LSC Use Only Proposal No: LSC Action-Date: AP-3/22/12	UWUCC Use Only Proposal No: 11-125f. UWUCC Action-Date: App-4/3/12 Senate Action Date: App 4-17-12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Anne Kondo**	Email Address **akondo@iup.edu**
Proposing Department/Unit **Chemistry**	Phone 74595

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

1. Course Proposals (check all that apply)

____ New Course ____ Course Prefix Change ____ Course Deletion

X Course Revision X Course Number and/or Title Change X Catalog Description Change

Current course prefix, number and full title: CHEM 113 Concepts in Chemistry I

Proposed course prefix, number and full title, if changing: CHEM 113 Advanced General Chemistry I

2. Liberal Studies Course Designations, as appropriate

X This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

____ Learning Skills X Knowledge Area ____ Global and Multicultural Awareness ____ Writing Intensive (include W cover sheet)

____ Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

____ Global Citizenship ____ Information Literacy ____ Oral Communication

____ Quantitative Reasoning ____ Scientific Literacy ____ Technological Literacy

3. Other Designations, as appropriate

____ Honors College Course ____ Other: (e.g. Women's Studies, Pan African)

4. Program Proposals

____ Catalog Description Change ____ Program Revision ____ Program Title Change ____ New Track

____ New Degree Program ____ New Minor Program ____ Liberal Studies Requirement Changes ____ Other

Current program name: ____

Proposed program name, if changing: ____

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	[signature]	2/23/12
Department Chairperson(s)	[signature]	2/23/12
College Curriculum Committee Chair	Anne Kondo	3/9/12
College Dean	[signature]	3/12/12
Director of Liberal Studies (as needed)	[signature]	3/26/12
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	4/13/12

Received MAR 26 2012 Liberal Studies

Received MAR 12 2012 Liberal Studies

Part II.

New Syllabus of Record

1. Catalog Description

CHEM 113 Advanced General Chemistry I (3c-3l-4cr)

Prerequisites: 550 on MATH SAT, High School Chemistry

Advanced General Chemistry is intended for well-prepared freshmen with high school chemistry and good math skills. Topics covered include atomic theory, chemical reactions, stoichiometry, thermochemistry, chemical bonding, molecular geometry, gas laws, the liquid and solid state and solution theory. Topics will be covered in greater depth and with more challenging problem solving than General Chemistry. Designed for majors within the College of Natural Sciences and Mathematics and to fulfill the Liberal Studies Natural Science Laboratory Sequence requirement for those students.

2. Course Outcomes

Objective 1: The students will demonstrate ease with the basic language of chemistry, including molecular formulas, nomenclature and the writing of chemical equations, and be able to explain the modern theory of atomic and molecular structure, and chemical bonding.

Expected Student Learning Outcomes 1&2: Informed and empowered learners.

Rational: Exams, homework assignments and laboratory reports will determine whether students understand elements, nomenclature, formulas, atomic and molecular structure, chemical reactions, chemical bonding, and the energy of physical and chemical changes.

Objective 2: The students will quantitatively analyze chemical processes, including stoichiometry with all states of matter, calculating thermodynamic properties and connecting the kinetic-molecular model for gases and its relationship to observed empirical laws.

Expected Student Learning Outcomes 1&2:: Informed and empowered learners.

Rational: In lecture, students will develop and apply problem-solving skills to solve advanced stoichiometry problems, involving all states of matter and related energy changes. In lab, student apply quantitative analysis to experimental measurements.

Objective 3: In the laboratory, students will apply the principles learned in lecture so that they can qualitatively and quantitatively collect and analyze experimental data and explain its significance. Students will learn experimental design, proper communication of scientific results, safety laboratory behavior and proper chemical disposal.

Expected Student Learning Outcomes 2&3:: Empowered and responsible learners.

Rational: Students will apply the language of chemistry in weekly experiments. They will apply quantitative reasoning in data collection and analysis. Students will be able to design experiments to test their ideas, and to draw relevant conclusions. Students will learn about safe laboratory behavior, including the safe handling of instruments and hazardous materials, to prevent injury to themselves or others, or harm to the environment.

3. Detailed Course Outline

Advanced General Chemistry I is intended to be a single lecture section with multiple lab sections. Ideally , one instructor will cover lecture and lab, although in some semesters, additional instructors may be needed to cover one or two lab sections.

Lecture Topics

1 hr = one 50 minute lecture

1. Review of Introductory Concepts of Chemistry — 2 hours.

   Atoms, molecules, and ions. Nomenclature and formulas. Chemical and physical properties.

2. Measurements and Moles — 2 hours

   Metric units, dimensional analysis, uncertainty. The mole, molar mass, determining empirical formulas.

3. Chemical Reactions — 5 hours

   Writing, balancing and analyzing chemical reactions. Aqueous phase reactions. Acids and Bases. Redox reactions. Assigning oxidation numbers.

   Exam 1 — 1 hour

4. Chemical Calculations — 6 hours

   Stoichiometry. Limiting Reagent. Reaction Yield. Molarity. Dilutions. Titrations.

5. The Properties of Gases — 3 hours

   Nature of gases. Gas Laws. Stoichiometry of reacting gases. Molecular motion in gases. Kinetic Molecular Theory of Gases.

   Exam 2 — 1 hour

6. Thermochemistry — 4 hours

   Energy, heat and enthalpy. Thermochemistry of physical changes. Thermochemistry of chemical changes. Hess's Law. Calorimetry.

7. Atomic Structure and the Periodic Table — 5 hours

   Wave-particle duality. Models of atomic structure. Atomic orbitals and quantum numbers. Electron configurations. Periodic trends in atomic structure. Periodic properties: size, ionization energy.

   Exam 3 — 1 hour

8. Chemical Bonds 4 hours

Ionic Bonds. Covalent Bonds. Lewis Structures. Octet Rule. Exceptions to the octet rule.

9. Molecular Structure 4 hours

Shapes of molecules and ions. Polar bonds and polar molecules. Bond strength. Bond length. Valence Bond Theory. Molecular Orbital Theory.

10. Liquids and Solids 3 hours

London Forces. Dipole-dipole interactions. Hydrogen Bonding. Liquid Structure. Solid Structure. Phase Changes.

Exam 4 1 hour

The final exam will occur during the final exam period.

Laboratory Topics - one laboratory period for each experiment

1. Safety, The Scientific Method
2. Graphing Relationships
3. Qualitative Observations
4. Hydrates
5. Precipitates
6. Analysis of an Antacid
7. Spectral Analysis for $Cu^{2+}_{(aq)}$
8. Heating and Cooling Behavior
9. Pressure, Volume, Temperature Relationships
10. Air Bags R Us
11. Potassium Hydroxide and Hydrochloric Acid
12. Atomic Spectrum of Hydrogen
13. Lewis Structure and VSEPR
14. Check-out, Final Lab Exam

4. Evaluation Methods

Exams	= 60%
In-class and Homework Assignments	= 15%
Laboratory Grade	= 25%
TOTAL POINTS:	= 100%

The laboratory grade will make up 25% of the overall grade. Lecture evaluation consists of quizzes, hourly exams, assignments and a final exam. The final exam usually contributes 25-30% of the lecture grade. The laboratory grade is made up of quiz grades (20% of lab grade for regular quizzes, and 10 % of lab grade for final lab exam) and grades on laboratory reports and/or notebooks (70% of lab grade). The student must earn 70% in the laboratory in order to pass CHEM 114.

5. Example Grading Scale

Final course grade is determined by the percentage earned by the student in both lecture and laboratory.

A $\geq$ 90% B $\geq$ 80% C $\geq$ 70% D $\geq$ 60% F < 60%

6. Undergraduate Course Attendance Policy
The University expects all students to attend class. The attendance policy for this course will be consistent with the Undergraduate Course Attendance Policy in the IUP Undergraduate Catalog.

7. Required textbook(s)
Lecture: Atkins, P., Jones L., *Chemical Principles, 5th ed.,* W.H. Freeman, NY, 2010.

Laboratory: Abraham,M. R.; Pavelich, M. J., *Inquiries into Chemistry,* Waveland Press, Inc., Prospect Heights, Il.,1999. (This laboratory manual has an older publication date, but remains one of the best guided inquiry chemistry laboratory manuals available.)

8. Special Resource Requirements

Safety: Some approved form of eye protection must be worn at all times in the laboratory. Students who do not comply with this regulation will be required to withdraw from the course.

Students are expected to have their own scientific calculators and access to a computer to use the computer-based programs and web-sites that provide supplementary materials. Some sections of the course may utilize on-line course materials as part of the instruction.

9. Bibliography
Brown, T.E., LeMay, H.E., Bursten, B.E., Murphy, C., Woodward, P., *Chemistry: The Central Science,* 12th ed., Prentice Hall, New Jersey, 2012

Garratt, J., Threlfall, R., Overton, T, *A Question of Chemistry: Creative Problems for Critical Thinkers,* Prentice Hall , NJ, 2000.

Jespersen, N.D., Brady, J.E., Hyslop, A., *Chemistry: The Molecular Nature of Matter*, 6th Ed., J. Wiley and Sons, N.J., 2011.

McGrayne, S. Bertsch, *Nobel Prize Women in Science: Their Lives, Struggles and Momentous Discoveries*, **2nd Ed.** Joseph Henry Press: Washington, DC, 2001

Morse, Mary, *Women Changing Science: Voices from a Field in Transition,* Perseus Publishing, Cambridge, MA, 2001.

Oxtoby, D.W., Gillis, H. P., Campion, A., *Principles of Modern Chemistry*, 7th Ed., Brooks-Cole, Connecticut, 2012.

Petrucci, R.H., Herring, F.G., Madura, J.D., Bissonnette, C., *General Chemistry: Principles and Modern Applications*, 10th ed., Prentice Hall , NJ, 2011.

Shearer, B.F., Shearer, B.S., Eds., *Notable Women in the Physical Sciences: A Biographical Dictionary*, Greenwood Press (1997).

Spencer, J.N., Bodner, G.M., Rickard, L.H., *Chemistry: Structure and Dynamics*, 5th Ed., J. Wiley and Sons, NJ, 2010.

Thompson, G.L., *Unheralded but Unbowed: Black Scientists and Engineers that Changed the World,* CreateSpace, 2009.

SAMPLE ASSIGNMENT
AIR BAGS 'R US

John Woolcock

Based on experiments developed by Jim Klent and Angelica Stacy (ChemConnections)

Scenario:

In this experiment, you have been asked by your boss, I.M. Gaseous, of the AIR BAGS 'R US Co., to investigate the design of a small-scale airbag system they want to produce as a child safety device for baby carriages. Because of the toxicity of sodium azide (the chemical used in car airbags), he suggests you use the reaction of sodium bicarbonate (baking soda) with aqueous HCl (stomach acid) that will produce carbon dioxide gas. The reaction is:

$$NaHCO_3\,(s) + HCl\,(aq) \rightarrow NaCl\,(aq) + CO_2\,(g) + H_2O\,(l)$$

Background Information: Automobile Airbags

Chemists can use concepts like stoichiometry, molar mass, and balanced chemical equations to predict just about anything about a chemical reaction. You may think that this kind of stuff never leaves the classroom, but virtually everything you can buy depends on a chemist determining how to mix things up. In industry, where huge amounts of chemicals are used, careful calculations can save millions of dollars in chemicals and disposal costs. This makes good economic and environmental sense. The invention of the automobile airbag, for example, required consideration of not only the chemistry, but economic and environmental factors. Chemists are trained to take this "big picture" approach to problem solving. In this investigation, you'll design a model air bag. You'll use the theoretical tools you've seen and used in lecture to decide how to optimize the reaction that inflates the bag.

The automobile airbag is a remarkable device. It is deceptively simple in concept, but the design requirements of the system are actually very demanding. When a crash occurs, an airbag must inflate rapidly – within 40 milliseconds! – to cushion the occupants against impact. The gas produced must be nontoxic, odorless, and cool enough to avoid burning the occupants. You'd also like the compounds used to be stable and nontoxic, and ones that don't expand unexpectedly. You also want compounds that can be disposed of easily and safely.

Sensors detect impact and electrically initiate the reaction to activate modern airbags. Sodium azide (NaN_3) is a stable solid, and a small pellet can easily be stored in an airbag compartment. A huge volume of nitrogen gas is produced rapidly and is nontoxic and relatively cool. Sodium azide itself is rather nasty, and there is a concern about its disposal in land fills from undeployed airbags.

The sodium metal produced in an airbag reacts violently with water. Fortunately, sodium metal can be transformed into the relatively inert compound $NaFeO_2$ by adding Fe_2O_3 (iron (III) oxide) to the pellet. The pellets also contain additives that enhance the rate at which the gas is produced while minimizing the heat. Some formulations are trade secrets, but all require careful chemical, environmental, and economic analysis. These issues, as well as the quest for better and cheaper systems, drive the search for other compounds and formulations for the gas-producing reaction used in the system.

The Ideal Gas Law and Mass-Mole Relationships

In the reaction shown above, the CO_2 gas produced obeys the Ideal Gas Law. In fact, at normal temperatures and pressures, all gases obey the Ideal Gas Law. This law combines together all the major properties of a gas: pressure (P), volume (V), temperature (T), and amount (n) or moles of gas. The algebraic expression of this law is:

$$PV = nRT$$

where P is the pressure of the gas in atmospheres (atm); V is the volume of gas in liters (L), n is the moles of gas (mol), T is the temperature of the gas in Kelvin (K), and R is the Ideal Gas Law Constant. The value of R is 0.0821 atm L mol^{-1} K^{-1}. With this equation and the measurement of any three properties, the fourth property can be calculated.

In most laboratories, the properties of P, V, and T are often measured in units different from those used in the Ideal Gas Law. In the lab, pressure is typically measured in *mm Hg* (millimeters of mercury) or *torr.* Volume is typically measured in milliliters (mL), and temperature is usually measured in degrees Celsius (°C). These units must be converted in order to use the Ideal Gas Law Constant, R.

Conversions: 760 torr = 760 mm Hg = 1 atm; 1 L = 1000 mL; K = 273 + °C

Once the number of moles of gas needed to fill the bag has been calculated, the exact mass of $NaHCO_3$ solid and the volume of 6 M HCl solution to make the desired amount of gas can be calculated. Let's suppose we need to make 1 mol CO_2 (g) to fill the air bag. The balanced reaction above shows us that 1 mol CO_2 (g) can be produced from 1 mol $NaHCO_3$ (s) and 1 mol HCl (aq). To find the mass of solid $NaHCO_3$ that is required, you'll need to convert from moles → mass as we've done in class.

The volume of HCl required is calculated differently since it is a solution instead of a solid. The quantity 6 M (M = Molar = moles/L) indicates that the solution contains 6 moles of HCl in every 1 L of HCl solution (6 mol HCl per liter). To find the volume, you must use this conversion factor to find the volume of solution needed to give you 1 mol HCl.

Helpful information for this lab

Chemical reaction to generate gas for your airbag:

$$HCl\ (aq) + NaHCO_3\ (s) \rightarrow NaCl\ (aq) + CO_2\ (g) + H_2O\ (l)$$

Combined Gas Law: Pressure is constant for the evolution of CO_2 (g), because the volume in the bag increases. Therefore, it is somewhat easier to use a variant of the Combined Gas Law (the relationship of moles-volume-temperature), instead of the more detailed Ideal Gas Law.

$$\frac{n_1 T_1}{V_1} = \frac{n_2 T_2}{V_2}$$

n_1 = number of moles of gas in the standard state (1.0 mol)
n_2 = number of moles of gas needed for the experiment
V_1 = volume of a gas in the standard state (22.4 L)
V_2 = volume of gas generated in the experiment
T_1 = temperature in the standard state (273 K)
T_2 = temperature of the experiment (current room temperature)

Pre-lab Questions

Complete these problems using the information above, before coming to lab. Show your work.

1. How many milliliters of 6.0 M HCl are needed to produce 2.0 mol CO_2? Remember, 6.0 M is the same as 6.0 mol/L.
2. Use the combined gas relationship and determine how many moles of gas are needed to fill a 5.0 L airbag at 25 °C.
3. Combine the above calculations and determine how many milliliters of 6.0 M HCl and how many grams of $NaHCO_3$ are needed to generate enough gas to fill a 10.0 L airbag.

Experiment

PART I.

Procedure

Your main objective is to design a model automotive airbag which expands to the largest possible volume without breaking the seal on the bag. To simulate an airbag, we will use a Ziploc™ bag.

Equipment

Work in pairs. Obtain the following items:

- 1 Ziploc™ bag	- 1 ruler or Vernier caliper
- 50 mL of 6 M HCl	- 10-15 g $NaHCO_3$
- stopwatch	- thermometer

You may need other items to complete the design of the airbag. Look at what's available, and ask the instructor/TA if there are other items available. If there is something other than above you think you may need, you'll need to explain why you think that you need them.

Because we will be using a modified combined gas law instead of the Ideal Gas Law, you will not need to determine atmospheric pressure (it is constant). You will need to determine the volume of the sealed baggie and the room temperature. Explain below how you determined the bag volume, and record the measurement.

PART II.

Design of An Airbag

The specifics of the design are up to your group, but we suggest the following:

- You should calculate the exact amounts of solid $NaHCO_3$ and 6 M HCl solution that are needed to produce just enough gas to create a cushion of the largest possible volume without breaking the seal on the bag. Record the amounts you use below.
- The trigger and deployment system should require minimal external parts or assistance.
- You should have the acid and the $NaHCO_3$ inside the airbag in a stable configuration that will survive handling without deployment until triggered.
- You will want to measure the thickness of the bag and how fast it inflates.

Address the following issues:

1. List safety considerations for testing your airbag, including handling and disposing of chemicals.
2. Show all calculations and reaction equations that were needed to predict the amounts of reagents predicted to fill the air bag.
3. Describe or sketch the design of your airbag, including the mechanism that you use as a trigger in the deployment. After each test of the airbag, empty all waste into the sink. The bags may be rinsed in the sink and wiped out with a paper towel to dry them for the next trial.

PART III.

Optimization of the Airbag Design

Once you have a successful airbag design that you can operate, use your model to determine if changing the amount of one or both of the reactants changes the speed of inflation or creates a better/poorer cushion. To do this, you may wish to consider doubling or halving the amount of either or both of the reactants, then deploy and measure the results (time, cushion). Write the amounts of reactants and the results of your trials in a table below.

Trial #	$NaHCO_3$ (g)	HCl (mL)	Time (s)	Cushion (cm)
1				
2				
3				
4				
5				

The Final Test

When you feel that your airbag is optimized, prepare the best set of conditions for one final run. When ready, call the instructor over to watch and time your airbag deployment. The time will be based on when the reaction finishes (stops fizzing).

PART IV.

Report

In addition to the tables and information above, explain the experimental variables you adjusted to optimize your airbag. Include why you chose the amounts you did, and why you think that the best airbag was made with those amounts (particularly if the amounts were different from those calculated from the balanced equation). Assess the quality of your airbag, and make suggestions for improvement.

Sample Assessment

CHEM 113: Grading Rubric for Air Bags 'R Us

Prelab Questions

- Each problem gives a word equation, number substitution, and shows appropriate unit analysis. Answers are numerically correct, with the correct number of significant figures and correct units. (5 points each; 15 points total)

Part I

- Clear explanation given of how the volume of the airbag was found(5 points)

Part II

- Safety considerations are complete and correct (5 points)
- Calculations of the amounts of reagents needed are correct. Each calculation gives a word equation, number substitution, and shows appropriate unit analysis. Answers are numerically correct, with the correct number of significant figures and correct units. (10 points each reactant; 20 points total)
- Description or sketch the design of your airbag is given (5 points)
- The mechanism used as a trigger in the deployment is described, works, and is creative (10 points).

Part III

- Results are given for optimization trials (units given, sig. figs. are correct) (5 points)
- Optimization trials are logical in sequence (5points)
- Final test shows working air bag which inflates sufficiently and quickly (5 points)

Part IV

- Explanation of optimization procedure is logical and well-stated (5 points).
- Assessment and suggestions for improvements are reasonable (10 points)

Style & Mechanics

- The report is neat in appearance, it includes the student's and lab partners' names. Any tables have titles. All numbers have units. (5 points).
- There are no spelling or grammatical errors (5 points).

Total points: 100

End of sample assignment/assessment

2. Summary of the proposed revisions.

1. Course title change from "Concepts in Chemistry I" to "Advanced General Chemistry I"
2. Pre-requisite addition of minimum MATH SAT score and high school chemistry
3. Catalog Description change
4. Change in course objectives to fit expected student learning outcomes
5. Minimum Lab Grade of 70% required for passing course.
6. Updated course text and bibliography
7. Included sample laboratory experiment/report and grading rubric associated with Objectives2&3.

3. Justification/rationale for the revision.

1. **Course title and pre-requisite changes** reflect the target audience for the course. The revision to Advanced General Chemistry is designed to improve retention of science majors. CHEM 111 (General Chemistry I) is an existing liberal studies Natural Science course for science majors that does not have any pre-requisites. CHEM 113 (Concepts in Chemistry I) was a Liberal Studies Science, freshman chemistry course for primarily chemistry majors, with a guided inquiry-based laboratory program that was designed to develop critical thinking skills. Over time, it has become apparent that students without any chemistry background, or with poor math skills, simply do not pass CHEM 113. Furthermore, well-prepared students are not challenged by CHEM 111. We frequently see these students transfer to other institutions. Students with high school chemistry or AP Chemistry and good math skills will be advised into CHEM 113. Less time is needed to cover fundamentals like dimensional analysis and atoms and nomenclature. The content and problem-solving of the course will be more challenging; the laboratory program will continue to be based on guided inquiry. Other students will be advised into CHEM 111, where those without the chemistry or math background will spend longer in lecture and lab working on basic concepts and mathematical analysis of chemical problems. Chemistry majors in CHEM 111 will have the opportunity to improve their math skills and still be exposed to chemistry. Because the core content of the CHEM 111 and CHEM 113 will be the same, students should be able to count CHEM 113 as their Liberal Studies Science. The chemistry department hopes these changes improve retention of all science majors, and chemistry majors in particular.
2. **Catalog Description changes** reflect the distinction between General Chemistry I and Advanced General Chemistry I.
3. **Change in course objectives** to fit expected student learning outcomes
4. Updated course text and bibliography - the syllabus of record was last updated in 2003.
5. Minimum Lab Grade of 70% required for passing course was the recommendation of two external evaluators at our last program review. Faculty approved raising the minimum passing lab grade from 65% to 70% to improve student learning and standards.
6. Included sample laboratory experiment/report and grading rubric associated with Objectives2&3.
7. Requested exemption from reading non-textbook fact or fiction book due to the high degree of quantitative analysis in the course.

4. The old syllabus of record.

OLD SYLLABUS OF RECORD FOR CHEM 113
CONCEPTS IN CHEMISTRY

I. CATALOG DESCRIPTION

COURSE TITLE:	CHEM 113, Concepts in Chemistry
NUMBER OF CREDITS:	4 cr (3c-3l-4sh)
PREQUISITES:	
COURSE DESCRIPTION:	Introductory course for chemistry majors. Topics covered include atomic theory, an introduction to chemical reactions, stoichiometry, thermochemistry, chemical bonding, molecular geometry, gas laws, the liquid and solid state and solution theory.

II. COURSE OBJECTIVES

A. Students will be familiar with the basic language of chemistry including molecular formulas, nomenclature and the writing of chemical equations.

B. Students will be able to carry out quantitative calculations related to chemical reaction systems and their applications (stoichiometry).

C. Students will understand the principles of chemical thermodynamics, specifically enthalpy.

D. Students will understand the current atomic model for matter and its historical development.

E. Students will understand the currently accepted models for chemical bonding and structure.

F. Students will understand the kinetic-molecular model for gases and its relationship to observed empirical laws.

G. Students will understand the states of matter and their characteristic properties.

H. Students will understand the principles of solution theory and the properties of solutions.

I. In the laboratory students will be able to apply the principles learned in lecture so that they can qualitatively and quantitatively analyze experimental data and explain its significance.

III. DETAILED COURSE OUTLINE

LECTURE

1. Introductory Concepts — 5 lectures
   Scientific measurement systems and units. Problem-solving techniques. Atoms, moleculres, and ions. The "mole" in chemistry. The periodic table of the elements. Chemical formulas and nomenclature.
2. Introduction to Inorganic Reactions — 4 lectures
   Writing and balancing chemical equations. Types of chemical reactions: acid-base, precipitation, oxidation-reduction, combustion.
3. Stoichiometry — 4 lectures
   Mass-mass relationships. Limiting reagent concept. Molar concentrations. Titrations and solution stoichiometry.
4. Thermochemistry — 3 lectures
   Enthalpy changes. Hess's Law. Standard enthalpies of formation. Calorimetry.
5. Atomic Structure — 6 lectures
   Historical development of atomic theory. Electromagnetic radiation. Development of quantum mechanics and orbitals. Electron configurations. Atomic properties and chemical periodicity.
6. Chemical Bonding — 4 lectures
   Ionic versus covalent bonds. Lewis structures. Properties of bonds.
7. Molecular Geometry — 4 lectures
   Molecular shape (VSEPR model). Hybrid atomic orbitals.
8. Gases and Their Behavior — 4 lectures
   Units of pressure and the simple gas-laws. The ideal gas law. Kinetic molecular theory (KMT). Applications of KMT.
9. Intermolecular Forces, Liquids and Solids — 3 lectures
   KMT and intermolecular forces. Properties of liquids. Properties of solids.
10. Solutions and Their Behavior — 3 lectures
   Units of concentration. The solution process. Colligative properties.

LABORATORY

1. Safety, The Scientific Method - Measurements
2. Graphing Relationships - Measurements
3. Qualitative Observations - Measurements
4. Hydrates - Mole Relationships
5. Precipitates - Mole Relationships
6. Spectral Analysis for $Cu_{(aq)}$- Mole Relationships
7. Dissolution Reactions - Thermochemistry
8. Potassium Hydroxide and Hydrochloric Acid - Thermochemistry
9. Atomic Spectrum of Hydrogen – Atomic Theory
10. Lewis Structure and VSEPR – Molecular Structure

11. Pressure, Volume, Temperature Relationships – Gas Laws
12. Decomposition of Alka-Seltzer – Gas Laws
13. Heating and Cooling Behavior – Solution Theory

IV. EVALUATION METHODS

The laboratory grade will make up 25% of the overall grade. Evaluation consists of quizzes, hourly exams, assignments and a final exam. The final exam usually contributes 25-30% of the lecture grade. The laboratory grade is made up of quiz grades and grades on laboratory reports and/or notebooks.

V. REQUIRED TEXTBOOK(S)

Lecture: Chang, R., *General Chemistry:The Essential Concepts*, 3 Edit., McGraw-Hill, New York, NY, 2003.

Laboratory: Abraham,M. R.; Pavelich, M. J., *Inquiries into Chemistry,* Waveland Press, Inc., Prospect Heights, Il.,1999.

VI. SPECIAL RESOURCE REQUIREMENTS

Safety: Some approved form of eye protection must be worn at all times in the laboratory. Students who do not comply with this regulation will be required to withdraw from the course.

Students are expected to have their own scientific calculators and access to a computer to use the computer-based programs and web-sites that provide supplementary materials. Some sections of the course may utilize WebCT as part of the instruction.

Liberal Studies Course Approval General Information

1. This course will have one lecture section. The lecture instructor will serve as course (lecture and lab) coordinator. All lab sections will do the same set of experiments. There is a department guideline standard evaluation procedure for all sections that requires a student to earn 70% in the laboratory portion of the course in order to pass.

2. Many important discoveries and advances in chemistry come from women and ethnic minorities: Madam Curie's discovery of radiation, Marie-Anne Lavoisier's translations and equipment sketches in the 1800s, George Washington Carver's contributions to plant chemistry, the periodic table described by Mendeleev. These landmark scientists and others are mentioned texts and by instructors.

3. The exception to non-textbook work is made due to the quantitative nature of the course in both lecture and laboratory. Students perform dimensional analysis, stoichiometry calculations and thermodynamic analysis. Students are required to use calculators for complex algebraic problem-solving and for logarithmic functions like pH. In lab, students will use computers for data collection, and will be expected to use software to graph and analyze their results.

4. General Chemistry I (CHEM 111) is an introductory chemistry course for science majors. This course starts from first principles of quantitative and qualitative analysis of matter, and develops those ideas throughout the course. We believe that CHEM 111 does not serve, as well as it should, those students who have had chemistry in high school and who have good math skills. CHEM 113 is a freshman general chemistry course intended for those better prepared students, and as such is not a true first course in a major sequence. On the other hand, because CHEM 113 covers the same general content as CHEM 111 (although more complex concepts are covered to a greater depth because less time is spent on introductory skills), we request that CHEM 113 be the Liberal Studies Natural Science course for those better-prepared students. CHEM 113 will no longer be restricted to chemistry (and chemistry-related) majors. We intend to challenge all well-prepared science majors with this first university course in chemistry. We hope this change will help us better retain both science majors and chemistry majors, by placing less-prepared science majors in CHEM 111, and invigorating the better-prepared science majors in CHEM 113.

Subject: **Changes to Concepts in Chemistry (CHEM 113/114)**
From: Anne E Kondo <akondo@iup.edu>
Date: 02/13/12 10:45 AM
To: luciano@iup.edu, hovan@iup.edu, talwar@iup.edu, mbriggs <lkup@iup.edu>, bharathn@iup.edu

This message has attached files. Show

Dear Colleagues,

Attached, please find course revision proposals for CHEM 113 and CHEM 114 (Concepts in Chemistry I and II). In the past, enrollment in these courses has been restricted primarily to chemistry, chemistry education, biochemistry and geology majors; the lab has been guided-inquiry. To better serve both well-prepared science majors and under-prepared chemistry/biochemistry majors, CHEM 113/114 will now be restricted to students who have high MATH SAT scores and have had chemistry in high school. CHEM 111/112, General Chemistry I and II, will continue to be open to all science majors, without pre-requisites. CHEM 113/114 will cover the same material as CHEM 111/112, but in greater depth and with more advanced problem solving. The laboratories in CHEM 113/114 will continue to differ from those in General Chemistry, with the former focusing on developing scientific skills through guided-inquiry lab experiments, and the latter providing a more directed experience of a wide range of concepts and techniques. Both courses will be available to your majors, although, due to resource issues, CHEM 113/114 will be capped to a limited number of sections.

We would appreciate a letter in response that we may attach to the curriculum proposal.

Sincerely,

Anne Kondo

No replies as of 2/23/12

Liberal Studies Course Approval Checklist
Instruction Sheet

Use this checklist for all Liberal Studies categories other than writing-intensive sections; a different checklist is available for this. If you have questions, contact the Liberal Studies Office, 103 Stabley, telephone 357-5715.

This checklist is intended to assist you in developing your course to meet IUP's Criteria for Liberal Studies and to arrange your proposal in a standard order for consideration by the Liberal Studies Committee (LSC) and the University-Wide Undergraduate Curriculum Committee (UWUCC). When you have finished, your proposal will have these parts:

_X___ Standard UWUCC Course Proposal Cover Sheet, with signatures and Liberal Studies course designation checked

_X___ Course syllabus in UWUCC format

____ UWUCC course analysis questionnaire. Needed only if this is a new course not previously approved by the University Senate. These are not considered by the LSC but will be forwarded to the UWUCC along with the rest of the proposal after the LSC completes its review.

_X___ Assignment instructions for one of the major course assignments and a grading rubric or grading criteria for that assignment

_X___ Answers to the four questions listed in the Liberal Studies Course Approval General Information (one page)

Submit the original of the completed proposal to the Liberal Studies Office (103 Stabley). In addition to the signed hard copy, email the proposal as a Word or RTF file attachment to Liberal-Studies@iup.edu.

Please Number All Pages