Anoka-Hennepin Secondary Curriculum Unit Plan

Department:	Science	Course:	IB Chemistry 12 (H)	Unit Title:	Acids and Bases	Grade Level(s):	12
Assessed Trimester:	Trimester B	Pacing:	Trimester B	Date Created:	6/24/2014	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 many reactions involve the transfer of a proton from an acid to a base but the acid–base concept can be extended to reactions that do not involve proton transfer.(IB 8.1 & IB 18.1)
- Students will know the characterization of an acid depends on empirical evidence gathered in the laboratory.(IB 8.2)
- Students will know the pH scale is an artificial scale used to distinguish between acid, neutral and basic/alkaline solutions.(IB 8.3)
- Students will realize the equilibrium law can be applied to acid–base reactions. (IB 18.2)
- Students will be able to develop a pH curve experimentally or mathematically. (IB 18.3)

Transfer

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

- Design and carry out an experiment that investigates the real world impact of an acid or base or both.

Meaning

Unit Understanding(s):

Students will understand that:

- A Brønsted–Lowry acid is a proton/H^+ donor and a Brønsted–Lowry base is a proton/H^+ acceptor.
- A Lewis acid is a lone pair acceptor and a Lewis base is a lone pair donor.
- Most acids have observable characteristic chemical reactions with reactive metals, metal oxides, metal hydroxides, hydrogen carbonates and carbonates.
- Salt and water are produced in exothermic neutralization reactions.
- Strong and weak acids and bases differ in the extent of ionization.
- There is an important mathematical relationship between K_a, K_b, and K_w.
- pH curves produced by the different combinations of strong and weak acids and bases have different characteristics.
- There is an important relationship between the pH range of an acid–base indicator and its pK_a value.
- Buffer solutions behave in a way that allows them to resist changes to pH.

Essential Question(s):

Students will keep considering:

- Chemistry makes use of the universal language of mathematics as a means of communication. Why is it important to have just one “scientific” language?
- The strength of an acid can be determined by the use of pH and conductivity probes. In what ways do technologies, which extend our senses, change or reinforce our view of the world?
- All rain is acidic but not all rain is “acid rain”. Scientific terms have a precise definition. Does scientific vocabulary simply communicate our knowledge in a neutral way or can it have value-laden terminology?
- The same phenomenon can sometimes be explored from different perspectives, and explained by different theories. For example, do we judge competing theories by their universality, simplicity or elegance?

Acquisition

Knowledge - Students will:

- Know amphiprotic species can act as both Brønsted–Lowry acids and bases.
- Know a pair of species differing by a single proton is called a conjugate acid-base pair.
- Know that when a Lewis base reacts with a Lewis acid a coordinate bond is formed.
- Know a nucleophile is a Lewis base and an electrophile is a Lewis acid.
- Know the formulas: pH = -log[H^+] and [H^+] = 10^{-pH}
- Know a change of one pH unit represents a 10-fold change in the hydrogen ion concentration [H^+].
- Know pH values distinguish between acidic, neutral and alkaline solutions.
- Know the ionic product constant, K_w= [H^+] [OH^-]= 10^{-14} at 298 K.
- Know strong acids and bases of equal concentrations have higher conductivities than weak acids and bases of the same concentration.
- Know a strong acid is a good proton donor and has a weak conjugate base.
- Know a strong base is a good proton acceptor and has a weak conjugate acid.
- Know that for a conjugate acid base pair, $K_a \times K_b = K_w$.
- Know the relationship between K_a and pK_a is (pK_a = -log K_a), and between K_b and pK_b is (pK_b = -log K_b)
- Know an acid–base indicator is a weak acid or a weak base where the components of the conjugate acid–base pair have different colours.
- Know that while the nature of the acid–base buffer always remains the same, buffer solutions can be prepared by either mixing a weak acid/base with a solution of a salt containing its conjugate, or by partial neutralization of a weak acid/base with a strong acid/base.

Reasoning - Students will:

- Identify the acid and base needed to make different salts.
- Distinguish between strong and weak acids and bases in terms of the rates of their reactions with metals, metal oxides, metal hydroxides, metal hydrogen carbonates and metal carbonates and their electrical conductivities for solutions of equal concentrations.
- Predict the type of solutions involved in a titration based on the general shapes of graphs of pH against volume for titrations and explain the important features of the graphed line.
- Select an appropriate indicator for a titration, given the equivalence point of the titration and the end point of the indicator.
- Predict the relative pH of aqueous salt solutions formed by the different combinations of strong and weak acid and base.

Skills - Students will:

- Deduce the Brønsted–Lowry acid and base in a chemical reaction.
- Deduce the conjugate acid or conjugate base in a chemical reaction.
- Balance chemical equations for the reaction of acids.
- Conduct an acid-base titration using chemical indicators.
- Solve problems involving pH, [H^+] and [OH^-].
- Correctly use a pH meter and universal indicator.
- Solve problems involving [H^+ (aq)], [OH^-(aq)], pH, pOH, K_a, pK_a, K_b and pK_b.
- Discuss the relative strengths of acids and bases using values of K_a, pK_a, K_b and pK_b.

Common Misunderstandings

- It is possible for mathematics to get in the way of some students' understanding of the chemistry of this chapter.
- Students incorrectly assume that one theory can explain the behavior of all acids and bases.
- Students narrowly believe all acids are something which eat away materials or which can burn you.
- Students incorrectly believe that pH is only related to acid/base concentration and do not consider acid/base strength.
- Students incorrectly assume that all acids and bases have a pH that falls on the 0-14 pH scale.
- Students incorrectly believe that when pH changes from a 4 to a 5 that there is a factor change in pH of 1 rather than 10.

Essential new vocabulary

- Acid
- Base
- Alkaline
- Neutralization
- Logarithm
- pH
- pOH
- Salt
- Titration
- Strong acid/base
- Weak acid/base
- Strong/Weak Electrolyte
- Indicator
- Conjugate acid/base
- Buffer