**Chapter Review**

**Chapter 7: Replication, Maintenance, and Rearrangements of Genomic DNA**

7.1

Different DNA polymerases play distinct roles in DNA replication and repair in both prokaryotic and eukaryotic cells. All known DNA polymerases synthesize DNA only in the 5′ to 3′ direction by the addition of deoxyribonucleotides to a preformed primer. As a consequence, one new DNA strand (the leading strand) is synthesized in a continuous manner at the replication fork whereas the other strand (the lagging strand) is formed by the joining of small fragments of DNA that are synthesized backward with respect to the overall direction of replication. DNA polymerases and various other proteins act in a coordinated manner to synthesize both leading and lagging strands of DNA. DNA polymerases increase the accuracy of replication both by selecting the correct base for insertion and by proofreading newly synthesized DNA to eliminate mismatched bases. DNA replication starts at origins of replication, which contain binding sites for proteins that initiate the process. In higher eukaryotes, origins may be defined by chromatin structure rather than DNA sequence. Telomeric repeat sequences at the ends of chromosomes are maintained by the action of a reverse transcriptase (telomerase) that carries its own template RNA.

7.2

A few types of common DNA lesions are repaired by direct reversal of the damage, but most are repaired by excision of the damaged DNA. The resulting gap is filled by newly synthesized DNA, using the undamaged complementary strand as a template. Mismatch repair specifically removes mismatched bases from newly synthesized DNA strands. If other mechanisms fail, specialized DNA polymerases are capable of replicating DNA across from a site of DNA damage, although the action of these polymerases may result in a high frequency of incorporation of incorrect bases. Double-strand breaks are repaired by recombination to rejoin the damaged strands, either by homologous recombination with an undamaged chromosome or by nonhomologous rejoining of the broken ends of a single DNA molecule.

7.3

Programmed DNA rearrangements of immunoglobulin and T cell receptor genes play a critical role in development of the vertebrate immune system. Additional diversity is provided to immunoglobulin genes by somatic hypermutation and class switch recombination, both of which result from enzymatic deamination of cytosines in DNA. Gene amplification results from repeated replication of a chromosomal region. In some cases, gene amplification provides a mechanism for increasing gene expression during development. It can also occur in cancer cells, resulting in the elevated expression of genes that contribute to uncontrolled cell proliferation.