

Millikin University
Student Learning in the Chemistry Major

By Ed Acheson, Paris Barnes, George Bennett, Clarence Josefson, Anne Rammelsberg

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. ACS Web Editions allows students to search 34 ACS journals online. SciFinder allows students to search a multitude of scientific journals in all areas of science. In terms of

õ I tggp nki jvö (an acceptable level or clearly heading in the right direction and not requiring any immediate change in course of action): 80% or more of the students tcpmgf ðcfsgwcvgö qt ðgzegngpvö;

õ [gnnqy nki jvö (not an acceptable level; either improving, but not as quickly as desired or declining slightly. Strategies and approaches should be reviewed and appropriate adjustments taken to reach an acceptable level or desired rate of improvement): 60% vq 80% qh vjg uvwfgpvu tcpmgf ðcfsgwcvgö qt ðgzegngpvö; cpf ðTgf nki jvö (qwt ewttgpn uvcvwu qt fktgevkqp qh ejcpig ku wpceegrvcng. Ko o gfkcvg, high priority actions should be taken to address this area): fewer than 60% of the stwfgpvu tcpmgf ðcfsgwcvgö qt ðgzegngpvö.

For reporting purposes, a rubric numeric score of 13-14 yknn dg eqpukfgtgf ðgzegngpvö; c score of 8-12 yknn dg eqpukfgtgf ðcfsgwcvgö; cpf c ueqtg nguu vjcp 8 yknn dg eqpukfgtgf ðpq o kpcnö.

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	3967	0.48	0.4800
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Table 3.

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

Rubric Category

student learning, this is one area where we must and will continue to work with students to strengthen their skills.

Y jknq fgrctv o gpv iqcn 3 ycu tcvgf ð i tggp nki jvö hqt cecfg oke {gct 2009-2010, we noted a decline in the quality of student research. We attribute this decline to two factors: 1. a decline in the quality of our students; and 2. extraordinary time pressures on faculty preventing them from devoting appropriate attention to student research.

As noted earlier, the number of chemistry majors has increased over the past five years. While we have seen an increase in absolute numbers of majors, the academic qualifications of these students, as measured by such things as ACT scores and high school preparation, is not as high as we would like. Recognizing this, the chemistry faculty will increase our efforts in the future, in cooperation with Admissions, to recruit more students with stronger academic backgrounds.

During academic year 2009-2010, faculty were asked to voluntarily teach overloads due to financial pressures at Millikin. All the tenured faculty in the Chemistry Department volunteered to do so, but teaching an overload necessitated sacrificing other duties such as supervision of student research. Furthermore, one faculty member was on sabbatical during the spring semester. Other faculty in the department supervised his research students, further diluting the time available to each individual student. We believe the quality of student research is directly proportional to the time the research mentor has to work with each student. With normal teaching loads and a full complement of faculty, we are cautiously optimistic that next academic year will see an increase in the quality of student research.

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

We conduct exit interviews with each of our graduating seniors. We ask students to be prepared to discuss the following six questions (students are given the questions in advance):

- 1.) What will you be doing one year from now?
- 2.) What will you most remember about your experience as a chemistry major five years from now?
- 3.) What, if anything, would you do differently if you had to complete your degree all over again?
- 4.) How would you advise a new chemistry student?
- 5.) What are the strengths of the chemistry program?
- 6.) What aspects of the chemistry program need improvement?

Students are open and honest in their responses to these questions. The overall message we receive from students is "keep doing what you have been doing". Even so, students often offer specific suggestions for improvements in the department, which we take to heart. Students have commented that our curriculum does not give students any historical perspective on the field of chemistry. We therefore modified CH482, Chemistry Seminar, to incorporate the reading of more historical texts. In recent years, we have read texts such as "Uncle Tungsten", "Einstein's Luck", "Collapse" and "Polio: An American Story." Students expressed a desire to have more exposure to forensic chemistry, so CH253, Intermediate Lab III, now includes one or two forensic chemistry projects each year.

Learning

In addition to the learning goals and assessment measures described in this report, we also use additional measures to assess student learning in the chemistry program. We continually monitor and evaluate these measures of student learning. We monitor the quality of our students' writing on formal laboratory reports, research proposals, and research reports. We see a downward trend in the quality of writing—a situation admittedly not unique to chemistry, but disturbing nonetheless. We encourage students to take advantage of the resources available at Millikin's Writing Center, and mentor students one-on-one. We administer standardized exams such as those developed by the American Chemical Society's Examinations Institute and the Educational Testing Service Major Field Test in Chemistry. We find that our students typically score below the 50th percentile on such standardized exams. We view the standardized exams as a measure of our students' long-term learning, and are concerned with the relatively poor performance of our students on these exams. We will devote more effort in the future to improving our students' long-term learning while still maintaining their excellent showing on our learning goals.

Improvement Plans

As noted above, one area we intend to work on is **improving long-term learning**. We administer the ETS Major Field Test in Chemistry in our seminar course, CH482. In

collect data in the coming years to be better able to identify trends that may need to be addressed in more depth.

Appendix 1: Curriculum Map for Chemistry

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 <i>clear</i> 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.	[1 point] You show some evidence of reading about the topic and are able to state some general ideas or issues from readings related to the topic. But there is no evidence of library research beyond the class textbook, secondary sources and the internet.
Grammar	[2 points] No spelling or grammar errors.	[1 point] Few spelling and grammar errors.	[0 points] Many spelling and grammar errors, use of incomplete sentences, inadequate proof reading.

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 not at the level worthy of an off-campus conference	[1 point] Work is not worth crowing about.
Notebook	[4 points] Notebook is clearly written and contemporaneous.	2 points] Notebook is contemporaneous but hard to follow.	[1 point] Your notebook is incomplete and a mess.
Safety	[2 points] You consistently use safe practice and clean up your work area.	[1 point] You consistently use safe practice but leave a mess behind.	[0 points] You work in an unsafe manner.

Final Presentation: written and oral report of results

Millikin University
Department of Chemistry
Student Learning Evaluation

Evaluation of: Department Goal 2.

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