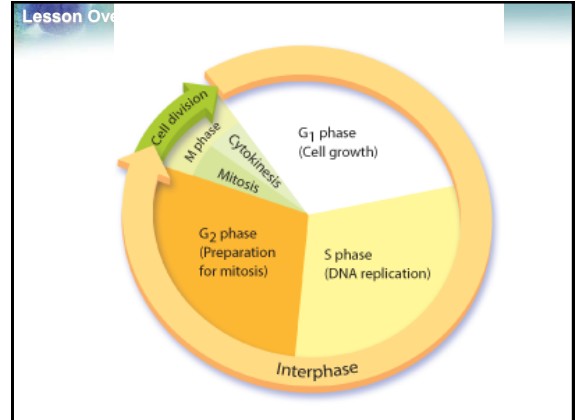


Lesson Overview

10.2 The Process of Cell Division

Biology Miller & Levine



Lesson Overview The Process of Cell Division

1. What role does cell division play in your life?
2. Does cell division stop when you are finished growing?

Lesson Overview The Process of Cell Division

Chromosomes

What is the role of chromosomes in cell division?

Lesson Overview The Process of Cell Division

Chromosomes

What is the role of chromosomes in cell division?

Chromosomes make it possible to separate DNA precisely during cell division.

Lesson Overview The Process of Cell Division

Chromosomes

The genetic information that is passed on from one generation of cells to the next is carried by **chromosomes**.

Every cell must copy its genetic information before cell division begins.

Chromosomes

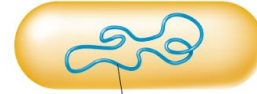
Each daughter cell gets its own copy of that genetic information.

Cells of every organism have a specific number of chromosomes.

Prokaryotic Chromosomes

Prokaryotic cells lack nuclei. Instead, their DNA molecules are found in the cytoplasm.

Most prokaryotes contain a single, circular DNA molecule, or **chromosome**, that contains most of the cell's genetic information.



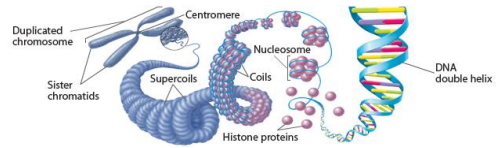
Chromosome

Prokaryotic Chromosomes

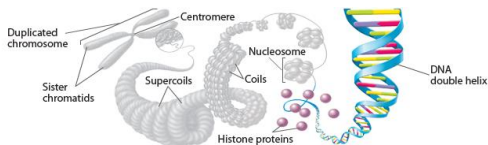


Eukaryotic Chromosomes

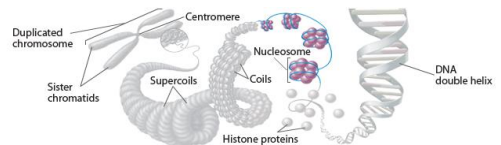
In eukaryotic cells, chromosomes are located in the nucleus, and are made up of **chromatin**.



Chromatin is composed of DNA and histone proteins.



DNA coils around histone proteins to form **nucleosomes**.



Lesson Overview The Process of Cell Division

The nucleosomes interact with one another to form coils and supercoils that make up **chromosomes**.

Labels in diagram: Duplicated chromosome, Centromere, Sister chromatids, Supercoils, Nucleosome, Coils, DNA double helix, Histone proteins.

Lesson Overview The Process of Cell Division

Chromosomes & Nucleus

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Lesson Overview The Process of Cell Division

The Cell Cycle

What are the main events of the cell cycle?

During the cell cycle, a cell grows, prepares for division, and divides to form two **daughter cells**.

Lesson Overview The Process of Cell Division

The Prokaryotic Cell Cycle

- The prokaryotic **cell cycle** is a regular pattern of growth, DNA replication, and cell division.
- Most prokaryotic cells begin to replicate, or copy, their DNA once they have grown to a certain size.
- When DNA replication is complete, the cells divide through a process known as **binary fission**.

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The Prokaryotic Cell Cycle

Binary fission is a form of **asexual** reproduction during which two genetically identical cells are produced.

For example, bacteria reproduce by binary fission.

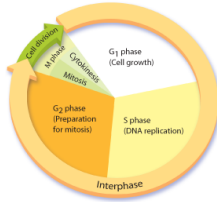
Labels in diagram: Cell membrane, DNA, DNA duplicates, Cell membrane indents, Cell divides; two new cells form.

Lesson Overview The Process of Cell Division

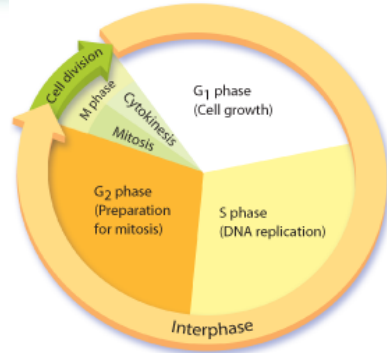
The Eukaryotic Cell Cycle

The eukaryotic cell cycle consists of four phases: **G₁, S, G₂, and M.**

Interphase is the time between cell divisions. It is a period of growth that consists of the G₁, S, and G₂ phases. The M phase is the period of cell division.



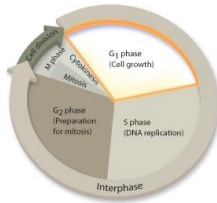
Lesson Overview



Lesson Overview The Process of Cell Division

G₁ Phase: Cell Growth

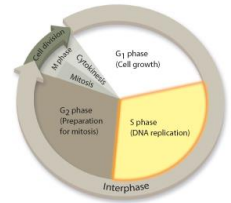
In the G₁ phase, cells increase in size and synthesize new proteins and organelles.



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S Phase: DNA Replication

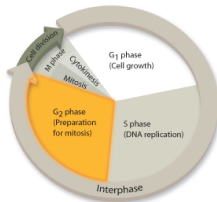
In the S (or synthesis) phase, new DNA is synthesized when the chromosomes are replicated.



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G₂ Phase: Preparing for Cell Division

In the G₂ phase, many of the organelles and molecules required for cell division are produced.



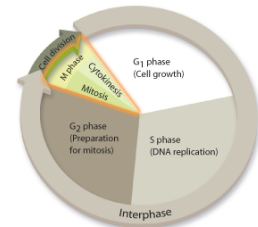
Lesson Overview The Process of Cell Division

M Phase: Cell Division

In eukaryotes, cell division occurs in two stages: **mitosis and cytokinesis.**

Mitosis is the division of the cell nucleus.

Cytokinesis is the division of the cytoplasm.



Mitosis

- What events occur during each of the four phases of mitosis?

Mitosis

← What events occur during each of the four phases of mitosis?

- During prophase, the genetic material inside the nucleus condenses and the duplicated chromosomes become visible. Outside the nucleus, a spindle starts to form.

Mitosis

← What events occur during each of the four phases of mitosis?

- During metaphase, the centromeres of the duplicated chromosomes line up across the center of the cell. Spindle fibers connect the centromere of each chromosome to the two poles of the spindle.

Mitosis

← What events occur during each of the four phases of mitosis?

- During anaphase, the chromosomes separate and move along spindle fibers to opposite ends of the cell.

Mitosis

← What events occur during each of the four phases of mitosis?

- During telophase, the chromosomes, which were distinct and condensed, begin to spread out into a tangle of chromatin.

Important Cell Structures Involved in Mitosis

Chromatid – each strand of a **duplicated** chromosome

Centromere – the area where each pair of chromatids is joined

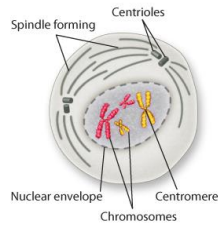
Centrioles – tiny structures located in the cytoplasm of animal cells that help organize the spindle

Spindle – a fanlike microtubule structure that helps separate the chromatids

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Prophase

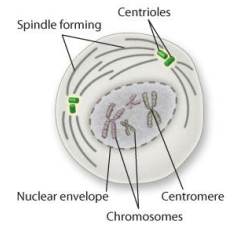
During **prophase**, the first phase of mitosis, the duplicated chromosome condenses and becomes visible.



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Prophase

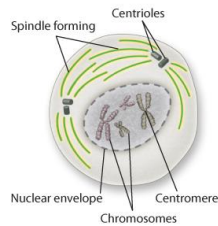
The **centrioles** move to opposite sides of nucleus and help organize the spindle.



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Prophase

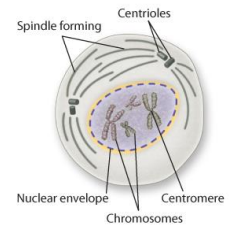
The spindle forms and DNA strands attach at a point called their **centromere**.



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Prophase

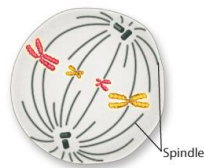
The nucleolus disappears and nuclear envelope breaks down.



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Metaphase

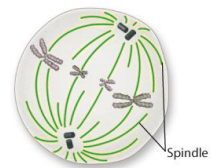
During **metaphase**, the second phase of mitosis, the centromeres of the duplicated chromosomes line up across the center of the cell.



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Metaphase

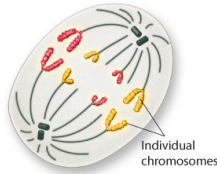
The spindle fibers connect the centromere of each chromosome to the two poles of the spindle.



Lesson Overview The Process of Cell Division

Anaphase

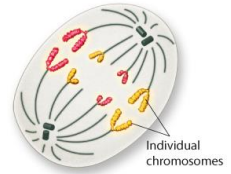
During **anaphase**, the third phase of mitosis, the centromeres are pulled apart and the chromatids separate to become individual chromosomes.



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Anaphase

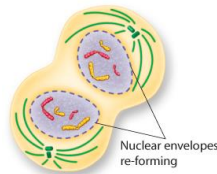
The chromosomes separate into two groups near the poles of the spindle.



Lesson Overview The Process of Cell Division

Telophase

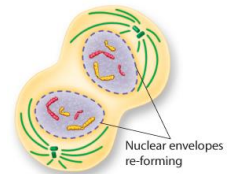
During **telophase**, the fourth and final phase of mitosis, the chromosomes spread out into a tangle of chromatin.



Lesson Overview The Process of Cell Division

Telophase

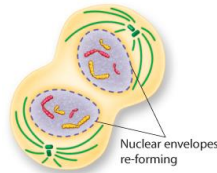
A nuclear envelope re-forms around each cluster of chromosomes.



Lesson Overview The Process of Cell Division

Telophase

The spindle breaks apart, and a nucleolus becomes visible in each daughter nucleus.



Lesson Overview The Process of Cell Division

Cytokinesis

How do daughter cells split apart after mitosis?

Cytokinesis

Cytokinesis completes the process of cell division – it splits one cell into two.

Cytokinesis

Cytokinesis is the division of the cytoplasm.

The process of cytokinesis is different in animal and plant cells.

Cytokinesis in Animal Cells

The cell membrane is drawn in until the cytoplasm is pinched into two equal parts.

Each part contains its own nucleus and organelles.

Cytokinesis in Plant Cells

- In plants, the cell membrane is not flexible enough to draw inward because of the rigid cell wall.
- Instead, a cell plate forms between the divided nuclei that develops into cell membranes.
- A cell wall then forms in between the two new membranes.

Bell Ringer:

- Briefly describe what takes place during each stage of mitosis.
- How is cytokinesis different from mitosis?

