Copy Before Division

Trace how one DNA molecule becomes two during S phase.

BIO.3.a "Construct an explanation of the process of DNA replication during cellular division (S-phase)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Number the actions of helicase, DNA polymerase, and ligase in the order they occur, then underline the sentence that explains why the new DNA molecules keep the original information.

A Skin Cell Gets Ready to Divide

1. When a skin cell prepares to divide to replace a scraped surface, it first copies its DNA. This copying happens in S phase of interphase, before the cell enters mitosis. Each chromosome contains one long DNA double helix, made of two strands joined by paired bases. The strands carry the instructions the future cells will need. Copying begins at many starting points along each human chromosome, which helps the cell finish the enormous task. At each starting point, the enzyme helicase breaks the bonds between paired bases and separates the strands. Each exposed strand can now serve as a template for a new strand.

2. A short RNA primer gives DNA polymerase a place to start on each template. DNA polymerase then adds DNA nucleotides by matching bases exposed on the template: A pairs with T, and C pairs with G. For example, if a template segment reads A C G, the new segment reads T G C. Pairing matters because the order of bases stores information. The two template strands run in opposite directions, while DNA polymerase can build a new strand in only one direction. One new strand grows continuously; the other is made in short pieces. DNA ligase joins those pieces into one strand.

3. Once the new strands have been built, each finished DNA molecule contains one strand from the original molecule and one newly made strand. This is called semiconservative replication. Because each old strand directs matching bases on a new strand, the two molecules usually carry the same base sequence as the original. DNA polymerase also checks many of the bases it adds and can replace a mismatched one. Errors can still remain, but checking reduces their number. After S phase, each chromosome has two identical copies called sister chromatids, joined together until they separate during cell division. The cell can then pass a copy of each chromosome to each new cell.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why must the skin cell copy its DNA in S phase before it enters mitosis?

2. Explain how helicase makes it possible for the cell to build two DNA molecules.

3. Why does matching A with T and C with G matter when DNA polymerase adds nucleotides?

4. How do ligase and DNA polymerase's checking each help make usable copies?

3 YOUR TURN

Your own words

A cell has a DNA segment with one strand that reads T A C G G A. In one paragraph, explain how S-phase enzymes make the new strands, give the sequence that matches this strand, and explain how the two finished DNA molecules prepare the cell for mitosis.

ANSWER KEY

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PART 1 · READ AND MARK

Number the actions of helicase, DNA polymerase, and ligase in the order they occur, then underline the sentence that explains why the new DNA molecules keep the original information. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why must the skin cell copy its DNA in S phase before it enters mitosis?	**The cell needs two copies of each chromosome so it can pass a copy to each new cell during division.**
2	Explain how helicase makes it possible for the cell to build two DNA molecules.	**Helicase separates the original DNA strands. Each exposed strand serves as a template for a new strand, producing two DNA molecules.**
3	Why does matching A with T and C with G matter when DNA polymerase adds nucleotides?	**The pairing rules let each original strand direct the order of bases in its new partner, preserving the DNA information.**
4	How do ligase and DNA polymerase's checking each help make usable copies?	**Ligase joins the short pieces of one new strand. DNA polymerase can replace mismatched bases, reducing copying errors.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

During S phase, helicase separates the original DNA strands. DNA polymerase uses the strand T A C G G A as a template and builds A T G C C T by matching A with T and C with G. It also builds a new partner for the other original strand. Where a new strand is made in short pieces, ligase joins them. Each finished DNA molecule has one original strand and one new strand. The cell can then separate its copied chromosomes during mitosis.

Accept explanations that connect strand separation, base pairing, and copying before mitosis, even if students use different wording. For Your Turn, the matching sequence must be A T G C C T.