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 directional requirement of DNA polymerase and the role of the short RNA sequences that must be present 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** how the daughter DNA molecules would differ from normal if a cell with a nonfunctional ligase enzyme attempted to replicate its DNA and then underwent cell division.

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

Question 2 — Analyze Model / Visual Representation

> **Simulation Task:** *Complete a full replication cycle from start to finish. After applying Ligase, observe the two completed daughter DNA molecules. Compare the original template strands (blue) with the newly synthesized strands (green) in each molecule. Reset and repeat if needed to observe the full process again.*

(A) (1 pt) **Describe** the composition of each daughter DNA molecule produced at the end of one round of replication, in terms of original and newly synthesized strands.

(B) (1 pt) **Explain** why removing or skipping any one step in the replication process prevents the subsequent steps from producing an accurate copy of the parent DNA molecule.

(C) (1 pt) **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 uncorrected errors introduced during DNA replication could affect allele frequencies in a population over many generations.

6.2.A.1