

1. Action Items from Previous Report (2013-2014)

The following action items were listed in the *Strategic Department Goals* worksheet submitted at the end of the 2013-2014 academic year:

- **Recruitment:** The Chair of the Chemistry Department spends an average of at least one hour each week recruiting new students. Most department members spend at least ten hours each semester recruiting new students. This includes involvement in scholarship weekends, registration of new students, interviewing students and showing them around the department, and hosting visitors in our classrooms.
- **Retention:**
 - Our best chemistry majors are hired as Peer Tutors who are available for ten to twelve hours per week to help students with homework and lab reports. Faculty hold study-sessions outside of class before most exams to review material with students.
 - We invite our best chemistry majors to participate in the chemistry department as lab assistants and student workers.

During the 2014-2015 academic year, the faculty in the Chemistry Department continued to make these same contributions to recruit and retain students. We note that there were no scholarship competitions this year, but chemistry faculty have participated in whatever recruitment activities for which our presence was requested, including the Academic Distinction Celebration hosted by Admissions in March.

Regarding retention, it has been routine for many years for the faculty in the department to hold review sessions and invite our best students to participate as tutors, lab assistants, and student workers.

The action item below was put forth by the Chemistry Department to be included in the Official Monitoring Report to the Middle States Commission on Higher Education.

- Require students to develop a research proposal during their junior year. Students will formulate research idea, select an advisor, gather relevant literature and write a proposal during the spring semester of their junior year.

The Chemistry Department was not able to accomplish this action item. Writing a research proposal is a significant undertaking. It requires careful deliberation to develop a project of significant scope. A thorough review of relevant scientific literature is necessary as well. The Chemistry Department considered it inappropriate to ask this of the students completing their junior year this past spring. Upper level coursework in chemistry is challenging, and it seemed unreasonable to pile the responsibility of writing a research proposal on top of the students' other demands, especially when no official course credit is given for this additional work. In the future, we intend to fulfill this action item by including the research proposal as an assignment in a course specifically designed for junior chemistry majors or first semester senior chemistry majors.

2. Assessment Activity 2014-2015

Below we list the Chemistry Department learning outcomes:

A student who graduates with a B.S. in Chemistry, B.A. in Chemistry, B.A. in Biochemistry, or B.A. in Environmental Chemistry degree will:

- A. Demonstrate the ability to conduct an internal or external research project.
- B. Be prepared for chemistry-related employment or admission into graduate or professional programs including medical, dental, or veterinary schools.
- C. Possess scientific literacy and problem-solving skills associated with the main branches of chemistry: analytical, biochemistry, inorganic, organic, physical and environmental.

Learning Outcome (A)

In fulfillment of learning outcome (A), students are expected to complete Chem490 or Chem495, which are one-credit courses in which the students undertake a research project that is sufficiently broad in scope and magnitude as to represent a significant contribution to scientific knowledge. In order to evaluate whether the students' work satisfies learning outcome (A), the Chemistry Department has created a series of four rubrics to assess the following components of a suitable research project:

Component of Research Project	Assessment
1. Original experimental work will be conducted by the student in the laboratory	Carrying Out Research Rubric
2. All research conducted will be recorded in a laboratory notebook	Laboratory Notebook Rubric
3. Results will be evaluated and effectively communicated	Research Report Rubric
4. Competency in operating modern instruments and handling chemicals and lab apparatus will be demonstrated	Carrying Out Research Rubric
5. Literature searches will be done effectively in support of the research proposal and report	Research Proposal Rubric Research Report Rubric

The Chemistry Department has decided that accumulating greater than 70% of the points associated with the criteria on each of the rubrics represents satisfactory achievement of learning outcome (A).

Three chemistry majors completed Chem490 during 2014-2015. All students scored better than 70% on the Carrying Out Research Rubric and Laboratory Notebook Rubric; however, none of the students scored better than 70% on the Research Proposal Rubric or the Research Report Rubric.

Learning Outcome (B)

In order to determine whether our students are satisfying learning outcome (B), the Chemistry Department reviews the following data:

- Annual records of the number of graduates who secure employment or gain admission to graduate or professional schools
- Records of the number and quality of internships, jobs, and summer-research programs in which students participate

There was one chemistry major who graduated in May of 2015; this same student completed an internship at Jamestown Coatings during academic year 2014-2015, and she is currently seeking employment. Two seniors (one of whom is double-majoring in chemistry and secondary education) need to return to Thiel to complete additional coursework before being awarded degrees. One student who completed her junior year has been provisionally accepted to attend pharmacy school in the fall of 2015 as part of our articulation agreement with Lake Erie College of Osteopathic Medicine.

A few chemistry majors applied for summer research positions through the Research Experience for Undergraduates (REU) program, which is funded by the National Science Foundation. As of the submission of this report, none of these students have yet been offered the opportunity to participate in the REU program this summer.

Learning Outcome (C)

To continue acquiring and refining their scientific literacy, upper class students must complete two chemistry seminar courses (Chem 470 and 480) in which they give several oral presentations on current, cutting edge research. The Chemistry Department was generally disappointed with the quality of the presentations given in these classes during Fall 2014 and Spring 2015. The students' work lacked sophistication and projected a rather superficial understanding of knowledge within the discipline.

To determine whether students acquire problem-solving skills, the Chemistry Department decided to administer the "Diagnostic of Undergraduate Chemistry Knowledge" (DUCK) examination for the first time at the end of the 2013-2014 academic year. The DUCK exam is a nationally normalized exam prepared by the American Chemistry Society (ACS) that contains 60 questions and requires 120 minutes to complete. This exam provides a direct measure of the knowledge that students acquire as a result of their chemistry coursework and other learning experiences. In April of 2014, all six graduating seniors were asked to complete the exam. This was possible because they all were enrolled in the seminar course (Chem 480) that Dr. Khalsa was teaching at the time.

The Chemistry Department did not have the opportunity to administer the DUCK exam during 2014-2015. Not all seniors who either graduated or were granted permission to walk had the flexibility in their schedules to take the exam.

3. Assessment Summary

During 2014-2015, three chemistry students enrolled in Chem490 and completed research projects. These three students satisfactorily achieved the standards outlined in the Carrying Out Research Rubric and the Laboratory Notebook Rubric, but their work did not satisfactorily meet the criteria in the Research Proposal Rubric and the Research Report Rubric. These students thus demonstrated that they were capable of carrying out the mechanics of performing laboratory work, but they lacked sophistication in their conception of their projects and their abilities to place any of their findings in a meaningful context.

Our only graduating senior is currently looking for employment and is reconsidering applying to graduate school.

Students enrolled in the upper level seminar courses delivered somewhat mediocre oral presentations and generally projected a rather disappointing level of understanding incommensurate with their status as advanced students.

4. Assessment Reflections

It is worth noting at the outset of these reflections that the current group of upperclass students majoring in chemistry is relatively weak. In comparison with the graduating class of 2014, which was very strong, the current students are much less driven and focused. Their work is of considerably lower quality.

The first item to address is the weakness in the research project reports submitted during this academic year. As mentioned above, we had no mechanism in place to get students to begin thinking about their projects before the semester in which the projects were undertaken. Formulating the conceptual framework for a project and then writing a proposal are tasks that are just too overwhelming to be completed in addition to other academic demands, especially if this proposal is not a component of a course grade. Furthermore, the time required for such deliberation is time that is not productively spent during the first few weeks of the very semester in which the project is to be completed. We view this as a primary factor in the disappointing quality of the reports submitted this year and in some previous years. In response to this, the Chemistry Department made significant changes to its curriculum during the 2013-2014 academic year, including the addition of two capstone courses to replace Chem 470 and 480, the upper level seminar courses. These capstone courses are scheduled to be offered for the first time in 2016-2017, and we anticipate that these courses will dramatically improve many deficiencies in the current curriculum that are obvious in this assessment report. The first of the two capstone courses will include an assignment to prepare a research proposal in anticipation of undertaking a research project in a subsequent semester. This should help the students produce projects that are noticeably improved. The proposals for these capstones courses will be submitted to the Curriculum Study Committee in the fall of 2015.

The Chemistry Department recognizes that this assessment would have been much more complete if we had administered the ACS DUCK exam this year, but it was not possible to find a convenient time to do so. In the future, the capstone courses should help address this. In particular, the second of the two capstone courses will serve as a convenient mechanism to gather all graduating seniors for the purpose of taking the ACS DUCK exam.

It was noted in this report that the oral presentations delivered in the upper level seminar courses (Chem 470 and 480) this year were not particularly well done. It is disconcerting that the evidence that we have for comparing the weaker presentations delivered this academic year is purely anecdotal. In the past, the Chemistry Department created an oral presentation rubric, but it has not been routinely implemented in evaluating the many presentations that students prepare in the upper level seminar courses. The chemistry faculty now recognizes the need to use this rubric more consistently.

5. Action Items

The Chemistry Department will focus on the following priorities during academic year 2015-2016:

- i. Course proposals will be submitted for two capstone courses that were included in principle as part of previous revisions to the chemistry curriculum. (These revisions were

approved by the Curriculum Study Committee and Faculty Council during the 2013-2014 academic year.) These capstone courses will have components that involve writing a research proposal and taking the ACS DUCK exam.

- ii. An oral presentation rubric will be revised if necessary and then will be implemented routinely to evaluate students' oral presentations in upper level coursework.
- iii. Course proposals will be submitted for all other courses that have yet been created and are scheduled to be offered in the near future as part of the revisions approved in 2013-2014. These include a one-semester physical chemistry course with a second semester offered as an elective to replace the two-semester sequence that is currently required. An introductory course in inorganic chemistry will also be proposed.
- iv. A significant obstacle with which incoming students typically struggle is their insufficient preparation for the quantitative rigors of our introductory chemistry courses. The Chemistry Department has been strongly considering revising the introductory sequence to begin with organic chemistry. This is attractive for numerous reasons. Many students who take general chemistry are "seeing it again for the first time," so to speak. Some topics may be familiar from their high school courses. Starting with organic chemistry might refresh or even reset the students' interest in the discipline. Since organic chemistry tends to be less heavily laden with calculations and quantitative reasoning, this approach also gives students time to strengthen their mathematical arsenal before tackling kinetics, thermodynamics, and equilibria. During the coming academic year, then, the Chemistry Department will invest significant energy into discussions about the logistics of modifying our curriculum to present organic chemistry first.