Unit 10: Chemical Kinetics

adapted from http://www.phschool.com/advanced/lesson_plans/chem_brown_2003/index.html

Objectives:

- Express the rate of a reaction in terms of changes in the concentration of a reactant or a product per time. Understand how to change from one to the other.
- Understand the difference graphically between average rate and instantaneous rate. Be able to calculate both.
- Explain the meaning of the reaction rate law and the rate law constant.
- Be able to determine a reaction rate law for a reaction from experimental data.
- Calculate the rate law constant (including units) after finding the rate law constant from experimental data. After this, calculate the rate of another experiment not included in the data.
- Understand what is meant by order in terms of a reactant as well as the overall order.
- Explain graphically the concept of activation energy and how temperature affects reaction rate.
- Understand how temperature affects the rate law constant for a reaction.
- Be able to relate the collision model to all of the above.
- Explain what is meant by a reaction mechanism and know the meaning of elementary steps, rate-determining step, and intermediate species.
- Be able to explain and show how a rate law is derived from a certain reaction mechanism.
- Describe the theory of how a catalyst works.

College Board Lab Objectives:

- Experimentally measure the rate of a reaction.
- Measure the effect of the concentration of a reactant on the rate.
- Determine the order with respect to this reactant.
- Obtain the rate law for the reaction from the data.

Suggested Labs:

- Rates of Chemical Reactions I
- Rates of Chemical Reactions II

Key Words:

chemical kinetics
reaction rate
instantaneous rate
reaction rate law
rate constant
reaction orders
overall reaction order
first-order reaction
half-life
collision model
activation energy
molecularity
activated complex (transition state)
reaction mechanism
elementary steps
adsorption
enzymes
intermediate
rate-determining step
catalyst
homogeneous catalyst
heterogeneous catalyst

Tips:

- A reaction's reaction rate law cannot be determined from the overall stoichiometric equation unless the reaction has a one-step mechanism.
- Reaction mechanisms must be in terms of concentrations of original reactants, not intermediates.
- Temperature has a twofold effect on rate; it increases the frequency and effectiveness of collisions between reacting molecules.