

Microbial Ecology Biol 687 Spring 2003 Test 1 Name _____

1. How are diatoms used in forensic science? (5)
2. Why is RNA-world an attractive hypothesis for the origin of life? (5)
3. Give the equations for photosynthesis and respiration (4)
4. Describe how eukaryotic cells formed, and the evidence for it, including existing examples of organisms and biochemical/ molecular evidence (10)
5. Are microbes intimately involved in almost all global biogeochemical cycling, including photosynthesis? (1)
6. Match the following: (20)

Item	Match
Pasteur	a. provided postulates definitive for establishing disease
Tyndall	b. Early microbial ecologist, reclusive and abrasive
van Leeuwenhoek	c. infectious proteins
Koch	d. classic taxonomic reference for bacteria
Winogradsky	e. oxygenic photosynthesis, Bacteria
Beijerinck	f. repeated heating kills bacterial spores
C B. van Niel	g. move by flagella inside cell wall and spiraling body through medium
Darwin	h. seed shrimp
Malthus	I. photosynthetic protozoa with few flagella
Concerns about water pollution	j. organization that forms when energy is passed through a liquid or gas
Prions	k. earliest cyanobacterial fossils
Bergey's Manual	l. first confirmation of fermentation
Cyanobacteria	m. evolution
Mycoplasmas	n. father of modern microbial ecology
Spirochetes	o. early life made of clay
Phytomasigophora	p. first to document existence of bacteria
Ostracoda	q. early book on population growth
Dissipative structures	r. no cell wall
Stromatolites	s. defined chemoautotrophy for first time
Genetic takeover hypothesis	t. spurred environmental microbiology

7. Fill in the following table with low or high for comparisons listed in each row in the appropriate cells: (10)

Property	Small scale (1-10 μ m)	(> 1-10 mm)

Turbulence		
Viscosity		
Inertia		
Relative energy required to swim		
Sinking speed		
Ability to filter particles		
Molecular diffusion		
Advective transport (eddy diffusion)		
Effect of nearby wall		
Strength of predator signals by hydrodynamic transmission		

8. Describe why biomass pyramids are often pyramid shaped (with primary producers with the largest biomass at the bottom) but sometimes not, and why production pyramids are always pyramid shaped (10)
9. Describe how ribosomal RNA (rRNA) can be used in taxonomic comparisons, both with closely related species and those distantly related, and how different regions of the molecule can serve as a molecular clock (15)
10. How do bacteria deal with starvation? (5)
11. Calculate the surface area/ volume ratio for a cube-shaped bacterium 1 μm on a side and one 100 μm on a side, and comment on how this may relate to nutrient uptake rates (6)
12. What did Ari Jumponnen and Loretta Johnson talk about? (9)

Biology 687 Microbial Ecology, 2nd exam, Spring 2003 Name _____

1. Draw and label the carbon cycle as it was presented in class (20)
2. Draw and label the sulfur cycle as it was presented in class (20)
3. Why is the oxic/ anoxic boundary a hotspot of microbial biogeochemical activity (5)?
4. Why does carbon monoxide not build up in the atmosphere (2)?
5. Why is it important to manage the nitrogen cycle in agriculture, both from an economic and an environmental aspect (3)?
6. Describe the random walk model of chemotaxis (5)
7. Why do magnetotactic microorganisms in the Northern Hemisphere swim toward the north (3)?
8. How might bacteria be important in reducing acid rain due to burning of fossil fuels (2)?
9. What color of light do phycobilisomes (containing phycobilins) absorb and why do these pigments give cyanobacteria a competitive advantage over organisms that only contain chlorophyll a (5)?
10. Describe why redox state explains a wider range of chemical conditions than does oxygen concentration (5)
11. How does methane escape methanotrophic bacteria when leaving the sediments of wetlands (5)?
12. Fill in the following table with low or high for each row (10)

Property	Low or High
“alpha” for a low-light adapted photosynthetic organism	
P_{max} for a high-light adapted photosynthetic organism	
Growth rate in lag phase	
Growth rate in log phase	
Growth rate in stationary phase	
Nutrient concentration with low dilution rate in a chemostat	
Amount of DNA in a cell that is just about to divide	
Absorption of infrared light by bacteriochlorophyll	
Nutrient concentration in oligotrophic conditions	
Relative number of electrons in a low redox solution	

13. What biochemical adaptations do heterocysts use to protect nitrogenase from oxygen (5)?
14. Why are nitrate, iron, and sulfate used in the listed order as microorganisms oxidize organic carbon (5)?
15. What is the “geritol solution” for the greenhouse effect (5)?

Microbial Ecology Biol 687 Test 3 Spring 2003 Name _____

1. What is the Redfield ratio, and how can it be used to assess nutrient limitation of microbial primary producers (5)?
2. Draw a Michaelis-Menten uptake curve and label both axes and the major points on the graph (5).
3. How has it been demonstrated that zooplankton can produce pulse of nutrients when they excrete (5)?
4. Why are filter feeders inefficient at capturing particles that are bacteria sized (5)?
5. What happens to the filtering rate in *Daphnia* as food particle concentration increases in the water (5)?
6. Give an example of a chemical defense against grazing in a microbial primary producer that also has a negative impact on human health (5).
7. Describe the potential benefits and dangers of releasing genetically engineered microorganisms, with examples of each (10).
8. What role do microbes play in generation of acid mine drainage (5)?
9. Fill in the following table (40).

Organism A	Organism B	Effect of A on B	Effect of B on A
Fungi (lichen)	Cyanobacteria		
Fungi (lichen)	Green alga		
Squid	<i>Vibrio</i>		
Plant	Mycorrhizae		
<i>Azolla</i>	<i>Anabaena</i>		
Host plant	<i>Agrobacterium</i>		
Ruminant	Protozoa		
Termite	Protozoa		
Polyp (coral)	Zooxanthella		
Ambrosia beetle	Fungi		
Harvester ant	Fungi		
Lethal lollipop fungi	Nematode		
Vent tube worm	Sulfur oxidizing bacterium		
<i>Rhizobia</i>	legume		
<i>Xenorhabdus</i>	Caterpillar infecting nematode		
<i>Septobasidium</i> fungi	Scale insect		
Cockroach	Cellulitic gut endosymbiont		
Ruminant	Cellulitic gut endosymbiont		
Frankia (actinomycete)	Alder tree		
Ice + <i>Pseudomonas</i>	Plant		

10. How do organisms' adaptations to cold alter their lipids and proteins (5)?
11. What is the evolutionary reason that *in situ* bioremediation works (5)?
12. Why are deep groundwaters considered a harsh environment for many microorganisms (5)?

1. Draw and label the nitrogen cycle as it was presented in class (20)
2. Describe how the properties of water (Reynolds number, inertia, and viscosity) influence the following processes (15)
 - Swimming rate of a microbe as a function of size
 - Sinking rate of a microbe as a function of size
 - Filtering efficiency of a filtering organism specializing on microbial prey as a function of prey size
 - The effect of a wall on a bacterium swimming nearby
 - Proportion of metabolic rate spent on locomotion as a function of cell size
3. How does an understanding of methanotrophy and methanogenesis contribute to our understanding of the greenhouse effect (5)?
4. Give three examples of mutualistic interactions between plants and microbes, including the benefits to both partners in both interactions (9)
5. List four examples of methods for determining microbial biomass along with positives and negatives for each (12)
6. Give three examples of mutualistic interactions between animals and microbes, including the benefits to both partners in both interactions (9)
7. Describe how rRNA sequence information can be used to make phylogenetic comparisons, how it can be used to estimate time since evolutionary divergence, and how it has been used to establish that most bacteria cannot be cultured from natural environments (10)
8. Why is human skin a harsh environment for microbes (5)?
9. Describe potential routes of transfer of genetic information among microorganisms and why this is an issue when considering release of genetically engineered microorganisms into the environment (5)
10. Match the concepts on the left with the letter of the best corresponding statement on the right (10)

Archaea	a. hepatotoxin
Cyanobacteria	b. oxic conditions
heat-stable protein	c. in situ fertilization and oxygenation
precipitation of FePO ₄	d. eat <i>Oscillatoria</i> and allow <i>Pleurocapsa</i> and <i>Calothrix</i> to dominate
high redox compound with high potential energy	e. low redox environment
Paradox of the plankton	f. strains that glow in the dark
bioremediation	g. not Bacteria or Eukarya
deep sea hydrothermal vent	h. competitive exclusion principle
ostracods	I. <i>Riftia</i> with endosymbiotic sulfur oxidizing bacteria
<i>Vibrio</i>	j. extensive alpha helix, beta sheet, sulfur linkages