**Program Name: Chemistry (Pre-Dentistry Track)**

**Assessed by: Jeff Goff, Dept. of Natural Sciences**

**Date/Cycle of Assessment: Submitted on 1/8/2021;**
**Reporting cycle of January 2019 – December 2019**

## 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 2019-December 2019*
**Submission Date:** *1/8/2021*

| 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 = 14.17; 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. Nevertheless, some changes to the wordings of the prompts are anticipated due to the fact that some student responses indicated a misunderstanding of the prompts. |
| 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 0.5$\sigma$ below national mean and no individual score lower than 1.5$\sigma$ 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 33.06 (-0.44$\sigma$). This year, three students failed to meet the -1.5$\sigma$ criterion with scores of -1.55$\sigma$, -1.64$\sigma$, and -1.91$\sigma$. 2) Class average on ACS Gen Chem pre-test is 18.30 giving strong evidence of student improvement (80.7% improvement in score from pre-test to post-test). | This year, the class average met the –0.5$\sigma$ criterion, but we had three individual scores that failed to meet the –1.5$\sigma$ criterion. Although the individual scores are disappointing, the cohort average is higher than 7 cohort averages collected over the last 12 years. 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 year or 2, the efficacy of this curriculum change should become more conclusive. The department has opted to postpone any remedial chemistry course development until this 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 0.5$\sigma$ below national mean and no individual score lower than 1.5$\sigma$ below the national mean on the ACS Organic Chem Exam. 2) Mean score no lower than 0.5$\sigma$ below national mean and no individual score lower than 1.5$\sigma$ below the national mean on the ETS chemistry exam Organic sub-category. | 1) Mean score on the ACS Organic Chem Exam was 32.14 (–0.58$\sigma$). No individuals failed to meet the -1.5$\sigma$ criterion. 2) Average sub-score on the Organic section of the ETS chemistry exam was 48.0 (+0.01$\sigma$). No individuals failed to meet the –1.5$\sigma$ criterion on the organic section. | 1) The results this year seem to be anomalous. Although no single student missed the individual minimum standard, the collective cohort average slightly missed the minimum standard. Furthermore, this cohort's average ACS Organic Exam score was the lowest documented over the last 10 years.<br>2) ETS Organic sub-scores were acceptable this year.<br>The conflicting results from our two assessments have given us pause as we reflect on potential changes. Given the historic success on these two instruments (and no changes in the curriculum), the department has opted to not make any changes to the curriculum at this time. We simply need to see if this is an anomaly or the beginning of a downward trend. |
| 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 3 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, and all individual element scores met the standard as well. On Safety Project #3, all students met the minimum composite score criterion of 24, and all individual element scores missed the minimum standard as well. | 1) All composite scores and elemental scores met the standard. These results stand in contrast to the results from the last several offerings of the course and seem to reflect positively on the curricular change that was implemented prior to this iteration of the course (an extra credit hour was added to the course). The shortcomings mentioned in previous reports have now, we believe, been sufficiently addressed, and no individual element scores are expected to miss the minimum standard in the future. No further changes are warranted at this time. |

| | | | |
|---|---|---|---|
| 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 6 instrumental assignments (i.e., GC instrument administered in Chem 221 and IR/MS/NMR assignments administered in Chem 322). | All students who passed the class met the minimum score of 15 on all 6 assignments. | This report contains data from the GC instrument for the first time, though data from the other 5 instruments have been collected for several years. An additional 3 instrumental assignments are anticipated to address the comments made at the last programmatic review. 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. 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).<br>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 2019 was 8.45. Lowest individual score was a 6.<br>2) Average improvement data is not yet possible for a single cohort (Fall 2018 – the first pre-test data available – won't have post-test data available until Spring 2022). Nevertheless, we can compare pre-test scores from the Fall 2019 cohort with the post-scores from Spring 2019. Average pre-test score for Fall 2019 was 4.35 and median was 4.5 (compare with average of 8.45 and lowest individual score of 6 for post-test values). "Improvement" in performance across these two different cohorts was 94% | 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., a 94.0% 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).<br>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 2019 was 8.45. Lowest individual score was a 6.<br>2) Average improvement data is not yet possible for a single cohort (Fall 2018 – the first pre-test data available – won't have post-test data available until Spring 2022). Nevertheless, we can compare pre-test scores from the Fall 2019 cohort with the post-scores from Spring 2019. Average pre-test score for Fall 2019 was 4.35 and median was 4.5 (compare with average of 8.45 and lowest individual score of 6 for post-test values). "Improvement" in performance across these two different cohorts was 94% | 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 $0.5\sigma$ below national mean and no individual score lower than $1.5\sigma$ below the national mean on the ETS chemistry exam composite score. 2) *Tentative* criteria for success on brand new in-house chemistry exam include a mean score no lower than 32 on the in-house chemistry exam and no individual score lower than 24. | 1) Mean ETS composite score is 155.0 (+0.45σ). No individuals failed to meet the $-1.5\sigma$ criterion.<br>2) No Data | 1) The ETS composite scores are certainly acceptable this year.<br>2) This new instrument does not yet have any post-test data. Post-test data anticipated in next year's report. |