Chapter 8
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The Cellular Basis of Reproduction and Inheritance

PowerPoint Lectures for

***Biology: Concepts & Connections,* Sixth Edition**

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CONNECTIONS BETWEEN CELL DIVISION AND REPRODUCTION

8.1 Like begets like, more or less

- Living organisms reproduce by two methods
  - **Asexual reproduction**
    - Offspring are identical to the original cell or organism
    - Involves inheritance of all genes from one parent
  - **Sexual reproduction**
    - Offspring are similar to parents, but show variations in traits
    - Involves inheritance of unique sets of genes from two parents

8.3 Prokaryotes reproduce by binary fission

- **Binary fission means "dividing in half"**

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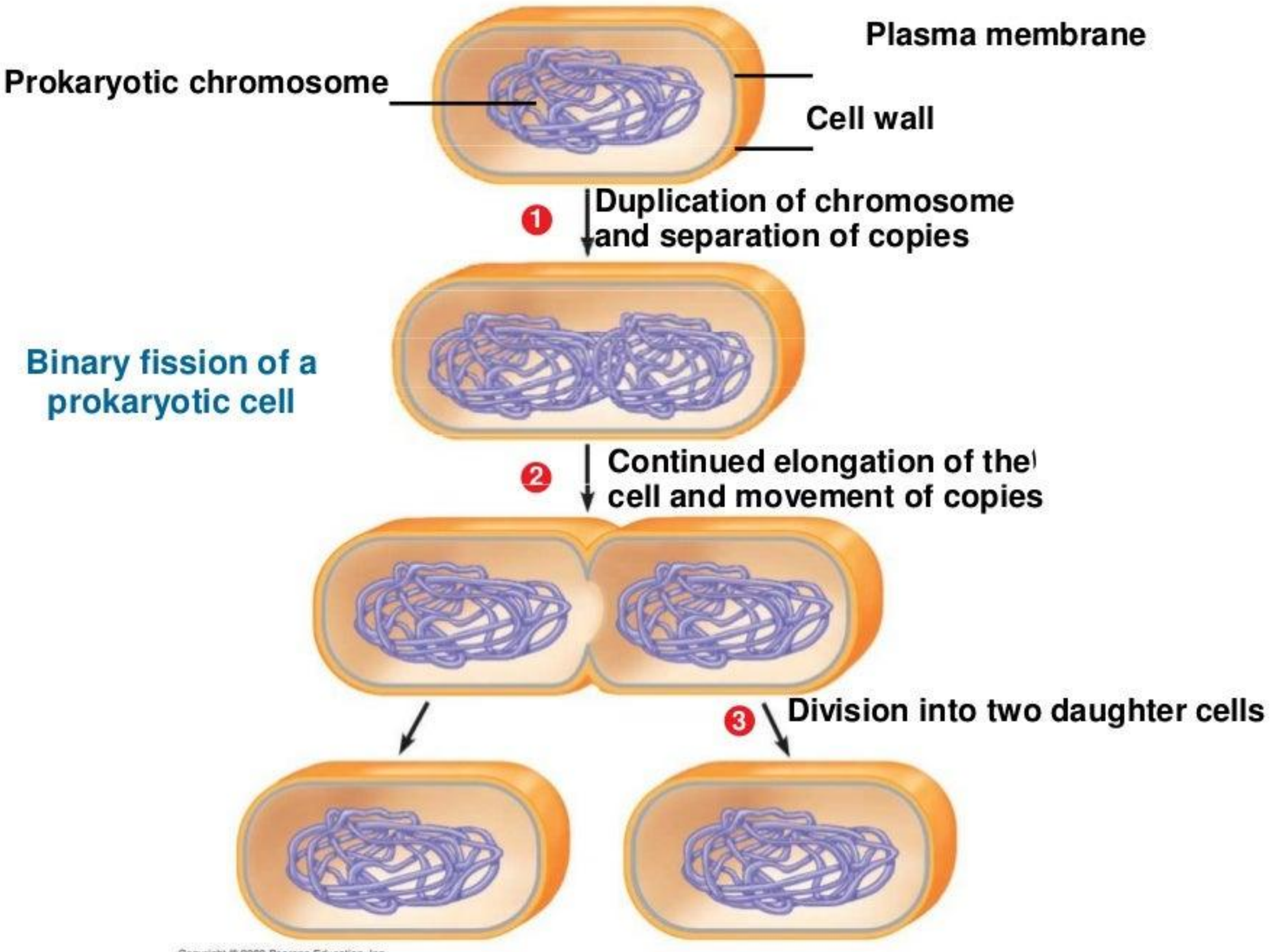
  - **Occurs in prokaryotic cells**
  - **Two identical cells arise from one cell**
  - **Steps in the process:**

    :–

    - **A single circular chromosome duplicates, and the copies begin to separate from each other**
    - **The cell elongates, and the chromosomal copies separate further**
    - **The plasma membrane grows inward at the midpoint to divide the cells**

Binary fission of a prokaryotic cell



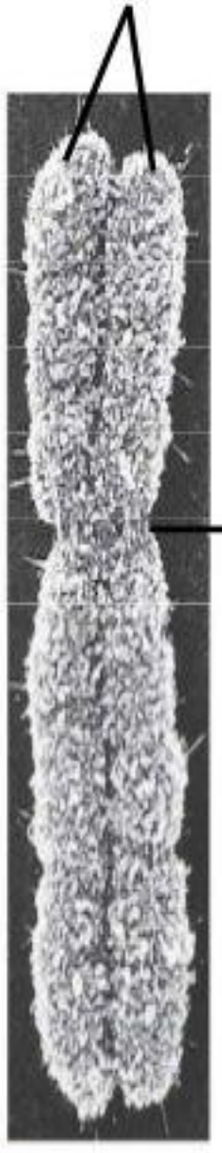
THE EUKARYOTIC CELL CYCLE AND MITOSIS

8.4 The large, complex chromosomes of eukaryotes duplicate with each cell division

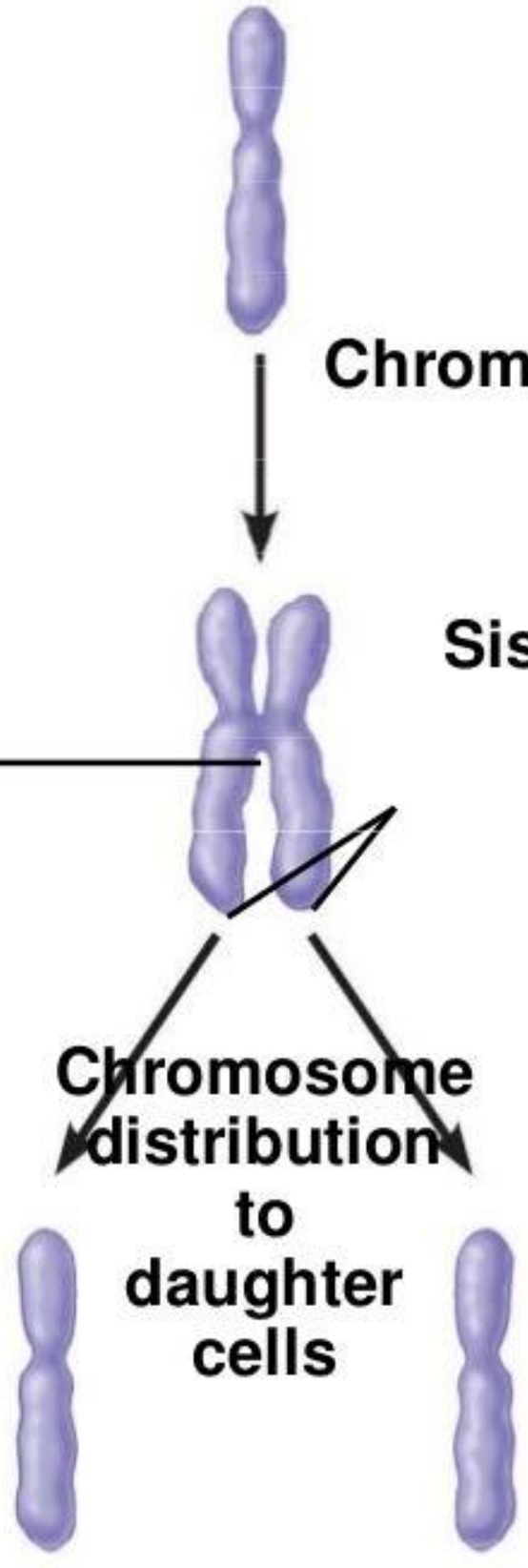
- **Eukaryotic chromosomes are composed of chromatin**
  - **Chromatin = DNA + proteins**
  - **To prepare for division, the chromatin becomes highly compact, and the chromosomes are visible with a microscope**
  - **Early in the division process, chromosomes duplicate**
  - **Each chromosome appears as two sister chromatids, containing identical DNA molecules**
  - **Sister chromatids are joined at the centromere, a narrow region**

Sister chromatids

Centromere



Electron micrograph
of a duplicated chromosome



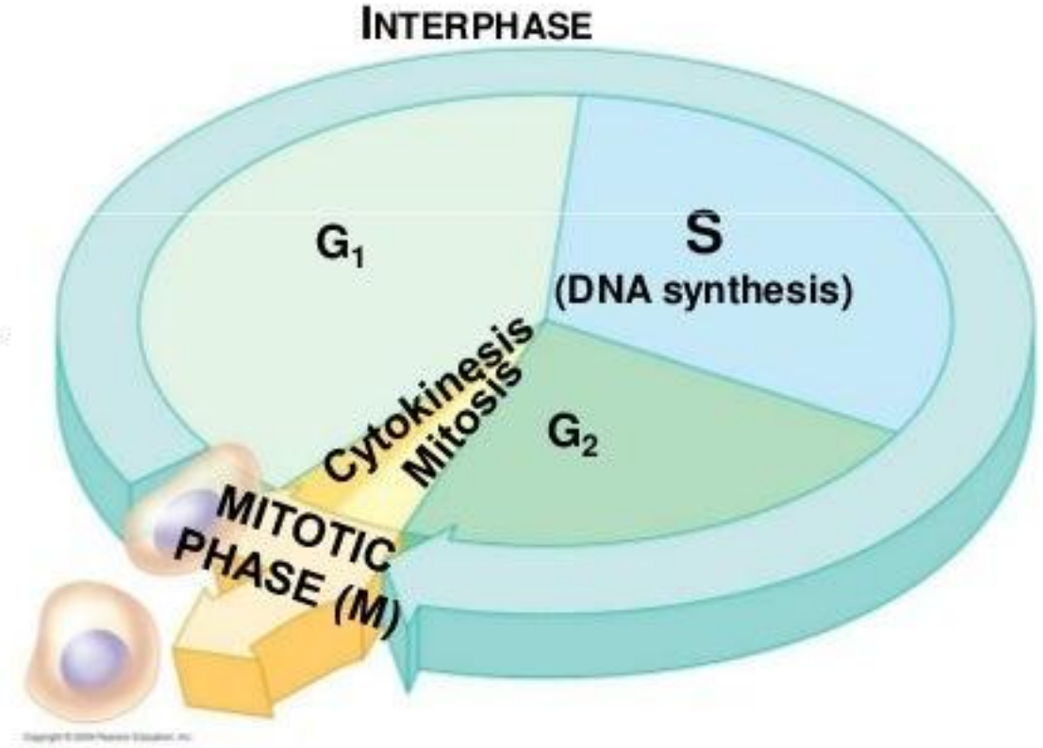
Chromosome duplication
and distribution

8.5 The cell cycle multiplies cells

- **The cell cycle** is an ordered sequence of events for cell division
- It consists of two stages

Interphase: duplication of cell contents
G1: growth, increase in cytoplasm
S: duplication of chromosomes
G2: growth, preparation for division

Mitotic phase: divisiMitosis: division of the nucleus
Cytokinesis: division of cytoplasm



The eukaryotic cell cycle

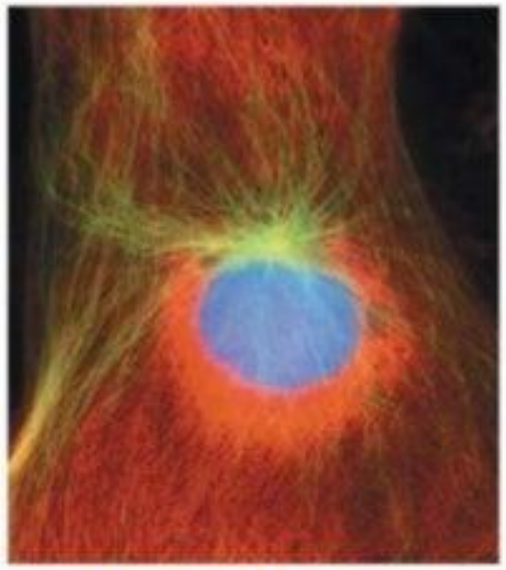
8.6 Cell division is a continuum of dynamic changes

- **Mitosis** progresses through a series of stages
  - **Prophase**
  - **Prometaphase**
  - **Metaphase**
  - **Anaphase**
  - **Telophase**

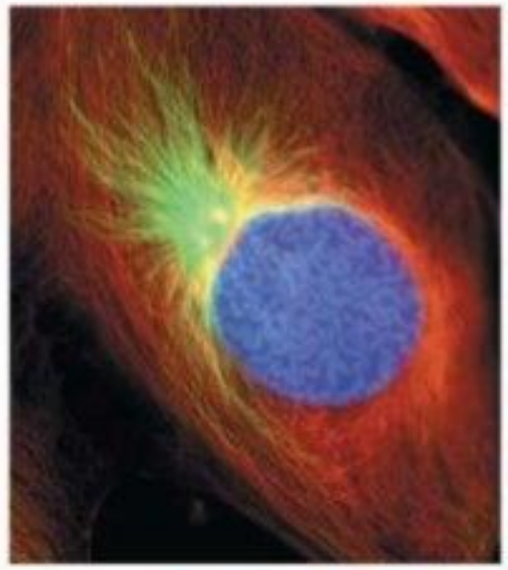
- **Cytokinesis** often overlaps telophase

8.6 Cell division is a continuum of dynamic changes

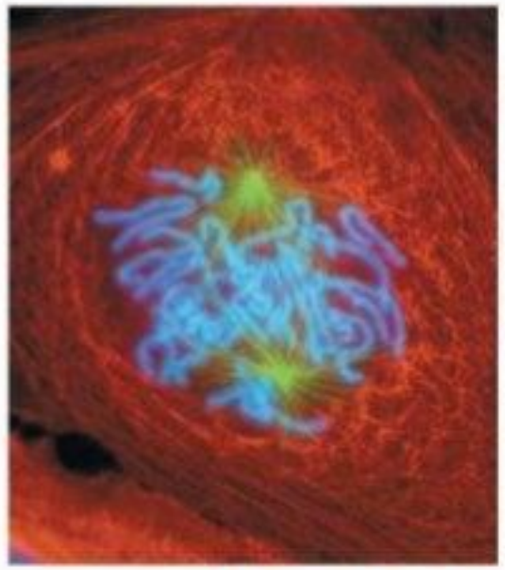
- **A mitotic spindle** is required to divide the chromosomes
  - **The mitotic spindle is composed of microtubules**
  - **It is produced by centrosomes, structures in the cytoplasm that:**
    - **Organize microtubule arrangement**
    - **Contain a pair of centrioles in animal cells**
  - **The role of centrioles in cell division is unclear**



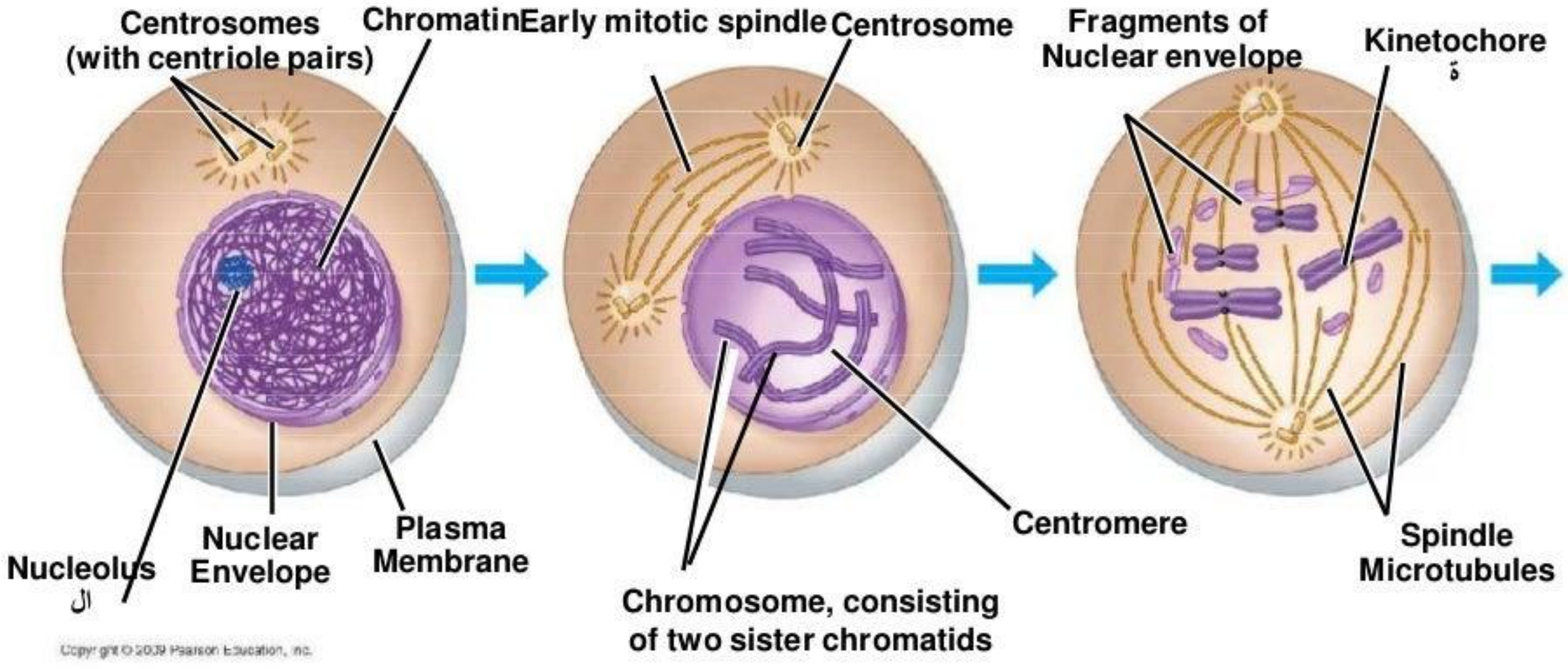
INTERPHASE



PROPHASE

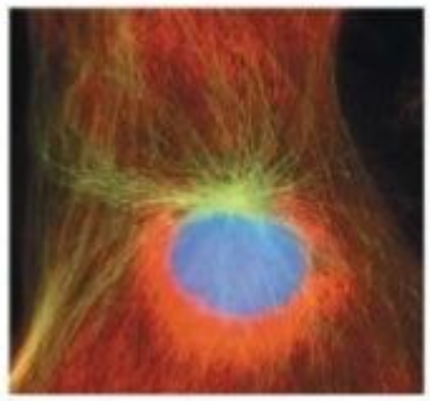


PROMETAPHASE

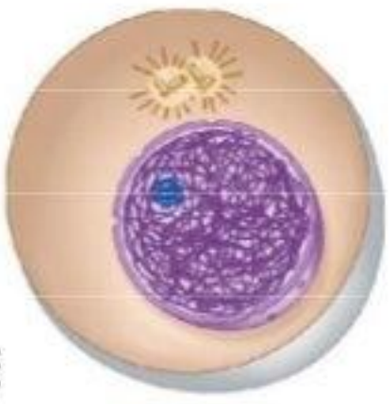


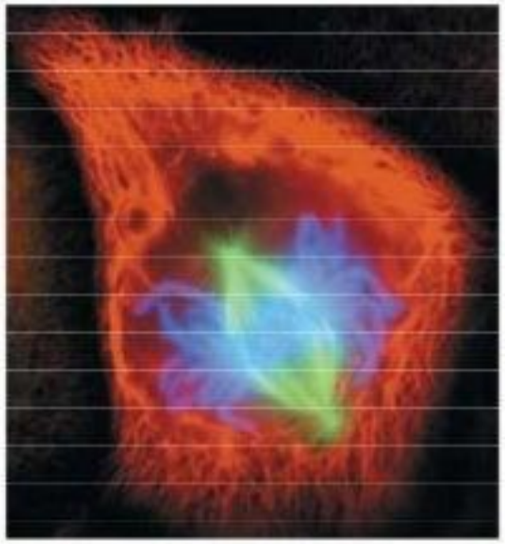
8.6 Cell division is a continuum of dynamic changes

- Interphase

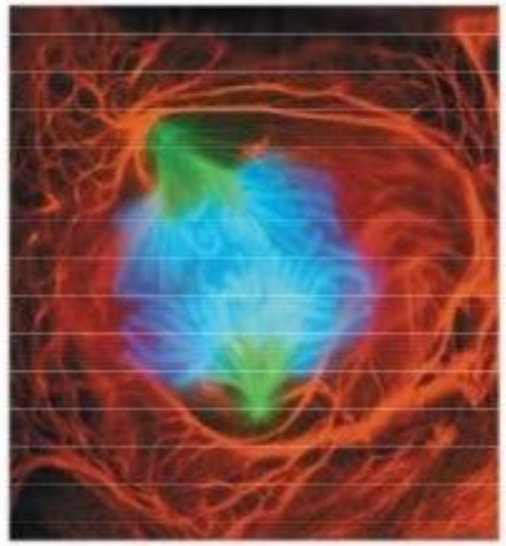


  - In the cytoplasm
    - Cytoplasmic contents double
    - Two centrosomes form
  - In the nucleus
    - Chromosomes duplicate during the S phase
    - Nucleoli, sites of ribosome assembly, are visible

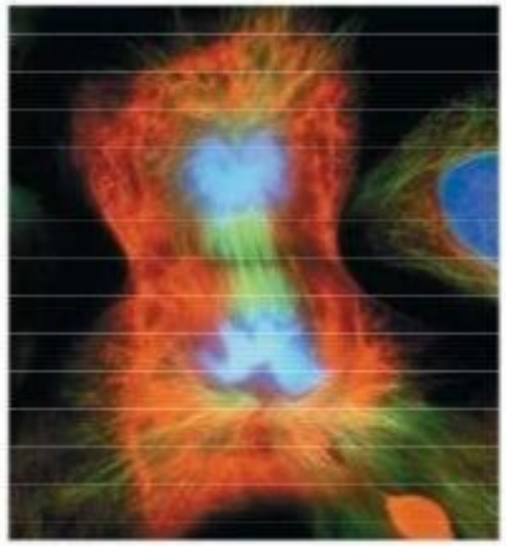




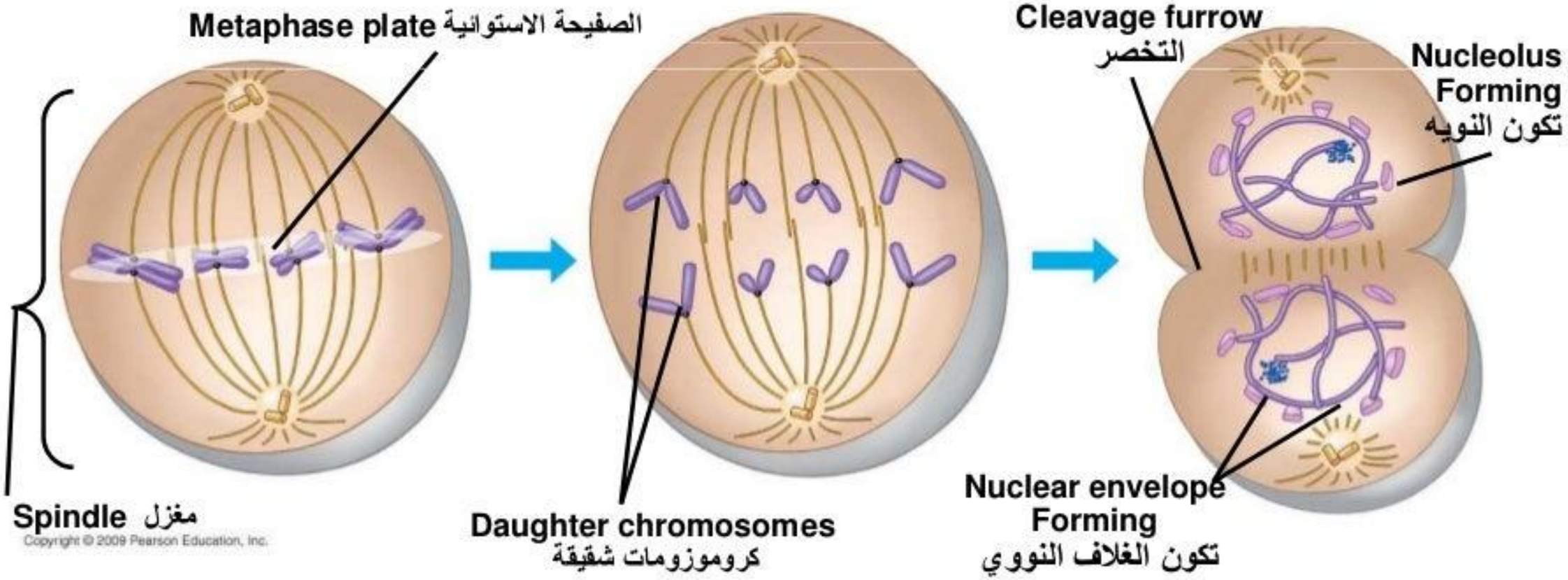
الطور الاستوائي METAPHASE



الطور الانفصالي ANAPHASE

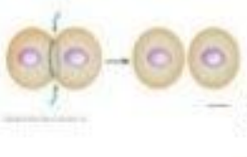


TELOPHASE AND CYTOKINESIS
الطور النهائي والانقسام السيتوبلازمي



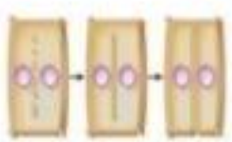
8.7 Cytokinesis differs for plant and animal cells

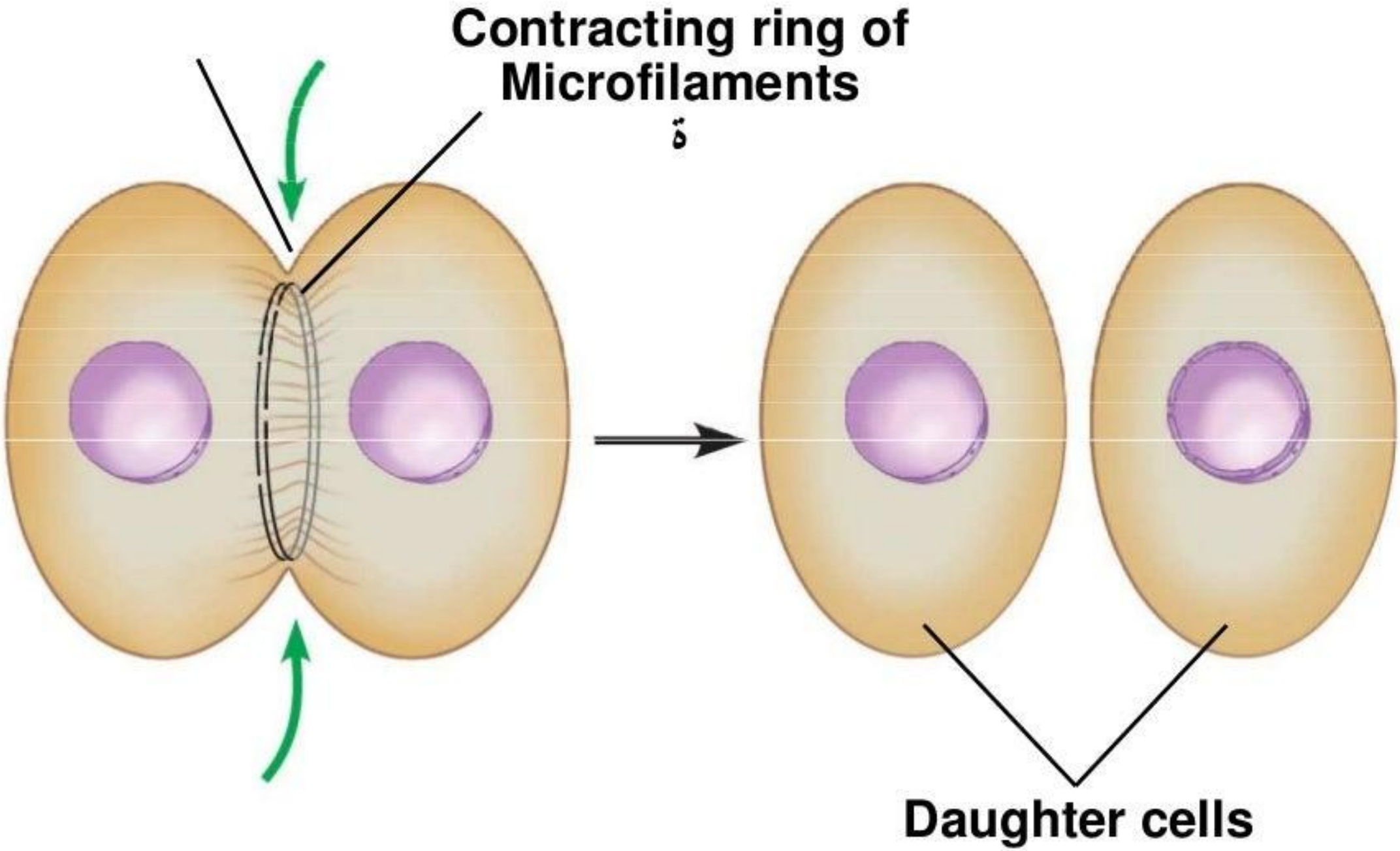
- **Cytokinesis** **Cleavage in animal cells**
  - A cleavage furrow forms from a contracting ring of microfilaments, interacting with myosin
  - The cleavage furrow deepens to separate the contents into two cells

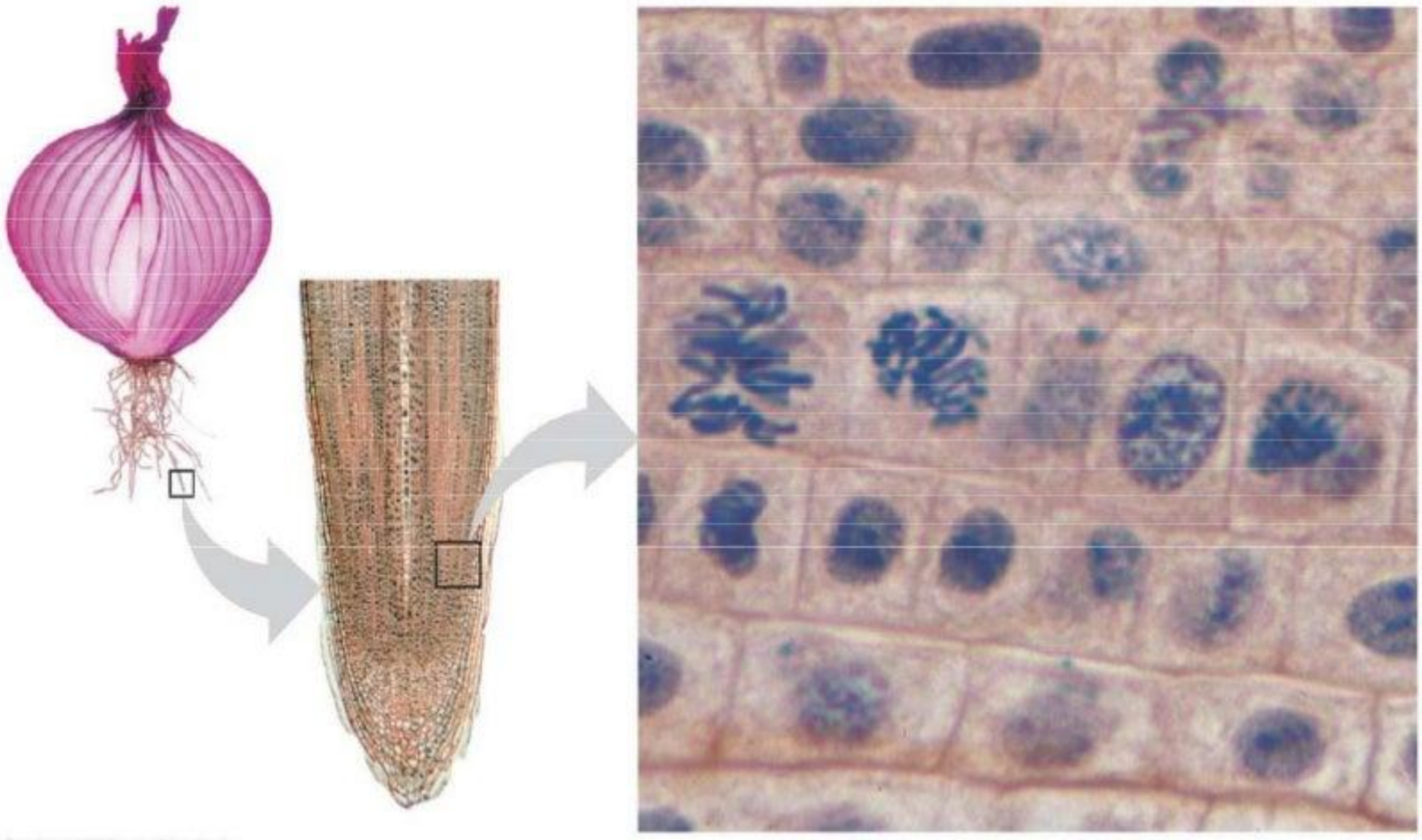


Cytokinesis in plant cells

- A cell plate forms in the middle from vesicles containing cell wall material
- The cell plate grows outward to reach the edges, dividing the contents into two cells
- Each cell has a plasma membrane and cell wall







Growth (in an onion root)

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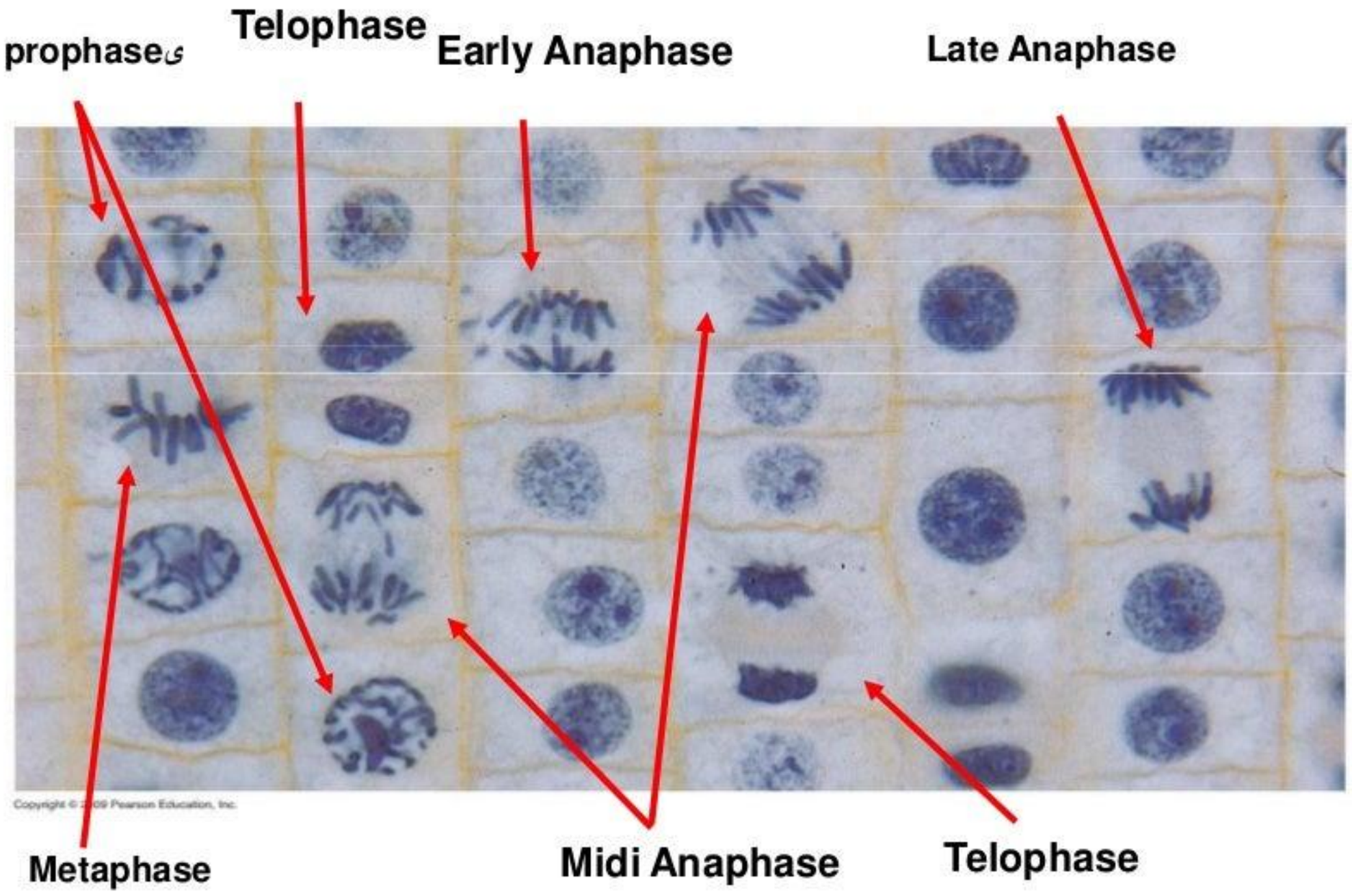
Mitosis



MEIOSIS AND CROSSING OVER

8.12 Chromosomes are matched in homologous pairs

- **Somatic cells** have pairs of homologous chromosomes, receiving one member of each pair from each parent
  - **Length**
  - **Centromere position**
  - **Gene locations**
    - **A locus (plural, *loci*) is the position of a gene**
    - **Different versions of a gene may be found at the same locus on maternal and paternal chromosomes**