

BIOLOGY 345

Name _____

Midterm I - 18 October 2010**PART I. Multiple choice questions – (3 points each, 33 points total).**

1. Which of the following metals was used in the construction of pipes in early Rome and may have contributed to the fall of the Roman empire?
 - A. Iron
 - B. Bronze
 - C. Gold
 - D. Lead
 - E. Silver

2. Louis Pasteur is recognized as the scientist who finally refuted which hypothesis using experiments involving microorganisms and swan-necked flasks?
 - A. Germ theory
 - B. Spontaneous generation
 - C. Immunization with first vaccines
 - D. Natural selection
 - E. Pasteurization principle

3. A bacterium with a single flagella on one end of its cell would best be considered?
 - A. Monotrichous
 - B. Lophotrichous
 - C. Peritrichous
 - D. Amphitrichous
 - E. None of the above, as this trait has yet to be discovered.

4. The fossil record for eucaryotes goes back almost 2.5 billion years, whereas the record for bacteria goes back to the heavy bombardment period at about ??? years.
 - A. 1.5 billion
 - B. 2 billion
 - C. 3.5 billion
 - D. 3.5 million
 - E. 4.5 billion

5. Cell walls are important features in both archaea and bacteria. Which of the following compounds best describes the biomolecular subunits found exclusively in an archaeal cell wall?
 - A. Diaminopimelic acid (DAP) & D-alanine interbridge
 - B. L-lysine & pentaglycine interbridge
 - C. N-acetylglucosamine (NAG) & N-acetylmuramic acid (NAM)
 - D. N-acetylglucosamine (NAG) & N-acetylalosaminuronic acid (NAT)
 - E. Dipicolinic acid & Lipotechoic acid

6. Viruses are not considered alive because they.....
- A. Do not possess nucleic acids.
 - B. Have only one kind of nucleic acid.
 - C. Are not cells.
 - D. Cannot replicate.
 - E. Are too small.
7. Which of the following is an invariant feature found among all microbial cells?
- A. Ribosomes
 - B. Endospores
 - C. Cell wall
 - D. Capsules
 - E. Flagella
8. Which of the following types of macromolecules provides the greatest amount in terms of weight (excluding water) in a typical microbial cell?
- A. RNA
 - B. Lipid
 - C. DNA
 - D. Protein
 - E. Polysaccharide
9. Recently there has been a scientific flurry to better understand the deep subsurface biosphere, what has been described so far?
- A. Nearly the same biomass as seen in surface biosphere
 - B. Nearly all bacterial and archaeal biomass
 - C. Biomass enriched in N and P
 - D. Not as metabolically active as surface biosphere
 - E. All of the above
10. Which of the following microscopy methods would allow for the highest resolution of a living sample?
- A. Confocal scanning microscopy
 - B. Phase contrast microscopy
 - C. Atomic force microscopy
 - D. Brightfield microscopy
 - E. Epifluorescence microscopy
11. Which of the following types of molecules is most likely to pass easily through the cell membrane?
- A. Water
 - B. An amino acid
 - C. A sugar (monosaccharide)
 - D. A small lipid
 - E. A salt ion, like Na^+ or Cl^-

PART II. Fill-in-the-blank – (Number of points in parentheses, 30 total).

12. (12 points) Arrange the following features in the order they would appear if you were traveling *from* the center of the cytoplasm of a Gram-negative cell *to* the external environment:

- A. Slime layer
- B. LPS layer
- C. Capsule
- D. Periplasmic space
- E. Ribosomes
- F. Cell membrane

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13. (18 points) Arrange the following variant features/structures first determining if they occur in the cytoplasm (**CP**), cell membrane (**CM**), or cell wall (**CW**). **Then** (second line) indicate if these variant features/structures are found exclusively in Bacteria (**Bac**), Gram-positive bacteria (**G+**), Gram-negative bacteria (**G-**), or Archaea (**Arc**). Example answer: CP Arc

_____ Hopinoids

_____ Pentaglycine interbridge

_____ Porins

_____ Teichoic acids

_____ Carboxysomes

_____ Biphytanyl tetraether lipids

_____ O-specific polysaccharide

_____ Magnetosomes

_____ Diaminopimelic acid (DAP)

PART III. Short answer questions – (Number of points in parentheses, 42 total).

14. (12 points) *Yersinia ruckeri* is a bacterium that causes “redmouth” disease first discovered in rainbow trout from the Hagerman Valley, Idaho. It has now spread to the rest of the Western United States, and elsewhere via fish hatchery stocks. This now common disease is characterized by fish with inflammation of the mouth and palate area. Outwardly, the fish become darker in color and sluggish, and the disease is enhanced when fish are stressed and/or when oxygen tension is low. If you were a fish pathologist, how would you **prove** that *Y.ruckerii* is the causative agent of the disease **red mouth**?
15. (5 points) What is specifically meant by the statement that; “All bacteria and archaea are osmotrophs”?
16. (5 points) You have a culture of your favorite cyanobacteria and are wondering if they have gas vesicles. How might you still go about testing for this variant structure even if you don’t have a microscope handy?

- 17.** (12 points) The life cycle of some types of bacteria can alternate between the vegetative cell and the endospore. Included on this list is *Bacillus anthracis*, which has once again reemerged as a serious threat in terms of biowarfare.
- A.** Name the disease associated with this organism?

 - B.** How long can endospores remain viable in general and why?

 - C.** What features do endospores share with vegetative cells?

 - D.** Which endospore structure specifically acts as a water-tight jacket?

 - E.** Name a characteristic compound found only in endospores?

 - F.** What is the *practical* significance of the teichoic acid component of *B. anthracis* cell walls?
- 18.** (5 points) What is the significance of the bacterium *Aquifex pyrophilus* having a cell membrane with only phospholipids, but with both ester and ether linkages?
- 19.** (3 points) What are the relative proportions of RNA and protein in a ribosome?

PART IV. Short Essay – (Number of points in parentheses, 45 points total).

- 20.** (15 points) Now that you know a bit more about variant and invariant structures and some key characteristics of microbial cells, describe **"5"** specific characteristics that you would use to design a **useful** taxonomy. Justify your taxonomic key by placing each of the chosen characteristics into a hierarchy of importance, i.e., which one would you look for first, etc. Design your classification system so that it might be used by other microbiologists to differentiate among all microorganisms that might be encountered in the real world. Please briefly describe the reasoning behind each of your choices.

- 21.** (15 points) A giant bacterium has recently been discovered in the digestive tract of a marine surgeonfish, this symbiont bacterium is named *Epulopiscium fishelsoni*. This bacterium has a gigantic rod morphology and grows up to **0.75 mm** in length (nearly 5 times bigger than a *Paramecium*). **(A)** Based on this information and what you already know about surface area to volume ratios, what are the major problems that this bacterium must overcome? **(B)** What advantage might this bacterium have achieved by being so large, especially when considering its native habitat? **(C)** What is the “normal” size range for most free-living bacteria and why?

- 22.** (15 points) Based on what you now know about microbial taxonomy, **(A)** what is it that the newer molecular microbial techniques have brought to the table, i.e., what major limitation have they allowed us to overcome? **(B)** Briefly describe the utility of DNA:DNA hybridization and FAME analysis, i.e., what are the positive aspects of each of these methods? **(C)** Now briefly describe why ribosomal RNAs are also so useful and what are some of the positive aspects that they have to offer. Also can you come up with at least one negative aspect of ribosomal RNAs, which leaves us needing other information in terms of determining a microorganism's natural history and/or taxonomy?