Supplemental Test Items to accompany OpenStax College *Concepts of Biology*. Note that not all chapters of OpenStax College *Concepts of Biology* have accompanying test items. Building on the community-oriented nature of OpenStax College resources, we invite you to submit items to be considered for future inclusion.

**Chapter 02: Chemistry of Life**

1. Water molecules have one oxygen atom that is more electronegative than the two hydrogen atoms bound to it. As a result, which type of bonding holds water molecules together? (Outcome #Id) (DOK 2) (Paired Item 1)
2. non-polar covalent bonding
3. polar covalent bonding\*
4. ionic bonding
5. Which of the following statements correctly identifies and describes the type of covalent bond found between oxygen and hydrogen in water molecules? (Outcome #Id) (DOK 2) (Paired Item 2)
6. polar covalent bonds because hydrogen is more electronegative than oxygen
7. hydrogen bonds because hydrogen is more electronegative than oxygen
8. polar covalent bonds because oxygen is more electronegative than hydrogen\*
9. A team of researchers is investigating a new carbon-rich molecule important to life. They find evidence for the presence of both *cis* and *trans* isomers of the molecule in a mixture of near-pure molecules. Which of the following must be contained in the new molecule? (Outcome #Id) (DOK 2) (Paired Item 1)
10. a double bond\*
11. an aliphatic hydrocarbon
12. a hydrocarbon ring structure
13. A team of researchers is investigating a new carbon-rich molecule important to life. They find evidence for the presence of a carbon-carbon double bond in the molecule. This observation means that the new molecule likely exists as which of following? (Outcome #Id) (DOK 2) (Paired Item 2)
14. a hydrocarbon ring
15. both *cis* and *trans* isomers\*
16. an aliphatic hydrocarbon
17. Consider the following chemical equation which depicts the mechanism by which humans maintain an acid-base balance in the blood:

H+ + HCO3- ↔ H2CO3 ↔ H20 + CO2

What happens if the carbon dioxide on the right is not removed from the blood via the lungs? (Outcome #Id) (DOK 3) (Paired Item 1)

1. The reaction will be driven toward the left, resulting in the blood becoming more acidic.\*
2. The reaction will be driven toward the left, resulting in the blood becoming more basic.
3. The reaction will be driven toward the center, and the pH of the blood will remain neutral.
4. Consider the following chemical equation which depicts the mechanism by which humans maintain an acid-base balance in the blood:

H+ + HCO3- ↔ H2CO3 ↔ H20 + CO2

What happens in this reaction if the blood becomes more acidic, and what is the physiological response? (Outcome #Id) (DOK 3) (Paired Item 2)

1. The reaction will be driven toward the left, and the blood will become more basic.
2. The reaction will be driven toward the right, and more CO2 will be removed via exhalation.\*
3. The reaction will be driven toward the center, and the pH of the blood will remain neutral.
4. A biologist isolates a large, unidentified molecule from some cells in his lab. What type of reaction could he initiate to determine whether the molecule is a polymer and, thus, a macromolecule? (Outcome #Ie) (DOK 2) (Paired Item 1)
5. condensation
6. dehydration
7. hydrolysis\*
8. A biologist isolates a large, unidentified molecule from some cells in his lab. He determines that the macromolecule breaks into smaller pieces with the concomitant loss of water. What reaction has he observed? (Outcome #Ie) (DOK 2) (Paired Item 2)
9. hydrolysis\*
10. condensation
11. dehydration
12. The disease called sickle-cell anemia is caused by a change in a single amino acid residue in the hemoglobin protein, resulting in a distortion of the protein’s shape at which levels? (Outcome #Ie) (DOK 2)
13. primary and quaternary
14. primary and secondary\*
15. secondary and tertiary
16. Why are humans unable to digest cellulose? (Outcome #Ie) (DOK 2)
17. Cellulose is made of glucose molecules connected by *β* 1-4 glycosidic linkages.\*
18. Cellulose is made of glucose molecules connected by *α* 1-4 glycosidic linkages.
19. Cellulose is made of glucose molecules connected by *α* 1-6 glycosidic linkages.
20. A biochemist is analyzing an aqueous solution of a pure unidentified macromolecule that she isolated from the cytosolic fraction of plant cells. After adding an enzyme that catalyzes the breaking of phosphodiester bonds, she observes that the macromolecule disappears. What is the most likely explanation? (Outcome #Ie) (DOK 3) (Paired Item 1)
21. The macromolecule was a polysaccharide from the cell wall.
22. The macromolecule was DNA from the chloroplast and mitochondria.\*
23. The macromolecule was a protein from the cytosol.
24. A biochemist is analyzing an aqueous solution of a pure unidentified macromolecule that she isolated from the cytosolic fraction of plant cells. She determined that the macromolecule is probably DNA from chloroplasts and mitochondria by adding an enzyme that catalyzed the destruction of the macromolecule. The enzyme most likely broke which type of bonds? (Outcome #Ie) (DOK 3) (Paired Item 2)
25. glycosidic
26. peptide
27. phosphodiester\*
28. Why are amino acids called “amino acids?” (Outcome #Id) (DOK 1)
29. They are single molecules that contain both an amine group and a carboxylic acid group.\*
30. They are subunits of macromolecules that act as both strong acids and strong bases in solution.
31. They are acidic and were first discovered by a Russian researcher by the name of Aminov.
32. The “backbones” of the macromolecules of life made of what element? (Outcome #1) (DOK 1)
33. carbon\*
34. nitrogen
35. oxygen
36. Which of the following elements is not particularly associated with living things? (Outcome #1) (DOK 1)
37. nitrogen
38. silicon\*
39. oxygen
40. How did the hydrocarbons found in petroleum products such as gasoline get their energy? (Outcome #1) (DOK 3)
41. from the decay of non-living substances
42. from fossilized molecules built up in previously existing living organisms\*
43. from kinetic energy
44. A molecule with more than one type of elements is known as a: (Outcome #1) (DOK 1)
45. macromolecule
46. protein
47. compound\*
48. Which of the following macromolecules are made from amino acids? (Outcome #1) (DOK 1)
49. proteins\*
50. complex carbohydrates
51. nucleic acids
52. Which of the following macromolecules are made from simple sugars? (Outcome #1) (DOK 1)
53. proteins
54. complex carbohydrates\*
55. nucleic acids
56. Which of the following macromolecules are associated with RNA and DNA? (Outcome #1) (DOK 1)
57. proteins\*
58. complex carbohydrates
59. nucleic acids
60. Fatty acids are a component of what type of macromolecule? (Outcome #1) (DOK 1)
61. lipids\*
62. complex carbohydrates
63. nucleic acids
64. Water molecules attract one another via: (Outcome #1) (DOK 1)
65. covalent bonds
66. ionic bonds
67. hydrogen bonds\*
68. What type of chemical bond stabilizes the 3 dimensional shapes of nucleic acids and proteins: (Outcome #1) (DOK 1)
69. covalent bonds
70. ionic bonds
71. hydrogen bonds\*
72. What type of chemical bond stabilizes crystals of table salt? (Outcome #1) (DOK 1)
73. covalent bonds
74. ionic bonds\*
75. hydrogen bonds
76. Atoms that gain or lose electrons are known as: (Outcome #1) (DOK 1)
77. elements
78. molecules
79. ions\*
80. The chemical group on an amino acid that distinguishes one form another is known as the: (Outcome #1) (DOK 1)
81. R group\*
82. P group
83. C group
84. The chemical bond between amino acids is called a \_\_\_\_\_\_\_ bond. (Outcome #1) (DOK 1)
85. phosphodiester
86. hydrogen
87. peptide\*
88. What level of protein structure is associated with the sequence of amino acids? (Outcome #1) (DOK 1)
89. primary\*
90. secondary
91. tertiary
92. What level of protein structure is associated the alpha helix and beta-pleated sheet? (Outcome #1) (DOK 1)
93. primary
94. secondary\*
95. tertiary
96. Proteins with more than one polypeptide chain are said to have a \_\_\_\_\_\_ structure. (Outcome #1) (DOK 1)
97. quaternary\*
98. secondary
99. tertiary
100. Why does heating up a protein such as an enzyme cause it to lose function? (Outcome #1) (DOK 3)
101. because it burns up
102. because it loses its shape\*
103. because it works best at low temperatures
104. Explain why cooked egg white never turns back into the clear egg white seen in a raw egg. (Outcome #1) (DOK 3)
105. because the protein is denatured in raw egg white
106. because the protein is denatured in cooked egg white
107. because the denaturing of the egg proteins is not reversible\*
108. Which of the following is not a component of a nucleotide? (Outcome #1) (DOK 1)
109. nitrogenous base
110. fatty acid\*
111. sugar