Study Guide
MICROBIAL DIVERSITY
Brock Ch. 14

This study guide covers the first part of Brock Ch. 14: Eukaryotic cell biology and eukaryotic microorganisms. In the humble opinion of YHP, this chapter is fraught with horrors! That's not because the organisms are worrisome – but because Brock's view of eukaryotic relationships is outdated and – if that weren't enough – is *not* based on a phylogenetic framework. As you know, that's the kiss of death for me. That said, there are some nuggets of useful information. You're responsible for the following; the rest can be largely ignored in favor of course notes. Someday, there will be a great book on eukaryote relationships/diversity/etc. – maybe you will help write it! – but until then, we'll do our best.

1. Eukaryote cells are complex and compartmentalized relative to prokaryote cells. The key feature is a **membrane-enclosed nucleus**, which contains the cell's genome, and in which DNA is organized into chromosomes.

    a. Briefly describe the structural features of the nuclear envelope.

2. Most eukaryotic cells have one of two **respiratory organelles**. Compare and contrast them below:

	Organelle	Role(s)	Distinguishing morphological features	Aerobic respiration or fermentation?	Example of "host" organism
a.					
b.					

3. Phototrophic eukaryotes typically have an additional class of organelles: chloroplasts. What is the twofold role of chloroplasts in phototrophic eukaryotes?

4. What is meant by the statement that 'eukaryote cells represent genetic chimera'?

5. Review the evidence that supports the theory of endosymbiosis. Be sure that you can make all of these arguments, and support them, for the exam.

6. Describe at least one other cytoplasmic structure common to many eukaryotes (give structure name, appearance, and function).

7. In section 14.6, we enter the world of eukaryote genetics, which is described in the context of a model eukaryote (the Ascomycotan yeast, *Saccharomyces cerevisiae*). While useful as a model, this paints only one portrait in a vast diversity of genetic systems. The key point for this class is to note that individual eukaryotes can frequently exist as either haploids or diploids. Make sure that you know the difference between these states (haploid vs. diploid). Then, synthesize the information, including that in Fig. 14.8, to address this question: How can a single haploid cell of *Saccharomyces* eventually yield a diploid cell?

8. Now, we'll move on to part II: eukaryotic microbial diversity. For this section, I suggest that you download the tree for Eucarya from the class website. Try to follow along on the tree as you read each section in the book. Remember that the book uses archaic terminology for the names of major groups. You will want to cross-reference as much as possible. I will go to GREAT LENGTHS in class to help you through this.

   *****IMPORTANT***!**

   The tree for Eucarya, presented on p. 482 as Fig. 14.11, is outdated (read: hideous, foul, should be ignored). We now know that several of the relationships shown here are not true. USE THE TREE THAT I PREPARED FOR THE COURSE!! USE THE TREE THAT I PREPARED FOR THE COURSE!! USE THE TREE THAT I PREPARED FOR THE COURSE!!

   In case that's not clear, USE THE TREE THAT I PREPARED FOR THE COURSE!!

   a. Which is of higher taxonomic rank in the 'new' system of nomenclature a domain or a kingdom?

   b. The text points out that diplomonads such as *Giardia*, microsporidia such as *Encephalitozoon,* and trichomonads such as *Trichomonas* are early eukaryotes. Actually, they aren't all early-diverging lineages of eukaryotes (we'll talk about that later). However, they do share a key feature: **they lack mitochondria.** What's the term for this?

   c. Did these organisms acquire and then lose mitochondria over evolutionary time, or never acquire them? Provide justification for your answer.

d. Microsporidia are pretty neat. They (a) lack all organelles, and (b) have a genome that is about half the size of that of a model bacterium (*E. coli*). For this reason, they were long thought to be early-diverging, ancient eukaryotes. Have a look at the tree I prepared for our class. What does this tree say about the placement of Microsporidia?

9. In section 14.8, we tackle the "protozoa." Here, please reference your tree from class!

Key points:

***Amoeba* and *Trypanosoma* are both part of 'flagellates and the other protists' on your tree.**

***Paramecium* is a member of the ciliates; this group, along with the apicomplexans, makes up part of the 'Alveolates'.**

As you'll see, we know that these lineages are distinct, but we don't know how they are related to each other (thanks to the giant polytomy at the heart of Eucarya).

Flagellates and 'the other protists': Trypanosomes and amoebae

a. What is the most important group of pathogenic flagellates in terms of human health?

b. Name one disease caused by a member of this group. As a note, it may help you to study this information if you annotate your phylogeny as you go along (e.g., write name of disease on the tree next to the branch containing the pathogen).

c. Next, we'll talk about the Amoebae. The book refers to two groups: the naked amoebae, and the shelled amoeba (foraminifera). Name one disease caused by a naked amoeba:

d. How are foraminifera distinguished from naked amoebae (examples can include habitat, morphology…)?

e. Name one major geographic feature that is made up of the shells, or tests, of foraminifera.

Ciliates and apicomplexans: the Alveolates

a. Unlike flagellates (which have flagella) and amoebae (which move by amoeboid movement if naked), the ciliates possess **cilia** during at least one stage of their life cycles. What is the other special feature of ciliates? What are the features of the macro- and micro-forms of this special feature?

b. Name a well-known ciliate.

c. Unlike flagellates and amoebae, which typically engulf their food by phagocytosis, the ciliates obtain food by ingesting particulates through a distinct oral region, which is connected to a gullet. From the gullet, food materials are moved into the cytoplasm, where they are enclosed in a food vacuole. Just FYI.

d. Note that ciliates are rarely parasitic on animals.

e. What are trichocysts, and what is their function in the ciliates?

f. The Apicomplexa comprise a large group of obligate parasites. What are two distinguishing features of this group?

g. What are sporozoites?

10. Moving on: the Fungi. Ah, what a lovely group! Sadly, Brock does an awful job of describing them. We'll have a special reading on the Fungi to make up for this tragic state of affairs. However, there are still a few key points that I'd like you to retain from this section of BR14.

    a. What are the three functional groups of fungi? (We will talk about phylogenetic groups later.)

    b. List four major habitats/lifestyles of fungi.

    c. True/false: fungi are all chemoorganotrophs.

    d. What polymer makes up fungal cell walls? In contrast, what polymer makes up plant cell walls?

e. What else makes up fungal cell walls?

f. What are hyphae? What's a mycelium?

g. True/false: no fungi are capable of sexual reproduction.

h. Remember that when you see a mushroom in nature, you are only seeing a tiny portion of the entire fungus: most of the fungal body (mycelium) is inside its substrate, such as soil or rotting wood.

i. Note that many fungi are dimorphic – that is, they can have a yeast-like and a filamentous phase in their life cycles. One such fungus is *Candida albicans*.

j. How can you distinguish yeast cells from bacterial cells?

11. On to the slime molds…

a. How are slime molds similar to fungi? To protozoa? How are they different?

b. What are the two major groups of slime molds? How do they differ?

c. Acellular slime molds were referred to by what name in class?

d. Cellular slime molds were referred to by what name in class?

e. Define pseudoplasmodium. Make sure that you can distinguish a pseudoplasmodium from a plasmodium (Refer to taxonomy and composition).

f. What compounds trigger the production of aggregation in cellular slime molds?

11. And finally – the algae. Brock has issues here, too, so we'll be brief and will improve on your knowledge of algae by some effort in lecture. In the meantime, a few key points:

a. Define **algae.**

b. Look at your tree. Note that the algae are not monophyletic: See the different branches leading to the Rhodophyta (red algae), Stramenopiles (which includes the brown algae and diatoms), the Alveolates (which contains the dinoflagellates), and the plants (which include the green algae)? Clearly, there are many different lineages of eukaryote life that comprise 'algae.'

c. One challenge with Brock is that the book uses 'algae' in the traditional way, talking about Rhodophytes, Stramenopiles, Alveolates, and Plants as though they are a single group. THIS IS NOT IDEAL for our course because the evolutionary histories of each group are so distinct. Thus, I would like you to get a few key concepts, but then to skip the end of the chapter. I'll give you everything you need in class to wade through the many lineages of algae.

Here's what I want you to know from the reading:

d. True or false: algae are prokaryotes.
e. True or false: cyanobacteria are algae.
f. True or false: algae are all unicellular.
g. True or false: all algae are oxygenic phototrophs.

h. Why are some algae not green?

PLEASE STOP READING at the end of page 492! The rest will just confuse you because, well, it's wrong. Sigh! We'll cover all the good stuff in class.