Undergraduate Program-Specific Student Learning Outcome and Success Annual Report

I. Program Information

Program/Department: Chemistry Program, Department of Biology and Chemistry
Department Chair: Mel Govindan
Department Assessment Committee Contact: John Ludlam (jludlam@fitchburgstate.edu)

II. Program-Specific Student Learning Outcomes (Educational Objectives)

List ALL Program-Specific SLOs first, and the assessment timeline (annual or bi-annual) for assessing each program SLO.

Program SLO	**Expected Timing of assessment (annual, semester, bi-annual, etc.)**
Problem Solving Skills, Chemical Literature and Information Management Skills, Communication Skills, Ethics	Spring 2017 (annual)
Disciplinary Knowledge and Skills	Spring 2017 (annual)

III. <u>SLO Assessment</u> (Please report on the SLO's most recently reviewed)

Using the table below, list and briefly describe the direct methods used to collect information assessing whether students are learning the core sets of knowledge (K), skills (S) and attitudes (A) identified as essential.

Dept. SLO #	**Assessment description (exam, observation, national standardized exam, oral presentation with rubric, etc.)**	**When assessment was administered in student program (internship, 4th year, 1st year, etc.)**	**To which students were assessments administered (all, only a sample, etc.)**
1. Problem Solving Skills	Oral presentation with rubric	4th year	All students in capstone course
2. Disciplinary Knowledge and Skills	Oral presentation with rubric	4th year	All students in capstone course
3. Chemical Literature and Information Management Skills	Oral presentation with rubric	4th year	All students in capstone course
5. Communication Skills	Oral presentation with rubric	4th year	All students in capstone course
7. Ethics	Oral presentation with rubric	4th year	All students in capstone course
2. Disciplinary Knowledge and Skills	Exam	4th year	All students in capstone course

IV. Summary of Findings: Briefly summarize the results of the assessments reported in Item III above and how do these compare to the goals you have set?

Other than GPA, what data/ evidence is used to determine that graduates have achieved the stated outcomes for the degree? (e.g., capstone course, portfolio review, licensure examination)	**Who interprets the evidence? What is the process? (e.g. annually by the curriculum committee)**	**What changes have been made as a result of using the data/evidence?**
Oral presentation with rubric (Appendix A), results summarized in Appendix B	Spring 2017 observation by assessment committee	None to date
Disciplinary knowledge and skills exam	Spring 2017 by assessment committee. Results not included in this report (exam administered during Final Exams)	None to date

V. SSC Data

Indicate a student success performance measure(s) that the department identified as a key measure that it wants to improve. Freshman retention, bottleneck courses, graduation rates, at risk student retention etc.

Student Success Measure (data point from SSC)	**Rationale for selection**	**Planned or Implemented Intervention**	**Current score/ Target Score**
Gateway course performance	There is no SSC data yet for the Chemistry major. However, Chemistry 1300 was identified as a critical gateway course for Biology majors. Student receiving less than a C had a very low probability of graduating in Biology.	To encourage students to master the content in Chemistry 1300 the department instituted the following in a Spring 2016 AUC proposal: "Chemistry majors must earn a minimum grade of 2.0 in General Chemistry I. If a grade below 2.0 is earned, General Chemistry I must be repeated before enrolling in General Chemistry II. Chemistry majors are limited to two attempts for this course." To increase the probability of success for students enrolled in General Chemistry II, the department initiated a Spring 2017 AUC proposal 39, by which MATH 0200 was reclassified as a pre-requisite course. Presently MATH 0200 is a pre-requisite concurrent course.	Data not yet available for new chemistry program.

VI. Phase I Data

Indicate department success performance measure(s) that the department identified as a key measure that it wants to improve (from phase 1 data). Number of graduates, number of majors, credit production, substitutions etc.

Department Performance Measure (data point from Phase 1)	**Rationale for selection**	**Planned or Implemented Intervention**	**Current score/ Target Score**
Number of Majors - Chemistry	The number of declared majors will be a key metric for determination of the growth and success of the new Chemistry major	Benchmarks for program enrollment were set in section E-2 of the 2013 New Academic Program proposal to the Board of Higher Education on the reinstatement of the Chemistry major at Fitchburg State University. While enrollment in the Chemistry program has nearly matched the enrollment targets, these values are closely monitored due to the importance for growing the enrollment to the health of the major. To this end, the Department plans to continue coordination with the Office of Admissions to assist with outreach and marketing efforts of this major at Fitchburg State University.	AY 2014-2015 Current 10 / Target 8 AY 2015-2016 15 /18 AY 2016-2017 28 / 30

VII. Activities and Adjustments to/Deviation from the Department Assessment Plan

Describe any changes in the assessment plan including new SLOs, new assessments.

The Chemistry program was reinstated in Academic Year 2014-2015 and Spring 2017 was both the first year the capstone Chemistry Seminar ran and the first time the Chemistry program was assessed. Together with the Director of Assessment (C. Cratsley) we accepted new SLOs (Appendix C) based on the American Chemistry Society standards. The Assessment Committee assessed (1) individual student oral presentations on semester-length research projects using a rubric and (2) disciplinary knowledge using an exam with questions contributed by the chemistry faculty.

Appendix A. Chemistry Seminar Presentation Assessment (May 9th, 2017) *Write comments on back, including suggestions for improving rubric.*
Presenter Name: _____ Presentation Title: _____

	Proficient 3	**Sufficient** 2	**Deficient** 1	**Rating (1, 2, 3 or N/A)**
Define problems clearly	Identifies a creative, focused, and manageable topic that addresses potentially significant yet previously less-explored aspects of the topic.	Identifies a focused and manageable/doable topic that appropriately addresses relevant aspects of the topic.	Identifies a topic that is far too general and wide-ranging as to be manageable and doable.	
Ability to retrieve information by searching the chemical literature	8 – 12 journal articles from the primary literature.	8 – 12 journal articles from the primary literature, some review articles included.	<8 journal articles from the primary literature, other sources such as web articles.	
Evaluate technical articles critically	Synthesizes in-depth information from relevant sources representing various points of view/approaches.	Presents information from relevant sources representing limited points of view/approaches.	Presents information from irrelevant sources representing limited points of view/approaches.	
Students present information in a clear and organized manner	Delivery of presentation is well-organized, professional, and coherent. Images and text are clearly readable to the audience.	Delivery of presentation is organized, professional, and coherent. Images and text are mostly readable to the audience.	Delivery of presentation lacks organization or is not always coherent. Images and text not always easily read by audience.	
Use relevant technology in communications	Effectively uses technology to present supporting text and images to the audience.	Uses technology to present supporting text and images to the audience.	Unable to use technology to present supporting text and images to the audience.	
Draws appropriate conclusions from chemical literature	Presentation interprets, connects and expands on results and conclusions from the different sources, and formulates a coherent argument about a topic.	Results from different sources are compared and contrasted but does not formulate a coherent argument about a topic.	Presentation mainly reports results and conclusions of journal articles from the primary literature.	
Use of modern instrumentation and computational modeling	Able to clearly express an understanding of basic principles of analytical instrumentation or computational modeling applied in the presentation. *For example: if the presentation deals with NMR, the student is able to explain the principle behind NMR*	Able to express an understanding of basic principles of analytical instrumentation or computational modeling applied in the presentation.	Unable to clearly express an understanding of basic principles of analytical instrumentation or computational modeling applied in the presentation	

	techniques.			
Proper citation of others' work	Properly cites sources in text and for images used in the presentation	Mostly cite sources in text or for images used in the presentation	Does not properly cite sources in text or for images used in the presentation	

Appendix B. Summary of Results.

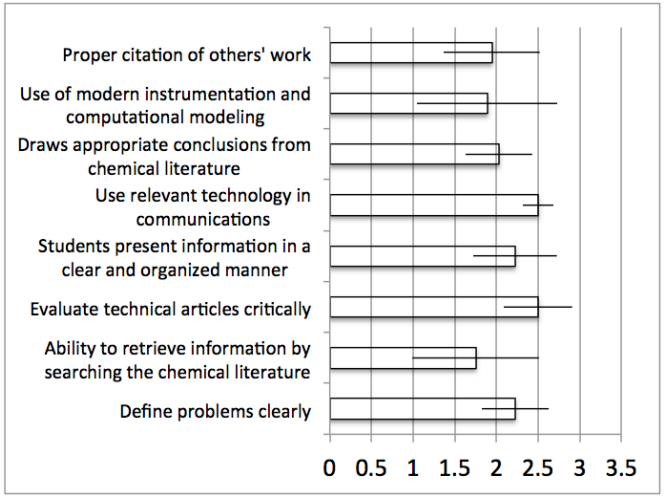

Figure 1. Results of assessment of oral presentation with rubric (Appendix A).

Three members of the Departmental Assessment Committee (two chemists and one biologist) evaluated oral presentations in the Chemistry Seminar Capstone Course in May 2017. Six of seven students presented on that day on individual semester length literature review projects on topics of their own choosing. This is the first graduating cohort of chemistry majors in the program.

On average, most learning outcomes were considered met (5/8 outcomes ranked sufficient (2.0) or better, all outcomes ranked at least 1.75). The highest ranked learning outcomes were “Use relevant technology in communications” and “Evaluate technical articles critically”. The lowest ranked learning outcomes were “Ability to retrieve information by searching the chemical literature” and “Use of modern instrumentation and computational modeling”. However, these two items were also difficult to judge accurately in the presentation. For example, proficiency in retrieving information from the chemical literature was determined as “8 – 12 journal articles from the primary literature” because this was part of the assignment. However, it was often difficult to tell how many articles were cited and whether they were primary literature. Future assessment efforts may consider also examining copies of the primary papers being presented or at least the students’ final review papers. This change would also better allow assessment of student ability to “Evaluate technical articles critically”.

In future years alternative modes of assessment should be considered for “Ability to retrieve information by searching the chemical literature” and “Use of modern instrumentation and computational modeling”.

Appendix C: Chemistry Learning Goals/Outcomes (Adapted from the American Chemical Society Standards)

1. Problem Solving Skills. Students should be able to define problems clearly, develop testable hypotheses, design and execute experiments, analyze data using appropriate statistical methods, understand the fundamental uncertainties in experimental measurements, and draw appropriate conclusions.

2. Disciplinary knowledge and skills
students should understand and be able to apply their understanding of all chemistry sub-disciplines and use appropriate laboratory skills and instrumentation to solve problems. These areas of knowledge and skills include:

- Basic chemical concepts such as stoichiometry, states of matter, atomic structure, molecular structure and bonding, thermodynamics, equilibria, and kinetics.
- Basic laboratory skills such as keeping a notebook, use of electronic balances and volumetric glassware, preparation of solutions, chemical measurements using pH electrodes and spectrophotometers
- Foundational knowledge and skills in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry.
- Foundational laboratory skills including synthesis of molecules, measurement of chemical properties, determination of structures, use of modern instrumentation and computational modeling.

3. Chemical Literature and Information Management Skills. Students should be able to retrieve information efficiently and effectively by searching the chemical literature, evaluate technical articles critically, and manage many types of chemical information.

4. Laboratory Safety Skills. Students should be able to demonstrate and apply their understanding of the concepts of safe laboratory practices. They should be able to evaluate and assess safety risks associated with laboratory experiences. Students must be able to:

- carry out responsible disposal techniques
- comply with safety regulations
- properly use personal protective equipment to minimize exposure to hazards
- recognize chemical and physical hazards in laboratories, assess the risks from these hazards, know how to minimize the risks, and prepare for emergencies.
- understand the categories of hazards associated with chemicals (health, physical, and environmental)
- use Safety Data Sheets (SDSs) and other standard printed and online safety reference materials

5. Communication Skills. Students should be able to present information in a clear and organized manner, write well-organized and concise reports in a scientifically appropriate style, and use relevant technology in their communications.

6. Team Skills. Students should be able to interact effectively in a group to solve scientific problems and work productively with a diverse group of peers.

7. Ethics. Students should understand and demonstrate responsible treatment of data, proper citation of others' work, and the standards related to plagiarism and the publication of scientific results. Students should also be able to explain the role of chemistry in contemporary societal and global issues, including areas such as sustainability and green chemistry.