

Name \_\_\_\_\_

## Photosynthetic Life – Midterm Exam #1 – Spring 2001

1-5 Select the single best answer for each of the following: (2 points each)

1. Which of the following is not true of oxygenic photosynthesis?

- a. It is unique to the cyanobacteria and their descendants.
- b. It involves interacting quinone-type (PSII) and Fe-S type (PSI) photosystems.
- c. It requires H<sub>2</sub>S as an electron donor.
- d. It is typically linked to carbon fixation by the Calvin cycle

2. If you wanted to isolate a culture of Heliobacterium, what kind of sample would you collect?

- a. Muck from a hot spring in Yellowstone National Park.
- b. Dry soil from an old rice paddy.
- c. Deep water from a stratified lake.
- d. Surface water from the middle of the Pacific Ocean.

3. Which of the following is not a monophyletic group based on SSU rRNA phylogenetic analyses?

- a. Gram negative bacteria
- b.  $\alpha$  &  $\beta$  (beta and gamma) proteobacteria
- c. Heliobacteria
- d. Cyanobacteria and plastids

4. Suppose that you have discovered what you believe is a new mechanism for carbon fixation in a previously uncultured organism, and you would like to know the sequence of biochemical reactions involved in this mechanism. Which of the following kinds of studies would you undertake first?

- a. Genomic analysis and functional proteomics.
- b. Fast fluorescence analysis coupled to inhibitor studies.
- c. Stable isotopic measurements of organic materials and substrata.
- d. Pulse-chase experiments using isotopically labeled precursors.

Name \_\_\_\_\_

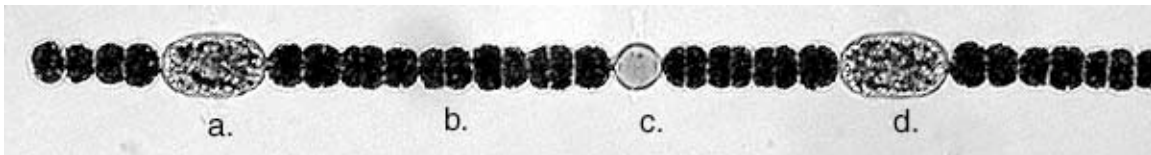
5. Which group of organisms is thought to be able to capture light most efficiently?

- a. Cyanobacteria
- b. Proteobacteria
- c. Green sulfur bacteria
- d. Heliobacteria

6-10 Fill in the blank (2 points each).

6. Bacteriochlorophyll *a* absorbs \_\_\_\_\_ light most strongly.
7. \_\_\_\_\_ photosynthesis occurs in the surface layers of lakes and microbial mats.
8. \_\_\_\_\_, \_\_\_\_\_, and allophycocyanin form the phycobilisomes found in Cyanobacteria and red algal plastids.
9. Heliobacteria are \_\_\_\_\_, which means that they can capture light energy but are not capable of carbon fixation.
10. H<sub>2</sub>S and \_\_\_\_\_ are the two most common electron donors in anoxygenic photosynthesis.

11-15 Refer to the following photomicrograph (2 points each).



11. What is the name of this organism?
12. How would you classify it?
13. If you wanted to find this organism in nature, where would you look?
14. What is the term for cells "a" and "d"?
15. What is the primary function of cell "c"?

16-19 Provide a brief (two or three sentence answer) for each of the following (5 points each):

16. *Trichodesmium* is a cyanobacterium found in tropical marine waters far from land. It does not form heterocysts, but is biochemically capable of nitrogen fixation. It is typically found as tight clusters of filaments. Suggest one plausible *biochemical* reason it would be beneficial for this organism to form these tight clusters.

Name \_\_\_\_\_

17. One summer day in Madison Wisconsin, after a long dry spell, a warm summer rain washed the gutters clean. Three days later Lake Mendota had what looked like green latex paint where there should have been water. Why did this happen? What organisms would you expect to find in that water (be as specific as you can).
18. Coniform stromatolites are small (ca 5mm diameter) conical structures that develop in hot springs through the activity of a microbial photoautotroph. What organism do you suspect is responsible for their formation, and why? How would you test this hypothesis?
19. Briefly describe the structure and function of gas vesicles. We discussed these primarily in the context of cyanobacteria, but they are also found in proteobacteria, green sulfur bacteria, and other prokaryotes.

Name \_\_\_\_\_

**20-21. Provide complete but concise answers to the following questions, and be sure to allow enough time to answer all components.**

20. Prepare a figure caption for the following figure, which is from Buchanan, Grissem, and Jones, 2000 "The Biochemistry and Molecular Biology of Plants", and refers to the oxygenic photosynthesis found in plant chloroplasts. You should attempt to account for the labeled structures and reactions shown in the figure, but do not need to go into detail describing features that are not shown here (25 points).

Name \_\_\_\_\_

21. With the assistance of diagrams as needed, describe the development of a typical Winogradsky column after it has been established. Assume that the column has both aerobic and anaerobic regions. Be sure to identify what organisms you might expect to find in the column, and where you would expect them to be found after the column has reached steady state. Your description should give a general sense of how the biota of the column would change over time, and what the column would be like five years after establishment (25 points).