

Study Guide
MICROBIAL DIVERSITY

BROCK Chapter 2, TOL Chapter 4

BROCK Chapter 2 will be more relevant on Exam 1 than will TOL Chapter 4. After reading BROCK Chapter 2, you should be able to answer/explain/complete the following questions. Note that we will address the Archaean and Eucarya trees of life later, so don't worry about the fact that they are not here.

1. Do all cells have a cell membrane?
2. Do all cells have a cell wall?
3. Do all cells have cytoplasm?
 - a. What are the major components of the cytoplasm?
 - i.
 - ii.
 - iii.
 - iv.
4. What is a ribosome, and what does it do?
 - a. Do all organisms have ribosomes in their cells?
 - b. Do all cells have ribosomes?
 - c. Where are ribosomes located in...
 - i. Prokaryote cells
 - ii. Eukaryotic cells
5. Draw and label the major characteristics of a typical prokaryote cell in the space below.

6. In real life, how big is the cell you just drew (in microns, or μm):
7. This cell could represent...(circle one)
 - a. An archaean
 - b. A bacterium
 - c. A single-celled fungus
 - d. A or B

8. List and explain three characteristics that would allow you to distinguish between a prokaryotic cell and a eukaryotic cell.

9. True or false: viruses are microorganisms.
10. True or false: viruses can replicate without invading a cell.
11. What is meant by the **genome** of an organism?

12. What is a **gene**?

13. Describe the organization and characteristics of the genetic material in a prokaryotic cell.

14. About how many different proteins are contained within a single cell of *E. coli*?

15. Draw our current understanding of the phylogenetic tree of life (not including viruses).
 - a. Which domains constitute the prokaryotes?
 - b. Put a star on the tree to indicate the root. This is the LUCA – the last, universal common ancestor.

Question 15, continued...

- c. Put a box around a lineage that flourishes at high temperatures.
 - i. Give an example of such an organism (name):
 - ii. What is the optimal temperature at which this organism flourishes?
 - iii. What is the optimal temperature for humans?
 - iv. What word is used to describe these and other microbes that flourish under conditions unfavorable to humans?
- d. Are Archaea more closely related to Eucarya or to Bacteria?
- e. What is this tree based on (what kind of data are used to infer the tree)?
- f. Why are those data especially useful in inferring the tree of life?
- g. Name the biologist who pioneered our understanding of the major domains of life.

16. Define **endosymbiosis**.

- a. What evidence suggests that some organelles arose via endosymbiosis?

17. List and describe the three major ways in which microbes 'make a living'

(all end in -troph):

- a. Circle the lifestyle(s) that is/are heterotrophic. Underline the lifestyle(s) that is/are autotrophic.
- b. How does the model organism *E. coli* make a living?
- c. Most cultured microbes make a living in which way?

18. True or false: all prokaryotes known to cause disease in humans are Bacteria.
19. List a few Bacteria that are Gram-positive.
 - a. What characteristic(s) do these Bacteria share?
20. True or false: the cyanobacteria are closely related to the Gram-positive bacteria.
21. True or false: the cyanobacteria are phototrophic.
22. True or false: the cyanobacteria are autotrophic.
23. True or false: the cyanobacteria produce oxygen, and were critical in shaping the planet for the evolution of aerobic life forms.
24. Draw our current understanding of the bacterial tree of life, labeling the major groups.
 - a. Circle the lineage on the tree that includes the pathogens causing syphilis and Lyme disease.
 - b. What does 'Env-OP' mean?
 - c. Put a box around the lineage on the tree that includes the most radiation-resistant organisms known.
25. What evidence do we have that life originated on a 'warm planet'?

26. How can we conclude that organisms are present in the environment if we never culture them?

27. Compare/contrast each pair: how are they different, and how are they similar?

a. Cyanobacteria and algae (give two differences and one shared characteristic)

b. Algae and fungi (give two differences and one shared characteristic)

c. Algae and protozoa (give two differences and one shared characteristic)

d. Protozoa and slime molds (give two differences and one shared characteristic)

From the TOL chapter:

28. What domains of life are represented among the oldest fossils? How old are those fossils?

29. Describe the putative LUCA (last universal common ancestor).

30. True or false: many eukaryotic cells depend on endosymbionts for energy.

31. True or false: the Proteobacteria contain the majority of Gram-negative species.

32. True or false: most life on Earth is prokaryotic – both in terms of number of species and numbers of cells.

Please review the questions at the end of BROCK Chapter 2.

Disclaimer: this handout is a guide, not a practice test! You will be asked to synthesize this sort of information on the exams. I am certain that you will do well if you can answer these questions thoroughly and carefully, AND if you give similar attention to the lecture notes.