

Name \_\_\_\_\_

1. Consider a filter feeding zooplankton such as *Daphnia*. Draw the relationship between particle size and capture rate, and describe what factors affect the shape of the curve with very large particles and very small particles. (15)
  
2. For the same zooplankton, graph the relationship between filtering rate and the concentration of particles and make a second graph of the capture rate (ingestion rate) as a function of the concentration of particles. (20)
  
3. Why does production of chemical compounds used to prevent bacterivory require that the species that produces it is a large part of the diet of the bacterial predator? (this should be answered in evolutionary terms) (5)
  
4. Why does the microbial loop represent a greater loss of carbon than other nutrients (such as nitrogen and phosphorus) to an ecosystem? (5)
  
5. What controls numbers of bacteria and very small algae in the open ocean, given that these organisms are too small to sink and too small to be filtered? (5)

6. Give three examples of mutualism, each involving at least one microbial partner, and describe the consequences of the relationship to both participants. (12)

Microbial participant	Effect on microbe	Other participant	Effect on other participant
1			
2			
3			

7. When sewage enters the aerobic portion of the sewage treatment processes, a large portion of the microbial community is killed by exposure to  $O_2$ . Contrast the expected values of  $V_{max}$  and  $K_s$  for the Monod equation relating carbon substrate concentration to growth of the early colonizing microbes with that of the microbes that are dominant later in the treatment process. Also, what pattern of microbial diversity would you expect as a function of time going through the sewage treatment plant? (8)

8. What parallels can we draw between microbes associated with plant roots and those associated with animal guts? (5)

9. What molecular adaptations (lipid, protein, DNA and RNA) are required for life at very high temperatures, and why do these adaptations lead to organisms that require high temperatures for metabolic activity? (15)

10. Genes for bioremediation of novel organic compounds arise rapidly and spread through the bacterial community. Describe how these genes spread, and given this fact, how is it possible that we still have distinct species or strains of bacteria (i.e. over billions of years, how have clusters of genes stayed distinct)? I know that this is a hard question, try anyway... (10)