

1. Match the best letter. One best for each (10)

Statement		Match
Pasteur	_____	a. first observer of single bacteria
Tyndall	_____	b. postulates to establish causative agent of disease
Van Leeuwenhoek	_____	c. medical sterilization
Spallanzani	_____	d. Swan-necked flask
Lister	_____	e. heat-resistant spores
Koch	_____	f. really great class that combines two interesting scientific disciplines
Greeks	_____	g. flux of energy in environment
early species introductions	_____	h. Mynah bird on Mauritius
ecosystem studies	_____	i. harmony in nature
Microbial Ecology	_____	j. heated meat does not spoil

2. Describe in detail how rRNA analysis can be used to make taxonomic comparisons, including how long ago two species diverged (relate to structure and function of the molecule) (10)

3. Discuss if viruses and prions are living organisms (5)

4. Describe the evidence for bacterial origin of chloroplasts and mitochondria, and discuss why mitochondria probably only became a feature of eukaryotic cells after oxygenation of the earth. (10)

5. Fill in the blanks in the following sentences (1 point each, 10 total)

Oxygenic photosynthetic bacteria with only chlorophyll a are called \_\_\_\_\_,

whereas those with chlorophyll a and b are called\_\_\_\_\_. Two other groups

of bacteria capable of photosynthesis, but that do not produce oxygen are \_\_\_\_\_

and \_\_\_\_\_. Most bacteria have cell walls, and this allows them to be

broken into two major groups, the \_\_\_\_\_ and the \_\_\_\_\_, based

on staining characteristics. The \_\_\_\_\_ don't even have cell walls.

Other bacteria resemble fungi in growth form (\_\_\_\_\_) or are spiral in

shape and locomote with flagella inside an envelope, such as the \_\_\_\_\_,

which includes *Treponema pallidum* the causative agent of syphilis. *Caulobacter* is a

bacterium that belongs to the group of \_\_\_\_\_ bacteria, a group that is distinguished by their mode of division.

6. Describe how life is poised between perfect order and complete randomness, and how this is related to potential information content of molecules (5)
7. Why does warm water float on 4 °C water, but ice float on 4 °C water as well? (4)
8. How does the Productivity to Biomass ratio compare for photosynthetic organisms that are microbial versus terrestrial plants? (4)
9. In the Silver Springs ecosystem, what functional group (trophic level) had the highest biomass, and what group had the greatest productivity per unit biomass? (5)
10. Why does adding salt lower the freezing point of water? (4)
11. Draw a graph of water velocity rate as a function of distance from a solid surface in flowing water (5)
12. Describe how viscosity and inertia are different for bacteria than humans, and how this affects attributes such as the amount of energy required to swim and cell shape. (10)
13. Draw and label the graph for photosynthesis versus irradiance (light intensity). There are 5 characteristics of the curve that need to be labeled. Both axes must be labeled as well. (8)
14. Describe specifically why cyanobacteria can live deep in lakes with significant populations of eukaryotic algae such as diatoms and dinoflagellates in the water above them, and why purple photosynthetic bacteria can survive in microbial mats below cyanobacteria. (10)

Name \_\_\_\_\_

1. Draw the carbon cycle as it was drawn in class, with oxic above, anoxic below and reduced to oxidized inorganic forms from left to right in the middle. (20)
2. Draw the iron cycle as it was drawn in class, with oxic above, anoxic below and reduced to oxidized inorganic forms from left to right in the middle. (15)
3. How could Precambrian life be driven by sulfur cycling without all the sulfate being used up for oxidation of carbon? (5)
4. What adaptations do heterocystous cyanobacteria use to protect nitrogenase (10)?
5. How come stationary phase may be more representative of the life of most microbes most of the time in the real world (5)?
6. Describe the ways that viral infections are propagated in microbial populations, including the factors that stimulate and those that inhibit spread of viral infections (10)
7. Draw representations of the microbial loop and the more simple view of aquatic foodwebs historically held by ecologists, (15)
8. Why does stoichiometry of food source control the relative rates that different nutrients are remineralized (5)?
9. What is the difference between the Monod equation and the Michaelis Menten relationship, and how is the Droop equation related to these (5)?
10. Why are microbial diversity and biogeochemical cycling often very high around anoxic/oxic interfaces, discuss with regard to redox gradients, potential energy, and diffusion rates? (10)

Match the best correct letter with each phrase, use each one only once (41)

<i>Legionella</i>	a) organisms living in close association
<i>Rhizobia</i>	b) associate with multiple species of protozoa
Endomycorrhizae	c) ++ interaction
evolutionarily advanced termites	d) +/- interaction
evolutionarily primitive termites	e) 0/+ interaction
competition	f) 0/- interaction
exploitation (predation)	g) -/- interaction
mutualism	h) 0/0 interaction
symbiosis	i) leghemoglobin
amensalism	j) fungal infection protects from wasp
commensalism	k) feeds faster in the light
neutralism	l) reduce drag
landfills	m) transport of mycorrhizal species
lethal lollipop	n) several obligate mycorrhizal partners
glowing meat	o) altered gene expression in mouse gut
bacteria on fish skin	p) Frankia/ alder association
ventral glow	q) common on many leaf surfaces
quadraflagellate zoospores	r) dinoflagellates help calcify reef
cactus and yeast	s) fungi predator on nematode
ice-minus	t) grows into plant roots
mushroom	u) alga and fungi
orchids	v) gene transfer from bacteria to plants
ice algae	w) high fiber diet stimulates gut methanogens
stromatolites	x) cultivate fungi
bark beetles	y) cultivate fungi on leaf cuttings
islands	z) complex protozoan community in gut
<i>Anabaena/Azolla</i>	aa) luminescent bacteria attract carrion eaters
microbial ecology	ab) microbial diversity in cow guts
<i>Pseudomonas</i>	ac) early release of genetically engineered microbes
Ectomycorrhizae	ad) ciliates with methanogens
establishment of gut flora	ae) Drosophila feed on yeast
gut microbe cycles	af) grow around outside of roots
Actinomycetes fix nitrogen	ag) rumen fungi
rumen subhabitats	ah) luminescent bacteria protect from predation
corals	ai) psychrophilic
Paramecium with algal endosymbiont	aj) centuries of rice cultivation
scale insects	ak) larger ones have greater diversity
harvester ants	al) Shark Bay
flatulent cockroaches	am) inoculate fungi that causes tree to wilt
crown gall formation ( <i>Agrobacterium</i> )	an) a really, really, interesting topic
lichen	ao) animal feeding schedules

2. Relate succession to the competitive and reproductive strategies of microbes and give one example of a successional sequence (15)

3. In a fungi that contains both a cyanobacterial and a green algal phycobiont describe the benefits of provided to all three partners (6)

4. What adaptations of nucleic acids, proteins, and lipids do hyperthermophilic organisms have? (9)
5. Why is deep marine water an extreme habitat? (4)
6. Why is deep groundwater an extreme habitat, and how do rates of respiration compare to those measured in other habitats? (4)
7. What steps can be taken to stimulate in situ bioremediation of groundwater spills, and why is it more difficult to clean up heterogeneous than homogeneous aquifers? (8)
8. What effect does acid precipitation have on microbial breakdown of complex recalcitrant organic molecules ? (5)
  
9. Why is it evolutionarily advantageous for microbes to use plasmids to contain information that confers resistance to environmental toxins? (8)

Final Biol 687 Microbial Ecology Spring 2001 Name \_\_\_\_\_

The following section will be figured as 5% of your course grade

- 1) Describe why antibodies were useful in establishing the habitats where *Vibrio cholerae* can be found, why conventional culture techniques did not work, and what method was used to verify that the antibodies did work (5).
  - 2) How are oxygen microelectrodes use to estimate photosynthetic rate with high spatial resolution (5)?
  - 3) Describe the microbial habitat in the human mouth (what makes it a harsh habitat), how many species have been cultured, the range of habitats, and positive and negative effects of microbes in the mouth (5).
  
  - 4) Ribosomal RNA techniques have been describe in numerous places in this course. Describe how rRNA can be used to distinguish between species that are closely related and those that are not, how it can be used as a marker for abundance of specific types of organisms in the environment, and now it can be used to establish identity of uncultured microbes in the natural environment (15)
  - 5) How does diffusion vary with spatial scale, turbulence, Reynolds number, increased difference in chemical concentrations, and surface area to volume (6)
  - 6) Diagram the nitrogen cycle as it was in class, with oxic above, anoxic below, and reduced to oxidized inorganic forms from left to right in the middle (15)
  - 7) Why do chemoautotrophic microorganisms require chemicals that are at a different oxidation-reduction potential than the general environment they inhabit and give one example of a habitat that provides chemicals in such a state (5)?
  - 8) How can microbes continue to grow in very nutrient poor waters, even though the measured rates of nutrient uptake would deplete the dissolved nutrients in hours or days? (5)
  - 9) Describe how you expect the filtration rate and food consumption rate of an organism such as *Daphnia* to vary as a function of particle size and particle concentration. (8)
  
  - 10) How has the view of the type of organisms that dominate primary production in the ocean and their size changed over the years (6)?
  - 11) What bearing do species introductions of animals and plants and their consequences have on how we go about releasing genetically modified microorganisms (6)?
  
  - 12) Describe two mutualistic relationships between microbes and plants, and two between microbes and animals (4 relationships in all) (8).
  - 13) What did Melody Kemp and Randy Bernot talk about? (6)
- Have a great summer!