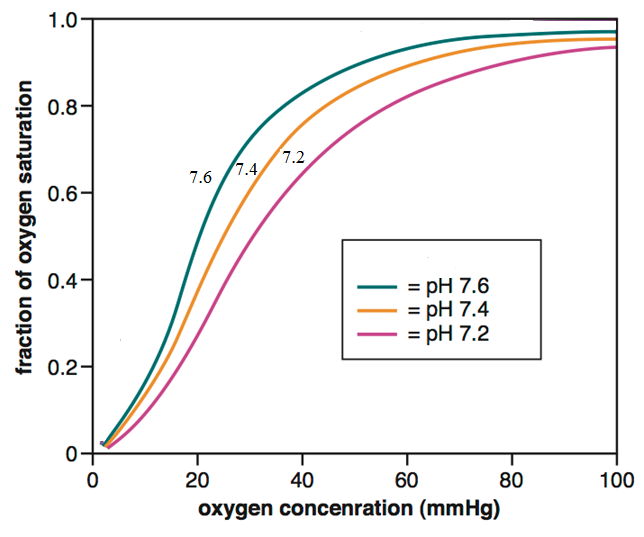
Name:

**Biol 112: Cooperative Binding of Hemoglobin Assignment**

During class, we examined the adaptive significance of the cooperative binding of hemoglobin and how to illustrate cooperative binding using a Hill plot. Now we will use our knowledge to examine how different conditions may affect the O2 binding affinity of hemoglobin and we will compare the cooperative binding of different hemoglobin molecules.

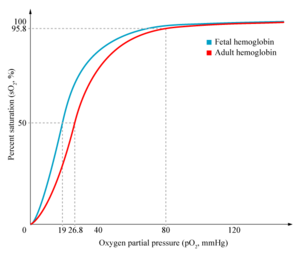
Total pts possible [13].

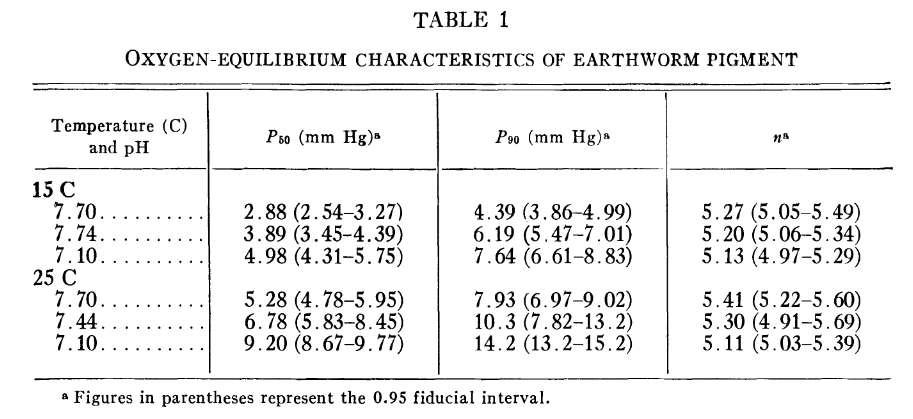
1. First, let’s examine how pH affects the O2 binding affinity of hemoglobin. Why are we interested in the effect of pH? The pH of the surrounding solution can affect a protein’s shape. A change in pH of the blood plasma can be altered by a number of factors including the fact that CO2 is a weak acid. Since pH is measured on a log scale, note that changing the pH from 7.6 to 7.2 is a change of 100.4 or 2.5-fold increase in H+ ion concentration. When a protein is surrounded by more H+ ions, its side chains move in response to the increased acidity. When a protein changes its shape, it also changes its function. In this case, hemoglobin alters the way it binds and releases oxygen in response to changes in blood plasma pH.
   1. [1 pt] According to the graph below, how does O2 binding affinity of hemoglobin change with rising pH of the blood plasma?



* 1. [1 pt] Consider that O2 is at its highest concentration in the lungs and CO2 is at its highest  
      concentration in the muscles. Which do you expect to have higher pH, lungs or muscles?

* 1. [1 pt] How does the binding affinity of hemoglobin at different pH levels work to increase the efficiency of the delivery of oxygen to the muscles?

1. Fetuses produce a different type of hemoglobin from adults. 
   1. [1 pt] Compare the ability of fetal hemoglobin to bind oxygen with adult hemoglobin. Which has a higher affinity? Explain how you know.
   2. [1 pt] Why do you think the fetal hemoglobin is advantageous for unborn babies but not for babies after birth?
2. [5 pts] The table below provides the P50 and Hill coefficient (n) for the earthworm, *Lumbricus terrestris*, at different temperatures and pHs from a study conducted by Cosgrove and Schwartz (1965) published in Physiological Zoology. With your knowledge of the oxygen dissociation curve and the Hill plot interpret the results. How does an increase in temperature or pH influence the oxygen dissociation curve? What can you deduce about the structure of earthworm hemoglobin from the values of the Hill coefficients?



1. [3 pts] The binding of O2 to three different types of O2-carrying pigments was measured and the oxygen dissociation and Hill plots for the three pigments are shown below. Match each oxygen-dissociation curve to each Hill plot and justify your answer.

