Anoka-Hennepin Secondary Curriculum Unit Plan

Department:	Science	Course:	IB Chemistry 12 (H)	Unit Title:	Kinetics	Grade Level(s):	12
Assessed Trimester:	Trimester A	Pacing:	Trimester A	Date Created:	6/23/2014	Last Revision Date:	

Course Understandings: *Students will understand that:*

- Problems can be solved and knowledge gained in a systematic way: solutions to one problem can create new questions and problems.
- Chemistry is recognized as significant in its application to other disciplines and the world.
- Ideas are expressed symbolically, numerically, and graphically.
- Behavior and properties of materials are organized, classified, and predicted utilizing periodic trends.
- Mathematical relationships are interpreted and manipulated to model the real world.
- The basic building blocks combine and recombine in a variety of ways to make all matter from the simple to the complex.
- The laws of chemistry predict outcomes that impact and apply to daily life.

DESIRED RESULTS (Stage 1) - WHAT WE WANT STUDENT TO KNOW AND BE ABLE TO DO?

Established Goals

- Students will know that the greater the probability that molecules will collide with sufficient energy and proper orientation, the higher the rate of reaction. (IB 6.1)
- Students will know that rate expressions can only be determined experimentally and these limit possible reaction mechanisms. In particular cases, such as a linear chain of elementary reactions, no equilibria and only one significant activation barrier, the rate equation is equivalent to the slowest step of the reaction. (IB 16.1)
- Students will know that the activation energy of a reaction can be determined from the effect of temperature on reaction rate.(IB 16.2)

Transfer

Students will be able to independently use their learning to: (product, high order reasoning)

- Design and conduct an experiment that collects data regarding one factor that impacts the rate of a reaction that occurs in the real world. How could you manipulate this factor in order to use this reaction to solve a problem?

Meaning

Unit Understanding(s):

Students will understand that:

- Species react as a result of collisions of sufficient energy and proper orientation.
- There are many factors that impact the success of species collisions.
- Reactions may occur by more than one step and the slowest step determines the rate of reaction (rate determining step/RDS).
- The order of a reaction can describe, with respect to a reactant, the number of particles taking part in the rate-determining step.
- Catalysts alter a reaction mechanism, introducing a step with lower activation energy.
- The Arrhenius equation uses the temperature dependence of the rate constant to determine the activation energy.

Essential Question(s):

Students will keep considering:

- The Kelvin scale of temperature gives a natural measure of the kinetic energy of gas whereas the artificial Celsius scale is based on the properties of water. Are physical properties such as temperature invented or discovered?
- Reaction mechanisms can be supported by indirect evidence. What is the role of empirical evidence in scientific theories? Can we ever be certain in science?

Acquisition

Knowledge - Students will:

- Know the rate of reaction is expressed as the change in concentration of a particular reactant/product per unit time
- Know activation energy (E_a) is the minimum energy that colliding molecules need in order to have successful collisions leading to a reaction.
- Know that by decreasing *activation energy*, a catalyst increases the rate of a chemical reaction, without itself being permanently changed.
- Know the molecularity of an elementary step is the number of reactant particles taking part in that step.
- Know that rate equations can only be determined experimentally.
- Know the order of a reaction can be either integer or fractional in nature.

Reasoning - Students will:

- Analyze graphical and numerical data from rate experiments.
- Explain the effects of temperature, pressure/concentration and particle size on rate of reaction.
- Describe the relationships between temperature and rate constant; frequency factor and complexity of molecules colliding.
- Sketch and explain energy profiles with and without catalysts.
- Sketch, identify, and analyze graphical representations for zero, first and second order reactions.
- Analyze a graphical representation of the Arrhenius equation in its linear form in order to determine activation energy for a reaction.
- Be able to determine the rate expression for a reaction when provided the mechanism for the reaction.
- Determine and evaluate values of activation energy and frequency factors from data.

Skills - Students will:

- Record concentration changes in a reaction by monitoring changes in mass, volume and color.
- Construct Maxwell–Boltzmann energy distribution curves to account for the probability of successful collisions and factors affecting these collisions, including the effect of a catalyst.
- Deduce a rate expression for an equation from experimental data and solve problems involving the rate expression.
- Use the Arrhenius equation to calculate activation energy.

Common Misunderstandings

- It is possible for mathematics to get in the way of some students' understanding of the chemistry of this chapter.
- Students may have the false impression that nearly every chemical reaction occurs instantaneously.
- Students often assume that reaction orders may be determined from stoichiometric coefficients.
- Students often confuse intermediates, catalysts and transition states.

Essential new vocabulary

- Reaction Rate
- Rate Constant
- Reaction Order
- Activation Energy
- Reaction Mechanism
- Molecularity
- Catalyst