

Homework Assignment #1 (Due April 16, 2009)

1) For the equation

$$dP/dt = f(\mu - g - r)$$

where P is phytoplankton, t is time, μ is growth, g is grazing, and r is respiration, explain in simple terms what the equation means.

2) The radiation at 15 m is 50% of the surface radiation as measured with a PAR sensor. What is the extinction coefficient (with units)? At what depth would you find 1% of surface radiation? What color water would you expect this to be? As a reminder, we can calculate light at depth using a modification of Beer's Law:

$$E = E_0 \times e^{-kz} \text{ (k is the extinction coefficient)}$$

3) The weakest photon of light that can still cause photosynthesis in plants is about 1018 nm (near infra-red). What would the energy be (HINT: You'll need to use the equation $E = hc/\lambda$). The shortest wavelength that can be used for photosynthesis is about 380 nm. What is the energy of that photon? If a plant (or phytoplankton cell) absorbed a blue (380 nm) and red (1018 nm) photon, and both can be used to drive photosynthesis, what happens to the extra energy?

4) Read Boyd et al (2000). Define Martin's "iron hypothesis" using standard notation (H_0 , H_1 , null and alternate hypothesis). Did SOIREE successfully prove or disprove this hypothesis? Why or why not?

5) Define the following terms (a sentence or less is fine):

Dark Reactions

Accessory Pigment

HNLC

Primary Production

Compensation Depth

Graduate Level questions: (undergraduates can answer these but it's not mandatory)

- G1. One step beyond the simple NPZ model is adding a detritus component. Draw an NPZD model, and explain what the "D" component is doing.
- G2. Draw the Z-scheme, and explain what you think would happen if the organism was limited by N, P, Fe, or C.
- G3. When a photosynthetic organism is cooled (i.e. when you put phytoplankton, for example, in colder water than normal) the cells react as though the light is brighter, even when you don't change the amount of light. Why?
- G4. "red tides" are discolorations of the surface ocean that often appear reddish-brown. Based on your understanding of pigments, ocean optics, and phytoplankton generally, explain what you think is happening (why does the water look reddish?)