

**Biology 150: 1<sup>st</sup> in-class examination**  
**Sept 16, 2005**

Name \_\_\_\_\_

**Circle the lab you attend: Wednesday, 3:00-4:50, Friday, 1:00-2:50, Friday, 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 **xx** questions worth a total of 50 points (plus a **2 point bonus** question). The point value of individual questions appears in parentheses.

1. Name the three assumptions or principles that underlie all science and describe what they each mean. (3)
  
  
  
  
  
  
  
  
  
  
2. You were given seven characteristics of living things in class. A male moth flying towards the source of female moth scent is an example of which of these? (1)
  
  
  
  
  
  
  
  
  
  
3. In order what are the four steps of the scientific method? (1)
  
  
  
  
  
  
  
  
  
  
4. The fact that the earth is very old (i.e. at least millions of years old) was recognized by science before Darwin's publication of "The Origin of Species".  
Who was the scientist credited with first convincing others that earth was old?  
**Or** What was the name of the book that he published?  
**Or** What was the year that he published his book in? (1)
  
  
  
  
  
  
  
  
  
  
5. Where do Monarch butterflies over-winter? What is remarkable about their migration? (2)
  
  
  
  
  
  
  
  
  
  
6. Name or describe any one example of artificial selection. (1)
  
  
  
  
  
  
  
  
  
  
7. What are the three most abundant elements in the Human body? (1)

8. Oxygen has an atomic number of eight.(4)
  - a. How many protons do Oxygen atoms have?
  - b. How many electrons do Oxygen atoms have?
  - c. How many bonds do Oxygen atoms usually make?
  - d. How many neutrons occur in  $^{16}\text{O}$ ,  $^{17}\text{O}$ , and  $^{18}\text{O}$ ?
9. Give an example of an ionic bond. (1)
10. Give an example of a polar covalent bond. (1)
11. Give an example of a non-polar covalent bond. (1)
12. What is the term given to molecules that are relatively insoluble in water? (1)
13. You lower a paper towel down until it just touches a puddle of water. What term describes the resulting movement of water onto the towel? Why does it occur? (2)
14. What is the pH of pure water? What is the  $[\text{H}^+]$  of pure water? (2)
15. Which has the highest specific heat: water, alcohol (ethanol), salt (NaCl), or granite? (1)
16. Draw the atomic structure of the following functional groups of organic molecules: (3)
  - a. Amino
  - b. Carboxyl
  - c. Hydroxyl
17. In reference to organic polymers, what does the term hydrolysis mean? (1)
18. How do *l*-lactic acid and *d*-lactic differ from each other (i.e. what one term describes their difference)? (1)

19. Glucose is the most common monosaccharide in nature. (3)
- How many carbons does it contain?
  - What disaccharide do two glucoses form?
  - What two polysaccharides does glucose form?
20. Name one reducing sugar and one non-reducing sugar. (1)
21. What is the term that describes (or names) oils and fats? (1)
22. Describe the structure of wax molecules of biological organisms. (2)
23. Cholesterol is what type of lipid? (1)
24. Draw the general structure of an amino acid. (1)
25. Name and describe two common forms of polypeptide secondary structure. (2)
26. In a deoxynucleotide the base is attached to the \_\_\_\_\_ carbon, the phosphate is attached to the \_\_\_\_\_ carbon and the absent Oxygen is missing at the \_\_\_\_\_ carbon. (3)
27. Briefly describe the structure of DNA indicating your understanding of the concepts of strands, base-pairing, and of anti-parallel. (3)

28. What three differences distinguish DNA from RNA? (1)

29. Define entropy. (1)

30. A spontaneous reaction is always \_\_\_\_\_ and is usually \_\_\_\_\_.  
(choose from existential, exothermic, exergonic, endothermic, hyperbole, endergonic, hydrophilic)  
(2)

31. What is activation energy? (1)

Bonus questions:

1. Describe the quaternary structure of the hemoglobin molecule. (1)

2. Which is it: Adenosine monophosphate, Deoxyadenosine monophosphate Uridine monophosphate, Deoxyuridine monophosphate and how do you know? (2)

**Biology 150: 2<sup>nd</sup> in-class examination**

Name \_\_\_\_\_

**Oct 12, 2005****Circle the lab you attend: Wednesday, 3:00-4:50, Friday, 1:00-2:50, Friday, 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 26 questions worth a total of 50 points (plus a two point bonus question). The point value of individual questions appears in parentheses.

1. Describe chemical equilibrium. Under what conditions is a reaction at chemical equilibrium? (1)
2. You perform a specific chemical reaction and determine that at chemical equilibrium that there are equal quantities of both reactants and products. What is the  $K_{eq}$ ? (1)
3. Define catalyst. (2)
4. What happens to  $K_{eq}$  during enzyme catalysis? (1)
5. Describe the cycle of enzyme-substrate interaction (i.e. What is the active site and how does it function?). (3)
6. Provided that prompt medical attention was available which type of poisoning would be preferable: saxitoxin or domollic acid? Why? (2)
7. Describe allosteric enzyme regulation. (2)

8. Describes how ATP hydrolysis drives coupled reactions. (3)
9. The discovery of which type of cell came first. Why? (1)
10. Describe the famous experiment first performed by Louis Pasteur in 1862. (2)
11. What hypothesis was Pasteur testing? (1)
12. Define osmosis. (2)
13. In the lab you prepare a dialysis bag containing 0.2 M sucrose. You place this model cell into a beaker of 0.5 M sucrose solution. What will happen? (1)
14. Distinguish between a hypertonic and a hypotonic solution. What is an isotonic solution? (1)
15. Describe fluid mosaic model of the cell membrane. What is the membrane composed of? How has the model been modified since it was first proposed? (4)

16. coupled transporters (i.e. cooperative ion channels) come in two types. What are they and how do they differ from each other? (2)
17. There are three forms of endocytosis. These include phagocytosis and pinocytosis. What is the third? Describe how it occurs. (3)
18. What happens in the nucleolus? (1)
19. Describe the structure of the nuclear envelope. (2)
20. How is the endoplasmic reticulum positioned relative to the nuclear envelope? (1)
21. Transport vesicles depart from the endoplasmic reticulum and fuse with the \_\_\_\_\_ face of the \_\_\_\_\_ in which molecules synthesized in the endoplasmic reticulum are \_\_\_\_\_ and \_\_\_\_\_ before being packaged into \_\_\_\_\_ vesicles. (5)
22. What is the space inside the inner membrane of mitochondria called? (1)
23. What is the space inside the inner membrane of chloroplast called? (1)
24. Name and describe two types of plastid. (1)
25. During the development of chloroplasts, small vesicles called \_\_\_\_\_ pinch off the inner membrane. These become arranged into stacks called \_\_\_\_\_. (2)

26. Describe the endosymbiosis hypothesis. To what structures does it supply? What evidence supports this idea? (4)

**BONUS QUESTION.**

1. Consider two chemical reactions. In the first, chemical A combines with chemical B to form chemical C and chemical D with a  $K_{eq}$  of 0.7 and a second reaction in which C and D combine to form E and F with a  $K_{eq}$  of 700. Starting by combining equal quantities of A and B which chemical(s) would be most abundant when the reaction was “complete”? Which chemical(s) would be least abundant? Explain. (2)



**Biology 150: 3rd in-class examination**

Name \_\_\_\_\_

Nov 2, 2005

**Circle the lab you attend: Wednesday, 3:00-4:50, Friday, 1:00-2:50, Friday, 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 21 questions worth a total of 50 points (plus two bonus questions). The point value of individual questions appears in parentheses.

1. Describe muscle contraction. What cytoskeletal elements are involved? How are they arranged? In short describe the structure and function of the sarcomere. (4)
2. Briefly, explain why rigor mortis occurs (1)
3. Movement associated with microtubules can be generated three ways within cells. Explain (2)
4. Diagram what the cross section of a flagellum would look like if viewed under a high power (electron) microscope. (1)
5. What is the name given to the gain of electrons from a less electronegative atom or molecule to a more electronegative atom or molecule? (1)
6. Described most simply, the initial reactions of glycolysis can be called glucose activation. Basically, what happens in glucose activation? (1)

7. Energy is harvested in glycolysis in the formation of what two kinds of energy carrier molecule? How many are generated (net gain) of each by glycolysis alone of a single glucose molecule? (2)
  
8. Where in the cell does fermentation occur? (1)
  
9. What critical function is served by fermentation? (1)
  
10. To what (and how many) is a single molecule of pyruvic acid converted in in each of the two forms of fermentation? (2)
  
  
11. Assuming there is plenty of oxygen present, describe the reaction that consumes pyruvic acid in the cells of your body. Where in the cell does the reaction occur? What is produced from the three carbon of the pyruvic acid and in what form is energy harvested from the reaction? (3)
  
  
12. In a single turn of the Kreb's cycle \_\_\_\_\_ donates carbons to the 4 carbon oxaloacetic acid to form \_\_\_\_\_ acid. This molecule is then oxidized first to  $\alpha$ ketoglutaric acid and then back to oxaloacetic acid with the production of \_\_\_\_\_ molecules of NADH, \_\_\_\_\_ molecules of FADH<sub>2</sub>, and \_\_\_\_\_ molecules of ATP with the release of \_\_\_\_\_ molecules of CO<sub>2</sub>.(6)
  
13. In respiration of a single molecule of glucose the molecule gives up a dozen electrons to energized electron carriers to what, in turn, do these energy carrier molecules give up these same electrons and what is the terminal electron acceptor? (2)
  
  
14. In most animal and plant cells 32 molecules of ATP are produced by complete respiration of a single glucose molecule. Briefly, indicate where/how all 32 are produced. (5)

15. Where in a plant cell does photosynthesis occur? Where do the light-dependent reactions occur? Where do the dark (or light-independent) reactions occur? (1)
16. 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 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 from one to another of another series of electron carrier molecules to reach the terminal electron acceptor \_\_\_\_\_. (6)
17. During photosynthesis what happens to the pH of the thylakoid lumen? What is the mechanism that produces this change? (2)
18. Rubisco (ribulose biphosphate oxygenase carboxylase) is the most abundant protein in nature. Describe the reaction it catalyses. (2)
19. Fredrick Miescher is generally credited with the discovery of \_\_\_\_\_? (1)
20. Briefly, describe the 1928 experiment by Fred Griffith that demonstrated the phenomenon of bacterial transformation. (2)
21. Briefly describe the 1952 experiment by Alfred Hershey and Martha Chase that used bacteriophages to demonstrate the importance of DNA in inheritance. (4)

**BONUS QUESTIONS:**

(a) The chemical dinitrophenol (DNP) is a lipid soluble molecule that collapses pH gradients across membranes by shuttling hydrogen ions across the membrane. This molecule is poisonous to your cells. Why? (2)

(b) Cyanide is fatal because it binds to a member of the mitochondrial electron transport chain and prevents that protein from being reduced. Briefly explain how this will lead to death. (1)

**Biology 150: 4th in-class examination**

Name \_\_\_\_\_

Nov 21, 2005

**Circle the lab you attend:    Wednesday, 3:00-4:50,    Friday, 1:00-2:50,    Friday, 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 xx questions worth a total of 50 points (plus 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. Describe the data each collected and how it was accounted for in the double helix model. (3)
  
  
  
  
  
  
  
  
  
  
2. Watson and Crick included in their publication of the double helix model a suggestion of how DNA replication might be accomplished in cells. Their idea has turned out to be essentially correct but DNA replication is more complex than they imagined. For *E. coli* DNA replication, describe replication on the lagging strand following the passage of the rep complex mentioning DNA polymerase I, DNA polymerase III, DNA ligase, single stranded binding proteins, primers, RNAPrimase, Okazaki fragments. (5)

3. What is a gene? (1)
4. What are frameshift mutations? (1)
5. What are point mutations? Describe the different possible consequences of point mutations falling within a gene. (3)
6. What are promoters? (1)
7. What is the name of the enzyme complex that performs transcription? (1)
8. How is transcription terminated? (2)
9. In eukaryotes, unlike in Prokaryotes, mRNA is subject to processing before it is used in translation. What happens in mRNA processing? (3)
10. The Nobel prize in 1968 went to Marshall Nirenberg and Har Gobind Khorana for the genetic code. Explain what they discovered and explain the strategy they used to make their discovery. (4)

11. Briefly describe stepwise the events of the translation cycle explaining the role of mRNA, the large and small ribosomal subunits, tRNA's, A-sites, P-sites, start codons, and termination codons. (8)

12. Assume the following sequence represents one end of a mRNA (shown 5' to 3'):

methyl-GGAAGGAGGUAACACAUGCCUCCUUAACUGCGGAGGAUAAA....

a) list the first 9 amino acids that would appear in the resulting peptide (3)

b) list the anti-codons, in order, of the first 6 tRNAs involved in the synthesis of that peptide (3)

c) give the base sequence of the gene transcribed into the mRNA (3)

13. Describe how restriction enzymes produce sticky ends. (1)

14. You have completed your studies at MSU and, armed with your Biology degree, you have landed a job in a Biotech company. Your first assignment is to make a DNA library of the zebra fish genome. Describe the steps you would take. (5)
15. You are given a small sample of human DNA and asked to use the polymerase chain reaction to make a large quantity of a small portion of the DNA of one particular chromosome. Describe how you would do this mentioning what you would need. (3)

**BONUS QUESTIONS:**

1. Erwin Chargaff, Rosalind Franklin, Francis Crick, and James Watson were young scientists when they made their most important contributions to science.  
Which one of them is still alive?
- Which one of them died this year?



**Biology 150: Final examination**  
**Dec 12, 2005**

Name \_\_\_\_\_

**Circle the lab you attend:**      **Wednesday, 3:00-4:50,**      **Friday, 1:00-2:50,**      **Friday, 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 47 questions worth a total of 100 points (plus 5 possible bonus points). The point value of individual questions appears in parentheses.

1. Describe the relative positions of the components of the *lac* operon. Indicate how protein binding regulates expression in the presence and the absence of the lactose sugar. (3)
2. Explain the difference between repressible and inducible operons. Which type is the *lac* operon? (2)
3. Describe what regulatory elements play a role in transcription regulation in eukaryote cells of genes located in euchromatin. (4)
4. Once mRNA reaches the eukaryotic cytosol it may or may not be translated. Explain. (3)
5. What is the difference between cell division and binary fission? (1)

6. Name the phases of mitosis and indicate the events that occur in each. (6)
7. Mitosis and Meiosis are very similar. Describe the major differences between the events of the first phase of meiosis I and the first phase of mitosis (3)
8. Describe the difference between the events of anaphase I and anaphase II. (2)
9. Name and briefly describe the life cycle typical of all plants (3)
10. Explain what is meant when genes are said to be loosely linked. (2)

11. What does Mendel's law of segregation state? (1)
  
12. What does Mendel's law of Independent Assortment state? Under what circumstances does this law hold and under what circumstances does it not? (3)
  
13. In experimental matings between true breeding "vermilion" eyed fruit flies and the common true breeding red eyed fruit flies the F1 generation consists entirely of flies with blue eyes. In a cross between F1 individuals, however, 317 blue eyed flies and 104 red eyed flies were produced in the F2. What do the results suggest to you? (2)
  
14. In a monohybrid cross between a heterozygous individual and homozygous recessive individual, what proportion of the progeny would be expected to display the dominant phenotype? What would be the genotype of those individuals? (2)
  
15. 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 and in what proportions would be expected? (4)

16. Assume you crossed AABB with aabb to get AaBb, what genotypes, and in what proportions, would be expected to result from a cross between the F1 (i.e. AaBb and AaBb) if the loci were very tightly linked? What phenotype and in what proportions would be expected? (4)
17. In a cross between AaBbCcddEE and aabbCCDdEe, what proportion of the offspring would be heterozygous for all four genes (2)
18. What is genetic recombination? (1)
19. What is sexual recombination? (1)
20. You cross AaBb with aabb and get the following result: 100 A-B-, 100 aabb, 1 A-bb, and 1 aaB-. How far apart do the loci map? (2)
21. In order what are the four steps of the scientific method? (1)
22. What are the three most abundant elements in the Human body? (1)
23. Give an example of a non-polar covalent bond. (1)
24. What is the pH of pure water? What is the  $[H^+]$  of pure water? (2)
25. Cholesterol is what type of lipid? (1)

26. Draw the general structure of an amino acid. (1)
27. What three differences distinguish DNA from RNA? (1)
28. Define entropy. (1)
29. A spontaneous reaction is always \_\_\_\_\_ and is usually \_\_\_\_\_.  
(choose from existential, exothermic, exergonic, endothermic, hyperbole, endergonic, hydrophilic)  
(2)
30. What is activation energy? (1)
31. Describe chemical equilibrium. Under what conditions is a reaction at chemical equilibrium? (1)
32. You perform a specific chemical reaction and determine that at chemical equilibrium that there are equal quantities of both reactants and products. What is the  $K_{eq}$ ? (1)
33. Describes how ATP hydrolysis drives coupled reactions. (3)
34. Describe fluid mosaic model of the cell membrane. What is the membrane composed of? How has the model been modified since it was first proposed? (4)

35. What happens in the nucleolus? (1)
36. Describe the structure of the nuclear envelope. (2)
37. Energy is harvested in glycolysis in the formation of what two kinds of energy carrier molecule? How many are generated (net gain) of each by glycolysis alone of a single glucose molecule? (2)
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41. Assuming there is plenty of oxygen present, describe the reaction that consumes pyruvic acid in the cells of your body. Where in the cell does the reaction occur? What is produced from the three carbon of the pyruvic acid and in what form is energy harvested from the reaction? (3)
42. In respiration of a single molecule of glucose the molecule gives up a dozen electrons to energized electron carriers to what, in turn, do these energy carrier molecules give up these same electrons and what is the terminal electron acceptor? (2)

43. Where in a plant cell does photosynthesis occur? Where do the light-dependent reactions occur? Where do the dark (or light-independent) reactions occur? (1)
44. What are promoters? (1)
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47. Briefly describe stepwise the events of the translation cycle explaining the role of mRNA, the large and small ribosomal subunits, tRNA's, A-sites, P-sites, start codons, and termination codons. (8)

**BONUS QUESTION:**

1. The following scientists all received the Noble prize. Match the prize winners with the accomplishment for which he was awarded the prize (5):

James Watson	_____	the genetic code
Peter Michel	_____	the lac operon
Jacques Monod	_____	the double helix
Hans Krebs	_____	the citric acid cycle
Marshal Nirenburg	_____	chemiosmosis