Biology 150: 1st in-class examination **Name**_____
Sept 18, 2009

Circle the lab you are registered in:
Monday, 11-12:50 **Monday, 3:00-4:50,** **Wednesday, 12:00-1:50,** **Thursday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 40 questions worth a total of 50 points (plus a couple of one point bonus questions). The point value of individual questions appears in parentheses.

1. The use of energy to actively maintain complex organization, a characteristic of all living things, is called _____. (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. (1)

3. There are two basic types of science. The recent report of the existence of a new species of salamander living in the southern Appalachia is an example of which type? (1)

4. Name the steps of the scientific method. (1)

5. Using the scientific method in the early 1980's, two Australian clinicians (i.e. medical doctors) Barry Marshal and Robin Warren made what important discovery? (1)

6. The scientific results of the scientific method always need to be confirmed by other researches. The term _____ is applied to hypotheses that have stood this test of time. (1)

7. Charles Darwin saw in nature three processes that explained the evolutionary change that others had already seen. Those three processes included competition for survival, _____, and inheritance of adaptive traits. (1)

8. Cabbage, kale, broccoli, kohlrabi, cauliflower, and brussels sprouts are all descended from *Brassica oleracea*, commonly known as _____. (1)

9. Which are the four most common elements in the human body? (1)

10. Each carbon atom has 6 electrons. How many reside in its outer electron shell? (1)

11. The atomic number of oxygen is 8. Therefore, each Oxygen atom has _____ electrons and it forms _____ covalent bonds. (2)

12. ^{1}H, ^{2}H, and ^{3}H are the three different _____ of Hydrogen. (1)

13. Give two examples of non-polar covalent bonds. (1)

14. Molecules that are ionic or that are rich in polar covalent bonds tend to dissolve easily in water and are there said to be _____ . (1)

15. The tendency of water to rise up surfaces composed of molecules rich in polar covalent bonds is referred to as _____ . (1)

16. Suppose a compound has a molecular weight of 150 g/mole and you wish to prepare 2 liters of a 100 mM solution. How much of the compound would you combine with 2 liters of water? (Note: don't forget the units) (1)

17. The pH is 5, what then is the concentration of H^{+}? (Note: don't forget the units.) (1)

18. Define buffer. (1)

19. Draw the structure of the following functional groups: (4)
    a) Amino b) carboxyl c) phosphate d) hydroxyl

20. Which type of geometric isomer is this compound? (1)

21. Name one hexose aldose. (1)

22. The word ending "ose" indicates what type of organic molecule? (1)

23. Name one polymer consisting glucose subunits connected by α (alpha) 1-4 linkages. (1)

24. What polymer is composed of N-acetylglucosamine subunits? (1)

25. The _____ reaction, which consumes a water molecule, separates a disaccharide into two monosaccharide. (1)

26. Sucrose is composed of what subunits? (1)

27. Sucrose, amylase, and glucose, which of these is(are) reducing sugars? (1)

28. Describe the structure of a triglyceride. (1)

29. What class of lipid is this molecule? (1)

30. Phospholipids are _____ (hydrophilic, hydrophobic or amphiphilic). (1)

31. Draw the structure of an amino acid. (1)

32. Proteins are assembled from a total of _____ amino acids. _____ of which have polar side-chains, while_____ have acidic, _____ basic, and _____ non-polar side chains. (1)

33. Protein structure is considered at four levels: (4)
    (a) Give two examples of secondary structure.

    (b) The unique sequence of amino acids in a protein is considered at what level?

    (c) Quaternary protein structure is a feature of only some proteins. Explain.

    (d) The tendency of hydrophobic regions to be pushed into the center of many polypeptides and the existence of covalent linkages between distant parts of a polypeptide are considered at what level?

34. Name the different types of nucleic acids. (1)

35. Name two purines. (1)

36. Name three pyrimidines. Which ones occur in which nucleic acid? (1)

37. Nucleotides contain a central sugar. To which of that sugar's carbons are the following attached: (4)

a) the nitrogen containing base

b) the phosphate(s)

c) another nucleotide

d) the OH missing in deoxyribose

38. What are the three differences between DNA and RNA? (1)

39. In a complete DNA molecule the strands are antiparallel. Explain. (1)

40. In complete DNA molecules which bases "base-pair" together? (1)

Bonus questions:

(1) What is the fifth most abundant element in the human body? (1)

(2) What type of lipid is this molecule? (1)

Biology 150: 2nd in-class examination **Name**_____
October 9, 2009

Circle the lab you are registered in:
Monday, 11-12:50 **Monday, 3:00-4:50,** **Wednesday, 11:00-12:50,** **Thursday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 29 questions worth a total of 50 points (plus a couple of two point bonus questions). The point value of individual questions appears in parentheses.

1. What appears to limit cell size? How? (2)

2. What are the two basic types of cells? What distinguishes them one from another? (2)

3. The semi-fluid contents of the cell are referred to as _____ while the term cytoplasm refers to the same minus the nucleus and the term _____ refers to the same minus all the organelles. (2)

4. What is chromatin composed of? (1)

5. Where are ribosomes synthesized? (1)

6. Name the two major forms of endoplasmic reticulum and describe what occurs in each. (2)

7. Transport vesicles leaving the ER go to what organelle? What happens in that organelle? (2)

8. What is the characteristic feature of microbodies? Name two types of microbody. What biochemistry occurs in each? (3)

9. What do lysosomes contain? (1)

10. Describe (and or draw and label) the structure of a mitochondrion. What are cristae? What is the inner space called? (3)

11. Describe (and or draw and label) the structure of a chloroplast. (3)

12. What three locations inside a plant cell can you find DNA? (1)

13. Microtubules are composed of what protein? (1)

14. Intermediate filaments are composed of what protein? (1)

15. Microfilaments are composed of what protein? (1)

16. Which type of cytoskeletal protein(s) are involved in muscle contraction? (1)

17. What is a centrosome? Where is it found? What does it contain? (3)

18. Describe the arrangement of microtubules in a basal body and in a cilium. (2)

19. The first model for the cell membrane was suggested in 1935 by Danielli and Davson. Describe their model. (1)

20. Following the development of the electron microscope in the 1950's the model of Danilli and Davson gave way to the unit membrane model. How did this model differ from the earlier model? (1)

21. Further improvements to microscopy technique and other experimental results gave us the currently accepted model for the structure of the cell membrane. Name and describe this model. (4)

22. Define diffusion. (1)

23. The rate or speed of diffusion is determined by what? (1)

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

25. What will happen to red blood cells exposed to an isotonic solution? (1)

26. Plant cells will become plasmolysed if exposed to what kind of solution? (1)

27. 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)

28. What are the two types of contransporters? (1)

29. Describe the sodium-potassium pump. What does it transport? How is it electrogenic? Where does the energy come from? (4)

Bonus questions:

(1) What goes pharyngula mean (i.e. or what is a pharangula)? (2)

(2) Consider a pendulum consisting of a ball swinging at the end of a length of string. How would it function differently in a vacuum that in the air? Why? (2)

Biology 150: 3rd in-class examination **Name**_____
October 9, 2009

Circle the lab you are registered in:
Monday, 11-12:50 **Monday, 3:00-4:50,** **Wednesday, 11:00-12:50,** **Thursday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 22 questions worth a total of 50 points (plus bonus questions worth a total of five points). The point value of individual questions appears in parentheses.

1. State the second law of thermodynamics. (1)

2. Consider a chemical reaction (actually the first step in glycolysis) in which glucose combines with ATP to produce glucose-6-phosphate. For this reaction the chemical equilibrium constant has a value of 610.

   a. At chemical equilibrium which compound will be the most abundant? (1)

   b. is this reaction considered spontaneous or non-spontaneous? (1)

   c. is ΔG negative, positive, or constant? (1)

3. Enzyme catalysis _____ (increases, decreases, leaves unchanged) activation energy and _____ (increases, decreases, leaves unchanged) ΔG. (2)

4. Describe the catalytic cycle of enzymes. How do enzymes work? (2)

5. How does enzyme activity change with temperature? (2)

6. Describe or illustrate the difference between competitive inhibition and non-competitive inhibition. (2)

7. Explain *how* enzymes actually couple ATP hydrolysis to other endergonic reactions. (2)

8. Name one specific example of feedback inhibition. (1)

9. What is the name given to the loss of electrons from a less electronegative atom or molecule to a more electronegative atom or molecule? (1)

10. What is the name given to the process by which living things extract energy from complex biological molecules? (1)

11. Outline glycolysis. Indicate the starting molecule, the use and production (and how many) of energy and electron carrier molecules. Name at least one intermediate molecule and the resulting partially oxidized product molecule(s). (4)

12. In the presence of oxygen, the product molecule(s) of glycolysis undergo the processes of aerobic respiration. Diagram the compete fate of this molecule(s) (i.e. outline its initial oxidation and the Citric acid cycle). Indicate how many of these molecules 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. (8)

13. Describe the events of oxidative phosphorylation (i.e. electron transport and chemiosmosis). Indicate what and where the electron carrier molecules are oxidized, the terminal electron acceptor, the location of electron transport, and the mechanism of ATP synthesis. (4)

14. Give an accounting of where and how many ATP are produced in a eukaryote cell during complete respiration of a single glucose molecule. (3)

15. *How* do rotenone and cyanide produce death? (2)

16. Explain *how* dinitrophenol (DNP), if taken in low doses, would effectively cause weight loss. (2)

17. During vigorous exercise describe the fate of pyruvic acid not consumed by aerobic respiration. (1)

18. Explain *how* fermentation allows glycolysis to continue.

19. A novice home-brewer making his first batch of beer ignores instructions and bottles the beer before fermentation is complete and the yeast has become dormant. Within a few days, one by one, all his bottles explode. What has happened? (2)

20. Respiration is subject to feedback inhibition. Explain. What molecule is the inhibitor? (2)

21. What is VO2 max? If an athlete significantly improved his VO2 max which would most improve his sprinting, middle distance running, or marathon running? Why? (3)

22. Describe the structure of a light harvesting complex. Where is it found? (2)

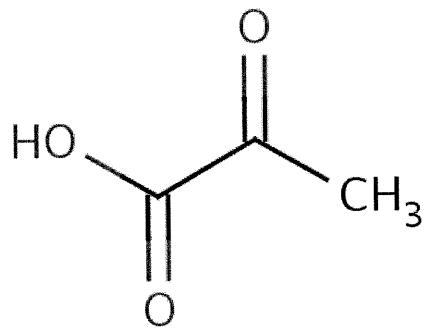
Bonus questions:

(1) Who is Haile Gebrselassie? (1)

(2) Who was J. Willard Gibbs? (1)

(3) In the second reaction of glycolysis, glucose-6-phosphate is isomerized to fructose-6-phosphate. The measured Keq of this reaction shows ΔG to be somewhat positive. Explain why or how this reaction is made to proceed. (2)

(4) What is the name of this molecule? (1)



Biology 150: 4th in-class examination **Name**_____
October 9, 2009

Circle the lab you are registered in:
Monday, 11-12:50 **Monday, 3:00-4:50,** **Wednesday, 11:00-12:50,** **Thursday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 17 questions worth a total of 50 points (plus a five point bonus question). The point value of individual questions appears in parentheses.

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

1. What reaction center occurs in cyclic photophosphorylation? Describe the path of electrons. How is energy captured?(3)

2. During non-cyclic photophosphorylation, electrons are first removed from molecules of _____, passed to the reaction center named _____ of photosystem _____. Following energization by light energy these electrons pass first to a primary acceptor and then from one to another of a series of electron carrier molecules to reach the reaction center named _____ of photosystem _____. Following a second energization by light energy these electrons pass to a primary acceptor and then from one to another of another series of electron carrier molecules to reach the terminal electron acceptor _____. (6)

3. If you were to measure the pH of the stroma and of the lumen of the thylakoids during daylight would the pH be the same or different? If different which would be lower? (2)

4. In the dark reactions of photosynthesis, the initial reaction combines CO2 with _____ to yield two molecules of phosphoglyceric acid (PGA). (1)

5. In a second phase of the dark reactions, phosphoglyceric acid is phosphorylated and reduced to yield _____. (1)

6. What is meant by bacterial transformation? Who discovered this phenomenon? (2)

7. In 1944 Oswald Avery, Colin Macleod, and Maclyn McCarty determined the molecular basis of bacterial transformation. Briefly outline their experiment. What did they conclude? (4)

8. In spite of the clear results of the experiment published by Avery, Macleod, and McCarty in 1944, most Biologists were not convinced of the apparent conclusion suggested by that work until the work of Alfred Hershey and Martha Chase appeared in 1952. Describe the experiment performed by Hershey and Chase and the conclusion that can be drawn from it. (4)

9. Describe the method used by Rosalind Franklin to determine aspects of the structure of the DNA molecule. (2)

10. What was **she** able to conclude from her experiments? (2)

11. The double helix model for the structure of DNA was first described by what two scientists? How did is account for each of the conclusions made by Rosalind Franklin? How did the model make sense of Chargaff's rules? (4)

12. DNA replication is described as being semi-conservative. Why? (1)

13. DNA replication turns out to be a complex process. For E. coli DNA replication, describe replication of the lagging strand following the passage of topoisomerase and helicase mentioning DNA polymerase I, DNA polymerase III, DNA ligase, single stranded binding proteins, primers, RNA primase, Okazaki fragments. (5)

14. Assume that the following, running 3' to 5', is the DNA (gene) sequence at the beginning of the coding sequence for a specific mRNA. Give (a) the sequence of the product of transcription and (b) the order of the first five amino acids in the resulting polypeptide.(3)

    TACCCGTTACGAGTACAAGGATTGAACAGTCACTGG

15. Processing of mRNA before it passes from the eukaryote nucleus into the cytosol involves cutting out and discarding portions called _____. The portions retained are called _____. In addition, the 5' end of the molecule is modified by _____ and the 3' end is modified by _____ (4)

16. Point mutations occurring within the coding portion of a gene can result in <u>three</u> different types of mutation consequences. Name and briefly describe the three types of point mutation. (3)

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

Bonus questions:

(1) Of the following eleven noteworthy scientists only five actually won a Nobel Prize. Who are they? Which three won the award together in 1962? Only one of the eleven is still alive today. Who is that? Name two other Nobel recipients, whose work I have described in this course, but who are not listed below. (5)

Fred Griffith, Martha Chase, Melvin Calvin, Erwin Chargaff, Maurice Wilkins, Oswald Avery, James Watson, Fredrich Miescher, Alfred Hershey, Francis Crick, Rosalind Franklin

Winners:

_____, _____, _____, _____, _____

Together: _____, _____, _____. Living: _____

Other winners: _____, _____,

Biology 150: Final examination **Name**_____
Sept 18, 2009

Circle the lab you are registered in:
Monday, 11-12:50 **Monday, 3:00-4:50,** **Wednesday, 12:00-1:50,** **Thursday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 51 questions worth a total of 100 points (plus a three point bonus question). The point value of individual questions appears in parentheses.

1. Name the steps of the scientific method. (1)

2. The scientific results of the scientific method always need to be confirmed by other researches. The term _____ is applied to hypotheses that have stood this test of time. (1)

3. Charles Darwin saw in nature three processes that explained the evolutionary change that others had already seen. Those three processes included competition for survival, _____ , and inheritance of adaptive traits. (1)

4. Molecules that are ionic or that are rich in polar covalent bonds tend to dissolve easily in water and are there said to be _____ . (1)

5. Suppose a compound has a molecular weight of 150 g/mole and you wish to prepare 2 liters of a 100 mM solution. How much of the compound would you combine with 2 liters of water? (Note: don't forget the units) (1)

6. The pH is 5, what then is the concentration of H^+? (Note: don't forget the units.) (1)

7. Draw the structure of the following functional groups: (4)
   a) Amino b) carboxyl c) phosphate d) hydroxyl

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

9. Name the different types of nucleic acids. (1)

10. Name two purines. (1)

11. What appears to limit cell size? How? (2)

12. What are the two basic types of cells? What distinguishes them one from another? (2)

13. Where are ribosomes synthesized? (1)

14. Name the two major forms of endoplasmic reticulum and describe what occurs in each. (2)

15. What three locations inside a plant cell can you find DNA? (1)

16. The rate or speed of diffusion is determined by what? (1)

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

18. 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)

19. What are the two types of contransporters? (1)

20. State the second law of thermodynamics. (1)

21. Enzyme catalysis _____ (increases, decreases, leaves unchanged) activation energy and _____ (increases, decreases, leaves unchanged) ΔG. (2)

22. Explain *how* enzymes actually couple ATP hydrolysis to other endergonic reactions. (2)

23. Outline glycolysis. Indicate the starting molecule, the use and production (and how many) of energy and electron carrier molecules. Name at least one intermediate molecule and the resulting partially oxidized product molecule(s). (4)

24. Describe the events of oxidative phosphorylation (i.e. electron transport and chemiosmosis). Indicate what and where the electron carrier molecules are oxidized, the terminal electron acceptor, the location of electron transport, and the mechanism of ATP synthesis. (4)

25. What reaction center occurs in cyclic photophosphorylation? Describe the path of electrons. How is energy captured?(3)

26. During non-cyclic photophosphorylation, electrons are first removed from molecules of _____, passed to the reaction center named _____ of photosystem _____. Following energization by light energy these electrons pass first to a primary acceptor and then from one to another of a series of electron carrier molecules to reach the reaction center named _____ of photosystem _____. Following a second energization by light energy these electrons pass to a primary acceptor and then from one to another of another series of electron carrier molecules to reach the terminal electron acceptor _____. (6)

27. In spite of the clear results of the experiment published by Avery, Macleod, and McCarty in 1944, most Biologists were not convinced of the apparent conclusion suggested by that work until the work of Alfred Hershey and Martha Chase appeared in 1952. Describe the experiment performed by Hershey and Chase and the conclusion that can be drawn from it. (4)

28. The cell cycle includes M phase and interphase. Which of these is longest? Interphase and M phase are themselves broken into periods or phases. Draw a diagram of the cell cycle including in correct order the sub-stages of both interphase and M phase. (3)

29. A lot happens in prophase. List the major events. (5)

30. Describe two forms of cytokinesis. In which organisms does each occur. (3)

31. What is term used to describe the equivalent process to cell division in prokaryotes. (1)

32. Sex would seem to reduce the likeliness of survival, something not encouraged by natural selection yet it persists. Why? (1)

33. _____ is the term used to describe cells that contain one set of chromosomes. (1)

34. At what stage of meiosis does crossing over occur? (1)

35. At what stage of meiosis does separation of homologs occur? (1)

36. At what stage of meiosis does synapsis occur? (1)

37. At what stage of meiosis does chromatid separation occur? (1)

38. There are three lifecycle type name and describe each and indicate which organisms each is typical of. (6)

39. Distinguish between the terms phenotype and genotype. (2)

40. Gregor Mendel did his important experiments in what decade (e.g. the 1830s the 1920s etc)? (1)

41. In Mendel's monohybrid experiments with purple and white flowered peas what were both the phenotypic and genotypic results in the F2 generation. (2)

42. State Mendel's first law. (2)

43. In a monohybrid cross between a heterozygous individual and a homozygous recessive individual what would be the expected genotypes and phenotypes on the progeny and in what proportions? (2)

44. State Mendel's second law. (2)

45. You cross AaBbCc with AaBbCc. (2)
    (a) What proportion of the offspring would be homozygous dominant for all 3 genes?

    (b) What proportion of the offspring would have the dominant phenotype for all 3 traits?

46. Who first discovered gene linkage? (1)

47. Who first discovered sex linkage? (1)

48. Who first mapped genes in fruit flies? (1)

49. Distinguish between sexual recombination and genetic recombination. (2)

50. You experimentally cross a true-breeding begonia with long internodes and deep red flowers with another with short internodes and pink flowers. All the progeny (i.e. the F1) have long internodes and deep red flowers. You allow these plants to reproduce by self-pollination. The resulting F2 consist mostly of a 3:1 ratio of plants with long internodes and deep red flowers to plants with short internodes and pink flowers but there was also a few individuals with either long internodes and pink flowers or short internodes and deep red flowers.
    a) What F2 result would Mendel's second law have predicted (i.e. which phenotypes in what proportions)? (2)

    b) What would appear the likely explanation for your "non-Mendelian" results? (2)

    c) Which of your F2 progeny are the genetic recombinant class(es)? (2)

51. You perform a second experiment with the plants from the previous question. You cross a plant of the F1 generation with more another plant with short internodes and pink flowers. The result in the progeny is a total of 1000 plants: 450 with long internodes and deep red flowers, 450 with short internodes and pink flowers, 50 with long internodes and pink, and 50 with short internodes and deep red flowers. (3)
    a) Which are the genetic recombinant class(es)?

    b) How far apart are the loci?

Bonus questions:

(1) Mendel conducted experiments with seven different genes (i.e. genes that impacted flower color, seed shape, seed color, plant height, pod shape, pod color, and flower location). Peas contain only seven chromosomes. Based on modern understanding of pea genes three of his gene loci were probably all located on chromosome four. Mendel never had any results that conflicted with his second law. Suggest why that might have been. (3)