Homework Assignment #2 (Due April 25, 2012)

1) If instead of chlorophyll a, the dominant pigment in photosynthesis was a carotenoid, what color would most plants be?

2) We can use phytoplankton pigments as “fingerprints” for who is in the water. For example, the carotenoid pigment fucoxanthin is a diagnostic marker for diatoms. If you had a sample with a lot of divinyl chlorophyll a, what type of algae is most likely dominant?

3) If the average irradiance in Monterey Bay is 1000 μmol photons m$^{-2}$ s$^{-1}$ and the 50% light penetration depth is 5 meters, calculate the compensation depth (the depth where oxygen production and respiration exactly balance). The compensation depth is usually considered to be where 1% of the surface light is still available.

4) Give some advantages and disadvantages of using chlorophyll fluorescence as a measure of total phytoplankton biomass.

5) Many people confuse chlorophyll and primary production (for example, when someone says they have a regular fluorometer, and therefore can measure primary production). What’s wrong with that statement?

6) Eppley determined that you could estimate maximum phytoplankton growth using nothing but a thermometer. How does this work?

7) How would you use M&Ms to explain photosynthesis?

8) Define the following terms:
   
   Photosynthetic Unit
   Z-scheme
   Critical Depth
   Redfield Ratio
   Variable Fluorescence
Graduate Questions:

G1. The maximum theoretical value for Fv/Fm is about 0.7. In the Boyd paper, the surface Fv/Fm values increased to about 0.4, while the deeper values approached the theoretical maximum. What explanation did the authors give for this? How would you test their hypothesis if you were asked to do so?

G2. The Dierssen et al. paper plotted remote sensing reflectance (Rrs, what a satellite would “see”) in Figure 2D for several algal groups. Based on the paper, and the results shown, do you think it is possible to identify “groups” of phytoplankton from a satellite using color, if you only had data from 412, 443, 490 512, 555, 670, and 748 nm (the standard MODIS wavelengths?)

G3. Based on your understanding of how satellite primary production models work, what is the single most important factor driving these models? Do you think these models are good or bad?