

5.1 The Cell Cycle

EQ('s):

Q1: If you want two batches of cookies, not just one, what do you need to do to the recipe?

Q2: How does this apply to cell division?

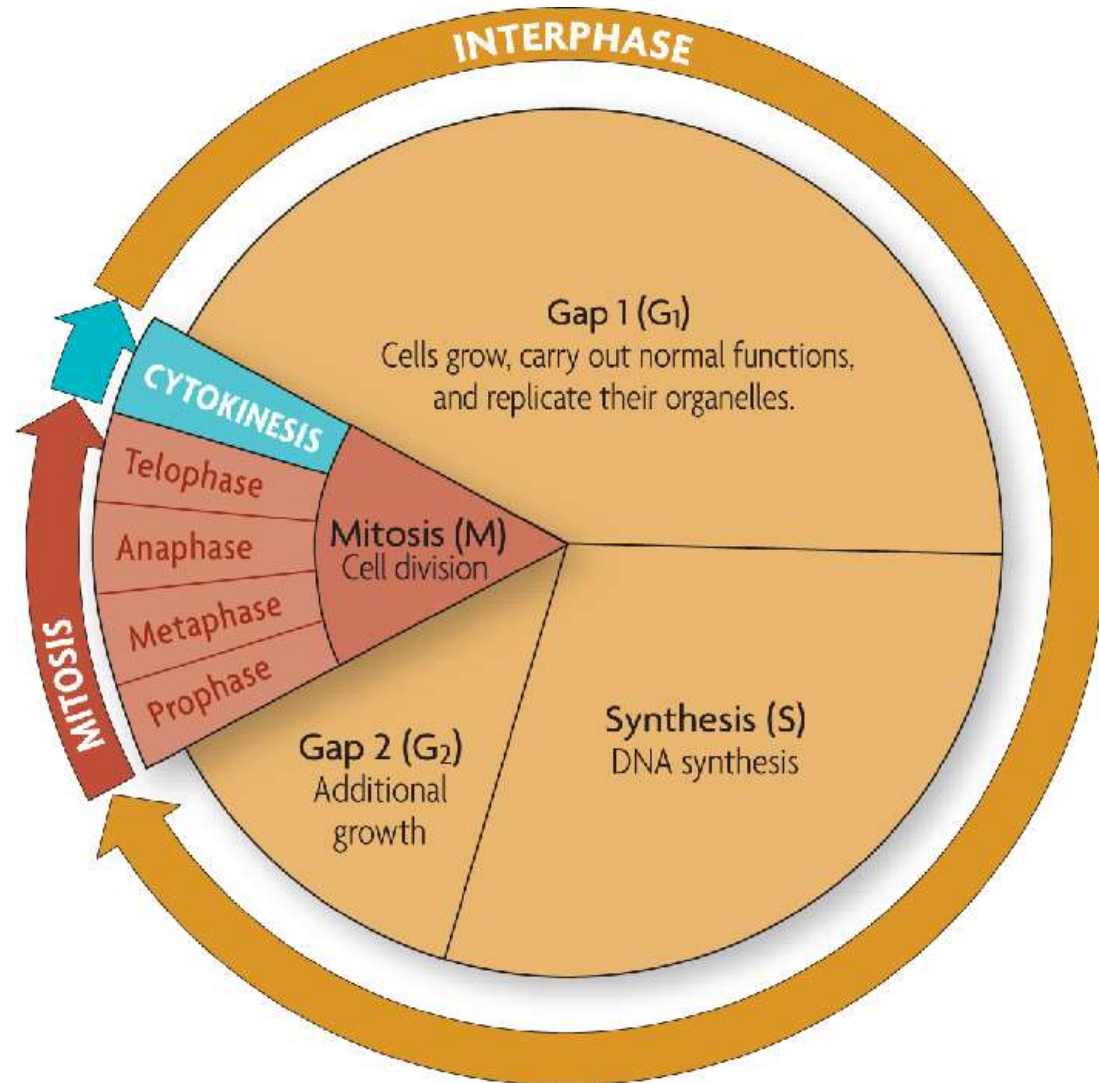


Cells
Alive!

5.1 The Cell Cycle

▶ Cell Cycle:

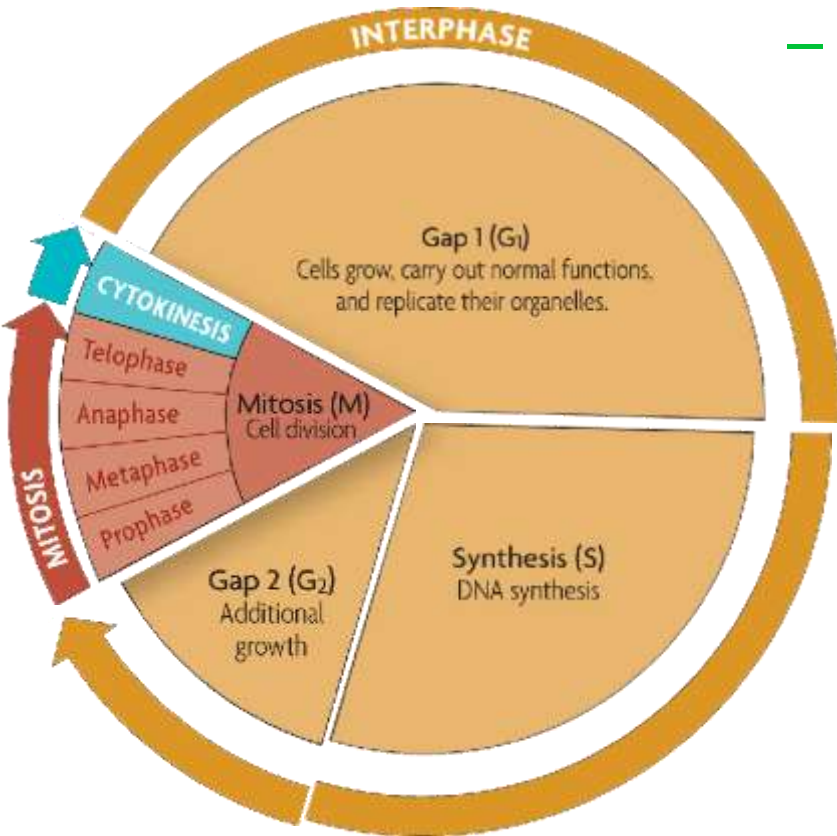
- The period between the “**birth**” and “**death**” of a cell.
- The **cell cycle** is a regular pattern of
 - **growth,**
 - **DNA replication,**
 - **and**
 - **cell division.**



- The main stages of the cell cycle are **Interphase, Mitosis** and **Cytokinesis**.

- **INTERPHASE:**

- where the cell **grows** and **replicates** (copies its **DNA**).
- is composed of **Gap 1, Synthesis, and Gap 2**.



- **Gap 1 (G₁):**

- cell **growth** and **normal** functions
- Cell grows to a point and problems begin to arise:

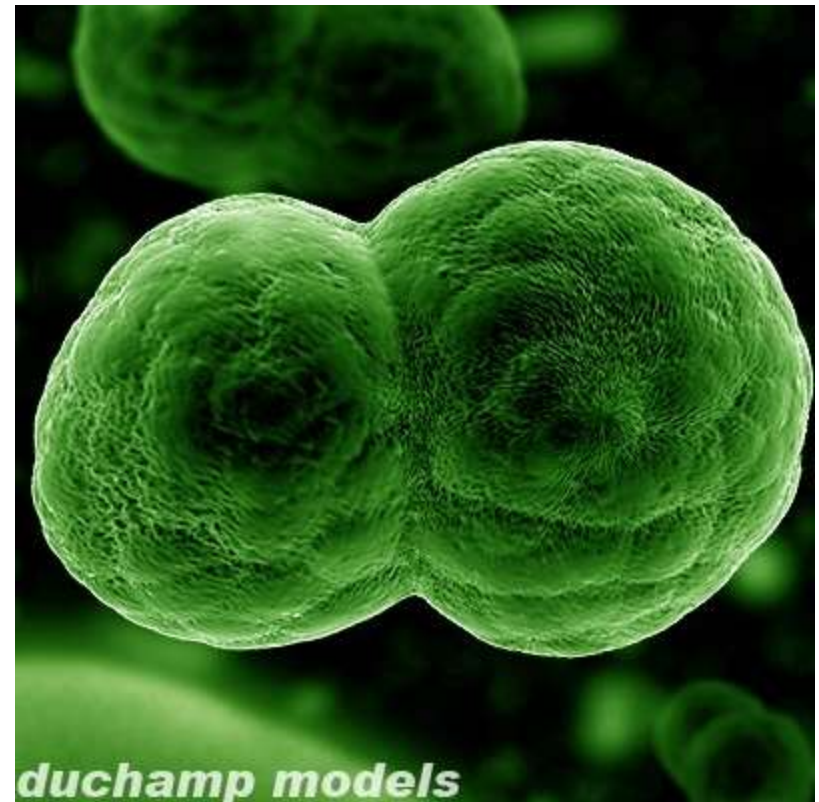
1. DNA will overload; if a cell gets too large, extra stress is put on the DNA in the cell
2. **Surface area** cannot accommodate the volume of the cell

- Cell will have to **divide**

5.1 The Cell Cycle

► Why do cells divide?

1. **Heal wounds**
2. **Grow new body parts**
3. **Replace dying cells**
4. **Produce eggs and sperm**



- **DNA synthesis (S):**

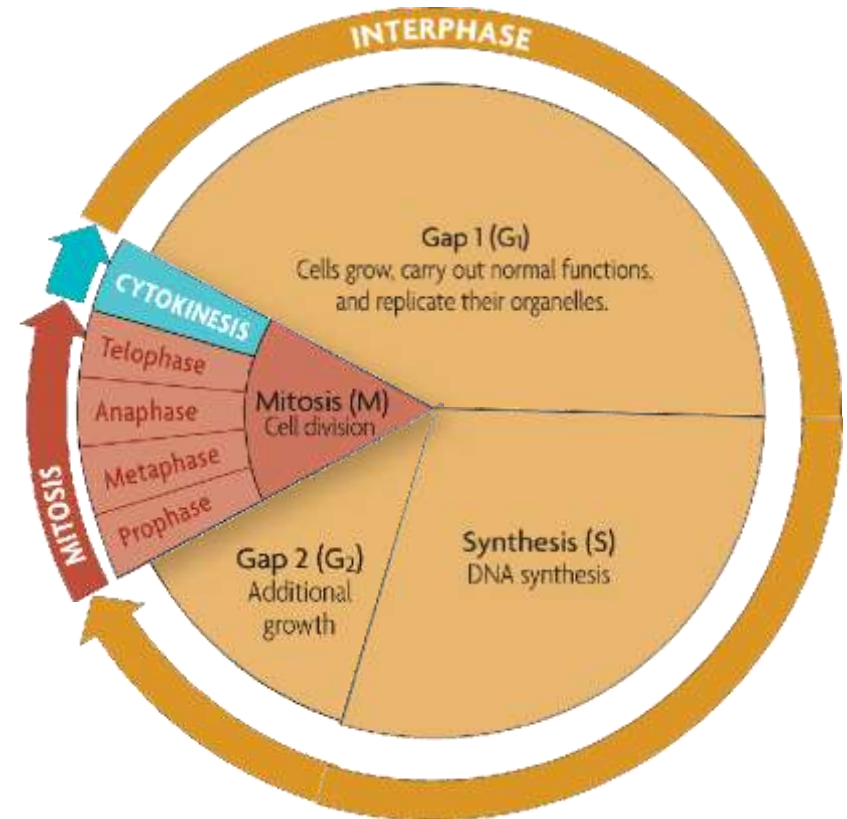
- copies DNA (DNA **Replication**)

- *More later...*

- **Gap 2 (G₂):**

- Cell continues to **grow**

- Makes sure the cell is ready to enter **mitosis**



- Mitosis occurs only if the cell is **large enough** and the DNA is **undamaged**.

5.1 The Cell Cycle

▶ Cells divide at different **rates**.

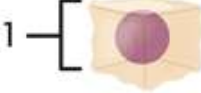
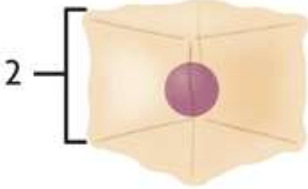
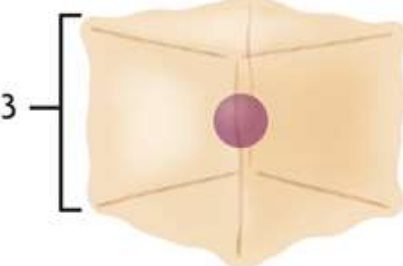
- The rate of cell division varies with the **need for those types of cells**.

CELL TYPE	APPROXIMATE LIFE SPAN
Skin cell	2 weeks
Red blood cell	4 months
Liver cell	300–500 days
Intestine—internal lining	4–5 days
Intestine—muscle and other tissues	16 years

- Some cells are unlikely to divide (G_0) – **neurons** and some **lymphocytes** rarely, infrequently, or never divide.

▶ Cell size is limited.

- Volume **increases faster** than surface area.
- **Surface area must allow for adequate exchange of materials.**

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

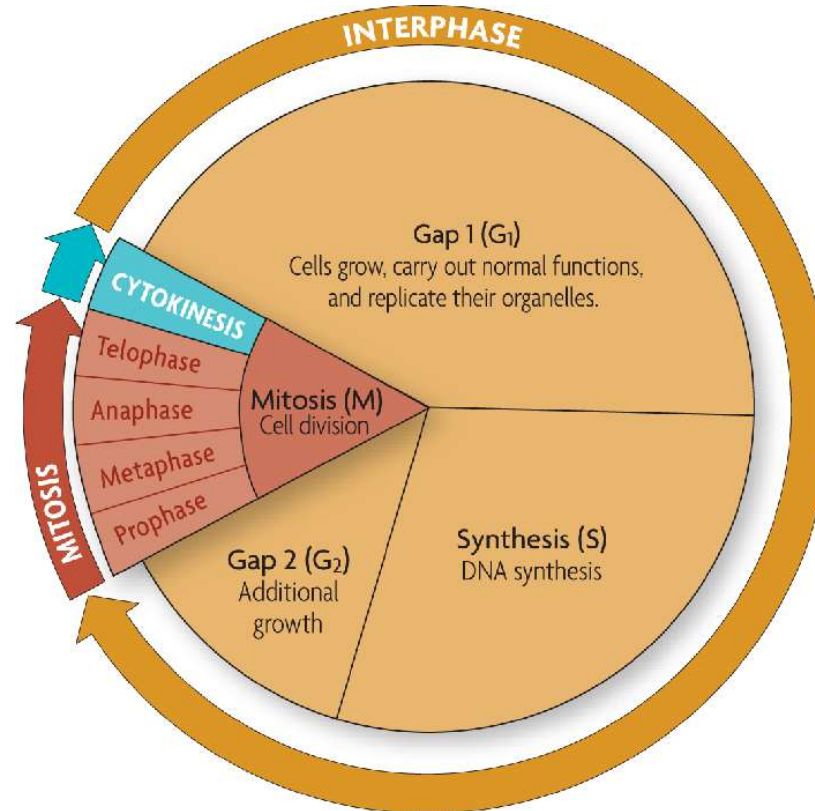
Q1: Which cell has the largest surface area?

Q2: Which cell size would be most efficient for transport and completing other cell activities?

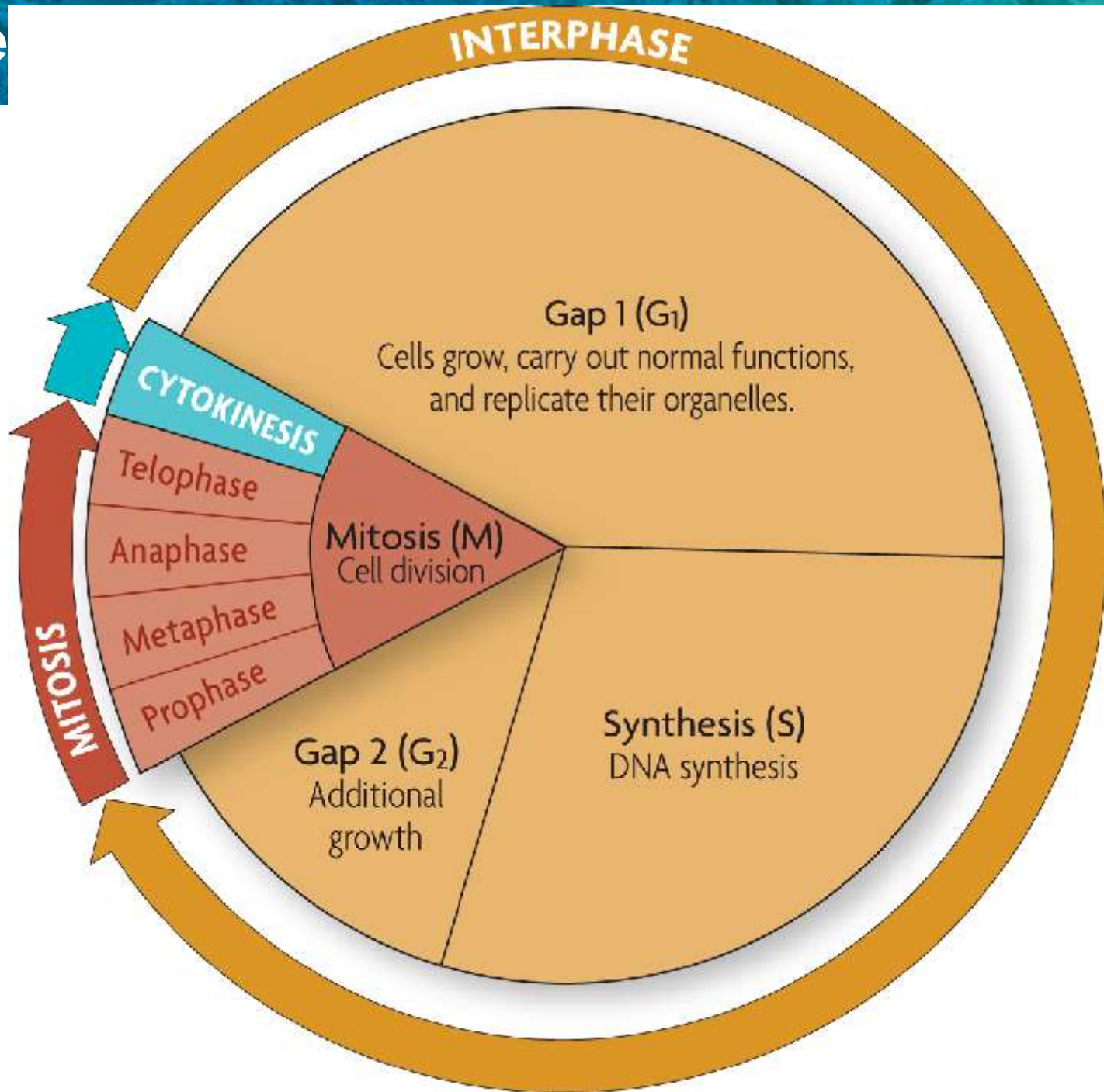
5.1 The Cell Cycle

▶ The cell cycle has four main stages.

- The cell cycle is a regular pattern of growth, DNA replication, and cell division.



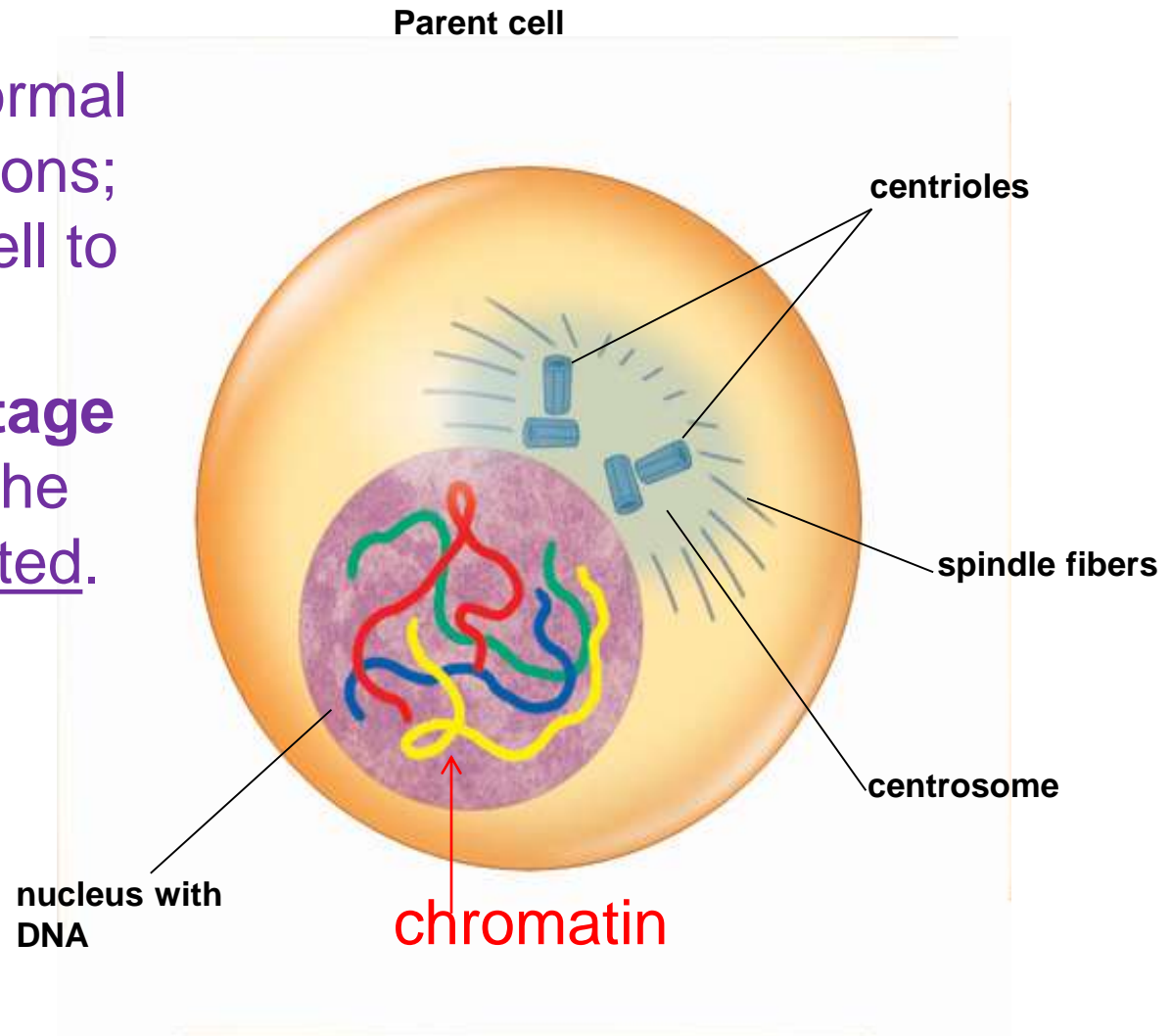
5.1 The



5.1 The Cell Cycle

- ▶ Mitosis and cytokinesis produce two genetically identical daughter cells.

1. **Interphase** normal growth & functions; prepares the cell to divide.
 - During the **S stage** of interphase, the DNA is duplicated.



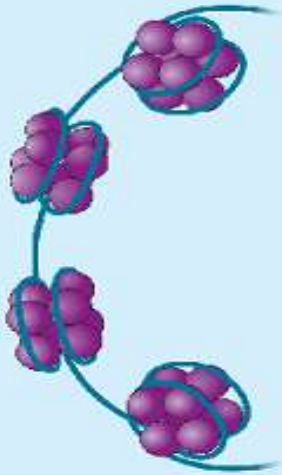
5.1 The Cell Cycle

▶ Chromosomes condense at the start of mitosis.

- DNA wraps around proteins (histones) that condense it.



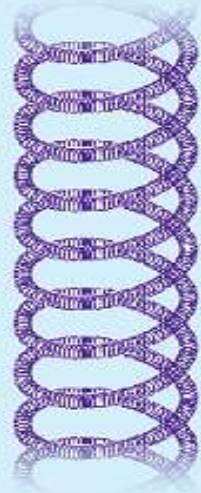
DNA double helix



DNA and histones



Chromatin



Supercoiled DNA

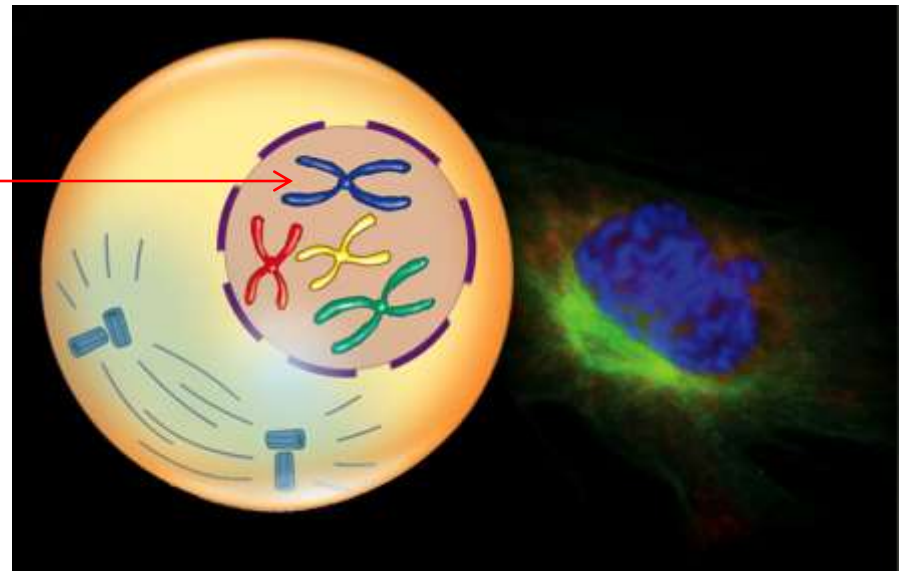


Condensed, duplicated chromosome

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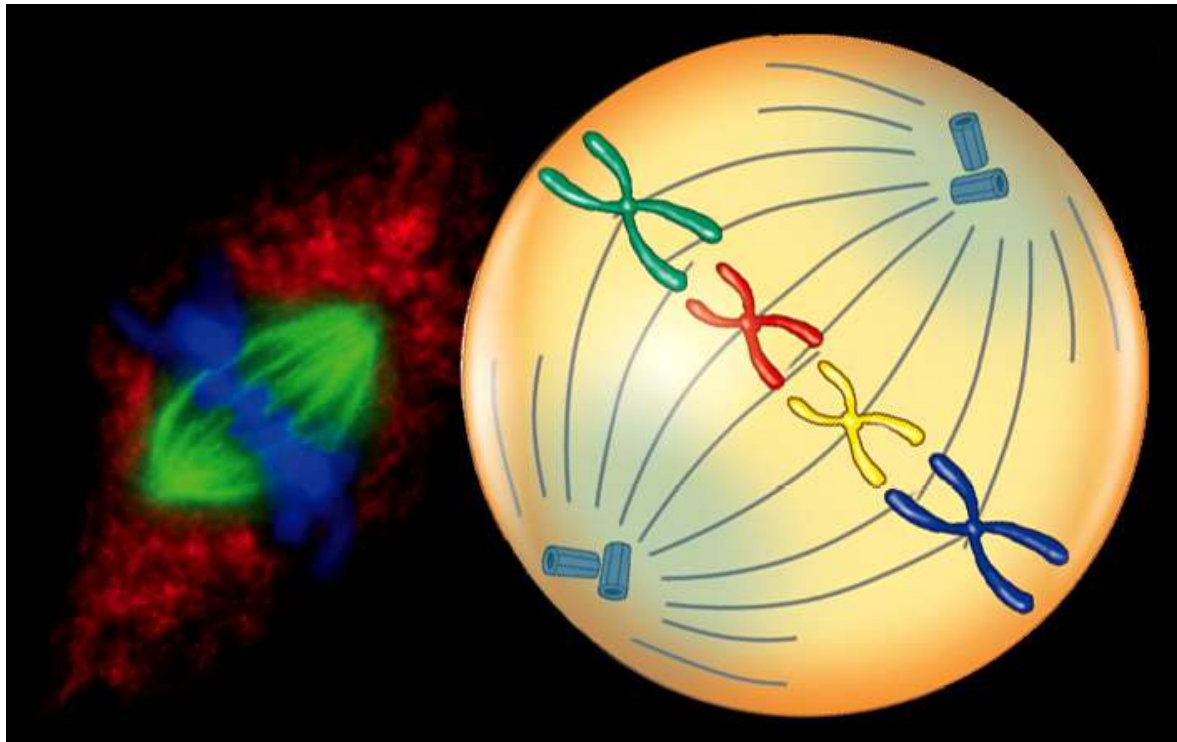
- Mitosis divides the cell's nucleus in **four phases**.
 2. During **MITOSIS: Prophase**, chromosomes condense and spindle fibers form.
 - Longest phase of mitosis
 - Centrioles move to opposite poles
 - Spindle fibers attach to centromeres of each chromatid
 - Near end: nucleolus disappears & nuclear envelope breaks down

duplicated
chromosomes



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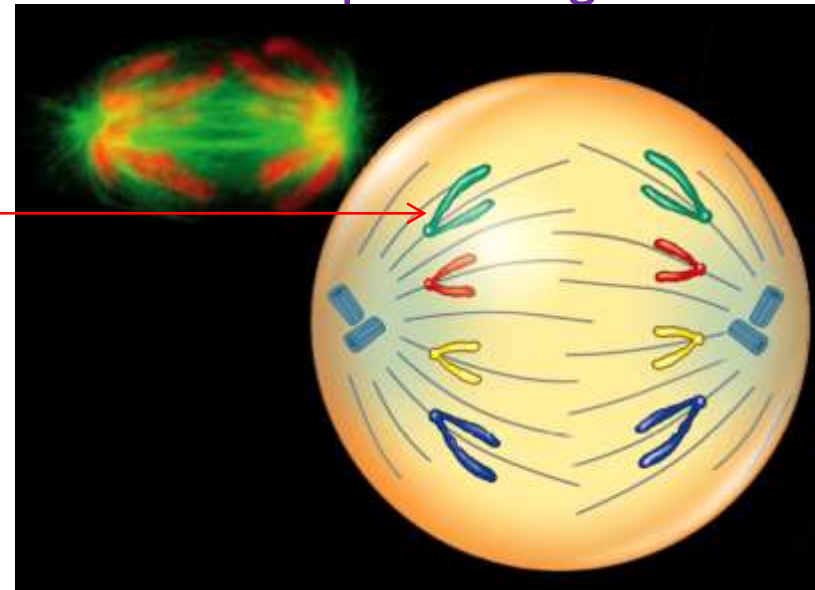
- Mitosis divides the cell's nucleus in four phases.
 3. During **MITOSIS: Metaphase**, chromosomes line up in the middle (equator) of the cell.
 - Very short phase
 - Microtubules connect centromeres to the poles of the spindle



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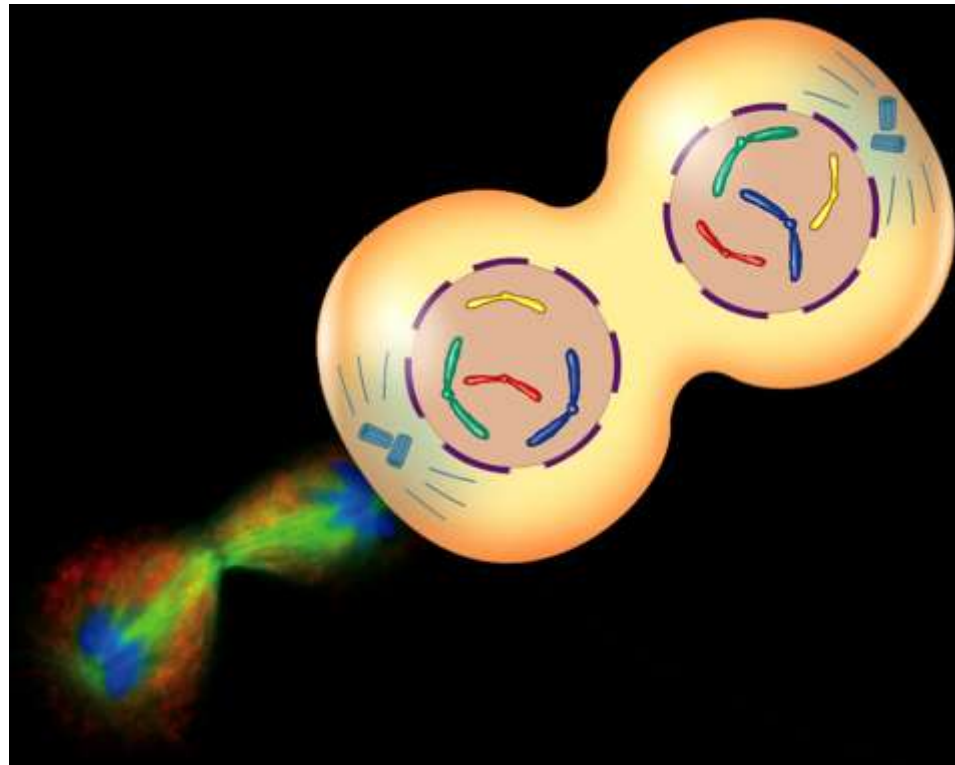
- Mitosis divides the cell's nucleus in four phases.
 4. During **MITOSIS: Anaphase**, sister chromatids separate to opposite sides of the cell.
 - Centromeres that join sister chromatids separate to become individual chromosomes
 - Chromosomes continue to move until they have separated into 2 groups near the poles of the spindle
 - Anaphase ends when the chromosomes stop moving

chromosomes



5.1 The Cell Cycle

- Mitosis divides the cell's nucleus in four phases.
 5. During **MITOSIS: Telophase**, the new nuclei form and chromosomes begin to uncoil.
 - Nuclear envelope reforms around each cluster of chromosomes
 - Spindle begins to break apart & nucleolus becomes visible



5.1 The Cell Cycle

- **6. Cytokinesis** differs in animal and plant cells.
 - Splitting of the cytoplasm
 - In animal cells, the membrane pinches closed.
 - In plant cells, a cell plate forms.

