BIOS 100 - Summer, 2008 **Name:**
Exam I, 18 July, 2008
Michael Muller, Instructor **TA:**

This exam consists of 52 questions lovingly spread over 8 pages. Please check to see that all the pages are present before you begin. Use a #2 pencil and bubble in all answers. There is a copy of the codon chart located at the end of the test. If you don't know what to do with that, you're in a heap of trouble. Your score will be posted on the UIC Blackboard site as soon as they are in. Good Luck!

The cell to the right contains glucose facilitated transport carrier proteins which can be activated and deactivated (i.e. they can allow glucose to flow down its concentration gradient or shut off so that no glucose can enter or leave the cell). Use this information plus the information provided in the diagrams to answer questions 1 - 4.

1. If the glucose facilitated transport carrier proteins are turned off, what will happen to the cell?
   A. Water will flow into the cell
   B. Water will flow out of the cell
   C. There will be no net movement of water

2. If the glucose facilitated transport carrier proteins are turned on, what will happen to the glucose?
   A. Glucose will flow into the cell
   B. Glucose will flow out of the cell
   C. There will be no net movement of glucose
   D. We cannot answer this because the direction of glucose movement is dependent upon the direction of water movement

3. If the cell had come to osmotic equilibrium before the glucose facilitated transport carrier proteins were turned on, what will happen to the flow of water?
   A. Water will flow into the cell
   B. Water will flow out of the cell
   C. There will be no net flow of water
   D. We cannot answer this because we will need to know the final concentrations of glucose inside and outside the cell

4. Entry of glucose into the cell by the glucose facilitated transport carrier proteins requires ATP energy?
   A. Yes, it does. That's my final answer.
   B. No, it doesn't. Did you think I'd fall for that? No deal.
   C. We don't know enough about the system to answer this question. Stop trying to trick me, Mike

5. How do plant leaves defy gravity and stick out?
   A. The bark supports the leaves
   B. Fibers and sclerids support the leaves
   C. Turgor pressure
   D. An internal "skeleton" of cellulose and lignin
   E. None of the above

6. Which of the following statements (A-D) about the Na+/K+ pump is FALSE. If statements A-D are true, then choose E.
   A. The Na+/K+ pump found in many cells in humans
   B. The Na+/K+ pump is an example of active transport system which involves an active transport carrier protein and a facilitated diffusion transport protein working together
   C. The Na+/K+ pump transports three Na+ out of the cell and two K+ into the cell
   D. The Na+/K+ pump is an example of an integral protein
   E. All of the above statements about the Na+/K+ pump are TRUE

7. Which of the following statements (A-D) about osmosis is FALSE? If statements A-D are true, then choose E
   A. Osmosis produces a physical force
   B. A cell placed in a hypotonic solution will expand and possibly burst
   C. An osmotically active solute can cross a semi-permeable membrane if the appropriate carrier protein is present.
   D. Osmosis always occurs from a hypotonic solution to a hypertonic solution
   E. All of the above statements about osmosis are TRUE

8. How can the facilitated diffusion carrier protein in the H^+/Sucrose transport system carry sucrose against its concentration gradient?
   A. It can't, it is a facilitated diffusion carrier protein and, therefore, must follow the rules of diffusion
   B. It utilizes ATP energy to pump sucrose against the gradient
   C. It is a symport so if the total gradient of the H+ and sucrose is greater outside than inside the cell, sucrose can be carried against its gradient.
   D. None of the above

9. I want to grow some plants in a growth chamber located in my closet. Which light bulb would be best for growing these plants?
   A. An ultraviolet bulb (350 nm)
   B. A blue bulb (450 nm)
   C. A green bulb (550 nm)
   D. A red bulb (650 nm)

10. If I couldn't find my first choice (i.e. the answer to #9), this color bulb would be my next best choice.
   A. An ultraviolet bulb (350 nm)
   B. A blue bulb (450 nm)
   C. A green bulb (550 nm)
   D. A red bulb (650 nm)

11. What is the function of NADPH and NADH?
   A. They are a direct source of energy that acts like ATP - they can phosphorylate molecules and cause their bonds to weaken and be more easily broken
   B. They can serve as nucleotide substitutes when Adenosine is not present
   C. They are strong oxidizers
   D. They are electron carriers - they are mobile throughout the cell and they can reduce other molecules
   E. None of the above

Matching - Use the key below to select the **best answers** for questions 12 - 19.

I. Glycolysis
II. Oxidation of Pyruvate
III. Krebs Cycle
IV. Oxidative Phosphorylation
V. Ethanol Fermentation
VI. Lactic Acid Fermentation
VII. Cyclic Photophosphorylation
VIII. Non-Cyclic Photophosphorylation
IX. Calvin-Benson Cycle

12. How many of the above processes have a net production of ATP?
A. Four B. Five C. Six D. Seven E. Eight

13. Which of the above processes have a net production of CO_2?
A. II, III B. II, III, V C. II, III, VI D. II, III, V, VI E. II, III, V, VII

14. Which of the above processes have a net production of O_2?
A. IV B. VII C. VIII D. VII, VIII E. IV, VII, VIII

15. Which of the above processes have a net production of NADH?
A. I, II B. II, III C. I, II, III D. VII E. VIII

16. Which of the above processes have a net consumption of NADH?
A. IV B. IV, V C. V, VI D. IV, V, VI E. III, IV, V, VI

17. Which of the above processes have a net production of NADPH?
A. VII B. VIII C. VII, VIII D. IX E. VII, VIII, IX

18. Which of the above processes have a net consumption of NADPH?
A. VII B. VIII C. VII, VIII D. IX E. VII, VIII, IX

19. How many of the above processes have a net consumption of ATP?
A. Zero B. One C. Two D. Three E. Four

20. Cyclic photophosphorylation utilizes:
A. Photosystem I only (p700) B. A. Photosystem II only (p6800)
C. Both Photosystem I and Photosystem II (p700 & p 680)

21. What is the function of plastoquinone in the electron transport chain of the thlyakoids?
A. It is the molecule which first steals the electron from PS II (p680) during non-cyclic photophosphorylation
B. It is the molecule which steals the electron from PS I (p700) during cyclic photophosphorylation
C. It is the molecule which pumps H+ from the stroma into the thylakoid space
D. It is the molecule which gives the electron to NADP to produce NADPH
E. B & C

22. What is the initial source of electrons in non-cyclic photophosphorylation?
A. O_2 B. H_2O C. CO_2 D. NAD^+ E. NADH

23. Which of the following statements (A-D) about cyclic and non-cyclic photophosphorylation is FALSE? If statements A-D are true, then choose E
    A. Both cyclic and non-cyclic photophosphorylation utilize PSI (p700)
    B. Plastoquinone is utilized in both cyclic and non-cyclic photophosphorylation
    C. ATP is produced in both cyclic and non-cyclic photophosphorylation
    D. Oxygen is produced in cyclic but not non-cyclic photophosphorylation
    E. All of the above statements about cyclic and non-cyclic photophosphorylation are TRUE

24. Which of the below statements (A-D) about Rubisco and photorespiration is FALSE? If statements A-D are true, then choose E.
    A. Rubisco is a large and very slow enzyme with an active site that fits both CO_2 and O_2 (O_2 is a competitive inhibitor to CO_2)
    B. Rubisco is concentrated in the bundle sheath cells of C_4 plants but is distributed throughout the mesophyll in C_3 plants
    C. Photorespiration is bad for the plant
    D. C_3 plants experience much more photorespiration than do C_4 plants
    E. All of the above statements about Rubisco and photorespiration are TRUE

25. In a C_4 plant, how many times is a molecule of CO_2 fixed to an organic molecule?
    A. Zero B. Once C. Twice D. Thrice E. Four times

26. Where is most of the Rubisco in a C_4 plant?
    A. Only in the mesophyll cells
    B. Only in the bundle sheath
    C. More or less equally distributed in the mesophyll and bundle sheath cells
    D. In both, but more concentrated in the bundle sheath cells
    E. In both, but more concentrated in the mesophyll cells

27. Where would you expect to find the highest proportion of C_4 plants in the flora?
    A. In a forest in Alaska
    B. In the tropical rainforests of Brazil
    C. Along the California coast
    D. In the prairies of Kansas and Oklahoma
    E. In the forests of the Vermont and New Hampshire

28. Which stage of aerobic respiration produces the most ATP?
    A. Glycoysis B. Oxidation of Pyruvate
    C. Krebs Cycle D. Oxidative Phosphorylation

29. What is the ultimate function of fermentation?
    A. The regeneration of NAD+ from NADH
    B. The removal of pyruvate from the system
    C. The production of ethanol or lactic acid
    D. The generation of more ATP from pyruvate
    E. None of the above

30. Which stage of aerobic respiration produces the most NADH?
    A. Glycoysis
    B. Oxidation of Pyruvate
    C. Krebs Cycle
    D. Oxidative Phosphorylation

31. What happens during beta oxidation?
    A. NADH is oxidized to NAD+
    B. Fatty acid chains are broken down into two-carbon units
    C. Proteins are hydrolyzed to produce individual amino acids
    D. Fatty acids are removed from the gycerol backbone
    E. None of the above

32. How does phosphofructokinase specifically regulate glycolysis?
    A. If glucose levels are high, phosphofructokinase will be activated so the cell can take advantage of these elevated levels
    B. If ATP levels are high, phosphofructokinase will be deactivated, effectively stopping glycolysis
    C. If glucose levels are low, phosphofructokinase will be deactivated since glycolysis is not necessary
    D. If ATP levels are low, phosphofructokinase will be activated so the cell can perform glycolysis and regenerate ATP
    E. None of the above

33. About how much of the energy from a glucose molecule is obtained when it is broken down to produce ATP in aerobic respiration?
    A. Almost 100%
    B. About 80%
    C. About 40%
    D. About 10%
    E. Almost 0%

34. What would happen if you were to disrupt a chloroplast so that the enzymes on the thylakoid membranes were intact and fully functional, but there were large holes connecting the thylakoid space and the stroma?
    A. The chloroplast would be able to produce both ATP and NADPH
    B. The chloroplast would be able to produce ATP but not NADPH
    C. The chloroplast would not be able to produce ATP but it could produce NADPH
    D. The chloroplast would not be able to produce either ATP or NADPH

Matching - Match the famous scientists on the left with the most appropriate reason that they are famous on the right. Answers may be used once, more than once, or not at all.

35. Hershey & Chase
36. Frederick Griffith
37. Rosalind Franklin

    A. Used protease and DNase to try to demonstrate what was the molecule of heredity - results were inconclusive
    B. X-ray crystalographer who first determined that DNA was a double helix
    C. First to demonstrate bacterial transformation
    D. First to publish the structure of DNA
    E. Used radiolabeled bacteriophages to demonstrate that DNA was the molecule of heredity

Use the non-template strand of DNA given below to answer questions 38-41. Notice that I called it a "non-template" strand of DNA - that's a hint...

*

5' A C T T T G A T G C G C **T** T T T C C A A C G C A T G A C C A T 3'

38. What is the DNA complement to this strand?
    A. 3' A C T T T G A T G C G C T T T T C C A A C G C A A G T C C A T 5'
    B. 5' A C T T T G A T G C G C T T T T C C A A C G C A A G T C C A T 3'
    C. 5' T G A A A C T A C G C G A A A A G G T T G C G T T C A G G T A 3'
    D. 5' A T G G A C T T G C G T T G G A A A A G C G C A T C A A A G T 3'
    E. None of the above

39. How many amino acids are in the protein encoded by the template strand of DNA associated with this piece of DNA?
    A. None B. Five C. Six D. Seven E. Eight

40. What would happen if the marked T nucleotide were changed to an A?
    A. No change in the amino acid structure
    B. Phenylalanine is change to isoleucine
    C. Lysine is changed to a stop codon
    D. Serine is changed to cysteine
    E. None of the above

41. The statement, "Lysine is changed to a stop codon" is an example of what kind of mutation?
    A. Silent (neutral) mutation B. Missense mutation
    C. Nonsense mutation D. Frameshift mutation
    E. None of the above

42. Which of the following statements (A-D) about telomeres and telomerase is FALSE?
    A. Telomeres are regions located on the ends of eukaryotic chromosomes which contain hundreds of repeating sequences of DNA
    B. Telomere regions of chromosomes contain no functional genes
    C. Telomerase is a type of DNA polymerase which can synthesize DNA 3' to 5'
    D. Almost all human cells contain active telomerase enzymes
    E. Telomerase activity is especially great in cancerous cells

43. DNA replication is:
    A. Conservative B. Semi-conservative C. Dispersive
    D. Liberal E. Middle of the road independent

44. If DNA replication were dispersive (and that's a hint to what is not the answer to #43), what would the results of the Meselson - Stahl experiment after two rounds of replication?

Standard A. B. C. D. E.

45. What is the wobble model of tRNA base pairing?
    A. The tRNA doesn't perfectly fit into the ribosome, it must "wobble" a bit to wedge itself into the A site
    B. The tRNA must "wobble" back and forth in the ribosome to form the peptide bond
    C. There are other nucleotides, such as inosine, which can pair up with more than one nucleotide
    D. Matches of the first codon position are variable when evaluating base pairing success
    E. None of the above

46. What amino acid is attached to the tRNA with the following anticodon: 3' UUG 5'
    A. Leucine B. Valine C. Asparagine D. Glutamine

47. Which of the above is not necessary for initiation of protein synthesis?
    A. A charged tRNA in the P site
    B. A charged tRNA in the A site
    C. A large ribosomal subunit
    D. A small ribosomal subunit
    E. A mRNA

Matching - use the key on the right to answer questions 48-50

48. This enzyme unwinds double-stranded DNA
49. This enzyme replicates most of the DNA in both the leading and the lagging strands
50. This enzyme removes RNA primers

    A. DNA polymerase I
    B. DNA polymerase III
    C. Primase
    D. Helicase
    E. Topoisomerase

51. Plant cells contain functional mitochondria
    A. True B. False

52. Increased atmospheric CO_2 levels will help plants with photosynthesis and ultimately benefit our agricultural production
    A. True B. False