

Biology 150: 1st in-class examination
Sept 19, 2008

Name _____

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. There are several characteristics of all living things. A bacterium in your intestines, when suddenly surrounded by the milk you just drank, begins to express (or “turns on”) the genes to produce the enzymes necessary to metabolize milk is an example of which of those characteristics? (1)
2. All scientific conclusions rest on three assumptions. Two of these are the assumption of natural causality and the assumption of common perception. Name the last of these assumptions and explain what it means. (2)
3. We can distinguish between two types of science. One of these, hypothetical (or explanatory) science is conducted using the scientific method. The other type of science is not. Name that other type of science. (1)
4. As an example of the scientific method I described the work of Barry Marshal and Robin Warren. State the steps of the scientific method and how it was used by Marshal and Warren. (4)
5. Darwin recognized that competition for survival exists (i.e. that more of any species or population are born than can possibly survive) and that individual organisms tend to pass on their physical characteristics to their offspring. What was his other important insight? (2)

6. Which of the following vegetables was **not** derived from wild mustard: broccoli, cabbage, kohlrabi, cauliflower, carrot, brussel sprouts, kale? What do we call the process used to derive these vegetable over the last 2500 years? (2)
7. What is meant by uniformitarianism? (2)
8. What are the three most common elements in the human body? What is the fourth? (2)
9. The number of *what subatomic particle* in an atom determines both the atom's atomic number and the number of its electrons? (1)
10. Carbon atoms have _____ electrons and form _____ covalent bonds. (2)
11. The decay of ^{14}C produces _____. (1)
12. 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 _____
13. If the pH is 7, what is the $[\text{H}^+]$? (Don't forget the units!) (1)
14. Molecules that tend to stabilize pH by taking up or releasing H^+ are called _____. (1)
15. Relative to water is the specific heat of the Styrofoam used to make disposable cups higher, the same, or lower? (1)
16. By definition, all organic molecules contain _____. (1)
17. Surface tension is explained by the tendency of water molecules to form _____ bonds between one another. (1)
18. Water climbing up a paper towel is an example of what phenomenon? (1)
19. Molecules that do not dissolve easily in water are said to be _____. (1)
20. Draw the structure of the following structural groups: (4)
a) Amino b) carboxyl c) phosphate d) hydroxyl

21. Name one disaccharide and name its constituent monosaccharides. (2)
22. Insect exoskeletons are made of what polysaccharide? It is formed of what monomers or subunits? (2)
23. Fats and oils are also called _____ . (1)
24. What happens during partial hydrogenation of vegetable oil? (3)
25. Describe the structure of a phospholipid. (3)
26. Cholesterol, testosterone, and estradiol are examples of what type of lipid? (1)
27. Draw the structure of an amino acid. (1)
28. What is the primary structure of a protein? (1)
29. Give two examples of the secondary structure of a protein. (2)

30. Name the two forms of nucleic acid. (2)

Bonus questions:

1. Marshal and Warren did their work in what country? (1)

2. The following two molecules are what type of isomer of each other? Draw the third. (2)

Biology 150: 2nd in-class examination
October 10, 2008

Name _____

Circle the lab you attend: Wednesday, 3:00-4:50, Wednesday, 8:00-9:50, Friday, 8:00-9:50

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are **23** questions worth a total of 50 points (plus 3 one point bonus questions). The point value of individual questions appears in parentheses.

1. The sugar in each nucleotide has how many carbons? Name four of them and describe what is distinctive about each. (4)
2. RNA is single stranded and DNA is double stranded. The sugar lacks an OH in RNA but not in DNA. What else differs between RNA and DNA? (1)
3. The DNA molecule is said to be anti-parallel. What does that mean? (1)
4. Which type of cell is typically smallest plant, animal, or bacterial? How small are those cells? (2)
5. What is the principle difference between eukaryotes and prokaryotes? (1)
6. Why are cells small? (2)
7. What is chromatin composed of? (1)
8. Name and describe the two principle forms of the endoplasmic reticulum. What is the function of each? (2)

9. What is the golgi? From what is it formed? What does it do? (2)

10. What is a lysosome? What does it contain? Where is it formed? (2)

11. What is a glyoxisome? What does it do in what organisms? (2)

12. Name and describe two forms of endocytosis. (2)

13. The endosymbiosis theory explains the existence of what organelles. What evidence supports the idea? (4)

14. Name each of the three types of cytoskeletal protein fibers and name the type of protein(s) they are made of. (3)

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

16. How wide is the cell membrane? (1)

17. Describe (and or diagram) the fluid mosaic model. How has it been modified since originally proposed? (4)

18. Define diffusion. What is the rate of diffusion proportional to? (2)

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

20. 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)

21. Name and explain the difference between the two forms of cotransport. (2)

22. What does the principle ion pump of plant, fungi, and bacterial cells transport? (1)

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

Bonus questions:

1. How wide is actin? (1)

2. What is dynein? (1)

3. What component of animal cell membranes explains their fluidity? (1)

Biology 150: 3rd in-class examination
October 31, 2008

Name _____

Circle the lab you attend: Wednesday, 3:00-4:50, Wednesday, 8:00-9:50, Friday, 8:00-9:50

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 some bonus questions). The point value of individual questions appears in parentheses.

1. What does the first law of thermodynamics state? (1)
2. What does the second law of thermodynamic state? (1)
3. When O_2 and wood combine in combustion to produce H_2O and CO_2 , is ΔH negative, positive, or neither? (1)
4. When ice melts: (3)
 - a) Is ΔG negative, positive, or neither?
 - b) Is ΔH negative, positive, or neither?
 - c) Is ΔS negative, positive, or neither?
5. A non-spontaneous reaction is referred to as a _____ reaction. (1)
6. What is meant if a chemical reaction is said to have reached chemical equilibrium? (1)
7. For a specific reaction the chemical equilibrium constant has a value of 8.361. The reaction is:
 - a) spontaneous b) superficial c) non-spontaneous d) oxidation e) exo-thermic (1)
8. Comparing an enzyme catalyzed reaction to the same reaction uncatalyzed: (1)
 - a) ΔG is more negative
 - b) ΔG is more positive
 - c) E_A is smaller
 - d) both a and c
 - e) none of the above
9. Enzymes are said to be highly specific. What does this mean? (1)

10. Describe and/or diagram how ATP hydrolysis actually functions to drive endergonic reactions in so-called “coupled reactions”. (2)
11. What is meant by feedback inhibition? (1)
12. Define respiration. (1)
13. Briefly outline the glycolysis pathway. Name the starting molecule, at two intermediates, the product molecule(s) and indicate the involvement of any energy carrier molecules. (6)
14. The carbon product of glycolysis (previous question) passes into the mitochondria describe the first reaction that occurs. (3)

15. Outline the Krebs's (citric acid) cycle. What molecule donates carbon to the pathway combining with what four carbon molecule? What six carbon molecule is produced? In a single turn of the cycle indicate the important redox reactions and any ATP produced. What is the fate of the donated carbon molecules? (4)
16. Describe and/or diagram the process, in the presence of ample O_2 , by which reduced electron carrier molecules produced by the Krebs's cycle are oxidized. Name those electron carrier molecules. Also indicate how this oxidation is coupled to the production of ATP. (4)
17. From a single molecule of glucose the processes of glycolysis and aerobic respiration yields considerable ATP. How much? Give an accounting of the ATP produced. Show or describe which stages yield how much ATP. Which ATP molecules result from substrate level phosphorylation? Which from oxidative phosphorylation? (4)
18. A yeast and sugar solution not exposed to O_2 produces considerable gas. What is that gas? Name and describe the process that yields this gas. What other molecule is produced in exactly the same quantity as the gas molecules? (3)

19. 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)
20. Describe the composition of a light harvesting complex. (1)
21. 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)
22. What photosystem is involved in cyclic photophosphorylation? (1)

BONUS QUESTIONS:

- (1) The chemical 2,4-dinitrophenol (DNP) was sold as a diet aid beginning about 1930. Explain how it might help dieters. Could rotenone serve the same purpose, why or why not? (2)
- (2) 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? (1)
- (3) Consider the reaction $A + B \rightarrow C + D$. Suppose it has a K_{eq} of 2. What would the K_{eq} be of $C + D \rightarrow A + B$? (1)

Biology 150: 4th in-class examination
November 24, 2008

Name _____

Circle the lab you attend: Wednesday, 3:00-4:50, Wednesday, 8:00-9:50, Friday, 8:00-9:50

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 3 bonus questions). The point value of individual questions appears in parentheses.

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

1. The so-called dark reactions of photosynthesis are also referred to as the _____ cycle after its discoverer or sometimes the _____ - _____ cycle after its two co-discoverers. (1)
2. In the first reaction of the dark reactions, CO₂ is combined with _____ by the enzyme _____ to form an unstable six carbon compound that spontaneously forms two molecules of Phosphoglyceric acid (PGA). (2)
3. In subsequent dark cycle reactions, PGA is phosphorylated and reduced using _____ and _____ (the two energy carrier molecules produced by the light reactions) to yield Phosphoglyceraldehyde (PGAL). (2)
4. DNA was first isolated and chemically characterized in 1870 by _____. (1)
5. Fred Griffith is credited with the discovery of bacterial transformation. What is bacterial transformation? Briefly, describe Griffith's experiment(s). (3)

6. In 1944, Oswald Avery, Colin Macleod, and Maclin McCarty showed that bacterial transformation, as demonstrated by Griffith required _____ but did not require _____. (1)

11. Define gene. (1)
12. Define codon. (1)
13. 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)
14. In eukaryotes pre-mRNAs are processed to become mRNAs. Describe the changes that occur. (3)
15. What are snRNAs? (1)
16. 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)

17. Describe and/or diagram the events of translation. In what order do the components come together? How is protein amino acid sequence determined? How is translation terminated? (5)
18. What is a frameshift mutation? What kind(s) of DNA changes produce these types of mutations?(1)
19. How do missense and nonsense mutations differ? (1)
20. Describe and/or diagram the lac operon. Name and indicate the relative location of the different elements. Describe how changing lactose concentration alters function. (4)
21. How do inducible and repressible operons differ? (1)
22. Describe and/or diagram the cell cycle. Show the relative size and location of Interphase, G2, G1, S, and Mphase. (1)

BONUS QUESTIONS:

- Describe the experimental method used in the late 1940's in a laboratory at UC Berkeley to discover the sequence of reactions of the "dark reactions" of photosynthesis. (2)
- Describe the experimental method used in the early 1960's in laboratories at the NIH in Maryland and at the U. of Wisconsin to discover the genetic code. (2)
- How many introns occur in the human B-globin gene? (1)

		Second Position				
		U	C	A	G	
First Position	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
	C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }	U C A G
	A	AUU } Ile AUC } AUA } AUG } Met	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } Gly GGC } GGA } GGG }	U C A G

Biology 150: Final examination

Name _____

Dec 15, 2008**Circle the lab you attend: Wednesday, 3:00-4:50, Wednesday, 8:00-9:50, Friday, 8:00-9:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 46 questions worth a total of 100 points (plus 5 possible bonus points). The point value of individual questions appears in parentheses.

1. Mitosis begins with prophase. Name the remaining phases of mitosis and briefly indicate what occurs in each. (2)
2. Cytokinesis takes two possible forms. Briefly describe how it occurs in animal cells and how it occurs in plants. (2)
3. What is a phragmoplast? (1)
4. Describe binary fission. In what organisms does it occur? (2)
5. What is the term used to name an organized illustration or photograph of the condensed chromosomes of an individual organism in which the homologous pairs are arranged together? (1)
6. Humans have how many pairs of homologous chromosomes? How many are autosomes? (2)
7. There are three lifecycle types in nature. Name and describe (and/or illustrate) each indicating when cells are haploid and diploid, where mitosis, meiosis, and fertilization occur. (6)

8. How does prophase I differ from prophase? (3)

9. The genetic material you produce in the individual gametes you produce is always a mix of the genetic material you received as a zygote from your two parents. This mixing of your parental genes in your gametes is ensured by two mechanisms. Name each of these mechanisms and explain how each contributes to genetic mixing. (4)

10. What term is used to name the location of a gene on one or both homologous chromosomes? (1)
11. Distinguish between the meaning of phenotype and genotype. (2)

12. What does it mean to say that certain genes are tightly linked? (1)

13. Gregor Mendel did his important experiments in what decade (e.g. the 1830s the 1920s etc)? (1)
14. In Mendel's monohybrid cross involving flower color all the F₁ individuals looked the same. What was their phenotype and what was their genotype(s)? (2)

15. Allowed to self-pollinate, the F₁ generation produced a mixture of phenotypes and genotypes in the F₂ generation. What were their phenotypes and what was their genotypes? (2)

16. In a cross between Aa and aa, what phenotypes and genotypes would result in what proportions? (1)
17. In a cross between AaBbCCDDEE and AaBbccddee, what proportion of the progeny would have the dominant phenotype for all five genes? (1)

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

19. You experimentally cross a true-breeding fruit fly with both forked bristles and vermilion eyes with a wild type fly. All the progeny (i.e. the F1) have normal (i.e. wild type) bristles and eyes. You allow the progeny to interbreed. The resulting F2 consist mostly of a 3:1 ratio of flies with normal bristles and eyes to flies with both forked bristles and vermilion eyes with a few with either forked bristles and normal eyes or normal bristles and vermilion eyes. (6)
- What do the results tell you?
 - Is sexual recombination evident? If so which flies form the sexual recombinant class(es)? (2)
 - Is genetic recombination evident? If so which flies form the genetic recombinant class(es)?
20. You perform a second experiment with the flies from the previous question. You cross some of the F1 with more true-breeding flies with forked bristles and vermilion eyes. The result in the progeny is a total of 1000 flies: 400 with normal bristles and eyes, 400 with forked bristles and vermilion eyes, 100 with forked bristles and normal eyes and 100 with normal bristles and vermilion eyes. How far apart are the genes? (2)
21. You have an interest in a certain wildflower and have collect a few mutant varieties you have found in nature. You already have some plants that lack the normal flower color and recently you have discovered a second population. Crossing plants for either population with the normal wild type plants shows the white flower phenotype to be recessive. Curious to know more about the genetic basis of the two white flowered populations you cross two white flowered plants from the two different populations the result is plants that have normal flower color. Explain the results. (2)
22. There are several characteristics of all living things. A bacterium in your intestines, when suddenly surrounded by the milk you just drank, begins to express (or “turns on”) the genes to produce the enzymes necessary to metabolize milk is an example of which of those characteristics? (1)

23. As an example of the scientific method I described the work of Barry Marshal and Robin Warren. State the steps of the scientific method and how it was used by Marshal and Warren. (4)
24. Darwin recognized that competition for survival exists (i.e. that more of any species or population are born than can possibly survive) and that individual organisms tend to pass on their physical characteristics to their offspring. What was his other important insight? (2)
25. 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 _____
26. If the pH is 7, what is the $[H^+]$? (Don't forget the units!) (1)
27. Molecules that tend to stabilize pH by taking up or releasing H^+ are called _____. (1)
28. Draw the structure of the following structural groups: (4)
a) Amino b) carboxyl c) phosphate d) hydroxyl
29. The sugar in each nucleotide has how many carbons? Name four of them and describe what is distinctive about each. (4)

30. RNA is single stranded and DNA is double stranded. The sugar lacks an OH in RNA but not in DNA. What else differs between RNA and DNA? (1)
31. The DNA molecule is said to be anti-parallel. What does that mean? (1)
32. Name and describe the two principle forms of the endoplasmic reticulum. What is the function of each? (2)
33. What is the golgi? From what is it formed? What does it do? (2)
34. What is a lysosome? What does it contain? Where is it formed? (2)
35. What is a glyoxisome? What does it do in what organisms? (2)
36. You have a piece of closed dialysis tubing (artificial selectively permeable membrane) containing 0.2 M sucrose in a beaker containing pure water what will happen to the tubing? What is the name for the process involved? (1)
37. What does the first law of thermodynamics state? (1)
38. What does the second law of thermodynamic state? (1)
39. When O_2 and wood combine in combustion to produce H_2O and CO_2 , is ΔH negative, positive, or neither? (1)

40. Briefly outline the glycolysis pathway. Name the starting molecule, at two intermediates, the product molecule(s) and indicate the involvement of any energy carrier molecules. (6)
41. The carbon product of glycolysis (previous question) passes into the mitochondria describe the first reaction that occurs. (3)
42. Outline the Kreb's (citric acid) cycle. What molecule donates carbon to the pathway combining with what four carbon molecule? What six carbon molecule is produced? In a single turn of the cycle indicate the important redox reactions and any ATP produced. What is the fate of the donated carbon molecules? (4)
43. In 1944, Oswald Avery, Colin Macleod, and Maclin McCarty showed that bacterial transformation, as demonstrated by Griffith required _____ but did not require _____.
(1)

44. The role of DNA in heredity was demonstrated most unambiguously by Martha Chase and Alfred Hershey in 1952. Briefly describe their experiment(s). (4)

45. Define codon. (1)

46. 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)

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)