Millikin University
Student Learning in the Chemistry Major

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Executive Summary

The Department of Chemistry supports the mission of the university in preparing students for professional success, democratic citizenship in a global community, and a personal life of meaning and value by producing graduates who achieve the following three chemistry-specific learning outcome goals:

1. Demonstrate the skills to solve problems and communicate through writing and speaking.
2. Discover how to integrate and apply knowledge and skills both within the chemistry community and between chemistry and other disciplinary communities.
3. Develop the capacity to address real-world scenarios in which chemistry plays a role.

outcome of an experiment is an accurate, reproducible, unambiguous result, not a predestined "right one."

2. Modern Chemistry is Integrated
   Chemists address problems with concepts and techniques that span the various sub-fields of chemistry. Moreover, biologists, nurses, psychologists, and physicians also regularly use these same concepts and techniques.
3. The Main Goal of Laboratory is Tackling a New Problem Capably
   We design experiments to develop maximum independence, not maximum coverage.

The curriculum map is included as Appendix 1. Our core curriculum introduces each student to four of the sub-fields of chemistry while providing a foundation in essential laboratory techniques. The additional courses in each emphasis then offer students more specialized technical training. Regardless of emphasis, undergraduate research is the capstone of the chemistry major at Millikin. It has three components, including the proposal, the research, and final written and oral presentations.

The proposal is part of the course CH254 Introduction to Research. The proposal must be a project suggested by a faculty member or an industrial mentor (with consent of a faculty member). The proposal includes a background section that shows careful reading of primary journals. Ideally, the research should be connected to a real-world problem.

In terms of the actual research, we look for consistent work over time. The student should try to do a project that might be presented at a meeting, especially the National Meeting of the ACS. The lab notebook is assessed to determine the quality and quantity of work. The best projects create new knowledge.

In CH482 Senior Seminar, the student writes the final report and presents the work orally. This presentation includes an explanation of the context of the work, the techniques used, the data, and what the results mean. The student is also expected to reflect on what he or she learned about chemistry in the process.

Just as the curriculum helps the department achieve goals for student learning outcomes and helps students actualize their plans of study, so too does the advising process. Advising in the Department of Chemistry facilitates and

a major. In order to realize this mission, we try to help students:

1. Develop plans of study for successfully achieving their degree and career goals,
2. Select courses each semester to progress toward fulfilling their plans of study,

3. Use the resources and services on campus to assist in fulfilling their plans of study, and
4. Graduate in a timely manner.

At least once a semester, the student meets in person with the academic advisor to discuss fulfillment of the plan of study.

Assessment Methods

We decided that assessment of the three stages of undergraduate research is the most informative way to assess the three learning outcome goals. The research project is the culminating event of each goal as well as the climax of each emphasis within the major. We have created rubrics for assessing the proposal, performance, and presentation of research. These rubrics are attached as Appendix 2.

Assessment Data

4 using the

As noted above, each department learning goal will be assessed by evaluating student learning in one class. Five to 10 students from each class will be randomly selected for evaluation. As a general rule, one-half of a given class will be selected; for classes with fewer than 5 students, all students in the class will be evaluated; for classes with greater than 20 students, 10 will be randomly selected.

The grading rubrics used to assess each learning goal have three categories: Excellent, Adequate, and Nominal. The range of points possible on each rubric is 2-
score of 8. A
of 8 on each rubric) if the department goals are being achieved. Realistically, however, there may be students, for a variety of reasons, who are ranked less than
he small sample sizes typically available in a given class, the following assessment criteria will therefore be used to evaluate student progress in achieving department learning goals:

ection and
not requiring any immediate change in course of action): 80% or more of the

desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired

ptable.
Immediate, high priority actions should be taken to address this area): fewer

For reporting purposes, a rubric numeric score of 13-14 will be considered
-12 will

Assessment data are listed in the tables below.

Table 1.

Department Goal 1: Demonstrate the skills to solve problems and communicate through writing and speaking.

Rubric Category	Percentage of students in category
Excellent	12.5
Adequate	62.5
Total of above (used for rating)	75
Nominal	25
Number of students evaluated	8
Average numeric score	8.75

Yellow

Table 2.

Department Goal 2. Discover how to integrate and apply knowledge and skills both within the chemistry community and between chemis97 0.48001 ref*527.26 402.91 0.48004 (

Table 3.

Department Goal 3. Develop the capacity to address real-world scenarios in which chemistry plays a role.

Rubric Category	Percentage of students in category
Excellent	37.5
Adequate	25
Total of above (used for rating)	62.5

On a less than p

3.) What, if anything, would you do differently if you had to complete your

support from the university must dramatically increase.

During 2013-2014, we searched for an analytical chemist to succeed Dr. Acheson. The search committee identified the top six candidates for phone interviews. Two of these candidates were hired at comprehensive universities equal in size to or smaller than Millikin before we had a chance to interview them on campus. Our fourth-ranked candidate was hired at an institution with an approximate enrollment of 1,500 students and

with what other institutions are offering. When a search proceeds as we imagine it, start-up funding is an investment that pays off in multiple decades of service by a dedicated and outstanding faculty member.

Learning

University Goals

1. Professional success
2. Democratic citizenship in a global environment
3. A personal life of meaning and value

Department Goals

1. Demonstrate the skills to solve problems and communicate through writing and speaking.
2. Discover how to integrate and apply knowledge and skills both within the chemistry community and between chemistry and other disciplinary communities.
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Curriculum Map (Lecture/Lab) (Bold = Chemistry core courses)

Year	**Dept. Goal 1**	**Dept. Goal 2**	**Dept. Goal 3**
1	CH121 or CH131/**151** **CH224/CH152**		
2	**CH232/CH253** **CH301/251** **CH302**/CH252		
3	**CH303**/CH351 CH304 CH432	**CH254** CH331/CH354	**CH391-392**
4	CH353 CH406 CH420/CH352 **CH482**	**CH482**	CH470 **CH491-492**

Appendix 2: Evaluation Rubrics for Undergraduate Research

The proposal: grading done by faculty member teaching Introduction to Research

	Excellent	Adequate	Nominal
Process	5 points] A thorough explanation of		

Research: evaluation by faculty mentor using notebook

	Excellent	Adequate	Nominal
Quantity	[5 points] You work consistently over the entire research period with clear evidence of significant weekly work. You consistently report to faculty mentor.	[3 points] You work consistently most of the time but miss from time to time	[1 point] You try to cram the work into a short period
Quality	[3 points] You work efficiently with some measure of success. Your work is worthy of submission to an off-campus conference	[2 points] You have some success but n38 61.36 669.94 Tm0 gC q9.3	

Final Presentation: written and oral report of results

	Excellent	Adequate	Nominal

Appendix 3: Student Learning Evaluation Forms

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 1.

Item evaluated: Final Presentation (written and oral report of results)
Student name:
Date of evaluation:
Evaluation by: Faculty member teaching Chemistry Seminar and/or Faculty Mentor
Faculty name:

Item	Criteria			Student Score
	Excellent	Adequate	Nominal	
Report	[5 points] A report having quality that might be submitted to a research journal. Includes background, data and methods, results, and discussion. Includes suggestion for further work.	[3 points] A good report but missing some aspect of an excellent report	[1 point] A report having minimal value	
Oral Presentation	[5 points] Clear, confident presentation. Audience questions are answered in a way to illustrate a complete knowledge of the topic.	[3 points] A good presentation but lacking clarity or confidence.		

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 3.
-world scenarios in which chemistry plays a

Item evaluated: Research (evaluation by faculty mentor using notebook)
Student name:
Date of evaluation:
Evaluation by: Faculty mentor
Faculty name:

Item	Criteria			Student Score
	Excellent	Adequate	Nominal	
Quantity	[5 points] You work consistently over the entire research period with clear evidence of significant weekly work. You			