Chemistry Department Assessment Plan
University of Wisconsin – Eau Claire
Redeveloped: Fall 2009 – Fall 2012
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Revised:

Chemistry Departmental Learning Goals:

1. Students will develop a rigorous understanding of chemical principles and techniques, based on established theory and practice.

2. Students will develop effective written and oral communication skills.

3. Students will develop the ability to formulate creative questions and critically analyze data and observations in the context of accepted models.

4. Students will realize that chemistry is a human endeavor, and that advances in chemistry impact society.

5. Students in multi-disciplinary programs will develop and utilize connections between chemistry and the other fields related to their particular major.

Alignment with UWEC Baccalaureate Learning Goals:

• Goal #1 corresponds directly to UWEC’s first Goal referring to Knowledge.

• Goal #2 corresponds directly UWEC’s third Goal referring to Communication skills.

• Goal #3 is an adaptation of UWEC’s Critical and Creative Thinking Goal.

• Goal #4 addresses issues related to UWEC Goals #4 & 5, Individual and Social Responsibility (and ethics), as well as Respect for Diversity.

• Goal #5 builds on UWEC’s Goal #6 which refers to Integrated Learning.
Outcomes

Outcomes for Learning Goal #1:

Students will develop a rigorous understanding of chemical principles and techniques, based on established theory and practice.

Students should be able to…

A. **Visualize and describe the particle nature of matter, and use it to rationalize observations and account for chemical mass balance.**

Examples of skills that demonstrate attainment include the ability to:

- Comprehend that matter is composed of atoms, and how this manifests integer-ratio relationships (*i.e.*, in chemical formulas and reactions)
- Describe the structure of atoms
- Appreciate the dual particle/wave nature of matter and electromagnetic radiation,
- Apply the Law of Mass Conservation to chemical reactions (*e.g.*, stoichiometry)

B. **Describe the structural properties of matter, predict chemical stability using both intuitive and quantitative considerations, and make connections between physical properties and chemical structure.**

Examples of skills that demonstrate attainment include the ability to:

- Distinguish between the various types of bonding and types of compounds
- Interpret stability in terms of structural representations
- Interpret thermodynamic data related to stability
- Recognize how structural features (particularly through intermolecular forces) dictate bulk physical properties

C. **Classify and predict chemical transformations, describe and rationalize reactivity via both intuitive and quantitative considerations.**

Examples of skills that demonstrate attainment include the ability to:

- Identify key reaction types (Acid/Base, Redox, etc.)
- Rationalize strengths of reagents in such reactions in terms of structure (*i.e.*, “intuitive”) and thermochemical data (*i.e.*, “quantitative”)
- Interpret and apply thermodynamic data to predict reactivity
D. Make observations/measurements and interpret them, prepare/synthesize compounds, and characterize chemical samples and their transformations.

This outcome addresses the development of core laboratory skills:

- Mass and volume measurements
- Analytical techniques
- Synthesis and purification techniques
- Molecular Isolation and separation techniques
- Characterization techniques
- Operation of standard instruments, and the interpretation of data from them

Outcomes for Goal #2:

**Students will develop effective written and oral communication skills.**

Students should be able to…

A. *Clearly communicate technical concepts to a scientific audience.*

Examples of skills that demonstrate attainment include mainly the ability to prepare laboratory reports and oral (or poster) presentations for a chemically-literate audience.

B. *Clearly communicate scientific ideas to a general audience.*

Examples of skills that demonstrate attainment include mainly the ability to prepare papers and presentations for a non-chemically-literate audience.

C. *Demonstrate information literacy, including the ability to search literature databases, as well as read and interpret articles.*

Examples of skills that demonstrate attainment include:

- The ability to read journal articles critically and for key content
- The ability to use literature databases to find articles
- The development of some awareness of scope of the chemical literature, and the procedures involved in the publishing process

Outcomes for Goal #3:

**Students will develop the ability to formulate creative questions and critically analyze data and observations in the context of accepted models.**

Students should be able to…

A. *Portray chemical structures, graphical representations and other mathematical models that and demonstrate systematic relationships.*
Examples of skills that demonstrate attainment include the ability to:

- The ability to draw structures (by hand and with graphical software)
- Create graphs
- Use graphs or equations to illustrate mathematical relationships within a set of data

B. Interpret qualitative observations, experimental numeric and spectral data, and computational results to deduce and comprehend relationships and draw conclusions.

Examples of skills that demonstrate attainment include the ability to:

- Interpret graphs and quantitative relationships therein
- Interpret spectra and other instrumental data
- Use data to characterize compounds, quantify the amount of a substance, or determine a physical property

C. Critically evaluate their own or others’ work within an appropriate context: established principles, published data, and/or theoretical predictions.

Examples of skills that demonstrate attainment include the ability to:

- Compare results (e.g. reaction yields, measured or computed properties) to the published values
- Explain discrepancies obtained via such comparisons
- Analysis of errors?

D. Synthesize elements of prior knowledge, literature research and experimental results to generate questions, propose and design experiments and procedures, and refine understandings.

Examples of skills that demonstrate attainment include successful student-driven (self-directed) work in a variety of laboratory settings, including:

- Laboratory practicals
- Qualitative analyses of unknowns
- Quantitative analysis of new substances
- Research projects

Outcomes for Goal #4:

Students will realize that chemistry is a human endeavor, and that advances in chemistry impact society.

A. Function as an effective member of a group or team, and conduct themselves with integrity in such a setting.

Examples of settings in which students can demonstrate this ability include:
• Lab courses that require students to work in teams or pairs
• Group projects in lecture courses
• Collaborative Research

B. Describe how new findings are disseminated within the scientific community, as well as the standards for validity and ethical conduct in this arena.

Examples of settings in which students can demonstrate this ability include:

• Upper-level lab courses
• Research (i.e. conference presentations or research publications)

C. Identify and describe instances in which breakthroughs in chemical technology have led to societal benefits, and others which have resulted in adverse effects on people and/or the environment.

This outcome refers directly to students’ ability to make connections between chemistry and society. Examples include the impacts of the chemical industry, fertilizers, CFCs, etc.

D. Realize that a chemist’s social identity and personal experiences can influence their work, and in turn, a chemists’ perspective may have influenced their viewpoint or outlook.

This outcome refers directly to students’ ability to make connections between ethnicity or nationality and a chemist’s work. Examples include: Fritz Haber’s work for the Germans, and Watson and Crick’s treatment of a Rosalind Franklin.