Program Name: Chemistry (Pre-Dentistry Track)

Assessed by: Jeff Goff, Dept. of Natural Sciences

Date/Cycle of Assessment: Submitted on 12/19/2019;
Reporting cycle of January 2018 – December 2018

Mission Statement:

The Malone University Department of Natural Sciences exists to engage students in the study of God's majesty and character by exploring His handiwork as it is revealed in Nature, both animate and inanimate; to promote the wise and thoughtful stewardship of the natural resources He has entrusted to us; and to encourage students to demonstrate God's love in their respective communities by using the knowledge and skills they acquire here.

Program Goals:

- Students should comprehend the central concepts of chemistry, the underlying assumptions of chemical knowledge, and be able to employ the methods of inquiry commonly utilized by practicing chemists at a level sufficient for entrance into graduate school, professional schools, and industry (Stems from Malone Educ. Goals A4, D1, and D3).
- Students should become proficient in solving chemical problems using both quantitative and qualitative approaches and in interpreting data generated by analytical instruments commonly employed by practicing chemists (Stems from Malone Educ. Goals C3, D4, and D5).
- Students should be able to apply the principles of Christian Stewardship to chemical practice and interpret chemical phenomena within a Christian worldview (Stems from Malone Educ. Goals D2, E1, and E5).

MALONE UNIVERSITY ANNUAL ASSESSMENT REPORT (See Appendix for Raw Data and Detailed Analysis)

Department: *Natural Sciences*
Program: *Chemistry (Pre-Dentistry Track)*
Assessed by: *Jeffrey M. Goff - Dept. of Natural Sciences*
Time Period Covered: *January 2018-December 2018*
Submission Date: *12/19/2019*

Program Intended Learning Outcomes (PILO)	Means of Program Assessment & Criteria for Success	Summary of Data Collected	Use of Results
Demonstrate the capability of integrating data and assessing phenomena within a Christian paradigm (Departmental Outcome A).	1) Average cumulative score $\geq$ 12; minimum cumulative score of 8; no individual component score of 1 on the Faith and Learning Assessment Instrument as scored by the associated rubric.	Average composite score = 15.92; minimum composite score = 10; all individual component scores were 2 or higher.	Average composite score, all individual composite scores, and all individual component scores met the departmental criteria for success. No changes to curriculum deemed necessary.
Demonstrate a comprehension of the central concepts of chemistry including the major theories and laws which govern chemical phenomena (Departmental Outcome B).	1) Mean score no lower than 0.5σ below national mean and no individual score lower than 1.5σ below the national mean on the ACS Gen Chem II Exam when administered as a post-test. 2) Average Cohort score on ACS Gen Chem II Exam should show at least a 70.0% improvement over the average cohort score when used as a pre-test.	1) Mean score on the ACS Gen Chem Exam is 36.07 (-0.16σ). This year, only one student failed to meet the -1.5σ criterion with a score of -1.54σ. 2) Class average on ACS Gen Chem pre-test is 18.30 giving strong evidence of student improvement (97.1% improvement in score from pre-test to post-test).	This year, the class average met the –0.5σ criterion and we had only a single individual score that failed to meet the –1.5σ criterion. Although the single individual score is disappointing, it is an improvement over last year when 5 students failed to meet the individual score criterion, and the class average has improved as well. Although several reasons were listed in the appendix in support of the fact that results on this instrument need to be used "with a grain of salt", we are encouraged by the improvement. The improvement over the last 2 years might possibly reflect the introduction of the new, alternative "Zoo Chem" option for Zoo & Wildlife Biology majors. Over the next 2 to 3 years, the efficacy of this curriculum change should become more conclusive. The department has opted to postpone any remedial chemistry course development until this 2 to 3 year time window is complete. The ACS Gen Chem II pre-test scores, when compared to the post-test scores, are extremely strong evidence that our students are improving as a result of our freshman chemistry sequence. The department has concluded that whether or not our students enter below the national average, they show significant improvement in content knowledge as a result of this course sequence. STEM readiness scores for this cohort suggest that only 35% of the class was "ready" for Chem 131.

Demonstrate an understanding of the relationships between structure and behavior of the chemical elements in their various forms and combinations (Departmental Outcome C).	1) Mean score no lower than 0.5σ below national mean and no individual score lower than 1.5σ below the national mean on the ACS Organic Chem Exam. 2) Mean score no lower than 0.5σ below national mean and no individual score lower than 1.5σ below the national mean on the ETS chemistry exam Organic sub-category.	1) Mean score on the ACS Organic Chem Exam was 46.4 (+0.59σ). No individuals failed to meet the -1.5σ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 43.7 (–0.30σ). No individuals failed to meet the –1.5σ criterion on the organic section.	1) ACS Organic Exam scores were acceptable this year. 2) ETS Organic sub-scores were also acceptable this year. The department has opted to not make any changes to the curriculum at this time.
Demonstrate safe laboratory practices and an environmental ethic as it pertains to chemical use and disposal (Departmental Outcome D).	Minimum scores of 20, 21, and 24 must be obtained respectively on 3 safety projects completed as a component of our Chem 201 course (Stewardship and Safety in Chemical Practice) and graded via associated rubrics. In addition to the composite scores criteria on all 3 projects, minimum individual element scores have also been set.	All 8 students reached the minimum score of 20 on Safety Project #1. In addition, no individual element score missed the standard. On Safety Project #2, all students who completed the course met the minimum composite score criterion of 21, but one individual element score failed to meet the minimum standard. On Safety Project #3, all students met the minimum composite score criterion of 24, though 1 individual element score missed the minimum standard.	1) Although two individual element scores missed the minimum standard, all composite scores met the standard. The instructor feels strongly that this was due to a lack of time. The extensive one-on-one time required of the professor/student precluded these individuals from repeating a few of the assessments to raise their scores to meet the standard for individual elements. Rather than fail the students, the instructor opted to allow the few sub-par scores with the intention of scheduling additional sessions at the next offering to give each student enough opportunities to meet the minimum scores on each project. The same problem was noted during the Fall 2013 and Fall 2015 offerings of the course, so the good intentions of the instructor have not been sufficient to accomplish the desired change. The department and full faculty recently approved a departmental proposal to add an extra hour to this course. The shortcomings mentioned above have now, we believe, been sufficiently addressed, and no individual element scores are expected to miss the minimum standard at the next offering in Fall 2019.

Demonstrate an ability to analyze various kinds of experimental data used in the chemical disciplines including the output of various instrumental techniques (Departmental Outcome E).	1) Each student must obtain a minimum cumulative score of 15 on each of 5 instrumental assignments (i.e., IR/MS/NMR assignments) completed in Chem 322.	All students who passed the class met the minimum score of 15 on all 5 assignments.	In Spring 2014, the instructor who initially developed the first 5 instruments implemented a policy of assigning a grade of "Incomplete" until a student had met the minimum criteria on all 5 assignments. As a result, the number of deficient criteria has dropped dramatically over the last couple of years. At the encouragement of the Chemistry Program's external reviewers, the departmental chemistry faculty have agreed to add an additional 4 instrumental assignments to the existing slate of 5. The chemistry faculty were hoping to implement these new assignments within the next one or two reporting cycles. The timeline for implementation may be delayed somewhat due to the retirement of one chemistry faculty and the fact that his replacement left after only one semester. To get the ball rolling, the faculty are shooting for Fall 2019 for full implementation. At the moment, however, no changes are warranted other than those already in motion.
Demonstrate a balanced concept of molecular, micro, and macro levels of biological phenomena in the context of human systems (Departmental Outcome L).	1) Mean score no lower than 8/12 on the A&P questions of the in-house biology post-test exam. No individual with a score lower than 5/12. (Note: New instrument – this criterion is still being evaluated). 2) Average improvement on A&P questions from pre-test to post-test should be at least 70% (Note: New instrument – this criterion is still being evaluated).	1) Average post-test score for Spring 2018 was 9.14. Lowest individual score was a 5. 2) Average improvement data is not yet possible for a single cohort (Fall 2018 entry won't have post-test data available until Spring 2022). Nevertheless, we can compare pre-test scores from the Fall 2018 cohort with the post-scores of Fall 2014 (year of entry) cohort collected this spring. Average pre-test score for Fall 2018 was 4.94 and median was 5.0 (compare with average of 9.14 and lowest individual score of 5 for post-test values). "Improvement" in performance across these two different cohorts was 85.0%	This instrument is in its infancy and has been altered twice already to increase its value/efficacy as it is "broken in" over the next year or so. Criteria for success will undoubtedly change over the next couple of years as well. This year, we can at least see that we have met our earliest criteria for success in a somewhat strained analysis (i.e., an 85.0% improvement across two different cohorts). In addition, note that the lowest score on the post-test instrument is better than the average score on the pre-test instrument. No need for curricular change based on these early findings.

Demonstrate the ability to properly relate biological structure and function in the context of human systems (Departmental Outcome M).	1) Mean score no lower than 8/12 on the A&P questions of the in-house biology post-test. No individual with a score lower than 5/12. (Note: New instrument – this criterion is still being evaluated). 2) Average improvement on A&P questions from pre-test to post-test should be at least 70% (Note: New instrument – this criterion is still being evaluated).	1) Average post-test score for Spring 2018 was 9.14. Lowest individual score was a 5. 2) Average improvement data is not yet possible for a single cohort (Fall 2018 entry won't have post-test data available until Spring 2022). Nevertheless, we can compare pre-test scores from the Fall 2018 cohort with the post-scores of Fall 2014 (year of entry) cohort collected this spring. Average pre-test score for Fall 2018 was 4.94 and median was 5.0 (compare with average of 9.14 and lowest individual score of 5 for post-test values). "Improvement" in performance across these two different cohorts was 85.0%	See comments in table cell for Departmental PILO 'L'.
Demonstrate the level of content mastery required for potential successful performance in chemical industry, graduate school chemistry programs, or professional schools (Departmental Outcome P).	1) Mean score no lower than 0.5σ below national mean and no individual score lower than 1.5σ below the national mean on the ETS chemistry exam composite score. 2) Mean score no lower than 0.5σ below national mean and no individual score lower than 1.5σ below the national mean on the ACS Organic Chemistry exam.	1) Mean ETS composite score is 143.7 (–0.36σ). No individuals failed to meet the -1.5σ criterion. 2) Mean score on the ACS Organic Chem Exam was 46.43 (+0.59σ). No individuals failed to meet the –1.5σ criterion.	1) ETS Composite data have been acceptable for the last several years. 2) ACS Organic Chem Exam criteria were met. No curricular changes are deemed necessary at this time based on these instruments.