Study Questions
Biology 2010
Week 3 (Jan. 27 & 29)

Readings
[ON RESERVE AT MARRIOT LIBRARY]

Required:

Campbell et al. Biology Chapters 27 & 28


Highly recommended:


Extras for fun (optional):


Study Questions

1. Compare and contrast the following in prokaryotic vs. eukaryotic cells/organisms:

   a. cell size
   b. membrane-bound organelles
   c. DNA and chromosome structure
   d. ribosomes
   e. flagella
   f. temperature and other stress tolerance
   g. approximate age according to fossil record
   h. reproduction
   i. cell wall structure
   j. membrane structure
   k. modes of nutrition

2. Compare and contrast the Archaea, Bacteria, and Eucarya (eukaryotes), noting the most important synapomorphies that distinguish each Domain. What prokaryotic group is thought by some to be the sister group to the eukaryotes? What evidence supports this view? What problems are there with this depiction of the tree of life?
3. Give a few examples of extremophiles. Describe the environmental conditions preferred by extremophiles and list some taxonomic groups in which they occur. Give a few examples of economically valuable products derived from extremophiles.

4. Explain the function of a cell wall. How do organisms lacking a cell wall compensate for absence of this feature? In the prokaryotes, what is the cost of having a cell wall?

5. Discuss four ways that genetic variation can arise in a population of bacteria. Do these processes represent vertical or horizontal transfer of genetic material?

6. What cellular properties determine the outcome of the Gram stain reaction? Give an example or two of bacteria that are Gram negative and Gram positive.

7. Compare and contrast the following:
   a. fermentation vs. anaerobic vs. aerobic respiration
   b. anoxygenic vs. oxygenic photosynthesis
   c. photoautotrophy vs. chemoautotrophy
   d. photoheterotrophy vs. chemoheterotrophy

   Give an example of each process, and understand the cellular and/or environmental requirements of each. Where appropriate, give an example of an organism that uses each metabolic mode.

8. Arrange the following in probable order of first appearance on earth.

   ____mitochondria
   ____oxygenic photosynthesis
   ____anaerobic respiration
   ____RNA
   ____DNA
   ____plants
   ____oxidized iron (e.g., Fe+++), sediments
   ____organic molecules

9. Using the cladograms in your textbook or handouts for the major prokaryotic groups, indicate which clades include photosynthetic members. Outline the hypotheses for the evolution of photosynthesis in the prokaryotes, (i.e., was it ancient or relatively derived?) What is different about “photosynthesis” in the halophilic archaea? Do you think that this represents a separate origin of “photosynthesis”?

10. Cyanobacteria are thought to be the closest relatives of the plastids of photosynthetic eukaryotes such as algae and land plants. All of these groups share several synapomorphies with respect to their photosynthetic apparatus and byproducts. What are these?
11. Give one specific example of the following:

a. carbon source in chemoautotrophs
b. an external oxidant (i.e., from the environment) in anaerobic respiration
c. the external oxidant (i.e., from the environment) in aerobic respiration
d. an energy source in chemoautotrophs
e. the energy source in photoheterotrophs
f. the external reductant (e- donor from environment) in oxygenic photosynthesis
g. an external reductant (e- donor from environment) in anoxygenic photosynthesis

12. Using your electron tower handout, rank the following external oxidants in order of their potential for energy generation (1 – least, 4 – most):

   Fe$^{+3}$   SO$_4^{2-}$   O$_2$   NO$_3^-$

13. Name three modes of carbon fixation in prokaryotes. What type do eukaryotes have?

14. Eukaryotic cells are thought to be chimeras originating from at least two separate endosymbiotic events. What organelles are thought to be derived from endosymbiosis with bacteria? What bacterial groups are thought to be most closely related to these organelles? Give some of the evidence for the endosymbiotic origin of these structures.