Advanced Chemistry

[Implement start year (2013-2014)]

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Unit 2: Patterns in Reactions - *Students will be able to independently use their learning to…*

"Engage intelligently in public discourse and debate about matters of scientific and technological concern." (from National Science Education Standards)

Stage 1 – Desired Results

Established Goals

2009 NJCCC Standard(s), Strand(s)/CPI #
(http://www.state.nj.us/education/cccs/)

5.1.12.A.1
Mathematical, physical, and computational tools are used to search for and explain core scientific concepts and principles.
5.1.12.A.2
Interpretation and manipulation of evidence-based models are used to build and critique arguments/explanations.
5.1.12.B.3
Empirical evidence is used to construct and defend arguments.
5.2.12.A.1
Electrons, protons, and neutrons are parts of the atom and have measurable properties, including mass and, in the case of protons and electrons, charge. The nuclei of atoms are composed of protons and neutrons. A kind of force that is only evident at nuclear distances holds the particles of the nucleus together against the electrical repulsion between the protons.
5.2.12.A.2
Differences in the physical properties of solids, liquids, and gases are explained by the ways in which the atoms, ions, or molecules of the substances are arranged, and by the strength of the forces of attraction between the atoms, ions, or molecules.
5.2.12.A.5
Solids, liquids, and gases may dissolve to form solutions. When combining a solute and solvent to prepare a solution, exceeding a particular

21st Century Themes
(www.21stcenturyskills.org)

_X_ Global Awareness
___Financial, Economic, Business and Entrepreneurial Literacy
___Civic Literacy
___Health Literacy
_X_Environmental Literacy

21st Century Skills

Learning and Innovation Skills:
___Creativity and Innovation
_X_Critical Thinking and Problem Solving
_X_Communication and Collaboration

Information, Media and Technology Skills:
__x_Information Literacy
__x _Media Literacy
__x_ICT (Information, Communications and Technology) Literacy

Life and Career Skills:
___Flexibility and Adaptability
_X_Initiative and Self-Direction
___Social and Cross-Cultural Skills
___Productivity and Accountability
___Leadership and Responsibility

concentration of solute will lead to precipitation of the solute from the solution. Dynamic equilibrium occurs in saturated solutions. Concentration of solutions can be calculated in terms of molarity, molality, and percent by mass. 5.2.12.B.1 An atom's electron configuration, particularly of the outermost electrons, determines how the atom interacts with other atoms. Chemical bonds are the interactions between atoms that hold them together in molecules or between oppositely charged ions 5.2.12.C.1 Gas particles move independently and are far apart relative to each other. The behavior of gases can be explained by the kinetic molecular theory. The kinetic molecular theory can be used to explain the relationship between pressure and volume, volume and temperature, pressure and temperature, and the number of particles in a gas sample. There is a natural tendency for a system to move in the direction of disorder or entropy. 5.2.12.C.2 Heating increases the energy of the atoms composing elements and the molecules or ions composing compounds. As the kinetic energy of the atoms, molecules, or ions increases, the temperature of the matter increases. Heating a pure solid increases the vibrational energy of its atoms, molecules, or ions. When the vibrational energy of the molecules of a pure substance becomes great enough, the solid melts. 5.2.12.B.3 The conservation of atoms in chemical reactions leads to the ability to calculate the mass of products and reactants using the mole concept. **Common Core Curriculum Standards for Math and English** (http://www.corestandards.org/) RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text. RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*. RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. RST.11-12.10 Read and comprehend science/technical texts in the grades	

11-12 text complexity band independently and proficiently	
Enduring Understandings: *Students will understand that . . .* *EU 1* Chemists look for patterns in chemical reactions to make sense of what they observe so they can use those patterns to make qualitative predictions regarding reaction outcomes. *EU 2* Chemical equations communicate valuable information about transformations of matter. *EU 3* Applying mathematics to chemical reactions allows chemists to make quantitative predictions regarding reaction outcomes.	**Essential Questions:** *EU 1* • What is the best way for a chemist to make reliable predictions? *EU 2* • How can chemists effectively communicate about changes in matter? *EU 3* • What is the value of stoichiometry in the larger world?

Knowledge:
Students will know . . .
 	
EU 1/ EU 2
• Reaction patterns for reactions in aqueous solution
  • Precipitation
  • Solubility rules
  • Redox reactions
  • Recognize simple reaction types as redox (combustion, synthesis, decomposition, single replacement)
  • Half-reaction method
  • Electrochemical cells
  • Acid-Base reactions
	Skills:
	Students will be able to . . .
	
	EU 1
	• Classify reaction types for chemical reactions listed under EU1 Knowledge
	• Predict the products of chemical reactions listed under EU1 Knowledge
	• Use the solubility rules to determine products.
	• Use reduction potentials to make qualitative and quantitative predictions about the reactions involved in a galvanic or electrolytic cell.

• Arrhenius/Bronsted • Conjugate acid/bases • Strong and Weak acid/base combinations • Reaction patterns for organic reactions • Fundamental Reactions • Biochemical Applications • Polymers • Reaction patterns for Complex Ion Chemistry *EU3* • Titration • Voltage	*EU 2* • Write complete, balanced molecular and net ionic equations for chemical reactions listed under EU1 Knowledge • Interpret chemical reactions using particulate representations. • Balance redox reactions using the half-reaction method *EU 3* • Calculate the standard voltage of an electrochemical cell • Measure the experimental voltage of an electrochemical cell • Calculate stoichiometric quantities within any of the studied reaction types • Perform a titration in order to determine an unknown quantity in a given substance

Stage 2 – Assessment Evidence

Recommended Performance Tasks: *Each unit must have at least 1 Performance Task. Consider the GRASPS form.*

- Students are working as an intern for your favorite automobile company. As an intern, your job is to test various methods of inflating air bags in order to determine the safest method for use in the manufacture of the cars. Since the materials used in airbags are relatively expensive, you begin by testing your methods with some common and readily available (cheaper) chemicals. To accomplish this task, interns will present evidence to their boss in the form of a lab report analysis to support whether or not this chemical combination could be used as an alternative system for use in cars. (EU1, EU2, EU3)

OR

- Students are asked to help an older relative who is taking calcium supplements. The relative would like to know which brand of supplements would be the best one to take. Given several samples of over-the-counter calcium supplements, they are asked to determine the percent calcium content in each and rationalize which compound would be the most beneficial to their relative based upon cost, bodily absorption and excipient content. Students will present their collection of evidence in a letter to their relative with brief explanations that support their recommendation. (EU1, EU2, EU3) (possible alternative: the analysis of over-the-counter antacid tablets for effective gas evolution in resolving acid reflux)

Other Recommended Evidence: *Tests, Quizzes, Prompts, Self-assessment, Observations, Dialogues, etc.*

- Quizzes and chapter tests to assess predicting reactant products, balancing chemical equations, and calculating stoichiometric quantities
- Formative assessment using individual contributions to class discussions and independent brief written responses
- Laboratory notebooks or reports may be used for assessment on lab skills and content
- Students select an article about emergent technology related to chemical reactions and are asked to construct a position paper stating their support or their objection.
- Qualitative Analysis: Students are asked to identify a variety of compounds based upon their physical properties and reaction patterns.

Stage 3 – Learning Plan

Suggested Learning Activities to Include Differentiated Instruction and Interdisciplinary Connections: *Consider the WHERETO elements. Each learning activity listed must be accompanied by a learning goal of A= Acquiring basic knowledge and skills, M= Making meaning and/or a T= Transfer.*

a. Demonstration of proper lab techniques for titration (A)
b. POGIL: Redox Reactions
c. Oxidation Reduction Titration Lab (bleach, oxalate, hydrogen peroxide, etc.) (M, T)
d. Gravimetric/Titration Lab (T) (see website)
   http://www.doctortang.com/AP%20Chemistry%20(Old)/Lab%2003%20Gravimetric%20and%20Solution%20Stoichiometry.pdf
e. % CO_2 in an Alka-Seltzer tablet Lab (M/T)
f. % Acetic acid in Vinegar Lab (M)
g. Oxidation states of Manganese Lab (demo/activity) (M)
h. Potassium Chloride/Potassium Chlorate Stoichiometry Lab (M)
i. Explanation of reaction types and demonstration of each classification (A/M)
j. Use sample reactions to differentiate between molecular, complete ionic, and net ionic equations (A/M)
k. Discussion and modeling of how to find the patterns in each type of reaction (A/M)
l. Preparation and reactions of Coordination Compounds Lab (M)
m. Single Replacement Quantitative Aqueous Redox Lab(M/T)
n. Students are given chemical reactant prompts and asked to identify the type of reaction, predict the products, and balance the reaction (molecularly and in net-ionic form, if possible). (M/T)
o. Students solve a variety of stoichiometry problems related to more practical larger world situations (M/T)
p. POGIL: The Electrochemical Cell
q. Discussion to distinguish between electrolytic and galvanic cells (A)
r. Students are given materials to make simple galvanic cells, tasked to create a cell which optimizes voltage and to write corresponding equations to support their work (M/T)
s. Students are given various roles in combination with a particular prompt that allows them to use their knowledge of stoichiometry to develop

answers to these real-world problems. (M/T) These may include, but are not limited to:

- Calculating the amount of chemicals needed for certain functions in space (amount of lithium oxide needed to "scrub" the internal atmosphere of carbon dioxide on the space shuttle, given # of passengers and length of mission)
- Determining the amount of specific types of rocket fuel needed for various functions of the space shuttle
- Calculating concentration of fertilizers necessary for various crops based on their specific uptake of nutrients
- This link provides some further explanation and additional ideas for ways of applying stoichiometry to real-life problems: http://www.wiziq.com/tutorial/73848-Chemistry-Stoichiometry-Real-Life-Stoichiometry (last accessed 7/12/12)