Study guide 4

Additional Resources:

Readings from Madigan and Martinko, 2006, Biology of Microorganisms
Chapters 13 and 19.

Readings from Staley et al. 2007, Microbial Life
Chapters 6, 18 and 25 and other sections as appropriate.

The Prokaryotes, vol. 1; chapter 2 (Stackebrandt)

Study questions:

1. Why is the anaerobic degradation of aromatic compounds of interest? Name an environment where this process is very important to human health.
2. In general terms, compare the anaerobic and aerobic degradation of aromatic compounds in terms of the number of organisms involved, the type of biochemical reactions used to destabilize the aromatic ring, the key intermediates, and the specificity of the organisms.
3. For the anaerobic degradation of 2,4-dichlorophenol, describe the sequence of reactions in terms of the chemical transformation that occurs and the organisms involved.
4. What are the energetic requirements for the conversion of benzoate to cylcohex-1,5-diene-1-carboxyl-CoA.
5. Compare the transformation of benzoate to the transformation of cylcohex-1,5-diene-1-carboxyl-CoA in terms of the types of enzymatic reactions that occur.
6. Describe the types of reactions used to convert a wide variety of aromatic compounds to benzoate (or benzoyl-CoA) during the anaerobic transformations. How is a very stable compound like toluene degraded?
7. Describe an experiment that demonstrates that dehalogenation of aromatic compounds under anaerobic conditions is an anaerobic respiration.
8. How can proteomics be used to deduce the genes involved in a catabolic pathway?
9. Describe the nature of the ectosymbionts of marine nematodes. What does the nematode do for the bacterium? What does the bacterium do for the nematode? Where are these symbionts found in the environment?
10. Describe the evidence for the physiological activity of the bacterial symbionts.
11. Describe the nature of the endosymbiosis of the bacteria in aphids. What do these bacteria do for the aphid? What is the nature of the evidence for this? Did the aphids and the endosymbionts coevolve?
12. Describe the nature of the endo- and ectosymbionts on anaerobic protists. How are they visualized? Where are they found? Compare this symbiosis to that between prokaryotes in interspecies H_2 transfer. Compare the symbiosis to that seen with aphids.
13. Describe the Ignicoccus-Nanoarchaeum symbiosis. Discuss whether this is a mutualistic or parasitic relationship.
14. Name some characteristics important for microorganisms used in biochemical production.
15. Describe the lactic acid bacteria.
16. Describe how selective plating techniques can be used to screen for different types of lactic acid bacteria.
17. Describe the types of adaptations to temperature common in prokaryotes.
18. How do proteins of thermophiles maintain their structure at high temperature.
19. How do bacteria maintain their membrane fluidity in response to high and low temperature?

20. Describe how archaeal membrane lipids.differ from those found in bacteria.
21. How do the archaeal lipids respond to growth at high temperature.
22. How do organisms respond to high water stress (low water activity). Know the approximate water activities of some common environments.
23. What happens to the ΔpH and ΔΨ during growth at low and high pH?

Define, distinquish, and/or define the following terms:

Benzoate
PCB
free radical
ortho pathway
meta pathway
para pathway
adaptation (as it is applied to the anaerobic degradation of aromatic compounds)
nematode
ectosymbiont
endosymbiont
carboxysome
chemocline
sulfur-oxidizing bacteria
mycetocyte
mycetosome
aphid
coenzyme F_{420}
Ignicoccus
Nanoarchaeum
Split genes
batch fermentation
fed-batch fermentation
productivity of a fermentation
lactic acid
homofermenters
heterofermenters
polylactate
nisin
psychrophile
mesophile
thermophile
hyperthermophile
membrane fluidity
ether lipids
isoprenoid
cyclopropane lipids
tetraethers
water activity
osmotic effect
matric effect
halotolerant
halophile
extreme halophile
glycine betaine
ectoine
trehalose
dimethylsulfonium propionate
acidophile
alkalinophile
barotolerant
barophile
obligate barophile
bar
atm (atmosphere)
Pa (Pascal)