CONCEPT: MITOSIS

Mitosis Entry

● Cells must pass through interphase, G_1 phase, S phase and G_2 phase before _____ into mitosis

□ **M-cyclins and Cdks** are responsible for entering the cell into mitosis

- These M-Cdks are activated by **Cdc25**

- Cdc25 is a phosphatase enzyme that removes inhibitory phosphates from the Cdk active site

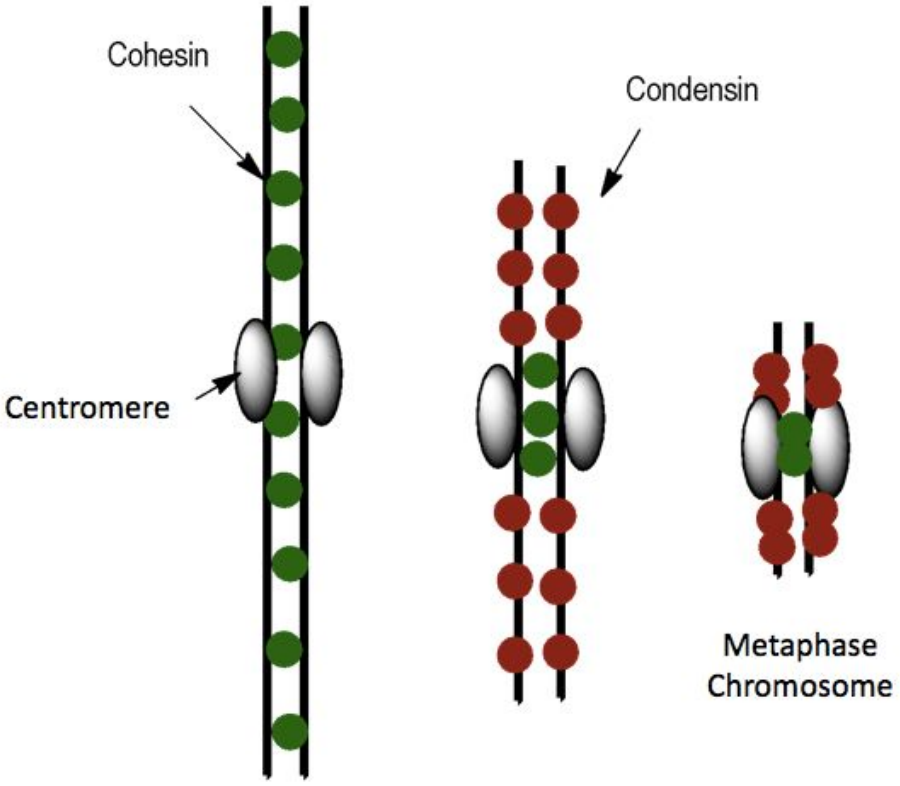
□ M-Cdks instigate chromosomal condensation – which is _____ for mitosis

- **Condensins** are protein complexes that assist in chromosomal condensation and segregation

- **Sister chromatids** are identical copies of a replicated chromosome attached via a centromere

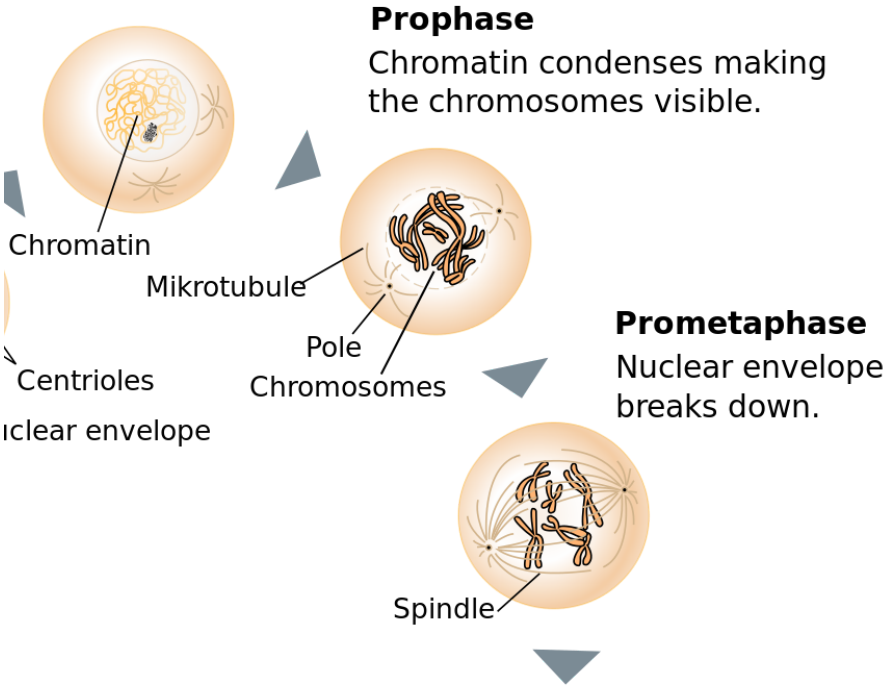
- **Cohesins** are protein complexes that hold two sister chromatids together and regulate their separation during anaphase

EXAMPLE: Cohesin and Condensin on sister chromatids



Steps of Mitosis

- Mitosis occurs in 6 steps
  - □ **Prophase** is when the *mitotic spindle* forms
    - The **mitotic spindle** is a network of **asters** (microtubules) and centrosomes that control mitosis
    - It is organized into two distinct **spindle poles** where microtubules are connected to centrosomes
    - Mitotic spindle forms via centrosome duplication (S phase) which move to opposite side of nucleus
  - □ **Prometaphase** is when the nuclear envelope is disassembled
    - Microtubules extending from the mitotic spindle attach to duplicated chromosomes (**kinetochores)**
    - Sister chromatids have a **bi-orientation,** meaning that they are attached to opposite spindle poles



  - □ **Metaphase** is when duplicated chromosomes align at the spindle equator
    - **Metaphase plate** forms with a line of chromosomes along the equator
    - **Spindle assembly checkpoint** check to see if the chromosomes align properly at metaphase plate
      - Delays entry into anaphase if they aren't aligned properly

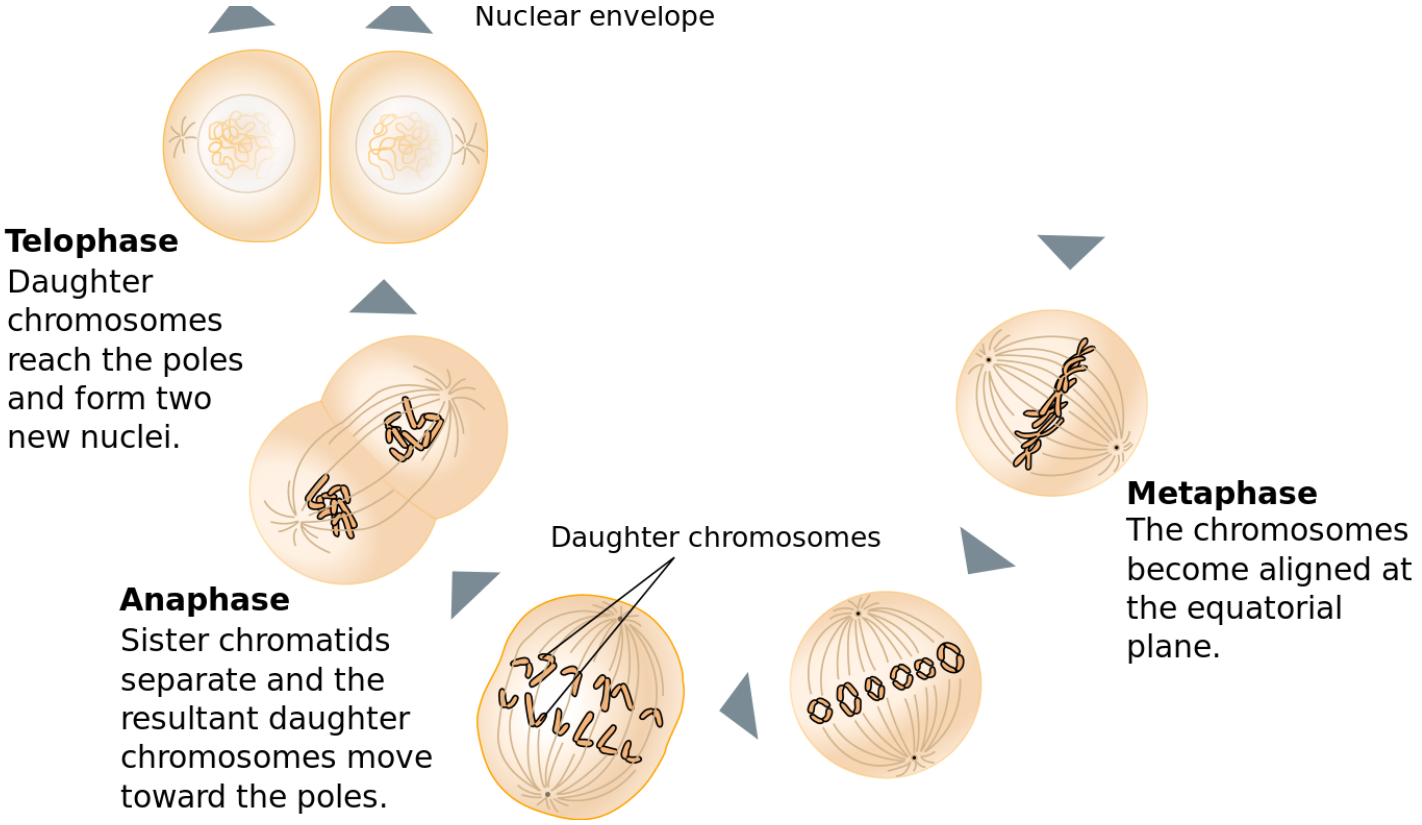
□ **Anaphase** is when cohesion is broken by *separase* and each sister chromatid is pulled to the spindle pole

- **A:** Sister chromatids begin moving towards the poles

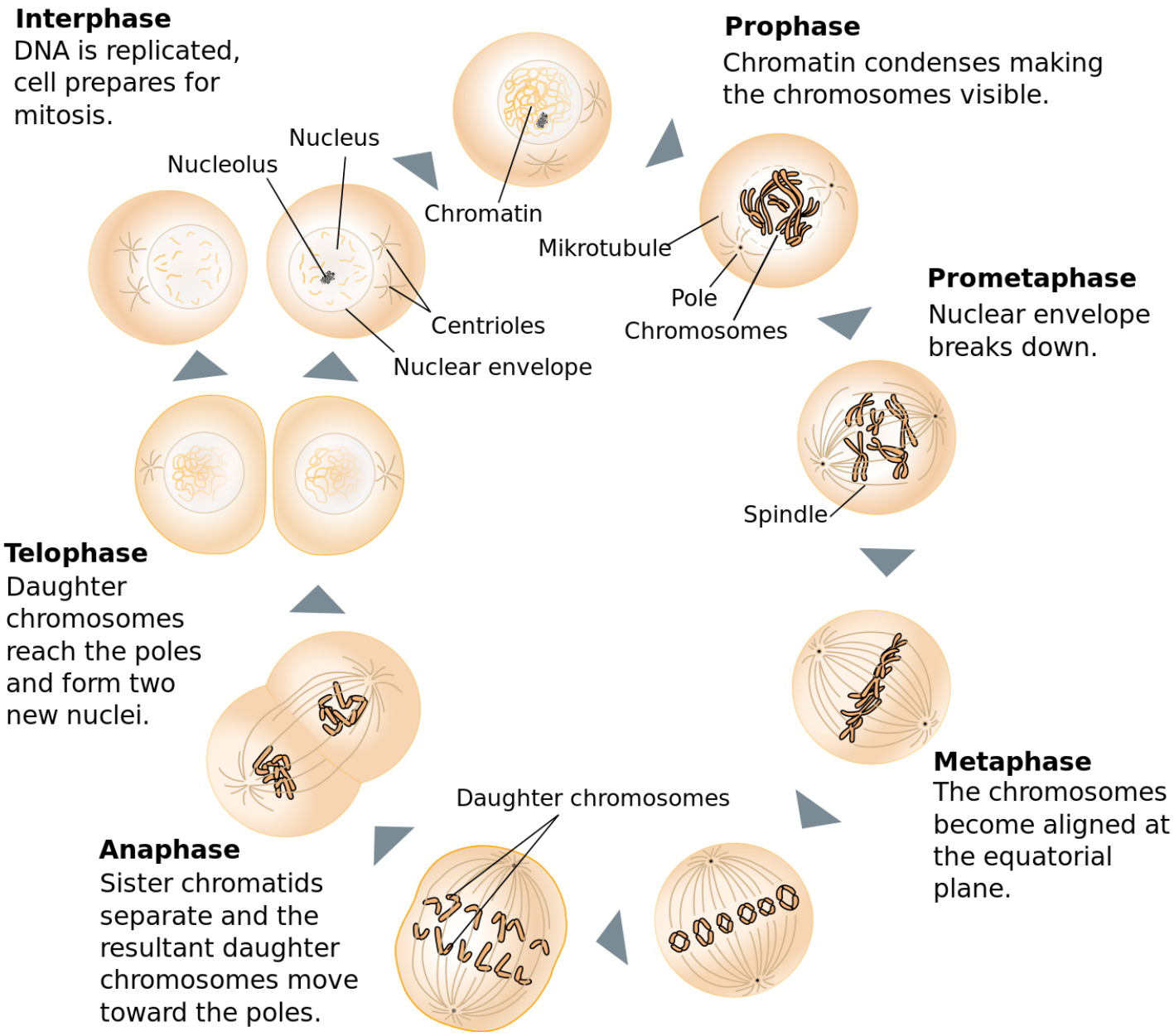
- **B:** The spindle poles move apart – further segregating the sister chromatids

- **Anaphase promoting complex** begins to form to degrade M phase cyclins (to prevent repeat of mitosis)

□ **Telophase** is when the nuclear envelope reforms and mitotic spindle disassembles



EXAMPLE: Overview of Mitosis



PRACTICE:

1. Which of the following is the correct order of mitosis?
    a. Prophase → Prometaphase → Anaphase → Metaphase → Telophase
    b. Prophase → Prometaphase → Metaphase → Anaphase → Telophase
    c. Prophase → Telophase → Anaphase → Metaphase → Prometaphase
    d. Prophase → Anaphase → Prometaphase → Metaphase → Telophase

2. In which of the following steps do the sister chromatids separate?
    a. Prophase
    b. Prometaphase
    c. Metaphase
    d. Anaphase
    e. Telophase

3. In which of the following steps does the cell cross the spindle assembly checkpoint?

a. Prophase
b. Prometaphase
c. Metaphase
d. Anaphase
e. Telophase

4. The nuclear envelope begins to reform in which of the following steps?

a. Prophase
b. Prometaphase
c. Metaphase
d. Anaphase
e. Telophase