

Investigation 18.A: Modelling DNA Structure and Replication Answer Key

Answers to Analysis Questions

1. Your answer will depend on the materials used to make your model. You should clearly state how your model was or was not useful in explaining the various aspects of DNA structure and replication, including the double helix structure, complementary base pairing, the sugar-phosphate backbone, hydrogen bonding between nitrogenous bases, antiparallel structure, semi-conservative replication of the leading and lagging strands, and the action of the key replication enzymes. Specific reference should be made to the limitations of the model.

2.

Enzyme	Function	Absence of enzyme
Helicase	Breaks hydrogen bonds and unwinds the double stranded DNA at the replication fork.	The other enzymes (below) would not be able to bind to the DNA because it (the DNA) would remain double stranded.
Primase	Starts a new chain by connecting ribonucleotides that are complementary to the existing strand of DNA (RNA primer).	The DNA strands would be open, but synthesis could not begin because DNA polymerase has to have an existing chain with a 3' end to add new nucleotides.
DNA polymerase	(I) Adds new nucleotides to the 3' end of a growing chain. (II) Proofreads the newly formed base pairs and cleaves out any nucleotides that do not fit. (III) Removes ribonucleotides at the 5' end (removes the RNA primer).	Only primer strands would exist on the opened DNA strands. No new DNA would be synthesized.
DNA ligase	Attaches Okazaki fragments together. (After the DNA polymerase has inserted all of the deoxyribonucleotides, ligase forms the last bond, attaching all of the chains together.)	The leading strand would be normal. However, the Okazaki fragments making up the lagging strand would never be joined, and therefore the new DNA would never be complete and functional.

3. Nucleic acids are soluble in water. Therefore, the nitrogenous bases, which are somewhat hydrophobic, must be positioned away from the water found in the nucleoplasm, and the polar phosphate groups (which are hydrophilic) must be on the outside of the molecule, interacting with the water.