**Name:** **Date:** **Section:**

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# DNA Replication Simulator Activity: Modeling DNA Synthesis

## 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:**

1. DNA polymerase can only add nucleotides in the ___' to ___' direction
2. 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**

1. **Step 1 - Topoisomerase:**

- Click Topoisomerase and apply to DNA
- Why is this necessary? _____

1. **Step 2 - Helicase:**

- Apply Helicase to the relaxed DNA
- What forms at this location? _____

**Part B: Primer Addition**

1. **Step 3 - Primase:**

- Apply Primase (RNA Polymerase)
- Count RNA primers added:
- Lagging strand: _____ primer(s)

**Part C: DNA Synthesis**

1. **Step 4 - DNA Polymerase:**

- Apply to BOTH strands separately
- Observe synthesis direction:



- Lagging strand moves _____ from the fork

1. **Interactive Synthesis:**

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



**Part D: Completion**

1. **Step 5 - DNA Ligase:**

- Apply Ligase



- What happens to RNA primers? _____

## Phase 3: EXPLAIN (10 minutes)

**Analysis of Replication Mechanisms**

1. **Key Patterns (Identify 3):**

- Pattern 2: Leading strand is _____, lagging is _____

1. **Cause-Effect Relationships:**

Complete the chains:

- Antiparallel strands → Different synthesis patterns → _____ fragments
- DNA Pol can't start synthesis → Primase required → _____

1. **Enzyme Function Summary:**

- ---

| Ligase |
| --- |

## Phase 4: ELABORATE (10 minutes)

### Applying Concepts

**Scenario Analysis:**

1. **Mutation in Helicase Gene:**

Effect on cell division: _____

1. **Telomere Problem:**

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

- Why not? _____

1. **Replication Speed:**

E. coli replicates at ~1000 nucleotides/second

Humans replicate at ~50 nucleotides/second

- Why the difference? _____

1. **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

1. **Process Understanding:** Explain why DNA replication is called "semiconservative" using evidence from the simulation. Include the fate of original strands. (3 pts)
1. **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)

1. **Systems Thinking:** Connect DNA replication to:
   - Mutations and variation (Unit 7): _____

(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: _____