PEEBEDU DNA Replication Simulator

Unit 6: Gene Expression and Regulation

Name: _____ **Period:** _____ **Date:** _____

> Open **peebedu.com** and navigate to **DNA Replication Simulator**. Click **Unzip the Mystery!** to begin. Read the introduction popup, which describes how DNA unzips and replicates in real-time. Review the five enzyme tools on the right panel and the progress checklist in the header.

Free Response Questions

Question 1 — Conceptual Analysis

> **Simulation Task:** *Apply Topoisomerase, then Helicase to unwind the DNA. Add RNA primers with Primase. Apply DNA Polymerase to the leading strand (click the bottom half of the canvas) and then to the lagging strand (click the top half). Drag complementary nucleotides from the free nucleotide pool to build the leading strand continuously. Then build the lagging strand, noting how synthesis proceeds in separate Okazaki fragments.*

(A) (1 pt) **Describe** the role of the short RNA sequences that must be present on a template strand before DNA polymerase can begin adding nucleotides.

(B) (1 pt) **Explain** why one new strand is synthesized as a single continuous piece while the other new strand is synthesized as multiple short fragments during DNA replication.

(C) (1 pt) **Predict** what will happen to the newly synthesised lagging strand if the ligase step is left out of the replication.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *Complete a full replication cycle from start to finish. As you drag nucleotides from the free nucleotide pool, note the 'Need:' label that appears above each highlighted position and the feedback message that follows each correct placement. After applying Ligase, compare the original template strands (blue) with the newly synthesized strands (green) in each of the two daughter molecules. Reset and repeat if needed to observe the full process again.*

(A) (1 pt) **Describe** the rule that determines which nucleotide from the free nucleotide pool can be placed opposite each base of a template strand.

(B) (1 pt) **Explain** why this pairing requirement allows each daughter DNA molecule to carry the same genetic information as the parent molecule.

(C) (1 pt) **Represent** In the box below, draw a labeled diagram of a replication fork showing: the two template strands with 5' and 3' labels, the leading strand with its direction of synthesis, the lagging strand with at least two Okazaki fragments and their direction of synthesis, RNA primers, and the positions of helicase and DNA polymerase.

Draw your diagram here.

(D) (1 pt) **Explain** how the copying of DNA during S phase allows mitosis to produce two daughter cells that carry identical genetic information.

6.1.B.1