Report

Learning Goals

Millikin students thrive through our unique approach to performance learning. In addition to a solid foundation in the theory of a given field, Millikin students gain practical, hands-on experience in their fields of study. Students in the Department of Chemistry demonstrate performance learning in the three stages of an undergraduate research project. Our students learn how to plan and communicate their plan for research by writing a proposal. They learn to conduct research by performing research. They learn how to communicate their results through written and oral presentations. We want our students to learn how to do chemistry the way chemists do it, and we accomplish that by having our students chemistry the way chemists do it.

The Department of Chemistry further 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. The mission of the department is to produce graduates who achieve the following three 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.

The successful graduate of the Department of Chemistry is not necessarily a professional chemist. For example, recent graduates are working in the chemical and pharmaceutical industry, practicing medicine or pharmacy, selling technical goods and services, running their own businesses, teaching, and working in the areas of government and law, among other things.

Snapshot

The Department of Chemistry is approved by the Committee on Professional Training (CPT) of the American Chemical Society (ACS). The department consists of five full-time faculty members representing the five major sub-fields of chemistry: analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. All chemistry majors choose one of

psychology, and exploratory studies, . Our CH224-Inorganic Chemistry and CH301/302-Organic Chemistry courses each serve approximately 50-65 students per year, primarily chemistry and biology majors. In the decade from 1994 to 2004, approximately nine majors per year graduated with chemistry degrees. Since 2004, the number of majors has typically been above that number-as high as 18 in 2008-in part due to our new science center. Slightly fewer than half of our graduates pursue advanced degrees.

The Department of Chemistry resides in the 83,000-square-foot Leighty-Tabor Science Center, which opened in the spring 2002 semester. We also joined Midwestern University in a dual-acceptance pre-pharmacy agreement. In terms of curriculum, our most recent initiatives have been in course delivery, specifically the Block CH121, designed for students with limited chemistry backgrounds, that meets five days a week for half the semester. The block concept was extended to our CH203/205 ð Essentials of Organic and Biochemistry service course during the spring 2005 semester. Beginning in 2008, ACS-CPT modified the curricular requirements necessary for program approval. A review of our curriculum indicates that our current curriculum meets the modified ACS-CPT requirements. Working in cooperation with the staff of Staley Library, we added two new resources in 2008 and 2009 for students to use in research: ACS Web Editions and SciFinder web version

continue this relationship and increase the number of students participating in the program.

The Learning Story

Three hallmarks characterize the typical learning experience provided through the chemistry major:

1. Do Chemistry as Chemists Do It
   Students use modern instruments from the first lab class in the first year; repeating experiments should be normal, not remedial. The desired 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 four components, including the proposal, the research, a final written report, and a final oral pre.05 599.98 Tm[( )] TJET 599.98 Tm[( )] TJET (l)-d

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 integrates reasoned choices that promote the studentûs growth as a person and as 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,

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

Table 4.

Year-by-Year Comparisons.

Year →		2008	2009	2010	2011
Goal ↓					
1	Rating percentage	89	80	83	89
	ñColorò rating	Green	Green	Green	Green
2	Rating percentage	100	83	100	100
	ñColorò rating	Green	Green	Green	Green
3	Rating percentage	80	100	80	80
	ñColorò rating	Green	Green	Gree	

research mentor has to work with each student. This year, the department taught normal teaching loads and had a full complement of faculty, and we are pleased to note that the quality of student research increased this year compared to last year. If students are to be prepared for professional success, it is vital that faculty have the time and resources to adequately mentor students.

As will be seen in Table 5 (the class of 2011 was one of the strongest groups we have had academically in many years. In addition to their academic success, 100% of the students who wanted to attend medical or professional school were admitted to the school of their choice. Students will attend such schools as University of Pennsylvania, Virginia Tech Carilion Medical School, University of Illinois – Chicago, and University of California – Irvine. Furthermore, 100% of the students who actively pursued industrial employment found jobs at companies such as Tate & Lyle, ADM, and Oberweis Dairy. Looking ahead to the class of 2012, we realize this group is not as strong as the class of 2011. We therefore anticipate a slight decline in our numerical evaluation of student learning. Nevertheless, we are pleased with how well the class of 2011 thrived during their time at Millikin.

While we are pleased that our students achieved an acceptable level of learning on all three of our learning goals, we know that we cannot rest on our laurels. We continually evaluate our curriculum, keeping two areas foremost in our evaluation: 1. Are we delivering a quality education to our students? and 2. How well do our students learn?

Quality

We are confident in the quality of our program. Our program is accredited

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

Curriculum Map (Lecture/Lab) (Bold = Chemistry core courses)

Year	**Dept. Goal 1**	**Dept. Goal 2**	**Dept. Goal 3**
1	CH121/**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 previous work to a clear study question followed by analysis of previous work to synthesis into a coherent proposal.	[3 points] Shows some evidence of the process: explanation to conjecture to analysis to synthesis but incomplete.	[1 point] Restates some general ideas or issues but shows no evidence of analysis.
Connection	[3 points] A good proposal has a history. This includes your personal experience, it has a real-world context, and it has a connection to previous work both at Millikin and in the literature.	[2 points] Shows you understand the history of the proposal by examining some of your own experiences in the past as they relate to the proposal but otherwise incomplete.	[1 point] Minimal connections made.
Readings	[4 points] In-depth synthesis of thoughtfully selected aspects of readings related to the proposal. The readings are significant and appropriate at the college level. While you may use data and primary texts collected from the internet, the majority of readings are from library sources. Makes connection between what is learned from readings and the proposal.	2 points] Goes into more detail explaining some specific ideas or issues from readings related to the topic. Makes general connections between what is learned from readings and the topic.	

Research: evaluation by faculty mentor using notebook

	Excellent	Adequate	Nominal
Quantity			

Final Presentation: written and oral report of results

	Excellent	Adequate	Nominal
Report	[5 points] A report having quality that		

Appendix 3: Student Learning Evaluation Forms

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 1.

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 2.
ñDiscover how to integrate and apply knowledge and skills both within the

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 3.
ñDevelop the capacity to address real-world scenarios in which chemistry plays a role.ò
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			