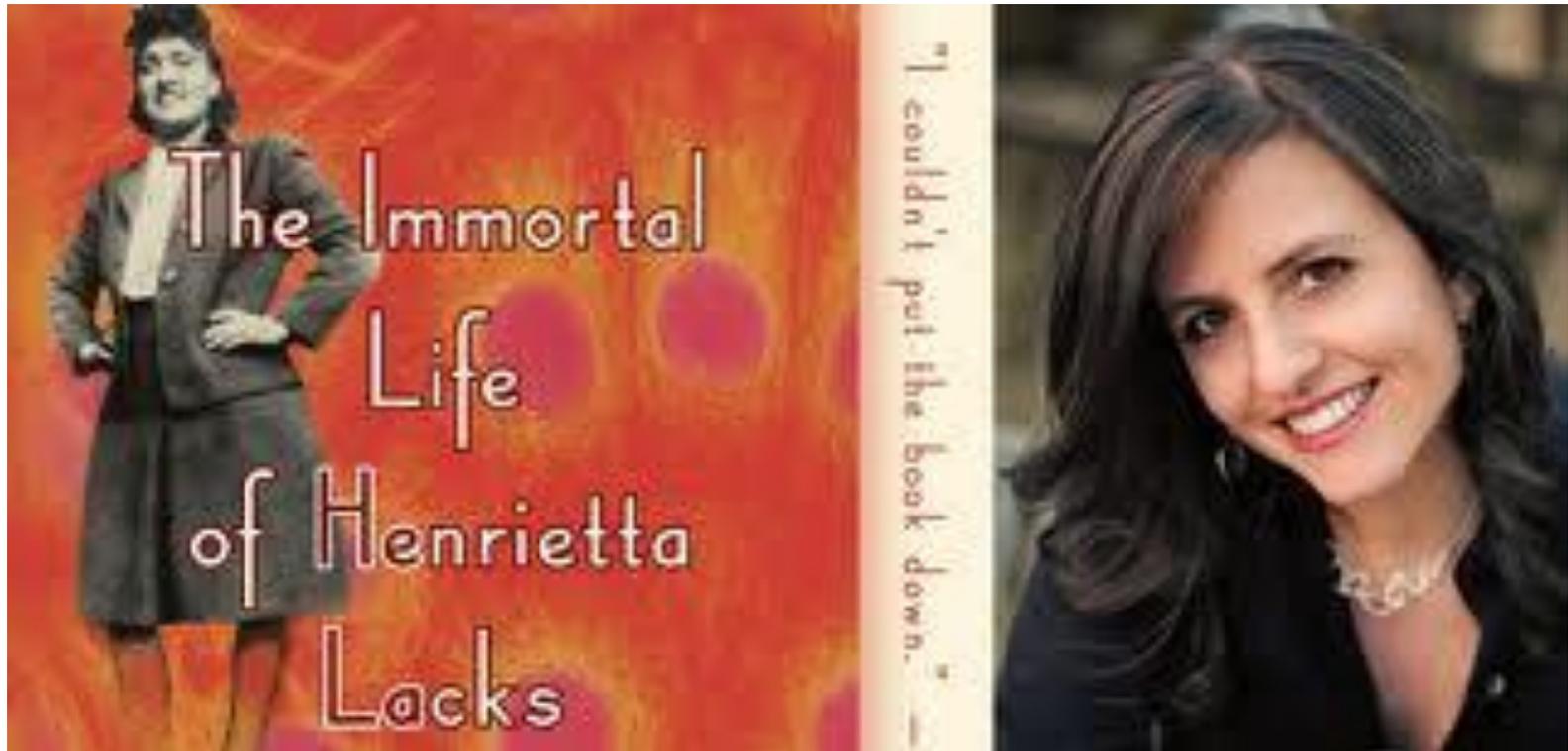
- Cancer is not just one disease, but **many diseases** – over **100 different** types of cancers



Prevalence of Cancer Worldwide* (1997)



*Source: *The World Health Report*, World Health Organization.



[HeLa cells](#)

[Ted Ed HeLa](#)

Phase	Chromosome Appearance & Location	Important Events
Interphase	DNA copies itself; chromatin	DNA replication, cell grows and replicates organelles
Prophase	Chromosomes coil up	Nuclear envelope disappears, spindle fibers form
Metaphase	Chromosomes line up in the middle	Spindle fibers connect to chromosomes
Anaphase	Chromosome copies divide and move apart	Spindle fibers pull chromosome copies apart to opposite poles
Telophase	Chromosomes uncoil back into chromatin	Nuclear envelopes reform, 2 new nuclei are formed, spindle fibers disappear
Cytokinesis	Chromatin	Division of the rest of the cell: cytoplasm and organelles