Copying the Code

Trace how one DNA molecule becomes two

GEN.1B.2 "Develop and use models to illustrate the mechanics of DNA replication."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline actions that change the DNA, circle the enzymes that perform them, and number the main steps from strand separation to finished copies.

What Happens at a Replication Fork?

1. Before a skin cell divides, it must copy its DNA so each new cell receives a full set of instructions. Picture one section of DNA as a ladder twisted into a spiral. The two side rails are strands that run in opposite directions, labeled 5′ to 3′ and 3′ to 5′. Each rung joins matching bases: A pairs with T, and C pairs with G. Those matches matter because either original strand can guide construction of its partner. A model of replication should track both the base matches and which strand is old or newly built.

2. Copying begins at many places along a human chromosome. At each place, helicase opens the DNA by separating the paired bases. The opening forms a replication fork that moves as more DNA unwinds. Each exposed original strand becomes a template. Primase places short RNA primers on the templates, giving DNA polymerase starting points. DNA polymerase adds DNA nucleotides to a primer, selecting a base that matches the template at each position. It can extend a new strand only at its 3′ end, so every new strand grows in the 5′ to 3′ direction.

3. Because the original strands point in opposite directions, new strands are built differently at a fork. On one template, polymerase follows the moving fork and makes a continuous leading strand. On the other, it builds short lagging-strand pieces away from the fork as more template becomes exposed. Later, the RNA primers are replaced with DNA, and DNA ligase joins the pieces. When copying is complete, each DNA molecule contains one original strand and one new strand. This is called semiconservative replication. A useful model shows base pairing, the order of enzyme actions, strand directions, and the old and new strands in both copies.

2 ANSWER WITH EVIDENCE

Use the passage

1. In a model of a replication fork, what should happen to the two original strands when helicase acts? What role does each strand then play?

2. A model shows a template running 3′ to 5′ toward a moving fork. Which way should its new strand grow? Should it appear continuous or in pieces?

3. A model shows short new pieces on one side of a fork. What two changes must occur before that new strand is complete?

4. A finished model shows two DNA molecules, each made only of new strands. What is wrong, and how should both copies be labeled?

3 YOUR TURN

Your own words

In two panels, model the replication of these original strands: 5′-ATGC-3′ and 3′-TACG-5′. Show the starting pair and both finished molecules, label each strand as original or new, mark where helicase separates strands and DNA polymerase adds bases, and use arrows to show each new strand growing 5′ to 3′.

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PART 1 · READ AND MARK

Underline actions that change the DNA, circle the enzymes that perform them, and number the main steps from strand separation to finished copies. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	In a model of a replication fork, what should happen to the two original strands when helicase acts? What role does each strand then play?	**The original strands separate. Each becomes a template for a new, complementary strand.**
2	A model shows a template running 3′ to 5′ toward a moving fork. Which way should its new strand grow? Should it appear continuous or in pieces?	**The new strand grows 5′ to 3′ toward the fork and appears continuous.**
3	A model shows short new pieces on one side of a fork. What two changes must occur before that new strand is complete?	**The RNA primers must be replaced with DNA, and DNA ligase must join the pieces.**
4	A finished model shows two DNA molecules, each made only of new strands. What is wrong, and how should both copies be labeled?	**Each finished molecule must have one original strand and one new strand, not two new strands.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1 shows the paired original strands, 5′-ATGC-3′ above 3′-TACG-5′, with helicase labeled where they separate. Panel 2 shows two molecules: original 5′-ATGC-3′ paired with new 3′-TACG-5′, and new 5′-ATGC-3′ paired with original 3′-TACG-5′. DNA polymerase is labeled at each new strand. A right-to-left arrow marks 5′ to 3′ growth of the new TACG strand; a left-to-right arrow marks 5′ to 3′ growth of the new ATGC strand.

Accept models with a different strand layout if the base pairs, original and new labels, and growth arrows are correct. The annotation order should follow the main sequence of events, though leading- and lagging-strand synthesis can occur at the same time.