EFB 462 Animal Physiology: Environmental & Ecological
Week 1 Self-Study Questions

1. What is the oxidation potential? Calculate the oxidation-reduction potential for the dissociation of water into oxygen and hydrogen.
2. State Dalton's Law of Partial Pressures. Assume the atmosphere's composition is as stated in Table 1.1 of your text. Calculate the partial pressures of the listed gases and report them, in torr, for air at sea level pressure, and for air at 10000 m altitude.
3. Distinguish between a dimension and a unit. What are the dimensions of pressure? What are the SI units of pressure? Calculate conversion factors to convert the units of atmospheres, torr, centimeters of water and pounds per square inch to the SI unit of pressure.
4. Calculate the molar quantity of nitrogen, oxygen and carbon dioxide in one liter of dry air at sea level pressure. Now calculate the molar quantities of these gases in one liter of water at 15^{o}C exposed to dry air at sea level pressure. How do the relative proportions of these gases differ between air and water?
5. In which type of environment, water or air, will costs of ventilating a gas exchange organ be higher? Justify your answer.
6. What is the difference between a gill and a lung?
7. Outline the mechanism of counter-current exchange in the fish gill. Discuss the selective forces that might have driven fishes to adopt this type of gas exchange device, and discuss why such devices are rare among air-breathers.
8. State Fick's Law for oxygen flux across a flat surface.
9. At what swimming speed will a striped bass switch from opercular pumping to ram ventilation of its gills? Justify your answer.
10. In Figure 1.13 of your text, oxygen flux across the skin of a frog is nearly constant through the year, while gas exchange across the lungs increases markedly during summer. In both circumstances, oxygen partial pressures in blood and atmosphere are steady. Explain why pulmonary exchange should vary while cutaneous exchange should not.
11. Calculate the lung volume, in cubic centimeters, of a 8 kg antelope.
12. Why should a lungfish be able to meet nearly its entire carbon dioxide exchange through the skin while it must use its lungs to handle oxygen exchange?
13. Describe the neural mechanisms that regulate breathing in a typical mammal, and compare it with the neural mechanisms controlling respiratory gas exchange in a typical teleost fish.
14. Describe the mechanism of tidal ventilation in a frog, and compare it with the mechanism of tidal ventilation in a mammal.
15. Describe the ventilatory mechanism of the avian lung.
16. Gas exchange across the avian egg shell is a diffusion-limited system, with no ventilatory component. Assume that on day *x* early in incubation, oxygen partial pressure in the air cell is 0.5 kPa less than in the atmosphere. Now suppose that on day *y*, the egg is consuming oxygen at a rate five times faster than it did on day *x*. What must the pO_2 in the air cell be, assuming that atmospheric pO_2 is 21.2 kPa?
17. The diffusion coefficient of oxygen in air is inversely proportional to the pressure. The partial pressure of oxygen in air is directly proportional to pressure. Discuss the net effect of moving an egg to high elevation, assuming pore area and shell thickness are unchanged.
18. An insect that uses glucose as a fuel consumes six moles of oxygen for every mole of glucose consumed. At the same time, six moles of carbon dioxide are produced for every mole of glucose consumed. In a tracheole with a closed spiracle, will the pressure remain constant, or will it change with time? Why or why not?