

**Program/Discipline:** Physical Science (Department) / Chemistry

**Instructional Manager:** Kevin Li

**Semester/Year:** Fall/2011

**Assessment Coordinator:** Dr. Tracy Mitchell

**Department Chair:** Dr. Walter Pravica

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**Plan Title:** Using the ACS Toledo Exam to Gauge Student Readiness for Chemistry 201

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:**

**Initial Plan**      **date: 8/2011**

**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:**                      Critical thinking.

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

**Evidence:**

What past results have led your department to conclude that this is an area needing attention?

1. Wright College's 2010 CAAP Scores indicated lower achievement in the areas of reading and critical thinking.
2. An increasing number of students placed into Chemistry 201 courses were underprepared (either lacking the high school chemistry course/Chem 121 course prerequisite completely or needing of a basic chemistry refresher course). As a result, Chemistry 201 retention and 201 student success rates decreased.

**Course(s) of Interest:**

What courses will be involved in your plan?

Chemistry 201 (General Chemistry I)

**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: This list of objectives is intended to cover the major topics covered by all instructors in the chemistry prerequisite (Chemistry 121 or similar) and math prerequisite (Math 99) for Chemistry 201.

The student should be able to recall definitions of scientific terms, demonstrate an understanding and solve qualitative and quantitative problems which involve:

1. Demonstrate familiarity with exponential notation and the proper use of significant figures.
  - a. Express any number in scientific notation (and vice versa).
  - b. Identify number of significant figures in a measurement (recognize non-significant zeroes).
  - c. Round a measurement to a given number of significant figures.
  - d. Calculate results considering rules of significant figures in addition/subtraction.
  - e. Calculate results considering rules of significant figures in multiplication/division.
2. Show familiarity with metric units, and conversion factors (e.g. volume, temperature, density, etc.).
  - a. Interpret Greek prefix multipliers (nano, micro, milli, centi, kilo, mega, etc.).
  - b. Convert one unit into another (e.g. how many kilograms is there in 720 milligrams?).
  - c. Calculate density problems

3. Demonstrate knowledge of Matter
  - a. Distinguish between physical and chemical properties/changes of matter.
  - b. Recognize/classify property/change of matter as physical or chemical.
  - c. Identify physical change as melting, freezing, condensation, evaporation, sublimation, or deposition.
  - d. Distinguish pure substances and mixtures
  
4. Demonstrate knowledge of elements, compounds, atoms, atomic structure and ions.
  - a. Interpret formulas of compounds, qualitatively and quantitatively.
  - b. Identify atomic number, atomic mass, and properties of the three basic subatomic particles.
  - c. Define isotopes, its relationship with mass number and atomic mass.
  - d. Determine the number of protons, electrons, neutrons in an isotope (or in ion of an isotope).
  - e. Explain formation of an ion (provide number of electrons added or removed from the atom?).
  - f. Predict the charge on the ions from the main groups elements.
  - g. Write the electron configuration for an atom of the element.
  - h. Identify the element from its electron configuration.
  
5. Interpret the periodic table, and its relationship to chemical and physical properties of the elements.
  - a. Determine the order of increasing/decreasing ionization energy in a given list of elements
  - b. Determine the order of increasing/decreasing atomic radius in a given list of elements
  - c. Determine the order of increasing/decreasing electronegativity in a given list of elements
  - d. Distinguish between metals, metalloids, nonmetals, and know their properties
  - e. Recognize members of the representative families of elements
  - f. Predict ion symbols of the main-group elements, correctly indicate their charges.
  
6. Name and give the formulas for simple ionic and covalent compounds.
  - a. Formulate the compound for a given name
  - b. Name the compound for a given formula
  - c. Formulate the compound from ions
  - d. List ions that compose a given compound, and correctly label the electrical charge on them.
  
7. Correctly identify different types of chemical reactions and properly balance chemical equations.

- a. Recognize redox-reaction (combustion, synthesis, decomposition) precipitation and acid-base reactions
  - b. Modify the coefficients for the reactants and the products of an unbalanced chemical equation.
  - c. Calculate the sum of coefficients of a chemical equation.
8. Do calculations using atomic mass and Avogadro's number.
    - a. Interconvert number of grams, moles and molecules
    - b. Calculate the % composition of a compound
    - c. Calculate the empirical and molecular formula from % composition and molecular mass.
  9. Solve stoichiometry problems (mole/mole, mass/mass).
    - a. Given a quantity of one reactant, calculate the quantity of another based on a chemical equation.
    - b. Calculate the quantity of the product based on limiting reagent
    - c. Calculate the theoretical yield of a chemical reaction
    - d. Calculate the percentage yield of a chemical reaction.
  10. Demonstrate knowledge on energy and the effect of energy on matter.
    - a. To understand energy and how energy flows
    - b. Distinguish between endothermic and exothermic process
    - c. Solve problems incorporating specific heat using the formula  $Q=s \times m \times \Delta T$
  11. Correctly identify various bonding types and know the properties of ionic and covalent compounds.
    - a. Classify bond type in a given compound or specific bond between two atoms
    - b. Determine the order of increasing/decreasing polarity in a given list of bonds
    - c. Determine orientation of dipole moment in a given bond or a molecule
    - d. Identify ionic, polar covalent and nonpolar covalent bonds of compounds
    - e. Know the differences in properties between covalent and ionic compounds.
    - f. Be able to draw Lewis and molecular structure
  12. List or recognize the basic postulates of the kinetic molecular theory and be able to do calculations based on gas laws relating pressure, volume, number of moles and temperature.
    - a. Convert between different temperature scales.

- b. Convert between different pressure units.
  - c. Given initial conditions (P, V, T), calculate final conditions (P, V, T).
  - d. Calculate the unknown quantity using  $PV = nRT$  equation.
13. Demonstrate familiarity with intermolecular forces and the energy requirements for changes of state.
- a. Identify intermolecular forces that exist between molecules of a given chemical substance.
  - b. Know the difference between hydrogen bond, dipole-dipole, and London dispersion forces.
  - c. Show familiarity with heating/cooling curve of substances.
  - d. Solve problem incorporating molar heat of fusion.
  - e. Solve problem incorporating molar heat of evaporation.
14. Do calculations with solutions of varying concentration units (mass, molarity, and dilution problems).
- a. Given quantities of a solute and a solution, calculate the percent concentration.
  - b. Calculate the molar concentration (molarity) from the quantity of the solute and the volume of a solution.
  - c. Calculate the amount of the solute contained in the solution based on the molarity and the volume
  - d. Calculate the volume of a solution of a known molarity based on the amount of the solute
  - e. Calculate the mass of the solute contained within a solution based on the percent concentration
  - f. Solve a “dilution problem”, that utilizes the dilution formula:  $M_1 \times V_1 = M_2 \times V_2$ .
15. Recognize and give the properties of acids/bases/salts and solve simple neutralization problems.
- a. Given an acid and a base write equation of the neutralization reaction they undergo.
  - b. Solve a “titration problem”, that utilizes the end point formula:  $M_{\text{acid}} \times V_{\text{acid}} = M_{\text{base}} \times V_{\text{base}}$ ; ( $n_{\text{H}^+} = n_{\text{OH}^-}$ ).
  - c. Calculate a pH of a solution, provided concentration of either  $\text{H}^+$  or  $\text{OH}^-$ .
  - d. Given a pH of a solution, calculate the concentration of  $\text{H}^+$  and/or  $\text{OH}^-$ .
  - e. Interconvert between pH and pOH.
  - f. List properties of acids, bases, and salts.

\*\*\*\*\*INSERT MATH 99 SLO's HERE\*\*\*\*\*

**Involved Faculty:**

Chemistry 201 Course Coordinator: Maria Valentino  
Chemistry 201 Instructors: All

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

**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 Physical Science Department is using the 2009 Toledo Chemistry Placement Exam, prepared by the American Chemical Society (ACS), consisting of 60 multiple-choice questions (a-d) which the student answers in 55 minutes. The test contains three parts, General Mathematics, General Chemical Knowledge and Specific Chemical Knowledge. The test is administered to Chemistry 201 students, within the first two days of class, in order to evaluate the preparedness of the students for the General Chemistry I (CHEM 201) course.

**Why:** The test is administered to Chemistry 201 students in order to evaluate the preparedness of the students for the General Chemistry I (CHEM 201) course. The goal is to identify prerequisite deficiencies early in the semester so that at risk students can be successfully relocated to a more skill appropriate Chemistry 121 (Basic Chemistry) course.

**How:** In order to use the Toledo Exam as an indicator of potential success in Chemistry 201, Chemistry 121 students were given the Toledo Exam. Using this information, minimum scores were identified that correlated to successful completion of Chemistry 121 (which is the Chemistry 201 prerequisite course). These threshold scores can be used to guide student advisement by identifying a weakness in basic chemistry, math or both while class schedules can still be adjusted.

**When:** The Toledo test is given the first day of class within a semester. If necessary, low scoring students can be switched from Chemistry 201 to Chemistry 121 during this time.

**Who:** The Chemistry 201 Coordinator, Dr. Maria Valentino.

**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).**

**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?

**Action Plan Based on Results and Analysis**

Based on what was learned, what additional steps will be taken to improve student learning?



