Name: _____ **Date:** _____

Section: _____

DNA Replication Simulator Activity

Understanding DNA Replication at the Molecular Level

Phase 1: ENGAGE (5 minutes)

Getting Started: Open peebedu.com and navigate to DNA Replication Simulator

Read the introduction popup about DNA replication.

Essential Question: How do cells accurately copy their entire genome before division? _____

Pre-Activity Review: DNA polymerase can only add nucleotides in the ___' to ___' direction The two strands of DNA run in _____ directions (parallel/antiparallel) Base pairing rules: A pairs with ___, G pairs with ___

Initial Hypothesis: Why might replication be different on the two strands?

Phase 2: EXPLORE (20 minutes)

Interactive DNA Replication Process

Part A: Initiation

Step 1 - Topoisomerase:

- Click Topoisomerase and apply to DNA

- Why is this necessary? _____

Step 2 - Helicase:

- Apply Helicase to the relaxed DNA

- What forms at this location? _____

Part B: Primer Addition

Step 3 - Primase:

- Apply Primase (RNA Polymerase)
- Count RNA primers added:

- Lagging strand: _____ primer(s)

Part C: DNA Synthesis

Step 4 - DNA Polymerase:

- Apply to BOTH strands separately
- Observe synthesis direction:

- Lagging strand moves _____ from the fork

Interactive Synthesis:

- Drag correct nucleotides to match template
- Record any errors and corrections:

Part D: Completion

Step 5 - DNA Ligase:

- Apply Ligase

- What happens to RNA primers? _____

Phase 3: EXPLAIN (10 minutes)

Analysis of Replication Mechanisms

Key Patterns (Identify 3):

- Pattern 1: All synthesis occurs in ___' to ___' direction

- Pattern 3: Multiple enzymes work _____ (sequentially/simultaneously)

Cause-Effect Relationships: Complete the chains:

- Antiparallel strands → Different synthesis patterns → _____ fragments

- DNA Pol can't start synthesis → Primase required → _____

Enzyme Function Summary:

- ———-

Ligase

Phase 4: ELABORATE (10 minutes)

Applying Concepts

Scenario Analysis:

Mutation in Helicase Gene: Predict consequences: _____ Effect on cell division: _____

Telomere Problem: The lagging strand can't replicate the very end of linear chromosomes.

- Why not? _____

Replication Speed: E. coli replicates at ~1000 nucleotides/second Humans replicate at ~50 nucleotides/second

- Why the difference? _____

Drug Target Design:

Many antibiotics target bacterial DNA replication. Design a drug that would:

- Target: _____ (which enzyme)

- Why selective for bacteria? _____

Phase 5: EVALUATE (5 minutes)

Assessment Questions

Process Understanding: Explain why DNA replication is called '`semiconservative`' using evidence from the simulation. Include the fate of original strands. (3 pts)

Pattern Application: A new polymerase mutant can synthesize in both 5'→3' AND 3'→5' directions. How would this change replication? Would Okazaki fragments still form? (3 pts)

Systems Thinking: Connect DNA replication to:

- Cell cycle regulation (Unit 4): _____

- Gene expression (Unit 6): _____

(4 pts)

Model Evaluation:

- What aspects of replication are simplified? _____

Research Topic: Investigate one DNA replication defect disease:

- Bloom syndrome
- Werner syndrome
- Cockayne syndrome

Explain which enzyme is affected and consequences: _____