PROGRAM ASSESSMENT REPORT
AY 2008-2009

Report Date: 6/1/09

School/College: Arts and Sciences

Department/Program: Chemistry

Person completing the Report: Tami Spector

1. **Overview Statement**: Briefly summarize the assessment activities that were undertaken this academic year, indicating:

    a. Which program learning outcomes were assessed this year.
    i) Solve typical theoretical and experimental problems in chemistry.
    ii) Acquire and analyze data using experimental, computational and instrumental methods.
    iii) Plan and perform chemical experiments, including running basic synthetic reactions and employing isolation and purification techniques.
    iv) Find, organize and present valid scientific information in written and oral form assisted by computer technology.

    b. Who in your department/program was involved in the assessment of the above learning outcomes: Claire Castro, Jeff Curtis, William Melaugh, Tami Spector, Kim Summerhayes. .

2. **Please Answers (sic) the Following Questions for Each of the Student Outcomes Assessed:**
    a. <u>What did you do?</u>
    Describe clearly and concisely how you assessed the learning outcomes that were evaluated this year (e.g., measures, research methods, etc.). [please use bullet points to answer this question]

    - Outcome (i):
        a) Overall evaluation of the 18 chemistry majors in Physical Chemistry I (Chem. 340) based on the learning outcomes rubric developed for this outcome.
        b) Analysis of chemistry major scores on embedded questions in the final exams for two sections of Organic Chemistry II (Chem. 231) taught by two different faculty (9 students). The questions assessed the students' abilities in spectroscopic analysis and synthesis.

- Outcome (ii), (iii) and (iv) :
  a) Overall evaluation of the 13 chemistry majors in Inorganic Chemistry (Chem. 420) based on the learning outcomes rubric for this outcome.
- Outcome (iii):
  b) Analysis of student achievement on a lab practical exam and semester long evaluation of their laboratory technique in Organic Chemistry Lab II for majors (Chem. 233) (11 students).

b. <u>What did the faculty in the department or program learn</u>?
Summarize your findings and conclusions as a result of the assessment indicating strengths and weaknesses in student learning demonstrated by this assessment.

Analysis of data

Outcome i.a (upper division majors):

<u>Theoretical Problem Solving Skills</u>	<u># of students/%</u>
Good to very good	10/18 (55%)
Average	6/18 (33%)
Poor	2/18 (11%)

Outcome i.b (lower division majors):

- Spectroscopic analysis:

Good to very good	6/9 (67%)
Average	3/9 (33%)
Poor	0/9 (0%)

- Synthesis:

Good to very good	5/9 (55%)
Average	0/9 (0%)
Poor to very poor	4/9 (45%)

Outcome ii.a (upper division majors):

<u>Data Acquisition and Analysis Skills</u>

Good to very good	6/13 (46%)
Average	3/13 (23%)
Poor	4/13 (31%)

Outcome iii.a (upper division majors):

Ability to Plan and Perform Experiments	# of students/%
Good to very good	6/13 (46%)
Average	3/13 (23%)
Poor	4/13 (31%)

Outcome iii.b (lower division majors):

Good to very good	8/11 (72%)
Average	3/11 (28%)
Poor	0/11 (0%)

Outcome iv.a (upper division majors):

Ability to Find, Organize and Present Scientific Info	
Good to very good	6/13 (46%)
Average	3/13 (23%)
Poor	4/13 (31%)

Conclusions:

Both lower division courses that were assessed were in Organic Chemistry, which is significantly less mathematical and more conceptual than upper division courses. This fact is reflected in the relatively higher achievement of majors in these classes relative to upper division students. Parsing the lower division data further, we find that theoretical multi-step synthesis problems challenge our students more than the other assessed lower division outcomes. Such synthesis problems involve a type of logic akin to mathematical reasoning, with which many of our students also struggle (see below).

Approximately half of upper division students will graduate with skills to excel professionally in chemistry, whether in industry or in pursuit of a higher degree. This accords with the trend that we have observed for our students following graduation. In addition, ~50% of our students are not adequately prepared for the theoretical and mathematical rigor of our upper division courses. The following factors contribute to this weakness:

- Some students come to USF with poor math abilities. These students often do not test into the calculus sequence required for the Chemistry major and, consequentially, must take precalculus before they can start the required calculus

sequence.

- The period between calculus (usually taken their Freshman year) and upper division chemistry courses leads to students forgetting the math necessary for upper division chemistry courses.
- The calculus students learn in Calculus I and II does not cover some of the methods students need to succeed in the upper division chemistry courses (e.g., differential equations).
- Some students take their upper division courses concurrently (e.g., Inorganic and Physical Chemistry I) rather than sequentially (first Physical Chemistry I, then Physical Chemistry II and finally Inorganic Chemistry) as the department prefers.

c. <u>What will be done differently as a result of what was learned</u>?
Discuss how courses and/or curricula will be changed to improve student learning as a result of the assessment. Include a discussion of how the faculty will help students overcome their weaknesses and improve their strengths.

To help students who are underprepared in theoretical problem solving at the lower division level we have implemented math placement cutoffs for entrance into General Chemistry I. Students must have EITHER a 480 on the math SAT OR a 20 on the Math ACT OR a 19 on the USF math placement test to take General Chemistry, and thus have multiple opportunities to test into General Chemistry I. Anticipating that some student's scores will prevent them from enrolling in General Chemistry I, we have shifted our Prechemistry course into the fall semester so that they can take a course aimed at enhancing their problem-solving skills and prepare them for the rigors of General Chemistry the following year.

For underachievers in upper-division theoretical problem solving, the math placement requirements and curriculum revisions already described will mitigate students' difficulties with the math required for their chemistry courses. In addition, we will now require students to achieve a B in both Physics II and Calculus II in order to simultaneously enroll Physical Chemistry I and Inorganic Chemistry.

We cannot at this juncture distinguish between student performance on outcomes in the laboratory and lecture classroom based on our current data. Similarly, insufficient data prevents us from properly accessing outcome iv. In the coming year the department will develop better assessment tools to evaluate these outcomes and tease out their nuances regarding student performance.

3. **Attach a copy of the components of the department/program assessment plan that have been modified since its initial submission:** We have changed none of the components listed below since initial submission of the assessment plan in October 2008. Perhaps after

completion of this first year in which we have analyzed assessment data the department will decide to change aspects of these plan components.

a. Program Mission
b. Program Learning Goals
c. Program Learning Outcomes
d. Program Learning Rubrics aligned with outcomes
e. Curriculum map that shows the courses that pertain to the outcome

Please return to: Provost Office by June 1, 2009

You can send your replies as either a Word attachment (to: marin@usfca.edu) or as a hard copy to: Provost Office, Lone Mountain Rossi Wing 4th floor.

If you have any questions, please contact: William Murry, Director of Institutional Assessment (wmurry@usfca.edu or x5486).