ANSWERS TO EXERCISES

1. plasma membrane
2. cholesterol
3. proteins
4. phospholipid
5. recognition proteins
6. receptor proteins
7. transport proteins
8. channel proteins
9. carrier proteins
10. endocytosis
11. pinocytosis
12. receptor-mediated endocytosis
13. phagocytosis
14. differential permeability
15. active transport
16. passive transport
17. desmosomes
18. gap junctions
19. plasmodesmata
20. tight junctions
21. false, less rapidly
22. true
23. false, hydrophilic
24. false, increasing
25. false, lower
26. true
27. true
28. true
29. true
30. false, phagocytosis
31. cell wall
32. plasma membrane
33. plasma membrane
34. cell wall
35. plasma membrane
36. cell wall
37. plasma membrane
38. plasma membrane
39. diffusion
40. osmosis
41. diffusion
42. osmosis
43. osmosis
44. hypotonic
45. hypertonic
46. hypotonic
47. hypertonic
48. hypotonic
49. isotonic
50. c
51. a
52. d
53. b
54. a
55. b
56. c
57. b
58. a
59. c
60. c
61. b
62. a
63. d
64. Although you were thirsty and your cells craved water, drinking the salty seawater was unwise because seawater is hypertonic (has a higher concentration of salts) to hypotonic cellular cytoplasm. So, in your stomach, cells will begin to lose water due to osmosis, since water flows through a selectively permeable membrane from regions of greater water concentration (the hypotonic cytoplasm) toward regions of lesser water concentration (the hypertonic seawater). Soon, your stomach cells will have lost so much water that they will begin to die, causing you to go into convulsions and, perhaps, die as well.
65. Phospholipid molecules in cell membranes interact with both nonpolar lipids (at their fatty acid ends) and polar water molecules (at their charged ends). Soaps work in a similar fashion. One way to make soap is to boil animal fat with sodium hydroxide, creating molecules of soap with fatty acid ends (nonpolar) and ends containing sodium ions (charged polar ends). When we apply soap to our hands, the nonpolar ends attract the greasy dirt. Then, when we rinse our hands, the soap molecules are attracted to the running water, pulling the greasy dirt off our hands as the soap is washed down the drain with the water.
66. An organism living in fresh water is hypertonic to its environment and constantly will be taking in excess water due to osmosis. This could lead to the cells in the organism bursting due to the increased amount of water. Aquatic plants counteract this by having rigid cell walls around their cells that prevent the cells from expanding to the point that they burst. Aquatic animals prevent bursting by constantly pumping the excess water out through contractile vacuoles in their cells and specialized organs in their bodies.

67. An organism living in salty water is hypotonic to its environment and constantly will be losing water due to osmosis. This could lead to the cells in the organism shriveling up due to the loss of water. Marine plants prevent water loss by storing water in their central vacuoles and adding salts to the water to slow or stop the effect of osmosis. Marine animals must constantly drink water to replace that which is lost. Such animals often have specialized organs, called "salt glands" to remove salt from the ingested water and pump it out of the organism.

68. Phospholipids have both nonpolar hydrophobic regions and polar hydrophilic regions. This allows them to associate spontaneously to form a bilayer pattern in membranes. The phospholipid bilayer not only determines the permeability properties of the membrane but also determines the nature of the proteins that can be associated with the membrane. The primary structure of the proteins determines their tertiary structures, which determines where in the membrane they will reside and what their functions will be. The ability of carbohydrates to form branched patterns confers on them the specificity needed to function as molecules involved in cellular recognition reactions.

69. In simple diffusion, all substances move in the direction of the concentration gradient, and no outside energy source is needed since the process is driven by the energy of molecular movement. In facilitated transport, specific types of molecules are transported by carrier proteins in the plasma membrane. Energy for facilitated transport comes from molecular movement of molecules moving in the direction of the concentration gradient. Facilitated transport can be in either direction across the membrane, depending on the concentration gradient. Active transport involves carrier proteins and is specific in the types of molecules affected. The major difference between active transport and the other two is the use of cellular energy to drive transport against a concentration gradient. Active transport is in one direction only.

70. Desmosome connections produce very tight adhesion between cells. Desmosomes are found attaching skin cells, where protection from physical stress is required to keep the skin intact. Tight junctions prevent movement of liquids between cells. Tight junctions are found between cells lining the urinary bladder to prevent leakage of urine into adjacent tissues. Gap junctions allow for communication between the cells involved. Gap junctions are found in cardiac muscle cells needed to contract in synchrony, since gap junctions allow for rapid transfer of electrical and chemical signals in the heart.

71. During the long arctic winters, temperatures fall far below freezing. For caribou to keep their legs and feet really warm would waste energy. Specialized arrangements of arteries and veins in caribou legs allow the temperature of the lower legs to drop almost to freezing, thus conserving body heat while the upper legs and trunk remain at body temperature. To remain fluid at these different temperatures requires the phospholipids in the membranes of cells in the upper and lower legs to be very different. The fluidity of a membrane is a function of the fatty acid tails of its phospholipids. Unsaturated fatty acids remain more fluid at lower temperatures than do saturated fatty acids. In caribou, the membranes of cells near the chilly hoof have lots of unsaturated fatty acids, whereas the membranes of cells near the warmer trunk have more saturated ones.

72. Poisonous snake venom contains phospholipase enzymes that attack the cell membranes of their prey, breaking down the phospholipids of the plasma membranes of cells, causing the cells to rupture and die. Thus, snake bites cause death of tissues around the bite, rupture of red blood cells in the bloodstream leading to oxygen loss, and rupture of the blood vessels as well as muscles. All animals, including snakes and humans, have phospholipase enzymes in their digestive tracts, where they aid in the breakdown of ingested food particles. The lining of the digestive tract protects the cells of the digestive organs from being attacked by the phospholipase enzymes used to digest food.

73. Due to active transport, cells use energy to move substances into or out of cells against a concentration gradient. For instance, this allows the kidney cells to reabsorb water and send it back into the blood stream. This also allows the root cells of plants to take up minerals from the soil and make them more concentrated in the cells. Without active transport, cells could never have concentrations of molecules different from their surroundings, making life impossible.

74. According to the authors of TheSnake.org web site, snake venom is used to immobilize prey, to begin the digestion of the prey, and as a defense against predators. Venoms are highly toxic secretions produced in special oral glands. Because these oral glands are related to the salivary glands of other vertebrates, venom can be considered a modified saliva. Venoms are at least 90% protein (by dry weight), and most of the proteins in venoms are enzymes. About 25 different enzymes have been isolated from snake venom, ten of which occur in the venoms of most snakes. Proteolytic enzymes, phospholipases, and hyaluronidases are the most common types. Proteolytic enzymes catalyze the breakdown of tissue proteins. Phospholipases, which occur in almost all snakes, vary from mildly toxic to highly destructive of musculature and nerves. The hyaluronidases dissolve intercellular materials and speed the spread of venom through the prey's tissue. Other enzymes include collagenases, which occur in the venom of vipers and pitvipers and promote the breakdown of a key structural component of connective tissues (the protein collagen). Ribonucleases, deoxyribonucleases, nucleotidases, amino acid oxidases, lactate dehydrogenases, and acidic and basic phosphatases all disrupt normal cellular function, causing the collapse of cell metabolism, shock, and death. Not all toxic chemical compounds in snake venoms are enzymes. Polypeptide toxins, glycoproteins, and low-molecular-weight compounds are also present in some snakes. The roles of the other components of venom are largely unknown. Every snake's venom contains more than one toxin, and in combination the toxins have a more potent effect than the sum of their individual effects. In general, venoms are described as either neurotoxic (affecting the nervous system) or hemotoxic (affecting the circulatory system), although the venoms of many snakes contain both neurotoxic and hemotoxic components.

According to researchers at the National Aquarium in Baltimore, anti-venom is made in a complex and time-consuming process, with the following steps. (1) Venom is extracted with gentle pressure on the venom glands, or mild electric shock to constrict muscles around the gland. (2) Venom is purified and freeze-dried. Dried venom can be stored for years in a cool place. (3) A weak venom solution is injected into a horse or other animal. The concentration is increased as the animal builds immunity. The host animal makes blood rich in antibodies. (4) Blood from the animal donor is separated into dark red cells and clear serum. The serum has antibodies against venom. (5) Clear serum is further purified, stabilized for storage and standardized for effectiveness.