Biology 150: 1ˢᵗ in-class examination   **Name_____**
Sept 14, 2007

Circle the lab you attend: Wednesday, 3:00-4:50,   Wednesday, 9:00-10:50,   Friday, 9:00-10:50

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are **30** questions worth a total of 50 points (plus a couple of bonus questions [3 points total]). The point value of individual questions appears in parentheses.

1. A characteristic of all living things is homeostasis. What does this term mean? (1)

2. All scientific conclusions rest on three assumptions. Two of these are the assumption of uniformity of natural laws and the assumption of common perception. Name the last of these assumptions and explain what it means. (2)

3. Name, in order, the steps of the scientific method and briefly describe, step by step, how it was used to discover the cause of peptic ulcers. (4)

4. Charles Darwin published "The Origin of Species" in 1859 in which he describe a mechanism to explain the already suspected phenomenon of evolution. His mechanism contained three elements or processes. Name and briefly explain/describe each. (3)

5. What geologist published in 1830 "Principles of Geology" the highly influential book that convinced Darwin among many others that the earth was very old? (1)

6. What are the three most abundant elements in most, if not all, living things? (1)

7. The nucleus of an atom contains what two types of subatomic particles? (1)

8. The atomic number of carbon is _____. It has _____ electrons in its outer shell, forms _____ covalent bonds, and three naturally occurring isotopes named _____, _____, and _____. (3)

9. For each of the following bonds indicate if they are non-polar covalent, ionic, or polar covalent.(1)
   C-C _____, O-H _____, Na-Cl _____, N-H _____, C-H _____

10. Detergents and phospholipids are examples of molecules that are said to be _____ meaning that because they contain one end of the molecule rich in polar bonds and on end rich in non-polar bonds they have both water soluble and water-insoluble properties. (1)

11. If the pH is 5, thus $[H^+]$ =   (1)

12. What is the specific heat of water (i.e. how many calories)? (1)

13. L-alanine is more abundant in your body than d-alanine. What of the alanine in your body is l-alanine? (1)

14. What is meant by the term buffer? (1)

15. Organic molecules are defined as _____ . (1)

16. Draw the atomic structure (atoms and bonds) of the following functional groups and indicate which are acidic: (5)
   a) amino   b) carboxyl   c) phosphate   d) sulfhydryl

17. Name one hexose (6 carbon monosaccharide). (1)

18. Sucrose is a _____ meaning it is of the linkage of two monosaccharides. In the case of sucrose case, the two component monosaccharides are _____ and _____.(3)

19. What type of reaction assembles monosaccharides into polysaccharides? (1)

20. How does the structure of amylose differ from glycogen? (1)

21. Name a polymer composed of N-acetylglucosamine subunits. (1)

22. What unifies the lipids as a group? (1)

23. Oils and fats of living organisms are collectively called _____. These molecules are composed of a central _____ molecule. Connected by ester bonds to three _____ molecules. (3)

24. Molecularly, how do saturated fats differ from unsaturated fats? (1)

25. Describe the composition of phospholipid molecules. (2)

26. Name one <u>non</u>-hormone steroid. (1)

27. Draw the general structure of an amino acid. (1)

28. The amino acids used by cells to assemble proteins number _____, and include _____ with hydrophobic R groups or side chains and _____ with _____ hydrophilic side chains. (3)

29. Every protein, no matter how long, will have an "amino terminus" or end and a "_____ terminus" or end. (1)

30. Name two examples of secondary protein structure. (2)

Bonus questions:

1. Water molecules tend to ionically dissociate into a hydroxide ion (OH⁻) and a hydrogen ion (H^+). In practice the hydrogen ion is associated with another water molecule forming a
_____ ion (H_3O^+).

2. The 2005 Nobel Prize in physiology or Medicine went to what two men? (2)

Biology 150: 2nd in-class examination   **Name**_____
October 8, 2007

Circle the lab you attend: <u>**Wednesday, 3:00-4:50,**</u>   <u>**Wednesday, 9:00-10:50,**</u>   <u>**Friday, 9:00-10:50**</u>

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are **28** questions worth a total of 50 points (plus a couple of bonus questions [3 points total]). The point value of individual questions appears in parentheses.

1. Name the bases of the nucleotides that form DNA. Which ones are purines and which are pyrimidines? (2)

2. Purines and pyrimidines, which have double rings? (1)

3. What are the three differences between RNA and DNA. (3)

4. Organisms with cells containing nuclei (and other organelles) are called _____. (1)

5. Describe (and/or draw) a nuclear envelope pore. Where is it located? With what is it filled? What is its function (4)

6. What is a nucleolus? (1)

7. The endoplasmic reticulum has two types. Name them and indicate their principle functions. (3)

8. Vesicles leaving the endoplasmic reticulum travel to what organelle? What happens there? What is the cisternal maturation model? (4)

9. What is meant by a glycoprotein? (1)

10. Draw a mitochondrion. Label membranes, cristae, and matrix. (1)

11. Draw a chloroplast. Label membranes, thylakoids, stroma, and grana. (1)

12. What does a lysosome contain? (1)

13. In a potato plant where would you find (a) chloroplasts, (b) chromoplasts, and (c) amyloplasts? (3)

14. What distinguishes microbodies from other organelles? Name two types of microbodies and indicate their functions. (3)

15. Name the three types protein fibers of the cytoskeleton. (1)

16. Describe the internal construction of a basal body. How does it differ from that of a flagellum? (2)

17. Describe the cycle of the motor protein (myosin head) as it functions during muscle contraction indicating ATP binding, hydrolysis, attachment, powerstroke, and the protein the motor protein attaches to. (4)

18. What is the function of intermediate filaments? (1)

19. In 1970 S.J. Singer and G. Nicolson published what has evolved slightly to be the currently accepted model of the plasma membrane. Name and describe their model. How has the model changed since it was originally proposed? (2)

20. Define diffusion. (1)

21. The rate of diffusion is proportional to what? (1)

22. You have a piece of closed dialysis tubing (artificial selectively permeable membrane) containing 0.2 M sucrose in a beaker containing 0.5 M sucrose what will happen to the tubing? What is the name for the process involved? (1)

23. Facilitated diffusion transporters are divided into two types name and describe each. Describe gating and selectivity filters and indicate to which these features apply. (2)

24. What are the two types of cotransport? (1)

25. Name and briefly describe the ion pump that establishes the plasma membrane electrical gradient in animal cells. What does it transport? Where does the energy come from? (2)

26. What does the first law of thermodynamic state? (1)

27. If a chemical reaction where ΔG is negative, is..:
    a) the reaction spontaneous?   b) ΔH negative? c) the is reaction going to proceed?

    (Indicate yes, no or unknown for each.) (1)

28. What is activation energy? (1)

Bonus questions:
    1. In a chemical reaction where ΔG is positive and ΔH is negative, under what circumstances will ΔS be positive? Why? (2)

    2. From what region of the ER do vesicles depart? (1)

Biology 150: 3rd in-class examination   Name_____
November 2, 2007

**Circle the lab you attend: <u>Wednesday, 3:00-4:50,</u>   <u>Wednesday, 9:00-10:50,</u>   <u>Friday, 9:00-</u>
<u>10:50</u>**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are xx questions worth a total of 50 points (plus some of bonus questions). The point value of individual questions appears in parentheses.

1. If, for a specific reaction where A↔B, Keq has a value of 0.5: (2)
   a) Is the reaction considered spontaneous?

   b) If, once this reaction is at chemical equilibrium, and the concentration of the product (B) equals 1 M, what will the concentration of A be?

2. Enzymes function as catalysts meaning they speed reactions by lowering _____ (1) (choose from: ΔG, activation energy, or Keq)

3. The location on an enzyme where the catalyzed reaction takes place is called _____ (1).

4. Enzymes are said to be highly specific. What does this mean? (1)

5. Explain how protein "turnover" is involved in enzyme regulation. (1)

6. Briefly explain the difference between competitive and non-competitive enzyme regulation. Which of these is a form of allosteric regulation? (3)

7. What is meant by feedback inhibition? (1)

8. Define oxidation. (2)

9. Briefly outline the glycolysis pathway. Name the starting molecule, at least one intermediate, the product molecule(s) and indicate the involvement of any energy carrier molecules. (6)

10. The carbon product of glycolysis (previous question) passes into the mitochondria where it is oxidized and all of its carbons are converted to CO_2. Diagram the compete fate of this molecule (i.e. aerobic respiration) outlining its initial oxidation, the Citric acid cycle, electron transport, and chemiosmosis. Indicate how many of this molecule enter the mitochondria from a single glucose molecule. In your diagram, show where all the carbons are converted to CO_2, name intermediate molecules, show the involvement (and number) of energy carrier molecules, name the terminal electron acceptor, and indicate the location and number of ATP synthesized. (12)

11. Runners get slower with increasing distance as different aspects of physiology become rate limiting. Explain. (6)

12. Describe the composition of a light harvesting complex. (1)

13. Diagram non-cyclic photophosphorylation. Show name and/or show the location of the photosystems, light absorption, electron transport, water splitting, the production of energized electron carriers, H^+ transport and ATP synthesis. (6)

14. What photosystem is involved in cyclic photophosphorylation? (1)

15. In the first step of the Calvin cycle what molecule is combined with CO2 to yield an unstable 6 carbon intermediate? (1)

16. Describe (or diagram) the 1944 experiment of Avery, Macleod, and McCarty testing the molecular cause of bacterial transformation. (5)

BONUS QUESTIONS:

(1) Fred Griffith, Oswald Avery, Colin Macleod, Maclyn McCarty, Alfred Hershey, Martha Chase – which <u>one</u> was awarded a Nobel Prize? (1)

(2) The chemical 2,4-dinitrophenol (DNP) was sold as a diet aid beginning about 1930. Explain how it might help dieters. (2)

(3) DNP was banned as a diet aid in 1938 but, even today, is still used by some members of the body building subculture. At least three deaths have been reported in the last three years. How might DNP result in death? (2)

Biology 150: 4th in-class examination Name_____
November 26, 2007

Circle the lab you attend: Wednesday, 3:00-4:50,   Wednesday, 9:00-10:50,   Friday, 9:00-10:50

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 20 questions worth a total of 50 points (plus 4 points in bonus questions). The point value of individual questions appears in parentheses.

Note: a copy of the genetic code is attached as the last page.

1. The double helix model for the structure of DNA first suggested by Watson and Crick depended on data collected by two other scientists Erwin Chargaff and Rosalind Franklin. <u>Describe the data</u> each collected and <u>how it was accounted for</u> in the double helix model. (3)

2. The double helix model indicated that DNA is anti-parallel? What does this mean? (1)

3. DNA replication in eukaryotes begins when regulatory proteins bind at several points along each chromosome called _____. Binding of these regulatory proteins allows an enzyme that separates the strands called _____ to bind. Separated strands are stabilized by _____. The new daughter strands produced by replication are designated by different names. The strand formed following the separating stands is called the _____ strand. The stand formed in a "backstitch" pattern, bit by bit, away from the separating strands is called the _____ strand and is formed in 1000-2000 base stretches called _____. These sections are initially separated by short 10 base RNA segments called_____. The enzyme complex that replaces the RNA segments with DNA is called _____. (8)

4. Distinguish between a point mutation and a frameshift mutation. (1)

5. Distinguish between a missense mutation and a nonsense mutation. (1)

6. Define gene. (1)

7. Describe transcription. What enzyme complex performs the activity. Where does it bind? Which way does it travel? Where does transcription actually start? Where/how does transcription terminate? What is produced? (5)

8. Describe mRNA processing. Mention and define introns, exons, and snurps. (4)

9. Briefly describe the method used to decipher the genetic code. (2)

10. Imagine the sequence CAACGCUUAAAAAGG occurs midway through the coding region of a processed mRNA. Assuming that the reading frame begins with the first letter, what amino acids, in what order, would occur at the relevant point in the resulting protein? (2)

11. The synthesis of protein is called _____. (1)

12. Beginning at the point that a mRNA molecule has already complexed with a ribosomal subunit, describe the events of protein synthesis to the point 2 amino acids are linked together. (4)

13. Describe the function of the example described in your textbook and in class of a <u>repressible</u> operon. (3)

14. What is the catabolite activator protein? Where does it bind? Under what circumstances? What does it do? (2)

15. What are nuclosomes? (1)

16. Distinguish between heterochomatin and euchromatin. (1)

17. During the cell cycle interphase is divided into periods. What are they and what distinguishes them? (1)

18. Name, in sequential order, and describe the events of each of the phases of mitosis. (5)

19. Distinguish between cell division and binary fission. (1)

20. Describe the differences in cytokinesis as it occurs in animal cells and in plant cells. (2)

BONUS QUESTIONS:

Erwin Chargaff, Rosalind Franklin, Francis Crick, and James Watson were young scientists when they made their most important contributions to science.

1. Which one of them is still alive? Hint: he was recently forced to retire as head of Cold Spring Harbor Laboratory, a leading molecular biology research center. (1)

2. Why (be specific) was he forced to resign. (2)

3. For what did H. G. Korana and M. Nirenberg receive the Nobel prize? (1)

Biology 150: Final examination   **Name**_____
Dec 12, 2007
**Circle the lab you attend: Wednesday, 3:00-4:50,   Wednesday, 9:00-10:50,   Friday, 9:00-
10:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are xx questions worth a total of 100 points (plus 5 possible bonus points). The point value of individual questions appears in parentheses.

1. What are the three most abundant elements in most, if not all, living things? (1)

2. The nucleus of an atom contains what two types of subatomic particles? (1)

3. The atomic number of carbon is _____. It has _____ electrons in its outer shell, forms _____ covalent bonds, and three naturally occurring isotopes named _____, _____, and _____. (3)

4. If the pH is 5, thus $[H^+]$ =   (1)

5. Draw the atomic structure (atoms and bonds) of the following functional groups and indicate which are acidic: (5)
    a) amino   b) carboxyl   c) phosphate   d) sulfhydryl

6. Name one hexose (6 carbon monosaccharide). (1)

7. Name one <u>non</u>-hormone steroid. (1)

8. Draw the general structure of an amino acid. (1)

9. Name the bases of the nucleotides that form DNA. Which ones are purines and which are pyrimidines? (2)

10. Purines and pyrimidines, which have double rings? (1)

11. What are the three differences between RNA and DNA. (3)

12. The endoplasmic reticulum has two types. Name them and indicate their principle functions. (3)

13. Draw a mitochondrion. Label membranes, cristae, and matrix. (1)

14. Draw a chloroplast. Label membranes, thylakoids, stroma, and grana. (1)

15. You have a piece of closed dialysis tubing (artificial selectively permeable membrane) containing 0.2 M sucrose in a beaker containing 0.5 M sucrose what will happen to the tubing? What is the name for the process involved? (1)

16. Name and briefly describe the ion pump that establishes the plasma membrane electrical gradient in animal cells. What does it transport? Where does the energy come from? (2)

17. If, for a specific reaction where A↔B, Keq has a value of 0.5: (2)
    a) Is the reaction considered spontaneous?

    b) If, once this reaction is at chemical equilibrium, and the concentration of the product (B) equals 1 M, what will the concentration of A be?

18. Enzymes function as catalysts meaning they speed reactions by lowering _____ (1)
(choose from: ΔG, activation energy, or Keq)

19. The location on an enzyme where the catalyzed reaction takes place is called _____ (1)

20. Briefly outline the glycolysis pathway. Name the starting molecule, at least one intermediate, the product molecule(s) and indicate the involvement of any energy carrier molecules. (6)

21. Describe the composition of a light harvesting complex. (1)

22. Describe (or diagram) the 1944 experiment of Avery, Macleod, and McCarty testing the molecular cause of bacterial transformation. (5)

23. The double helix model for the structure of DNA first suggested by Watson and Crick depended on data collected by two other scientists Erwin Chargaff and Rosalind Franklin. Describe the data each collected and how it was accounted for in the double helix model. (3)

24. The double helix model indicated that DNA is anti-parallel? What does this mean? (1)

25. Describe transcription. What enzyme complex performs the activity. Where does it bind? Which way does it travel? Where does transcription actually start? Where/how does transcription terminate? What is produced? (5)

26. Describe the function of the example described in your textbook and in class of a <u>repressible</u> operon. (3)

27. What advantage does sexual reproduction appear to provide groups of organisms that is not provide by asexual reproduction? (1)

28. Briefly name and describe (and/or diagram) the three types of lifecycles that occur in eukaryote organisms. Indicate the location of meiosis, mitosis, zygote, fertilization, haploid cells, diploid cells, and the types of organisms each lifecycle is typical of. (8)

29. What is the difference between haploid and diploid cells? (1)

30. Prophase I of meiosis differs from mitotic prophase in three ways. Name or describe each. (3)

31. In what phase of meiosis do the homologous chromosomes separate? (2)

32. In what phase of meiosis do the chromatids separate? (2)

33. Distinguish between locus, gene, and allele. (3)

34. What is meant if it said that gene A and gene B are tightly linked? (1)

35. Describe the results of Mendel's monohybrid cross of purple and white flowered plants. What was the phenotype(s) of the F1 generation and of the F2 generation? (3)

36. What genotypes, and in what proportions, would be expected to result from a cross between AaBb and AaBb assuming there is no linkage? What phenotype(s) and in what proportions would be expected? (4)

37. State Mendel's first and second laws. (4)

38. You experimentally cross a stubby winged fruit fly with a hairless abdomen with a wild type fly. All the progeny (i.e. the F1) have normal wings and normal hairy abdomens. You allow the progeny to interbreed. The resulting F2 consist almost entirely of a 3:1 ratio of flies with normal wings and normal hairy abdomens to flies with stubby wings and hairless abdomens although you also find a small number of flies with stubby wings and normal hairy abdomens and with normal wings but hairless abdomens.
   a) Briefly explain the results. (3)

   b) Is sexual recombination evident? If so which flies form the genetic recombinant class(es)? (2)

   c) Is genetic recombination evident? If so which flies form the genetic recombinant class(es)? (2)

39. You perform one more experiment with the flies from the previous question. You cross some of the F1 with more true breeding stubby winged and hairless abdomen flies. The result in the progeny is a total of 200 flies: 80 with normal wings and normal hairy abdomens, 80 with stubby winged and hairless abdomen flies, 20 with stubby wings and normal hairy abdomens and 20 with normal wings but hairless abdomens. How far apart are the loci? (2)

THREE BONUS QUESTIONS:

1) Gregor Mendel attended which university? (1)

   a) Cambridge   b) Oxford   c) Harvard   d) Vienna   e) Berlin

2) At his death Mendel held the position of _____ at the Brno monastery. (1)

    a) head gardener   b) abbot   c) foot man   d) accountant   e) pharmacist

3) You have two different lines of true breeding corn that differ in three traits. One grows tall, has unvariegated leaves and has smooth anthers. The other is dwarf, variegated, and has wrinkled anthers. In the F_1 smooth anther (S) is dominant over wrinkled anther (s), green (G) is dominant over variegated (g), and tall (T) is dominant over dwarf (t). Allowing the F_1 to self shows the three genes to be linked. You test cross the F_1 with a completely homozygous recessive and analyze the appearance of 1000 progeny. Most plants were about a 50:50 mix of either the dominant phenotype for all three genes or are recessive for all three. Among those evidencing genetic recombination, however, you note that 30 are either dwarf and green or tall and variegated, that 20 are either green and wrinkled or variegated and smooth, and 50 were tall and wrinkled or dwarf and smooth. Indicate the order of these linked genes and the number of map units separating them. (3)