2009-2010 Assessment Plan Report

PROGRAM ASSESSMENT REPORT
AY 2009-2010

Report Date: August 2010

School/College: College of Arts and Sciences

Department/Program: Chemistry

Person completing the Report: Professor Claire Castro

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

    a. which program learning outcomes were assessed this year.

    Outcome a: *Identify and articulate foundational chemical principles of each sub-discipline in our curriculum* (new);

    Outcome b: *Solve typical theoretical and experimental problems in chemistry* (on-going);

    Outcome c: *Acquire and analyze data using experimental, computational and instrumental methods* (on-going);

    Outcome d: *Perform and plan chemical experiments, including running basic synthetic reactions and employing isolation and purification techniques* (on going);

    Outcome e: *Find, organize and present valid scientific information in written and oral form assisted by the use of computer technology*. (on-going)

    b. who in your department/program was involved in the assessment of the above learning outcomes:

    Jeff Curtis, Larry Margerum, Claire Castro, Megan Bolitho, Giovanni Meloni, Willie Melaugh

    Summary: Of our six program outcomes, we continued assessment in four areas and began assessment for a fifth; only one program outcome has not yet been assessed. Our methods of assessment ranged from using standardized American Chemical Society exams, embedded questions in exams, class grades on specific assignments, overall class grades, and student presentations at scientific meetings. The courses

involved in the program assessment included both upper division and lower division classes, as well as lecture-only and lecture-lab courses.

2. **Please Answers 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.).

• **Outcome a:** *Identify and articulate foundational chemical principles of each sub-discipline in our curriculum*

1. A standardized American Chemical Society (ACS) exam (70 multiple choice questions) was given as part of the final exam to all students enrolled in second semester General Chemistry (Chem 113). The scores for 77 students (two sections), regardless of major, were recorded. (While the official major count was much lower, there is so much flux with freshmen changing majors at the end of their first year, we felt that data a larger population would provide a more accurate snapshot of students' ability to "identify and articulate foundational chemical principles.") The results from this test were then compared with the national average,(Table 1), which was viewed as our benchmark

2. A standardized American Chemical Society (ACS) exam (50 multiple choice questions) was given as part of the final exam to all 13 students (9 were majors) enrolled in Analytical Chemistry (Chem 260). These results were compared to the national average (Table 1), which was viewed as our benchmark.

3. Embedded questions on the final exams for three sections of the first semester of Organic Chemistry (Chem 230) were uniformly graded for 4 chemistry majors. These questions dealt specifically with basics of organic chemistry and included assessing students' abilities to: "predict the product" of a reaction; to develop a mechanism using curved arrow formalism; to interpret simple NMR spectra (Table 2).

• **Outcome b:** *Solve typical theoretical and experimental problems in chemistry*

1. Analysis of chemistry major scores on embedded questions in the final exams for both sections of Organic Chemistry II (Chem 231). These questions assessed the students' abilities in interpreting spectroscopy, developing a synthesis of a molecule, and in presenting a mechanism for a reaction.

2. Overall evaluation (course grades) of the 14 chemistry majors in first semester Physical Chemistry (Chem 340).

• **Outcome c:** *Acquire and analyze data using experimental, computational and instrumental methods*

1. Assessment of 9 chemistry majors performance on a final laboratory practical in Analytical Chemistry (Chem 260);

2. Overall evaluation of 12 chemistry majors in Inorganic Chemistry (Chem 420), based on the assessment rubric for this outcome.

• **Outcome d:** *Perform and plan chemical experiments, including running basic synthetic reactions and employing isolation and purification techniques*

1. Overall evaluation of 12 chemistry majors in Inorganic Chemistry (Chem 420), based on the assessment rubric for this outcome;

2. Overall evaluation of 6 chemistry majors in Integrated Laboratory (Chem 410), based on the assessment rubric for this outcome.

• **Outcome e:** *Find, organize and present valid scientific information in written and oral form assisted by the use of computer technology*

1. Overall evaluation of 12 chemistry majors in Inorganic Chemistry (Chem 420), based on the assessment rubric for this outcome;

2. Overall evaluation of 6 chemistry majors in Integrated Laboratory (Chem 410), based on the assessment rubric for this outcome;

3. Overall evaluation 9 chemistry majors in Research Methods and Practice (Chem 397) who either presented research posters or a research talk at an American Chemical Society (ACS) meeting.

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

Findings

1. Outcome a: *Identify and articulate foundational chemical principles of each sub-discipline in our curriculum*

(Note: All classes assessed for this outcome were lower-division)

Table 1: Results for ACS standardized exams (2007 version) for Chem 113 (General Chemistry II) and Chem 260 (Analytical Chemistry). National averages in parenthesis. For comparison, assessment from 2009 is also included.

Course	Avg # correct	S. D.	High score	Low score	Total pts possible
Chem 113 (2009) n=78	35.4 (39.4)	9.5	59	15	70
Chem 113 (2010) n=77	37.4 (39.4)	9.8	67	21	70
Chem 260 (2010) n=9	26.4 (27.5)	7.3	36	17	50

Table 2: Results for embedded questions in Organic Chemistry I final exam (Chem 230); n=4.

Type of Problem	Possible points	Averge score	High score	Low score
predict the products	38	21	38	10
mechanism	10	5.8	10	2
spectral interpretation	10	8.3	10	5

Conclusions:

i. **General Chemistry**: If one assumes the national average on a standardized test reflects the benchmark for this outcome, then the performance of our students compares reasonably well (53% vs 56%).

ii. **Analytical Chemistry**: With data on only 9 students, it is difficult to draw a firm comparison between the national average for the standardized exam and the USF average. The preliminary results indicate that our students compare well with the

benchmark standard.
iii. **Organic Chemistry I**: We are unable to draw any conclusions, based on the small number of chemistry majors during this semester. In the future, we will use data from all enrolled students to get a clearer picture of how our learning outcomes are being met by the student population.

2. **Outcome b**: *Solve typical theoretical and experimental problems in chemistry*

(Note: one lower division course and one upper division course were used to assess this outcome)

Lower Division
Table 4: Results for embedded questions in Organic Chemistry II final exam (Chem 231); n=6.

Type of Problem	Possible points	Avg. score	High score	Low score
aromaticity	9	5.7	9	3
spectroscopy	12	12.0	11	6
mechanism	9	4.6	9	2
multi-step synthesis	14	7.3	14	0

These results translate into the following assessment:
17% good to very good
33% average
50% poor

Upper Division

Overall grades of 14 students in Chem 340 (Physical Chemistry I):
36% good to very good;
64% average;
0% poor

Conclusions:

i. Organic Chemistry II: We are unable to draw any firm conclusions, based on the small number of chemistry majors in this class. Clearly there is a range of student ability, with the number of students performing poorly being more populous than the number of students performing very well. However, like Organic Chemistry I, Organic Chemistry II is a large course that serves students interested in pre-professional health programs as well as chemistry majors. Thus, in the future, we will use data from all enrolled students to get a clearer picture of how our learning outcomes are being met by the student population.

ii. **Physical Chemistry I**: All students met the benchmark standard for this outcome, which is an improvement from last year's assessment (11% poor). However, relative to 2009, the %good to very good decreased (36% vs 55%), while %average increased (64% vs 33%). This may be due to different faculty teaching the course rather than a significant change in students' abilities to meet the outcomes.

3. Outcome c: *Acquire and analyze data using experimental, computational and instrumental methods*

(Note: one lower division course and one upper division course were used to assess this outcome)

Lower Division

Lab Practical Scores for Chem 260 (Analytical Chemistry) are listed below. The practical was to devise and carry out an experiment to obtain the pKa of an unknown weak acid. The benchmark score was determined to be 70%.

3 (33%) scored >90%;
2 (22%) scored 70-89%;
1 (11%) scored 60-69%;
3 (33%) scored 50-59%

These scores translated to the following assessment of:
55% good to very good;
11% average;
33% poor.

Upper Division

Using a variety of activities/assignments in Chemistry 420 lab (Inorganic lab), the following overall assessment was obtained (n=12):

67% good to very good;
33% average
0% poor

Conclusions:

i. **Analytical chemistry:** As this was the first time this course was assessed, it is difficult to draw a conclusion. However, that 3 students did poorly on the lab practical reflects the possible need to introduce more "devise and plan" type experiments earlier into the curriculum.

ii. **Inorganic Chemistry**: All students were found competent regarding this outcome. This reflects an improvement from the previous year, in which 31% (4 students) performed below the benchmark. This change may be due simply to variation in student body as the curriculum from the previous year was not changed significantly.

Outcome d: *Perform and plan chemical experiments, including running basic synthetic reactions and employing isolation and purification techniques*

(Note: only upper division courses were used to assess this outcome)

A. Using a variety of activities/assignments in Chemistry 420 lab (Inorganic lab), the following overall assessment was obtained (n=12):

67% good to very good;
33% average
0% poor

B. Using a variety of activities/assignments Chemistry 410 (Integrated lab), the following overall assessment was obtained, n=6:
50% very good;
50% good

Conclusions:

i. **Inorganic Chemistry**: All students were found competent regarding this outcome. As mentioned above, the improvement shown regarding performance in this outcome as compared to the previous year is possibly due to the variability in student performance from year to year.

ii. **Integrated Lab:** As this was the first time this course was assessed, it is difficult to draw a conclusion, however we note that all students were found to meet our

benchmark standard.

Outcome e: *Find, organize and present valid scientific information in written and oral form assisted by the use of computer technology*

(Note: 3 upper division courses were used to assess this outcome)

A. Using a variety of activities/assignments in Chemistry 420 lab (Inorganic lab), the following overall assessment was obtained (n=12):

67% good to very good;
33%% average
0% poor

B. Using a variety of activities/assignments Chemistry 410 (Integrated lab), the following overall assessment was obtained, n=6:

100% good to very good

C. Final poster and oral presentations for 9 students in Chem 397 (Research Methods and Practice):

33% very good;
67% good
0% poor

Conclusion:

Student performance in all three of these courses reflect that all of our majors met the benchmark for this outcome–all were able to find and articulate scientific information, whether as a student report, a mini-class presentation, or a formal presentation at a scientific meeting in a coherent fashion.

c. <u>What will be done differently as a result of what was learned this year</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.

In general, we seem to be doing well in major courses with a lab component. Although, experiments often undergo revision, and lecture styles change, the data does not indicate that a significant change in the curriculum needs to occur as of this writing. More difficult to assess are the introductory courses (General Chemistry and Organic Chemistry) that serve as gateways to the major. While the results of the ACS

standardized exam in General Chemistry suggests that the USF student average is slightly below the national average, this may be due to the USF population (with poorer math skills) rather than be due to a curricular issue. This Fall (2010) the Department will discuss the possibility of increasing the math requirement for General Chemistry I. It is also difficult to determine the strengths/weaknesses of the curriculum when we have such few chemistry majors–variations in student abilities from year to year can skew the statistics, rendering them meaningless. To address this, we will try and assess the entire class for the lower division courses, instead of just the majors.

d. <u>What actions were taken this academic year "to close the loop" relative to what was discovered from last years assessment activities?</u>
Discuss how courses and/or curricula changed to improve student learning as a result of last year's assessment. Include a discussion of how the faculty helped students overcome their weaknesses and improve their strengths.

Last year we implemented a modest increase in the math requirement for those students interested in enrolling in General Chemistry (480 math SAT or 20 on math ACT or 19 on USF math placement), with the goal of setting higher expectations for problem-solving in the course and reducing the number of poorly performing students. While this possibly occurred, as mentioned above, the Department is interested in increasing further the pre-requisite for General Chemistry.

3. **Attach a copy of the components of the department/program assessment plan that have been modified since its initial submission:**
    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

Nothing has been changed.

Please return to: Provost Office by June 1, 2010

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).