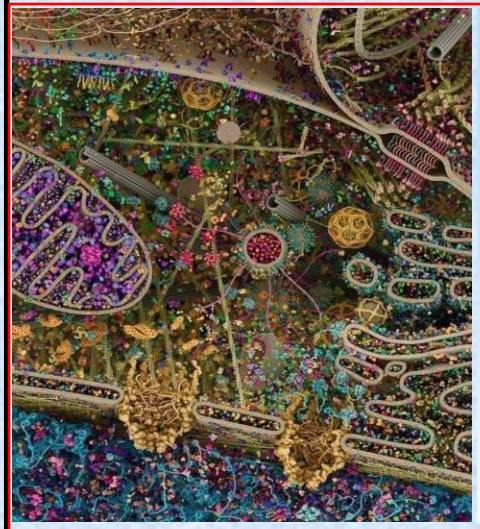
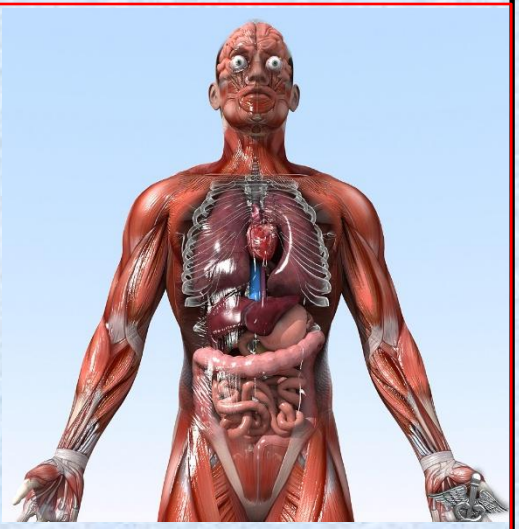
General Animal Biology

Zoo-109 | علم الأحياء | **109- حـيـن**





For Pre-Medical Students **Common First Year**

السنة الأولى المشتركة - المسار الصحي

1447-H – 2026

Reference: *Campbell, N. A. and Reece, J. B. (2014). Biology (10th edition). Pearson Education. Inc. USA.*

عمادة التعليم الإلكتروني والتعلم عن بعد
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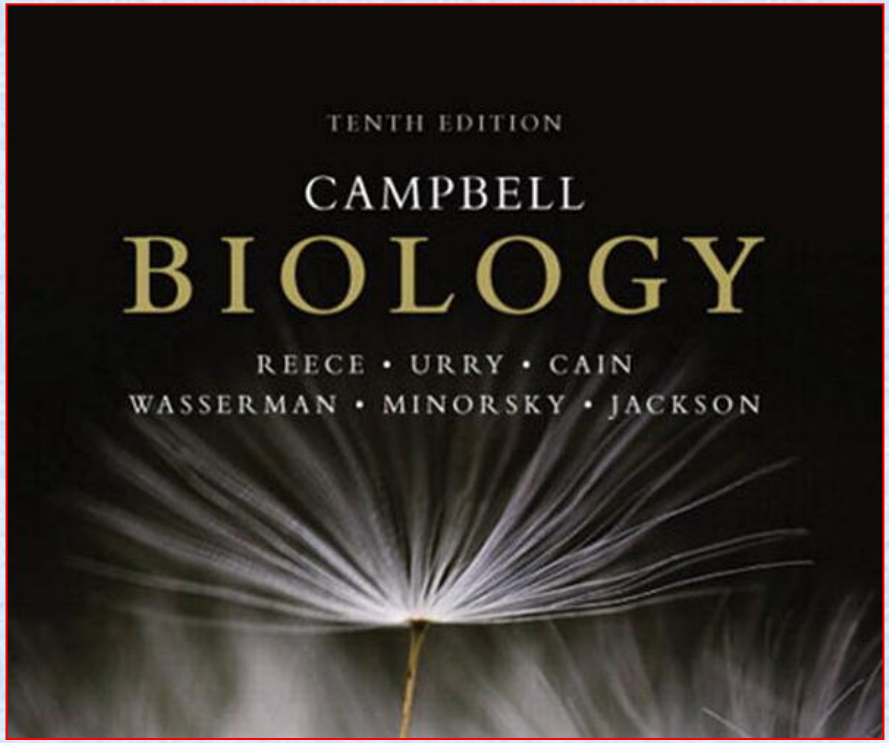
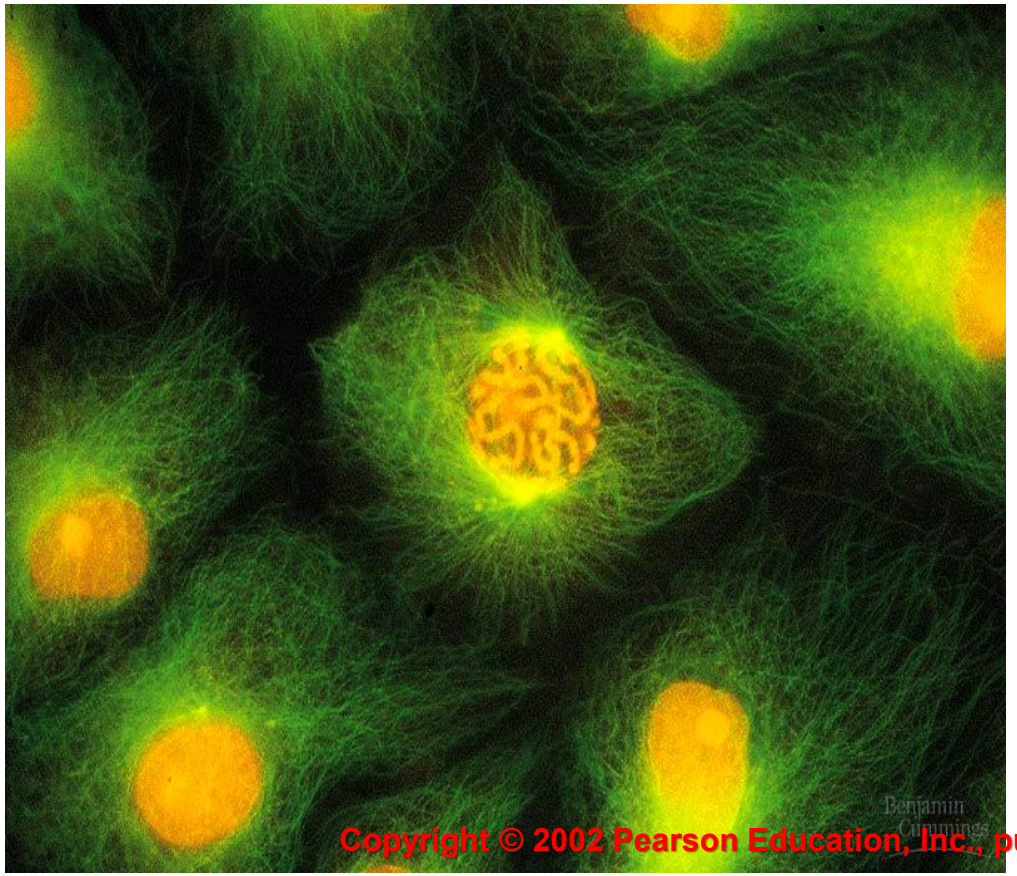
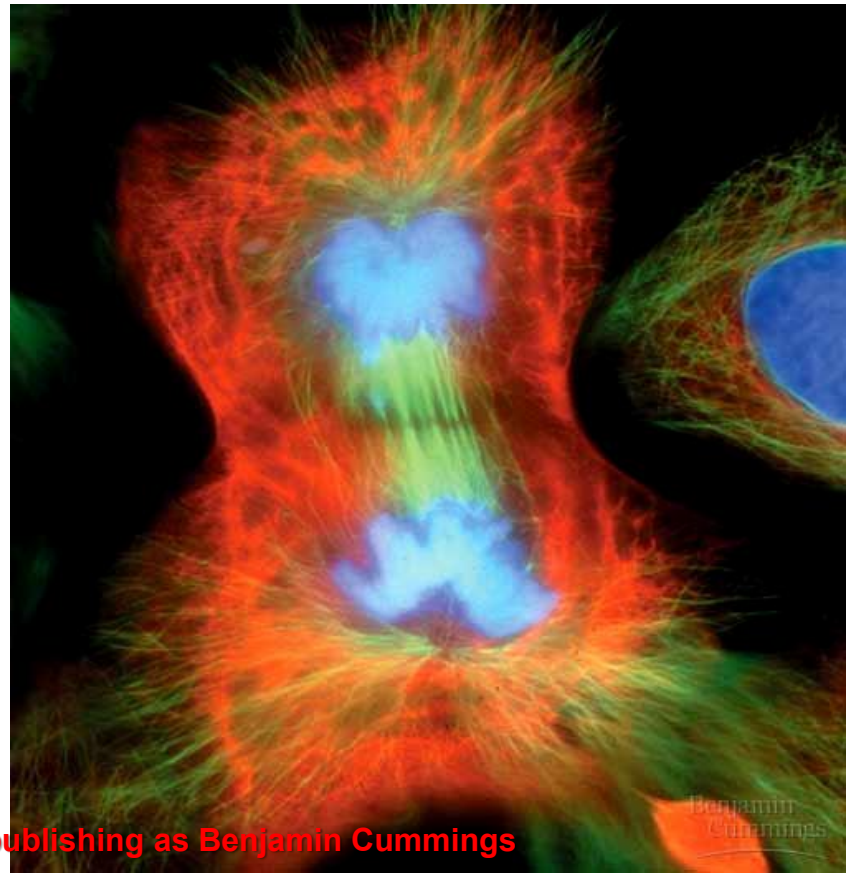
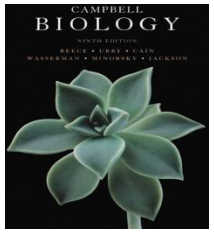


بسم الله الرحمن الرحيم

THE CELL CYCLE: The Key Roles of Cell Division



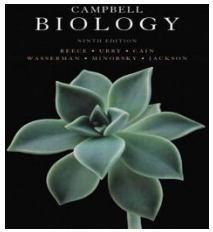




Objectives

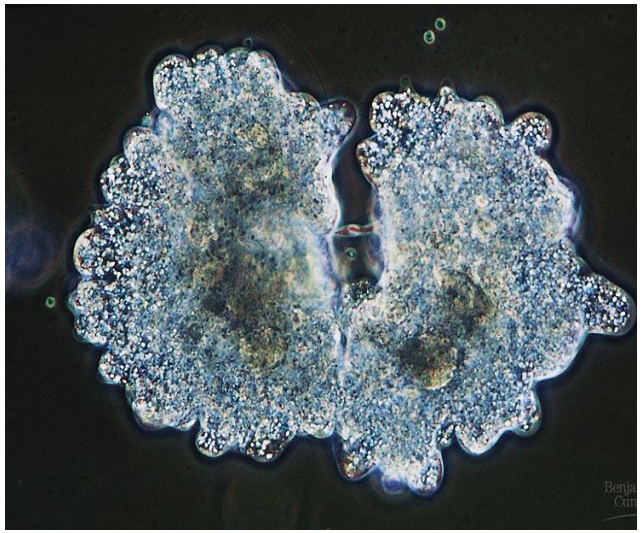
The Key Roles of Cell Division: Introduction

- **Cell division distributes identical sets of chromosomes to daughter cells.**
  - Cellular Organization of the Genetic Material.
  - Distribution of Chromosomes During Eukaryotic Cell Division
- **The mitotic phase (M) alternates with interphase in the cell cycle**
  - Phases of the Cell Cycle



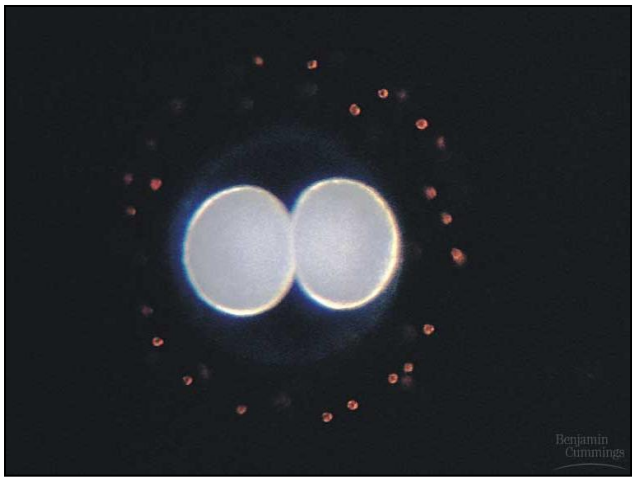
Introduction

- **The continuity of life from one cell to another is based on the reproduction of cells *via* cell division.**

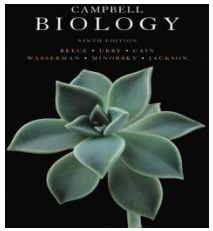


- **This division process occurs as part of the cell cycle (the life of a cell from its origin in the division of a parent cell until its own division into two new cells).**

- **The division of a unicellular وحيد الخلية organism (e.g. Amoeba) reproduces an entire organism, increasing the population.**

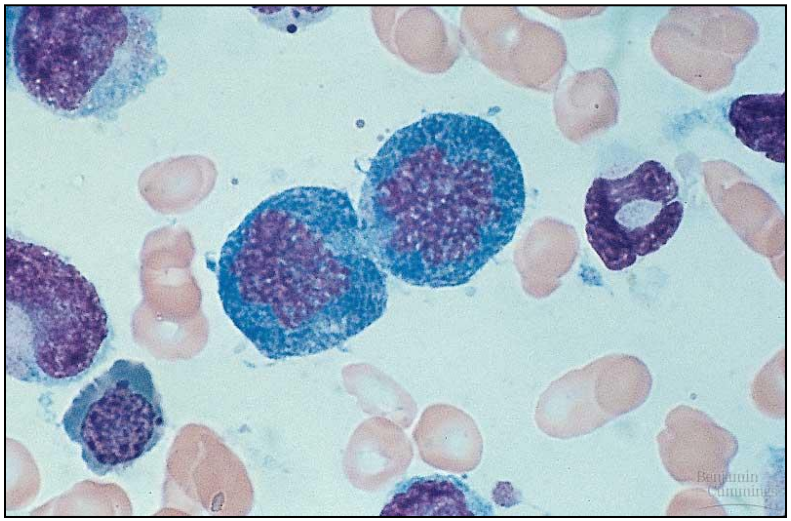


- **Cell division is also central to the development of a multicellular عديد الخلايا organism that begins as a fertilized egg or zygote.**



Introduction

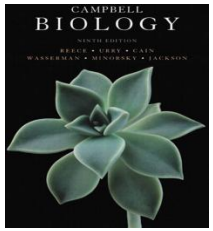
Multicellular organisms also use cell division to repair and renew cells that die normally or by accidents (e.g. blood cells from bone marrow).



Cell division distributes the genetic material (DNA) to two new daughter cells.

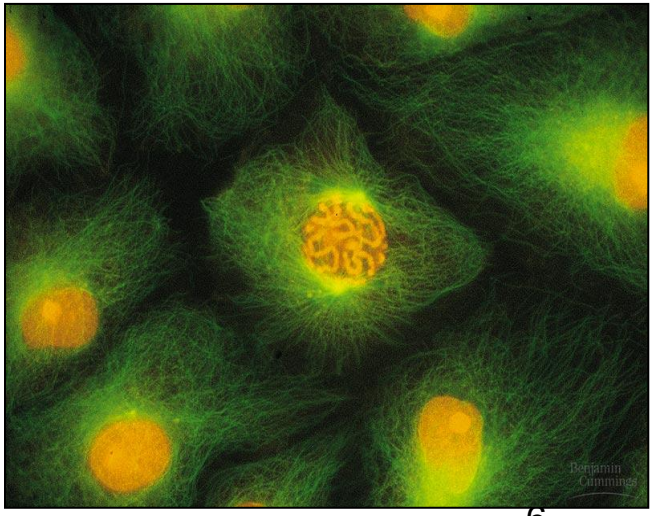
Division is different among cells:.

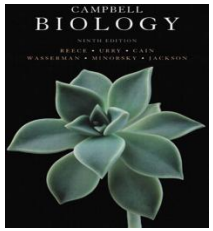
- **Skin cells divide frequently.**
- **Liver cells divide when needed (**damage repair**).**
- **Nerve cells and muscle cells never divide.**



Cell division distributes identical sets of chromosomes to daughter cells

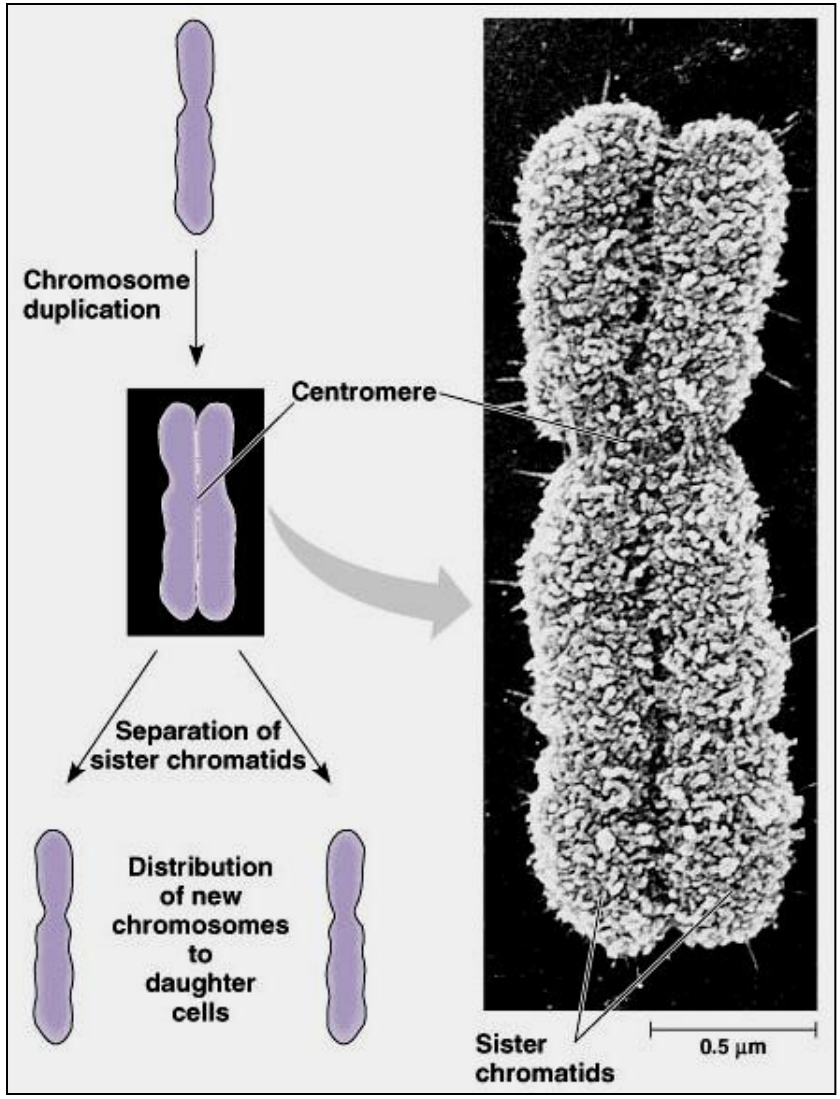
- **A cell's genetic information (genome البنك الـچيني) is packaged as DNA.**
  - ✓**In prokaryotes, the genome is often a single long DNA molecule.**
  - ✓**In eukaryotes, the genome consists of several DNA molecules.**
- **A human cell must duplicate about 3m of DNA and separate the two copies such that each daughter cell ends up with a complete genome.**
- **DNA molecules are packaged into chromosomes.**
  - **Every eukaryotic species has a characteristic number of chromosomes in the nucleus.**
  - **Human somatic cells (**body cells) الخلية الجسدية **have 46 chromosomes.**
  - **Human gametes** أمشاج, (the sex cells) **(**e.g. sperm or ovum**) have 23 chromosomes, half the number in a somatic cell.**
- **Each eukaryotic chromosome consists mainly of a long linear DNA molecule.**

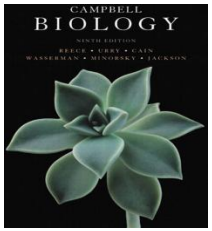




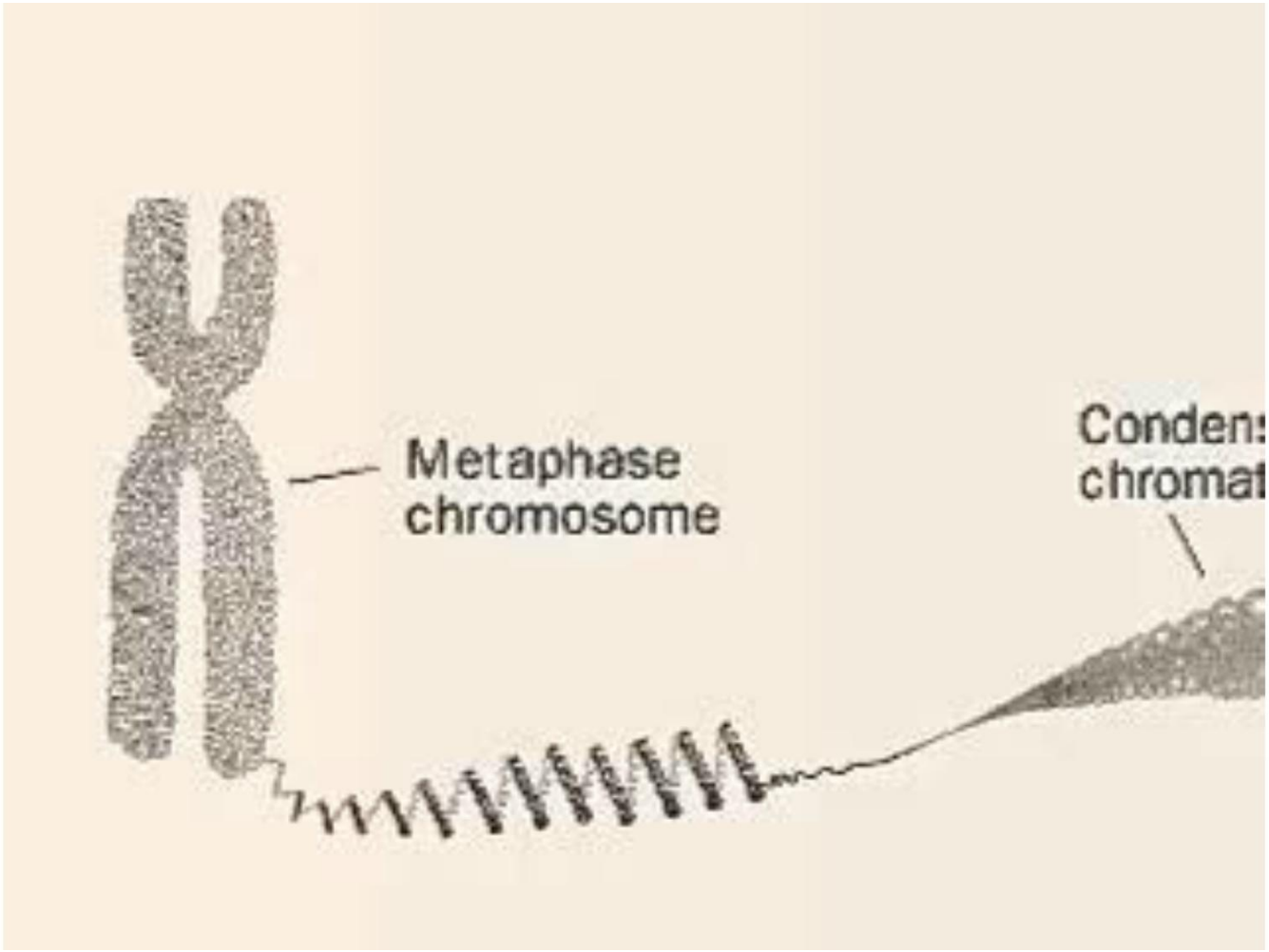
Chromosome

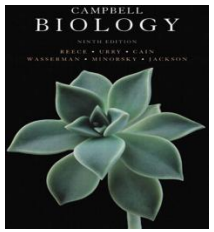
- Each chromosome has hundreds or thousands of genes.
- Genes are the units that specify an organism's inherited character الصفات الوراثية.
- The DNA-protein complex is organized into a long thin fiber called (Chromatin).
- After the DNA duplication, chromatin condenses to form the (Chromosome).
- Each duplicated chromosome consists of two sister "Chromatids" which contain identical copies of the chromosome's DNA.
- The narrow region where the chromosomal strands connect is called the centromere.
- Later, the sister chromatids are pulled apart and repackaged into two new nuclei at opposite ends of the parent cell during cell division.
- The process of the formation of the two daughter nuclei is called (mitosis) and is usually followed by division of the cytoplasm (cytokinesis الإنشطار الخلوي). It occurs in somatic cells الخلايا الجسدية.





Chromosome

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Chromosome


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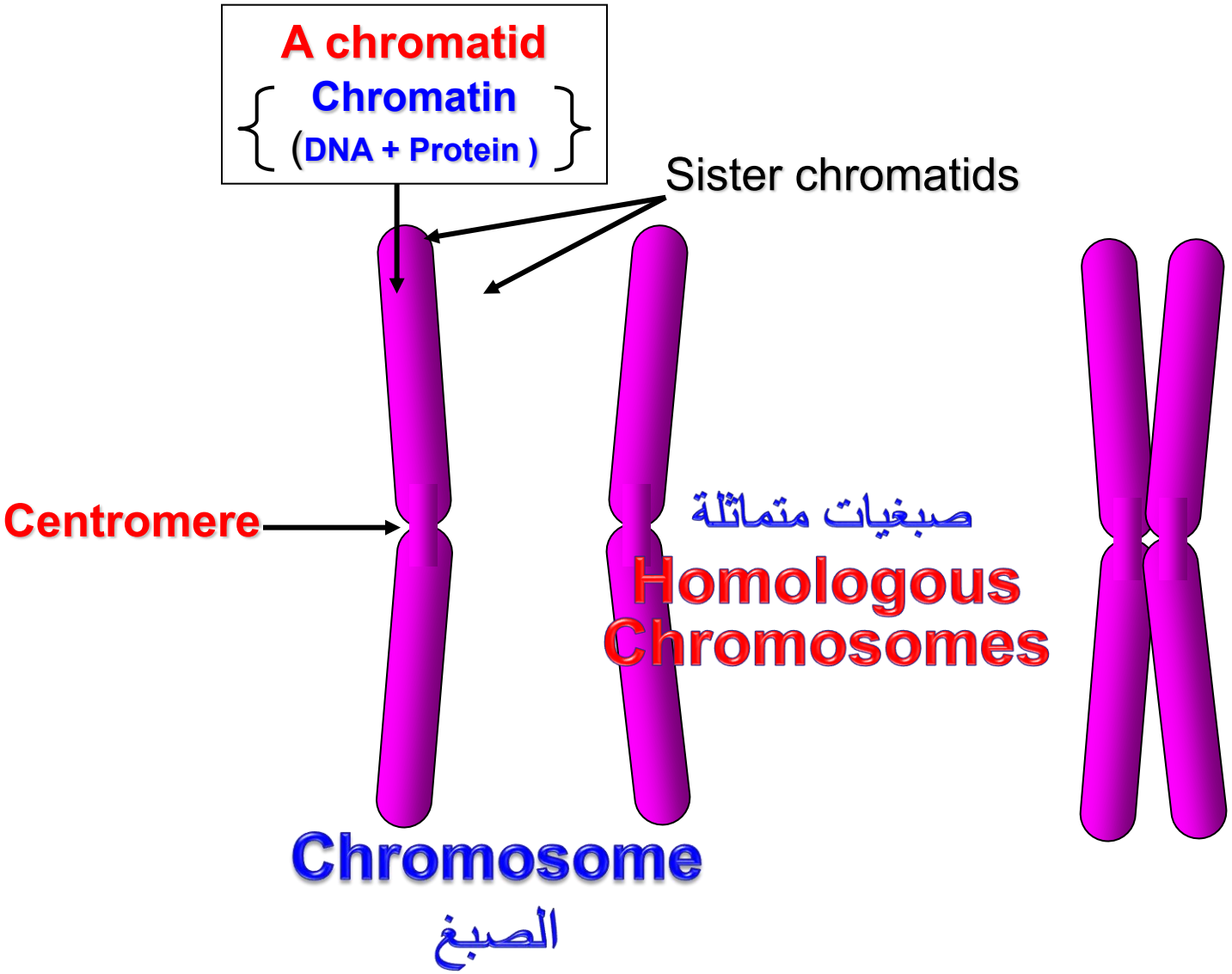
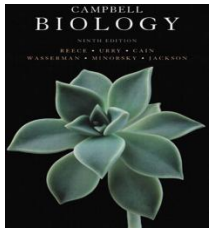
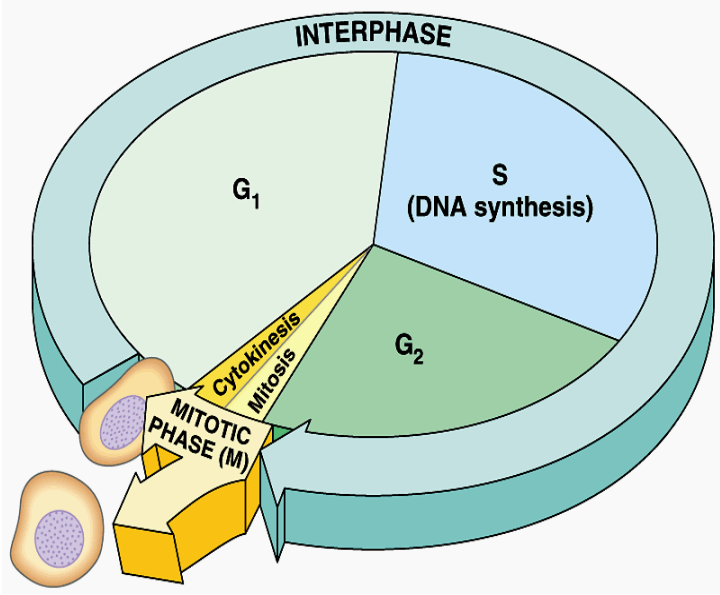

A chromatid
Chromatin
(DNA + Protein)
Sister chromatids
Centromere
صبغيات متماثلة
Homologous Chromosomes
Chromosome
الصبغ



The Mitotic Cell Cycle (division)

- The mitotic (M) phase of the cell cycle alternates تتبادل with the much longer interphase المرحلة البينية.
  - The M phase includes mitosis and cytokinesis الإنشطار الخلوي .
  - Interphase accounts for 90% of the cell cycle.
- During interphase the cell prepares for division by producing cytoplasmic organelles and copying its chromosomes.

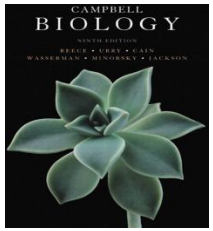


A. Interphase has three sub-phases:

1. The G_1 phase ("First Gap"): cell is carrying out its everyday activities.
2. The S phase ("Synthesis"): genetic material replicates itself, which allows the cell to contain enough material for 2 cells upon division.
3. The G_2 phase ("Second Gap"): cellular organelles are produced to allow for an adequate amount for the new cells being produced.

B. Division phase (M). The cell starts the division process.

The resulting daughter cells may then repeat the cycle again.



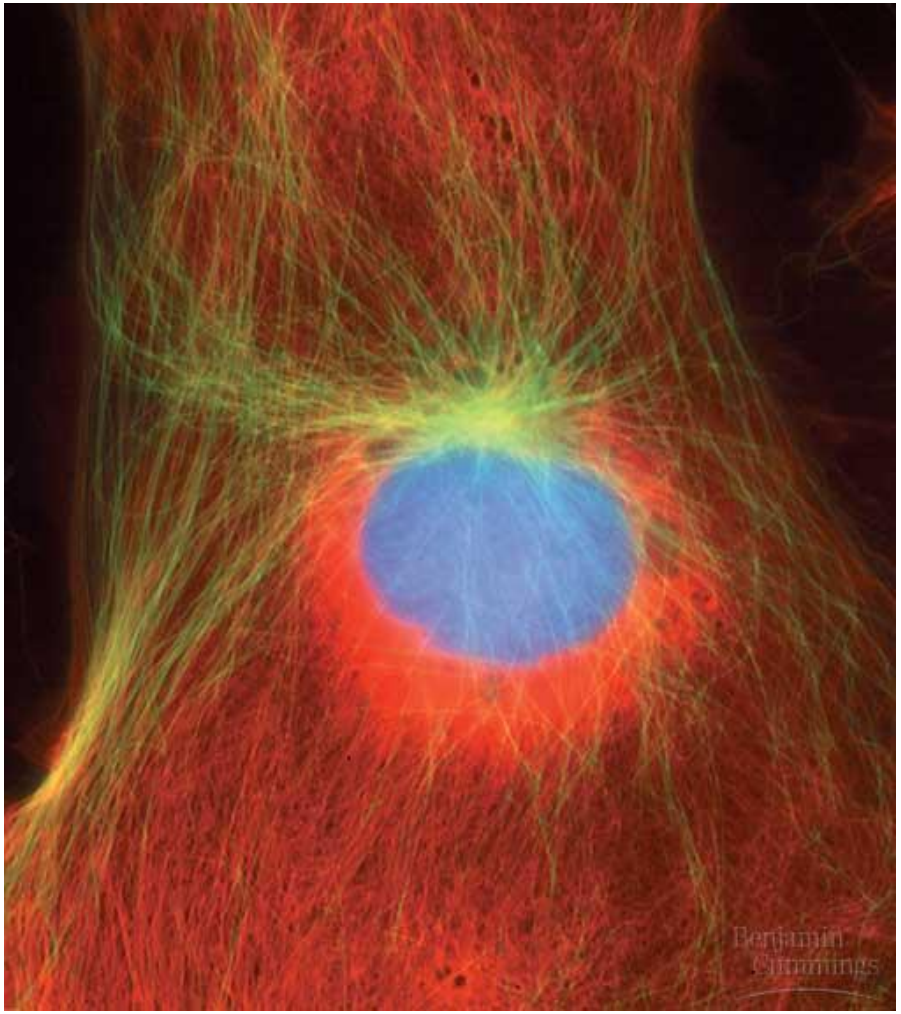
A) M phase (Mitosis)

Usually includes five sub-phases مراحل فرعية:

- **Prophase,** التمهيدية
- **Prometaphase,** قبل الإستوائية
- **Metaphase,** الإستوائية
- **Anaphase,** الإنفصالية
- **Telophase.** الإنتهائية

- **By late interphase (G2), the chromosomes have been duplicated** تضاعفت **but are loosely packed.**

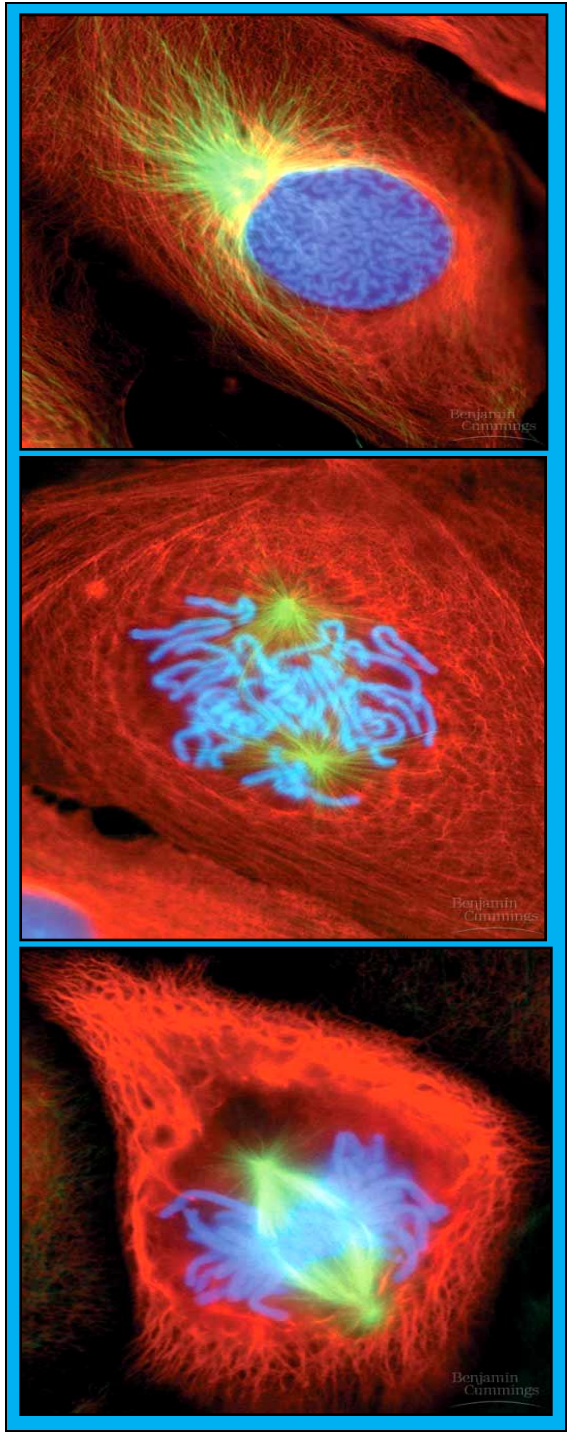
- **The centrosomes have been duplicated and begin to organize microtubules into an aster ("star").**



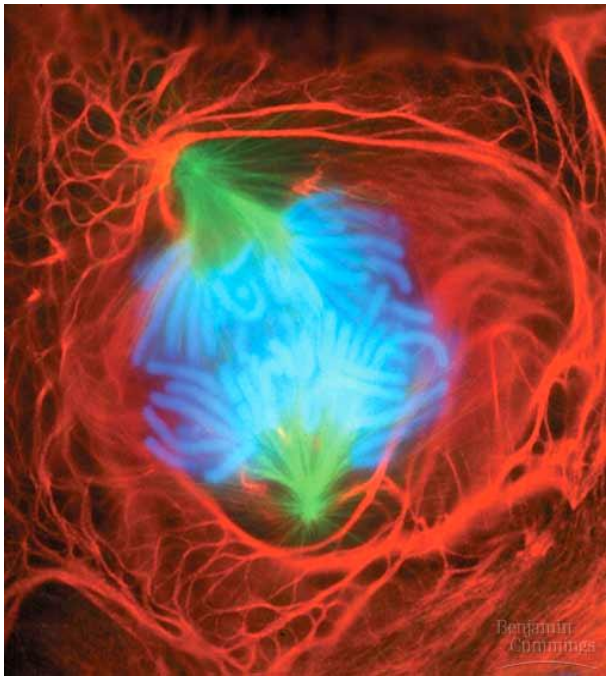
1) **Prophase**, التمهيدية **the chromosomes are tightly coiled, with sister chromatids joined together, The nucleoli disappear. The mitotic spindle begins to form and appears to push the centrosomes away from each other towards opposite ends (poles) of the cell.**

2) **Prometaphase**, قبل الإستوائية **the nuclear envelope fragments and microtubules from one pole attach to one of two kinetochores (*special regions of the centromere*) while microtubules from the other pole attach to the other kinetochore.**

3) **Metaphase,** الإستوائية **the spindle fibers push the sister chromatids until they are all arranged at the imaginary plane equidistant between the poles, defining metaphase.**

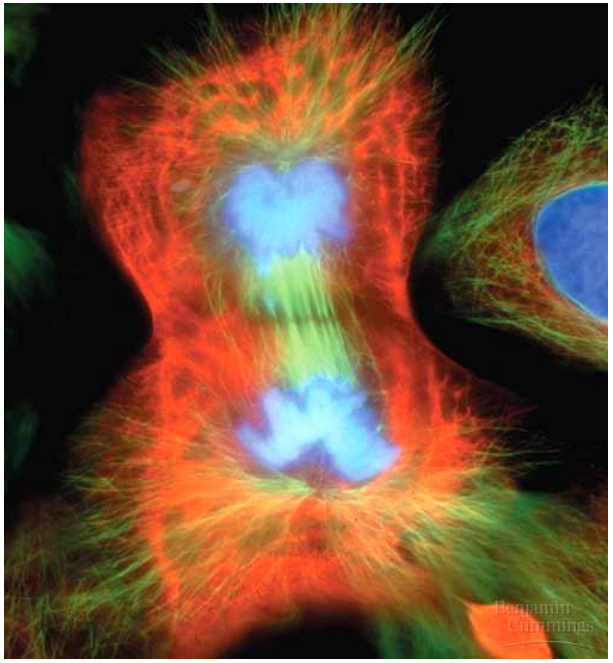


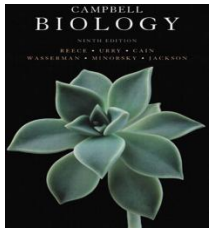
4) **Anaphase**, الإنفصالية **the centromeres divide, result in separating the sister chromatids. Each is then pulled toward the pole to which it is attached by spindle fibers. By the end, the two poles have equivalent collections of chromosomes.**



5) **Telophase,** الإنتهائية **the cell continues to elongate as free spindle fibers from each centrosome push off each other.**

- **Two nuclei begin to form, surrounded by the fragments of the parent's nuclear envelope.**
- **Chromatin becomes less tightly coiled.**
- **Cytokinesis, begins as the division of the cytoplasm occurs.**

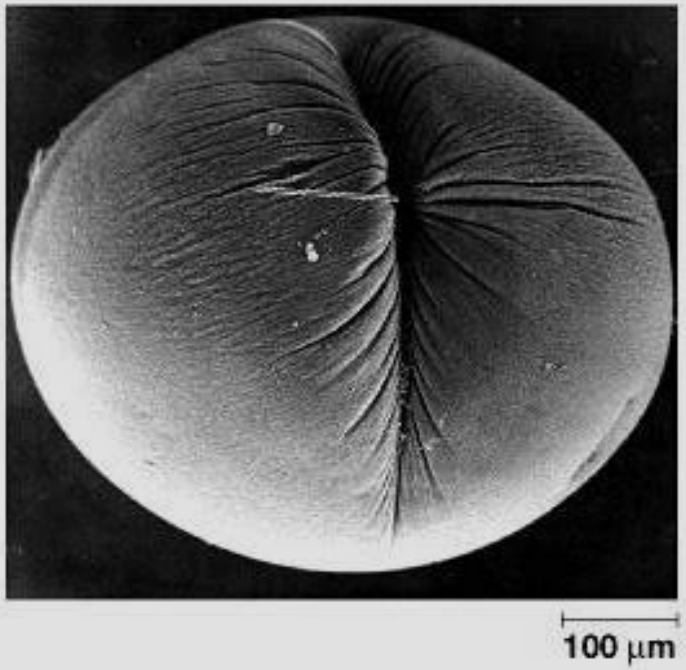


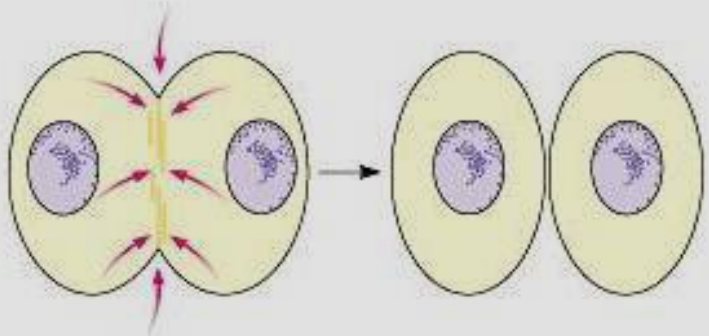


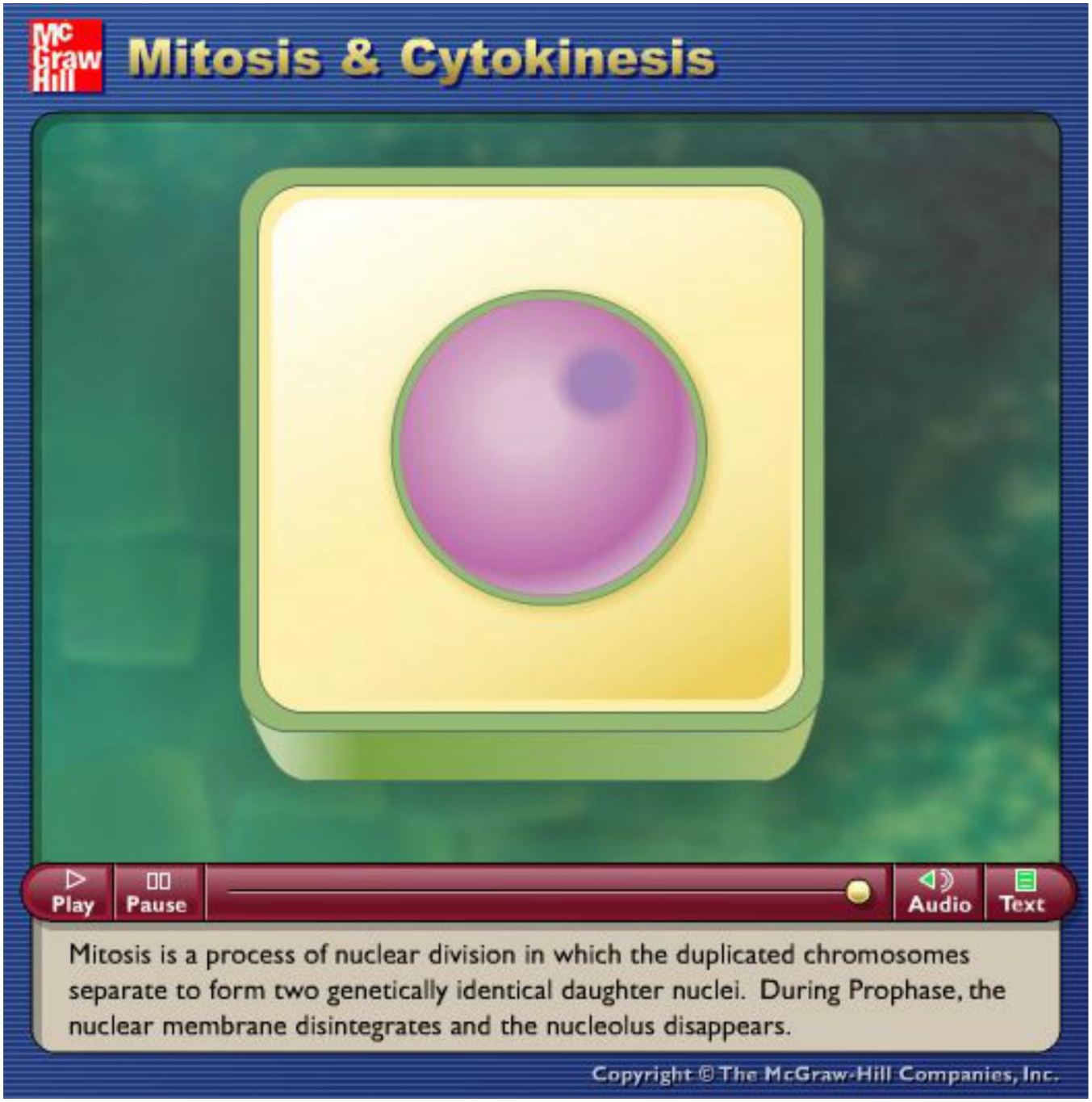
B) The cytokinesis: الإنشطار الخلوي

Cytokinesis: is the division of the cytoplasm

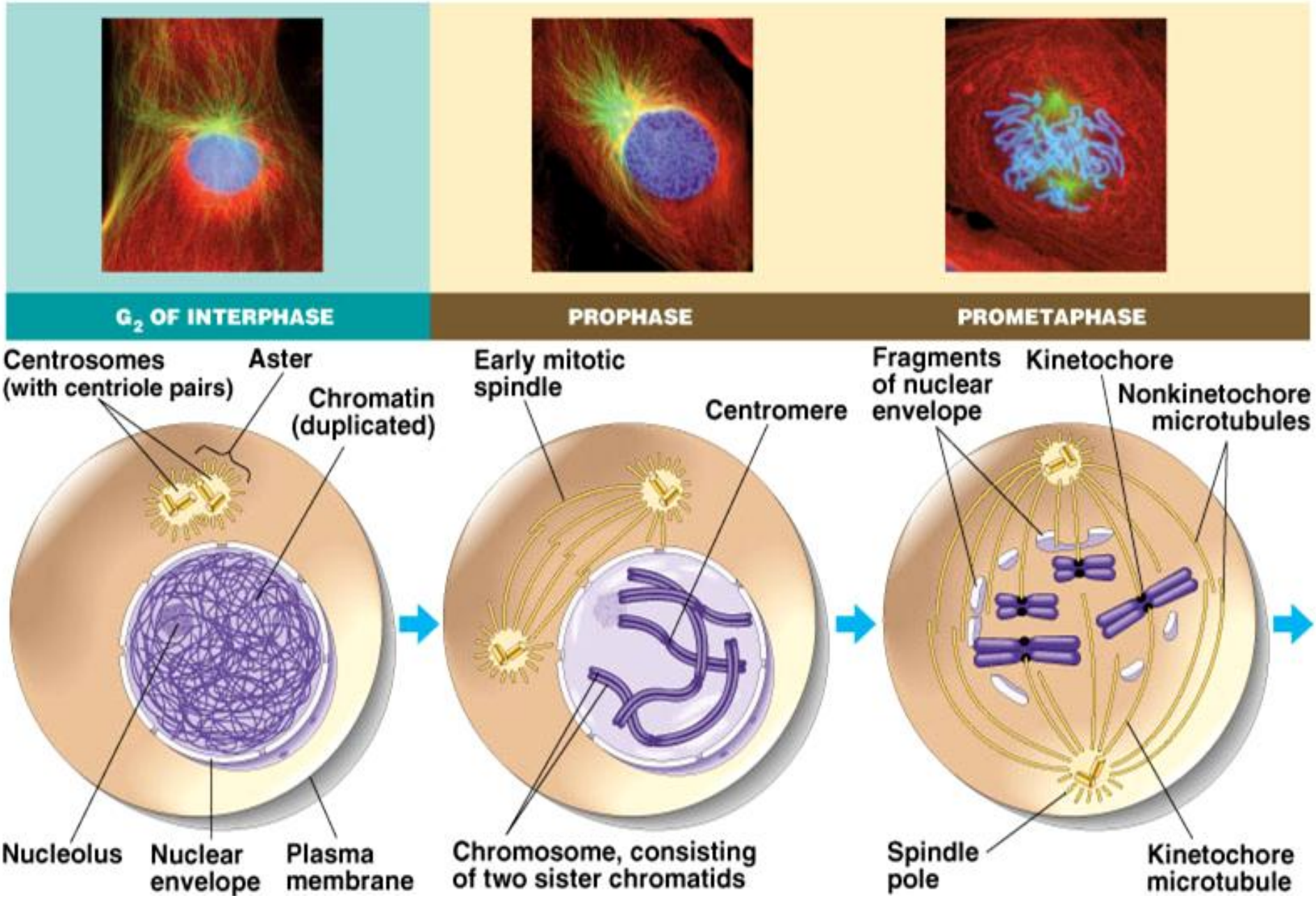
- Cytokinesis typically follows mitosis.
- Contraction إنقباض of the cell pinches the cell into two new cells

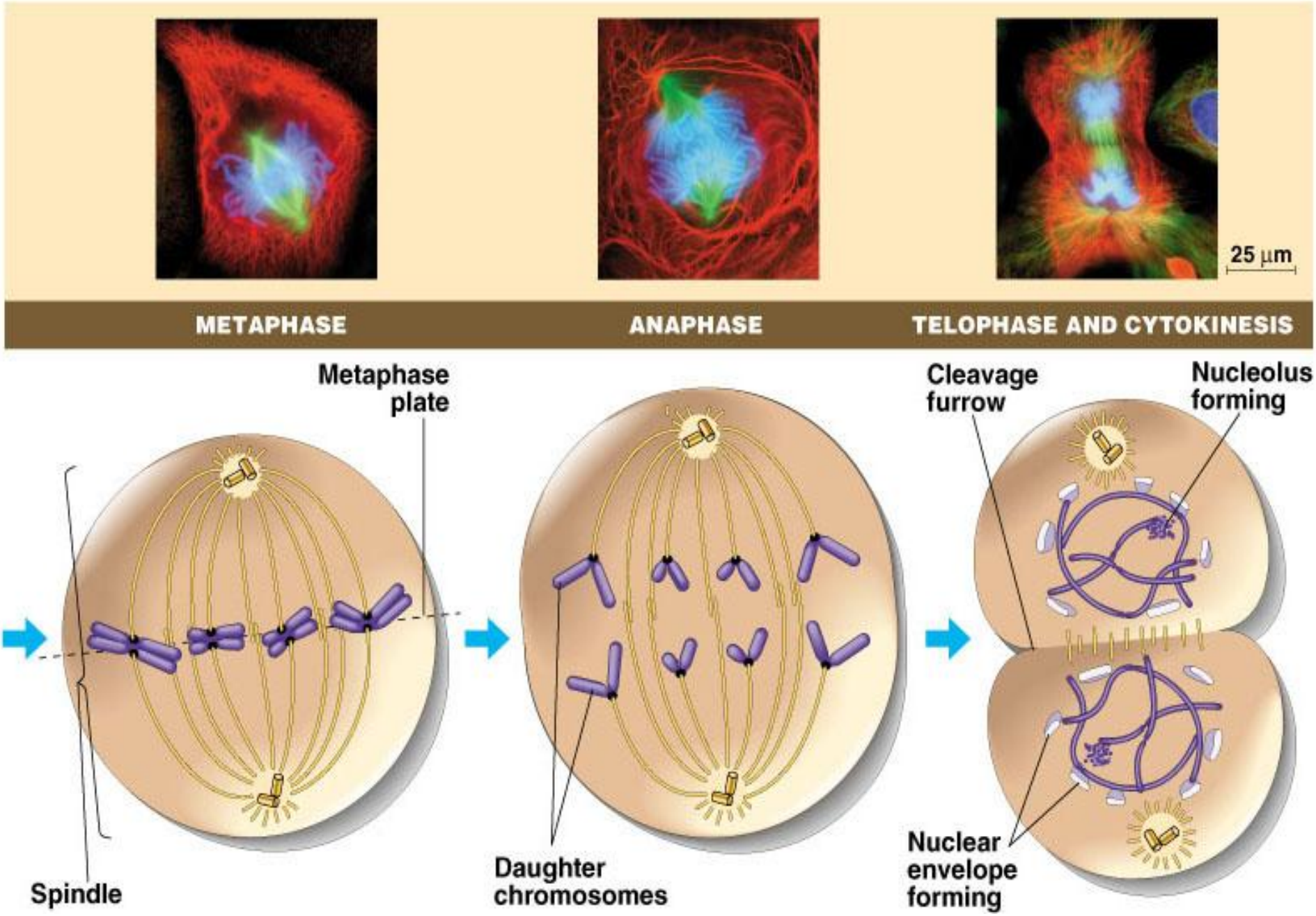


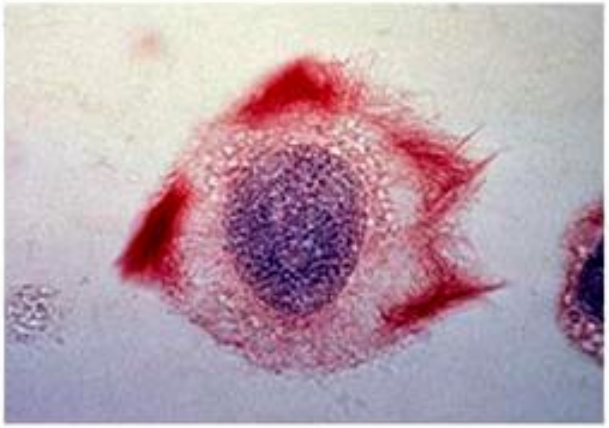




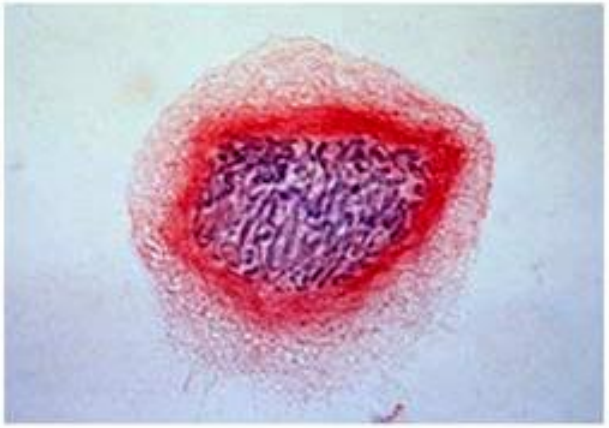
Source: http://highered.mcgraw-hill.com/sites/dl/free/0072437316/120060/ravenanimation.html


G2 OF INTERPHASE
PROPHASE
PROMETAPHASE
Centrosomes (with centriole pairs)
Aster
Chromatin (duplicated)
Nucleolus
Nuclear envelope
Plasma membrane
Early mitotic spindle
Centromere
Chromosome, consisting of two sister chromatids
Fragments of nuclear envelope
Kinetochore
Nonkinetochore microtubules
Spindle pole
Kinetochore microtubule


25 µm
METAPHASE
ANAPHASE
TELOPHASE AND CYTOKINESIS
Metaphase plate
Spindle
Daughter chromosomes
Cleavage furrow
Nucleolus forming
Nuclear envelope forming



Interphase



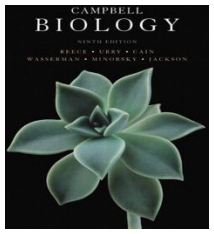
Prophase

Prometaphase

Metaphase

Anaphase

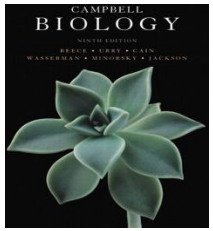
Telophase



Summary of the cell cycle

Cell Cycle

- Interphase
  - G1
  - S
  - G2
- Mitotic phase (the division process)
  - Mitosis (M)
    - Prophase التمهيدية
    - Prometaphase قبل الإستوائية
    - Metaphase الإستوائية
    - Anaphase الإنفصالية
    - Telophase الإنتهائية
  - Cytokinesis



Mitosis: hints

How many cells are produced and are they similar?

Produces 2 genetically identical cells

What abbreviation and name describes the fact that they contain 2 sets of chromosomes?

form diploid (2n) cell

Does the division reduce the number of chromosomes or maintain the same number?

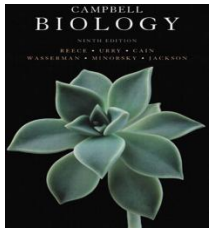
Maintains the same number of chromosomes in each daughter cell

How many cell divisions are there?

1 cell division

How many steps are there in mitosis?

5 steps



Definitions

Genes: The units that specify an organism's inherited characters.

Chromatin: A DNA-protein complex which is organized into a long thin fiber

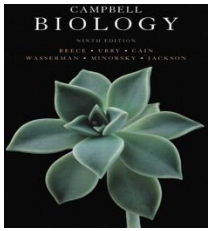
Chromosome: The package that is formed from a condensed, coiled and folded chromatin.

Chromatids: Two sister arms (chromatids) formed from each duplicated chromosome. They contain identical copies of the chromosome's DNA

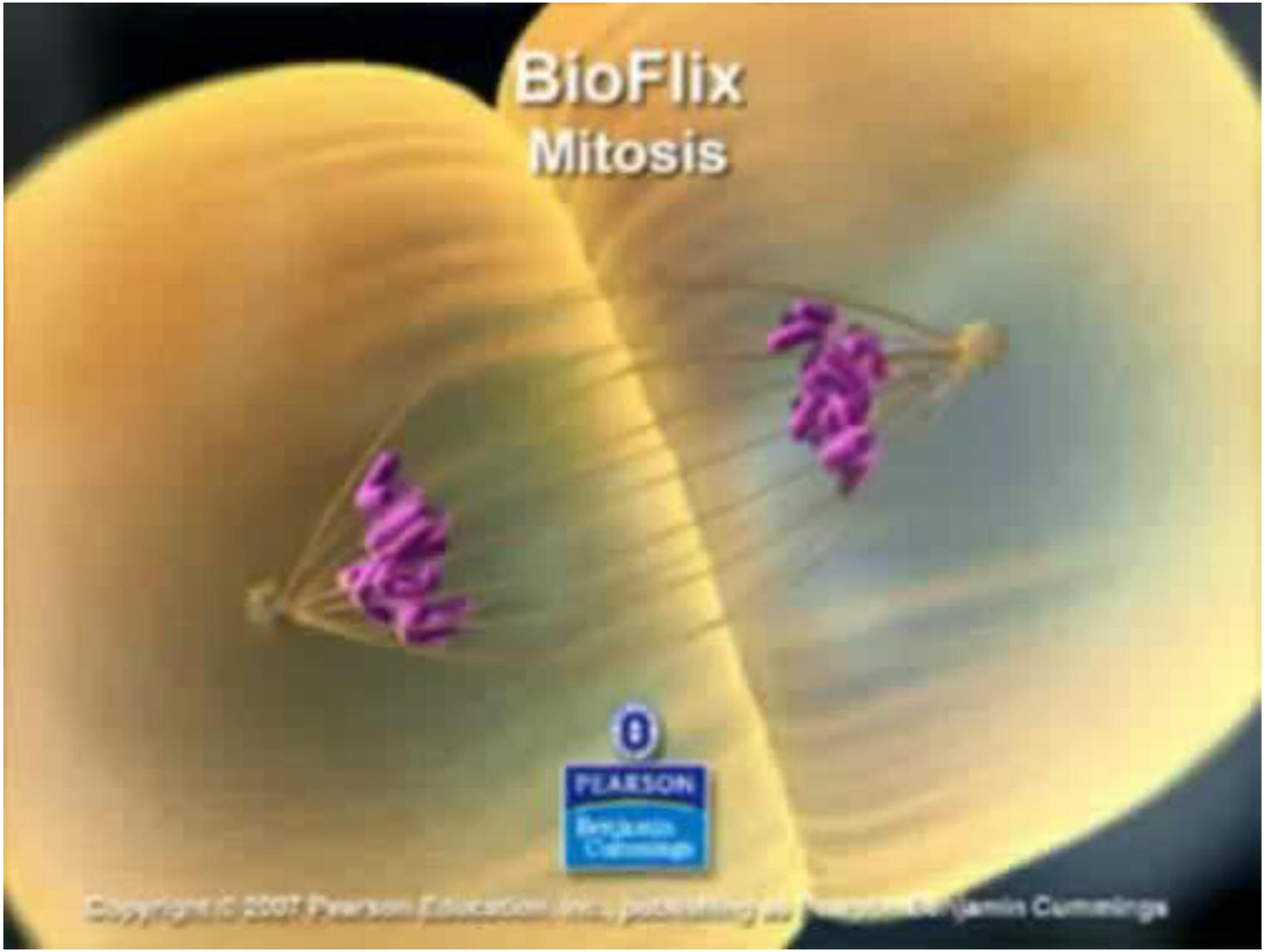
Centromere: The narrow region at which the chromosomal strands (Chromatids) are connected together.

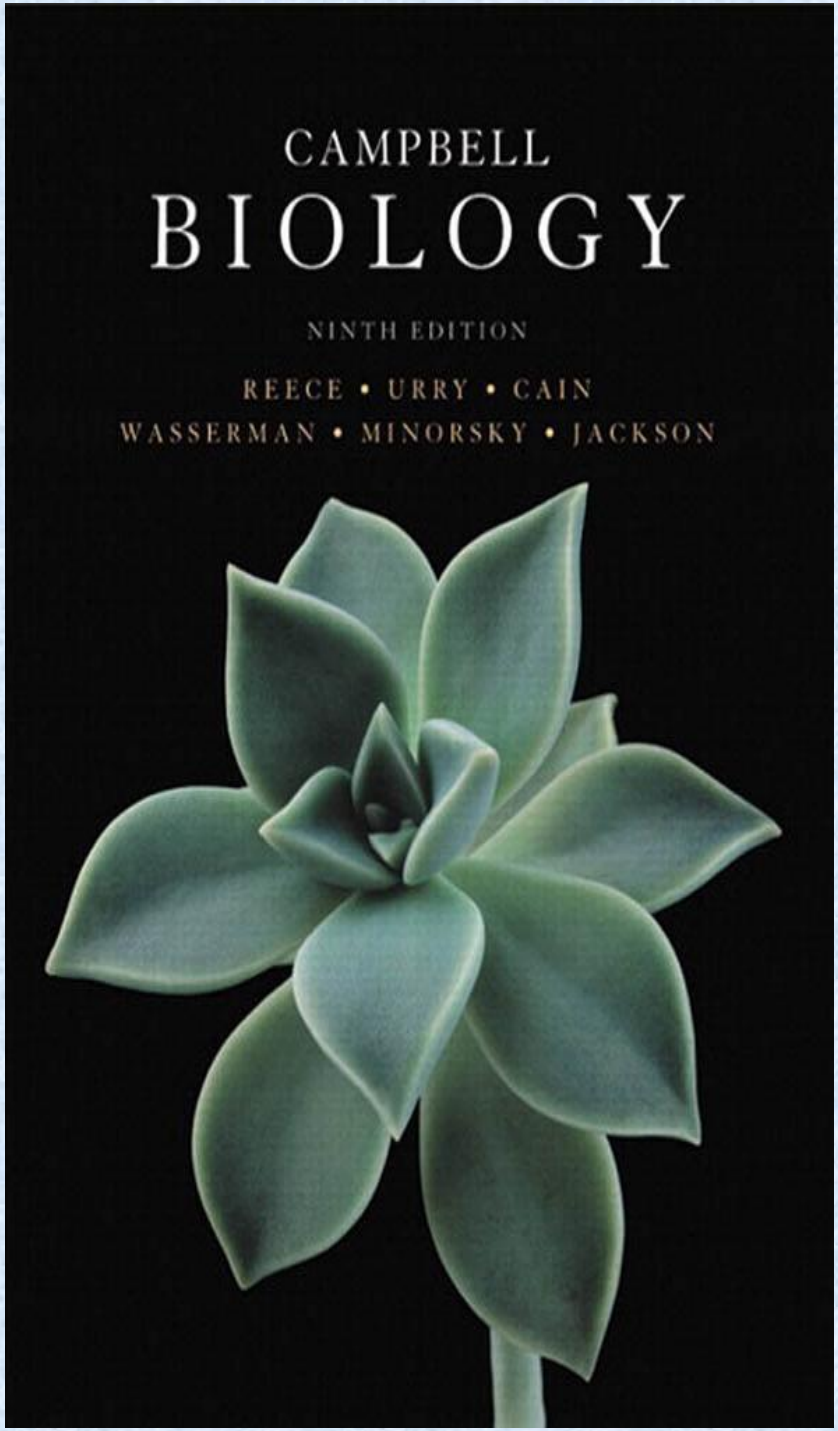
Mitosis: Is the division process which forms two somatic daughter cells

Cytokinesis: الإنشطار الخلوي Is the division stage of the cytoplasm which follows mitosis.


CAMPBELL
BIOLOGY

Mitosis


BioFlix
Mitosis
PEARSON
Benjamin Cummings



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Thank you very much

شكرا جزيلا

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