ANSWERS TO EXERCISES

1. DNA
   nucleotides
   helix
2. four
3. Adenine
   cytosine
   guanine
   GC and AT
4. semiconservative
5. Helicase
   polymerase
   ligase
6. AATC
   GTTAC
7. Chromosomes
8. false, double
9. false, bases
10. true
11. true
12. false, phosphorus
13. true
14. false, thymine
15. false, semi
16. false, nucleotides
17. c
18. c
19. e
20. b
21. c
22. b
23. c
24. d
25. d
26. a
27. b
28. a
29. Suppose a hypothetical single-stranded DNA molecule has the base sequence AAAAAAAAAA. During replication, the DNA polymerase would make a complimentary DNA molecule with the base sequence TTTTTTTTTT. Then, the DNA polymerase would have to make a complementary copy of the TTTTTTTTTT DNA molecule, which would be AAAAAAAAAA, the same as the original gene. Then, the TTTTTTTTTT molecule would have to be broken down, since it isn't a normal DNA molecule for that organism. This scheme, where two replications yield one new DNA molecule, is much less efficient than replicating a double-stranded DNA molecule, where one round of semiconservative replication yields two DNA molecules.
30. Hydrogen bonding between specific base pairs in the center of the helix holds the two strands together. Three hydrogen bonds hold guanine to cytosine; two hydrogen bonds hold adenine to thymine. Cytosine, theoretically, could pair with either guanine or adenine. Of the two possibilities, cytosine always pairs with guanine because they have complementary chemical side groups positioned so that three hydrogen bonds link them.
31. Within a double helix of DNA, whether from bacterial or human sources, adenine base pairs with thymine, and cytosine base pairs with guanine (A-T and C-G base pairs). Thus, within a DNA molecule, the amounts of A and T must be equal, as well as the amounts of C and G. However, since human DNA has more A-T pairs and fewer C-G base pairs than tuberculosis bacterial DNA, this accounts for the differing percentages when the DNAs are compared. Also, since each base pair contains a base with two rings of atoms (A and G) and a base with one ring of atoms (C and T), there has to be a total of 50% one-ring bases and 50% two-ring bases within any DNA molecule.

32. You might extract DNA from heat-killed strain A bacteria and mix it with living type B bacteria. If type B bacteria can absorb DNA fragments and use them as genes, the type B cells that absorb the normal vitamin B_6 gene could then begin to make the vitamin and behave like living type A cells. This would demonstrate that DNA is the genetic material. In a second experiment, you might extract protein from the heat-killed strain A cells and mix it with living type B bacteria. If type B bacteria can absorb the protein fragments but not use them as genes, the type B cells still could not make the vitamin. This would demonstrate that protein is not the genetic material.

33. The greater the number of hydrogen bonds attracting different molecules to each other, the greater will be the amount of energy needed to break all the hydrogen bonds and allow the molecules to separate from each other. Due to this, it takes more heat energy to separate G from C (3 hydrogen bonds involved) than to separate A from T (2 bonds). Thus, the higher the percentage of G-C pairings within a DNA molecule, the higher the DNA must be heated before the double stranded molecule separates into a pair of single stranded entities. It will take more heat to separate double stranded DNA from Species A (with 60% G-C base-pairs) than to separate double stranded DNA from Species B (with 30% G-C base pairs).

34. What the scientist's data would suggest is that in this peculiar type of DNA, A pairs with G and T pairs with C. There would be two problems with these data. The chemical structures of A and G make them incapable of forming hydrogen bonds with each other; likewise, the chemical structures of T and C make them incapable of forming hydrogen bonds with each other. In addition, even if A-G and C-T pairings were possible, this would mean that some pairings would involve a two-ring base pairing with a two-ring base (A-G), and some pairings would involve a one-ring base pairing with a one-ring base (C-T). That would mean the diameters of the G-C and A-T paired bases would be of different widths, neither of which would fit properly in the space available in a standard double stranded DNA molecule.

35. Molecule One: 5'-CGTAGTAGTAGAATATTGCTGCACC-3'
3'-GCATCATCATCTTATAACGACGTGG-5'
Molecule Two: 5'-AGTGCGAAGGCTCCTTGGGAACGTG-3'
3'-TCACGCTTCCGAGGAACCCTTGCAC-5'
The numbers of GC base pairs in molecule one is 11, while the number of AT base pairs in molecule one is 14. The numbers of GC base pairs in molecule two is 15, while the number of AT base pairs in molecule one is 10. Therefore, molecule two has more hydrogen bonds holding the two strands together than does molecule one, and molecule two is more stable at a higher temperature (see Question 33).

36. The double stranded DNA molecule would have the following proportions of bases:
one strand: 10% T, 20% A, 30% C, and 40% G
other strand: 10% A, 20% T, 30% G, and 40% C
Collectively: $60 \div 200 = 30\%$ A-T and $140 \div 200 = 70\%$ G-C, which means that A = 15%, T = 15%, G = 35%, and C = 35%

37. To recognize a possible melanoma in your skin, remember to check moles for "ABCD": Asymmetrical shape, irregular Border, irregular Color, or a Diameter bigger than the eraser on the end of a pencil.

38. According to the National Cancer Institute, a carcinoma is cancer that begins in the cells that cover or