DNA Replication Project

Goal: Students will learn about the complex story of DNA Replication through **3** learning activities:

1) Simulate the replication of one DNA "gene" **on paper**
2) Simulate the replication of one DNA "gene" using color-coded "pop-it" **beads**
3) Narrate the detailed story of one DNA "gene" replicating by creating a **booklet**

Introduction: The accurate replication of DNA is a critical life process. All eukaryotic organisms copy their genetic "blueprint" during the Synthesis phase of Interphase during the cell cycle. This production of two identical sets of DNA molecules is essential for cells undergoing growth, the repair of injured tissue, replacing old cells, or in the preparation of reproductive cells such as sperm and eggs. The activities of this project will help you better appreciate and understand this fascinating, yet complex microscopic drama of life.

Directions:

- **Part 1: Simulate replication on paper**
  a. Fill in the DNA gene diagram with the following 24-lettter gene code: **GATTACAGATTACAGATTACAGAT**
  b. Draw pictures of DNA replication as Mr. Roberts guides you play by play on the overhead

- **Part 2: Simulate replication using color-coded beads**
  a. Build a model of the 24-letter gene using the color-coded beads according to the following key:

White = deoxyribose and ribose (as needed for primers)	Green = guanine
Red = DNA phosphate group	Blue = cytosine
Black = RNA phosphate group (for primer)	Yellow = adenine
Pink = uracil (for primer)	Orange = thymine

  b. Create the **6** enzyme "characters" involved in the DNA replication story → color, label, and cut out each "paper character" or use pictures from clipart or the Internet to represent the following **6** enzymes:

DNA Helicase	DNA Ligase
DNA Polymerase I	DNA Repair Enzyme
DNA Polymerase II	RNA Primase

  c. Simulate each of the **11** scenes of DNA replication (see the play by play below) using your bead model. Be sure to place all the enzyme "characters" in their proper locations in each scene. After Mr. Roberts has verified the accuracy of each scene, you may proceed to model the next scene.

11 SCENES OF DNA REPLICATION

1. DNA gene overview: 2 complimentary strands of 24 letters each spiraled in a helix shape
2. 2 DNA **Helicase** enzymes bind to the DNA gene in the middle and begin to unwind and unzip the DNA strands creating an origin site for replication.
3. RNA **Primase** enzymes insert 2 RNA Primers (2 nucleotides or NT) which "jump start" the top & bottom LEADING strands.
4. 2 DNA **Polymerase I** enzymes each begin to build a leading strand in a different directions by adding 4 new complimentary DNA nucleotides in 5'→3' direction beginning at the RNA primer's free 3' end.
5. As Polymerase I adds 2 more NT to the leading strands, Primase begins (directly across) building 1st RNA Primers (2 NT) to begin LAGGING strands.
6. While Polymerase I adds 4 more NT to finish the LEADING strand, 2 new Polymerase I enzymes add 4 NT (5'→3') to the LAGGING strand (forming the 1st Okazaki fragment) and then "bump" into previously built LEADING strand primers. Primase is also busy building the 2nd LAGGING strand primer (2 NT) starting from the end of the parent DNA strand.
7. LEADING strand polymerase I enzymes disappear out of view as the LAGGING Polymerase I "leapfrogs" to the 2nd primer and then builds the 2nd Okazaki fragments (add 4 NT) until bumping into the 1st Okazaki fragment primers.
8. **Polymerase II** enzymes replace the RNA primers with DNA nucleotides (but cannot link new DNA to "neighbor" DNA)
9. **Ligase** links all the DNA fragments into 2 continuous chains
10. **Repair Enzyme** proofreads down the nitrogen bases and repairs mistakes or mutations in the code
11. Final Overview of semi-conservative replication: 2 identical genes (each ½ old and ½ new DNA)

- **Part 3: Create a booklet to narrate the DNA replication story →see Booklet Directions Page**