Annual Key Assessment Findings and Curricular Improvements

Chemistry Department/A&S

Undergraduate BA/BS Program in Chemistry/Biochemistry/Environmental Chemistry

AY 2015-2016

I. Key Assessment Findings

The CUA Chemistry Department is periodically reviewed by the American Chemical Society for approval of its BS chemistry degree. Approval is granted to institutions meeting faculty, instrumentation, library, and curriculum criteria. The Chemistry Department submitted its latest comprehensive report to ACS in July 2012. The next review should be in 2017.

Senior Assessment

Three candidates for May 2016 graduation completed written research papers and gave oral presentations of their topics, which fulfilled the senior assessment requirement for these students. The group included candidates for the BS in Chemistry and the BS in Biochemistry. All students passed the senior assessment (see table 1).

Table 1 Undergraduate Comprehensive Exam Results

	Fail		Pass		High Pass		Pass w/Honors		
	#	%	#	%	#	%	#	%	TOTAL
BS Chemistry	0	0.00%	1	100.00%	0	0.00%	0	0.00%	1
BS Biochemistry	0	0.00%	2	100.00%	0	0.00%	0	0.00%	2

As indicated in the table of results for the senior assessment rubric that follows, most candidates met expectations in all categories.

Table of Results
Student Learning Assessment Rubric
Department of Chemistry
Chemistry BS, Biochemistry BA/BS, Environmental Chemistry
Senior Assessment

Trait	Level						Mean	Total N
	Exceeding Expectations (3pts)		Meeting Expectations (2pts)		Below Expectations (1pt)			
	N	%	N	%	N	%		
1) Proficiency in curricular content and chemical concepts in the comprehensive paper	2	67%	1	33%	0	0%	2.67	3
2) Written presentation of scientific topics	2	67%	1	33%	0	0%	2.67	3
3) Effective use of peer reviewed scientific literature	0	0%	3	100%	0	0%	2.00	3
4) Oral communication and presentation of scientific topics	2	67%	0	0%	1	33%	2.33	3

1) The "N" represents the number of students at each level of performance for each trait.
2) The "%" represents the percentage of the number of students falling at the level performance for each trait against the total number of students.
3) The mean is the average of all scores across the levels within the trait.

Senior Assessment Rubric

Trait	Level		
	Exceeding Expectations (3pts)	Meeting Expectations (2pts)	Below Expectations (1pt)
1) Proficiency in curricular content and chemical concepts in the comprehensive paper	-Explains concepts clearly and accurately. Links laboratory (or literature) research methods and results to principles learned in coursework. -Defines a research problem (literature or student's own laboratory experience). -Explains experimental design for study of problem. -Accurately analyzes data and clearly presents findings. -Draws/discusses appropriate conclusions. -Discusses topics beyond the coursework exposure.	- Explains concepts clearly and accurately. Links laboratory (or literature) research methods and results to principles learned in coursework. - Defines a research problem (literature or student's own laboratory experience). - Explains experimental design for study of problem. - Accurately analyzes data and clearly presents findings. -Draws/discusses appropriate conclusions.	- Demonstrates limited and/or inconsistent understanding of curricular content, chemical concepts and related areas in the paper. - Fails to explain concepts clearly and accurately. - Does not integrate laboratory (or literature) research methods and results to principles learned in coursework.

2) Written presentation of scientific topics	- Logical presentation following standard scientific reporting format. - No apparent flaws in the scientific reasoning.	- Logical presentation following standard scientific reporting format. - No serious flaws in the scientific reasoning.	- The comprehensive paper is poorly written: it does not present a logical discussion of a topic. - There are serious errors in stated facts or in the scientific

	- Technically wellwritten. - No grammatical errors.	- May contain minor mistakes which do not invalidate the main point(s) of the paper. - May contain minor grammatical errors, but not enough to affect understanding by the reader.	reasoning presented in the paper.
3) Effective use of peerreviewed scientific literature	- Relevant and more than sufficient number of citations of peer-reviewed scientific literature. - Includes current citations. - Thorough and critical evaluation of technical articles. - Literature citations follow an acceptable format.	- Contains a minimum number of citations of relevant peer-reviewed scientific literature. - Includes current citations. - Literature citations follow an acceptable format.	- The comprehensive paper does not contain adequate citations, either to allow the reader to conclude that proper credit has been given to scientific research sources or to bolster statements or conclusions presented in the paper. Enough recent articles have not been cited to ensure that an up-todate review of the topic has been performed.

4) Oral communication and presentation of scientific topics	- Information is presented in a clear and organized manner. - Understanding of the subject matter is apparent. -Explanations are understandable by the general chemistry audience. - Slides, charts, handouts are neat and well-organized. - Appropriate use of chemical structure drawing programs and/or computer presentation software. - Literature references are cited where appropriate for data presented. - Answers to questions reveal a strong conceptual understanding of the topic. - Extrapolates findings of research (either laboratory work or literature work) to address more advanced questions.	- Information is presented in a clear and organized manner. - Understanding of the subject matter is apparent and explanations are understandable to someone in the narrow field of the topic, but not to the general chemistry audience. - Slides, charts, handouts are neat and well-organized. - Appropriate use of chemical structure drawing programs and/or computer presentation software. - Literature references are cited where appropriate for data presented. - Answers to questions reveal a conceptual understanding of the topic. -Cannot extrapolate findings of research (either laboratory or literature work) to address more advanced questions.	-In an oral presentation, the information is not presented in a clear and organized manner. - The student does not display an understanding of the subject matter.

Graduate Placement

Of the three graduates in chemistry and biochemistry in 2016, one has accepted a position as a research assistant in the NIAID clinical center as part of a post baccalaureate program at the NIH, one is attending an MD program at the University of Texas, Medical Branch, and one is attending the Material Science and Engineering program at CUA.

II. Performance in key courses

"Capstone" course: Seniors in the Chem BS program and in the Biochem BS program in this academic year did not take a single course that could be considered a "capstone" course for the programs. All seniors did, however, take Chem 405, Science Communication. All Chem BS majors took Chem 352 and all Chem BS and Biochem BS majors took Chem 401. All Biochem BS majors took Chem 472. Enrollment, grade, and course evaluation data are provided for these courses for the last offerings for the class graduating in Spring 2016.

Physical Chemistry II – Chem 352 (Spring '16)**:**
The Department of Chemistry analyzed course grade, evaluation, and enrollment data in Chem 352 for the last offering of the course (Spring 2016).

For the offering of this course in Spring 2016, enrollment was 3 students. The grades of students in this class spanned A- to A- with an average grade in this course of 3.70 (A-). Course evaluations are not available for this period.

Advanced Inorganic Chemistry – Chem 401(Fall 2014):
The Department of Chemistry analyzed course grade, evaluation, and enrollment data in Chem 401 for the last offering of the course (Fall 2014).

For the offering of this course in Fall 2014, enrollment was 8 students. The grades of students in this class ranged from A to C- with an average grade in this course of 3.09 (B). Course evaluations are available for this period. A 6.49 average course rating and a 6.80 average instructor rating (out of 7) were obtained.

Biochemistry II – Chem 472 (Spring 2015):
The Department of Chemistry analyzed course grade, evaluation, and enrollment data in Chem 472 for the last offering of the course (Spring 2015) taken by this graduating class.

For the offering of this course in Spring 2015, enrollment was 8 students. The grades of students in this course ranged from A to F. The average grade in this course was 3.13 (B). Course evaluations are available for this period. A 6.39 average course rating and a 6.75 average instructor rating (out of 7) were obtained.

Science Communication – Chem 405 (Fall 2015)
The Department of Chemistry analyzed course grade, evaluation, and enrollment data in Chem 405 for last offering of the course in Fall 2015. For the offering of this course in Fall 2015 the enrollment was 4 students. The grades of students in this course ranged from A to F. The average grade in this course was 2.83 (B-). Course evaluations are not available for this course.

III. Curricular Improvements

General Chemistry Labs

In Fall 2015, Dr. Katherine Havanki redeveloped the curriculum for General Chemistry I Lab (Chem 113). The new curriculum is highly aligned with the lecture component of the sequence (Chem 104); topics taught in lecture are experienced by the students through hands-on chemistry activities in the lab. Keeping in mind the challenge of the Laudato Si' to "protect our common home", Dr. Havanki designed all new activities which decrease safety hazards to the students and drastically reduce the production of hazardous waste in the lab, a cost savings for the university.

Dr. Havanki wrote eight new labs that focused on developing technical skills and safe chemical handling while teaching measurement, density, differences in types of compounds, limiting reagents, thermodynamics, and gas laws. Using the computers in the Chemistry Department, students were also introduced to computer modeling software allowing them to visualize compounds and concepts, such as polarity and bond angle, studied in class.

Chem 113 ended with a three-week scenario lab. The goal of this module was to give students an immersive research experience (from development to presentation) within prescribed parameters. Students were able to select one of three scenarios linked to current events: studying the effect of fluoridated water on tooth decay, the cleanup of a chemical spill in a riverbed, and improving a procedure for reclaiming semi-precious metals from the effluent of mining operations. Given a list of materials and an overarching goal, teams of two or three students developed a research proposal (including: research question(s), procedures, chemical safety information, and an analysis plan for data) by drawing on their experience from previous laboratory activities. Proposals were evaluated by the teaching staff before students engaged in their experiment to ensure student safety. Students ordered their own materials and equipment from the stockroom, collected data, and wrote reports on the research findings. Informal feedback from the students indicated that the scenario lab was their favorite activity of the semester because it allowed them to design and run their own experiment.
In Spring 2016, the General Chemistry II Lab (Chem 114) activities remained the same as previous semesters; however, Dr. Havanki introduced a new scenario lab. In this three-week activity, students selected one of two scenarios that were tied to topics studied in lecture: the kinetics of bleaching dyes or the identification of an unknown acid. Students worked in groups

of two or three to develop a proposal, order materials, and collect data. The scenario lab culminated in a poster session where students presented scientific posters about their findings. Feedback from the students indicated that they enjoyed the scenario lab and learned a lot about scientific research in the process.

For the upcoming academic year, Dr. Havanki will develop new labs for Chem 114 that are closely aligned with the lecture curriculum and write new scenarios that can be used in Chem 113 and Chem 114. The new labs will continue to focus on building laboratory skills and reinforcing concepts from General Chemistry Lecture while introducing new techniques that are used in later chemistry offerings. Dr. Havanki will also perform an evaluation of the scenario lab modules to determine its overall impact on the course and effectiveness on student learning.

Instrumentation

~$260K in instrumentation was acquired in donations from the DEA. The department also purchased a Perkin Elmer FT Infrared Spectrophotometer with ATR accessory to be used in the Instrumentation and Organic Chemistry labs. Currently plans are being made to purchase a 60MHz NMR, which will be heavily used in the organic lab sequence, Chem 213 and Chem 214, and introduced into the general chemistry labs Chem 113 and 114.