Anoka-Hennepin Secondary Curriculum Unit Plan

Department:	Science	Course:	IB Chemistry 12 (H)	Unit Title:	Redox Processes	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 voltaic cells convert chemical energy to electrical energy and electrolytic cells convert electrical energy to chemical energy.(IB 9.2)
- Students will know energy conversions between electrical and chemical energy lie at the core of electrochemical cells. (IB 19.1)

Transfer

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

- Identify a redox reaction that has a practical use in their everyday life, but because of barriers, is not being put to use. Identify these barriers and use chemistry knowledge to make a prediction on how this barrier could be overcome.

Meaning

Unit Understanding(s):	Essential Question(s):
Students will understand that: ● Voltaic (*Galvanic*) cells convert energy from spontaneous, exothermic chemical processes to electrical energy. ● Electrolytic cells convert electrical energy to chemical energy, by bringing about non-spontaneous processes. ● A voltaic cell generates an electromotive force (EMF) resulting in the movement of electrons from the anode (negative electrode) to the cathode (positive electrode) via the external circuit. The EMF is termed the cell potential ($E°$). ● When aqueous solutions are electrolysed, water can be oxidized to oxygen at the anode and reduced to hydrogen at the cathode. ● Gibbs free energy is mathematically related to cell potential.Current, duration of electrolysis and charge on the ion affect the amount of product formed at the electrodes during electrolysis. ● Electroplating involves the electrolytic coating of an object with a metallic thin layer.	**Students will keep considering:** ● Is energy just an abstract concept used to justify why certain types of changes are always associated with each other? Are concepts such as energy real? ● The SHE is an example of an arbitrary reference. Would our scientific knowledge be the same if we chose different references?

Acquisition

Knowledge - Students will:	Skills - Students will:
• Know oxidation occurs at the anode (negative electrode) and reduction occurs at the cathode (positive electrode) in a voltaic cell. • Know oxidation occurs at the anode (positive electrode) and reduction occurs at the cathode (negative electrode) in an electrolytic cell. • Know the standard hydrogen electrode (SHE) consists of an inert platinum electrode in contact with 1 mol dm^{-3} hydrogen ion and hydrogen gas at 100 kPa and 298 K. The standard electrode potential (E^o) is the potential (voltage) of the reduction half-equation under standard conditions measured relative to the SHE. Solute concentration is 1 mol dm^{-3} or 100 kPa for gases. E^o of the SHE is 0 V. • $\Delta G^o = -nFE^o$. When E^o is positive, ΔG^o is negative indicative of a spontaneous process. When E^o is negative, ΔG^o is positive indicative of a non-spontaneous process. When E^o is 0, then ΔG^o is 0. **Reasoning - Students will:** • Explain how a redox reaction is used to produce electricity in a voltaic cell and how current is conducted in an electrolytic cell. • Distinguish between electron and ion flow in both electrochemical cells. • Deduce the products of the electrolysis of a molten salt. • Predict whether a reaction is spontaneous or not using E^o values. • Explain the products formed during the electrolysis of aqueous solutions. • Determine the relative amounts of products formed during electrolytic processes. • Explain the process of electroplating.	• Construct and annotate both types of electrochemical cells. • Produce a typical voltaic cell using two metal/metal-ion half-cells. • Calculate cell potentials using standard electrode potentials. • Determine standard free-energy changes (ΔG^o) using standard electrode potentials.

Common Misunderstandings	Essential new vocabulary
• Many students find electrochemistry difficult because they have not fully mastered common electricity concepts, specifically the differences and relationships among current, voltage, and resistance (I, V, and R). • Students struggle with correctly applying the terms oxidation, reduction, cathode and anode. • Students struggle with interpreting reduction potentials found in data tables. These potentials are usually written as **REDUCTION** half-reactions and the potentials given are for the equation as written at standard laboratory conditions.	• Oxidation • Reduction • Electrode • Cathode • Anode • Salt bridge • half-cell • Voltaic (galvanic) cell • electrolytic cell • SHE • Cell potential • half-reaction • standard electrode potential • Spontaneous