

General Biology II (101-HTK) DNA Replication Concepts and Learning Outcomes

Topic	Concept	Learning Outcomes
DNA replication: unwinding the helix, synthesis of the leading strand, synthesis of the lagging strand, and the role of telomerase in eukaryotic DNA replication	<ol style="list-style-type: none"> 1. DNA replication requires DNA polymerase which catalyzes the addition of nucleotides in the 5'→3' direction (adding to the 3' end of each strand). 2. DNA replication involves 3 major steps: (1) opening of the helix (DNA helicase) and keeping the strands separated (single-strand binding proteins), (2) Synthesis of the leading strand through continuous synthesis of a complementary strand, and (3) synthesis of the lagging strand (Okazaki fragments) through discontinuous synthesis of the other complementary strand. The fragments are then joined together by DNA ligase. 3. Telomeres (short DNA sequence at the 3' end of eukaryotic DNA) are not replicated and therefore are removed unless telomerase is present. 	<ol style="list-style-type: none"> 1. Cite the evidence from Meselson and Stahl's experiment that enabled scientists to differentiate between semiconservative replication of DNA and alternative models of DNA replication 2. Summarize how DNA is replicated and identify the role of the different proteins involved in this process 3. Differentiate between continuous replication and discontinuous replication of DNA 4. Define telomere and summarize how in some cells telomerase replicates the 3' end of eukaryotic DNA
DNA error repair: proof-reading, mismatch repair, and excision repair	<ol style="list-style-type: none"> 4. DNA polymerase makes errors when replicating DNA. Also, DNA is continuously subjected to alterations and damage. Proofreading mechanisms correct errors in replication as DNA polymerase builds new DNA. Mismatch repair mechanisms correct base-pairing mismatches following DNA replication. Excision repair mechanisms remove abnormal/damaged bases and replace them with functional bases. 	<ol style="list-style-type: none"> 5. Outline the mechanisms involved in proofreading errors in DNA replication and repairing base-pairing mismatches and damage
Polymerase chain reaction (PCR)	<ol style="list-style-type: none"> 5. Polymerase chain reaction (PCR) makes multiple copies of DNA sequences using DNA polymerase from <i>Thermus aquaticus</i> (Taq polymerase). 6. PCR amplification process involves a cyclical process in which a sequence of 3 steps is repeated over and over again. These 3 steps are: DNA denaturation, RNA primer annealing, and DNA extension. 	<ol style="list-style-type: none"> 6. Describe how PCR amplifies DNA <i>in vitro</i> 7. Perform simple calculations to determine the number of DNA copies produced following a certain number of PCR cycles