Supplementary Resource Document for Bego et al. (2024) “Single-Paper Meta-Analyses of the Effects of Spaced Retrieval Practice in Nine Introductory STEM Courses: Is the Glass Half Full or Half Empty?”

Assessment Items for Unity of Life, exported from Blackboard

1. Oxygen has 8 electrons. How many single bonds can oxygen make?

    a. 0
    b. 1
    *c. 2
    d. 3
    e. 4

2. Carbon has 6 electrons. How many single bonds can carbon make?

    a. 0
    b. 1
    c. 2
    d. 3
    *e. 4

3. Neon has 10 electrons. How many single bonds can neon make?

    *a. 0
    b. 1
    c. 2
    d. 3
    e. 4

4. Nitrogen has 9 electrons. How many single bonds can nitrogen make?

a. 0

*b. 1

c. 2

d. 3

e. 4

5. Monomers are joined with _____ reactions.

a. hydrolysis

*b. dehydration

c. both, depending on the polymer

6. Polymers are broken down with _____ reactions.

*a. hydrolysis

b. dehydration

c. both, depending on the polymer

7. Which of the following is the correct pairing?

a. monomers joined--hydrolysis; polymers broken--dehydration

*b. monomers joined--dehydration, polymers broken--hydrolysis

c. monomers joined--dehydration, polymers broken--dehydration

d. monomers joined--hydrolysis, polymers broken--hydrolysis

8. _____ reactions join monomers to make polymers and _____ reactions break polymers to make monomers.

*a. dehydration, hydrolysis

b. hydrolysis, dehydration

c. dehydration, dehydration

d. hydrolysis, hydrolysis

9. What type of bonding is associated with a protein's secondary structure?

*a. hydrogen bonds between amino & carboxyl groups of different amino acids

b. disulfide/nonpolar bonds between R groups of different amino acids

c. peptide bonds between different amino acids

10. What type of bonding is associated with a protein's primary structure?

a. hydrogen bonds between amino & carboxyl groups of different amino acids

b. disulfide/nonpolar bonds between R groups of different amino acids

*c. peptide bonds between different amino acids

11. What type of bonding is associated with a protein's tertiary structure?

a. hydrogen bonds between amino & carboxyl groups of different amino acids

*b. disulfide/nonpolar bonds between R groups of different amino acids

c. peptide bonds between different amino acids

12. Which bond type is matched CORRECTLY with the protein structure?

*a. primary--peptide bonds between different amino acids

b. secondary--disulfide/nonpolar bonds between R groups of different amino acids

c. tertiary--hydrogen bonds between amino and carboxyl groups of different amino acids

13. Which of the following cellular components are found in all cells?

a. plasma membrane

b. DNA

c. cytoplasm

d. ribosomes

*e. all of the above are correct

14. Which of the following cellular components is NOT found in all cells?

a. DNA

b. plasma membrane

*c. mitochondria

d. ribosomes

e. lysosomes

15. In addition to plasma membranes, DNA, and cytoplasm, what cellular component is found in all cells?

*a. ribosomes

b. lysosomes

c. Golgi

d. nuclei

e. endoplasmic reticulum

16. Which of the following cellular components are found in all cells?

a. plasma membrane
b. DNA
c. cytoplasm
d. ribosomes
*e. all of the above are correct

17. Which of the following monomers is in cellulose, glycogen, and starch?

*a. glucose
b. lactose
c. thymine
d. carbon

18. Which of the following polymers is composed of glucose monomers?

a. cellulose
b. glycogen
c. starch
*d. all of the above

19. Repeating monomers of _____ make up cellulose, glycogen, and starch.

a. tryptophan
b. lactose
c. adenine
*d. glucose

20. Which of the following monomers is in cellulose, glycogen, and starch?

*a. glucose

b. lactose

c. thymine

d. carbon

21. What evidence is there from mitochondria and chloroplasts that support the endosymbiotic theory?

1. have a double membrane 2. have own genetic material 3. have bacterial-sized ribosomes 4. have own lysosomes

a. 1&2

*b. 1-3

c. 1-4

22. The endosymbiotic theory comes from the DNA, double-membrane, and lysosomes of the mitochondria.

a. True

*b. False

23. What evidence is there from mitochondria and chloroplasts that support the endosymbiotic theory?

1. they have own genetic material 2. they have eukaryotic-sized ribosomes 3. they have lysosomes 4. they have nuclei

*a. 1

b. 1&2

c. 1-3

d. 1-4

24. What evidence is there from mitochondria and chloroplasts that support the endosymbiotic theory?

1. have a double membrane 2. have own genetic material 3. have bacterial-sized ribosomes 4. have own lysosomes

a. 1&2

*b. 1-3

c. 1-4

25. What is the concentration of hydroxide ions in a solution where pH = 10?

*a. 10^{-4} M

b. 10^{4} M

c. 10^{-10} M

d. 10^{10} M

26. What is the concentration of hydroxide ions in a solution where pH = 6?

a. 10^{-6} M

b. 10^{6} M

c. 10^{8} M

*d. 10^{-8} M

27. What is the concentration of hydroxide ions in a solution where pH = 4?

a. 10^{-4} M

b. 10^{4} M

*c. 10^{-10} M

d. 10^{10} M

28. What is the concentration of hydroxide ions in a solution where pH = 5?

a. 10^{-5} M

b. 10^{5} M

*c. 10^{-9} M

d. 10^{9} M

29. What are the ends of a protein called?

*a. N terminus & C terminus

b. 5' terminus & 3' terminus

c. either works, depending on the protein

30. What are the ends of a DNA molecule called?

a. N terminus & C terminus

*b. 5' terminus & 3' terminus

c. either works, depending on the DNA

31. What are the ends of a RNA molecule called?

a. N terminus & C terminus

*b. 5' terminus & 3' terminus

c. either works, depending on the RNA

32. N & C refer to the ends of _____, whereas 5' & 3' refer to the ends of _____.

a. nucleic acids, proteins

*b. proteins, nucleic acids

c. proteins, proteins

d. nucleic acids, nucleic acids

33. Which of the following membrane conditions results in higher membrane fluidity?

a. cholesterol

b. double bonds in the fatty acid tails

c. long fatty acid tails

*d. all of the above are true

34. Which of the following membrane conditions results in higher membrane fluidity?

a. no cholesterol

b. only single bonds in the fatty acid tails

*c. short fatty acid tails

d. all of the above are true

35. Higher membrane fluidity is dependent on the presence of cholesterol, double bonds in the lipid fatty acid tails, and short fatty acid tails.

*a. True

b. False

36. Which of the following membrane conditions results in higher membrane fluidity?

a. cholesterol

b. double bonds in the fatty acid tails

c. short fatty acid tails

*d. all of the above are true

37. A membrane has 0.5 M salt on the left side and 1.2 M salt on the right side. No salt can move across the membrane. What is the primary direction that the water moves?

a. to the left

*b. to the right

c. it moves equally across the membrane

38. A membrane has 0.9 M salt on the left side and 0.4 M salt on the right side. No salt can move across the membrane. What is the primary direction that the water moves?

*a. to the left

b. to the right

c. it moves equally across the membrane

39. A membrane has 1.2 M salt on the left side and 1.2 M salt on the right side. No salt can move across the membrane. What is the primary direction that the water moves?

a. to the left

b. to the right

*c. it moves equally across the membrane

40. A membrane has 0.3 M salt on the left side and 1.0 M salt on the right side. No salt can move across the membrane. What is the primary direction that the water moves?

a. to the left

*b. to the right

c. it moves equally across the membrane

41. A membrane has 0.5 M salt on the left side and 1.2 M salt on the right side. What is the primary direction that the salt moves?

*a. to the left

b. to the right

c. it moves equally across the membrane

42. A membrane has 0.9 M salt on the left side and 0.6 M salt on the right side. What is the primary direction that the salt moves?

a. to the left

*b. to the right

c. it moves equally across the membrane

43. A membrane has 0.5 M salt on the left side and 0.5 M salt on the right side. What is the primary direction that the salt moves?

a. to the left

b. to the right

*c. it moves equally across the membrane

44. A membrane has 0.5 M salt on the left side and 0.3 M salt on the right side. What is the primary direction that the salt moves?

a. to the left

*b. to the right

c. it moves equally across the membrane

45. An endergonic reaction but not an exergonic reaction

    a. is not spontaneous
    b. has a positive ΔG
    *c. both are correct of endergonic reactions only

46. An endergonic reaction but not an exergonic reaction

    *a. is not spontaneous
    b. has a negative ΔG
    c. both are correct of endergonic reactions only

47. An endergonic reaction but not an exergonic reaction

    a. is spontaneous
    *b. has a positive ΔG
    c. both are correct of endergonic reactions only

48. An endergonic reaction but not an exergonic reaction

    a. is not spontaneous
    b. has a positive ΔG
    *c. both are correct of endergonic reactions only

49. When ΔG is never spontaneous, ΔH is _____ and ΔS is _____.

    a. positive, positive
    b. negative, negative

*c. positive, negative

d. negative, positive

50. When ΔG is always spontaneous, ΔH is _____ and ΔS is _____.

a. positive, positive

b. negative, negative

c. positive, negative

*d. negative, positive

51. A negative ΔH and a positive ΔS results in a reaction that is

*a. always spontaneous

b. never spontaneous

c. sometimes spontaneous

52. When ΔG is never spontaneous, ΔH is _____ and ΔS is _____.

a. positive, positive

b. negative, negative

*c. positive, negative

d. negative, positive

53. Which of the following is true when an enzyme is used compared to when an enzyme is not used in a reaction?

a. the free energy of the reaction changes

*b. the activation energy of the reaction changes

c. both change

d. neither change

54. There is always a change in free energy and never a change in activation energy when an enzyme is used compared to when an enzyme is not used in a reaction.

a. True

*b. False

55. When an enzyme is used in a reaction, there is ____ change in free energy and ____ change in activation energy.

a. a, no

b. a, a

*c. no, a

d. no, no

56. Which of the following is true when an enzyme is used compared to when an enzyme is not used in a reaction?

a. the free energy of the reaction changes

*b. the activation energy of the reaction changes

c. both change

d. neither change

57. The purpose of cellular respiration is to make _____ by _____.

*a. energy, oxidizing glucose

b. glucose, oxidizing energy

c. energy, reducing glucose

d. glucose, reducing energy

58. Which of the following occurs in cellular respiration?

a. making energy
b. oxidizing glucose
c. reducing glucose
d. both A & C are correct
*e. both A & B are correct

59. During cellular respiration, glucose is oxidized and energy is made.

*a. True
b. False

60. The purpose of cellular respiration is to make _____ by _____.

*a. energy, oxidizing glucose
b. glucose, oxidizing energy
c. energy, reducing glucose
d. glucose, reducing energy

61. Hydrogens are moved into the _____ during the ETC and back into the _____ during chemiosmosis.

a. matrix, inner membrane space
*b. inner membrane space, matrix
c. cytoplasm, matrix
d. matrix, cytoplasm

62. During chemiosmosis, the hydrogens are moved from the _____ to the _____, which is the opposite of what happens during the ETC.

a. matrix, inner membrane space

*b. inner membrane space, matrix

c. cytoplasm, matrix

d. matrix, cytoplasm

63. During the ETC, the hydrogens are moved from the _____ to the _____, which is the opposite of what happens during chemiosmosis.

*a. matrix, inner membrane space

b. inner membrane space, matrix

c. cytoplasm, matrix

d. matrix, cytoplasm

64. Hydrogens are moved into the _____ during the ETC and back into the _____ during chemiosmosis.

a. matrix, inner membrane space

*b. inner membrane space, matrix

c. cytoplasm, matrix

d. matrix, cytoplasm

65. Put the steps of cellular respiration in order:

1. glycolysis
2. pyruvate oxidation
3. TCA
4. ETC

66. Which step of cellular respiration is LAST?

a. TCA
b. glycolysis
*c. ETC
d. pyruvate oxidation

67. Which step of cellular respiration is SECOND?

a. TCA
b. glycolysis
c. ETC
*d. pyruvate oxidation

68. Put the steps of cellular respiration in order:

1. glycolysis
2. pyruvate oxidation
3. TCA
4. ETC

69. What is/are the net output(s) in glycolysis?

a. 1 glucose
b. 2 ATP
c. 2 NADH
d. 2 pyruvate
*e. b, c, & d

70. _____ is the input in glycolysis.

*a. 1 glucose
b. 2 ATP
c. 2 NADH
d. 2 pyruvate
e. b, c, & d

71. 1 glucose, 2 ATP, 2 NADH, and 2 pyruvate are the inputs and outputs of

a. ETC
b. TCA
*c. glycolysis
d. pyruvate oxidation

72. What is/are the net output(s) in glycolysis?

a. 1 glucose
b. 2 ATP
c. 2 NADH
d. 2 pyruvate
*e. b, c, & d

73. How many carbons are in pyruvate, glucose, and acetyl co-A?

a. 6, 2, 3
b. 3, 2, 6
c. 6, 3, 2
*d. 3, 6, 2
e. 2, 6, 3

74. Unlike acetyl coA and glucose, pyruvate has _____ carbons.

a. 2
*b. 3
c. 4
d. 5
e. 6

75. Unlike pyruvate & glucose, acetyl co-A has _____ carbons.

*a. 2
b. 3
c. 4
d. 5
e. 6

76. How many carbons are in pyruvate, acetyl coA, and glucose?

a. 6, 2, 3
*b. 3, 2, 6
c. 6, 3, 2
d. 3, 6, 2
e. 2, 6, 3

77. What is a <u>similarity</u> between aerobic respiration & fermentation?

a. both require oxygen
*b. both regenerate NAD+
c. both make the same amount of ATP

d. both B & C are correct

78. What is a difference between aerobic respiration & fermentation?

a. only aerobic respiration regenerates NAD+
b. aerobic respiration makes more ATP
c. only fermentation doesn't require oxygen
*d. both b & c are correct

79. The use of oxygen, more ATP made, and the regeneration of NAD+ are seen in

*a. aerobic respiration
b. fermentation
c. both

80. The lack of oxygen use, less ATP made, and the regeneration of NAD+ are seen in

a. aerobic respiration
*b. fermentation
c. both

81. Which of the following are reactants of photosynthesis and products of cellular respiration?

a. glucose & water
b. oxygen & glucose
c. oxygen, energy, & water
*d. carbon dioxide, energy, & water

82. Which of the following are products of photosynthesis and reactants of cellular respiration?

a. glucose & water

*b. oxygen & glucose

c. oxygen, energy, & water

d. carbon dioxide, energy, & water

83. Glucose & oxygen are

a. products and reactants of photosynthesis

b. products and reactants of cellular respiration

*c. reactants of cellular respiration & products of photosynthesis

d. products of cellular respiration & reactants of photosynthesis

84. Carbon dioxide, energy, and water are

a. products and reactants of photosynthesis

b. products and reactants of cellular respiration

c. reactants of cellular respiration & products of photosynthesis

*d. products of cellular respiration & reactants of photosynthesis

85. The Calvin cycle

a. uses sunlight directly

b. has an electron transport chain

*c. makes sugar for the plant

d. make ATP & NADPH

86. The light reactions

a. do not use sunlight directly
*b. have an electron transport chain
c. make sugar for the plant
d. use ATP & NADPH

87. Sunlight is transformed into ATP & NADPH using an electron transport chain in the

a. Calvin cycle
*b. light reactions

88. The Calvin cycle

a. uses sunlight directly
b. has an electron transport chain
*c. makes sugar for the plant
d. make ATP & NADPH

89. Which of the following processes is labeled with the incorrect location?

a. glycolysis--cytoplasm
b. TCA--matrix
c. light reactions--thylakoid membranes
d. Calvin cycle--stroma
*e. ETC--cytoplasm

90. Which of the following processes is labeled with the incorrect location?

a. glycolysis--cytoplasm

b. TCA--matrix

*c. light reactions--inside thylakoids

d. Calvin cycle--stroma

e. ETC--mitochondrial inner membrane

91. Which of the following processes is labeled with the incorrect location?

a. glycolysis--cytoplasm

b. TCA--matrix

c. light reactions--thylakoid membranes

*d. Calvin cycle--chloroplast outer membrane

e. ETC--mitochondrial inner membrane

92. Which of the following processes is labeled with the incorrect location?

*a. glycolysis--matrix

b. TCA--matrix

c. light reactions--thylakoid membranes

d. Calvin cycle--stroma

e. ETC--mitochondrial inner membrane

93. Which process is labeled with the incorrect function in the Calvin cycle?

a. carbon fixation--CO2 is made into an organic molecule, 3-PGA

*b. reduction--Rubisco is used to move energy from ATP & NADPH to make organic sugar

c. regeneration--RuBP is remade

94. Which process is labeled with the incorrect function in the Calvin cycle?

a. carbon fixation--Rubisco makes CO2 into an organic molecule, 3-PGA

b. reduction--energy from ATP & NADPH is added to make organic sugar

*c. regeneration--organic sugar is taken out of the cycle to be used in the cell

95. Which process is labeled with the incorrect function in the Calvin cycle?

*a. carbon fixation--O2 is converted into an organic molecule, 3-PGA

b. reduction--energy from ATP & NADPH is added to make organic sugar

c. regeneration--organic sugar is taken out of the cycle to be used in the cell

96. Which process is labeled with the incorrect function in the Calvin cycle?

a. carbon fixation--CO2 is made into an organic molecule, 3-PGA

*b. reduction--Rubisco is used to move energy from ATP & NADPH to make organic sugar

c. regeneration--RuBP is remade