WRIGHT COLLEGE
PROGRAM/DISCIPLINE ASSESSMENT FORM

Program/Discipline: Physical Science (Department) / Chemistry **Instructional Manager:** Kevin Li

Semester/Year: Fall/2011 **Assessment Coordinator:** Dr. Tracy Mitchell **Department Chair:** Dr. Walter Pravica
Email: tmitchell@ccc.edu

Plan Title: Using ACS Examinations to Gauge the Achievement of Student Learning Outcomes for Chemistry 203 (General Chemistry II)

Part A: Initial Plan: due to your assessment coordinator for review before the Aug 26 Assessment Committee meeting
Part B: Midsemester Update: due to your assessment coordinator for review before the Oct 21 Assessment Committee meeting
Part C: Further Updates: due date will be determined

The current submission is which of the following:

x Initial Plan date: 08/2011

□ Mid-year update date: _____ **□ Final Report date: _____**

College Mission: Wright College is a learning–centered, multi-campus institution of higher education offering students of diverse backgrounds, talents, and abilities a quality education leading to baccalaureate transfer, career advancement, and/or personal development.

Program/Discipline Mission: The mission of the Department of Physical Sciences is to provide our students with solid foundations in Chemistry, Physics, and Physical Sciences so that articulation of classes and material content will allow for a seamless transition into their chosen fields of interest. Our charge is to encourage students to view physical phenomena critically and develop insights which will help them discover and understand the principles that govern events in nature. All are encouraged to develop their curiosity, enhance their intellectual skills, progressively mature, and recognize the growing role of science in society.

A. Initial Assessment Plan

Area of Focus:

Your department efforts are to improve learning in what topic/area?

Critical thinking.

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Evidence: What past results have led your department to conclude that this is an area needing attention?	Wright College's 2010 CAAP Scores indicated lower achievement in the areas of reading and critical thinking.
Course(s) of Interest: What courses will be involved in your plan?	Chemistry 203 (General Chemistry II)
Intended Program Student Learning Outcomes (SLOs) List each relevant SLO that this project pertains to.	DEPARTMENTAL SLO: Students who complete (physical) science courses at Wright College will be able to: 1) Reason methodically to evaluate and solve qualitative and quantitative problems using appropriate scientific models and/or mathematical manipulations. COURSE SLO's: At the conclusion of the term, the students will: 1. Recall the definitions of scientific terms and appropriately use the terms to identify various aspects of chemical kinetics, chemical equilibrium, thermodynamics, acid-base chemistry, electrochemistry, nuclear chemistry, and coordination chemistry. 2. Apply previous knowledge of chemical reactions in aqueous solution (acid-base, precipitation, redox) to provide a foundation for topics focusing on chemical equilibrium and thermodynamics. 3. Solve qualitative and quantitative problems which involve: <u>Kinetics</u> a. Predicting the impact of certain factors (concentration, temperature, catalysts, activation energy) on the rate of chemical reactions. b. Calculating the reaction rate given concentration and time. c. Relating the rate of formation of products to the rate of disappearance of reactants given a balanced equation. d. Formulating rate laws from experimental data or a proposed mechanism. e. Recognizing the differences between first order and second order reactions. <u>Equilibrium</u> f. Writing the equilibrium-constant expressions for reactions. g. Relating the magnitude of an equilibrium constant to the relative amounts of reactants and products in the equilibrium mixture. h. Manipulating the equilibrium constant to reflect changes in the chemical equation. i. Calculating an equilibrium constant from given concentrations/pressures or equilibrium concentrations/pressures from a given equilibrium constant. j. Predicting the outcome of disrupting a system at equilibrium by changing concentrations, volume/pressure, or temperature using Le Chatlier's principle.

Acid-Base Equilibria

k. Defining and identifying Arrhenius, Bronsted-Lowry, and Lewis acids and bases.
l. Defining, identifying, and relating (strengths) of conjugate acid-base pairs.
m. Relating (mathematically) the $[H^+]$, the $[OH^-]$, the pH and pOH of aqueous solutions using K_w and pK_w at 25°C.
n. Calculating the pH of a strong acid, strong base, weak acid, weak base, salt, or buffer solution given initial concentrations and equilibrium constants, K_a or K_b, when appropriate.
o. Calculating the K_a or K_b from an initial concentration and pH or from K_w for conjugate acid-base pairs.
p. Predicting the acidic, basic or neutral nature of an aqueous salt solution.
q. Defining and identifying buffer solutions.
r. Interpreting and extracting the information revealed by an acid-base titration curve.

Solubility Equilibria

s. Calculating K_{sp} from molar solubility and molar solubility from K_{sp}.
t. Predicting the outcome of disrupting a system at equilibrium via the introduction of a common ion, the hydronium ion, or a complexing agent.

Chemical Thermodynamics

u. Recalling the three Laws of Thermodynamics.
v. Defining, predicting (via sign designation) and calculating (via Hess's Law or tabulated standard state values) the enthalpy, entropy, and free energy changes for reactions.
w. Relating (mathematically) the enthalpy, entropy, and free energy changes for reactions using the Gibbs-Hemholtz equation.
x. Predicting the effect of temperature on spontaneity given the enthalpy and entropy changes for reactions.
y. Relating (mathematically and theoretically) the standard free energy change and equilibrium constant for a reaction.
z. Calculating the free energy change under nonstandard conditions.

Electrochemistry

aa. Defining and identifying oxidation, reduction, oxidizing agents and reducing agents.
bb. Assigning oxidation numbers to isolated atoms or atoms within molecules or ions.
cc. Balancing redox reactions in acidic or basic solutions.
dd. Identifying and defining the anode, cathode and salt bridge as applicable to voltaic/galvanic and electrolytic cells.
ee. Ranking oxidizing agents and reducing agents by strength given standard reduction potentials.
ff. Calculating standard cell potentials from standard reduction potentials and nonstandard cell potentials using the Nernst equation.
gg. Relating (mathematically and theoretically) the standard cell potential, the standard free energy change and equilibrium constant for a reaction.
hh. Relating (mathematically) the amounts of products and reactants in redox reactions to electrical

charge.

Nuclear Chemistry

ii. Defining the properties of alpha, beta, and gamma radiation.
jj. Constructing and balancing nuclear equations using nuclide symbols.
kk. Defining the processes and identifying the applications of nuclear fission and nuclear fusion.
ll. Calculating the ages of objects or the amounts of radioactive nuclei remaining given the initial amount and half-life.

Chemistry of Coordination Compounds

mm. Identifying the components, general properties and structural features of coordination compounds.
nn. Determining the central metal's oxidation number, the charge of the complex ion, and the coordination number.

4. Draw logical conclusions from laboratory activities using the scientific method and knowledge of chemical kinetics, chemical equilibria, acid-base chemistry, selective precipitation/qualitative analysis and electrochemistry.

Involved Faculty:

List the instructor(s) participating in the assessment process for each outcome listed above.

Chemistry 203 Course Coordinator: Tracy Mitchell
Chemistry 203 Instructors: Krys Ochwat, Warren Menezes, Vasilios Soupos

Assessment/Intervention Process

Address the following questions:

- **What** approach will be used?
- **Why** was this process selected?
- **How** will student learning be measured?
- **When** will data collection be completed?
- **Who** will analyze the results?

What: The 2006 Second Term General Chemistry Exam is a 70-question, multiple-choice exam, prepared by the American Chemical Society (ACS) to assess the knowledge gained by students after completing the second semester of the General Chemistry sequence (i.e. Chemistry 203). Composite norms provided by ACS for this exam are based on the scores of 1,315 students in 16 colleges.

Why: The majority (i.e. 59/70) of the ACS examination questions are linked to the Chemistry 203 student learning outcomes (SLOs).

How: Externally, Wright College student scores are compared to the composite norms as an indicator of overall achievement with respect to student learning over the course of the semester. Internally, a detailed question analysis is performed to 1) identify the most commonly missed questions and 2) identify the most commonly selected incorrect answer for these questions as a means to identify the most common mistakes and misconceptions in reasoning. After identifying the most common mistakes and misconceptions, the course coordinator recommends certain topics be emphasized or particular correlations be made to improve student learning and general problem-solving skills.

When: The ACS exam is given during the 16th week of the semester. The data is typically analyzed within the next two-three weeks and is submitted as a report to the department Assessment Coordinator.

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	Who: Tracy Mitchell, Chemistry 203 Course Coordinator
	B. Midyear Update – due Oct 21
Completely describe all actions that have occurred since this past August with respect to your department's Assessment Plan. **Attach any relative documents (rubrics, surveys, other assessment tools).**	

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Are there any obstacles to the implementation of the plan that the Assessment Committee should know about or can assist with?	
Summary of Results and Analysis of Data Collected What were the results of the assessment process? What was learned from the results?	**Part C – due TBD**

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Action Plan Based on Results and Analysis Based on what was learned, what additional steps will be taken to improve student learning?