Lab-wide Learning Outcomes for DNA Explored

Knowledge-Based Outcomes

Upon completion of *DNA Explored*, students should be able to:

1. Explain that DNA encodes information in the sequence of nucleotides.
2. Explain base pairing, including why GC pairs are stronger than AT pairs, and how base pairs are held together (hydrogen bonds).
3. Define the goal of DNA replication as making one accurate copy of all the DNA in a cell.
4. Understand the functional relationship between the enzymes that synthesize nucleic acids (e.g., primase) and the polymer they synthesize (e.g., RNA primers).
5. Summarize some basic differences between DNA and RNA, which includes distinguishing the sugar and bases that are found in each, and identifying DNA as the primary molecule for storing biological information during an organism's lifetime and across generations.

Skills-Based Outcomes

Upon completion of *DNA Explored*, students should be able to:

1. Identify the 5′ and 3′ ends of a DNA strand, given an image or description of a DNA strand or replication fork.
2. Anticipate the functional consequence of a given perturbance to DNA replication. This may involve a drug, toxin, or environmental condition which alters or inhibits a DNA replication enzyme.

DNA Explored, Part 1: DNA Structure

Knowledge-Based Outcomes

Upon completion of *Part 1: DNA Structure*, students should be able to:

1. Define DNA, explaining its location in cells for prokaryotes and eukaryotes.
2. Distinguish between dNTPs, nucleotides, and DNA.

Skills-Based Outcomes

Upon completion of *Part 1: DNA Structure*, students should be able to:

1. In a diagram of a nucleotide or a larger DNA molecule, identify and label the constituent parts of nucleotides (bases, ribose/deoxyribose, phosphate group).
2. Read and write DNA sequences with correct 5′/3′ orientation, and predict complementary sequences.

DNA Explored, Part 2: DNA Replication

Knowledge-Based Outcomes

Upon completion of *Part 2: DNA Replication*, students should be able to:

1. Explain why lagging strands are synthesized in a discontinuous way during replication, and how this differs from the way leading strands are synthesized.
2. Recognize that DNA polymerase makes mistakes in replicating DNA, and describe the consequence of this for the cell and for daughter cells if mistakes are not repaired.

3. Explain the order in which helicase, primase, DNA polymerase III, DNA polymerase I, and ligase are used during replication, indicating the role each protein plays, and why the order of use matters.
4. Describe how DNA polymerase III proofreads, which includes the detection of incorrect nucleotides, and the replacement of mismatched nucleotides with correct nucleotides.

Skills-Based Outcomes

Upon completion of *Part 2: DNA Replication*, students should be able to:

1. Guide a cell through replication after the formation of the pre-replication complex and proceeding through the correct sequence of events with the appropriate enzymes.
2. Given an illustration of a replication fork with primers attached, indicate which end of the primer DNA polymerase will add onto, and which direction polymerase will move.
3. Identify newly synthesized strands of DNA from an image of a replication fork.
4. Identify leading and lagging strands in a figure of a replication bubble at different points during DNA replication.