Study Guide
MICROBIAL DIVERSITY
Brock Ch. 12, IV

This study guide covers Brock Ch. 12, part IV: the phylum **Cyanobacteria, including both cyanobacteria and prochlorophytes**. Note that the phylum cyanobacteria is sister to the Gram-positive bacteria in Fig. 12.1.

1. Three groups of bacteria are generally considered to be phototrophic. These include the purple bacteria (including the purple sulfur bacteria and the purple nonsulfur bacteria), which we have discussed already; the green bacteria (including the green sulfur and green non-sulfur bacteria), which each form a distinct phylum; and the cyanobacteria, which includes the true cyanobacteria and the prochlorophytes.

   Use the part IV, and the information on pages 352-356, to fill in the following table.

Phylum	Gram+/-	Which chloro-phylls?	Phyco-bilins?	Tolerance of H_2S	Oxygenic?
Purple sulfur bacteria					
Purple nonsulfur bacteria					
Green sulfur bacteria					
Green nonsulfur bacteria					
True cyanobacteria					
Prochlorophytes					

2. There are five groups of true cyanobacteria. Describe the characteristics of each group below (don't worry about % GC content). Make sure you can define baeocytes, heterocysts, and other special terms (you can use the space below to write the definitions of these terms).

Group I. Unicellular. These are unicellular and reproduce by…
Group II. Pleurocapsalean. These are unicellular but colonial, and reproduce by…
Group III. Oscillatorian. These are filamentous and divide by binary fission in a single plain.
Group IV. Nostocalean. These are filamentous and have **heterocysts, which are…**

Group V. Branching. These are filamentous and – as the name suggests – have a branching form.

3. For photosynthesis, true cyanobacteria have chlorophyll a, and a unique pigment, **phycobilin**, which is…

4. Name and describe several ways in which heterocysts differ from vegetative cells.

5. True or false: heterocysts are found in all cyanobacteria.
6. True or false: many true cyanobacteria are capable of gliding motility.
7. True or false: true cyanobacteria have true flagellae.
8. True or false: to culture true cyanobacteria, you will need to give them vitamins.
9. True or false: many true cyanobacteria can poison water by secreting neurotoxins.
10. True or false: true cyanobacteria are algae.
11. True or false: some cyanobacteria are symbionts of other organisms, eg., plants and fungi.
12. True or false: true cyanobacteria are though to have been the origin of earth's oxygen atmosphere.

13. What role might cyanobacteria play in deserts like the Sonoran desert?

14. Important genera to know among the cyanobacteria: *Nostoc* and *Spirulina.* Both of these are often sold as health foods! What groups do these belong to? Imagine that you have (A) a filamentous cyanobacterium with heterocysts, and (B) one that is filamentous but lacks heterocysts. Which one is *Nostoc* and which is *Spirulina*?

15. Prochlorophytes may have single-cell or filamentous growth forms. The first one to be discovered, *Prochloron*, lives as a symbiont in marine invertebrates called sea squirts (ascidians). These have membranes that resemble the chloroplasts of plants. Until the prochlorophytes were discovered, it was thought that chloroplasts represented the evolutionary acquisition of cyanobacteria. However, this was always a problematic hypothesis, because phycobilins are present in cyanobacteria (chlorophyll a + phycobilins)…but the chloroplast contains chlorophylls a and b, and no phycobilins. Thus, it would seem that prochlorophytes are the ancestors of chloroplasts. However, phylogenetic analyses suggest that instead, it was another descendant of the common ancestor of cyanobacteria and prochlorophytes that led to the chloroplast.

    Under this scenario, phycobilins and several different chlorophylls were present in the ancestor of prochlorophytes, cyanobacteria, and chloroplasts. Over time, cyanobacteria lost some chlorophylls; prochlorophytes lost phycobilins; and chloroplasts lost phycobilins and some chlorophylls.