

**SES: Methods in Microbial Ecology**  
**Fall 2015**

**Problem Set 1 (Due 17 Sept 15)**

*Answers to the questions below should be short, usually just one sentence or even one word, unless otherwise requested. Each question is worth 10 pts unless otherwise indicated. Partial credit is given for any reasonable attempt to answer a question, so don't leave any questions blank! Also, please show your calculations when a quantitative answer is required.*

**Please work independently on these problems.**

- 1) Explain how microbes that are strict anaerobes (that is, they perish in the presence of oxygen) can survive and flourish in environments where the bulk phase is replete with oxygen, such as in soils and the open oceans.
- 2) What two reactions do bacteria use to ameliorate nitrogen-based eutrophication?
- 3) Primary productivity (CO<sub>2</sub> fixation rate) in aquatic systems is often measured by placing water in an airtight glass bottle and measuring the increase in oxygen or organic <sup>14</sup>C accumulation (<sup>14</sup>C-method) over a several hour incubation period. Why may this approach produce incorrect results in very shallow aquatic environments (assume NO benthic photosynthesis occurs)?
- 4) A) In DNA-based phylogeny, why is it important to choose a gene that does not exhibit rapid mutation rates? B) Which prokaryote domain has a close relation to Eukarya?
- 5) A) List four macromolecule constituents of living cells. B) What are micronutrients? C) What is a guild?
- 6) A) We do not find chemoorganoautotrophs in nature. Why not? B) What bacteria and metabolic process did Winogradsky discover?
- 7) Metabolically classify (i.e., Chemolithoheterotroph; table from lecture notes) the organisms that use the following energy and carbon sources:

	Carbon Source	Energy Source
a)	CO <sub>2</sub>	Light
b)	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> → 2 CO <sub>2</sub> + 2 C <sub>2</sub> H <sub>6</sub> O
c)	(CH <sub>2</sub> O) <sub>n</sub>	H <sub>2</sub> S + ½ O <sub>2</sub> → S + H <sub>2</sub> O
d)	C <sub>2</sub> H <sub>6</sub> O	Light
e)	CH <sub>4</sub>	5CH <sub>4</sub> + 8NO <sub>3</sub> <sup>-</sup> + 8H <sup>+</sup> → 5CO <sub>2</sub> + 4N <sub>2</sub> + 14H <sub>2</sub> O

- 8) A) What trace metal limits phytoplankton (algae) growth in parts of some oceans? B) Why was it so difficult for oceanographers to demonstrate that this trace metal was the cause of the growth limitation?
- 9) A) Why are prokaryotes only one kingdom (Monera) in the older phylogeny tree? B) Are Ciliates more closely related to Proteobacteria or Thermococcus? C) How do algae differ from cyanobacteria?
- 10) Explain one way a rumen microbial system can be destabilized, and explain what happens.