Name: ____________________ **Date:** ____________
Section: ________

DNA Replication Simulator Activity

The Amazing Process of DNA Replication

Phase 1: ENGAGE (5 minutes)

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

Click through the introduction to learn about DNA replication.

The Big Question: Before every cell division, DNA must be copied perfectly. How does a cell copy 3 billion base pairs without making mistakes? _______

Quick Review:

- DNA bases: A pairs with ___, G pairs with ___
- DNA strands run in opposite directions (antiparallel)
- New DNA is always built 5' to 3'

Think About It: If you had to copy a book, would it be easier to: _______ Copy it all at once from start to finish Copy it in sections with multiple helpers

DNA uses the second strategy! Let's see how.

Phase 2: EXPLORE (20 minutes)

Step-by-Step DNA Replication

Part A: Getting DNA Ready

Tool 1 - Topoisomerase: Select and click on the DNA

What happens? ______________________

Why needed? Think of untangling headphone wires!

Tool 2 - Helicase: Apply to the relaxed DNA

What it does: ______________________ What shape forms? This is the ‘`replication _______`‘

Part B: Starting Points

Tool 3 - Primase: Apply to the unwound DNA

Count the RNA primers:

- Bottom strand (leading): _____ primer(s)

Key Insight: DNA polymerase can’t start from scratch!

Part C: Building New DNA

Tool 4 - DNA Polymerase: Click on EACH strand separately!

Leading strand (bottom):

- Synthesis direction: Toward / Away from fork

Lagging strand (top):

- Synthesis direction: Toward / Away from fork

Interactive Building: Drag the correct nucleotides!

Tips for success:

- A matches with ___

- Watch the `Need: __` hint
- Green = correct, Red = wrong

Part D: Finishing Up

Tool 5 - DNA Ligase: Apply to complete replication

What does it connect? _______ These chunks are called `_______ fragments`

Phase 3: EXPLAIN (15 minutes)

Making Sense of What You Saw

The Key Patterns (Find 3):

- Pattern 1: DNA synthesis ALWAYS goes ___' to ___'

- Pattern 3: Multiple enzymes must work in _______

Fill in the Process Map:

DNA twisted → Topoisomerase → DNA _______ DNA closed → Helicase → DNA _______ No starting point → Primase → RNA _______ Template ready → DNA Polymerase → New _______ Fragments separate → Ligase → Continuous _______

The Replication Team: Match each enzyme to its job:

Enzyme: Job:

- Topoisomerase • Joins DNA pieces
- Helicase • Adds RNA starters
- Primase • Untwists DNA
- DNA Polymerase • Unzips DNA
- Ligase • Builds new DNA

Why Different on Each Strand?

Draw arrows showing synthesis direction:

Leading strand: ————————————————→ Lagging strand: ←—— ←—— ←——

The lagging strand is made backwards in pieces because _______

Phase 4: ELABORATE (12 minutes)

Real-World Connections

Application Scenarios:

DNA Testing: Crime labs use PCR to copy DNA evidence. Which enzyme is most like the one in PCR? _______ Why do they heat the DNA first? (Hint: What does helicase do?) _______

Cancer and Replication: Some cancers have mutations in DNA repair enzymes. Predict what happens if:

- Polymerase makes more mistakes: _______

Antibiotics: Some antibiotics block bacterial DNA replication. Good target enzyme: _______ Why it works: _______

Design Challenge:

You're creating a replication inhibitor drug.

- Target which step? _______

- Side effects to consider? _______

Phase 5: EVALUATE (8 minutes)

Show What You Know

Sequence the Steps: Number in order (1-5): ___ DNA polymerase synthesizes new strands ___ Ligase joins fragments ___ Helicase unwinds DNA ___ Primase adds RNA primers ___ Topoisomerase relaxes DNA

Explain the Difference:

Your friend asks: '`Why can't both strands be copied the same way?`' Your answer: _______________________________

Problem Solving: A cell has a mutation - it can't make Okazaki fragments.

- Which enzyme is probably broken? _______
- Can the cell still replicate its DNA? Yes / No / Partially

Make Connections: How does accurate DNA replication relate to:

- Inheritance: _______
- Cancer: _______

Model Check:

- One thing that surprised you: _______

Vocabulary Summary:

- **Replication Fork:** Y-shaped region where DNA unwinds
- **Leading Strand:** Synthesized continuously toward fork
- **Lagging Strand:** Synthesized in fragments away from fork
- **Okazaki Fragments:** Short DNA pieces on lagging strand

- **Semiconservative:** Each new DNA has one old strand, one new