Chemistry Department

2017-2018 Annual Assessment Report

The mostly closely assessed course in the Chemistry Department is the introductory sequence (General Chemistry - CHEM110, CHEM 120). The Chemistry Department runs 5-7 concurrent sections and it is a gateway to a large number of science majors and professional programs. In 2013, we published a paper detailing our new CHEM110 & CHEM120 laboratory program developed and assessed in 2003- 2009 [*J. Chem. Ed.* **2013**, 694-699]. After improving the laboratory, we looked toward student success in the course.

Anecdotal evidence has long suggested that weak math skills track with poor success in Chem110 and Chem120. In 2013-2014, Professor Lars Seme of the Hendrix College Mathematics and Computer Science Department did an analysis for the Office of Advising to examine this link. In particular, three questions were investigated:

1. Was there evidence that math training was linked to success in chemistry?
2. If so, was there a math ACT cut-off below which students should be discouraged from starting General Chemistry as freshmen?
3. Did taking the lowest math course ("Functions and Models") concurrent with the first General Chemistry course improve student outcomes?

The final report "Preparation of General Chemistry -2013-14" can be found on the Chemistry Department Moodle page. A regression analysis was done on data from students who took either CHEM110 or CHEM120 between the Fall of 2004 and Spring 2013 where MATH ACT scores were also available. This data included a total of 1260 students where 1224 students started in CHEM 110. The regression analysis showed a clear correlation between MATH ACT score and grade earned in CHEM110 ($R = 0.535$, $p << 0.01$). In short, based on the 70% confidence intervals, there was a low chance of attaining a "C" in CHEM110 if the student's MATH ACT was less than 24.

A significantly smaller data set (180 students) was used to examine the effect of taking "Functions and Models" (MATH120, lowest level math class) on CHEM110 grades for students with a MATH ACT of less than 24. While the effect was small, students that took MATH120 before taking CHEM110, consistently outperformed the students who took no math class. There was a slight preference for taking MATH120 before, rather than concurrently, with CHEM110.

The results from this analysis were first included in new student advisor training in 2014-2015. Ideally, application of this study to first year advising should result in:

1. fewer students starting the CHEM110 with a weak math background and
2. fewer students unsuccessfully completing the CHEM110 course (unsuccessful = W, F, or D).

We will assess the effect of this change in first-year advising by:

1. comparing the % of CHEM110 students with MATH ACT less than 24 in the before the advising change cohort (Fall 2004 – Spring 20013) and after the advising change cohort (Fall 2014 – Spring 2018).

    a. At a deeper level, we will try to see if the students with an ACT of less than 24 taking CHEM110 have taken or are enrolled in MATH120 (Functions and Models). This data might be inaccessible.
2. comparing the % of CHEM110 students unsuccessfully completing CHEM110 in the before the advising change cohort (Fall 2004 – Spring 20013) and after the advising change cohort (Fall 2014-Spring 2018).

Liz will get the data from Randy Peterson and report her first round of analysis at the fall chemistry department retreat.

Present Assessment Work –Written Scientific Communication Our present assessment work centers on the effectiveness of teaching scientific writing in the Chemistry major. The ultimate assignment for written scientific communication is our capstone paper which builds upon writing assignments in physical chemistry, laboratory reports in ATEC, and longer library research papers written in CHEM350 (optional in the major) and CHEM440 (required for the major). Shorter, laboratory note-book write-ups are required in the 100 and 200 level chemistry major courses.

The capstone paper in the senior year is particularly designed to help strengthen students in three of our six learning goals:

#1. acquire the fact-based knowledge necessary to understand chemistry as citizens and practice it as scientists,
#3. develop the critical thinking skills necessary to assess and assemble facts and data, and
#5. communicate chemistry effectively in written and oral forms.

Each capstone paper is guided by one faculty member and the resulting paper is read by the mentor and one other faculty member. One of the challenges of this assignment is the number of faculty involved in guiding and assessing the work. We have four new colleagues (within first two years) in a department of eight fulltime faculty.

We want to know:

1. Are our standards for the capstone paper consistent across the department?
2. Are students effectively communicating science in a written form in the senior paper?
    a. If not, where are the weaknesses?

In 2016-2017 we developed a grading rubric to strengthen consistency of expectations across the capstone papers. The grading rubric gives broad generalizations for strong science and strong writing.

Although the faculty seem to value the rubric, we need to validate the rubric with an intention of examining consistency of expectations across subdivisions of the chemistry faculty (e.g. organic, biochemistry, and physical chemistry). To this end:

1. in the August of 2018 the department will choose two non-"A" papers from the recent past. Before the fall retreat, each paper will be graded by ½ the department by using the rubric (see table I for who works with which paper).

2. rubric assessment and individual grading notes for written portion will be collected from each faculty member.
3. In the next step during our August retreat, pairs of faculty from different sub-disciplines will discuss their grading, any differences they had in grading (pairs are listed below). These discussion pairs will record their differences, and will propose a manner to clarify the rubric or the paper directions.
4. The discussion groups will grow from pairs to groups of 4 to repeat the assignment in Step #3.

These discussions should either prove that the rubric functions well, suggesting that faculty have similar expectations of the assignment, or differences in expectations will be illuminated so that the rubric or the assignment directions can be edited.

Group #	**Paper A**		**Paper B**	
1	Andres	Peter	David	Bill
2	Heidi	Liz	Mike	Courtney

Score	Criteria	Excellent
Content 60 pts	**Topic**	• Relevant to the field of chemistry and is based on the state-of-the-science or cutting-edge research in chemistry. (last 10 years) • Short, informative and catchy title
	Abstract (Write this last)	• Follows guidelines for length (150 words or less) • Concisely answers the "what?", "why?", "how?", and "to what end?"(describes context, purpose, and content) • Engages the reader
	Introduction:	• Provides context for the topic by identifying it's relation to the field of chemistry • Demonstrates a complete, clear, and accurate understanding of the 'big picture' "Why is this question important/ interesting in this field? What do we already know? What do we not yet understand? What problem/question is this paper addressing?"
	Background:	• A concise, specific and well-organized description of the knowledge necessary to digest the scientific content of the paper • Completely accurate and referenced correctly • Relevant to the topic • Critical terms and abbreviations are defined
	Synthesis/Analysis	• Creatively synthesizes relevant information from multiple primary sources in the chemistry literature • Critically assess information presented • Compares and contrasts information from multiple sources • Major points presented in the paper support the analysis
	Information	• A well-organized, concise, comprehensive and accurate description of a large amount of high quality, challenging information/data that supports the research paper topic • Describes all chemical information accurately and adequately for the reader to understand the challenging topics presented • Chemical information is supported by writer's pre-existing chemical knowledge from coursework completed at Hendrix
	Conclusion	• Creates and defends a new position and/or additional insight based on a reasoned assessment of the information presented • Presents significance and limitations of conclusions • Presents future directions that are salient, plausible and insightful • Fully evaluates validity of writer's conclusions and assumptions based on data and information presented
Writing 40 pts	**Writing quality**	• 12 pt font, 1 in. margins, page #s • Correct grammar and spelling • Carefully edited and proof-read. (One can only achieve this through multiple revisions) • Word choices facilitate reader's understanding • Sentence and paragraph structure clear and well-organized • Informative subheadings that aid comprehension and organization • An organizational strategy illustrating evidence of active planning for presenting information clearly and effectively • Effective transitions to aid flow of information from one main point to another • Meets paper length requirements
	Figures	• Support the major points presented • Discussed within the text of the paper • Have descriptive captions, including appropriate references
	References	• Appropriate peer-reviewed and primary literature sources are used • Indicate an extensive literature search was performed (at least 8 references) • Properly and accurately cited within text and bibliography. (See *ACS Style Guide*)

Late Penalty: 10%/day for 1st 3 days; 5%/day after that

Assessment tools routinely used by the Chemistry department (updated spring 2018)		
Assessment Type \ **Assessment Standard**	Internal	External
Informal	• Student Course Evaluations (Used formally during faculty evaluation years) ***Indirect*** • Common Assessments across concurrent course sections: Gen Chem I & II, Org I & II, PChem II and Biochem; Common finals for concurrent laboratory sections: GenChem I & II, Org I & II, Biochem, and ATEC lab. • List of External Student Research Presentations • Senior Independent Research Paper (Used formally and externally in 5 yr ACS-CPT review)	• ACS-National Standardized Final exams: Chem120; Chem 250; Chem 310; Chem 320; Chem 330; Chem 350; Chem440 • Professional Plans of Recent Graduates
Formal	• Senior Capstone papers • Senior Capstone seminar presentations • Senior Survey: Student Assessment of Learning Gains (SALG) ***Indirect*** • Hendrix Annual Assessment Update	• Senior Capstone exam (MFT or ACS-DUCK) • ACS-CPT (5 year cycle with yearly updates) • Hendrix Program review (8 - 9 year cycle)

Assessment Audit: Departmental Learning Goals versus Individual Course Goal (Spring 2018)

This chart uses a 3 point scale to indicate the correlation between the departmental learning goals and individual courses: N/A Not Applicable; 1 Slightly Important; 2 Moderately Important; 3 Very Important

Department Goals: / Courses:	Acquire fact-based knowledge	Execute Exp'ts / Design Exp'ts	Develop critical thinking skills to assess and assemble facts & data	Work effectively in groups	Communicate chemistry effectively	Assess the ethics of work
Chem 100 Concepts	3	N/A	2	1	3	3
Chem 101 Chem of Envir.	3	2 / 1	3	3	3	3
Chem 101 Lab	1	3 / 1	3	3	1	1
Chem 110 &120 Gen Chem	3	N/A	2	1	1	1
Gen Chem Lab	2	2 / 1	3	2	2	1
Chem 150 Adv. Gen Chem	3	N/A	2	1	1	1
Chem 150 Lab	2	2 / 1	3	2	2	1
Chem 240 & 250 Organic	3	N/A	3	N/A	1	2
Organic Lab	3	3 / 1	3	2	2	3
Chem 280 Env. Analysis	3	NA / 3	3	2	3	3
Env. Anal. Lab	2	3 / 3	3	3	2	1
Chem 310 & 320 P-Chem	3	N/A	3	1	3	1
ATC Lab	2	3 / 3	3	3	3	2
Chem 320 lab	3	3 / 1	3	3	2	1
Chem 330 Biochem.	3	3 / 3	3	2	2	2
Biochem Lab	3	3 / 1	3	3	2	1
Chem 335 Adv BioChem	3	N/A	2	1	1	1
Chem 340 Adv. Inorg.	3	N/A	3	1	2	2
Chem 350 Adv. Anal.	3	N/A / 1	3	2	3	2
Chem 410 Adv. P-Chem	3	2 / 2	3	1	2	1
Chem 450 Fac. Spon. Res.	2	3 / 3	3	2	3	3
Chemistry Capstone Paper	3	N/A	3	N/A	3	1