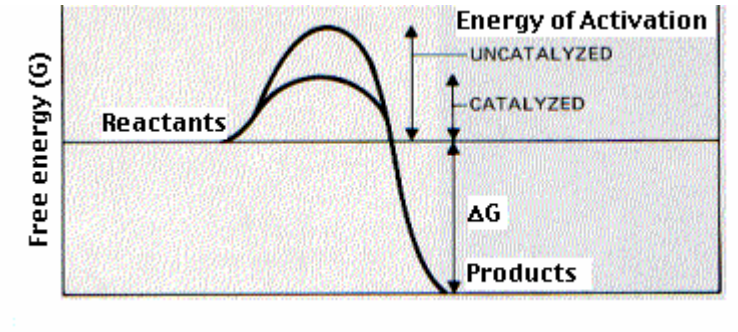
INS 099 Data Analysis Summer 2007

Day 4: Enzymes and Enzymatic activities

Due Fri. July 20, 2007

Enzymes

Enzymes are proteins that regulate complex biochemical reactions in animals, plants, and microorganisms. An enzyme is able to catalyze only one (or a small subset) of chemical reactions in which substrates are acted up on to ultimately yield products. A reaction catalyzed by an enzyme reaction will have its energy of activation **lowered** (see below).



http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Enzymes.html

Part 1

Today, you will quantitatively investigate the reaction catalyzed by the enzyme catalase. Go to: http://bioweb.wku.edu/courses/Biol114/enzyme/enzyme1.asp

The enzyme catalase carries out the following reaction:

Read through the following module and answer these questions:

1. How much H_2O_2 was consumed in the reaction?

2. If we had repeated the experiment, measured and found 2 ml of H_2O_2 remaining, would this second reaction have a higher or lower rate of reaction?

3. Which tube had the highest rate of reaction?

4. What variable(s) caused the differences in reaction rates for each tube? Explain.

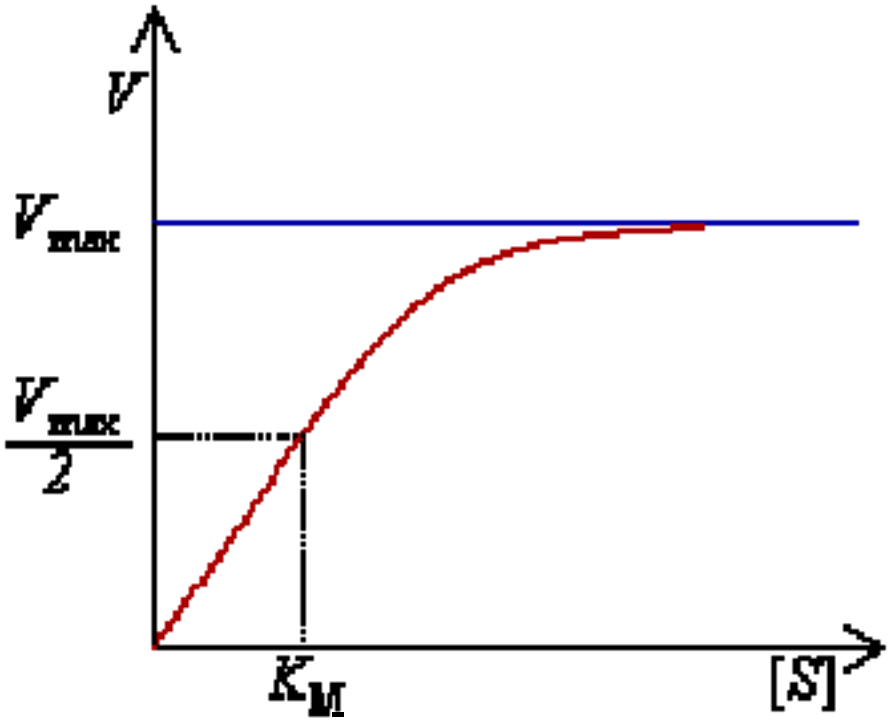
5. Plot the data from your virtual experiment using Excel or Minitab to be turned in with this module. How would you explain the difference between the reaction rate at 34°C and at the rate at 44°C?

Part 2

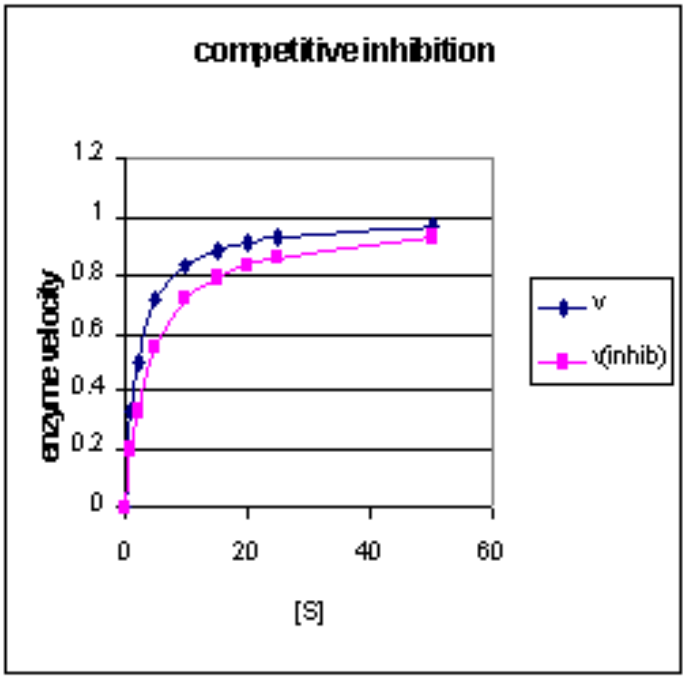
Kinetics: enzyme behavior

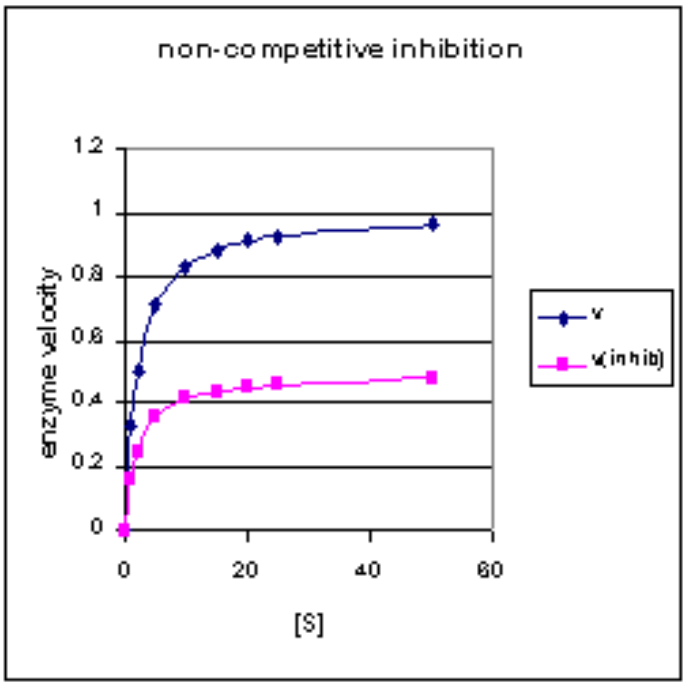
As you have just learned, a number of factors, such as temperature, dictate the behavior of an enzyme (basically how fast the reaction proceeds). Other factors include: pH, how much enzyme is present, how much substrate is available, how much product has already been produced, and inhibiting compounds. In many *in vitro*, in lab, settings we will want to optimize our enzyme's activity and will, therefore, need to optimize conditions. This is where 1) mathematical modeling, and 2) plotting, and understanding, data becomes quite important.

Take for instance a plot of enzymatic activity under standard conditions. This graph is what you might likely see. The dependent variable is activity, or velocity (*V*), and the independent variable is substrate concentration, [S].



http://en.wikipedia.org/wiki/Michaelis-Menten_kinetics





http://web.pdx.edu/~rueterj/algae/notes/regulation2.htm

For the 2nd part of this enzyme model you will be characterizing an enzyme using a simulation at:

http://www.brooklyn.cuny.edu/bc/ahp/BioWeb/BioWeb.Lab1.main.html

Let's begin by determining the optimal pH and temperature for the enzyme. **How would you do this? Plot the data for your 1) pH and 2) temperature characterization curves. Turn in these graphs.**

Now you will characterize your enzyme further by determining the K_m of the enzyme for its substrate and the V_{max} of the reaction. **What is a K_m? a V_{max}? Turn in the plots that you used to determine K_m and V_{max}.**