



Cell Cycle

IST-1.B.1

In eukaryotes, cells divide and transmit genetic information via two highly regulated processes.



Cell Cycle

IST-1.B.2

The cell cycle is a highly regulated series of events for the growth and reproduction of cells—

a. The cell cycle consists of sequential stages of interphase (G_1 , S , G_2), mitosis, and cytokinesis.

b. A cell can enter a stage (G_0) where it no longer divides, but it can reenter the cell cycle in response to appropriate cues. Nondividing cells may exit the cell cycle or be held at a particular stage in the cell cycle.



Cell Cycle

IST-1.C.1

Mitosis is a process that ensures the transfer of a complete genome from a parent cell to two genetically identical daughter cells—

- a. Mitosis plays a role in growth, tissue repair, and asexual reproduction.**
- b. Mitosis alternates with interphase in the cell cycle.**
- c. Mitosis occurs in a sequential series of steps (prophase, metaphase, anaphase, telophase)**

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What are the three phases of the cell cycle?

What are the three phases of the cell cycle?



Interphase

Mitosis

Cytokinesis

Note:

**Interphase is BEFORE mitosis
and cytokinesis is AFTER mitosis**

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**Which phase of interphase does
the cell grow?**

- A. G_1**
- B. S**
- C. G_2**
- D. All of them**

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Which phase of interphase does the cell grow?

D. All of them (G_1 , S, G_2)



Interphase is the phase that takes place before mitosis.

During this phase, the cell will grow and, specifically through S phase, the DNA will be replicated (synthesized).

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**Which phase of interphase does
DNA replication occur?**

- A. G_1**
- B. S**
- C. G_2**
- D. All of them**

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Which phase of interphase does DNA replication occur?

B. S



The S phase is part of interphase. During that phase of interphase, the DNA is synthesized. A copy of DNA is made so each cell will receive an equal amount of DNA (and identical)



Mitosis divides...

A. Chromosomes

B. Cytoplasm

C. Nucleus

D. Organelles

Mitosis divides...

C. Nucleus



Mitosis is nuclear division. This involves the separation of the chromosomes which results in two nuclei. Cytokinesis is the division of the cytoplasm which results in two cells.



Cytokinesis divides...

- A. Chromosomes**
- B. Cytoplasm**
- C. Nucleus**
- D. Organelles**

Cytokinesis divides...

B. Cytoplasm



Cytokinesis is the division of the cytoplasm which results in two cells. Mitosis is nuclear division. This involves the separation of the chromosomes which results in two nuclei.

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**A cell can undergo mitosis and
not cytokinesis**

A. True

B. False

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**A cell can undergo mitosis
and not cytokinesis**

A. True

**This causes a cell to be
multinucleated. An example of a
cell that is multinucleated are
skeletal muscle cells.**

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What is the result of mitosis without cytokinesis? Example.

What is the result of mitosis without cytokinesis? Example.



The cell will be multinucleated (so the cell will have multiple nuclei)

Ex: muscle cells

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If the cell doesn't get the go ahead at G₁ checkpoint what happens?

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If the cell doesn't get the go ahead at G₁ checkpoint what happens?

The cell enters a non-dividing state called G₀.

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**Identify an example
of a cell in G_0 .**

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Identify an example of a cell in G_0 .



Neurons

Muscles

Liver



Which phase involves sister chromatids on middle plate?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

Which phase involves sister chromatids on middle plate?

B. Metaphase



Metaphase is when the sister chromatids align on the metaphase plate in the middle of the cell. The tug-of-war between microtubules allows for the chromatids to align in this format to ensure that cells get equal chromosomes.



Which phase involves sister chromatids pairing?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**



Which phase involves sister chromatids pairing?

C. Prophase

Prophase is when the cell is preparing to divide. The chromatin condenses, sister chromatids pair up, and mitotic spindles move to opposite poles.



Which phase involves single chromatids moving to poles?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

Which phase involves single chromatids moving to poles?

A. Anaphase



Anaphase involves the sister chromatids moving apart to opposite poles. The microtubules are attached to each centromere and shorten which "reels" the chromosomes to the poles.



Which phase involves nuclear envelope forming?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**



Which phase involves nuclear envelope forming?

D. Telophase

Telophase forms the two new nuclei. This is when the new nuclear envelope is forming around the chromosomes that have separated to opposite poles. The chromosomes decondense to form chromatin.



Cancer treatment involves chemotherapy with drugs that inhibit microtubules from depolymerizing.

Which phase would the cell be stopped in?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

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Cancer treatment involves chemotherapy with drugs that inhibit microtubules from depolymerizing.

Which phase would the cell be stopped in?

B. Metaphase



Metaphase is the phase where the sister chromatids are bound to microtubules on the metaphase plate while anaphase is the depolymerizing of the microtubules to pull them to the opposite poles.

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How does the parent and daughter cell compare in mitosis?

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How does the parent and daughter cell compare in mitosis?



Parent cell AND daughter cells are diploid ($2N$)

Parent cell AND daughter cells are genetically identical

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How many rounds of replication of DNA before mitosis?

- A. 0**
- B. 1**
- C. 2**
- D. 3**

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How many rounds of replication of DNA before mitosis?

B. 1



The daughter cells need to be identical. In order to create two identical cells from one cell, you need to replicate the DNA once then divide the cell once.

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How many rounds of division in mitosis?

A. 0

B. 1

C. 2

D. 3

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**How many rounds of
division in mitosis?**

B. 1



The daughter cells need to be identical. In order to create two identical cells from one cell, you need to replicate the DNA once then divide the cell once.

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Independent Assortment?

A. Does NOT occur

B. Does occur

Independent Assortment?

A. Does NOT occur



Independent assortment involves the homologous chromosomes aligning on the metaphase plate. This leads to genetic diversity as the maternal and paternal chromosomes will segregate into different cells. Since mitosis involves sister chromatids which are identical, then independent assortment does not occur.

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Crossing Over?

A. Does NOT occur

B. Does occur

Crossing Over?

A. Does NOT occur



Crossing over involves nonsister chromatids exchanging genetic information. Mitosis involves sister chromatids so crossing over does not occur.



Which phase of interphase is responsible for DNA replication?

- A. G₁**
- B. G₂**
- C. M**
- D. S**

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Which phase of interphase is responsible for DNA replication?

D. S

DNA replication involves synthesizing a new DNA strand.

This takes place during interphase, specifically the S phase.

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Which of the following is not part of interphase?

- A. G_1**
- B. G_2**
- C. M**
- D. S**

Which of the following is not part of interphase?

C. M



Interphase is the phase preceding the mitotic phase (M). The cell is preparing to divide by growing, replicating its DNA, and synthesizing organelles. The three phases are G_1 , S, and G_2 .

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The cell grows through all three phases of interphase.

- A. True**
- B. False**

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The cell grows through all three phases of interphase.

A. True

As the cell prepares to divide, the cell will grow through all of the phases of interphase.

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**Interphase occurs _____ mitosis
in the cell cycle.**

- A. After**
- B. Before**
- C. During**

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**Interphase occurs _____
mitosis in the cell cycle.**

B. Before

Interphase is the longest phase and it precedes mitosis. During interphase, the cell prepares to divide by growing and replicating chromosomes. This must take place prior to nuclear or cellular division.



**Cytokinesis occurs _____ mitosis
in the cell cycle**

- A. After**
- B. Before**
- C. During**

**Cytokinesis occurs _____
mitosis in the cell cycle**

A. After



Mitosis is the division of the nucleus and cytokinesis is division of the cytoplasm. The cell must divide the nucleus prior to dividing the cell or the resulting daughter cell will not have a nucleus. Cytokinesis must take place after mitosis.

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**Identify the four phases of
mitosis**

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**Identify the four phases
of mitosis**



- > **Prophase**
- > **Metaphase**
- > **Anaphase**
- > **Telophase**



**Phase of mitosis that
chromosomes condense and pair**

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

**Phase of mitosis that
chromosomes condense
and pair**

C. Prophase



**Prophase is when the cell is
preparing to divide. The
chromatin condenses, sister
chromatids pair up, and mitotic
spindles move to opposite poles.**



Phase of mitosis when sister chromatids are pulled to opposite poles.

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

Phase of mitosis when sister chromatids are pulled to opposite poles.

A. Anaphase



Anaphase involves the sister chromatids moving apart to opposite poles. The microtubules are attached to each centromere and shorten which "reels" the chromosomes to the poles.



Phase of mitosis when sister chromatids align on plate in middle of the cell

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**



Phase of mitosis when sister chromatids align on plate in middle of the cell

B. Metaphase

Metaphase is when the sister chromatids align on the metaphase plate in the middle of the cell. The tug-of-war between microtubules allows for the chromatids to align in this format to ensure that cells get equal chromosomes.



Phase of mitosis when two nuclear envelopes form.

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

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Phase of mitosis when two nuclear envelopes form.

D. Telophase

Telophase forms the two new nuclei. This is when the new nuclear envelope is forming around the chromosomes that have separated to opposite poles. The chromosomes decondense to form chromatin.



Microtubules unable to depolymerize would stop the cell cycle in what phase?

- A. Anaphase**
- B. Metaphase**
- C. Prophase**
- D. Telophase**

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Microtubules unable to depolymerize would stop the cell cycle in what phase?

B. Metaphase



Metaphase is when the sister chromatids align on the metaphase plate in the middle of the cell. The tug-of-war between microtubules allows for the chromatids to align in this format to ensure that cells get equal chromosomes.